Economic Impact Assessment of Designating Critical Habitat for the Lynx (*Lynx Canadensis*)

Prepared for
The Geraldine R. Dodge Foundation
163 Madison Ave.
P.O. Box 1239
Morristown, NJ 07962-1239

by

Defenders of Wildlife
1130 Seventeenth St., NW
Washington, DC 20036

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Author's Note - January 2005

Since the completion of this report in summer of 2004, Montanans have rejected Initiative 147 in November of 2004. That initiative sought to overturn the Montana ban against cyanide mining created by an earlier Initiative, I-137. As a result of this new development, designation of lynx critical habitat can no longer cause the negative impacts on the McDonald gold mine project that formed part of the high-impact scenarios for designation of lynx critical habitat in Montana presented in this report. Rather, the mine project now will be prevented independently of designation of lynx critical habitat. With the mine impacts excluded from the scenarios, designation is expected to generate net benefits in all four scenarios in Montana, that is, at both national and local levels of analysis and for both high and low impact estimates. The report already stated that it was likely that the mine area would be excluded from designation as critical habitat, and therefore developed separate impact estimates for that case. Given that it is no longer possible for designation of lynx critical habitat to impact the mine, only the lower halves of Tables III.5.a-3 and III.5.a-4, which show net economic benefits and benefit-cost ratios, respectively, as a result of designation under exclusion of the mine from the designated critical habitat, are now relevant. Likewise, the impacts of designation associated with mining, presented in Tables III.3.c.22, III.4.b-28, III.4.b-33 and III.5.a-1, are no longer relevant.

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ARM	Administrative Rules Montana
ATV	All terrain vehicle
BA	Biological assessment
BCS	Base Case scenario
BMP	Best Management Practices
BMU	Bear Management Unit
BOD	Biochemical oxygen demand
BT	Benefits transfer
CAA	Clean Air Act
CBA	Cost-Benefit Analysis
C.F.R.	Code of Federal Regulations
CHAU	Critical Habitat Analysis Unit
CPI	Consumer price index
CS	Consumer surplus
CV	Contingent valuation
CWA	Clean Water Act
dbh	Diameter at breast height
DC	Department of Conservation (Maine)
DEP	Department of Environmental Protection (Maine)
DEQ	Department of Environmental Quality (Montana)
DNRC	Department of Natural Resources and Conservation (Montana)
DOT	Department of Transportation
EPA	Environmental Protection Agency
ESA	Endangered Species Act (*Act*)
FHWA	Federal Highway Administration
FMP	Fire Management Plan
FWS	Fish and Wildlife Service
HAZMAT	Hazardous materials
HCP	Habitat Conservation Plan
LAU	Lynx Analysis Unit
LCAS	Lynx Conservation Assessment and Strategy
LURC	Land Use Regulation Commission (Maine)
MCA	Montana Code Annotated
ME	Maine
mmbf	Million board feet
MN	Minnesota
MT	Montana
NF	National Forest
NFHCP	Native Fish Habitat Conservation Plan
NFP	National Fire Plan
NHS	National Highway System
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service / Non-point source
NPV	Net Present Value
OHVRs	BLM and FS Off-Highway Vehicle Restrictions
PDR	Private discount rate
PIWA	Protection and Improvement of Waters Act (Maine)
PMS	Pavement Management System
PS	Producer surplus

PV	Present value
RV	Recreational vehicle
SCORP	State Comprehensive Outdoor Recreation Plan
S&K	Salish and Kootenai
SDR	Social discount rate
SMZ	Streamside Management Zone (Montana)
SOD	Sediment oxygen demand
sq. ft.	Square feet
SUP	Special use permit
TMDL	Total Maximum Daily Load
U.S.	United States
USACE	United States Army Corps of Engineers
U.S.C.	Unites States Congress
USDI	Unites States Department of the Interior
USEPA	Unites States Environmental Protection Agency
WUI	Wildland Urban Interface

Acknowledgments

This report on the economic impacts of designating critical habitat for the Canadian Lynx (*Lynx Canadensis*) reflects the contribution of several individuals, both within Defenders of Wildlife and from those persons who have played critical roles in the review process. First and foremost, Dr. Timm Kroeger must be recognized for his research and leadership skills, without which this report could not have been completed at such a high level of excellence. Dr. Kroeger's persistence, analytic rigor and organization have made this report a standard for Defenders' Conservation Economics Program and for economic analyses to be carried out by the NGO community.

Under Dr. Kroeger's leadership, this report reflects the hard work and input of several individuals. As members of the conservation economics team, project interns Mr. John Slack of Georgia Technological Institute, and Mr. Michael Chaveas of Indiana University, provided invaluable research and writing skills for determining the physical and economic impacts of critical habitat designation. Their contributions were crucial to the development and completion of this analysis.

At the very beginning of this research project a team from Defenders of Wildlife was formed to bring a multitude of required expertise and perspectives to this research project. This team approach was imperative due to the fact that the economic analysis presented here takes place within a given legal institutional framework and under recommended biological conditions necessary for lynx recovery and conservation. From Defenders' legal staff, insights and contributions from Michael Senatore, Michael Leahy, and Bill Snape set the institutional parameters of the study. From Defenders' technical and planning staff, Dr. Martin Smith, Lisa Osborn, Jeff Lerner, Nina Fascione, Minette Johnson, and Dr. Chris Haney all provided critical expertise with respect to the biological requirements for lynx recovery.

Finally, this report has benefited from peer reviews provided by outside economists known for their expertise in impact analysis and by lynx biologists. With respect to economics we would like to thank Dr. Thomas Power of the University of Montana, Dr. John Loomis of Colorado State University, and Dr. Kevin Boyle of the University of Maine for their helpful discussions and reviews of earlier drafts of this study. We are also thankful to Dr. Clayton Apps of Aspen Wildlife Research of Calgary for reviewing the restrictions on selected land use activities that seem justified under management for lynx recovery.

Frank Casey, Ph.D.
Director, Conservation Economics Program
Defenders of Wildlife

Executive summary

The U.S. Endangered Species Act (ESA) mandates the designation of critical habitat for all plant and animal species that are federally listed as threatened or endangered. However, the Secretary of the Interior may exempt an area identified as critical habitat from designation as such, if and only if the benefits of such an exemption outweigh the benefits of designating the area, unless exclusion would lead to the extinction of the species. This provides an avenue for economics to enter into the designation process, in the form of analyses of the economic impacts from designation.

Designation of critical habitat for a species provides an additional level of protection afforded to that species beyond that provided by listing under the ESA, because the standard for protection is increased from simply avoiding jeopardy to a species' continued existence, to avoiding the adverse modification of the species' habitat. This additional protection may result in changes in those land use activities in the designated area that are carried out, funded, or permitted by federal agencies, if those activities are deemed to adversely modify the habitat of the species in question. These changes in land use activities in turn may carry associated costs and/or benefits.

A number of objections have been advanced on philosophical grounds against making decisions on species extinction on the basis of an economic calculus. In addition, there exist economic arguments that call into question the validity of the use of cost-benefit analysis on decisions that involve long time periods and irreversibility. These economic arguments focus mainly on issues of intergenerational equity and incomplete information.

These criticisms not withstanding, an analysis of the costs and benefits of designating critical habitat for a species has value as one factor that society may take into account in evaluating decisions that, in the last instance, must be made in the democratic political process. In order for economic analyses to fulfill their role of informing the decision-making process, however, it is of crucial importance that these analyses be reasonably unbiased.

This, unfortunately, has generally not been the case for the Fish and Wildlife Service's (FWS) economic analyses of the impacts of designating critical habitat. Most of these analyses devote a disproportionate amount of effort to the estimation of costs. In many cases, the estimation of benefits receives qualitative, cursory, or no treatment at all. In addition, in the instances where benefits are quantified, they are, unlike the costs of designation, generally not expressed in monetary terms, which reduces their impact in the decision-making process. This results in biased analyses and distorted estimates of the net economic impact of designation which in turn tends to lead to suboptimal policy decisions.

Unfortunately, but hardly surprising, the exclusive economic focus on the cost side of designation of critical habitat impacts has supported attempts to weaken the ESA.

The omission of benefits is justified by the FWS with the claim that benefit estimates would be characterized by unacceptable uncertainty, due to the claimed lack of the data required for the generation of the estimates, and the claimed prohibitive costs of overcoming these shortcomings. However, for many designations, value estimates are available in the academic literature for the benefit categories generated by the designation. Through the application of appropriate economic methodologies, these estimates can be adjusted to establish boundaries around benefit estimates of a particular designation. Importantly, it is not obvious why the monetary benefit estimates that can be generated with accepted economic valuation methodologies generally should be characterized by higher uncertainties than the monetized cost estimates currently constructed in FWS's economic impact analyses, given that the latter often are based on a large number of elaborately constructed assumptions that generally are reasonable, but nonetheless arbitrary.

A second criticism of FWS's economic analyses of designation of critical habitat is that these analyses do not always distinguish properly between impacts from listing and impacts from designation. Section 4 of the ESA requires an analysis of the economic impacts of designating critical habitat, and prohibits consideration of economic impacts in the context of listing. Frequently, however, impacts caused by the listing of a species are included in the FWS's economic analysis of the impacts of designation. Because the FWS's analyses do not include comprehensive estimates of monetized benefits, and frequently include no monetary benefit estimates at all, the failure to distinguish between impacts from designation and those from listing further distorts the cost-benefit picture by inflating the cost side.

This study fulfills three important purposes: first, it will serve as a guide by which to examine the FWS's own economic analysis of designation of critical habitat for the lynx, and will serve as a basis for informing their analysis. Second, and of equal importance, the conceptual framework we develop may provide information and guidance for future economic analysis of designation, both within and outside the FWS. Third, our study constitutes a contribution to the literature on the methodology of cost-benefit estimation for recovering endangered species.

Compared to previous economic impact analyses associated with critical habitat designation, this report provides several methodological innovations and decision making aids that can provide policy makers with a larger scope of information with respect to the costs and benefits of designations. First, through a rigorous inventory and analysis of base line conditions, the incremental economic impacts of critical habitat designation, over and above a listing decision, are identified and valued. Second, numerous categories of benefits from the designation decision are identified and valued to the extent possible, thereby providing a template or a blue print that future analyses can employ. Third, a conceptual framework has been adopted that allows for transferability of the methods and results from the case study areas to other locations. This framework is characterized by developing specific land use classifications that are defined in two dimensions: land use (or cover), and land ownership. These two dimensions determine the extent of economic impacts on any particular land use classification and allow for the calculation of per acre net benefits. These per acre net benefits can be assigned to lynx habitat conservation areas outside of the two case study locations for the same land use classifications. Fourth, all net impacts are reported for four scenarios defined by high and low cost estimates, and whether the impacts are local or national in scope. The details of these innovations and the results of the economic analysis are summarized below.

In this study, we draw heavily on the economics literature and compile a conceptual framework and methodology that is intended to guide the development of a complete economic impact analysis of critical habitat designation, which must include a thorough treatment of the benefits in addition to the costs of designation.

Our framework addresses the selection of appropriate spatial boundaries of analysis; the identification of impacts attributable to designation vs. listing, and a complete list of value categories and specific costs and benefits that should be considered in all economic analyses of critical habitat designations. This report also includes a discussion of benefit transfer approaches that may be used to estimate the monetary value benefits for a specific designation on the basis of appropriate existing studies, in cases where primary data generation is infeasible. We apply our framework to two case studies (Montana and Maine) in which we estimate the economic impacts critical habitat designation for the lynx (*Lynx Canadensis*), a listed species that currently is awaiting such designation.

An economic analysis that aspires to being complete must include the full range of values identified by economic theory. These values comprise direct use values, indirect use values (generally referred to as ecosystem function values), option values, and non-use values. Some of these values can be categorized as market benefits, others are non-market benefits.

In the Montana and Maine case studies, we develop quantitative monetary estimates of the direct and indirect costs of designating critical habitat for the lynx. The direct costs result from the changes in land use activities necessitated by the designation, as well as from additional consultation effort. We include all types of costs in the analysis: foregone development opportunities; project modifications and delays; negative changes in property values; economic multiplier effects; and transactions costs in the form of consultations.

On the benefits side, we quantify benefits associated with improved lynx conservation and conservation of natural landscapes (such as the prevented conversion of high-value scenic lands, avoided loss of ecosystem services, and positive changes in property values). In addition, we develop some quantitative estimates of the avoided costs of public services that would result from designation of lynx critical habitat. However, the monetization of this type of benefit is beyond the scope of this analysis.

Our study serves as an example of a case in which a lack of available primary benefit estimates could be used as a pretext for avoiding monetary quantification of some benefit categories. Most importantly, the valuation of the non-use benefits of improved lynx conservation must be based on other species, since no study exists of the value that people place on lynx conservation. Unfortunately, there is no study of people's valuation of any wild felid. Nevertheless, by applying benefits transfer techniques and by assuring that the requirements for valid estimates are fulfilled by the species we use as donors for value estimates, we are able to overcome this challenge. To address the unavoidable uncertainties involved in benefit transfers, we use different transfer approaches to construct lower and upper boundaries for the benefits of lynx conservation. We find that the value of the estimated non-use benefits of improved lynx conservation exceeds all other benefit categories affected by critical habitat designation for the lynx, and does so by a considerable margin. This attests to the paramount importance of quantifying all benefits of designation, not just those for which data are readily available.

However, there remain some benefits that currently are beyond monetary quantification. This is true above all for several of the ecosystem service function values, because for many of these service functions there exists no quantitative estimate of their contribution to human economic systems. This omission of several benefit types from our study makes our benefit estimate conservative.

Because of the uncertainties that surround many impacts of designation of critical habitat for the lynx, we develop upper and lower-bound estimates for most impacts. In addition, we select two spatial boundaries for our analysis, a local and a national one. Since the ESA is a federal policy, the conceptually appropriate boundary setting is at the national level. Such boundary selection is further demanded by Executive Order 12866, which requires the inclusion in economic analyses of all impacts of a policy. Nevertheless, we realize the importance of the local impacts of designation, and therefore add a second boundary that only includes the counties in which the area proposed for designation of lynx critical habitat is situated. The first is our "wide," the second our "narrow" boundary of analysis. The combination of upper and lower-bound estimates and wide (national) and narrow (local) spatial boundaries results in four impact scenarios. Our results show that in all four scenarios in Montana, and in three out of the four scenarios in Maine, the estimated benefits of designation outweigh the costs, with smaller but positive net economic benefits on the local level, and larger net benefits on the national scale.

In the Montana case study, estimates of present value net benefits of designation range from $203 million to $540 million (benefit-cost ratios of 26 and 31, respectively) under the national impact accounting scenario, and from $3.4 million to $5.0 million (benefit-cost ratios of 1.3 and 1.2, respectively) in the local impact scenario. Costs could outweigh benefits to the study area only in the highly unlikely event that designation of critical habitat for the lynx would prevent the development of a major gold mine project. Even in this scenario, however, benefits could still be larger than costs, because abandonment of the mine project could avoid sizeable economic losses to local fisheries and related tourism, reductions in water quality and required compensating improvements in water provision infrastructure, as well as permanent environmental damage at the site. However, due to the complexity of the required analysis, none of these potential negative impacts has been quantified in monetary terms in this analysis, leading to underestimates in the economic benefits of preventing development of the mine.

In the Maine study area, estimated net present benefits range from approximately $32 million to $59 million (benefit-cost ratios of 21 and seven, respectively) under national-level impact accounting, and from approximately -$6 million to $1 million (benefit-cost ratios of -0.5 and 1.5, respectively) if only local impacts are considered.

While the two proposed designation areas are comparable in size, the economic impacts of CHD differ significantly due to the contrasts in land ownership and spatial extent of federal nexi. In the case of Montana, 80 percent of the study area is in federal ownership and most non-federal lands have a federal nexus, making them subject to land use restrictions under designation. In contrast, just over one percent of the proposed Maine designation area is in federal ownership, while 91 percent is private land, and eight percent is state land. The majority of the non-federal lands do not come under a federal nexus or do not do so until the final years of our study period.

Finally, this report develops a methodology that allows the transfer of our cost estimates for designation of critical lynx habitat to areas outside of our case study areas. Based on the results of our two case studies, we estimate ranges of the average per-acre costs of CHD for the lynx on lands in different ownerships and uses. These estimated cost ranges can serve in compiling a-priori estimates of the cost of CHD for the lynx in areas outside of the Maine and Montana case studies. Because the two primary determinants of the impacts of designation are land cover/use and land ownership, the estimates are developed for all combinations of land use/cover and ownership, or land classes. Impacts and associated costs and benefits of designation of critical habitat also depend on the restrictions on land use activities that exist in the absence of designation. Since these baseline regulations for each land class differ in our two study areas, we should be able to capture the resulting variations in per-acre costs by establishing a range of cost estimates for each land class in the two study areas. This methodology generates ranges of land class-specific cost estimates that may serve to generate first-order approximations of the costs of such designation in other areas. We focus on costs only, because in the absence of information on the relationships between lynx populations and changes in specific land use activities, it is not possible to distribute the benefits associated with expected lynx population increases by land class.

Our analysis demonstrates that conceptually complete economic analyses of the impacts of designation of critical habitat are feasible, if one accepts uncertainties in the benefits estimation comparable to those commonly accepted in the generation of the cost estimates of the FWS's analyses of designation.

I. Introduction and background

The present study examines the economic costs and benefits of designating critical habitat for the lynx (*Lynx Canadensis*). The lynx was chosen as a case study because it is a federally listed (ESA) species expected to have its critical habitat designated within the near future. The lynx also serves as a good example of many of the difficulties that can be associated with generating monetary estimates of the benefits of critical habitat designation (CHD), because it requires the application of a wide range of valuation methodologies.

The lynx also may be considered quite a special case, because a considerable number of management plans attempt to reduce negative impacts on the species. For example, the Lynx Conservation Assessment and Strategy (LCAS), prepared by a federal interagency team, identifies management guidelines for a variety of land use activities, including winter recreation, grazing, road construction, forest management, and mining, and is adhered to by most Forest Service (FS), Bureau of Land Management (BLM), and National Park Service (NPS) lands on which lynx are present. In addition, a number of National Forest plans are undergoing amendments, with particular emphasis on minimizing negative impacts on lynx. This leads to a baseline level of protection of lynx on federal lands that is higher than for most other listed species awaiting CHD. Therefore, the incremental protection that designation of critical habitat affords to the species, and with it the incremental benefits and costs, should, ceteris paribus, tend to be relatively smaller than for other species.

This chapter provides a brief introduction to the main issues relating to economic analyses of designation of critical habitat. These comprise the legal definition of critical habitat; the legal requirement for conducting economic analysis before designating critical habitat for a species; and the current methodology employed in these economic analyses, specifically highlighting their shortcomings. Many of these issues are more fully explored in the next chapter, which describes in detail a recommended methodology to be employed in economic analyses of critical habitat, the one we employ in this study.

I.1 Objectives of and need for the study

This study has two primary objectives. The first is to provide a blueprint for how to conduct a comprehensive, and conceptually complete, economic analysis of the impacts of critical habitat designation (CHD) under the Endangered Species Act (ESA, or Act, 16 U.S.C. §§ 1531 et seq.). The second is to apply that framework to a specific case, namely the lynx, and estimate the costs and benefits of designating critical habitat for that species.

We believe that our study will encourage the Fish and Wildlife Service (FWS, or Service) to include monetized estimates of the beneficial impacts of designating critical habitat in their future economic analyses of CHD. In addition, we believe that the framework for analysis we develop here will be helpful to others who attempt to evaluate quantitatively the economic impacts of designation.

The need for inclusion of monetized benefit estimates in analyses that aim to estimate the economic impacts of designating critical habitat is obvious. Designation of critical habitat, like the majority of public policies, creates both positive and negative impacts, or, in other words, benefits and costs. An economic analysis of these impacts must include both of these types of impacts, positive and negative (U.S. Office of Management and Budget 2003b). If it fails to do so, the findings of the analysis are of little use to policy-makers, because they do not present a complete picture of the impacts caused by the policy. That reasoning is straightforward, and constitutes the basis for the exclusion provision of the ESA, under which the Secretary of the Interior may exclude any part of the identified critical habitat for a species from designation if the benefits of exclusion outweigh the benefits of designation, provided that exclusion does not lead to the extinction of the species (16 U.S.C. § 1533(b)(2)). Therefore, one would expect the Service's economic analyses to treat benefits and costs in the same way, thereby allowing for a meaningful comparison of the two. In the absence of a common denominator for positive and negative impacts, it is unclear how the two can be weighted objectively when deliberating decisions to exclude parts of the identified critical habitat.

Providing information on the costs of a public policy without providing corresponding information on the benefits does not encourage informed decision-making. For example, what is one to make of the information that a policy is expected to cost the nation one million dollars? Is that policy economically favorable or disadvantageous for the country? The answer to that question is "It depends." It depends on whether the benefits the policy is expected to generate are less than one million dollars, or equal to or larger than one million dollars. The question to whether or not the policy is favorable for the country cannot be answered without that information. Information on the absolute size of costs is thus of limited value in making well-informed policy decisions.

This study presents a framework for the quantification of the monetary value of those benefits. The components of that framework have long been well-established in the disciplines of environmental and natural resource economics. The methodologies employed have been tested and validated extensively and have become part of mainstream economic theory.

That is not to say that estimation of the monetary value of environmental goods and services is always possible, free of uncertainties, or a low-effort endeavor. Especially in the realm of ecosystem services valuation, there still exist gaps in value estimates for many specific ecosystem types and services. However, a wealth of high-quality, peer-reviewed valuation studies is available, as are value transfer methodologies that can adjust those value estimates to policy sites if no primary data are available or their generation is considered not feasible. Most importantly, the uncertainties encountered in benefits monetization are not necessarily larger than those routinely accepted in the generation of monetized cost estimates.

A second shortcoming of FWS's current economic analyses of CHD is the agency's historic and ongoing failure to adequately define the operative legal protection which comes with the designation of critical habitat. Section 7(a)(2) of the ESA imposes two substantive standards on all federal agencies. First, each federal agency must avoid any action which is "likely to jeopardize the continued existence of any endangered species or threatened species" and second, they must not undertake any action which is likely to "result in the destruction or adverse modification" of critical habitat. In 1986 the FWS promulgated virtually identical regulatory definitions for these two standards and then subsequently relied on its conflated definitions of "jeopardy" and "adverse modification" to adopt a policy that critical habitat does not provide any additional protection for endangered and threatened species beyond that afforded by listing under the ESA. The FWS then relied on this policy to justify its decision to forgo designation of critical habitat for the overwhelming majority of listed species. The argument from the FWS being that it is simply a waste of limited resources to designate critical habitat for listed species where the resulting protections are simply redundant with those already provided under the "jeopardy" standard. Where the FWS was forced to designate critical habitat through court order, it almost always maintained that the benefits were minimal to nonexistent, as were the economic impacts.

In 2001 two federal court decisions were issued which upended the FWS's approach to both designating critical habitat and assessing its economic impacts. First, in Sierra Club v. U.S. Fish and Wildlife Service, 245 F.3d 434 (5th Cir. 2001), the court ruled that FWS's regulatory definition of "adverse modification" was illegal and facially invalid. Specifically, the court ruled that FWS's definition was improper because it defined "adverse modification" as an action which affects the value of critical habitat to both the recovery ***and*** survival of a species and, therefore, imposes a higher threshold than the ESA language permits. In particular, the court relied on the ESA's definition of critical habitat as that habitat which is "essential to the conservation [i.e., recovery]" of listed species to rule that "adverse modification" must be defined instead to encompass actions that threaten a species' recovery alone.

Second, in New Mexico Cattle Growers Ass'n v. U.S. Fish and Wildlife Service, 248 F.3d 1277 (10th Cir. 2001), the court overturned the FWS's so-called "baseline" approach to assessing the economic impacts of designating critical habitat whereby the agency only examined the incremental impacts resulting from critical habitat or, in other words, those impacts that occur above and beyond simply listing a species. The court found that because the FWS assumes as a matter of policy that critical habitat provides no additional protection for listed species, its baseline approach in turn guarantees that the economic impacts from designating critical habitat will also be nonexistent. In an effort to give some effect to the ESA's requirement for a meaningful economic analysis of critical habitat, the court invalidated the FWS's baseline approach.

The FWS's response or lack thereof to these two decisions is an instructive starting point for discussing the current Administration's approach to critical habitat and analyzing its economic impacts. First, the New Mexico Cattle Grower's decision was seized upon almost immediately as an excuse to both revisit existing critical habitat designations and also to greatly expand the emphasis and focus on evaluating the potential economic costs of designating critical habitat. The Sierra Club decision, in sharp contrast, has been all but ignored by the Administration and, in fact, to this day the FWS is without a legal regulatory definition of "adverse modification." Despite the lack of any coherent and lawful notion of what constitutes "adverse modification" of critical habitat the FWS, nonetheless, continues to issue economic analyses which purport to assess the potential economic costs of designating critical habitat. Plainly, however, it is simply not possible to meaningfully evaluate the impacts of designating critical habitat before first determining potential regulatory impact of designation, which of course is currently impossible in the absence of a definition of "adverse modification." The economic analysis conducted under this Administration are also highly questionable in light of the fact that they are fundamentally premised on two patently inconsistent policies. First, notwithstanding the court's decision in Sierra Club, this Administration continues to maintain that the designation of critical habitat is a meaningless exercise in that it provides no additional protection for listed species, while at the same time asserting that critical habitat imposes substantial economic costs on society. Obviously, if as this Administration assumes critical habitat provides no additional conservation benefit and has no regulatory impact beyond that of listing a species, then it is axiomatic that it also cannot have any economic impact, aside from that associated with additional consultation costs.

If the ESA's provision requiring the FWS to consider the "economic impacts" of designating critical habitat is to be fulfilled, then the potential economic benefits of critical habitat must be meaningfully considered. This study provides guidance on how to generate such estimates.

I.2 Critical Habitat Designation under the ESA

Critical habitat for a threatened or endangered species under the ESA is defined as

> (i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 4 of this Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and
> (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of this Act, upon a determination by the Secretary that such areas are essential for the conservation of the species.
> (16 U.S.C. § 1532 (5)(A)(i) and (ii))

The ESA's requirement for designation of critical habitat is extremely stringent. The only discretion the Secretary of the Interior has in designating critical habitat is provided by the prudency and determinability exceptions (16 U.S.C. § 1533 (a)(3)(A)(1)). The ESA itself does not define the term prudent in the context of critical habitat designation, but the Service defines imprudent designations as those designations that (1) increase the threat to the species, or (2) would not be beneficial to the species (see 50 C.F.R. § 424.12(a)(1)(i)–(ii) [2002]). In recent years, the Service has increasingly relied on the "not beneficial" argument in avoiding designation of critical habitat. It has done so arguing that designation does not provide any additional protection to listed species. Given that this argument is based on a definition of adverse modification that has been ruled facially invalid (Sierra Club), it is not surprising that many of the Service's recent not prudent decisions have been rejected in court (see Sinden 2004:159). Unlike lack of prudency, lack of determinability may not prevent designation, but may only delay it, for a maximum of twelve months (16 U.S.C. § 1533 (b)(6)(C)(ii)).

As discussed in the preceding section, a substantial hurdle in considering the economic impacts of designating critical habitat has been the lack of a lawful and meaningful definition of "adverse modification." While this paper focuses principally on methodologies for evaluating the potential economic benefits of designating critical habitat, conducting that evaluation with respect to the lynx first required some workable definition of what would constitute "adverse modification" of lynx critical habitat. For this we were guided as a general matter by the ESA's statutory language and the court's ruling in Sierra Club which indicate clearly that the designation and protection of critical habitat should be focused on helping to ensure a species' long-term recovery, as opposed to the FWS's implementation of the "jeopardy" standard which has generally been focused on simply maintaining a species' survival in the short-term. It is also important to note that both standards only apply to actions carried out, funded, or authorized by federal agencies. Therefore, critical habitat generally only adds protection on federal lands or lands that have some federal nexus, that is, on which activities are to be carried out that require federal permits or receive federal funding.

I.3 The legal requirement for economic impact analysis (EIA) in CHD

As pointed out above, economics enters the designation of critical habitat via the ESA's requirement that the Secretary designate critical habitat only "after taking into consideration the economic impact, and any other relevant impact, of specifying any particular area as critical habitat", and via granting him or her the discretion to

> "exclude any area from critical habitat if he determines that the benefits of such exclusion outweight the benefits of specifying such area as part of the critical habitat, unless he determines, based on the best scientific and commercial data available, that the failure to designate such area as critical habitat will result in the extinction of the species concerned."
>
> (16 U.S.C. § 1533 (b)(2))

These stipulations provide the basis for the Service's economic analyses of the impacts of designating critical habitat.

The ESA does not specify the format those economic analyses should follow. However, both economic theory and Office of Management and Budget regulations (US OMB 2003a, b) do provide clear guidance on how to conduct conceptually correct economic impact analyses. Two of the central tenets of a correct analysis are that it include and quantify both costs and benefits (US OMB 2003b:5518), and that it express them in equivalent metrics, preferably in money terms, as far as reasonably possible (US OMB 2003b:5518-21).

The FWS's economic analyses follow neither of the two. Instead, the statement commonly found in recent FWS economic analyses of CHD is that "*the Service believes that the benefits of critical habitat designation are best expressed in biological terms that can be weighed against the expected cost impacts of the rulemaking*" (italics in original; see USDI FWS 2004a). How exactly one might weigh biological benefits against monetary costs is not explained, an omission that invites arbitrary decisions with respect to the exclusion of specific critical habitat areas from designation.

I.4 Review of the Fish and Wildlife Service's current impact analysis practice

The historical development of the Service's economic analyses of CHD has recently been documented in great detail elsewhere (see Sinden 2004), and it is not necessary to review it here. Instead, here we briefly summarize the treatment, or lack thereof, of benefits in the Service's economic analyses. A brief overview of the treatment of benefits in some recent economic analyses is sufficient to illustrate the extent of the problem.

In its Draft Economic Analysis of Critical Habitat Designation for the Mexican Spotted Owl (USDI FWS 2000d), the Service devotes 26 pages to the development of monetary cost estimates, and two to a qualitative discussion of benefits. In the Final Draft Economic Analysis of Critical Habitat Designation for the Santa Cruz Tarplant (USDI FWS 2002b), 22 pages are devoted to estimating costs, while benefits are discussed qualitatively on a single page. The Service's final Draft Economic Analysis of Critical Habitat Designation for the Cactus Ferruginous Pygmy-Owl (USDI FWS 2002c) contains 62 pages devoted to a quantitative estimation of monetized costs, and two pages of qualitative description of benefits. In the Economic Analysis of Critical Habitat Designation for the Gulf Sturgeon (USDI FWS 2003b), the Service devotes 33 pages to costs, four to benefits. Again, benefits remain unquantified and not monetized. In the Final Economic Analysis of Critical Habitat Designation for Vernal Pool Species (USDI FWS 2003e), the ratio is 81 to five, again without any monetized estimates of benefits. Most recently, the Draft Economic Analysis of Critical Habitat Designation for the Bull Trout (USDI FWS 2004a), a 235-page document, includes one full paragraph devoted to benefits. In this we find the Service's statement, cited in the previous section, that benefits of CHD are believed to "*be best expressed in biological terms*" (italics in original; ibid.:I-14).

Although the Bull Trout economic analysis is remarkable for the complete absence of any discussion of benefits of CHD for the species, considering the length of the document, it is even more remarkable for another reason. Originally, that analysis, as prepared under contract by Bioeconomics Inc., included detailed quantitative estimates of the monetary value of several benefit categories, covering some 55 pages.[1] However, in the document published by the Service (USDI FWS 2004a), the quantitative benefits section is nowhere to be found, and there is no reference to it anywhere in the document. Aside from the obvious questions that raises about what occasioned such a decision, this example shows that monetary quantification of the benefits of CHD was indeed possible in that particular instance, contrary to the Service's continually advancing claims to the contrary.

This example also shows how crucial it is to include benefits in any analysis of CHD. The Bull Trout study estimates the costs of designation at between $230 and $300 million over ten years. By comparison, the original study estimated the value of a recovered Bull Trout fishery alone to be worth as much as $215 million. Given the other direct use, indirect use, and non-use benefits associated with the designation of critical habitat for the species, it is far from clear that the monetary value of the costs of designation is larger than that of the benefits. Indeed, the opposite is not unlikely, namely, that the monetary value of total benefits may outweigh total costs.

[1] See Endangered Species and Wetlands Report, April 2004, Vol. 9 No. 7, p. 18.

II. Economic Impact Analysis of Critical Habitat Designation: Methodology

This chapter defines the scope of the present economic analysis. Key issues include the identification of the base case and designation scenarios, including the setting of spatial and temporal boundaries and the clear distinction between the impacts from listing (triggered by the "jeopardy" provisions of the ESA) and those that result from the designation of critical habitat (triggered by the "adverse modification" provisions of the ESA); the selection of the types of impacts included and the approaches chosen to valuate these impacts; and the choice of discount rate. We also present a short critique of the approach commonly used in the FWS's economic analyses of CHD, as well as a proposed conceptually correct methodology for estimating impacts of environmental designation of critical habitat.

II.1 Identification of Base Case ("Without CHD") Scenario for area proposed for CHD

a. Boundary selection: spatial and temporal delimitation of economic impacts included in the analysis

Economic theory defines the impacts of a policy as any changes in the base case scenario, which comprise both costs and benefits. Executive Order 12866 takes an identical approach by defining impacts as changes in "the state of the world that would exist without the proposed action."[2] Clearly, if a policy generates both benefits and costs, both of these constitute economic impacts and as such both must be included in an economic analysis. Moreover, an economic impact analysis that aims to be reasonably unbiased must attempt to assess both costs and benefits in the same units, wherever possible. Specifically, it is not acceptable that an analysis presents costs in quantitative terms while benefits are expressed in qualitative terms, or that costs are expressed in monetary terms while benefits are expressed in physical units. Such use of different types of treatment or of different denominators invariably distorts the results because most consumers of the information generally will tend to focus on the quantitative or monetary estimates, respectively. Even more importantly, it is imperative that the analysis devote an equal amount of effort to estimating both costs and benefits, something that historically generally has not been done in the FWS's economic impact analyses of CHD.[3] Obviously, in many cases lack of information will make the generation of exact quantitative or monetary estimates difficult for some impacts. However, it should generally be possible to construct lower- and upper-bound ranges of estimates for most impacts. Hence, it is not acceptable to avoid quantification and monetization of impacts simply on the basis of the uncertainty surrounding the estimates.

The definition of impacts of a policy as all of the changes in the base case scenario attributable to the policy requires that impacts on all sectors of society be included. Specifically, impacts are not just those effects experienced by the regulated community, but the totality of effects experienced by society at large.

[2] See Executive Order 12866 (1993), "Regulatory Planning and Review", 58 Federal Register (190):51735.

[3] The FWS does not itself carry out these analyses, but rather contracts them out. Hence, unequal treatment of costs and benefits in CHD analyses could in part be attributed to the economic consultancies that prepare the analyses. Nevertheless, it is the responsibility of the Service to demand that these analyses include a balanced treatment of benefits. At least in one case, the Service deleted the benefits section from the economic analysis prepared by an outside consultancy (see Endangered Species and Wetlands Report, April 2004, Vol. 9 No. 7, p. 18).

Spatial and temporal boundaries of the analysis

In its economic analyses of CHD the FWS has generally chosen a ten-year time frame (see for example USDI FWS 2001, 2002b, 2002c, 2003b), based on the argument that impacts during such a period are "reasonably foreseeable" (USDI FWS 2002c:1-5). Selection of a ten-year horizon is necessarily arbitrary but is generally reasonable, unless of course there exists reasonable certainty that some impacts of a high magnitude will occur beyond that time or that impacts will extend more than ten years into the future. In such cases, a short, ten-year time frame may introduce a systematic bias if, and only if, the time profiles of costs and benefits differ.

Such difference in time profiles may be a genuine problem in analyses of critical habitat, where designation may result in the protection of habitat that otherwise would be reduced in quantity or quality. Designation in many cases may generate benefits far into the future, in the form of ecosystem services provided by the protected habitat, and also in the form of direct and non-use values, such as recreational value or existence value, respectively, as well as intrinsic values. By contrast, evidence suggests that the temporal profile of costs of designation often shows a concentration of costs in the immediate aftermath of designation (or even before, if markets anticipate the designation), because in the medium and especially in the long term, a dynamic economy will adjust to the impacts from designation, thereby lowering the costs of designation over time (see for example Power 2000; ECONorthwest 1994). Based on this argument, a relatively short time horizon of ten years is expected to skew the relative value of costs and benefits of critical habitat designation. In the case of habitat preservation, a short timeframe of analysis will tend to inflate costs relative to benefits. The resulting error in the net economic impact of designation will increase with the size of the discount rate chosen.

Despite these considerations, in the present analysis we follow common FWS procedure and choose a ten-year time frame. This introduces a conservative bias into our estimates of the net economic impact of designation of lynx critical habitat. Such a conservative stance is in keeping with our general approach throughout the study of developing benefit estimates.

As with most environmental policies, designation of critical habitat generally will generate costs and benefits at various spatial scales. Obviously, some of these will occur in the local area or region in which the designated habitat lies, for example in the form of changes in land use activities, property values, and increased protection of the species that are benefiting from the designation. In addition, however, designation may often have direct impacts in other regions of the country. For example, if the designation reduces the rate of residential development in the designation area and its surroundings, some or all of that development may be displaced into other parts of the country. In addition, people outside of the designation area may attach value (existence, stewardship, or bequest) to the species protected by the designation.

One of the central tenets of modern democratic societies like the US is that all individuals matter. Based on this premise, public policymakers should consider the impacts of their policies on all persons in the relevant political jurisdiction. The previously cited Executive Order 12866 attests to that, in defining as impacts of a policy all changes in the base case scenario caused by the policy, regardless of the locality of incidence. Since the ESA is a federal law, and designation of critical habitat is a federal policy, Executive Order 12866 via its definition of impacts mandates the inclusion of the impacts on all persons in the US.

Economic theory likewise suggests the inclusion of all benefits and costs in an analysis of economic impacts.[4] The conceptually correct approach to setting the spatial boundaries of the present analysis therefore is to include all of the US, that is, to count the costs and benefits of lynx CHD to all individuals across the US. This is the approach we take in this analysis. Notwithstanding the justifications for setting the boundary at the national level, lower-level jurisdictions are often more concerned with how a federal policy affects them in particular than how it affects the general welfare. To accommodate these concerns, we develop a second set of local impact estimates by selecting a second spatial boundary that only includes the counties into which the area proposed for CHD falls, in order to assess the net impact that CHD would have generate in these counties.

b. Distinction between impacts from listing (the "jeopardy" provisions) and impacts from critical habitat designation (the "adverse modification" provisions)

In order to quantitatively estimate the economic impacts of designating critical habitat for a species, it is necessary to specify the impacts that are attributable to the designation, and not to other causes. As with any public policy, the marginal impact of critical habitat designation is estimated as the difference between the ***with*** designation and the ***without*** designation scenarios (USEPA 2000; Loomis and Helfand 2001). The without designation scenario provides the base case against which the incremental impact of the proposed critical habitat designation is assessed.[5] This base case includes the economic impacts of all policies and other variables other than critical habitat designation, or "the state of the world that would exist without the proposed action" (U.S. Government 1993).[6] It includes, for example, the impacts of other environmental policies, such as federal and state environmental laws and regulations, including the listing of the species under the Endangered Species Act (hereafter Act, or ESA; U.S. Congress 1973), which causes impacts via the jeopardy, no take, and permitting provisions (Sections 7(a)(2), 9, and 10, respectively, of the Act). Attributable to the designation are only those impacts that occur above and beyond the impacts caused by those other policies and other variables. The following section presents the basis for distinguishing the impacts of critical habitat designation from those of listing. The specific implications of this distinction in the case of the lynx are analyzed in part III of this study.

Distinguishing between the impacts of listing versus critical habitat designation

Section 4 of the ESA contains two distinct substantive standards which afford protection to listed species: the "jeopardy" standard, which seeks to prevent activities that would "*jeopardize the continued existence* of any threatened or endangered species" (16 U.S.C. § 1536(7)(a)(2); emphasis added), and the destruction or adverse modification standard (ibid.). Although the concepts of continued existence of a species (i.e., its survival in the short term) and recovery of a species are related, survival and recovery are not the same, notwithstanding the FWS's historically defining

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[4] This is not surprising of course, as both modern political theory and welfare economics share strong utilitarian roots. Economic theory, however, would suggest the inclusion even of impacts that occur beyond US boundaries.

[5] The terms *marginal* and *incremental* are used interchangeably. What is analyzed is the proposed designation of a single, defined area as a whole, not of a number of small, separate sub areas. Hence, we are not estimating continuous or stepped cost functions that would require distinguishing between the two terms.

[6] "Other" variables could include, for example, all economic trends associated with the overall growth rate and sectoral composition, employment, population, etc.

them in ways that make a distinction between the two de facto impossible.[7] The FWS argues that clear-cut distinctions between the concepts of survival and recovery are difficult because "if survival is jeopardized, recovery is also jeopardized" (USDI FWS 1986:19934). And although that statement of course must be true, the converse is a non-sequitur: a species may survive, at least for some period of time, at a precarious population level that lies below that at which it would be considered to have recovered to a viable, that is, sustainable population reasonably safe from the threat of extinction due to stochastic events or an insufficient gene pool. In other words, in the biological sciences there clearly exists a distinction between survival and recovery of a species. In the legal realm, there does, too.

Designation of critical habitat under section 7 of the ESA has the goal of protecting a species by preventing the destruction or adverse modification of the species' habitat (16 U.S.C. § 1536(7)(a)(2)). Given accepted principles of statutory construction, Congress must have intended critical habitat to have meaning independently of the jeopardy standard (see Houck 1993). A meaningful role for critical habitat (i.e., one independent of jeopardy) further is suggested by Congress' 1978 amendment of section 7 of the Act, in which critical habitat was linked specifically to the ***conservation*** of a species (see 16 U.S.C. § 1532(5)(a)). Hence, critical habitat must afford a species protection that is different from that afforded under the ***jeopardy*** standard. Specifically, critical habitat makes sense as a conservation tool if it regulates those actions that, although detrimental to a species' recovery, do not actually threaten its immediate survival (which actions falling under the jeopardy standard do). As Snape ***et al.*** (2001:20) point out, "interpreting critical habitat as that habitat needed for a species' recovery is consistent with the overriding goal of the ESA", namely, the recovery of a species to the point at which the measures provided for in the Act are no longer necessary (16 U.S.C. § 1532(3); 16 U.S.C. § 1533(g)(1)). If the jeopardy standard is aimed primarily at ensuring the short-term survival of a species, while the adverse modification standard is directed at ensuring its recovery and conservation, it should be expected that the two provisions are, in general, not identical in terms of the restrictions they impose on permissible activities.

In practice, the benefit to a species of having its critical habitat designated accrues via the ESA's consultation mechanism (*Sierra Club v. USFWS*, 245 F.3d 434 (2001)). While in the absence of designation, a federal action agency must consult with the FWS or NMFS on any action that is likely to "jeopardize the continued existence of any endangered species or threatened species" (16 U.S.C. § 1536(a)(2)), designation imposes an additional consultation requirement in cases where an action is likely to result in the "destruction or adverse modification of habitat of such species"(ibid.).

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[7] The FWS has defined jeopardizing as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 C.F.R. § 402.02), while destruction or adverse modification is defined as "a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species " (ibid). However, in one case in 1992, the FWS drew a distinction between recovery and survival in the designation of critical habitat for the Spotted Owl, stating that "the adverse modification standard may be reached closer to the recovery end of the survival continuum, whereas, the jeopardy standard traditionally has been applied nearer to the extinction end of the continuum (USDI FWS 1992:1822). As pointed out by the Fifth Circuit Court of Appeals, the FWS's definition of adverse modification in terms of survival and recovery (50 C.F.R. § 402.02) is inconsistent with the Act, and hence facially invalid (*Sierra Club v. USFWS*, 245 F.3d 434 (2001)).

Based on the above arguments, the implications of the jeopardy and adverse modification standards for the protection of listed species differ in at least two respects. First, designation of critical habitat seeks to regulate federal actions and actions with a federal nexus that are likely to destroy or adversely modify ***potential*** habitat of a species (habitat not currently occupied by the species, but deemed necessary for the species' recovery, see 16 U.S.C. § 1532(5)(a)(ii)) – actions that might not be addressed under the jeopardy standard. This much is conceded by the FWS (USDI FWS 1999). Second, this same distinction between mere short-term survival of a species and actual recovery may be applied to individual habitat units or subsections within the geographical range currently occupied by a species: actions that are detrimental to the conservation and, hence, recovery of a listed species, but that do not ***further*** reduce the suitability of a specific area as habitat for a listed species, might not trigger the provisions of the jeopardy standard, since they might not endanger the species' immediate survival; such actions, however, may well constitute a violation of the adverse modification standard, if they would be considered detrimental to the conservation (and hence, recovery) of the species. Assume, for example, that a given forest management plan prescribes pre-commercial thinning on a given number of acres in snowshoe hare foraging habitat per year. If that thinning volume maintains, on average, in any given year the area of the forest that is suitable for snowshoe hare foraging habitat, thinning the next such forest patch according to plan would not further reduce the suitability of the forest as habitat for snowshoe hares, since the thinning would maintain the annual average browse habitat. Hence the thinning would not result in increased jeopardy to lynx. At the same time, that thinning may well be considered an adverse modification of lynx habitat, because in the absence of the action, the area suitable as snowshoe hare foraging habitat and hence lynx foraging habitat would be larger, inviting an increase in the number of lynx, or, in other words, the process of lynx recovery. As such, the harvest might not violate the jeopardy standard, but might violate the adverse modification standard. This example demonstrates that adverse modification should carry a lower burden of proof than jeopardy (Salzman 1990); therefore, designation of critical habitat should be expected to regulate, at least in some cases, activities that the jeopardy standard would not.

In sum, the designation of critical habitat may lead to additional consultations (adverse modification consultations in addition to jeopardy consultations, see *Sierra Club v. USFWS*, 245 F.3d 434 (2001)), and to restrictions on or prohibition of activities that would not take place in the absence of such designation.[8]

II.2 Economically relevant impact categories (benefits and costs)

As discussed in section II.1.a, a comprehensive economic impact or cost-benefit analysis of a public policy must consider all impacts of the policy on society's welfare. These impacts can take various forms and can occur in the market and non-market realms, ranging from direct financial costs or benefits to gains or losses in individuals' utility.

In order to ensure the comparability of the various impacts, these are commonly expressed in terms of changes in consumer or producer surplus. Consumer surplus (CS) is the difference between the price an individual pays for a good or service and the maximum amount he or she would have been willing to pay to obtain the good or service.

[8] For example, according to the U.S. Army Corps of Engineers, "the development of the proposed critical habitat designation [for the gulf sturgeon] has caused FWS to adopt a more stringent approach during consultations, resulting in more costly project modifications and an increased number of formal consultations" (USDI FWS 2003b: para. 183).

Table II.2-1: Potential economic impacts of CHD for species *x*: Generic template*

Value category		*Potential change in value due to CHD* *Benefits*	*Costs*	
Direct use values	*B-1*	• Increased development opportunities for some sectors	• Forgone development opportunities for some sectors [3]	*C-1*
	B-2	• Reduced possibility of (local) extinction of species *x* (*recreation, tourism - avoided loss of consumer and producer surplus*)	• Reduced consumer surplus from higher prices for CHD-restricted uses [9]	*C-2*
	B-3	• Reduced possibility of (local) extinction of other ESA species (*recreation, tourism - avoided loss of consumer and producer surplus*)	• Project modifications[10]	*C-3*
	B-4	• Higher economic rents [4] /	• Higher transactions costs (*consultations and project delays*)	*C-4*
	B-5	• Higher land values (*from preservation of high environmental quality*) [4, 7]	• Reduced economic rents/producer surplus [4] /	*C-5*
	B-6	• Increased consumer surplus (*increased utility of CHD-compatible recreational activities in absence of CHD-incompatible activities with negative externalities*) [1]	• Reduced land/capital asset values (*incl. from uncertainty*) [3, 4]	*C-6*
	B-7	• Net social benefit from reducing baseline activities with negative net social benefits [2]		
	B-8	• Avoided health damages		
Indirect use values (ecosystem function values)	*B-9*	Avoided loss of ecosystem function values of area designated as CH [5]		
Option value	*B-10*	Avoided loss of non-market option values of area designated as CH		
Non-use values	*B-11*	Avoided loss or reduction of stewardship, existence, and intrinsic values associated with area designated as CH		
Avoided cost of non-smart growth, including:	*B-12*	Avoided negative externalities of urban sprawl [6]		
Avoided cost of community services		Avoided cost of public infrastructure for development projects in area designated as CH [8]		
Loss of social capital	*B-13*	Avoided loss of social cohesion and associated problems [8]		

Notes: * Not all B/C categories are relevant in every case of CHD. Also, *B-4* and *B-5*, and *C-5* and *C-6* are not mutually exclusive. [1] For example, increased enjoyment of snowshoeing or cross-country skiing without presence of snowmobiles. [2] For example, logging or grazing on public lands at fees below social cost. See examples given in Rachlinski (1997) and Houck (1995). [3] Insofar as future development opportunities are anticipated, the lost opportunities of development will be captured, at least partly, in reduced land/capital asset values. [4] To the extent that land is used for marketed output, land values capture economic rents, and vice versa. [5] Includes the ecological regulatory function of the species of concern (especially important for keystone species). [6] For example, health damages from increased air pollution due to increases in private transport as a result of urban sprawl. [7] See for example Nelson et al. (2002). [8] See for example ECONorthwest (2002a). [9] Refers to consumption goods, i.e., not capital assets. [10] Refers to land and capital assets (buildings etc.).
Sources: General value categories based on Barbier (2000) and Brown and Shogren (1998).

An individual's willingness-to-pay (WTP) expresses the total benefit the individual receives from the good or service. If this total benefit exceeds the price, CS for the good or service is positive. If price and WTP are equal, CS is zero. Consumer surplus is represented graphically by the area enclosed by price, demand curve, and y-axis.

Producer surplus (PS) is defined as the difference between the production cost of a good or service and the price at which that good or service is sold. If price equals production cost, PS is zero. If the production cost is lower than the price, PS is positive. Producer surplus is represented graphically by the area enclosed by production cost, price, and the y-axis

Changes in CS and PS represent changes in the net benefits for an individual or a firm, respectively, and hence imply changes in societal welfare. In other words, an event that increases CS or PS, *ceteris paribus*, leads to an increase in society's overall welfare. If an event impacts both PS and CS, then society as a whole is better off as long as the sum of the CS and PS changes is positive.

Table II.2-1 presents a comprehensive list of the costs and benefits of habitat conservation that have been identified in the economic literature. In some designation cases, some of the costs (C-1, C-2,..., C-6) listed in the table represent different expressions of the same phenomenon. The same is true for benefits (B-1, B-2,..., B-13). In order to avoid double counting, it is therefore necessary to carefully consider the value captured by one cost or benefit when analyzing a particular designation. For example, foregone development opportunities for a sector may lead to reduced economic rents in that sector. Counting both would result in a double counting of the respective costs.

Not every designation of critical habitat is likely to generate all of these impacts, or even affect all of the impact categories. Furthermore, different designations may vary considerably in terms of the relative magnitudes of their impacts in different value categories (shown in leftmost column of the table). Nevertheless, the table provides a list of the potential impacts that any designation of critical habitat may cause and that therefore should be considered in the economic analysis of any designation.

As discussed in chapter III of this study, the designation of critical habitat for the lynx is expected to impact all economic benefit categories, with the exception of the maintenance of social capital.[9]

A variety of techniques have been developed for the quantification of impacts and their expression in monetary units. Specifically, thanks to methodological advances in the fields of environmental and natural resources economics in the last few decades it is now possible to estimate the monetary value of most types of environmental values (Cropper 2000). These advances consist not only in methods that allow the generation of more reliable primary data (or the generation of data at all), but also in the development of value-transfer approaches that allow the generation of second-best benefit estimates on the basis of existing studies. This second achievement is crucial because it makes possible the generation of value estimates in cases where budget constraints prevent primary data collection.

[9] The concept of social capital employed here is the one used by Putnam (2000), with specific focus on networks of civic engagement. Designation of critical habitat may, in some cases, reduce the erosion of such networks that historically has been associated with, among other things, increased suburbanization, by placing development restrictions on some lands that otherwise would have been consumed by urban sprawl (for further examples of how habitat protection may benefit social cohesion, see ECONorthwest 2002a).

II.3 Quantification of benefits generated by designation of critical habitat

The designation of critical habitat for the lynx is expected to have two main beneficial impacts. These are an increased chance of recovery of the lynx population, and an increase of the amount of land maintained in an undeveloped or less developed state.

Improved prospects for lynx recovery

All of the direct impacts on land use activities attributable to the designation of critical habitat for the lynx by design are expected to be conducive to the recovery of lynx populations in the study area. Designation of critical habitat for the lynx is expected to redirect some land use activities from lynx habitat (mostly forest) to already more developed (generally, non-forest) habitat and to habitat types used primarily for travel and dispersal, thereby improving the quality and quantity of denning and primary foraging habitats (compared to the no-CHD scenario). Examples of CHD impacts are redirected and/or prevented new residential developments, prevented or modified expansion of winter recreation, and some road projects (those that would increase transect length or reduce roadside vegetation, or add ancillary construction such as pull-outs, rest or parking areas, and scenic view areas). Further, some activities are expected to potentially be entirely precluded, as is the case for new mining projects. Through all of these impacts, designation of critical habitat is expected to promote an increase in lynx populations and hence lynx recovery.

Preservation of undeveloped landscapes

The reduction in the amount of land converted to extractive uses or developed into residential areas carries a variety of values, a comprehensive listing and discussion of which is given elsewhere (Daily et al. 1997; Kiker and Hodges 2002). These values derive from the visual attributes of the landscape itself (for example, higher values of already developed properties; superior recreation experience in undeveloped viewsheds) or from the ecosystems that exist in it. In the case of the lynx, CHD leads to the prevention of the destruction or modification of forest ecosystems. These systems provide benefits in the form of crucial ecosystem services such as maintenance of local and regional nutrient and water cycles (Aber and Melillo 2001) and of biodiversity.

To the extent that people place a value on the recovery of lynx populations and on the protection of other forest species, and to the extent that people value the other (besides habitat provision) services provided by forested ecosystems, economic theory requires that those values be included in the present analysis. The validity of including both non-use and option values in economic analyses also has been recognized by the courts (U.S. Court of Appeals 1989) and in legislation (U.S. Department of Commerce 1994; U.S. Department of Interior 1994). A wealth of research has shown that people do in fact value the preservation and recovery of threatened and endangered species (see for example the studies cited in White et al. 2001), and that they value undeveloped landscapes (see for example White and Lovett 1999; Kiker and Hodges 2002). In fact, the high value people attach to undeveloped landscapes is evident from the popularity of national parks and national forests, with an estimated 214 and 277 million recreation visits, respectively, in 2002 (USDA FS 2002d, USDI NPS 2003e).

The types of benefits relevant for the present analysis are shown in Table II.3-1.

Table II.3-1: Relevant benefits from designation of critical habitat for lynx

Object of value	*Value*	*Corresponding value category in Table II.2-1*
Lynx	Stewardship value	B-11
	Existence value	B-11
	Intrinsic value	B-11
Undeveloped landscapes	Option value (for mining)	B-10
	Ecosystem function value	B-11
	Recreation value (scenic beauty/ aesthetic character of landscape)	B-6
	Property values	B-5
	Existence value	B-11
	Intrinsic value	B-11
	Avoided negative externality of decentralized development: public services (where applicable)	B-12
	Carbon sequestration	B-11
Biodiversity maintenance (species other than lynx)	Stewardship value	B-11
	Existence value	B-11
	Intrinsic value	B-11

Quantification of values

Although there exist a number of approaches for quantifying the benefits of environmental amenities and services (see Figure II.3-1), contingent valuation (CV) generally is considered the approach of choice (Arrow et al. 1996; Krupnick and Portney 1991). This is despite the difficulty of designing the survey instrument in such a way as to obtain unbiased and consistent value estimates (Diamond and Hausman 1994; Stevens et al. 1991, Stevens et al. 1993), and its likely inability to accurately capture ecological function values (Cropper 2000; Vatn and Bromley 1995).[10] The former problem may be overcome through the careful design and administration of the instrument (Arrow et al. 1993). The latter criticism is more serious, however, as it argues that WTP-based approaches are inherently unable to generate valid estimates of the value of ecosystem services. Ecosystem function values, therefore, may in many cases better be estimated via other approaches (see Figure II.3-1). However, inherent limitations in our understanding of the systems' functioning suggests that all estimates of the functional value of ecosystems be considered with caution.[11]

[10] An excellent discussion of the conceptual problems underlying the use of CV in the valuation of ecosystem services can be found in Vatn and Bromley (1995).

[11] An additional problem in the quantification of ecosystem functional values lies in the multi-attribute character of most ecosystems. For example, a wetland provides water filtration services that could be replaced by a water filtration plant. However, the avoided cost of the plant does not represent the value of the wetland, as the natural system provides many additional functions that the human-made one (the plant) does not; examples of these services are sediment and flood control, spawning ground and nursery for fish, maintenance of biodiversity, etc. Accurate valuation requires a careful inventory of all services and of the direct, indirect, and non-use values that they generate (see for example Barbier 2000).

Figure II.3-1: Categories of economic values of ecosystems and available valuation approaches

Value categories:

Total Economic Value = **Use value** + **Non-use value**

= Direct use value + Indirect use value *(ecosystem functional values)* + Option value

Existence value + intrinsic value + bequest/stewardship value

Quantification approaches:

Direct use value	Indirect use value	Option value	Non-use value
Travel Cost Method	Production function approach	Contingent Valuation Methods	Contingent Valuation Methods
Surrogate market valuation[1]	Damage costs avoided	Individual Choice models	
Hedonic prices	Preventive expenditures		
Contingent Valuation Methods	Travel Cost Method		
	Surrogate market valuation		
	Contingent Valuation Methods		
	[Replacement cost]		

Notes: [1] Household production function models. Replacement cost is in brackets because its use in ecosystems valuation in many cases is problematic.
Source: Based on Barbier (2000).

As discussed above, many of the value categories associated with the designation of critical habitat for the lynx are non-use values (see Table II.3-1). The methodology commonly used for quantification of these values is contingent valuation (CV) (see Figure II.3-1).[12]

In CV surveys, respondents are commonly presented with a hypothetical situation in which they are asked to assign a monetary value to a specific good or service, or a bundle of goods or services. If the CV format follows best-practice design principles (see Arrow et al. 1993), valid value estimates can be generated, and respondents' replies represent reasonably accurate expressions of their willingness-to-pay (WTP) for that good or service. In fact, there exists by now ample evidence in the benefits estimation literature that CV-based WTP estimates are generally in line with estimates based on revealed preference approaches (Hanemann 1994). The use of WTP for benefits quantification, besides being the conceptually correct approach to quantifying economic values in monetary terms (Arrow et al. 1996), allows the comparison of costs and benefits on the basis of a common denominator.[13]

Unfortunately, there exists no WTP estimate for lynx, or, for that matter, for any other felid species.[14] Ideally, the FWS would conduct such a study for its economic impact analysis of CHD for lynx, designed to estimate WTP for the value measures and types generated by the improvements in lynx conservation that CHD would bring about. That, however, has not happened yet. Since the resources available for conducting this study did not allow the generation of primary data, the methodology of benefit transfer represents the only possible approach for generating quantitative estimates of WTP for the benefits generated by lynx CHD.

Benefit transfer commonly is defined as the adaptation of value estimates generated at a study site to another site (the "policy site") for which such estimates are desired but no primary data for their generation are available (Rosenberger and Loomis 2001). Benefit transfer is a convenient tool for the efficient generation of benefit estimates, provided that several conditions are fulfilled that ensure the validity of the benefit estimates generated for the policy site. These conditions are: 1) that the policy context is defined precisely, including the type and magnitude of the expected policy impacts, the characteristics of the population affected, the type of value measure (average or marginal value) used, the category of value (direct use, indirect use, non-use, total economic value) measured, and the degree of certainty surrounding the transferred data; 2) that the data available for the study site are of sufficient quality (sample size, sound economic method, sound empirical technique, and sufficient number of similar study sites to allow credible statistical inferences) and that the background information is sufficient (population characteristics); and 3) that study and policy site possess similar characteristics (similar resource, type and degree of change in resource, and source of change; similar demographic characteristics,

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[12] An alternative valuation approach that is used lees often is conjoint analysis.

[13] In this study, the benefits to be valued are increases of species' populations or of environmental amenities that are expected to occur as a consequence of designation of critical habitat for the lynx. Conversely, if benefits to be analyzed are the prevented decrease of species populations or the prevented loss of environmental amenities, respondents' assigned values should be elicited in the form of their willingness-to-accept (WTA) such losses or degradations, because the ownership status is reversed in such a situation. Since individuals generally are less hesitant to forego hypothetical gains than they are to accept hypothetical losses (the so-called endowment effect), WTP and WTA generally differ, the latter being higher than the former (Hanemann 1991; Adamowicz et al. 1993).

[14] We confirmed this absence of WTP studies for felid species with a number of prominent felid researchers in the United States, Canada, and Europe. It may be possible to construct values for some large cats used in trophy hunting through the use of indirect WTP methods, but the resulting estimates would be of no use for the present study due to the differences in people's perception of the large cats and of lynx, and, most importantly, due to the fact that no hunting of lynx will be allowed during the period analyzed in this study.

especially income and cultural background; and, if recreation activities are valued, a similar condition and quality of the recreational experience at both sites) (Rosenberger and Loomis 2001; Brower 2000).

Approaches to Benefits Transfer (BT)

Benefits transfer (BT) can take the form of a value transfer or of a function transfer. A value transfer is the application of a single-point or average-value estimate from a study site to the policy site. In a benefit function transfer, a model is used that statistically relates benefit measures to the independent study variables, that is, the study characteristics (demographics and resource characteristics). Benefit function transfers either are based on demand or benefit functions estimated for a study site, or on meta-analysis. Meta-analysis is commonly defined as a regression analysis of the findings of several empirical studies that systematically explores study characteristics as possible explanations for the variation of results observed across primary studies (Brouwer 2000; USEPA 2000). In both function transfer approaches (demand and meta-analysis), the values of key variables from the policy case are inserted into the benefit function, to develop policy-site-specific value estimates.

A review of the recent literature suggest that meta-analysis is emerging as the approach of choice in BT (Smith 1992; Loomis and White 1996; Brouwer 2000; USEPA 2000; Rosenberger and Loomis 2001; Chattopadhyay 2003). Fortunately, there exists one such meta-analysis of threatened and endangered species (Loomis and White 1996) that can be used to construct a meta-analysis-based value estimate for the lynx. In addition to meta-analysis-based value estimates, we generate benefit estimates via the value transfer approach, based on another small to medium-sized carnivore for which such values are available and that arguably represents a suitable basis for such a transfer (the river otter).

Although BT seems to become the approach of choice in cases where primary valuation studies are infeasible, it is not without problems. Because there rarely are policy sites whose most important WTP-relevant characteristics exactly match study sites for which original data have been generated, and because studies do not always measure all aspects of the perceived resource quality of the environmental amenities of a study site for which WTP is elicited and thereby prevent the incorporation of all relevant resource quality aspects into meta-analysis functions, meta-analysis-based BT may potentially introduce large errors into BT-based benefit estimates (see for example Kirchhoff et al. 1997). Nevertheless, BT may provide a useful tool for estimating the order of magnitude of values (ibid.).

Value of improved chances of recovery of lynx populations

The single-point estimate benefit transfer employed in estimating the (anthropocentric) value of the lynx does not simply consist in the standard BT procedure of adapting value estimates from one site to another (UK to US), but in addition in a transfer of value from one species to another. Although the literature suggests the potential use of benefit transfer functions, specifically, meta-analysis, for the valuation of unstudied species (Loomis and White 1996), the use of single or average-value estimate is more controversial. In order to achieve a reasonable degree of confidence in the results it must be assured that public perception of and attitudes toward the Canada lynx are reasonably similar to those of the species that serves as value donor. Specifically, type of species (Loomis and White 1996), and physical appearance and public profile of the species (Samples et al. 1986) have been identified as significant factors in determining WTP.

The Canada lynx is a medium-sized carnivorous feline. Average weight is 8-9 kg for females, and 9-10.5 kg for males; average body length is 76-84 cm for females, and 80-90 cm for males (Mowat et al. 1999). It can be assumed that most people in the United States are familiar with the species in the sense that they have a more or less correct idea of its appearance.[15] In addition, the (Canada) lynx is not known as a predator of domestic livestock or game species. These characteristics set the lynx apart from most other mammalian carnivores for which WTP estimates are available (see for example Loomis and White 1996), such as the gray wolf (*Canis lupus*) and the grizzly bear (*Ursus arctos horribilis*).

Two species that arguably fulfill the requirement of being perceived fairly similarly to the lynx are the river otter (*Lutra lutra*) and the red wolf (*Canis rufus*). The river otter is a medium-sized aquatic carnivorous mammal 55-95 cm in length and between five (5) and twelve (12) kg in weight. The red wolf is a medium-sized wild canid that ranges from 20-36 kg in weight and that in size falls between the coyote and the gray wolf (USDI FWS, Red Wolf Species Account, at *http://endangered.fws.gov/i/a/saa04.html*, accessed Dec. 2003; Rosen 1997).

The otter is a high-profile or "flagship" conservation species in the UK (White et al. 1997). White et al. (1997) report that 66 percent of their respondents were aware that otters are under threat in England, and 67 percent of respondents were willing to pay the amount specified in their questionnaire (the survey was referendum-type, that is, each respondent was faced only with one payment which he or she could refuse or accept; solicited payments ranged from £1 to £20).[16]

49 percent of Rosen's survey respondents knew that the red wolf is an endangered species and 52 percent were aware that red wolves feed primarily on wildlife, but only 25 percent were aware that they weigh between 20-36 kg (Rosen 1997). Between 70.5 and 79 percent of respondents favored red wolf recovery, depending on the location of recovery (ibid.).

The lynx falls between the otter and red wolf in terms of both size and weight. None of the three represents a threat to humans, and none is known for preying on domestic livestock.

In addition to the public profile of a species, however, the valuation context is of paramount importance for respondents' WTP. Specifically, the type of change in resource quality or quantity being valued is crucial. What the designation of critical habitat for the lynx in the proposed area in northwestern Montana is expected to produce is an increase in the likelihood of recovery of the lynx population in the area, compared to the population that would be expected to exist without designation of critical habitat. Hence, the most appropriate sources of WTP estimates would be studies that elicit respondents' WTP for improvements in the chances of recovery of a species or increases in species' populations. WTP estimates for reintroduction of species or prevented extinction of species would be less appropriate, because the nature of the good to be valued is fundamentally different. Reintroduction of a species most likely has a higher value for most respondents than does a population increase of a species that is still naturally occurring in the wild. In addition, the fact that Rosen's (1997) respondents were informed that the red wolf is endemic to the Eastern United States (i.e., it is not found anywhere else in the world) is likely to increase respondents' WTP.

Therefore, using Rosen's (1997) WTP for red wolf reintroduction as the basis for a benefit transfer for improved lynx conservation in our study area most likely would result in an

[15] The fact that lynx are frequently confused with bobcats is of no relevance here because of the similarity in appearance of the two species (Ruediger et al. 2000).
[16] Percentage based on numbers given in table 5 in White et al. (1997).

overestimate of WTP, because the qualitative nature of the proposed action is different. In addition, the fact that red wolves in the eastern US have become an attraction for wildlife watchers leads to additional doubts regarding the appropriateness of using the red wolf as a WTP donor species, because lynx are inherently more secretive animals that lend themselves much less to such activities. For these reasons, Rosen's (1997) red wolf study is less suitable for our analysis and we chose the river otter (*Lutra lutra*) as the donor species for a point value benefit transfer. Nevertheless, for purposes of comparison, we do report red wolf-based benefit-transfer estimates below, but we do not use them in the estimation of lynx WTP.

This leaves the river otter as the only remaining candidate for benefit transfer. Unlike the otter in the UK, the lynx in the US is not a flagship conservation species (as is for example the bald eagle). This suggests that use of WTP estimates for otter may introduce an upward bias into the estimated WTP for lynx conservation. On the other hand, the lynx is generally perceived as a particularly "cute" and charismatic animal.[17] On balance then, it would appear that the WTP estimate reported in White et al.'s (1997) otter study is generally suitable for benefit transfer to the lynx.

Due to the uncertainties surrounding lynx ecology, study area lynx population, and number of mortalities and morbidities caused by the various land use activities examined in the present study, it is difficult to generate a quantitative best estimate of the size of the lynx population increase under CHD that would have an acceptable degree of confidence. The magnitude of the increase in lynx population is important however, as research suggests that magnitude of population change is a significant factor in WTP (Loomis and White 1996). Therefore, we generate WTP estimates for two scenarios: one in which the lynx population increases by 10 percent, and one in which it increases by 25 percent.

The total forest area that would be prevented from outright conversion as a result of CHD in constitutes only an insignificant amount of total lynx habitat in both of our proposed designation areas. However, the various land use restrictions associated with lynx CHD are likely to have impacts on lynx populations that are disproportionately larger than the acreage of lynx habitat protected from development. The primary reason for this is that the protection of the respective limiting habitat type in every LAU and the reductions in habitat fragmentation and barriers to movement and dispersal together increase not just the *quantity* of lynx habitat but its *quality*. In addition, impacts of lynx CHD reduce lynx mortality, for example through an expected reduction in the number of roadkills through project modifications (especially the US 93 project in Montana).

Single-point transfer WTP estimate

White et al. (1997) examined the WTP of area households in the UK for a 25 percent increase in otter populations. Since WTP is, among other things, dependent on income (or more accurately, wealth, data on which however are harder to obtain), that is, on ability to pay (ATP) (Arrow et al. 1996), we adjust White et al.'s (1997) WTP estimated average area-household WTP for income differences between White et al.'s (1997) study area and our case study areas. First, we convert their WTP estimate to its UK equivalent by multiplying WTP by the ratio of the UK average per-capita income and the average per-capita income in the White et al. (1997) study area (North

[17] See for example The Denver Post, "Lynx cute but costly for DOW" (article published February 9, 1999, accessed 19 December 2003 at ***http://lynx.uio.no/lynx/nancy/news/cofe999b.htm***), or the Vegas Rover news article #2 on February 28, 2002 (***http://www.lrclv.com/2-28-02.html#1***, accessed December 19, 2003), which refers to lynx as "cute critters."

Yorkshire, UK).[18] We then adjust for 1997-2001 UK inflation and then convert the resulting UK-equivalent, £-denominated WTP to its US, $-denominated equivalent using the purchasing power parity-adjusted ratio of US GNP and UK GNP (see eq. 1).[19] This adjustment takes the following form:

$$WTP_{US} = WTP_{UK} \,(\text{per-capita } GNP_{PPP\text{-}US} \,/\, \text{per-capita } GNP_{PPP\text{-}UK})^{\varepsilon}. \qquad (\text{eq. } 1)$$ [20]

Finally, to derive the estimated WTP of the average household in our study areas, we convert the WTP estimate obtained via eq. (1) to its equivalents for our study areas by multiplying the former by the ratio of the average population-weighted per-capita income of the counties in which our study areas are located and the average US per-capita income.[21]

The WTP for a 10 percent increase in lynx populations is assumed to be half of the estimated WTP for a 25 percent increase, instead of 40 percent of the WTP for a 25 percent increase. This assumption seems reasonable given that research suggests that WTP increases sub-proportionately with increases in species population (Loomis and White 1996).

In addition to the WTP estimate for area households, we develop an estimate of the WTP of out-of-area visitors, which White et al. (1997) did not estimate. Since the literature shows that WTP of visitors for protection of threatened and endangered species exists and generally exceeds that of area households (see Loomis and White 1996), it must be included in the analysis. We estimate visitor WTP by multiplying the White et al. (1997)-based WTP of the average study area household by the WTP ratio of visitors and area households observed in our meta-analysis transfer estimates (2.18:1). Because White et al.'s WTP estimate takes the form of a lump sum payment that captures WTP over a period of more than just one year, we multiply our visitor WTP estimate by only one year's worth of out-of-area visitors when deriving total visitor WTP for lynx population increases. In doing so, we assume conservatively that there will be no increase in visitor numbers during the ten year projection period.

The above procedure allows the estimation of the WTP of study area households and visitors for lynx population increases. However, species or habitat protection programs often generate substantial benefits beyond the boundaries of the proposed study area (see for example Pate and Loomis 1997; Loomis 2000b).[22] Therefore, WTP must be estimated and summed over all populations that have a WTP for the policy in question. Total WTP in the US for lynx

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[18] The per-capita income ratio is based on data given in UK's Office of National Statistics (UK ONS 2001).
[19] Relative prices of traded and non-traded goods often differ between countries, thereby distorting income comparisons that are based on currency-based exchange rates (since the latter form on the basis of trade and financial flows only). To overcome or at least reduce this distortion, for purposes of accurate comparisons of local incomes across countries incomes are expressed in terms of their relative purchasing power in a reference country, which under current practice is the US (World Resources Institute et al. 1998). In 2001, the UK£ to US\$ GDP_{PPP} ratio was 0.7 (World Bank 2003).
[20] WTP may be nonlinearly dependent on income level (Cropper and Simon 1996). However, due to the lack of empirical studies on this issue, no estimates of the income elasticity factor (ε) of WTP are yet available (Cesar et al. 2002; World Bank 1999). Therefore, WTP is assumed to be a linear function of income with an elasticity of one.
[21] In 2001, the population-weighted average per-capita income in our study area counties was 78.3 percent of the average national per-capita income (Smith 2002).
[22] Loomis (2000b) examined household WTP to prevent reductions in the protection of a group of 62 threatened and endangered species. He found that for households located 1000 miles from the area proposed for protection, average household WTP was still approximately 70 percent of that of households in the study area, and even at 2500 miles it was still 20 percent of that in the study area.

conservation in the Montana study area is the aggregate of WTP of local households, out-of-area visitors, and the remainder of US households. Recent research suggests that WTP for species and habitat protection generally is an inverse function of distance from the locale of protection (Loomis 2000b). Hence, a WTP distance-decay function must be employed to estimate the WTP of those US households that do not reside in the study area and do not visit the area (Loomis 2000b). Distance-weighted WTP can then be summed over all US households to arrive at total national WTP. Ideally, one would derive national WTP by weighting all US residents by their respective distances from the study area, the weighting factors being defined by the WTP-distance gradients at the specific locations. A more practical approach, and the one employed in this study, is to estimate WTP for the remainder of the US households by using the current US mean center of population, which is located in south-central Missouri, at a distance of approximately 1,250 and 980 miles, respectively, from our case study areas, and the distance-adjusted WTP factors for those distances, which are 0.65 for the Montana study area and 0.7 for the Maine study area (based on Loomis 2000b).[23, 24] This procedure introduces an upward bias into the aggregate outside-of-study-area WTP estimate for the Montana study area, as the distance-decay gradient estimated by Loomis (2000b) shows an increasing (negative) slope with increasing distance, indicating an increase in the rate of decline of WTP above 1,100 miles from the study site. However, since WTP is strongly dependent on ability-to-pay (ATP), and since the average per-capita income for the counties in our study area (in 2001) is almost 22 percent below the average US per-capita income, by not adjusting for the higher US average income we introduce a large (countervailing) downward bias into the out-of-study-area WTP estimate that makes the resulting estimate conservative.[25]

Meta-analysis benefits transfer

For the second WTP estimate we use Loomis and White's (1996) meta-analysis regression function in its reduced double-log form.[26] The equation takes the following form:

$$\begin{aligned}\ln WTP = \; & c + \beta_1 \cdot \ln\Delta POP + \beta_2 \cdot PAYFREQUENCY \\ & + \beta_3 \cdot VISITOR + \beta_4 \cdot MARINE + \beta_5 \cdot BIRD \qquad \text{(eq. 2)},\end{aligned}$$ [27]

where ln is the natural log, c is the intercept, the β's are elasticities, ΔPOP is the proposed percentage change in population size (10 and 25 percent, respectively, in our case), PAYFREQUENCY is a dichotomous variable indicating the type of payment, coded 1 for one-time payment and 0 for an annual payment, VISITOR is a dichotomous variable indicating whether the respondent is a visitor (coded 1) or a local household (coded 0), MARINE is a dichotomous variable coded 1 for marine mammal and zero otherwise, and BIRD is a dichotomous variable coded 1 if the species for which WTP is elicited is a bird, and 0 otherwise. In our BT, the last two dummy variables assume a value of zero, and the VISITOR variable is coded 1 to estimate WTP of visitors, and 0 to estimate WTP of households. In our estimates, we coded the PAYFREQUENCY variable 1 (one-time payment); coding it 0 would yield approximately three-times higher WTP estimates for the population changes we examine.

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[23] See U.S. Census Bureau at ***http://www.census.gov/geo/www/cenpop/geogctr.pdf.*** Data are for the year 2000.
[24] We use Loomis' (2000b) estimated benefit gradient for a group of 62 threatened and endangered species.
[25] Data on relative per-capita income in Montana counties taken from Smith (2002).
[26] The reduced model contains only variables that Loomis and White (1996) found to be significant at the 0.1 level or higher.
[27] Equation (2) yields WTP estimates in 1993 Dollars, because it was derived using benefit values expressed in 1993 prices.

Values associated with the prevented development of undeveloped landscapes

The designation of critical habitat for the lynx is expected to lead to the preservation of the undeveloped state of some amount of predominantly forested landscape. Such preservation carries a number of economic values.

Ecosystem function values

Maintenance of forests and wetlands in their natural state avoids the loss or degradation of the ecosystem service functions provided by the natural systems present on these lands (Talberth and Moskowitz 1999). These services for example include maintenance of the hydrological cycle, which produces large benefits to all sectors of society. The value of the water provision services alone - excluding navigation, waste dilution, flood control, channel maintenance, aquatic habitat provision, wetland functions, and non-use values - of the national forests in the Northern US Forest Service region (comprising northeastern Washington, northern Idaho, Montana, and North Dakota, with the largest share of national forest lands being located in Montana) is very conservatively estimated at approximately $430 million per year (USDA FS 2000b). The Forest Service Northern region forest lands cover some 25 million acres, which results in an estimated *direct use* value of water-related forest ecosystem services of $18 per acre. As the Forest Service (USDA FS 2000b) points out, this estimate is to be considered a very conservative one, due to the many services omitted from valuation.

Unfortunately, estimates of the economic value of ecosystem services exist for only a handful of the most important services provided by the type of forest that characterizes our study areas (see Table II.3-2). More information is available for valuation of the services provided by wetlands, which make up part of the area that may be prevented from conversion in our Montana study area. Wetlands which have considerably higher ecosystem function values than temperate or boreal forests, primarily due to their importance in disturbance regulation, water supply, and waste treatment capacities.

Non-use values

In addition to the above indirect use values associated with the prevented development of forested lands, many people also value the pristineness of landscapes and the maintenance of biodiversity or, at a minimum, the avoided loss of habitat for species (endangered, threatened, and other). Such avoided losses have intrinsic value, and in addition people also attach stewardship and existence values to them.

Stevens et al. (1991) report the results of a CV survey in which they asked respondents to allocate their WTP for four animal species (Atlantic salmon, coyote, wild turkey, and bald eagle) to use value and several existence value categories. The resulting breakdown of WTP indicates that intrinsic value accounted for almost half (48 percent) of stated WTP of respondents, while use (including option) value accounted for only seven percent of WTP, and bequest value for 34 percent.

The monetary quantification of the intrinsic value of a species by respondents is of course conceptually problematic. Since the intrinsic value of a species is defined as the value that species has independently of its appreciation by humans, a species' intrinsic value cannot be objectively assessed by humans, because humans' assigned values are always based on their held values and preferences which, by definition, are irrelevant for the intrinsic value of the species. It is not obvious how this problem can be overcome without recourse to some form of ecocentric value metric (for example the embodied energy or e*m*ergy concept of value proposed by H.T. Odum; see for example Odum et al. 1987, Brown et al. 1995). It may therefore be conceptually more appropriate to consider peoples' combined WTP for individual non-use values as their WTP for existence value in general, and accept that in addition to use and non-use values, animate objects and ecosystems have intrinsic value that is beyond quantification by humans.

Table II.3-2: Estimates of economic values of ecosystem services provided by temperate/boreal forests and wetlands

Ecosystem function	*Value 2002$/acre/yr*		*Valuation method* [1]
	Forest	*Wetland*	
Gas regulation	n.a.	65 [2]	AC
Climate regulation	43 [2]	n.a.	AC
Water regulation	n.a.	-	-
Water supply and in-stream recreation	18 [3]	1867 [2]	MP/CV [4]
Disturbance regulation	n.a.	2230 [2]	AC/RC
Nutrient cycling	n.a. *(373)* [5]	n.a.	-
Soil retention	n.a. *(99)* [5]	n.a.	-
Soil formation	5 [2]	n.a.	AC
Waste treatment	43 [2]	2052 [2]	RC/CV
Habitat provision	n.a.	149 [2]	MP/CV
Biodiversity maintenance	n.a.	n.a.	-
Total	109	6363	

Notes: [1] Information on primary method of valuation taken from de Groot et al. (2002): AC - avoided cost; RC - replacement cost; CV - contingent valuation; MP - market price. Values based on data for temperate/boreal forests from [2] Costanza et al. (1997) and on [3] USDA FS (2000b). [4] Value from various uses (off-stream, hydroelectric generation, recreation) valued with various methods (USDA FS 2000b). [5] Values in parentheses are estimates for tropical forests in which, on average, rate of nutrient cycling and susceptibility to erosion are much higher than in temperate or boreal forests. Therefore, these values are not appropriate for transfer to the study area forests. They are given only to indicate the order of magnitude of the respective ecosystem service values. Values given by sources were adjusted to 2002 prices using the CPI (Council of Economic Advisors 2003). n.a. - not available.

The WTP breakdown into use and non-use values reported by Stevens et al. (1991) resulted from a survey that focused on animal species, not on landscapes or parts thereof. The relative importance of non-use values (existence, bequest, stewardship) does however seem to be similar in the case of landscapes. Kramer et al. (2002) observed, in a study of people's WTP for the protection of the remaining healthy spruce-fir forests in the southern Appalachian Mountains, that existence value accounted for 57 percent of total WTP, while bequest value accounted for 30 percent, and use value for only 13 percent. The high existence value component in people's WTP for landscapes makes sense, for one because landscapes possess instrumental value for species' existence, but also because, independently of the latter, landscapes are of spiritual, cultural, and aesthetic importance to people.

Since the WTP for lynx conservation already captures the instrumental component of the existence value of landscape with respect to lynx, that value is double-counted if WTP for lynx and WTP for landscapes in our study area are summed. Since the lynx is only one of several ESA-listed species in our study areas, and since people do not just value those species that are considered threatened or endangered, double-counting of this intrinsic value component is likely to introduce only a marginal upward bias into the estimated total benefits of lynx CHD in the study areas.

Recreational use values

Prevention of development of forested lands leads to the avoidance of the loss of the value of the recreational experience on said lands and to the avoided reduction of the value of recreation on adjacent lands (most importantly, areas that have the protected lands in their viewshed). Site quality, that is, attractiveness, is an important criterion in site selection by recreationists and influences the quantity of recreation benefits received (see for example Loomis 1995). For example, the value hikers place on hiking in undeveloped areas is generally (*ceteris paribus*) higher than the value they place on hiking in partly developed areas. Forested lands in particular provide large direct consumptive and non-consumptive benefits in the form of fishing and hunting, and wildlife watching, respectively (USDI FWS and USDC CB 2003; USDI FWS 2001c; USDI FWS 2001d). The prevented decline in the recreational quality of various sites in the proposed lynx CHD area does result in overall benefit gains to recreationists compared to the base case (i.e., no designation) scenario, which may induce increases in the number of visitation days and related regional recreation revenues (see for example Loomis 1995). In addition, non-users may attach existence value to these “natural” landscapes or to particular subsystems thereof. Some evidence suggests that the recreational and non-use (moral/spiritual/aesthetic) values of national forests are increasing at the expense of commodity-related values (Bengston et al. 1999). These existence values have been addressed in the preceding section on non-use values.

Option value

Prevented development and the associated conversion of natural ecosystems in some cases also leads to the prevented loss of the option value of lands. This is particularly true for lands that in the absence of CHD would have been used for surface mining by the McDonald gold project in the Montana study area. Option value is captured as part of an individual’s use value, and, to the extent that recreation is the highest-valued activity in the area in which the mine would be located, therefore is already included in the recreational value estimates.

Biodiversity losses

Designation of critical habitat may in some cases impact (local) biodiversity, through the prevention of a decline in habitat quantity or quality, or both. Biodiversity carries ecosystem function value (see Table II.3-2), but it also carries non-use value (see Table II.3-1); hence, avoided species loss provides both indirect use and non-use values.[28] If the value people place on the increment in local species richness that would result from lynx CHD were large enough to attract visitors to the area that otherwise would have stayed away, biodiversity maintenance would additionally have direct use value for the study area in the form of increased recreation values (recreation-related increased consumer and producer surpluses).[29]

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[28] In our case, the non-use value of the lynx should not be included in the (non-use) value of local biodiversity maintenance, because the value of the lynx, except its intrinsic value component, has already been considered individually.

[29] Biodiversity maintenance in general also has direct use value because most likely a fair number of future medicines will be developed from chemical compounds yet to be discovered in organisms. The

The impact of lynx CHD on biodiversity during the study period however likely is negligible. CHD for the lynx does not take large amounts of land out of development and only places relatively minor additional use restrictions on those lands that it affects. Therefore, it is unlikely that the incremental protection from lynx CHD in Montana or Maine would affect the probability of species extinctions in any appreciable way. The direct-use values of the potential biodiversity impacts of lynx CHD are therefore omitted from Table II.3-1, and neither the direct use nor the non-use values of biodiversity maintenance due to lynx CHD are estimated.

Property values and public services costs of sprawl

Designation of critical habitat may in some cases lead to restrictions on residential development. To the extent that these restrictions prevent the replacement of natural ecosystems by physical infrastructure such as buildings, roads, driveways etc., the maintenance of the natural character of these lands may increase the value of surrounding properties that already have been developed. Such an increase in property values would constitute a benefit of CHD.

Restrictions on residential construction and road construction may also lead to a reduction in the negative social externalities associated with the two. There exists by now a sizeable literature that documents the negative impacts of urban sprawl. Low-density development patterns cause a multitude of negative externalities, from human health impacts (morbidity and mortality from air pollution and from traffic accidents) resulting from increases in private transport and in the per-capita energy consumption of fossil fuels, to increases in the rate of conversion of landscapes, loss of social cohesion, and increased costs of public service provision, to name but a few (Burchell et al. 2002, Nelson et al. 2002). Public services include roadway construction and maintenance, sewer extensions and hookups, police, firefighting, schools, etc.

II. 4 Choice of discount rate

Most public policies generate economic impacts (costs and/or benefits) over a period of time longer than one year. Because individuals generally exhibit a positive rate of time preference, or put differently, because individuals generally prefer present consumption over future consumption (see for example The Economist 1999), it is necessary to express the streams of costs and benefits caused by a policy over time in terms of their respective present values in a specific year, the base year.[30] This is achieved via discounting.[31] Hence, all economic costs and benefits generated by a public policy during the time period of concern must be discounted to the base year and summed up. The result of such discounting and aggregation of positive and negative impacts yields the net present value (NPV) of the policy, the sum of all discounted benefits minus the sum of all discounted costs.

The rate of time preference varies among individuals; most importantly, it varies between companies and private individuals, due to different access to capital markets, different tax rates,

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prospecting activities of major pharmaceutical companies attest to this value. However, most such prospecting occurs in tropical ecosystems, which are thought to contain the fast majority of terrestrial species yet to be discovered.

[30] Consumption is the commonly used proxy for income or wealth, which itself serves as an imperfect proxy for welfare.

[31] A discount rate, just like an interest rate, reflects the opportunity cost of time, that is, the rate of time preference of individuals. The rate of time preference reflects the relative value individuals place on future consumption versus present consumption. An individual's rate of time preference is a function, besides of his/her preferences, of his/her resource endowment.

different time frames taken into account in decision making, etc. In addition to these private discount rates (PDRs), however, society as a whole exhibits a time preference, which is commonly referred to as the social discount rate (SDR). The choice of whether to use the SDR or a PDR in the estimation of impacts of a decision depends fundamentally on whose impacts are to be counted in the analysis. In decisions made by a private entity (a person or firm), that entity will normally be concerned primarily about the impacts its decisions have on itself. That focus justifies the use of a PDR. However, when analyzing the economic impacts of a public policy, for example an environmental policy such as the designation of critical habitat, it is generally argued that because the state has a responsibility to society as a whole, the impacts of the policy on all of society must be included in the analysis. Therefore, when analyzing the economic effects of public policies, economic theory requires the use of cost-benefit analysis. Cost-benefit analysis in turn requires the use of the SDR (Arrow et al. 1996; USEPA 2000). SDRs are lower than private discount rates since, for a variety of reasons, society as a whole exhibits a lower time preference than individuals (see Caplin and Leahy 2001).

The SDR is the rate at which society as a whole is willing to trade off (at the margin) present consumption for future consumption. This rate is not directly observable; it is, however, reflected in market interest rates, together with the perceived risk associated with an investment, uncertainty, tax rates, and expected inflation.[32, 33] Free of the latter distortions, one obtains the pure social rate of time preference, which is the rate that should be used in the evaluation of public projects (Arrow et al. 1996).[34] The average of the market interest rates on practically risk-free investments, reduced for inflation, represents a reasonably good starting point for an estimate of the pure rate of social time preference.[35]

This approach to deriving the appropriate social rate by which to discount the intra-generational impacts of public environmental policies is also the one recommended by the EPA in its *Guidelines for Preparing Economic Analyses* (EPA 2000):

> "...practical economic analyses must use social discounting to assist in evaluating environmental policies. What is offered in the empirical literature for choosing a social discount rate focuses on estimating the consumption rate of interest at which individuals translate consumption through time with reasonable certainty. For this, historical rates of return, post-tax and after inflation, on "safe" assets, such as U.S.

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[32] Risk is defined as the quantifiable probability of the occurrence of an event, while uncertainty is defined as the probability of the occurrence of an event that cannot be measured in quantifiable terms.

[33] The real interest rate (that is, the interest rate net of inflation) is defined as i_r = rate of time preference + risk adjustment + uncertainty adjustment; the nominal interest rate as $i_n = (1 + i_r)(1 + \text{rate of inflation}) - 1$.

[34] This approach derives the SDR from the discount rates of individuals. An important criticism of basing social discount rates on individuals' rates of time preference is that myopia and selfishness lead to a suboptimal and unjust allocation of resources across time. The former is a result of the shortsightedness of people; the latter results because future generations are not participants in present-day credit (and political) markets (Bishop 1993). The state as guardian of society's welfare should be expected to prevent the resulting misallocation through employing appropriately corrected (i.e., lower than individuals' private) discount rates in the evaluation of public projects (Caplin and Leahy 2001). That is especially called-for in projects that generate temporally far-off effects, for which much lower inter-generational discount rates are suggested (The Economist 1999; EPA 2000). Based on this argument, an SDR derived purely on the basis of the preferences of present market participants is still higher than the SDR that would maximize social welfare over time.

[35] This interest rate however still is biased upward because it still contains the effects of taxes and of imperfections in capital markets.

> Treasury securities, are normally used, typically resulting in rates in the range of one to three percent..." (EPA 2000:47).

The SDR suggested by the EPA for intragenerational time frames is two to three percent (US EPA 2000).[36] The Office of Management and Budget in its discounting guidelines suggests a seven percent discount rate for cost-benefit analysis of public projects with a ten-year time frame (US OMB 2003a,b). This rate however does not qualify as an SDR as it is based on the average pre-tax rate of return on private sector investments in recent years. In this analysis we use a discount rate of three percent.

II.5 Critique of approaches commonly used in impact estimation

Critique of FWS's economic analyses of CHD

Contrary to what is suggested by economic theory, the FWS in its analyses of economic impacts of CHD does not apply a cost-benefit framework; rather, the FWS analyses are (often misleadingly) termed economic impact analyses (EIA). In many cases this is a misnomer, as economic impacts of designation in practically all cases comprise both costs and benefits, while FWS analyses often focus exclusively on the costs of designation to the regulated community (see for example USDI FWS 2000a).[37] In the cases where the analyses do include benefits, the latter receive a disproportionately small amount of attention and almost always remain unquantified (see for example USDI FWS 2000d, 2002b, 2003e). In addition, in the rare cases where one or a few benefit categories actually are quantified in monetary terms, the estimated benefits, in contrast to costs, tend to be labeled "potential" benefits (see for example USDI FWS 2000d, 2003e) and, in some cases, receive no mention in the report summary that exclusively focuses on the estimated costs of designation (see for example USDI FWS 2002c). A rigorous economic impact analysis of CHD obviously must include both costs and benefits (ECONorthwest 1994).

In 1993 the FWS commissioned a blueprint for how to prepare high-quality, comprehensive analyses of the economic impacts of habitat conservation, and it has been available to the FWS for almost ten years now (see ECONorthwest 1994). Unfortunately, this blueprint seems to have been ignored in subsequent analyses of CHD, as evidenced by the fact that benefits of designation have continued to receive disproportionately small attention or, in some cases, no attention at all.

An additional problem with the FWS's economic analyses of CHD is that in estimating the cost of CHD, often no distinction is made between costs attributable to designation and costs that derive from listing (see for example USDI FWS 2003e). That is not only conceptually incorrect (and incidentally, constitutes a violation of Executive Order 12866), but it clearly inflates cost estimates of CHD. The argument advanced for such indiscriminate treatment of costs generally is that

> "...total cost associated with section 7 ... may result either from the listing of the species (the jeopardy standard) or from the designation itself (the adverse

[36] This SDR is the appropriate one for intra-generational time frames (roughly, 25 years or less). SDRs for inter-generational time frames are lower (The Economist 1999).

[37] Economic impact analysis draws on the macro-economic input-output accounting developed by Wassily Leontief in the first half of the last century. The dominant economic and environmental paradigm of that time still regarded natural resource supplies as essentially inexhaustible, and therefore the environment was not included in input-output analyses. Though understandable at its time, it is negligent of analysts to employ unchanged that framework with its exclusive attention on manufactured goods and services in today's economy, given that the economic importance of environmental resources, including environmental quality, has been so exhaustively documented, and has even spawned the development of its own subdisciplines in economics (natural resources and environmental economics, respectively).

modification standard). Because it can be difficult to pre-determine the standard that drives a section 7 consultation, all costs related to the implementation of section 7 are included in the total cost estimates presented in the FEA [Final Economic Analysis]" (USDI FWS 2003e:ES-4).

Clearly, CHD-related costs can and must be estimated as the incremental cost attributable to CHD; in the above consultation example, that increment is the difference between the costs of consultations based on the adverse modification standard and those of consultations based on the jeopardy standard.

Approaches to estimating the economic impacts of designation

In cases where designation of critical habitat leads to non-negligible impacts on the supply of natural resource inputs to the economy, economy-wide repercussions of these impacts must be taken into account. For example, if CHD in a particular case reduces the availability of timber lands, the reduced timber volume will not only lead to a reduction in local timber jobs, but will in addition lead to reductions in industries that produce inputs used by the timber harvest industry,[38] which will lead to output reductions and job losses in those industries, which in turn will affect the industries from which those industries procure their inputs, and so on. In other words, the immediate, direct impact of CHD, in this case a reduction in timber harvests and timber harvest industry output and employment, has indirect impacts that manifest themselves in other industries.

Conversely, the reduction in extractive uses in an area will in many cases tend to improve the level of environmental amenities, which tends to increase the area's attractiveness both as a destination for visitors and as a place to live. This increases the outputs of local industries that serve these clienteles. In addition, increased amenities may attract new firms that seek the highly qualified workforce that can afford to locate in the often comparatively expensive areas characterized by high environmental quality (Power 2000, 2001; ECONorthwest 1994). These impacts generally manifest themselves over the medium to long term, as individuals react to changes in environmental quality of a location.

The estimation of the economy-wide, direct and indirect effects of changes in resource availability usually occurs with the help of multiplier analysis. The multipliers that link different sectors in the economy commonly are estimated using econometric techniques or input-output models. These multipliers serve to estimate the initial, short-term economy-wide impact in terms of economic output and/or employment that results from an external shock in the supply of the natural resource(s) affected by a policy. On the subnational and especially the local levels, there generally do not exist models that allow the estimation of the long-term impacts of "shocks" caused by changes in resource availability. In such cases, the second-best approach consists in employing a series of steps that estimate the initial impacts on the economy, describe the expected long-term effects, and then analyze the expected transition of the economy from the immediate impacts to the long-term effects (ECONorthwest 1994).

As just described, the preferred methodology for estimating the short-term, initial impacts is based on multiplier effects derived from input-output models, the most common one being

[38] It is important in this example to distinguish the timber harvesting from the timber processing industry and other industries that use timber and wood products as inputs, as the latter generally will be able to substitute timber from other areas for local timber if local timber supplies fall.

Impact Analysis and Planning (IMPLAN).[39] These models do not incorporate the price effects of designation that may result from reduced supplies of natural resources as a function of CHD (see Hughes 2003). Changing prices however will trigger a series of adjustments throughout the economy to the initial external shock, and these adjustments influence the real long-term impacts of CHD. Estimation of the long-term effects requires the inclusion of the change in perceived environmental quality or quality of life due to CHD (if any), the impact on the regional economy of this change in the attractiveness of the local area, and the impact of this in terms of changes in production costs, prices, output, and employment in the sectors positively impacted by the improved quality of life (ECONorthwest 1994).

All local/regional models (IMPLAN, input-output, economic-base) are based on data taken from snapshots of the economy at a given point in time, and therefore are not dynamic. Projections of economic impacts that use such static models however will tend to lead to biased long-term impact estimates because they do not capture the dynamic nature of the economy and its capacity to adjust to changes in the underlying conditions (e.g., structural shifts in the economy, changing input-output relationships etc.) (Hughes 2003).

Since our analysis indicates that CHD for the lynx will not have significant impacts on local quality of life and related sectors during the short, ten-year time period analyzed, nor on local natural resources inputs, and hence, prices, there is no need to distinguish between short-term and long-term impacts. Therefore, in the present study we can employ a simpler approach for estimating the secondary (i.e., multiplier-based) economy-wide market-based impacts that are expected to occur. The only potential impacts that could result in multiplier effects occur in the residential and winter recreation sectors, and only in the upper-bound impact scenarios. We quantify the total economy-wide value of these impacts in terms of the lost output in these two sectors and the related multiplier-effects in the local economy.

It is important also to be aware that multiplier-based impact analyses only identify market-based impacts of changes in resource inputs. Non-market-based impacts of designation of critical habitat (or any other environmental policies that affect natural resource inputs, for that matter) will not be captured. Examples of such impacts are changes in ecosystem services, such as erosion control and water supply, and non-use values, such as existence, bequest, and stewardship values. These need to be estimated separately in order to complete the impact estimate.

II.6 Identification of Critical Habitat for the lynx in the contiguous 48 States

Primary lynx (*Lynx canadensis*) habitat in the contiguous 48 States has been identified in three regions: the Cascades and Rockies, the Great Lakes region, and the Northeast (McKelvey et al. 1999).[40] The total size of primary lynx habitat in these regions is estimated at 6,550 mi^2, 53,641 mi^2, and 10,298 mi^2 in the Cascades, Northern Rockies, and Southern Rockies, respectively; 37,161 mi^2 in the Great Lakes region; and 25,227 mi^2 in the Northeast (Hickenbottom et al. 1999, based on McKelvey et al. 1999). Lynx primary habitat in the Northern Rockies is found in Montana, Wyoming, Idaho, Washington, and Oregon; in the Southern Rockies, in Colorado

[39] Economic base models generally should not be used due to the conceptual problem of distinguishing between "basic" and "non-basic" industries and the resulting easy misapplication (see ECONorthwest 1994).

[40] *Primary lynx habitat* here is defined following McKelvey et al. (1999) as those geographical areas the land cover of which falls under vegetation classifications that contain 75 percent or more of the superimposed lynx occurrences (see also Hickenbottom et al. 1999). This definition is also used in the *Lynx Conservation Assessment and Strategy* (LCAS; see Ruediger et al. 2000).

Wyoming, and Utah; in the Cascades, in Washington and Oregon; in the Great Lakes region, in Minnesota, Wisconsin, and Michigan; and in the Northeast, in Maine, New Hampshire, Vermont, New York, Massachusetts, and Pennsylvania (McKelvey et al. 1999).

a. Selection of case study areas

The present study estimates the economic impacts of designating critical habitat for the lynx in the contiguous United States for two case study areas. These areas were selected based on the presently best available scientific information on lynx habitat in the lower 48 States. A case study approach with two study areas was chosen because the size of the total identified primary lynx habitat in the contiguous 48 States (see Table II.6.a-1) makes it difficult to conduct an in-depth analysis of the impacts of critical habitat designation (CHD) for primary lynx habitat in its totality.

Methodology used in the selection of the two case study areas

The principal aim in the selection of the case study areas was that they yield externally valid estimates of the economic impacts of CHD for the lynx. In other words, the estimates of costs and benefits from CHD derived from the case study areas should be broadly applicable to other areas in the contiguous US. Since land ownership and land use/cover are the two main determinants of the impacts of CHD, it was essential that the study areas encompass the whole range of potential combinations of land ownership and land use/cover. To ensure the generalizability of the estimated economic impacts of CHD, we decided to choose two main geographic areas of lynx primary habitat in the US as case studies. This allows an inter-area comparison of the impact estimates.

Composition of land ownership (federal, other non-federal public, tribal, private) and land use/cover vary across the US. Therefore, it is likely that the economic impacts of CHD for an area of a given size also vary across the US. In order to avoid invalid generalizations of impacts that are solely based on area, we estimate impacts not simply by area, but by area *for given land ownership–land use combinations*. Since the impact estimates we develop are land class-specific (i.e., particular to specific land ownership–land use combinations), our estimates of the economic impact of lynx CHD can be scaled up to areas beyond our study areas by taking into account the land class composition of the target area.

The starting point in defining the areas to be analyzed in the present study are figures 8.19 through 8.23 in McKelvey et al. (1999), which show areas of lynx occurrence in the contiguous United States overlaid on vegetation classes, dominant vegetation types, or potential dominant vegetation types, respectively, and elevation (except in the Great Lakes region, where elevation was not used to define areas of primary lynx occurrence).[41]

[41] McKelvey et al. (1999) is also relied upon by the FWS in its recent notice of remanded determination of status for the lynx (see USDI FWS 2003: 40085).

Table II.6.a-1: Federal and non-federal land ownership in identified primary lynx habitat in the contiguous US and areas examined in the present study

	Northern Rockies/ Cascades		*Western US total* [a]		*Study Area 1*		*Great Lakes*		*Northeast*		*Study Area 2*	
	mi^2	%	mi^2	%	mi^2	%	mi^2	%	mi^2	%	mi^2	%
Federal [b]	46,612 [c]	77	54,949	78	10,388	81	6,967	19	1,714	7	158	1
Non-Federal	13,579	23	15,540	22	2,481	19	30,194	81	23,513	93	11,232	99
Total	60,191	100	70,489	100	12,869	100	37,161	100	25,227	100	11,389	100

Notes: [a] Comprises Northern Rockies, Southern Rockies, and Cascades. *Study Area* refers to areas analyzed in this study. Study Area 1: Northwestern Montana; Study Area 3: Northern Maine. [b] Comprises mainly FS, BLM, and NPS lands, the first two of which are listed separately in Hickenbottom et al. (1999). Where applicable, NPS lands have been added to Hickenbottom et al.'s FS and BLM acreages, based on NPS acreages given in Table 1 in USDI FWS (2003c). In addition to the three listed major federal land ownership categories, traces (<1%) of primary lynx habitat in some of the study areas also occur on BR and FWS lands. [c] Includes 1,501 mi^2 on NPS lands.
Sources: Hickenbottom et al. (1999); USDI FWS (2003c); numbers for *Study Areas* based on calculations by authors.

III. MONTANA CASE STUDY

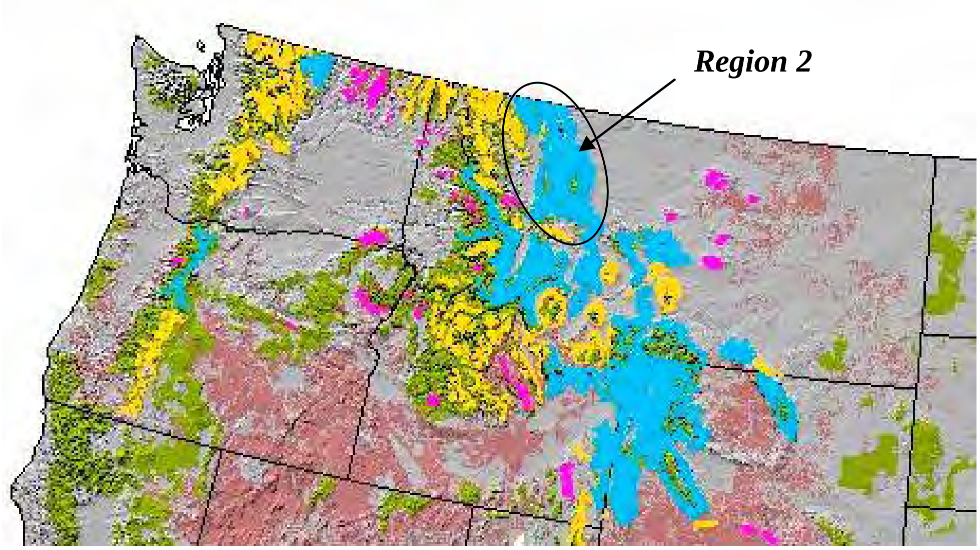
1. Identification of lynx habitat in Montana

According to McKelvey et al. (1999), the highest incidence of lynx occurrences in the western United States is in the northern and central mountain ranges of northwestern Montana (see also USDI FWS 2003c), indicating an apparent lynx population center there (Predator Conservation Alliance 2002).

2. Selection of Montana case study area

Within northwestern Montana, a recent Forest Service (FS) and Bureau of Land Management (BLM) study has identified one of several areas in the U.S. West as having a "higher likelihood for supporting lynx conservation" (Fig. 4 in Hickenbottom et al. 1999). This area indicated by the northernmost contiguous blue-shaded area in Montana in Figure III.2-1 labeled *Region 2* (hereafter referred to as *Region 2*). This area is identified as a separate Region because it is geographically separated from the remaining areas of lynx occurrence in the Northern Rockies by Interstates I-15 and I-90 in the East and South, respectively. To the west, we set arbitrary boundaries for our analysis along county lines (Lincoln and Sanders counties). Since *Region 2* encompasses all land ownership and use/cover types found throughout the areas proposed for designation of lynx critical habitat in the western US, and therefore the whole range of potential economic impacts of designating critical habitat for lynx, we chose it as our western U.S. case study area.

Figure III.2-1: Proposed CHD area in Montana



Note: Blue areas indicate areas of higher likelihood of supporting lynx conservation.
Source: Based on Hickenbottom et al. (1999).

To identify the potential lynx habitat within that region, we use the land cover classifications of the National Land Cover Data (NLCD). Lynx habitat is grouped into three tiers or cover types that are relevant to the estimation of economic impacts from CHD. Land cover types in which lynx habitat occurs in Montana are distinguished into three tiers (with numbers and descriptors in parentheses indicating NLCD land cover classes):

Tier 1: Primary lynx habitat (42 Evergreen Forest, 43 Mixed Forest, 41 Deciduous Forest, and 33 Transitional); these are areas which contain lynx denning, foraging, and travel and security habitats;
Tier 2: Secondary lynx habitat (51 Shrubland, 71 Grassland/Herbaceous, 91 Woody Wetlands); these areas are mostly used by lynx for dispersal and travel between blocks of primary habitat, but also represent secondary and opportunistic foraging grounds;
Tier 3: Tertiary lynx habitat (31 Bare Rock etc.); mostly used for travel and dispersal.

Tier 1 represents forested lands in which CHD may have direct impacts on timber harvest and recreational activities. *Tier 2* represents lands on which CHD potentially has impacts primarily on grazing of domestic livestock (although some grazing also occurs on forest lands).

The area proposed for designation of critical habitat for the lynx is identified as *Tier 1* habitat plus *Tier 2* and *Tier 3* habitats that are fully enclosed within *Tier 1* habitat. The decision of whether or not to include a particular peripheral area in the proposed lynx CHD area was based on criteria of lynx ecology, specifically, the existence of a linkage area that provides connectivity of the particular habitat block with the main ***Region 2*** habitat (Ruediger et al. 2001), and the presence of canopy cover associated with suitable lynx habitat. The latter comprises both late successional forests (for travel under cover, denning) and early successional forests (for foraging) (Aubry et al. 1999; Ruediger et al. 2000).

Tier 2 habitats fulfilling the above requirements are included in the analysis because lynx occasionally are found in non-forested areas, such as the shrub-steppe habitats in eastern Montana (Aubry et al. 1999). Even though such observations are thought to likely represent either transient individuals or resident animals searching opportunistically for prey (ibid.), dispersal, exploratory movements or travel between primary habitats on the one hand and opportunistic foraging on the other are both related positively to the recovery of lynx populations and therefore *Tier 2* habitat is included in our analysis.[42]

In Montana, lynx occurrences range across elevation classes of 750 to 3,000 meters (McKelvey et al. 1999). Although, based upon the frequency of occurrences, elevations between 1,500 m and 2,250 m can be said to represent primary areas of lynx occurrence in Montana (ibid.), lands with elevations that lie outside of this range likely are used for travel between blocks of higher-elevation habitats, and also for dispersal and as opportunistic foraging grounds (Aubry et al. 1999), both of which may be important for lynx recovery. We decided therefore against excluding lands at elevations outside of the 1,500-3,000 m range from the proposed critical habitat area.

The maps of vegetation types or classes used by McKelvey et al. (1999) indicate the general land cover in the respective areas, and as such are useful for identifying areas *generally* suitable as lynx habitat. By comparison, the NLCD provides much more detailed information. However, whether or not a specific location *actually* is suitable as lynx habitat depends on the vegetation that actually exists in the area. Differences between vegetation types and classes generally supported by an area and the vegetation actually present in the area are caused by natural and/or human disturbances (e.g., non-climax or invasive species colonizing an area after fire, ice damage, windfalls, insect

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[42] As Aubry et al. (1999) observe, especially in montane systems with high amounts of spatial heterogeneity, dispersal success may be enhanced by exploratory movements to locate suitable habitat. Non *Tier 1* habitats would therefore be conducive or even essential for lynx recovery in spatially heterogeneous environments.

infestations etc.; desertification; landslides; land conversion to agriculture, and erection of built infrastructure). The NLCD data sets are based on 1992 information. Therefore, it was necessary to verify the suitability as lynx habitat of all areas identified by our NLCD-based analysis. High-resolution aerial photographs and land parcel primary use information, where available, were used to verify the NLCD-based assessment.[43] The so identified lynx habitat represents the actual land area that is impacted by CHD for the lynx.

The Montana study area comprises approximately 8.2 million acres, or almost 12,900 mi^2, approximately one fifth of the primary lynx habitat identified by the FWS for the Northern Rockies as a whole (53,641 mi^2; see Table II.6.a-1). Our Maine case study area covers approximately 7.3 million acres or 11,400 mi^2, accounting for approximately 45 percent of all identified lynx habitat in the Northeastern U.S.

III.2.a Land type classifications for lynx critical habitat study areas

In this section we present the methodology we use to develop estimates of costs and benefits of lynx CHD that are landownership- and land type-specific. The resulting estimates of costs per acre of land of a specific ownership and use/cover can be employed to develop rough estimates of the economic impacts of lynx CHD outside of the two areas we examine in our case studies.

The land type classification presented in the following is based on critical habitat designation (CHD) *economic impact categories.* These categories are defined by the type and severity of impacts on land use that are expected to result from designation of an area as lynx critical habitat. The main determinants of the type and severity of these impacts are land ownership and land use or cover.[44] These two variables form the two dimensions of the land type classification matrix used in this analysis (see Table III.2.a-3-Montana). Land ownership and land cover for the Montana case study area are shown in Figures III.2.a-1 and -2.

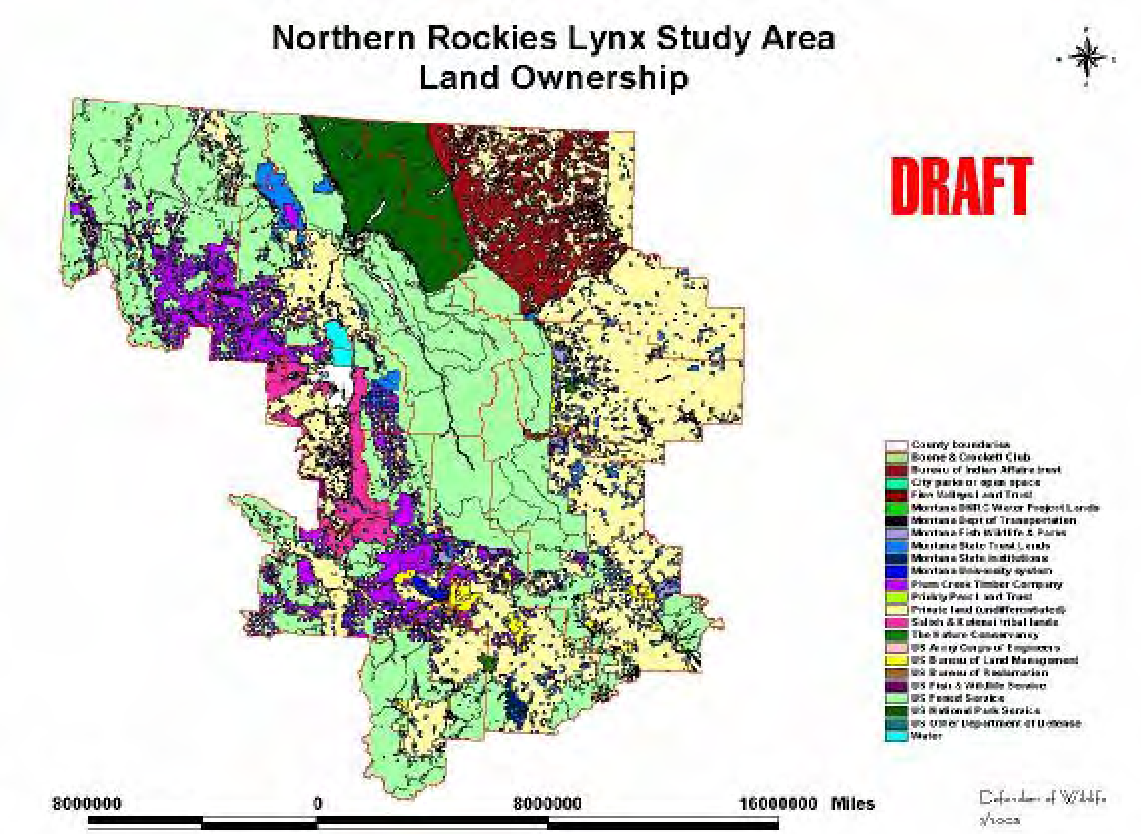
Each of the cells in the matrix is characterized by a specific change in land use activities as a function of designating lynx critical habitat on the particular land type. This change, or ***impact***, is the difference in land utilization between the *with CHD* case and the *without CHD* case for the particular land type, which carries associated land ownership and use/cover-specific costs and benefits. Since the cells in the matrix represent specific land types encompassing all potential combinations of ownership and use found in the proposed lynx CH area, every piece of land in the lynx CHD study area can be assigned to a specific cell in the matrix, for which estimates of costs and benefits are derived on a per-acre basis by assigning monetary values to the various impact categories. The impact categories relevant to each individual cell (i.e., land type) are drawn from the Table II.2-1, *Categories of potential economic impacts of CHD for species* x*: Generic template.* The impacts comprise both direct effects, that is, changes in the type or intensity of land use activities, such as timber harvest, grazing, or recreation, as well as indirect effects, that is,

[43] Aerial photographs with 1m resolution were obtained from TerraServer (http://terraserver-usa.com/). Land use/cover information (*National Land Cover Data Set* and *Parcel Agricultural Use*) was obtained from the Montana Natural Resource Information System (http://nris.state.mt.us/mapper/).

[44] It is important to note that the marginal impact of critical habitat designation (CHD) for a species depends upon the severity of existing land use restrictions. Existing land use restrictions may result from, among other things, designated CH for other species, habitat management plans, species recovery plans, or forest management regulations, e.g., maintenance of a minimum volume or acreage of specific tree age classes and/or species, water quality-related management constraints, etc., and, specifically in our case study, the Canada Lynx Conservation Assessment and Strategy (LCAS, see Ruediger et al. 2000) by which both the Forest Service and the Bureau of Land Management have agreed to abide (see USDA FS and USDI FWS 2000; USDI BLM and USDI FWS 2000).

associated on-site and off-site effects, such as changes in property values or reductions in consumer surplus from increased prices, and consultations.

Figure III.2.a-1: Land ownership in Montana study area



Getting from Land Type Classifications to Critical Habitat Analysis Units

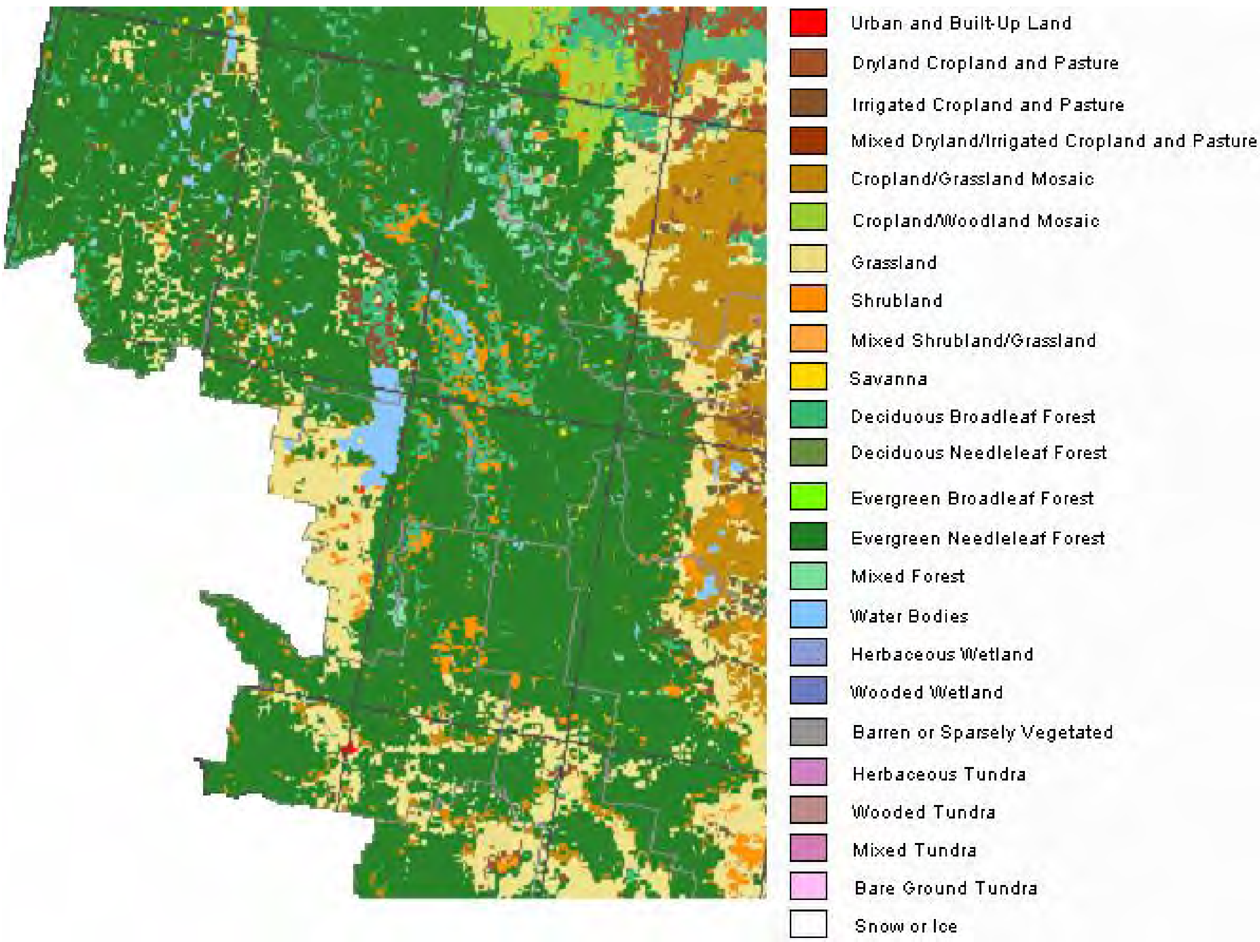
For any designation of a particular area as critical habitat for a given species, there may be some land uses/covers for which the species-relevant restrictions applicable under CHD are very similar or even identical across different land ownership categories.[45] This similarity of restrictions results from the fact that all land ownership fundamentally falls into two categories: one is subject to CHD-related land use restrictions, the other not. All federal lands and those non-federal lands that have a federal nexus fall into the former category, while all non-federal lands without such nexus fall into the latter category.[46] Therefore, designating critical habitat for the lynx on, for example,

[45] It is important to be aware that the restrictions that are of importance for the analysis are only those that are relevant to the protection of a specific species. For example, if on NPS lands in a given area grazing is not allowed at all, while it is allowed on certain FS lands where it is restricted in such a manner that lynx impacts are negligible, then these NPS and FS lands would effectively posses the same restrictions *from the perspective of lynx protection.* In the following, the term ***restrictions*** is used as shorthand for species-relevant restrictions.

[46] Because Section 7 of the ESA requires that all federal agencies ensure that any action they authorize, fund, or carry out not be "likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species" (16 U.S.C. § 1536(a)(2)), the most important general distinction among land ownership types with respect to impacts is that into federal and non-federal with a federal nexus on the one hand, and non-federal on the other. Since

forest lands may result in similar or perhaps identical incremental restrictions on timber management and recreation activities for lands across a variety of ownerships, if those lands are subject to CHD restrictions and have similar or identical land use restrictions in the absence of designation. For purposes of estimating for an area as a whole the impacts of CHD, all such lands with a particular land use/cover, similar pre-designation land use restrictions, and subject to CHD restrictions may be treated as a single class.[47]

Figure III.2.a-2: Land cover in Montana study area



Source: USGS (2002).

Section 7 of the ESA applies to *all* federal agencies, any changes in current (i.e., without lynx CHD) utilization practices of lands of a particular land use/cover type that are required for compliance with the CH-related provisions of the ESA will be the same across all federally held lands of that particular use/cover type. Specifically, any federal or federally funded or regulated action on designated lynx CH that potentially may be detrimental to lynx requires ex-ante consultation with the FWS (16 U.S.C. § 1536 (b)(1)).

[47] Lands carrying special designations may imply differences in restrictions even if they are in the same ownership category. An example of a special designation is FS forested lands designated as Federal Wilderness. That designation carries with it restrictions on land use that lead to impacts from CHD for lynx on this land that may differ from impacts of CHD for lynx on other FS (or other federal agencies') forest lands that do not carry such designation (or comparable designations). The difference in incremental impacts results from the higher baseline protections enjoyed by wilderness lands.

All future land use activities of a particular kind that, absent CHD, are expected to occur on lands pertaining to this class face the same post-CHD restrictions. These restrictions establish a common screen which all future projects must pass. Hence, all future changes in activities due to CHD can be summed for such lands across the respective ownership categories, and the impacts of CHD can be assessed for the area as a whole under that land cover (e.g., reduced stocking on grazing lands). Pooling of land classes obviates the need to estimate the impacts from designation for each land class individually and represents an efficient way of analyzing CHD impacts if the incidence of impacts is not of concern.[48]

Estimating incremental impacts and costs of lynx CHD by land class and over all land classes

The sum of the incremental impacts of CHD is the product of 1) the changes in land use activities for a given land class that result from the additional restrictions due to CHD, if any (see fourth column in Table III.3.a.ii-4), and 2) the total acreage of lands in the respective land class - summed over all land classes. The monetary value of the impacts of CHD is composed of the unit values assigned to the individual impacts multiplied by the number of impacts. By way of example, if CHD were to lead to an average estimated reduction of timber harvests on state timber lands of x board feet per year per acre compared to the BCS, and there are y acres of that land class (state timber lands) affected by the designation, then the impact of CHD would be estimated as $x \cdot y$ board feet per year. The present value of the harvests forgone would be estimated as the discounted stream of future revenues associated with the sale of the forgone harvests.

Identification of required changes in current land use activities on designated lynx critical habitat

The first step in identifying the land types that potentially may be grouped together for purposes of this analysis is the identification for each land type of the restrictions on specific land use activities that exist without designation of critical habitat, that is, in the base case scenario (BCS), and of the incremental use restrictions that would result under CHD through application of the adverse modification standard. These incremental restrictions are identified based on lynx ecology, specifically foraging, denning, and security cover requirements.[49] The economic impacts of CHD are a function of the BCS development of the various land use activities and the incremental restrictions placed on the latter due to designation (see Table III.2.a-1).

Table III.2.a-1: Change in base line activities under critical habitat designation

Land use type	*Change in activities **compared to BCS***
Grazing	
- Cattle/sheep	e.g., reduction in cattle/sheep stocking increase by 25 percent
- Goats	e.g., reduction in goat stocking increase by 50 percent

Note: Percent numbers in examples are chosen arbitrarily.

[48] In this study we develop cost estimates by land ownership to allow comparisons among different land ownership types and generation of impact estimates outside of the areas examined here.

[49] The primary aspects with respect to foraging are abundance of snowshoe hares (the primary lynx prey in the Northern Rockies) and interspecific exploitation competition. Exploitation competition in northwestern Montana occurs principally with coyotes and bobcats, and to lesser degrees cougars, fishers, and wolverines, and during winter is strongly dependent on accessibility of lynx primary foraging grounds to competitors (Buskirk et al. 1999).

Once the lynx CHD-related impacts, that is, the changes in BCS land use activities, have been identified, the categories of costs and benefits associated with each of those impacts can be identified (see Table III.2.a-2).

Table III.2.a-2: Benefits and costs associated with changes in activities

Change in land use activities	*Costs **	*Benefits **
e.g., reduction in cattle/sheep stocking density by 25 percent	C-3, C-5,...	B-7, B-9,...
e.g., reduction in goat stocking density by 50 percent	...	...

Notes: * Costs and benefits are taken from Table II.2-1,*Categories of potential economic impacts of CHD for species x: Generic template*.

Montana study area

Table III.2.a-3-Montana shows the land classes present in the Montana case study area, and the applicable laws and regulations restricting land use activities in the respective land classes. (A detailed description of the relevant provisions for each land class is given in Table III.3.a.ii-4.)

Land classes that are subject to essentially identical or very similar pre-CHD restrictions (as relevant to lynx conservation) can, for purposes of this analysis, be grouped together into a single class by land use/cover type and by most stringent applicable restrictions, since of the different regulations that apply to a given land class, only the most stringent one is relevant in estimating the incremental costs of CHD.

For example, federally owned lands, Montana State Trust lands, and Plum Creek lands primarily used for livestock grazing can all be treated as subject to essentially the same grazing restrictions, since the first are governed by the LCAS, while the latter are subject to the LCAS (due to federal nexi) as well as other grazing regulations set forth in the Montana DNRC HCP and the Montana State Forest Land Management Rules, or in the NFHCP, respectively (see Table III.2.a-3-Montana). [50] Since the grazing guidelines spelled out in the LCAS are more restrictive than those entailed in the other two regulations (see Table III.3.a.ii-4, column two, row two), for purposes of the present analysis all three of those land classes can be treated as comparable in terms of the restrictions they place on livestock grazing. The most restrictive regulations in each land class are shown in blue in Table III.2.a-3 for all land classes found in the study area. For each land use or cover type (that is, each column in Table III.2.a-3-Montana), the land classes with identical or similar restrictions (as defined by the most stringent restrictions) are pooled into ***Critical Habitat Analysis Units (CHAUs)***. Such pooling of land classes simplifies estimates of the economic impacts for a study area of 8.2 million acres.[51]

[50] Some non-private lands belong into the same category, due to their federal nexus. Specifically, grazing on private lands in the Sun and Cutbank-Two Medicine TMDL planning areas is subject to the LCAS because of the federal nexus established via the CWA. Grazing on private lands outside of these areas generally is not (except on Plum Creek lands).

[51] The grouping together of land classes based on their highest common denominator of restrictions of course is based on the assumption that the agency responsible for implementation of the respective restrictions does actually see to their implementation. In the foregoing example of grazing restrictions on Montana State Trust lands, federally owned lands, and Plum Creek Timber lands, the combination of the three land classes into one single group will only lead to valid estimates of the actual restrictions on land use activities on those lands if the FWS sees to the inclusion of the LCAS grazing guidelines into Montana's DNRC HCP and TMDL plans, and if the local authorities responsible for implementation actually follow the rules.

Pooling obviates the need to estimate the impacts from designation for each land class individually (although in this study such estimates by land class are in fact developed to allow impact comparisons among different land ownership types and allow transfer to other areas outside of those studied in this analysis). Rather, the incremental *impacts* from designation can now be estimated for a given CHAU by applying the incremental *restrictions* to the BCS estimates for the respective CHAU. By way of example, if incremental grazing restrictions under CHD lead to a prohibition on new pasture acreage, and the projected BCS growth in pastures during the period of analysis were 20,000 acres, then the incremental impact of CHD on grazing in CHAU 1 would be a reduction in BCS pastures by 20,000 acres, which translates into associated economic impacts (costs and/or benefits). The economic impacts associated with each restriction are estimated by quantifying the benefits and costs associated with the physical impacts on a given CHAU.

The vertical grouping of land classes by most restrictive regulations and federal/private with nexus or non-federal without nexus results in the following *Critical Habitat Analysis Units* (CHAUs):

CHAU 1: Grazing

CHAU 2: Timber

CHAU 3: Mining

CHAU 4a: Recreation - summer (non-forested)

CHAU 4b: Recreation - summer, MT State Trust lands (non-forested)

CHAU 5: Recreation - winter (non-forested)

CHAU 6a: Recreation - summer (forested)

CHAU 6b: Recreation - summer, FS&BLM (forested)

CHAU 7: Recreation - winter (forested)

CHAU 8: Roads and utilities, MT State Trust and MT State University lands

CHAU 9: Roads and utilities, Federal and Private lands

Table III.2.a-3: Land type classes for lynx CHD, and associated regulations that restrict land uses of concern to lynx

Land use/cover *Land ownership*	*Agricultural lands*		*Mining*	*Non Canopy areas*[3]		*Forested lands not used for timber*		*Developed lands*	
Federal lands	*Grazing**	*Timber – by stumpage value*[1,2]		*Recreation*[4] *3 season*	*winter*	*Recreation*[4, 5] *3 season*	*winter*	*Residential/ Commercial*	*Infrastructure (Roads, utilities)*
BIA Trust Land									LCAS
BLM		LCAS		OHVRs[12]	LCAS	LCAS, OHVRs	LCAS		LCAS
BR				[12]					
FS	LCAS	LCAS		OHVRs[12]	LCAS	LCAS, OHVRs	LCAS	n.a.	LCAS
FS-Fed. Wilderness	n.a. /LCAS	n.a.	n.a.	OHVRs[12]	LCAS	LCAS, OHVRs	LCAS	n.a.	n.a.
FWS	n.a.	n.a./LCAS		[12]	LCAS	LCAS	LCAS	n.a.	LCAS
NPS	n.a./LCAS	n.a./LCAS	n.a.	[12]	LCAS/ n.a.	LCAS	LCAS/ n.a.	n.a.	LCAS
Non-Federal Lands w/out nexus	negl.	negl.	negl.	negl.	negl.	negl.	negl.	negl.	negl.
Non-federal lands w/ federal nexus:									
MT FWP	negl./LCAS	n.a.	n.a.		LCAS	LCAS	LCAS		
MT State Trust Land[8]	LCAS, DNRC HCP, SFLMR	LCAS, SFLMR, DNRC HCP	LCAS, DNRC HCP, SFLMR[6]	DNRC HCP [12]	LCAS, DNRC HCP, SFLMR[6]	LCAS, DNRC HCP, SFLMR[6]	LCAS, DNRC HCP, SFLMR[6]	n.a.	DNRC HCP, SFLMR[7], SMZ law, LCAS
MT State Univ.	LCAS, SFLMR	LCAS, SFLMR	LCAS	[12]	LCAS	LCAS, SFLMR	LCAS, SFLMR	n.a.	LCAS, SFLMR
Private land – Plum Creek Co.	LCAS, NFHCP	LCAS, NFHCP/ Forestry BMPs	LCAS, NFHCP/ Forestry BPMs	[12]	LCAS	LCAS	LCAS	n.a.	Forestry BMPs, LCAS, NFHCP
Private lands under conservation easement/ owned by conservation organization	LCAS[9]	Forestry BMPs/SMZ law, LCAS	n.a./ LCAS	[12]	LCAS	LCAS	LCAS	none[#]	LCAS
Private Land - other	LCAS[§ 9]	LCAS[§ 11]	LCAS[§], 17-24-7 ARM	[12]	LCAS[§]	LCAS[§]	LCAS[§]	none[#]	LCAS[§]
Tribal Lands	LCAS	LCAS		LCAS	LCAS	LCAS	LCAS	n.a.	LCAS
Tribal Wilderness	LCAS	n.a.		LCAS	LCAS	LCAS	LCAS	n.a.	LCAS

Notes: See next page.

Notes to Table III.2.a-3: The regulation(s) stipulating the most stringent restrictions on a specific land use activity for a given land class is (are) highlighted in blue. BIA – Bureau of Indian Affairs; BLM – Bureau of Land Management; BR – Bureau of Reclamation; FS –Forest Service; FWS – Fish and Wildlife Service; MT FWP – Montana Department of Fish, Wildlife and Parks; NPS –National Park Service; SFLMR - MT State Forest Land Management Rules. * Land under cropping or grazing generally does not constitute suitable lynx habitat. However, where such uses occur in areas that otherwise would be considered suitable lynx habitat, or that could constitute linkage areas between blocks of primary lynx habitat, designation of the respective areas as critical habitat may be justified. The LCAS does not contain specific management guidelines for lands in crop production. Rather, the relevant guidelines for crop production areas are those for winter use/access and road construction (see Table III.3.a.ii-4). [1]Stumpage values may be estimated by zone (not distinguished into species): Montana Dept. of Revenue. 2002. Forest Valuation Zones 2003. Forestland Reappraisal Report. February 2002. Helena: MT Department of Revenue; or by tree species: Bureau of Business and Economic Research, University of Montana. *Montana Sawlog and Veneer Log Price Report*. Missoula, MT: University of Montana. Quarterly. [2] Some lands used for timber extraction will also possess recreational value. All other things equal, that value will depend on the type of the timber harvest regime (clear cutting vs. selected felling) and the time since the last harvest. [3]For example, bare rock or ice/snow fields at high elevation. [4]Recreation values are likely to be different for National Park lands and other lands, due to the fact that the former attract more out-of-region tourists than the latter. If willingness-to-pay (WTP) is used for monetary quantification of the value of the recreation activity, one can, on average, expect out-of-region tourists to express a higher WTP for recreation than local residents, if average income of the former is higher than that of the latter (which is a reasonable assumption given that the average per-capita income of the region is likely to be lower than that of out-of-region tourists able to afford a visit to the study area. Since WTP depends on ability-to-pay (ATP, a function of income), the monetary value of recreation of out-of-region tourists will be higher than that of regional tourists. This difference in WTP justify treating National Park lands different from other lands suitable for recreation. [5] Recreation includes subcategories of non-motorized recreation (such as hiking, snowshoeing, cross-country skiing, skiing, mountain climbing) and motorized recreation (using snow mobiles, ATVs and ORVs). [6] Montana's SFLMR do not directly address mining, but the rules regarding future and non-essential roads are relevant here. [7] With respect to road building, the SFLMR potentially go beyond the LCAS guidelines in that they include a provision that stipulates that unnecessary existing roads in lynx habitat be obstructed or obliterated (even if the term "unnecessary" is ambiguous and makes it hard to judge the future impact of this provision). CHD would require obliteration of future "sanctioned" temporary roads upon completion of the harvest activity for which the roads were constructed. For future projects, this requirement would be equivalent to a similar provision in the SFLMR. The LCAS does not contain such a provision, hence, in this specific instance the SFLMR may be stricter and have to be considered together with LCAS as most restrictive standards applicable on MT State Forest lands in the BCS, if indeed the SFLMR provision is enforced and the potential goal conflict on State Forest lands (between lynx conservation and long-term revenue maximization) does not prevent lynx-conservation measures from being implemented. (The MT DNRC state that such a conflict does not exist because the SFLMR promote long-term forest health and thereby maximize long-term revenue; see Montana 2003a:436). [8] The DNRC HCP is not yet available in final form, so that the specific restrictions on land uses that it will eventually entail cannot be assessed with certainty. [9] Grazing on private lands in the Sun and Cutbank-Two Medicine TMDL planning areas is subject to the LCAS. On private lands outside of these areas, it is not (except on Plum Creek lands). [10] Federal nexus does not exist in Flathead Headwaters, Flathead Stillwater, and Swan TMDL planning areas. [11] Federal nexus is established in all TMDL planning areas except the Sun, Teton, and Cutbank-Two Medicine areas. [12] The only restriction the LCAS places on summer recreation activities is to limit public use of temporary logging roads. Those roads will by definition be located in forested areas. [§] Not all land use activities on all private lands have a federal nexus. The federal nexus only exists for those land use activities addressed in the respective TMDL plans. See Table III.3.a.ii-3. [#] Restrictions on land use, where they exist, are not specific enough with respect to lynx habitat requirements to allow assessment (examples are zoning ordinances, where they exist; see for example Flathead County Planning and Zoning Office (no date)).

III. 3 Identification of Base Case Scenario for areas impacted by CHD for the lynx

a. Relevant Base Case information for the areas affected by proposed lynx CHD

The Base Case scenario (BCS) is the *without designation* scenario, that is, it describes the uses that the areas proposed for critical habitat designation for the lynx are expected to provide in the absence of the designation. These uses may be classified broadly into commercial and non-commercial direct use, indirect use, and non-use.[52] The BCS is the result of the expected future trajectories of the independent variables that influence the respective uses. By contrasting the BCS with the expected future development of the uses provided under designation of critical habitat for the lynx (the *with designation* scenario), an estimate of the incremental impacts of the designation is obtained. These impacts carry associated costs and benefits. The magnitude of the various impacts expected to result from designation of critical habitat depends, ceteris paribus, on the difference between the use restrictions imposed by existing environmental laws and regulations, and the total restrictions that would result under designation of critical habitat. Hence, differences between the two study areas in their respective baselines of existing environmental laws and regulations can be expected to lead to differences in the magnitude of the total impact of critical habitat designation for the lynx in the respective areas.[53]

This section first details the main economic characteristics of the two areas examined for designation of critical habitat for the lynx. It then presents the land use/cover and ownership types found in the areas proposed for designation, as well as current land use restrictions due to existing environmental laws and regulations. The next sections present, respectively, projections of future uses by land ownership and type of primary use or cover over a period of ten (10) years, and an assessment of the marginal impacts on land use activities due to the additional restrictions on land utilization that would result from the designation of critical habitat for the lynx. The marginal impacts of designation are derived based on the distinction between the ESA's jeopardy and adverse modification standards as discussed in section II.3.

III.3.a.i Relevant economic characteristics of the proposed CHD area in Montana

The nine counties which are contained, at least in part, within the study area cover a combined area of approximately 16.3 million acres. The actual area studied for impacts due to the critical habitat designation of lynx, however, includes just 8.2 million acres. These counties (Flathead, Glacier, Lake, Lewis and Clark, Lincoln, Missoula, Pondera, Powell, and Teton) ha a combined population of just over 307,000 in 2001, or 34 percent of the state's population, and exhibited a cumulative population growth rate of 20 percent in the decade of the 1990's. Population growth in recent years however seems to have slowed down; it stood at 0.8 percent in the year 2000. The highest population in the area is located in Missoula county (96,303 people), the majority of which is not contained in our study area, while the smallest population is in Pondera county (6,345). Flathead county had the most rapidly growing population in the study area during the 1990's, increasing by 25.8 percent. Average per capita income in the nine county region was $17,095 in 1999, slightly below the state

[52] Non-use is of course not a use, but rather the absence of use. However, since this study estimates the value of the economic impacts of critical habitat designation, and since something may be valued without being used, the non-use category is added to the direct and indirect use categories listed above.
[53] More specifically, differences in the environmental regulatory baselines of the three study areas are likely to lead to differences in the impacts of critical habitat designation *per unit area* on comparable land classes (that is, lands in particular use and ownership).

average of $17,151. Flathead county, contained in its entirety within our study area boundaries, had the highest average per-capita income ($18,112).[54]

Tables III.3.a.i-1, III.3.a.i-2, and III.3.a.i-3 below summarize relevant economic and demographic information for this region of Montana, displayed by county. Table III.3.a.i-1 provides population and growth rates, per capita income in 1999, and along with Tables III.3.a.i-2 and III.3.a.i-3, displays the employment and payroll numbers of 2001 for the sectors of the economy that could potentially be impacted by critical habitat designation, including construction, mining, all aspects of the timber industry, and travel and recreation. The largest of the potentially impacted industries in these counties are those of construction, which employs approximately 6,884 workers, and food service and drinking establishments, employing over 10,000 individuals. Combined, however, these two sectors account for less than 16 percent of all employment in these counties. The only other potentially impacted sectors of the economy which constitute more than one percent of total employment in these counties are wood products manufacturing (3%-3.2%) and traveler accommodations (2.23%-2.8%).

[54] All figures are from the U.S. Census Bureau, Montana State and County Quickfacts; *http://quickfacts.census.gov/qfd/states/30000.html*

Table III.3.a.i-1: Demographic and economic data on construction and mining for counties in CHD study area in Montana

County	*Population (2001)*	*Population growth 2000-2001*	*Population growth 1990-2000*	*Per capita income*	*All sectors Employment*	*All sectors Payroll ($1000)*	*Construction[1] Employment*	*Construction[1] Payroll ($1000)*	*Mining[2] Employment*	*Mining[2] Payroll ($1000)*
Flathead	76,269	2.4%	25.8%	$18,112	29,075	$706,566	2,539	$85,519	38	$1,339
Glacier	13,125	-0.9%	9.3%	$11,597	2,095	$51,404	124	$3,619	59	$2,205
Lake	26,904	1.5%	26%	$15,173	5,436	$120,659	329	$7,537	0-19	D
Lewis & Clark	56,094	0.7%	17.3%	$18,763	20,980	$508,058	1,155	$40,549	0-19	D
Lincoln	18,664	-0.9%	7.8%	$13,923	3,806	$81,941	166	$4,529	0-19	D
Missoula	96,303	0.5%	21.8%	$17,808	42,622	$1,071,327	2,252	$83,258	32	$442
Pondera	6,345	-1.2%	-0.1%	$14,276	1,371	$28,640	233	$9,112	0-19	D
Powell	7,076	-1.4%	8.5%	$13,816	1,087	$21,305	43	$1,080	0	$0
Teton	6,387	-0.9%	2.8%	$14,635	1,155	$20,937	43	$810	0	$0
TOTAL	307,167	0.83%	20.28%	$17,095	107,627	$2,610,837	6,884	$236,013	129-205	-
Montana	904,460	0.25%	12.9%	$17,151	301,460	$7,226,881	18,607	$635,106	4,486	$235,770
% of area total[3]							6.4	9	0.1-0.2	

Notes: All employment and payroll figures are from 2001. D = Withheld to avoid disclosing data of individual companies. NAICS Codes: [1] 23; [2] 21. [3] In 1999.
[4] Percentage of the total employment in these counties coming from this sector.
Source: U.S. Census Bureau, 2001 County Business Patterns (NAICS); http://censtats.census.gov/cgi-bin/cbpnaic/cbpsel.pl

Table III.3.a.i-2: Demographic and economic data on the timber industry for counties in CHD study area in Montana

County	*Forestry & Logging*[1] *Employment*	*Payroll ($1000)*	*Forestry support activities*[2] *Employment*	*Payroll ($1000)*	*Lumber (wholesale)*[3] *Employment*	*Payroll ($1000)*	*Wood products mfg*[4] *Employment*	*Payroll ($1000)*	*Paper mfg*[5] *Employment*	*Payroll ($1000)*
Flathead	252	$7,812	8	$131	20-99	D	1,286	$47,358	0-19	D
Glacier	0	$0	0	$0	0	$0	0-19	D	0	$0
Lake	20-99	D	0	$0	3	$75	229	$6,613	0	$0
Lewis & Clark	10	$405	0-19	D	0-19	D	13	$331	0	$0
Lincoln	100-249	D	0-19	D	0	$0	594	$19,220	0	$0
Missoula	250-499	D	10	$503	50	$1,635	990	$32,091	500-999	D
Pondera	0	$0	0	$0	0	$0	0	$0	0	$0
Powell	20-99	D	0	$0	0	$0	100-249	D	0	$0
Teton	0	$0	0-19	D	0	$0	0-19	$0	0	$0
TOTAL	652-1,129	-	18-75	-	73-171	$1,710	3,212-3,399	$105,613	500-999	-
Montana	1000-2499	D	20-99	D	674	$23,022	4,847	$155,143	500-999	D
% of area total[6]	0.6-1		<0.1-0.1		0.1-0.2		3-3.2		0.5-0.9	

Notes: All employment and payroll figures are from 2001. D = Withheld to avoid disclosing data of individual companies. NAICS Codes: [1] 113; [2] 1153 (includes wood technology, forestry economics, marketing, firefighting, pest control, and consulting); [3] 4213; [4] 321; [5] 322. [6] Percentage of the total employment in these counties coming from this sector.
Source: see Table III.3.a.i-1.

Table III.3.a.i-3: Demographic and economic data on recreation and travel for counties in CHD study area in Montana

	Nature parks and similar[1]		*Skiing facilities*[2]		*Traveler accommodation*[3]		*RV parks and rec. camps*[4]		*Food service and drinking places*[5]	
County	*Employment*	*Payroll ($1000)*	*Employment*	*Payroll ($1000)*	*Employment*	*Payroll ($1000)*	*Employment*	*Payroll ($1000)*	*Employment*	*Payroll ($1000)*
Flathead	0-19	D	20-99	D	1,120	$16,071	49	$1,774	2,928	$28,402
Glacier	0	$0	0	$0	20-99	D	0-19	D	205	$2,051
Lake	0-19	D	0	$0	136	$1,816	11	$249	448	$4,353
Lewis & Clark	0-19	D	20-99	D	250-499	D	0-19	D	1,689	$15,187
Lincoln	0	$0	0-19	D	20-99	D	0-19	D	355	$2,907
Missoula	0	$0	0	$0	905	$9,889	26	$707	4,172	$40,464
Pondera	0	$0	0	$0	0-19	D	0	$0	100-249	D
Powell	0	$0	0	$0	20-99	D	0-19	D	143	$1,391
Teton	0	$0	0-19	D	0-19	D	0-19	D	63	$387
TOTAL	0-57	-	40-236	-	2,471-2,995	-	86-181	-	10,103-10,252	$95,142
Montana	20-99	D	500-999	D	5000-9999	D	250-499	D	30,581	$282,518
% of area total[6]	<0.1-0.1		<0.1-0.2		2.3-2.8		0.1-0.2		9.4-9.5	

Notes: All employment and payroll figures are from 2001. D = Withheld to avoid disclosing data of individual companies. NAICS Codes: [1] 71219; [2] 71392; [3] 7211; [4] 7212; [5] 722. [6] Percentage of the total employment in these counties coming from this sector.
Source: see Table III.3.a.i-1.

III.3.a.ii Existing environmental regulations affecting the proposed lynx CHD area in Montana

A number of environmental laws and regulations restrict permissible land use activities. In addition, special designations (e.g., federal wilderness, roadless area) and conservation easements

Table III.3.a.ii-1: Environmental laws and regulations limiting land use activities of concern to lynx conservation in the two study areas

	Laws, regulations, management plans		
Study area	*ESA -related*	*Other Federal*	*State/Private*
Montana	ESA jeopardy standard [0]	Federal CWA (Sections 402 and 404)	Montana Water Quality Act (303(d) List) [2]
	HCPs (one currently under review [0])	LCAS (FS, BLM, *NPS* [3])	MT Streamside Management Zone Law (Forestry BMPs) [00]
	Recovery plans for listed species [0]	LCAS-based amendments of BLM and FS Land Management Plans (in progress)	MT State Forest Land Management Rules
		Forest management plans: old growth requirements etc. [1]	Conservation easements
		Federal Wilderness areas National Parks	
		National Fire Management Plan	
Maine	ESA jeopardy standard [0]	Federal CWA (Sections 402 and 404)	LURC protection districts and zoning regulations
		LCAS (FS, *NPS* [2])	Maine Protection and Improvement of Waters Act, Maine Shoreland Zoning
		National Fire Management Plan	Maine Statewide Standards for Timber Harvest in Shoreland Areas
		Federal Wilderness areas National Parks	Maine Natural Resources Protection Act (NRPA)
			Conservation easements
			Maine Forest Practices Act
			Sustainable Forest Initiative
			Liquidation Harvesting Act

Notes: CWA – Clean Water Act; [0] See Table III 3.a.ii-2. [1] For example, Kootenai National Forest, where on June 27, 2003 logging was ordered halted until the FS completes an old-growth inventory for the forest. See *The Ecology Center, Inc. v. Castaneda,* CV 02-200-M-DWM. [2] List of "Impaired and threatened waterbodies in need of water quality restoration", prepared according to CWA section 303(d). See Montana Department of Environmental Quality (2000a). [3] NPS and FWS have not yet signed a lynx conservation agreement like those that exist between the FS and the FWS and the BLM and the FWS. However, management activities in Glacier National Park follow LCAS guidelines. [00] See 77-5-3 MCA (Montana Code Annotated, 2001).

limit acceptable uses as well. Table III.3.a.ii-1 shows specific environmental laws, regulations, and special designations that prescribe limitations on permissible uses in the two case study areas examined in this study.

In addition to these restrictions on permissible activities, there exist a number of environmental quality and conservation incentives that may benefit the lynx. Examples of such incentive systems are the Environmental Quality Incentives Program, the Wildlife Habitat Incentives Program, the Conservation Reserve Program, and the Wetland Reserve Program (Soil and Water Conservation Society 2004) which seek to encourage the voluntary adoption of conservation measures. However, since these incentives do not prescribe behavior and hence may or may not be followed on particular sites, they are here not included in the list of environmental restrictions on land use activities. The specific restrictions that these laws and regulations place on particular lands are discussed in this section. In section 3.c below these restrictions are compared with those that would be relevant under designation of critical habitat for the lynx.

In the following, we present a list of land use activities that have been identified as being detrimental to the lynx. We identify, for each of the three study areas, those restrictions on these activities that exist in the *without designation* scenario, and specify those that likely would be imposed in the *with designation* scenario. The difference between the former and the latter are the direct impacts attributable to critical habitat designation for the lynx. These direct impacts, together with their associated, indirect impacts, make up the total impacts of critical habitat designation.

Land use activities detrimental to lynx

Several land use activities have the potential to affect lynx negatively by reducing habitat quality or quantity for lynx. These activities are livestock grazing, timber harvest, fire prevention or suppression, recreation, mining, and infrastructure and other development (construction of roads or utility stations and corridors, and commercial or housing development) (Ruediger et al. 2000). On lands managed according to the recommendations made in the LCAS, future projects are likely not to result in jeopardy findings. This is especially true in Montana, where FS and BLM land management plans are being amended to incorporate the management guidelines set forth in the LCAS, which, according to the FWS, will provide even more protection to the lynx than the existing agreement of the agencies to abide by the LCAS in their management activities (USDI FWS 2003c). Hence, most future projects in those areas will likely go forward without major modifications. On non-federal lands with a federal nexus, the baseline of lynx protection is substantially lower, consisting primarily in state environmental laws and the ESA's jeopardy provision. We assume that the FWS will determine that most future projects are unlikely to result in jeopardy findings, and hence, most projects in lynx habitat on other than federal lands or lands with a federal nexus are likely to go forward unmodified. It is in these cases where designation of critical habitat will effect the largest change over the BCS, though the impact of additional critical habitat consultations and associated project modifications (*Sierra Club v. USFWS*, 245 F.3d 434 (2001)).

In cases where the ESA demands actions that stand in conflict with other laws, the resulting conflicts may lead to land management decisions that do not reflect purely the demands of the ESA.[55] For example, in the case of wildfire management, a (managed) return to historic fire regimes may be the preferred option under the goal of lynx recovery.

[55] Similar goal conflicts could conceivably be created by the ESA itself, in the case that several listed species may require conflicting land management activities for their recovery.

Table III. 3.a.ii-2: ESA species potentially found in proposed lynx CH in Montana

Species / *County*	*Flathead*	*Glacier*	*Granite*	*Lake*	*Lewis and Clark*	*Lincoln*	*Missoula*	*Pondera*	*Powell*	*Teton*	*HCP*	*Recovery Plan*
Bald Eagle (*Haliaeetus leucocephalus)* [1]	T	T	T	T	T	T	T	T	T	T	MT DNRC	
Wolf (*Canis lupus*)[0]	E	E	E	E	E	E	E	E	E	E		Yes
Black-tailed Prairie Dog (*Cynomys ludovicianus*)*					C							
Bull Trout (*Salvelinus confluentus*)[3]	T	T	T	T	T	T	T		T		Plum Creek; MT DNRC	
Grizzly Bear (*Ursus arctos horribilis*)**	T	T		T	T	T	T	T	T	T	MT DNRC	Yes
Kootenai River White Sturgeon (*Acipenser transmontanus*)[4]						E						Yes
Montana Artic Grayling (*Thymallus arcticus*)*					C					C		
Mountain Plover (*Charadrius montanus*)					PT							
Piping Plover (*Charadrius melodus*) [5]								T				Yes
Spalding's Catchfly (*Silene spaldingii*) [5, 6]	T			T		T						
Water Howellia (*Howellia aquatilis*)[7]				T			T					

Notes: [1] Proposed for delisting. [0]Currently, wolves in the Northwestern Montana (NWMT) Recovery Area form part of the Northern Rocky Mountain wolf population and are designated as endangered (USDI FWS et al. 2003). The NWMT wolf recovery area overlaps with proposed lynx critical habitat, and as such is relevant to the current study as part of the existing environmental regulations affecting the proposed lynx critical habitat area. However, the wolf is likely to be delisted, providing approval by the FWS of the wolf management plans of Montana, Idaho, and Wyoming (USDI FWS et al. 2003). [2] Likely no overlap with lynx habitat. [3] CH has been proposed for almost the entire area proposed for lynx CH in this study. However, the FWS lacks the funds to complete it. ** Northern Continental Divide recovery zone (Bader 2000). [4] No CH itself in lynx study area, but feeding streams. [5] No CH in study area. [6] Occurs in grasslands. [7] Found in wetlands. T–Threatened, E–Endangered, X–Experimental, P–Proposed, C–Candidate, PT–Proposed threatened. * Listing "warranted but precluded." The Grey Wolf has been omitted from the list due to its anticipated delisting. MT DNRC HCP under evaluation by the FWS (USDI FWS 2003a). Besides the bald eagle, bull trout, and grizzly bear, the HCP developed by the MT DNRC also covers lynx (*Lynx canadensis*), and several species of concern, namely wolverine (*Gulo gulo*), fisher (*Martes pennanti*), northern goshawk (*Accipiter gentilis*), black-headed woodpecker (*Picoides arcticus*), pileated woodpecker (*Dryocopus pileatus*), flammulated owl (*Otus flammeolus*), and westslope cutthroat trout (*Oncorhynchus clarki lewisi*) (ibid.). Area covered by proposed HCP is approximately 700,000 acres of forested State school lands, used primarily for activities related to forest management under the State Forest Land Management Rules (ibid.).

Sources: http://mountain-prairie.fws.gov/endspp/County%20Lists/MT_county_list.htm Specific Information for the species obtained from Fed. Reg. entries for the species.

However, such an approach may be precluded, for various reasons, most likely political or legal ones. When estimating the impact of designation of critical habitat for the lynx, impact estimates therefore must be based on reasonably implementable management scenarios. In the following, the land use activities with the potential to negatively affect lynx are briefly discussed.

1. Livestock grazing

Livestock grazing is common in lynx habitat in the Northern Rockies (Ruediger et al. 2000). Livestock potentially competes with snowshoe hares for forage (Ruediger et al. 2000). The summer diet of hares consists primarily of forbs, grasses, leaves of shrubs, and some woody browse, while in winter it mainly consists of twigs and some bark of bushes and trees, but also forbs and grasses where they can be reached under the snow cover (Hodges 1999). Cows and sheep predominantly eat grasses and legumes, but generally eat only small shares of forbs and browse, while goats prefer browse over grasses or clover. Both cows and sheep therefore generally will not compete with hares for forage directly, also because snowshoe hares generally avoid open areas where they are not protected by canopy cover. In contrast, because of their overlap in forage species and range, competition between goats and hares may occur in forests. In addition, larger livestock may prevent regeneration of prime snowshoe hare forage (aspen) by trampling of saplings, leading to indirect foraging competition. Since livestock can't be stocked on northern grazing lands in the US during winter due to the deep snow cover and extreme weather conditions, the principal concern regarding forage competition between snowshoe hares and domestic livestock is the impact of livestock grazing in proposed lynx habitat during spring, summer and fall on availability of winter browse for hares (Ruediger et al. 2000).

2. Timber harvest

Any human activity that increases the exploitation competitiveness of other carnivores potentially has a detrimental effect on lynx. Of primary concern in this respect are activities that increase access by competitors to lynx habitat during winter months (Ruediger et al. 2000, Buskirk et al. 1999), since currently not much is known about exploitation relationships between lynx and other carnivores during the remainder of the year (Buskirk et al. 1999).

Not all forms of logging are detrimental to lynx. This is evidenced by the example of Maine, where lynx populations appear to be doing well in the presence of high timber harvest volumes (USDI FWS 2003c). The reason for this is that logging, including clearcutting, leads to vegetation regrowth, which creates conditions conducive to snowshoe hares. Like non-manmade disturbances such as insect infestations, disease, blowdowns, fires, or ice storms, logging, if appropriately managed, can create a landscape pattern of forest vegetation patches in different successional stages, which is suitable for lynx because such a pattern fulfills lynx' multiple habitat requirements (forage, cover/security, and denning) (Aubry et al. 1999).

3. Recreation

Winter recreation

Any activities that lead to snow compaction in lynx habitat may lead to an increase in exploitation or interference competition for lynx, by providing winter access into lynx habitat to competitors (Buskirk et al. 1999). Of particular concern are groomed and ungroomed snowmobile and cross-country ski trails (Buskirk et al. 1999).

Summer recreation

Summer recreation activities in or near lynx denning habitat may negatively impact kitten survival if the resulting disturbances lead to relocation of kittens (Ruediger et al. 2000).

4. Roads/backcountry trails

Roads used during winter allow lynx exploitation competitors access into lynx habitat during winter. Roads with a high traffic volume also contribute directly to lynx mortality though collisions (Ruediger et al. 2000), and constitute barriers to lynx movement (Ruediger et al. 2000, Apps 2000).[56]

5. Wildland fire prevention/suppression

Suppression of natural fire regimes, unless offset by silviculture regimes that mimic impacts of such fires, leads to changes in the age structure of forests towards higher old-growth, thereby reducing the quality of lynx foraging habitat in such forests (Ruediger et al. 2000).

6. Mining

The main impact of mining on lynx likely occurs through the development of access roads for exploration and development, which, if used during winter, provide access to lynx competitors (Ruediger et al. 2000). In addition, mining (especially surface mining) may directly impact lynx through the destruction of habitat or the reduction of habitat quality.

Restrictions applicable in the Montana study area in the absence of designation of critical habitat

ESA-related and other federal restrictions (LCAS, HCPs)

Table III.3.a.ii-4 shows the land use restrictions that exist in Montana in the base case scenario, that is, the restrictions that are in place in the absence of designation (column 2), for the land use activities that have been identified as detrimental to lynx (column 1). The table also lists the restrictions that would likely be put into place following designation of critical habitat for lynx (column 3), as well as the difference between the two sets of restrictions (column 4).

[56] Research suggests that it is primarily dispersing animals that fall victim to vehicle collisions. The effective barrier that a road represents increases, besides with traffic volume, also with the overall width of the cleared area, including shoulders and non-canopy cover strips along roads.

LCAS-based restrictions

1. Livestock grazing

Reduction of forage competition for snowshoe hares requires the management of livestock grazing in particular areas or situations. Grazing is to be prevented in openings created by fire, until such time as successful regeneration of the shrub and tree components occurs. Grazing must further be managed in aspen stands to ensure sprouting and sprout survival, and in shrub-steppe habitats within the elevational ranges that encompass forested lynx habitat, to achieve mid-seral or higher conditions. Finally, grazing must be managed in riparian areas in lynx habitat to maintain or achieve cover and forage for prey species (Ruediger et al. 2000; Table III.3.a.ii-4).

These restrictions on livestock grazing are stipulated in the LCAS, and as such presumably are already being implemented on BLM and FS lands (USDI BLM and USDI FWS 2000; USDA FS and USDI FWS 2000). They are currently being incorporated into Northern Rockies land management plan amendments (USDA FS and USDI BLM 2002a, 2002b).

The LCAS-based recommendations for restricting domestic livestock grazing in lynx habitat greatly reduce forage competition between hares and livestock, with the exception of goats. Goat browsing would directly reduce the availability of winter browse for hares, even assuming the LCAS-based grazing recommendations were fully implemented.

2. Timber harvest

Specific forest management activities restricted by the LCAS are those that would reduce denning habitat, either through logging of life trees or the removal of down logs or root wads (salvage logging), and pre-commercial thinning, in cases where it is likely to negatively impact the availability of snowshoe hare browse (i.e., thinning may be delayed until stands no longer provide snowshoe hare habitat).

3. Winter recreation

The LCAS stipulates that there be no net increase on federal lands in groomed or designated over-the-snow routes and designated snowmobile play areas per LAU (Ruediger et al. 2000). It further places restrictions on the development of new recreation projects and on the expansion of existing developments that are intended to ensure the continued functional effectiveness of lynx habitat (Ruediger et al. 2000:91; see also Table III. 3.a.ii.-3).

4. Roads/backcountry trails

The LCAS stipulates there be no net increase in groomed or designated over-the-snow routes (except for winter logging-related activities) or snowmobile play areas, that new roads be located away from forested stringers, and that public use of temporary logging roads be limited (Ruediger et al. 2000). It further prescribes consultations on all new highway construction on federal lands (federal nexus via federal highway funding through FHWA), with the goal of maintaining or restoring connectivity between habitat blocks through mitigative measures (e.g., under- or overpasses).

5. Wildland fire prevention/suppression

The LCAS prescribes that (1) burn prescriptions be designed so as to regenerate or create snowshoe hare habitat; that (2) construction of permanent fire beaks on ridges or saddles in lynx habitat be avoided; that (3) construction of temporary roads and machine fire lines be minimized to the extent possible during suppression activities; and that (4) to the extent possible, burn prescriptions be designed and suppression actions be conducted such that adequate denning habitat is maintained. Finally, the LCAS mandates that a post-disturbance assessment be conducted after large fires prior to salvage harvests, in order to evaluate the potential for denning and forage habitat.

6. Mining

On mining projects where over-snow access is required, the LCAS stipulates that use be restricted to designated routes, and that roads be closed to the public.

As already pointed out, the currently ongoing amendments of Northern Rockies land management plans are supposed to incorporate the LCAS standards and objectives to ensure the effective implementation of the latter (USDA FS and USDI BLM 2002a, 2002b). Since the amendment process has not yet been completed, it is impossible to assess whether or not in fact all of the LCAS standards will be carried over unmodified into the amended land management plans. Some of the standards have been weakened in draft amendments (see Gaillard and Leahy 2001). If the final amendments were to fall short of incorporating all of the LCAS standards in their original form, the base case scenario of land use restrictions on BLM and FS lands would be lower than we assume it to be here, and the difference between the base case and the CHD scenarios would be larger. As a result, CHD may result in larger impacts than those that we expect in this study.

Habitat Conservation Plans (HCPs)

MT DNRC HCP

The Montana Department of Natural Resources and Conservation (MT DNRC) is in the process of preparing a HCP for five threatened species and seven species of concern (see Tables III. 3.a.ii-1 and -2; USDI FWS 2003a). The plan covers approximately 700,000 acres of forested State school trust lands in Montana managed by the MT DNRC, including the 378,000 hectares of State trust lands in the Montana study area. These lands are currently managed according to Montana's State Forest Management Rules adopted in March of 2003 (Montana 2002; Montana 2003a). The proposed HCP would include the lynx, and conservation strategies would cover, among others, silviculture, road management, riparian area management, grazing on classified forest lands, and land use planning (USDI FWS 2003a). Although no specific measures for lynx protection have yet been spelled out, the fact that the lynx is among the five threatened species covered by the HCP, and that the FWS must approve any HCP after conducting an environmental review, suggests that the protection measures afforded the lynx under the final HCP would in many respects resemble the measures identified in the LCAS.

There are some land use activities, specifically winter recreation and wildland fire management, that currently are not included in the activities for which conservation measures will be developed in the plan (See USDI FWS 2003a:22413-14). However, based upon the stated goals of the DNRC HCP, it can be expected that lynx-specific restrictions will be incorporated into the management plan.

For example, the management plan will explicitly address human disturbance associated with road access for the specified species, including the lynx. The HCP will fully and independently identify and analyze the conservation needs of all species included, and include any additional actions necessary for their conservation (ibid.: 22413). It appears likely that the minimization of disturbance as a management goal will lead to the incorporation into the DNRC HCP of the restrictions on winter recreation spelled out in the LCAS.

By comparison, other state lands in Montana currently offer lynx little protection from negative impacts due to winter recreation activities. The only areas carrying categorical restrictions on snowmobiling lie outside of the proposed lynx critical habitat boundaries (see 12-6-601(1)(a) and (2)(a) MCA). On the remaining state lands, snowmobile use generally is allowed on roads if permitted by local traffic laws or regulations. In addition, on unleased lands, snowmobiling is allowed in all areas except where it is expressly prohibited (MT DNRC 2003). On state forest lands, the New Rules (Montana 2002) permit snowmobiling during the specified grizzly bear denning period, Nov. 16 to March 31 (see ibid., *New Rule XXXII*).

Plum Creek Timber Company Native Fish HCP

1.4 million acres of Plum Creek lands in Montana are covered by a HCP for native fish species (NFHCP). The NFHCP focuses primarily on water quality (USDI FWS 2000b, Plum Creek 2000), and covers almost seven percent of all lands, or 28 percent of all non-federal lands, respectively, in the Montana lynx critical habitat study area. Most of the measures spelled out in the NFHCP are directed at road/skid trail construction and management, riparian management, implementation of forestry and grazing best management practices, and land use planning, with management practices to adopt adaptive management techniques (see Table III.3.iii.a-3).[57] Currently, an amendment to the NFHCP is planned that would extend to the grizzly bear the incidental take permits issued in relation with the plan, and incorporate an approximate additional 15,000 acres (USDI FWS 2002d).[58]

Federal and Tribal Wilderness Areas and National Wildlife Refuges

More than 25 percent of all lands in the proposed lynx critical habitat in Montana carry designation as Federal Wilderness. These lands comprise the Scapegoat Wilderness (240,000 acres in Helena NF, Lewis and Clark NF, and Lolo NF); the Bob Marshall Wilderness (1,009,356 acres in Flathead NF and Lewis and Clark NF); the Great Bear Wilderness (286,700 acres, Flathead NF); and the Mission Mountains Wilderness (75,588 acres, Flathead NF). The wilderness areas are managed under the 1964 Wilderness Act (16 U.S.C. 1131 et seq., 78 Stat. 890). Currently, the only livestock grazing in the areas is by recreationists' pack animals and government administrative stock. No timber harvest is occurring ((USDA FS 1985, USDA FS 1986), no new livestock grazing leases will be given (16 U.S.C. 1131 et seq. Sec. 4(d)), and no timber harvesting will occur except for fuelwood collection of dead or down material (USDA FS 1990 Sec. 2323.53).

[57] All of Montana's Forestry BMPs (of which only those applying to riparian areas are mandated through the SMZ law) are implemented on all Plum Creek lands in the Montana study area (Plum Creek 2000). Livestock grazing on Plum Creek lands occurs on nearly 600,000 acres in Montana, with an estimated more than 10,000 cows, and is to follow Plum Creek's grazing BMPs (Plum Creek 2000).

[58] The amendment would cover approximately 71,000 acres of Plum Creek lands in Lincoln, Sanders, Flathead, Lake, Missoula, Powell, and Lewis and Clark counties, most of which falls into the proposed lynx critical habitat area analyzed in this study (USDI FWS 2002d).

All federal wilderness areas fall within National Forests. The management provisions of the respective forest plans (including those for designated wilderness areas) that are relevant to lynx conservation do not exceed the protection afforded to lynx under the LCAS. In addition, the FS implements the LCAS on all its lands, and forest management plans are currently being revised to incorporate LCAS guidelines into the management guidelines. Hence, the lynx conservation measures applied in designated federal wilderness areas in the study area are assumed equivalent to the forestry project standards listed in the LCAS (see Table III.3.a.ii-4).

In the National Wildlife Refuges (Swan River and Blackfoot Valley) and several waterfowl production areas within the proposed critical habitat boundaries managed by the FWS, snowmobiling is generally prohibited but, where allowed, is restricted by the provisions defined in the LCAS.[59]

In addition to the federal wilderness areas, the Montana study area contains approximately 91,500 acres of tribal wilderness lands.

National Parks

Glacier National Park accounts for more than 15 percent of the area proposed in this study for designation as critical habitat for lynx. No grazing of domestic livestock or timber harvest is permitted in the park; motorized winter use is prohibited, and there are no groomed trails. However, there is some backcountry camping and hiking, and cross-country skiing and snowshoeing (USDI NPS 1999).

The National Park Service (NPS) and the FWS are currently in the process of preparing a conservation agreement for the lynx, and Glacier National Park already "considers the recommendations in the Canada Lynx Conservation Assessment and Strategy prior to undertaking any new activities in lynx habitat" (USDI NPS 2003:41). However, since so far no mapping of lynx habitat in the park has been carried out by the park service (ibid.), there must exist some uncertainty in some instances as to whether or not management actions for a specific area should follow the LCAS guidelines.[60] Since the NPS-FWS agreement has not been signed yet, NPS lands are listed separately from FS and BLM lands in Table III.3.a.ii-4.

BLM and FS Off-Highway Vehicle Restrictions (BLM and FS OHVRs)

Since 2001 and 2003, the FS and BLM lands, respectively, underlie year-round restrictions of motorized off-highway travel (USDI BLM 2003; USDA FS 2001c). Such travel is limited to official administrative use, and only to the minimum necessary to accomplish required work (USDI BLM and USDA FS 2001a). Cross-country motorized travel is defined as vehicles driving (wholly or partly) on undisturbed ground or on livestock trails not clearly in continuous use by motorcycles over a period of years (USDI BLM and USDA FS 2001a:12). Motorcycles traveling on single track trails do not qualify as motorized off-highway travel, and permit-specific exceptions to the restrictions are allowed (see USDI BLM and USDA FS 2001a:12-19). The restriction does not apply to snowmobile travel.

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[59] Snowmobiling in these locations is generally prohibited because it constitutes a recreational use that can be classified as disruptive to wildlife or interfering with the use and enjoyment of a refuge by others engaged in wildlife-dependent recreation, a use which is conflicting with the primary purposes of the National Wildlife Refuge system and therefore may be prohibited (USDI FWS 2001b: 3674).
[60] This uncertainty could be eliminated through the designation of critical habitat

Flathead National Forest Winter Motorized Recreation Amendment 24

The FS is proposing limitations on snowmobile use that would programmatically allow snowmobile use to occur on about 738,000 acres of NFS lands (the Island Unit of the Swan Lake District is not included in this number; USDA FS 2003b). When site-specific restrictions are applied, snowmobiling can occur on approximately 647,000 acres. Programmatic Forest Plan direction would prohibit snowmobile use on about 1.56 million acres, including wilderness. This would represent a reduction of the current area open to snowmobile use by 34 percent. Specifically, snowmobile use would be excluded from 338,000 acres of lynx habitat on NF lands on which currently it is permitted (ibid.:2-14). Currently, however, it is not known if and when the proposed Forest Plan amendment would take effect.

Confederated Salish and Kootenai tribal lands[61]

The taking of lynx by both members and non-members of the Tribes was closed in the mid-1980s by Tribal Council action as a result of concerns about both lethal and non-lethal taking of lynx and its potential effects upon the local population and its status. That closure remains in effect today. In addition, the Tribes urged the Montana Fish, Wildlife and Parks to enact similar closures for Reservation lands and adjacent off-Reservation areas in the early 1990s as a conservation measure for the species.

The Tribal Wildlife Management Program reviews virtually every project that has the potential to adversely impact wildlife or wildlife habitat on the Reservation. Each project is studied in detail under the Tribes' NEPA process. The Tribes utilize the Lynx Conservation Assessment and Strategy (LCAS) guidelines as a guide for project evaluation. Each project that is deemed by Tribal Wildlife Management Program staff to have potential impacts upon lynx or other listed species receives a Biological Assessment and subsequently undergoes consultation with the US FWS under Section 7 of the ESA. The Tribes’ overall guidelines for resource management are included in their Comprehensive Resource Plan, and forest management guidelines for lynx are built into the Tribes’ recently updated Forest Management Plan.

Restrictions due to state laws and regulations or private agreements

Water quality regulations

Montana’s Water Quality Act (75-5-101 et seq. MCA, 2001) defines Montana water quality standards (Montana Department of Environmental Quality [DEQ] 2002) based upon EPA guidelines (USEPA 2002) developed pursuant to the federal Clean Water Act (CWA, 33 U.S.C. 1251 et seq., 2002). Montana water bodies classified as impaired are listed on the state’s 303(d) list (Montana Department of Environmental Quality 2000b), and have watershed-wide water quality restoration plans developed by the Montana DEQ and approved by the EPA. Some of the watershed planning areas in the proposed lynx critical habitat area in Montana already have been completed and approved, with others to follow in the near future.[62]

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[61] Personal communication with Dale Becker, Wildlife Program Manager, Confederated Salish and Kootenai Tribes (Jan. 2004).

[62] The Flathead Lake, Blackfoot Headwaters, Sun, Swan, and Teton TMDL planning areas have approved water quality restoration plans (Montana DEQ 2000b, 2001; USEPA 1999). Plan development for the Flathead Headwaters and Cutbank-Two Medicine planning areas is scheduled to be completed in 2003 and 2004, respectively, with Flathead-Stillwater, Middle Blackfoot, and Tobacco to follow in 2005 (Montana DEQ and USEPA 2003).

The Montana water quality restoration plans identify the relative contributions of sources to critical pollutants, and specify appropriate control measures. In the majority of the planning areas for which total maximum daily loads (TMDLs) have been completed or for which provisional assessments are available, agriculture and/or silviculture/timber harvest have been identified as the major non-point sources of water pollution.[63]

The actions proposed for improving water quality include restoration activities, land use planning to address the problem of rapid development outside of incorporated areas (especially in the Flathead Lake area, see Montana DEQ 2001), modified irrigation practices and public acquisition of some irrigated agricultural lands (USEPA 1999), as well as the increased implementation of silviculture, agriculture, and grazing best management practices (BMPs; see Montana DEQ 2001b). Some of the water restoration-related BMPs may be beneficial for lynx conservation. For example, Montana's Streamside Management Zone (SMZ) Law (77-5-301 though 307 MCA, 2001), which is part of the state's forestry BMPs, identifies permissible timber harvest methods and procedures in riparian areas. Increased application of BMPs can generally be assumed to have beneficial impacts on lynx because riparian zones are important habitat for lynx and snowshoe hares (Ruediger et al. 2000).

TMDL-related changes in land management practices will likely impose some new lynx-relevant restrictions on some private lands, primarily in riparian areas. On Plum Creek Timber Company lands, which account for almost half of all private lands in the study area, these restrictions, or more stringent ones, are already in place (see NFHCP above). Similarly, on state lands these restrictions generally are already in place due to Montana's forestry and grazing BMPs and State Forest Management rules (see below).

Montana State Forest Land Management Rules

Montana's New Forest Land Management Rules (Montana 2002; Montana 2003a) mandate land management under application of a fine filter approach for endangered, threatened, and sensitive species, focusing on a single species' habitat requirements "to the extent consistent with the Endangered Species Act" (Montana 2002: 2552). On blocked lands, management for desired future forest condition is to be characterized by the historic proportion and distribution of forest types and structures (ibid.). Specifically, silvicultural regimes are typically to be based on natural disturbance regimes (stand-replacement, mixed-severity, and non-lethal fire; insects; disease; and wind), emulating patchiness, patch size and shape, regeneration patterns, downed wood, species composition, and other characteristics of natural disturbance events.

Besides these general prescriptions, the Rules specifically incorporate management directions for lynx habitat (see New Rule XXXV in Montana 2002 and Montana 2003a), including restrictions on pre-commercial thinning, road construction and maintenance, retention of denning and

[63] In the Flathead Lake TMDL planning area, agriculture and silviculture are the major contributors (Montana DEQ 2001a; Montana Water Center 2003), but population growth in unincorporated areas is foreseen as a major future threat to water quality (Montana DEQ 2001a); in the Teton and Sun areas, agriculture (USEPA 1999; Montana Water Center 2003); in the Swan area, silviculture, resource extraction, and construction (Montana Water Center 2003); in Flathead-Stillwater, silviculture (ibid.); in the Cutbank-Two Medicine area, agriculture and livestock grazing (ibid.); in the Middle Blackfoot and Tobacco areas, agriculture and silviculture (ibid.); and in the Blackfoot Headwaters planning area, agriculture, mining, and silviculture (ibid.).

foraging habitats, retention of coarse woody debris, salvaging, and grazing (see Table III.3.a.ii.-3).

Together with these management directions, however, the rules prescribe that all silviculture treatments shall be designed with the goal of maintaining the future productivity and revenue generation capacity of state forests (New Rule XX(1), Montana 2002:2559), stating that management regimes "shall realize the productive capability of the site for producing desired products and benefits" (New Rule XX(4) ibid.).[64] Maximization of two or more objectives (for example, lynx conservation and revenue generation) however is impossible if the independent variables (available management actions) influencing both or all objectives are the same. Hence, unless it can be argued that lynx are essential to promoting the future revenue generating capability of state forests, or that managing for lynx according to the New Rules does not negatively impact management plans that seek to maximize revenue generation across time, there is a clear trade-off between lynx conservation and the fulfillment of the mission and declared goal of state forest management in Montana.[65] It is not clear whether or how often conflicts between conservation and revenue generation will be resolved in favor of conservation, and therefore it is difficult to assess to what extent the lynx will actually obtain all of the potential benefits from the conservation objectives stipulated in Montana's New Rules.[66]

Nevertheless, due to the variety of habitats required by lynx, lynx conservation according to the proposed rules (especially XXXV) should generally not place too stringent restrictions on forest management on State lands, the compatibility of the conservation and revenue objectives being primarily a question of sufficient planning effort. Hence, one may presume that the lynx conservation measures spelled out in the Rules generally will be implemented on State forest lands.

Swan Valley Grizzly Bear Conservation Agreement

Almost the entire Montana lynx critical habitat designation study area is co-extent with an area covered by an HCP-like agreement for the grizzly bear between the USFS, USFWS, MT DNRC, and Plum Creek Timber Company signed in 1995 (Plum Creek 2000:1-13; Dobey and Carr 1999). The agreement, which is voluntary and therefore not enforceable, covers approximately 369,000 acres southeast of Flathead Lake. The measures stipulated comprise reduced road access (seasonal closures, permanent closures, and reclaiming of some closed roads); maintenance of so-called linkage zones intended to provide bears access between the Bob Marshall and Mission Mountain Wilderness areas; rotation of commercial activities such that seven out of the eleven subunits of the area covered by the agreement are inactive for between three and six years; and the retaining of natural buffers around roads, tree harvest areas, and road construction locations, to provide visual concealment and security to bears. However, salvage operations and administrative use are allowed during specified time periods (16 June to 31 August and 16 November to 31 March) even in the inactive units, which has raised some concern as to the

[64] Montana's DNRC is "required to manage these lands for financial gain and protection of the corpus of the trust with undivided loyalty to that mandate" (Montana 2003a:436).
[65] DNRC argues that the New Rules provide the appropriate balance between current revenue maximization and protection of the corpus of the trust, thus providing for the express legal purpose of the trust (Montana 2003a:436). The reasoning behind this is that the rules promote forest health which in turn is seen as the basis for maintenance of future revenues (ibid.:420).
[66] The quality of the lynx conservation provisions generally seems adequate, based on comparisons with the measures suggested in the LCAS. An exception to this is perhaps the requirement that at least ten percent of foraging habitat acreage be maintained (see Rule XXXV(8)(b)(i), Montana 2002). As one commenter on the New Rules remarked, that may be very little (see comment 297 in Montana 2003a:479).

effectiveness of the management plan in protecting grizzlies from disturbance (Dobey and Carr 1999). Part of the time periods during which salvage and administrative activities are permitted falls into the immediate post-natal period for Lynx and therewith has the potential to lead to disturbance of denning animals. In addition, the size of the openings allowed in Even Age Cutting Units (clearcuts or seedtrees) of up to 600 feet from cover is likely so large that it has the potential to create barriers to lynx movement, and too large for much of the regrowing vegetation to serve as snowshoe hare forage) (Agee 1999, Hodges 1999).

Since the Swan Valley Grizzly Bear Conservation Agreement is not an ESA Section 10 HCP, it does not constitute a federal nexus. Therefore, future activities of the signatories or future amendments to the agreement would not trigger consultations under the ESA or possible project modifications related to lynx conservation. In the absence of enforceability of the agreement, the minimum protection accorded to lynx in the area covered by the agreement will therefore depend on the ownership of the various land parcels. FS lands covered by the agreement (both national forests and federal wilderness areas) carry the use restrictions spelled out in the respective FS land management plans (currently undergoing revision), while forested lands managed by Montana's DNRC carry restrictions based on the Montana SMZ Law, the Montana State Forest Land Management Rules, and water quality restoration (TMDL) plans.[67] Plum Creek lands are governed by the NFHCP and MT state laws (the SMZ law, which is incorporated into the NFHCP; Montana's prohibitions on open burning based on 17-8-6 ARM; and (TMDL-based) water quality restoration plans under Montana's CWA 303(d) list). The other private lands in the Agreement area (less than 20,000 acres) carry restrictions based on State laws, most importantly water quality recovery (TMDL) plans (Montana Clean Water Act), riparian management regulations (Montana SMZ Law), and restrictions on prescribed burning (Montana Clean Air Act).[68] Some of those non-Plum Creek private lands (approximately 1,500 acres) carry conservation easements.

Montana's Strip and Underground Mine Reclamation Act

Montana's Strip and Underground Mine Reclamation Act (82-4-201 et seq. MCA) authorizes the MT DEQ to withhold approval of an application for a prospecting, strip-mining, or underground-mining permit when such activity would put at risk the area's "biological productivity, the loss of which would jeopardize certain species of wildlife or domestic stock"(82-4-227(2)(b) MCA). If permits are granted, certain regulations governing the operation and reclamation of the mining site may entail protection for lynx, for example locating roads to "minimize impacts to important fish and wildlife species or other species protected by state or federal law", or fencing of roads to "guide locally important wildlife to underpasses" (17-24-751(2)(b) and (c) ARM).

One aluminum processing plant and one peat mine (in Flathead NF) are active in the study area, both in Flathead county (USGS *Mineral Resources Online Spatial Data*; Montana Bureau of Mines and Geology and USGS 2002). Several other mines are located in the vicinity of the study area (gemstone, sulfur, and lead mines and/or processing plants), but all lie a few miles outside of the study area boundary (USGS 1998).

As set forth in section 402 of the federal Clean Water Act (33 U.S.C. §1251 et seq.), all construction projects larger than one acre must have a stormwater permit. In addition, the CWA

[67] There are no Montana State Trust lands in the area of the Swan valley covered by the agreement, so the MT DNRC HCP does not apply to this area.
[68] Montana's Clean Air Act (CAA; Section 75-2-101 et seq., MCA) regulates prescribed burns and other open burning on non-federal lands (17-8-6 ARM, Montana 2003).

(33 USC §1251 et seq.) and the Clean Air Act (CAA) (42 USC §7401 et seq.) apply to mining sites regardless of where they are located (U.S. EPA 1994:1-57). These permits establish a federal nexus for mining operations and hence require consultation with the FWS.

Conservation easements

Various government and non-government organizations (USFS, USFWS, Montana Department of Fish, Wildlife and Parks, Montana Land Reliance, The Nature Conservancy, Flathead Land Trust, and Five Valleys Land Trust) hold easements on lands in the Montana study area, totaling approximately 20,000 acres. Additionally, The Nature Conservancy (TNC) owns almost 21,000 acres of land in the study area. Together, these lands account for roughly 0.6 percent of the proposed critical habitat in Montana. Conservation agreements vary in the restrictions they place on land use activities. It is likely however that some of the activities that have the potential to affect lynx detrimentally are prohibited on TNC lands and on some of the lands under easement.

Non-federal lands with federal nexus

Almost the entirety of the lands in the Montana study area not in federal ownership is covered by one or several federal nexi. The spatially most extensive nexus is given via the TMDL planning process, pursuant to the National Pollutant Discharge Elimination System (NPDES) of the federal CWA (Sec. 402 CWA). The NPDES mandates that plans be established for all waters with impaired quality, to manage activities that create point-source and non-point source pollution which affects the quality of those waters (see Sec. 304 (f) CWA). All watersheds in the area proposed for designation of critical habitat are TMDL planning areas (Montana Natural Resource Information System [NRIS] 2003), therefore all non-federal lands in these areas have a federal nexus: any land use plan and any changes in land use plans for TMDL planning areas that may affect lynx would trigger consultations with the FWS pursuant to section 7 (a)(2) ESA. However, the water quality-related activities in any one of the relevant TMDL planning areas generally comprise only one or a few of the activities of concern for lynx conservation. Therefore, if a particular plan develops guidelines, for example, for grazing and agriculture in the planning area, then the management of these two activities as specified in the plan would be subject to consultation with the FWS. This would allow the incorporation of LCAS-based guidelines for the specific activities covered in the respective plans.[69] Other land use activities relevant to lynx conservation but not addressed in the TMDL plan, such as, in this example, silviculture, would not be subject to consultation with the FWS. Hence, lynx conservation measures can only be incorporated into the specific land use activities addressed in a particular TMDL plan. As a result, the non-federal lands in the TMDL planning areas, except those covered by other federal nexi, will likely be subject to combinations of LCAS-based guidelines that vary by TMDL planning area. Hence, on approximately 49 percent of the non-federal area proposed for critical habitat designation, only one or some of the LCAS-based lynx conservation management guidelines will be applicable (see Table III.3.a.ii-3).

Additional federal nexi with smaller geographical coverage than that of the TMDL planning areas exist via Montana's DNRC HCP (in preparation, see USDI FWS 2003a) which covers approximately 378,000 acres of state trust lands in the study area (approximately 24 percent of all non-federal lands); and the planned amendments to the Plum Creek HCP (NFHCP), which covers the Plum Creek lands in the area (27 percent of all non-federal lands in the Montana study area).

[69] This presupposes, of course, that the FWS pursues the incorporation of the respective LCAS guidelines into TMDL plans.

Table III.3.a.ii-3: Primary land use activities of concern in Montana's TMDL planning areas in proposed lynx CHD area

	Primary factors of concern identified in TMDL plans or related analyses				
TMDL planning area	*Silviculture*[1]	*Agriculture*	*Grazing*	*Mining*	*Development/ construction*
Tobacco	x	x			
Flathead Headwaters	x				
Flathead-Stillwater	x	x			x
Flathead Lake	x	x		x	x
Swan	x			x	x
Middle Blackfoot	x	x			x
Blackfoot Headwaters	x	x		x	
Sun		x	x		x
Teton		x			
Cutbank-Two Medicine		x	x		

Notes: [1] Including logging road construction/maintenance.
Sources: Montana DEQ 2001a, 2002a, 2003a; Montana Water Center 2003; USEPA 1999.

The National Fire Plan (USDA and USDI 2003) establishes federal nexi via the Rural (DOI) and Volunteer (FS) Fire Assistance Programs for those rural and volunteer fire departments that routinely help fight fires on or near DOI lands (BLM, BIA, FWS, NPS); the Forest Service's State Fire Assistance Program (SFA), which provides matching grants to fund mitigation and education campaigns, community plans, hazard mitigation projects, and firefighter training; and the Forest Service's Economic Action Program.[70]

A federal nexus is further present in the case of construction permits issued by the Army Corps of Engineers under Section 404 of the CWA, of which an average of 84 per year were issued during 1999-2001 (the latter being the latest year for which complete data are available, see Montana Natural Resource Information System 2003).[71] EPA stormwater permits under the CWA establish a federal nexus for specified construction projects (generally, for all projects larger than one acre), mining operations (active as well as abandoned, see USEPA 2000b), and municipal sewer systems. Mining operations are further regulated by the Comprehensive Environmental Response, Conservation, and Liability Act (CERCLA, U.S.C. § 42 Chapter 103, as amended; USEPA 2000b), as is the sole Superfund site in the study area (Milltown Reservoir Sediments). A total of approximately 130 mining sites and eight experimental and raw prospecting sites are located on non-federal lands in the study area (Montana Natural Resource Information System).[72] The combined size of the areas covered by the stormwater, mining, and hazardous waste nexi accounts only for a very small part of the study area.

Finally, federal-aid highway funding (Montana Legislative Fiscal Division 2002) and the Federal Highway Administration/Montana Department of Transportation Roads and Bridges Historic Preservation Plan (FHWA and Montana DT 1989) establish federal nexi for highway construction and for selected road and bridge maintenance projects in the study area.

[70] In 2002, the Rural, Volunteer, SFA, and Economic Action programs disbursed $853,000, $379,000, $1.87 million, and $80,000, respectively, in Montana (USDA and USDI 2003).
[71] Most of the permits are for small-scale projects. (Based on data from Montana Natural Resource Information System 2003).
[72] The mining sites include those classified as "producers" and "past producers", "developed deposits", "other", and "unknown" (Montana Natural Resource Information System 2003).

III.3.b Assessment of marginal impacts of lynx CHD: restrictions on land use activities beyond those due to existing environmental regulations

The marginal impacts of designating critical habitat for the lynx are all those changes in base case scenario land use activities (these being the *direct* impacts, for example a reduction in snowmobile-based recreation; plus additional consultation efforts) that are deemed necessary for the recovery of the lynx, as well as their associated effects (these being the *indirect* impacts, for example changes in real estate prices). The direct marginal impacts of designation of critical habitat for the lynx derive from the changes in land use activities induced by a change in the management goal for the species - from the prevention of its decline to ensuring its recovery.

Critical habitat imposes changes in land use activities above and beyond those justified on the grounds of the jeopardy standard, for reasons discussed above: in the presence of designated critical habitat, land use activities that adversely modify such habitat of a species and hence impede the species' recovery without however imperiling the survival of the species would be subject to prohibition under critical habitat, but not under the jeopardy standard. Hence, designation of critical habitat entails some land use restrictions that likely would not occur under the jeopardy standard.

III.3.b.i Incremental restrictions on land use activities from designation of critical habitat for the lynx

The restrictions on land use activities justified under CHD for the lynx are discussed in the following (see also third column in Table III.3.a.ii-4). All of these restrictions are designed to prevent actions that would lead to adverse modification of lynx habitat. The *incremental* restrictions under CHD are the land use activities that restrictions justified under CHD impose above and beyond the restrictions under the base case scenario (BCS) (see far right column in Table III.3.a.ii-4).

It is unlikely that current protection of the lynx under FWS's interpretation of the ESA's jeopardy provision would prevent the activities precluded by these incremental restrictions, because none of these activities by itself would significantly increase the risk of the species becoming extinct. The historical record corroborates this assessment, as almost 90 percent of all formal consultations under the ESA have resulted in no jeopardy findings (Houck 1993). Therefore, the restrictions identified in the following are incremental to the listing of the lynx under the ESA.

The restrictions on land use activities that are imposed under the no adverse modification standard applied in designated critical habitat are fundamentally of a forward-looking nature. They primarily affect future actions in the designated area. Currently ongoing activities are impacted only to the extent that they are based on federal permits that must be renewed (since upon renewal these permits are subject to consultation with the FWS). The CHD-based restrictions on land use activities are the following:

1. Livestock grazing

Under the adverse modification standard, any change in land utilization activities that would be considered detrimental to the *recovery* of the lynx population would be inadmissible on federal lands or lands with a federal nexus. This includes any expansion of pastures, development of new pastures, or increase in the utilization rate of existing pastures in lynx habitat, all of which would constitute adverse modifications, because they would have the potential to reduce forage or habitat quality or quantity for snowshoe hares. Hence, under the adverse modification standard, all of the former would be ruled out, as would be an increase in the number of goats grazing on open ranges in lynx habitat. These restrictions would go beyond those stipulated under the LCAS, which do not rule out the development of new pastures or the expansion of existing pastures, but only suggests specific management practices for pastures.

Most grazing lands in the study area are subject to the same restrictions (CHAU 1 in Table III. 2.a-1), except for some private lands (other than Plum Creek lands) outside of the Sun and Cutbank-Two Medicine TMDL planning areas. On the former, the incremental restrictions consist in there not being any new pastures, any increase in size of pastures, or any increase in stocking rates (including goats for noxious weed management), while grazing on the latter is not affected by CHD.

2. *Timber harvest*

Under the adverse modification standard, the only permissible logging activities are those that do not reduce prospects for lynx recovery. This implies that no habitat degradation is allowed, a standard that generally imposes more stringent limitations than the LCAS, which allows forest management activities that may lead to a 15 percent increase in currently unsuitable lynx habitat in a lynx analysis unit (LAU) within a 10 year period (Ruediger et al. 2000). The LCAS defines currently unsuitable lynx habitat as areas with vegetation cover in an early successional stage in which the developing vegetation does not yet support snowshoe hare populations during all seasons (Ruediger et al. 2000:103).

In general, since lynx use a variety of forest habitats from early succession to old-growth, most harvests will lead to negative impacts on some type of lynx habitat (forage, denning, cover/security). What is important for lynx recovery, however, is that there be no reduction in the acreage that represents the *limiting* habitat type in a given area. Therefore, under the adverse modification standard there would not be any logging in the habitat types that are considered to be limiting lynx recovery in a given area. For example, in an area where foraging habitat is considered the limiting factor on lynx populations, timber harvests in non-foraging habitat types would be acceptable, because an appropriate timber harvest regime would encourage regrowth of vegetation that in turn would increase snowshoe hare foraging habitat, thereby improving the chances of recovery for the lynx population.[73] Such harvests would lead to improvements in overall lynx habitat quality especially if the harvest results in the juxtaposition of lynx denning and foraging habitats (Ruediger et al. 2000). Permissible harvests also would have harvest unit size limits so as not to produce openings that impede lynx movement or use by snowshoe hares (Ruediger et al. 2000), and would maximize edge length so as to maximize the area used by snowshoe hares during regrowth of vegetation. Use of new logging roads and all silviculture activities would be restricted in the vicinity of denning sites during the denning period, and new roads would be closed during the winter months with deep snow cover.

On federal lands and lands with a federal nexus, the incremental restriction from CHD would be that no habitat degradation of 15 percent over 10 years will be allowed, except if activities occur in non-limiting habitat type, and if that habitat type does not become limiting through the activities.

[73] For example, in LAUs in which there is a supply of high-quality denning habitat that is beyond what is considered sufficient, some logging might be permitted in denning habitat, provided it occurs outside of the denning period.

3. *Recreation*

Winter recreation

Under the no adverse modification standard, no ***gross*** increase in groomed or designated snowmobile or cross-country trails or alpine runs would be admissible. This requirement clearly is more stringent than one of no ***net*** increase stipulated in the LCAS. The reason for the shift in focus from net to gross is that the implementation of a policy of no net increase is essentially infeasible. It is not possible to deconstruct existing trails/runs in such a manner as to effectively prevent their use by people, including non-motorized use, at the point where new trails are added.[74] Hence, any new trail or run or snowmobile play area would be expected to increase the potential for access by competitors, and therewith would reduce the likelihood of recovery of the lynx population, and hence would constitute a violation of the adverse modification standard. The same applies to trail improvements (amplification or surface treatments), which are likely to induce increased use and hence will likely lead to increased snow compaction. Besides groomed and designated over-the-snow routes and snowmobile play areas, off-trail winter recreation may facilitate access for lynx competitors (Ruediger et al. 2000). Hence, no expansion of such activities would be compatible with the no adverse modification standard. This restriction will only lead to additional impacts if it is accompanied by sufficient monitoring and enforcement efforts. Finally, every new large-scale alpine ski development or extension within lynx forage, denning, or cover/security habitat would signify a reduction in lynx habitat, and as such would violate the no adverse modification standard.

Summer recreation

Under managing under the adverse modification standard, no new camp sites or facilities would be allowed in lynx denning habitat, and no new ORV/ATV or hiking trails would be permitted (to avoid providing winter access for lynx competitors). There would be no sanctioned increase in cross-country motorized travel, and any new campsites, facilities and trails in proximity to denning sites would be closed during the denning period (May-August).[75]

Since currently no motorized cross-country travel is allowed on FS and BLM lands and since the LCAS limits public use of temporary logging roads, the incremental restrictions on summer recreation activities from CHD for the lynx on FS and BLM lands consist of the prevention of the construction of new camp sites or facilities in lynx denning habitat, the construction of new ORV/ATV or hiking trails, and the closure of new campsites and trails in proximity to denning sites during the denning period. On other federal lands and lands with a federal nexus, additionally there would be no increase in cross-country motorized travel.

[74] Unlike in the case of motorized users, people on foot (cross-country skiers, snowshoers) and lynx competitors cannot be kept off the deconstructed trails simply by closed entrance gates. To ensure non-use, those trails likely would have to be completely fenced in, or replaced with vegetative cover hindering movement, at the time the new trails are constructed or designated.

[75] Unlike in the case of timber harvest, no exception is made for campsites or facilities in areas where denning habitat is not the limiting factor for lynx recovery, because the campsite will permanently reduce suitable habitat, while timber harvest will only temporary reduce habitat.

4. Roads/utility corridors

Under the adverse modification standard, there would be no new roads or extensions of existing roads in lynx habitat.[76] Public motorized use of "sanctioned" new temporary logging roads (see timber harvest above) would be prevented to limit disturbance to lynx; all use of such roads would be prevented around denning sites during the denning period and during months with winter snow cover; and these sanctioned temporary roads would be effectively obliterated subsequent to completion of activities. In addition, all new temporary logging road mileage would be conditional upon the effective obliteration of equal mileage of existing temporary logging roads (i.e., no net increase).

The incremental restrictions on public lands and lands with federal nexus under CHD are that there would not be any new roads or trails for winter logging-related activities, and sanctioned new logging roads would be closed during the denning period and months with winter snow. Public motorized use of new sanctioned temporary logging roads would not only be limited, but instead would be ***prevented*** though effective exclusion devices. Finally, all such new sanctioned temporary logging roads would be effectively obliterated and vegetation reestablished sufficient to prevent motorized use.

5. Wildland fire management/prescribed burns

Restrictions under the no adverse modification standard would aim to prevent impacts from fire-prevention and suppression activities that would reduce habitat quality for the lynx. The National Fire Management Plan (USDA and USDI 2003) foresees a continued increase in fuel treatment activities, including a more widespread use of prescribed burns and the use of wildland (naturally ignited) fires to reduce fuel buildup. These activities may mimic historic low-intensity natural fire regimes. However, most lynx habitat lies in areas that historically also have experienced high intensity fires, changing vegetation at the stand or landscape scales (Agee 1999). Controlled burns that mostly consume undergrowth generally produce different regrowth patterns than high-intensity fires. Nevertheless, in combination with the likely continued recurrence of catastrophic fire events within our ten year analysis period, prescribed fires and wildland fires should lead to fire impacts that are more similar to historic fire regimes than the combination of decades-long suppression and catastrophic fires. If wildland fire management follows the guidelines stipulated in the LCAS, it should lead to an increase in vegetation regrowth that is likely to increase snowshoe hare habitat and therefore will be beneficial to lynx.

The only incremental restriction with respect to wildland fire management is that no salvage logging of large-diameter downed trees and no removal of root wads would be allowed in fire prevention activities, even in cases where lynx denning habitat is considered to be "adequate" under the LCAS (i.e., where it accounts for at least 10 percent of an LAU). The justification for this restriction is that in burned areas, regeneration of vegetation will tend to create high-quality snowshoe hare foraging grounds within a few years of burning. Since the highest-quality lynx denning habitat is that which is located in proximity to lynx foraging habitat (Ruediger et al. 2000), the quality of denning sites in burned areas is superior to that of most other areas.

[76] Unlike temporary logging roads, permanent roads lead to permanent destruction of habitat and to increased fragmentation of the remaining habitat.

6. Mining

Under management for lynx recovery, mining-related activities that would lead to adverse impacts on lynx recovery by destruction of denning, foraging, or security habitat or an increase in habitat fragmentation would be prohibited. Potentially affected by the prohibition are exploration activities, access roads, mine tailings, and mine pits.

Since currently applicable restrictions only cover the use or location of roads related to mining activities (see Table III.3.a.ii-4), the incremental restrictions under CHD would be that there not be any new mining sites, any extensions of current mining sites (that would require permit renewal), or any new roads to existing mining sites.

7. Residential development

New residential developments in primary lynx foraging and denning habitat would not be allowed because they reduce habitat quality and/or quantity through the destruction of primary lynx habitat. Likewise, developments that negatively impact areas suitable as travel corridors or linkage areas between primary blocks of lynx habitat would not be allowed. Low-density construction, which is the norm for the majority of residential construction in the area identified as lynx habitat, would not be prevented if it occurs in habitat used primarily for travel (openings, meadows), and provided that the project and ancillary structures (e.g., fences) do not substantially reduce the utility of the habitat for lynx.

8. Consultations

The presence or absence, respectively, of designated critical habitat implies distinct differences for consultations. If critical habitat has been designated, the ESA imposes an additional consultation requirement in cases where an action will result in the "destruction or adverse modification" of critical habitat (*Sierra Club v USFWS*, 245 F.3d 434). In the presence of designated critical habitat, federal agencies are required to consult with the FWS or NMFS in all instances where their actions are likely to affect the ***recovery*** of a listed species, and not just in cases where such actions are likely to negatively affect both ***survival*** and ***recovery***, triggering consultation under the jeopardy provisions of section 7(a)(2) (see *Sierra Club v USFWS*, 245 F.3d 434:443).

In December of 2002, a federal court found the FWS to be in violation of its duty to designate critical habitat, and, in order to afford the lynx some measure of improved protection until such time at which designation finally occurred, the court stipulated that the FWS must formally consult with federal land management agencies on any project that may affect lynx (see Defenders of Wildlife v. Norton 2002, 239 F.Supp.2d 9). This represented a marked departure from the previous procedure based on the ESA jeopardy provision, under which a land management agency can proceed with a project without going through the formal consultation process with Fish and Wildlife Service if the agency determined, with the FWS's written concurrence, that a project under consideration may affect, but was not likely to adversely affect lynx.

However, in a more recent ruling (Defenders of Wildlife v. Norton 2004), the injunctive relief given in December of 2002 against written concurrence by the FWS of an action agency's finding of "not likely to adversely affect" has been lifted. Therefore, formal consultations currently are, again, not required for projects that in the opinion of the FWS are not likely to adversely affect lynx. There will, however, likely be an increase in consultations.

The incremental consultation impact of CHD consists of three aspects: an increase in the complexity of consultations for projects that in the absence of designation would have undergone only informal consultations or formal consultations based on the jeopardy standard;[77] reinitiation of consultations for projects that already have undergone consultations prior to the designation of critical habitat; and additional consultations on projects that in the absence of lynx CHD would probably not undergo consultations even though a federal nexus may exist. The latter is assumed to be the case for many single-unit residential construction projects in the study area.[78]

In addition, if critical habitat is designated in an area not currently inhabited by a species (see ESA section 3 (5)(A)(ii)), federal agencies are generally required to consult on activities carried out, permitted, or funded by these agencies in such areas, while they frequently do not do so under the jeopardy standard. CHD therefore likely would lead to additional consultations in areas not recognized to be currently occupied by lynx. However, present existence of lynx is recognized in the entire area proposed for CHD in Montana (McKelvey et al. 1999, Hickenbottom et al. 1999), so that under CHD no additional consultations are expected to be caused by the ***potential habitat*** provision of ESA section 3 (5)(A)(ii)).

A number of formal consultations between the FWS and federal and state agencies on the lynx have taken place (see USDI FWS 2000c) in the context of the development of the lynx science report (Ruggiero et al 1999), the LCAS (Ruediger et al. 2000), and the development of the conservation agreements with the FS and BLM (USDA FS and USDI FWS 2000; USDI BLM and USDI FWS 2000). The ongoing revisions of the Northern Rockies FS and BLM land management and land use plans will require additional consultations (see USDA FS and USDI BLM 2002a and 2002b), all of which of course are part of the BCS.

[77] Some consultations that would have been informal in the absence of CH must proceed to formal status with CHD in order to consider habitat impacts (see for example USDI FWS 2003b:27; or see USDI FWS [2002], which reports a case where action agencies halted consultations with the FWS after a court order vacated a CHD). In addition, the adverse modification standard is likely to require a more comprehensive analysis due to the change in the quality of impact analysis and the increase in the number of potentially precluded activities.

[78] Due to the comparatively large number of residential construction projects anticipated over the time period analyzed in this study, this assumption biases our consultation cost estimates upward.

Table III.3.a.ii.-4: Land use activities potentially detrimental to lynx, and restrictions on activities under *Base Case* and *with designation* scenarios - Montana

Land use activity	*Restriction on activity under base case scenario (BCS)*	*Restriction justified under adverse modification standard (CHD)*	*Incremental change from BCS to adverse modification*
Livestock grazing	No grazing in openings created by fire, until successful regeneration of shrubs and trees; no grazing in aspen stands during sprouting, and until sprout survival is ensured; managed grazing in shrub-steppe habitats in lynx habitat; manage livestock grazing in riparian areas to maintain or achieve mid seral or higher condition to provide cover and forage for prey species. (*LCAS*) Grazing practices must be designed to minimize loss of riparian vegetation, maintain/restore riparian plant species, and maintain different age classes in desired plant communities. (*MT State Forest Land Management Rules*) Implement conservation measures to reduce impact of grazing on lynx and other species in upland and riparian zones (*MT DNRC HCP*) Implement grazing BMPs, especially in riparian areas (*MT CWA TMDLs*)	No new livestock pastures in lynx habitat; no increase in size of pastures in lynx habitat; no increase in livestock utilization rate on pastures in lynx habitat; no increase in stocking of goats.	
	Restrictions by land ownership: FS, BLM, and S&K tribal lands: *LCAS* MT State Lands w/out nexus: *MT State Forest Land Management Rules*, plus *MT CWA TMDLs* where applicable MT State Trust lands w/out nexus: *MT DNRC HCP* and *MT State Forest Land Management Rules*, plus *MT CWA TMDLs* where applicable Plum Creek lands w/out nexus: Plum Creek grazing BMPs (*NFHCP*), plus *MT CWA TMDLs* where applicable Other non-federal lands w/out nexus: *MT CWA TMDLs* where applicable Non-federal lands with nexus: the foregoing, plus *LCAS*		Federal lands and lands with Federal nexus (*CHAU 1*): no new pastures, no increase in size of pastures, no increase in stocking rates (including goats for noxious weed management). Other lands: none

- over -

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Timber harvest	Management actions not to change >15 % of lynx habitat in LAUs to unsuitable condition within 10 yr period; no pre-commercial thinning until trees are no longer useful as snowshoe hare habitat; generally, no post-disturbance salvage harvests on areas <5 acres (for exceptions see LCAS); in aspen stands, harvest is to favor aspen regeneration; design harvest units to mimic natural disturbance pattern and scale and retain natural connectivity across landscape. (*LCAS*) No broadcast burning; no operation of vehicles except on established roads; no clearcutting; no road construction except to cross stream/wetland; no handling of toxic materials in ways that may harm wildlife. (*MT SMZ Law*) Consider wildlife habitat in harvest decisions. (*MT Forestry BMPs*) No pre-commercial thinning in lynx habitat until lower tree limbs are six feet high; on blocked portions of Stillwater, Swan River, and Coal Creek State forests: management activities shall retain denning habitat on approximately 5 % of total lynx habitat acreage within each applicable grizzly bear BMU sub-unit in patches ≥ 5 acres, manage for at least 10 % in mixed mature and young foraging habitat of total lynx habitat acreage per sub-unit, and salvage in mature foraging habitat only if understory sapling densities are not reduced to below the moderately-stocked condition and abundance of coarse woody debris is enhanced or not appreciably altered; on other lands, on parcels containing appreciable amounts of lynx habitat: maintain a minimum of 5 acres denning habitat, where present, and, *in areas where broader habitat conditions allow*, retain approximately 10 % of lynx habitat acreage in mature or young foraging habitat (XXXV(8)(b)(1)); no salvage in stands necessary to meet denning habitat requirements; emulate natural disturbance events in silvicultural treatments, and attempt to emulate historic forest characteristics (patch size, stand age composition etc.); use coarse and fine-filter approaches to meet lynx' (and other species') habitat requirements "to the extent consistent with the ESA"; while also maintaining future revenue generating capability. (*MT State Forest Land Management Rules*)	No degradation of limiting habitat type (denning, forage, or travel/security); no logging in denning habitat during denning period. No degradation of linkage areas/corridors. Maximize edge of harvested areas. (See also below under restrictions on logging roads.)

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	Manage stand structure, composition, age, and diversity, salvage, snags, downed wood, patch conditions, fragmentation, thinning, cover needs for lynx requirements, among other species. (*MT DNRC HCP*) Implement silviculture BMPs in riparian areas. (*MT CWA TMDLs*)		
	<u>*Restrictions by land ownership:*</u> Forested FS, BLM, and S&K tribal lands: *LCAS*. State forested lands w/out nexus: *MT State Forest Land Management Rules*, *MT CWA TMDLs* where applicable MT State Trust lands w/out nexus: s.a. *MT DNRC HCP*, *MT State Forest Land Management Rules*, and *MT CWA TMDLs* where applicable Private forest lands w/out nexus: *MT Forestry BMPs*, *MT SMZ Law*, *MT CWA TMDLs* where applicable; Plum Creek lands: **all** MT Forestry BMPs (*NFHCP*), *MT CWA TMDLs* where applicable Non-federal lands w/ nexus: the foregoing, plus *LCAS*		Federal lands and lands with federal nexus (*CHAU 2*): No habitat degradation allowance of *15 %/10 yr* (see leftmost column), except in non-limiting habitat type and if that type does not become limiting through the activity.
<u>Winter Recreation</u>	No net increase per LAU in groomed or designated over-the-snow routes or snowmobile play areas on federal lands; prevent actions that reduce landscape connectivity; design new developments to direct use away from diurnal security habitat; protect security habitat around proposed developments or expansions; in ski area expansions, provide adequately-sized coniferous inter-trail islands; limit ski area operating hours in new or expanded developments to provide sufficient nocturnal foraging opportunities. (*LCAS*)	No additional trail mileage (gross, not net); no trail improvements; no increased volume of off-trail snowmobile or cross-country recreation; no new ski runs; no extension/amplification of ski runs; no new development of large-scale winter recreation areas or expansion of existing areas; no new overnight huts in lynx habitat; no night-snowmobiling in lynx habitat.	
	<u>*Restrictions by land ownership:*</u> FS, BLM, and S&K tribal lands: *LCAS* NPS lands: *LCAS*		<u>Federal lands and lands with federal nexus (*CHAUs 5* and *7*):</u> No new gross trail mileage; no trail improvements; no

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	State lands: i) MT DNRC HCP lands: *MT DNRC HCP/LCAS* ii) other State lands w/out nexus: - *leased: depends on owner* - *unleased: generally none* (*MT DNRC 2003*) iii) other state lands w/ nexus: *LCAS* Private lands w/out nexus: none Private lands w/ nexus: the foregoing, plus *LCAS*		increased volume of off-trail snowmobile or cross-country recreation; no new ski runs; no extension/amplification of ski runs; no new development of large-scale winter recreation areas or extension of existing areas; no new overnight huts in lynx habitat; no night-snowmobiling in lynx habitat.
Summer Recreation	BLM and FS lands: No cross-country motorized travel, except minimum required official administrative use. (*BLM and FS OHVRs*) Limit public use of temporary logging roads. (*LCAS*)	No new camping sites or facilities in denning habitat. No new ORV/ATV or hiking trails (winter access for lynx competitors); no increase in cross-country motorized travel; closure of new campsites and trails in proximity to denning sites during denning period (May-August)	FS and BLM (CHAUs 4a and 6a): No new camp sites or facilities in denning habitat. No new ORV/ATV or hiking trails. Closure of new campsites and trails in proximity to denning sites during denning period (May-August). Other federal lands and lands w/ nexus (CHAU 4b): s.a., plus no increase in cross-country motorized travel.
Roads/utility corridors	No net increase in groomed or designated over-the-snow routes – does not include winter logging-related activities; locate roads away from forested stringers, and minimize road building on ridgetops and areas important for connectivity; limit public use of temporary logging roads; minimize road building in areas important for lynx habitat connectivity; design new logging roads, especially the entrance, for effective closure upon completion of sale activities; consultations on all new highway projects in federal lands. (*LCAS*)	No new roads or road extensions. No new temporary logging roads or logging road extensions, except where needed to conduct silviculture activities that do not degrade lynx habitat quality (see restrictions on timber harvest activities above) - and no net	

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	Reduce impact of roads regarding human disturbance and seasonal security (*MT DNRC HCP*) No road construction in SMZs except to cross stream/wetland (*MT SMZ Law*) Plan transportation systems for the minimum number of road miles; incorporate use of temporary roads; consider closure or abandonment of roads accessible to motorized vehicles for roads non-essential to near-term future management plans; obstruct or obliterate unnecessary existing roads in lynx habitat. (*MT State Forest Land Management Rules*) Road construction and maintenance restrictions in riparian areas (*MT CWA TMDLs*)	increase in logging roads, including temporary ones; effective closure of new logging roads to public motorized use and closure of such roads to all use in denning habitat during denning period; *effective* closure of roads during months with winter snow, and obliteration of roads (including reestablishment of vegetation) subsequent to completion of harvest activities.	
	<u>*Restrictions by land ownership*</u>*:* FS, BLM, and S&K tribal lands: *LCAS* NPS lands: *LCAS* State forested lands: *MT State Forest Land Management Rules, MT SMZ Law* MT State Trust lands: *MT DNRC HCP* and *MT State Forest Land Management Rules, MT SMZ Law* Private lands: *MT CWA TMDLs* where applicable; Plum Creek: MT Forestry BPMs (*NFHCP*), *MT SMZ Law* Non-federal lands w/ nexus: the foregoing, plus *LCAS*		Modifications in cases where vegetation removal or transect length increase would occur.
<u>Wildland fire management/ prescribed burns</u>	Design burn prescriptions to regenerate or create snowshoe hare habitat; avoid construction of permanent fire beaks on ridges or saddles in lynx habitat; minimize construction of temporary roads and machine fire lines to the extent possible during suppression activities; to the extent possible, design burn prescriptions and conduct suppression actions such that adequate denning habitat is maintained; after large fires, conduct post-disturbance assessment prior to salvage harvest to evaluate potential for denning and forage habitat. No grazing in openings created by fire, until successful	To the extent possible, return to historic fire regimes, i.e., restore fire as an ecological process. Design broadcast burning to retain coarse woody debris; no salvage logging of large-diameter downed trees and no removal of root wads.	

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	regeneration of shrubs and trees; no grazing in aspen stands during sprouting, and until sprout survival is ensured. (*LCAS*)		
	Restrictions by land ownership: FS and BLM lands and non-federal lands w/ federal nexus: ***LCAS*** NPS lands: ***LCAS*** Private lands: ***17-8-6 ARM (“Open burning”)***		Federal lands and lands w/ federal nexus: No salvage logging of large-diameter trees at all, no removal of root wads.
Mining	Restrict unavoidable over-snow access to designated routes; close roads to public. (*LCAS*) Locate and operate haul and access roads to avoid or minimize impacts to important fish and wildlife species or other species protected by state or federal law; fence roadways where specified by the department to guide locally important wildlife to roadway underpasses. (*17-24-751(2)(b-c) ARM, “Strip and Underground Mine Reclamation Act: Topsoiling, Revegetation, and Protection of Wildlife and Air Resources”)*	No new mining sites, no extensions of current mining sites (that require permit renewal), no new roads to existing mining sites.	
	Restrictions by land ownership: FS, BLM, and S&K tribal lands: ***LCAS*** NPS lands: n.a. State forested lands: ***MT State Forest Land Management Rules***, ***MT CWA TDMLs*** where applicable, and ***LCAS***. **-** MT DNRC HCP lands: ***MT DNRC HCP***, ***MT CWA TMDLs*** where applicable, and ***LCAS*** Private lands: ***17-24-7 ARM***, ***MT CWA TMDLs*** where applicable; and ***LCAS***. **-** Plum Creek: in addition to foregoing: MT Forestry BPMs (*NFHCP*)		No new mining sites, no expansion of sites, and no new roads to existing mining sites if these lead to degradation of lynx habitat.

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Residential development/ Construction	Do not compromise landscape connectivity. (*LCAS*)	No new permanent building structures in lynx foraging and denning habitat. No new structures in travel corridors or linkage areas that would reduce the use of these areas by lynx.	No new permanent building structures in lynx foraging and denning habitat.

Notes: Restrictions under BCS based on Table III.3.a.ii-1. ARM - Administrative Rules of Montana. LAU - lynx analysis unit. MT – Montana. MT DNRC HCP- Montana Department of Natural Resources and Conservation Habitat Conservation Plan. NFHCP-Native Fish Habitat Conservation Plan (Plum Creek 2000). SMZ - Streamside Management Zone.
Sources: Ruediger et al. 2000; Montana Code Annotated (MCA) 2001; Montana 2002 and 2003a; Montana DEQ 2001b; USDI FWS 2003a. See also text.

III.3.c Projections of future development of land use activities and incremental impacts of CHD for the lynx

The impacts of CHD described in this section are based on the avoidance of activities that lead to the adverse modification of lynx habitat, as listed in Table III.3.a.ii-4. Only those impacts that are assumed to occur during the ten-year time frame are included. For purposes of this analysis, it is assumed that designation of critical habitat for the lynx occurred by the end of 2003. The projection period therefore is 2004-2013.

Winter recreation

It is estimated that Montana received 9.6 million visitors in 2001, who spent $1.7 billion dollars statewide, making tourism the largest industry in Montana after agriculture (MT DFWP 2003). Winter recreation opportunities are an important component of this industry, considering that 20 percent (1.9 million) of these visitors came in the winter months of December through March (another 21 percent visited in spring and fall). The study area is a popular winter sports destination for Montana residents and visitors to the state alike (MT DFWP 2003). Downhill skiing/snowboarding, snowshoeing, cross-country skiing, and snowmobiling opportunities draw recreationists to the region. While the magnitude of impacts that each of these have on lynx and their habitat varies, they all have the potential to subject the designated critical habitat to some level of adverse modification. Each of these forms of winter recreation will be dealt with here separately.

Downhill skiing/snowboarding

Alpine skiing and snowboarding resorts are an important consideration in lynx habitat due to the requirements of clearing forests to create downhill runs and ski lifts which modify or destroy foraging and denning habitat. These resorts also create areas of concentrated human activity. While lynx have been known to be rather tolerant of the presence of humans, large amounts of activity, which stretch into the early denning season, may have deleterious impacts on kitten survival (Ruediger et al. 2000). Adverse modification of lynx critical habitat could result from any expansion of these ski areas, which includes clearing of hillsides for additional runs or ski lifts, widening of runs, or expansion of parking areas or ancillary service structures.

Ski resorts in the study area also contribute significantly to the local tourist and recreation economy. There are currently three developed downhill ski areas within the region of study; Teton Pass Ski Area in the Lewis and Clark National Forest, and Blacktail Mountain and Big Mountain in Flathead National Forest. These resorts receive an average total of over 285,000 visits per season,[79] supporting jobs and boosting seasonal revenue to local businesses, including restaurants, hotels, and equipment outfitters. A series of recent studies by the University of Montana's Institute for Tourism and Recreation Research (ITRR) revealed that ten percent of Montana households participated in downhill skiing and four percent in snowboarding during the winter of 1998-99. Three percent of the residents of northwest Montana identified downhill skiing or snowboarding as their primary outdoor recreation activity, while 1.3 percent of non-resident visitors participated in these activities (MT DFWP 2003).

[79] Based on 2000 data from the Montana Statewide Comprehensive Outdoor Recreation Plan. Big Mountain: 250,000 visits/year, Blacktail: 29,000 visits/year, and Teton Pass: 6000 visits/year.

The Teton Pass Ski Area, located within the Lewis and Clark National Forest and operating under a Special Use Permit (SUP), is currently proposing renovations and expansions which may not be permitted if lynx critical habitat were to be designated, since lynx are known to occur within the ski area's SUP boundaries, which contain both foraging and denning habitat (USDA FS 2003e). This resort currently has 26 runs covering 79 acres. The proposed action would increase the number of lifts within the SUP from three (of which only two are operable) to five (all operable). The action would also increase the acreage of ski runs from 79 to 119. If we assume that each run will continue to average three acres, as it does now, this will lead to 13 new runs. Other infrastructure that would be enlarged under this plan includes the expansion of the lodge from 4,290 square feet to 8,600 square feet. The driving force behind these proposed developments is the resort's questionable economic sustainability with its current infrastructure and the need to compete with other resorts in the area by diversifying its recreational opportunities to include more runs for all levels of skiing experience, creating an inner tube slope, developing a terrain park for snowboarders as well as skiers, providing ten snowmobiles for rent, increasing the size of its lodge for visitors, and creating artificial snowmaking capabilities. With these improvements, the Teton Pass Ski Area anticipates a five percent annual growth rate, increasing its visitation from the 6,000-8,000 of recent years to 17,000 per year within ten years (USDA FS 2003e).

The Environmental Assessment of this project finds that this action may impact grizzly bear and lynx populations, but is unlikely to adversely affect them. This Assessment finds that 172 acres of the SUP area is considered denning, foraging, or travel habitat for lynx, and no more than 35-50 acres would be affected by the proposed project. Since the 172 acres comprise only 1.3 percent of the lynx habitat within the 13,087 acre LAU, the action would likely be allowed to go ahead with little or no change under the guidelines of the LCAS (USDA FS 2003e). However, under the no adverse modification standard some of the proposed activities would not be permitted. Therefore, critical habitat designation would impart an incremental restriction, beyond those of the BCS, to development in this case.

Under the standard of no adverse modification, the planned expansion of the ski resort would have to be re-designed in such a manner that the development activities will not result in any degradation or loss of potential lynx habitat. This does not mean that no improvements can be made to the Teton Pass Ski Area, nor should it be assumed that visitor numbers decrease due to loss of customers to competing ski resorts. Several of the proposed projects will, most likely, be allowed to go ahead, while several others have the potential to proceed if some changes are made. Therefore, while the restrictions that accompany critical habitat designation can be expected to prevent some of the desired expansion activities, they will not prevent the resort from diversifying the activities it offers. Table III.3.c-1 shows the proposed actions, according to the Teton Pass Ski Area Environmental Assessment, and what, if any, changes would be required to avoid adverse modification of lynx habitat.

As an upper-bound estimate of potential impacts from designation, we assume that all proposed projects will be carried out within the next ten years in the absence of CHD. Our lower-bound estimate will only consider those proposed actions classified as "immediate" in the Environmental Assessment, assuming that the "foreseeable actions" will not take place within the ten-year time span of our study. The total estimated impacts from CHD to the Teton Pass Ski Area in the upper-bound scenario would be 1) the prevention of construction of 13 new ski runs; 2) prevention of the construction of three new lifts; 3) 1.9 miles of additional cross-country trail for a competitive course can only be constructed if it avoids lynx habitat, making modifications

Table III.3.c-1: Expansion projects at Teton Pass Ski Area likely to be affected by CHD

	Likely impacts from CHD		
Immediate projects	*Prevention of project*	*Modification of project*	*Additional consultation effort*
Construct 800 ft lift with additional runs	yes	-	yes
Improve and extend cross-country trail by 1.9 miles	-	yes	yes
Create inner tube area, possibly w/ short lift[1]	-	no	no
New ski patrol lodge to patrol all runs[2]	-	yes	yes
Pave existing parking lots	-	yes[3]	yes
Remove an existing, inoperable chair lift	-	yes[3]	yes
Rental facility in parking lot for 10 snowmobiles	-	no	no
Develop snowboard and ski terrain park	-	no	no
Construct 2000 ft lift with additional runs	yes	-	yes
Remodel and expand lodge from 4290 to 8600 sq ft.	-	yes[3]	yes
Develop snowmaking capabilities with underground mainline and double size of existing 100,000 gal. reservoir	-	yes[3]	yes
Foreseeable projects			
Construct 2350 ft lift to existing runs	yes	-	yes
Connect rental facility w/ lodge	-	yes[3]	yes
Remove "Mighty Mite" lift and replace w/ new lift	-	yes[3]	yes

Notes: Developed from information in Teton Pass Ski Area Environmental Assessment (USDA FS 2003e). [1]Assumes this lift will be in an already cleared portion of slope. [2]The necessity of this project arises from the increased number of runs, and their associated areas, requiring additional patrols. Since the extension of runs will be prevented under CHD, the costs of having to cancel this project will not be considered here as the necessity for this project no longer exists if the additional runs are not built. [3]May have to take place outside of denning season to avoid construction and noise disturbance, causing potential delays.

likely;[80] and 4) consultation costs, including the extra planning required to complete the permitted projects outside of ecologically sensitive areas and time periods for lynx. The lower-bound scenario includes all of these activities, except the construction of one of the lifts.

The Blacktail Mountain ski area, located in the Flathead National Forest, received approximately 29,000 visits in 2000, up 45 percent from 20,000 when it opened in 1998. It is the only one of the three ski resorts in the study area which has shown growth in numbers of visits over the last ten

[80] The Environmental Assessment details planned activities but does not specify the location of this additional mileage.

years (MT DFWP 2003). The mountain currently has four lifts and 23 runs.[81] There are plans for a certain amount of expansion of the resort within the next three to five years, possibly of both facilities and runs. This potential work, however, is still in the early stages of discussion and no figures have been released (Doug Strawn, Blacktail Mountain ski area, personal communication). In order to develop an upper-bound estimate of costs we assume that the expansion plans will be designed to make the resort competitive, in terms of numbers of runs and lifts, with the statewide visitation leaders in the "regional ski area" category.[82] The leader in this category in Montana is the Discovery Ski Area in the southwestern part of the state (MT DFWP 2003). This resort has six lifts and 46 runs (MT Dept. of Commerce 2003b). For an upper-bound estimate of the costs of CHD, we assume that Blacktail Mountain will attempt to match these numbers, and will pursue an expansion by two lifts and 23 runs. We also make the assumption that the resort will seek to expand its lodge facilities to accommodate more visitors. This project would most likely be permitted but may be delayed and/or modified through the consultation process. As a lower bound estimate, we assume that only one new lift will be constructed, with an additional 11 runs, and that no new lodge capacity will be planned.

Based on the above growth assumptions, CHD will impose some restrictions on the Blacktail Mountain resort. At the high end of potential impacts the costs will come in the form of 1) two new lifts not being built; 2) the expansion of 23 new runs not being permitted; 3) some level of modification to the expansion of lodge facilities being required; and 4) additional consultation costs on three projects. On the low end, impacts will be in the form of 1) one new lift not being built; 2) no expansion of 11 runs; and 3) additional consultation costs, but for only one project.

Big Mountain Resort, also in Flathead National Forest, is the largest downhill ski resort in the study area. It received 250,000 visits in 2000 and has averaged around as many each year since 1990, with a peak of about 280,000 in 1994. In terms of number of visitors, this resort is second only to the Big Sky ski area statewide (MT DFWP 2003). Because of the large capacity at the current time, there are no plans for expansion. The resort could accommodate up to 750,000 visitors per year, three times the current visitation rate, without any further expansion (Michael Moffite, Big Sky ski area, personal communication). There are no anticipated impacts on this resort from CHD.

The total impacts to the downhill skiing and snowboarding sector, in terms of projects prevented, delayed, or modified, are displayed in Table III.3.c-2, with the specific projects impacted outlined in Table III.3.c-3. The upper-bound scenario assumes that consultations have already taken place at Teton Pass for the first new lift to be constructed and for the expansion of the cross-country ski trail, and that these will have to be reinitiated under CHD.

Table III.3.c-2: Impacts to the downhill ski/snowboard sector due to CHD

	Projects			*Consultations*	
Impacts	*prevented*	*delayed*	*modified*	*increased effort*	*reinitiation*
Upper-bound	5	4	6	13	2
Lower-bound	3	2	4	8	-

Note: Includes all ski recreation areas.

[81] From Blacktail Mountain website, ***http://www.blacktailmountain.com/trailmap.html***

[82] The State Comprehensive Outdoor Recreation Plan defines Regional Ski Areas as those that receive between 20,000 and 70,000 visitors per year.

Table III.3.c-3: Downhill ski/snowboard sector projects likely to be impacted by CHD

Ski Area	*Impacts* Upper-bound	Lower-bound
Teton Pass	- 13 new runs not built - not able to construct 3 new lifts - 1.9 mi of XC ski trail modified - consultation costs - extra planning to complete modified permitted projects - increased crowding	- 13 new runs not built - not able to construct 1 new lift - 1.9 mi of XC ski trail modified - consultation costs - extra planning to complete modified permitted projects - increased crowding
Blacktail Mountain	- 23 new runs not built - not able to construct 2 new lifts - consultation costs - extra planning to complete modified permitted projects - increased crowding	- 11 new runs not built - not able to construct 1 new lift - consultation costs - extra planning to complete modified permitted projects - increased crowding
Big Mountain	- none	- none
TOTAL	- 36 new runs not built - 5 new lifts not built - 1.9 mi of XC ski trail modified - consultation costs - increased planning costs	- 19 new runs not built - 3 new lifts not built - 1.9 mi of XC ski trail modified - consultation costs - increased planning costs

Snowshoeing

Snowshoeing is an activity that is growing in popularity among winter sports enthusiasts due to the fact that the equipment is relatively inexpensive and new technologies have made the sport more accessible to a wider range of people in recent years (Montana Dept. of Commerce 2003). In the year 2000, 0.3 percent of all non-resident visitors to Montana reported participating in snowshoeing. Two percent of Montana households reported participating in the sport in the winter of 1998-99 (MT DFWP 2003).

Snowshoeing is a dispersed activity in which participants can reach areas that snowmobilers and even cross-country skiers may not. Potential adverse modifications to lynx habitat from this activity come from snow compaction, which may facilitate winter access to lynx habitat by competitors such as coyote and bobcat (Ruediger et al. 2000). The impact of snowshoeing may be diminished due to the fact that it does not require the maintenance of a system of groomed trails, thus any compacted routes through the snow are temporary. While it may become necessary to control access by snowshoers to a few sensitive areas, the economic effects are assumed to be negligible as there are ample snowshoeing opportunities in the region.

Cross-country skiing

Any expansion of cross-country skiing, which takes place on both groomed and un-groomed trails throughout the area, may cause adverse modification to lynx habitat in that it has the potential to increase access to lynx habitats by competitors through snow compaction. Cross-country skiing has a five percent participation rate among Montana households, with 0.6 percent of state residents identifying it as their primary outdoor recreation activity in 2000, with 0.4 percent of non-residents participating in the sport during their visits to the state (MT DFWP 2003).

The National Forests and National Park that are, at least in part, included in the study area currently contain more than 300 miles of cross-country ski trails.[83] It is reasonable to expect that, as populations rise, so, too, will the demand for more trail mileage. Helena National Forest actively encourages the development of new trails (USDA FS 1981), while the Teton Pass Ski Area in Lewis and Clark National Forest has officially proposed new trail mileage (USDA FS 2003e).

Economic impacts arising from critical habitat designation would come in the form of restrictions that prevent the expansion of cross-country ski trails in lynx habitat. In order to estimate the expected growth of trail mileage in the absence of CHD, we assume that participation in the sport remains at five percent for residents and 0.4 percent for visitors (MT DFWP 2003). We also assume that visitation to Montana will grow proportionally with the U.S. population as a whole.

As an upper-bound estimate of impacts, we assume that mileage of ski trails will increase proportionally with the total number of skiers during the next ten years. In other words, with every percent increase in number of participants, there will be an equal percent increase in total trail mileage. According to the State Comprehensive Outdoor Recreation Plan, 35 percent of the cross-country trails in the state are located in the northwest sector, of which our study area makes up approximately two-thirds. Therefore, we assume that 23.3 percent of cross-country skiing in the state takes place in the study area. Based on these assumptions, we estimate that three new miles of trail would be constructed each year in the absence of CHD as the number of participants rises with increases in the state's and the nation's populations, for a total of 30 miles in ten years. Under the restrictions of CHD, no new trails could be constructed on these lands. Following our assumptions above, this will lead to an 8.8 percent increase in the average density of skiers during the skiing season, from 66.7 per mile of trail in 2013 in the absence of CHD to 72.6 per mile with CHD.

For a lower-bound estimate we assume what seems to be a more likely scenario, namely, that trail growth would not keep pace with the increase in the population of participants over the next ten years, but instead would grow at half the rate of the upper-bound estimate. Therefore, 15 new miles of trail would be constructed in the next ten years in the absence of CHD. In this scenario the density of skiers would rise to 69.2 per mile of trail in 2013 without CHD. In this case the increase to 72.6 skiers/mile/year with CHD would constitute a 4.9 percent increase. Table III.3.c-4 presents the upper and lower-bound impacts of CHD on cross country skiing. These numbers assume that land managing entities will attempt to have trail construction approved every year in the upper-bound case, and every third year in the lower-bound. This perhaps overstates the costs of consultation due to CHD, as it is more likely that land managers will become aware of the restrictions on new trail construction and cease to expend resources on consultations. Consultations may also be required, however, on activities designed to maintain existing trails.

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[83] Derived from various sources. Flathead NF from Flathead Valley tourism website (*http://www.fcvb.org/html/ccski.html*), Lewis and Clark NF, Helena NF, and Lolo NF from Montana Department of Commerce winter recreation website (*http://www.wintermt.com/xcski.htm*), Kootenai NF from Kootenai NF website (*http://www.fs.fed.us/r1/kootenai/recreation/activitiesx/xcountry/list.shtml*), and Glacier NP from the Glacier NP cross-country skiing and snowshoeing brochure (*http://www.nps.gov/glac/pdf/xc2000.pdf*). The entirety of these trails in some forests may not be within boundaries of study area.

For our upper-bound estimates it is assumed that trail maintenance activities will occur every year and that consultations for 2004 have already taken place and will have to be reinitiated. In the lower-bound scenario we assume this maintenance to occur every third year.

Table III.3.c-4: Upper and lower-bound CHD impact estimates on cross-country skiing

Impacts	*Miles of new trail prevented*	*Density increase*	*Consultations [1]* increased effort	reinitiation
Upper-bound	30	8.8%	60	6
Lower-bound	15	4.9%	18	-

Note: [1]Assumes one annual consultation per NF and NP in the upper bound, and every third year in the lower.

Snowmobiling

Snowmobiling is an activity of increasing popularity and importance in Montana and across the country. Snowmobiling has a seven percent participation rate among Montana households, with participants taking part in the activity with a mean frequency of 2.8 times per month. Approximately 0.6 percent of visitors to the state participate during their time in Montana. Meanwhile, the number of registered snowmobiles in the state increased 60 percent, from about 15,000 to 24,000, between the winters of 1990-91 and 2000-2001 (Sylvester 2002) and it is estimated that 65 percent of snowmobiles in Montana are not registered (Sylvester 1998). According to the Montana Snowmobile Association, the counties included in our study area contain at least 15 registered snowmobile organizations.[84] As snowmobiles gain in popularity and technological advancements continue, previously impassable terrain becomes accessible, and the need to regulate the sport has become more apparent.

Snowmobile activities are an important component of the local winter recreation economy. Sylvester (2002) estimates that non-residents spend about $225/activity day and that there were 204,000 non-resident activity days in the winter of 2001-02.[85] These estimates put the value to the Montana economy of non-resident snowmobilers at $44 million per year. Resident activity days were last estimated for the 1997-98 season at 1.2 million, with an average expenditure of $60 per day (Sylvester 2002).

While it is estimated that resident snowmobiling grew by 65 percent in the 1990’s, some recent data show that non-resident participation has dropped from 19 percent (267,007) of visitors in 1998 to just 6 percent (115,422) in 2001 (MT Dept of Commerce 2003c). Sylvester (2002) reports a similar trend in terms of activity days. In the 1997-98 season there were 222,000 non-resident activity days in the state, a number that decreased to 204,000 in the 2001-2002 season, an eight percent drop. It should be noted, however, that from 1987-88 to 2001-02, non-resident snowmobile activity days have increased 89 percent, from 108,000 (Sylvester 2002).

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[84] From MT Snowmobile Association website; *http://mtsnow.org*: Flathead Snowmobile Association, Lincoln County Snowcats, Ten Lakes Snowmobile Club, Cabinet Ridge Riders, Mission Mountain Snowmobile Club, Montana Night Riders, Bitterroot Ridge Runners, Garnett Preservation Association, Missoula Snowgoers, Montana Mountain Mushers, Seeley Lake Driftriders, Helena Snowdrifters, Ponderosa Snow Warriors, Great Falls Snowmobile Club, Cut Bank Snowgoers.

[85] An activity day is defined as the product of the estimated number of snowmobilers and their average number of outings each season.

Under the terms of the LCAS there can be no net increase in mileage of groomed trails or designated snowmobile play areas. Therefore, any costs associated with non-increasing trail mileage cannot be attributed to CHD. The difference in restrictions between the LCAS and critical habitat designation lies in the fact that CHD would prevent ***any*** new trail mileage. That is, new trail construction would be prevented irrespective of the closure of existing trails (see section III.3.b). The incremental impact of CHD depends on how much value snowmobilers forego due to the prevented opening of trails in new areas (maintaining total trail mileage), and whether or not this restriction diminishes the number of snowmobilers who return to the area or the number of their activity days. It is possible that a certain number of riders from outside the region could decide not to return to the study area if they knew they would not have the opportunity to experience new trails. However, we do not expect this to result in a substantial number of visitors not returning when they otherwise would have. The reason for this is the abundance of trails and the outstanding scenic attractiveness of the area. Unless potential return visitors have exhausted their options in terms of trails in the area, the impacts of CHD on numbers of visitors who do not return is likely to be negligible. Additionally, Sylvester (2002) found that non-resident snowmobilers are much more willing than state residents to accept controls and regulations on the sport, including increased law enforcement and limits on the number of people on the trails, required entry permits, the discouragement of large groups, etc. It is also conceivable that the additional protections from development provided by CHD could make the region more desirable to snowmobilers, despite the prevention of gross trail mileage increases.

Similarly, although resident snowmobilers may lose a portion of the enjoyment they receive from riding in new areas, it seems unlikely that they would reduce their activity days in the absence of new trail mileage. Through polls of both resident and non-resident participants, Sylvester (2002) also found that the demand for long trails appears to be declining. In 1994, 69 percent of residents and 79 percent of non-residents responded that long trails were a facility they considered "very desirable." In 2002 those ranking long trails in this category declined to just 36 and 49 percent for residents and non-residents, respectively, indicating that participants may be more satisfied with the trails they have at present. The network of trails and play areas in the study area is expansive and participants should be able to continue enjoying these areas, even if no new trails are developed. Due to the LCAS's existing restriction on net increases of trail mileage, any loss of utility from crowding cannot be attributed to the CHD, as miles of trails would not increase to accommodate growing participation in the next ten years even in the absence of designation. Therefore, we conclude that any effect of CHD on snowmobiling activity will be negligible.

<u>Summer recreation</u>

The most important consideration during the spring and summer months is to avoid disturbance of denning habitat in order to prevent the associated potential increase in kitten mortality (Ruediger et al. 2000). Some of the primary activities of concern in the summer months are hiking, camping, and motorized off-road vehicles.

Hiking

The National Forests and National Park within the study area contain thousands of miles of hiking trails (MT DFWP 2003). The construction and repair of trails is an ongoing process. While hiking is an activity that causes little disturbance, thousands of visitors to the area each year can create significant cumulative effects in the form of trash and noise. Use of the trails by horseback riders also deteriorates the trails more rapidly and leads to problems of erosion and trampled vegetation. To avoid adverse modification, no new trails would be permitted through lynx habitat. Trail mileage is increasing through many of the National Forest lands,[86] therefore such a restriction would bring a cost with it in terms of lost potential opportunities for recreational hikers and through the potential overcrowding of existing trails if the popularity of hiking increases.

Using the same set of assumptions employed to estimate the impacts to cross-country skiing, we can arrive at a projection of trail mileage that would be constructed without CHD and an estimate of how much more crowding can be expected under CHD. It is assumed that participation will remain at 37 percent of state residents and 12.4 percent of non-residents (MT DFWP 2003). According to the State Comprehensive Outdoor Recreation Plan (SCORP), 34.2 percent of inventoried hiking trails are in the northwest region of the state. Since the study area is roughly two-thirds of the northwest region, we assume that two-thirds of the hiking trails (22.8 percent of the state's trails) in the northwest are in the study area. If we assumed in this case that trail mileage will grow proportionally with the population of hikers, as we did in the case of cross-country skiers, this would result in the construction of 500 miles of new trails in the ten years of the study period. It seems extremely unlikely that trail construction would be carried out at this tremendous pace, and there is no evidence that it is occurring. Therefore, as our upper-bound estimate we assume that trail mileage will grow at half this rate, or by 25 miles of new trail per year, for a total of 250 miles in the next ten years. Our lower-bound scenario assumes half that growth, 12.5 miles per year or 125 in ten years. Again, it is assumed that visitation to Montana increases proportionally with the U.S. population. CHD would prevent this expansion of trails and impose consultation costs on repairs for existing trails. In the upper-bound we assume that trail maintenance and construction occur annually, while in the lower bound we assume that they occur once every three years. Our assumptions imply that density of annual hikers per mile of trail would grow from 74.5 in 2013 in the absence of CHD in the upper-bound, or 76.2 in the lower-bound, to 77.9 with CHD, an increase of 4.5 and 2.2 percent, respectively. Table III.3.c-5 presents the upper and lower-bound impact estimates. We assume that trail construction plans are subject to consultations each year and that 2004's consultations will have to be reinitiated in the upper-bound; our lower-bound scenario assumes that consultations occur every third year, with no reinitiation needed.

Table III.3.c-5: Upper and lower-bound CHD impact estimates on non-motorized trails

Impacts	*Miles of new trail prevented*	*Density increase*	*Consultations increased effort*	*Consultations reinitiation*
Upper-bound	250	4.5%	60	6
Lower-bound	125	2.2%	18	-

Camping

Camping is another popular activity in the study area, and throughout Montana, which draws substantial numbers of out of state visitors. This section covers both tent camping and RV camping, at sites with and without hookups. It is estimated that 3.6 percent of visitors and 18

86 Lolo NF forest has averaged 18 miles of trail construction/reconstruction per year since 1986 (USDA FS 2001d). Kootenai NF is developing two new segments of 900ft and 1/8 mi each in 2003 (USDA FS 2003d). Helena NF constructed 4 new mi of trail in FY 2000 (USDA FS 2000). All of these activities may not be entirely conducted in the study area.

percent of residents take part in tent camping each year, while 8.4 percent and 13 percent, of visitors and residents, respectively, take part in RV camping (MT DFWP 2003). Along with expenditures for campsite fees, participants contribute to the local economy through sales at bars, grocery stores, and gas stations, and are likely to take part in other recreational activities during their camping trips.

The SCORP indicates that approximately 22.4 percent of campground tent spaces are located in the northwest sector of the state. If we again assume that approximately two-thirds of those sites are in the study area, this amounts to an estimated 14.9 percent of the state's tent sites. The northwest region contains 31.7 percent of the state's RV sites, which leads us to assume that 21.1 percent are in the study area (MT DFWP 2003). By following the same set of assumptions used in the cross-country skiing and hiking sections above, we conclude, as an upper-bound estimate, that in the absence of CHD an average of 3.1 tent camp sites would be added per year, for a total of 31 spaces in 10 years. Twelve spaces for RV's would be constructed each year, a total of 120 by 2013. This expansion would be prevented under CHD. Our lower-bound estimate again assumes that only half of the upper-bound sites would actually be developed in the next ten years, 16 tent and 60 RV sites.

As with other activities, if expansion of facilities is proscribed, then increased crowding is likely to occur with the CHD. Under the above-mentioned assumptions for the upper-bound scenario the rate of campsite use would increase nine percent, from an average of 250 campers per site in 2013 without CHD to 273 at tent sites with CHD. The density of use at RV sites would grow from 167 people per site without CHD to 182 with designation, also a nine percent increase. For our lower-bound estimate use of campsites would be 259.4 campers per site in 2013 in the absence of CHD at tent sites and 173 at RV sites. Designation would therefore increase density by five percent in each case. Again, consultation costs would only arise when maintenance would need to be carried out at campsites or if new campsite construction is proposed. While it is likely that managers would not expend resources on consultations for proposing new campsite development once they become aware of the restrictions from CHD, we assume here, to err on the conservative side, that new sites are proposed each year in the upper-bound scenario, and every third year in the lower-bound. We assume the same maintenance schedules for the upper and lower-bound estimates as we did for hiking trails. Table III.3.c-6 illustrates the total impacts on both types of camping. It is also assumed that annual site construction plans are subject to consultations and that 2004's consultations will have to be reinitiated in the upper-bound; and every third year in the lower-bound, with no reinitiation needed.

Table III.3.c-6: Upper and lower-bound CHD impact estimates on camping

Impacts	*New campsites prevented*	*Density increase*	*Consultations*	
			increased effort	*reinitiated*
Upper-bound	151	9%	60	6
Lower-bound	76	5%	18	-

Off-Highway Vehicles (OHVs)

Off-Highway Vehicles (OHVs) are another segment of summer recreation that attracts large numbers of participants. Approximately 1.3 percent of visitors and ten percent of residents participated in 2000 and 1998-99 respectively (MT DFWP 2003). This is an activity, however, on which critical habitat designation will have little additional effect. Cross-country motorized travel is already not permitted on BLM and Forest Service lands due to Off-Highway Vehicle

Regulations, which cover the majority of our study area. While CHD may impose some restrictions that affect individuals on a small scale, it is unlikely to cause any changes to the economy of the study area.

Total impacts on recreation

The total impacts on recreational activities in the study area are outlined in Table III.3.c-7.

Table III.3.c-7: Total estimated upper and lower-bound impacts to recreation

	Impacts	
	Upper-bound	*Lower-bound*
Downhill ski projects		
prevented	5	3
delayed	7	4
modified	9	6
Foregone mi. of new trail		
cross-country ski	30	15
hiking	250	125
Users/mi. increase		
cross-country ski	8.8%	4.9%
hiking	4.5%	2.2%
Foregone new campsites	151	76
Users/site increase	9%	5%
Consultations		
increased effort	193	62
reinitiation	20	-

Grazing

As a component of Montana's agricultural industry, livestock grazing is an important part of the state's agricultural economy. It is an activity that has the potential to adversely modify lynx habitat, and it is a sector of the economy that could potentially be affected by critical habitat designation. Livestock may compete with snowshoe hares for foraging material and could have an impact on the prey base of the lynx.

The vast majority of hypothetical new grazing projects on federal lands or lands with a federal nexus in the proposed lynx critical habitat would likely not meet the jeopardy standard, resulting in the projects generally going ahead without modifications.[87] Under designation, new grazing projects in lynx habitat may violate the no adverse modification standard, in which case they would be inadmissible or would have to undergo modifications.

Incremental restrictions that may be justified under the no adverse modification standard of CHD include no new livestock pastures, no increase in the size of pastures, no increase in livestock

[87] Historically, almost 90 percent of all formal consultations under the ESA have resulted in no jeopardy findings (Houck 1993).

utilization rates, and no increase in stocking of goats. From the data available, however, it appears that grazing of livestock is decreasing across the study area.[88]

On federal lands, the marginal impact on grazing from designation of critical habitat is likely to be very small. BLM and FS lands, which together account for 59 percent of the area proposed as lynx critical habitat in MT, already are being managed according to the recommendations made in the LCAS.[89] Grandfathered grazing of domestic livestock is sanctioned in Federal Wilderness areas; however, in the wilderness areas in the proposed CHD area (which account for 45 percent of FS lands in the area), grazing only occurs by government administrative stock and recreationists' pack animals. Limited grazing is sanctioned also on selected National Park lands, but not in Glacier National Park, which accounts for another 15 percent of the lands in the MT area. The only other federal lands in the study area are administered by the Bureau of Reclamation (BoR), FWS, and Bureau of Indian Affairs (BIA), together accounting for 62 thousand acres, or approximately one percent of total federal lands in the study area.

Forest Service lands

Each of the National Forests contained, at least in part, within the study area, allow some level of grazing. The 1986 forest plan of the Lewis and Clark NF predicted grazing pressure of 72,100 Animal Unit Months (AUM) per year for the years 1997-2006.[90] Through 2001, the average AUM per year has been 70,800. The 2001 Forest Monitoring report shows that grazing has been decreasing over the last five years (USDA FS 2001f). If we assume that grazing will remain at no more than the average of the last five years, it seems clear that CHD will not impose any further impacts on grazing within the Lewis & Clark NF.

The Kootenai NF plan of 1987 projected 12,600 AUM per year through 2001. The average over this time period was only 83 percent of this figure (10,441 AUM), while in 2001 just 56 percent of the projection (7,017 AUM) was realized (USDA FS 2001e). These numbers lead us to assume that CHD will not impose any additional impacts as grazing levels are well below the projected amounts and appear to be declining. Likewise, the 2001 Forest Monitoring report of Lolo NF shows that grazing activity is declining. AUMs have decreased every year since 1987, reaching an all time low of 2,423 AUM in 2001, just 17 percent of the annual projection of 14,300 AUM in the 1986 forest plan (USDA FS 2001d).

Flathead NF and Helena NF do not appear to have monitoring reports available that contain the same detail of data as the other three National Forests. The 1985 forest plan of Flathead NF projects 5,900 AUM through 2005, increasing to 6,200 through 2015 (USDA FS 1985). If we

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[88] Overall, domestic livestock populations are stable or decreasing in the affected counties (see USDA 1999a and earlier editions).

[89] In Montana, the counties containing areas proposed for designation of lynx critical habitat in 1997 produced a total of approximately 1,200 goats, down from about 1,800 in 1992. The area proposed for CHD for the lynx amounts to less than 40 percent of the combined area of those counties, and of that approximately 45 percent are off limits to domestic livestock grazing, except government administrative stock and recreationists' pack (75 percent of the CHD area is in federal ownership, of which in turn 60 percent are off limits to livestock grazing). Therefore, the number of goats grazed on federal lands in proposed lynx critical habitat likely is much smaller than 1,200.

[90] AUM is a measure of grazing use. It is the amount of forage needed to support 1 animal unit for 1 month. Although there are varying definitions of an animal unit, the BLM defines it as 1 cow, or 1 horse, or 5 sheep (***http://www.blm.gov/utah/resources/grazing***/).

assume that these projections are correct, which is questionable considering that the projections from the other National Forests in the study area all overestimated actual AUMs in their forest plans, then the impact of CHD would be to keep grazing at 5,900 AUM beyond 2005. Thus, CHD would have the impact of reducing grazing by 300 AUM per year from 2006-2013, a total of 2,400 AUM through 2013.

Helena NF's forest-wide management direction projected 48,500 AUM through 2005 and 50,000 from 2006-2015 (USDA FS 1981). These projections are quite old and again it is likely that they are overestimates of actual use. However, assuming them to be accurate, we can assess the impact of CHD, which would require grazing levels to remain at 48,500 AUM, thereby reducing future grazing by 1,500 AUM per year from 2006-2013, a total of 12,000 AUM. For the purposes of this analysis, we will assume the forest plan projections of these two forests are correct. Our lower-bound scenario assumes the projections are overestimates, as in the other forests, and that critical habitat designation will have no impact on livestock grazing in the national forests of the study area.

Other lands

Goats and sheep sometimes are employed for weed control purposes. Based on information provided by county weed coordinators, it appears that these programs do not contribute a great deal to the numbers of grazing livestock in our study area. The only county that may be impacted by CHD is Lewis and Clark, which has plans to double its current stock of 600 goats and 1,000 sheep used for weed control in 2004. This is an action that may not be permitted under CHD, but only some of the planned areas will be affected by the CHD-related impacts.

Table III.3.c-8 below shows that since 1993 numbers of cattle and sheep in the counties of our study area have been declining overall. With the exceptions of small increases in head of cattle in Lewis and Clark, Pondera, Powell, and Sanders counties, all counties have shown substantial decreases in heads of livestock over the last ten years, and even these four counties show decreases in both cattle and sheep over the last five years. The trend is particularly pronounced in sheep. Judging by these figures, it appears that a reasonable assumption can be made that livestock density in the study area will either continue to decline, remain stable, or at least not increase in a substantial manner. Since livestock grazing is not increasing in the base case scenario, critical habitat designation should not have any additional impacts on grazing.

In sum, it appears that the impacts of critical habitat designation on grazing will be minimal. While it may be necessary for approximately 14,400 AUM of grazing to be foregone in Flathead and Helena National Forests over the next ten years, grazing numbers throughout the counties of the study area have been declining for the last decade or more, leaving doubt that there would be any impact at all, even in these National Forests. Table III.3.c-9 illustrates the potential impacts on grazing in the region. In terms of increased consultation efforts, we assume that each year's grazing permits require a consultation on the part of the National Forest in question.

Table III.3.c-8: Head of cattle and sheep by county in the study area

	County	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*Change 93-03*
Flathead	cattle	20,100	20,000	20,300	20,300	17,500	17,300	17,300	15,700	15,500	14,000	12,600	-37.31%
	sheep	1,600	1,500	1,400	1,200	900	800	800	700	900	1,100	500	-68.75%
Glacier	cattle	36,000	30,800	36,000	36,500	39,400	39,500	3,900	37,000	38,000	34,000	32,000	-11.11%
	sheep	1,000	900	700	600					500		600	-40.00%
Lake	cattle	58,000	59,000	62,000	58,000	57,000	55,000	55,000	55,000	53,000	51,000	53,000	-8.62%
	sheep	5,200	5,000	4,400	4,200	4,200	4,400	3,600	3,400	3,500	3,600	1,400	-73.08%
Lewis & Clark	cattle	38,700	38,600	42,000	45,800	44,700	44,000	45,000	47,000	46,000	39,000	40,000	3.36%
	sheep	7,700	7,000	5,900	5,500	5,000	4,800	4,600	4,000	3,500	3,600	3,900	-49.35%
Lincoln	cattle	5,200	4,900	5,100	5,000	4,600	4,300	4,400	3,800	3,600	3,500	3,600	-30.77%
	sheep												
Missoula	cattle	13,400	14,000	14,500	15,000	13,700	13,100	12,700	11,700	12,000	10,500	11,200	-16.42%
	sheep	1,700	1,800	1,600	1,500	1,200	1,100	1,100	1,100	1,200	1,500	1,600	-5.88%
Pondera	cattle	23,500	23,600	27,300	24,600	26,000	27,100	28,300	29,700	28,900	25,500	24,500	4.26%
	sheep	6,000	6,100	6,000	6,100	7,000	7,500	6,000	6,400	6,800	7,000	3,300	-45.00%
Powell	cattle	45,000	41,000	44,000	51,000	51,000	52,000	51,000	51,000	50,000	49,000	47,000	4.44%
	sheep	2,600	2,100	1,800	1,500	1,400	1,500	1,300	1,100	1,300	1,000	800	-69.23%
Sanders	cattle	19,800	17,800	18,900	20,200	20,300	21,100	21,600	21,800	22,700	19,900	20,700	4.55%
	sheep									500			
Teton	cattle	61,000	66,000	67,000	69,000	68,000	62,000	59,000	55,000	56,000	55,000	58,000	-4.92%
	sheep	10,000	9,700	9,200	8,800	8,700	8,400	7,800	7,400	7,200	6,400	5,500	-45.00%
TOTAL	*Cattle*	320,700	315,700	337,100	345,400	342,200	335,400	298,200	327,700	325,700	301,400	302,600	-5.64%
	Sheep	35,800	34,100	31,000	29,400	28,400	28,500	25,200	24,100	25,400	24,200	17,600	-50.84%

Source: Adapted from data obtained from the Montana Agricultural Statistics Service, http://www.nass.usda.gov/mt/

Table III.3.c-9: Estimated impacts to grazing sector from CHD

Impacts	Projects prevented	Projects delayed	Projects modified	Consultations[1] increased effort	Consultations[1] reinitiation
Upper-bound	-	-	16	16	-
Lower-bound	-	-	-	-	-

Notes: [1] Each year's grazing permits counted as one project. Impacts in this case from a total of 14,400 foregone AUM over the ten year period in the upper-bound scenario.

Timber

Due to the fact that lynx require different habitat types for denning, cover/security, and foraging, timber harvests do not have to be excluded to avoid adverse modification. The important determinant in deciding what constitutes an adverse modification in a given case is the limiting habitat type. If denning habitat is limiting, then logging activities will adversely modify the overall habitat quality since lynx need the thicker cover of more mature stands in order to maintain successful dens. If, however, foraging habitat is determined to be limiting, timber harvest may improve overall lynx habitat by clearing areas which can then provide forage for snowshoe hares.

The LCAS allows timber harvests that lead to no more than a 15 percent increase in unsuitable lynx habitat in a ten-year period. Unsuitable habitat is defined as that in which vegetative cover is in an early successional stage and does not support snowshoe hare populations in all seasons (Ruediger et al 2000). Under CHD, there would be no allowance for this increase in unsuitable habitat, and no reduction of the limiting habitat type would be permitted. Logging would be permitted in non-limiting habitats, so long as the harvest would not cause this non-limiting habitat to become the limiting habitat type. Additionally, if foraging habitat is of the limiting type, any logging activity may have to take place outside of the denning season if lynx are present in the area and utilizing those denning sites. Size limits of harvested areas may also be required to prevent the creation of openings of a size that restricts lynx movement.

While the harvest data of the five National Forests in our study area show irregular peaks and valleys in terms of annual harvest volume, it appears that logging has decreased over the years, dramatically in some cases, throughout all five forests. These National Forests have fallen below the projected Forest Plan harvest volumes every year, with the exception of only two of the last 15 years before 2002 in Lewis and Clark NF. Collectively, from 1998-2001, the five forests averaged 113 million board feet (mmbf) each year.[91] Table III.3.c-10 presents a comparison of the projected annual harvest volumes from the forest plans of each of the National Forest with the actual mean and median harvests.

Flathead National Forest is projecting harvests of 20-25 mmbf per year in the next several years (Gary Dahlgren, Flathead NF, personal communication). This harvest volume would mark an increase from just 6.1 mmbf in 2002, yet still be significantly less than the 1998 harvest of 33.9 mmbf (MT DEQ 2001a). There are more than 1.2 million acres of unreserved forest land in Flathead NF, 51 percent of which are considered suitable for timber. These approximately 620 thousand suitable acres contain an estimated 4.1 billion board feet of sawtimber (O'Brien 1999).

[91] Derived from various forest monitoring reports referenced in the following paragraphs. While data were available as far back as 1987 and as recently as 2003 for some forests, these were the only four years for which data were available for all five forests.

Table III.3.c-10: Projected vs. actual harvests on NF lands

Forest		Volume harvested (mmbf)		
		projected	*mean*	*median*
Flathead [1]		*20-25*	13.7	8.9
Lewis & Clark [2]		12.6	11.2	9.6
Helena [3]		15	6.0	-[6]
Kootenai [4]				
	1988-1995	233	131.2	-[7]
	1996-2002	150	66.7	-[7]
Lolo [5]				
	1987-1995	107	64.7	76.0
	1996-2001	131	27.0	24.0

Notes: [1] Projection is for harvests in near future (Gary Dahlgren, personal communication). Harvest data available for: [1] 1998-2002; [2]1987-2001; [3]1997-2001; [4]1988-2002; [5]1987-2001. [6]Average harvest in the years 1997-99 was 8.7, individual year data only for 2000 and 2001. [7] From data on average harvest between 1988-92 and 1993-97, and annual data for 1997-2002.

While the 1986 Forest Plan for the Lewis and Clark National Forest projected harvesting on 1,800 acres of land per year through 2006, the forest averaged only 1,107 acres in the 15 years through 2001, and just 1,020 in the last five years. The average volume harvested over those two time periods was 11.24 mmbf and 9.56 mmbf, respectively. Projections in the 1986 Forest Plan were for 14 mmbf from 1987-96 and 17 mmbf from 1997-2006 (USDA FS 2001f).

Harvests in Helena NF, Lolo NF, and Kootenai NF have also consistently fallen short of projected volumes. Their forest plans predicted harvests of 15 mmbf per year for Helena NF (USDA FS 1981), and 107 mmbf per year from 1987-95 and 131 mmbf per year from 1996-2015 in Lolo NF (USDA FS 1986). In Kootenai NF, a harvest of 233 mmbf per year was predicted in the 1987 forest plan. In 1995, however, the Chief of the Forest Service issued a decision, due to a technical error in the original calculations, declaring that the forest could not exceed a sale volume of 150 mmbf per year in subsequent years (USDA FS 2002b).

Since LAUs each have a size of at least 25-50 square miles (16,000-32,000 acres) of contiguous habitat (Ruediger et al. 2000), and since denning habitat generally is not seen as limited if it accounts for at least ten percent of an LAU in patches of at least five acres, and is in proximity to foraging habitat (Ruediger et al. 2000:82), the logging restrictions imposed by the adverse modifications standard should generally offer sufficient flexibility for the spatial allocation of harvest volumes similar to those specified under the LCAS.[92] Flathead National Forest serves as an example. Data show that the vast majority of the forest, about 1.3 million acres, is in the "large tree" stand class, defined as trees nine inches or more in diameter at breast height (d.b.h.) (O'Brien 1999), and constituting habitat that may be suitable for denning. There are over 619,000 acres of unreserved forest land considered suitable for timber harvest. This area contains approximately 4.1 billion board-feet of sawtimber (O'Brien 1999). Harvest projections for the near future call for between 20 and 25 mmbf per year. While it may be necessary to relocate certain harvest activities if they are in areas where denning habitat is a limiting factor, it seems

[92] The occurrence of quality denning habitat is not restricted to older mature forests. Rather, such habitat also may be found in stands of more than 20 years of age that are regenerating after disturbance (Ruediger et al. 2000). In addition, the development of suitable denning habitat can be increased through selected logging of patches of large-diameter trees, leaving the downed trees and root wads in place.

unlikely that harvests of 20-25 mmbf per year could not be realized considering the size of the forest in question and the volume of suitable timber contained in it.

Logging in the study area includes not only timber harvests in National Forests but also on all other lands. Timber harvests from National Forest lands made up just 38.6 percent of the total harvests in those counties in 1988. The remainder came from other public lands (4.3 percent), forest industry lands (38.8 percent), and non-industrial private lands (18.3 percent) (Conner and O'Brien 1993).

It appears that due to the restrictions already in place from the LCAS, and the apparent trend of decreasing harvest volumes across the study area, little, if any, decreased logging will take place on account of designation of critical habitat for the lynx. If costs are incurred due to CHD, they will take the form of additional consultations with the FWS before logging activities are carried out, project modifications in the form of relocation of harvest activities due to denning habitat and the associated need to repeat timber sale preparations (planning, surveying, tree marking), and the potential for reduced profitability if a portion of the harvests must be moved to a secondary or tertiary site due to limiting habitat concerns. Table III.3.c-11 shows the upper and lower-bound estimates of impacts on the timber industry. We assume that logging volumes in the National Forests remain at their average during 1998-2001 (113 mmbf per year) and continue to make up 38.6 percent of the total annual harvest in the counties of our study area. Therefore, we forecast annual harvests of 292.7 mmbf, or 2,927 mmbf in ten years. The upper-bound scenario assumes that 15 percent of harvest activities will have to be relocated due to CHD and that, during the first two years of the study period, those harvests that must be modified will face delays while adjusting to the new regulations. This percentage of relocated harvests is chosen because lynx denning habitat is not considered limiting as long as it makes up ten percent or more of an LAU (Ruediger et al. 2000). The lower-bound scenario assumes only a five percent relocation rate and no delays after the first year. Estimated numbers of consultations are based on the assumption of one consultation per National Forest per year and one per year for private lands in the lower-bound. The upper-bound assumes one consultation per year for each NF and each of the three other land ownership categories.

Table III.3.c-11: Impacts to the timber industry due to CHD

	Timber Volume (mmbf)			*Consultations*	
Impacts	*prevented*	*delayed*	*modified*	*increased effort*[1]	*reinitiated*
Upper-bound	-	87.8	439.1	80	16
Lower-bound	-	14.6	146.4	60	6

Notes: [1] Based on assumption of one consultation per NF forest per year and one for private lands in the lower bound and one consultation per year per NF and per other owner group in the upper bound.

Roads

Several road and bridge projects are scheduled to be carried out in the proposed lynx critical habitat during the projection period. Of these, some constitute restoration projects, while others entail new construction. The former generally are not expected to lead to adverse modification of to the extent that they do not lead to an increase in physical built infrastructure. Conversely, new road construction generally will lead to adverse modification because it inevitably converts habitat into lower quality (from the perspective of the lynx) paved surfaces.

Generally, the only projects in lynx habitat that would be in conflict with the no adverse modification standard are new road construction and, potentially, increase of total transect length (through addition of lanes, widening of existing lanes, addition or widening of shoulders, or tree removal along the road). Bridge rehabilitation/replacement should generally not constitute adverse modification under CHD.

In the BCS, all highway projects, all projects involving roads on Federal lands, and all projects involving historic roads and bridges that may negatively impact lynx must undergo consultation with the FWS.[93] Since it is accepted by federal land management agencies that lynx are present in all of the Montana study area (McKelvey et al. 1999, Hickenbottom et al. 1999), there is no potential habitat (primary habitat currently not occupied) in the study area that would require consultations under the adverse modification standard but not in under the jeopardy standard. Hence, the number of highway, other road, and bridge projects that require formal consultation in the Montana study area is the same in both the BCS and the CHD scenarios. The only differences under CHD would be a potential increase in the complexity of consultations, since the adverse modification standard may require a more detailed analysis of impacts than would occur under the jeopardy standard, and possible changes in the design of project modifications, if any, justified under the former standard. In addition, for projects that already have undergone consultations, the consultation process would be reinitiated because the new standard of protection for lynx (adverse modification) is more stringent than the current one (jeopardy).[94]

The following is a list of the planned road and bridge work in lynx habitat during the projection period, and the impacts that CHD is estimated to have on the projects (see also Table III.3.c-12).

Federal Highway Administration and Montana Department of Transportation Roads and Bridges Historic Preservation Plan

Seven of the 88 bridges to be restored under the Roads and Bridges Historic Preservation Plan of the Federal Highway Administration and the Montana Department of Transportation (USDOT FHWA and Montana DOT 1989) are located in lynx habitat.[95] Also to be restored are Montana Highway 35 from Polson to Bigfork, which partly lies in lynx habitat, and old U.S. Highway 10 between Interstate 90 Exit No. 22 and St. Regis, and the Old Troy - Libby Highway, both of which traverse NF lands. The expected impact of CHD would consist in an increase in the complexity of consultations for the individual projects. Modification of projects is unlikely because of the presumed absence of adverse modification of habitat.

U.S. Highway 93 improvement project

On a 56 mile-long stretch of US 93 from Evaro to Polson, improvements are planned, including addition of two lanes (USDOT FHWA 2001a). Construction is scheduled to commence some

[93] By court order, all federal agencies generally must consult with FWS on any project that might harm lynx until critical habitat is designated for the lynx (see Defenders of Wildlife v. Norton 2002, 239 F.Supp.2d 9).

[94] Following the LCAS's guidelines does not exempt federal action agencies from such reinitiation of consultations. Although the LCAS was developed as a guidance document for federal land management agencies that would inform decision makers on how to adjust land management activities such that the likelihood of harm to lynx from such activities would be minimized, the LCAS does not provide the same level of protection to lynx as does CHD (see Table III.3.a.ii-3). Therefore, CHD requires reinitiation of consultations conducted under the jeopardy standard.

[95] These are bridges numbers 1, 2, 3 and 4 in the Missoula area, number 8 in the Butte area, and numbers 1 and 5 in the Great Falls area listed in Appendix 5 of FHWA and Montana DOT (1989).

time in 2004, although specific dates have yet to be determined (Montana Department of Transportation 2003).

The only lynx habitat affected would be the northern one of the only two significant forested linkage areas along US 93 south of Flathead Lake, a circa three mile-long stretch north of Evaro (Missoula County), which traverses Salish and Kootenai tribal lands.[96] The Evaro corridor has been identified as potential lynx travel corridor (USDOT FHWA and Montana DOT 2001b:35). In addition, two other areas, Ravalli Hill and the Jocko River, may constitute potential travel corridors (ibid.). A 2001 report by the FHWA and Montana Department of Transportation concluded that the proposed project may adversely affect lynx in two ways: first, though a potential increase in collisions with vehicles along fenceless sections of the widened road; second, through increased barriers to movement and dispersal, caused by the addition of two lanes and expected increase in traffic, removal of roadside vegetation, and fencing along road in the vicinities of 44 planned wildlife crossing structures (USDOT FHWA and Montana DOT 2001b). On the other hand, the construction of wildlife crossings with fences in their vicinity may reduce the threat to lynx from vehicle collisions along the fenced sections. Since no data are available on the use by lynx of wildlife crossings, and since use of these structures may require some time for familiarization with the structures (USDOT FHWA and Montana DOT 2001b), the proposed project would possibly trade off reduced collisions along fenced sections of the affected section of US 93 for increased barriers to movement and dispersal along the entire length of the affected section.

CHD would require additional consultation effort, specifically, a reinitiation of consultations due to the change of evaluation standard from jeopardy to adverse modification. This may lead to a delay of construction, currently scheduled to commence in spring of 2004. Furthermore, potential adverse modification of lynx habitat is expected to lead to some form of project modification, specifically, the potential installation of additional wildlife crossings and the extension of fencing in lynx habitat, to avoid vehicle collisions. Under the existing project plan, there would be a total of eight wildlife crossing structures in the three-mile stretch north of Evaro that lies in forested lands, including one wildlife overcrossing, and one multi-span bridge, the remaining being concrete box culverts or corrugated metal pipe (USDOT FHWA and Montana DOT 2001b).[97] In addition, there would be an open-span or multi-span bridge over the Jocko River with a span of 300-400 feet, and another such bridge (100-150 feet span each) in the Jocko/Spring Creek area, with another corrugated metal pipe or concrete box culverts within a mile of each of these two areas, and two culverts or pipe crossings in the Ravalli Hill area (USDOT FHWA and Montana DOT 2001b:25). Because of the lack of information on the use by lynx of crossing structures, it is currently uncertain whether or not the total number of crossings can be considered sufficient for lynx, or whether a particular type of crossing would be preferable. Hence, we assume that the current number and type of crossing structures is sufficient. However, to avoid increased collisions of lynx with vehicles, we also assume that an extension of fencing would occur. Currently, there exists approximately one mile of road in the area of concern that would not be fenced.

[96] The southern linkage area lies south of the US 93 project area, hence, only the northern stretch would be affected.
[97] The overpass would support 4 feet of topsoil and vegetation for cover (USDOT FHWA and Montana DOT 2001b:24).

Construction work on Montana Highway 200

The Montana Department of Transportation plans construction work on a segment of Montana Highway 200, between Lincoln and Lewis and Clark County Highway 279 (between mileposts 75.7 and 83). The project is programmed, but construction is not expected to begin before 2011 (personal communication, Mick Johnson, Montana DOT, Nov. 25 2003). CHD for the lynx would likely lead to increased consultation effort, but is unlikely to lead to project modification.

Going-to-the-Sun Road rehabilitation, Glacier National Park

The planned rehabilitation of the Going-to-the-Sun Road (2004 through 2010 or 2011; Table 2 in USDI NPS 2002a) and Belton Bridge (expected September 2003 to April 2004, USDI NPS 2003b), both in Glacier National Park, are unlikely to negatively impact lynx habitat. Under CHD, there would be additional consultation efforts, specifically, reinitiation of consultations because of a change in the protection standard from jeopardy to adverse modification, and potentially some modification of the additional ancillary structures and activities contained in the NPS's preferred alternative. The latter include such items as construction of scenic view parking lots, movement, addition, or reconfiguration of parking and pullouts to improve safety and traffic flow, addition of slow-moving vehicle pullouts, and vista and roadside vegetation clearing (from Table 2 in USDI NPS 2002a).

Construction of an access path to private property on Snyder Ridge, Glacier National Park

Construction of an access path to private property on Snyder Ridge, Lake Mc Donald is planned (USDI NPS 2003d). The path has the purpose of facilitating the construction of a non-residential storage structure on the parcel, in an area that currently is undeveloped (USDI NPS 2003d).

Under CHD for the lynx, the project would lead to adverse modification of lynx habitat because of the degradation of a small part of currently undeveloped lynx habitat (USDI NPS 2003d). The path, to be used during one winter by ATVs for materials transport to the property may result in facilitated winter access for lynx competitors, and the development of non-residential facilities will destroy habitat. However, the joint property owners hold deeded rights to construct an access road across Park lands to their property, which they are willing to waive in exchange for construction of the path. In contrast to such a road, the path is planned to be for short-term use only (one winter), following which the affected vegetation will be fully rehabilitated (USDI FWS 2003d). Hence, the path would constitute the less harmful alternative from the perspective of lynx conservation. CHD would lead to reinitiation of consultations and possibly minor project modifications under the adverse modification standard.

Copper Creek Road Improvements, Lewis and Clark County

The Forest Service proposes improvement of Copper Creek Road (located in Helena NF north of Montana Highway 200 just east of Lincoln), including repaving existing pavement, paving existing gravel, upgrading dirt surface to gravel, and widening a single-lane bridge to a two lane-bridge on an existing two-lane road (USDA FS 2002a).[98] The project includes 14.2 miles of Copper Creek Road from the junction at State Highway 200 passing through Forest Service, State, and private land. As proposed, the project would reconstruct the road to an American Association of State Highway and Transportation Officials design standard corresponding to

[98] The Copper Creek Road provides access to Snowbank Lake, Copper Creek Campground, and the Indian Meadow Trailhead for accessing the Scapegoat Wilderness.

"Rural Recreational and Scenic Roads." This design standard includes an overall width (including shoulders) of 20 ft (ibid.). Construction is expected to begin in late summer 2004, and last 12 months (including winter cease of operations).

Table III.3.c-12: Road and bridge projects in Montana study area likely to be affected by CHD: BCS and assumed impacts of CHD

Project	*Likely impacts from CHD*		
	Prevention of project	*Modification of project*	*Additional consultation effort*
Historic Bridge and Highway restoration			
7 bridges, 2 highways (19 mi total)	-	(yes)[1]	yes, all projects
MT-35 Polson to Bigfork (25 mi in CHD area)	-	(yes)[1]	yes
US-93 improvement			
Three-mile stretch north of Evaro	-	yes, plus project delay	reinitiation
Montana-200			
Eight-mile stretch east of Lincoln	-	no	yes
Copper Creek Road Improvements			
14.2 mi, stretching north from Montana-200	-	(yes)[2]	yes
Going-to-the-Sun-Road rehabilitation (GNP)	-	yes, project delay	reinitiation
Construction of access path to private property on Snyder Ridge (GNP)	-	yes	reinitiation
US-2			
Reconstruction of 1.1 mi segment, 1.3 miles west of Hungry Horse	-	(yes)[1]	yes
PMS overlay on 2.2 mi segment, GNP east end	-	no	yes
Reconstruction, 2.9 mi segment of Montana-487 (Big Mountain Road)	-	(yes)[1]	yes
PMS overlay, 6.4 mi segment of Montana-486 (north of Columbia Falls)	-	no	yes

Notes: mi - miles. [1] To the extent that road rehabilitation is accompanied by vegetation clearing or construction of parking lots along roads, the latter would constitute adverse modification of lynx habitat, and would likely have to be dropped, leading to project modification. [2] In locations where the proposed design standard for road reconstruction leads to increased transect length and associated adverse modification of lynx habitat. Parentheses indicate that respective impacts may occur. The uncertainty is due to the fact that the projects either have not been finalized at the time of this writing, or that the available project information is not specific enough to warrant a definite conclusion regarding the impact.

Under CHD, the project would likely require additional consultation effort. In addition, reconstruction of the road to the proposed design standard would likely lead to some minor increases in transect length in some locations, which may lead to project modifications in some sections of the road to avoid adverse modification of lynx habitat.

Other projects [99]

A number of other mostly small projects are planned in the proposed lynx critical habitat area (see Table III.3.c-12). The unavailability of sufficient information on several of the planned and anticipated projects requires the construction of upper and lower-bound estimates for impacts (see Table III.3.c-13).[100] This is necessary for two reasons. First, the exact nature of a planned project will define whether or not modifications will be necessitated under CHD. Second, it is currently not known how many of the planned Historic Bridge and Highway restoration projects will be carried out during the time frame used in this analysis.

The estimated resulting upper-bound impact from lynx CHD on road and bridge work is based on the assumption that all Historic Bridge and Highway restoration projects in the designation area will be carried out within the time frame considered, and that all projects that potentially require modifications actually will require them. These assumptions result in an estimated 16 projects that require modifications, 17 consultations with increased complexity (CHD as opposed to jeopardy), and three cases in which consultations would be reinitiated. In addition, two of the projects would be delayed through CHD.

In the lower-bound estimate, it is assumed that half of the Historic Bridge and Highway restoration projects in the designation area will be carried out during the next ten years, and that none of the projects that potentially may require modifications actually will require modifications.[101]

Table III.3.c-13: Upper and lower-bound CHD impact estimates on road and bridge work in proposed lynx CHD area in Montana

		Projects		*Consultations*	
Impacts	*prevented*	*delayed*	*modified*	*increased effort*	*reinitiation*
Upper-bound	-	2	16	17	3
Lower-bound	-	2	3	11	3

Note: See text for assumptions underlying estimates.

Fire management

In the BCS, a continued increase is expected in fuel treatment activities under the National Fire Plan (USDA and USDI 2003), including a more widespread use of prescribed burns and use of wildland (naturally ignited) fires to reduce fuel buildup. This process may tend to produce results that mimic historic low-intensity natural fire regimes. However, most lynx habitat lies in areas that historically also have experienced high intensity fires, changing vegetation at the stand or landscape scales (Agee 1999). Controlled burns that mostly consume undergrowth generally produce different regrowth patterns than high-intensity fires. Nevertheless, in combination with the likely recurrence of catastrophic fire events until current high fuel stocks are reduced, prescribed fires and wildland fires during the projection period should lead to fire impacts that are

[99] This information was obtained from the Montana Department of Transportation (Sheila Ludlow, personal communication, 3 Dec. 2003). The projects described are projected to be carried out during 2004-2008. No information was available for road work beyond that time frame.

[100] Specifically, whether or not a given reconstruction or restoration project will result in an increase in transect length or removal of roadside vegetation, will influence whether or not project modifications are likely to be required under CHD.

[101] The latter projects are characterized by a *(yes)*[1] entry in the modification column in Table III.3.c-12.

more similar to historic fire regimes. The concomitant increase in vegetation regrowth is likely to increase snowshoe hare habitat and therefore to benefit lynx (USDI NPS 2003:74).

Because of the high percentage of federal lands in the Montana study area and the federal funding of fire-related activities on non-federal lands (through the State Fire Assistance, Rural and Volunteer Fire Assistance, and Economic Action programs described above), most fire management actions in that area should involve some form of consultation with the FWS, which is expected to result in the application of the LCAS wildland fire guidelines. Incremental restrictions under CHD (no salvage logging of large-diameter downed trees and root wads) are not expected to lead to increased project costs. However, CHD would require formal consultations on all projects, which increases consultation costs.

In Glacier NP, the proposed Fire Management Plan (USDI NPS 2003) foresees a minimum of 21 prescribed burns and/or mechanical fuel reduction projects between 2004 and 2008 (ibid.,:17), and an increase in mechanical fuels reduction in wildland-urban interface areas and backcountry areas with higher concentrations of developments. Under CHD, consultations on the proposed Fire Management Plan (FMP) would be reinitiated, but the plan would likely not be found to be in violation of the adverse modification standard, due to the expected overall beneficial effects on lynx of re-establishing fire regimes that more closely resemble natural fire conditions (USDI NPS 2003). In addition, future project-specific consultations would have to be carried out, which may entail a higher degree of resource commitment than would be the case in the BCS.

Designation of critical habitat is expected to lead to reinitiation of consultations for those federal fuel treatment projects and for those treatment projects with a federal nexus that already have undergone consultations, due to the additional protection provided under CHD. Future projects will likely require higher consultation efforts due to additional restrictions and project modifications justified under the no adverse modification standard. To the extent that salvage of large-diameter burned down trees or root wads would occur (which the LCAS does not rule out under certain conditions), CHD would lead to project modification, which however would be minor and would likely result in negligible impacts.

Assuming that wildland-urban interface (WUI) hazardous fuel treatment projects are generally located outside of the proposed lynx CH designation area, we focus only on non-WUI treatments. Total non-WUI hazardous fuel reduction acreage on federal lands or by federal agencies in Montana as a whole was approximately 24,500 acres in 2002 (see Table III.3.c-14), less than the total non-WUI area treated in 2001 and less than the projected non-WUI treatment total for 2003, which were approximately 47,400 and 43,500 acres, respectively (USDA and USDI 2002, USDI and USDA 2003b). We use the 2002 non-WUI acreage as the lower bound, and the 2001 treatment acreage as the upper bound for our estimate of the size of future annual non-WUI treatments during the projection period.

In the absence of information about total treatment acreage in the proposed designation area, we assume that the acreage of non-WUI treatments is proportional to the acreage treated on federal lands in Montana as a whole. In other words, we estimate the non-WUI treatment size on a particular action agency's lands in the proposed designation area by multiplying that action agency's total treatment acreage in all of Montana by the ratio of the agency's lands in the study area and in Montana as a whole.

TableIII.3.c-14: Hazardous fuels treatments in Montana, 2002

	Wildland-Urban interface				*Other Hazardous fuels treatments*					
	Mech.	*Prescribed Fire*	*Other*	*Sub-total*	*Mech.*	*Prescribed Fire*	*Other*	*Sub-total*	*Total*	*Wildland Fire Use*
	acres									
BIA	41	60	1,537	1,638	961	2,617	-	3,578	5,216	15,249
BLM	3,146	182	-	3,328	510	2,823	-	3,333	6,661	
FS	5,754	5,134	-	10,888	5,799	9,958	-	15,757	26,645	
FWS	-	-	-	-	-	978	-	978	978	
NPS	36	10		46		865	-	865	911	33

Notes: Mech. - mechanical.
Source: USDA and USDI (2003).

The treatment size of non-WUI projects on FS lands in Montana in 2004 ranges from approximately 40 acres to about 10,000 acres, with an estimated average treatment size of around 200 acres.[102] Since FS lands account for the overwhelming majority (approximately 98 percent) of non-NPS federal lands in the study area (information on NPS hazardous fuel treatments in the designation area is available and these lands are therefore treated separately; see above), we use the FS average treatment size estimate of 200 acres to derive an estimate of the number of treatments. The projected number of annual treatments during the projection period of course varies between the upper-bound and lower-bound impact estimates, which assume different sizes of total area treated per year. We assume that each treatment requires its own consultation. The number of estimated treatments on lands of the action agencies in the designation area during the projection period is shown in Table III.3.c-15.

Table III.3.c-15: Assumed impacts of CHD on hazardous fuel reduction projects in proposed Montana lynx CHD area

Hazardous fuel reduction projects	*Likely impacts from CHD*		
Mechanical and prescribed burn projects by land ownership, 2004-2013 [low-high estimate]	*Prevention of project*	*Modification of project*	*Additional consultation effort*
BIA - 1-2 projects	no	(yes)[1]	yes, all projects
BLM - 3-5 projects	no	(yes)[1]	yes, all projects
FS - 180-411 projects	no	(yes)[1]	yes, all projects
NPS - 21 projects (planned)	no	(yes)[1]	yes, all projects; reinitiation of consultations on GNP FMP

Notes: [1] Where tree or root wad removal would occur in BCS. FMP - Fire Management Plan.

The potential impact of the so-called "Healthy Forests Initiative" (H.R. 1904) on the BCS is difficult to assess, due to the fact that the new law is only beginning to be implemented. One of its most important provisions likely is the one stipulating that federal land management agencies will no longer have to consult with the FWS or the National Marine Fisheries Service on fuel-reduction projects which are likely to adversely affect threatened and endangered species or critical habitat. If the agencies in fact decided to make use of that provision, the number of consultations on hazardous fuel reduction projects would be dramatically reduced in both the

[102] Personal communication with FS Region 1 fuels specialist, May 1, 2004.

BCS and the CHD scenarios. The net effect would be that there would be no incremental consultation costs from lynx CHD for those projects on which the agencies do not consult with the Services, so the fire-management-related costs of lynx CHD would decline compared to the estimate developed in this study. Therefore, our fuel reduction-related consultation impact estimates for lynx CHD are likely to be an overestimate.

It is important to note, however, that federal land management agencies are still required to abide by the jeopardy and no adverse modification provisions of section 7 of the ESA. In other words, actions that would result in jeopardy or adverse modification will continue to be illegal. Therefore, CHD could still lead to project modifications and associated costs, even if consultations are no longer required.

Residential Development

Demographic trends

The overwhelming majority of the human population in the area is located in the Flathead basin. Within the basin, the bulk of the population is concentrated in the area extending from the northern shore of Flathead Lake to Kalispell, Columbia Falls, and Whitefish. Overall, population in the basin increased by 25 percent between 1990 and 2000, but most of that increase took place in the Flathead Lake and Stillwater/Whitefish sub-basins (see Table III.3.c-16).

Table III.3.c-16: Population in the Flathead basin, 1990 and 2000

	Population		*Increase*	
Sub-basin	*1990*	*2000*	*Absolute*	*%*
Flathead Lake	37,660	49,296	11,636	31
Stillwater/Whitefish	30,079	36,017	5,938	20
North Fork	273	414	141	52
Middle Fork	582	553	-29	-5
South Fork	1,327	1,311	-16	-1
Swan	4,407	5,461	1,054	24
Flathead Basin total	74,328	93,052	18,724	25

Source: Table 2.6 in Montana Department of Environmental Quality (2001a).

In 2000, the populations of the three municipalities together accounted for 31 percent of the population in Flathead County. However, this share increases to 58 percent if populations residing beyond city limits but within the boundaries of the municipal planning areas are included (see Table III.3.c-16). These boundaries generally extend 4.5 miles beyond city limits.

The geographic distribution of projected population increases in Flathead County reflects a trend of increasing settlement in non-incorporated areas, with the three largest urban centers in the county expected to grow slower than the county as a whole (see Table III.3.c-17). These densely populated areas however lie outside of the proposed lynx critical habitat, because the land cover types are generally not conducive to lynx.

Subdivision activity in Flathead county has been increasing from 1996-2000, with a total of 2,986 new subdivisions created during that period, covering some 14,700 acres (Flathead Regional Development Office 2001b). Of all new lots and tracts created since 1973, 73 percent are in rural Flathead county, that is, in non-incorporated areas, 15 percent in the city of Kalispell, nine percent in the city of Whitefish, and three percent in the city of Columbia Falls (ibid.).

Table III.3.c-17: Population and projected increases, Flathead County and Tri-City area

Population	*2000*	*2003*	*2005*	*2010*	*2015*
Flathead county	74,471	79,220	82,250	89,590	96,890
% increase over 2000		6.4%	10.4%	20.3%	30.1%
absolute increase over 2000		4,749	7,779	15,119	22,419
Tri-City area					
Kalispell	14,223	14,785	15,172	16,184	17,265
Whitefish	5,032	5,183	5,283	5,554	5,825
Columbia Falls [1]	3,645	3,857	4,005	4,400	4,834
% increase over 2000		4.0%	6.8%	14.1%	21.9%
absolute increase over 2000		924	1560	3238	5024
All Tri-City area planning jurisdictions [2]	43,114				

Notes: [1] Growth projections based on 2001-2002 growth rate of 1.9 percent. [2] Includes populations living beyond city limits, but within city planning jurisdictions. Planning jurisdictions of the three cities generally extend up to 4 1/2 miles beyond city limits.
Sources: Kalispell City Planning Board (2003b); Whitefish City-County Planning Board (2002); U.S. Census Bureau, Population Division (2003).

Subdivision activity in 2000 is roughly consistent with these numbers (68, 6, 22, and 4 percent, respectively), with the exception of Whitefish, which has experienced increasing development of new lots in the Iron Horse Subdivision. The rapid growth in subdivision activity in unincorporated areas is of particular concern, since these areas are more likely to bring into development lands containing suitable lynx habitat. In some cases the expansion of subdivisions at the outskirts of the cities may be an issue.

Table III.3.c-18: Residential construction activity in Flathead County, 1995-2000

Area	*1995-1999 5yr annual mean*	*2000*	*1995-2000 6 yr annual mean*
Kalispell	126.6	147	130
Whitefish	37	82	44.5
Columbia Falls	29.2	18	27.3
Outside of municipalities but within Tri-City building jurisdictions [1]	3	75	15
Unincorporated areas [2]	467.6	365	450.5
Total	663.4	687	667.3

Notes: [1] Usually extending one mile beyond city limits. [2] Rural sewer districts and on-site septic systems.
Sources: Flathead Regional Development Office (2001a); Tri-City Planning Office (2003).

Together with subdivision growth, construction of new homes has been strong and increasing since 1998. In 2000, 64 percent of all new homes in Flathead County (687 units) were constructed outside of the Tri-City area (Flathead Regional Development Office 2001a).[103]

The observed wide fluctuations in residential construction activity during recent years do not reveal any obvious trend change in the rural/urban split (see Figure III.3-1). New construction in rural Flathead County in recent years has included a substantial number of new residences that lie

[103] About 70 percent of newly constructed residences in 2000 were single-family homes (ibid.).

outside of city limits, but within Tri-City building jurisdictions (see Table III.3.c-18). These constitute urban sprawl that in some, but not all, cases encroaches upon lynx habitat.

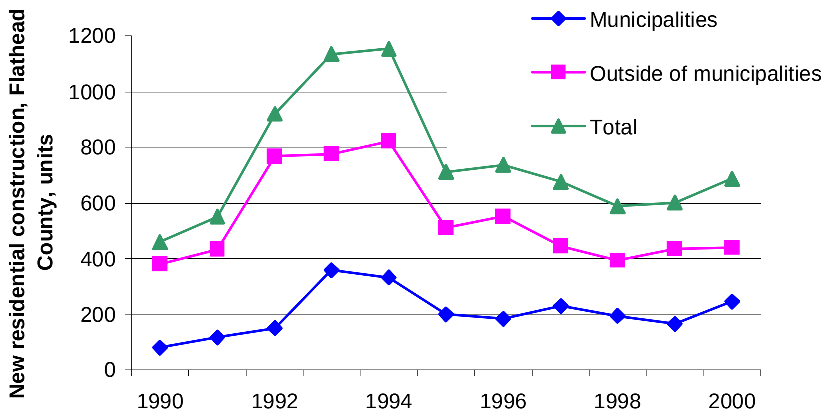

Figure III.3.c.1: Residential construction activity in Flathead County, 1990-2000

An examination of the exact locations of new residential construction in Flathead County (see Flathead Regional Development Office 2001a) shows that in 2000, there were a total of 18 locations on which construction took place in lynx habitat (Tier-1 and Tier-2), with an approximate total of 44 residences constructed on these sites. This amounts to 6.4 percent of all newly constructed residences in Flathead County in that year.

In the remaining counties, new construction activity in lynx habitat is low in both comparative and absolute terms. The highest activity occurs in Seeley Lake (Missoula County), which has been experiencing population and housing growth of almost four percent per year during 1996-2001 within a five mile radius of Seeley Lake (Seeley Lake Area Chamber of Commerce 2003).[104] New subdivision development from 1995-2002 in Seeley Lake occurred at the rate of about one per year (Missoula County Surveyor's Office 2003). Not all of the new construction sites may be in Tier-1 or Tier-2 lynx habitat. Conversely, subdivisions may contain multiple residences. Therefore, and given the supply of existing undeveloped lands open to development, it seems reasonable to assume an average of five newly constructed residences in lynx habitat per year during the next ten years.[105]

In eastern Lake County, which makes up the northern half of the Swan TMDL planning area, population is heavily concentrated on the northeastern shore of Flathead Lake, especially Big Fork and eastward (Montana Department of Environmental Quality 2001a). This area is dominated by pasture and low density residential development and is generally unsuitable as lynx habitat. Much of the remainder resides in Condon and Swan Lake, with an estimated combined population of about 150 in 2000 (Montana Natural Resource Information System 2003). The population for the valley as a whole is estimated at around 800.[106] Currently, less than ten parcels

[104] Population within a five mile radius of Seeley Lake was 1,684 in 2001 (Seeley Lake Area Chamber of Commerce 2003).
[105] There are currently several dozen properties in and around Seeley Lake that have recently been sold or are still for sale. See for example Clearwater Realty at *http://www.clearwaterriverrealty.com/land/land7.html* (accessed Nov. 2003).
[106] See *http://www.clearwaterriverrealty.com/area2.html* (accessed Nov. 2003).

are available in the valley for residential development.[107] We assume an average of one to five new residential developments per year over the next ten years.

In Lewis and Clark County, population increases generally have been accommodated through development of existing parcels and limited subdivision activity (Lewis and Clark County Planning Department 2003). The high quality scenic resources of the area are expected to continue to attract more residents, and demand for seasonal cabins and recreational homes is also likely to increase (ibid.). Subdivision creation in the entire county was 685 in 2002, but the bulk of subdivision development is located in the Helena valley (ibid., p. 88), which lies outside of the area identified as critical lynx habitat. The only town in Lewis and Clark County that generally lies within lynx habitat is Lincoln (with a population of 1,100 in 2000). Population growth in the Lincoln area has been rapid during the last decade, and currently several dozen properties are for sale, some of them in lynx habitat.[108] Since much of the area within a three mile radius of the town center is in pasture, we may assume that there are between one and ten new residential constructions per year in lynx habitat.[109]

If the percentage of all residential construction that occurs in lynx habitat remains at its 2000 level (6.4 percent) in Flathead county, and residential construction during the projection period remains on average at its mean annual rate during 1995-2000 (667 units), then an estimated total of 440 residential units would be constructed in lynx habitat in Flathead County during the ten year projection period. Given the expected slightly faster population growth in rural areas, this may be a conservative estimate in the sense that it may underestimate the share of future new residential construction that would potentially be located in lynx habitat. On the other hand, in their newly developed growth management plans, the municipalities aim to redirect future development towards from leap-frogging and sprawl beyond city limits to vacant areas within city limits (see for example Whitefish City-County Planning Board 2002), which could potentially lower the rate of new residential construction in lynx habitat.

In the remaining lynx habitat proposed for designation, the projected number of average annual residential developments over the next ten years is assumed to remain at its estimated present level. The ranges of estimated construction activity in the Swan and Middle Blackfoot TMDL planning areas, respectively, are used to construct upper and lower boundaries for construction activity in lynx habitat in the study area as a whole (see Table III.3.c-19). Critical habitat designation-related restrictions on development in lynx habitat are assumed to impact construction activity only beginning with the year following approval by the EPA of the water quality improvement plans in the respective TMDL planning areas.

The data in Table III.3.c-19 represent the estimated quantity of residential units that would be subject to incremental restrictions attributable to CHD for the lynx. It is very likely that not all of these projects would be prevented, however. Most construction activity in lynx habitat exhibits a very low-density development pattern, with usually one residence per property and large (> 10 acres) properties. The restrictions deemed justified under the no adverse modification standard (see Table III.3.a.ii.-4) would prevent any new construction in Tier-1 habitat (denning and foraging), but not in Tier- 2 or -3 habitat used primarily for dispersal and movement between Tier 1 habitat blocks. On some properties where Tier-2 or -3 habitats are dominant, low-density

[107] See ***http://www.swanvalley.com/srvreland.html*** (accessed Nov. 2003).
[108] See for example ***http://www.mthomesandland.com/PPropVacantLand.html*** (accessed Nov. 2003).
[109] In the Lincoln sewer district there have been a total of 20 new hookups over the last seven years, indicating that the majority of new developments lie outside of Lincoln proper (personal communication with Laura Nicolai of the Lincoln Chamber of Commerce; Nov. 20 2003).

residential construction would therefore be possible under certain conditions. These are the relocation of any planned construction in Tier-1 habitat to selected areas of Tier-2 or -3 habitat; strict limitations to changes in the property's vegetation; and refraining from construction of structures that would inhibit lynx travel, such as fences or other barriers.

Table III.3.c-19: Estimated residential construction activity in lynx habitat in Montana study area in 2003, and projections 2004-10

TMDL Planning Area	*TMDL completion date*	*Estimated total number of new residential construction, 2004-2013*	
		BCS	*of which subject to restrictions under CHD* [2]
Flathead Headwaters [1]	2003	50	0 [4]
Flathead Lake	2001	160	160
Flathead Stillwater [3]	2005	230	184
Swan	2002	30 (10 to 50)	30 (10 to 50)
Middle Blackfoot	2005	110 (20 to 200)	88 (16 to 160)
Total, LOW scenario		470	370
Total, HIGH scenario		690	554

Notes: [1] Comprises North Fork Flathead, Middle Fork Flathead, and South Fork Flathead subbasins. [2] Construction projects subject to restrictions because of CHD are those that occur in the years following the completion of the TMDL plan for the planning area in which the projects lie. [3] Includes Stillwater and parts of Flathead Lake subbasins. Estimates are based on construction activity in lynx habitat in 2000 in a) the Flathead Basin subbasins: South Fork Flathead (1), Middle Fork Flathead (2), North Fork Flathead (2), Flathead Lake (16), and Stillwater (23); b) Swan Valley (1-5); and c) Middle Blackfoot, Seeley Lake and Lincoln areas (1 to 10 each). [4] Construction in the Flathead Headwaters TMDL planning area is assumed to not be subject to restrictions under CHD as construction has not been identified as a priority issue for water quality control (see Table III.3.a.ii-3).
Sources: Montana Department of Environmental Quality and USEPA (2003); Montana Department of Environmental Quality (2001a); Flathead Regional Development Office (2001a); see also text.

Development of parcels completely covered by Tier-1 habitat however would be precluded. Construction that would have occurred on such parcels is expected to relocate to adjacent areas where it would be permitted, or to relocate to outside of the study area. Given the expected small number of precluded developments, and the comparatively large supply of still available non-Tier-1 lands with attractive scenery, it is unlikely that a large share of Tier-1 projects would relocate to other geographic regions outside of the study area or the counties in which it falls. In any case, since the conceptually correct boundaries of the present analysis are those of the entire United States, it is irrelevant if some residential construction were to relocate to outside of the study area, as long as it is displaced to another region of the country and not abroad. For a regional impact estimate, relocation of projects to outside of the study area does make a difference of course. Under such narrow spatial boundaries of analysis, the 93 units that are expected to leave the study area would entail impacts on the construction sector, and the properties on which these units would have been placed would lose part of their value. Given that the number of prevented units is very small compared to the total properties available for development, the average price of developable properties would likely not be affected by the designation. Therefore, the lost value of the affected properties probably would not be compensated by a concomitant value increase of developed and developable properties.

The total numbers of residential units that would be precluded or that would have to undergo modification, respectively, can only be estimated. As with the other land use activities, we develop a lower-bound and an upper-bound estimate of these impacts (see Table III.3.c-20).

The upper-bound estimate is based on the assumption that all expected new residential BCS construction in lynx habitat would occur in Tier-1 habitat, that all of the respective properties have Tier-2 or Tier-3 components suitable for relocation of the projects or, alternatively, that sufficient properties with Tier-2 or -3 habitat are available in the study area, and that all prospective developers would be willing to build in those areas of the properties or on such properties, respectively. Relocation of projects into Tier-2 or -3 habitats leads to high impact estimates because it requires consultations. No consultations are required outside of lynx habitat, hence, relocation of projects within lynx habitat results in a higher impact estimate of the cost of designation than would occur if it was assumed that projects would leave the study area. Using the upper-bound estimate of 554 new residential construction projects in lynx habitat (see Table III.3.c-19), the total number of construction units displaced *within* lynx critical habitat ("displaced internally") is estimated at 554, with zero projects displaced from the study area. Of the modified (internally displaced) projects, all of those scheduled for 2004 are assumed to incur project delays due to reinitiated consultations.

The lower-bound impact estimate is based on the assumption that 25 percent of the projects developed absent CHD for the lynx will leave the study area (thereby avoiding modifications - however, they are still assumed to undergo consultations), while the lands occupied by the remaining projects possess suitable quantities of Tier-2 or -3 habitat to allow relocation of projects on those properties; and on the lower-bound estimate of construction activity in Table III.3.c-19. In the lower-bound scenario, half of the projects scheduled for 2004 are assumed to suffer delays. Since most of the projects projected to be realized during 2004-2013 likely will not yet have resulted in concrete planning efforts, the transactions costs associated with relocation of the projects are neglected in this study.

All consultations for housing projects are additional consultations because it is assumed that they would not have taken place in the absence of lynx CHD. This likely overstates consultation costs, as some of the consultations would probably have occurred for other ESA species in the area. All consultations regarding these residential developments are expected to be low-effort consultations.

Table III.3.c-20: Upper and lower-bound estimates of the impact of lynx CHD on residential construction activity in proposed lynx CHD area in Montana

	Units impacted by CHD, by impact			*Consultations*	
*Impacts**	*prevented* [1]	*delayed* [2]	*modified* [3]	*additional*	*reinitiation*
Upper-bound	0	26	554	554	-
Lower-bound	93	11	277	370	-

Notes: *Upper- and lower-bound scenarios under wide spatial boundaries (all of US). Under narrow spatial boundaries (study area counties), the scenario that results in upper-bound impacts under wide boundaries becomes the lower-bound scenario, and the scenario that results in lower-bound impacts under wide boundaries becomes the upper-bound scenario, based on the estimated costs of the respective scenarios. [1] Prevented projects are those that relocate to outside of the study area. [2] All (upper-bound scenario) or half (lower-bound scenario), respectively, of the projects anticipated for 2004 are assumed to be delayed, to some extent, due to project reevaluation and/or modification. The numbers of expected projects in TMDL planning areas with plans completed by 2003 are 26 (upper-bound) and 22 (lower-bound), respectively. [3] Modified projects are those that relocate on-site or within the study area.

Construction projects displaced from the study area cause welfare-relevant impacts on economic activity only if the boundaries of analysis include solely the study area counties. In that case, the fact that the forgone local development opportunities for the affected sectors are compensated for by increased development opportunities for these sectors outside of the study area is ignored.

Mining

Minerals exploration has been limited for many years in the United States in general, and markedly so in Montana, with the 2002 season standing out as one of the least active on record for Montana (Montana Bureau of Mines and Geology and USGS 2002:28.1). The only currently foreseeable potential mining development in the Montana study area is the proposed McDonald Gold Project by Canyon Resources Corp., a cyanide heap-leach mine in the Blackfoot valley near Lincoln in Lewis and Clark County, with a total impacted area of eight square miles and an expected total surface disturbance of four square miles, the largest mine of its kind in the US.[110]

The project is currently impeded by Montana Initiative 137 (I-137), enacted in 1998, which bans the development of new gold and silver mines that use open-pit mining and cyanide in the treatment and recovery process. The company has filed suits in state and federal courts to have the Initiative overturned, or, alternatively, to obtain a "takings" damage award. The Montana State District Court's adverse ruling of the company's suit was appealed to the Montana Supreme Court in January 2003, with a judicial ruling possible during the first half of 2004. In addition, the company is planning to place a repeal of I-137 on the ballot for citizen vote at the general election in November 2004. It claims that a poll of Montana voters conducted earlier in 2003 indicates that a substantial majority of voters support changing or repealing I-137.[111]

Since it is impossible to predict the outcome of the McDonald Project at this time, two scenarios are distinguished (see Table III.3.c-21). The first assumes that the project remains blocked due to Initiative 137, in which case CHD for the lynx would have no impact on the project. In the second scenario, it is assumed that Initiative 137 is overturned. In that case, absent CHD for the lynx, two sub-scenarios are distinguished: the mining project may go ahead according to plan, or it may be temporarily put on hold, canceled, or modified due to the impending designation of the Blackfoot River as critical habitat for the bull trout (*Salvelinus confluentus*) (USDI FWS 2004a, USDI FWS 2002e: 71258).[112] Hold, cancellation, or modification of the mining project are all possible once critical habitat for the Bull trout is designated, because of the anticipated adverse modification of Bull trout habitat through the project. A finding of adverse modification is likely, given the expected impacts of the mine on various aspects of water quality and quantity relevant to the trout.[113] However, since currently only the draft version of the economic impact analysis

[110] Montana Environmental Information Center, http://www.meic.org/blackfoot.html (accessed Nov. 2003).

[111] Pre-feasibility study of Canyon Resources' McDonald Gold Project shows project economics and increased Size. Press release, Oct. 7 2003. (*http://biz.yahoo.com/prnews/031007/latu009_1.html*, accessed Nov. 2003).

[112] In November of 2002, the FWS proposed designation of critical habitat for the Bull trout, including the entire Blackfoot River drainage (USDI FWS 2002e). However, due to a court-approved settlement agreement, in February of 2003 FWS re-opened the comment period on the CHD, with may 12 as the closing date, and a final rule designating critical habitat for the Bull trout required to be submitted to the Federal Register no later than October 1, 2003 (USDI FWS 2003d). The latter deadline has passed, however, without publication of the final rule.

[113] According to the Montana Environmental Information Center (MEIC 2000), all cyanide heap-leach projects in Montana have seen leakage and unpermitted discharges, and because of the enormous size of the project, such leaks, of cyanides and heavy metals, are to be expected. (According to MEIC, EPA studies have found that liners like the ones which the proposed McDonald mine plans to use underneath the heap-

for the designation of critical habitat has been completed (USDI FWS 2004a), it is still possible that the headwaters of the Blackfoot River could be excluded from designation on the basis of claims that the benefits from exclusion would outweigh the benefits of designation.[114] Such exclusion however would only be justified if either there were assumed to exist no project modifications that could reduce adverse impacts on the Bull trout to acceptable levels, or if the costs associated with such modifications would be prohibitive.

Only in this last case, in which the Blackfoot headwaters are excluded from designation of critical habitat for the Bull trout, would the designation of critical habitat for lynx be expected to lead to a finding of adverse modification for the project. Such a finding is likely because of the multiple adverse impacts on lynx that would be caused by the mine, such as increased winter access for lynx competitors, irreversible destruction of lynx habitat, and disturbance during denning periods. These expected impacts would lead to project cancellation, or, alternatively, if the benefits from exclusion of the area from CHD for the lynx were shown to outweigh the costs of inclusion, to the exclusion of the project area from such designation.

The former case (case 2b-2 in Table III.3.c-21) represents the highest impact scenario from lynx CHD, and is therefore chosen as the upper boundary of designation impacts on mining in the Montana case study area. The lower boundary is represented in the other cases described above (see cases 1 through 2b-1 in Table III.3.c-21).

Within the upper bound scenario itself a range of impacts and associated cost and benefit estimates can be generated. For example, the costs to the mining project of CHD for the lynx can range from those that result from the mere ***postponement*** of the mining profits and salaries, tax revenues, and boost to the local economy during the lifetime of the project (an estimated 14 years) until such time at which the lynx recovered and were removed from the list of threatened and endangered species, and hence the lynx CHD-based impacts on the mining project would cease to exist, to those costs that would result from the project forever forgone, due to non-recovery (but also non-extinction and hence non-delisting) of lynx. The latter of course represent an extreme upper value of costs, since the lynx may recover and be delisted as a result of designation of critical habitat or other conservation efforts. The cost of project postponement

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leach pads and holding ponds average one leak per acre. That translates into 880 leaks from the heap-leach pads and 70 leaks from the holding ponds. In addition, the mine is expected to cause oxygen depletion (due to the nitrates used in blasting the pit), sedimentation, and stream dewatering (due to the withdrawal of approximately two million gallons of water per day for processing, and an additional 2.5 million gallons per day will be pumped out of the mined area because the groundwater level in the mine has to be reduced by 800 feet for the mining process) with associated changes in water temperature, to which trout are highly sensitive. Canyon Resources, notwithstanding these arguments, claims that "because of the way the project has been designed and will be operated as a zero discharge operation, it WILL NOT [upper case in original] affect the chemistry, flow, or fisheries of the nearby rivers, and therefore, will not in any way impact the Bull Trout" (http://www.canyonresources.com/investor/faq.html, accessed Dec. 1, 2003).

[114] Whether or not such claims would be justified or not depends of course on whether or not all relevant cost and benefit categories are included in the analysis, something historically not done in the FWS's economic impact analyses of designation of critical habitat. In the case of the McDonald Gold Mine project, increased costs of downstream municipal water treatment (Lincoln lies just eight miles downstream of the mine project), reduced value of fisheries, irreversible damage to the scenery and reduction of the value of real estate in the viewshed, large-scale deposition of toxic and non-biodegradable heavy metals and cyanide in streambeds and soils, and disruption of the local water cycle with associated impacts on wildlife and vegetation all need to be considered as costs of the project, to be weighted against forgone profits, tax revenues, salaries, and temporary boost to the local economy during the expected 14 year lifetime of the project.

would increase with the temporal distance of delisting and the discount rate used: at a discount rate of three (seven) percent per year, the cost of a ten year project postponement would be 26 percent (49 percent) of the benefits of project realization.[115] Of course, the foregoing refers to the gross costs of project postponement only, that is, not corrected for the present value of the benefits of postponement.

Table III.3.c-21: Impacts of lynx CHD on mining activities in Montana study area

BCS Projects	*Likely impacts from CHD*		
	Prevention of project	*Modification of project*	*Additional consultation effort*
McDonald Gold mine project (eight miles east of Lincoln, Lewis and Clark County)			
Case 1: I-137 upheld, project cancelled	n.a.	n.a.	n.a.
Case 2: I-137 overturned			
a: project cancelled due to Bull trout critical habitat	n.a.	n.a.	n.a.
b: project goes ahead with modifications due to Bull trout CHD			
b-1: project area excluded from lynx CHD	n.a.	n.a.	n.a.
b-2: project area included in lynx CHD	yes	n.a.	yes, reinitiation

Since lynx recovery to the point of delisting is unlikely to occur by the time the analysis period ends (2013), and since it may not occur for a considerable time thereafter, we use the present value of the project forever forgone as an extreme upper bound cost estimate of CHD for mining.

Table III.3.c.22: Upper and lower-bound estimates of the impact of lynx CHD on mining activities in Montana study area

Impacts	*Projects impacted by CHD, by impact* prevented	delayed	modified	*Consultations* increased effort	reinitiation
Upper-bound	1	-	-	1	-
Lower-bound	0	-	-	-	-

III.4 Economic values associated with impacts of lynx CHD on specified land use activities

In this study, the impacts of lynx CHD are considered for all major land use activities with potentially negative impacts on lynx. These activities are grazing, timber management and harvest, recreation, road construction, fire management (specifically, hazardous fuel treatments), mining, and residential development. For purposes of analytical clarity, impacts here are distinguished into direct ones, that is, on-site changes in the utilization of the designated lands (prevention and modification of activities adversely affecting lynx habitat, and, where applicable, increases in competing, CHD-compatible activities) as well as additional consultation effort; and indirect ones, that is, any changes other than the physical on-site impacts. Both direct and

[115] For a 20 year project delay due to lynx CHD and at a three (seven) percent annual discount rate, costs would be 45 (74) percent of project revenues, minus the present value of benefits attributable to the project delay.

indirect impacts carry associated economic values. In the framework of cost-benefit analysis, impacts that affect society as a whole negatively are referred to as costs, while impacts that affect society as a whole positively are referred to as benefits. Impacts that generate identical amounts of positive and negative effects in society are neutral from a cost-benefit perspective. Good examples of the latter are increases in efficient (non-distorting) taxes, or property value decreases in one location and property value increases of equal magnitude in another location. Such impacts simply lead to resource transfers from one group in society to another, and as such do not constitute social costs (Tietenberg 2000).

Federal law mandates cost-benefit analysis (CBA) of regulatory actions (Executive Order 12866, *Regulatory Planning and Review*). Of course, for CBA to be useful as a decision-making tool, all costs and benefits associated with the regulatory action in question must be included in the analysis. This necessity is self-evident, and has been clearly expressed in guidelines governing the preparation of economic analysis by government agencies (US EPA 2000, US OMB 2003 a, b). The FWS professes to recognize this necessity, and in recent economic analyses of CHD states that the costs and benefits of CHD "may include (but are not limited to) changes in land use, environmental quality, property values, or time and effort expended on consultations and other activities by federal landowners, federal action agencies, and in some instances, State and local governments and/or private parties" (see for example USDI FWS 2002c:P-1). Despite this professed recognition, however, the overwhelming emphasis in FWS economic analyses of CHD has been on the cost side, with clearly disproportionately large efforts devoted to the generation of cost estimates.

Both benefits and costs of a public policy (whether the latter takes the form of a specific level of regulation or a specific control measure) occur in a wide variety of forms and often carry diverse units (see Table II.2-1). Some of the costs and benefits are easily quantifiable, while others are difficult to measure, and some may in fact be intangible. After identifying and quantifying the physical impacts of a government action, values are assigned to these costs and benefits. Because money usually is the most convenient common unit of measurement for the diverse benefits, the latter are generally expressed in monetary terms, as far as that is possible. Economists have devoted considerable effort to developing tools for quantifying hard-to-value costs and benefits (Cropper 2000).[116] The attractiveness of CBA derives to a large extent from the fact that it provides a framework for systematically integrating costs and benefits across their various scales, by converting them to a common denominator, a currency-based price.

In this section we present a summary of the upper and lower bound estimates of the impacts of CHD identified in the previous section. We then identify the value (cost and benefit) categories associated with those impacts, and identify for each impact those value categories that are relevant in the Montana case study area.[117] Finally, we develop monetary estimates for these impacts.

All of the above-mentioned impacts of CHD on land use activities also lead to the improved conservation of lynx habitat and ecosystems, the expected concomitant improved recovery of lynx populations, and the associated likelihood of improved conservation of other species found

[116] Values that intrinsically may be beyond quantifiability are those associated with some ecosystem services or components of ecosystems (Cropper 2000; Vatn and Bromley 1995), and, of course, intrinsic values.
[117] In the discussion below, the respective cost and benefit categories are identified by the numbers they have been assigned in Table II.2-1 "Categories of potential costs and benefits...", e.g., (C-3) for costs related to project modifications.

in lynx habitat, all of which represent economic benefits of designating critical habitat for the lynx (see Table II.3-1). We aggregate these benefits over all impacts as a whole instead of assessing them for each impact category individually. That analysis is presented in the next section

III.4.a Relevant cost and benefit categories

We consider all values associated with the impacts of lynx CHD on all major land use activities. The potentially applicable value categories (comprising both costs and benefits) are identified based on Table II.2-1. These values are estimated in sections III.4.b and c.

III.4.b Costs of lynx CHD in Montana study area

Winter recreation

Each section below details the assumptions made in generating estimates of the monetary cost expected from designation critical habitat for the lynx. The cost to each individual sector, within winter recreation, considers only direct costs to that industry and consumer surplus impacts. A later section addresses the multiplier impacts that lost winter recreation activity as a whole would have on associated industries (hotels, restaurants, etc.) which depend, in part, on winter recreation tourism for their revenues.

Downhill skiing/snowboarding

The potential physical impacts from critical habitat designation described in the previous section carry associated monetary costs. The primary cost categories for downhill ski and snowboard resorts include foregone development opportunities in the form of restrictions on expansions of ski runs and the chair lifts to service them (cost category C-1 in Table II.2-1), project modifications such as the redesigning of certain planned developments to ensure a prevention of adverse modification of lynx habitat (C-3), higher transaction costs in the form of increased consultations (C-4), and, perhaps, a loss of consumer surplus if visitation increases but the number of slopes cannot, thus decreasing the enjoyment participants receive from the activity (C-2). This final category may not be relevant for the study area due to the fact that data show no increasing visitation trend at two of the three resorts in the study area. The third, Blacktail Mountain, experienced increased visitation from 1998-2000, but this may be due to the fact that the resort was newly opened in 1998. Since the majority of ski resorts in the state did not evidence a growth trend in the 1990s, it seems unlikely that Blacktail Mountain's visitation will grow significantly in the next ten years in the absence of expansion.

To estimate forgone producer surplus for the three ski areas, we first estimate the revenue impacts of lynx CHD. Three revenue estimates are developed for each affected ski area: *without CHD* upper and lower-bound estimates, and a *with CHD* estimate. From these estimates we can project monetary costs of CHD to each area and associated industries. In order to arrive at these estimates of costs potentially imposed on each of the resorts and associated industries it is necessary to make a number of assumptions. The assumptions made to derive the cost estimates are explained in the sections below (see Table III.4.b-1). First, we assume that visitors are distributed evenly across price categories (adult, child, student, etc.). While this may lead to an underestimate of revenue figures, such bias may, at least in part, be counter-balanced by the fact that many skiers are likely to have multi-day discount passes, a factor not taken into account here. Second, since 35 percent of the state's population resides in our study area counties, and since area residents presumably visit the ski areas more often than non-residents, we assume that half of the skiers are from in-state and half from out-of-state. If we assume that 70 percent of in-state visits are from area residents, then 65 percent of the visits to the ski areas are from non-residents of the area. Therefore, 65 percent of visits are considered to bring export earnings to the local economy. Finally, we also assume that one-half of non-residents of the study area rent their ski equipment, and that when they rent, they do so for all three items (boots, skis, and poles).

Table III.4.b-1: Assumptions made in calculating changes in producer surplus

Ski area	*CHD*	*Upper-bound*	*Lower-bound*
All		Pre-tax profit margin is 7.1 percent	
Teton Pass	- visitation remains 6000/yr - visitors distributed evenly across price categories - 65% of visits are from non-residents of study area - ½ of visitors rent equipment	- visitation remains 230.8/run/yr - 3 acres/run; 13 new runs - 65% of visits are from non-residents of study area - visitors distributed evenly across price categories - ½ of visitors rent equipment - 3 new lifts start operation in 2005, '08, and '11 - lift ticket prices increase 10% each time new lift opens - prices of equipment rental rise by $1 w/ each new lift	- see left - see left - see left - see left - see left - 2 new lifts start operation in 2005 and '08 - see left - prices of equipment rental rise by $1 w/ each new lift
Blacktail Mt	- visitors distributed evenly across price categories - 65% of visits are from non-residents of study area - visitation grew at 1%/year from 2000-04 - visitation continues to grow at 1%/year through 2013 - ½ of visitors rent equipment	- will build 2 new lifts and 23 new runs - 65% of visits are from non-residents of study area - visitors distributed evenly across price categories - visitation grew at 1%/year from 2000-04 - from 2005 visits will remain 1,312/run/yr - lift ticket prices increase 10% each time new lift opens - ½ of visitors rent equipment - prices of equipment rental rise by $1 w/ each new lift - lodge expansion by 8,620 sq ft	- will build 1 new lift and 11 new runs - 65% of visits are from non-residents of study area - visitors distributed evenly across price categories - visitation grew at 1%/year from 2000-04 - from 2005 visits will remain 1312/run/yr - lift ticket prices increase 10% with new lift - ½ of visitors rent equipment - prices of equipment rental rise by $1 w/ new lift - will not expand lodge
Big Mt	- no expansion	- one quarter of extra visitors from Blacktail Mt will transfer here - 65% of visits are from non-residents of study area - ½ of visitors rent equipment	- no transfer of skiers

The categories of revenue we calculate to compare the *with* and *without* CHD scenarios are income from ski lift tickets and rentals. Prices in 2003$ were obtained from the websites of each of the ski areas and deflated to 2002$ using a rate of 2.3 percent.[118] Resorts also earn income through the sale of items such as food and souvenirs, but these are considered under the 'associated industries' section. Table III.4.b-7 compares the upper and lower-bound impact cost estimates from 2004-2013 based on the calculations described in the following sections.

Teton Pass Ski Area

Revenue without CHD, upper-bound

The upper-bound scenario anticipates that all of the proposed actions listed in the Environmental Assessment of each project (USDA FS 2003e) will be completed in the ten-year study period. These projects include the construction of three new lifts and 40 acres of new runs. As no information is available on how many runs will be constructed on those 40 acres, we assume that the new runs will maintain the current average of approximately three acres per run, leading to 13 new slopes.

We assume, in the upper-bound scenario, that visitation will rise according to the resort's goals of expansion, to 17,000 visits per year by the end of 2013 (USDA FS 2003e). We assume the number of visits will increase linearly in each year of the study period. Teton Pass currently has 26 ski runs and in 2000hosted 6,000 visits. We assume that one new lift will come into operation in each of 2005, 2008, and 2011. Each of the first two will open up six and seven new runs, respectively. The final lift will simply connect existing runs and would not involve any new slopes (USDA FS 2003e).

There are four categories of on-day lift tickets at Teton Pass; child ($11.72), student ($16.61), adult ($21.49), and senior ($11.72).[119] Therefore, following our previously stated assumption of equal visitation across price categories, the average visitor to the ski area pays $15.39 per day. It is assumed that ticket prices will rise by ten percent as each new lift opens up.[120]

The resort also raises revenue from equipment rentals. Costs are currently $11.72 for skis, $6.84 for boots, and $2.93 for poles, a total of $21.49 per day. These prices will also increase with the opening of each of the new lifts, it is assumed, by $1 per item.[121] The assumptions of rising lift ticket and rental prices are made based on the idea that ski resorts which offer a wider variety of slopes and terrain to their customers can afford to charge higher prices.

Based on these assumptions we calculate a total present value (PV) revenue for the ski area of $2,017,698 over the ten-year period, at a three percent discount rate.

Revenue without CHD, lower-bound

The lower-bound scenario assumes that only those actions classified as "immediate" in the Environmental Assessment (USDA FS 2003e) will be completed in the ten-year period. Therefore, while only two of the three lifts built in the upper-bound scenario would be constructed, all 13 runs would still be completed, as the third planned lift was not to be developed with any new accompanying runs. In this case, we assume that visitation rises with the new runs

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[118] From the Council of Economic Advisors. 2003. Economic Indicators, October 2003. *http://www.gpoaccess.gov/indicators/03octbro.html*
[119] From the Teton Pass website, *www.skitetonpass.com*
[120] Average price increases to $16.92 from 2005-07, $18.62 from 2008-10, and $20.48 from 2011-13.
[121] Raising prices to $24.49 from 2005-07, $27.49 from 2008-10, and $30.49 from 2011-13.

so as to remain at 230.8 visits/run/year. Also, the time period for construction of the new runs and lifts will remain as they are in the upper-bound condition, with the difference being that the lift built in 2011 will not be completed in this case.

Prices are assumed to again rise ten percent with each new lift.[122] Rental price increase will also be the same in 2005 and 2008 as they were in the upper-bound case. There will be no rental price increase in 2011.

These assumptions result in an estimated total PV revenue of $1,394,884 over the ten-year period at a three percent discount rate.

Revenue with CHD (no expansion)

Critical habitat designation will prevent the construction of all new slopes and ski lifts at Teton Pass (C-1). We assume that in the absence of the expansion of facilities visitation will remain stagnant at 6,000 visitors per year, as there does not appear to be an increasing visitation trend at this resort according to the SCORP (MT DFWP 2003). We will also assume that lift ticket and equipment rental prices remain stable over the next ten years. These assumptions allow us to calculate a revenue stream for Teton Pass Ski Area under the restrictions of CHD. Using a three percent discount rate, total PV revenue in the ten year study period is estimated at $869,454.

We derive estimates of lost producer surplus by multiplying lost revenue by the profit rate. Since information on the profit rate is not available for the ski resorts in our study area, we use the national average rate instead. On a national level, the average pre-tax profit margin of ski areas in the winter of 2000-2001 was 7.1 percent (SkiPressWorld 2002). Table III.4.b-2 presents the estimated foregone profits in the Teton Pass Ski Area due to CHD.

Table III.4.b-2: Foregone producer surplus at Teton Pass Ski Area under CHD

	Upper-bound	*Lower-bound*
Foregone profit	$81,525	$37,306

Project modification costs

Several planned projects, as described in the Environmental Assessment (USDA FS 2003e), are likely to be permitted to proceed under CHD, but with some modifications (C-3). It is anticipated that these modifications will also create costs to the ski area in terms of additional planning and changes to the construction schedules. The upper-bound scenario assumes that some level of modification will have to take place on five of the proposed projects which will go ahead under CHD, while the lower-bound presumes modifications will be required on three projects.

The projects requiring modification are outlined in Table III.4.b-3, along with the forecasted costs of those changes. The majority of these modifications will come in the form of delays due to the necessity for completing construction outside of the denning season. Additional costs will also be incurred from a reinitiation of the planning phase of certain projects. There are a number of planned projects which may or may not require some form of modification under CHD, but due to the fact that in a worst case scenario the activity would only have to take place in a different

[122] Prices are the same as in upper-bound condition except after that 2008 they remain at $18.62.

time of the year and most likely without any substantial increase in price, these cost increases are considered to be negligible.[123]

It was necessary to make several assumptions in deriving the costs estimates shown in Table III.4.b-3. The cost of planning the new cross-country ski course location is based on a rough estimate of average construction and planning costs of hiking trails. Trail construction costs can be highly variable, depending on such factors as terrain, vegetation, stream crossings etc. Due to the fact that this new trail cannot disturb lynx habitat, we assume that it will be constructed primarily on land that is not densely vegetated, and because it is a relatively short trail, we also assume that any stream crossings will be avoided. Using these assumptions we estimate a trail construction cost of $5 per foot, fifteen percent of which is assumed to be layout and planning costs. This places the expected modification costs at $7,524 per new trail.

The inoperable lift will be removed with or without CHD, the question being what the additional cost would be for removal outside of the denning season. In order to estimate deconstruction costs we use the cost of construction from a 1,950 ft lift built in New York state in 1987 (NY State Dept of Taxation and Finance 1987). The cost of construction for this project was $1,057,195, inflated to 2002$.[124]

Table III.4.b-3: Project modifications and forecasted costs to Teton Pass Ski Area

Upper and lower-bound			
Project	*Anticipated modification*	*Source of cost*	*Cost (PV)*
Groom and extend cross-country ski trail by 1.9 mi	Grooming of existing trail can proceed, but new mileage would have to be outside of lynx habitat	Planning for new course location	$7,524
Remove inoperable ski lift	May have to be done outside denning season	Delays, work in colder months	$29,258
Develop snowmaking capabilities w/ underground mainline and expansion of reservoir by 100,000 gal	May have to be done outside denning season	Delays, work in colder months, could become multi-year project	$106,056
Upper-bound only			
Project	*Anticipated modification*	*Source of cost*	*Cost*
Expansion of the lodge by 4310 sq ft	Would have to be done without altering any lynx habitat	Redrawing plans for expansion	$61,418
Remove 690 ft "Mighty Mite" lift and replace w/ new 1350 ft lift	Length of new lift can't be longer than old one if it would disturb lynx habitat. May have to be done outside denning season	Delays, work in colder months	$14,034
TOTAL		*Upper-bound*	$211,932
		Lower-bound	$138,677

If we assume costs for deconstruction are one-quarter that of construction, and that the cost is proportional to the length of the lift, then the 1,440 ft inoperable lift would cost $195,052 to deconstruct in the absence of CHD. We assume that this cost will increase by 15 percent under

[123] These projects include paving of the parking lot and connecting the rental facility to the lodge.
[124] Using a 1987-2002 cumulative inflation rate of 58.5 percent from ***http://inflationdata.com/inflation/inflation_rate/InflationCalculator.asp***

CHD due to the possibility of inclement weather and the narrow window of time between the end of denning season and the beginning of ski season. Therefore, the additional modification costs are estimated at $29,258. We use this same set of assumptions to estimate the additional cost of removing the 690 ft "Mighty Mite" lift and replacing it with a new lift. These assumptions lead to a modification cost of $14,034 for the lift that are attributable to CHD.

The development of snowmaking capabilities and expansion of the reservoir to double its capacity to 200,000 gallons will have to be performed in a manner that minimizes disturbance to lynx. This, most likely, will mean work will have to be performed outside of the denning season. As costs of such an operation can be somewhat variable, we base our anticipated cost on data from a planned snowmaking project at Pajarito Mountain resort in New Mexico.[125] This resort forecasts a cost of $502,000 for the installation of snowmaking equipment and construction of a 15 acre-ft (4.9 million gallons) reservoir. If we assume the costs to be proportional to the size of the project, and since Pajarito will be making snow for 1.42 times the number of runs (37 vs. 26) found at Teton Pass, Teton Pass' cost would be approximately $353,521 in the absence of CHD. With designation, however, it is likely that this project will have to be completed outside of denning season to avoid disturbance. We assume that the expected cost of the project is raised by 30 percent in this case due, again, to the strong possibility of inclement weather, but also to the short window of time between the end of denning season and the freezing of the ground, as well as the start of the ski season, which makes it likely that the project will take more than one year for completion. This results in a CHD-attributable cost increase of the project by $106,056.

While the proposed expansion of the lodge by 4,310 ft is a project that falls in the "immediate" category, we assume for our lower-bound scenario that no lynx habitat would be affected under the current plans, and thus no modification costs would be incurred. Our upper-bound scenario, however, assumes that the current plans will impact lynx habitat and that the project will need to be modified in order to proceed. If we assume construction costs to be $95 per square foot,[126] the total cost of this project would be about $409,450. If we assume 15 percent of this cost is for planning, then the additional costs of modification will be $61,418.

Finally, we will assume that all modification costs are incurred in the first year of the study period, therefore only requiring the totals to be discounted by one year. These assumptions and estimates bring the total modification costs to Teton Pass from CHD to $213,152 in the upper-bound scenario and $139,635 in the lower-bound scenario.

These figures represent the costs incurred to Teton Pass due to required project modifications. The impacts to the study area, however, are somewhat different. The difference arises from the fact that a portion, if not all, of the increased work effort caused by these modifications will be performed with local inputs, thus simply transferring resources from one sector of the study area (ski resorts) to another (industries providing the inputs). These transfers reduce the cost of the modifications to the study area. In our upper-bound scenario we assume that only 25 percent of the increased costs from modifications are received as payment by local companies and residents, thus making the costs to the study are one-quarter smaller than the costs to Teton pass. The lower-bound scenario assumes that 75 percent of these costs are for services performed by companies within the study area. Therefore, the net costs to the study area of these project modifications are as described in Table III.4.b-4.

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[125] An Approach to Snowmaking for Pajarito. ***http://www.skipajarito.com/snowmaking_approach.html***. Accessed December 17, 2003.

[126] Based on average home construction costs on ***http://www.b4ubuild.com/***

Table III.4.b-4: Net costs to the study area from Teton Pass project modifications required by CHD

	Upper-bound	*Lower-bound*
Net costs of project modifications	$158,949	$34,669

Note: PVs at three percent discount rate.

Blacktail Mountain Ski Area

Revenue without CHD, upper-bound

Since we do not have specific information regarding planned expansions, only that they are likely to occur, the upper-bound scenario anticipates that Blacktail Mountain will attempt to expand to the level where it will have the same number of runs and lifts as the visit leaders in the "regional ski area" category, as defined by the SCORP (MT DFWP 2003). This calls for the construction of two new lifts and 23 additional runs.

We assume that visitation rise in proportion to expansion. Blacktail Mountain currently has 23 ski runs and hosted 29,000 visits in 2000 (MT DFWP 2003).[127] This resort is unique in the study area in that it exhibited an upward trend in number of visits from 1998-2000 (MT DFWP 2003). Therefore, we do not assume that visitation has remained stagnant since 2000, but rather, that it has grown at the rate of one percent per year, and will reach 30,176 visits in 2004, an average of 1,312 visits per run per year. We assume that as the number of runs increases the average visits per run per year will remain at 1,312. We assume that one new lift will come into operation in 2005 and another in 2008, and that 11 runs will accompany the first lift, and 12 will be developed with the second. It is also assumed that ticket prices will rise by ten percent as each new lift opens up.[128] There are currently four categories of one-day lift tickets at Blacktail Mountain; child ($13.68), student ($21.49), adult ($32.24), and senior (free). Therefore, the average visitor to the ski area pays $16.85 per day. Equipment rental costs per day are currently $17.59 for skis (the average between the cost of regular and high performance skis), $6.84 for boots, and $2.93 for poles, a total of $27.36.[129] These costs also increase with the arrival of each of the new lifts, it is assumed, by $1 per item.[130] These assumptions result in an estimate a total revenue of $10,265,692 over the ten year study period at a three percent discount rate.

Revenue without CHD, lower-bound

The lower-bound scenario assumes that approximately half of the developments will occur that would take place in the upper-bound scenario. Therefore, 11 new runs and one new ski lift would be constructed. Again, the assumption is made that visitation will rise with the new runs so as to remain at 1,312 visits/run/year. Also, the time period for construction of the new runs and lift remain as they are in the upper-bound condition, with the difference that the lift built in 2008, and the runs that go with it, will not be completed in this case. The assumption that visitation has grown to 30,176 by 2004 also remains unchanged.

[127] From the Blacktail Mountain website, *www.blacktailmountain.com*
[128] Average price increases to $18.54 per day from 2005-07, and to $20.39 per day from 2008-13.
[129] Costs of lift tickets and rental equipment are from the resort's website, *www.blacktailmountain.com*.
[130] Raising prices to $30.36 per day from 2005-07, and to $33.36 per day from 2008-13.

Lift ticket prices are assumed to again rise ten percent with the new lift.[131] Equipment rental price increases are the same in 2005 as they are in the upper-bound case, and will remain at that level for the remainder of the study period. These assumptions permit us to estimate a total revenue of $7,972,279 over the ten year period at a three percent discount rate.

Revenue with CHD (no expansion)

Critical habitat designation will prevent the construction of all new trails and ski lifts at Blacktail Mountain as well. We assume that the one percent per year growth in visitation expected since 2000 in the absence of expansion will remain stable throughout the ten year study period.[132] As we did in the case of Teton Pass, we again assume that lift ticket and rental equipment prices remain stagnant over the next ten years. These assumptions allow us to estimate a revenue stream for Blacktail Mountain Ski Area under the restrictions of CHD. Using a three percent discount rate we estimate a total revenue of $5,325,548 in the ten year study period. Foregone producer surplus is derived by multiplying foregone revenues by the average national pre-tax profit margin of ski resorts, 7.1 percent (see Table III.4.b-5).

Table III.4.b-5: Foregone producer surplus at Blacktail Mt. Ski Area due to CHD

	Upper-bound	*Lower-bound*
Foregone profit	$350,750	$187,918

Note: PVs at three percent discount rate.

Project modification costs

Since there are currently no official plans for expansion at Blacktail Mountain, we are unsure whether an expansion of ski slopes would be accompanied by increased development of the lodge facilities. Therefore, our upper-bound scenario assumes that there will be plans to expand the lodge within ten years and that this project will be permitted after consultation, but will require some modification. We assume an expansion of twice the size of that projected at Teton Pass, or 8,620 square ft. Using the same assumption of $95 per square foot, we reach a total cost of $818,900 without CHD. If we again assume that planning costs make up 15 percent of this, then the cost of reinitiating the plans will be up to $122,835. At a three percent discount rate this cost is $119,257. As we did with the modification costs at Teton Pass, we must again consider how much of this cost to Blacktail Mountain constitutes also a cost to the entire study area or whether it is merely a transfer among sectors within the area. In our upper-bound scenario, we again assume that 25 percent of the inputs required for the modification are provided by firms in the study area, thus reducing the upper-bound impact to $89,443 at a three percent discount rate. The lower-bound scenario assumes no lodge expansion and therefore no modification to projects and no associated costs.

Big Mountain Ski Area

This resort, the largest of the three in the study area, has no current plans for expansion in the foreseeable future (Michael Moffite, personal communication). Therefore, there will be no

[131] Prices will average $18.54 per day from 2005-13.
[132] Visitation will then be 30,176 in 2004 and will increase to 33,003 in 2013.

physical impacts to the resort in terms of foregone trail or lift expansion, and there will be no costs associated with the designation of critical habitat.

While we are not projecting any expansion of lifts or runs at Big Mountain, we do expect that this resort may benefit from CHD in the form of transferred skier activity days. While we have not anticipated a growth in visitation at Teton Pass in the absence of expansion during the study period, we do predict that Blacktail Mountain will continue to grow in terms of visitation. Our lower-bound estimate assumes that one-quarter of the increased visitors at Blacktail Mountain will be displeased with the increased crowding that is expected to occur under CHD and will move their skiing activity to Big Mountain, a resort with extra capacity at present. The rest will either stay at Blacktail Mountain or move to other resorts outside of the study area. These transfers will result in a total of 2,207 extra visits throughout the ten year period. Using the same assumptions as were employed in calculating the costs of foregone revenue for the other two resorts we can calculate what the increased revenue for Big Mountain would be from these transfers. The average cost of one-day lift tickets is currently $36.54. We assume that one-half of visitors rent equipment, which costs an average of $16.61 per day for skis, poles, and boots.[133] These assumptions bring our estimate of increased revenue to $79,844 with a three percent discount rate. The upper-bound scenario remains unaffected by displaced skiers, as we assume, in that case, that these skiers will relocate their skiing to resorts outside of the study area. The expected profit gains for Big Mountain from CHD are shown in Table III.4.b-6.

Table III.4.b-6: Producer surplus *gains* by Big Mt. resort under CHD

	Upper-bound	*Lower-bound*
Profit gain	$0	+ $5,669

Note: PV at three percent discount rate.

Skiers

If the absence of expansion of ski trails were to lead to a significant increase in the crowding on slopes, it could be assumed that skiers would lose a certain amount of enjoyment from the experience and would suffer a loss in consumer surplus. In the case of the Montana study area, however, there is no clear pattern of increasing visitation at two of the three ski resorts. While there may be some loss of consumer surplus to skiers visiting Blacktail Mountain if its trend of rising visitation continues over the next ten years, it is likely that the loss of enjoyment will be minor, particularly considering the vast array of alternatives in ski areas in the western part of the state outside of the study area. Rosenberger and Loomis (2001) estimate average consumer surplus for downhill skiers in this region of the United States to be $37.91 per activity day.[134] We have assumed that visitation to Blacktail Mountain increases by one percent per year, making visitation in 2013 ten percent greater than in 2003. Only the skiers at Blacktail Mountain will be affected by an increase in visitation. To quantify the lost enjoyment on the part of skiers due to increased crowding we use an index of decreasing benefits per activity day based on the number of other recreationists encountered, as presented by Loomis and Walsh (1997). Since Loomis and Walsh do not present a value specifically for downhill skiing, we will use the index they have produced for trail activities in general. It should be noted that this is not a perfect method and may overstate the consumer surplus loss due to the fact that the index from Loomis and Walsh

[133] From the Big Mountain Resort website; ***http://www.bigmtn.com/***
[134] Inflated from $33.02 in 1996$ using inflation rate of 14.8 percent from 1996 to 2002 from ***http://inflationdata.com/inflation/inflation_rate/InflationCalculator.asp***

(1997) is for trails in wilderness areas.[135] It is unlikely that skiers' benefits will diminish as rapidly since they were most likely not expecting a "wilderness experience" on the slopes to the same degree as a hiker or cross-country skier.

If we assume that skiing is taking place at Blacktail Mountain for four months of the year, that skier activity days are divided among morning, afternoon, and evening, and if we assume that skiers will use an average of half of the 23 runs at the resort in an activity day, it is possible for us to estimate how perceived crowding, in terms of number of other skiers encountered, increases over the years. As crowding increases, the index of benefits, derived from Loomis and Walsh (1997), declines.[136]

These assumptions lead to an estimated decline in consumer surplus of $0.62 per activity day by 2013 in the upper bound, and just $0.31 in the lower-bound. When multiplied by the number of visits over the next ten years, however, the loss is more substantial, resulting in a decline in total consumer surplus of $82,054 in the upper-bound scenario, or $41,168 in the lower-bound over the ten-year period.

Table III.4.b-7: Valuation of total costs to the downhill ski industry

Impact type	*Upper-bound*	*Lower-bound*
	2002$ (PV 2003)	
Teton Pass		
Foregone PS (C-1)	$81,525	$37,306
Modifications (C-3)[1]	$158,949	$34,669
Blacktail Mt.		
Foregone PS (C-1)	$350,750	$187,918
Modifications (C-3)[1]	$89,443	$0
Big Mt.		
Foregone CS (B-1)	$0	- $5,669
Skiers		
Foregone CS (C-2)	$82,054	$41,168
TOTAL	$762,722	$295,392

Notes: [1] We assume all modification costs are incurred in 2004, and thus are only discounted one year. PS - producer surplus; CS - consumer surplus.

Snowshoeing

As discussed in the previous section on potential incremental impacts of critical habitat designation on winter recreation activities, we do not anticipate that CHD will have a significant economic impact on snowshoeing activity in the study area. It is possible that restrictions on use of certain areas by snowshoers could go into effect under designation, but due to the fact that participants are still relatively few and because they do not require a network of groomed,

[135] The index for 0 people encountered is 1.00, or no loss of consumer surplus. If 5 people are encountered, the index decreases to 0.89, or 89% of the consumer surplus value at 0 other people. It continues to decrease to 0.79 at 10 people, 0.70 at 15, 0.60 at 20, and finally 0 for 25 other recreationists encountered.
[136] Loomis and Walsh present figures only for additional individuals encountered on the trails in multiples of five. The average numbers of people/hour/trail do not increase by such large amounts, requiring us to extrapolate the estimated index of lost consumer surplus using the average change per person (or fraction of person) between each of the categories given by Loomis and Walsh.

compacted trails, we expect that restrictions will be minimal and will affect only a very small portion of the recreationist population. If participation in this activity grows substantially in the future, however, it is possible that snowshoe use will have to be restricted in more areas and that increased crowding could result, causing a loss of consumer surplus. It is also possible that the popularity of snowshoeing could increase significantly in the near future, making restrictions necessary. Therefore, for any studies projecting costs beyond the end of our study period, it may be necessary to re-examine impacts of CHD on snowshoers.

Cross-country skiing

Section III.3.c., on incremental impacts of CHD on winter recreation, explained that we anticipate the primary costs incurred from designation, apart from increased consultation efforts on the part of the land managing entity, to be in the form of lost consumer surplus on the part of participants due to an increase in crowding as the sport gains participants but no new trails are constructed in the region.

In the incremental impacts section of this report we anticipated that with designation of critical habitat crowding would increase annually until it reached 73 skiers/mile/year. As an upper-bound scenario this would compare to a steady 67 skiers/mile/yr in each year of our study period. The lower-bound scenario predicted that trail construction would not keep up with increasing participation in the absence of CHD, but that it would only increase at half that rate. This scenario anticipated fifteen new miles of trail would be built in the ten years, rather than 30 as in the upper-bound scenario. This lower-bound predicts a density level of 69 skiers/mile/year by 2013. Based on our assumption that participation will increase proportionally as population grows, with critical habitat designation crowding on the trails will increase by 8.8 percent over its present condition in the ten years of the study period. This is equivalent to less than six extra skiers using each mile of trail in the year 2013 versus 2003.

Rosenberger and Loomis (2001) estimated consumer surplus for skiers to be $28.59 per activity day in this region.[137] Estimates of percentage of residents and visitors who participate, and the frequency with which they do so, from the SCORP (MT DFWP 2003) allow us to calculate the number of activity days for each of the ten years of the study period. Five percent of Montana residents cross-country ski with a mean frequency of 9.5 times per month during the winter months[138] (38 times per year), while 0.4 percent of visitors participate, and we assume they do so at a frequency of one-tenth that of residents, 3.8 times per year. As was explained in the incremental impacts section, 35 percent of cross-country ski trails are located in the northwest region of the state (MT DFWP 2003), and since the study area covers approximately 2/3 of this region, we assume that 23.3 percent of all cross-country skiing in the state occurs in the area. These numbers and assumptions lead us to a prediction of an average of almost 467,000 cross-country skiing activity days in each of the ten years of our study period, or a total of nearly 4.7 million activity days.

Consumer surplus on the part of cross-country skiers decreases as a function of increasing density of skiers on the trails. Loomis and Walsh (1997) describe the effects of congestion on consumer surplus in several outdoor recreation activities by assigning an index of benefit change as a

[137] Inflated from $24.90 per day in 1996$ using inflation rate of 14.8 percent from 1996 to 2002 from *http://inflationdata.com/inflation/inflation_rate/InflationCalculator.asp*

[138] The *frequency of participation* figures in the SCORP are frequencies just during the months of the season in which people participate in those activities (Walter Timmerman personal communication).

function of the number of other recreationists encountered on the trail.[139] From the information we derived previously on approximate number of activity days in each year of the study period, and the information we have on number of trails in the study area, we can estimate how crowded the trails are, and how crowded they will be in the future with and without CHD. Currently, there are 292 miles of cross-country trail in this region. If we assume cross-country skiing is taking place during four months of the year, and during an average of six hours per day, and if we also assume that an average trail is three miles long, then we arrive at figures of people/hour/trail for each of the years of our study period.[140] As this number increases, the consumer surplus value of $28.59 per day will decrease by the corresponding index figure from Loomis and Walsh (1997).[141] By multiplying the consumer surplus per person derived here by the number of activity days, we arrive at a total consumer surplus figure. The process is then repeated to find total consumer surplus for the upper-bound scenario without CHD (where it remains at $28.59/person since trail construction keeps up with increased participation), and for the lower-bound scenario without CHD (where trail construction is carried out at half the rate of the upper-bound scenario).

These assumptions lead to a decline of just $0.39 in consumer surplus per activity day by 2013 in the upper-bound scenario by the end of ten years and a loss of $0.20 in the lower-bound scenario. While the individual loss of consumer surplus would hardly seem noticeable to participants, the large number of activity days expected in the next ten years make the figure of cumulative lost consumer surplus significant. The estimates of this cumulative loss of value over ten years are displayed in Table III.4.b-8.

Table III.4.b-8: Lost consumer surplus to cross-country skiers due to CHD

	Upper-bound	*Lower-bound*
Foregone Consumer Surplus	$752,501	$374,936

Note: PVs at three percent discount rate.

Snowmobiling

The previous section on incremental impacts of CHD explains that designation is expected to have negligible economic effects on snowmobiling activity. This is largely due to the pre-existing restriction on net increases in trail mileage as dictated by the LCAS. The only incremental restriction imposed by CHD would be the prevention of any additional gross trail mileage. We do not consider the potential loss of consumer surplus to participants in this case, as we did for cross-country skiers, because any increase in crowding in the next ten years is something that would occur whether or not critical habitat is designated. For a more detailed explanation of why the impacts of CHD on snowmobiling are expected to be negligible, please refer to section III.3.c, ***Projections of future development of land use activities and incremental***

[139] The index for 0 people encountered is 1.00, or no loss of consumer surplus. If 5 people are encountered, however, the index decreases to 0.89, or 89% of the consumer surplus value at 0 other people. This number continues to decrease to 0.79 at 10 people, 0.70 at 15, 0.60 at 20, and finally reaches 0 at 25 other recreationists encountered.
[140] We are assuming here that all skiers utilizing the same 3 miles of trail in the same hour will run into each other.
[141] Loomis and Walsh present figures only for additional individuals encountered on the trails in multiples of five. The average numbers of people/hour/trail do not increase by such large amounts, requiring us to extrapolate the estimated index of lost consumer surplus using the average change per person (or fraction of person) between each of the categories given by Loomis and Walsh.

impacts of CHD for the lynx. Our finding of negligible expected impacts is in line with the FS's own assessment that there would be imperceptible economic impacts as a result of proposed restrictions on snowmobiling on Flathead NF lands that would reduce the areas open to snowmobiles by 33 percent compared to current levels, and would reduce the total area of open and commonly used snowmobile terrain by approximately ten percent (USDA FS 2003b:2-14).

Associated industries

There are a number of industries in the study area which depend, at least in part, on winter recreation tourism. These include, but are not limited to, restaurants, hotels, outfitters, and grocery stores. Designation of critical habitat has the potential of reducing the growth rate of visitation to the area by winter sports enthusiasts compared to the *without CHD* case, thus reducing the revenue these associated industries would earn compared to the revenue they would generate in the absence of CHD. In order to estimate the impact that critical habitat designation will have on these industries we need to project estimates of the number of activity days across all winter recreation activities in the absence of CHD and with CHD. We also need to know how much money the average visitor spends per activity day.

When estimating the impacts on these industries, we only consider those recreationists who are coming from outside of the study area counties, both from Montana and from the rest of the country, because we assume that local residents will continue to recreate locally. For downhill skiing we use the total visitation numbers as activity days for that sport and follow the assumptions outlined in the section above to predict upper and lower-bound estimates of numbers of visits each year in the absence of CHD as well as a visitation estimate under CHD. In order to determine how many of these visitors are from outside of the area we assume, as we did in evaluating the foregone profits of downhill skiing, that since the counties of the study area contain approximately 35 percent of the state's population and because it is more likely that locals engage in these activities in the study area more often, we assume that 70 percent of state resident activity days for downhill skiing are by local residents. We further assume that 50 percent of visitors to the ski areas are Montanans and 50 percent are from out-of-state. Therefore, since 30 percent of activity days are from state residents from outside of the study area, 65 percent of all activity days are from non-residents.

To estimate non-resident snowmobile and cross-country skiing activity days, we use the percent participation figures for Montanans and visitors, and the frequency of participation given in the SCORP (MT DFWP 2003) to determine the number of activity days from in and out-of-state. Figures on frequency of participation are given only for state residents, requiring us to use information on snowmobiling from Sylvester (2000) indicating 3.5 activity days per non-resident. This data is not available for cross-country skiing, for whom we assume a frequency of one-tenth that of residents, or 11.4 activity days per year. We again assume that 30 percent of the in-state activity days are from those who do not live in the of the study area counties.

As explained in the previous sections, we do not predict a change in activity days among cross-country skiers or snowmobilers with or without CHD, due to the large quantity of trails which already exist for these activities and because of the great scenic beauty of the region. Therefore, the change in overall activity days is attributable to the foregone expansion of the ski areas. Table III.4.b-9 shows the predicted total winter recreation activity days from non-residents of the study area in each year with and without CHD.

Table III.4.b-9: Winter recreation activity days for non-resident visitors of the study area

Year	*CHD*	*Without CHD* *upper-bound*	*lower-bound*
2004	476,595	476,596	476,596
2005	479,529	489,509	489,615
2006	482,442	493,020	492,331
2007	485,354	496,530	495,047
2008	488,267	510,274	498,814
2009	491,179	513,785	501,530
2010	494,751	517,955	504,906
2011	497,899	521,702	507,858
2012	501,048	525,448	510,810
2013	504,196	529,195	513,763
TOTAL	4,901,261	5,074,012	4,991,269

To estimate what this difference in activity days might mean to local businesses in terms of foregone revenue we use spending estimates derived by the University of Montana's Institute for Tourism and Recreation Research (ITRR) from tourist surveys. Table III.4.b-10 breaks down the average daily spending of vacationing visitors to the state by category. The ITRR tabulated spending by group, with an average group size of 2.44 people.

Table III.4.b-10: Average daily expenditures by vacationing visitors to Montana

Spending Category [1]	*Average Daily Expenditures* *group (mean = 2.44 people)*	*individual*	*Local production %*	*RIMS II Final Demand earnings multipliers*
Gasoline, oil	$25.80	$10.57	0	0.38
Retail sales	$29.79	$12.21	100	0.78
Restaurants, bars	$27.52	$11.28	100	0.58
Hotels, B&Bs	$21.14	$8.66	100	0.57
Grocery	$11.81	$4.84	10	0.35
Auto rental, repair	$4.64	$1.90	85	0.85 [3]
Outfitters, guides	$7.24	$2.97	100	0.76 [4]
Campgrounds	$3.92	$1.61	100	0.57 [5]
Transportation fares	$0.13	$0.05	100	0.72
Misc.	$2.12	$0.87	10	0.73
TOTAL	$134.11	$54.96	70.9 [2]	0.66

Note: [1]The category of "licenses and entrance fees" ($5.2 per group, or 3.7 percent of total average daily expenditures) has been left out because much of this money goes to federal or state entities and in fact leaves the area. [2] Weighted. [3] Multiplier for business services. [4] Multiplier for personal services. [5] Multiplier for Hotels and lodging places and amusements.
Sources: Daily expenditures from the University of Montana Institute for Tourism & Recreation Research (2003). Local production shares from Stynes (1999), except *Auto rental, repair*, *Outfitters, guides*, *Campgrounds*, and *Transportation fares*. RIMS II earnings multipliers are from Chang (1998) and Stynes (1999), rounded to two digits.

If we assume that Montana residents from outside of the study area have the same spending habits as non-resident visitors, and use this total individual daily expenditure as an estimate of money spent per activity day, we can calculate estimates of foregone revenue by local businesses during the ten year study period. We make the assumption, since we are dealing with activity days and not numbers of visitors, that there is no overlap of activity days between activities.

In other words, we are assuming that no participants have an activity day of snowmobiling and an activity day of downhill skiing, for example, on the same calendar day. This is probably not always true, but as a generalization it is likely to hold in the majority of cases.

To estimate the impact on the local economy of reduced visitor spending resulting from reduced visitor numbers, we correct the average daily expenditures per visitor in each spending category by the estimated local production rate of that spending category. This “capture rate” expresses the share of sales value in that category that is produced locally. In the absence of published information on capture rates for our study area, we use the values given for Michigan by Stynes (1999; see Table III.4.b-10). Since the capture rate generally increases with the geographical extension of what is considered the “local” economy, the actual capture rates in our study area are likely to be smaller than those reported by Stynes. This introduces an upward bias into our impact estimates. However, in the absence of information on the relationship between size of impact area and capture rate, it is not possible to make informed adjustments to the individual capture rates. The overall capture rate in our study area is estimated to be 71 percent (see Table III.4.b-10), that is, of every tourist dollar spent in the area 71 cents are paid for local inputs or retail margins.

These local inputs in turn stimulate the local economy through their associated multiplier effects. In order to estimate the total (direct and indirect) net impact of the forgone skiing-related visitor spending in terms that are equivalent to the consumer surplus loss estimates and ski area producer surplus loss estimates developed above, we convert the estimated local economy revenue losses from reduced visitor spending by using the Bureau of Economic Analysis’ RIMS II final demand earnings multipliers. These multipliers allow the conversion of our estimates of demand change (i.e., foregone captured visitor spending) into the total forgone local household earnings associated with that demand change (US Department of Commerce 1997).

Lacking the RIMS II sectoral final demand earnings multipliers for Montana, we use those for Michigan (see Table III.4.b-10). The resultant overall final demand earnings multiplier in our study area is estimated at 0.66, implying that the average dollar of locally captured visitor spending results in 66 cents of additional earnings for local households. Since the magnitude of a multiplier effect is positively related to market size (Hughes 2003) the multipliers we use in this study likely are too large and therefore result in overestimates, because of the comparatively small size of our study area economy compared to the Michigan economy. For comparison, the overall personal earnings multiplier of the tourism sector in Michigan has been estimated at 0.6 (Chang) and 0.66 (Stynes 1999), while that of Vermont’s tourism sector has been estimated at 0.55 (the latter using IMPLAN, not RIMS II) (University of Vermont, Department of Community Development and Applied Economics et al. 1999).

Multiplying the estimated lost local earnings per foregone visitor day, $25.8 per day, by the projected upper-bound and lower-bound estimated reductions in visitor days (see Table III.4.b-9) as a result of CHD, and summing the discounted foregone annual earnings over the projection period (2004-2013) yields the estimated total forgone earnings to the study area from reduced visitor spending due to CHD (see Table III.4.b-11).

These amounts will reduce the lower-bound estimate of the costs of CHD on associated industries. This leads to the predictions of foregone revenue to the industries associated with winter recreation displayed in Table III.4.b-11.

We expect that these numbers overestimate the true winter recreation-related costs to the local economy from CHD, not only for the reasons described in the preceding paragraphs, but also because a significant amount of this revenue may still flow to the area if critical habitat is designated. This is due to the fact that we cannot account for visitors who come to the study area for more than just these recreational activities and would continue to visit, even if they didn't engage in winter sports activities.

Table III.4.b-11: Estimated foregone total earnings (RIMS II) to Montana study area from reduced visitation days associated with potential CHD impacts on winter recreation

	Upper-bound	*Lower-bound*
Foregone total earnings to study area	$3,773,391	$1,981,163

Notes: PVs at three percent discount rate. The lower-bound estimate includes the expected visitation increases in the Big Mountain resort (a total of 1,433 visitor days over the ten year period).

It is possible that with lynx critical habitat designation, and presumed subsequent recovery of their numbers in the study area, that lynx-based tourism could emerge in the area. While it is uncertain whether or not such an industry could be created due to the elusive nature of the species, it should be noted here that this ecotourism potential could exist. While we will not quantify any potential tourism benefits from this activity here, if such a tourism sector were to emerge, an economic benefit to local service industries would arise along with it.

Total costs to winter recreation

The total potential costs to winter recreation of critical habitat designation for lynx in our Montana study area are illustrated below in Table III.4.b-12.

Table III.4.b-12: Total non-consultation opportunity costs of CHD to winter recreation in Montana study area

Activity	*Upper-bound*	*Lower-bound*
Alpine ski area foregone CS	$82,054	$41,168
foregone PS	$432,276	$219,555
modification costs	$248,392	$34,669
Cross-country skiing foregone CS	$752,501	$374,936
Associated foregone local earnings	$3,773,391	$1,981,163
TOTAL	$5,288,613	$2,651,491

Note: All PVs, using a three percent discount rate. CS and PS stand for consumer and producer surplus, respectively.

Summer recreation

The following sections detail all assumptions and calculations necessary to arrive at estimates of the potential costs to summer recreation activities and industries which may accompany designation of lynx critical habitat. As in the winter recreation section above, each sub-section of summer recreation activities below reflects only the direct costs to that sector.

Hiking

The primary categories of costs related to non-motorized trail activities due to CHD are expected to be from increased consultation efforts on the part of land managing entities and from a loss of consumer surplus to hikers from increased crowding of trails if new trail construction is prohibited yet participation continues to grow.

To estimate the loss of consumer surplus we use the predictions of increasing density of hikers that were derived in the incremental impacts section. With a 37 percent participation rate among state residents and a 12.4 percent rate among visitors, we anticipate that with designation of critical habitat, crowding would increase linearly from 71.4 hikers/mile/year in 2004 to 77.9 hikers/mile/year in 2013. The upper-bound scenario presumes that in the absence of CHD new trail construction will not keep pace with the growing number of participants, but rather at half this rate, leading to the construction of 250 miles of new trail in the ten year study period. Under these conditions, density of hikers on the trails will grow to at 74.5 hikers/mile/year by 2013. The lower-bound anticipates new trail construction will proceed at half the rate of the upper-bound scenario, leading to a density in 2013 of 76.2 hikers/mile/year. Based on our assumption that participation will increase proportionally as population grows with critical habitat designation, crowding on the trails will increase by 4.5 percent over its present condition in the ten years of the study period in the upper-bound case, and by 2.2 percent under the lower-bound assumptions.

The estimate of consumer surplus for hikers in this region, according to Rosenberger and Loomis (2001), is $36.56 per activity day.[142] The estimates of percentages of residents and visitors of the state who participate in hiking, and the frequency with which they do so, provided by the SCORP (MT DFWP 2003) allow us to calculate an approximate number of activity days for each of the ten years of the study period. Thirteen percent of Montanans engage in hiking and 12.4 percent of visitors hike while in the state. The frequency of participation is not provided in the outdoor recreation plan, only a frequency of participation for walkers is given, 13.6 times per month. Since walking is an activity that the majority of people participate in, it seems unlikely that participants take part in hiking with nearly this frequency. Therefore, we assume that hiking makes up only ten percent of the walking activity. We will also assume that trail hiking only takes place during the spring, summer, and fall, or nine months of the year.[143] Therefore, we deduce that hikers participate in this activity with a mean frequency of 1.4 times per month, or 12.6 times per year. It is assumed that the frequency of visitor participation is one-tenth this amount, or 1.26 times per year. The inventory numbers provided in the outdoor recreation plan indicate that 34.3 percent of the state's hiking trails are in the northwest section of the state, and since our study area covers approximately two-thirds of this region, we assume that 22.9 percent of the state's hiking takes place in the study area. These numbers allow us to arrive at an estimate

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[142] Inflated from $31.85 in 1996$ using inflation rate of 14.8 percent from 1996 to 2002 from *http://inflationdata.com/inflation/inflation_rate/InflationCalculator.asp*

[143] The participation frequencies of activities per month indicated in the State Comprehensive Outdoor Recreation Plan do not reflect year-round averages, but rather frequencies during the months in the season of that type of activity (Walter Timmerman, personal communication).

of more than 1.4 million activity days per year, or over 14 million hiking activity days during the ten year study period.

Consumer surplus on the part of hikers decreases as a function of increasing density of hikers on the trails. Loomis and Walsh (1997) describe the effects of congestion on consumer surplus in several outdoor recreation activities by assigning an index of benefit change as a function of the number of other recreationists encountered on the trail.[144] From the information we derived previously on approximate number of activity days in each year of our study period and the information we have on number of trails in the study area, we can estimate how crowded the trails are, and how crowded they will be in the future with and without CHD. Currently, there are 4,864 miles of hiking trail in this region. If we assume hiking is taking place during nine months of the year, and during an average of six hours per day, we arrive at figures of people/hour for each of the years of our study period.[145] As this number increases, the consumer surplus value of $36.56 per day decreases by the corresponding percentage.[146] By multiplying the consumer surplus per person derived here by the number of activity days, we arrive at a total consumer surplus figure. The process is then repeated to find total consumer surplus for the upper-bound scenario without CHD, and for the lower-bound scenario without CHD.

These assumptions result in an estimated decline of a mere $0.02 in consumer surplus per activity day by 2013 in the upper-bound scenario and a loss of less than one cent in the lower-bound scenario. While the loss of individual consumer surplus would surely be imperceptible to individual participants, the large number of activity days expected in the next ten years make the cumulative lost consumer surplus somewhat more significant. This cumulative loss of value over ten years is estimated at approximately $38 thousand to $100 thousand (Table III.4.b-13).

Table III.4.b-13: Estimated forgone consumer surplus to hikers due to CHD

	Upper-bound	*Lower-bound*
Foregone Consumer Surplus	$100,434	$37,593

Note: PVs, using a three percent discount rate.

Camping

This section will consider the costs to both tent and RV camping due to CHD. The primary categories of costs related to this activity are expected to be from increased consultation efforts on the part of land managing entities and from a loss of consumer surplus to campers from increased crowding of sites if new construction is prohibited yet participation continues to grow.

[144] The index for 0 people encountered is 1.00, or no loss of consumer surplus. If 5 people are encountered, however, the index decreases to 0.89, or 89% of the consumer surplus value for 0 other people. This number continues to decrease to 0.79 at 10 people, 0.70 at 15, 0.60 at 20, and finally reaches 0 for 25 other recreationists encountered.
[145] We are assuming here that all skiers utilizing the same 3 miles of trail in the same hour will run into each other.
[146] Loomis and Walsh present numbers only for additional individuals encountered on the trails in multiples of five. The average numbers of people/hour do not increase by such large amounts, requiring us to extrapolate the estimated index of lost consumer surplus using the average change per person (or fraction of person) between each of the categories given by Loomis and Walsh.

Tent camping

We assume that CHD will prevent the construction of any new campsites in lynx habitat. To estimate the loss of consumer surplus we use predictions of increasing density of campers.

With an 18 percent participation rate among state residents and a 3.6 percent rate among visitors we anticipate that, with designation of critical habitat, crowding of the campsites would increase from 250 campers/site/year in 2004 to 273 campers/site/year in 2013. The upper-bound scenario of impacts presumes that in the absence of CHD new site construction will keep pace with the growing number of participants and that density of campers will remain at 250 campers/site/year throughout the study period. The lower-bound anticipates new site construction will not keep pace with participation rates, but will only increase at half the rate of the upper-bound scenario, leading to a density in 2013 of 259 campers/site/year. Therefore, in the lower-bound condition, 16 new tent sites will be constructed in the ten years, versus 31 in the upper-bound scenario. Based on our assumption that participation will increase proportionally as population grows, with critical habitat designation crowding at the campsites will increase by 9 percent over its present condition in the ten years of the study period. This is equivalent to 22.5 extra campers using each site in the year 2013 versus 2003.

The estimate of consumer surplus for campers in this region, according to Rosenberger and Loomis (2001), is $29.70 per activity day.[147] The estimates of percentages of residents and visitors of the state who participate in camping, and the frequency with which they do so (taken from SCORP, MT DFWP 2003) allow us to calculate an approximate number of activity days for each of the ten years. Eighteen percent of Montanans engage in tent camping, with an average frequency of 2.1 times per month, or 18.9 times per year if we assume the vast majority of this activity takes place in nine months of the year.[148] While camping may still take place to some degree during the winter months, it is likely to be at a much lower frequency and those participating are not likely to suffer from any crowding effects during those months. The camping rate of visitors is 3.6 percent while in the state. We will assume that visitors engage in camping at one-tenth the rate of residents, or 1.89 times per year. The inventory numbers provided in the outdoor recreation plan indicate that 22.4 percent of the state's tent camping sites are in the northwest section of the state, and since our study area covers approximately two-thirds of this region, we assume that 14.9 percent of the state's tent camping takes place in the study area. This results in an estimated mean of almost 598,000 activity days per year, or nearly 6 million tent camping activity days during the ten-year study period.

Consumer surplus on the part of campers decreases as a function of increasing density of campers. Loomis and Walsh (1997) describe the effects of congestion on the consumer surplus of participants in several outdoor recreation activities by assigning an index of benefit change as a function of the number of other recreationists encountered.[149] From the information we derived previously on approximate number of camping nights in each year of our study period and the

[147] Inflated from $25.87 in 1996$ using inflation rate of 14.8 percent from 1996 to 2002 from *http://inflationdata.com/inflation/inflation_rate/InflationCalculator.asp*

[148] The participation frequencies of activities per month indicated in the SCORP do not reflect year-round averages, but rather frequencies during the months in the season of that type of activity (Walter Timmerman personal communication).

[149] The index for 0 people encountered is 1.00, or no loss of consumer surplus. If 5 people are encountered, however, the index decreases to 0.81, or 81% of the consumer surplus value at 0 other people. This number continues to decrease to 0.79 at 10 people, 0.53 at 15, and finally reaches 0 for 20 other recreationists encountered.

information we have on number of campsites in our study area, we can estimate how crowded the sites are, and how crowded they will be in the future, with and without CHD. Currently, there are 303 tent campsites in our study area. If we assume camping is taking place during nine months of the year, then we can estimate people/campsite/night for each of the years of our study period. As this number increases, the consumer surplus value of $29.70 will decrease by the corresponding index figure from Loomis and Walsh (1997).[150] By multiplying the consumer surplus per person value derived here by the number of camping nights, we arrive at a total consumer surplus figure. The process is then repeated to find total consumer surplus for the upper-bound scenario without CHD (where it remains at $29.70/person since site construction keeps up with increased participation), and for the lower-bound scenario without CHD (where site construction is carried out at half the rate of the upper-bound scenario).

These assumptions result in an estimated decline of $0.69 in consumer surplus per participant per night by 2013 in the upper-bound scenario by the end of ten years and a loss of $0.34 in the lower-bound scenario. The large number of activity days expected in the next ten years make the figure of cumulative lost consumer surplus quite significant. The estimated total lost value over ten years ranges from about $820 thousand to $1.65 million (see Table III.4.b-14).

Table III.4.b-14: Estimated foregone consumer surplus of tent campers due to CHD

	Upper-bound	*Lower-bound*
Foregone Consumer Surplus	$1,647,154	$818,807

Note: PVs, using a three percent discount rate.

RV camping

In order to estimate the lost consumer surplus to RV campers from CHD, we use the same basic set of assumptions employed for tent campers above. With a 13 percent participation rate among state residents and an 8.4 percent rate among visitors, we anticipate that with designation of critical habitat crowding of the campsites would increase annually from 167 campers/site/year in 2004 to 182 campers/site/year in 2013. The upper-bound scenario of impacts presumes that in the absence of CHD new site construction will keep pace with the growing number of participants and that density of campers will remain at 167 campers/site/year throughout the study period. The lower-bound case anticipates new site construction will not keep pace with participation rates, but will only increase at half the rate of the upper-bound scenario, leading to a density in 2013 of 173 campers/site/year. Therefore, in the lower-bound condition 60 new RV sites will be constructed in the ten years, versus 120 in the upper-bound scenario. Based on our assumption that participation will increase proportionally as population grows, CHD will increase crowding at the campsites by 9 percent in the ten years of the study period. This is equivalent to 15 extra campers using each site in the year 2013 versus 2003.

Since Rosenberger and Loomis (2001) do not differentiate between tent and RV campers in their estimates of consumer surplus values, we will assume that consumer surplus for RV campers also is $29.70 per activity day. The estimates of percentages of residents and visitors of the state who participate in camping, and the frequency with which they do so, provided by the SCORP (MT

[150] Loomis and Walsh present figures only for additional individuals encountered at campsites in multiples of five. The average numbers of people/hour/site do not increase by such large amounts, requiring us to extrapolate the estimated index of lost consumer surplus using the average change per person (or fraction of person) between each of the categories given by Loomis and Walsh.

DFWP 2003) allow us to calculate an approximate number of activity days for each of the ten years of the study period. Thirteen percent of Montanans engage in RV camping, with a frequency of 2.1 times per month, or 18.9 times per year if we assume the vast majority of this activity takes place in nine months of the year.[151] While in the state, 3.6 percent of visitors camp. We assume that the average visitor engages in camping at one-tenth the rate of residents, or 1.89 times per year. The inventory numbers provided in the outdoor recreation plan indicate that 31.7 percent of the state's RV camping sites are in the northwest section of the state, and since the study area covers approximately two-thirds of this region, we assume that 21.1 percent of the state's RV camping takes place in the study area. These numbers result in an estimate of almost 853,000 activity days per year, or over 8.5 million RV camping activity days during the ten year study period.

We use the Loomis and Walsh indices of decreasing benefits as a function of crowding at campsites, as we did for tent camping. We can estimate how crowded the sites are, and how crowded they will be in the future, with and without CHD. Currently, there are 1,169 RV campsites in our study area. If we assume camping is taking place during nine months of the year then we can estimate people/campsite/night for each of the years of our study period. As this number increases, the consumer surplus value of $29.70 will decrease by the corresponding index figure from Loomis and Walsh (1997).[152] By multiplying the consumer surplus per person value derived here by the number of camping nights, we arrive at a total consumer surplus figure. The process is then repeated to find total consumer surplus for the upper-bound scenario without CHD (where it remains at $29.70/person since site construction keeps up with increased participation), and for the lower-bound scenario without CHD (where site construction is carried out at half the rate of the upper-bound scenario).

These assumptions lead to a decline of just $0.26 in consumer surplus per night by 2013 in the upper-bound scenario by the end of ten years and a loss of $0.14 in the lower-bound scenario. The large number of activity days expected in the next ten years, however, make the figure of cumulative lost consumer surplus quite significant. The estimates of this cumulative loss of value over ten years are displayed in Table III.4.b-15.

Table III.4.b-15: Estimated forgone consumer surplus of RV campers due to CHD

	Upper-bound	*Lower-bound*
Foregone Consumer Surplus	$888,638	$447,971

Note: PVs at three percent discount rate.

Off Highway Vehicles (OHVs)

As discussed in the previous section on potential incremental impacts of critical habitat designation on summer recreation activities, we do not anticipate that CHD will have a significant economic impact on Off Highway Vehicle activity in the study area. While this is a popular

[151] The participation frequencies of activities per month indicated in the SCORP do not reflect year-round averages, but rather frequencies during the months in the season of that type of activity (Walter Timmerman, personal communication).

[152] Loomis and Walsh present figures only for additional individuals encountered at the campsites in multiples of five. The average numbers of people/hour/site do not increase by such large amounts, requiring us to extrapolate the estimated index of lost consumer surplus using the average change per person (or fraction of person) between each of the categories given by Loomis and Walsh.

activity in Montana, cross-country motorized travel is already prohibited, by the OHVR, on BLM and Forest Service lands, which cover the majority of our study area. While there may be some costs to this activity associated with CHD, the incremental impact of the designation, beyond existing regulations, is expected to be negligible.

Associated industries

As with winter recreational activities there are a number of businesses in the study area which depend, in part, on summer recreation tourism. These include, but are not limited to, restaurants, hotels, outfitters, and grocery stores. The designation of critical habitat has the potential of reducing the rate at which visitation to the area by recreation enthusiasts would grow if there were no restrictions on the expansion of facilities, thus reducing the revenue these associated industries would earn in the absence of CHD. However, for all of the summer activities examined, we expect that there will be no loss of activity days. This assumption is made because it is assumed that visitation will continue to grow in the next ten years due to the draw of the natural landscape and multiple outdoor recreation opportunities, as well as the fact that individual lost consumer surplus is very small for each of the activities in question. While the consumer surplus of individual recreationists is expected to be somewhat diminished by an increase in crowding, we do not predict significant numbers of visitors who would come to the area in the absence of CHD to stay away in its presence. It is possible that in the longer term increased crowding could have this effect on tourism, but we do not expect it during the ten year study period.

Total costs to summer recreation

The total potential costs to summer recreation of critical habitat designation for lynx in our Montana study area are shown in Table III.4.b-16.

Table III.4.b-16: Total estimated costs of CHD to summer recreation

Activity	*Upper-bound*	*Lower-bound*
Hiking	$100,434	$37,593
Tent camping	$1,647,154	$818,807
RV camping	$888,638	$447,971
TOTAL	$2,636,226	$1,304,371

Note: PVs at three percent discount rate.

<u>Total impacts to recreation</u>

The total anticipated costs of lynx CHD to all recreation activities and related industries in the study area are estimated to range from about $4 million to $7.9 million over the ten-year study period (see Table III.4.b-17). The cost category with the single largest impact is the multiplier effect on local industries associated with winter recreation activities. Camping and cross-country skiing incur the second and third-highest impacts, respectively.

Table III.4.b-17: Net costs of CHD on recreation in the study area

Affected sector	*Upper-bound*	*Lower-bound*
Downhill ski/snowboard	*PV(2003) in 2002$*	
Teton Pass		
foregone PS (C-1)	$81,525	$37,306
modifications (C-3)	$158,949	$34,669
Blacktail Mountain		
foregone PS (C-1)	$350,750	$187,918
modifications (C-3)	$89,443	$0
Big Mountain		
increased PS (B-1)	$0	($30,753)
Skiers		
foregone CS (C-2)	$82,054	$41,168
Cross-country skiing		
foregone CS (C-2)	$752,501	$374,936
Hiking		
foregone CS (C-2)	$100,434	$37,593
Camping		
Tent - foregone CS (C-2)	$1,647,154	$818,807
RV - foregone CS (C-2)	$888,638	$447,971
Associated multiplier impact		
foregone earnings (C-1)	$3,773,391	$1,981,163
Total	$7,924,839	$3,955,862

Note: CS and PS refer to consumer and producer surplus, respectively. Three percent discount rate is used.

Grazing

As pointed out in section III.3.c, the number of livestock in the counties of our study area have been declining consistently over the past ten years. It is likely that this trend will continue with or without the designation of lynx critical habitat. Therefore, it seems reasonable to conclude that there will be no costs associated with the CHD on the grazing sector. However, in order to err on the conservative side, as an upper-bound scenario we assume, in the absence of recent data, that the AUM projected by the forest plans of Flathead and Helena National Forests have been accurate up to this point and will continue to remain accurate throughout our study period, despite the fact that the forest plan projections of the other three National Forests of the study area all overestimated grazing activity. As pointed out in section III.3.c, these forest plans call for increasing AUM by 300 and 1,500 per year from 2006 to 2013 in Flathead and Helena NF's respectively.

Using private grazing fee rates for Montana from the USDA's National Agricultural Statistics Service (2003) we estimate the value of an AUM at $15.10.[153] With this estimate we project a cost of $179,843 to the grazing sector over the next ten years using a three percent discount rate (Table III.4.b-18).

[153] The private rate, not the lower one charged on FS lands, is the appropriate rate for estimating the market value of an AUM, as it is less distorted by subsidies than grazing rates on federal lands.

Table III.4.b-18: Non-consultation cost of CHD for livestock grazing

Upper-bound	*Lower-bound*
$179,843	$0

Note: PVs at three percent discount rate.

Timber

As discussed in section III.3.c, we do not expect critical habitat designation to reduce the volume of timber harvested during our study period. When lynx foraging habitat is the limiting factor, logging activities can be beneficial, thus improving overall habitat quality for lynx. We anticipate that CHD will impose costs on the timber industry through project modifications, due to the necessity of relocating some harvests to areas where denning habitat is not the limiting habitat type. In addition, we expect that CHD will cause costs through delays in the first few years of the study period since some harvests in areas of limited denning habitat that are already planned may have to be postponed while a new harvest site is located, surveyed, and prepared for harvest.

We have previously assumed that annual harvests in the study area will remain at approximately 292.7 mmbf, or 2,927 mmbf over ten years. Our upper-bound scenario assumes that 15 percent of this volume, a ten year total of 439.1 mmbf, will have to be relocated away from the most economically preferred sites due to lynx habitat concerns, but that this volume of timber will still be logged from other locations, perhaps at a reduced profit level. We believe that 15 percent is an adequate upper-bound assumption of harvests that will need to be relocated due to the hypothesis that denning habitat for lynx need only be ten percent of an LAU in order to not be limiting (Ruediger et al. 2000). This makes it unlikely that a high percentage of timber harvests would cause denning habitat to become the limiting type. The lower-bound estimate presumes that only five percent of the total volume, 146.4 mmbf in ten years, will have to be relocated.

Relocation costs will potentially be incurred in two ways. The first takes the form of timber sale preparation. We presume that private logging companies and the Forest Service may have already performed surveys, prepared sale plans, performed environmental analyses, and drawn up contracts for harvests in the first few years of our study period. If critical habitat designation requires any of these harvest sites to be moved, this work will have to be repeated for the new area to be logged. Our upper-bound estimate presumes that repeating the preparation procedures for those relocated harvests will be necessary in the first two years of our study period, affecting 87.8 mmbf of timber. The lower-bound scenario assumes that this preparation has only taken place for the harvests of the first year of the study period, thus affecting 14.6 mmbf.

The second type of cost due to relocation may occur in the form of reduced profitability, assuming that the original sites were initially chosen because of the higher profit that could be attained by logging those trees, rather than the ones at the site to which CHD will force the harvest to move. The upper-bound scenario assumes that profitability of the harvests at the new locations is ten percent lower than at the original sites. The lower-bound assumption reduces profitability by only three percent. These estimates are chosen due to the large volume of unreserved timber suitable for harvest in the study area, which make it likely that profitability will not be reduced much when moving sites.

Timber companies will also incur a cost from delays in harvesting due to CHD. If logging sites have to be re-planned for the first two years in the upper-bound case, or just the first year in the lower-bound, the resulting delays imply lost value. This foregone value is the opportunity cost of the forgone profits from the delayed harvests, equivalent to the interest that profits could and would have earned during the delay period had they been realized. We assume that the only costs incurred from the delays will be the difference in the value of harvesting timber in 2004 versus 2005 or 2006, in the lower and upper-bound scenarios, respectively. Based on average sawlog prices during 2000 through the third quarter of 2003 (Bureau of Business and Economic Research, various years), the profitability of timber harvests, and the percentages of tree species in the National Forests of the study area, we can calculate expected annual revenues from timber harvests in the absence of CHD. To estimate the amount of revenue as profit from timber harvests we use data from the Plum Creek Timber Company.[154] In the years 1998 through the third quarter of 2003, Plum Creek reported an average net income of 32.2 percent of total revenue. Due to the fact that Plum Creek is one of the largest private timberland owners in the United States, with operations throughout the country, it should be noted that it is likely that these estimates of profitability may be a rather high average for our study area. We assume that the species composition in the national forests is the same as that in the rest of the study area and that logging is performed in proportion to the species composition. Table III.4.b-19 shows the average price in 2003 of the primary species harvested in the region, along with their composition in the national forests of the area, the average volume harvested of each species (assuming that total harvests will remain at 292.7 mmbf/year), and estimated profits using the profitability level of the Plum Creek Timber Company.

Table III.4.b-19: Species value, composition, and estimated annual harvests

Species	*Price per mbf*[1]	*Composition in NF*	*Estimated annual harvest (mbf)*[2]	*Estimated annual profit*[3]
Douglas fir	$381.44	37.0%	108,236	$13,293,766
Lodgepole pine	$393.69	16.5%	48,190	$6,108,938
Western larch	$383.52	16.4%	48,088	$5,938,545
Engleman spruce	$385.49	10.3%	30,278	$3,758,286
Subalpine fir	$342.66	6.0%	17,454	$1,925,835
Ponderosa pine	$383.92	4.6%	13,332	$1,648,170
Grand fir	$329.44	4.0%	11,806	$1,252,362
Other[4]	$372.94	2.2%	6,412	$769,967
Western red cedar	$478.39	2.0%	5,852	$901,441
Western hemlock	$327.77	1.0%	3,053	$322,239
TOTAL		100.0%	292,700	$35,919,549

[1] mbf = thousand board feet; Average prices from 2000 through third quarter of 2003. [2] Based on forecast of 292.7 mmbf per year from 2004-13 (see text). [3] Equivalent to 32.2 percent of the product of species price and harvest volume. [4] Assumes weighted average price of all other species.
Sources: Prices: Bureau of Business and Economic Research, The University of Montana. Species Composition: DeBlander (2000, 2001); O'Brien (1999); Wilson (2001); Wilson and Miles (2000).

The costs of repeating the timber preparations in the early years of the study period are based on the estimated timber sale preparation cost of $40.82/mbf.[155] This figure was derived from the Forest Monitoring report of Lolo National Forest for fiscal years 2000 and 2001 (USDA FS

[154] Available at *www.plumcreek.com*.
[155] The average cost from the years 1995-2001 in Lolo NF was $34.60 in 1995$. Costs vary greatly from year to year and the upper and lower outliers of $18/mbf and $119/mbf in 1997 and 2000, respectively, were omitted. Inflated from 1995$ to 2002$ using a cumulative rate of 18 percent from *http://inflationdata.com/inflation/inflation_rate/InflationCalculator.asp*

2001d). Assuming that 15 percent of the annual harvest volume will have to be relocated and that timber sale preparations will have to be repeated in the first two years of the study period in the upper-bound scenario, the estimated relocation costs for our upper-bound scenario are approximately $3,429,324 in present value (PV) terms. With five percent relocation and repetition of sale preparations in the first year only, estimated PV costs for our lower-bound scenario are $580,001. These values represent costs to the timber company performing the logging operations. However, a significant portion of these expenditures will flow into the local economy in the form of wage payments and equipment purchases. That portion does not represent a cost to the study area, but simply a resource transfer from one segment of society to another.

As in the estimation of the net impacts of project modifications at the downhill ski areas, we assume in the upper-bound impact scenario that just 25 percent of these expenditures will remain in the local area. In the lower-bound scenario that number increases to 75 percent. These assumptions lead to an estimated net cost to the study area of $145 thousand to $2.6 million from repeating timber sale preparations (see Table III.4.b-20).

In order to estimate the costs in the form of foregone profit due to the potential necessity of relocating a portion of harvests it should be noted that since we are dealing with hypothetical timber harvest sites it is impossible to know the comparative value of one of these timber stands versus the other. We can only presume that those doing the harvest work will select the sites where they can achieve the highest profit and that under CHD, from time to time, it may be necessary to prevent logging on a portion of those sites. Due to the large amount of timberlands in the study area it is likely that the value of the second or third-best harvest site is not greatly inferior to the value of the first-best site. The upper-bound assumes that profitability of the relocated harvests is reduced by ten percent from their level in the without CHD case. The lower-bound estimate assumes a profit decrease of just three percent for the relocated harvests. Foregone profits over the ten year study period are estimated at approximately $460 thousand to $4.6 million (see Table III.4.b-20).

If delays are incurred on 15 percent of the volumes scheduled for harvest in 2004 and 2005 in the upper-bound scenario, the cost of delay are the discount rate times 15 percent of the annual BCS profits for both 2004 and 2005.[156] Thus, due to time preference, with a three percent discount rate, these delays will cost the timber industry $300,281 over the ten years.

The lower-bound scenario predicts that just five percent of logging projects will be relocated and delays will only occur in the first year. Therefore, the cost of delays is five percent of 2004's harvest being moved to 2005. A three percent discount rate leads to a lost value of $50,786 (see Table III.4.b-20).

Total expected costs to the study area from possible timber harvest restrictions as a result of lynx CHD are estimated to range from about $655 thousand to about $7.5 million (see Table III.4.b-20). These estimates exclude CHD-related consultation costs, which are estimated at the end of this chapter.

[156] Harvests delayed in 2004 are realized in 2005, and those delayed in 2005 are realized in 2006. Hence, receipt of 15 percent of each year's profits is delayed by one year.

Table III.4.b-20: Total anticipated non-consultation costs of CHD to the timber sector

Source of cost	*Upper-bound*	*Lower-bound*
Repeated timber sale preparations	$2,571,993	$145,000
Foregone profit from relocation	$4,596,016	$459,602
Delays	$300,281	$50,786
TOTAL	$7,468,290	$655,388

Note: PVs at three percent discount rate.

It should be noted that these cost estimates may overstate the costs attributable to CHD for the lynx. The impending designation of critical habitat for the bull trout is expected to have major impacts on forest management activities in the proposed lynx CHD area (see USDI FWS 2004a), which may include a substantial share of the changes in timber harvest that the present study attributes to the lynx.

National-level costs of grazing, timber, and recreational uses (wide boundary of analysis)

When the accounting domain of our analysis is extended to include the entire United States, many of the costs are decreased due to the fact that they become transfers from the study area to other regions of the country, which receive the business or employment lost to the area.

Winter recreation

Downhill skiing/snowboarding

When looking at the impacts of CHD on a national scale, it is logical to expect that the vast majority, if not all, of the costs incurred by the ski resorts of our study area will transfer to other regions of the country. The foregone profits that each resort may experience as a result of not being permitted to expand their runs will not be lost to the national economy. There are multiple options of ski areas across western Montana and Idaho that make it highly unlikely that those skiers who, due to lynx CHD, withdraw from Teton Pass, Blacktail Mountain, and Big Mountain, do not relocate their recreation activities to somewhere else. It is possible that some skiers who would have recreated in the study area in the absence of CHD would move their skiing to southern Canada due to the proximity of several resorts in southern Alberta and British Columbia. However, the proportion of those electing to use this option is assumed to be quite small. The small amount of consumer surplus that was estimated to be lost at Blacktail Mountain in the upper-bound scenario in that case would still be lost on a national scale.

The costs of modifications to planned projects that are expected to be permitted under CHD, but with some changes, also constitute transfers when observing impacts on a national scale (25 and 75 percent of these inputs to those modifications were assumed to derive from outside of the study area). The same is true for CHD-related planning and construction costs. Therefore, the modification costs described in the study area section above disappear on the national scale.

Cross-country skiing

In the previous section we anticipated a significant loss of collective consumer surplus on the part of cross-country skiers due to increased crowding on the trails by employing Loomis and Walsh's

(1997) estimates of lost benefits to recreationists as a function of increased crowding. We also assumed that participation in this sport would grow in proportion to population growth, which would lead to an increase of a maximum of 8.8 percent more skiers on each mile of trail in the year 2013 than there were in 2003. This led to a $0.39 decrease in consumer surplus per activity day per participant. For an individual skier, these numbers hardly seem noticeable, and this is why we have assumed that there would be no decrease or leveling-off of cross-country skiing activity days. If crowding reached the point where skiing was noticeably less enjoyable for the participants, it is again unlikely that a significant number would quit the sport. It seems more likely that they would simply move their activity out of the study area. As with downhill skiing, the only way CHD would create a cost in terms of lost skier activity days would be if a certain number decided to move their activities north of the border. We do not anticipate that this will happen with any more than a trace of participants within the ten years of our study period. If our assumptions are incorrect, and 39 cents of lost consumer surplus is enough to move skiers out of the study area, the costs would transfer away from lost consumer surplus (as the trails will now be less crowded for those who remain) and would instead be reflected as losses to associated industries in the study area (hotels, restaurants, etc.). Therefore, we conclude that costs of collective consumer surplus loss will remain on the national level.

Associated industries

The loss of revenue to businesses that rely on recreation for a portion of their revenue occurs due to a loss of visitors who would presumably visit the area if the restrictions of CHD were not in place. The assumption is that skiers who would come to the region to ski as the resorts expand to offer new opportunities will go skiing somewhere else. Therefore, on a national scale, there will be no loss to these industries as CHD will simply relocate this spending to another area.

Summer Recreation

Hiking

The effects of CHD on hiking on a national scale are much the same as they are for cross-country skiing. This is due to the fact that the main cost categories of CHD for this activity would be from consultation costs and from lost consumer surplus due to increased crowding.

As was the case with cross-country skiing, we anticipate a significant loss of collective consumer surplus on the part of hikers due to increased crowding on the trails. We also assume that participation in this sport will grow in proportion to population growth, which would lead to an increase of 9.1 percent in hikers on each mile of trail in the year 2013 compared to 2003. This leads to a maximum (final year) loss of $0.02 in consumer surplus per activity day. For an individual hiker, these numbers, once again, would hardly seem noticeable, and this is why we have assumed that there would be no decrease or leveling-off of hiking activity. If crowding reached the point where hiking were noticeably less enjoyable for the participants, it is again unlikely that a significant number would quit the sport. It seems more likely that they would simply move their activity out of the study area. As with downhill and cross-country skiing, the only way CHD would create a cost in terms of lost skier activity days would be if a certain number decided to move their activities north of the border. We do not anticipate that this will happen with any more than a few of participants within the ten-year study period. If our assumptions are incorrect, and 2 cents of lost consumer surplus is enough to move hikers out of the study area, the costs would transfer away from lost consumer surplus (as the trails will now be less crowded for those who remain) and would instead be reflected as losses to associated industries in the study area (hotels, restaurants, etc.). Therefore, we conclude that the costs of collective consumer surplus loss in the study area carry over onto the national level.

Camping

As with hiking and cross-country skiing, costs to camping in the study area came from consultations and loss of consumer surplus caused by crowding. Our assumptions in the previous section on costs to the study area are that, as with cross-country skiing and hiking, there will be losses in consumer surplus due to increased crowding, but that reduced surplus will not be enough to reduce the number of participants over the next ten years. We predicted that crowding will increase by 22.5 tent campers and 15 RV campers per site in the year 2013 as compared to 2003, an increase of nine percent in both cases. We anticipate that the consumer surplus of individual campers in the study area will be diminished by a maximum of just $0.69 for tent campers, and $0.26 for RV campers, by the end of the ten-year period. Again, we do not anticipate that this is an amount that will drive campers out of the study area. This cumulative lost consumer surplus therefore, will still be lost, even when the accounting domain is extended to the entire country.

Grazing

Based on data showing a consistent decrease in head of sheep and cattle in the study area over the last ten years, our lower-bound estimate of impacts to the region predicts that there will be no costs to this sector from CHD. In order to err on the conservative side, our upper-bound estimate of costs to the study area predicts that CHD would decrease grazing levels by 14,400 AUM over the next ten years. If this upper-bound scenario is accurate, we anticipate that, on a national level, this reduced grazing activity will be transferred out of the study area in one way or another, but would not be eliminated. Those herders who have access to grazing lands outside of the study area will simply shift where their herd grazes, while those who do not have easy access to such land could potentially sell the livestock and thus be compensated financially for the loss of available AUMs.

Timber

Expenses for repeating timber sale preparations are, to some extent, transfers within the study area. In addition, any employment or payments to individuals outside of the study area would now be considered a transfer when looking at the national accounting domain. Delays and lost profitability caused by CHD from forcing a portion of harvest to move from the most economically desired site to one of less value will remain as costs, even on the national level. However, this cost of lost profitability is likely to be reduced since there are large areas of forest within a reasonable distance of the study area, which increases the potential of locating harvest sites that are as profitable as the one which would be selected in the absence of CHD. In order to estimate this lost profitability from relocating timber harvests we assume, as an upper bound, that the 15 percent of timber harvests which will have to be relocated due to CHD now are just five percent less profitable than at the original site, while in the lower-bound condition, we assume that only one percent of profitability is lost on the five percent of harvests that must be relocated. This leads to the national-level estimates of lost profitability shown in Table III.4.b-21.

Table III.4.b-21: Foregone profits of timber harvest on national scale due to CHD

	Upper-bound	*Lower-bound*
Foregone profits	$2,298,008	$153,201

Total costs to recreation, grazing, and timber

The total costs to recreation, grazing, and timber on a national scale due to CHD are shown in Table III.4.b-22.

Table III.4.b-22: Total non-consultation costs, nationally, to recreation, grazing, and timber due to CHD

Source of cost	*Upper-bound*	*Lower-bound*
	2002$ (PV 2003)	
Downhill skiing/snowboarding:		
lost consumer surplus (C-2)	$82,054	$41,168
Cross-country skiing:		
lost consumer surplus (C-2)	$752,501	$374,936
Hiking:		
lost consumer surplus (C-2)	$100,434	$37,593
Camping:		
lost consumer surplus (C-2)	$2,535,792	$1,266,778
Timber:		
delays	$300,281	$50,786
lost revenue	$2,298,008	$153,201
TOTAL	$6,069,070	$1,924,462

Note: Based on three percent discount rate.

Costs associated with lynx CHD impacts on road and bridge projects

Impacts of lynx CHD on road construction carry various costs associated with project modifications, delays, and increased consultation effort or reinitiation of consultations (Table III.4.b-23).

Consultations

All consultations that occur after designation of critical habitat for the lynx are formal in nature. Those projects that already have undergone consultations for the lynx will see them reinitiated; in this case, the incremental effort attributable to CHD is the full cost of the reinitiated consultations. For those projects that have not yet undergone consultations, the incremental consultation effort from lynx CHD is the difference between the effort involved in conducting the informal consultation that would have occurred in the absence of lynx CHD, and the effort involved in conducting a formal consultation required under CHD.

Incremental consultation effort attributable to CHD is distinguished into low, medium, and high effort, depending on the expected complexity of consultations. The assessment of the complexity of consultations in turn is based on the size and nature of the affected project. The estimated consultation effort of each project is described below.

Project modification and delays

Two projects are likely to be delayed through CHD for the lynx (see Table III.3.c-12).
One is the re-construction (most importantly, addition of two lanes) of a section of US-93 north of Evaro, planned for some time in 2004 (Montana Department of Transportation 2003). The other is the planned rehabilitation of the Going-to-the-Sun Road in GNP, scheduled for 2004-

2011 (USDI NPS 2002a). The costs of the delays represent an increase in transactions costs, and are caused by any necessary changes in the construction schedule (due to project modifications and consultations). Since planned road work doesn't begin during the winter months, there still remain several months between the proposed CHD and start-up of construction activities for the two projects for which delays are expected. Therefore, no costs related to delay in materials or equipment use are expected.

Table III.4.b-23: CHD-related impacts on road and bridge projects in Montana study area

Project	*Estimated costs of CHD impacts*	
Impact type:	*Modification/delay of project*	*Additional consultation effort*
Historic Bridge and Highway restoration		
7 bridges; 2 highways (19 mi total)	none; none	yes [low (7), medium (2)]
MT-35 Polson to Bigfork (25 mi in CHD area)	none	yes [medium (1)]
US-93 improvement		
Three-mile stretch north of Evaro	1 mile of fence,	yes [reinitiation, high (1)]
Montana-200		
Eight-mile stretch east of Lincoln	none	yes [high (1)]
Copper Creek Road Improvements		
14.2 mi, stretching north from Montana-200	(perhaps some minor design changes)[2]	yes [medium (1)]
Going-to-the-Sun-Road rehabilitation (GNP)	Some changes in ancillary structures, project delay	yes [reinitiation, high (1)]
Construction of access path to private property on Snyder Ridge (GNP)	(perhaps minor changes)	yes [reinitiation, low (1)]
US-2		
Reconstruction of 1.1 mi segment, 1.3 miles west of Hungry Horse	(perhaps some minor design changes)[1]	yes [low (1)]
PMS overlay on 2.2 mi segment, GNP-east end	no	yes [low (1)]
Reconstruction, 2.9 mi segment of Montana-487 (Big Mountain Road)	(perhaps some minor design changes)[1]	yes [medium (1)]
PMS overlay, 6.4 mi segment of Montana-486 (north of Columbia Falls)	no	yes [low (1)]

Notes: Based on Table III.3.c-12.

Project modifications in general may result in minor to major costs, depending on the project. Modification costs comprise necessary revisions of the project design, which take the form of additional engineering man-hours. They may also include additional materials needed for increases in project size or changes in project design (for example, additional wildlife crossings and related fencing).

Historic Bridge and Highway restoration

Restoration of historic bridges is unlikely to require modifications in project design. Possibly, modifications could occur in the form of the timing of work, or in cases where bridges are located in close proximity to lynx denning habitat. Most bridge projects however are unlikely to be affected, since bridges are associated with permanent disturbance in the form of vehicular traffic. The incremental disturbance through restoration work may therefore be negligible.

The historic highway restoration projects are more likely to require modifications, especially if infrastructure additions are planned (additional rest areas, scenic view stops, or pull-outs) or construction is scheduled to be carried out in close proximity to denning habitat during the denning period. Since the projects are not among the MT DOT road projects scheduled for the next five years, there is no reason to assume that project plans are in an advanced phase and would require modifications. Rather, lynx CHD-requirements can be incorporated into the plans from the outset.

Consultation effort is expected to be low for all historic bridge projects, and medium for all historic highway projects. Both project types generally do not involve substantial clearing of vegetation and hence are likely to have no or only small impacts on lynx habitat. Highway projects are expected to involve medium effort due to their larger size.

U.S.-93 improvement project

As described in the previous section, potential modifications would consist of approximately one mile of additional fencing (2.4 m/8 ft, page wire) north of milepost 12.3. The costs of this fence (including installation) are approximately $23,000.[157] Consultation effort is expected to be high due to the complexity of the project and the fact that reinitiation of consultations will occur.

MT-200 and Copper Creek Road

In some areas, modification of the design of the Copper Creek project may be required to avoid lynx habitat destruction. In the case of MT-200, that is unlikely, as the project has not been designed yet. Both projects are likely to require additional consultation effort.

Going-to-the-Sun Road rehabilitation

Lynx CHD may potentially require minor design changes, such as modifications of planned additional parking lots, pull-out areas, and scenic vistas, etc., because of the vegetation clearing associated with the latter. Where such design changes are necessary, they will likely lead to attempts to relocate some of the structures into areas that do not constitute lynx Tier-1 habitat. Such relocation requires planning effort and associated costs and in addition may result in delays of the construction work on the road segments affected by the relocations. It should be considered, however, that, even if modifications should prove necessary, relocation of ancillary structures does not necessarily have to lead to project delays. Rather, the construction schedule is so long that it may be possible to change the construction sequence of segments to accommodate modifications without causing delays on all modified road segments.

Total annual design and engineering costs for the whole project are estimated at $40.4 million for whole period (USDI NPS 2002a: 165). The entire rehabilitation project covers some 49.7 miles of road, with a combined total of 230 individual repair projects (the 11-mile-long Alpine segment alone comprises more than 190 repair projects; USDI NPS 2002a:58). Of course, not all projects require the same engineering and design input, but total design and engineering expenditures by all projects would yield an estimated average $175,600 per project. Many of the projects affected, however, are comparatively small (see Table 3 USDI NPA 2002a:49): the total of 57

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[157] One mile of fence on both sides, at an estimated cost of $2,865 per ¼ mile (*http://www.gov.on.ca/OMAFRA/english/engineer/facts/99-057.htm#costs*).

visitor improvement-related structures that may impact vegetation together lead to a combined aerial disturbance of only 4.5 acres for the NPS's preferred alternative (USDI NPS 2002a: 49).[158] In addition, many of these projects lead to no or only negligible new disturbance. This is true for example for projects classified as "Improve information, orientation, interpretation", which account for 25 of the 57 visitor improvement-related projects; "rehabilitated toilets", which account for a further three; "rehabilitation of trails", which account for another 10; and "reconfiguration or provision of areas for transit stops", which together account for seven projects (of these, the former do not destroy habitat, while the latter may - we assume four of the seven projects are reconfigurations). Even projects due to their nature may lead to new disturbance do not necessarily impact vegetation. For example, the "improved vehicle parking and pedestrian circulation" project in Road Camp, together with improvement of vistas, rehabilitation of trails, and improvement in information, orientation, and interpretation is expected to lead to only 0.03 acres of new disturbance.

Excluding these projects that are not expected to lead to new vegetation disturbance, there remain 15 projects potentially requiring modification. A good part of the engineering effort, however, will not have to be replicated in the process of adjusting a project to its new site. We assume that only 50 percent of project design and engineering effort will have to be redone for relocation. Since most of the projects are small compared to the road surface/drainage/bridge/ tunnel projects, they are assumed to require less-than-average D&E effort. We assume 30 percent of the average D&E project effort for such projects. This results in an estimated total of $395,100 in CHD-attributable relocation-related costs for the Going-to-the-Sun Road. The consultation effort associated with the modifications is expected to be high, due to the complexity of the project and the fact that reinitiation is required.

Access path to Snyder Ridge, GNP

Any modifications of the construction of the temporary access path that may be indicated under lynx CHD will be minor. Consultation effort is expected to be low, but reinitiation is required.

US-2 projects

Minor design changes may be required for the reconstruction of the 1.1 mile segment: in cases where roadside vegetation clearing is planned, such clearing may have to be modified. Both projects are expected to lead to low consultation effort due to the nature of the projects (reconstruction, pavement management system [PMS] overlay) and small size.

MT-487 reconstruction project

Reconstruction would be impacted only in locations where roadside vegetation clearing is planned. Such clearing would in some cases have to be modified. Expected consultation effort is medium. Except where stated above, in cases where project modification consists solely in changes of the planned clearing of roadside vegetation, the costs associated with these modifications are assumed to be negligible. Expected consultation effort is low due to the nature of the project (PMS overlay) and small scale.

[158] The actual road surface/drainage/bridge/tunnel rehabilitation projects are assumed to lead to negligible new disturbance.

Finally, most projects are expected to incur more resource-intensive consultations due to lynx CHD (because of the identification of CHD-compatible project design modifications), and for some projects reinitiation of consultations is anticipated.

Table III.4.b-24: Upper and lower bounds of impacts of lynx CHD on road and bridge construction projects in Montana study area

Roads/Bridges Impacts	*Projects prevented*	*delayed*	*modified*	*Consultations increased effort*	*reinitiation*
Upper-bound	0	2	16	17	3
Lower-bound	0	2	3	11	3

Notes: Benefit categories associated with prevented projects are presented in Table II.3-1. Upper and lower-bound estimates are from Table III.3.c-13.

Total non-consultation costs for road and bridge projects in the proposed designation area are estimated at $418,000.

Costs associated with lynx CHD impacts on fire management

As already pointed out, costs of CHD on hazardous fuel reduction projects are expected to occur only in the form of consultation costs, due to the fact that fuel treatment projects in general are not likely to adversely affect lynx habitat, unless root wads and downed trees are removed. Abstaining from the latter two practices is not likely to increase treatment costs.

Table III.4.b-25: CHD-related impacts estimates of lynx CHD on fire management

Impacts	*Units impacted by CHD, by impact prevented*	*delayed*	*modified*	*Consultations increased-effort*	*reinitiation*
Upper-bound	0	0	(all) [1]	440: low	1: high
Lower-bound	0	0	(all) [1]	206: low	1: high

Notes: Modification likely consist only in not removing root wads and down trees.

Costs associated with lynx CHD impacts on residential development

The impacts of lynx CHD on residential development (see Table III.4.b-26) carry various associated costs and benefits. Some of these are sensitive to where the spatial boundaries of the analysis are drawn (study area or respective counties vs. country as a whole).

Table III.4.b-26: Upper and lower bounds of impacts of lynx CHD on residential development

Residential construction Impacts	*Units impacted by CHD, by impact prevented*	*delayed*	*modified*	*Consultations additional*	*reinitiation*
Upper-bound	0	26	554	554	-
Lower-bound	93	11	277	370	-

Source: See Table III.3.c-20.

First, CHD may lead to costs in the form of reduced property values for undeveloped but developable properties on designated lands with a federal nexus. In the present case, such reductions in property values are possible on properties that are primarily in Tier-1 lynx habitat and that do not have sufficient acreage of Tier-2 or -3 habitat to accommodate the development that would have occurred absent lynx CHD. If the boundaries of analysis are set at the national level, these reductions in property values are likely compensated by a commensurate benefit of CHD in the form of an increase in property values of already developed properties, and increased property values in areas that attract the displaced projects (properties within the study area with developable Tier-2 and -3 habitat, and properties outside of the study area). If the boundaries of analysis are set around the study area (including non-lynx habitat of high aesthetic value), increases in property values outside of the study area that occur as a result of CHD for lynx in the study area would not be included on the benefit side, leading to a corresponding net property value decrease in the study area as a result of CHD. Only in the latter (narrow boundary) case, the "externally displaced" projects would also carry associated costs in the form of forgone development opportunities for construction-related sectors of the local/regional economy.

Where CHD leads to project modifications, these modifications represent costs of lynx CHD. As is the case with reduced values of capital assets, the cost of modifications occurs in the form of either reduced consumer or reduced producer surpluses. If the modifications needed to achieve required lynx-CHD compatibilization of projects lead to cost increases of development, these are either borne by consumers (in cases where landowners carry out the projects) or producers (in cases where developers hold developable properties with Tier-2 or -3 habitats intended for sale), or, in the case of properties intended for sale, both, the incidence depending on the elasticity of demand. In addition, consumer surplus would be reduced in cases where the CHD compatibilization leads to lower utility for consumers.[159]

The project modifications likely to occur under CHD are 1) relocation of the construction site from one area of the property to another, 2) reduction/prevention of fencing, 3) reduction/prevention of vegetation changes. In some instances modifications potentially could include a reduction in project size (e.g., a reduced footprint). However, in such cases it is assumed that the development will be moved to another location, the impacts of which are considered under project relocations associated with lynx CHD. Such relocations have social costs only if they occur outside of the chosen impact analysis boundary; hence, only those projects classified as "prevented" by CHD (see Table III.4.b-26) are relevant and only if the narrow (local) impact analysis boundary is chosen.

Besides land asset values and project modifications, CHD will also lead to additional costs in the form of increased consultation effort due to higher-effort consultations or reinitiation of past consultations. Increases in consultation costs represent increased transactions costs. Affected parties are the FWS, the private entities involved in the project, and the action agencies involved in a project, if any.

Finally, designation of critical habitat for the lynx may lead to project delays because of necessary modifications in planning or the time needed for conducting critical habitat consultations. The incremental consultation effort relevant here is only that which is directly attributable to lynx CHD.

The question of whether or not project delays legitimately can be attributed to CHD is a difficult one (see USDI FWS 2002c). The argument in favor of the existence of delay costs is that CHD leads to delays in profit realization for developers or land sellers, which carries a true economic

[159] Lower utility for consumers of modified project designs is analytically expressed as a downward shift in the demand curve. Such a shift would occur if property owners were to receive less satisfaction from CHD-compatibilized development designs than from designs unrestricted by lynx CHD-related restrictions. Examples of such development restrictions are restrictions on allowable vegetation changes, fencing of properties, etc.

cost. The counterargument is that with appropriate project planning, additional consultation effort need not result in project delays.[160] Although the latter argument is of course correct, it remains true that some projects that in the absence of CHD would have been carried out with a given, imperfect amount of planning, under CHD may incur delays due to extended consultations. The fact that the increased real estate costs that may be associated with such delays have not been observed (see USDI FWS 2002c, fn. 160) does not refute the validity of the delay cost argument. Rather, a very elastic real estate demand may have resulted in developers/sellers absorbing the delay-related costs, with real-estate prices remaining stable.

We argue that at least for projects expected to be realized in 2004, lynx CHD will likely result in project delays, because the planning process will in most instances already have begun at the time of CHD. Therefore, we assume delays for all projects anticipated for 2004. For subsequent years, some projects will undoubtedly be planned imperfectly, which in particular instances may lead to project delays and the associated costs.

The forgone local (study area) earnings that results from the prevented construction of 93 residential units is the forgone construction expenditure multiplied by the local economy's final demand earnings multiplier, estimated at 0.71 for new construction. We use the median value of owner-occupied single unit houses in Montana ($99,500[161]) as a proxy for the average construction cost of a single-residence unit. Using house value as a proxy for construction cost leads to an overestimate of construction expenditures, since the house value includes the value of the property on which the house is located. Conversely, using the Montana median house value tends to bias our estimate downward because the average value of houses in the study area is likely to be higher due to the properties' high amenity values. We assume that these two errors approximately balance each other out.

Assuming a final demand earnings multiplier of construction-related expenditures of 0.71 (based on the respective multiplier in Michigan given in Stynes 1999) and a three percent annual discount rate, the PV of the total economic impact of 93 prevented residential units is estimated at approximately $5.7 million. The estimated loss in construction industry employment associated with the approximately nine residential units which in the upper-bound impact scenario are assumed to be prevented by CHD (for a total estimated 93 prevented units over 10 years) is negligible in relative terms and very small in absolute terms. These nine units account for only a fraction of one percent of annual residential construction activity in the counties in which lynx CH would be located: for example, in 2000, 687 residential units were constructed in Flathead county, and another 1,554 in Missoula.[162] The number of construction jobs lost due to CHD is estimated at 19.5 for the Montana study area counties, compared with a Montana total of 5,837 general building construction jobs in 2000 (estimated to increase to 7,847 in 2010) and 19,699 total construction jobs (estimated to increase to 25,761 in 2010) (Montana Department of Labor and Industry 2003).[163]

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[160] Well-known proponents of the relevance of delay costs and the lack thereof, respectively, are David Sunding and Stephen Meyer (see discussion of the issue in USDI FWS 2002c).

[161] US Census Bureau, State and County Quick Facts - Montana. (***http://quickfacts.census.gov/qfd/states/30000.html*** accessed Jan 2004).

[162] The number for Missoula County is based on the number of total residential permits (Missoula Area Development Corporation 2003).

[163] Estimate of lost construction jobs is derived by multiplying the estimated total construction value of the prevented units (average of $99,500 per unit) with the ratio of gross social product of the construction sector in Montana (US Department of Commerce, Bureau of Economic Analysis 2003) and construction employment (Montana Department of Labor and Industry 2003).

Designation is estimated to take 93 local properties out of development. No information on the average value of properties in the study area exists. Based on a non-scientific sampling of local real estate company websites, we assume an average value of $50,000 per property. If 93 such properties were taken out of development due to lynx CHD, the total present value (PV) of reduced property values under narrow boundaries would be $4.1 million. This number however likely represents an overestimate as it assumes that 100 percent of the property value is lost. The actual cost of CHD in terms of reduced property values likely is substantially lower. The fact that a given property does not get developed during the time-frame of analysis (2004-2013) because the prospective buyer relocates his or her residential project to outside of the designation area does not mean that the property cannot be developed. As stated in our assumptions on residential impacts, some prospective developers may simply relocate to outside of the area because they do not accept the development restrictions that lynx CHD brings with it, such as for example the requirement to locate a structure on a particular part of the property (in Tier-2 or -3 habitat as opposed to Tier-1 habitat). In such cases, development at a later stage is still possible (and likely, given the strong growth in the area's population and housing), so the actual property value cost of lynx CHD is the opportunity cost of the reduction in property value due to CHD-related development restrictions.[164] Likewise, properties on which full-scale residential developments are precluded still have market value due to the possibility of smaller-scale developments. In addition, owners of neighboring properties may be interested in acquiring such properties. As a lower-bound estimate, therefore, we assume that lost property value from lynx CHD is only 50 percent of the upper-bound cost estimate. We assume that, because of the small number of residential units whose development is assumed to be prevented by CHD, impacts on the average value of comparable properties in the study area or nationally are negligible.

The cost of project modifications attributable to lynx CHD takes the form of redesigning projects that already have completed the design phase (which is assumed to be true for all 2004 projects, and for none of the post-2004 projects); and potentially reduced consumer and/or producer surpluses for all projects. Not all modifications however are likely to lead to actual reductions in consumer utility. Specifically, the modifications considered here do not include reductions in the size of the project footprints, since in cases where that is required the respective projects are assumed to relocate to properties that allows preservation of the project design. The changes in project design that are considered as modifications in this study (reduction in fencing or vegetation removal, and relocation of structures) in most are likely to have only negligible impacts on consumer surplus. Hence, we include in our modification cost estimate only the design costs incurred through the redesigning of projects that have completed the design phase. We assume that, on average, redesign of a project due to CHD-related modifications will cost $10,000.

Finally, we assume that projects delayed due to lynx CHD-related redesign or consultations will on average be delayed by six months. At a 10 percent annual interest rate on the capital value of the total project (house value plus property value), the average delay cost is estimated at $7,500.

The total estimated cost of the impacts on residential development of designating lynx CHD varies considerably with the choice of spatial boundary. The major part of the difference is due to the expected relocation of residential housing projects to outside of the study area, which leads to losses to the local economy and hence high impacts in the narrow (local) boundary setting, but not in the wide (national) boundary setting (see Table III.4.b-27). The benefits associated with

[164] The opportunity cost of the reduction in property value is the present value of the forgone investment opportunity that could have and would have been realized with the receipts.

the relocation or modification of residential development projects due to CHD are discussed in the next section.

Table III.4.b-27: Cost of non-consultation impacts of lynx CHD on residential construction

	Boundary	*Lower bound*	*Upper bound*
		PV 2002$ [1]	
Lost local economic impact	narrow	0	5,746,444
	wide	0	0
Reduced property value	narrow	2,042,770	4,085,541
	wide	2,042,770	4,085,541
Project modifications	narrow	260,000	220,000
	wide	220,000	260,000
Project delays	narrow	195,000	82,500
	wide	82,500	195,000
Total	narrow	2,497,770	10,134,484
	wide	2,345,270	4,540,541

Notes: Under narrow boundaries, the upper-bound cost estimate assumes there are an estimated 93 projects that leave the study area and the surrounding counties and relocate elsewhere, and 277 projects that are modified, 26 of which require (partial) redesigning; the lower-bound scenario assumes that zero projects leave the area and that 554 undergo modifications, 22 of which require redesign. For wide boundary scenario, see Table III.3.c-20. [1] At three percent annual discount rate.

<u>Costs associated with lynx CHD impacts on mining</u>

The prevention of the McDonald Gold Mine project would cause both positive and negative impacts, and associated costs and benefits, respectively. The negative impacts are examined here, the positive in the next section.

Forgone mining profits and household earnings, associated tax receipts, and mining-related multiplier effects in the regional economy as a result of lynx CHD all constitute designation costs. Likewise, increased effort in project-related consultations represents a cost of lynx CHD.[165] The impact that abandonment of the project has on gold and silver prices is judged to be imperceptible due to the miniscule impact on world production of these commodities and the well-integrated and global nature of the respective markets. As discussed in the previous section, the upper-bound costs attributable to lynx CHD are those of the complete abandonment of the project. Preceding this abandonment, consultation costs would be incurred. It is assumed that these consultations would be of a high effort level.

The lower-bound costs of CHD for mining are zero, as in that scenario the mine would not be prevented due to lynx CHD, either because the mine would be prevented due to a confirmation of Initiative 137, or because the mine area would be excluded from designation. The quantification of the upper-bound cost associated with the prevention of the mine is based on information published by the mine operator, Canyon Resources Corp.[166] As an approximation of the lost

[165] Because the project has been changed from its original design, consultations will be reinitiated even in the absence of lynx CHD, should the anti-mining initiative be overturned in November of 2004. Hence, lynx CHD will result in increased-effort consultations, not in reinitiation.
[166] *<u>http://www.spjv.com/economic.htm</u>*, accessed Jan. 2004.

profit due to mine prevention we use the damage award for which Canyon Resources is suing in its suit for damages of lost profits ($500 million). It seems likely, however, that this amount represents an overestimate of actual lost profits to the company in case of mine prevention.

The social cost of mine prevention further comprises foregone tax receipts and royalties, which the company claims are an estimated total of $150 million over 14 years; the foregone earnings from the economic multiplier effect associated with the mine's expenditures for procured goods and services, amounting to a claimed total of $550 million over 14 years of mine operation; and foregone earnings of mine workers, from a claimed estimated annual payroll of $14 million (with a claimed local share of 80 percent). All of these cost estimates may be high or overestimates.

Furthermore, the costs mentioned in the previous paragraph do not represent the actual opportunity costs to the economy from the CHD impacts on mining. Rather, the foregone producer surplus associated with mining is the difference between the profits of the McDonald mine project and those that could have been obtained if the investment instead would have been used for the next-best investment opportunities, that is, those with the highest rates of return. To estimate the foregone producer surplus, one would therefore need to know the rate of return of the mining project, and that of the next-best investment opportunities. That information is of course difficult to obtain. However, considering that average profitability of metal-ore mining companies in the U.S. in 2002 was 6.1 percent, while that of all industries was 6.3 percent (BizStats 2003), it seems unlikely that the mining project would achieve a substantially higher profit rate than the next-best investment opportunities. Even if we assume that the McDonald project would achieve a substantially higher return than the average of the metal-ore mining industry, for example 10 percent, and that the alternative, next-best investment opportunities would yield no more than the ***average*** rate of return of all industries, then the difference in profit rates would be 3.7 percent. That is, the foregone producer surplus (opportunity cost) of not developing the mine would be 37 (10-6.3) percent of the assumed profits generated by the project during the period analyzed in this study (2004-2013), or approximately $108 million (see Table III.4.b-28).[167] There is however no reason to assume that investment in the mine would necessarily yield higher returns than the next-best opportunities, in which case the opportunity cost of the foregone producer surplus from the mine would be zero. We assume that none of the foregone profits accrue to the study area, as Canyon Resources is a publicly traded company, and so the share of the profits that would accrue to residents in the study area counties likely is negligible.

Likewise, taxes and royalties do not in full measure represent opportunity costs, because the mine would require the provision of public services, which of course are not free. Reduced costs of service provision however represent benefits of CHD, which are discussed in the next section.

Foregone salaries of mine-related jobs do represent opportunity costs of preventing the mine only to the extent that these jobs would be filled with otherwise unemployed individuals, or to the extent that the alternative employment the prospective mine employees would engage in is lower-paid. It is likely that the claimed 387 jobs would be partly filled by attracting employed persons from those "other" jobs, and in that case the additional earnings (consumer surplus) would amount only to the difference in present earnings of those people and their earnings as mine employees.

[167] Pre-tax property income has shown a declining trend over the recent years (U.S. Department of Commerce, Bureau of Economic Analysis 2002), but as long as the rates of mining and non-mining sectors do not behave differently, this does not impact our analysis.

Table III.4.b-28: Estimated non-consultation costs of CHD for mining projects in Montana study area and nationally

Cost component	*Costs of CHD*	
	Lower bound	*Upper bound*
	PV $2002	
Foregone PS (mine profits)		
narrow boundary	-	none
wide boundary	-	108,289,524 [1]
Foregone taxes and royalties		
narrow boundary	-	92,002,028
wide boundary	-	92,002,028
Foregone employee earnings		
narrow boundary	-	37,431,592 [2]
wide boundary	-	74,863,183
Foregone multiplier earnings associated w/ mine inputs		
narrow boundary	-	76,745,025 [3]
wide boundary	-	282,084,406 [4]
Total - narrow boundary	-	206,178,644
Total - wide boundary	-	557,239,141

Notes: All values annualized and discounted at 3 percent. [1] Assumes pre-tax profit rate of the mine project of 10 percent. [2] Assumes three quarters of mine jobs are filled with individuals that would otherwise have worked in jobs paying 50 percent of their mine salary, and one quarter of jobs filled with individuals that otherwise would have been unemployed. [3] Assumes local capture rate of 35 percent and final demand local earnings multiplier of relevant industries of 0.65. [4] Assumes a national capture rate of 95.1 percent and a final demand earnings multiplier of 0.88.

In addition, it is unlikely that the positions would be filled predominantly by residents of the study area counties. The seasonally adjusted unemployment rate in Montana in March 2004 stood at 4.2 percent, significantly below the national rate of 5.7 percent (Montana Department of Labor and Industry, Research and Analysis Bureau 2004). Hence, it seems highly likely that a share of the positions would be filled by attracting workers from outside of the study area. The foregone earnings component of the cost of preventing the mine would then in part fall outside of the study area.

Since total metallic mineral mining employment in the study area is less than 200 persons (Montana Department of Labor and Industry, Research and Analysis Bureau 2003), we assume that half of the projected 387 mining-related jobs will be filled with non-area residents. We further assume that three quarters of the mine jobs will attract workers that otherwise would have been employed in other jobs, and we assume that the mine jobs pay on average twice as much as those other jobs. Treating hypothetically foregone mining jobs in full measure as lost jobs would not be justified, because the historical evidence shows that even dramatic reductions in employment in extractive industries have not lead to concomitant reductions in overall jobs (see for example Power 2000, 2001).

Finally, the opportunity costs to the local economy from preventing the mine operation do not consist in the total market value of the mine inputs, estimated at $550 million over 14 years, but rather in the local earnings associated with those goods and services. Those earnings depend, besides on the value of the inputs, also on the local capture rate (i.e., the share of the value of the various inputs that is produced locally, and retail margins), and on the final demand earnings multiplier of the industries producing those inputs. Given that large shares of the inputs are likely made up of fuel, transportation equipment and machinery, and electricity, water and other utility services, the capture rate associated with the mine inputs is likely to be low; petroleum products and heavy machinery and transportation equipment have comparatively low local capture rates since much of these inputs are not produced locally (see Stynes 1999). Assuming an overall local capture rate of 35 percent for the mine inputs, and an average local final demand earnings multiplier of 0.65, the foregone local earnings during the analysis period associated with the mine inputs would amount to approximately $77 million in PV terms (see Table III.4.b-28).

For the U.S. economy as a whole, we estimate the capture rate as the ratio of gross domestic product and current account deficit (95.1 percent); and the final demand earnings multiplier by dividing national personal income by the difference of GDP and the current account deficit (88 percent; all based on data for 2003 from U.S. Department of Commerce, Bureau of Economic Analysis 2004). The above estimated costs of CHD in Montana of course are only incurred if Initiative 137 is overturned in Montana, and if in addition the Secretary of the Interior decides to include the mining area as designated critical habitat for lynx.

Consultations

The total number of expected lynx-related consultations in the Montana study area during 2004 and 2013 is shown in Table III.4.b-29, distinguishing additional and increased effort consultations on the one hand, and reinitiated consultations on the other, and indicating the expected effort level.

Table III.4.b-29: Consultation impacts of lynx CHD in Montana study area

	Number of consultations caused by lynx CHD, by type and effort level			
	Lower bound		*Upper bound*	
Land use activity	*Additional/ Increased-effort*	*Reinitiation*	*Additional/ Increased-effort*	*Reinitiation*
Grazing	- - -	- - -	low: 16 - -	- - -
Timber management	low: 30 - high: 30	low: 6 - -	- - high: 80	- - high: 16
Recreation	low: 18 - high: 44	- - -	low: 60 - high: 133	low: 6 - high: 14
Road and bridge projects	low: 6 medium: 4 high: 1	low: 1 high: 2	low: 10 medium: 5 high: 1	low: 1 high: 2
Wildfire management	low: 206 - -	- - high: 1	low: 440 - -	- - high: 1
Residential construction	low: 370 - -	- - -	low: 554 - -	- - -
Mining	- - -	- - -	- - high: 1	- - -

The cost of the incremental consultation effort, that is, that part of the consultation effort that can be attributed solely to designation of critical habitat for the lynx, differs between additional consultations, reinitiated consultations, and increased-effort consultations. In the case of additional and reinitiated consultations, the full consultation cost is attributed to the designation if additional consultations or reinitiation occur because of the designation. In the case of increased-effort consultations only the difference between the cost of the informal consultation that would occur absent CHD and the cost of a formal consultation that occurs under CHD constitutes consultation costs attributable to CHD.

We develop estimates of the unit costs of increased consultation effort by subtracting the *without-CHD* consultation cost from the *with-CHD* consultation cost. For example, if a road project in the absence of lynx CHD would require a (low-effort) informal consultation at a cost of *x*, and after designation would require a (low-effort) formal consultation at the cost of *y*, then the incremental consultation cost of designation for that project is (*y*-*x*).

Our estimates of unit costs of informal and formal consultations are based on consultation cost data given in USDI FWS (2003b), which describe average consultation costs on the basis of historical section 7 files from a number of FWS Ecological Services offices around the country (ibid.:49). Our low-effort values are equivalent to USDI FWS's (2003b) *Low* values; our high-effort estimates are equivalent to their *High* values; and our medium-effort estimates are the average of their *Low* and *High* values. The cost estimates presented in parentheses in Table III.4.b-30 for the action agency include the costs of preparing a biological assessment (BA).

Table III.4.b-30: Calculation of change in unit consultation costs from lynx CHD

Type of consultation	*FWS*	*Action Agency*	*Third party*	*Total increment*	
	(A)	*(B)*	*(C)*	*(A)+(B)+(C)*	*(A)+(B)*
		Unit cost , in 2002$			
low-effort informal	1,000	(2,000) [1] 1,000 [2]	1,200		
low-effort formal	3,100	(9,600) [1] 3,100 [2]	2,900		
difference	***2,100***	*(7,600)* [1] ***2,100*** [2]	***1,700***	***5,900***	***4,200***
medium-effort informal	2,050	(5,800) [1] 2,050 [2]	2,050		
medium-effort formal	4,600	(15,100) [1] 4,600 [2]	3,500		
difference	***2,550***	*(9,300)* [1] ***2,550*** [2]	***1,450***	***6,550***	***5,100***
high-effort informal	3,100	(9,600) [1] 3,100 [2]	2,900		
high-effort formal	6,100	(20,600) [1] 6,100 [2]	4,100		
difference	***3,000***	*(11,000)* [1] ***3,000*** [2]	***1,200***	***7,200***	***7,200***

Note: See text for explanation. [1] Includes cost of preparation of biological assessment. [2] Corrected for cost of biological assessment.
Source: USDI FWS (2003b).

For projects that involve preparation of a BA even in the absence of CHD, the cost associated with the BA must be subtracted from the action agency cost increments attributable to CHD ("*difference*" in Table III.4.b-30). We assume that without the cost of the biological assessment, the consultation costs of the action agency are identical to those of the FWS. The adjusted incremental CHD consultation cost estimates are presented in bold. The estimated total incremental cost of CHD consultations is shown in the right-hand column of Table III.4.b-30. These values do not include the cost of preparing BAs. For projects for which BAs are required under CHD but for which BAs would not have been prepared absent lynx CHD, we add estimated BA costs. Specifically, biological assessments may need to be prepared for individual residential developments and their costs must be included in CHD-attributable consultation costs. These assessments need not be overly complicated as they would primarily focus on assessing the vegetation cover on the relevant parcel and its relation to surrounding vegetation. For this reason, the cost of these biological assessments is substantially lower than for the larger projects on which the BA cost data given in USDI FWS (2003b) are based. We assume a BA cost of $500 per residential development project. BA costs for logging projects are assumed to be $6,500 on average, which is the difference between low-effort formal consultation costs of an action agency and the FWS (see values in parentheses in Table III.4.b-30).

From Table III.4.b-30 we derive unit cost estimates for incremental consultation effort due to CHD (Table III.4.b-31). The unit cost of reinitiated consultations attributable to CHD is the full consultation cost, minus the preparation of a biological assessment, which has to be (and in the case of reinitiated consultations, already has been) prepared even in the absence of CHD.

Not all projects would undergo consultations absent CHD; generally, only those on federal lands are all likely to undergo consultations in the absence of CHD. By contrast, most residential development projects will probably not undergo consultations in the absence of CHD. To make our consultation cost estimate conservative (i.e., avoid an underestimation of consultation costs attributable to lynx CHD), we assume that no residential construction project would undergo consultation in the absence of lynx CHD. Therefore, the full consultation costs of these projects are assigned to CHD (see “additional” consultations in Table III.4.b-31).

Table III.4.b-31: Incremental unit consultation cost from CHD

Type of consultation	*Incremental consultation cost due to CHD, by type and effort*				
	FWS (A)	*Action agency (B)*	*Third party (C)*	*Total incremental cost (A+B+C)*	*Total incremental cost (A+B)*
			Unit cost , in 2002$		
Additional					
Low-effort	3,100	3,100	2,900	9,600/15,600[1]	6,700/12,700 [2]
Medium-effort	4,600	4,600	3,500	13,200/19,200[1]	9,700/15,700 [2]
High-effort	6,100	6,100	4,100	16,800/22,800[1]	12,700/18,700 [2]
Increased effort					
Low-effort	2,100	2,100	1,700	5,900	4,200
Medium-effort	2,550	2,550	1,450	6,550	5,100
High-effort	3,000	3,000	1,200	7,200	6,000
Reinitiated					
Low-effort	3,100	3,100	2,900	9,100	6,200
Medium-effort	4,600	4,600	3,500	12,700	9,200
High-effort	6,100	6,100	4,100	16,300	12,200

Notes: [1] Sum of columns *A*, *B* and *C* of rows “low-effort formal”, “medium-effort formal”, and “high-effort formal”, respectively, in Table III.4.b-30, plus estimated cost of BA for residential unit ($500) or logging project ($6,500). [2] As under [1] but only summation of columns *A* and *B*. See text for further explanation. *Source*: Table III.4.b-30.

Some logging activities on private lands are expected to apply for incidental take permits even in the absence of CHD, which would lead to consultations and the preparation of BAs. In such cases, the costs of CHD would be increased effort costs, and not full additional consultation costs. We assume that half of all logging projects on private lands in the proposed lynx critical habitat area apply for incidental take permits even in the absence of lynx CHD.[168] For the remaining logging projects on non-federal lands in lynx habitat, the cost of a BA (estimated at $6,500 on average) is included in CHD-related consultation costs.

Not all projects involve third parties. Projects located on federal lands often may only affect the FS and the FWS. On non-federal lands, consultations often do involve third-parties. However, consultations on residential construction projects are assumed to involve only the FWS and the developer. Consultations on road and bridge projects on federal lands and consultations on all non-ski recreational projects on federal lands are assumed to involve only the FWS and an action agency (FS or NPS). Consultations on all timber-management projects on federal lands are assumed to involve only the FWS and the FS or NPS, but in contrast to road and bridge projects, all such projects are assumed to undergo BA's even in the absence of lynx CHD. On private lands, only the FWS and one private party are assumed to engage in consultations, except in the case of mining projects, which also would involve the EPA.

Table III.4.b-32: Total estimated consultation costs from lynx CHD in Montana study area

Land use activity	*Lower bound*	*Upper bound*
	Total cost, PV 2002$	
Grazing	0	50,287
Timber management	319,788	668,505
Recreation	297,110	1,122,417
Road and Bridge Projects	84,011	110,106
Wildfire management	770,715	1,634,015
Residential construction	2,113,059	3,089,635
Mining	0	22,800
Total	3,584,684	6,697,766

Notes: Numbers indicate cost estimates for all consultations listed in Table III.4.b-29. All values annualized at three percent discount rate.

It is likely that the consultation cost estimates are biased upward, because many of the consultations attributed to the lynx would likely be initiated for the Bull trout. This is especially the case for consultations regarding timber management, residential development, and road and bridge projects (USDI FWS 2004a).

Furthermore, our assumption that federal action agencies will attempt to construct new trails in lynx habitat throughout the 10-year projection period even under CHD, introduces an upward bias into our incremental consultation cost estimates of CHD. This is especially true given the potentially large number of trails and hence trail-related consultations. A countervailing bias may be introduced by assuming, as described above, that a number of projects only involve the FWS and one other party (either an action agency or a non-federal party.

A further upward bias in our consultation cost estimates derives from the fact that we do not take into account that future consultations on FS and BLM projects can be streamlined, after the

[168] Based on the shares of timber harvest in the proposed CHD area over the period of analysis is that are forecast to occur on federal and non-federal lands, we assume 55 consultations for projects on federal lands in the lower-bound estimate, and eleven for projects on private lands; in the upper-bound estimate, the corresponding numbers are 60 and 36, respectively.

currently ongoing forest plan revisions incorporate the directions/guidelines, standards and objectives of the LCAS (see for example USDI FWS 2000c).

Total cost of lynx CHD in Montana study area

Finally, summing all cost estimates, we arrive at the estimated total ten-year costs of designating the proposed lynx critical habitat in Montana (see Table III.4.b-33). The estimated total costs vary widely across the four scenarios, from $8.3 million in the lower-bound scenario under wide spatial boundaries, to $575 million in the upper-bound scenario under wide spatial boundaries and the assumption that designation of critical habitat for the lynx would actually lead to prevention of the McDonald Gold mining project.

Table III.4.b-33: Total cost of lynx CHD in Montana study area and nationally

	Wide boundary		*Narrow boundary*	
	Lower bound	*Upper bound*	*Lower bound*	*Upper bound*
		PV(2003) 2002$		
Grazing	*n.a.*	*n.a.*	*n.a.*	179,843
Timber management	203,987	2,598,289	655,388	7,468,290
Recreation	1,720,475	3,470,781	10,870,295	21,441,302
Road and bridge construction	418,000	418,000	418,000	418,000
Wildfire Management [1]	*n.a.*	*n.a.*	*n.a.*	*n.a.*
Residential construction	2,345,270	4,540,541	2,497,770	10,134,484
Mining	0	557,239,141	0	206,178,644
Consultations	3,584,684	6,697,766	3,584,684	6,697,766
Total	8,272,416	574,964,517	11,111,704	239,001,866

Notes: All present values at 3 percent annual discount rate. n.a. - not applicable. [1] Project modifications for hazardous fuel treatment projects are assumed to be negligible, as they would likely consist only in *not* removing root wads and downed logs.
Sources: Tables III.4.b-17, -18, -20, -22, -28, -32.

The main determinant factor in the cost difference between lower-bound and upper-bound scenarios is the McDonald gold mine project, which may (upper bound) or may not (lower bound) be prevented by the designation of critical habitat for the lynx. If the mine would be prevented instead through confirmation of Initiative 137, or if the mine area would be excluded from designation, total costs of CHD would drop by almost 98 percent to $13.6 million under wide (national-level) study boundaries, and by 86 percent to $32.8 million under narrow boundaries (study area counties only).

Total costs are higher under narrow (local) spatial boundaries than under wide (national) boundaries since some of the impacts of lynx CHD that lead to costs in the study area lead to compensating benefits in the remainder of the country, thereby neutralizing the effects of these impacts for the country as a whole.

III.4.c Benefits of critical habitat designation for the lynx

The designation of critical habitat for the lynx is expected to have two main beneficial impacts. These are an increased chance of recovery of the lynx population in the study area, and an increase of the amount of land maintained in an undeveloped or less developed state. The values associated with these impacts are expected to be substantial.

Value of improved chances of recovery of lynx populations

The value of a lynx population increase in the Montana study area as a result of CHD for the lynx is estimated using the methodologies described in section II.3. WTP estimates are derived for the two increase scenarios, 10 percent and 25 percent.

Table III.4.c-1 shows our single-point estimate and meta-analysis-based estimates for average WTP of area households, out-of-area visitors to the study area, and the remainder of US households (i.e., not including study area households and visitors). For comparison purposes, the corresponding values of a single-value benefit transfer based on the red wolf are also included in the table.

Single-point transfer WTP estimates

For reasons discussed in section II.3, we use the river otter as value donor species. The lump sum WTP estimate for a 10 percent increase in lynx populations in the Montana study area, expressed in 2002 prices, is $7.2 per household, and $14.5 for a 25 percent increase (see Table III.4.c-1). Average WTP of visitors is higher, ranging from $15.8 for a 10 percent increase to $31.5 for a 25 percent increase (all lump sum values).

WTP for households that do not reside in the study area and do not visit the area is estimated using Loomis' (2000b) value distance function. WTP of those households is lower, ranging from $6 for a 10 percent increase in lynx populations to $12 for a 25 percent increase.

Rosen (1997) reports lower-bound and upper-bound estimates of area households' annual WTP for the reintroduction of the red wolf in the eastern U.S. of $ 30 and $ 70 (in 1997$), respectively. Adjusting for the relative average per-capita income difference between Rosen's (1997) eight study area counties and our Montana study area and correcting for inflation, benefit transfer would yield lower-bound and upper-bound benefit estimates of $28 and $65 (2002$), respectively, per study area household per year.[169]

Meta-analysis benefits transfer

Using eq. (2) in section II.3 we obtain estimates of the WTP of study area households, and of visitors to the study area from outside of the area. WTP estimates for non-area and non-visiting US households are then developed as previously described, by applying the value-distance function gradient from Loomis (2000b).

The WTP estimate derived via the meta-analysis benefit transfer is approximately a fifth smaller than that based on the single-point value transfer of the otter-based WTP (see Table III.4.c-1): By

[169] Average per-capita income of each of the two regions (our Montana study area and Rosen's eight county study area) is calculated as the population-weighted average income of the counties that make up each region.

comparison, use of even the lower-bound red wolf-based WTP transfer estimate would generate lynx WTP estimates over an order of magnitude higher than those generated by the otter-based transfer.

Table III.4.c-1: WTP estimates for lynx conservation in the Montana study area

Method of benefit estimation	*Percent increase in lynx population in study area*	*Average WTP per household in study area*	*Average WTP per visitor in study area*	*Average WTP for average non-area and non-visiting US household*
			all values in 2002 $	
Point value benefits transfer				
- *Otter-based*	10 %	7.24 lump sum [1, 2]	15.76 lump sum [3]	6.00 lump sum [4]
	25 %	14.48 lump sum [2]	31.51 lump sum [3]	12.01 lump sum [4]
- *Red Wolf-based*	*(Re-introduction)*	*27.73 per year* [5]	*60.12 per year* [3]	*22.99 per year* [4]
Meta-analysis benefit transfer	10 %	5.52 lump sum	11.97 lump sum	3.59 lump sum
	25 %	11.53 lump sum	24.98 lump sum	7.49 lump sum

Notes: Estimates are for 2003, i.e., assuming a CV study had been conducted in that year. [1] Equivalent to 1/2 of White et al.'s (1997) value for 25 percent increase. [2] Point value WTP estimates from White et al. (1997) are adjusted from 1997£ to 2002$ using the UK CPI, the 2001 PPP-adjusted GDP ratio of the UK and the US, the US CPI, the per-capita income ratio of White et al.'s (1997) study area (North Yorkshire) and the UK average, and the per-capita income ratio of the Montana study area counties and the US average. For additional information, see text. [3] Based on ratio of visitor WTP to area household WTP (2.18:1) observed in meta-analysis WTP estimates. [4] Based on average area household WTP corrected for difference in average per-capita income between study area and US, and adjusted using WTP distance decay factor from Loomis (2000b). [5] Based on Rosen's (1997) lower-bound value; upper-bound of WTP estimated at 64.7 per year.
Sources: White et al. (1997); Rosen (1997); Loomis (2000b); World Bank (2003); UK Office of National Statistics (ONS) (*http://www.statistics.gov.uk*), UK ONS (2001); Council of Economic Advisors, *Economic Indicators* (various issues).

Aggregate WTP for respective population segments are shown in Table III.4.c-2. They are derived by summing average WTP per area or US household or out-of-area visitor, respectively, over all area households, US households, and out-of-area visitors, respectively. The aggregate estimates are not yet adjusted for non-response rates in the source surveys, a procedure often employed to ensure the conservative nature of WTP estimates. We adjust for non-response rates in the next step, when generating lower- and upper-bound WTP estimates for lynx CHD (see Table III.4.c-3).

In order to ensure the conservative nature of our estimates, we assume that non-responses in our source studies (Loomis and White 1996; White et al. 1997) express zero WTP. The response rate for our single-point benefit transfer estimate is 42.9 percent (the product of survey response rate [64 percent] and the rate of respondents willing to pay the asked rate [67 percent]; see White et al. 1997). For our meta-analysis-based WTP estimate, the response rate for households is 49.2 percent, and that for visitors is 60.6 percent, which represent the averages of household and visitor response rates, respectively, in the studies cited in Loomis and White (1996).

Our lower-bound estimate of total WTP for lynx population increases is based on a 10 percent expected lynx population increase, the benefit transfer estimate based on Loomis and White's (1996) meta-analysis, and the response rate adjustment just described.

Table III.4.c-2: Aggregate WTP estimates for CHD-caused lynx conservation in study area

		Size of lynx population increase	*WTP* [1] *2002$*	*Type of payment*
Point-value BT - Otter-based	Area households	10%	0.9 million	lump sum
		25%	1.8 million	
	Visitors [2]	10%	30.3 million	lump sum
		25%	60.6 million	
	Rest of US [4]	10%	528.0 million	lump sum
		25%	1,056.0 million	
Meta-analysis BT	Area households [3]	10%	0.7 million	lump sum
		25%	1.4 million	
	Visitors [2]	10%	23.0 million	lump sum
		25%	48.0 million	
	Rest of US [4]	10%	400.0 million	lump sum
		25%	834.9 million	

Notes: [1] WTP estimates not yet adjusted for non-response rate in source studies. [2] Out-of-area visitors only. Numbers of out-of-area visitors are derived from visitation numbers for the National Forests in the area and Glacier National Park, by using the zip code information (for the NFs) to subtract numbers of area visitors from total visitation numbers (USDA FS 2001, 2002b, 2002c, 2003f; USDI NPS 1999:160, and *http://www.fs.fed.us/r1/ helena/planning/fy00_fact_sheet.htm*, accessed Dec. 2003). [3] Number of study area households estimated as population in study area counties divided by average Montana household size. Based on projected population increase in study area (from Montana Dept. of Commerce - CEIC 2002). Assumes visitor numbers remain constant at 2001-2002 level. [4] Based on projected US population growth (US Census Bureau 2000).

Table III.4.c-3: Upper and lower-bound WTP estimates for lynx population increases in the Montana study area

WTP estimate		*WTP 2002$* [1]
Lower-bound [2]	Area households [3]	0.3 million
	Visitors [4]	13.9 million
	Rest of US	197.0 million
Upper-bound [5]	Area households	0.9 million
	Visitors	36.6 million
	Rest of U.S.	519.9 million

Notes: All WTP estimates based on Table III.4.c-2, adjusted for non-response rates in source studies and three percent annual discount rate (except lump sum-based WTP estimates). [1] Assumes constant average income and attitudes in study area and US as a whole. [2] Based on meta-analysis benefit transfer for a 10 percent lynx population increase. [3] WTP multiplied by percentage of survey population in White et al. (1997) willing to pay the asking price (42.9 percent). [4] Based on area household WTP multiplied by household/visitor WTP ratio of the meta-analysis WTP estimates (2.18:1). [5] Based on single-point benefit transfer estimate for 25 percent increase in lynx population.

The upper-bound benefit estimate is based on the single-value benefit transfer using White et al.'s (1997) WTP estimate and a 25 percent lynx population increase.

The lower-bound and the upper-bound WTP estimates result from multiple low-end and high-end assumptions, respectively. Hence, as is to be expected, the range of estimated total WTP is quite large, with the high benefit estimate approximately three times as large as the low estimate. The estimates vary considerably more with respect to the choice of the spatial boundary of the analysis. If the boundary is drawn around the study area, estimated WTP for increases in the lynx population ranges from $14.3 million to $37.5 million. Benefits are far larger at the national level, ranging from $211 million to $557 million.

As discussed above, the BT literature suggests that in general, functional transfers may lead to smaller errors in the resulting transfer estimates than single-value transfers. This seems to be the case especially the more dissimilar the study site/object and the policy site/object (Chattopadhyay 2003). This would argue for choosing the meta-analysis based WTP values not just for the lower-bound estimates but also for the upper-bound ones, in which case the upper-bound WTP estimates would drop by roughly one fifth, to $441 million at the national level, and $29.8 million at the local level.

Values associated with the prevented development of undeveloped landscapes

CHD-attributable restrictions on grazing, timber harvest, road construction, and wildfire management are expected to lead to no or only negligible impacts on forest or wetland conversion. CHD impacts on recreation, residential development, and mining, on the other hand, are likely to result in the prevented conversion of forest and wetland ecosystems, and therefore the prevented loss of the values generated by these systems (see Table III.4.c-4).

CHD for lynx leads to the expected prevention of forest conversion of between 79 (lower bound) and 120 (upper bound) acres for downhill ski and snowboard runs, and between one and three acres for campsites.[170] In addition, an estimated 14-27 miles and 228-455 miles of cross-country ski trails and hiking trails, respectively, are estimated to be prevented due to lynx CHD. At an average trail width of three feet, this results in a prevented loss of forest to trails of between 88 (lower bound) and 175 (upper bound) acres.

Residential development in the study area counties is predominantly single unit-type, and that is particularly true for the unincorporated areas in which most of the lynx habitat is located (US Census Bureau 2003b). For purposes of valuation of ecosystem services, per-acre impacts of modified and prevented residential developments can be considered as identical, as both imply a prevented loss of forest habitat.[171] Over the ten-year time period analyzed, CHD for the lynx then is estimated to result in protection of habitat that would otherwise have been converted to between 370 (lower bound) and 554 (upper bound) residential developments. In the absence of data on the average footprint size of homes in unincorporated areas in the study area, we assume an average footprint size of 2000 sq. ft. for houses, 500 sq. ft. for ancillary buildings (garage, sheds), and 2000 sq. ft. for vegetation removal for other purposes (driveway, landscaping),

[170] The campsite estimate assumes 15 ft ×15 ft for tent sites, 16 ft × 30 ft for RV sites, and equivalent space requirements for services, access roads, and spaces between tent or RV sites.

[171] Recall that modifications of residential construction projects in designated lynx habitat are assumed to include the relocation of built structures (houses, ancillary buildings, driveways) to non-Tier-1 habitat, that is, to non-forested parts of the properties, thereby leading to the preservation of forest cover.

resulting in an assumed average of 4,500 sq. ft. (or 0.10 acre) of forest lost per residential development in lynx habitat.

The total forest area that would be taken out of development is estimated at between 206 and 2,915 acres (lower and upper bounds, respectively), which constitutes only an insignificant amount of total lynx habitat in the proposed designation area.

Table III.4.c-4: Estimated prevented loss of forest and wetland ecosystems from land use activity restrictions attributable to lynx CHD

Land use activity	*Prevented loss of ecosystems*			
	Forest		*Wetland*	
	Upper bound	*Lower bound*	*Upper bound*	*Lower bound*
		acres		
Recreation [1]	297.9	167.5	-	-
Residential development	57.2 [2]	38.2 [3]	-	-
Mining	2560	0	42	0
Total	2915	206	42	0

Notes: [1] Hiking and cross-country trails, downhill ski and snowboard runs, and campsites. [2] 554 units modified. [3] 277 units modified plus 93 units prevented.

Only one future mining project (the McDonald gold mine) is expected to be potentially impacted by lynx CHD. Surface disturbance due to the project is estimated at four square miles, with an additional area of equivalent size on which various land cover changes would occur (MEIC 2000).[172] The affected area is primarily forested, but also includes a 42 acre wetland that would be destroyed by the mine (MEIC 2000). As discussed in the impact section, the lower-bound scenario results in zero impacts of lynx CHD on the project.

The wide range in the estimated acreage of forest lands impacted by CHD is due to the large area covered by the McDonald Gold mine project, which may (upper bound) or may not (lower bound) be halted due to lynx CHD. The quantity of benefits created by lynx CHD is therefore highly dependent on whether or not said designation leads to cancellation of the project or not.

Ecosystem function values

Due to the more complete valuation information on wetlands compared to temperate forests (see Table II.3-2) and the high value of some wetland functions, the relatively small wetland area that is affected by lynx CHD in Montana (through the possible prevention of the McDonald gold mine project) generates substantial benefits that amount to almost half of the total ecosystem service benefits attributable to lynx CHD in Montana (see Table III.4.c-5).

The total ecosystem service value created by lynx CHD over the ten-year projection period is shown in Table III.4.c-5. It is calculated by multiplying the discounted annual service values per acre by the total acreage of forest and wetland areas preserved due to CHD, and summation of the annual values.

The total estimated ecosystem services value of lynx CHD is the value of the prevented loss of such services due to conversion of forest to built structures and non-forest vegetation (e.g., lawns)

[172] The potential impact of the mine on ecosystem service provision is much larger, due to expected heavy metal and cyanide leaching, lowering of the local groundwater level, and nitrate pollution.

and, in the case of the McDonald gold mining project, the loss of wetlands. Because a small share of the forest cover assumed lost per residential development is replaced by other vegetation (lawns etc.) which also provides ecosystem services, albeit at a much smaller scale than a forest ecosystem, the assumption that all ecosystem services are lost following forest conversion may lead to an overestimate of ecosystem service benefits of CHD. On the other hand, the generally high intensity of use of agrochemicals on landscaped properties and the negative ecosystem impacts associated with such use, will tend to counteract this bias. In addition, because of the many ecosystem services not included in the analysis, the benefit estimates likely represent substantial underestimates of the actual ecosystem service benefits attributable to lynx CHD.[173]

Table III.4.c-5: Estimated present value of the ecosystem service benefits generated by lynx CHD in Montana, by land use restricted due to CHD

Land use	*Ecosystem service value*	
	Upper bound	*Lower Bound*
	2002$ (PV)	
Recreation	285,452	160,511
Residential development	54,841	36,627
Mining	4,801,243 [1]	0
Total	5,141,536 [2]	197,138

Notes: [1] $2.35 million (49 percent) of which is attributable to wetland conservation. [2] 46 percent of which is attributable to wetland conservation. Present values (2003) of annual benefit flows during ten year time period considered in this analysis, at three percent annual discount rate.

Non-use values

The amount of lands in the Montana case study area that would be taken out of development due to lynx CHD is very small, estimated at between 206 and 1,957 acres (see Table III.4.c-4). Furthermore, CHD-related land use restrictions are not expected to prevent the large-scale conversion of one single, contiguous area, but rather the development of many small, dispersed parcels. Therefore, the WTP reported in other studies for whole landscapes generally is of limited transferability to the study area. For this reason, we assume that the aggregate existence value of the many small dispersed areas that lynx CHD would prevent from conversion is small. The only exception to this is the area in which the McDonald Gold mine would be located, just east of Lincoln in Lewis and Clark counties. The mine would create a permanent and dramatic, large-scale change on an area of considerable size (four square miles of surface disturbance, and an additional four square miles on which various land cover changes will occur). This area lies within the viewshed of Helena National Forest's Scapegoat Wilderness (Helena NF surrounds the mine on all sides) and of MT Highway 200, which is designated as scenic route.

Kramer et al. (2002) report WTP to protect part (along roads and trails) and all of the forest described in their CV, and also estimate the component values of WTP (use, existence and bequest). We use their findings to estimate the WTP attributable to preservation of the scenic beauty of the potential mine site for local residents in the vicinity of the proposed mine (Lincoln) and for users of the local portion of Scenic Highway MT 200.

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[173] For example, if the economic values of nutrient circulation and erosion prevention services provided by temperate forests were only one fifth of those estimated for tropical forests, the value of the estimated forest ecosystem services for our study area would almost double.

Kramer et al.'s (2002) sample frame were area households within 500 miles (approximately one day's drive) of the spruce-fir forests to be valued, about three quarters of which lie within Great Smoky Mountain National Park. They found that WTP depends on the size of the protected area, which suggests that the calculation of WTP per acre is justified.[174] With a total area of the spruce-fir forest ecosystem of 26,600 ha and an estimated annual lower-bound and upper-bound (95 percent confidence interval) WTP of $11.81 and $24.84, respectively (Kramer et al. 2002), the estimated average annual WTP per acre is between $0.00044 and $0.00093 per person. The WTP values used are the lower ones reported by Kramer et al. (2002), which are those for protection of only those forest areas that are close to trails and roads, or approximately one third of the total ecosystem; WTP per person for all of the forest was almost twice as high, between $18.49 (lower bound) and $40.96 (upper bound) per year.

Traffic data (MT DOT 2003b) show that the average daily number of vehicles using MT 200 in the Lincoln area in 2002 was 2,165 (monitor use station A-70 east of Lincoln). That section of MT 200 is unlikely to serve as a daily commuter road for anyone but Lincoln residents, as Lincoln is the only town or settlement for which the road constitutes the shortest connection to the nearest urban center. Even if we assume that all Lincoln residents (approximately 1,100) use the road on a daily basis, the road is used by on average 1,065 non-local residents per day, or approximately 389,000 per year. Most of these are likely to be visitors to the area, since MT 200, together with US 83, is the main access road to Scapegoat Wilderness.

Table III.4.c-6: Estimated non-use value of preventing four square mile surface disturbance caused by the planned McDonald gold mine project

	WTP	
	Upper bound	*Lower bound*
	2002$ (PV) [3]	
Lincoln residents [1]	17,816	8,469
Visitors on scenic route MT 200 [2]	629,495	299,289
Total	647,308	307,758

Notes: Non-use value is estimated to account for 87 percent of WTP (Kramer et al. 2002). [1] Population estimated at 1,100, with average annual non-use WTP of $0.99 (lower bound) and $2.08 (upper bound) for avoiding the 2,560 acre surface disturbance. [2] Average non-use WTP assumed to be 1/10 of that of Lincoln residents. Number of non-area residents using MT 200 is estimated at 388,275 per year, based on average daily traffic volume in 2002 on MT 200 east of Lincoln of 2,165 cars, of which 1,100 are assumed to be driven by Lincoln residents. [3] PV (2003) are from annual benefit flows during ten year time period considered in this analysis, discounted at three percent per year. Operations on the mine site are assumed to begin in 2005.

We assume that the average WTP of visitors is only 1/10th of the average annual WTP of households. This is a conservative assumption, since average WTP of visitors generally is higher than that of households. In addition, by assuming that there is only one visitor per vehicle, the estimate becomes even more conservative. Counting only the non-use portion of WTP, which in Kramer et al.'s (2002) study accounts for 87 percent of total WTP, the non-use value of preventing the four square mile surface disturbance expected to occur during the projection

[174] As stated above, survey subjects were asked to value the preservation of the health of all of the respective forest, or of only the part that exists along roads and trails.

period (from 2005 on when operation of the mine could begin) is estimated at between $0.31 million and $0.65 million in present value terms (at a three percent annual discount rate).

There are a number of factors that potentially introduce (opposing) biases into our WTP estimate for non-use benefits due to lynx CHD. First, our source study WTP estimates (Kramer et al. 2002) are for a forest area of which three-quarters are located in a well-known and extremely popular National Park. Therefore, average WTP may be higher than for the forest that may be lost in our study area, which is mostly due to land cover conversion on non-federal lands. Also, the potential value-loss in our case study area does not result from the loss of the actual ecosystem that is used for recreation (which would be Scapegoat Wilderness or other parts of Helena National Forest), but from the loss of scenic beauty of part of the landscape within the viewshed of those recreation areas, and from the loss of scenic beauty within view from a highly frequented Scenic Highway.

On the other hand, the mine project would lead to a particularly drastic conversion and loss of scenic beauty, from a forest landscape to an open-pit mine, that arguably is much more dramatic than the replacement of one type of forest by another, as would be the case in the Kramer et al. (2002) study. Kramer et al.'s results show the importance of scenic beauty as a determinant of people's WTP. The authors asked subjects to grade the importance of scenic beauty as a reason for protection of the forests, as "very important", "somewhat important", and "not important". Despite of coding very important as "1" and both "somewhat important" and "not important" as zero, the mean value of the scenic beauty variable was 0.69 (with a SD of 0.46).

In addition, only that part of the proposed mining area on which major surface disturbance would occur is included in the valuation (an estimated four square miles), while the expected additional area impacted by the mine of equal size and the remaining small areas converted for residential use are excluded. Furthermore, we assume conservatively that there will not be any increase in the number of visitors to the area or of traffic on MT 200. Finally, and most importantly, our assumption that average WTP of visitors is only 1/10 of average WTP of residents is likely to introduce a very conservative bias.

Recreational use values

Over the ten-year time frame analyzed in this analysis, the number of expected forest sites on which land conversion would occur in the absence of lynx CHD is rather small, estimated at between 370 and 554 sites. The combined acreage of the associated lost forest cover is also small, with the exception of the area covered by the proposed McDonald gold mine project. Since there exists no study that assesses the loss in benefits to recreationists that is associated with low-density recreational development in the vicinity of major recreation sites, we focus in this study on the recreation benefits that would be lost through the proposed mine.

Using the above-cited study by Kramer et al. (2002) that develops estimates of the share of WTP for their study area forests that can be attributed to direct recreational use (13 percent), we quantify the value of the prevented loss of recreational benefits to residents in the vicinity of the mine site (residents of Lincoln) and to non-resident users of the scenic route MT 200 in the area. As in the estimation of the non-use values of preventing the mine from development, we assume the WTP of visitors is only 1/10 of the WTP of area residents. The estimated annual recreational value of keeping the area proposed for mining out of development is estimated at $0.15 - $0.31 for the average resident, and $0.02 - $0.03 for the average non-resident recreationist (users of MT 200 only). The present value of the total recreational use value associated with preventing the McDonald gold mine project is estimated at between $46,000 and $98,000 (see Table III.4.c-7).

As is the case for the estimate of the non-use value of lynx CHD, the estimated use value of lynx CHD is conservative, because only the impact of designation on the mining project is considered, while the benefits of prevented forest conversion on the other sites are assumed to be zero.

Table III.4.c-7: Estimated recreational use value of preventing four square mile surface disturbance caused by the planned McDonald gold mine project

	WTP	
	Upper bound	*Lower bound*
	2002$ (PV) [3]	
Lincoln residents [1]	2,662	1,266
Visitors on scenic route MT 200 [2]	94,062	44,721
Total	96,724	45,987

Notes: See notes to Table III.4.c-6. Use values are estimated at 13 percent of total WTP (Kramer et al. 2002); $0.15 to $0.31 per resident, and 1/10 of that per visitor.

Public services costs of sprawl

The strain on public budgets from urban sprawl has been identified as a concern in the study area (see for example Whitefish City-County Planning Board 2002; Kalispell City Planning Board 2003a), as have been the implications of continuing sprawl for air quality (Montana DEQ 2000c). The new growth policies for the Tri-city area for example state that “Infill development is needed to fully utilize the land and make urban services more economical” (Whitefish City-County Planning Board 2002:9). The policies explicitly state the goal of “managing growth to prevent deterioration of the local quality of life” and “alleviate the public burden of increased taxes and congested infrastructure and services” (Whitefish City-County Planning Board 2002:10). The public services identified as the ones particularly affected by continued growth in the unincorporated areas adjacent to the cities are firefighting, police, and sewage and water supply. In Kalispell and Whitefish, police and firefighting resources are becoming increasingly inadequate due to sprawl, necessitating additional infrastructure (fire and police stations) and personnel investments (Kalispell City Planning Board 2003a, Whitefish City-County Planning Board 2002).

The cost of sprawl on police and firefighting that would be avoided due to lynx CHD is not easily quantifiable. In some areas, cities may extend these services to adjacent unincorporated areas and may try to recuperate the incremental costs from the beneficiaries (see for example plans in the Tri-city area: Whitefish City-County Planning Board 2002), in which case there would be no external costs of sprawl for the respective services. In other cases, the county or state may provide the needed services and finance them out of general revenues or user fees, in which case sprawl would lead to negative externalities. In general, whenever it is impossible to charge the affected beneficiaries for the full incremental cost of service provision, that part of service costs that is in excess of the cost of comparable service provision in municipal areas constitutes the service cost of sprawl. The external service cost of sprawl may take the form of increased fiscal demand on the part of the relevant government (municipal, county, or state) or an increased level of crowding for the remaining service consumers. In the former case, the increased fiscal outlays will eventually lead to increased fees for all service users or to increases in taxes. In the case of increased crowding, the same may occur if service provision is increased to maintain the average provision level. If the increase in crowding is not remedied the costs take the form of reduced average utility of service consumers and/or direct monetary costs (e.g., increased fire insurance premiums due to the worsening of the protection rating, increased crime rates, and potentially increased health risks due to the reduced service provision density).

Increasing subdivision development within some distance outside of city limits is expected to bring many of these developments onto the public sewer system, which will require new sewer main lines and lift stations, the placement and time of installation of which however currently is still unknown (see for example Kalispell City Planning Board 2003a:52A).

Only a small share of these increased sewer service costs however is attributable to the residential developments that would be impacted by lynx CHD, as the majority of the developments prevented by lynx CHD are expected to be located in the more outlying areas that usually have on-site sewer systems. The costs of the latter are borne entirely by the property developer/owner, except for the environmental costs associated with leaks and aging septic and cesspool systems, which mostly constitute social costs. The latter type of contamination has been identified as a growing problem for water quality in some parts of the study area (see for example Kalispell City Planning Board 2003a:55A). Although there are a number of studies that value the environmental impacts of water quality reductions from nutrient contamination, the lack of estimates on water quality impacts in the study area prevents the generation of estimates for this analysis.[175]

It is important to note that the costs of sprawl are different from the costs of population growth (Nelson et al. 2002). Growth in western Montana is expected in the base case scenario as well as under designation of critical habitat for the lynx. Designation would not reduce population growth in western Montana in general or in the study area in particular; rather, it would redirect to the incorporated areas some (but not all) of the residential development that in the absence of designation would occur in rural areas.[176] Thereby, lynx CHD would create benefits in the form of avoided negative externalities associated with the prevented projects.

Unlike the reductions in water quality and related impacts that result from sprawl-related defective septic and cesspool systems, which almost fully constitute net social costs, the increased costs of public services likely do not translate into increased net social costs on a basis of one to one. For example, the income of additional personnel hired for service provision (police officers, firefighters, utility plant operators, administrative personnel) may generate new employment and feed back into the local economy. However, the increase in taxes that is likely to occur to finance at least part of the sprawl-related increase in service provision costs leads to deadweight losses because of the inefficient nature (in an economic sense) of all major taxes (payroll, income, sales tax). It is this deadweight loss that, together with sprawl-related reductions in environmental quality, represents the real net social cost of increased sprawl-related resource requirements of public services, and that to some extent would be avoided with lynx CHD in the study area.[177]

Although the generation of a quantitative estimate of this deadweight loss is beyond the scope of this study, some rough understanding of the sprawl-related social cost of services that is avoided

[175] It should be noted that this reduction in environmental quality does not constitute a cost of public services due to sprawl, but rather an external cost of decentralized development (see Table II.3-1).
[176] Recall that a share of the residential developments impacted by lynx CHD is assumed to relocate to non-Tier-1 areas within the designation area.
[177] This is true for sewer systems and fire and police services. Other public services, such as road construction, may carry additional social costs, for example in the form of the lost amenity value of landscapes.

through lynx CHD can be gleaned by looking at the projects that are expected to be prevented due to the designation.

In the lower bound impact scenario, all residential projects incompatible with lynx CHD are assumed to relocate onto non-Tier-1 lands within the designation area, some of them on-site, some to other sites; hence, the avoided costs of public service provision of lynx CHD would be zero, since there is no reason to assume that properties that constitute lynx habitat and possess non-Tier-1 areas are generally located closer to municipal areas. In the upper-bound impact scenario, 93 projects are assumed to be displaced from the designation area. Under narrow impact-analysis boundaries, the public service provision benefit of lynx CHD would be the avoidance of the sprawl-related component of the external costs of service provision to these 93 developments. The actual net benefit of lynx CHD would be the avoided deadweight loss associated with these costs and avoided social costs from pollution. Under wide (national-level) boundaries, however, the upper bound may lead to zero benefits if the displaced developments were to relocate into unincorporated areas in other regions, or to benefits equivalent to those in the narrow boundary case, if the projects were to relocate into incorporated areas in their new locations.

If one assumes that the avoided residential developments were to be equipped with on-site septic systems (as is likely to be the case due to their expected location far from municipal areas and generally outside of rural sewer districts), lynx CHD would not lead to avoided public service costs for sewer service. The direct sprawl-related external public service cost of police and fire service provision to 93 residential developments is the incremental provision cost that is due to the low-density settlement pattern of these developments. At an average household size of 2.45, the approximate increase in population in unincorporated areas that would result from 93 new houses is 228 individuals. With one officer per 500 persons as a general guideline for adequate police staffing (Kalispell City Planning Board 2003a), 93 developments would suggest a need for roughly one half additional officer. That, however, would also be the case if the units were built in incorporated areas. In the more outlying rural areas, adequate police protection would require more than one half additional officer, to maintain similar response time and levels of routine patrolling in spite of the longer distances between residences. The sprawl-caused additional manpower requirement for police for an additional 93 rural residences is perhaps on the order of one half additional officer, which carries associated personnel and infrastructure costs (police vehicle acquisition and maintenance, etc.). The annual cost associated with this additional policing effort is perhaps around $20-30 thousand, which would be the amount by which total tax revenue would need to be raised in order to finance the additional policing. The net social cost associated with this amount would however only be some fraction thereof, equivalent to the deadweight loss associated with the resulting tax increase.

In addition to preventing this deadweight loss, lynx CHD would result in the avoided social costs in the form of the environmental quality impacts of contamination from septic and cesspool systems from the 93 developments, as pointed out above.

Apart from the social costs of public services associated with residential developments, lynx CHD could (in the upper-bound impact estimate) also lead to avoidance of the social costs associated with the prevention of the McDonald gold mine project. Realization of the mining project is expected to lead to over 2,500 supply trucks traveling on MT 200 per year, including 788 truckloads of diesel fuel, 386 truckloads of sodium cyanide and 236 truckloads of ammonium nitrate (MEIC 2000). This would represent a five percent increase over the already very high current volume of heavy truck traffic on that segment of the highway (approximately 49,000 heavy trucks in 2002; MT DOT 2003b). Due to the increased traffic volume and the large quantities of hazardous materials transported, there exists a substantial risk of increased accidents due to mining-related traffic. Specifically, with 2,500 trucks per year, 56 percent of which transport hazardous materials, and with an assumed 20 tons average load per truck and an assumed average haul distance (from point of origin) of the mine input materials of 50 (200) miles, the mine-related truck traffic would be statistically likely to cause two (eight) hazardous materials (HAZMAT) incidents and four (15) additional crashes over the nine years of mine development and operation that would fall in the period of analysis.[178]

The costs of the crashes and incidents caused by the mine-related trucking activity are not estimated here, but they include property damage and environmental contamination from HAZMAT spills, personal injuries and/or fatalities, and police, fire, HAZMAT, and medical authorities.

Summary: Benefits of lynx CHD in Montana study area

The information needed to compile a quantitative estimate of the full suite of benefits generated by lynx CHD is currently not available. The primary reason for this is the still incomplete scientific understanding of some of the service functions performed by ecosystems, and/or the lack of studies that quantify some of these functions and estimate their economic values.

Despite this omission, this analysis shows the substantial economic benefits that designation of critical habitat for the lynx would generate in Montana. The total monetary value of these benefits over the ten-year time period included in this study (2004-2013) depends on the spatial scale of the analysis (study area counties only vs. US as a whole), and on a variety of assumptions that have to be made regarding the impacts of lynx CHD and the monetary values of the benefits associated with these impacts. All of these assumptions have been stated in the respective sections of the study, but we will repeat the most important ones below.

Because of these assumptions and the potential for error that exists in each of them, we developed lower and upper boundaries for all impact estimates as well as for the monetary values associated with these estimated impacts. Even the assumptions made in the development of the upper boundaries of beneficial impacts are generally conservative. Therefore, the lower-bound estimate of the economic benefits from lynx CHD should be considered extremely conservative, while the upper-bound estimate should be considered as being less, but still somewhat, conservative. In other words, it is very likely that the lower-bound benefit estimate is a substantial underestimate of actual benefits from lynx CHD, while the upper-bound benefit estimate is much less likely to be an overestimate of actual benefits.

Under the conceptually correct boundary setting that considers the impacts of the designation for the US population as a whole (the “wide” boundary setting), the total monetary present value of the benefits that designation of critical habitat for the lynx in Montana would generate is estimated at between $212 million and $563 million for the ten-year time frame considered in this analysis (see Table III.4.c-8). Using the narrow boundary setting that considers only those

[178] Estimates based on USDOT Bureau of Transportation Statistics (2002). National-level HAZMAT incident likelihood per HAZMAT ton-mile is derived from *ibid*. as total number of highway HAZMAT incidents divided by total HAZMAT highway ton-miles (1997 data). National-level non-HAZMAT crash likelihood for highway truck traffic per ton-mile is derived as total number of large truck highway crashes divided by total intercity truck ton-miles (from *ibid*.).

impacts from the designation that occur in the counties in which the proposed designation area is located, total benefit estimates range from $15 million to $43 million over ten years.

Table III.4.c-8: Total estimated monetary value of benefits from lynx CHD in Montana study area

Value of:	*Boundary selection* [1]	*WTP* Upper bound	*WTP* Lower bound
		PV(2003) in 2002$ [2]	
Lynx conservation	Narrow	37,450,969	14,282,432
	Wide	557,389,791	211,267,823
Undeveloped landscapes			
Avoided loss of Ecosystem	Narrow	5,141,536	197,138
Function Values	Wide	5,141,536	27,470
Avoided loss of Non-Use Value (Recreation only)	Narrow/Wide	647,308	307,758
Avoided loss of Use Values (Recreation only)	Narrow/Wide	96,724	45,987
Avoided Cost of Public Services	Narrow/Wide	> 0	> 0
Total Value	Narrow	43,336,538	14,833,315
	Wide	563,275,359	211,649,038

Notes: [1] Narrow boundary includes only study area and surrounding counties; wide boundary includes all of US. See text for explanation. [2] A three percent annual discount is used in the PV calculations.
Sources: Tables III.4.c-3, III.4.c-5, III.4.c-6, III.4.c-7.

Under narrow boundaries, only those benefits of lynx conservation are considered that accrue to residents of the study area counties and to out-of-area visitors to the study area, while in the wide boundary setting benefits to all US residents are counted.

In the case of the benefits generated by the prevention of the development of undeveloped landscapes, a wide setting of the spatial boundaries shows that some of the local benefits of lynx CHD may be neutralized through the impacts that such designation may have outside of the study area. The lower-bound benefit estimate of the avoided loss of ecosystem services assumes that the 93 residential units whose construction in the study area is expected to be prevented by lynx CHD are displaced into forested areas in other regions of the US, thereby negating at the national level any ecosystem benefit gains from the protection of the associated areas in the study area. In this case, only the ecosystem service benefits of the residential units that are modified in the study area due to lynx CHD (93 units) are retained at the national level. Likewise, the lower-bound estimate under wide analysis boundaries assumes that the ski area expansions and other recreational developments assumed to be prevented in the study area due to lynx CHD move to somewhere else within US, thereby nullifying on the national level any associated ecosystem service gains achieved in the study area. The boundary setting has no impact on ecosystem service benefits from avoided mining projects, as the lower-bound estimate assumes that the only relevant project is not prevented by lynx CHD.

The upper-bound benefit estimate under wide boundaries assumes that recreational developments are not displaced to anywhere else, that the 93 residences displaced from the study area do not move onto forested land anywhere else, and that the McDonald gold mine project is prevented due to lynx CHD and does not move anywhere else.

The benefits derived from the avoided loss of the recreational use and non-use values associated with prevented landscape conversion are unaffected by the boundary selection. These benefits are considered only for the large contiguous area in which the McDonald gold mine project is proposed. It can neither be assumed that residents would move because of the mine, nor that tourists would stay away from the area. After all, one can safely assume that visitors who come to the area do not primarily do so for scenic drives on route MT 200 in the Lincoln area, but rather to use that route as a means of getting to one of the national forests in the area or to Glacier National Park. Therefore, estimates of recreational values of lynx CHD are the same for both spatial boundaries.

Monetary estimates of the avoided benefits and cost of public services that lynx CHD would lead to are not developed in this study. However, the preceding section presented some quantitative estimates of the physical benefits of this type expected to be generated by lynx CHD, and showed that lynx CHD is expected to lead to ***net*** social benefits in this category.

The most important assumptions that make our estimates of the benefits of designation of lynx CHD in Montana conservative are the following. First, a downward bias in our benefit estimates derives from the fact that we could only include those ecosystem services in our analysis for which monetary estimates exist in the literature. Hence, our estimates of the avoided loss of ecosystem services that would result from lynx CHD are necessarily incomplete. Second, we do not develop monetary estimates of the public service costs avoided through lynx CHD. Third, we do not account for the intrinsic value of the increased lynx population or the avoided loss of ecosystems.

Finally, we do not try to estimate the value of the reductions in negative externalities from environmental pollution that are expected to result from lynx CHD. For example, avoided urban sprawl reduces the number of leaks from septic and cesspool systems that cause ground and surface water contamination. Even more importantly, if lynx CHD would lead to the prevention of the McDonald gold mine project, a whole suite of ecosystem damages would be avoided. Preventing surface and groundwater contamination from toxins (heavy metals and cyanide) and nitrates may carry substantial associated benefits (improved fisheries, reduced municipal water treatment costs). The same is true for preventing the disruption of the local water cycle (due to the withdrawal of about 4.5 million gallons of water per day used in processing and pumped out of the mined area in which the groundwater level has to be reduced by 800 feet for the mining process), and for preventing project-related sedimentation (see MEIC 2000).

III.5 Comparison of Costs and Benefits of CHD for the lynx in Montana

The analyses presented in the preceding sections can be combined to compare the estimates of the economic value of the positive and negative impacts from CHD in the proposed designation area in Montana.

Table III.5.a-1: Local and national-level costs and benefits of designating lynx critical habitat in the Montana study area

Impacts of lynx CHD	*Boundary selection* [1]	*Upper bound*	*Lower bound*
		PV(2003) in 2002$	
Benefits	Wide	563,275,359	211,649,038
Costs	Wide	574,964,517	8,272,416
Benefits	Narrow	43,336,538	14,833,315
Costs	Narrow	239,001,866	11,111,704

Notes: A three percent annual discount is used in all PV calculations. [1] Narrow boundary includes only study area and counties in which the latter is located; wide boundary includes all of US. See text for explanation.
Sources: Tables III.4.b-33 and III.4.c-8.

As can be seen from Table III.5.a-1, the benefits of designating lynx CH outweigh the costs of designation except if lynx CHD were to prevent the realization of the gold mine project. If the mine project is prevented for reasons other than lynx CHD, or if the mine area is exempted from the designation area, designation of critical habitat for the lynx would generate substantial net economic benefits. This is shown by a comparison of the cost and benefit estimates in the "lower-bound" column in Table III.5-1. Especially if the impact accounting boundary is set at the appropriate, that is, the national, level, the benefits of designation would outweigh costs by a wide margin.[179]

The scenarios in which the costs of designation are estimated to outweigh the benefits of designation are those that assume that designation of critical habitat for the lynx will lead to the prevention of the McDonald gold mine project. It is important to recall, however, that the listed benefit estimates in none of the scenarios include the avoided cost of environmental contamination and the associated avoided negative impacts on local water quality, fisheries, and ecosystems that would result from preventing the mine, due to the absence of estimates of the severity of contamination.

If the Secretary of the Interior were to decide that the benefits of excluding the mining project area from designation of lynx CH outweigh the costs of inclusion, and if therefore the mining area were to be excluded from the proposed CHD area, then benefits of lynx CHD outweigh costs of designation in all four valuation scenarios (see Table III.5.a-2). It is important to point out that the mine may very well continue to be prevented for reasons other than designation of critical habitat for lynx. In November of 2004, Montanans will vote on Initiative 147 that aims to repeal the cyanide mining ban adopted through Initiative 137. If the repeal were to fail, the mine would be prevented independently of any designation of critical habitat.

[179] Section II.1 of this study presents the justification for setting the boundaries of analysis at the national level.

Table III.5.a-2: Local and national-level costs and benefits of designating lynx critical habitat in the Montana study area under exclusion of the McDonald gold mine project

Impacts of lynx CHD	*Boundary selection*	*Upper bound*	*Lower bound*
		PV(2003) in 2002$	
Benefits	Wide	557,730,084	211,295,293
Costs	Wide	17,725,376	8,272,416
Benefits	Narrow	37,791,263	14,479,570
Costs	Narrow	32,823,222	11,111,704

Notes: See notes to Table III.5.a-1.

III.5.a Estimated net economic impact of CHD

The estimated net benefits of designating critical habitat for the lynx in the proposed area in Montana are substantial, ranging from over $3 million to $540 million over the ten-year time period analyzed (see Table III.5.a-3). Only in the highly unlikely event that the mine were to be prevented as a result of the designation would designation have net social costs. It is reasonable, however, to assume that the mine area would be excluded from designation. In that case, designation would generate net benefits in all four impact scenarios (see lower half of Table III.5.a-3).

Table III.5.a-3: Net economic benefits of CHD in proposed designation area in Montana under inclusion and exclusion of McDonald gold mine area in designation

Boundary selection	*Upper bound*	*Lower bound*
Inclusion of mine area	*PV(2003) in 2002$*	
Wide	-11,689,158	203,376,622
Narrow	-195,665,328	3,721,611
Exclusion of mine area		
Wide	540,004,708	203,022,877
Narrow	4,968,041	3,367,866

Source: Table III.5.a-2.

The benefit-cost ratios of the designation range from slightly over one to 31 (see Table III.5.a-4). Only if the mining project would be prevented due to lynx CHD would the ratio drop below one.

Table III.5.a-4: Benefit-cost ratios of CHD in proposed designation area in Montana under inclusion and exclusion of McDonald gold mine area in designation

Boundary selection	*Upper bound*	*Lower bound*
Inclusion of mine area		
Wide	0.98	26
Narrow	0.18	1.3
Exclusion of mine area		
Wide	31	26
Narrow	1.2	1.3

Source: Table III.5.a-2.

It should be noted that the truncation of those CHD impacts that occur beyond the ten-year time frame analyzed here is likely to distort the cost-benefit ratio further due to the different temporal structure of cost and benefit streams (see section II.1.a). Only in the case that lynx CHD would prevent the McDonald gold mine project would the truncation not lead to a bias against benefits.

III.5.b Distribution of costs and benefits by land ownership

The costs of CHD are not distributed evenly across the different land ownership categories (see Table III.5.b-1). Rather, the costs of CHD impacts on activities on federal lands are higher than those on non-federal lands, except in the unlikely case that CHD causes the prevention of the gold mine project (see fns. in Table III.5.b-1). These costs are assigned to State lands in the table, as the mine would be located on School Trust lands.

Table III.5.b-1: Total cost of CHD for lynx in proposed Montana designation area, by land ownership type

Land Ownership	*Narrow Boundary*		*Wide Boundary*	
	Lower-bound	*Upper-bound*	*Lower-bound*	*Upper-bound*
Federal lands	*$408,043*[1]	*$1,086,794*[1]	*$388,632*[1]	*$877,384*[1]
FS	$3,787,255	$10,424,200	$1,377,628	$3,910,479
FWS	$1,922,625	$3,562,124	$1,922,625	$3,562,124
NPS	$1,096,010	$1,789,688	$1,096,010	$1,789,688
BLM	$5,215	$9,702	$5,215	$9,702
BIA	$2,628	$3,891	$2,628	$3,891
EPA [4]	-	$6,100	-	$6,100
TOTAL federal lands	*$7,221,776*	*$16,882,499*	*$4,792,738*	*$10,159,368*
Non-federal lands w/nexus				
MT State lands	$36,897	$206,226,889	$36,897	$557,287,386
Private - forest industrial	$405,512	$4,372,542	$147,762	$1,591,771
Private - forest non-industrial	$3,443,420	$11,515,837	$3,290,920	$5,921,893
Salish & Kootenai	$4,100	$4,100	$4,100	$4,100
TOTAL non-federal lands	*$3,889,928*	*$222,119,368* [2]	*$3,479,678*	*$564,805,150* [3]
TOTAL	$11,111,705	$239,001,867	$8,272,416	$574,964,518

Notes: Consultation costs are included. [1] The incidence of these amounts across the federal landowners is not known. [2] If the mine area is excluded from designation, costs from CHD impacts on non-federal lands are $15.9 million. [3] If the mine area is excluded from designation, costs from CHD impacts on non-federal lands are $3.5 million. [4] The EPA does not own any lands, but is included here to give a complete account of the costs.

Table III.5.b-1 is derived by aggregating costs of CHD for each land owner over all land classes (see Table III.2.a-3).

In order to develop estimates of the per-acre cost of CHD by land ownership, the consultation costs incurred by the FWS for projects not located on FWS lands must be assigned to the appropriate land ownership. For example, the Service's consultation costs for timber management projects must be assigned to the respective FS and private lands on which those projects are located.

By assigning the FWS consultation costs to the appropriate land ownership and dividing total costs of CHD for each land ownership by the number of acres held by that owner, the average costs of CHD for each land ownership can be derived, expressed as dollars per acre (see Table III.5.b-2).

These cost estimates clearly show that designation costs per acre are higher on non-federal lands, where they range from $3 to $11 per acre for all non-federal lands pooled, or up to $141 per acre if the mine were to be prevented by lynx CHD). On federal lands, estimated costs per acre are less than a third of that, ranging from less than $1 to slightly over $2 per acre for all federal lands pooled. For the study area as a whole, estimated costs range from $1.3 per acre to $4 per acre without the mine, or $29 per acre if the mine were prevented by CHD.

Table III.5.b-2: Estimated average per-acre cost of CHD for the lynx by land ownership; Montana

	Low	*High*
	$/acre	
FS	0.8	2.3
NPS	1.3	2.3
BLM	0.1	0.1
BIA	0.1	0.1
MT state lands	0.1	0.0/478 *
Private - forest industrial	1.1	10.6
Private - non forest industrial	9.9	28.4
Salish & Kootenai	0.0	0.0

Notes: * Excluding/including mine area. Low and high cost estimates based on lower bound and upper bound impact scenarios, respectively. Costs expressed as PV(2003) in 2002$.
Sources: Table III.5.b-1.

MAINE CASE STUDY

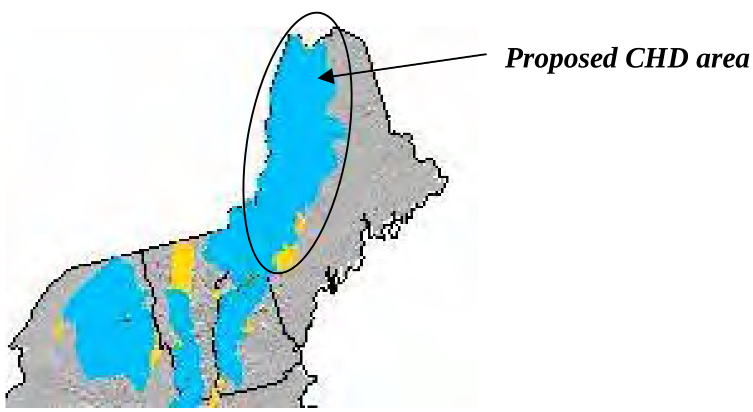
IV.1 Identification of critical habitat for *Lynx Canadensis* in Maine

Our identification of critical lynx habitat in Maine is based on McKelvey et al. (1999). McKelvey et al. (1999) identified dominant vegetation classes and elevation levels associated with primary lynx occurrence in the northeastern U.S. Most lynx observations in Maine were recorded in red spruce-balsam fir/sugar maple-birch-beech forests, and sugar maple-birch-beech forests and red spruce-balsam fir forests (ibid.). Based on this analysis, and taking into account elevation classes, primary lynx habitat in the region is characterized as Mixed Forest-Coniferous Forest-Tundra (ibid.). Vegetation analysis shows that, unlike in the Montana case study, essentially the entire area contained within the boundaries of the area identified by McKelvey et al. (1999) constitutes suitable lynx habitat (vegetation information from U.S. Geological Survey and USDA FS 2002).

IV.2 Selection of case study area

The areas of primary lynx occurrence in Maine identified by McKelvey et al. (1999) are the areas we propose for designation of critical habitat for the lynx, shown in Figure IV.2-1. The only areas that should be excepted from designation are urban and built-up lands (see Figure IV.2-2).

Figure IV.2-1: Proposed lynx critical habitat designation area in Maine



Note: Blue areas indicate areas of higher likelihood of supporting lynx conservation.
Source: Based on Hickenbottom et al. (1999).

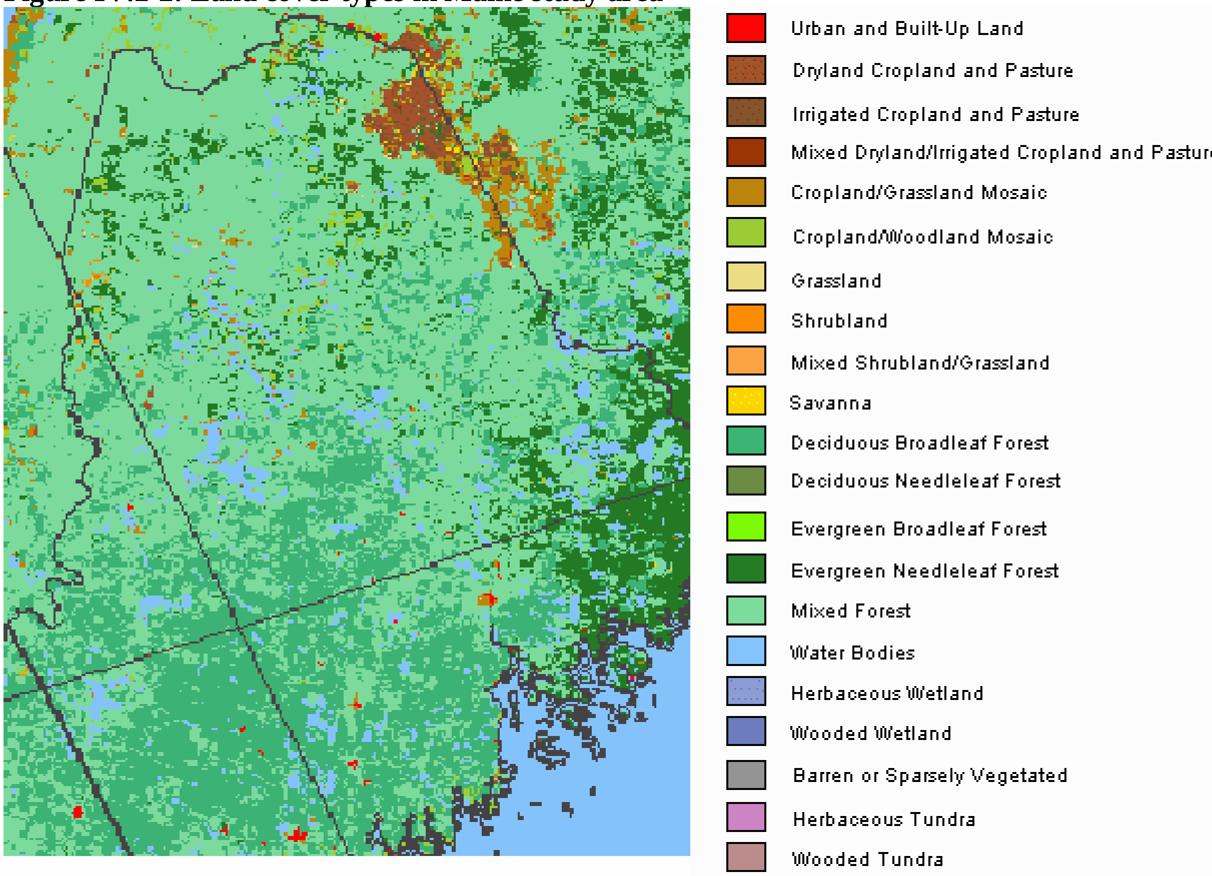
Table IV.2-1: Location and size of proposed lynx CHD in Maine

County	*Land area* [1] (acres)	*Area in lynx CH* [2]	*Lynx CH area* [2] (acres)
Aroostook	4,270,080	western 40 percent	1,708,032
Franklin	1,086,720	northwestern 85 percent	923,712
Oxford	1,329,920	northern 70 percent	930,944
Penobscot	2,173,440	~3 percent in northwestern part	65,203
Piscataquis	2,538,240	northwestern 70 percent	1,776,768
Somerset	2,512,640	northern 75 percent	1,884,480
TOTAL	13,911,040	52 percent of combined six-county area	7,289,139

Notes: [2] Approximate.
Sources: [1] U.S. Census Bureau, *State and County Quick Facts*, at: *http://www.maine.gov/portal/facts_history/ stats_population.html#uscb*, accessed Mar. 2004.

This habitat extends across parts of six counties; none of these counties are completely covered by the proposed critical habitat.

Figure IV.2-2: Land cover types in Maine study area



Source: USGS (2002).

The proposed lynx CHD area in Maine is located almost entirely on non-federal lands. The only federally administrated areas are 100,850 acres in the Maine Land Use Regulation Commission (ME LURC) jurisdiction, comprising portions of White Mountain National Forest, Lake Umbagog National Wildlife Refuge, NPS lands along 180 miles of the Appalachian Trail (the remaining 101 miles pass through State lands), and a DOD training facility. The most essential uses of these areas are forestry, recreation, and preservation of wildlife habitat (ME LURC 1997:49). The State of Maine holds approximately 544 thousand acres in the proposed designation area, the majority of which is managed by the Bureau of Parks and Lands, comprising Baxter State Park and several other State Parks, Preserves, Wilderness areas, and some other units. The remaining lands are in private ownership. North Maine Woods manages recreation on approximately 3.5 million acres of the private lands north of Baxter State Park and west of Route 11, and the Nature Conservancy (TNC) manages a number of tracts with conservation easements (ME LURC 1997:50).

IV.2.a Land type classifications for lynx critical habitat study area in Maine

The classification scheme of the lands in the proposed designation area according to land ownership and land use or land cover in the case of Maine is less complex than in Montana. This is due to the smaller number of land ownership classes, primarily for federally held lands.[180] The land classes and the existing BCS land use restrictions in Maine are shown in Table IV.3.a.ii-4 (see next section).

IV. 3 Identification of Base Case Scenario for areas in Maine impacted by CHD for the lynx

Almost the entire area proposed for CHD for the lynx is situated in the jurisdiction of the Maine Land Use Regulation Commission (ME LURC). The jurisdiction comprises much of western, northern, and eastern Maine, a total of 10.4 million acres, 90 percent of which is in unorganized townships, and 95 percent is forested (ME LURC 1997:28). These forestlands include the majority of Maine's industrial forestlands (ibid.:29).

Timber production is, and in the near future is estimated to remain, the most significant economic use of the forest resource in the LURC jurisdiction, followed by recreation and related activities (ME LURC 1997). New uses have emerged in the 1990s, such as wind power development and mining (ME LURC 1997).

In four of the six counties in which the proposed lynx CHD area is located, in 1998 forest products (wood products, pulp, and paper) provided only 5.5 percent (Aroostook County), 6 percent (Piscataquis County), 7 percent (Penobscot County) and 17.5 percent (Somerset County), respectively, of total income (Power 2001), and even smaller percentages than that in terms of total jobs. Maine's timber supply outlook 1995-2045 (ME FS 1998) estimates that in the mid 1990s harvest exceeded forest regrowth by about 14 percent, and predicts declining harvest volumes in the future.

Recreational use in the LURC jurisdiction is increasing, and residential development has been rapid during the last two decades (ME LURC 1997:50). LURC expects that, with the increasing decline in comparable-quality recreation opportunities in the Northeast and the advancing retirement of the baby boomer generation, demand for both recreation and residential construction will likely increase (ME LURC 1997:52).

A potentially major development in the proposed designation area is the creation of a proposed Maine Woods National Park and Preserve (Power 2001) that would cover approximately 3.2 million acres within the proposed designation area. However, even if the decision is made to create that park, it will take decades to actually acquire the individual properties out of which it would be made up (ibid.). Since our projection period only extends to 2013, we do not incorporate the potential creation of the park into our analysis. The trends of the lynx-relevant land use activities are discussed in more detail in section IV.3.c below.

IV.3.a.i Economic characteristics of the proposed CHD area in Maine

The six Maine counties contained, at least in part, within our study area cover a combined area of approximately 13.9 million acres. The actual area studied for impacts due to the critical habitat designation of lynx, however, includes just 7.3 million acres. These counties (Aroostook, Franklin, Oxford, Penobscot, Piscataquis, and Somerset) had a combined population of nearly 372,000 in 2001, or 29 percent of the state's population, and exhibited a collective population decline of 3.36 percent in the decade of the 1990's, decreasing a further 0.24 percent in the year 2000. The largest population in the area is located in Penobscot county (145,385 people), the majority of which is not contained in our

[180] For a description of the methodology used in developing land type classifications, please refer to section IV.2.a in the Montana case study.

study area. Piscataquis county has the smallest population (17,177). The greatest rate of population decline in the 1990's occurred in Aroostook county, falling nearly 16 percent.

Per capita income in the six county region was $16,491 in 1999, significantly lower than the state average of $19,533. Penobscot county had the highest income, with earnings of $17,801 per capita.[181]

Tables IV.3.a.i-1, IV.3.a.i-2, and IV.3.a.i-3 below summarize relevant economic and demographic information for this region of Maine, displayed by county. Table IV.3.a.i-1 provides total population and population growth figures, per capita income in 1999, and along with Tables IV.3.a.i-2 and IV.3.a.i-3 displays the employment and payroll numbers for the year 2001 for the sectors of the economy that could potentially be impacted by critical habitat designation, including construction, mining, all aspect of the timber industry, and travel and recreation. The largest of these potentially impacted industries in the six counties are those of construction (7,385 employees), paper manufacturing (between 6,783 and 11,560 employees), and food service and drinking establishments (8,723 employees). Combined, however, these three sectors account for between 17 and 22 percent of all employment in these counties. When considered in the aggregate, forestry and its supporting activities, along with all wood and paper product manufacturing and lumber wholesale, account for between 14,395 and 21,149 workers in these counties or 11 - 16 percent of all jobs (the ranges are due to differences in various data sources).

IV.3.a.ii Existing environmental regulations of relevant land use activities in the study area

This section provides a brief description of the restrictions on land uses that exist in the Maine study area in the absence of CHD for the lynx. We only include stipulations that are relevant to lynx conservation. The regulations that apply to particular land classes found in the proposed lynx CHD area are shown in Table IV.3.a.ii-4. Table IV.3.a.ii-5 incorporates that same information and also shows the restrictions on particular land use activities that are expected to apply under CHD for the lynx (see section IV.3.b.i of the Montana case study for the justification of these restrictions), as well as the incremental restrictions, that is, the difference between the existing, BCS restrictions, and those expected under CHD.

LCAS

The Forest Service (FS) Region 9 (Eastern Region) is participant to the lynx conservation agreement between FS and FWS (USDA FS and USDI FWS 2000). The lynx conservation agreement is applicable to all FS lands identified as lynx habitat in the LCAS (USDA FS and USDI FWS 2000:5). The LCAS identifies the northwestern region of Maine as the most suitable area in the eastern US for supporting lynx populations (Ruediger et al. 2000:68). This region is shown in figure 4 in Hickenbottom et al. (1999). In addition, the NPS has reportedly been in the process of drawing up a lynx conservation agreement with the FWS; it therefore may be presumed that, like Glacier National Park in Montana, the LCAS is being implemented, or in the near future will be implemented, on NPS lands in Maine. In addition, land use activities relevant to lynx conservation that have a federal nexus will be subject to consultation by the federal action agency with the FWS. It is assumed that the Service will incorporate LCAS-based restrictions into projects. The main nexus in terms of spatial extension is created by the NPDES of the U.S. CWA. The National Highway System and the National Fire Plan establish further nexi.

[181] All figures are from the U.S. Census Bureau, Maine State and County Quickfacts; ***http://quickfacts.census.gov/qfd/states/23000.html***

Table IV.3.a.i-1: Demographic and economic data for construction and mining for counties in CHD study area in Maine

		Population growth			*Total*		*Construction*[1]		*Mining*[2]	
County	*Population (2001)*	*2000-2001*	*1990-2000*	*Per capita income*[3]	*Employment*	*Payroll ($1000)*	*Employment*	*Payroll ($1000)*	*Employment*	*Payroll ($1000)*
Aroostook	73,140	-1.54	-15.95	$15,033	25,517	$573,283	745	$25,149	0	$0
Franklin	29,586	0.51	1.55	$15,796	10,229	$259,443	408	$13,748	0-19	D
Oxford	55,378	0.78	4.99	$16,945	15,945	$391,416	674	$18,614	0-19	D
Penobscot	145,385	-0.04	-1.13	$17,801	59,142	$1,623,553	2,566	$94,471	0	$0
Piscataquis	17,177	-1.01	-8.10	$14,374	4,538	$104,578	130	$4,117	0-19	D
Somerset	51,014	-0.16	2.14	$15,474	16,667	$480,302	2,862	$131,157	0	$0
TOTAL	371,680	-0.24	-3.36	$16,491	132,038	$3,432,575	7,385	$287,256	0-57	-
Maine	1,286,670			$19,533	500,030	$14,204,726	28,113	$1,001,818	20-99	D
% of area total[4]							5.6	8.4	~0	

Notes: All employment and payroll figures are from 2001. D = Withheld to avoid disclosing data of individual companies. NAICS Codes: [1] 23; [2] 21. [3] In 1999.
[4] Percentage of the total employment in these counties coming from this sector.
Source: U.S. Census Bureau, 2001, County Business Patterns (NAICS); *http://censtats.census.gov/cgi-bin/cbpnaic/cbpsel.pl*

Table IV.3.a.i-2: Demographic and economic data on the timber industry for counties in CHD study area in Maine

	Forestry & Logging[1]		*Forestry support activities*[2]		*Lumber (wholesale)*[3]		*Wood products mfg*[4]		*Paper mfg*[5]	
County	*Employment*	*Payroll ($1000)*	*Employment*	*Payroll ($1000)*	*Employment*	*Payroll ($1000)*	*Employment*	*Payroll ($1000)*	*Employment*	*Payroll ($1000)*
Aroostook	500-999	D	20-99	D	0-19	D	1,429	$44,735	1,000-2,499	D
Franklin	250-499	D	0-19	D	0-19	D	495	$12,440	1,000-2,499	D
Oxford	100-249	D	0-19	D	0-19	D	1,592	$35,244	1,000-2,499	D
Penobscot	500-999	D	0-19	D	160	$3,618	783	$17,882	2,783	$135,812
Piscataquis	100-249	D	0-19	D	0-19	D	601	$14,681	0	$0
Somerset	250-499	D	0-19	D	0	$0	832	$17,643	1,000-2,499	D
TOTAL	1,700-3,494	D	20-127	D	160-236	-	5,732	$142,625	6,783-11,560	-
Maine	2,500-4,999	D	127	$2,609	971	$32,458	7,924	$211,976	11,560	$620,306
% of area total[6]	1.3-2.6		<0.1-0.1		0.1-0.2		4.3	4.2	5.1-9.7	

Notes: All employment and payroll figures are from 2001. D = Withheld to avoid disclosing data of individual companies. NAICS Codes: [1] 113; [2] 1153; [3] 4213; [4] 321; [5] 322. [6] Percentage of the total employment in these counties coming from this sector.
Source: see Table IV.3.a.i-1.

Table IV.3.a.i-3: Demographic and economic data on recreation and travel for counties in CHD study area in Maine

	Nature parks and similar[1]		*Skiing facilities*[2]		*Traveler accommodation*[3]		*RV parks and rec. camps*[4]		*Food service and drinking places*[5]	
County	*Employment*	*Payroll ($1000)*	*Employment*	*Payroll ($1000)*	*Employment*	*Payroll ($1000)*	*Employment*	*Payroll ($1000)*	*Employment*	*Payroll ($1000)*
Aroostook	0	$0	87	$542	250-499	D	0-19	D	1,696	$14,344
Franklin	0	$0	500-999	D	250-499	D	20-99	D	1,001	$8,757
Oxford	0	$0	100-249	D	1,560	$22,262	20-99	D	906	$8,103
Penobscot	0	$0	0	$0	1000-2499	D	0-19	D	4,081	$43,116
Piscataquis	0	$0	0	$0	91	$568	1	$116	217	$2,180
Somerset	0-19	D	0	$0	20-99	D	20-99	D	822	$7,887
TOTAL	0-19	-	687-1,335	-	3,171-5,247	-	61-336	-	8,723	$84,387
Maine	20-99	D	1,000-2,499	D	8,586	$155,601	559	$25,778	34,749	$423,447
% of area total[6]	~0		0.5-1		2.4-4		<0.1-0.3		6.6	2.5

Notes: All employment and payroll figures are from 2001. D = Withheld to avoid disclosing data of individual companies. NAICS Codes: [1] 71219; [2] 71392; [3] 7211; [4] 7212; [5] 722. [6] Percentage of the total employment in these counties coming from this sector.
Source: see Table IV.3.a.i-1.

U.S. Clean Water Act

Most of the watersheds in the proposed lynx CHD area in Maine are classified as impaired under the U.S. CWA (ME Department of Environmental Protection 1998a). The only three not classified as impaired are the Upper St. John, the Allagash, and the East Brach Penobscot. The remaining watersheds, for all of which TMDL plans have been or will be prepared, contain varying numbers of water bodies with impaired uses: Fish (3 water bodies), Aroostook (14), West Branch Penobscot (6), Upper Kennebec (2), Lower Kennebec (51), Dead (2), Upper Androscoggin (3), Lower Androscoggin (21), and Piscataquis (4).

In virtually all impaired water bodies in the proposed CHD area, non-point sources (NPS) have been identified as a/the critical source category (ME DEP 1998c), and the majority of the impaired waters are listed on Maine's NPS priority watershed list (ME DEP 1998a). Forestry, agriculture, developed areas, and roads all are significant sources in almost all cases (ME DEP 1998b), although the importance ranking of sources varies. In same cases forestry is the number one contributor, including logging roads (ME DEP 2000a), in others, residential development and roads are the main sources (ME DEP 2001a). Most of the TMDLs are developed for water quality standards; however, a number of TMDLs focus exclusively on habitat (Upper and Lower Richardson Lake, West Branch Penobscot River, Caucogomuc Lake, Seboomook Lake, Ragged Lake, Flagstaff Lake, Toothaker Lake, Aziscohos Lake; ME DEP 1998c).

The TMDL plans establish a federal nexus via the EPA's national pollutant discharge elimination system (NPDES). As of January of 2001 the state of Maine is lead administrative authority on the NPDES and the CWA, but the EPA retains full authority over control of compliance and enforcement; specifically, the EPA will continue to review all permits and approve TMDL plans (ME DEP and USEPA 2000a). The TMDL plans for the impaired water bodies in our study area establish a federal nexus. We assume that the TMDL-related consultations in which EPA will engage with the FWS, only those lynx conservation concerns will be incorporated into TMDL plans that address land use activities identified as being of primary concern from a TMDL perspective. These are forest management, including logging roads, and residential development. The lynx-protection measures that via the federal nexus may be incorporated into the TMDL plans will however only take effect after the TMDL plans have been approved by the EPA and are beginning to be implemented. Most of the impaired water bodies in the study area will have TMDL plans developed between 2003 and 2011 (ME DEP 1998c): the West Branch Penobscot River (BOD and SOD TMDLs), Androscoggin River, Dead River, Flagstaff Lake, and Lower and Upper Richardson Lake, between 2003 and 2008;[182] the West Branch Penobscot River (habitat TMDL), Greenlaw stream, Blood Brook, Baker Stream, Carrabassett River, Daigle Pond, Black Lake, Cross Lake, Ragged Lake, Canada Falls Lake, Caucogomuc Lake, Seboomook Lake, Fitzgerald Pond, Brassua Lake, Toothaker Lake, Aziscohos Lake, between 2008 and 2011 (ME DEP 1998c). Already completed are the Madawaska Lake and the Androscoggin River TMDLs (ME DEP 1998c). For areas that are scheduled to have TMDL plans developed between 2003 and 2008, we assume that nexus-caused lynx protections will begin to take effect in 2009. For areas for which plans are scheduled to be developed between 2008 and 2011, we assume that such protections begin in 2012.

Based on this decision criterion, nexus-related land use restrictions are expected to become implemented in 2009 in the Dead watershed, the upper half of the Lower Androscoggin watershed (i.e., that part of the watershed which lies in the study area), the West Branch Penobscot watershed (except the western quarter), and the Upper Androscoggin watershed (all, if upstream of TMDL-lakes

[182] Reports for the West Branch Penobscot and the Androscoggin rivers were completed in 2003 (ME DEP 2003a, 2003b) but as of February 2004 had not yet been approved by the EPA.

is included). Beginning in 2012, nexus-related restrictions are expected to be implemented in the northwestern part of the Lower Kennebec watershed (i.e., that part of the watershed which lies in the study area), the Upper Kennebec watershed (only two lakes will have TMDLs, but if upstream waters are included, then the whole western half of watershed is covered), the northwestern half of the Piscataquis watershed, and the remaining western quarter of the West Branch Penobscot watershed. In addition, nexi will affect the drainage basins of a number of lakes in the Fish and Aroostook watersheds.

Table IV.3.a.ii-1 shows the water bodies in the proposed Maine lynx CHD area for which TMDL plans will be developed by 2008 or 2011, respectively.

Table IV.3.a.ii-1: TMDL water bodies in proposed Maine lynx CHD area

Watershed	*TMDL Water body*	*Source type**	*Activity***	*TMDL primary concerns*
Lower Androscoggin	Androscoggin River	**PS** & NPS	**FM**	Organic enrichment, DO, dioxin, PCBs, bacteria
Upper Androscoggin	Lower Richardson Lake	n.a.	*RD*	Habitat alterations
	Upper Richardson Lake	n.a.	*RD*	Habitat alterations
	Aziscohos Lake	n.a.	*RD*	Habitat alterations
Dead	Dead River	n.a.	-	Aquatic life
	Flagstaff Lake	n.a.	*RD*	Habitat alterations
West Branch Penobscot	West Branch Penobscot	**PS** & NPS	**FM**	Organic enrichment, DO, habitat
	Seboomook Lake	n.a.	*RD*	Habitat
	Ragged Lake	n.a.	*RD*	Habitat
	Caucogomuc Lake	n.a.	*RD*	Habitat
	Canada Falls Lake	n.a.	*RD*	Habitat
Piscataquis	Blood Brook	n.a.	-	Aquatic life
	East Pond	**NPS**	**RD**, **FM**, **R**	Algal growth/chlorophyll
Upper Kennebec	Fitzgerald Pond	n.a.	**RD**, **FM**, **R**	Algal growth/chlorophyll
	Brassua Lake	n.a.	*RD*	Habitat
Lower Kennebec	Carrabassett Stream	NPS	*FM*	Organic enrichment, DO
	Toothaker Pond	n.a.	*FM, RD*	Algal growth/chlorophyll
	Baker Stream	NPS	*FM*	Organic enrichment, DO
Fish	Black Lake	n.a	*FM, RD*	Algal growth/chlorophyll
	Cross Lake	n.a.	*FM, RD*	Algal growth/chlorophyll
	Daigle Pond	n.a.	*FM, RD*	Algal growth/chlorophyll
Aroostook	Madawaska Lake	NPS	**RD**, **FM**, **R**	Algal growth/chlorophyll, Organic enrichment, DO
	Greenlaw Stream	PS	-	PCBs

Notes: * Dominant source type indicated in **bold**. DO - dissolved oxygen, NPS - non-point source, PCB - polychlorinated biphenyl, PS - point source, n.a. - not available. ** If source information available, sources are given in **bold** face; only lynx-relevant activities are listed: RD - residential development, FM - forest management, including logging roads, R - roads.
Sources: EPA 1998 Section 303(d) List Fact Sheet for Maine at *http://oaspub.epa.gov/waters/state_rept.control?p_state=ME*, accessed Feb. 2004; ME DEP (2000a, 2001a, 2003a, 2003b).

In the right column, the primary factor(s) or concern for each TMDL are listed. As indicated above, the lynx-relevant nexus-based land use restrictions that are expected to be incorporated into the TMDL plans are those that pertain to the land use activity or activities and sources identified as primary concern(s) in the respective TMDL plans. Since the TMDL plans for the majority of water bodies still have not been prepared, we use the following procedure for identifying the likely land use activities of concern for those water bodies.

If the available TMDL information identifies "habitat" or "habitat alterations" as primary concern, we assume that residential development is the primary focus of the respective TMDL plan. In all cases where "organic enrichment", low levels of "dissolved oxygen" (DO), or "algal growth/chlorophyll" are identified as primary concerns, we assume that forest management, including logging roads, and in the case of lakes, residential development are a primary concern (see for example ME DEP 2000a, 2001a). The lynx-relevant activities are listed in column four (*Activity*). If source information is available, lynx-relevant source activities are listed in bold face. If the source identification is based on our approach as described above, sources are given in italics.

Based on this assessment, we assume that approximately one third of the proposed Maine lynx CHD area will be subject to federal nexus-related restrictions on lynx-relevant land use activities by 2009, and approximately an additional 20 percent by 2012.

Individual land use activities have smaller nexus areas. For example, residential housing development is of concern primarily for lakes (see Table IV.3.a.ii-1), and therefore the area covered by TMDL nexi is only the drainage basin, or part thereof, and feeding streams of the TMDL plan lakes. The spatial extension of the TMDL nexus is larger for forest management activities due to the fact that forest management activities cover a much larger area than residential housing construction and also occur close to a number of rivers and streams that carry a TMDL nexus for forest management activities.

U.S. Endangered Species Act

The lynx is one of a number of federally listed species found in Maine. Table IV.3.a.ii-2 lists those federally listed species that are likely to be found in the proposed lynx CHD area. None of these species has critical habitat designated in the proposed lynx CHD area, and none has recovery plans or HCPs in the area.[183] The ESA's no-take and jeopardy provisions that apply to these species are unlikely to afford significant protection to the lynx; two out of the seven species are fish, and two are plants found only in a small number of very small areas. Of the remaining three, the bald eagle is on the road to recovery, the cougar is officially considered extinct in the region; individual gray wolves (the northeastern DSP or Eastern Timber Wolf) have been found in northwestern Maine and most of the area analyzed here for proposed lynx CHD has been identified as one of the areas where re-establishment possibilities for the eastern timber wolf exist (USDI FWS 1992b). However, it is currently thought that there exists no evidence of a breeding population of wolves (USDI FWS 2003f). Because of the historic rarity of jeopardy findings (see Houck 1993), it seems unlikely that expected land use activities during the ten-year time frame analyzed here would result in jeopardy findings for the wolf or lynx.

183 The Atlantic Salmon HCP in Maine does not include proposed lynx CHD areas (Maine Atlantic Salmon Task Force 1997).

Table IV.3.a.ii-2: Other ESA species potentially found in proposed lynx CH in Maine

Species / *County*	Aroostook	Piscataquis	Penobscot	Somerset	Franklin	Oxford	*HCP*	*Recovery Plan*
Bald Eagle (*Haliaeetus leucocephalus)* [1]	T	T	T	T	T	T		
Wolf (*Canis lupus*) [2]	T	T	T	T	T	T		Yes [5]
Eastern cougar (*Felis concolor couguar*) [3]	E	E	E	E	E	E		
Maine Atlantic salmon (*Salmo salar*) [4]							Yes [6]	
Shortnose sturgeon (*Acipenser brevirostrum*)	E	E	E	E	E	E		
Furbish lousewort (*Pedicularis furbishiae*)	E							
Small whorled pogonia (*Isotria medeoloides*)	T	T	T	T	T	T		

Notes: [1] Proposed for delisting. [2] Eastern DSP. [3] Presumed extinct in the Northeast, although numerous sightings have been reported. [4] Likely not present in rivers in proposed lynx CHD area. [5] Recovery Plan for the eastern timber wolf. T–Threatened, E–Endangered. [6] Not in study area.
Sources: Specific Information for the species obtained from Fed. Reg. entries for the species.

Maine laws and regulations

LURC Comprehensive Land Use Plan

Maine's LURC has jurisdiction over much of the proposed designation area (central and western Maine). LURC's primary tools for guiding land use activities are zoning regulations and land use standards, which are administered via permit review and notification procedures. Forest resources in the jurisdiction are protected through zoning, with some uses generally prohibited. There are 13 protection zones or subdistricts (ME LURC 1997:5), comprising approximately 18 percent of the commission's jurisdiction. Each of these districts is characterized by particular restrictions on extractive or land conversion activities. The *Fish and Wildlife Protection Subdistrict* (P-FW) places restrictions on 185,000 acres of forest land that provide habitat for wintering deer. The *General Management Zone* (M-GN) is intended to enable forestry and agriculture to occur with minimal interference from unrelated development (e.g., residential use) in areas where protection afforded by Protection Subdistricts is not necessary. *Protected-Mountain Area* (P-MA) zoning regulates certain land use activities in mountain areas (generally, at elevations above 2,700 feet). Approximately 100 mountains in the LURC jurisdiction meet P-MA zoning qualifications (ME LURC 1997:43). However, such zoning does not prevent resource extraction: between 1983 and 1992, LURC issued 16 Forestry Operations Permits for harvesting in P-MA zones, affecting some 6,500 acres of land. *Recreation protection* (P-RR) and *Resource Plan* (P-RP) zoning along rivers covers some 659 miles of rivers and prohibits dams, impoundments, and residential and commercial development (between 250 and 500 feet of the river).

With respect to development, LURC's principles are to encourage new development adjacent to existing development, or in areas already having public services, to protect the jurisdiction's principal values. However, LURC can only apply its development standards on lots that are not exempt from subdivision review. Unfortunately, there are many large exempt lots originally created for forestry purposes where LURC cannot control subdivision activity This is recognized as a problem for preserving the natural resource values of the jurisdiction (ME LURC 1997). LURC's policies regarding development and its 13 protection zones and subdistricts can be expected to prevent some land use activities that otherwise would have degraded lynx habitat quality, while there are no restrictions on such activities on the exempt lands.

Maine Protection and Improvement of Waters Act, *Maine Statewide Standards for Timber Harvest in Shoreland Areas*, and *Maine Shoreland Zoning*

The Maine Protection and Improvement of Waters Act (ME PIWA) places restrictions on haul and access roads and the timing of harvest (generally encouraging harvest in sensitive areas during winter months to minimize vegetation disturbance). In addition, the act restricts timber harvesting in streamside management zones (SMZs), but not along small, first-order streams (ME DEP 1998b). The latter exemption, however, is discontinued in the proposed new Statewide Standards for Timber Harvesting in Shoreland Areas (ME DC 2003b). The new statewide standards become binding on January 1, 2006. Until then, towns can either repeal the existing timber harvesting provisions of their Shoreland Zoning Ordinances, adopt identical standards as an amendment to their Shoreland Zoning Ordinances, or retain their current Shoreland Zoning Ordinance. Current municipal Shoreland Zoning Ordinances must conform to minimum standards set by Maine's Department of environmental Protection (ME DEP) for designated shoreland zones. These zones are defined as areas within 250 feet of great ponds (ponds larger than 10 acres), rivers below the 25 square mile drainage point), tidal waters, coastal wetlands, and non-forested freshwater wetlands larger than 10 acres; and areas within 75 feet of streams below the outlet of a great pond, or below the juncture of two first-order streams. The standards place restrictions on timber harvest (no more than 40 percent of total tree volume per acre in any ten-year period of trees of more than 4.5 inches dbh, and a minimum remaining tree volume of at least 60 square feet basal area per acre of woody vegetation of more than one inch dbh), on clearcut openings (none within 75 feet of shore; beyond

75 feet, no openings greater than 10,000 square feet, and openings larger than 5,000 square feet must be at least 100 feet apart), and on the placement of land management roads (at least 25/50/100 feet from shore, depending on water body class; and no new permanent land management roads in shoreland areas zoned as resources protection districts) (ME DC 2003a). However, these standards do not apply to timber removal for the purpose of development.

The current minimum standards in shoreland areas therefore do not provide significant protection to lynx habitat in municipal riverine areas, because they do not restrict development of these lands. The only provisions conducive to lynx conservation are the size limit on clearcuts in shoreland areas and the spacing of such clearcuts, which would provide openings with regenerating vegetation that would constitute appropriate foraging habitat for snowshoe hares; and the prevention of new permanent land management roads in Resource Protection Districts. In any case, shoreland zones in municipal areas may not in all cases constitute primary lynx habitat because lynx generally avoid developed areas, and municipal areas account for only a small share of total lands in the proposed CHD area.

Likewise, the ME PIWA does not seem to be relevant to lynx because its stipulations focus on road design for run-off control, and the conducting of timber harvest activities in erosion-prone areas during winter months. The latter provision may in some cases benefit lynx as it may reduce logging activities during denning period. On the other hand, winter logging may increase access for lynx competitors.

Maine Natural Resources Protection Act (NRPA)

Maine's Natural Resources Protection Act (ME DEP 2002a) regulates activities that affect protected natural resources. These comprise rivers and streams, great ponds, fragile mountain areas, freshwater wetlands, significant wildlife habitat, coastal wetlands and coastal sand dune systems. The following activities in, on, or over any of these resources require permits: dredging, bulldozing, removing or displacing soil, sand, vegetation or other materials; draining or otherwise dewatering; filling, including adding sand or other material to a sand dune; or any construction, repair or alteration of any permanent structure. Sensitive wildlife areas include habitat for species on official federal or state lists of endangered species; deer wintering areas and travel corridors; habitat for waterfowl and wading birds including nesting and feeding areas; shorebird nesting, feeding and staging areas; and seabird nesting islands.

Specifically relevant to lynx is NRPA's stipulation that said activities avoid sensitive wildlife habitat. Since the lynx is a federally listed species, lynx habitat in Maine is subject to the NRPA. This means that at least in theory, lynx habitat in Maine would be protected from activities requiring permits. However, since lynx habitat comprises a variety of habitat types, and since the total area of these habitats makes up a substantial part of western and northern Maine, it is unlikely that these habitats actually enjoy the protection from all disturbances that a strict interpretation of the NRPA would suggest.

In cases where lynx habitat overlaps with other protected resources (for example, fragile mountain areas), it is likely that NRPA's restrictions on activities may still benefit lynx even if the permits are not specifically designed for lynx habitat protection. The NRPA defines fragile mountain areas as lands above 2,700 feet in elevation from mean sea level. In the southern range of the proposed CHD area, there are a number of areas in that elevation class. On such lands, the NRPA does not prevent all disturbance activities; rather, it requires that projects be designed so as to minimize impacts. Nevertheless, it is likely that NRPA affords some protection to lynx habitat because it tends to reduce the scale of projects and the degree of disturbance to vegetation.

Maine Essential Habitat Rule - Maine Endangered Species Act [184]

Under Maine's Endangered Species Act, "essential habitat" may be designated for species listed under the act. So far, only the bald eagle, roseate tern, piping plover and least tern have received essential habitat designations. Existence of essential habitat requires state agencies to consult with the ME Department of Inland Fisheries and Wildlife on any projects they fund, permit, license, or carry out. Lynx is not listed under Maine's ESA, but the protection of the essential habitat areas designated for these other species in some cases may benefit lynx. However, the total land area in our study area that is designated as essential habitat is less than five square miles, so the impact of this provision on lynx in the proposed CHD area is negligible.

Maine Forest Practices Act

Maine's Forest Practices Act primarily regulates the size of clearcuts and of the buffer zones between those cuts. The total area clearcut statewide in 2002 was 18,388 acres, an increase by almost 30 percent over the previous year. However, the area clearcut in 2002 only amounts to three percent of the total area harvested (ME DC 2003d). The relative importance of clearcuts shows a general decline over the last two decades, from 18 percent of all harvests in 1987, to six percent in 1997 (ME DC 1999a). The Act defines a clearcut as any harvest greater than 5 acres resulting in a basal area of less than 30 square feet per acre of trees over 4 ½ inches diameter at breast height (DBH). The Act also requires a forest management plan, signed by a professional forester, for any clearcut over 20 acres, and requires notification of the Maine Forest Service prior to harvest as well as reporting of species, volume, stumpage price, acreage harvested, and method of harvest (ME DC 2002a).

Under the act, clearcuts are divided into three categories. Category 1 consists of clearcuts of 5 to 20 acres, Category 2 cuts are those between 21 and 75 acres, and Category three clearcuts are those from 76 to 250 acres in size. Clearcuts greater then 250 acres are not permitted under the Act.[185] All clearcuts must be separated by a buffer of 250 feet in width, and the buffer must be equal to or greater than the area of the clearcut for categories 2 or 3. These two higher categories also require reporting of a reason for the clearcut, and category 3 cuts must explain how the clearcut will provide for water quality protections and wildlife habitat needs (ME DC 2002a).

The only stipulation in the Maine Forest Practices Act (Maine Office of the Reviser of Statutes 2003) that seems to restrict timbering activities that could impact lynx negatively is a requirement to maintain a minimum distance of 250 feet between clearcuts of more than five acres. Depending on the type of vegetation found in a particular buffer between clearcuts, such buffers may provide security cover for lynx during travel and dispersal.

Sustainable Forestry Initiative (SFI)

The SFI is an effort to improve forest management practices of member companies (the American Forest & Paper Association - AF&PA). All major Maine forest management and paper companies are members of SFI. The SFI applies LURC's forestry BMPs. These are not of much relevance to lynx protection as they focus on practices that impact water quality. Exceptions are the maintenance of filter strips, in which more than 60 percent of trees above six feet in height have to remain standing, and the reseeding of harvest sites. The latter may speed up the regrowth of vegetation and hence the forage availability for

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[184] Maine Administrative Rules 09-137 (Department of Inland Fisheries and Wildlife), Chapter 8.05 *Essential Habitat for Species Designated as Endangered or Threatened*.
[185] In 2002, the average clearcut size was 22 acres, and only one cut exceeded 75 acres (MDOC, FS 2003).

snowshoe hares. However, the SFI does *not* prevent pre-commercial thinning, the forest management activity of primary concern in lynx conservation.

Maine's Low Impact Forestry Project (LIFP)

The Low Impact Forestry project focuses primarily on investing in long-term management and the harvesting of individual high-value trees, and the minimization of damage from harvest to the remaining crop trees and soil. It is not obvious that such management practices are necessarily beneficial to lynx conservation. Rather, small-scale clearcuts generally will provide superior snowshoe hare foraging grounds and therefore are more conducive to lynx conservation. Specifically, the LIFP does not prevent pre-commercial thinning.

Maine Erosion and Sedimentation Control BMPs

These BMPs address road construction and stabilization and house lot development, but only cover the type and method of construction, not the location. Hence, these BMPs are unlikely to have a significant effect on lynx habitat conservation.

Liquidation Harvesting Act

Liquidation harvesting, estimated to be between three and 12 percent of all harvested acres each year, consists of the purchase of timberlands followed by the harvest of all commercial timber and then the resale of that land, usually within two years of the initial purchase. These harvests often retain just enough stocking of low quality timber to avoid meeting the definition of clearcuts in the Forest Practices Act (ME DC 1999a). The Act to Promote Stewardship of Forest Resources, also known as the Liquidation Harvesting Act, aims to create rules to "substantially eliminate" the process of liquidation harvesting.[186] At this point in time the rules pertaining to this act are merely in the draft stage and are not due to take effect until January 1, 2005. These rules, perhaps somewhat modified from the current draft, should take effect during our ten-year study period, and will have an impact on the base-case regulations (ME DC 2004a).

The draft rules for this act state that any parcels greater than 20 acres in size that are bought, cut, and sold within five years must fulfill at least one of three conditions: 1) Harvests on those parcels must not exceed 40 percent of the basal area of trees with a DBH of 4.5 inches or greater; 2) their harvest plans must be signed by a licensed forester; or 3) the owners must demonstrate hardship originating from an emergency necessitating harvest of more than 40 percent of the merchantable timber or sale of the land. Exceptions are made for any lands owned prior to the effective date, lands that are certified by a third party, parcels less than 500 acres harvested by a Master Logger, any parcels owned by individuals who own less than 100 acres statewide, any lands permitted for land conversion to other uses, lands which exchange hands by way of a gift or sale to a relative, any sales pursuant to eminent domain, transfers of common and undivided land, and transfers for roads (ME DC 2004a). Only a very small portion of lands harvested in the state is likely to fail meeting at least one of these exceptions, as Table IV.3.a.ii-3 illustrates. It seems, by way of the numerous exemptions or the ability to proceed with harvests if a harvest plan is signed by a licensed forester, that these proposed rules will have very little impact in terms of increasing the stringency of the base-case regulations.

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[186] From the Maine Forest Service webpage on the Liquidation Harvesting Stakeholders Group, *http://www.state.me.us/doc/mfs/fpm/liq/mainpage.html*

Table IV.3.a.ii-3: Maine lands exempted from Liquidation Harvesting Rules

Exception to liquidation harvesting rules	*Harvested land meeting exception*[1]
- Land held for 5+ years	- 80% of harvested land
- 3rd party certification	- 1/3 of harvested land
- Parcels <500 ac harvested by Master Logger	- 40% of annual harvested acres
- Landowners of <100 acres	- 90% of non-industrial owners
- Lands permitted for conversion	- 5,000-10,000 acres/year
- Land that will be sold before effective date	- unknown (could be large in anticipation of rule)
- parcels <20 acres	- unknown
- Sales or gifts to relatives	- unknown
- Sales pursuant to eminent domain	- unknown
- Transfer of common and undivided land	- unknown
- Sales for roads	- unknown

Notes: [1] Lands within each of the exemption categories may overlap.
Source: Presentation by State Foresters to the Agriculture, Conservation, and Forestry Committee, January 28, 2004, *http://www.state.me.us/doc/mfs/fpm/liq/docs/acf_pres/04-0115LQH%20GRAPHIC%20012604.pdf*

Tree Growth Tax Law

The Tree Growth Tax Law aims to persuade land owners to keep their lands in timber production and "encourage their operation on a sustained yield basis" by offering tax incentives toward this end. The program reduces the assessed value of forest land, thereby reducing property taxes. To qualify, parcels must be at least ten acres in size and must produce commercial forest products, rather than forest products produced for the sole use of the landowner. Forest management plans prepared by licensed foresters are required for enrollment in the program, along with statements from a licensed forester every ten years testifying that the land is being managed according to the plan. Enrollment in the program transfers with any sale or other change of ownership in the land, and a penalty to recapture the tax benefit received by the landowner is assessed if the parcel is removed from the program (ME DAFS 2003).

While the Tree Growth Tax law does not directly address modifications to lynx habitat, or that of any other wildlife species, it is important to note that these tax incentives encourage landowners to keep their land forested rather than develop it.

Federal Nexus

The identification of applicable federal nexi locates those non-federal lands on which land use activities may be modified or restricted to make them compatible with critical habitat-based lynx conservation.

Point sources

A number of point sources in the proposed designation area operate under federal permits for air and water pollutant discharges, thereby establishing a federal nexus for these sources.[187] However, since these permits regulate the on-site process operation of point sources, and since these sources' operation it is not likely to have impacts on lynx protection, their relevance to lynx conservation is negligible. Rather, lynx protection may be furthered via nexi that cover non-point sources.

[187] There are 19 sources with water discharge permits, and approximately 25 sources with air emission permits in the proposed designation area. In addition, there is one mine in the area (crushed stone) and several dozen other sources that are operating under hazardous waste permits (National Atlas of the United States [2000], *http://nationalatlas.gov*, accessed February 2004).

Table IV.3.a.ii-4: Land type classes in lynx CHD area, and associated regulations that restrict land uses of concern to lynx

Land use/cover / *Land ownership*	*Agricultural lands*		*Non Canopy areas* [3]		*Forested lands not used for timber*		*Developed lands*	
			Recreation [4]		***Recreation*** [4, 5]			
Federal lands	*Grazing**	*Timber – by stumpage value*[1,2]	*3 season*	*winter*	*3 season*	*winter*	*Residential/ Commercial*	*Infrastructure (Roads, utilities)*
FS	n.a	LCAS, SSTHSA	[12]	LCAS	LCAS	LCAS	n.a.	LCAS
FWS	n.a.	n.a./LCAS	[12]	LCAS	LCAS	LCAS	n.a.	LCAS
NPS	n.a.	n.a./LCAS	[12]	LCAS/ n.a.	LCAS	LCAS/ n.a.	n.a.	LCAS
Non-Federal Lands w/out nexus	n.a.	FPA, LHA, CLUP, SSTHSA, NRPA, *(TGTL)*					CLUP, NRPA, *(TGTL)*	CLUP, NRPA
Non-federal lands w/ federal nexus: [11]								
State Lands	n.a.	CLUP, FPA, SSTHSA, NRPA, LCAS					NRPA	CLUP, NRPA, LCAS
Private land	n.a.	LCAS,§ FPA, LHA, CLUP, SSTHSA, NRPA, *(TGTL)*	[12]	LCAS	LCAS§	LCAS§	NRPA, *(TGTL)*	CLUP, NRPA, LCAS§
Private lands under conservation easement/ owned by conservation organization [13]	n.a.	(LCAS), FPA, LHA, CLUP, SSTHSA, NRPA	[12]	(LCAS)	(LCAS)	(LCAS)	NRPA	CLUP, NRPA, (LCAS)

Notes: The colors indicate the Critical Habitat Analysis Units; see Table III.2.a-3. If several regulations apply to a given land class, the regulation(s) stipulating the most stringent restrictions on a specific land use activity for a given land class is (are) highlighted in blue. FS –Forest Service; FWS – Fish and Wildlife Service; NPS –National Park Service; * Land under cropping or grazing generally does not constitute suitable lynx habitat. However, where such uses occur in areas that otherwise would be considered suitable lynx habitat, or that could constitute linkage areas between blocks of primary lynx habitat, designation of the respective areas as critical habitat may be justified. The LCAS does not contain specific management guidelines for lands in crop production. Rather, the relevant guidelines for crop production areas are those for winter use/access and road construction (see Table IV.3.a.ii-5). [4]Recreation values are likely to be different for National Park lands and other lands, due to the fact that the former attract more out-of-region tourists than the latter. If willingness-to-pay (WTP) is used for monetary quantification of the value of the recreation activity, one can, on average, expect out-of-region tourists to express a higher WTP for recreation than local residents, if average income of the former is higher than that of the latter (which is a reasonable assumption given that the average per-capita income of the region is likely to be lower than that of out-of-region tourists able to afford a visit to the study area. Since WTP depends on ability-to-pay (ATP, a function of income), the monetary value of recreation of out-of-region tourists will be higher than that of regional tourists. This difference in WTP justify treating National Park lands different from other lands suitable for recreation. [5] Recreation includes subcategories of non-motorized recreation (such as hiking, snowshoeing, cross-country skiing, skiing, mountain climbing) and motorized recreation (using snow mobiles, ATVs and ORVs). [11] Federal nexus is established in all TMDL planning areas from the date on which TMDL plans are approved. [12] The only restriction the LCAS places on summer recreation activities is to limit public use of temporary logging roads. Those roads will by definition be located in forested areas. § Not all land use activities on all private lands have a federal nexus. The federal nexus only exists for those land use activities addressed in the respective TMDL plans. See Table IV..3.a.ii-1 and accompanying text. [13] LCAS applies only to those lands holding federally granted easements. FPA – Maine Forest Practices Act; LHA – Liquidation Harvesting Act, rules only in draft form and don't take effect until 1/2005; the majority of land likely will be exempted from the LHA for various reasons (see text); TGTL – Tree Growth Tax Law, not mandatory rules, but rather financial incentives to keep land in forested state rather then develop it. Only commercial forest lands are eligible. LURC's Comprehensive Land Use Plan (CLUP) restricts extractive and development activities in Protection Subdistricts. SSTHSA - Statewide Standards for Timber Harvesting in Shoreland Areas. NRPA - Maine Natural Resources Protection Act - provides some protection for Sensitive Wildlife Habitat and Fragile Mountain Areas.

Recreation

Downhill skiing/snowboarding

Of the eight downhill ski resorts in the study area, it appears that a federal nexus exists for just one, Saddleback Mountain. This nexus appears in the form of a "scenic easement" recently purchased by the National Park Service to protect the view along a portion of the Appalachian Trail. The easement covers 322 acres near Saddleback Mountain ski area, and could prevent this resort from expanding its operations into that easement under CHD. This nexus is not expected to carry any costs with it during the ten years of our study period, however. It is estimated that Saddleback could expand to ten times its current capacity by upgrading its existing facilities, constructing new lifts already approved by LURC, and by expanding into an area known as the "saddle bowl" (USDI NPS *no date*).[188] It is highly unlikely that this ski resort would seek to expand its operations beyond ten times its current capacity in the next ten years. Therefore, we do not consider any costs to be associated with CHD. Beyond 2013, however, it is possible that Saddleback would one day wish to expand into the area of the scenic easement if critical habitat had not been designated.

All trail activities (cross-country skiing, snowmobiling, hiking, ATV riding, horseback riding, and mountain biking) - Recreational Trails Program (RTP)

From 1993 to 2003, the Bureau of Parks and Lands received $4.4 million from the Recreational Trails Program (RTP). The RTP is a part of the Transportation Enhancement Program of the Federal Highway Administration (FHWA) and provides federal highway funds for recreational trail construction and maintenance (ME DC 2003c). While the state received an average of less than $188,000 per year in 1993, 1996, and 1997,[189] funding has increased to an average of $639,000 per year from 1998 through 2003.[190] This funding source would establish a nexus on future trail construction activities under CHD, although these amounts make up a rather small proportion of all trail maintenance and construction costs.

The State of Maine's Trail Funding Program dictates that a minimum of 30 percent of all RTP funds allocated by the FHWA be used for motorized vehicle trails, and a minimum of another 30 percent must be used on non-motorized trails. The funding may be used for trail construction and maintenance, for the purchase of land for trails, for construction of trailhead facilities, or for education programs relating to responsible trail use and safety.[191] This funding source creates a nexus that could prevent the extension of trail mileage in designated lynx habitat. However, this funding makes up only a relatively small proportion of all money spent by the state on trail construction, maintenance, facilities improvements, and other costs involved with the state's trail network.[192] Hence, it is easy to imagine that allocations of the RTP funds could be assigned to trail work outside of critical lynx habitat, thus avoiding a federal nexus for trails in lynx habitat.

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188 This bowl alone could hold 36 new trails and 7 new lifts.

189 No funds were allocated by the program to any state in 1994 and 1995.

190 From the FHWA's Recreational Trails Program website: *http://www.fhwa.dot.gov/environment/rectrails/recfunds.htm*

191 From the Maine Trails Funding Program website: *http://www.maine.gov/doc/parks/programs/community/trailsfund.html*

192 From 1993-2001 the state spent approximately $16 million on snowmobile and ATV trails alone. The RTP provided just over $2.9 million to Maine in this same period. If this is representative of costs in any nine year period, then the RTP can provide only about 18% of just the snowmobile and ATV trail costs. When cross-country skiing, hiking, mountain biking, and horseback riding are factored in, the proportion of trail funding which originates from the federal government must decrease greatly.

Timber - Clean Water Act (CWA)

The majority of our study area does not possess a federal nexus, and this situation will not change during the majority of our study period. As discussed previously in the section on the Clean Water Act, most of the watersheds in the proposed study area are impaired and are expected to have Total Maximum Daily Load (TMDL) plans finalized within our ten year study period. These plans will establish a federal nexus on certain regions. Timber harvesting will be affected and could face restrictions, and therefore costs, under the TMDL plans in watersheds where forestry has been identified as an activity of primary concern. There are nine such regions, covering approximately 2.9 million acres, that will be covered by a TMDL nexus. Two are expected to begin facing CHD restrictions in 2009, and the other seven will face those restrictions beginning in 2012. In 2009 the West Branch Penobscot watershed and the Lower Androscoggin watershed, covering 1.58 million and 1.21 million acres respectively, will fall under the CWA imposed nexus. In 2012 those watersheds where forestry will face restrictions due to a nexus are Fitzgerald Pond (4,200 acres) in Somerset County; Carrabassett Stream (6,500 acres) and Toothaker Pond (500 acres) in Somerset and Franklin counties; and Black Lake (2,700 acres), Cross Lake (20,800 acres), Dagle Pond (4,800 acres), and Madawaska Lake (32,300 acres) in northern Aroostook County.[193, 194]

Housing construction - Clean Water Act (CWA)

The federal CWA establishes a nexus via the TMDL plan approval process. This nexus has the potential to affect lynx conservation by restricting development of new housing and extractive land uses.

The federal nexi established through the CWA require that EPA consult with the FWS in the process of evaluating the TMDL plans. Whether or not the agency actually will do so is hard to assess ex ante. Historical evidence suggests that it has not always complied with its consultation obligations under the ESA, as evidence by a recent lawsuit over failure to consult with the National Marine Fisheries Service (NMFS) on the approval of certain pesticides (Washington Toxics Coalition et al. vs. EPA et al. 2002). On the other hand, it stands to reason that same lawsuit and the exposed past failure to comply with its consultation obligations could result in an improved consultation record in the future.

Road construction - National Highway System (NHS)

Several roads in the proposed Maine lynx CHD area are eligible for federal funding from Maine's NHS allotment. These are U.S. Route 201 (Old Canada Road, a national scenic byway) and U.S. Route 2 west of Dixfield. Through the consultations with the FWS, lynx-relevant restrictions on road construction may be relevant for future projects on these roads. Based on currently available information on planned projects on these roads, two projects on U.S. Route 201 may be subject to consultations, and two on Route 2.

[193] The acreages listed above were estimated with assistance from maps on the EPA's TMDL website for Maine: *http://oaspub.epa.gov/waters/state_rept.control?p_state=ME*.
[194] There are 341,000 acres of working forest that receive federal tax credit incentives from the New Markets Tax Credit program (Weems 2004). Such incentives would establish a federal nexus for this area. However, the area is just adjacent to the proposed designation area, and not a part of it.

Hazardous fuel reduction projects - National Fire Plan (NFP)

In 2002, the Department of the Interior and the Forest Service spent a combined total of $1.5 million on NFP activities in ME; $87,654 of this was in the form of rural fire assistance (DOI), 379,425 in the form of state fire assistance (FS), and $97,736 in Volunteer fire department assistance (FS); DOI in 2002 contracted for $439,764 for NFP activities in Maine (USDA and USDI 2003). For 2003, a marked increase of NFP activities in ME was planned, to $3.4 million total, including $876,000 in state fire assistance (FS), and 343,000 in combined rural (DOI) and volunteer (FS) fire assistance (USDI and USDA 2003a). These assistance schemes carry a federal nexus.

IV.3.b Assessment of marginal impacts of lynx CHD

The impacts caused by the designation of critical habitat for the lynx are a function of the incremental increase in restrictions on specific land use activities, and the base case level of these land use activities. The increase of restrictions on activities that have the potential to impact lynx negatively is due to the stringent no adverse modification standard that is used to evaluate projects in designated critical habitat. The incremental restrictions attributable to CHD for the lynx translate into economic impacts. These include both costs and benefits.

i. Incremental restrictions on land use activities from CHD for the lynx

The methodology for identifying the incremental restrictions on lynx conservation-relevant land use activities is explained in section III.3.b.i of the Montana case study. For Maine, these incremental restrictions under CHD are shown in Table IV.3.a.ii-5.

IV.3.c Projections of future development of land use activities and incremental impacts of CHD for the lynx

Unlike Montana, where a majority of the land in our study area was either federally owned or involved a federal nexus, Maine has very small portions of land, relative to the size of the study area, that are in federal ownership. In addition, the largest part of the area will not carry a federal nexus for most of the ten years of the study period. As described previously, a nexus is anticipated for some parts of the study area beginning in 2009 and for some additional areas in 2012, due to the fact that TMDL plan design and approval are completed by those dates.

Recreation

Recreation opportunities in northern Maine are plentiful in all seasons and a wide array of businesses rely on visitors who travel to the region to ski, fish, hike, hunt, camp, snowmobile, and ride ATVs. Due to the fact that the vast majority of land in the proposed lynx CHD designation area is privately owned, access to these lands by the public in order to engage in these activities is largely dependent on the good will of private landowners. Across 3.5 million acres in the northern part of Maine, all of it within the area proposed for designation, landowners have come together to form North Maine Woods, Inc. North Maine Woods manages recreational access and facilities across private and state lands in the area on behalf of private landowners, both industrial and non-industrial, and the state. The land is managed as a working forest while visitors are charged entrance fees for access in order to raise funds to maintain trails and campsites.[195]

[195] Information on North Maine Woods, Inc. is available at ***http://www.northmainewoods.org/***

Official restrictions on recreational activities on private lands are few and access is dependent upon the cooperation of individual landowners. There has been a growing concern in recent years over maintaining the goodwill of private landowners in order to ensure that they will continue to allow access to their lands by recreationists in the face of increasing levels of participation and technological advances on the part of snowmobiles and ATVs which allow participants to travel greater distances and over previously impassable terrain, as well as from concerns over the irresponsible behavior of a minority of participants (ME DC 2003c). In response to these concerns regarding the use of ATVs, the Governor of Maine formed a Task Force on ATV Use in May of 2003 in order to address "the social, legal, and environmental problems caused by irresponsible ATV operation" (ME DC 2003c). The task force concluded that an increase in trails from the present 2,200 miles to 7,000 in the next five years was needed to avoid the problems of overcrowding and rapid degradation of the trails. While this may be a positive step in terms of decreasing conflicts with landowners, the large increase in trail mileage could be detrimental to lynx habitat. The task force also encouraged the development of multi-use trails, to be shared by ATVs, snowmobiles, bikes, horses, and hikers, a recommendation that could be positive for lynx as this would slow the rate of increase in the combined mileage for all of these individual types of trails (ME ATV Task Force 2003). It is uncertain at this point if or when these recommendations will be implemented, and what the impact on total trail mileage would be.

The majority of laws pertaining to ATV and snowmobile riding apply to the registration of equipment and to personal safety and that of other riders.[196] Except for a provision in Maine's ATV law which restricts the operation of ATV's on alpine tundras to times when ground is frozen and covered with sufficient snow to prevent direct damage to vegetation,[197] there are no statewide laws restricting the use of ATVs or snowmobiles other than the requirement of users to respect private landowners' posted exclusion signs. There are no state snowmobile restrictions that would be relevant to lynx.

As was the case for timber management on Forest Service lands, recreation management of these lands already follows the guidelines spelled out in the LCAS. However, there are only 53,000 acres of FS lands in western Maine along the New Hampshire border.

Grazing

Only a relatively small portion of the lands in northern Maine is used for any type of agriculture at all. This is due to multiple factors, including soils which are poorly suited to agricultural activity, distant markets, and the fact that the vast majority of land is used for timber production (ME LURC 1997). Beyond the restrictions of the LCAS that apply to FS and NPS lands and lands with a federal nexus, there do not appear to exist any statewide regulations that would affect grazing in the study area in the absence of CHD. Grazing is confined to pasture lands, which do not constitute critical habitat for lynx, and thus CHD for the lynx does not create any impacts on grazing.

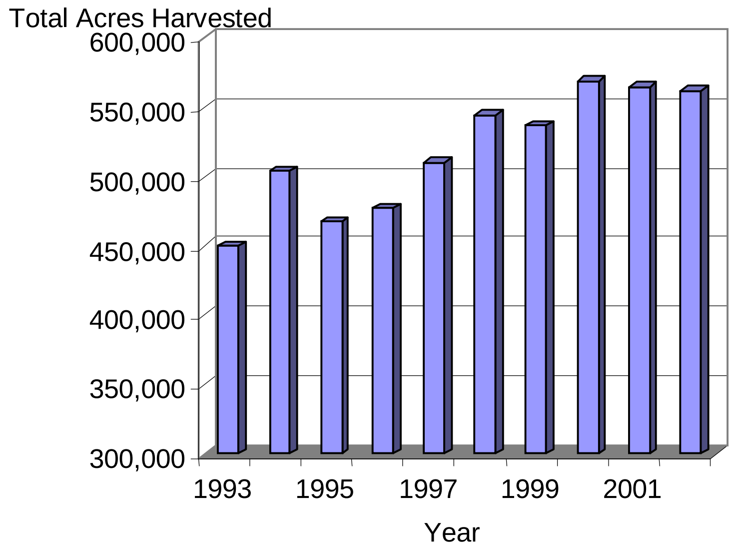
[196] ATV laws: *http://www.mainerec.com/atv3.asp?Category=35&PageNum=35*
Snowmobiling laws: *http://www.mainerec.com/snowlaw1.asp?Category=111&PageNum=111*

[197] Maine Office of the Reviser of Statutes. Maine Revised Statutes Title 12 Ch. 715 (§7851- 7901-A), at §7857 22-A.

Timber

From 1993 to 2002, the area of timberland harvested statewide has exhibited an upward trend, rising by 25 percent in that period (Figure IV.3.c-1).[198] The increase in acres harvested, however, has been accompanied by a 64 percent decrease in acreage of clearcuts during the same time period. In 1993 clearcuts made up 11.4 percent of all harvested acres, while in 2002 that figure had dropped to just 3.3 percent.[199]

Figure IV.3.c-1: Total area harvested statewide, 1993-2002



Source: Maine Department of Conservation, Forest Service Silvicultural Activities Reports 1994 and 1996-2002, *http://www.state.me.us/doc/mfs/pubs/annpubs.htm#silvi*

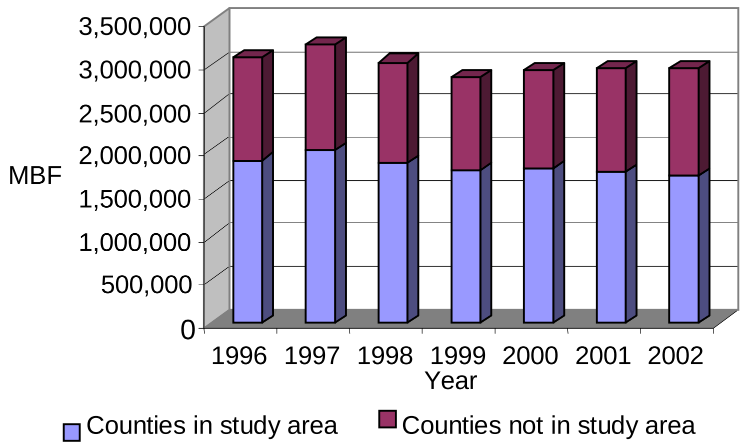
The volume of sawlogs and pulpwood combined, meanwhile, has also declined, falling by 4.3 percent statewide and by 9.5 percent in the counties in our study area between 1996 to 2002 (Figure IV.3.c-2).[200] Approximately 60 percent of the volume of timber harvested statewide originates from counties in our study area.[201] It should be pointed out, however, that none of these counties lies completely in the proposed CHD area. Rather, as detailed in section IV.2, the proposed CHD area accounts for just over one half of the combined area of the six counties (see Table IV.2-1). Therefore, considerably less than 60 percent of statewide harvest volume originated from the proposed CHD area.

Forest based manufacturing in Maine contributed $5.6 billion to the state economy in 1998, accounting for 40.5 percent of Maine's total manufacturing sales (North East State Foresters' Association 2001). However, Power (2001) documents that in Piscataquis County only six percent of total income that same year was directly attributable to forest products. The numbers

[198] Acreage harvested has increased by 17.8% since 1996. Data from ME Department of Conservation, Forest Service Silvicultural Activities Reports 1994 and 1996-2002.
[199] This is up from a ten year low of 2.3%, or 13,185 acres, in 2000.
[200] Data on sawlog and pulpwood volumes was only available from the Maine Forest Service website for 1996. Data on area harvested was available from 1993.
[201] Between 1996 and 2002, the high was 62.3% in 1997 and the low was 57.7% in 2002. Data from ME Department of Conservation, Forest Service Wood Processor Reports 1996-2002.

are similar in Penobscot (7 percent) and Aroostook (5.5 percent) counties, and somewhat higher in Somerset County (17.5 percent). Likewise, only four to five percent of all jobs in Piscataquis, Penobscot, and Aroostook counties were directly tied to forest products in 1998. Statewide, the lumber and wood products and pulp and paper industries made up just over four percent of all Maine income and jobs (Power 2001).[202]

Figure IV.3.c-2: Total volume of sawlogs and pulpwood harvested in counties of study area and statewide, 1996-2002



Note: Pulpwood, measured in cords, has been converted to mbf at a conversion ratio of 2 cords = 1 mbf.
Source: Maine Department of Conservation, Forest Service Wood Processor Reports 1996-2002, h*ttp://www.state.me.us/doc/mfs/pubs/annpubs.htm#wdproc*

All indications seem to point to an impending decrease in harvest volumes, loss of employment in the wood and paper products sectors, or both. A 1998 Maine Forest Service report concluded that under current management practices, harvest levels are outpacing growth by 14 percent (ME DC 1998a). The report calls for improved management activities by way of high yield silvicultural practices such as pre-commercial thinning, establishing plantations, and controlling competing vegetation through herbicides in order to increase growth rates so that harvesting can remain at current levels (ibid.). The assumptions made in this report, however, have been criticized by Caldwell (1999) for not incorporating any changes in land available for harvest over the 50 year projection period. Caldwell (1999) argues that timberland conversions to agriculture and reversions of farmland back to timberland are no longer the sole dynamic at work in land use change. Increasingly large amounts of land are being converted for residential development, making it highly unlikely that they will ever revert back to timberland. The large tracts of land being purchased for conservation easements or by private individuals who intend not to allow timber harvesting was not taken into account by the Maine Forest Service. These assertions are confirmed by the LURC Comprehensive Land Use Plan (ME LURC 1997), which points out that recent land transactions have led to a marked decrease in average parcel size, reducing the probability that landowners will manage these lands for commercial forestry and making it less economical to do so. The pace of change in landownership has further increased since the release of LURC's Land Use Plan in 1997.

202 These statistics refer only to *direct* impacts, they do not include indirect and induced employment and income.

Even if the changes suggested by the Maine Forest Service were successful at ensuring that harvest levels can remain stable into the future, Power (2001) argues that that would not be enough to save the industry from losing large numbers of jobs in the next 50 years. He points out that employment and real wages in the forest products sector were falling in the 20 years before 1998, despite increasing levels of sawlog and pulpwood harvests. The wood products industry for decades has been experiencing labor-reducing technological change, with falling levels of employment per unit of output. Maine is also at a disadvantage in a national market due to the fact that, for climatic reasons, it takes longer for commercial trees to reach maturity; labor, energy, and transportation costs are higher; and the mills are older, smaller, and have higher maintenance costs than in competing regions in the southeastern United States (Power 2001). While the intensive silvicultural practices recommended by the Maine Forest Service in their 1998 Timber Supply Outlook could allow current harvest levels to continue without outpacing new growth, Power (2001) notes that few landowners have been willing to make the investments necessary for the implementation of such practices.

Projections from the Maine Department of Labor agree with these predictions of continued employment loss in the wood products sector. The Maine Employment Outlook to 2010 report predicts losses of 1.3 percent in lumber and wood products employment and a loss of 12.2 percent in paper and allied products jobs (ME DL 2003a).[203]

Due to the fact that lynx require different habitat types for denning, cover/security, and foraging, timber harvests do not have to be excluded to avoid adverse modification. The important consideration when determining what constitutes adverse modification is which habitat type is limiting for lynx. If denning habitat is limiting, then logging activities will adversely modify the overall habitat quality since lynx need the thicker cover of more mature stands in order to maintain successful dens. If, however, foraging habitat is determined to be limiting, timber harvest may improve overall lynx habitat by clearing areas which can then provide forage for snowshoe hares.

The LCAS allows timber harvests that lead to no more then a 15 percent increase in unsuitable lynx habitat in a ten year period. Unsuitable habitat is defined as that in which vegetative cover is in an early successional stage and does not support snowshoe hare populations in all seasons (Ruediger et al 2000). Under CHD, there would be no allowance for this increase in unsuitable habitat, and no reduction of the limiting habitat type would be permitted. Logging would be permitted in non-limiting habitats, so long as the harvest does not cause the non-limiting habitat to become limiting. Additionally, if foraging habitat is of the limiting type, any logging activity may have to take place outside of the denning season if lynx are present in the area and utilizing those denning sites. Size limits of harvested areas may also be required to prevent the creation of any openings of such a size that lynx movement would be restricted.

There are two types of areas where timber harvesting activity could be impacted by CHD. The first is White Mountain National Forest, which is primarily located in New Hampshire, but extends into Oxford County in Maine. The second is private lands that will come under a federal nexus due to the TMDL plans which we anticipate will be completed in 2009 and 2012, respectively.

[203] More specific projections of employment through 2010 in this industry include: Forest and conservation workers (-1.9 percent); fallers (-9.2 percent); logging equipment operators (-1.9 percent); log graders and scalers (-11.7 percent); all other farming, fishing, and forestry workers (-7 percent); paper goods machine setters, operators, and tenders (-9.7 percent).

Table IV.3.a.ii-5: Land use activities potentially detrimental to the lynx, and restrictions on activities under *Base Case* and *designation* scenarios - Maine

Land use activity	*Restriction on activity under BCS*	*Restriction justified under adverse modification standard (CHD)*	*Incremental change from BCS to adverse modification*
Livestock grazing	No grazing in openings created by fire, until successful regeneration of shrubs and trees; no grazing in aspen stands during sprouting, and until sprout survival is ensured; managed grazing in shrub-steppe habitats in lynx habitat; manage livestock grazing in riparian areas to maintain or achieve mid seral or higher condition to provide cover and forage for prey species. (*LCAS*)	No new livestock pastures in lynx habitat; no increase in size of pastures in lynx habitat; no increase in livestock utilization rate on pastures in lynx habitat; no increase in stocking of goats.	None, since no grazing lands in CHD area.
	Restrictions by land ownership: FS and NPS lands: *LCAS* ME State Lands w/out nexus: *(Grazing BMPs)* Other non-federal lands: *ME CWA TMDLs* where applicable Non-federal lands with nexus: the foregoing, plus *LCAS*		None, since no grazing lands in CHD area.
Timber harvest	Management actions not to change >15 % of lynx habitat in LAUs to unsuitable condition within 10 yr period; no pre-commercial thinning until trees are no longer useful as snowshoe hare habitat; generally, no post-disturbance salvage harvests on areas <5 acres (for exceptions see LCAS); in aspen stands, harvest is to favor aspen regeneration; design harvest units to mimic natural disturbance pattern and scale and retain natural connectivity across landscape. (*LCAS*) In shoreland zones: at <75 ft from shore, no harvest of >40% of volume/acre/10 yrs, and no clearcuts; at >75-100 ft from shore, no clearcut openings of >10,000 sq feet; openings >5,000 sq ft must be 100 ft apart. (*ME Shoreland Zoning/new Statewide Standards for Timber Harvest in Shoreland Zones)* No clearcuts over 250 acres; must have buffer of 250 ft between	No degradation of limiting habitat type (denning, forage, or travel/security); no logging in denning habitat during denning period. No degradation of linkage areas/corridors. Maximize edge of harvested areas. (See also below under restrictions on logging roads.)	

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	clearcuts and it must be > or equal to size of cut if cut is >20 acres; management plan signed by professional forester required if cut is >20 ac. (*ME Forest Practices Act*) Parcels >20 ac bought, cut, and sold within 5 years must limit harvest to no more than 40% of basal area of trees with 4.5" or more DBH; several exceptions possible; not effective until 1/1/05. (*Liquidation Harvesting Act*)		
	Restrictions by land ownership: Forested FS and NPS lands: *LCAS*. Private forest lands w/out nexus: *Liquidation Harvesting Act*, *ME Forest Practices Act* Non-federal lands w/ nexus: the foregoing, plus *LCAS*		Federal lands and lands with federal nexus (*CHAU 3*): No habitat degradation allowance of *15 %/10 yr* (see leftmost column), except in non-limiting habitat type and if that type does not become limiting through the activity.
Winter Recreation	No net increase per LAU in groomed or designated over-the-snow routes or snowmobile play areas on federal lands; prevent actions that reduce landscape connectivity; design new developments to direct use away from diurnal security habitat; protect security habitat around proposed developments or expansions; in ski area expansions, provide adequately-sized coniferous inter-trail islands; limit ski area operating hours in new or expanded developments to provide sufficient nocturnal foraging opportunities. (*LCAS*)	No additional trail mileage (gross, not net); no trail improvements; no increased volume of off-trail snowmobile or cross-country recreation; no new ski runs; no extension/amplification of ski runs; no new development of large-scale winter recreation areas or expansion of existing areas; no new overnight huts in lynx habitat; no night-snowmobiling in lynx habitat.	
	Restrictions by land ownership: FS lands: *LCAS* NPS lands: *LCAS*		Federal lands and lands with federal nexus (*CHAUs 6* and *8*): No new gross trail mileage; no trail improvements; no increased volume of off-trail snowmobile or cross-country recreation; no new ski runs; no

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			extension/amplification of ski runs; no new development of large-scale winter recreation areas or extension of existing areas; no new overnight huts in lynx habitat; no night-snowmobiling in lynx habitat.
Summer Recreation	Limit public use of temporary logging roads. (*LCAS*)	No new camping sites or facilities in denning habitat. No new ORV/ATV or hiking trails (winter access for lynx competitors); no increase in cross-country motorized travel; closure of new campsites and trails in proximity to denning sites during denning period (May-August)	FS lands (CHAUs 5a): No new camp sites or facilities in denning habitat. No new ORV/ATV or hiking trails. Closure of new campsites and trails in proximity to denning sites during denning period (May-August). Other federal lands and lands w/ nexus (CHAU 5b): s.a.
Roads/utility corridors	No net increase in groomed or designated over-the-snow routes – does not include winter logging-related activities; locate roads away from forested stringers, and minimize road building on ridgetops and areas important for connectivity; limit public use of temporary logging roads; minimize road building in areas important for lynx habitat connectivity; design new logging roads, especially the entrance, for effective closure upon completion of sale activities; consultations on all new highway projects in federal lands. (*LCAS*) Land management roads at least 25/50/100 feet from shore, depending on class of water body; no new permanent land management roads in shoreland areas zoned as resources protection districts. (*ME Shoreland Zoning/new Statewide Standards for Timber Harvest in Shoreland Zones*)	No new roads or road extensions. No new temporary logging roads or logging road extensions, except where needed to conduct silviculture activities that do not degrade lynx habitat quality (see restrictions on timber harvest activities above) - and no net increase in logging roads, including temporary ones; effective closure of new logging roads to public motorized use and closure of such roads to all use in denning habitat during denning period; *effective* closure of roads during months with winter snow, and obliteration of roads (including reestablishment of vegetation) subsequent	

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	Minimize vegetation disturbance in fragile mountain areas and avoid projects in sensitive wildlife habitat (*NRPA*)	to completion of harvest activities.	
	Restrictions by land ownership: FS lands: *LCAS* NPS lands: *LCAS* State forested lands: *NRPA* Private lands: *NRPA* Non-federal lands w/ nexus: the foregoing, plus *LCAS*		
Wildland fire management/ prescribed burns	Design burn prescriptions to regenerate or create snowshoe hare habitat; avoid construction of permanent fire beaks on ridges or saddles in lynx habitat; minimize construction of temporary roads and machine fire lines to the extent possible during suppression activities; to the extent possible, design burn prescriptions and conduct suppression actions such that adequate denning habitat is maintained; after large fires, conduct post-disturbance assessment prior to salvage harvest to evaluate potential for denning and forage habitat. No grazing in openings created by fire, until successful regeneration of shrubs and trees; no grazing in aspen stands during sprouting, and until sprout survival is ensured. (*LCAS*)	To the extent possible, return to historic fire regimes, i.e., restore fire as an ecological process. Design broadcast burning to retain coarse woody debris; no salvage logging of large-diameter downed trees and no removal of root wads.	
	Restrictions by land ownership: FS lands and non-federal lands w/ federal nexus: *LCAS* NPS lands: *LCAS*		Federal lands and lands w/ federal nexus: No salvage logging of large-diameter trees at all, no removal of root wads.
Mining	Restrict unavoidable over-snow access to designated routes; close roads to public. (*LCAS*)	No new mining sites, no extensions of current mining sites (that require permit renewal), no new roads to existing mining sites.	
	Restrictions by land ownership: FS lands: *LCAS* NPS lands: n.a.		None, since no mining activity foreseen in proposed CHD area.

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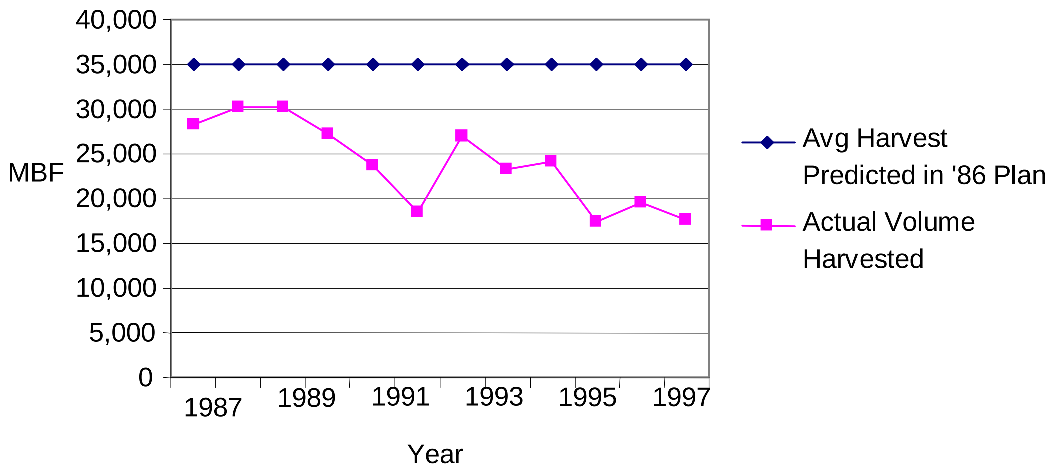
	State forested lands: Private lands: *ME CWA TMDLs* where applicable		
<u>Residential development/ Construction</u>	Do not compromise landscape connectivity. (*LCAS*) Protect natural resource values in LURC Protection Subdistricts (protected mountain areas, Fish and Wildlife protection, recreation protection and resource plan subdistricts). (*LURC Comprehensive Land Use Plan*) No unpermitted construction, repair or alteration of any permanent structure in Fragile Mountain Areas or Sensitive Wildlife Habitat (*NRPA*)	No new permanent building structures in lynx foraging and denning habitat. No new structures in travel corridors or linkage areas that would reduce the use of these areas by lynx.	
	<u>*Restrictions by land ownership:*</u> NPS and FS lands: *LCAS* LURC jurisdiction, non-exempt lands: *LURC Comprehensive Land Use Plan, NRPA* All other: *NRPA*		Federal lands and lands w/ federal nexus: No new permanent building structures in lynx foraging and denning habitat

White Mountain National Forest

The 1986 Forest Plan for the White Mountain National Forest predicted that harvest levels would average 35,000 mbf per year. From 1987 through 1998, however, the actual average harvest was less than 24,000 mbf, and harvests appear to be decreasing (USDA FS 2000c). Figure IV.3.c-3 below illustrates the predicted and actual harvest levels during this time period. These numbers reflect forest wide harvests, yet only 52,850 acres (6.6 percent) of the nearly 800,000 acre National Forest is in the state of Maine.

Figure IV.3.c-3: Predicted and actual harvest volumes in White Mountain NF, 1987-1998



Source: USDA FS (2000c)

Lynx Analysis Units (LAUs), as defined in the LCAS, are recommended as being between 25 and 50 square miles (16,000-32,000 acres), approximating the home range size of a female lynx, and denning habitat is not considered limited as long as it makes up at least ten percent of the LAU and is in proximity to foraging habitat (Ruediger et al. 2000). Therefore, it is likely that logging operations will be allowed to proceed in the White Mountain National Forest as they would under the LCAS in most cases. Timber harvests have been below the level anticipated by the 1986 Forest Plan, and seem to be declining in recent years, while there are roughly 345,000 acres of suitable forest land in the national forest (USDA FS 2000c). While it may be necessary to relocate certain harvest activities if they are in areas where denning habitat is a limiting factor, it seems unlikely that logging activities would be unable to proceed considering the size of the forest in question and the volume of suitable timber contained in it. Of course, a more detailed and spatially explicit study of growth rates in the forest would be needed to determine whether or not this presumption is borne out.

Because of the LCAS-based restrictions already in place on timber harvests on FS lands in the study area and the apparent trend of decreasing harvest volumes across the study area, it appears that little, if any, decreased logging will take place on account of designation of critical habitat. Where costs will be incurred due to CHD, they will come in the form of additional consultations with the U.S. Fish and Wildlife Service before logging activities are carried out, through project modifications in the form of relocation of harvesting activities due to limited denning habitat and the associated need to repeat timber sale preparations (planning, surveying, tree marking), and the potential for foregone profitability if a portion of the harvests must be moved to a secondary or tertiary site due to limiting habitat concerns. Table IV.3.c-1 displays the upper and lower-bound estimates of impacts on the timber harvests in the White Mountain NF. We assume that logging volumes in the forest as a whole will continue at the average of the years 1987-98, at 24 mmbf per year. There does not appear to be any data readily available which indicates what portion of this harvest level has come from the Maine side of the forest. Therefore, since 6.6 percent of the forest is located in Maine, we assume that same proportion of harvested timber originates in Maine as well. This results in an estimate of approximately 1.6 mmbf per year, or 16 mmbf in ten years.

The upper-bound scenario supposes that 15 percent of harvest activities will have to be relocated due to CHD and that those harvests which must be modified will face delays while adjusting to the new regulations during the first two years of the study period. This low percentage of relocated harvests is due to the assumption that lynx denning habitat is not considered limiting as long as it makes up ten percent or more of an LAU (Ruediger et al. 2000). The lower-bound scenario assumes only a five percent relocation rate and no delays after the first year. Estimated numbers of consultations are based on the assumption of one consultation per year in the upper-bound, and one every three years in the lower bound due to the expectation that since the Maine portion of the forest makes up such a small percentage of the total area, harvest plans will not necessarily be prepared in every year of the study period.

Table IV.3.c-1: Impacts on timber harvests in the White Mountain NF

	Timber Volume (mmbf)			*Consultations*	
Impacts	*prevented*	*delayed*	*modified*	*increased effort*	*re-initiated*
Upper-bound	-	0.48	2.4	10	2
Lower-bound	-	0.08	0.8	3	1

Private Lands

The overwhelming majority of timber harvested in Maine originates from privately owned forest lands. While it is difficult to assess exact acreage of land owned by each entity in the private forest industry, we estimate that between 4 and 5 million acres of our study area is owned by ten different timber companies. Data also show that an average of 1,823 mmbf of timber per year is harvested, from all landownership classes, in the counties of our study area. This volume makes up 60 percent of the average volume harvested each year statewide, but only 52 percent of the total area of these six counties is in our study area.[204]

Over the majority of the study area, and for most of the ten year study period, no federal nexus exists that could restrict timber harvests on private lands under CHD. However, as previously discussed, the presence of impaired water bodies under the Clean Water Act will force the implementation of TMDL plans which establish a federal nexus on certain portions of our study area. There are nine such regions, covering approximately 2.9 million acres, which will be covered by a nexus due to TMDL plans before the end of our study period. Two are expected to begin facing CHD restrictions in 2009, and the other seven will face those restrictions beginning in 2012. In 2009 the West Branch Penobscot watershed and the Lower Androscoggin watershed, covering approximately 1.6 million and 1.2 million acres, respectively, are assumed to place a CWA nexus on forest management. In 2012 those watersheds where forestry is expected to face restrictions due to a nexus are Fitzgerald Pond (4,200 acres) in Somerset County; Carrabassett Stream (6,500 acres) and Toothaker Pond (500 acres) in Somerset and Franklin counties; and

[204] Data on harvest volumes obtained from Maine Department of Conservation, Forest Service Wood Processor Reports 1996-2002, ***http://www.state.me.us/doc/mfs/pubs/annpubs.htm#wdproc***

Black Lake (2,700 acres), Cross Lake (20,800 acres), Dagle Pond (4,800 acres), and Madawaska Lake (32,300 acres) in northern Aroostook County.[205]

Since privately owned timber companies generally do not publish their harvest plans and schedules, it is difficult to estimate with any certainty the volume of harvests that will be affected by CHD under this nexus. This uncertainty makes it necessary to assume that over the ten year study period, harvest volumes will be distributed evenly across the counties of our study area. Since the study area includes approximately 52 percent of the total combined area of the counties, we assume that 948 mmbf/year will be harvested from proposed designation lands in the six counties.

For the majority of the study period, timber harvests throughout the study area, except for those in White Mountain National Forest, will be unaffected by CHD-related restrictions. In 2009, however, a federal nexus will come into play, due to the completion of the TMDL plan process, and will place on approximately 2.8 million acres the same harvest restrictions described for the White Mountain NF. According to a North East State Foresters' Association report (2001), 86 percent of the land area of Maine is classified as suitable timberland. If we assume that this statewide percentage of suitable timberland holds true in our study area, then the affected area of timberland in these two watersheds will be 2.4 million acres. This area falling under a federal nexus represents approximately 33 percent of the 7.3 million acre study area and, if we assume the average annual harvest of 948 mmbf is evenly distributed, the nexus will impact the harvest of 312.8 mmbf in each of the years 2009-2011. In 2012, another 71,800 acres will come under a federal nexus,[206] bringing the total area affected up to 34 percent of the study area, affecting a total of 322.3 mmbf per year in 2012 and 2013.

Our assumptions regarding upper and lower-bound estimates of impacts are the same as those utilized in the case of the White Mountain National Forest. In the years 2009-11, 312.8 mmbf per year, or a total of 938.4 mmbf in three years, will be impacted by CHD. Again we assume that 15 percent of harvest activities will have to be relocated due to CHD. In this case we do not assume that harvests will face any delays, because of the ample time they have to prepare for the new restrictions: critical habitat designation becomes effective in 2004, but the private lands do not have a federal nexus until 2009. The lower-bound scenario assumes only a five percent relocation rate. In the years 2012 and 2013, an additional 71,800 acres will fall under a federal nexus. When combined with the previous volume totals, which will still be under a federal nexus in this time period, the total harvest volume impacted will be 322.3 mmbf per year, or 644.6 mmbf over both years.

The estimated number of consultations is based on the assumption of one consultation per year per landowner in the upper-bound, and one every three years in the lower bound due to the expectation that there will not necessarily be harvest plans prepared in every year of the study period for each area. We assume also that from 2009-11, between three and seven landowners are affected, and in 2012 and 2013, five to ten landowners. Table IV.3.c-2 illustrates the total impacts to the private forest industry and Table IV.3.c-3 displays the impacts to the forest industry as a whole, combining private and federal land.

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[205] The acreages listed above were estimated with assistance from maps on the EPA's TMDL website for Maine: ***http://oaspub.epa.gov/waters/state_rept.control?p_state=ME***.

[206] We do not take 86% of this figure in this case due to the fact that the maps available from the EPA are more detailed for these drainages, permitting us to approximate the areas that are not likely to be suitable timberlands.

Table IV.3.c-2: Impacts on timber harvests on private land

	Timber Volume (mmbf)			*Consultations*	
Impacts	*prevented*	*delayed*	*modified*	*increased effort*	*re-initiated*
Upper-bound	-	-	237.5	41	-
Lower-bound	-	-	79.2	8	-

Table IV.3.c-3: Impacts to timber harvests on private and federal land

	Timber Volume (mmbf)			*Consultations*	
Impacts	*prevented*	*delayed*	*modified*	*increased effort*	*re-initiated*
Upper-bound	-	0.48	239.9	51	2
Lower-bound	-	0.08	80	11	1

Recreation

Background

There are less than 90,000 acres of Federal lands with public access in the proposed designation area, divided among Lake Umbagog National Wildlife Refuge and White Mountains National Forest in Oxford County, and the Appalachian Trail corridor through Oxford, Franklin, Somerset, and Piscataquis counties.[207] State ownership adds about 540,000 more acres of public lands in the form of state parks and public reserved lands. Due to the fact that the majority of the land in the north woods of Maine is owned privately, a great deal of recreational opportunities in the area relies on the continued goodwill of landowners to allow public use of their lands.

The pattern of private landownership in northern Maine has changed a great deal in the last decade, and continues to do so. A mix of land sales between timber companies, purchase of conservation easements by private conservation organizations and other individuals, and sales of parcels for development have fragmented land ownership. This increased pace of land transfers and the fact that many timber companies do not make information on the acreage of their landholdings readily available make it difficult to assess the exact composition of landownership at any given time. It appears, however, that between four and five million acres, some 55 to 70 percent) of the lands in the study area are owned by ten timber companies.[208] The two largest of these companies, J.D. Irving Ltd. and Plum Creek Timber Company, are the largest landowners in the state.

Private and state lands covering 3.5 million acres in the study area currently are managed for multiple use recreation by a cooperative organization known as North Maine Woods, Inc. (NMW). NMW operates entry checkpoints around the region and collects user fees from recreationists, which are used to construct and maintain campgrounds and trails.[209] Additionally,

[207] The Federal government owns approximately 13,000 additional acres in Franklin County at the U.S. Naval Survival, Escape, and Evasion Training Facility. This land is not available for recreation by the public.
[208] This information was compiled from timber company websites and from the Natural Resources Council of Maine's *North Woods News* (***http://www.maineenvironment.org/nwoods/land_sales.htm***). The timber companies referred to here are Great Northern Paper, Hancock Timber Resources Group, International Paper Company, J.D. Irving Ltd., McDonald Investment Company, MeadWestvaco, Pingree Family Forest Partnership, Plum Creek Timber Company, Prentiss and Carlisle, and Yankee Forest LLC (primarily owned by Yale University).
[209] Further information on North Maine Woods, Inc. can be found at ***http://www.northmainewoods.org/***

the Plum Creek and Meadwestvaco timber companies have open use policies for recreationists on their land, which opens up another 1 million to 1.5 million acres to recreational uses (ME ATV Task Force 2003).[210]

In recent years a number of conservation easements have been purchased in the area. These easements have come about through agreements between a varying mix of timber companies, the state, private individuals, and national or regional conservation organizations. While the terms of each easement vary, the majority of them have been established to allow continued recreational use and to allow for management as sustainable, working forests, while protecting these lands from development. More than 1.5 million acres in the study area have been established as some form of conservation easement or have been purchased outright for conservation purposes. Table IV.3.c-4 outlines this type of land ownership. All of these lands remain open for recreational use.

The most stringent restrictions on any of these lands may apply to those owned by Roxanne Quimby, founder of the Burt's Bees company, who intends to manage her lands as a wildlife sanctuary by not allowing timber harvesting or hunting and limiting motorized access (Austin 2003). John Malone, a media entrepreneur who holds large tracts of land in northern Somerset County, however, has continued to allow access to his land by recreationists, including hunters (Austin 2002).

General recreation trends

Day visits to Maine state parks increased 33 percent (or by an average of 4.1 percent per year) from 1.75 million in 1993 to 2.32 million in 2001. However, 73 percent of those visits were to coastal parks, outside of our study area. There is also no guarantee that the increasing trend will continue; for example, the period from 1985 to 1993 exhibited a 27.5 percent decrease in day use visits (ME DC 2003c).

Table IV.3.c-4: Land held as conservation easements or in privately owned conservation lands in study area

Participants in easement	*Acreage*
Pingree Family and New England Forestry Foundation [1]	762,192
West Branch Project [2]	329,000
Nature Conservancy and Great Northern Paper (Katahdin) [3]	241,000
Nature Conservancy (St. John River)[4]	185,000
John Malone [5]	68,424
Roxanne Quimby [6]	40,004
Appalachian Mountain Club [7]	36,691
TOTAL	1,662,311

[2] Easement held by the State of Maine. [4] Purchased from International Paper. [5] Not an easement, full ownership in northern Somerset county (Austin 2002).
[6] 24,083 as a single parcel bordering Baxter State Park, [7] Property purchased from International Paper.
Sources: [1]*http://www.newenglandforestry.org/projects/pingree.asp*;
[2]*http://www.centralmaine.com/view/columns/300952.shtml*;
[3]*http://www.gnpaper.com/pr/pressreleases.htm*;
[4, 6, 7]*http://www.maineenvironment.org/nwoods/land_sales.htm*.

[210] Portions of these lands overlap with the land managed by North Maine Woods, Inc.

In the Allagash Wilderness Waterway public use dropped by 18 percent from 1993-2002, with camping declining 17 percent. Both camping and day use at Baxter State Park also declined by five percent each in the 1990's, from 145,000 to 138,000 visitor days (ME DC 2003c). On lands managed by North Maine Woods, Inc., visitor days increased from 205,000 in 1993 to 284,000 in 2001 (up 40 percent).

However, a great deal of this increase is likely to have been simply a function of the fact that NMW added 700,000 acres to the lands it manages in 1999 (ME DC 2003c).[211] The overall trend since the mid 1970's, however, is growth in overall recreation activity. The Maine Land Use Regulation Commission estimates that the demand for backcountry recreation in New England is growing by more than double the rate of population growth (ME LURC 1997).

"Marketable pleasure trips", those trips to, and within, Maine which are taken for reasons other than business or visiting friends or relatives, numbered 22.9 million in 2001. Eighty-one percent of these were days trips, equally divided between residents and non-residents, and 22 percent of travelers reported outdoor activities as their reason for travel. Of those taking overnight trips in the state, 38 percent traveled for the "wilderness" experience, 27 percent visited a national or state park, 22 percent came to see wildlife (including 17 percent seeking "unusual" wildlife), 19 percent went hiking, 5 percent backpacking, and three percent downhill skiing (ME DC 2003c). The majority, 77 percent, of those visiting lands managed by North Maine Woods were Maine residents. Ten percent of visitors to these lands resided in Canada and eight percent in other New England states (ME LURC 1997).

Winter recreation

It is estimated that Maine received 24.9 million non-resident visits in 2001, 69 percent of which were day trips.[212] Maine residents added another 18.1 million trips within the state, making tourism, from within as well as without, an important component of the state's economy. While only 51 percent of all non-resident trips to the state were in the "marketable pleasure trip" category, it is not known what portion of those traveling primarily for business or to visit friends and relatives also engage in outdoor recreation activities while in Maine (ME DC 2003c).

Winter recreation opportunities are an important component of the tourism industry in the northern part of the state, which provides expansive opportunities for snowmobiling, downhill and cross-country skiing, and snowshoeing. While the magnitude of impacts each of these have on lynx and their habitat varies, they all have the potential to subject the designated critical habitat to some level of adverse modification. Each of these forms of winter recreation will be dealt with here separately.

Downhill skiing/snowboarding

Alpine skiing and snowboarding resorts are an important consideration in lynx habitat due to the potential destruction of foraging and denning habitat for the creation of new downhill runs and ski lifts. Four season resorts also create areas of concentrated human activity. While lynx have been known to be rather tolerant of the presence of humans, large amounts of activity, which stretch into the early denning season, may have deleterious impacts on kitten survival (Ruediger et al. 2000). Adverse modification of lynx critical habitat could occur from any expansion of

[211] The Ragmuff-Seboomook forest.
[212] 79 percent of those day trips were made by residents of the Boston area.

these ski areas, which includes clearing of hillsides for additional runs or ski lifts, widening of runs, or expansion of parking areas.

Maine is a popular downhill skiing destination in the northeastern U.S., with 17 such ski areas statewide, including eight in the study area.[213] The State Comprehensive Outdoor Recreation Plan (SCORP) estimates that three percent of overnight marketable trips to the state involve downhill skiing, and that 16.3 percent of Maine residents skied in the 1991-92 season (ME DC 2003c). This percentage of nonresident participants underestimates the true percentage as it does not include those whose primary reason for travel was business or visiting friends or relatives, but also involved skiing. It also does not include day trips and it seems reasonable to assume that a substantial number of residents of other New England states and Canada travel to Maine to ski but do not stay overnight. Total estimated activity days (from overnight and day trips by in-state and out-of-state visitors) in the 2002-03 season numbered 1,296,910, slightly above the 1,262,498 skiing days per year average of the previous five years. Peak visitation occurred in the 2000-01 season with 1,323,524 activity days (SkiPressWorld 2003).

The size of the resorts in the study area varies widely, from the small resort of Black Mountain, with 13 trails serviced by two lifts,[214] to Sugarloaf, the largest resort in the state, with 138 runs and 15 lifts.[215] While several of these ski areas may be planning at least small scale expansions in the near future, the majority of them are privately owned and located on private lands,[216] and our analysis does not reveal any federal nexus that could limit this expansion. The sole exception to this case is Saddleback Mountain, near Rangeley. The National Park Service recently purchased lands adjacent to the Appalachian Trail, including a 322 acre "scenic easement" which would restrict development of the ski area on this land, and could prevent it entirely under critical habitat designation. However, it is estimated that Saddleback could expand to ten times its current capacity by upgrading its existing facilities, constructing new lifts which have already been approved by the Maine Land Use Regulation Commission (LURC), and by expanding into an area known as the "saddle bowl"[217] (USDI, NPS *no date*). Therefore, since it seems highly unlikely that Saddleback would desire to expand its operations to more than ten times present capacity within the ten years of our study period, we don't expect that any cost would be associated with expansion restrictions due to CHD, even in this ski area with a federal nexus on adjoining land. In sum, we do not foresee any impacts of lynx CHD on alpine skiing or snowboarding.

Snowshoeing

Little data exist regarding the rate of participation among visitors or residents for snowshoeing in Maine. We would expect that the number of people participating in this winter activity is growing, but thus far participation has not reached a level to detrimentally affect lynx or their habitat. Potential adverse modifications to lynx habitat from this activity come from snow compaction, which may facilitate winter access to lynx habitat by competitors such as coyote and bobcat (Ruediger et al. 2000). The impact of snowshoeing may be diminished due to the fact that this activity does not require the maintenance of a system of groomed trails, thus any compacted

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[213] Big Squaw Mountain, Mt. Abram, Saddleback Mountain, Black Mountain, Sugarloaf, Sunday River, Eaton Mountain, and Titcomb Mountain.
[214] Black Mountain of Maine website: ***http://www.skiblackmtnofme.org/***
[215] Sugarloaf website: ***http://www.sugarloaf.com/***
[216] Big Squaw Mountain, however, is one-third state owned.
[217] Estimates indicate that this bowl would support up to 36 new trails and 7 new lifts (USDA, NPS *no date*).

routes through the snow are temporary. It is possible that the popularity of snowshoeing will increase markedly in the next ten years. If this occurs, restrictions may have to be placed on the sport in lynx habitat, causing tangible costs to the industry and its participants. We do not anticipate such a trend before 2013, but this activity should be considered for any future projections of costs beyond that point.

Cross-country skiing

There are at least 19 ski areas in the northern woods of Maine that offer downhill and/or Nordic skiing opportunities, with over 870 km (541 miles) of trails exclusively for cross country skiing.[218] A significant portion of the state's snowmobile trails are also used by cross country skiers (Vail 2002). Statewide, the SCORP (ME DC 2003c) estimates that only seven percent of the trail mileage (113 miles) used by cross country skiers is located on federal lands, while 56 percent is located on privately owned land. Any expansion of cross-country skiing involving new groomed or un-groomed trails throughout the area may cause adverse modification to lynx habitat in that it has the potential to increase access to lynx habitats by competitors through compaction of snow. National trends show that participation in this sport grew by more than 20 percent in the second half of the 1990's (ME DC 2003c).

We do not anticipate any federal nexi that could restrict the development of cross-country ski trails on non-federal lands in the next ten years. Economic impacts arising from critical habitat designation could come in the form of restrictions that prevent the expansion of cross-country ski trails in lynx habitat on the less then 90,000 acres of public access federal lands. In estimating the expected growth of trail mileage in the absence of CHD, we assume that participation in the sport remains at 16.7 percent of residents (ME DC 2003c).[219] Since no data is available on the number of out of state visitors who cross-country ski in Maine we assume that the ratios of percent participation between residents and non-residents that existed in the Montana case study (5 percent vs. 0.4 percent), is the same for Maine. Based on the assumed 16.7 percent resident participation rate in the activity, we estimate a 1.3 percent participation rate among non-residents. We also assume, as we did in the Montana case, that visitation to the state will grow proportionally with the U.S. population as a whole. Furthermore, we assume that since seven percent of the state's cross-country ski trails are on federal lands, and since 54 percent of the federal land in Maine is in the study area, that 54 percent of federal trails are in the study area and therefore, that 3.8 percent of the state's total of cross-country ski trails are affected by a federal nexus.[220] Finally, we assume that skiers are distributed more or less evenly across all trails,[221] leading to the conclusion that 3.8 percent of cross-country skiing activity days take place on federal lands in our study area.

In the case of Maine, the figures calculated above translate differently into numbers of resident participants and non-resident participants. For residents, the proportions of skiers were calculated from the state population, based on reported participation rates, ensuring that there is no double counting. For non-residents, however, the SCORP only gives the number of *visits* to the state,

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[218] A list of these ski areas can be found on the Maine Nordic Ski Council website: *http://www.mnsc.com/xcski.htm*

[219] The SCORP states that 16.7 percent of residents reported cross-country skiing close to home and 6.9 percent reported skiing away from home. We assume here that those who ski away from home also spend some time skiing close to home, and therefore use the 16.7 percent figure as the overall participation rate.

[220] Not including military installations which are off limits to public use.

[221] Of course, we realize that the actual distribution is not even, but in the absence of data indicating actual distributions, this is the best that can be done.

not *visitors*, therefore it is likely that a great deal of these visits are from repeat visitors to the state. This distinction means that the figure calculated with the methodology described in the previous paragraph represents activity days from non-residents, not numbers of participants.[222] In order to estimate the number of participant non-residents, we assume that non-residents participate in cross-country skiing at one-quarter the frequency of residents in the northern U.S., as reported by Cordell et al. (1997), or two times per year.

As an upper-bound estimate of impacts, we assume that mileage of ski trails will increase proportionally with the total number of skiers during the next ten years in the absence of CHD. In other words, with every percentage increase in number of participants, there will be an equal percentage increase in total trail mileage. This is a high estimate, as currently existing trails could likely absorb some increases in use without becoming crowded. Based on the assumptions stated above, we estimate that an average of half a mile of new trail would be constructed each year in the absence of CHD on federal lands as the number of participants rises with the state and national populations, for a total of five miles in ten years. Under the restrictions of CHD, no new trails could be constructed on these lands. Following the assumptions above, this will lead to an increase in density from 233 skiers per year per mile of trail in the year 2013 in the absence of CHD to 248 skiers per year per mile that same year under CHD, an increase of 6.4 percent.

For a lower-bound estimate we assume what seems to be a more likely scenario, that trail growth would not keep pace with the increase in the population of participants over the next ten years; we assume an increase in trail mileage of half that assumed in the upper-bound estimate. Therefore, just 2.5 new miles of trail would be constructed in the next ten years in the absence of CHD. In this scenario the density of skiers would rise to 242 per year per mile of trail in 2013 without CHD. In this case, the increase to 248 skiers/mile with CHD in that same year would constitute a 2.5 percent increase. Table IV.3.c-5 below presents the estimated upper and lower-bound impacts of CHD on cross country skiing. These numbers assume that each land managing entity will attempt to have trail construction approved every other year in the upper-bound case, and every five years in the lower-bound.[223] This, perhaps, overstates the costs of consultation due to CHD, as it is more likely that land managers will become aware of the restrictions on new trail construction and cease to expend resources on consultations. Consultations may also be required, however, on activities designed to maintain existing trails.

Table IV.3.c-5: Upper and lower-bound CHD impact estimates on cross-country skiing

Impacts	*Miles of new trail prevented*	*Density increase*	*Consultations[1]* *increased effort*	*re-initiation*
Upper-bound	5	6.4%	10	2
Lower-bound	2.5	2.5%	4	-

Note: [1]Assumes one each consultation by the FS and NPS every other year in the upper-bound, and every fifth year in the lower.

[222] This distinction was not made in the Montana case study due to the remoteness of that state, making it less likely that a significant portion of visits were from repeat visitors in the same year.

[223] It does not make sense here to assume, as we did in the Montana case, that consultations would take place every year in the upper-bound condition and every three years in the lower-bound as it is unlikely that the land managing entities would construct these trails in fractions of a mile at a time, consulting for each fraction.

For our upper-bound estimates it is assumed that trail maintenance activities will also occur every other year and that consultations for 2004 have already taken place and will have to be re-initiated. The lower bound estimate assumes this maintenance to occur once every five years. Since the Maine portion of Lake Umbagog National Wildlife Refuge does not currently contain any cross-country ski trails, we will assume that they will not construct any in the next ten years, and thus will not go through any consultations.

Snowmobiling

Snowmobiling is an extremely popular sport in Maine and a great deal of this activity takes place in the northern woods of the state. The state's network of groomed trails extends for almost 13,000 miles, more than 50 percent of which is located in Aroostook, Penobscot, Oxford, and Somerset counties (ME DC 2003c). This mileage also includes 2,500 miles of the Interconnected Trail System (ITS), known as the "snowmobile superhighway." Ninety-four percent of the trails are located on private land (Vail 2002). Snowmobile registration increased by more than 50 percent between the winters of 1992-93 and 2000-01, to 98,000 machines (ME DC 2003c), and there is evidence that interest from out-of-state riders continues to grow. Between 1996 and 1998, while in-state registrations increased by only 3.7 percent, non-resident registration jumped by 71 percent (Reiling 1998). Vail (2002) estimates the annual impact of snowmobilers on the state economy to be between $150 million and $160 million, even after adjusting for the fact that a large portion of equipment expenditures are sent out of the state since no snowmobiles are manufactured in Maine.

The state's snowmobile clubs, of which there currently are 287, maintain about 95 percent of the trail network (Associated Press 2004).[224] They perform this work through financial support from member dues and through the state's Trail Grant Program, which covers approximately two-thirds of the costs of maintenance activities. The network length, however, has not been keeping pace with the growth in popularity of the sport. While the 1990's saw a 50 percent increase in snowmobile registrations, trail mileage expanded by just 22 percent (Vail 2002). In recognition of the snowmobile industry's importance to the state's winter economy, however, the state legislature recently approved a bill that would protect snowmobile clubs from liability in the case of rider injury. This bill, which passed both the state's House and Senate unanimously, arose out of concern from snowmobile clubs losing insurance coverage in the face of lawsuits, which could have led to a lack of maintenance of trails, threatening many communities which rely on the tourism income from snowmobilers (Associated Press 2004).

In a survey of state residents, 11.9 percent of those polled reported snowmobiling near home, and 6.4 percent away from home (ME DC 2003c). There is no anticipated federal nexus that would prevent the expansion of snowmobile trails on non-federal lands in the case of critical habitat designation for lynx. Additionally, considering that the LCAS already prevents the ***net*** expansion of trails in lynx habitat on Forest Service land, the only foreseeable cost to snowmobilers and the associated industry would be in the form of lost opportunities for expansion of ***gross*** mileage of trails, as was the case in Montana.

The only additional impact from CHD will depend on how much value snowmobilers forego due to the prevented opening of trails in new areas, and whether or not this restriction will diminish the number of snowmobilers who return to the area or the number of activity days they take part in. It seems reasonable to expect that a certain number of riders from outside the region will

[224] 121 of these clubs are headquartered either in our study area, or close enough that their members are likely to ride within the area.

decide not to return to ride on these federal lands in the near future if they know they will not have the opportunity to ride any different trails than on their previous visit, if they do have such opportunities elsewhere and if their expected utility from exploring such trails is higher than the continued use of Maine's trails. However, considering the small proportion of lands that are in federal ownership, it is not expected that the CHD restrictions will result in a noticeable number of visitors not returning to the region as a result of CHD. The high scenic attractiveness of the area and the abundance of trails, which will likely continue to increase though expansions on non-federal lands, make negative snowmobile visitation impacts unlikely. Moreover, it is conceivable that the CHD-related restrictions on development on federal lands in the study area and on non-federal lands coming under the anticipated TMDL nexus could, in fact, make the region more desirable to snowmobilers, despite the prevention of gross trail mileage increases.

While these impacts have the potential to either increase or decrease the numbers of snowmobile activity days in the area (compared to the BCS), the shift in either direction is likely to be relatively small and we predict the net effect to be negligible between 2003 and 2013.

Summer recreation

The most important consideration during the spring and summer months is to avoid disturbance of denning habitat in order to prevent the associated potential increase in mortality of lynx kittens (Ruediger et al. 2000). Some of the primary activities of concern in the summer months are hiking, camping, and use motorized off-road vehicles.

Hiking

While hiking is an activity that causes relatively little disturbance, thousands of visitors to an area each year can create significant cumulative effects in the form of trash and noise. Use of the trails by horseback riders also deteriorates the trails more rapidly and leads to problems of erosion and trampled vegetation. To avoid adverse modification, no new trails would be permitted on lynx habitat on federal lands. Such a restriction may cause costs in terms of lost utility to hikers, either in the form of reduced numbers of additional recreational hikers or of increased crowding of existing trails, if the popularity of hiking increases.

Maintaining an accurate inventory of trail mileage statewide is a difficult task due to changing land ownership and the frequency and length of partial or complete trail closings, as well as new trail mileage that is added. This task is particularly difficult in a state such as Maine where the land is predominantly under private ownership and trail construction or closures may not always be reported. Nevertheless, the Department of Conservation has estimated Maine's hiking trail mileage at approximately 2,417 miles. When bicycle and equestrian trails, often used by hikers, are added to this figure, the total trail mileage reaches 3,811. It is estimated that only 17.1 percent of these trails (650 miles) are on federal lands (ME DC 2003c).[225] Due to the fact that data collection for trail mileage on state and federal public lands is much easier than for private lands and because trail mileage on public lands is less likely to vary, it seems possible that the proportion of trails on private land has been underestimated, and those on public lands overestimated.

Using the same set of assumptions employed to estimate the impacts to cross-country skiing, we generate projections of the trail mileage that would be constructed without lynx CHD and an estimate of how much more crowding can be expected under CHD. We assume that the

[225] The Appalachian Trail alone makes up 281 of these miles.

participation rate will remain stable at 19.6 percent of state residents, as reported in the SCORP (ME DC 2003c). Due to the fact that data are not available on the percentage of non-resident participants, we follow the same assumptions made in the case of cross-country skiing and presume that the ratio of resident to non-resident participation is the same as it was in the Montana case, where it was three to one. These assumptions yield an estimated non-resident participation rate of 6.6 percent. Since the SCORP reports that 17.1 percent of non-motorized trails are located on federal land, and considering that 54 percent of federal lands in the state are in the proposed designation area, we assume that 9.2 percent of hiking in the state takes place on federal lands in the area. In the absence of any more detailed data, we assume here, once more, that hiking is approximately evenly distributed across all the trails of Maine. Again, we assume that visitation to Maine increases proportionally with the U.S. population.

Once again, the figures calculated above translate differently into numbers of resident participants and non-resident participants. For residents, the proportions of hikers were calculated from the state population, based on reported rates of participation, ensuring that there is no double counting and that the number derived is that of participants. For non-residents, however, the SCORP only provides us with the number of *visits* to the state, not *visitors*, therefore it is likely that a great deal of these visits are from repeat visitors to the state. This distinction means that the figure calculated with the methodology in the previous paragraph represents activity days from non-residents, not numbers of participants.[226] In order to estimate the number of participant non-residents, we assume that non-residents participate in hiking at one-quarter the frequency of residents in the northern U.S., as reported by Cordell et al. (1997), or four times per year.

As an upper-bound estimate of impacts, we assume, as we did in the case of cross-country ski trails, that mileage of trails over the next ten years will increase proportionally to the total number of participants. Based on the assumptions stated above, we estimate that an average of three new miles of trail would be constructed each year in the absence of CHD on federal lands as the number of participants rises with the state and national populations, for a total of 30 miles in ten years. Under the restrictions of CHD, no new trails could be constructed on these lands. Based on our assumptions, this would lead to an increase in average hiker density from 172 hikers per year per mile of trail in the year 2013 in the absence of CHD to 185 per mile with CHD, or 7.6 percent.

For a lower-bound estimate we again assume that trail growth will not keep pace with the increase in the population of participants over the next ten years, but instead will grow at half the rate of the upper-bound estimate. Under that scenario, an estimated 15 new miles of trail would be constructed in the next ten years in the absence of CHD, resulting in an average density of hikers of 181 per year per mile of trail in 2013 in the absence of CHD. With designation, the lower-bound scenario would result in an increase to 185 hikers per mile per year, or 2.2 percent more than in the BCS. Table IV.3.c-6 presents the upper and lower bound impacts of CHD on hiking trails and hikers. These numbers assume that land managing entities attempt to have trail construction approved every year in the upper-bound case, and every third year in the lower-bound. This, perhaps, overstates the costs of consultations due to CHD, as it is more likely that land managers will become aware of the restrictions on new trail construction and cease to expend resources on consultations. Consultations may also be required, however, on activities designed to maintain existing trails. For our upper-bound estimates we assume that trail maintenance planning activities will occur annually and that consultations for 2004 have already

[226] This distinction was not made in the Montana case study due to the remoteness of the study area from out-of-state population centers, making it less likely that a significant portion of visits were from repeat visitors in the same year.

taken place and will have to be re-initiated. The lower-bound estimates that maintenance planning will occur every three years.

Table IV.3.c-6: Upper and lower-bound CHD impact estimates on non-motorized trails

Impacts	*Miles of new trail prevented*	*Density increase*	*Consultations[1]* increased effort	re-initiation
Upper-bound	30	7.6%	30	3
Lower-bound	15	2.2%	9	-

[1]Assumes one consultation per NF, NP, and NWR unit per year in the upper-bound, and every third year in the lower.

Camping

There are approximately 42 thousand campsites throughout Maine, ranging from primitive tent sites with no amenities to sites equipped for RVs with full utility hookups. Ninety-two percent of these are on private land. Camper nights increased by 18 percent from 1993 to 2001, from 208,000 to 245,000, rebounding from a 26 percent decrease in the period 1985 to 1993. Three-quarters of these nights were spent at inland campgrounds, although not necessarily within our study area. Camping nights also increased across the NMW lands, by 50 percent from 1993 to 2001. As mentioned earlier, however, this increase is partly due to the fact that the size of the lands managed by NMW increased by 25 percent in 1999 when it incorporated the 700,000 acres Ragmuff-Seboomook forest in its recreation management (ME DC 2003c).

It is estimated that 20.6 percent of residents take part in primitive camping, while 26.7 percent enjoy developed camping (ME DC 2003c). Developed camping is defined as camping at sites with running water, flush toilets, picnic tables, and grills. Primitive camping occurs at sites with outhouses, "rustic" picnic tables, fire rings, and no running water.[227] Considering that almost none (0.03 percent) of the vehicle campsites are located on federal lands, and that participation numbers for tent and RV campers are reported separately, we only consider costs associated with tent camping. We assume that the participation rate of 20.6 percent for primitive camping reflects the proportion of participants engaging in tent camping. Making the same assumptions about non-resident participation rates we make in the cross-country skiing and hiking sections, we again assume that the ratio of resident to non-resident participation rates is the same as in Montana (18 percent vs. 3.6 percent) for tent camping. This assumption results in an estimated non-resident participation rate in tent camping of 4.1 percent.

The SCORP indicates that approximately 4.5 percent of campground tent spaces (1,195 tent spaces) are located on federal lands statewide. If we assume that these sites are distributed roughly evenly across federal lands and that all tent campsites are utilized roughly equally, then, due to the fact that 54 percent of federal lands in the state are in our study area, we estimate that 2.4 percent of all tent camping in the state takes place on these federal lands in our study area.

As in the case of the other recreation activities, figures calculated above translate differently into numbers of resident participants and non-resident participants. For residents, we calculate the proportions of campers from the state population, based on reported rates of participation, ensuring that there is no double counting and that the number derived is that of participants. For

[227] These terms are not specifically defined in the SCORP but were clarified through personal communication with Cindy Bastey of the Maine Bureau of Parks and Lands.

non-residents, however, the SCORP only gives the number of *visits* to the state, not the number of *visitors*, and it is likely that a share of these visits are made by repeat visitors to the state. This means that the estimated number of non-resident campers, if calculated using the methodology in the previous paragraph, represents activity days from non-residents, not numbers of participants.[228] In order to estimate the number of participant non-residents, we assume that non-residents participate in camping at one-quarter the frequency of residents in the northern U.S., as reported by Cordell et al. (1997), or two times per year.

Based on the assumptions we used in the cross-country skiing and hiking sections above, we estimate that, as an upper-bound, in the absence of CHD a total of 56 spaces would be developed in ten years on federal lands. The lower-bound scenario anticipates growth at half this rate in the absence of CHD, or a total of 28 new sites over ten years.

As with other activities, if expansion of facilities is proscribed, then increased crowding is likely to occur. The above-mentioned assumptions for the upper-bound scenario lead us to expect that the average number of campers per site per year at tent sites would increase by 6.9 percent over the time period analyzed, from an average of 29 campers per site in 2013 without CHD, to 31 with CHD. Our lower-bound estimate puts average visitor density at campsites at 30 in 2013 in the absence of CHD, in which case designation would increase camper density by 3.3 percent. Given that the number of campsites assumed to be prevented by CHD amounts to only a negligible percentage of all campsites in Maine, any potential increases in crowding on federal lands could lead to substitution effects that would reallocate visitation from increasingly crowded to other sites, thereby effectively preventing any increases in crowding. Nevertheless, we assume here that such substitution would not occur.

Consultation costs would only arise when maintenance plans need to be approved at campsites or if new campsite construction or site expansions are proposed. While it is likely that managers would not expend resources on consultations from proposing new campsite development once they become aware of the restrictions from CHD, we assume here, to err on the conservative side, that new sites will be proposed each year in the upper-bound scenario, and every third year in the lower-bound. We assume the same maintenance schedules for the upper and lower-bound estimates as we did for hiking trails. Table IV.3.c-7 illustrates the estimated total impacts of lynx CHD on camping. We assume that site construction plans are subject to consultations each year in the upper-bound scenario and every third year in the lower-bound scenario, and that 2004's consultations will have to be re-initiated in the upper-bound but not in the lower-bound case.

Table IV.3.c-7: Upper and lower-bound CHD impact estimates on camping

Impacts	*New campsites prevented*	*Density increase*	*Consultations[1] increased effort*	*Consultations[1] re-initiated*
Upper-bound	56	6.9%	20	2
Lower-bound	28	3.3%	6	-

Note: [1]Assumes one consultation per NF, and NP units per year in the upper-bound, and every third year in the lower.

[228] This distinction was not made in the Montana case study due to the remoteness of that study area from out-of-state population centers, which make it less likely that a significant portion of visits were from repeat visitors in the same year.

We further assume that since the Maine side of Lake Umbagog National Wildlife Refuge does not currently contain any campsites, it will not seek to develop any in the next ten years as the area of the refuge is largely occupied by the lake.

ATVs (OHVs)

Like snowmobiling, ATV riding is a sport that has gained a great deal of popularity in recent years. Between 1993 and 2001, the number of registered vehicles grew 109 percent to almost 55,000 (ME DC 2003c), with retail sales of ATVs reaching approaching 10,000 per year. Growth of trail mileage to support this expanding sport, however, has not kept pace with the numbers of participants. There are less than 2,500 miles of ATV trails statewide, compared to nearly 13,000 miles of snowmobile trail, and concern has been growing over issues of crowding and the continued support of private landowners in the face of trail degradation and increasing problems with trespassing (ME ATV Task Force 2003). In response to these concerns, the Governor of Maine formed an ATV task force to attempt to address these issues, to find ways to increase the safety,[229] increase community support, and address environmental concerns (ME DC 2003c).

In mid-December of 2003 the task force submitted its recommendations to the Governor. The committee concluded that irresponsible use of ATVs through trespassing, digging up land, and polluting streams is driving an increasing number of private landowners to ban not only ATVs from their land, but all recreational uses. This abuse of privileges is causing a burden not only to landowners who must repair damage to their land and attempt to keep irresponsible riders out, but also to the largely recreation-based economy of northern Maine. Among their many recommended solutions, the task force suggested increased legal protections for landowners, a higher level of ATV law enforcement, and stiffer penalties for illegal operation of ATVs (ME ATV Task Force 2003).

The task force concluded that ATV riders are willing to travel an average of 20 miles to reach trails and that they require a trail at least 25 miles long to attract them. Based on these statistics and the growing popularity of ATVs, the task force concluded that a 7,000 mile trail system is needed, an increase of 4,500 miles, with a priority on connecting trails and creating loops. It called for the construction of 1,000 new miles per year, which would cost, on average, $670 per mile for construction and about $262 annually per mile for maintenance. Accompanying this recommendation is a call to research landowner incentive programs to increase the land available for trail expansion (ME ATV Task Force 2003).

While ATV riding is a popular and widespread outdoor activity in Maine, we do not expect it to be affected by CHD for the lynx. ATV trails and riding can be detrimental to lynx habitat; however once again, there does not appear to be any nexus that could impose restrictions on riding on non-federal lands. On the other hand, ATVs are not permitted in the White Mountain National Forest, on the Appalachian Trail, or in the Lake Umbagog National Wildlife Refuge. Since we have no reason to assume that ATVs will be permitted in these areas in the next ten years, we can conclude that there would be no trail construction for this activity with or without critical habitat designation.

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[229] Since 1993 there have been 2,241 reported injuries from ATVs, with 35 fatalities. 2002 saw a record number of reported injuries (327) with a near record number of fatalities (6). Half of the drivers in all crashes since 1993 were under the age of 20. Additionally, between 1998 and 2000, only 27 reported accidents occurred on ATV trails, and 1,176 occurred off marked trails (ME ATV Task Force 2003).

Whitewater rafting (bases)

Whitewater rafting started to become popular in northern Maine in the 1970's and '80's and continues to grow today. While the impacts this activity has on lynx habitat may not be widespread, there are areas that could be of potential concern due to concentrated use. Whitewater rafting trips launch from established bases which, on busy weekends, cater to more than 150 people. This high level of use leads to traffic problems, and elevated levels of waste and sewage which are higher and more concentrated than for other activities, with the exception of downhill skiing (ME LURC 1997). Establishment of these bases may also lead to expanded roadways. The majority of commercial rafting takes place on the Kennebec, Penobscot, and Dead rivers, with 65 percent of all commercial participants in Maine rafting on the Kennebec. Allocations of permitted passengers are made to outfitter guides to limit the traffic on these rivers, but the rate of participation is still exhibiting growth within these limits, increasing from 60,000 to 91,000 participants between 1993 and 2001 (ME DOC 2003c).

Due to the fact that a large number of rafting companies are already established, and that caps on numbers of passengers are in place, we do not anticipate that any restrictions from CHD would impact this activity. However, if the sport continues to grow and rafting companies decide to expand their bases in size and/or number it is possible that new restrictions could take effect due to CHD. Once again, these restrictions would only block development of bases on federal lands, and even in a scenario of rapidly expanding popularity, it is not likely that CHD would have any impacts.

Total impacts on recreation

The total impacts on recreational activities in the study area are outlined in Table IV.3.c-8. No impacts are expected on alpine skiing, and impacts on cross-country skiing, hiking, and camping

Table IV.3.c-8: Estimated upper and lower-bound impacts of lynx CHD on recreation in Maine

	Impacts	
	Upper-bound	*Lower-bound*
Downhill ski projects		
prevented	0	0
delayed	0	0
modified	0	0
Foregone mi. of new trail		
cross-country ski	5	2.5
hiking	30	15
User/mileage increase		
cross-country ski	6.4%	2.5%
hiking	7.6%	2.2%
Foregone new campsites	56	28
Users/site increase		
tent	6.9%	3.3%
Consultations		
increased effort	60	19
reinitiation	7	0

are expected to be very small, consisting only in single-digit increases in crowding for the each of the three activities. In addition, we anticipate that CHD for the lynx would result in a total of 19 to 60 additional and increased effort consultations, and between zero and seven reinitiated consultations.

Grazing

As previously noted, agriculture, as a whole, occupies only a relatively small portion of land in the state as a whole. Livestock grazing in Maine is confined almost completely to pasturelands. These lands do not constitute critical lynx habitat and in 1997 accounted for only 2.3 percent of all farmland in Maine, the vast majority of which lying outside of the proposed designation area. Between 1992 and 1997, cattle numbers in the study area increased three percent to 49,704, while sheep decreased 18.5 percent to 3,652.[230] While CHD would prevent the increase of livestock pastures and their stocking rates in CH areas with a federal nexus, it appears unlikely that grazing activity would spread across such lands in the absence of CHD, considering what small land areas are federally owned or have a nexus that could impact grazing. Therefore, we anticipate no impacts on this sector from CHD.

Wildfire management

2002 and 2003 have seen sharp increases in federally-sponsored hazardous fuel reduction activities on non-federal lands in Maine. Estimated 2003 expenditures on hazardous fuel suppression projects were $1.9 million, up by more than three and a half-fold from $409 thousand in 2002 (USDI and USDA 2003a), and by more than two-fold from $608 thousand in 2001 (USDA and USDI 2002). Despite these fluctuations in total outlays for hazardous fuel treatments in Maine, the information on the breakdown of activities between Wildland Urban Interface (WUI) and non-WUI treatments shows that the latter have been consistently increasing (see Table IV.3.c-9).

In 2002, non-WUI treatments accounted for almost 90 percent of total USDI and USDA hazardous fuel treatment project acreage (but only for 46 percent of total federal outlays for hazardous fuel treatments, see USDA and USDI 2003). In 2003, hazardous fuel treatments were planned on approximately 1,800 acres in Maine, half of which in WUI areas (USDI and USDA 2003a).

Table IV.3.c-9: Acreage of Federally-funded non-WUI hazardous fuel treatments in Maine, 2001-2003

	2001	2002	2003
Non-WUI treatments	60	480	900 *

Notes: Projects funded and/or carried out by USDI and USDA. * Expected.
Sources: USDA and USDI 2002, 2003; USDI and USDA 2003a.

The acreages shown in Table IV.3.c-9 are for projects funded by the USDI and USDA. Some of these projects may be carried out by state agencies. For example, the ME FS expects to treat approximately 400 aces in 2004, with an average treatment size of less than 20 acres.[231] We

[230] From the 1997 Census of Agriculture Highlights posted on the New England Agricultural Statistics Service website: ***http://www.nass.usda.gov/nh/***
[231] Personal communication with Bill Williams of the ME FS, April 12 2004.

assume that all of the ME FS fuel treatment projects with federal (USDI, USDA) involvement are included in the National Fire Plan reports that provide the basis for the treatment estimates in Table IV.3.c-9. Since only projects with federal involvement are relevant for our analysis (because of the federal nexus they establish), we base our treatment projections on USDA and USDI data. In the absence of information on the size of future treatments of federally-linked non-WUI projects in Maine, we construct two scenarios. Both are based on an expected doubling between 2004 and 2013 of the total non-WUI area treated per year.[232] In the low impact scenario, we assume that annual quantity of acres treated will be equal to the 2002 level (480 acres) in 2004, and will double by 2013, the end of our projection period. This translates into an estimated average increase of treated area by 53 acres per year. In the high impact scenario, we assume that the total non-WUI area treated in 2004 is equal to the expected total of 2003 treatments (900 acres; see Table IV.3.c-9), that it will also double until 2013, implying an increase in average annual treatment area by 100 acres.

We convert total annual area treated into total number of treatment projects assuming an average size of hazardous fuel reduction projects in Maine of 15 acres. In the lower-bound impact estimate, 480 acres of total area treated in 2004 would translate into 32 treatments, rising to 64 in 2013. In the upper-bound impact estimate, 900 acres treated would translate into 60 treatments in 2004, increasing to 120 in 2013. These projects include future FS projects on which specific information is available, such as 49 hazardous fuel treatments planned for the next five years in the Maine part of the White Mountain National Forest (USDA FS 2003g).[233]

Clearly, not all of the treatments would require individual consultations. Rather, because of the relatively small total acreage treated in a given year, we assume in the lower-bound impact scenario that there will be one consultation on non-WUI fuel reduction projects per year in the first five years, and two per year in the last five years. This takes into account the expected doubling of total treatment area during the projection period. In the upper-bound impact scenario, we assume twice that volume of consultations. This would result in a total of 15 and 30 consultations over 2004-2013 in the lower-bound and upper-bound impact scenarios, respectively.

In addition, the NPS' Appalachian Trail Park Office (NPS-ATPO) is developing a Fire Management Plan and Environmental Assessment that evaluates full suppression of wildland fires (but not the use of prescribed fire or mechanical thinning for management purposes) (USDI NPS, Appalachian Trail Park Office 2003). The final draft FMP/EA is expected to be completed by May 2004; hence, consultations on the draft probably were ongoing or completed in December of 2003, the hypothetical date of lynx CHD considered in this analysis, and therefore we assume that they have to be reinitiated due to CHD.

Since the passage of H.R. 1904 (the "Healthy Forests Initiative") hazardous fuel treatments with a federal nexus are no longer required to undergo consultation with the FWS. To what extent and within what time frame this change in consultation requirements will impact actual consultation activity on such projects is difficult to assess. We assume in both of our impact estimates that consultations will continue to occur on all hazardous fuel treatments. This assumption clearly

[232] See foregoing footnote.
[233] Seven sites in the Saco Ranger District and 42 sites in the Androscoggin RD, ranging from 1 to 40 acres. (*http://www.fs.fed.us/r9/white/projects/assessments/fuels_projects/Forest-wide%20spreadsheets-6-6-03.xls*)

will tend to bias our impact estimates upward.[234] We assume therefore that all consultations would be increased-effort consultations, except for the NPS-ATPO's FMP/EA, which would be a reinitiated consultation. All are assumed to be of a high-effort nature (see Table IV.3.c-10).

Since hazardous fuel treatments do not by design have a detrimental impact on lynx, we assume that none of the BCS projects will be prevented, although some may need to be modified from BCS designs. Since such modifications are likely to be minor (e.g., no removal of large woody debris or down logs) and the designs for most projects in our projection period in all likelihood have not been developed yet, we assume that project modification costs are negligible.

Table IV.3.c-10: Impacts of CHD on hazardous fuel treatment in non-WUI areas in Maine

	Hazardous fuel treatments			*Consultations*	
Impacts	*prevented* [1]	*delayed* [2]	*modified* [3]	*increased effort*	*reinitiation*
Upper-bound	-	-	some	30	1
Lower-bound	-	-	some	15	1

Residential development

Over the last three decades, the proposed lynx CHD designation area in Maine has experienced residential development in many scenic locations, particularly on lakefronts. This development has resulted in increased subdivision activity and housing construction, especially in Maine's western and central mountain areas, which account for a substantial part of the proposed designation area (ME LURC 1997). This trend in housing construction is masked by aggregate, LURC jurisdiction-level population figures, which show a decrease over the last decade and a half that is mostly due to a dramatic population decline in Maine's largest county, Aroostook. It is masked further by a compositional change in the stock of new housing, which shows a relative increase in rural housing construction compared to housing construction in towns or plantations.[235]

The increasing trend of parceling up large landholdings into smaller lots that subsequently are prone to residential development is seen as endangering, in the long run, large-scale commercial forestry, ecological diversity, and recreation in a remote setting (ME LURC 1997). LURC is actively seeking to control these trends through legislative changes (ME LURC 1997:36):

> Development which commits land irrevocably to other [than forestry and compatible recreational activities and agricultural activities] uses and detracts from the forest resource will be directed to locations where it will not significantly affect this valuable economic and recreational resource" (ME LURC 1997:36).

LURC's goal regarding housing development, as relevant to lynx, is spelled out in its revised Comprehensive Land Use Plan of 1997: to prevent sprawl of residential development into non-incorporated areas, and to direct growth to towns best suited to accommodate it (ME LURC

[234] It should be noted that federal land management agencies are still required to abide by the jeopardy and no adverse modification provisions of section 7 of the ESA. In other words, actions that would result in jeopardy or adverse modification to listed species will continue to be illegal.
[235] Plantations are a form of local government in Maine that lack some of the powers granted to towns.

1997:135). The ancillary benefit of such redirection of future development is that the discouraging of sprawl also "keeps the cost of providing public services, facilities and utilities as low as possible" (ME LURC 1997:115). This is an important concern in the jurisdictions, as the cost of public services and facilities associated with residential development usually more than offsets increased tax revenues from development in unincorporated areas (ME LURC 1997:119).

However, the impact of this policy will only occur over time, and is not yet evidenced in the latest available construction figures (1999 to March 2000).

In the most recent period, aggregate population in the counties in which the proposed lynx critical habitat area is located shows a decline of about three percent during the period 1990-2001, with decreases in three counties (Aroostook, Penobscot, and Piscataquis) outweighing increases in the other three (Franklin, Oxford, and Somerset) (see Table IV.3.c-11). This trend diverges from the population of Maine as a whole, which shows an increase of about five percent over the same period.

Table IV.3.c-11: Recent population trends in the Maine counties in the proposed lynx CHD area

County	*Aroostook*	*Franklin*	*Oxford*	*Penobscot*	*Piscataquis*	*Somerset*	*all six counties*	*MAINE Total*
POP 2001	73,140	29,586	55,378	145,385	17,177	51,014	371,680	1,286,670
POP 1990	86,986	29,003	52,598	146,531	18,653	49,744	383,515	1,228,250
Δ90-01	-16%	2%	5%	-0.8%	-8%	3%	-3.1%	4.8%

Notes: POP - population; Δ - change.
Sources: U.S. Census Bureau, *State and County Quick Facts*, at: *http://www.maine.gov/portal/facts_history/ stats_population.html#uscb*, accessed Mar. 2004.

Estimates of the future population in the six counties over the time period analyzed in this study shows that the recent trend of overall decrease will reverse itself. By 2015, the population of the six counties is expected to surpass its 1990 level (see Table IV.3.c-12). The strongest population increases are projected for the counties in Maine's western mountain region (Franklin, Oxford, and Somerset), in which populations even increased during the 1990-2001 period (see Table IV.3.c-11). Not surprisingly, that area has also absorbed a disproportionately high share of the housing development in LURC's jurisdiction over the last decades. Between 1971 and 1991, the Western Mountain region absorbed 45 percent of all new residences in the jurisdiction (ME LURC 1997:102).

Table IV.3.c-12: Population trends in the Maine counties in proposed lynx CHD area

County	*Aroostook*	*Franklin*	*Oxford*	*Penobscot*	*Piscataquis*	*Somerset*	*all six counties*	*MAINE Total*
POP 2015	74,209	30,969	58,729	150,050	16,626	53,812	384,395	1,377,128
POP 2000	74,283	29,435	54,951	145,446	17,353	51,097	372,565	1,278,670
Δ00-15	-0.1%	5.2%	6.9%	3.2%	-4.2%	5.3%	3.2%	7.7%

Source: Maine State Planning Office (2001a).

Housing construction activity in the counties in which the proposed lynx critical habitat area is located predominantly occurs in towns and plantations. The average annual construction activity in the counties is shown in Table IV.3.c-13 for each county as a whole, and for the unincorporated areas in each county outside of towns and plantations; for the period 1990-1998, and for the most recent period available, 1999 till March 2000. Housing construction outside of towns and plantations is calculated as the difference between total housing construction in a county and the housing construction in towns and plantations in the county. The distinction between construction activity in towns or plantations on the one hand and outside of these areas is useful because construction outside of settlements has a higher likelihood of adversely affecting lynx habitat.

Table IV.3.c-13: Recent construction activity in Maine counties in the proposed lynx CHD area, total and outside of towns and plantations

	Aroostook		*Franklin*		*Oxford*		*Penobscot*		*Piscataquis*		*Somerset*	
	total	rural	total	rural	total	rural	total	rural	total	rural	total	rural
1999-March 2000	514	130	524	75	817	22	834	162	461	84	437	48
1990-1998 avg/yr	417	87	277	17	485	11	929	220	176	36	495	45

	All above counties combined, excluding Penobscot [1]	
	total	rural
1999-March 2000 (1)	2,753	359
1990-1998 avg/yr (2)	1,850	195
increase (1) over (2)	48.8%	84.4%

Notes: avg - average; yr - year. "Rural" refers to housing construction outside of towns and plantations, while "total" includes construction in rural areas and in towns and plantations. [1] Only a small area in the northwest of Penobscot County falls into the proposed lynx CHD area. Therefore, we do not include the Penobscot County data in our projections of housing construction trends.
Source: Maine Census Data Program. 2002. Table DP-4. Profile of Selected Housing Characteristics: 2000. Column P - Year Structure Built: Total Housing Units.
http://www.state.me.us/spo/economics/census/docs/prof1_4datame.xls, accessed Feb. 2004.

As Table IV.3.c-13 shows, all counties in the proposed lynx critical habitat area except Penobscot County show higher construction activity in unincorporated areas in the 1999-March 2000 period than in the average year during the period 1990-1998. Since the former period covers more than one full year, however, the numbers are not strictly comparable. Nevertheless, the numbers show an apparent relative increase in rural construction activity during the most recent period (1999 to March 2000) compared to the average during 1990-1998: while total housing construction in the period 1999-March 2000 in towns and plantations increased by 44.6 percent over the 1990-1998 average, construction outside of towns and plantations increased by over 84 percent. It is unlikely that there was a sudden jump in rural construction activity in the later period; rather, the number of average annual rural housing construction during 1990-1998 is likely to mask an increasing share of rural housing construction in total housing construction in the respective counties. This interpretation of the data is consistent with LURC's (1997) concern about increasing construction activity outside of existing settlements.

No official estimates exist of future housing construction activity in rural areas of the counties in which the proposed lynx CHD area is located. Projections of changes in the stock of occupied housing exist only for municipalities (towns and plantations) (see Table IV.3.c-14), but they are not useful as a trend indicator for rural construction, for two reasons. First, because of the observed and ongoing change in the urban-rural division of the population in many of Maine's northwestern counties, growth trends in municipalities and non-incorporated areas diverge. Secondly, basing estimates of construction activity on changes in occupied housing stock would lead to underestimation of construction, because temporary or permanent abandonment and deconstruction of housing units decrease the existing stock of occupied units, so that interannual changes in the stock of occupied units are not solely the result of construction activity. This is evidenced by the fact that the number for occupied housing units in the counties is below the number of total housing units (Maine Census Data Program 2002), and is further confirmed by the existence of a large stock of permanently or seasonally vacant units (Maine State Planning Office 2003c).

Table IV.3.c-14: Estimated change in stock of occupied municipal housing units, 2003-2013

	Aroostook	*Franklin*	*Oxford*	*Penobscot*	*Piscataquis*	*Somerset*	*Total*
stock increase 2004-2013	8.1%	9.8%	10.1%	6.3%	6.8%	9.3%	9.1% [1]
stock increase 2004-2013	2,291	1,053	2,161	3,464	466	1,799	12,391

Notes: [1] Total for all six counties combined (i.e., weighted average).
Source: Maine State Planning Office (2003a).

For these reasons, we use the recent historic housing construction activity in rural areas as the basis of our projections of housing construction activity during the period 2004-2013. Since the TMDL nexus will only affect areas around selected waterbodies in the proposed lynx CHD area, or more specifically, housing developments in the drainage basins of selected lakes and their feeding streams, only a subset of total rural housing development will be impacted by lynx CHD. To develop a quantitative estimate of this subset, information on the distribution of new housing development in rural areas is needed.

According to ME LURC (1997:102), new development has gravitated toward shorelines. 43 percent of all permits for new residences since the 1980s were for properties located on waterbodies, mostly lakes, and roughly 73 percent of approved subdivision lots were located on a waterbody.

In our projections of future housing construction activity in the proposed lynx CHD area, we use the first number (43 percent) as our lower-bound value for the share of construction in the rural areas of the counties that will be in the vicinity of water bodies, and the second (73 percent) as the upper bound.

However, not all lakes in the proposed lynx CHD area will have TMDL plans developed. Only 15 lakes situated in that area are expected to have TMDL plans (see Table IV.3.a.ii-1). Most of these lakes have experienced some housing development, all of them are likely to be developed further, based upon issued permits for subdivision development and building units (see ME LURC 1997:103-104), and for all of them housing development has been identified as a concern in their TMDL plans (see Table IV.3.a.ii-1). Nevertheless, the lakes on the TMDL list are not the only ones along which building permits have been issued (see ME LURC 1997:103). Based on the historic permit record (ME LURC 1997:103), it appears that between 25 and 35 percent of the permits issued for housing development have been in areas along the TMDL-list lakes in the proposed CHD area.

Our lower-bound impact scenario then contains the following assumptions: 1) during the projection period, rural housing construction activity in the counties with proposed lynx critical habitat will continue at its average rate during the period 1990-1998; 2) 43 percent of all future rural housing development in the proposed lynx CHD area will occur in the vicinity of lakes; 3) the lakes with TMDL nexus account for 25 percent of all rural construction activity in the vicinity of lakes.

Our upper-bound scenario assumes that 1) during the projection period, rural housing construction activity in the counties with proposed lynx critical habitat will continue at the same rate as during the period 1999 - March 2000; 2) 73 percent of all future rural housing development in the proposed lynx CHD area will occur in the vicinity of lakes; and that 3) the lakes with TMDL nexus account for 35 percent of all such construction.

Both scenarios assume that four out of the 15 TMDL lakes in the proposed CHD area will have nexus-related lynx conservation measures implemented from 2009 on, and that the remainder will have them implemented from 2012 on. 2009 and 2012, respectively, are the years following the periods during which TMDL plans for the lakes have to be approved (see Table IV.3.c-15). Only those construction projects along the respective lakes after these dates will be affected by nexus-related lynx conservation measures.

Table IV.3.c-15: Completion dates of TMDL plans for lakes in proposed lynx CHD area, Maine

TMDL plan completion period	*Waterbody*
2003-2008	Flagstaff Lake, Lower and Upper Richardson Lakes, East Pond
2008-2011	Aziscohos Lake, Black Lake, Brassua Lake, Canada Falls Lake, Caucogomuc Lake, Cross Lake, Daigle Pond, Fitzgerald Pond, Madawaska Lake, Seboomook Lake, Toothaker Pond

Source: ME DEP (1998c).

Based on these scenario assumptions, the lower and upper bound estimates of the number of rural housing constructions projects potentially affected by lynx CHD in Maine is 59 and 256, respectively (see Table IV.3.c-16). The small number of projects affected prior to 2012 is due to the fact that only four of the 15 lakes with TMDL nexus are expected to have their TMDL plans completed before 2012.

Table IV.3.c-16: Estimated number of rural housing construction projects in proposed Maine lynx CHD area with TMDL nexus

Scenario	*Number of housing units carrying a federal nexus*		
	2009-2011, per year	2012-2013, per year	*Total, 2009-2013*
LOW	6	21	59 [1]
HIGH	24	92	257 [1]

Notes: [1] Total may not add up due to rounding of annual figures.
Source: Scenario assumptions described in text; Table IV.3.c-13.

The LOW and HIGH scenarios represent the estimated range of possible incremental impacts of lynx CHD in the proposed designation area on the local housing sector. In addition, under CHD the housing projects will have to undergo consultations, and possibly modifications from the original designs that would have been realized in the absence of lynx CHD. Delays however are unlikely, as the time at which the federal nexus is established is still at least 5 years into the future, so that, given appropriate timely action, delays can be avoided.

We develop two scenarios for the estimation of the actual impacts of CHD on housing projects. These scenarios allow taking into account not only the uncertainty that exists with respect to the estimated numbers of housing projects that will be subject to a CHD nexus (shown in Table IV.3.c-16), but also uncertainty associated with the actual impacts that CHD may have on individual projects. These potential impacts range from no modification to changes in project design to prevention of the project, depending on whether or not a specific project is judged to reduce the quantity or quality of lynx habitat in the designation area. The answer to the latter question depends on the type of habitat that the project would be located on: Tier-1, Tier-2, or Tier-3.[236]

The restrictions deemed justified under the no adverse modification standard (see Table IV.3.a.ii-5) would prevent any new construction in Tier-1 habitat (denning and foraging), but not in Tier- 2 or -3 habitat that is used primarily for dispersal and movement between Tier-1 habitat blocks. On some properties where Tier-2 or -3 habitats are dominant, low-density residential construction would therefore be possible under certain conditions. These are the relocation of any planned construction in Tier-1 habitat to selected areas of Tier-2 or -3 habitat; strict limitations to changes in the property's vegetation; and refraining from construction of structures that would inhibit lynx travel, such as long fences or other barriers.

Development of parcels completely covered by Tier-1 habitat however would be precluded. Construction that would have occurred on such parcels is expected to relocate to adjacent areas where it would be permitted (i.e., areas outside of lynx habitat or parcels with suitable Tier-2 or -3 habitat), or to relocate to outside of the study area. Analysis of aerial photographs of the drainage areas of the waterbodies that carry a TMDL nexus for residential development shows that many of these areas are not entirely in Tier-1 habitat. This suggests that in many cases, there may exist the possibility of avoiding adverse modification through appropriate project modifications.[237] However, since the location of property boundaries is not visible on aerial photographs, it is impossible to assess the share of potentially developable properties that has Tier-2 and/or Tier-3 habitat, or the size(s) of the latter habitats on given properties.

We develop two cases to deal with the uncertainty in the share of developable properties with sufficient non-Tier-1 areas.[238] These assume that 30 and 50 percent, respectively, of the properties in the TMDL nexus areas that are expected to be developed have sufficiently large areas of contiguous non-Tier-1 areas to accommodate the BCS construction activities without modifications of the overall project design, or with some modifications, while the remainder of projects would be prevented in their BCS properties. Combining these cases with the construction estimates from Table IV.3.c-16 yields lower-bound and upper-bound estimates of construction impacts of CHD.

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[236] For a description of the habitat types please refer to section IV.2 of the Montana case study.
[237] Aerial photographs obtained from Terraserver (*http://www.terraserver.microsoft.com/*) and MEGIS, the Maine Office of GIS (*http://apollo.ogis.state.me.us/*).
[238] The procedure employed differs from that used in the Montana case study, where, at least for the county dominating total construction volume in the proposed CHD area, estimates of construction sites in lynx habitat could be based on overlaying vegetation maps and aerial photographs with actual construction maps.

In the lower-bound impact scenario under narrow spatial boundaries (i.e., comprising the six study area counties only), 70 percent of hypothetical (BCS) residential units that would be constructed between 2009 and 2012 are assumed to be displaced from properties because of insufficient quantities of contiguous non-Tier-1 habitat (which are assumed to account for 20 percent of all properties that would be developed in the BCS) or because prospective developers refuse to accept making these modifications. Since there is a sufficient number of nexus-free developable properties available in the proposed designation area to absorb these displaced projects, and since, in addition, there are large comparably-attractive areas outside of the proposed CHD area but still within the six counties in which the CHD area is located, and both inside and outside of the LURC jurisdiction, it is assumed that no units leave the six-county area.[239] Of the remaining BCS projects, 2/3 are assumed to require modifications (changes in fences, alignment of structures, vegetation changes), and 1/3 can proceed without changes or can "relocate" on their BCS properties from Tier-1 to non-Tier-1 habitat without modifications of the project design.[240] Applying these shares of impacts to the low estimate of housing construction with a federal nexus (59 units) results in an estimated number of 41 units being prevented from construction in their BCS location, 12 units requiring modification, and six units proceeding unchanged, i.e., they "relocate" on-site (i.e., to non-Tier-1 areas on their respective properties) without modifications to the project design. All 59 units that would have been expected to be built in the BCS would require consultations.

The upper-bound impact scenario (narrow boundaries) assumes that 50 percent of BCS units are displaced from their hypothetical BCS locations to other areas within the study area counties outside of areas that carry a nexus (see Table IV.3.c-17). Of the remaining projects, 4/5 require modifications (changes in fences, alignment of structures, vegetation changes), and 1/5 can proceed unchanged or can "relocate" on their BCS properties from Tier-1 to non-Tier-1 habitat without modifications of the overall project design. Applying the rate of project modifications to the high estimate of housing construction with a federal nexus (257 units) results in an estimated number of 103 units requiring modification. All 257 units that would have been expected to be built in the BCS would require consultations. In both scenarios, project modification costs are assumed to be incurred for all projects that require modifications.

Table IV.3.c-17: Upper and lower-bound estimates of the impact of lynx CHD on residential construction activity in proposed lynx CHD area in Maine

	Units impacted by CHD, by impact			*Consultations*	
Impacts	*prevented* [1]	*delayed* [2]	*modified* [3]	*increased effort*	*reinitiation*
Upper-bound	129	-	103	257	0
Lower-bound	41	-	12	59	0

Notes: [1] Prevented projects relocate to outside of the nexus area, but are assumed to stay within CH designation area or counties in which the designation area is located. [2] No delays are anticipated, as CHD is assumed to occur five or more years before the nexus would become active. [3] Modified projects are those that relocate on-site.

It is important to point out that in both of the above scenarios it is presumed that developers are not aware of the potential restrictions on development in TMDL areas that may result from CHD

[239] Recall that only approximately half of the combined land area in the six counties is proposed for lynx CHD (see Table IV.2-1).

[240] "Relocate" is set in quotation marks because some developers may avoid locating projects into the TMDL area after the nexus comes into effect (supposing of course they are aware of the nexus and its implications).

for the lynx. In general, however, one may presume that at least some developers will be aware of this issue, in which case they could choose to simply place their projects in the vast nexus-free areas in the proposed designation area. Or, they could assess, based on the FWS' designation document, which properties in the TMDL nexus areas are unlikely to require project modifications, in which case the modification cost could be avoided. Such exposure-minimizing behavior is all the more likely as the nexus in the respective areas will only become effective in 2009 or 2012, respectively, leaving developers several years to find out about the nexus. If developers were to take the above strategies, modifications and/or consultations could in many cases be avoided. Hence, both above scenarios are likely to overestimate the impacts of CHD on the housing sector.

Since no displacement of construction activity to outside of the study area is expected, no distinction is needed between narrow (study area counties) and wide (national level) boundary impacts, because CHD does not lead to reduced economic activity in the local economy. The estimated costs and benefits associated with CHD impacts on the housing construction sector are presented in section IV.4.

Roads

Several planned construction projects on National Highway System (NHS) roads in the study area are likely to be subject to consultations with the Service, if the state uses funds from its NHS allotment for these projects. The only two NHS roads in the proposed lynx CHD area are U.S. Route 201 (Old Canada Road, a national scenic byway) and U.S. Route 2 west of Dixfield. Available information on the planned projects on these roads that indicates that a total of four could potentially require consultations with the Service (see Table IV.3.c-18). In addition, the NPS is the lead agency for a project on Maine Route 4 that will be carried out in 2004 or 2005, thereby establishing a federal nexus for that project (see Table IV.3.c-18).

Table IV.3.c-18: Planned road projects with a federal nexus in the proposed Maine lynx CHD area

Date on which project is/will be advertised	*Type of project*	*Relevant to lynx* [1]	*Project budget*
U.S. 201			
April 2004	Highway improvements	Likely	$ 3,402,500
October 2005	Highway improvements	Likely	$ 2,883,000
U.S. 2 (west of Dixfield)			
February 2004	Resurfacing of 8.4 miles	Possibly	$ 1,919,000
July 2008	Highway improvements	Likely	$ 425,000
Maine Route 4			
Site review conducted July 2003	Relocate and upgrade 3-mile section	Likely	n.a.

Notes: [1] Depends on actual project design. n.a. - not available
Source: ME DOT at *http://www.state.me.us/mdot/contractor-consultant-information/rfp-rfq/advertise-date.php (accessed Feb. 2004);* NPS Appalachian Trail Office at *http://data2.itc.nps.gov/parks/appa/ppdocuments/810%20EA%20schedule%20final%2011%2003.doc* (accessed Mar. 2004).

Whether or not a particular project requires consultations and potential modifications depends on the specific project design. Since resurfacing of roads does not change the actual dimensions of the road or its ancillary structures, if any, and since it does not imply removal of roadside vegetation, one of the projects on Route 2 would not be expected to require modifications. The remaining four projects however, would seem to have the potential to adversely modify lynx habitat. All projects that adversely modify habitat quality for lynx or that destroy lynx habitat require consultations. Adverse modification includes removal of roadside vegetation, widening of roads (additional lanes, widening of lanes, addition or widening of shoulders), and erecting of roadside barriers (guard structures, fences).

All consultations are assumed to occur in the year preceding the construction activity. The estimated costs from CHD for these projects is presented in section IV.4.b.

Mining

No new mining projects are foreseen in the proposed lynx CHD area in Maine during the time frame covered in the analysis.

Consultations

The total volume, as well as the type and complexity, of CHD-related consultations in the proposed Maine CHD area for lynx are shown in Table IV.3.c-19. The table lists the number, level of effort (low, medium, or high), and type of consultation impact (increased-effort, additional, or reinitiated consultation) caused by lynx CHD.

Table IV.3.c-19: Consultation impacts of lynx CHD in Maine study area

	Number of consultations caused by lynx CHD, by type and effort level			
	Lower bound		*Upper bound*	
Land use activity	*Increased-effort/ additional*	*Reinitiation*	*Increased-effort/ additional*	*Reinitiation*
Grazing	n.a.	n.a.	n.a.	n.a.
Timber management	- medium: 11 -	- medium: 1 -	- medium: 51 -	- medium: 2 -
Recreation	low: 19 - -	- - -	low: 60 - -	low: 7 - -
Road and bridge projects	low: 3 - high: 1	- - -	low: 3 - high: 1	- - -
Wildfire management	- - high: 15	- - high: 1	- - high: 30	- - high: 1
Residential construction	low: 59 - -	- - -	low: 257 - -	- - -
Mining	n.a.	n.a.	n.a.	n.a.

Notes: Low, medium, and high refer to the estimated level of effort involved in consultations.

The incremental consultation effort attributable to CHD may take the form of re-initiated consultations, additional consultations (i.e., consultations that absent CHD would not have taken place), or an increase in the complexity of consultations, all of which imply resource commitments and hence costs on the part of the involved parties. All timber consultations are assumed to be of medium-effort. On private lands with a federal nexus no consultations are expected to occur in the absence of CHD, so all consultations on private lands assumed to occur after CHD are additional consultations.

By contrast, on federal lands it is assumed that the consultations expected to occur under CHD would also occur in the absence of designation. Hence, all consultations in lynx CH on federal lands are assumed to be increased-effort consultations.

All recreation-related consultations are expected to fall into the low-effort category. Most are of the increased-effort type as the associated projects are on federal lands and therefore are presumed to involve consultations even in the absence of CHD, with the remainder consisting in reinitiations.

The three road projects on non-federal lands are assumed to require modifications that are of low complexity, and it is assumed that none of them has undergone consultations or would undergo consultations in the absence of CHD. The project on State Route 4 is expected to be of high complexity, and is expected to undergo consultations even in the absence of CHD, due to the involvement of the NPS and the substantial nature of the project, so that the incremental cost consists of the increased consultation effort due to CHD.

As explained in the previous section, all consultations related to residential construction are additional consultations, and all consultations on hazardous fuel treatments are assumed to be increased-effort consultations.

IV.4 Estimation of costs and benefits of CHD for the lynx - Maine

IV.4.a Relevant cost and benefit categories

We consider all values associated with the impacts of lynx CHD on all major land use activities. The potentially applicable value categories (comprising both costs and benefits) are identified based on Table II.2-1. These values are estimated in sections IV.4.b and c.

IV.4.b Costs of lynx CHD in Maine study area

Winter recreation

Each section below details the assumptions and the generation of monetary costs expected to be incurred from the designation of critical habitat for the lynx. The cost to each individual sector within winter recreation considers only direct costs to that industry. A later section addresses the multiplier impacts that lost winter recreation activity as a whole would have on associated industries (hotels, restaurants, etc.) which depend, in part, on winter recreation tourism for their revenues.

Downhill skiing/snowboarding

While in our Montana study area there were multiple ski areas located on federal lands, and therefore facing restrictions on their future development and expansion in the face of critical habitat designation, in the case of Maine there are no such resorts located on federal land. We also do not anticipate any federal nexus which would impose restrictions similar to those in the Montana case with CHD. Therefore, as was described earlier, we do not anticipate any physical impacts due to designation, and thus no monetary costs to the industry. Likewise, since no expansion restrictions are anticipated from CHD, no increases in crowding, and the accompanying loss of consumer surplus to skiers, can be attributed to CHD in Maine.

Snowshoeing

We do not anticipate that CHD will have a significant economic impact on snowshoeing activity in the study area. It is possible that restrictions on use of certain areas by snowshoers could go into effect under designation, but due to the fact that participants are still relatively few and because they do not require a network of groomed, compacted trails, we expect that restrictions will be minimal and will affect only a very small portion of the recreationist population. If participation in this activity grows substantially in the future, however, it is possible that use will have to be restricted in more areas and that increased crowding could result, causing a loss of consumer surplus. It is also possible that the popularity of snowshoeing could increase significantly in the near future, making restrictions necessary. Therefore, for any studies projecting costs beyond the end of our study period, it may be necessary to re-examine impacts of CHD on snowshoers.

Cross-country skiing

We anticipate that the primary costs to the cross-country skiing sector incurred from designation of critical habitat, apart from increased consultation efforts (C-4 in Table II.2-1) on the part of the land managing entity, will be in the form of lost consumer surplus on the part of participants (C-2 in Table II.2-1) due to an increase in crowding as the sport gains participants, but with no new trails constructed on federal lands in the region.

When estimating the incremental impacts of CHD, we anticipated that crowding on the trails located on federal land would increase annually with designation of critical habitat until it reached 248 skiers/mile of trail per year. As an upper-bound scenario this would compare to a steady 233 skiers/mile of trail/year in each year of our study period, a 6.4 percent increase in crowding. The lower-bound scenario assumed that trail construction would not keep up with increasing participation in the absence of CHD, but that it would only increase at half that rate. This scenario anticipated 2.5 new miles of trail would be built in the ten years, rather than five as in the upper-bound scenario. This lower-bound anticipates a density level of 242 skiers/mile of trail/year by 2013. Based on our assumption that participation will increase proportionally as population grows, trail crowding will increase by 2.5 percent over its present condition in the ten years of the study period.

Rosenberger and Loomis (2001) estimated consumer surplus for skiers to be $33.10 per activity day in this region.[241] The Maine SCORP (ME DC 2003c) does not provide estimates on frequency of participation in specific outdoor activities as Montana's did, forcing us to use regional estimates of participation frequency as reported by Cordell et al. (1997). They show that cross-country skiers in the northern U.S. participate in this activity with a mean frequency of 8.1 times per year. We assume residents of Maine participate at this annual rate to arrive at a figure for activity days per year by state residents. Since the figures of non-resident visitation provided by the SCORP are numbers of *visits* not *visitors*, we cannot know how many of those visits were made by people traveling to the state once a year and how many constitute multiple visits by the same individuals. Given the relative proximity of major metropolitan areas, and the fact that Maine is easily reachable for day trips from several New England states and Canada, we can assume that repeat visits in the same year are common and that the previously calculated participation figures for non-residents, based on estimated proportion of visitors who participate in the activity, already represent the number of non-resident activity days, rather then merely the number of participants.[242]

As explained in the incremental impacts section, we assume that 54 percent of the trails on federal lands statewide are located in our study area, accounting for approximately 3.8 percent of all of the state's cross-country ski trails. We assume also that skiing is distributed evenly across all trails so that 3.8 percent of all cross-country skiing in Maine takes place on the federal lands in our study area. These numbers and assumptions result in a prediction of an average of more than 81,000 cross-country skiing activity days in each of the ten years of our study period, or a total of over 815,000 activity days.

It seems reasonable to presume that consumer surplus on the part of cross-country skiers decreases as a function of increasing density of skiers on the trails. Loomis and Walsh (1997) estimate the effects of congestion on the consumer surplus of participants in several outdoor recreation activities. Table IV.4.b-1 illustrates the anticipated rate of decreased consumer surplus on trail activities as crowding increases.

Based on our estimates of the approximate number of activity days in each year of our study period and the information we have on number of trails on the federal lands of our study area, we can estimate how crowded the trails are, and how crowded they will be in the future with and without CHD.

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[241] 2002 prices, adjusted from $28.83 in 1996 prices using a cumulative inflation rate of 14.8 percent; *http://inflationdata.com/inflation/inflation_rate/InflationCalculator.asp*

[242] This distinction was not made in the Montana case study because, due to its more remote location, it is less likely that the share of repeat visits was high in any given year.

Table IV.4.b-1: Index of lost benefits as a result of increased crowding on trails

Number of other skiers encountered	0	5	10	15	20	25
Index of benefits	1.00	0.89	0.79	0.70	0.60	0.00

Source: Based on Loomis and Walsh 1997.

Currently, there are 61 miles of cross-country trail on federal lands. Assuming that cross-country skiing is taking place during four months of the year, and during an average of six hours per day, we can generate estimates of crowding for each of the years of our study period.[243] As this number increases, the consumer surplus value of $33.10 will decrease by the share estimated by Loomis and Walsh (1997).[244] We arrive at a total consumer surplus by multiplying the consumer surplus per person derived by the number of activity days. The process is then repeated to find total consumer surplus for the upper-bound scenario without CHD (where it remains at $33.10 per person since trail construction keeps up with increased participation), and for the lower-bound scenario without CHD (where trail construction is carried out at half the rate of the upper-bound scenario).

These assumptions lead to an expected per-capita decline of just $0.25 in consumer surplus per activity day in the upper-bound scenario by the end of ten years and a loss of $0.13 in the lower-bound scenario. While the individual loss of consumer surplus would seem hardly noticeable to participants, the large number of activity days expected in the next ten years make the figure of cumulative lost consumer surplus significant. The estimates of this cumulative loss of value over ten years are displayed in Table IV.4.b-2.

Table IV.4.b-2: Lost consumer surplus to cross-country skiers due to CHD

Upper-bound	*Lower-bound*
$87,431	$45,607

Note: At three percent discount rate.

Snowmobiling

The previous section on incremental impacts of CHD details why designation is expected to have negligible economic effects on snowmobiling activity. This is primarily due to the lack of an anticipated federal nexus on the development of new trails on private lands, where 94 percent of the existing trails are located. Additionally, ***net*** trail mileage increases will already be prevented by the LCAS on the federal lands of the area, leaving ***gross*** trail mileage increases as the sole impact attributable to CHD.[245]

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[243] We are assuming here that all skiers utilizing the same three miles of trail in the same hour will encounter each other.

[244] Loomis and Walsh present figures only for additional individuals encountered on the trails in multiples of five. The average numbers of people/hour/trail in our scenarios do not increase by such large amounts, requiring the extrapolation of the estimated index of lost consumer surplus using the average change per person between the points estimated by Loomis and Walsh.

[245] In this case "federal lands" in our study area refers almost exclusively to the White Mountain National Forest. Lake Umbagog NWR is primarily occupied by the lake and wetland habitats, and snowmobiling is not permitted on the Appalachian Trail.

In the case of snowmobiling, there is no potential loss of consumer surplus for participants, because any increase in crowding in the next ten years would be attributable to the LCAS, not to CHD. (For a more detailed explanation of why the impacts of CHD on snowmobiling are expected to be negligible, please refer back to section IV.3.c, *Projections of future development of land use activities and incremental impacts of CHD for the lynx*.) While we recognize that some measure of enjoyment on the part of riders may be lost as a result of limiting changes to the trail system on federal lands, we expect this loss to be of minimal value. We are not aware of the rate at which gross trail mileage on federal lands changes under current regulations, but due to the limited area occupied by the White Mountain National Forest in Maine, it is unlikely that this trail system on federal lands is very dynamic to begin with.

Associated industries

In the Montana case study we discussed the costs associated with critical habitat designation to industries which rely on winter recreation for a significant portion of their business. These include, among others, restaurants, hotels, outfitters, and grocery stores. The loss of revenue to this industry in Montana was due to a projection of foregone increases in numbers of skiers visiting the ski resorts of the study area. In the case of Maine, we do not anticipate any impacts to ski resorts or future numbers of visitors. Considering the small area, relative to the study area as a whole, where CHD will impact recreation, we do not predict any change in visitor numbers to the region, and hence do not foresee CHD impacts on winter tourism-related industries.

It should be noted here that the potential exists for decreased trail-related recreation activities on federal lands. Although unlikely, due to the small amount of lost individual consumer surplus, it is possible that some participants may shift a portion of their activity outside of these lands. The majority of this activity would be likely to shift to private and state lands in the study area. In this case, there may be a shifting of benefits from businesses adjacent to, or within, federal lands, to those near the new activity site. Therefore, designation may have negative impacts on the tourism sector in some areas of the study area, but these would be balanced by comparable positive impacts in other areas.

Total costs to winter recreation

The total potential costs to winter recreation of critical habitat designation for lynx in our Montana study area are illustrated in Table IV.4.b-3. We predict the only costs associated with designation to come from a loss of consumer surplus on the part of cross-country skiers.

Table IV.4.b-3: Total costs of CHD to winter recreation

Activity	*Upper-bound*	*Lower-bound*
Downhill ski/snowboarding	$0	$0
Cross-country skiing	$87,431	$45,607
Associated industries	$0	$0
TOTAL	$87,431	$45,607

Note: At three percent discount rate.

<u>Summer recreation</u>

The following sections detail all assumptions and calculations necessary to arrive at estimates of the potential costs to summer recreation activities and industries that may accompany designation of lynx critical habitat. As in the winter recreation section above, each sub-section of summer recreation activities below reflects only the direct costs to that sector.

Hiking

The primary categories of costs related to non-motorized trail activities due to CHD are expected to be from increased consultation efforts (C-4 in Table II.2-1, discussed below) on the part of land managing entities and from a loss of consumer surplus (C-2 in Table II.2-1) to hikers from increased crowding of trails if new trail construction is prohibited yet participation continues to grow.

As discussed in section IV.3.c on incremental impacts of CHD in Maine, crowding on the trails located on federal land is expected to increase annually until hiker density reaches 185 hikers/mile of trail/year. As an upper-bound scenario this would compare to 172 hikers/mile of trail/year in each year of our study period, an result in a 7.6 percent increase in crowding. The lower-bound scenario expects that trail construction would not keep up with increasing participation in the absence of CHD, but that it would only increase at half that rate. This scenario anticipates that 15 new miles of trail would be built in the ten years, rather than 30, as in the upper-bound scenario. This lower-bound predicts a density level of 181 hikers/mile of trail/year by 2013 in the absence of CHD. Based on our assumption that participation will increase proportionally with population growth, crowding on the trails will increase with critical habitat designation by 2.2 percent over its BCS condition in the ten years of the study period.

The estimate of consumer surplus for hikers in this region, according to Rosenberger and Loomis (2001), is $71.92 per activity day.[246] The Maine SCORP (ME DC 2003c) does not provide estimates on frequency of participation in specific outdoor activities as Montana's version did, thereby requiring us to use regional estimates of participation frequency as reported by Cordell et al. (1997). These authors report that hikers in the northern U.S. participate in this activity with a mean frequency of 16 times per year. We assume residents of Maine participate at this annual rate to arrive at an estimate of resident activity days. Since the figures of non-resident visitation provided by the SCORP are numbers of *visits*, not *visitors*, we cannot know how many of those visits were made by people traveling to the state once a year and how many constitute repeat visits by the same individuals. Given the relative proximity of major metropolitan areas, and the fact that Maine is easily reachable for day trips from several New England states and Canada, we can assume that repeat visits in the same year are common and that the participation figures for non-residents previously calculated based on estimated proportion of visitors who participate in the activity, already represents the number of non-resident activity days, rather than merely the number of participants.[247]

As discussed in the section on incremental impacts, we assume that 54 percent of the trails on federal lands statewide are located in our study area, which accounts for approximately 9.2 percent of all the state's hiking trails. We assume also that hiking is distributed approximately evenly across all trails so that 9.2 percent of all hiking in Maine takes place on the federal lands of our study area. These numbers and assumptions result in a prediction of an average of more than 546,000 hiking activity days per year in our study period, or a total of almost 5.5 million activity days in ten years.

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[246] Expressed in 2002 prices, inflated from $62.65 in 1996$ using cumulative inflation rate of 14.8 percent; *http://inflationdata.com/inflation/inflation_rate/InflationCalculator.asp*

[247] This distinction was not made in the Montana case study because, due to its more remote location, it is less likely that the number of visits were made up, to any large degree, of repeat visitors in the same year.

Consumer surplus on the part of trail users decreases as a function of increasing congestion on the trails (Loomis and Walsh 1997). The rate of decreasing consumer surplus is displayed in Table IV.4.b-1 above.

Based on the approximate number of activity days in each year of our study period and the information we have on number of trails on the federal lands of our study area, we can estimate how crowded the trails are, and how crowded they will be in the future with and without CHD. Currently, there are 351 miles of hiking trails on federal lands in the study area. Assuming that hiking is taking place during nine months of the year, and during an average of eight hours per day, and further assuming that an average trail is three miles long, we generate estimates of trail congestion for each of the years of our study period.[248] As congestion increases, the consumer surplus value of $71.92 will decrease by the corresponding percentage given in Loomis and Walsh (1997).[249] By multiplying the estimated consumer surplus per person by the number of activity days, we arrive at a total consumer surplus figure. The process is then repeated to find total consumer surplus for the upper-bound scenario without CHD (where surplus remains at $71.92/person since it is assumed that trail construction keeps up with increased participation), and for the lower-bound scenario without CHD (where trail construction is carried out at half the rate of the upper-bound scenario).

These assumptions lead to a decline of just $0.19 in consumer surplus per activity day in the upper-bound scenario by the end of ten years and a loss of $0.10 in the lower-bound scenario. While the individual loss of consumer surplus would hardly seem noticeable to participants, the large number of activity days expected in the next ten years make the figure of cumulative lost consumer surplus significant. The estimates of this cumulative loss of value over ten years are displayed in Table IV.4.b-4.

Table IV.4.b-4: Lost consumer surplus to hikers due to CHD

Upper-bound	*Lower-bound*
$405,693	$194,174

At three percent discount rate.

Camping

While in the Montana case study we divided camping into tent and RV campers, we consider both types together for Maine because the SCORP does not differentiate between the two. The primary categories of costs related to this activity are expected to stem from increased consultation efforts (C-4 in Table II.2-1) on the part of land managing entities and from a loss of consumer surplus (C-2 in Table II.2-1) to campers from increased crowding of sites if new construction is prohibited yet participation continues to grow. We assume that CHD will prevent the construction of any new campsites in lynx habitat on federal lands and lands with a federal nexus (see Table IV.3.a.ii-5). To estimate the loss of consumer surplus we use the predictions of increasing density of campers derived in the incremental impacts section of this paper. Estimates of consultation costs are presented in a later section.

[248] We are assuming here that hikers utilizing the same three miles of trail during the same hour will see each other.
[249] Loomis and Walsh present figures only for additional individuals encountered on the trails in multiples of five. The average numbers of people/hour/trail do not increase by the as much as the estimates given in Loomis and Walsh, requiring extrapolation of their estimated index of lost consumer surplus.

In the previous section we anticipated that with designation of critical habitat, crowding of the campsites would increase from 29 campers/site/year in 2004 to 31 campers/site/year in 2013. The upper-bound scenario of impacts presumes that in the absence of CHD new site construction will keep pace with the growing number of participants and that density of campers will remain at 29 campers/site/year throughout the study period. The lower-bound anticipates that new site construction will not keep pace with participation rates, but will only increase at half the rate of the upper-bound scenario, leading to a density in 2013 of 30 campers/site/year. Therefore, in the lower-bound estimate, 28 new tent sites would be constructed in the ten years, versus 56 in the upper-bound scenario.

The estimate of consumer surplus for campers in this region, according to Rosenberger and Loomis (2001), is $27.94 per activity day.[250] The Maine SCORP (ME DC 2003c) does not provide estimates on frequency of participation in specific outdoor activities as Montana's version did; hence, we have to use regional estimates of participation frequency as reported by Cordell et al. (1997). The latter report that campers in the northern U.S. participate in this activity with a mean frequency of 7.9 times per year.[251] Assuming that residents of Maine on average participate at this annual rate, we generate an estimate of resident activity days. Since the figures of non-resident visitation provided by the SCORP are numbers of *visits*, not *visitors*, we cannot know how many of those visits in a given year were made by people traveling to the state once a year and how many constitute multiple visits by the same individuals. Given the relative proximity of major metropolitan areas, and the fact that Maine is easily reachable for day trips from several New England states and Canada, we can assume that repeat visits in the same year are common and that the participation figures for non-residents previously calculated based on the estimated proportion of visitors who participate in the activity already represent the number of non-resident activity days, rather than merely the number of participants.[252]

As discussed in the section on incremental impacts, we assume that 54 percent of the campsites on federal lands statewide are located in our study area, which accounts for approximately 2.4 percent of all campsites in the state. We assume also that camping is distributed evenly across all sites so that 2.4 percent of all camping in Maine takes place on the federal lands in our study area. These numbers and assumptions result in an expected average of more than 78,000 camping nights per year in our study period, or a total of almost 783,000 nights in ten years.

Consumer surplus on the part of campers decreases as a function of increasing crowding on campgrounds. Table IV.4.b-5 illustrates the anticipated rate of decreased consumer surplus on camping as crowding increases.

Table IV.4.b-5: Index of lost benefits from increased crowding on campsites

Number of other campers encountered	0	5	10	15	20	25
Index of benefits	1.00	0.81	0.79	0.53	0.00	0.00

Source: Based on Loomis and Walsh 1997.

[250] In 2002 prices, inflated from $24.34 in 1996$ using a cumulative inflation rate of 14.8 percent; *http://inflationdata.com/inflation/inflation_rate/InflationCalculator.asp*
[251] We use the estimate of "primitive area" camping frequency here, rather then the "developed camping" frequency of 10.8.
[252] This distinction was not made in the Montana case study because, due to its more remote location, it is less likely that the number of visits were made up, to any large degree, of repeat visitors in the same year.

From our previously estimated number of activity days in each year of our study period and the information we have on number of campsites on the federal lands of our study area, we can estimate how crowded the sites are, and how crowded they will be in the future, with and without CHD for the lynx. Currently, there are 645 campsites on federal lands in our study area. From participation and number of campsites we can estimate camper densities (people/campsite/night) for each of the years of our study period. As density increases, the estimated consumer surplus of $27.94 will decrease by the corresponding amount.[253] By multiplying the consumer surplus per person value derived here by the number of camping nights, we arrive at a total consumer surplus figure. The process is then repeated to find total consumer surplus for the upper-bound scenario without CHD (where it remains at $27.94/person since site construction keeps up with increased participation), and for the lower-bound scenario without CHD (where site construction is carried out at half the rate of the upper-bound scenario).

These assumptions lead to a decline of just $0.03 in consumer surplus per night in the upper-bound scenario by the end of ten years and a loss of $0.02 in the lower-bound scenario. While the individual loss of consumer surplus is negligible, the large number of activity days expected in the next ten years makes the cumulative loss of consumer surplus somewhat more significant, yet still very low. The estimates of this cumulative loss of value over ten years are displayed in Table IV.4.b-6.

Table IV.4.b-6: Lost consumer surplus of campers due to CHD

Upper-bound	*Lower-bound*
$9,101	$4,837

Note: At three percent discount rate.

ATVs (OHVs)

As discussed in section IV.3.c, we do not anticipate CHD to have an economic impact on All Terrain Vehicle activity in the study area. While this is a popular activity in Maine, it is already not permitted in the White Mountain National Forest, the Lake Umbagog NWR, or on the Appalachian Trail. We do not anticipate that ATV use on these lands would be permitted in the next ten years in the absence of CHD.

Associated industries

As with winter recreational activities there are a number of businesses in the study area that depend, in part, on summer recreation tourism. These include, but are not limited to, restaurants, hotels, outfitters, and grocery stores. We do not expect that the designation of critical habitat will reduce visitation numbers to the area by recreationists, and therefore we do not expect CHD to cause any associated costs to these industries. CHD restrictions on some recreational activities in the small area of the state affected by such designation should not impact the numbers of tourists traveling to the region to take part in any of the activities discussed above, or others not discussed.

[253] Loomis and Walsh present figures only for additional individuals encountered at the campsites in multiples of five. The average numbers of people/hour/site in our study area do not increase by such large amounts, necessitating the extrapolation of lost consumer surplus from Loomis and Walsh's values.

Total costs to summer recreation

The total potential costs to summer recreation of critical habitat designation for lynx in our Maine study area are shown in Table IV.4.b-7. The upper-bound cost estimate is approximately twice as high as the lower-bound estimate. In both scenarios, almost all costs to summer recreation stem from lost consumer surplus for hikers.

Table IV.4.b-7: Total costs of CHD to summer recreation

Activity	*Upper-bound*	*Lower-bound*
Hiking	$405,693	$194,174
Camping	$9,101	$4,837
TOTAL	$414,794	$199,011

Note: At three percent discount rate.

<u>Total impacts to recreation</u>

The estimated total cost in the study area to recreation during the 10-year period analyzed range from approximately one quarter million dollars to half a million dollars (see Table IV.4.b-8). Over 80 percent of these costs are caused by expected CHD impacts on summer recreation activities, with lost consumer surplus from hiking accounting for almost all of the latter impacts. The remaining 20 percent of costs represent lost consumer surplus for cross-country skiers.

Table IV.4.b-8: Costs of CHD on recreation in the study area

Lost consumer surplus (C-2)	*Upper-bound*	*Lower-bound*
	PV 2003 (2002$)	
Cross-country skiing	$87,431	$45,607
Hiking	$405,693	$194,174
Camping	$9,101	$4,837
Total	$502,225	$244,618

Note: At three percent discount rate.

<u>Grazing</u>

As pointed out in section IV.3.c, we do not anticipate any impacts from CHD on grazing.

<u>Timber</u>

We do not expect critical habitat designation for the lynx in the proposed designation area to reduce the volume of timber harvested during our study period. When lynx foraging habitat is the limiting factor, logging activities can be beneficial, thus improving the overall quality of lynx habitat. Where we anticipate costs from CHD to the timber industry these stem from necessary project modifications due to the relocation of some harvests to areas where denning habitat is not the limiting habitat type. In addition, costs are incurred for consultations and for delays. Delays may occur in the first few years of the study period, due to the potential postponement of some harvests in areas of limited denning habitat that are already planned until a new harvest site is located, surveyed, and otherwise prepared for harvest. Once again, we must separate the impacts on federal lands from those on non-federal lands.

White Mountain National Forest

We have previously discussed, we assume that annual harvests on the Maine side of the WMNF will remain at approximately 1.6 mmbf, or 16 mmbf over ten years. Our upper-bound scenario assumes that 15 percent of this volume, a ten year total of 2.4 mmbf, will have to be relocated away from the most economically preferred sites due to lynx habitat concerns, but that this volume of timber will still be extracted in other locations, although at an assumed reduced profit level. We believe that 15 percent is an adequate upper-bound assumption of harvests that will need to be relocated because of the assumption that denning habitat for lynx need only be ten percent of an LAU in order to not be considered limiting (Ruediger et al. 2000), which makes it unlikely that a high percentage of timber harvests would cause denning habitat to become the limiting habitat type. The lower-bound estimate presumes that only five percent of the total volume, 0.8 mmbf in ten years, will have to be relocated.

Costs from relocation will potentially be incurred in two ways. The first takes the form of timber sale preparations. We presume that the Forest Service, or private logging companies who have been contracted to harvest timber in the WMNF, may have already performed surveys, prepared sale plans, performed environmental analyses, and drawn up contracts for harvests during the first few years of our study period. If critical habitat designation requires any of these harvest sites to be moved, this work will have to be repeated for the new area to be logged. Our upper-bound estimate presumes that repeating the preparation procedures for those relocated harvests is necessary in the first two years of our study period, affecting 0.48 mmbf of timber. The lower-bound scenario assumes that this preparation has only taken place for the harvests of the first year of the study period, thus only affecting 0.08 mmbf.

The second type of cost from relocation may occur in the form of reduced profitability, assuming that the original sites were initially chosen because of the higher profit that could be attained by logging those trees, rather than the ones at the site to which CHD will force the harvest to move. Because the harvest areas that potentially would have to be relocated are small compared to the total resource, it is unlikely that the substitute harvest sites would be of a lower quality than the original sites. Relocation, therefore, is not expected to result in substantial reductions in profits from the relocated harvest volume. Therefore, in our upper-bound scenario we assume that profitability of the harvests at the new locations is ten percent lower than at the original sites. In the lower-bound scenario, we assume profitability decreases by only three percent.

Timber harvests will also incur a cost from delays in harvesting due to CHD. If logging sites have to be re-planned for the first two years (the upper-bound case) or the first year (the lower-bound case), the resulting delays imply deferred profits. We assume that the only costs incurred from the delays are the difference in the value of harvesting timber in 2004 versus 2005 or 2006, in the lower and upper-bound scenarios, respectively. Based on average sawlog prices from 1998 through 2002, the profitability of timber harvests, and the rate of harvest of each tree species in Oxford County, we can calculate expected annual revenues and profits from timber harvests in the absence of CHD.[254] To estimate the amount of revenue as profit from timber harvests, we use data from the Plum Creek Timber Company.[255] In the years 1998 through the third quarter of 2003, Plum Creek reported an average net income of 32.2 percent of total revenue. Due to the fact that Plum Creek is one of the largest private timberland owners in the United States, with

[254] Stumpage prices by species for the state and by county were obtained from the Maine Forest Service Stumpage Price Reports, 1998-2002. Volume of species harvested by county were obtained from the Maine Forest Service Wood Processor Reports, 1998-2002.
[255] Available at *www.plumcreek.com*.

operations throughout the country, it should be noted that it is likely that these estimates of profitability may be rather high as an average for our study area. We assume that the proportions in which each species is logged in the national forest are the same as that in the rest of the county.

Table IV.4.b-9 illustrates the average price of the primary species harvested in the region, along with the relative rates of harvest in Oxford County, the average volume harvested of each species (assuming that total harvests will remain at 1.6 mmbf/year), and the estimated forgone profits using our estimate of profitability from the Plum Creek Timber Company data.

Due to a lack of region-specific information on average costs of timber sale preparations, we use the same cost estimates as employed in the Montana case study, $40.82/mbf, provided by the Lolo National Forest Monitoring Report (USDA FS 2001d). Costs of timber sale preparations should be similar across national forests, but even if they are not, the expected total costs of repeating such preparations are so small that the impact on total CHD costs in Maine would be negligible.

Table IV.4.b-9: Species value, harvest rates, and estimated annual harvests on the Maine side of White Mountain National Forest

Species	*Price per mbf (2002$)* [1]	*Relative harvest rates in Oxford County*	*Estimated annual harvest (mbf)* [2]	*Estimated annual profit (2002$)* [3]
Spruce and fir	$277.29	16.7%	266.8	$23,823
White/red pine	$269.67	55.9%	894.3	$77,654
Hemlock	$214.15	4.5%	71.9	$4,960
Other softwood	$239.84	0.0%	0.6	$43
Beech	$209.12	2.5%	39.9	$2,688
White Birch	$266.22	6.5%	104.3	$8,938
Yellow Birch	$334.01	1.9%	30.2	$3,247
Sugar Maple	$379.91	2.6%	40.8	$4,994
Red Maple	$228.19	2.9%	45.9	$3,376
Oak[4]	$412.73	3.5%	56.3	$7,483
Ash	$280.46	1.5%	24.3	$2,194
Aspen	$191.60	0.1%	1.6	$98
Other hardwood	$291.15	1.4%	23.1	$2,166
TOTAL		100.0%	1,600	$141,664

[1] mbf = thousand board feet; Average estimated mill-delivered prices from 1998 through 2002; only data on stumpage prices is available from the Maine Forest Service; $150/mbf was added to the stumpage price to account for cutting and yarding and trucking the logs. [2] On Maine side of the WMNF; based on forecast of 1.6 mmbf per year from 2004-13 (see text). [3] Equivalent to 32.2 percent of the product of species price and harvest volume. [4] Price is average of white and red oak.
Sources: Prices: Maine Forest Service Stumpage Price Reports, 1998-2002. Estimated added cost of $150/mbf to convert stumpage price to mill-delivered price was derived from Northern Woodlands Magazine, *http://www.northernwoodlands.com/mill_prices.html*. Species Composition: Maine Forest Service Wood Processors Reports, 1998-2002.

By assuming that 15 percent of the annual harvest volume has to be relocated and that timber sale preparations will have to be repeated in the first two years of the study period in the upper-bound scenario, and five percent relocation and repeating of preparations in the first year in the lower-bound case, we estimate the costs of relocation as $18,746 at a three percent discount rate for our upper-bound estimate and a lower-bound estimate of $3,170 at three percent, respectively. In both scenarios, therefore, cost impacts of lynx CHD over the ten-year time period analyzed here would be small. These amounts constitute costs for the timber company performing the logging operations, but a substantial share of them also represents income for the employees performing the sale preparations; this share simply constitutes a resource transfer from one segment of society (timber companies) to another (timber company employees), not a net cost to society. This increased income of individuals has associated local economic multiplier effects. Since we do not have the required RIMS multipliers, and because of the small values in question here, we neglect the multiplier effects, and instead simply assume that in the lower-bound and upper-bound scenarios 25 percent and 75 percent, respectively, of the additional expenditures on sale preparations remain in the study area counties. These assumptions lead to the net costs to the study area from repeating timber sale preparations shown in Table IV.4.b-10.[256]

Table IV.4.b-10: Timber harvest costs of lynx CHD in the White Mountain National Forest

Source of cost	*Upper-bound*	*Lower-bound*
	2002$, PV (2003)	
Repetition of timber sale preparations	$14,060	$793
Foregone profits from relocation	$18,126	$1,813
Delay costs	$1,184	$200
Total costs	$33,370	$2,806

Note: At three percent discount rate.

In estimating the costs in the form of foregone profit from the potentially necessary relocation of a portion of harvests, it should be noted that since we are dealing with hypothetical timber harvest sites it is impossible to know the actual comparative value of one of these timber stands versus the other. We can only presume that those doing the harvest work will select the sites where they can achieve the highest profit and that under CHD, from time to time, it may be necessary to prevent logging on a portion of those sites. Due to the large amount of timberlands in the study area it is likely that the value of the second or third-best harvest site is not greatly inferior to the value of the first-best site. The upper-bound cost scenario assumes that profitability of the relocated harvests is reduced by ten percent compared with the without CHD case. The lower-bound estimate assumes a profit decrease of just three percent for the relocated harvests. These foregone profits over the ten year study period are displayed in Table IV.4.b-10.

If delays are incurred on 15 percent of the volumes scheduled for harvest in 2004 and 2005 in the upper-bound scenario, the cost of delay are the discount rate times 15 percent of the annual BCS profits for both 2004 and 2005.[257] Thus, these delays will impose a cost on the timber industry. Equivalent to the opportunity cost of time. The lower-bound scenario assumes that just five percent of logging projects will be relocated and delays will occur only in the first year. Therefore, the cost of delays stems from five percent of 2004's harvest being postponed to 2005. Table IV.4.b-10 shows the costs of delays expected to be incurred by the timber industry.

[256] In this analysis we effectively treat the timber companies as locally-owned, thereby introducing a conservative (pro-cost) bias into our estimates. If companies are owned primarily by individuals residing outside of the study area (as generally is true for the large, publicly traded timber companies), any additional expenditures for timber sale prescriptions that lead to income in the study area would have a positive net economic impact in the local area.

[257] Harvests delayed in 2004 are realized in 2005, and those delayed in 2005 are realized in 2006. Hence, receipt of 15 percent of each year's profits is delayed by one year.

Non-Federal Forest Lands

We utilize the assumptions and calculations discussed above for the WMNF to estimate costs to the timber industry across the much wider area of non-federal lands in our study area. We do not anticipate any federal nexus to impose restrictions on logging in federal lands until the year 2009, the expected completion date for a number of TMDL plans in the proposed designation area, with additional land coming under the nexus in 2012. Unlike in the case of the WMNF, the only cost category applicable here is that of foregone profits due to relocation of harvests. We expect that if critical habitat is designated in 2004, timber companies will be able to anticipate the impending nexus that will affect them in 2009 or 2012 and will not perform timber preparations on land they will not be able to harvest on, nor will they suffer delays from relocation.

We estimated that the study area produces approximately 948 mmbf of pulpwood and sawlogs per year in the absence of CHD, and that harvests of 312.8 mmbf will be impacted by the TMDL plans coming into effect in 2009. The TMDL plans which should be completed in 2012 will bring the impacted harvests up to 322.3 mmbf per year. Our upper-bound scenario assumes that 15 percent of this volume, a five-year total of 237.5 mmbf, will have to be relocated away from the most economically preferred sites due to lynx habitat concerns, but that this volume of timber will still be logged on other locations, albeit perhaps at a reduced profit level. The lower-bound estimate presumes that only five percent of the total volume, 79.2 mmbf over five years, will have to be relocated.

Costs on non-federal lands, in this case, is incurred due to relocation necessitated by lynx habitat considerations. Assuming that the original sites were initially chosen because of the higher profit that could be attained by logging those trees, rather than the ones at the site to which CHD will force the harvest to move, the restrictions would result in a reduced profit level. The upper-bound scenario assumes that profitability of the harvests at the new locations is ten percent lower than at the original sites. The lower bound assumes profitability is reduced by three percent.

Based on average sawlog prices from 1998 through 2002, the profitability of timber harvests, and the rate of harvest of each tree species in the study area counties, we can calculate expected annual revenues from timber harvests in the absence of CHD.[258] To estimate the amount of revenue as profit from timber harvests, we again use data from the Plum Creek Timber Company,[259] which reports pre-tax profits of 32.2 percent of total revenue. We assume that the species composition and shares of harvests in the study area is the same as for the counties as a whole. Table IV.4.b-11 shows the average price of the primary species harvested in the region, along with their harvest rates and shares in the six county study area, and the estimated profits using our estimate of profitability from the Plum Creek Timber Company data.

As for WMNF harvests, the upper-bound estimate of costs assumes that profitability of the relocated harvests is reduced by ten percent from their level in the without CHD case. The lower-bound estimate assumes a profit decrease of three percent for the relocated harvests. These foregone profits over the ten year study period are displayed in Table IV.4.b-12. The forgone profits from relocation of some harvest sites under CHD are a result of an assumed lower profitability (due to lower revenues or higher costs) of the substitute sites.

[258] Stumpage prices by species for the state and by county were obtained from the Maine Forest Service Stumpage Price Reports, 1998-2002. Volume of species harvested by county were obtained from the Maine Forest Service Wood Processor Reports, 1998-2002.
[259] Available at *www.plumcreek.com*.

Table IV.4.b-11: Species value, harvest share, estimated annual harvests, and estimated forgone profits of timber harvests on non-federal lands

Species	*Price per mbf*[1] *(2002$)*	*Harvest share*[2]	*Estimated annual harvest (mbf)*[3] *2009-11*	*2012-13*	*Estimated annual profit (2002$)*[4] *2009-11*	*2012-13*
Spruce and fir	$275.87	47.0%	146,964	151,427	$13,054,801	$13,451,286
White/red pine	$259.19	15.9%	49,774	51,286	$4,154,036	$4,280,197
Hemlock	$211.75	7.0%	21,854	22,518	$1,490,062	$1,535,316
Other softwood	$216.98	0.0%	12	13	$849	$875
Beech	$211.68	1.4%	4,535	4,673	$309,142	$318,531
White Birch	$272.92	3.7%	11,467	11,815	$1,007,694	$1,038,298
Yellow Birch	$278.79	2.2%	6,876	7,085	$617,287	$636,034
Sugar Maple	$331.29	3.7%	11,613	11,966	$1,238,877	$1,276,502
Red Maple	$234.58	2.4%	7,551	7,781	$570,400	$587,724
Oak[5]	$400.01	0.9%	2,802	2,887	$360,924	$371,885
Ash	$277.63	0.9%	2,774	2,858	$247,998	$255,529
Aspen	$200.49	14.6%	45,621	47,006	$2,945,113	$3,034,558
Other hardwood	$264.85	0.3%	956	985	$81,514	$83,990
TOTAL		100.0%	312,800	322,300	$26,078,695	$26,870,727

[1] mbf = thousand board feet; average estimated mill-delivered prices from 1998 through 2002; only data on stumpage prices is available from the Maine Forest Service; $150/mbf was added to the stumpage price to account for cutting and yarding and trucking the logs; based on statewide average stumpage prices. [2]In the six counties containing our study area. [3] Based on forecast of 1.6 mmbf per year from 2004-13 (see text). [4] Equivalent to 32.2 percent of the product of species price and harvest volume. [5]Average price of white and red oak.
Sources: Prices: Maine Forest Service Stumpage Price Reports, 1998-2002. Estimated added cost of $150/mbf to convert stumpage price to mill-delivered price was derived from Northern Woodlands Magazine, *http://www.northernwoodlands.com/mill_prices.html*. Species Composition: Maine Forest Service Wood Processors Reports, 1998-2002.

Table IV.4.b-12: Foregone profits due to relocation of timber harvests on non-federal lands

Upper-bound	*Lower-bound*
$1,563,302	$156,330

Note: At three percent discount rate.

The total cost of lynx CHD on timber harvests on private and public lands is estimated at between $160,000 and $1.6 million over the ten year time period (see Table IV.4.b-13).

Table IV.4.b-13: Total anticipated costs of CHD to the timber industry

Source of cost	*Upper-bound*	*Lower-bound*
Repeated timber sale preparations	$14,060	$793
Foregone profit from relocation	$1,581,428	$158,143
Delays	$1,184	$200
TOTAL	$1,596,672	$159,136

Note: At three percent discount rate.

National-level Costs (wide boundary of analysis)

When the accounting domain of our analysis is extended to include the entire United States, the size of the cost in several cost categories is reduced. This is the case in all instances where costs are the result of reduced economic activity in the study area and some or all of that activity is relocated from the study area to other regions of the US. The costs to the study area from reduced activities become benefits to those other areas that receive the business or employment lost in the study area.

Winter recreation

Downhill skiing/snowboarding

We anticipate no costs to this sector of winter recreation in the study area due to the fact that there appears to be no federal nexus which could restrict activities, growth, or expansion on any of the ski resorts in northern Maine. Therefore, there will also be no costs to the national economy.

Cross-country skiing

In the previous section we anticipated a small reduction in individual consumer surplus due to increased crowding caused by trail construction restrictions under CHD. This resulted in a sizeable loss of aggregate consumer surplus over ten years when totaled over the entire cross-country skiing population of our study area. The predicted upper-bound loss of $0.25 of consumer surplus per activity day, decreasing from a value of $33.10 to $32.85, may hardly be noticeable to individual skiers, which is why we have assumed that there would be no decrease or leveling-off of cross-country skiing activity days.[260] If crowding reached the point where skiing was noticeably less enjoyable for the participants, it is again unlikely that a significant number would quit the sport. It seems more likely that they would simply move their activity out of the study area, or possibly in this case, simply move to another part of the study area that does not face restrictions on trail expansion. Consequently, the only way CHD would result in a cost from lost skier activity days would be if skiers decided to move their activities to parts of Maine outside of the study area, to other New England states, or to Canada. We do not anticipate that this will be the case for any more than a few participants within the ten years of our study period. If our assumptions are incorrect, and 25 cents of lost consumer surplus is enough to move skiers out of the study area, then the costs from those relocated skiers would not take the form of lost consumer surplus (as the trails will now be less crowded for those who remain), but instead would take the form of reduced local economic impacts from the associated reductions in local economic activity (hotels, restaurants, etc.). Since we do not expect this to happen during our projection period, however, we carry over unchanged from the local to the national level our estimated costs in the form of consumer surplus losses for to cross-country skiers.

Summer Recreation

Hiking

The effects of CHD on hiking on a national scale are much the same as they are for cross-country skiing. This is due to the fact that the main cost categories of CHD would be from consultation costs and from lost consumer surplus due to increased crowding.

[260] The same of course is true in the lower-bound scenario.

As was the case with cross-country skiing, we anticipate only a small loss of $0.19 in individual consumer surplus, from $71.92 to $71.73, which leads to the more significant cumulative loss of $405,693 across all participants in ten years in the upper-bound scenario, and $194,174 in the lower-bound scenario (see Table IV.4.b-7). For an individual hiker, these numbers, once again, would hardly seem noticeable, and this is why we assume that there will be no decrease or leveling-off of hiking activity due to CHD. If crowding reached the point where hiking were noticeably less enjoyable for the participants, it is again unlikely that a significant number would quit the sport. It seems more likely that they would simply move their activity out of the region impacted by CHD to parts of the study area with no federal nexus, and in some cases, out of the study area all together. As with cross-country skiing, the only way CHD would create a cost in terms of lost hiking activity days, on a national scale, would be if a certain number of participants decided to move their activities to parts of Maine not included in the study area, other parts of New England, or to Canada. We do not anticipate that this will happen with any more than a small fraction of participants within the ten-year study period. If our assumptions are incorrect, and 19 cents of lost consumer surplus is enough to move hikers out of the study area, then the costs from those relocated skiers would not take the form of lost consumer surplus (as the trails will now be less crowded for those who remain), but instead would take the form of reduced local economic impacts from the associated reductions in local economic activity (hotels, restaurants, etc.). Therefore, we conclude that the estimated costs from consumer surplus loss in the study area carry over onto the national level.

Camping

As with hiking and cross-country skiing, costs to camping in the study area stem from consultations and loss of consumer surplus caused by crowding. Our assumptions, as with cross-country skiing and hiking, are that there will be losses in consumer surplus due to increased crowding, but that the decreases in consumer surplus will not be enough to reduce the number of participants over the next ten years or the rate of growth in participation. We anticipate that the consumer surplus of individual campers in the study area will be diminished by a maximum of just $0.03, an imperceptible amount to individual campers. Even the cumulative loss amounts to only $9,101 over ten years in the upper bound at a three percent discount rate. Again, we do not anticipate that this is a loss that will drive campers out of the study area. This cumulative lost consumer surplus, therefore, will still be lost, even when the accounting domain is extended to the entire country.

Associated industries

As a consequence of our assumptions that the small amounts of lost individual consumer surplus on the part of cross-country skiers, hikers, and campers would not be enough to keep participants from skiing in the impacted area, we did not predict a loss of activity days in the study area. Therefore, we do not anticipate that the service industries associated with outdoor recreation will suffer any costs due to CHD in this case. The same will hold true on a national scale. If our assumption here was incorrect, and a number of recreationists did decide to participate in their respective activities in regions not impacted by CHD restrictions, the chances that they would simply move to a part of our study area with no federal nexus seem high. If they did leave the area to recreate elsewhere, the reduced local economic activity would be transferred to the new tourist destinations frequented by the displaced visitors. Only those who would choose to move their activities north of the border would cause a cost on a national scale. However, we do not anticipate recreationists to leave the region as a result of the estimated small decrease in individual consumer surplus.

Grazing

Given that livestock grazing in Maine takes place primarily on pasture lands and that these lands are not considered critical lynx habitat, we concluded that no costs would be incurred by the grazing sector in Maine due to lynx CHD, and therefore none are incurred at the national level.

Timber

Expenses for repeating timber sale preparations are, to some extent, transfers within the study area. In addition, any employment or payments to individuals outside of the study area would now be considered a transfer when looking at the national accounting domain. Delays and lost profitability caused by CHD from forcing a portion of harvest to move from the most economically desired site to one of less value remains a cost on the national level. However, this cost of lost profitability is likely to be reduced since there are large areas of forest within a reasonable distance of the study area, which increases the potential of locating harvest sites that are as profitable as the one which would be selected in the absence of CHD. In order to estimate this lost profitability from relocating timber harvests we assume in the upper-bound scenario that the 15 percent of timber harvests that may have to be relocated due to CHD now are just five percent less profitable than at the original site. In the lower-bound scenario, we assume that profitability the five percent of harvests that must be relocated is reduced only by one percent. This change is made for harvests in both the White Mountain National Forest and on non-federal lands. This results in the national-level estimates of lost profitability shown in Table IV.4.b-14.

Table IV.4.b-14: Foregone profits of timber harvests on national scale due to CHD

	Upper-bound	*Lower-bound*
Forgone profits	$790,714	$52,714

Note: At three percent discount rate.

Total costs to recreation, grazing, and timber

The total costs from CHD to recreation, grazing, and timber on the national level are shown in Table IV.4.b-15.

Table IV.4.b-15: Total costs, nationally, to recreation and timber due to CHD

Source of cost		*Upper-bound*	*Lower-bound*
Cross-country skiing:	lost consumer surplus	$87,431	$45,607
Hiking:	lost consumer surplus	$405,693	$194,174
Camping:	lost consumer surplus	$9,101	$4,837
Timber:	delays	$1,184	$200
	lost profits	$790,714	$52,714
TOTAL		$1,294,123	$297,532

Note: At three percent discount rate.

National-level costs are expected to be between a quarter (lower-bound scenario) and 40 percent (upper-bound scenario) lower than local costs (see Table IV.4.b-15 and Tables IV.4.b-8 and 13). In the lower-bound scenario, 83 percent of national-level costs stem from lost consumer surplus for recreation activities, the remainder from foregone profits from timber harvests. In the upper-bound scenario, over 60 percent of costs stem from reduced profitability of timber harvests.

Residential development

The high and low estimates of impacts on the housing sector in the study area counties are given in Table IV.4.b-16.

Table IV.4.b-16: Upper and lower-bound estimates of the impact of lynx CHD on residential construction activity in proposed lynx CHD area in Maine

	Units impacted by CHD, by impact			*Consultations*	
Impacts	*prevented* [1]	*delayed* [2]	*modified* [3]	*increased effort*	*reinitiation*
Upper-bound	129	-	103	257	0
Lower-bound	41	-	12	59	0

Notes: [1] Prevented projects relocate to outside of the nexus area, but are assumed to stay within the counties in which the designation area is located. [2] No delays are anticipated, as CHD is assumed to occur five or more years before the nexus would become active. [3] Modified projects are those that relocate on-site.

Given the expected small number of developments that would be precluded on the sites they would have located absent lynx CHD (an estimated 41 to 129), and the comparatively large supply of still available non-Tier-1 lands with attractive scenery outside of the nexus areas,[261] it is unlikely that prevented projects would choose to relocate to areas outside of the proposed designation area or outside of the counties into which it falls. Because the supply of developable lands (both with and without TMDL nexus) during our projection period far exceeds the projected construction activity, it is unlikely that lynx CHD will affect the average market price for developable properties in the study area. In other words, no welfare losses due to quantity rations are expected. Rather, we expect that the market values of the properties that would have been developed absent CHD will be reduced due to the CHD-associated development restrictions. These properties of course do not lose all of their market value. Rather, they are still attractive for owners of neighboring lots that may wish to prevent even those forms of development on adjoining properties that fall short of the precluded full-scale residential projects. We therefore assume that the average reduction in the value of affected undeveloped properties will be between 25 and 75 percent.

If, alternatively, we assume that the market prices for developable properties were to increase from CHD, the resulting real-estate value impacts would be expected to be approximately compensating in the study area counties as a whole (i.e., there would be an intrasocietal transfer of wealth in the form of market price reductions for developable properties restricted by CHD and market price increases in non-restricted ones). Due to the large supply of developable land of comparable quality (in terms of environmental amenities), supply shortages are not expected.

An estimation of the reduction in the value of the average property for which full residential development is restricted as a result of CHD would require complete information about the value of all local properties and the specific locations at which residential developments would be prevented under CHD. Since we do not have that information, we derive our average value on the basis of information about lakefront and non-lakefront property values in the TMDL areas. This approach seems reasonable given that there is no reason to expect that the average value of

[261] The majority of lakes in the proposed CHD area do not have a TMDL nexus.

properties on which development is prevented under CHD is different than that of the average property in the area.

Non-random sampling of available waterfront and waterview properties in the drainage areas of the TMDL-nexus lakes revealed prices ranging from around $35,000 to more than ten times that amount, which is not surprising given the large size differences among the lots and different scenic and other location attributes.[262] However, a large number of lots were priced around $75,000. Therefore, we use that figure as an average value for the undeveloped properties affected by CHD. At a value reduction of 25 and 75 percent, respectively, the average property on which CHD prevents full residential development would then suffer a decrease in property value of $18,750 and $56,250, respectively.

The changes in project design that are considered as modifications in this study (reduction in fencing or vegetation removal, and relocation of some ancillary structures) are likely to have only minor or negligible impacts on consumer surplus. Therefore, we include in our modification cost estimate only the design costs incurred through the redesigning of projects that have completed the design phase. We assume that, on average, redesign of a project due to CHD-related modifications will cost $10,000.

Total present value (PV) costs to the construction sector associated with lynx CHD are estimated to range from approximately $700,000 to $6.4 million (see Table IV.4.b-17). More than four fifths of these costs are the result of reductions in the value of properties that face development restrictions as a result of CHD.

Table IV.4.b-17: Cost of impacts of lynx CHD on residential construction

	Lower bound	*Upper bound*
	PV 2002$ [1]	
Lost local economic impact	n.a.	n.a.
Reduced property value	593,614	5,603,139
Project modifications	92,662	795,347
Project delays	n.a.	n.a.
Total	686,276	6,398,486

Notes: [1] At three percent annual discount rate.

CHD for the lynx is expected to lead to consultations for housing projects. As in the Montana case study, we assume that in the absence of CHD, no consultations would take place for housing projects, hence the incremental consultation cost is the full cost of consultations. Reinitiation of consultations is not assumed to occur because at least five years remain until potential CHD-related construction restrictions come into effect, making it unlikely that housing projects have already undergone consultations. The incremental consultation costs attributable to CHD are estimated separately at the end of this section.

[262] Real estate information obtained from Realtor.com at *http://www.realtor.com/maine/nbregion.asp?poe=realtor*, accessed Mar. 2004.

Wildfire management

As discussed in the incremental impacts section (IV.3.c), hazardous fuel treatment projects are not expected to incur costs beyond those related to consultations on the treatments. These consultation costs are explained below.

Road construction

A total of four projects in the proposed designation area are expected to be affected by CHD (see Table IV.3.c-18). The potential impacts occur in the form of consultations (discussed in the next section), project modifications, and project delays.

Projects for which design or bidding are underway at the time of lynx CHD are likely to incur additional costs for redesign and/or redevelopment of bidding contracts. The design of the project on U.S. Route 201 scheduled to be advertised in April 2004 is likely to have been developed by the ME DOT by the time of the CHD date used in this analysis (December 2003). Project specifications would therefore need to be checked for their compatibility with the requirement of no adverse modification of lynx habitat. If adverse modification is expected, project specifications would need to be revised. These modifications represent planning costs attributable to CHD. However, the planning effort is likely to be less resource intensive than the full engineering studies done by the potential contractors in preparation of the bidding. In the absence of any information on the costs incurred by the Montana DOT for the design modifications, we assume that these costs amount to $20,000. This amount would be equivalent to three to four person-months worth of engineering time, which should be sufficient to introduce the modifications into the planning design.[263]

Since the advertisement dates of all projects are after the hypothetical CHD, bidding proposals have not been developed at the time of CHD, hence no CHD-related modification costs for contractors are incurred.

Delays due to CHD are not expected, as all projects were, or will be, advertised for bidding after the time of the hypothesized designation.

The expected total present value of the non-consultation costs for road projects due to CHD are therefore estimated at $20,000.

Cost of CHD consultations

The anticipated consultation costs of CHD for the lynx are based on the incremental burden that CHD imposes on consultations, as shown in IV.3.c-19, and the unit cost estimates for incremental consultation effort developed in the Montana case study (see section III.4.b). Total estimated present value (PV) consultation costs vary by a factor of more than three between the lower and upper-bound scenarios, ranging from approximately $627,000 to over $2.4 million (see Table IV.4.b-18).

Total consultation costs are the same in the narrow and wide boundary settings because we assume that no projects will be cancelled simply because of CHD for the lynx. Any projects that are prevented leave the study area only after consultations result in a finding of adverse impact.

[263] The identification of the required project modifications is not included in this estimate, as it occurs separately in the process of consultations between the FWS and the ME DOT.

This may be a rather conservative assumption that may result in an overestimate of the number of consultations and the associated costs.

Table IV.4.b-18: Total estimated consultation costs from lynx CHD in Maine study area

Land use activity	*Lower bound*	*Upper bound*
	Total cost, PV 2002$	
Grazing	none	none
Timber management	114,535	531,010
Recreation	61,106	236,703
Road and Bridge Projects	24,948	24,948
Wildfire management	89,331	166,461
Residential construction	336,947	1,467,719
Mining	none	none
Total	626,867	2,426,842

Notes: Numbers indicate present value (PV) cost estimates for all consultations listed in Table IV.3.c-19, at three percent discount rate.

Total costs

The total cost of designating critical habitat for the lynx in the proposed designation area in Maine are estimated to range from less than two to approximately eleven million dollars over the period 2004-2013 (see Table IV.4.b-19). Residential construction, exclusive of the associated consultations, in all scenarios is the land use category that is expected to incur the highest cost, accounting for more than a third (lower-bound impacts) to almost two thirds (upper-bound impacts) of total costs, independent of whether wide or narrow spatial boundaries of analysis are chosen. Under lower-bound impact estimates, recreation incurs the second-largest costs from CHD, while under upper-bound impact estimates, forestry shows the second-largest costs.

Table IV.4.b-19: Total local and national-level costs of lynx CHD in Maine study area

	Wide boundary		*Narrow boundary*	
	Lower bound	*Upper bound*	*Lower bound*	*Upper bound*
		PV(2003) 2002$		
Grazing	none	none	none	none
Timber management	52,714	791,898	159,136	1,596,672
Recreation	244,618	502,225	244,618	502,225
Road and bridge construction	20,000	20,000	20,000	20,000
Wildfire Management	none	none	none	none
Residential construction	686,276	6,398,486	686,276	6,398,486
Mining	none	none	none	none
Consultations	626,867	2,426,842	626,867	2,426,842
Total	1,630,475	10,139,451	1,736,897	10,944,225

Notes: All present values at three percent annual discount rate.

Consultation costs, if considered separately from the associated land use activities that cause the consultations, actually are the single largest cost category in the lower-bound impact scenarios, and the second-largest (behind residential development) in the upper-bound impact scenario, accounting for almost half (lower-bound impacts) or a quarter (upper-bound impacts) of total costs.

IV.4.c Benefits of lynx CHD in Maine study area

We do not assess the benefits of CHD for the changes in individual land use categories. Rather, our benefit estimates are based on the sum of impact that lynx is expected to have across all land use categories. This treatment of benefits in an aggregate form is justified because, unlike unit costs, unit benefits do not vary across land uses.[264]

The relevant benefit categories in the analysis of CHD were discussed in section III.4.c. In the Maine study area, the only two benefit categories that are relevant are the improved prospects for lynx conservation and ecosystem services generated by the ecosystems saved from conversion. The non-use values of areas that are prevented from conversion are not considered here. In the absence of any contiguous, large-scale development project (like the McDonald mine in Montana) that would cause substantial scenic deterioration along highly frequented tourist routes, the impacts of the remaining changes in land use activities (residential development, recreational development) during the time period considered in this analysis are unlikely to have a perceptible effect on non-use values in the Maine study area. Therefore, we limit our estimation of the value of the prevented development of undeveloped areas to the ecosystem service value of these areas. Likewise, the value associated with avoided costs of public services does not apply in the Maine case study, because it is assumed that all displaced residential developments will relocate to the vast nexus-free areas within the CH designation area, so that the designation area as a whole is unlikely to experience lower costs of sprawl as a function of CHD for the lynx.

As shown in Table III.4.c-1 in the Montana case study, the benefits of landscape protection may also include increased real estate values on already developed properties. However, such value increases are unlikely in the absence of a shortage of remaining properties open for development. Since we do not assume that designation of critical habitat for the lynx in the proposed area will lead to such a shortage in the time period analyzed (2004-2013), we do not include any value increases in our benefit estimates.

Value of improved chances of recovery of lynx populations

In our estimation of the value of improved lynx conservation, that is, of an increase in Maine lynx populations, we employ the estimation procedure discussed in the Montana case study. This consists of the estimation of the size of the increase in Maine lynx populations under CHD relative to the Base Case Scenario, and the application of the different transferred WTP values to that change.

The expected cumulative impact on lynx of the land use changes as a function of designation of critical habitat is much smaller in Maine than in Montana. This is the result of a number of factors. The most important one among these are the large differences between the two areas in terms of federal ownership and federal nexi. Unlike in Montana, where over 80 percent of the proposed designation area is federally owned, in Maine only a very small part, 1.4 percent of the proposed designation area is in federal ownership. Likewise, the extensive federal nexi that exist

[264] By way of example, the economic benefits generated by the preservation of an acre of forest are the same, regardless of whether that acre was conserved by preventing residential development, preventing recreational development (campsites, trails, ski runs, etc.), or preventing infrastructure build-up.

on non-federal lands in the proposed Montana designation area is not found in Maine. Federal nexi only come into effect towards the end of the time period analyzed, in 2009 and 2012, respectively. These nexi cover less than a quarter (from 2009) or approximately half (from 2012) of the study area, depending on the particular land use categories covered.

The total forested area that would be taken out of development in Maine under CHD for the lynx is estimated at between eight and 22 acres (lower and upper bounds, respectively; see Table IV.4.c-5), which constitutes an insignificant amount of total lynx habitat in the proposed designation area. However, the various land use restrictions associated with lynx CHD are likely to have impacts on lynx populations that are disproportionately larger than the acreage of lynx habitat protected from development. The main reason for this are the protection of the respective limiting habitat type in every LAU and the reductions in habitat fragmentation and barriers to movement and dispersal, which together increase not just the ***quantity*** of lynx habitat but also its ***quality***, both of which increase lynx productivity. Especially in the case of timber harvest activities, the qualitative impacts are dominant, since we do not expect reductions in harvest volume, but rather relocation of harvest sites. In the case of hazardous fuel reduction and fire suppression activities, both habitat quantity and quality would be increased, while prevented residential development would primarily improve habitat quantity. Unlike in the case of the Montana study area, however, reductions in lynx mortality from CHD-related modifications to road projects are not expected in Maine.

The total impact of the reductions in habitat quantity and quality on lynx populations in Maine is very hard to estimate, not only because estimates of the total area on which deterioration of habitat quality would be prevented are speculative, but also because of the lack of data on lynx population numbers, reproduction rates, and kitten survival in Maine. It is, however, likely that the impact of CHD on lynx populations is considerably smaller in Maine than in Montana. In Maine, we expect lynx populations to be impacted only marginally by CHD. All increases in the low percent range are equally reasonable and equally arbitrary. To err on the conservative side, we assume that lynx populations in the study area under CHD would increase by one (lower bound) and two percent (upper bound) over BCS levels.

Single-point transfer WTP estimate

In section II.3 we discuss in detail the derivation of the single-point WTP transfer estimates for the lynx. We employ the same WTP estimates also in the Maine area, with the following three adjustments.

First, we adjust the WTP estimate of the Montana study area for the difference in the population-weighted average per-capita incomes of the counties in our Montana study area and those of our Maine study area. Based on Census Bureau data,[265] the counties in which the proposed lynx CHD area in Maine is located had an average population-weighted per-capita income in 2001 of $17,336 (in 1999 prices), 2.4 percent higher than that of our Montana study area counties. Hence, the per-capita WTP estimate of the Montana case study was increased by that percentage to take into account the income difference.

Second, the WTP estimate is adjusted downward for the much smaller expected increase in lynx populations from CHD in the Maine study area. Specifically, our per-capita WTP estimate for the Montana study area for a 25 percent lynx population increase, which was based on the WTP

[265] U.S. Census Bureau, *State and County Quick Facts*, at: http://quickfacts.census.gov/qfd/ , accessed Mar. 2004.

estimate for an equal-magnitude population increase of the river otter reported by White et al. (1997), adjusted to Montana study area income levels, had to be reduced to the one (lower bound) and two (upper bound) percent lynx population increases expected in Maine. Assuming a linear relationship between population increase and WTP for that increase, we multiplied the per-capita WTP values of our Montana study area by 1/25 and 2/25, respectively, after adjusting for income differences.

These two WTP adjustments are needed for the estimation of individual and aggregate WTP for lynx population increases in the Maine study area. To estimate the national-level WTP for increases in lynx populations in Maine, we employ Loomis' (2000b) value-distance function, as discussed in the Montana case study. However, the geographic position of the Maine study area relative to the US mean population center differs from that of the Montana study area. Specifically, the center of the Maine study area is located approximately 980 miles from the US mean population center, while the center of the Montana study area was located 1,260 miles from the mean population center of the US. Hence, the distance decay of WTP over the US population as a whole is smaller in the case of Maine (30 percent) than in the case of Montana (35 percent).

Since national-level per-capita WTP estimates for both study areas are derived from the same original WTP estimate (WTP for a 25 percent lynx population increase) and are taking into account the relative per-capita income differences between the study areas and the national level, they are consistent.

The WTP for lynx population increases of visitors to the study area is estimated analogously to that in the Montana case study. Of the total estimated 12.7 million marketable pleasure trips to Maine (i.e., from out-of-state) in 2001, 20 percent, or approximately 2.5 million, occurred in the "Maine Lakes and Mountains" area (ME DC 2003c). We make the conservative (i.e., benefit estimate-lowering) assumption that visitation from out-of-state individuals does not increase during our study period (2004-2013), although such increases are expected (ME LURC 1997).

The WTP estimates for lynx population increases in Maine generated by the single-point benefits transfer are shown in Table IV.4.c-1. For a one percent increase in Maine lynx populations, per-capita lump-sum WTP estimates based on the single-point value transfer are less than $1 for residents and individuals who do not visit the proposed designation area, and $1.60 for study area recreationists from out of state. For a two percent increase, the values range from one dollar to about $3.20. These values are not yet corrected for non-response rates.

Meta-analysis benefits transfer

The WTP estimates using Loomis and White's (1996) meta-analysis benefits transfer equation are derived as discussed in section III.4 of the Montana case study, but with the population change variable set at the Maine case study levels (one and two percent increase, respectively). The meta-analysis estimates are slightly higher than the single-point estimates (see Table IV.4.c-1).

In estimating aggregate WTP for the three populations, we multiply the per-capita WTP estimates shown in Table IV.4.c-1 by the non-response rates reported in the source studies.[266]

[266] In the case of the single-point values, WTP of residents is multiplied by the share of resident respondents in White et al. (1997) that was willing to pay the asking price (42.9 percent); visitor WTP was multiplied by the rest-of-US response rate of 54.4 percent reported in Loomis for a nationwide survey (2000b:316); and visitor WTP was multiplied by the average response rate of visitors reported in Loomis and White (1996). The meta-analysis WTP estimates are corrected for the response rates for visitors (60.0

Table IV.4.c-1: Per-capita WTP estimates for lynx population increase in Maine

Method of benefit estimation	*Percent increase in lynx population in study area*	*Average WTP per household in study area*	*Average WTP per visitor in study area*	*Average WTP for average non-area and non-visiting US household*
			all values in 2002 $	
Point value benefits transfer	1 %	0.59 lump sum	1.61 lump sum [1]	0.52 lump sum [2]
	2 %	1.19 lump sum	3.22 lump sum [1]	1.03 lump sum [2]
Meta-analysis benefit transfer	1 %	0.87 lump sum	1.88 lump sum	0.61 lump sum
	2 %	1.52 lump sum	3.29 lump sum	1.06 lump sum

Notes: [1] Based on ratio of visitor WTP to area household WTP (2.18:1) observed in meta-analysis WTP estimates. [2] Based on average area household WTP corrected for difference in average per-capita income between study area and US, and adjusted using WTP distance decay factor from Loomis (2000b).
Sources: Table III.4.c-2 in Montana case study, and adjustments described in text.

Interpreting non-response as expressing a zero WTP and correcting average per-capita WTP by the non-response rate generally is considered to generate conservative benefit estimates.

Table IV.4.c-2: Aggregate WTP estimates for lynx population increase in Maine

		Size of lynx population increase	*WTP [1] 2002$*	*Type of payment*
Point-value BT	Area households	1%	0.12 million	lump sum
		2%	0.24 million	
	Visitors [2]	1%	2.47 million	lump sum
		2%	4.95 million	
	Rest of US	1%	31.28 million	lump sum
		2%	62.56 million	
Meta-analysis BT	Area households	1%	0.17 million	lump sum
		2%	0.30 million	
	Visitors [2]	1%	2.90 million	lump sum
		2%	5.06 million	
	Rest of US	1%	36.78 million	lump sum
		2%	64.23 million	

Notes: [1] All WTP estimates adjusted for non-response rates reported in source studies. [2] Out-of-state visitors only.

Our lower-bound WTP estimate (see Table IV.4.c-3) for lynx population increases in Maine is based on an assumed lynx population increase due to CHD of one percent over the BCS, the single-point (lump sum) benefit transfer estimate, and the response rate adjustments to WTP described above. The upper-bound benefit estimate is based on the meta-analysis benefit transfer estimate and an assumed two percent increase in the Maine lynx population.

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percent) and residents (49.2 percent), based on the average of the respective response rates in the studies reported in Loomis and White (1996); the Rest-of-US per-capita WTP is adjusted for the average response rate of residents reported in Loomis (2000b; 54.4 percent).

Table IV.4.c-3: Upper and lower-bound WTP estimates for lynx population increases in the Maine study area

WTP estimate		*WTP* *PV(2003), 2002$* [1]
Lower-bound [2]	Area households [3]	0.12 million
	Visitors	2.47 million
	Rest of US	31.28 million
Upper-bound [4]	Area households	0.30 million
	Visitors [5]	5.06 million
	Rest of U.S. [6]	64.03 million

Notes: [1] All WTP estimates based on numbers in Table IV.4.c-2, adjusted for non-response rates in source studies. Upper-bound estimates assume constant average income and attitudes in study area and US as a whole. [2] Based on single-point estimate transfer for a 1 percent lynx population increase. [4] Based on meta-analysis benefit transfer estimate for a two percent increase in the lynx population. [5]Assumes visitor numbers remain constant at the 2001-2002 level. [6] Based on projected US population growth (US Census Bureau 2000).

The estimated WTP for the hypothetical lynx population increases in Maine for our four scenarios range from a minimum value of $2.6 million for the study area counties (narrow spatial boundaries, lower-bound impacts) to $69.6 million (wide spatial boundaries, upper-bound impacts) (see Table IV.4.c-4). The narrow boundary captures only the WTP of residents and out-of-state visitors to the proposed designation area, while the wide spatial boundary in addition includes WTP in the rest of the US. As pointed out in the methodology section, since the ESA is a national policy, the national level is the appropriate one for the aggregation of economic values across individuals.

Table IV.4.c-4: WTP for lynx population increase in Maine under narrow and wide boundaries

Spatial boundary	*Lower bound*	*Upper bound*
	PV(2003) in 2002$ [2]	
Narrow	2.6 million	5.4 million
Wide	33.9 million	69.6 million

Source: Table IV.4.c-3.

A cautionary note is in order regarding both the lower-bound and the upper-bound WTP estimate for lynx population increases in Maine. Both estimates derive monetary values for population changes that are far smaller than those in the source studies. For example, White et al. (1997) estimated WTP for a population change of 25 percent, while the estimated changes in the population of our target species in Maine range from one to two percent. By reducing our single-point transfer WTP estimates to 1/25 or 2/25, respectively, of the value of a 25 percent population change, we make the implicit assumption that WTP is a linear function of the magnitude of population change. The same is true for our transfer values based on the use of Loomis and White’s (1996) meta-analysis WTP function. That function was estimated from a sample of WTP studies that elicited WTP for population changes ranging from 30 to 100 percent, with the mean population change heavily tilted toward the upper of the two values. By using that function to estimate our upper-bound WTP value, associated with a population change of two percent, we apply the function outside of the region over which it was estimated. On the other hand, as discussed in section III.4.c, our WTP values also incorporate a number of conservative assumptions that would tend to correct upward biases that could result for the above-mentioned reasons.

Preservation of undeveloped landscapes

The value categories associated with undeveloped landscapes are shown in Table II.3-2. We focus here on the value of the ecosystem services the loss of which is expected to be prevented as a result of CHD for the lynx in Maine.

The only land use categories for which lynx CHD in Maine would result in the preservation of undeveloped forest ecosystems are recreation and residential development. As described in the impacts section (IV.3.c), impacts from changes in recreation development are expected to occur in the form of prevented construction of campsites, and cross-country and hiking trails. CHD impacts on residential construction take the form of on-site relocation of (planned) structures into non-Tier-1 habitat (25 in the upper-bound and six in the lower-bound impact scenario), modification of ancillary structures (103 in the upper-bound and 12 in the lower-bound impact scenario), and relocation to outside of the nexus area of units that don't move onto non-Tier-1 habitat on their properties (104 and 35, respectively, in the two scenarios). However, since the prevented developments that do not relocate on-site are assumed to relocate into nexus-free areas, they do not result in any net gains in terms of preservation of ecosystems in the proposed designation area. We use the same unit estimates of preserved ecosystem area as in the Montana case study. A development that relocates on-site into non-Tier-1 habitat is assumed to prevent the loss of forest ecosystem equivalent to the footprints of the main and ancillary structures, including vegetation clearing for driveway and landscape changes, which we assume to amount to an average of 4,500 sq. ft. (or 0.10 acre) of forest lost per residential development in lynx habitat. Developments that require modifications in the project design (i.e., in the alignment of ancillary structures) are assumed to yield ecosystem area savings equivalent to the area occupied by those structures (2500 sq. ft., or 0.06 acres).

Since CHD would impact residential construction activity only from 2009 on, it would generate ecosystem service benefits only in the last five years of the period covered in this analysis.

In the proposed Maine lynx CHD area, CHD is expected to prevent the loss of only an insignificant amount of forest, estimated at between eight and 22 acres of forest (see Table IV.4.c-5). The estimation of the ecosystem service value generated by this area is based on the unit values of forest ecosystem services presented in Table II.3-2 ($109 per acre per year). Due to the small area that CHD is expected to prevent from conversion in Maine, the PV of these benefits is small, estimated at between approximately eight thousand and 21 thousand dollars (see Table II.3-2)

Table IV.4.c-5: Estimated prevented loss of forest ecosystems in Maine from land use activity restrictions attributable to lynx CHD

Land use activity	*Prevented loss of forest ecosystem*	
	Upper bound	*Lower bound*
	acres	
Recreation [1] [4]	13.6	6.8
Residential development	8.5 [2]	1.3 [3]
Total	22.1	8.1

Notes: [1] Hiking and cross-country trails, and campsites. [2] 103 units with modifications to ancillary structures and 25 units relocated on-site onto non-Tier-1 habitat. [3] 12 with modifications to ancillary structures plus 6 units relocated on-site onto non-Tier-1 habitat. [4] Assuming an average area of 324 ft^2 for each camp site, and an equivalent area per site to account for space between sites, and space requirements of entrance roads and bathrooms on the campground; assuming average width of hiking and cross-country trails of three feet.
Sources: Table III.3.c-5 and III.3.c-6; III.3.c-17 and accompanying text.

Table IV.4.c-6: Estimated present value (PV) of the ecosystem service benefits generated by lynx CHD in Maine study area

Land use	*Ecosystem service value*	
	Upper bound	*Lower Bound*
	2002$ (PV)	
Recreation	13,003	6,497
Residential development	3,796	581
Total	16,773	7,078

Notes: Present values (2003) of annual benefit flows during ten year time period considered in this analysis, at three percent annual discount rate.
Source: Table II.3-2 and Table VII.4.c-5.

A comparison of the estimated value of lynx conservation and ecosystem services generated by lynx CHD in the proposed designation area in Maine shows that the former clearly dominates the latter, by more than two to more than four orders of magnitude, depending on the choice of impact estimates and boundary setting (see Table IV.4.c-7).

The lower-bound estimate of the benefits of CHD in Maine is likely a considerable underestimate, for a number of reasons. The most important is the WTP transfer approach used in the estimation of the lower-bound benefits. The lower-bound benefit estimate contains a WTP estimate for lynx population increases that is based on a single-point transfer from another species (the river otter); the benefits transfer literature suggests that estimates based on functional transfers generally have lower errors, especially in the case where the object of valuation differs between study and policy site. The function transfer-based WTP estimates yield much higher benefit estimates for lynx population increases than our single-point WTP estimates (about three times higher). Since the benefits of lynx population increases make up close to 100 percent of total estimated benefits from lynx CHD, the lower-bound benefit estimate of lynx CHD could therefore justifiably be set at approximately eight times the value of our lower-bound estimate. Hence, our lower-bound estimate would seem to be extremely conservative.

Table IV.4.c-7: Total estimated monetary value of benefits from lynx CHD in Maine study area

Value object	*Boundary* [1]	*WTP* *Upper bound*	*Lower bound*
		PV(2003) in 2002$ [2]	
Lynx conservation	Narrow	5,361,519	2,592,409
	Wide	69,594,273	33,872,253
Undeveloped landscapes			
Avoided loss of Ecosystem	Narrow	16,773	7,078
Function Values	Wide	16,773	7,078
Total Value	Narrow	5,378,292	2,599,486
	Wide	69,611,046	33,879,331

Notes: [1] The narrow boundary includes only study area and counties in which it is contained; the wide boundary includes all of US. [2] A three percent annual discount is used in the PV calculations.
Sources: Tables IV.4.c-6, IV.4.c-4.

A second downward bias in all of our benefit estimates derives from the fact that we only include those ecosystem service values in our analysis for which monetary estimates have been developed in the literature. Hence, our estimates of the avoided loss of ecosystem services that would result from lynx CHD are necessarily incomplete, and do not include such services as nutrient cycling, soil retention, disturbance regulation, or gas regulation. Given the small forest area that lynx CHD would preserve, however, the omission of these values does not have a substantial impact on our total benefit estimates.

IV.5 Comparison of Costs and Benefits of CHD for the lynx in Maine

A comparison of costs and benefits of CHD in the proposed Maine designation area shows that in three out of the four scenarios, expected benefits outweigh expected costs (see Table IV.5.a-1). Only in the high impact scenario under the narrow boundary setting is designation expected to result in net costs.

Table IV.5.a-1: Local and national-level costs and benefits of designating CHD in Maine study area

Impacts of lynx CHD	*Boundary selection* [1]	*Upper bound*	*Lower bound*
		PV(2003) in 2002$ [2]	
Benefits	Wide	69,611,046	33,879,331
Costs	Wide	10,139,451	1,630,475
Benefits	Narrow	5,378,292	2,599,486
Costs	Narrow	10,944,225	1,736,897

Notes: [1] Narrow boundary includes only study area and counties in which the latter is located; wide boundary includes all of the US. [2] At three percent discount rate.
Sources: Tables IV.4.b-19, IV.4.c-7

In the other three scenarios, benefits outweigh costs by a considerable margin. The estimated net benefits for the four scenarios are shown in Table IV.5.a-2.

For the wide boundary scenarios, which estimate the economic impacts of the designation on the national level, benefits are expected to outweigh costs by factors of 7 and 21 for lower-bound and upper-bound impact estimates, respectively. Under the national-level study boundary, estimated net present value (PV) benefits from designation in Maine range from $32 to $59 million (see Table IV.5.a-2). The high impact scenario under narrow boundaries yields a net cost estimate of $5.6 million.

Table IV.5.a-2: Net benefits and benefit-cost ratios of CHD impact scenarios in Maine (Present values)

Boundary [1]		*Upper bound*	*Lower bound*
Wide	NB	$59,471,594	$32,248,856
	BCR	6.9	20.8
Narrow	NB	-$5,565,933	$862,589
	BCR	-0.5	1.5

Notes: Net benefits (NB) in PV (2003) in 2002$; BCR - benefit-cost ratio.
Source: Table IV.5.a-1

Our estimates of the benefits of lynx conservation in Maine are subject to somewhat increased uncertainty compared to those in Montana because they are based on the application of benefit estimates or functions to population changes that are very different from those in the source studies. Conceivably, then, our lynx conservation benefit estimates could be biased upwards, if it was the case that WTP for such small population increases is less than proportional to WTP for the larger population increases examined in the source studies. However, the fact that our lower-bound benefit estimates for lynx conservation, being based on a point value transfer, are likely to be biased downward considerably (the function transfer WTP for a one percent population increase are about three times larger), would tend to counteract this overestimate.

IV.5.b Distribution of costs and benefits by land ownership

In Maine, the share of costs of CHD falling onto federal land owners is smaller than that falling on non-federal land owners (see Table IV.5.b-1). Under both spatial boundaries, costs on non-federal land owners are between 30 and 50 percent higher in the low-impact scenario; under high impacts, the ratio is much higher, ranging from slightly less than four to slightly more than four. Table IV.5.b-1 is derived by aggregating costs of CHD for each land owner over all land classes (see Table IV.3.a.ii-4).

In order to develop estimates of the per-acre cost of CHD by land ownership, the consultation costs incurred by the FWS for projects not located on FWS lands must be assigned to the appropriate land ownership. For example, the Service's consultation costs for timber management projects must be assigned to the respective FS and private lands on which those projects are located.

Table IV.5.b-1: Total local and national-level costs of CHD for lynx in proposed Maine designation area, by land ownership type

Land Ownership	*Narrow Boundary*		*Wide Boundary*	
	Lower-bound	*Upper-bound*	*Lower-bound*	*Upper-bound*
Federal lands				
FS	$309,144	$693,930	$306,942	$669,623
FWS	$359,352	$1,426,236	$359,352	$1,426,236
NPS	$24,805	$66,340	$24,805	$66,340
Total fed lands	$693,301	$2,186,506	$691,099	$2,162,199
Non-federal lands w/nexus				
ME DOT	$28,454	$28,454	$28,454	$28,454
Private lands	$1,015,142	$8,729,264	$910,922	$7,948,797
Total non-federal w/ nexus	$1,043,596	$8,757,718	$939,376	$7,977,251
TOTAL	$1,736,897	$10,944,224	$1,630,475	$10,139,451

Note: Consultation costs are included, assigned to the relevant land ownership.

By assigning the FWS consultation costs to the appropriate land ownership and dividing total costs of CHD for each land ownership by the number of acres held by that owner, the average costs of CHD for each land ownership can be derived, expressed as dollars per acre (see Table IV.5.b-2). The per-acre cost estimates clearly show that designation costs per acre are highest on federal lands, where they range from $5 to $11 per acre for all federal lands pooled. On non-federal lands, estimated costs per acre are an order of magnitude smaller, ranging from $0.2 to $1.4 per acre for all non-federal lands pooled.

Table IV.5.b-2: Estimated average per-acre cost of CHD for the lynx by land ownership; Maine

	Low	*High*
	$/acre	
FS	7.1	16.2
FWS	1.1	4.2
NPS	1.6	4.3
ME state lands	0.1	0.1
Private lands	0.2	1.5

Notes: Low and high cost estimates based on lower bound and upper bound impact scenarios, respectively. Costs expressed as PV(2003) in 2002$.
Sources: Tables IV.2-1 and IV.5.b-1.

The lower costs of designation on non-federal lands is not surprising, given that the majority of those lands in the Maine study area do not have a federal nexus, while those that do have such a nexus do not develop it until the final years of the period under analysis. For the study area as a whole, the estimated average cost per acre of CHD for the lynx ranges from $0.2 per acre (lower bound) to $1.5 per acre (upper bound).

These average costs per acre are lower than in the Montana study area for which average per-acre costs of CHD for the lynx were estimated to be between $1.3 (lower-bound impact scenario) and $4 (upper bound if the mine area is excluded or the mine is not prevented by lynx CHD) or $29 per acre (upper bound if the mine is prevented by lynx CHD).

V. Sensitivity analysis: Confidence in results and external relevance of findings

The estimation of both costs and benefits of critical habitat designation in our two study areas is based on a series of assumptions. Such assumptions are unavoidable if cost and benefit estimates are to be constructed in the face of imperfect information and the uncertainties that characterize any projection of human activities. Our approach throughout the study has been to deal with these uncertainties by defining ranges of reasonable values for those variables for which available information was insufficient to construct impact estimates. These ranges of assumptions result in our lower-bound and upper-bound estimates of costs and benefits of critical habitat designation for the lynx.

All assumptions, as well as their implications for the results, are discussed in the respective cost and benefit sections of our two case studies. In this section we examine to what degree potential biases in some of these assumptions could critically affect the main finding, namely, the expectation that designation of critical habitat for the lynx would generate considerable net benefits in both study areas in all impact scenarios. In doing so, we focus specifically on potential biases in our benefit estimates. This focus is justified as the central premise advanced in this study is the necessity of including benefit estimates in economic analyses of the impacts of CHD, and because our benefit estimates are derived with the use of specific valuation methodologies that we suggest be employed in benefits estimation.

In addition to discussing the impact of potential biases in benefit estimates, we discuss the external validity of our per-acre costs estimates of CHD by land ownership. The applicability of these cost estimates to areas outside of those examined in the present study is central to their usefulness in compiling rough approximations of the costs of CHD for the lynx in those areas.

V.1 Impacts of potential biases in benefit estimates

As discussed in section III.4.c, there are a number of issues associated with basing benefits estimation on stated preference techniques. However, these issues can be addressed through careful study design and implementation, with the exception of those associated with using CV for the valuation of ecosystem function services. Importantly, willingness-to-pay (WTP) estimates that are obtained using the CV method have shown to be generally similar to those obtained with the help of revealed preference methods (see Hanemann 1994).

Since we are utilizing existing studies to derive our benefit estimates, it was of paramount importance to ensure that those studies employed high-quality survey instruments. In addition, it was important that their results were internally consistent and also were consistent with standard economic axioms. Our source studies fulfill all of the above requirements (Loomis and White 1996; White et al. 1997).

To ensure the conservative nature of our benefit estimates, that is, to avoid their being biased upward, we employed the respective adjustments commonly suggested in the economic literature. The most important among these are the interpretation of no response as expressing a zero WTP, and the use of a value-distance decay function to estimate WTP across populations living at different spatial distances from the good being valued.

In addition, our lower-bound WTP estimates for lynx population increases are constructed using single-point value transfer. Since the single-point value estimates are considerably lower than those that would result from using benefit function transfer, which is the benefits transfer approach identified in the literature as the preferred one, our lower-bound benefit estimates are likely to be particularly conservative.

Despite having taken these precautions to guard against upward biases in benefit estimates, our benefit estimates could still be somewhat overstated. This would be the case if, despite our efforts to ensure that the species we use for benefits transfer have a public image and use profile comparable to that of the lynx, people had a higher WTP for the source species than for the lynx. Even if this were the case, however, our findings of positive net benefits of lynx CHD would not necessarily be incorrect. To show why this is so, we consider by how much our WTP estimates for the lynx would have to be overestimated in order to reduce our net benefit estimates of lynx CHD to zero.

Given that the estimated benefits of lynx CHD in all scenarios are substantially larger than costs, those benefits would have to be overestimated by between 85 and 97 percent in the wide boundary scenarios, and between 13 and 33 percent in the narrow boundary scenarios to reduce estimated net benefits of CHD to zero (see Table V.1-1).

Table V.1-1: Percentage of overestimation of WTP for lynx conservation at which net benefits of lynx CHD would be reduced to zero

		Lower bound	*Upper bound*
Maine	**wide**	**95 %**	**85 %**
	narrow	33 **%**	n.a. [1]
Montana	**wide**	**96 %**	n.a. [1] / **97 % ***
	narrow	25 **%**	n.a. [1] / 13 **%** *

Notes: * Without / with exclusion of mine area. [1] n.a. because estimated net benefits in this scenario are negative.

In other words, given that the national-level (wide) impact analysis is the relevant one from a policy analysis perspective, WTP for lynx population increases would have to be overestimated by approximately 100 percent for CHD to produce no net benefits for society. Even if WTP were overestimated by that much, designation of critical habitat for the lynx would still create benefits that would fully balance its associated costs.

Total estimated net benefits for the two study areas combined

If critical habitat were designated in the proposed study areas of Maine and Montana, total national-level benefits from that designation may be slightly smaller than the sum of the national-level benefits associated with each of the two designation areas. The reason for this is that the out-of-area benefits that designation in each study area generates in the other study area may be overestimated if designation were to occur in both areas. This presumption is based on the assumption that residents in one study area would have a lower WTP for lynx conservation in the other study area if lynx conservation would also occur in their area. The basic economic principle underlying this argument is that of decreasing marginal utility.

However, the overestimate of benefits that would result from simple aggregation of the two individual case study benefit estimates is likely to be small. This is due to the small share of the total U.S. population that resides in the two study areas or that visits them, and to the long distance between the two areas. This distance leads to low estimated WTP of residents in one study area for lynx conservation in the other area, because of the large WTP distance decay coefficient.

V.2 Transferability of cost and benefit estimates to other areas

Cost estimates

One reason we developed estimates of the per-acre cost of designating critical habitat for the lynx for different land ownership types (see Tables III.5.b-2 and IV.5.b-2) was to compare costs across different ownership types. An additional purpose of those estimates, however, is that they may be used to construct rough approximations of the costs of designating critical habitat for the lynx in areas that lie outside of our study areas.

Our two case study areas differ substantially in their levels of baseline protection for lynx, and in the intensity and relative importance of major land use activities characterizing particular land classes. These differences result in marked differences in per-acre costs of lynx CHD between the study areas. Therefore, the transferability of our per-acre cost-estimates to other areas depends crucially on selecting that case study that most closely resembles the target area in terms of baseline restrictions, land cover, current land use activities, and expected future trends in these activities.

Table V.2-1 makes clear why it is important to carefully select the more appropriate of the two case studies as a basis for generating cost approximations for other areas. The table shows the ranges of per-acre costs in our two study areas for the two most basic land ownership classifications, federal and non-federal lands. The ranges in each case are based on the lower and upper bounds of cost estimates. Despite of the fact that the cost range for each land class in a case study area is quite large, with the upper bound being as much as seven times as high as the lower bound, the cost ranges of each land class for the two study areas do not overlap. As a result, the total range of potential average per-acre costs for each land class across our two study areas is very large, with upper bound costs generally more than an order of magnitude higher than lower bounds, and almost two orders of magnitude higher for non-federal lands (see right column in Table V.2-1). Therefore, the challenge of selecting the more appropriate of the two case studies cannot be avoided by instead resorting to using the total range of per-acre cost estimates for each land class found in our two areas, because the range of the resulting cost estimates would be so large as to make these estimates of little use.

Table V.2-1: Per-acre cost ranges for federal and non-federal lands in the two study areas

Land Ownership	*Montana **	*Maine **	*Total range*
		$/acre	
Federal lands	1 - 2	5 - 11	1 - 11
Non-federal lands	3 - 11 (141)	0.2 - 1.4	0.2 - 11
All lands	1.3 - 4 (29)	0.2 - 1.5	0.2 - 4

Notes: * Figures indicate cost ranges for pooled federal and pooled non-federal lands, respectively. All values in PV (2003) and 2002$.
Sources: Tables III.5.b-2 and IV.5.b-2.

It is important to note that both of our case study areas cover vast spatial expanses (more than seven and eight million acres, respectively). Therefore, the per-acre cost estimates for particular land ownerships represent averages that may not be representative of any particular subpart of the total area in that ownership. On the other hand, precisely because of the large area included in this analysis, the land ownership-specific average per-acre costs for each of the two areas as a whole are less likely to be distorted by local idiosyncrasies, that is, particular areas with particularly high or low costs. For these two reasons, the appropriateness of using our per-acre cost estimates as first-order approximations of costs of CHD for the lynx in other areas is generally positively correlated with the size of those target areas.

Benefit estimates

As discussed in chapters III and IV, the paucity of available information on lynx populations, lynx morbidity mortality, and elasticities of lynx populations to changes in specific land use activities in the two study areas make impossible the estimation of the benefits of lynx CHD for specific land ownerships or land classes. For this reason, we chose a range of lynx population increases for each of the respective areas as a whole. For the same reason, it is not possible to derive estimates of the benefits of lynx CHD per acre. Estimates of the benefits of lynx CHD for other areas can be developed by applying the methodology we present in section III.4.c.

VI. Conclusions

This study was inspired by a strongly perceived need to highlight several important issues with respect to FWS's current economic impact analyses of the designation of critical habitat, and to suggest how these shortcomings may be corrected.

The two crucial issues in FWS's economic impact analyses result from, first, using definitions of the key terms "jeopardy" and "adverse modification" that make the two virtually indistinguishable, and second, the complete omission of any monetary valuation of the benefits from designation of critical habitat.

Defining jeopardy and adverse modification in essentially identical terms is a clear contradiction to Congressional intent as expressed in the ESA, and the practice has been held facially invalid (Sierra Club v. US Fish and Wildlife Service 2001). The definition of these terms is essential in constructing the baseline and the impact estimates in any analysis of critical habitat designation. Conflating the definitions of jeopardy and adverse modification, the Service then proceeds to argue that designation of critical habitat does not provide any benefit to species.

The incremental impacts can be identified by literally interpreting the adverse modification provision of the ESA. Under such literal interpretation, designation of critical habitat prohibits any action that would reduce habitat quality or quantity for the species in question. Such construction of the meaning of adverse modification should, in most cases, allow a clear distinction of the baseline (protection afforded to the species in the absence of designation, including those protections provided by the jeopardy provisions) and designation scenarios.

The second paramount issue concerning the Service's economic impact analyses of critical habitat designation is the lack of any estimates of monetized benefits from designation. The existence of such benefits, as well as methods for their quantification in monetary terms, have long been identified in the fields of environmental and natural resource economics. Most importantly, there is nothing that suggests that monetized benefit estimates are characterized by inherently larger uncertainties than are monetized cost estimates. Moreover, the development of benefits estimates that are, in uncertainty terms, on a par with the cost estimates given in the Service's economic analyses, does not necessarily require a disproportionate commitment of resources on the part of the Service. Rather, with the same effort currently devoted to the monetization of the costs of designation of critical habitat, high-quality benefits estimates could be developed. There is, therefore, no justification for excluding economic benefits from impact monetization. To argue that this additional resource commitment is not feasible, and that instead all effort should continue to be committed to the cost side, is disingenuous. If the Service's resources do not allow the preparation of complete economic analyses, then arguably it would be better not to pursue any economic analyses at all rather than ones that deliver findings that tend to systematically distort the decision-making process through their lack of balance.

The present study offers a template for how to construct conceptually complete economic analyses of the impacts of critical habitat designation. Importantly, it does so not by advancing some new, untested approaches, but rather by applying methodologies and concepts that have long been well-established in economics.

One would be hard-pressed to imagine a time of higher urgency for balanced economic analysis than the one we find ourselves in today. The stream of unbalanced analyses of the economic impacts of critical habitat designation with their exclusive focus on the cost side have undoubtedly played their part in precipitating the current attempts to weaken the critical habitat provisions of the ESA. These attempts take the form of H.R. 2933 (U.S. Congress 2003), which proposes substantial changes to the critical habitat provisions of the ESA that would make the designation of critical habitat essentially discretionary, and very likely would result in weakening the protection of threatened and endangered species.

This study compiles a comprehensive blueprint of the cost and benefit categories potentially affected by the designation of critical habitat, and presents different approaches to quantifying these benefits in monetary terms. It then uses the lynx (*Lynx Canadensis*), a species listed as threatened under the ESA but as yet without designated critical habitat, as a case study for applying the blueprint and conducting a comprehensive analysis of the economic impacts of critical habitat designation.

The impact analysis presented in this study differs from those done by the FWS in four key aspects. First, based on established economic theory, we identify the full range of categories of economic costs ***and*** benefits generated by the designation of critical habitat. Second, we do not limit the analysis of impacts to specific sectors of the economy, such as the real estate sector or the timber industry, but include all sectors. Third, we develop estimates of economic impacts not just for the local level, but also for the nation as a whole. Forth, using well-established economic methodologies, we develop quantitative estimates of the economic benefits of the designation.

Because the total area identified in the lower 48 States as suitable habitat for lynx conservation exceeds 130,000 square miles, a detailed analysis of the entirety of this area exceeds the resources of this study. Instead, we chose two study areas that are likely to represent the extremes on the scale of impact severity that designation might cause. Since these impacts are in large measure dependent upon the land ownership composition of the studied area and the existence of a federal nexus, we chose northwestern Montana and western Maine as our case study areas. These two represent the extremes of federal and non-federal land-ownership found in lynx habitat in the lower United States: fully four-fifths of the lands in our Montana study area are federally owned, while only one one-hundredths of the Maine study area is federally owned.

To appropriately deal with the uncertainties in the impacts resulting from designation, we developed low-impact and high-impact scenarios that are likely to capture ranges of possible impacts. In addition, we employed two spatial study boundaries, one of which considers the economic impacts of designation on only the counties that are in our respective study areas, while the other considers all impacts across the United States. The latter boundary is the correct one from a policy analysis perspective, given that the designation is the result of a federal law, the ESA, and generates impacts across the U.S.

Our results show that in seven out of the eight scenarios (combining different spatial boundaries of analysis and high and low impact estimates) examined, benefits of designation are expected to surpass costs, assuming that the McDonald gold mine area in Montana would be excluded from designation. In several of these seven scenarios benefits are expected to outweigh costs by a substantial margin. Only in one case, the high-impact scenario counting only local impacts, would designation be expected to generate net costs in Maine.

Importantly, our results also confirm that the generation of defensible benefit estimates is possible through application of standard methodologies from the fields of environmental and natural resources economics, and that it is so at a level of effort that is commensurate with that commonly devoted to the construction of defensible cost estimates.

Furthermore, our analysis shows that there is no obvious difference in the magnitude of the uncertainties that characterize the hierarchies of assumptions necessary to estimate both costs and benefits of designation. Therefore, the argument commonly advanced by the FWS, that benefits estimation is not feasible given resource constraints, is unfounded.

It is important to recognize that economics is an analysis tool that can be helpful in evaluating particular aspects of policy decisions. It is not the only, nor necessarily the primary, approach to identifying what may be considered wise public policies. The principal reason is that economics, and cost-benefit analysis in particular, are not value-free, because they define the optimal policy as that which conforms to the particular economic definition of efficiency (Sagoff 1988). Hence, basing policy decisions on economic analysis alone is tantamount to espousing efficiency as the primary goal of society. In a democratic and just society, however, there exist a multitude of other, often competing goals, and conflicts between these can only be resolved in a legitimate way through the political process.

We do not argue that cost-benefit analysis is the preferable approach to decision-making. However, if economic arguments are brought to bear on the policy deliberation process, as is the case with the ESA in general and critical habitat designation in particular, then great care must be taken that the economic tools applied to policy analysis are employed in a balanced and unbiased fashion. If that is not the case, as is true for most of the Service's "economic impact" analyses of critical habitat designation, then the positive contribution that economic analysis can make to reaching a fuller understanding of the implications of the policy at hand is, at best, grossly diminished. At worst, in cases where economic aspects weigh heavily in the decision-making process, biased economic analyses tend to degrade the quality not only of the deliberation process, but also of the final decision.

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