SECTION TWO

Elements of ESA-Related Conservation Planning

Conservation planning is an interdisciplinary process that can involve many stakeholders and goals. Here we identify four elements — scientific integrity, meaningful public input, adequate funding and legal enforcement — that are essential for effective conservation planning. Each of these elements is described in detail. Highlights from plans are noted and national trends are discussed.

Science

Biological information and scientific principles underlie the entire process of conservation planning. For each plan, there must be ecological information on the species concerned, survey information for the planning area and a monitoring program to track population and habitat changes. A variety of biologists need to be involved in plan development, including independent scientists with no financial stake in the outcome of the plan. Scientific principles must be applied to various aspects of the plan, from preserve design to habitat and species management. Here, we address how the plans that we reviewed have incorporated these basic scientific considerations.

Design of Conserved Areas

Geographic Scope of Planning

According to the FWS and NMFS HCP handbook, "neither the ESA nor its implementing regulations limits the size of an HCP planning area.... HCP boundaries should encompass all areas within the applicant's project, land-use area, or jurisdiction within which any permit or planned activities likely to result in incidental take are expected to occur" (pp. 3-11, FWS and NMFS 1996). Given this flexibility, there is one simple aspect of plans that can improve conservation planning from the very beginning: the ability to define the plan's geographic scope in a biologically relevant manner. This advantage is not possible in traditional HCPs under Section 10 of the ESA. Rather than defining the planning area according to biologically determined criteria (i.e., watershed, community type, ecosystem, etc.), traditional single-landowner HCPs are designed around an area where the landowner wishes to conduct activities that result in incidental take (O'Connell and Johnson 1997). Nevertheless, in two programs, for southern California and for the sandhills region of North Carolina, the federal government has overcome this apparent limitation.

First and most importantly, in the first pilot program for the NCCP in southern California, the geographic area is defined by the extent of coastal sage scrub remaining (rather than jurisdictional boundaries). At the beginning of the program, a scientific review panel of five prominent conservation biologists was assembled to develop very general guidelines for conservation of coastal sage scrub, based on ecological information. When the coastal California gnatcatcher was listed as threatened, this comprehensive view of coastal sage scrub (the bird's habitat) was essential in implementing immediate regulations on development and providing the basis for an ecosystem-wide planning effort.

On a much smaller scale, the safe-harbor program for red-cockaded woodpeckers in the sandhills region of North Carolina was also delineated by a physiographic region. The sandhills region supports one of the largest remaining red-cockaded woodpecker populations and is one of 15 designated recovery populations (FWS 1985). The region contains woodpeckers on state lands and on Fort Bragg Military Reservation, but those two areas are not adjacent to each other, and 30 percent of the known woodpecker groups in the region occur on private lands that lie in between or proximate to the two tracts of public land. Those private lands are targeted for agreements under the sandhills safe-harbor program.

Preserve Design

Preserve design is especially relevant to the large-scale plans that establish a system of preserves or special management areas, including plans for urban areas (e.g., Balcones Canyonlands Conservation Plan), large single-landowner plans (e.g., Plum Creek Timber Company) and plans for individual species (e.g., Louisiana Black Bear). In a general sense, these plans consist of designating certain areas where development or other activities that destroy habitat are permitted and certain areas where habitat will be conserved. The amount, quality and spatial configuration of the preserved habitat is central to the plan's success in sustaining endangered species. Consequently, the preserve design must be based on an adequate understanding of which habitats are occupied by endangered species, population estimates for those species and identification of appropriate unoccupied habitat. Some plans contain the implicit assumption that preserve areas will function to sustain viable populations of various species (e.g., the golden-cheeked warbler under the Balcones Canyonlands plan and the MSCP in San Diego). To succeed, these plans must provide: (1) preserve areas which can sustain breeding individuals, (2) ways for those individuals to move between the preserve areas and (3) protection for unoccupied habitat, so that such habitat remains suitable for future colonization.

The first requirement of preserve design is for the protected areas to sustain breeding individuals. In order to accomplish this, management actions must be based upon a summary and analysis of life history information, foraging ecology (including understanding the relationship between foraging habitat and reproductive success), nesting or breeding requirements, predation and disease (natural threats) and human-caused threats. Unfortunately, there is often not enough information about the requirements of species to determine whether a given plan will address these factors. Moreover, because habitats vary geographically, cookbook habitat prescriptions for particular species are inappropriate, and planners must often gather specific information for particular conservation plans.

This difficulty in establishing preserves based on scientific information is obvious in planning for two comparatively well-studied bird species: the northern spotted owl and the red-cockaded woodpecker. For the spotted owl, controversy has persisted for years about how much area is required to sustain a typical breeding pair of owls. In the early 1970s, the Oregon Endangered Species Task Force asked leading spotted owl biologist Eric Forsman what minimum area would be required for owl pairs. He said:

> Well, all we know is we have yet to find a pair of them in an area where there is less than about 300 acres of old growth. That's how scientific it was.... It was the biggest mistake we could have made, because it turned out in the late seventies, after we started looking at some telemetry data, it was obvious that 300 acres wasn't even close to being enough in most areas. (from Yaffee 1994)

Since then, numerous studies using radio telemetry were performed to determine what acreage the owls use, and what acreage defines a "core area" that owls use most intensively (e.g., Carey et al. 1990, Zabel et al. 1995). Today, landowners (without HCPs) avoid taking owls by maintaining proper late successional habitat for owls in a circle with a radius of 1.8 to 2.7 miles from an owl nest. Unfortunately, even this information is insufficient in determining what minimal area owls require in order to breed successfully, given that habitat requirements vary dramatically according to geographic regions (Bingham and Noon 1997).

A similar heated debate over habitat requirements for red-cockaded woodpecker groups has occurred as well. Jerome Jackson, a professor at Mississippi State University who has been studying red-cockaded woodpeckers for 30 years, has observed that woodpeckers utilize 100 to 1,000 acres of forest. Nevertheless, there is little biological information on the minimum foraging requirements of breeding woodpeckers (necessary to avoid take), and a peer-reviewed study found no association between woodpecker nesting success and the availability of pine trees or degree of fragmentation (Beyer et al. 1996). Amidst this controversy, in 1985 the U.S. Forest Service adopted the recommendations of the 1985 Red-Cockaded Woodpecker Recovery Plan for 125 acres of habitat for each group, combined with other requirements (USFS 1985). In 1992, in response to a demand from private landowners for information on what would be required for them to avoid take, FWS produced a manual for private lands (FWS 1992a). Without scientific justification, this manual only requires half as much foraging habitat as required on federal land. Moreover, these requirements apply to landowners throughout the woodpecker's range, even though habitat requirements are dramatically variable among geographic regions. Clearly, private landowners have benefited from this geographic variability and uncertainty concerning woodpecker habitat.

Although this issue of minimal foraging requirements is unresolved, the private lands manual contains a clearly risky strategy in allowing private landowners to have substantially reduced requirements for woodpecker habitat. Not only has the manual for private lands governed take prohibitions since 1992, but it is the basis for the baseline requirements of landowners in safe-harbor agreements like the sandhills program and various statewide HCPs for red-cockaded woodpeckers. Landowners who participate in the safe-harbor program must maintain only 60 acres of habitat per woodpecker group that lives on the property today. The agreements extend for 99 years. Therefore, if new scientific information indicates that current regulations are insufficient, the baseline cannot increase.

In addition to the difficulty of defining necessary amounts of habitat for species, still less is known about what actually constitutes landscape connectivity or corridors between preserved areas. There is, in fact, no clear scientific consensus on whether corridors facilitate movement for target species (Cox 1992) and whether the potential benefits of wildlife corridors, such as demographic support and prevention of genetic inbreeding (Noss 1987), outweigh the potential problems, such as facilitation of the spread of disease or exotic species between preserves, and the economic cost of setting aside corridors (Hess 1994; Simberloff and Cox 1987; Simberloff et al. 1992). In addition, corridors designed for particular target species may not function effectively for other taxa (e.g., a large mammal corridor under a highway may not help some invertebrates). Moreover, focusing on corridors may overlook other important aspects of landscape connectivity, such as the habitat quality of all elements of a planning area and their spatial configuration (Taylor et al. 1993). Nevertheless, conservation planning must allow for movement of individuals between preserves of high quality habitat, especially when (1) areas not set aside for habitat will certainly be converted or degraded and (2) habitat patches by themselves do not sustain viable populations.

The third essential component is the protection of areas that are not currently occupied by endangered species to prevent the species from becoming limited to current locations without the ability to move to new areas if necessary. This is one respect in which conservation plans can go beyond the prohibition of "take" in the ESA, in which landowners must not harm occupied habitat. This protection must be tied to monitoring that can determine whether unoccupied areas become colonized. Unfortunately, it will be extremely difficult to understand how animals colonize unoccupied, protected habitats when some monitoring programs keep track only of occupied habitats to determine when they are abandoned, as occurs with many HCPs in the Pacific Northwest for the northern spotted owl (e.g., Weyerhaeuser Willamette draft HCP).

In our critiques of preserve designs established in particular plans, it is important to keep in mind that some plans reviewed here did not establish preserves to mitigate for take occurring under the plan, or failed to be consistent with recovery in other ways. The Ben Cone HCP, for example, authorized take of 12 red-cockaded woodpecker groups without the requirement of setting aside preserves for woodpeckers elsewhere. Such unmitigated habitat loss is clearly worse than insufficient preserve design, and such examples are discussed elsewhere in this report (see Incidental Take, Minimization and Mitigation).

Positive Examples

Of the HCPs reviewed here, plans developed for timber harvest management in the Pacific Northwest (including the Washington DNR HCP, the Weyerhaeuser Willamette Timberlands HCP and the Plum Creek Timber Company HCP) include substantial reductions in timber harvest in riparian buffers. These companies are undertaking these conservation measures in order to improve habitat conditions for salmon species, and these measures are considerably more protective than state regulations for riparian buffers. For example, salmon spawning areas must have large woody debris and reduced sedimentation, which translates to reduced timber harvesting along streams and management practices to reduce erosion. With a high likelihood that some salmon species will be listed during the timeframe of these HCPs, it has become very important to have conservation strategies for salmon in these HCPs, even though no salmon conservation is required under the ESA before the species are proposed to be listed.

It is unknown what forest practices will be required for riparian areas when salmon species are listed, but it may be substantially more protective than current state regulations. Currently in Washington, state forest practice rules allow some harvest within 25 feet of streams, and non-fish-bearing streams have no minimum width of riparian management zones, which allows intensive harvest next to the stream. This contrasts sharply with federal lands. The scientific assessment team that developed recommendations for the Northwest Forest Plan established much larger buffers of 300 feet on fish-bearing streams (FEMAT 1993).

The HCPs reviewed here are substantially better for salmon than are current state regulations, although it is unclear how they would measure up to obligations under Section 9 of the ESA once the salmon are listed. In short, these measures are better than practices of other private landowners, but they do fall short of the scientific assessment team's recommendations. The Washington DNR HCP establishes, for all permanent streams, an average riparian buffer width of 150 feet, with a minimum of 100 feet. Within that, no harvest will occur in the first 25 feet, and minimal harvest will occur in the rest of the buffer. For the Plum Creek Timber Company HCP, fish-bearing streams will have 200-foot buffers, with a 30-foot no harvest zone, and non-fish-bearing streams will have a 100-foot managed buffer. For the Weyerhaeuser Willamette HCP, riparian buffers of 50 to 100 feet will be established for fish-bearing streams, to improve the contribution of large woody debris. In addition, these plans include other measures to improve stream conditions, such as a commitment to conduct watershed analysis and road management plans.

All of these measures, from watershed analysis to reducing harvest along streams, are quite costly compared to state regulations in the absence of HCPs. Harvest along hundreds to thousands of miles of streams within planning areas are affected. It will be important, however, to ensure that adaptive management of riparian areas is implemented throughout these HCPs, as more information becomes available about what is required to recover these decimated salmon runs.

In terms of preserve design and setting aside habitat, one of the best examples among our reviewed plans is the San Bruno Mountain HCP in San Mateo County, California. The planning area for San Bruno Mountain is 3,500 acres, nearly 2,000 acres of which was in county ownership. Under the plan, private landowners are allowed to develop on 368 acres of open space land while agreeing to convey 800 acres of land to the county government for conservation and to fund management of butterfly habitat. This results in 81 percent of the mountain being in public ownership, protecting 87 percent of mission blue butterfly habitat and 93 percent of callippe silverspot butterfly habitat through public ownership or Section 9 prohibitions for private landowners not part of the HCP.

The San Bruno Mountain plan, however, did not explicitly incorporate preserve design principles per se or elaborately justified preserve areas. Minimization of development in outlying areas was largely because of topographic constraints - that is, developers wished to build only on areas at the base of the mountain, leaving a large tract of public land in the middle of the planning area. The final plan resulted in the augmentation of a large area of protected land, some of which was suitable butterfly habitat, some of which was invaded by exotic vegetation. The plan does result in incidental take of butterflies. In fact, some habitat developed under the plan was part of designated essential habitat under a draft butterfly recovery plan (Bean et al. 1991). Nevertheless, in addition to increased protection for acreage conveyed from private to county ownership, the plan generates funds for habitat management, without which habitat would not remain suitable for butterflies. Implementation of this management continues to be challenging (see box on San Bruno Implementation).

Of the plans reviewed here that include establishment of preserves according to principles of preserve design, the most disappointing example was the Balcones Canyonlands Conservation Plan. The Balcones plan went through a long and contentious planning process, spanning eight years. The plan began with the establishment of a biological advisory team to make biological recommendations about what would be required to preserve viable populations of the endangered species in the area, including the golden-cheeked warbler, black-capped vireo and cave invertebrates. The most contentious part of the plan was the biological advisory team's recommendations for preserves for the two endangered bird species. According to the team's 1990 report, in order for the plan to result in viable populations of both bird species within the planning area, there must be enough habitat to support 500 to 1,000 breeding pairs in the preserves (the team recommended two such populations for the golden-cheeked warbler). According to their calculations, this would require an HCP with 130,000 acres of preserves (Travis County is 648,000 acres), after taking into account decline in habitat quality due to edge effects, urbanization and habitat fragmentation.

These recommendations were deliberately developed with no reference to the political and economic contexts. In order to follow the recommendations completely, the plan would have required hundreds of millions of dollars and extensive restoration of areas that were significantly degraded (130,000 acres of intact habitat no longer existed, for example). Instead of trying to achieve the goals recommended in the biological advisory team's report (i.e., viable populations), planners decided to implement the recommendations to the extent possible. Unfortunately, the team's recommendations became a science-based high-water mark that simply was not practical to achieve and served to illustrate the precarious condition of the warbler and vireo.

The plan allows take of 55 percent of the black-capped vireo population and up to 71 percent of the identified golden-cheeked warbler habitat in the planning area. In the final preserve design, the total preserve acreage will be at least 30,428 acres distributed in seven preserve units, if all anticipated funding is realized. In addition, the plan was instrumental in the establishment of Balcones Canyonlands National Wildlife Refuge, where management for significant numbers of the endangered birds will enhance populations. While the acreage of the preserve and the wildlife refuge captures much of the large, relatively unfragmented habitat patches for the birds, and while habitat management will slow habitat degradation due to public use, the preserve design falls far short of original, biologically based expectations. Indeed, "the current consensus of the wildlife agencies appears to be that... the proposed action could threaten the population viability of the golden-cheeked warbler in the permit area" (Final HCP, pp. 4-19). Obviously, the 35,000-acre preserve system is much smaller than the 130,000 acres recommended by the biological advisory team. In implementing the plan, however, the city of Austin and wildlife agencies may be able to ameliorate this inadequate acreage by managing habitat so that it sustains higher numbers of warblers and vireos. The team's 1990 report, however, specifically addressed habitat management versus acquisition and preservation: "It is thus impossible even to identify all the threats caused by habitat destruction, much less to address these threats by intensive management. Because of this, without preservation of adequate habitat even the most intensive management will eventually fail" (p. 2). The relationship between management and acquisition, however, was not examined in detail by the team, and the ultimate success of some of the management techniques is not guaranteed.

Aside from inadequate land acquisition for protection, edge effects and the effects of urbanization may have a large impact on the warblers. Twenty percent of the plan's preserves are within 330 feet of the preserve boundary or other type of edge. The biological advisory team recommends that less than five percent of any preserve be within that distance from an edge, and research subsequent to the team's recommendations indicated that these warblers will not occupy otherwise suitable habitat that has 1-10 homes within 1,650 feet or has 11-30 percent urbanization within one kilometer (Engels 1995). In addition, utility corridors currently cut through some of the preserves, increasing edge (although there are steps to reduce this under the plan). Moreover, urbanization itself has other effects such as increased numbers of nest predators such as blue jays (*Cyanocitta cristata*), which will add to edge effects in decreasing the carrying capacity of reserves (Engels and Sexton 1994). Given these indications from biological research, the plan's preserve design may support a much smaller warbler population than anticipated.

According to the recovery plan for the golden-cheeked warbler (FWS 1992b), recovery will not be sufficient until each of eight regions has at least one viable population on its own or through connections to other regions. One of the eight regions encompasses the Balcones planning area. In addition, the warblers in Travis County are particularly important because the county has 40 percent more warbler habitat than any other county. Despite the importance of this area, it is possible that the planning area will not sustain viable populations of the two bird species because of the insufficient preserve acreage, edge effects and lack of intensive habitat management.

Multiple-Species Planning

The complexity of preserve design discussed above is magnified when multiple species are taken into account. Nevertheless, all conservation plans affect multiple species, whether or not they result in incidental-take permits for multiple species. Conservation planning for multiple species, including unlisted species, can address the dilemma of preventing the decline of species before they are critically endangered and receive protection under the ESA. The trade-off, however, is that landowners want incidental-take permits issued for multiple endangered species, as well as a commitment that the HCP is sufficient for unlisted species, so that no additional actions are required upon new listings. When this assurance is granted, unlisted species that become listed in the future will be included in the incidental take permit unless FWS can demonstrate that the HCP would jeopardize the continued existence of the species. This assurance to the landowner regarding his/her responsibilities for species that could be listed in the future is an extremely important incentive to landowners, especially those in areas with a high density of proposed and candidate species, such as California and Florida.

Providing assurances to landowners for unlisted species must be accompanied by adequate conservation for those species in the conservation plan. Congress clearly intended as much in establishing Section 10 in 1982: "In the event that an unlisted species addressed in the approved conservation plan subsequently is listed pursuant to the Act, no further mitigation requirements should be imposed if the conservation plan addressed the conservation of the species and its habitat as if the species were listed pursuant to the Act." (H.R. Report No. 97-835, 97th Congress, Second Session, and 50 FR 39681-39691; italics added). Although the FWS made this point even more clear in the *Habitat Conservation Planning Handbook* (FWS and NMFS, 1996; Chapter 4), this standard is extremely difficult to meet for unlisted species, because there is almost always much less known about unlisted species.

One way of attempting to deal with multiple species is through a "habitat-based" HCP. The NCCP program (see introduction) takes this approach, whereby species are grouped according to the habitat communities they require, and landowners infer that there is adequate protection for each species through protection for each habitat type. We discuss this approach as exemplified in the MSCP later.

This attempt to broaden HCPs and other conservation plans to benefit multiple species is frustrated by two important factors. First, legally, HCPs and other plans are part of the ESA, which imposes legal responsibilities regarding individual species (Rohlf 1991). Indeed, it is extremely difficult to define habitats and ecosystems precisely so that they can be legally protected (Orians 1993). Second, from a scientific perspective, predicting and monitoring the effects of management actions on communities and ecosystems is much more difficult than for individual species. Merely protecting certain habitat types in a configuration appropriate for one species does not guarantee adequate protection for multiple species. Perhaps the best way of addressing this dilemma is to determine scientifically what endangered, indicator or keystone species exist in a system and to monitor those species (Murphy et al. 1997 — see Appendix B). To date, however, it has been extremely difficult to define and identify true indicator and keystone species (Landres et al. 1988; Mills et al. 1993; Power et al. 1996). In addition, target species are typically vertebrate species, which are generally poor indicator species (Landres et al. 1988).

San Bruno's Conservative Approach

The San Bruno Mountain HCP contains a good strategy for addressing multiple species because there were surveys for other sensitive species, there were an assessment and protection of potential habitat for those sensitive species in the planning area, and there was no attempt to provide landowner assurances with respect to other species not studied during the planning process.

The conservation strategy of the plan emphasizes grassland habitat for two imperiled species — the mission blue butterfly and the callippe silverspot butterfly. That region also has several other endangered species, including two additional endangered butterflies — the San Bruno elfin *(Callophrys mossii bayensis)* and the bay checkerspot *(Euphydryas editha bayensis)*. The elfin is dependent upon brush habitat rather than grassland, and the HCP designates "potential habitat" for this species. If development is proposed in potential habitat, a separate impact study must be performed, but incidental take outside potential habitat is permitted through the HCP. For the bay checkerspot butterfly, the only individuals lived on one portion of the mountain, which was already protected by San Mateo County. The HCP simply contained a prohibition on development or trail building within those areas of the county park and established annual monitoring for this species.

Particular care was taken to avoid impacts on another federally endangered species, the San Francisco garter snake *(Thamnophis sirtalis tetrataenia).* FWS and the California Department of Fish and Game had determined that suitable habitat existed on the mountain, but they could not find the species in searches of the area. When the HCP was developed, the environmental consulting firm contracted a research herpetologist at U.C. Berkeley expert on the San Francisco garter snake, Ted Papenfuss, to prepare a map of the snake's potential habitat on the mountain. As with the elfin, further impact studies must be done for development to occur in those potential habitat areas. If snakes are found, no take can occur. Outside potential habitat areas, incidental taking through development is permitted under the HCP.

The approach contained in this HCP, which emphasizes thorough survey for the covered species, designation and protection of potential habitat, and assurances to landowners for areas outside potential habitat, is a practical approach to planning for multiple species. Under this approach, landowners can receive assurance that development can occur in areas that are not potential habitat, but habitat destruction is not permitted in occupied or suitable unoccupied habitat until more information is available and the exact impact is known.

Washington DNR's Blanket Assurances

Since the San Bruno Mountain HCP in 1982, conservation plans have become considerably more complicated, covering larger areas and affecting more sensitive species. In Washington, the HCP for state-owned land managed by the Department of Natural Resources (1.6 million acres) contains assurances that the incidental take permit will include each species that becomes listed during the 70 to 100 years of the HCP, unless the plan would jeopardize the species' continued existence. Determining jeopardy to such species, however, will be extremely difficult because DNR did not survey for these species before the HCP, and "under this HCP, DNR shall not be required to survey for nests, dens, roosts, or individual occurrences of unlisted species" (p. IV-134, Draft HCP).

In the HCP document, each unlisted but sensitive species that may be on the property is individually addressed. For nearly every sensitive species, however, there is a justification of why the conservation strategy designed for owls, murrelets and salmon suffices for habitats needed by these other sensitive species. It may be true that species that become listed in the future will coincide with suitable habitat created under the HCP. Unfortunately, for many species it will be impossible to predict whether this is true, despite the blanket assurances for DNR provided under the HCP. For example, species that depend upon old growth habitat will be included in the permit upon listing, even though the amount of old growth on DNR lands decreases under the HCP. DNR does plan to protect 100,000 acres of owl nesting, roosting and foraging habitat (old growth) for demographic support of spotted owls on federal lands. However, old growth is protected only in 300-acre patches. The riparian management zones will provide old growth, but not until the end of the planning period. Despite such sparse provision of old growth habitat, DNR still receives assurances for old-growth dependent species and all other species.

National Trends

In many ways, the examples of the San Bruno Mountain HCP and the Washington DNR HCP represent the respective extremes in good protection of multiple species versus assured permits without biological justification. Clearly, landowners have a powerful incentive to engage in conservation planning and to protect unlisted species if they are protected from regulations regarding those species upon listing. By providing some assurance to landowners, FWS can promote conservation plans oriented towards ecosystems and watersheds rather than management of patches currently occupied by endangered species. In trying to strike the balance between conservation and assurances, FWS has tried several approaches, all somewhere between the San Bruno Mountain HCP and the Washington DNR assurances. Most of these approaches are "habitat-based," where there is an assumption that if a habitat type is sufficiently protected under a plan, species associated with that habitat type are protected well enough. Unfortunately, those assumptions do not hold at times and often require much more scientific information to determine whether protecting target species and habitat types adequately provides for other species (Murphy et al. 1997, see Appendix B).

In this report, the plan that most explicitly uses this approach is the Multiple Species Conservation Program (MSCP) in southwestern San Diego County. A "covered species" list is at the heart of the plan, since it specifies which species are included in the incidental take permit. During the planning process, a list of 57 "covered" species was expanded to 85 even though no significant conservation improvements were added to the MSCP. This list was generated by analyzing where sensitive species occur in the MSCP area, what habitats they use and the degree of population or habitat protection under the preserve system.

There are several types of species on the covered species list. First, a species can be deemed "covered" based on what proportion of the species' range in the planning area is protected under the plan. Second, wetland-associated species are deemed to be "covered" because of federal regulations protecting wetlands (even though the local wetland regulations were being modified before the final MSCP approval). Third, some species are considered "covered" because the MSCP would have an insignificant impact on them. For example, such covered species as the golden eagle (*Aquila chrysaetos*) and the mountain lion *(Felis concolor)* are wide- ranging, and some species are peripheral to the planning area and have few or no occurrences within that area. Uncovered species, if subsequently listed, can also be incorporated into a take permit. Public agencies will pay for any additional preservation that is necessary if the species depends upon a habitat type that is "sufficiently conserved" under the original plan. For species dependent upon habitat types that are not sufficiently conserved, a combination of public and private money will be required for additional protections.

Of the plans reviewed here, two HCPs in the Pacific Northwest have assurances to landowners based on protection of habitat types. In the Plum Creek Timber Company HCP, the breeding and feeding habitat preferences of all 285 vertebrate species in the planning area are consolidated into 16 "lifeforms." For each lifeform, the habitat required by the species is defined in terms of stand structure. Since Plum Creek Timber Company performs inventories of stand structures under the HCP (and arguably in the absence of an HCP), they will be able to keep track of whether stand structures will decline or increase under the plan. From this, they will infer whether wildlife in each lifeform are likely to decline or increase. Although this analysis is the basis of granting assurances for all 285 species, there are several serious flaws in this approach. First, a lifeform can contain a group of species that have very different biological requirements (e.g., bats, peregrine falcons and mountain goats are in one lifeform). Second, the stand structure analysis is not spatially explicit (i.e., there is no analysis of habitat patch size or connectivity between patches). Third, the focus on stand structures ignores habitat characteristics that are relevant to particular species (e.g., elevation parameters, geographic location).

The Weyerhaeuser Willamette draft HCP has a habitat-based approach to the level of assurances granted to Weyerhaeuser for particular species. In this case, FWS recognizes that the HCP is designed for land that has very little old-growth habitat and that species associated with that habitat are not necessarily well protected under the plan. To resolve this, under this draft HCP there are three tiers of species. Tier 1 species are listed or proposed for listing. Tier 2 species are all other unlisted species except Tier 3 species, which are those "interior, upland, older-forest-dependent species that may not benefit form the HCP prescriptions" (pp. 2-20, draft HCP). Weyerhaeuser will receive a permit for Tier 2 species when they are listed. Tier 3 species will be included in the incidental take permit only if "Weyerhaeuser can demonstrate that this HCP maintains, enhances or establishes the habitat conditions or features associated with the species' use of managed forests" (pp. 2-22, draft HCP). This draft HCP represents one way of explicitly tying assurances for landowners to the level of uncertainty associated with the adequacy of the plan for particular species.

Finally, it is important to emphasize that conservation plans cannot be used as an excuse not to list species that, according to scientific information, should be listed. This issue has a high profile in the MSCP, where environmental groups are suing to list the short-leafed dudleya *(Dudleya blochmaniae* spp. *brevifolia* — a rare plant) because according to scientific information, it is imperiled right now whether or not the

MSCP is implemented. This is especially true for "pre-listing agreements," where conservation plans are developed in order to avoid listing species that clearly deserve the protections of the ESA (e.g., the Atlantic Salmon Conservation Plan).

Management Techniques

To address the needs of listed and unlisted species, a conservation plan requires not only solid preserve design, but active management based upon validated management techniques. A comprehensive preserve management plan should aim to maintain suitable habitat over time and possibly to restore disturbed areas. In particular, active management must redress the problem of species and habitats suffering from (1) exotic species invasions, (2) suppression of natural disturbance regimes and (3) adverse edge effects.

Invasion from exotic species threatens habitat in many areas. More than half of all federally listed species are adversely affected by interactions with non-native species, and nine of the 21 most endangered ecosystems in the United States are significantly affected by exotic invasion (Flather, Joyce and Bloomgarden 1994; Noss and Peters 1995). For some habitats addressed by plans in this report, the conservation plan may not succeed without success in controlling exotic invasion. For the San Bruno Mountain HCP, large portions of butterfly habitat are taken over by such exotic plants as gorse, broom, eucalyptus and fennel. For the lower Colorado River, many rare native fish species suffer from the introduction of exotic fish species. For HCPs that permit residential development, it may be vitally important to curtail introduction of an exotic predator, the domestic cat (e.g., the Fel-Kran Plumbing HCP for the Perdido Key beach mouse).

For many plans, habitat and species also cannot persist without active management to mimic or allow natural disturbance regimes (e.g., periodic fire or flood). In fact, the disruption of natural disturbance regimes affects numerous habitats nationwide, including at least ten of the 21 most endangered ecosystems in the United States (Noss and Peters 1995). For example, several HCPs reviewed here concern the red-cockaded woodpecker, a resident of longleaf pine habitat in the southeastern United States. Longleaf pine forests are maintained by periodic fire that clears out the less fire-resistant hardwoods (Bridges and Orzell 1989), and without that occasional fire disturbance, habitat becomes unsuitable for woodpeckers.

In developing a multiple species conservation plan for the lower Colorado River, it will be essential for the agencies involved to address the importance of annual floods to riparian vegetation and aquatic communities up and down the river. Historically, flooding occurred along the lower Colorado and its tributaries each spring, and flooding conditions are necessary for seed germination of native cottonwoods and other vegetation (Ohmart et al. 1977). Moreover, many of the native aquatic species are adapted to warm, fast-flowing water and periodic flood conditions. But many of these native species are being outcompeted by exotics that thrive in the cold, relatively still waters being released from the huge dams that have been constructed along the Colorado River.

Preserve management must also address "edge effects" that can adversely affect communities on the edge of preserves, such as increased wind at the edge of forests, nest parasitism by cowbirds that lay eggs in birds' nests located close to the forest edge, predation by such opportunistic predators as raccoons (Procyon lotor) and domestic cats, increased human presence, and exotic species invasion. These factors (among others) can have significant negative impacts on species dependent upon interior habitats. Conservation plans must contain monitoring of potential edge effects, management prescriptions to ameliorate such effects, and preserve design that delineates adjacent land use and buffer areas.

Of the conservation plans analyzed here, the MSCP in San Diego County will be affected most by edge effects. This plan creates a preserve system while allowing development outside the preserve areas and allowing some infrastructure development within the preserves. The plan acknowledges that under this scenario, edge effects are potentially severe. If the MSCP is implemented as intended and funding is sufficient, each preserve tract will have a habitat management plan, which will delineate habitat buffers and specify measures that managers will take to minimize edge effects. Building new roads in preserved areas is likely to be very difficult in the MSCP because any such project would require a major amendment to the plan (a process requiring FWS approval). Moreover, a highly controversial expansion of Route 56 in San Diego County will be completed so that it does not run through sensitive habitat identified in the MSCP planning efforts. In addition, the biological monitoring plan emphasizes detection of changes in habitat quality over time, especially edge effects. Dr. Ted Case at the University of California, San Diego, has proposed an institute that would bring researchers together to perform studies of these increasingly isolated habitat preserves. While this institute is not part of the MSCP per se, the emergent studies would be peer-reviewed and published in scientific journals, and the researchers would communicate their results to local management agencies and the broader scientific community.

Adaptive Management

Management plans should be put into place immediately after preserves are established, but there must also be a method to change management techniques according to changing conditions. Any science-based conservation plan must incorporate techniques of adaptive management, whereby experimental approaches to management are monitored and changed with information generated by those experiments (Walters 1986). Plans must also contain the capability for changes in management that take into account new monitoring information, ecological knowledge, and/or changing environmental conditions. Decisions regarding management in conservation plans, to be effective, must be explicitly tied to monitoring and biological goals of the plan (Murphy et al. 1997).

There are several reasons why conservation plans must include provisions for incorporating changes in management. The plan may have unpredicted consequences for the species; or new information may become available during the timespan of the plan. Also, stochastic environmental fluctuations, as well as demographic fluctuations, typically occur in populations, and management must be able to respond to those fluctuations. Despite the importance of environmental variability (Lacy 1993) and catastrophic events (Mengel and Tier 1994; Schaffer 1987) to the likelihood of population persistence, almost no species' recovery plans have information on environmental variability (Schemske et al. 1994; Tear et al. 1995), and few plans evaluated here incorporated such information.

It is difficult to assign responsibility for guaranteeing the persistence of species which decline because of environmental factors or catastrophic events beyond human control. But it is irresponsible and against the public interest for HCPs to be designed as if environmental fluctuations will not occur. FWS has recognized that the applicant should provide for "changed circumstances" or contingencies that can reasonably be anticipated during the course of an HCP, but this has mainly applied to foreseeable changes in the plan or its implementation, rather than biological changes (FWS and NMFS 1996). Under the no-surprises policy, changes in plans will be very difficult to impose, and it is essential that landowners incorporate up front the possibility of natural fluctuations by designing plans that can adapt to them. Although the no-surprises policy makes extensive plan changes quite difficult, some plans have incorporated methods for employing an experimental approach or tying management to monitoring results. Some of the best examples include the Massachusetts piping plover HCP and the Washington DNR HCP.

Positive Examples

The safe-harbor program for the sandhills region of North Carolina is a good example of a program that promotes active habitat management through incentives to landowners. As discussed earlier in this report, periodic fire disturbance has historically maintained longleaf pine forests, home to the endangered red-cockaded woodpecker. In the absence of fire or active management to remove hardwood understory, areas become unsuitable for woodpeckers. Although Section 9 of the ESA prohibits landowners from taking woodpeckers or destroying their habitat, there is no requirement that they manage the habitat so that it remains suitable. For this species and many other species that depend upon habitat that requires active management, current ESA regulations fail to protect them in the long term. Under the sandhills safe-harbor program, however, participating landowners sign a Certificate of Inclusion in which they agree to perform voluntary habitat management or enhancement (e.g., hardwood removal, periodic burning, or drilling cavities for woodpecker nests) in exchange for the assurance that any additional woodpeckers that settle on the property will not result in additional land-use restrictions.

When the Louisiana black bear was listed as threatened in 1992, private landowners raised many questions about their obligations under the ESA, and also about what land management techniques are compatible with bears. Although the 4(d) rule for the bear only forbids destruction of denning sites and does not protect any other habitat per se, the Black Bear Conservation Committee recognized the need to inform landowners about management that is compatible with or beneficial to the bear. The committee wrote the *Black Bear Management Handbook* and distributed it widely among landowners, especially those in the two important river basins that harbor the bears. This handbook identifies forestry and agricultural practices that benefit bears, including maintaining riparian corridors, limiting road construction and selecting and locating crops so that they provide both forage and cover for bears.

Despite the other problematic aspects of the HCP for piping plovers (because it decreases protection for the birds from vehicular and pedestrian disturbance), the HCP contains a rigorous strategy for adaptive management, where incidental take is tied explicitly to population fluctuations and reproductive success of the plovers. Under this programmatic HCP, beach managers can participate in the HCP and therefore receive the benefits of somewhat relaxed restrictions on recreation only if a variety of criteria are met. Some of these requirements are that: (1) for that specific beach, the plover population's rate of increase was at least 15 percent over the previous two years; (2) the plovers in the management zone of that particular beach (there are eight management zones in the state) have averaged at least 1.5 chicks fledged per pair over the previous several years; and (3) the entire Massachusetts piping plover population has averaged at least 1.5 chicks fledged per pair in the previous year. Explicitly tying any possible incidental take to the results of monitoring both locally and regionally ensures that a declining population will not have authorized incidental take, regardless of whether that decline was due to effects of the HCP or environmental conditions.

Negative Examples

The agreement between Plum Creek Timber Company, the U.S. Forest Service, the Montana Department of Natural Resource Conservation and FWS is designed to coordinate management to conserve grizzlies in the Swan Valley by promoting habitat connectivity between the Swan Mountains and the Mission Mountains and reducing mortality risk to grizzlies. This agreement does take a positive step in provisions to rotate commercial activities through the area's subunits so that seven of 11 subunits are inactive for between three and six years. However, prescriptions for road management in the planning area are inadequate, despite the impacts of roads on grizzly bears. According to the 1993 *Grizzly Bear Recovery Plan* (FWS 1993), "roads probably pose the most imminent threat to grizzly habitat today" (p. 21). Because roads result in direct mortality by vehicles, roads decrease the amount of effective bear habitat and promote habituation of bears to humans (Elgmork 1978; Brannon 1984; McLellan 1989). According to one study in the area, habitat that has greater than one mile per square mile open road density was used significantly less than normal by adult grizzlies (Mace and Manley 1993).

The U.S. Forest Service has recognized the importance of road density and adheres to rec-

Grizzly Bear *(Ursus arctos horribilis)*

The grizzly bear is one of the few large carnivores in the U.S. and, for many people, the grizzly bear symbolizes wilderness itself. This large bear can weigh up to 1,200 pounds and gets its name from the occasionally grizzled appearance of fur on the head. Grizzlies are too large to climb trees, but they can run up to 30 miles per hour. They consume not only fish and mammals, but also berries, leaves and grasses. In the winter, all grizzly bears hibernate until spring, usually in caves.

Unfortunately, with each passing spring, when the bears emerge from hibernation, their world has deterioriated. Grizzlies once roamed most of the western and southwestern U.S., but eradication programs associated with settlement in the West involved systematic bear hunting, trapping and poisoning. The grizzly bear population in the U.S. plummeted, and the bear has been eliminated from its range in the lower 48 states except for a few core populations.

Although direct killing of grizzly bears has the most dramatic influence on their populations, a much more insidious and irreversible threat puts the species most at risk: habitat destruction. Grizzly bears require large tracts of roadless wilderness areas in order to thrive, but those wilderness tracts have been developed or logged throughout the years. Most importantly, roads increasingly crisscross important bear habitats, and bears seek to avoid those fragmented areas. But roads bring people closer to bears, and this can result in road kills or killings for human self-defense.

GRIZZLY BEAR, THOMAS KITCHIN/TOM STACK & ASSOCIATES

The current FWS recovery plan for the grizzly bear proposes seven recovery areas scattered across Colorado, Idaho, Montana, Washington and Wyoming. The recovery goals for those areas include maintaining necessary habitat and enhancing grizzly populations. Defenders of Wildlife is leading an effort to reintroduce grizzly bears into one of those recovery areas, the Bitterroot ecosystem in north-central Idaho and western Montana.

Another recovery area, the Northern Continental Divide Ecosystem, contains important habitat in private ownership, such as Plum Creek Timber Company's tracts under the Swan Valley Conservation Agreement. The recovery of grizzly bears in the lower 48 states cannot occur without protection of remaining roadless tracts in recovery areas and augmentation through reintroduction and recolonization.

ommendations of the special road management task force of the Interagency Grizzly Bear Committee. According to the analysis of this task force, female bears can tolerate approximately 19 percent of a home range having a road density of more than one mile per square mile. Consequently, each subunit of the Flathead National Forest has less than 19 percent road densities greater than one mile per square mile. Yet in the Swan Valley Agreement, roads will be managed so that each subunit will have less than 33 percent with more than one mile per square mile. In addition, "the long-term goal is to *voluntarily* reach no more than 21 percent of any subunit exceeding one mile of open road per square mile" (p. 3, italics added). Moreover, here we have been referring to open roads. This agreement sets up no requirements on closed road densities, nor does it establish a plan to reclaim closed roads, which can be open for "administrative use." Therefore, the guidelines for road densities are actually less protective in Swan Valley than in the rest of the Flathead National Forest and far less protective than recommended by biologists.

Because the San Bruno Mountain HCP has been implemented for 15 years, it is much easier to identify management difficulties than for plans that have been recently approved. Although managers have encountered numerous difficulties in plan implementation thus far, habitat management for San Bruno has not been a failure, and there are lessons for the implementation of subsequent conservation plans.

The success of the San Bruno Mountain HCP in sustaining endangered butterflies ultimately rests on the effectiveness of management activities that are necessary for maintaining grassland habitat. Indeed, the major advantage of establishing this HCP was the creation of a funding source and program for actively managing the grassland habitat which is threatened by natural succession to brushland as well as invasion by exotic species such as gorse, broom, eucalyptus and fennel. In general, the plan has failed to reduce the extent of exotic species and restore areas to native grassland suitable for butterflies. A strategy designed to reverse the spread of exotics into native grassland, however, has been effective, and some people argue that many acres of grassland would have been lost this way without the HCP. Nevertheless, the goals of the original HCP were to reclaim disturbed areas to grassland and restore some areas degraded by exotic species to native grassland.

Difficulty in fulfilling habitat management goals has occurred because at the beginning of the plan there was little understanding about exotic removal techniques and restoration ecology, and therefore there was no specific management strategy that was approved along with the HCP. Removal of exotics has been harder and more costly than originally anticipated, and some attempts at restoring grassland have failed. For example, probably the most controversial aspect of this plan has been habitat management. In 1995, Planned Sierra Resources offered to clearcut 63 acres of eucalyptus in the planning area for free, and the county accepted the offer. Unfortunately, erosion resulted from the removal of vegetation, the eucalyptus has resprouted (although volunteers have helped to control resprouts). Reclamation of the clearcut area is expected to take more than ten years.

After ten years of plan implementation, Thomas Reid Associates developed an exotic species management plan for gorse, broom, fennel and eucalyptus in the planning area. These plans summarized the extent of invasion, techniques to remove those invasive species, what had been done in the first ten years of the plan to control them and priorities for future action.

This type of strategic plan, focusing on specific techniques, particular high-priority locations and experimental approaches, should be approved by FWS along with the plan.

Because conservation plans (especially HCPs) often focus on single species, there is a temptation to minimize and mitigate harm by emphasizing manipulation of individual animals instead of preserving and managing habitat. Yet for 88 percent of listed species, habitat loss is a major factor in the decision to list (Wilcove et al. 1996). For these species, any program that seeks to authorize take of occupied habitat, mitigated by transplantation of individuals to protected sites, results in a loss of protected habitat and is detrimental to species survival in the long term. Moreover, for some species, there is a trend toward deemphasizing the importance of protecting individuals where they currently live and translocating endangered species from private to public land. In general, this approach loses sight of the purpose of the ESA, which is to conserve species and the ecosystems upon which they depend (ESA §2).

It is highly questionable whether translocation programs can be effective unless habitat loss also is addressed. Unfortunately, there are many examples of species-specific, intensive transplantation programs in our sample of conservation plans. For the Coleman Company HCP for the Utah prairie dog, the plan allows development on land with a prairie dog colony after transplantation of all 116 prairie dogs to BLM land. Transplantation has been an increasingly popular technique for Utah prairie dog management on private agricultural land, and since 1992 increasing numbers of prairie dogs have been transplanted from private to public land. Yet according to a recent report by state wildlife officials, transplantation has not been well researched or proven to be effective:

> A better understanding of habitat requirements of Utah prairie dogs is required to allow managers to identify transplant sites and manage habitat in a manner suitable for prairie dogs. Guidelines contained in the *Utah Prairie Dog Recovery Plan* are vague and have never been tested scientifically.... (p. 28, Utah Division of Wildlife Resources 1997).

In fact, a study that attempted to track 430 transplanted prairie dogs determined that approximately 21 percent of prairie dogs stayed in the surrounding area of release, and individuals recaptured multiple times appeared to gain an abnormally low amount of weight. What effect this dispersal of groups from transplantation sites has on the social behavior of prairie dogs is unknown.

In Clark County, Nevada, the HCP for the Mojave desert tortoise employs a strategy to avoid take by translocating tortoises from areas slated for development. Although this HCP began in 1995, the tortoise relocation strategy was in place for the county under a short-term HCP from 1991 to 1995. The short-term HCP allowed incidental take on approximately 30,000 acres of tortoise habitat, and tortoises that were rescued from development sites were transferred to a holding facility, where an upper respiratory tract disease spread among the captive population. At the beginning of the long-term HCP (reviewed here), 250 of the tortoises rescued during the short-term HCP were languishing in the

Desert Tortoise Conservation Center, which had no additional space for tortoises. Others had been adopted as pets, highly questionable for a threatened species.

Despite the utter failure of the short-term HCP, the long-term Clark County HCP relies on transferring tortoises to the Desert Tortoise Conservation Center. Under the HCP, a subcommittee of representatives of BLM, the Nevada Department of Wildlife, National Park Service biological resources division and FWS was established to determine an appropriate translocation site. While emphasizing scientific input into this aspect of the HCP is a step in the right direction, it would have been more appropriate to postpone approval of a large-scale, 30-year HCP until there was some confidence in the effectiveness of translocation techniques.

As a third example, the translocation of red-cockaded woodpeckers is a central management technique for many HCPs approved to date (including all three HCPs analyzed in this

Longleaf Pine Forest Ecosystem

In the southeastern U.S. in the 1700's, European explorers documented spacious, tall forests with 20 to 100 yards between trees, where the ground was covered with grass and a large variety of herbaceous plants. By the early 1900's, much of that longleaf pine forest community that had once dominated more than 60 percent of the uplands on the southeastern coastal plain had disappeared (Bridges and Orzell 1989).

Today, over 98 percent of the original longleaf pine stands on the southeastern coastal plain, and 85 percent on the west Gulf coastal plain, have disappeared, replaced in large part by agriculture and tree farms. Some 3.8 million acres of longleaf pine forests remain, with only 5,000 acres of old growth. The remaining sites have become highly fragmented and degraded.

This dramatic decline in longleaf pine forests is due in part to fire suppression. Under natural conditions, fallen longleaf pine needles, mixed with wiregrass and other grasses, create an easily ignitable mixture. Under those conditions, lightning ignited fires every one to ten years in each forest, which helped to maintain the ecosystem's species diversity by keeping any one species from outcompeting the others. In fact, most of the biodiversity of the longleaf pine ecosystem is situated in the ground layer of the community, and a single forest stand can contain 200 species of plants. In addition, the fires prevented hardwood trees from replacing the pines over time. When fire was suppressed upon settlement, this fundamental change altered the ground community and allowed hardwood trees to take over areas once home to long-leaf pine stands.

Today, longleaf pine forests are rare not only because of fire suppression but because of extensive logging, clearing for agricultural fields and urban development. Moreover, the rarity of this once-extensive ecosystem has led to the precarious status of many animal species. Twenty-seven federally listed species and 99 other sensitive species live in the longleaf pine communities of the Southeast (Noss et al., 1995). Among the imperiled species in the longleaf pine ecosystem are the gopher tortoise, indigo snake, Bachman's sparrow and Sherman's fox squirrel.

report), and is part of statewide HCPs being developed for at least four southern states, including the draft HCP for the red-cockaded woodpecker in Texas. Typically, when a landowner destroys habitat he or she mitigates the loss by allowing the otherwise doomed woodpecker group to be captured and translocated and by providing money to build artificial nest cavities on another site. But widespread reliance on this technique does not appear to be justified. In 143 translocation attempts by the Forest Service between 1989 and 1994, the success rate was 70 percent for single juvenile females but only 20 percent for adult males, and other studies have found that translocation of adult males is generally unsuccessful (Allen et al. 1993; Jackson et al. 1983; Peters 1996). This controversial technique underlies the continuing debate over whether woodpecker recovery is mainly limited by a shortage of birds for unoccupied habitat (according to Ralph Costa, woodpecker recovery coordinator for FWS) or the amount of suitable habitat, especially on private land (see Endangered Species and Wetlands Report, February and March 1997).

Biological Monitoring

Biological monitoring is essential to evaluate the effectiveness of management techniques and to adapt management to changing conditions over time. In order to determine whether a conservation plan is producing the expected results with respect to maintaining or enhancing endangered species populations, there must be biological monitoring of both the species and its essential habitat. This is particularly crucial for plans that rely upon manipulative techniques for restoring habitat or translocating individuals. At the same time, this monitoring must be combined with an adaptive management program.

If properly implemented, monitoring can significantly advance knowledge about endangered species on private lands. Much more is known about biological resources on public land than on private land, a fact seriously impeding recovery plans and conservation efforts for species that occur on both. Surveying and monitoring associated with conservation plans could help fill a major gap in information about biological resources on private lands.

From monitoring data, land managers should be able to determine whether plans are fulfilling stated biological goals, whether management changes are necessary to adapt to changing conditions (adaptive management), and whether actions under the plan have inadvertently caused a species to decline so much that the plan jeopardizes the species' continued existence. Therefore, monitoring must go beyond counting acres of habitat and individual animals and address (1) multiple species, (2) parameters for ecological models, (3) spatial patterns, (4) cumulative effects, (5) information that directly links it to identified biological goals and adaptive management, (6) thresholds beyond which the plan jeopardizes the species' continued existence and (7) the greater need for quantitative data over qualitative information.

FWS's HCP monitoring guidance provides sound advice. "The services should strive to collect sufficient information to detect trends in covered species populations, changes in the quality and/or quantity of the habitat (e.g., restoration of the streamside riparian area), or determine if the biological goals of the HCP are being achieved (e.g., if the mitigation strategies are producing the targeted habitat conditions)" (p. 5, USFWS 1997. Habitat Conservation Plans Monitoring Guidance). Moreover, the guidance states that biological monitoring is a requirement of federal regulations and the responsibility of the landowner. This monitoring guidance is apparently necessary, because many of the monitoring programs for plans approved before the guidance were inconsistent with suggestions from the services.

It is unreasonable to require extensive monitoring for all plans, no matter how small. Indeed, for the HCPs that are small in scale and/or have a short time span, monitoring may be an inappropriate requirement. Even though there is no individual monitoring required in small HCPs, it is important that FWS conduct programmatic monitoring of multiple small HCPs in order to detect cumulative effects of numerous small HCPs or other management actions on species recovery.

Positive Examples

As part of the Volusia County HCP for five species of sea turtles, FWS required that the county develop a sea turtle monitoring program that had to be approved by FWS. This monitoring program has the goals of documenting the temporal and spatial distribution of sea turtle nests, marking nests for protection from recreation and vehicles, documenting the reasons for any nest failures and monitoring daytime sea turtle nesting and any sea turtle strandings. These goals will be accomplished through daily sea turtle nesting surveys each year between May and October and weekly inventories of nest locations and status. In addition, annual reports are required three months before the nesting season begins so that FWS and the Florida Department of Environmental Protection can evaluate compliance with the HCP and the effectiveness of the HCP and recommend needed changes to increase the effectiveness of protective actions.

This extensive monitoring program is possible largely because the Volusia County HCP is a programmatic HCP, in which the permittee (the county) has the infrastructure and cadre of volunteers to carry out intensive monitoring. In another programmatic HCP, the Massachusetts HCP for piping plovers, there is also extensive monitoring of piping plovers by the wildlife agencies as well as a requirement that private beach managers participating in the HCP monitor the plovers on their beaches. Both of these examples have established good monitoring programs, although this was more simple than for other plans because habitat monitoring is greatly simplified and public agencies are charged with the monitoring.

In perhaps the most complex example of this report, the Multiple Species Conservation Program (MSCP) in San Diego County contains a biological monitoring program in place from the beginning of the program's implementation. Considering that the monitoring plan developed by the wildlife agencies is projected to cost, on average, only approximately $235,000 a year, this biological monitoring plan is a cost-effective way to engage in monitoring at a number of levels. In this monitoring plan, there is habitat monitoring (of acreage of natural habitat, changes in habitat through disturbance like fire and flood and changes in habitat quality over time), monitoring of wildlife corridor usage and monitoring of certain target species. Most of the techniques are quantitative, and permanent transects or monitoring plots are established at particular sampling sites.

Because there is not enough money to monitor all areas and covered species adequately, monitoring is oriented toward detecting dramatic population changes in certain target species and expected changes in habitat quality (especially edge effects). A maximum of 29 permanent habitat monitoring plots ranging from 50 to 200 acres in size will be established for the planned 172,000-acre preserve. This sparse sampling reflects the inadequate budget for biological monitoring. Fortunately, this biological monitoring program is just one of many aspects of the MSCP that will be part of tracking biological resources in the planning area, in addition to biological surveys of new parcels in the preserve system and research programs of independent scientists and agency biologists. This monitoring system is one of the most comprehensive for any conservation plan.

Negative Examples

One of the worst aspects of biological monitoring for HCPs is the absence of a government program to monitor the effects of all of the small HCPs being approved. Small HCPs typically do not have biological monitoring because of the "negligible" effects on species and the short time frame of the incidental take permit. Nevertheless, according to the services' database, most HCPs are small, and multiple small and large HCPs have been approved for certain species such as the golden-cheeked warbler and the northern spotted owl. Without a program for monitoring the potentially large effects of multiple small HCPs, the services have publicly promoted HCPs without keeping up with them. In addition, they have made it impossible to understand the cumulative effects of the approved HCPs.

National Trends

Biological monitoring programs for conservation plans obviously can vary between intensive daily tracking and total absence of monitoring. Most of the plans we reviewed have insufficient monitoring. In some cases, there is monitoring of endangered species populations but very little or no habitat or vegetation monitoring. For example, in the San Bruno Mountain HCP there is an annual assessment of an index of the population size of several endangered butterfly species. Each year the environmental consulting company walks transects and counts butterflies along those transects. This measure of a portion of the population is meant to represent the status of the population relative to previous years, but the location of the transects changes from year to year, which makes year-to-year comparisons dubious. Whether or not this method accurately assesses the overall butterfly population, the monitoring is insufficient because there has been no habitat monitoring to track changes in native vegetation that the butterflies use and the extent of exotic invasion.

By contrast, in the Fort Morgan Paradise Joint Venture HCP for the Alabama beach mouse, four times each year there are a survey and control of house mice (which compete with the beach mouse) and feral domestic cats (which eat the beach mouse), but the responsibility for monitoring the beach mouse is on FWS.

The approach for the Washington DNR HCP emphasizes habitat monitoring with less for endangered species. Although the program was not expected to be complete and approved by the services until late 1997, the HCP document establishes three types of monitoring: (1) compliance monitoring, involving reports on whether harvesting activities are in compliance with the HCP (each harvest will be recorded in a Geographic Information System), (2) effectiveness monitoring, in which DNR records the stand structure and habitats that result from their actions and (3) validation monitoring, in which such species as the spotted owl are monitored in relation to harvesting activities and habitat conditions. Validation monitoring is at the heart of whether the HCP is effective for endangered species, yet the HCP indicates that this monitoring will occur for only one portion of the planning area on the Olympic Peninsula, not in most of the planning area.

In general, it appears that biological monitoring is a secondary priority in implementing conservation plans and that monitoring funds take away money from habitat conservation. For example, in the Metropolitan Bakersfield HCP,

> for the most part, qualitative assessment in monitoring programs for biological resources can provide sufficient information to evaluate the status of the species of concern.... While monitoring is an important aspect of the plan, it should not overburden the funding program and take funds away from the land acquisition or management programs.

That view is also summarized in the Balcones Canyonlands Conservation Plan: "While the importance of monitoring and research is evident, it is likely to remain a secondary priority for funding by the permit holders" (pp. 2-41, HCP). When a bond measure was rejected by Travis County voters (see section on funding in this report), monitoring was scaled back in favor of land acquisitions. A comprehensive monitoring program for all of the preserves is still under development. To date, for the golden-cheeked warbler (an endangered species), biologists have kept track of where the birds' territories are located, including establishment of permanent plots to be surveyed each year, but the monitoring program does not track nesting success, survival or adult and juvenile movement. Presence/absence data on the warblers is unlikely to produce a clear picture of how development and urbanization under the plan affects the warblers.

Probably the best future models of monitoring will combine applicant and public funds and coordinate independent research or information from ongoing study sites to supplement a large-scale monitoring plan (this may occur under the MSCP). Unfortunately, because monitoring has been viewed as a secondary priority that steals funds from real conservation, most monitoring programs for plans reviewed here are not adequate for making scientifically sound determinations about population trends of key species, changes in habitat quality and the effects of plan activities. When monitoring for small-scale HCPs is effectively absent, it is clear that plans that are eagerly approved today will be difficult to understand, difficult to adapt and more risky to species in the future.

Independent Science

The process of developing conservation plans always involves FWS biologists and usually involves the landowner's biologists (either on staff or in a hired environmental consulting firm); there is no rule regarding involvement of outside scientists. This lack of a formal role for independent biologists (who do not work for a stakeholder and are not invested in the plan's outcome) in conservation planning reflects the fact that there is no general consensus about whether and how to involve them. Nevertheless, within the context of plan development, there is no doubt that scientists who have expertise in the species and habitats of concern can lend important data and advice on management and preserve design. In addition, review of plans by independent scientists can increase the credibility of the biological information and conservation strategies.

Not only must there be involvement of individuals who have no financial stake in a conservation plan, but planners must take into account independent, peer-reviewed literature that is relevant to the plan. When substantial peer-reviewed literature is available, plan strategies should not be overly reliant on gray literature (i.e., reports by agencies, environmental consulting firms or timber harvesting companies). In the majority of cases, there is not much peer-reviewed information on particular species and habitat, and we cannot necessarily expect that site-specific information that is needed for HCPs would be peer-reviewed in a scientific journal. For most HCPs, there is an obvious reliance on grey literature, even for habitats and species that are well represented in peer-reviewed scientific journals.

To date, there are several ways that independent scientists have been involved in conservation plans: (1) through informal consultation, (2) through involvement in a technical or steering committee and (3) through participating in a scientific review panel.

Informal Consultation

For many conservation plans, independent scientists are informally contacted to provide information or review information for a plan. In the MSCP, experts were asked to contribute or to review the data for particular species or habitats. For the Volusia County HCP, biologists were asked to review the draft HCP. There are many other examples, but informal consultation without more formal scientific review can be problematic because scientists may be asked to contribute or review large amounts of information without compensation (many of these biologists, not surprisingly, decline to participate). In addition, scientists must know that their suggestions will be taken seriously, but this informal consultation involves no explicit process for incorporating their recommendations and making those recommendations known to the public.

Technical Advisory Teams

Many of the plans reviewed here involved technical committees that assembled and summarized biological information in order to make recommendations. For example, the science team for the Washington DNR HCP (made up mostly of state and federal wildlife biologists) met for one to three days a month for 18 months in order to design a conservation strategy presented to DNR. An academic scientist invited to participate declined because of the tremendous time commitment. Clearly, involving independent scientists in these committees is a step in the right direction, but independent scientists need professional or financial incentives in order to participate in a process that could involve a substantial time commitment for multiple years.

Another problem is that technical advisory committees may not be structured so recommendations by independent scientists have as much weight as recommendations from industry or agency biologists. For example, in the Georgia statewide HCP for red-cockaded woodpeckers, Todd Engstrom, a plant ecologist for the Tall Timbers Research Station in Florida, has been involved as an independent scientist in the Scientific Advisory Committee. He and others on the committee began negotiations with a wider range of options to encourage private landowners in appropriate conservation measures (including economic incentives, etc.). As negotiations proceeded, however, it was clear that the Georgia Forestry Commission would determine the options for private landowners.

It can be difficult to coordinate the activities of the technical committee and the plan's steering committee so technical recommendations are adequately implemented. In 1990, before the Balcones Canyonlands Conservation Plan was drafted, a biological advisory team with biologists from agencies, academia, consulting firms and a nonprofit conservation group produced a report analyzing the biological information and providing planning recommendations (discussed in this report under Design of Conserved Areas). The advisory team leader, Douglas Slack of Texas A&M University, repeatedly was instructed not to consider economic or political factors but to concentrate on what would be necessary to conserve viable populations of the endangered species, based solely on biological information. In the end, the team's recommendations proved politically impossible to implement. The 1992 draft plan did not come close, and when funding was not approved for the 1992 draft plan, it was scaled back even more. The final plan approved in 1996 was not reviewed by the independent scientific team, which by then had been dissolved. (However, two groups of government scientists did review the plan). Planning officials are currently trying to establish a scientific committee to review HCP implementation.

Aside from technical teams for conservation plans, some plans reviewed here had at least one independent scientist involved in the steering committee actually negotiating the plan. These scientists can lend expertise and a more objective opinion about plan activities. This can be difficult for independent scientists, however, because of the huge time commitment (which may be more than in a technical committee). Also, in the politically charged negotiations associated with developing these plans, the biologist must participate in aspects of the plan that are outside of his or her technical expertise.

Scientific Review Panels

In another approach, independent scientific review panels have been utilized for some conservation plans as a way of incorporating independent science and lending credibility to plans. Through independent review, scientists can maintain objectivity and still inform, guide and evaluate plans as they develop. Of all the plans evaluated in this report, only two had independent scientific review at some stage — the NCCP in California and the San Bruno Mountain HCP.

Initially in the NCCP, independent scientists were involved in establishing general scientific guidelines for the entire NCCP area. The NCCP was created through California legislation in 1991, when the California Department of Fish and Game established a scientific review panel for the program. This panel was composed of five prominent conservation biologists familiar with the ecoystem in question: Dennis Murphy, Peter Brussard, Michael Gilpin, Reed Noss and John O'Leary. The panel was charged with analyzing field data and other research on the coastal sage scrub habitat and developing general conservation guidelines that would address preserve design and upper boundaries on the ability to develop on remaining coastal sage scrub.

After the panel finished its task of developing the conservation guidelines, another panel of six scientists served as independent scientific advisors. These individuals were to be consulted on an *ad hoc* basis, but this has largely not materialized (Natural Resources Defense Council 1997). Nevertheless, the scientific review panel did evaluate the biological information contained in maps for the MSCP and certified the habitat evaluation maps which identified important areas to preserve. Although the original panel is a good example of how independent scientists could be formally consulted in conservation planning, since the conservation guidelines were established there has been considerable dissatisfaction with the consistency of the subregional plans with the conservation guidelines and with the lack of independent scientific input for individual subregional plans.

The first HCP contains a good example of independent review of biological information. Before the HCP was developed, Thomas Reid and Associates completed an extensive two-year biological study of the biological resources on the mountain. Documented were utterfly population size, density and distribution, the plant communities, identified butterfly habitats and historical plant succession information. Before the HCP proceeded, a team of three prominent independent butterfly experts was convened to review the information (Paul Ehrlich, Arthur Shapiro and Ward Watt from Stanford University). This team affirmed that the study's methods were sound but urged caution in interpreting the information into land-use plans. This approach to incorporating an independent scientific review of available biological information is an excellent way of involving independent scientists at an appropriate early stage in the planning process without requiring them to engage in plan negotiation that can be extremely time-consuming and politically influenced. Unfortunately, since the San Bruno Mountain HCP, formal scientific review panels have not been established for successive HCPs. Today on San Bruno Mountain, those involved with the HCP are working to develop a new master plan for the HCP area that would be a collaboration between San Francisco State University and San Mateo County.

National Trends

Nearly all of the plans reviewed here did not have formal independent scientific panels. This is true across the nation, not only for small HCPs but for large-scale conservation plans involving multiple sensitive species. Particularly egregious is the lack of a formal independent review of the MSCP, which involved massive amounts of biological information and which was part of the NCCP process that started with scientific review. The MSCP planners informally consulted with some independent biologists on specific species or locations, but without an independent review of the final plan and its implications the risks of the plan to species are magnified. In addition, small-scale HCPs (which comprise the majority of HCPs) typically have no involvement from outside scientists.

Complex conservation plans require involvement of independent scientists in various ways, from informal consultation to a scientific review panel. We have found that given the proper incentives for involvement, it may be best to establish scientific panels, complemented by informal consultation with other scientists. For large-scale plans (not low-effect plans), there should be a panel of independent scientists with expertise in local species and systems who can evaluate progress and results at multiple stages throughout the process, including evaluation of the adequacy of existing biological knowledge, preliminary plan recommendations, a final draft, monitoring and adaptive management plans, and monitoring reports as the plan is being implemented. It is impractical to have a scientific review only near the end of the process, just before FWS issues the incidental take permit. Landowners and FWS are legitimately concerned that this evaluation could second-guess the expertise of the FWS biologists and could be a bomb that sends people who have been developing the plan for months or years back to the drawing board. Including a panel review process at multiple stages avoids this concern and reflects the proper role of science in conservation planning (Hosack et al. 1997).

Although few of the plans reviewed here had a formal scientific review process at any stage, some of the plans had informal review by independent scientists, and an increasing number of plans are incorporating scientific review. In fact, the Society for Conservation Biology is developing a statement on independent scientific review which will apply to review of some ESA-related conservation plans. In addition, an increasing number of HCPs involve studies by the Biological Resources Division (BRD, formerly National Biological Service), and all BRD studies must be peer-reviewed.