A Petition to List the Giant Manta Ray (*Manta birostris*), Reef Manta Ray (*Manta alfredi*), and Caribbean Manta Ray (*Manta c.f. birostris*) as Endangered, or Alternatively as Threatened, Species Pursuant to the Endangered Species Act and for the Concurrent Designation of Critical Habitat

A Swimming Manta Ray at Flower Garden Banks National Marine Sanctuary (http://www.nmfs.noaa.gov/pr/images/fish/mantaray_fgbnms_noaa.jpg).

Submitted to the U.S. Secretary of Commerce acting through the National Oceanic and Atmospheric Administration and the National Marine Fisheries Service

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I. INTRODUCTION

Petitioner Defenders of Wildlife ("Defenders") is dedicated to the protection of all native animals and plants in their natural communities. With more than 1.2 million members, supporters, and activists, Defenders is a leading advocate for the protection of threatened and endangered species. Defenders' 2013-2023 Strategic Plan identifies sharks and other elasmobranchs as one of several categories of key species whose conservation is a priority for our organization's work.[2]

Through this Petition, Defenders hereby formally requests that the Secretary of Commerce ("Secretary"), acting through the National Marine Fisheries Service ("NMFS"), an agency within the National Oceanic and Atmospheric Administration ("NOAA"), list the giant manta ray (*Manta birostris*), reef manta ray (*Manta alfredi*), and Caribbean manta ray (*Manta c.f. birostris*) (collectively and generically "Manta Rays") as "endangered," or alternatively as "threatened," species under the Endangered Species Act ("ESA"). 16 U.S.C. §§ 1531–44. We request that NMFS list the three Manta Ray species throughout their entire ranges. Listing the Manta Rays under the ESA would be consistent with the United States' recognition of commercial overutilization threats to these species requiring conservation measures and would be in furtherance of the United States' support of the proposal to list the entire *Manta* genus under Appendix II of the Convention on International Trade in Endangered Species of Flora and Fauna ("CITES") in 2013 (*see* USFWS, 2013 at 2). In the alternative, if NMFS finds that there are distinct population segments ("DPSs") of Manta Rays, we request that those DPSs be listed under the ESA. Additionally, because the ESA's definitions of both endangered and threatened species provide for listing species that are threatened or endangered "throughout all or a significant portion of [their] range," Defenders requests that, in reviewing this Petition, NMFS specifically analyze whether the Manta Rays are endangered or threatened throughout all or any significant portion of their ranges. *See* 16 U.S.C. §§ 1532(6), (20).[3] Finally, we request that NMFS designate critical habitat for these species concurrent with listing for those areas within U.S. jurisdiction. *See* 16 U.S.C. § 1533(b)(6)(C); 50 C.F.R. § 424.12. This Petition is submitted pursuant to the ESA, 16 U.S.C. § 1533(b)(3)(A), the ESA's implementing regulations, 50 C.F.R. § 424.14, and the Administrative Procedure Act, 5 U.S.C. § 553(e).

Defenders anticipates that, in keeping with 50 C.F.R. § 424.14(a), NMFS will acknowledge the receipt of this Petition in writing within 30 days. As fully set forth below, this Petition contains all the information requested in 50 C.F.R. §§ 424.14(b)(2)(i)–(iv) and 16 U.S.C. § 1533(e). All cited documents are listed in the References section, electronic copies of these documents accompany this Petition, and pinpoint citations to these have been provided where appropriate.

[2] More information on Defenders' work is available on our website, https://www.defenders.org, and Defenders' 2013-2023 Strategic Plan is available at https://www.defenders.org/publications/defenders-strategic-plan-2013-2023.pdf.

[3] Should NMFS determine that Manta Ray DPSs do in fact exist and that those DPSs warrant ESA listing, then Defenders requests that NMFS analyze whether those DPSs represent a significant portion of these species' ranges such that listing of these species as a whole is appropriate.

II. GOVERNING PROVISIONS OF THE ENDANGERED SPECIES ACT

A. Species and Distinct Population Segments

The ESA defines the term "species" to include "any subspecies of fish, wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." 16 U.S.C. § 1532(16). The distinct population segment ("DPS") language from this definition allows NMFS to protect vertebrate species, such as Manta Rays, under the ESA regionally. NMFS and the U.S. Fish and Wildlife Service ("FWS") have jointly published principles for defining a DPS. 61 Fed. Reg. 4722 (Feb. 7, 1996). In order to satisfy the DPS criteria, a vertebrate species population must be discrete from other populations of the species and significant to the species. These terms are defined as follows:

> A population segment of a vertebrate species may be considered discrete if it satisfies either one of the following conditions:
>
> 1. It is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors. Quantitative measures of genetic or morphological discontinuity may provide evidence of this separation.
> 2. It is delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4(a)(1)(D) of the Act.

61 Fed. Reg. at 4725.

> If a population segment is considered discrete under one or more of the above conditions, its biological and ecological significance will then be considered in light of Congressional guidance . . . that the authority to list DPS's be used ". . . sparingly" while encouraging the conservation of genetic diversity. In carrying out this examination, the Services will consider available scientific evidence of the discrete population segment's importance to the taxon to which it belongs. This consideration may include, but is not limited to, the following:
>
> 1. Persistence of the discrete population segment in an ecological setting unusual or unique for the taxon,
> 2. Evidence that loss of the discrete population segment would result in a significant gap in the range of a taxon,
> 3. Evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historic range, or
> 4. Evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics.

61 Fed. Reg. at 4725.

Although these guidelines are "non-regulatory" and serve only as policy guidance for the agencies, 61 Fed. Reg. at 4723, the courts have upheld this policy as a "reasonable interpretation" of ambiguous language in the ESA. *See, e.g., Maine v. Norton*, 257 F. Supp. 2d 357, 385–87 (D. Me. 2003). Therefore, should NMFS not list these three species throughout their ranges, NMFS should use these criteria to evaluate any populations that it identifies.

B. Significant Portion of the Species' Range

The ESA defines an "endangered species" as any species which is "in danger of extinction throughout all or a significant portion of its range," 16 U.S.C. § 1532(6), and a "threatened species" as one which "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." 16 U.S.C. § 1532(20). The ESA does not further define or explain the meaning of the "significant portion of its range" ("SPR") language. However, NOAA and FWS issued a final policy on the interpretation of this SPR language on July 1, 2014. 79 Fed. Reg. 37,577. According to this new policy, a portion of a species' range constitutes a "significant portion" if "the portion's contribution to the viability of the species is so important such that without the members in that portion the species would be in danger of extinction, or likely to become so in the foreseeable future, throughout all of its range." 79 Fed. Reg. at 37,580.

Under this new definition, a species could only be listed under the SPR provision if NMFS: (1) determined that the species is neither endangered nor threatened throughout all of its range; (2) determined the specific biological importance of that portion of the species' range where it is facing threats; and (3) determined that impairment of this portion of the species' range would increase the vulnerability of the species to the threats it faces to the point that the entire species would be in danger of extinction, or likely to become so in the foreseeable future. 79 Fed. Reg. at 37,583. The courts have consistently rejected this interpretation of the SPR language because it effectively requires that the species face a "species as a whole" extinction risk, thus reading the SPR language out of the statute. When faced with an entirely similar prior interpretation of the SPR language by FWS, the United States Court of Appeals for the Ninth Circuit explained:

> If . . . the effect of extinction throughout "a significant portion of its range" is the threat of extinction everywhere, then the threat of extinction throughout "a significant portion of its range" is equivalent to the threat of extinction throughout all its range. Because the statute already defines "endangered species" as those that are "in danger of extinction throughout all . . . of [their] range," the Secretary's interpretation of "a significant portion of its range" has the effect of rendering the phrase superfluous. Such a redundant reading of a significant statutory phrase is unacceptable.

Defenders of Wildlife v. Norton, 258 F.3d 1136, 1145 (9th Cir. 2011).

NMFS' new SPR Policy also appears to require that the loss of the species in the portion of its range at issue result in a risk of extinction to the species throughout its entire range in order for that portion to be classified as significant. Therefore, this new interpretation is similarly inconsistent with the language of the ESA and is also in violation of the Ninth Circuit's holding in *Norton*. *See* 16 U.S.C. §§ 1532(6), (20); *Norton*, 258 F.3d at 1145. Nonetheless, as detailed below, under any reasonable interpretation of the ESA's SPR language, and even under NMFS' new overly restrictive, and likely illegal, policy, the three Manta Ray species are endangered or threatened in at least a significant portion of their ranges and should therefore be listed throughout their ranges. Defenders asks NMFS to appropriately consider this SPR issue in its review of this Petition.

C. Listing Factors

NMFS must make its determination of whether a species is endangered or threatened based solely on the following five factors set forth in 16 U.S.C. § 1533(a)(1):

A. The present or threatened destruction, modification, or curtailment of its habitat or range;
B. Overutilization for commercial, recreational, scientific, or educational purposes;
C. Disease or predation;
D. The inadequacy of existing regulatory mechanisms; and
E. Other natural or manmade factors affecting its continued existence.

In order to be listed, a species need only face a sufficient threat under a single factor. *See Humane Soc'y of the U.S. v. Pritzker*, 75 F. Supp. 3d 1, 7 (D.D.C. 2014) *appeal dismissed*, No. 15-5038, 2015 WL 1619247 (D.C. Cir. Mar. 17, 2015) (citing *Sw. Ctr. For Biological Diversity v. Babbitt*, 215 F.3d 58, 60 (D.C. Cir. 2000)). Any combination of threats, considered cumulatively under multiple factors, will also support listing. As discussed in detail in this Petition, the Manta Ray species face threats under all five of the listing factors and clearly warrant listing (*see generally* Section IV. "IDENTIFIED THREATS TO THE PETITIONED SPECIES: FACTORS FOR LISTING," *infra*).

D. 90-Day and 12-Month Findings

"To the maximum extent practicable," NMFS is required to determine "whether the petition presents substantial scientific or commercial information indicating that the petitioned action may be warranted" within 90 days of receiving a petition to list a species. 16 U.S.C. § 1533(b)(3)(A). This is referred to as a "90-day finding." A "negative" 90-day finding ends the listing process and is a final agency action subject to judicial review. 16 U.S.C. § 1533(b)(3)(C)(ii). A "positive" 90-day finding leads to a formal, more comprehensive "status review" and a "12-month finding" determining, based on the best available science, whether listing the species is warranted, not warranted, or warranted but precluded by other pending listing proposals for higher priority species. 16 U.S.C. § 1533(b)(3)(B). "Not warranted" and "warranted but precluded" 12-month findings are also subject to judicial review. 16 U.S.C. § 1533(b)(3)(C)(ii).

NMFS' regulations define "substantial information," for purposes of 90-day petition findings, as "that amount of information that would lead a reasonable person to believe that the measure proposed in the petition may be warranted." 50 C.F.R. § 424.14(b)(1). In making a finding as to whether a petition presents "substantial information" warranting a positive 90–day finding, NMFS considers whether the petition:

i. Clearly indicates the administrative measure recommended and gives the scientific and any common name of the species involved;
ii. Contains detailed narrative justification for the recommended measure; describing, based on available information, past and present numbers and distribution of the species involved and any threats faced by the species;

iii. Provides information regarding the status of the species over all or a significant portion of its range; and

iv. Is accompanied by appropriate supporting documentation in the form of bibliographic references, reprints of pertinent publications, copies of reports or letters from authorities, and maps.

50 C.F.R. §§ 424.14(b)(2)(i)–(iv). The Petition satisfies these requirements.

E. Reasonable Person Standard

Both the relevant case law and the language of NMFS' regulation, by setting the "reasonable person" standard for substantial information, underscore the point that the ESA does *not* require "conclusive evidence of a high probability of species extinction" in order to support a positive 90-day finding. *See, e.g., Ctr. for Biological Diversity v. Morgenweck*, 351 F. Supp. 2d 1137, 1140 (D. Colo. 2004); 50 C.F.R. § 424.14(b)(1). In reviewing negative 90-day findings, the courts have consistently held that the evidentiary threshold at the 90-day review stage is much lower than the one required under a 12-month review. *See, e.g.*, *Ctr. for Biological Diversity v. Kempthorne ("CBD v. Kempthorne II")*, No. CV 07-0038-PHX-MHM, 2008 WL 659822, at *8 (D. Ariz. Mar. 6, 2008) ("[T]he 90-day review of a listing petition is a cursory review to determine whether a petition contains information that warrants a more in-depth review."); *see also Pritzker*, 75 F. Supp. 3d at 10-13 (holding that NMFS' decision was arbitrary and capricious when it determined that conflicting evidence or "some level of uncertainty" was sufficient to show that the petitioner had failed to provide "substantial evidence" that listing was appropriate at the 90-day finding stage); *Moden v. U.S. Fish & Wildlife Serv.*, 281 F. Supp. 2d 1193, 1203, 1204 (D. Or. 2003) (holding that the substantial information standard is defined in "non-stringent terms" and that "the standard in reviewing a petition . . . does not require conclusive evidence.").

In fact, courts have characterized the 90-day finding determination as a mere "threshold determination" and have held that it contemplates a "lesser standard by which a petitioner must simply show that the substantial information in the Petition demonstrates that listing of the species *may* be warranted." *See Pritzker*, 75 F. Supp. 3d at 15 (quoting *Colo. River Cutthroat Trout v. Kempthorne,* 448 F. Supp. 2d 170, 176 (D.D.C. 2006)); *Morgenweck*, 351 F. Supp. 2d at 1141 (quoting 16 U.S.C. § 1533(b)(3)(A) (emphasis added)); *see also Ctr. for Biological Diversity v. Kempthorne ("CBD v. Kempthorne I")*, No. C 06-04186 WHA, 2007 WL 163244, at *3 (N.D. Cal. Jan. 19, 2007) (holding that in issuing negative 90-day findings for two species of salamander, FWS erroneously applied "a more stringent standard" than that of the reasonable person). Accordingly, a petition does not need to establish that there is a high likelihood that a species is either endangered or threatened at the 90-day finding stage.

Moreover, as explained by the courts, NMFS must give the "benefit of the doubt" to the petitioners – and thus the species:

> The 'may be warranted' standard . . . seems to require that in cases of . . . contradictory evidence, the [agency] must defer to information that supports petitioner's position. It would be wrong to discount the information submitted in a petition solely because other data might contradict it. At [the 90-day finding] stage, unless the [agency] has demonstrated the *unreliability* of information that supports the petition, that information cannot be dismissed out of hand.

CBD v. Kempthorne I, 2007 WL 163244, at *4 (emphasis added). In fact, the court in *Pritzker* determined that NMFS' expressed need for more conclusive information was itself sufficient to suggest a reasonable person "might conclude 'a review of the status of the species concerned' was warranted." 75 F. Supp. 3d at 11. NMFS' failure to provide a positive 90-day finding and complete a status review was thus found to be arbitrary and capricious. *Id.* at 10-13.

F. Best Available Scientific and Commercial Data

NMFS is required to make an ESA listing determination for the Manta Rays under the listing factors based exclusively on the best *available* scientific and commercial data. *See* 16 U.S.C. § 1533(b)(1)(A); 50 C.F.R. § 424.11(b). Therefore, NMFS cannot deny listing merely because there is little information available, if the best *available* information indicates that these Manta Rays are endangered or threatened under any one, or any combination, of the five ESA listing factors.[4] This is particularly important during the 90-day review because, as noted above, NMFS must make a positive 90-day finding and commence a status review when a "reasonable person" would conclude, based on the *available* evidence, that listing may be warranted. *See, e.g., Morgenweck*, 351 F. Supp. 2d at 1140-41; *Pritzker*, 75 F. Supp. 3d at 10-11. Because the United States supported listing all Manta Rays under CITES (USFWS, 2013 at 2), indicating that they are threatened by overutilization for commercial purposes, NMFS should have no problem determining that information sufficient to convince a reasonable person that listing the Manta Rays may be warranted exists within 90 days.

1. The International Union for the Conservation of Nature ("IUCN")

The IUCN is the world's oldest and largest global environmental network and has become a leading authority on the environment (IUCN, Undated at 1). It is a neutral, democratic membership union with more than 1,200 government and non-governmental organization ("NGO") members, and almost 11,000 volunteer scientists and experts in more than 160 countries (IUCN, Undated at 1). Its work is supported by over 1,000 professional staff in 45 offices and hundreds of partners in public, NGO, and private sectors around the world (IUCN, Undated at 1).

As part of its work, the IUCN compiles and updates the IUCN Red List, "the definitive international standard for species extinction risk . . ." (IUCN, Undated at 1). The IUCN Red List assessments are recognized internationally, are relied on in a variety of scientific publications, and are used by numerous governmental organizations and NGOs. The IUCN Red List has also been used to inform multi-lateral agreements, such as CITES, the Convention on Migratory Species, and the Convention on Biological Diversity. As a result of the scientific rigor with which Red List species

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[4] *See City of Las Vegas v. Lujan*, 891 F.2d 927, 933 (D.C. Cir. 1989) ("[Section 4] merely prohibits the Secretary from disregarding available scientific evidence that is in some way better than the evidence he relies on. Even if the available scientific and commercial data were inconclusive, he may – indeed must – still rely on it at this stage . . ."); *Trout Unlimited v. Lohn*, 645 F. Supp. 2d 929, 950 (D. Or. 2007) ("[T]he agency 'cannot ignore available biological information'") (quoting *Kern Co. Farm Bureau v. Allen*, 450 F.3d 1072, 1080-81 (9th Cir. 2006); *In re Polar Bear Endangered Species Act Listing and 4(d) Rule Litigation*, 794 F. Supp. 2d 65, 106 (D.D.C. 2011) ("As this Court has observed, 'some degree of speculation and uncertainty is inherent in agency decisionmaking' and 'though the ESA should not be implemented 'haphazardly' . . . an agency need not stop in its tracks when it lacks sufficient information.'") (quoting *Oceana v. Evans*, 384 F. Supp. 2d 203, 219 (D.D.C. 2005).

extinction risk determinations are made, both NMFS and FWS have utilized IUCN data and Red List listing determinations when making ESA listing decisions even though the IUCN Red List criteria differ from the ESA's statutory requirements for listing a species as endangered or threatened. This is because the IUCN is considered a credible source of scientific data that meets the "best available science" requirement of the ESA. *See* 16 U.S.C. § 1533(b)(3)(A). NMFS' reliance on these findings is further supported by a recent study that found that, with respect to marine fish species, IUCN Red List listings were not biased towards exaggerating threat status and that IUCN Red List listings can serve as an accurate flag for relatively data-poor fisheries (Davies & Baum, 2012 at 7). In fact, based on the listing criteria that must be evaluated and applied, the IUCN Red List is an even more objective evaluation of a species' extinction risk than the more subjective narrative criteria used in the ESA listing process.

One example of NMFS' reliance on these Red List determinations comes from its decision to list the Guadalupe fur seal as a threatened species. In that decision, NMFS specifically noted that,

> The Guadalupe fur seal is listed by IUCN as "vulnerable." Included in this category are species "believed likely to move into the 'Endangered' category in the near future . . ." and species whose populations "have been seriously depleted and whose ultimate security has not yet been assured." This classification corresponds more closely with the ESA definition of "threatened" than "endangered" and therefore, it appears that the "threatened" status is consistent with the IUCN category of vulnerable.

50 Fed. Reg. 51,252, 51,254 (Dec. 16, 1985).[5]

Through such actions, NMFS has repeatedly recognized the IUCN Red List as a legitimate source of information on species endangerment. However, in addition to a general recognition of IUCN data and determinations as a source of the best available information on extinction risk, the Guadalupe fur seal decision is important for another reason as well. With regard to the Guadalupe fur seal, NMFS noted the IUCN's "vulnerable" extinction risk determination for the species and applied the corresponding ESA listing status, "threatened."

However, NMFS has recently stated that, when a petition cites to IUCN threat classifications, NMFS "will evaluate the source of information that the classification is based upon in light of the standards on extinction risk and impacts or threats . . ." 80 Fed. Reg. 48,053, 48,055 (August 11, 2015). While Defenders certainly believes it is appropriate for NMFS to look at the underlying data, this alone is not enough. NMFS should ensure that it gives adequate weight to the opinions of the reasonable scientists who made these IUCN threat determinations as well, especially given the fact that they are often preeminent experts on the species being assessed. As such, these scientists bring nuanced opinions and personal observations that may not be available in, or obvious on the face of, the scientific articles referenced in the IUCN finding. The IUCN threat assessments are the

[5] *See also, e.g.,* 77 Fed. Reg. 26,478, 26,481 (May 4, 2012) (dwarf seahorse 90-day finding, citing IUCN reports and findings); 77 Fed. Reg. 61,556, 61,561 (Oct. 10, 2012) (Nassau grouper 90-day finding, citing IUCN reports and findings); 77 Fed. Reg. 73,220, 73,253 (Dec. 7, 2012) (proposed listing determination for 82 coral species, citing IUCN reports and findings); 77 Fed. Reg. 76,740, 76,748 (Dec. 28, 2012) ("These [IUCN Red List] listings highlight the conservation status of listed species and can inform conservation planning and prioritization."); 75 Fed. Reg. 70,169, 70,170 (Nov. 17, 2010).

culmination of scientific data and expert opinion and should be given weight beyond the mere citations that they include. They are each essentially scientific articles quantifying threats to species and should be treated as an additional, independent source. Defenders urges NMFS to consider the IUCN's threat assessments for *Manta birostris* and *Manta alfredi* (both vulnerable) in this way when making its 90-day finding for these species.[6]

2. IUCN's Assessment of the Manta Rays

Similar to the Guadalupe fur seal, the IUCN Red List classifies both *Manta birostris* and *Manta alfredi* as vulnerable species worldwide (*see* Marshall, *et al.*, 2011 – 1 at 3; Marshall, *et al.*, 2011 – 2 at 3). Therefore, these IUCN determinations should be sufficient to at least list these species as threatened under the ESA throughout their ranges. However, these Red List determinations were made over five years ago, with threats to these species and population declines continuing since then (*see* Marshall, *et al.*, 2011 – 1 at 5 (date of assessment November 1, 2010); Marshall, *et al.*, 2011 – 2 at 4 (date of assessment November 1, 2010); Section III. G. "Population Trend," *infra*; Section IV. "IDENTIFIED THREATS TO THE PETITIONED SPECIES: FACTORS FOR LISTING," *infra*). As a result, these species likely now qualify under the more stringent ESA definition of an "endangered" species. *See* 16 U.S.C. § 1532(6).

III. SPECIES DESCRIPTION

A. Common Name

This Petition will refer to *Manta birostris* by the common name "giant manta ray" throughout (Marshall, *et al.*, 2011 – 1 at 4).

This Petition will refer to *Manta alfredi* by the common name "reef manta ray" throughout (Marshall, *et al.*, 2011 – 2 at 4).

This petition will refer to *Manta c.f. birostris*, the third reputed species, as the "Caribbean manta ray" throughout as it does not appear to have a well-recognized common name thus far (Marshall, *et al.*, 2011 – 1 at 4; Ari, 2014 at 182).[7]

B. Taxonomy

Until 2009, the genus *Manta* was thought to be monotypic, with all Manta Rays being categorized as giant manta ray (*Manta birostris*) specimens (*see* CoP16-Prop-46 at 4; Marshall, *et al.*, 2009 at 1; Marshall, *et al.*, 2011 – 1 at 4; Marshall, *et al.*, 2011 – 2 at 4). Currently, the division of the genus into *Manta birostris* and *Manta alfredi* is well accepted and has been supported by genetic research (*see* CoP16-Prop-46 at 4; Marshall, *et al.*, 2009 at 1; Marshall, *et al.*, 2011 – 1 at 4; Marshall, *et al.*, 2011 – 2 at 4). However, there is also a likely third species, *Manta c.f. birostris*, in the Caribbean, Gulf of

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[6] The IUCN has not made a separate determination as to the status of *Manta c.f. birostris*.

[7] Because the taxonomic division of the genus *Manta* is still being determined (*see* Section III. B. "Taxonomy," *infra*), the Caribbean manta ray has not yet received its own distinct Latin name. The "*c.f.*" in *Manta c.f. birostris* comes from the Latin word "conferre," which means "compare to" or "confer." Therefore, the Caribbean manta ray's current Latin name essentially explains that it is similar to, but not the same as, the giant manta ray.

Mexico, and off the coast of the southeastern United States (*see* CoP16-Prop-46 at 4; Marshall, *et al.*, 2009 at 1; Marshall, *et al.*, 2011 – 1 at 4). However, due to the recent revisions in this genus, the 2011 IUCN listing determination for the giant manta ray stopped short of stating that the Caribbean manta ray is in fact a third species (*see* Marshall, *et al.*, 2011 – 1 at 4). In order to avoid this species differentiation difficulty, CITES listed the entire *Manta* genus "(including *Manta birostris*, *Manta alfredi* and any other possible species of *Manta*)" to ensure that protection for potential additional species, including the Caribbean manta ray, would not disappear when they were taxonomically separated from the two well-accepted species classifications (*see* CoP16-Prop-46 at 1).

The best available science indicates that the Caribbean manta ray is indeed a distinct species, and NMFS should be treat it as such in a listing determination.[8] Listing all three species would also be consistent with the United States' support of the Manta Ray CITES listing (*see* USFWS, 2013 at 2) that listed the entire *Manta* genus (*see* CoP16-Prop-46 at 1). However, if NMFS determines that the Caribbean manta ray is not a separate species, then Defenders requests that NMFS list the giant manta ray, including all specimens in the Caribbean, Gulf of Mexico, and southeastern United States (this would make the listing inclusive of those locations that Defenders attributes to both giant and Caribbean manta rays), and the reef manta ray throughout their respective ranges.

The data in Clark, 2001 supports the differentiation of the Caribbean manta ray from the giant manta ray. This study was released before the genus was split and therefore assumed that all of the Manta Rays surveyed were *Manta birostris*, but the data is still useful post-differentiation of the *Manta* genus because it shows genetic differences that support the genus' differentiation into at least three species. Clark, 2001 looked at mtDNA data from Manta Rays sampled from the western Pacific (Hawaii, French Frigate Shoals, Yap, and Fiji), Baja, and the Gulf of Mexico (Clark, 2001 at 50). This study found that "[t]hese three populations were well resolved in phylogenetic analysis and differed from one another by at least 14 nucleotide substitutions. Closely related mtDNA haplotypes differing by one to seven nucleotide substitutions were found within each population, and two individuals from the Gulf of Mexico (Gulf 1 & Gulf 2) grouped with mantas from Baja." (Clark, 2001 at 50). This indicates that two of the five Manta Rays from the Gulf of Mexico were closely-related to the Manta Rays from Baja and that three of the five Gulf of Mexico Manta Rays were not.

While this study did not determine that the different groups were all necessarily separate species, it did indicate that

> The neighbor-joining tree showed strong (PB = 100%) bootstrap support for a group comprised of haplotypes from the western Pacific, strong (PB = 89%) support for a group that included Baja 1-8 plus Gulf 1 and Gulf 2, and strong (PB = 100%) support for a group including Gulf 3-5. There was moderate (PB = 73%) support for Baja 4 occupying a basal position relative to all other Baja samples plus Gulf 1 and Gulf 2. There was moderate (PB = 66%) support for a grouping of all samples from Baja and the Gulf of Mexico.

[8] If NMFS determines that the Caribbean manta ray is in fact a subspecies of the giant manta ray, and not a distinct species, then it should consider listing the subspecies under its ESA authority. *See* 16 U.S.C. § 1532(16) (including subspecies in the ESA definition of a species).

(Clark, 2001 at 43). The most logical explanation for this data would be that some of the Gulf of Mexico specimens are genetically distinct from both the other Gulf of Mexico specimens and the Baja specimens, but that the other Gulf of Mexico specimens are not genetically distinct from the Baja specimens. Because only giant manta rays exist in Baja, a mix of giant manta rays and Caribbean manta rays are known from the Gulf of Mexico, and reef manta rays appear to be more widely represented in the western Pacific (especially as these specimens appear to be associated with specific islands), this data supports the separation of these three groups into the three species proposed in the taxonomic descriptions that follow (*see* Section III. D. "Habitat and Range," *infra*; *see also* Section III. C. "Physical Characteristics," *infra* (indicating a variety of physical characteristics that can be used to differentiate between the three species)). Because Defenders believes that the best available science indicates that the Caribbean manta ray is a distinct species, Defenders will refer to the Caribbean manta ray as a species throughout this Petition.

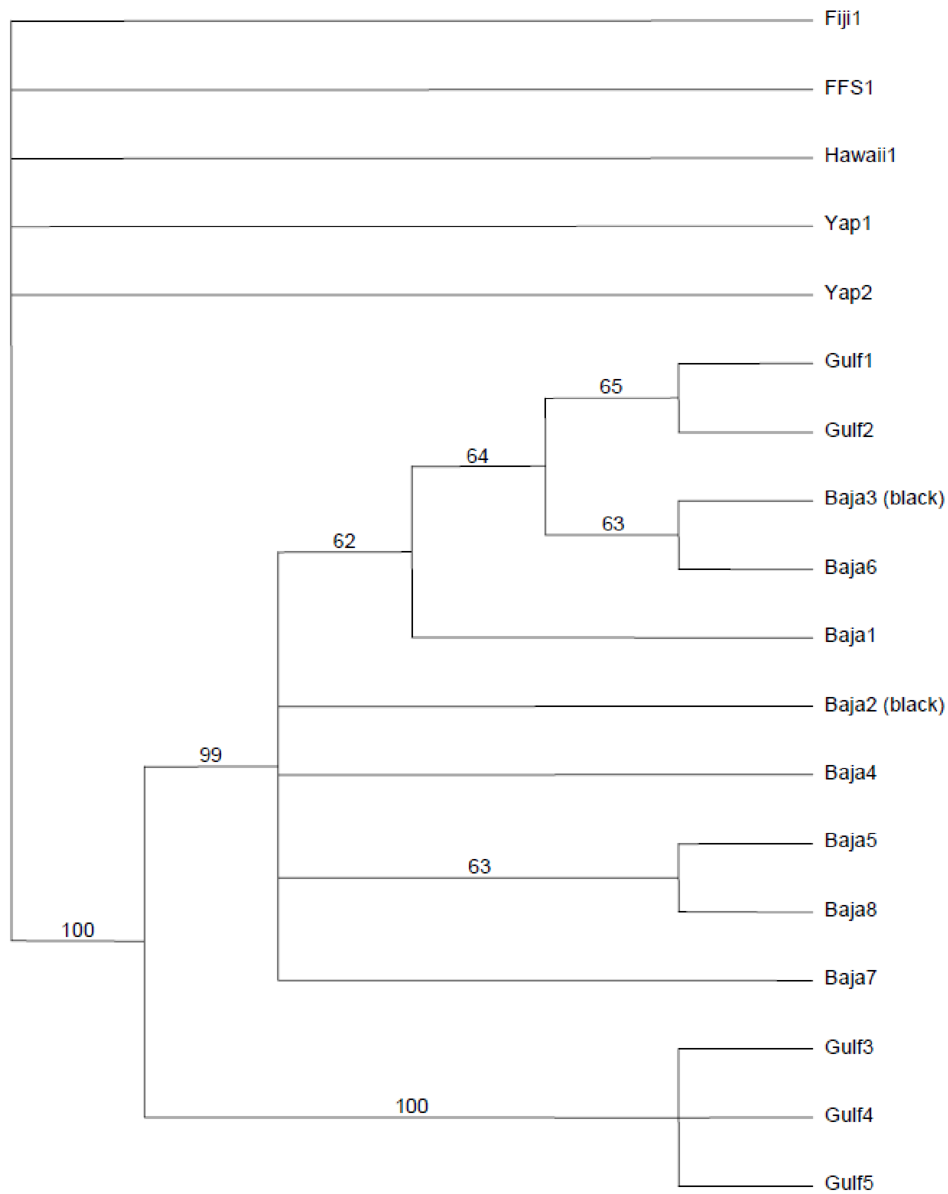

Figure 1. Clark, 2001's most-parsimonious tree representing phylogenetic relationships among mtDNA haplotypes of *Manta birostris* based on analysis of 2626 bp of the protein-coding regions

ND5, ND6, and part of cytochrome *b*. Numbers at tree nodes indicate number of times a branch appeared in 1000 nonparametric bootstrap replicates (Clark, 2001 at 42).

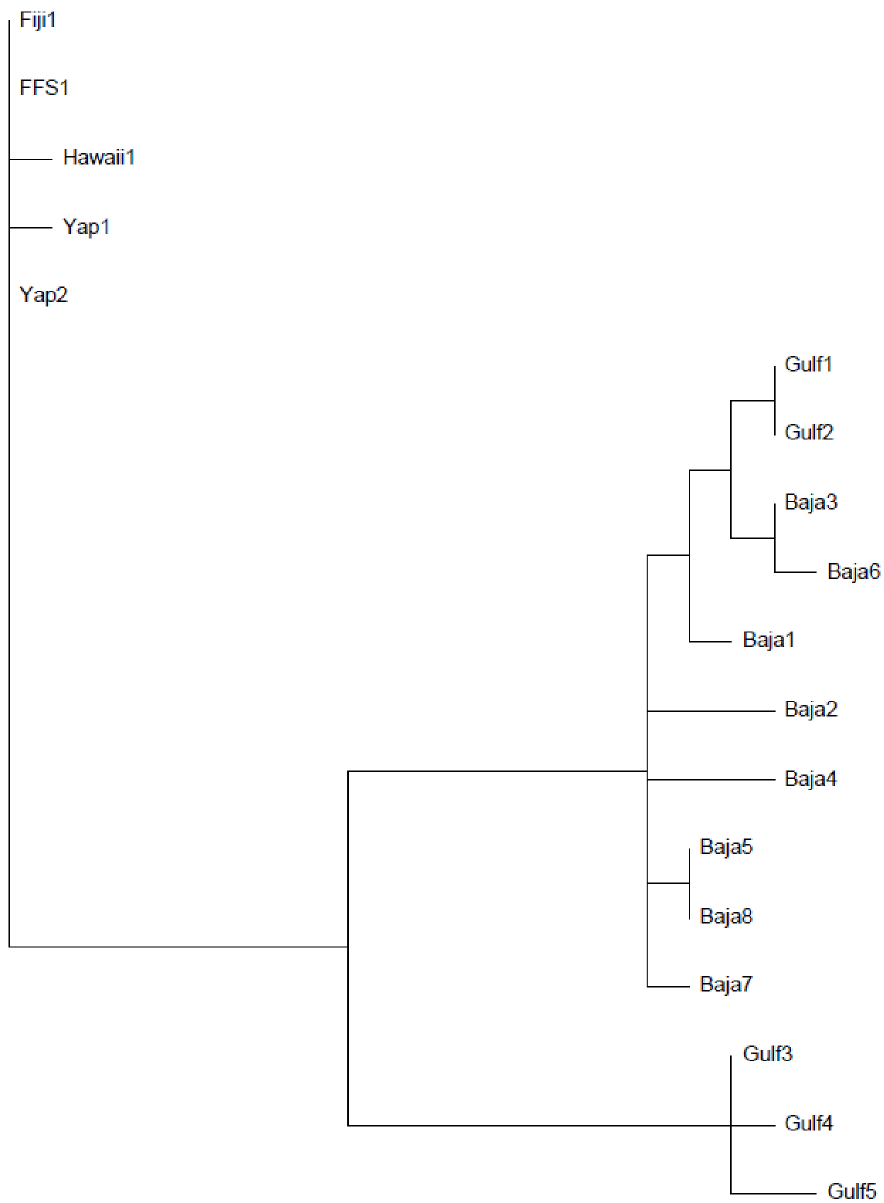

Figure 2. Phylogenetic relationships among mtDNA haplotypes of *Manta birostris* based on maximum-parsimony analysis of 2626 bp of the protein-coding regions ND5, ND6, and part of cytochrome *b* (Clark, 2001 at 41). These indicate that three of the specimens in the Gulf of Mexico are divergent from two of the other Gulf of Mexico specimens and all of the Baja California specimens as well as all of the western Pacific specimens.

The taxonomy of the giant manta ray is as follows:

Kingdom	*Animalia*
Phylum	*Chordata*
Class	*Chondrichthyes*
Order	*Rajiforms*
Family	*Mobulidae*
Genus	*Manta*
Species	*M. birostris*

Figure 3. Giant manta ray taxonomy (Marshall, *et al.*, 2011 – 1 at 3).

The taxonomy of the reef manta ray is as follows:

Kingdom	*Animalia*
Phylum	*Chordata*
Class	*Chondrichthyes*
Order	*Rajiforms*
Family	*Mobulidae*
Genus	*Manta*
Species	*M. alfredi*

Figure 4. Reef Manta Ray taxonomy (Marshall, *et al.*, 2011 – 2 at 3).

The taxonomy of the Caribbean manta ray is as follows:

Kingdom	*Animalia*
Phylum	*Chordata*
Class	*Chondrichthyes*
Order	*Rajiforms*
Family	*Mobulidae*
Genus	*Manta*
Species	*c.f. birostris*

Figure 5. Caribbean manta ray taxonomy (*see* Marshall, *et al.*, 2011 – 1 at 3).

C. Physical Characteristics

All three Manta Rays are very similar in appearance, which likely contributed to the longtime confusion over their taxonomy and their recent taxonomic differentiation into separate species. They are all massive, wing-shaped elasmobranchs whose sleek hydrodynamic bodies appear almost two-dimensional at first glance as they swim through the ocean (Manta Trust, Undated at 1). They have a terminal mouth and large cephalic fins in front of their eyes that unfurl during feeding to form a funnel, channeling large amounts of seawater into the Manta Rays' mouths (Stevens, 2011 at 12; Manta Trust, Undated at 1-2). When feeding, these species' mouths appear cavernous as their wings propel them through the ocean and the gill slits on their throat filter the water rushing into their mouths (Manta Trust, Undated at 2). These gill slits are lined by gill plates designed to capture plankton from the seawater (Manta Trust, Undated at 2). Their lateral eye position on either side of their heads allows them to see downward and forward clearly, but likely impairs their ability to see upward and behind their body (Venables, 2013 at 8 (citation omitted)).

Figure 6. Reef manta ray swimming with cephalic lobes rolled and mouth closed (not actively eating) (Jaine, *et al.*, 2012 at 4).

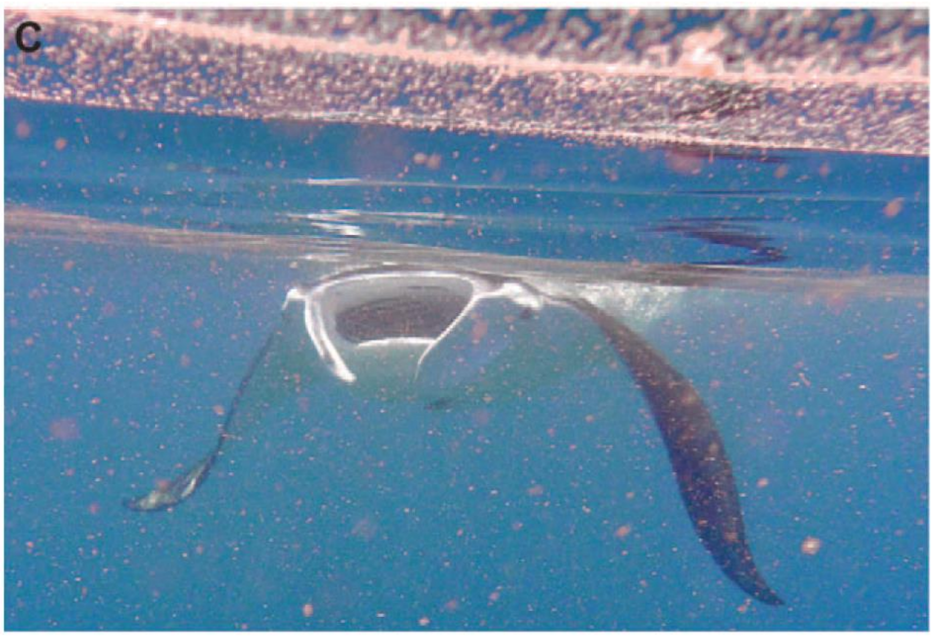

Figure 7. Reef manta ray ram feeding, swimming against the tidal current with its mouth open and sieving zooplankton from the water (Jaine, *et al.*, 2012 at 4).

The three Manta Ray species were eventually distinguished "in part based on their body coloration: the coloration of their dorsal surface, ventral surface, and mouth area, and the presence of distinct white-colored shoulder patches," which serve as "distinguishing identification keys." (Ari, 2014 at

180-81 (citing Marshall, *et al.*, 2009)).[9] Differentiation is also possible based on other "morphometric measurements and easily identifiable external characteristics . . ." (Mourier, 2012 at 1 (citing Marshall, *et al.*, 2009); Marshall, *et al.*, 2011 – 1 at 4).

Marshall, *et al.*, 2009 at 20-26, which is incorporated by reference rather than restated in its entirety, provides a much more detailed description of these differences.

1. Giant Manta Ray

The giant manta ray is the largest living ray in the world (IUCN, 2011 – 2 at 2). It can grow to more than 23 feet (7 meters) across (IUCN, 2011 – 2 at 2), with anecdotal reports of specimens that are up to 29.5 feet (9 meters) across (CMS, 2014 at 3 (citation omitted)). It can also reach weights up to 5,300 pounds (2,400 kilograms) (NOAA, 2015 – 1 at 1). As a planktivore,[10] this species truly is a gentle giant of the ocean.

One of the distinct features that makes differentiation of the giant manta ray from the other two species possible is its dark mouth coloration (Ari, 2014 at 181). In addition, it also has very distinctive shoulder patches that aid in identification (Ari, 2014 at 181). These white shoulder markings form two mirror image right triangles which create a shape resembling the letter "T" in black across the top of its head (Stevens, 2011 at 12). The trailing underside edge of its enormous pectoral fins are usually shaded black with gill covers that often have black shading/flaring (Stevens, 2011 at 12). It has a knob-like bulge at the base of its tail and a ventral spot pattern clustered around its lower abdominal region (Stevens, 2011 at 12). It also has a long, thin tail that trails behind it as it glides through the water (*see* Stevens, 2011 at 12).

Marshall, *et al.*, 2009 at 4-10, which is incorporated by reference rather than restated in its entirety, provides a much more detailed description of the species.

2. Reef Manta Ray

While still enormous by any standard, the reef manta ray is significantly smaller than the giant manta ray. The reef manta ray grows to an average of 11.5 feet (3.5 meters) disk width and reaches a maximum size of 16.4 feet (5 meters) (CMS, 2014 at 3 (citation omitted)). It can also reach weights of up to 3,000 pounds (1,350 kilograms) (NOAA, 2015 – 1 at 1). The reef manta ray has a very similar appearance to the giant manta ray, but it has a white to light gray mouth, as opposed to the giant manta ray's dark mouth (Ari, 2014 at 181). It also has a small depression at the base of its tail where the giant manta ray has a bulge (Stevens, 2011 at 13). It often has ventral spots between its branchial gill slits and spread across the trailing edge of its pectoral fins and abdominal region (Stevens, 2011 at 13). Its dorsal markings are more varied than the giant manta ray, with individuals ranging from almost completely white to almost completely black across the whole dorsal surface (Stevens, 2011 at 13). The transition between white and black markings on the dorsal surface is also

[9] A recent study indicates that some of the coloration differences used to distinguish between these species can fluctuate when the Manta Rays are excited (*see generally* Ari, 2014). Though this should be taken into account when differentiating between Manta Rays, there is no indication that this should draw the separation of the Manta Rays into three species into doubt, especially considering the other differences that exist between them.

[10] A planktivore is an animal that feeds primarily or exclusively on plankton.

more blurred across the color boundary in the reef manta ray than in the giant manta ray, where these transitions are bolder, and the white coloration on the reef manta ray's back is more like a letter "Y" than a letter "T" (Stevens, 2011 at 12, 13).

Marshall, *et al.*, 2009 at 13-18, which is incorporated by reference rather than restated in its entirety, provides a much more detailed description of the species.

3. Caribbean Manta Ray

The Caribbean manta ray shares some characteristics with the giant manta ray, such as a large maximum disc width and the presence of a distinct, reduced caudal spine. However, clear differences exist between the Caribbean manta ray and the giant manta ray "including dissimilar denticle morphology and distribution, intermediary dentition and, most noticeably, differences in dorsal and ventral [coloration]." (Marshall, *et al.*, 2011 – 1 at 4). These coloration differences include the Caribbean manta ray's white or cream mouth region, brownish back coloration, and lack of large white shoulder bars (Ari, 2014 at 181, 182).

Marshall, *et al.*, 2009 at 22-26, which is incorporated by reference rather than restated in its entirety, provides a much more detailed description of the species.

D. Habitat and Range

The recent taxonomic differentiation of these species makes reliance on habitat and range descriptions difficult. All pre-2009, and likely at least some post-2009, habitat and range discussions will necessarily fail to differentiate between the three species, which makes individualized discussions of habitat and range more difficult. This Petition has assessed the available information and attempted to draw the proper species-specific conclusions from all of the available data. Generally speaking, Manta Rays as a genus are circumglobal in range (CMS, 2014 at 3). "*M. birostris* is the more widely distributed, inhabiting tropical, subtropical, and temperate waters, while *M. alfredi* is found in tropical and subtropical waters." (CMS, 2014 at 3 (citations omitted)). However, the Caribbean manta ray appears to be a regional endemic, with a limited distribution covering the Gulf of Mexico, the Caribbean, and the southeastern coast of the United States (CMS, 2014 at 3). The giant and reef manta rays and giant and Caribbean manta rays are sympatric in some locations and allopatric in others (CMS, 2014 at 3; Marshall et al, 2011 - 1 at 4 (citations omitted)). However, Caribbean and reef manta rays appear to be allopatric throughout their ranges (CMS, 2014 at 3). This is due to the fact that, while "*M. birostris* is widely distributed around the world, . . . *M. alfredi* is absent in the east Pacific and west Atlantic Oceans." (*See* Mourier, 2012 at 1 (citations omitted)).

"Within this broad range, Manta populations are sparsely distributed and highly fragmented, likely due to their resource and habitat needs." (CoP16-Prop-46 at 4; *see also* CMS, 2014 at 3). As a result, there appears to be little genetic exchange amongst the identified populations (*see, e.g.,* CoP16-Prop-46 at 2-3). "Given that globally only twenty-four subpopulations (14 *M. alfredi*, 9 *M. birostris*, 1 *M. c.f. birostris*) in fifteen countries have been studied and approximately twenty-five other, mostly very small, aggregations in fifteen more countries have been identified through tourism operations and fisheries, and further manta ray sightings in all other range States are very infrequent, it can be inferred that global population numbers are quite small." (CoP16-Prop-46 at 3).

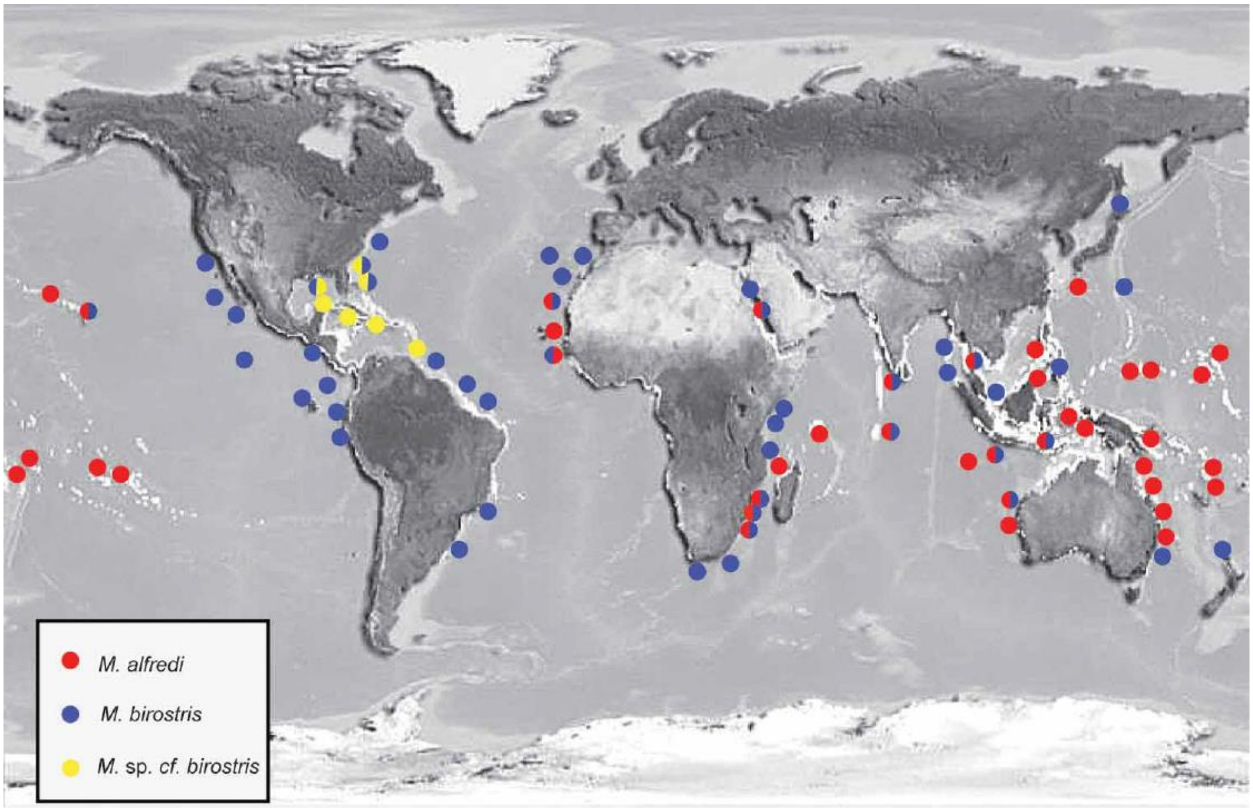

Figure 8. Worldwide distribution of Manta Rays (red dots mark reef manta ray populations, blue dots mark giant manta ray aggregations, and yellow dots mark Caribbean manta ray populations (Marshall, *et al.*, 2009 at 12).

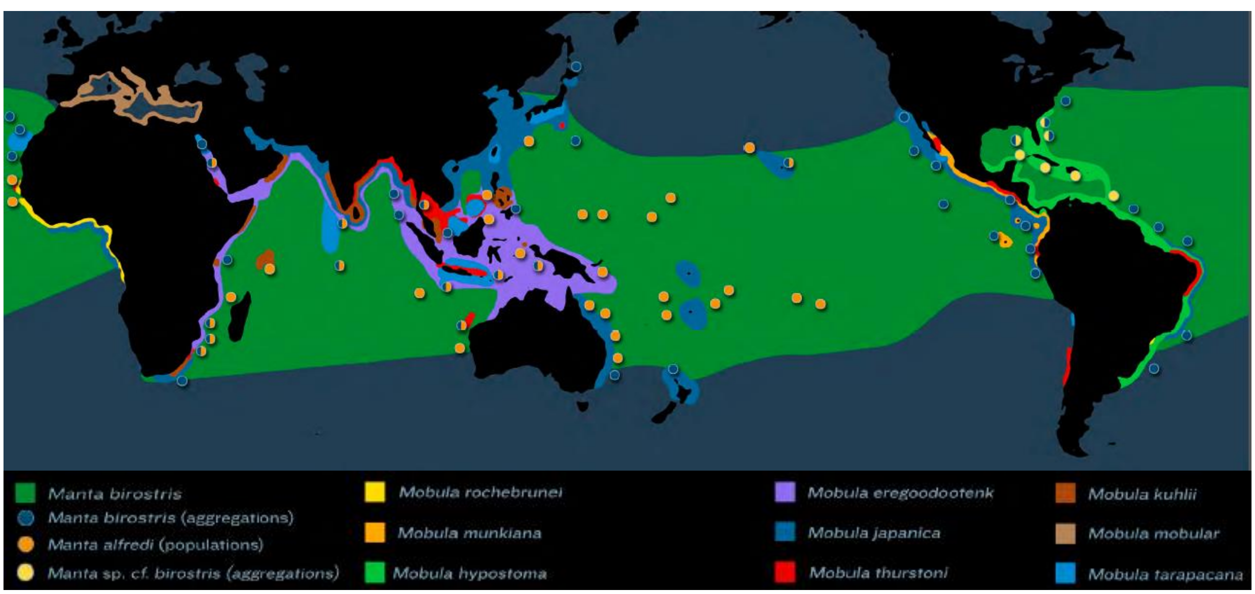

Figure 9. Estimated worldwide mobulid[11] distributions with the green band representing the giant manta ray's distribution, blue circles marking known giant manta ray aggregation sites, orange circles

[11] The term "mobulid" refers to rays in the family *Mobulidae*, which includes the Manta Rays.

marking reef manta ray populations, and yellow circles marking Caribbean manta ray populations (Heinrichs, *et al.*, 2011 at 12-13).

1. Giant Manta Ray

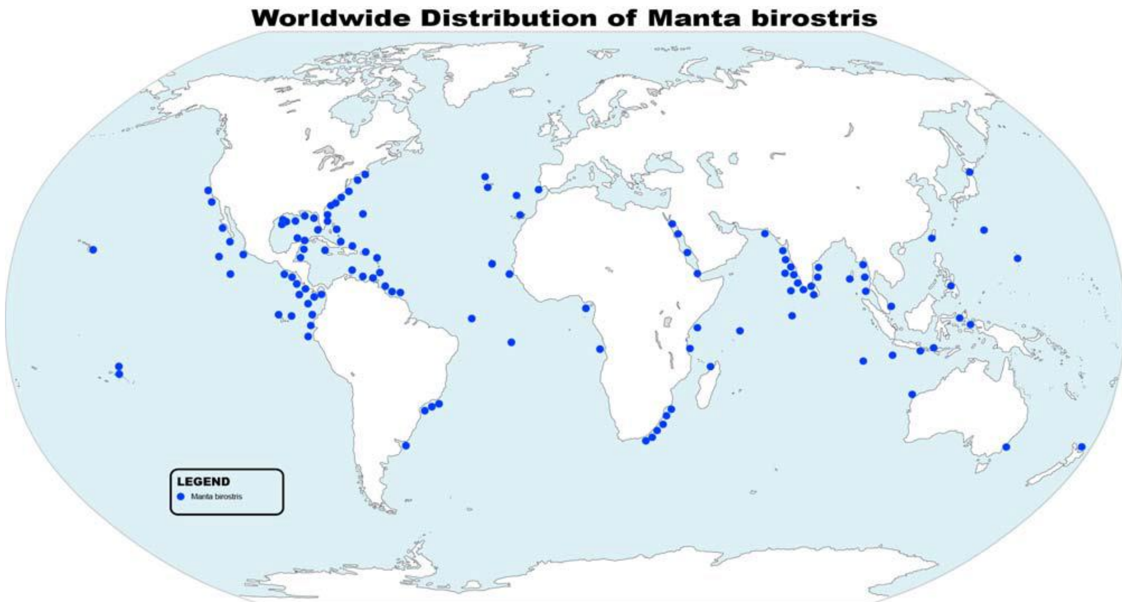

Figure 10. Map identifying giant manta ray sighting locations (CoP16-Prop-46 at 20). However, note that this map does not distinguish between the giant manta ray and Caribbean manta ray and that the utility of this map is limited based on that shortcoming (*cf.* Figure 8, *supra*; Figure 9, *supra*).

The giant manta ray is the most widely distributed member of the genus (Marshall, *et al.*, 2009 at 1). It is considered more oceanic, migratory, cold-water tolerant, and offshore distributed than the reef manta ray (Couturier, *et al.*, 2011 at 628; Medeiros, *et al.*, 2015 at 2). Giant manta rays spend "the majority of their time in deep water, paying occasional visits to coastal areas with productive upwellings,[12] oceanic islands, and offshore pinnacles and seamounts." (Deakos, 2010 at 2 (citations omitted); *see also* NOAA, 2015 – 1 at 1). They "visit cleaning stations on shallow reefs, are sighted feeding at the surface inshore and offshore, and are also occasionally observed in sandy bottom areas and seagrass beds." (NOAA, 2015 – 1 at 1). While the giant manta ray is not a permanent inhabitant of these areas, it is a regular seasonal visitor during specific, predictable times of the year (Marshall, *et al.*, 2011 – 1 at 6). In some locations, the giant manta ray is sympatric with the reef manta ray. However, where sympatric, the two species typically exhibit different habitat use and movement patterns (Marshall, *et al.*, 2009 at 11). It is also sympatric with the Caribbean manta ray in some locations (*see* Figure 8, *supra*; Figure 9, *supra*).

The giant manta ray "has been documented to occur as far north as southern California and Rhode Island on the United States west and east coasts, Mutsu Bay, Aomori, Japan, the Sinai Peninsula, Egypt and the Azores Islands in the Northern Hemisphere and as far south as Peru, Uruguay, South

[12] In the context of seawater, upwelling is the process by which less-dense, warmer surface water is drawn away from a shore area by offshore currents and is replaced by denser, colder water from deeper in the water column. Because the latter type of water is typically more nutrient-dense, it can trigger increased planktonic productivity in the location of the upwelling.

Africa and New Zealand in the Southern Hemisphere." (Marshall, *et al.*, 2009 at 10-11). A 2015 study offered the first photographic evidence, confirming previous unverified reports, of giant manta rays in eastern Australian waters (Couturier, *et al.*, 2015 at 1), and the species appears to be occasionally present elsewhere in Australia as well (Venables, 2013 at 10 (citations omitted)). The giant manta ray is considered native to Australia; Belize; Bermuda; Bonaire, Saint Eustatius, and Saba; Brazil; Cayman Islands; Christmas Island; Colombia (Malpelo Island); Costa Rica (Cocos Island and the Costa Rican mainland); Cuba; Curaçao; Djibouti; Dominican Republic; Ecuador (Galápagos); Egypt; El Salvador; French Guiana; French Polynesia; Guatemala; Guyana; Honduras (mainland coast); India (Andaman Islands, Andhra Pradesh, Goa, Gujarat, Kerala, Maharashtra, and Tamil Nadu); Indonesia (Bali, Papua, and Sumatra); Jamaica; Japan; Kenya; Malaysia; Maldives; Mexico (Baja California, Baja California Sur, Quintana Roo, Revillagigedo Islands, Sinaloa, and Yucatán); Mozambique; Myanmar (Coco Islands and the Myanmar mainland); New Zealand (North Island); Nicaragua; Nigeria; Commonwealth of the Northern Mariana Islands; Panama; Peru; Philippines; Portugal (Azores and Madeira); Saint Martin (French part); Senegal; Seychelles (the main island group); Saint Maarten (Dutch part); South Africa (Eastern Cape Province, KwaZulu-Natal, and Western Cape); Spain (Canary Islands); Sri Lanka; Sudan; Taiwan (main island); Tanzania; Thailand; Trinidad and Tobago; United States (Alabama, California, Delaware, Florida, Georgia, Hawaiian Islands, Louisiana, Maryland, Mississippi, New Jersey, North Carolina, South Carolina, Texas, and Virginia); Uruguay; and Venezuela (*see* Marshall, *et al.*, 2011 – 1 at 6; Mourier, 2012 at 2; Couturier, *et al.*, 2015 at 1).[13] However, it would likely not be resident in any of these places year round (*see* Marshall, *et al.*, 2011 – 1 at 6).

2. Reef Manta Ray

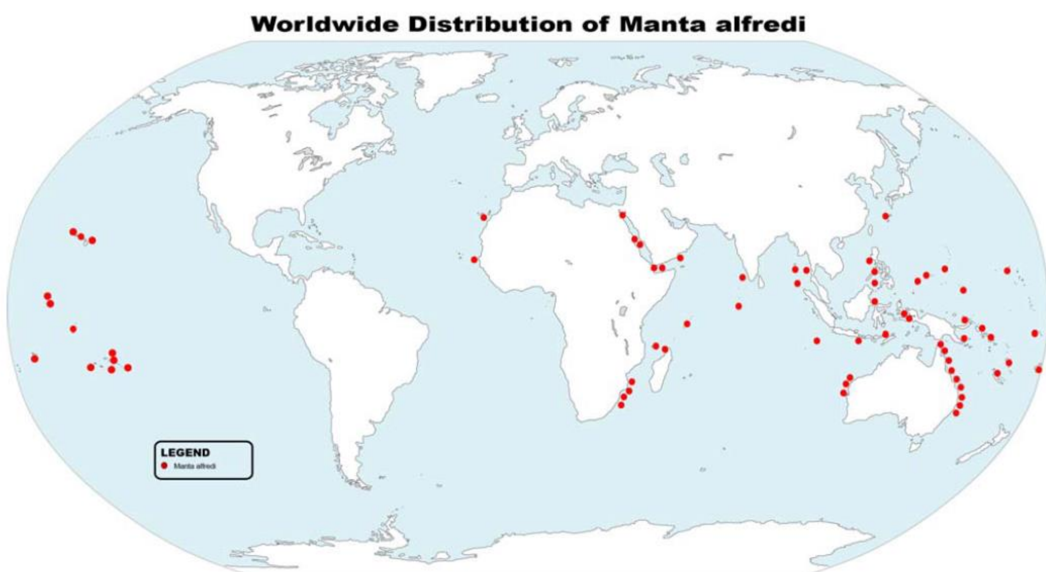

Figure 11. Map identifying sighting locations of the reef manta ray (CoP16-Prop-46 at 20).

[13] While the giant manta ray is considered native in all of these places, some of the occurrences may in fact be a mix of Caribbean and giant manta rays or could be Caribbean manta rays alone, thus making its range somewhat uncertain (*see* Section III. C. "Physical Characteristics," *supra*).

The reef manta ray has a smaller, more tropical distribution than the giant manta ray (Marshall, *et al.*, 2009 at 1). The species is commonly sighted inshore or on the continental shelf, around tropical and subtropical coral and rocky reefs, seamounts, and islands (Couturier, *et al.*, 2011 at 628; CMS, 2014 at 4; NOAA, 2015 – 1 at 1). It occurs in a semi-circumglobal range in, relatively speaking, large groups near coral reefs and rocky shores "and may also be associated with areas or events of high primary productivity (e.g., upwelling)." (Medeiros, *et al.*, 2015 at 2; CMS, 2014 at 4 (citations omitted); NOAA, 2015 – 1 at 1 (citations omitted)). Tagging studies indicate that reef manta rays frequent waters from 0-10 meters during daylight hours, inhabiting deeper water through the night (Braun, *et al.*, 2014 at 1). They can dive to depths in excess of 150 meters, with evidence of some making dives to depths of over 400 meters (*see* Braun, *et al.*, 2014 at 1).

The reef manta ray

> is widespread in the Indian Ocean, with images and sightings of *M. alfredi* from the Red Sea in the north to Durban, South Africa in the south, and from mainland Thailand in the north to waters off Perth, Australia in the south. In the eastern and south Pacific, *M. alfredi* occurs from the Yaeyama islands, Japan in the north to the Solitary Islands, Australia in the south and is sighted as far east as French Polynesia south of the equator and the Hawaiian islands north of the equator. Two reports and photographs of *M. alfredi* from the north Atlantic off the Canary Islands and the Cape Verde Islands and historical reports and photos of *M. alfredi* off the coast of Senegal in North West Africa are the only evidence of populations of *M. alfredi* in Atlantic waters.

(Marshall, *et al.*, 2009 at 18 (internal citation omitted); *see also* Medeiros, *et al.*, 2015 at 2 ("data show that this species does not occur in the east Pacific and west Atlantic Oceans) (citation omitted)). A number of reef manta ray aggregations have been located across this range (*see, e.g.,* CMS, 2014 at 3-4, 5-6, 7 (Maldives); Anderson, *et al.*, 2010 at 22 (Maldives); Venables, 2013 at 15 (Bateman Bay, Australia); Couturier, *et al.*, 2011 at 633 (east coast of Australia); Deakos, *et al.*, 2011 at 246 (Maui, Hawaii, United States)). These aggregations typically are associated with shallow coral reef locations and are used for feeding, mating/courtship, and utilization of cleaning stations, where the reef manta rays solicit fish, predominantly Hawaiian cleaner wrasses (*Labroides phthirophagus*) and saddle wrasses (*Thalassoma duperrey*) in Hawaii, to remove parasitic copepods and other unwanted materials from their body surface (*see* Venables, 2013 at 15 (citation omitted); Deakos, *et al.*, 2011 at 246-47; Deakos, 2010 at 2).

The reef manta ray is considered native to Australia (New South Wales, Northern Territory, Queensland, and Western Australia); British Indian Ocean Territory (Chagos Archipelago); Cape Verde; Christmas Island; Cocos (Keeling) Islands; Cook Islands; Djibouti; Egypt (Red Sea portion); Fiji; French Polynesia (Society Islands and Tuamotu); Guam; India (Andaman Islands); Indonesia (Bali, Java, Papua, and Sulawesi); Japan (Nansei-shoto); Madagascar; Malaysia; Maldives; Marshall Islands; Micronesia; Mozambique; New Caledonia; Commonwealth of the Northern Mariana Islands; Oman; Palau; Papua New Guinea (Bismarck Archipelago, North Solomons, and the main island group); Philippines; Saudi Arabia; Senegal; Seychelles (main island group); South Africa (KwaZulu-Natal); Spain (Canary Islands); Sri Lanka; Sudan; Thailand; United States (Hawaiian Islands); and Yemen (Marshall, *et al.*, 2011 – 2 at 5-6; Verdote & Ponzo, 2014 at 2). "Preliminary studies at major aggregation sites suggest resident population sizes are generally small, with some areas having large seasonal influxes." (Marshall, *et al.*, 2011 – 2 at 6).

3. Caribbean Manta Ray

The Caribbean manta ray exhibits similar habitat preferences to the reef manta ray (CMS, 2014 at 4; NOAA, 2015 – 1 at 1). It is thus "[c]ommonly sighted along productive coastlines with regular upwelling and island groups." (Marshall, *et al.*, 2009 at 24 (citations omitted)). However, the Caribbean manta ray "appears to be endemic to the Atlantic Ocean and Caribbean," occurring "as far north as North Carolina and as far south as Venezuela." (Marshall, *et al.*, 2009 at 24 (citations omitted); *see also* CMS, 2014 at 3; NOAA, 2015 – 1 at 1). Its range includes the Gulf of Mexico and other waters along the eastern coast of the United States (CMS, 2014 at 3). In some Atlantic, and particularly in some Caribbean, locations, the Caribbean manta ray exhibits sympatric occurrence with the giant manta ray (Marshall, *et al.*, 2009 at 24; Marshall, *et al.*, 2011 – 1 at 4). However, where this sympatric range occurs, "there is some evidence that differences in fine-scale habitat selection and seasonal habitat use may occur in some locations." (Marshall, *et al.*, 2011 – 1 at 4 (citations omitted)). Notarbartolo-di-Sciara & Hillyer, 1989 appears to indicate that the Venezuelan Caribbean between Puerto la Cruz and Isla Margarita is "a major feeding ground" for the Caribbean manta ray (Notarbartolo-di-Sciara & Hillyer, 1989 Abstract).[14] Its range states appear to include the United States, Mexico, several Caribbean Island Nations, Venezuela, and perhaps some other Central and South American countries (*see* Figure 8, *supra*; Figure 9, *supra*).

E. Feeding

Manta Rays are all large filter-feeding elasmobranchs that feed almost entirely on plankton (*see* Manta Trust, Undated at 1-2; CMS, 2014 at 4).

> Plankton is defined as weakly swimming or drifting micro-organisms that inhabit the pelagic zone of the oceans, seas and bodies of fresh waters and which are unable to resist ocean currents. They encapsulate a huge variety of different species, many of which are planktonic only for a portion of their lifecycle; for example, most coral reef fish larvae drift around as part of the planktonic soup until they mature into adults. Plankton are divided into two main functional groups; the first being phytoplankton, which includes the plants, such as algae, which are able to produce their own food through photosynthesis, while the second group contains all the animals which are referred to as zooplankton. While still tiny, the zooplankton are generally much larger than phytoplankton, and so it is this food source which the manta rays, and other large marine filter feeders such as the whale shark and basking shark, feed upon.
>
> One of the most diverse and abundant zooplankton groups found in the oceans are the copepods, and it is these tiny animals (along with arrow worms, mysid shrimps, and a host of other tiny critters) which the manta rays prefer to dine upon. Each of

[14] This paper was published long before the species' differentiation and therefore refers to the Manta Rays seen as giant manta rays. However, the individuals were likely Caribbean manta rays based on the shallow depth these individuals were observed at and the geographic location of these sightings (*see* Notarbartolo-di-Sciara & Hillyer, 1989 Abstract (discussing shallow depth and location); Figure 8, *supra* (showing that this is within the Caribbean manta ray's range and is slightly north of the giant manta ray's known range); Figure 9, *supra* (same); Manta Trust, Undated at 3 (discussing giant manta ray's general aversion, as compared to reef manta rays, to aggregation); Deakos, 2010 at 2 (discussing majority of giant manta ray's time spent in deep water).

> these tiny water flea-like crustaceans is rich in energy, but in order to sustain themselves manta rays must extract vast quantities of these animals from the water column.
>
> Although plankton could be considered to be one of our oceans most abundant food sources, the nature of plankton means it is not evenly dispersed throughout the marine realm; concentrating in certain 'hotspots', which are often ephemeral, forming with the ebb and flow of the tides or the shifting of the seasons. Mantas have become experts in predicting and seeking out these productive areas of food and taking advantage of them when they occur.

(Manta Trust, Undated at 1).

As discussed in Section III. C. "Physical Characteristics," *supra*, the Manta Rays use their enormous mouths and funnel-like cephalic fins to channel water into their bodies as they swim through the oceans (Manta Trust, Undated at 1-2; *see also* Figure 12, *infra*). This water streams through these species' five gill slits on the bottom side of their throats where their sieve-like, feathered gill plates strain out any plankton that is larger than a grain of sand (Manta Trust, Undated at 2; *see also* Figure 13, *infra*). "Once the plates have netted a mouthful of planktonic food, the manta closes its mouth and coughs, back flushing the trapped plankton from the gills into the back of its throat before swallowing its mouthful of highly nutritional prey." (Manta Trust, Undated at 2). In captivity Manta Rays have been observed eating about 12% of their body weight each week, which is "27 [kilograms] (60 pounds) of microscopic plankton, fish larvae, copepods, and other zooplankton in a single day for an average sized, 3 [meter] wide, manta which weighs over 1.5 [tons]." (Manta Trust, Undated at 3). However, it is unlikely that Manta Rays can reliably find this quantity of food in the wild (Manta Trust, Undated at 3).

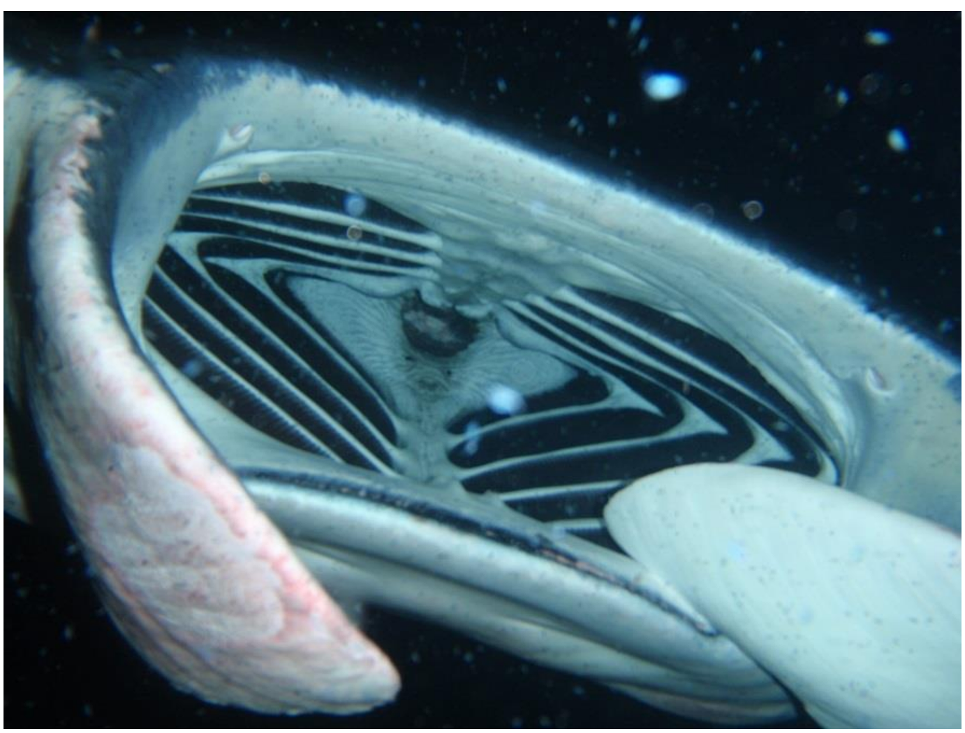

Figure 12. Inside a feeding Manta Ray's mouth (Photo Credit: Rosa Indenbaum).

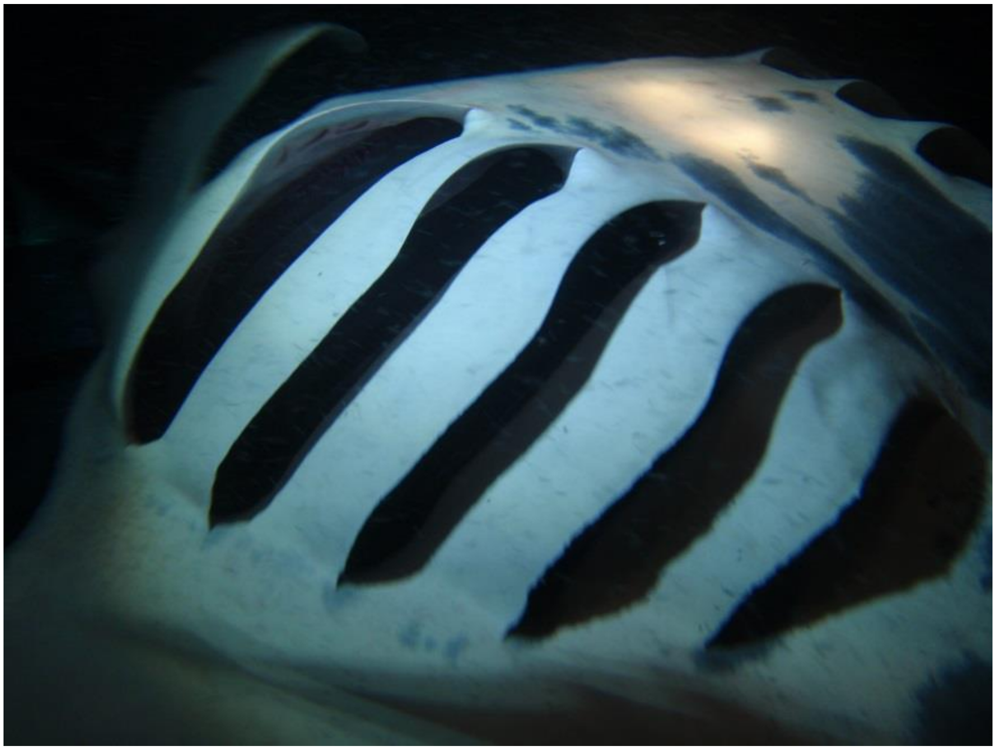
Figure 13. Water streaming through a feeding Manta Ray's five sets of gill slits (Photo Credit: Rosa Indenbaum).

Manta Rays have developed a number of feeding strategies that enable them to maximize their plankton intake while minimizing their energy expenditure relative to that intake (Manta Trust, Undated at 2). These include barrel rolling backwards, sometimes for hours, to exploit concentrated patches of plankton; cruising millimeters above the sea floor to ingest plankton that has sunk to the bottom to avoid predation; surface feeding to ingest plankton that settles just below the water's surface; forming feeding chains to work cooperatively when dense plankton patches are located; and even taking part in "cyclone feeding," which is where as many as 150 individuals form a spiraling column in the water that acts as a centrifuge pulling the plankton into their waiting mouths (this final strategy only appears to occur a few times per year in two locations (Hanifaru Bay in the Maldives and in the Red Sea near Sudan) when conditions are perfect) (*see* Manta Trust, Undated at 2; Venables, 2013 at 13).

Though "anecdotal observations by sailors far out at sea have reported massive feeding aggregations of giant manta rays at the surface in the Pacific Ocean," giant manta rays appear to be more solitary and less likely to engage in large feeding aggregations than reef manta rays (Manta Trust, Undated at 3). There are known reef manta ray aggregations on both the Indian and Pacific coasts of Australia (Venables, 2013 at 10, 15). Large aggregations are known to occur in Australia, Mexico, Mozambique, the Maldives, Hawaii, and Micronesia and can sometimes be enormous in size with hundreds of individuals participating (Graham, *et al.*, 2012 at 1; Venables, 2013 at 15). "These aggregations are thought to [often] be [the result of seasonal peaks] in the abundance of zooplankton, or an alteration in the schooling [behavior] of prey which augments feeding." (*See* Venables, 2013 at 15 (citations omitted)). Individuals may travel amongst these aggregations to take advantage of seasonal, localized increases in productivity (Germanov & Marshall, 2014 at 7).

F. Reproduction and Lifespan

Manta Rays are very long-lived and slow-growing species (CMS, 2014 at 3). In fact, their estimated longevity is at least 40 years with natural mortality expected to be low (CMS, 2014 at 3 (citations omitted)).[15] Maturation varies significantly by population and species.[16] Generally, where differences exist, the reef manta ray appears to be slightly more fecund than the giant manta ray, which is not surprising given its relatively smaller size.

> Size at maturity for the Giant Manta Ray may vary slightly throughout its range, but males in southern Mozambique mature at approximately 400 [centimeters disc width] while females appear to mature well over 400 [centimeters disc width]. In Indonesia, data from fisheries dissections suggest that in that region male Giant Manta Rays mature at 375 [centimeters disc width], while females may mature by approximately 410 [centimeters disc width].

(Marshall, *et al.*, 2011 – 1 at 9 (citations omitted)). Giant manta ray maturity appears to typically occur at around 10 years of age (*see* Marshall, *et al.*, 2011 – 1 at 9; NOAA, 2015 – 1 at 1).

Age at maturity varies wildly across reef manta ray populations and sexes with males maturing at approximately 3-6 years in Kona, Hawaii and females maturing at 15 years or more in the Maldives (*see* CMS, 2014 at 3 (citations omitted); Marshall, *et al.*, 2011 – 2 at 8). With these disparate maturity ages in mind, maturity appears to come at 10 years on average for reef manta rays (NOAA, 2015 – 1 at 1). Reef manta ray males

> in southern Mozambique mature at approximately 300 [centimeters disc width], while females appear to mature at slightly less than 400 [centimeters disc width]. However, [reef manta ray] males in the Republic of Maldives mature at sizes of 250 [centimeters disc width], while the females mature at 300 [centimeters disc width]. In Hawaii, the largest female and male [reef manta rays] were reported at 362 and 303 [centimeters disc width], respectively, and size at sexual maturity was estimated at 335 [centimeters disc width] for females and 280 [centimeters disc width] for males.

(Marshall, *et al.*, 2011 – 2 at 9 (citations omitted)).

In addition to their late maturation, female Manta Rays typically only produce one pup on average every two to three years, though this reproductive periodicity is extended to one pup every seven years in the Maldives (*see* CMS, 2014 at 3 (citations omitted); Marshall, *et al.*, 2011 – 1 at 9 ("There is little information on the reproductive biology or ecology of this species although reports of litter

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[15] Though the longevity estimate is at least 40 years, the longest reported time between first and last sightings of a reef manta ray thus far is 31 years for a female in Hawaii (Dulvy, *et al.*, 2014 at 7 (citation omitted); *see also* (Deakos, *et al.*, 2011 at 246 (referencing an individual, possibly the same one, that had been seen for 27 years) (citation omitted)). Therefore, maximum age may in fact be lower.

[16] There does not appears to be any data on the Caribbean manta ray's maturation times or sizes, but they are likely similar to the giant manta ray's given their other physical similarities (*see* Section III. C. "Physical Characteristics," *supra*).

size are consistently of a single offspring.") (citations omitted)).[17] While this periodicity is already very long, there appears to be variation in these reproduction periods amongst and within individuals and based on conditions of the species' environment (Dulvy, *et al.*, 2014 at 12). For instance, a complete cessation of pregnant females has been observed in the Maldives in recent years, which may hint at much more variable, and longer, reproductive periodicity than was once assumed (*see* Dulvy, *et al.*, 2014 at 12 (citation omitted)).

Manta Rays have a gestation period of 10-14 months (CMS, 2014 at 3 (citations omitted); Deakos, *et al.*, 2011 at 246). "[A]s with all Myliobatiform stingrays, [Manta Rays] have a characteristic viviparous reproductive mode called lipid histotroph. The placenta is not formed, but the uterine mucosa develops glandular trophonemata, responsible for lipid-rich secretions of histotroph or uterine milk, enabling the embryo to increase in size significantly during gestation." (Medeiros, *et al.*, 2015 at 6 (citation omitted)). "Manta offspring are some of the largest offspring of any ectotherm in the ocean. The size of birth of manta pups is 130–150 [centimeters] disc width, considering the maximum linear dimension this is one of the largest of any elasmobranch." (Dulvy, *et al.*, 2014 at 5). This energy-intensive reproductive strategy indicates a significant demand on the part of the gravid female.

These species' late maturation translates to generation times on the order of 25 years (*see* CMS, 2014 at 3; Marshall, *et al.*, 2011 – 1 at 9 (giant manta ray); Marshall, *et al.*, 2011 – 2 at 8 (reef manta ray)).[18] Late maturity and infrequent births mean that females can only produce 4-15 pups over their lifetime, should they live out their natural life (*see* CMS, 2014 at 3). As a result of their limiting life history characteristics, Manta Rays "have among the lowest 'fecundity' of all elasmobranchs . . ." (*see* NOAA, 2015 – 1 at 1; *see also* CMS, 2014 at 3; Section IV. E. 4. "K-Selected," *infra*). Populations are therefore exceptionally vulnerable to extirpation and slow to recover once depleted (CMS, 2014 at 3). This also indicates that the possibility of successful re-colonization following extirpation would also be low (CMS, 2014 at 3).

Manta Ray mating behavior has been termed a "mating train" because courtship involves multiple males pursuing, and attempting to mate with, a single female (Deakos, *et al.*, 2011 at 246 (citation omitted). The timing of these mating trains varies by location, but appears to peak during the locations' summer months (Deakos, *et al.*, 2011 at 246 (citations omitted)). "Female manta rays are likely the limiting sex as they provide the only parental investment in the form of [the aforementioned approximately] 12 [month] gestation period, and multiple males appear to compete for access to a single female in a mating train." (Deakos, *et al.*, 2011 at 256 (citation omitted)). "Knowledge about the development and growth of neonate rays, as well as on the location of mating, birthing and nursery habitats of [Manta Rays], is poor." (Medeiros, *et al.*, 2015 at 6 (citations omitted)).

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[17] While not the norm, reef manta rays have an annual ovulatory cycle and can, and have, reproduced annually both in captivity and in the wild on occasion (Marshall, *et al.*, 2011 – 2 at 8). In addition, though rare, there are reports of pregnancies of two reef manta ray pups at a time (Marshall, *et al.*, 2011 – 2 at 8 (citations omitted)).

[18] "Generation time is the average age of adults which can be approximated as halfway between age at first maturity and maximum age. Thus female mantas may be actively breeding for 30 years and the age at which 50% of total reproductive output is achieved would be approximately 24–25 years." (Marshall, *et al.*, 2011 – 1 at 9).

G. Population Trend

The available population trend information for these species led the IUCN to conclude that both the giant[19] and reef manta rays have decreasing population trends overall (*see* Marshall, *et al.*, 2011 – 1 at 8; Marshall, *et al.*, 2011 – 2 at 7).[20] "A longterm study of manta ray populations in *protected areas* has revealed that even these populations are only stable at best." (Heinrichs, *et al.*, 2011 at 14; *see also* CoP16-Prop-46 at 8 (giant manta ray declines in Western Australia where they receive some protection); White, *et al.*, 2015 at 1, 9 (giant manta ray declines in Cocos Island MPA)). "Globally a decline of 30% is strongly suspected." (CMS, 2014 at 4 (citations omitted)). However, the declines in specific populations are often *much* higher (*see, e.g.,* CoP16-Prop-46 at 8 (86% decline in one location in just 8 years)). In addition, the available decline statistics are in the context of a lack of historical baseline data, indicating that these observed decline statistics are conservative and underestimate the decline that these species have already faced (CoP16-Prop-46 at 3). Where population estimates are lacking, "a decline in manta sightings has been noted in a number of locations including Japan, French Polynesia, and Mexico." (Dewar, *et al.*, 2008 at 2 (citations omitted)). Commercial extinction is suspected in Lamakera, Indonesia; the Sea of Cortez; the Lakshadweep Islands, India; and potentially in other areas as well (*see* CoP16-Prop-46 at 7, 25 (citations omitted)).

"Sustained pressure from fishing (both directed and incidental) has been isolated as the main cause of these declines." (CoP16-Prop-46 at 7 (citation omitted)). "From available evidence it can be inferred and projected that under current fishing pressure levels, *Manta* populations will continue to exhibit a declining trend in the future, putting the survival of these species at risk." (CoP16-Prop-46 at 2). In fact, under 2013 levels of fishery pressure, the observed rates of decline would be expected to drive Manta Ray populations worldwide down to 15-20% of their historical baseline by 2023 (CoP16-Prop-46 at 3). These facts indicate large declines of Manta Rays that are expected to continue into the future.

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[19] The Caribbean manta ray was not assessed separately from the giant manta ray, so the decreasing population trend that the IUCN noted for the giant manta ray should be imputed to the Caribbean manta ray as well (*see* Marshall, *et al.*, 2011 – 1 at 8).

[20] These population trend assessments represent the scientific opinions of Manta Ray experts after a review of the best available science, and NMFS should thus treat these population trend assessments as conclusions drawn in scientific articles (*see* Section II. F. "Best Available Scientific and Commercial Data," *supra*). NMFS should not rely on the sources that the IUCN cites alone, thereby ignoring these scientific conclusions.

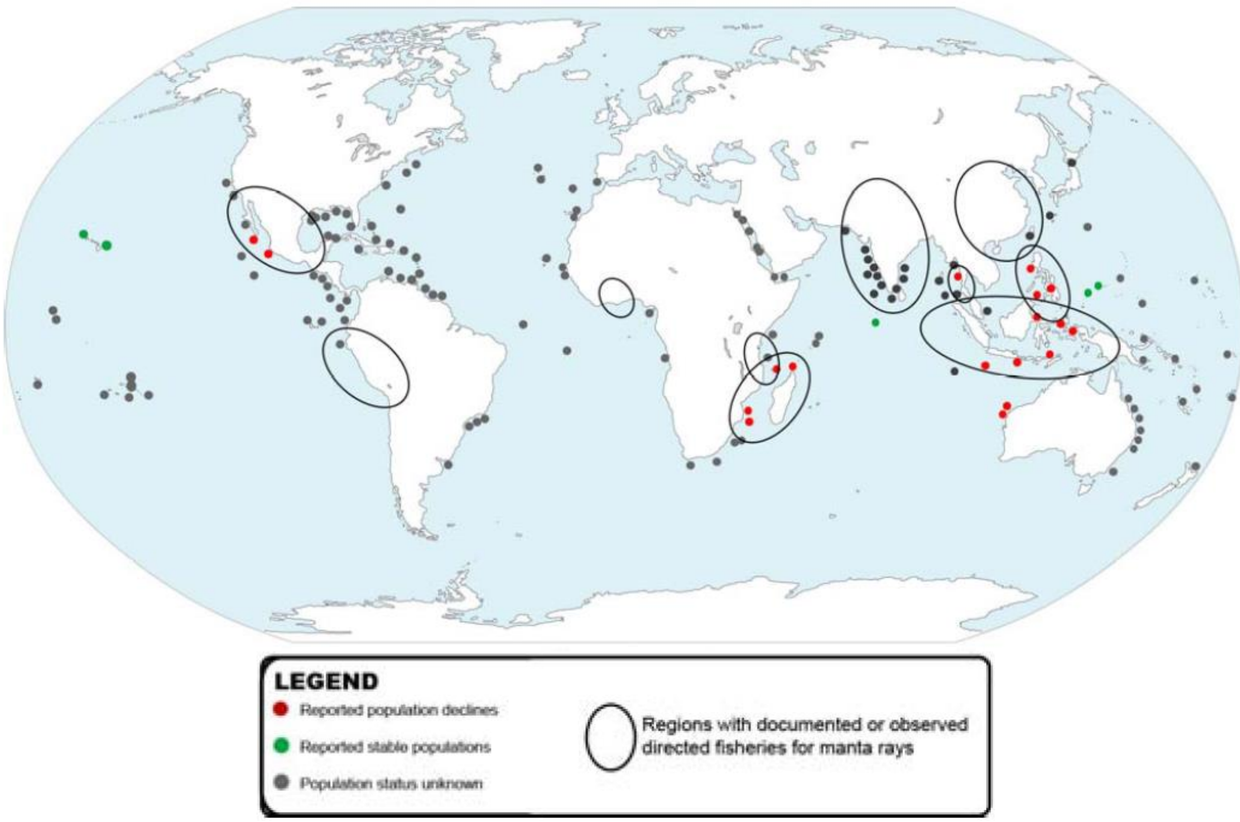

Figure 14. Manta Ray population trends (CoP16-Prop-46 at 26 (citation omitted)). Note that there are no known stable populations in, or even typically near, the waters of countries with documented or observed directed Manta Ray fisheries. This indicates the apparent universal unsustainability of such fisheries on both a local and more regional level.

While the aforementioned declines in Manta Ray populations alone are clearly grounds for concern, the paucity of existing populations make such declines even more troubling.

> Given that globally only twenty-four subpopulations (14 *M. alfredi*, 9 *M. birostris*, 1 *M. c.f. birostris*) in fifteen countries have been studied and approximately twenty-five other, mostly very small, aggregations in fifteen more countries have been identified through tourism operations and fisheries, and further manta ray sightings in all other range States are very infrequent, it can be inferred that global population numbers are quite small.

(CoP16-Prop-46 at 3). This paucity of Manta Ray populations indicates that the elimination of a single population of any of the Manta Ray species would be significant to that species as a whole.

In addition, these populations are generally very small, which increases their susceptibility to decline (*see* Section IV. E. 3. "Small Populations," *infra*). In "areas where mantas have been studied, the local populations have generally been estimated to be of the order of 50–350 individuals." (Anderson, *et al.*, 2010 at 22 (citation omitted); *see also, e.g.,* Figure 15, *infra*; Deakos, *et al.*, 2011 at 254 (290 identified individuals in Maui); Mourier, 2012 at 2-3 ("In total, 66 different individual *M. alfredi* were identified (12 males and 54 females) and 11 individual *M. birostris* (no males and 11 females) [in a 2011-2012 study of the Marquesas Islands in French Polynesia].")). These small population sizes mean that even a relatively small loss of individuals can have extreme population-level effects. For example, sightings of Manta Rays at Okinawa fell from 50 in 1980 to 30 in 1990 to 14-15 in 1997 (CoP16-Prop-46 at 7 (citation omitted)). Though the loss of 35-36 individuals from a population would often not be cause for concern in a very numerous species, the loss of this many individuals from the Okinawa Manta Ray population represented a 70+% decline in just 17 years (CoP16-Prop-46 at 7 (citation omitted)). Therefore, even a relatively small number of mortalities can have dramatic impacts on these small populations.

While there are a few "larger" populations in places including Mozambique, the Maldives, and Australia (*see* Deakos, *et al.*, 2011 at 254; Anderson, *et al.*, 2010 at 22; Rohner, *et al.*, 2013 at 162-163 (citation omitted); Venables, 2013 at 15), many of these populations are largely made of transient visitors with few permanent residents and/or are subject to threats that are capable of causing them to decline very quickly (*see, e.g.,* Venables, 2013 at 15; CoP16-Prop-46 at 3, 8; Dulvy, *et al.*, 2014 at 12; CMS, 2014 at 4). In addition, even these larger populations are still actually quite small. For instance, the population of reef manta rays from the Maldives is the only Manta Ray population with over 1,000 identified individuals and with an estimated population of over 1,500 (*see* CoP16-Prop-46 at 6). In fact, no giant manta ray populations are estimated as even exceeding 650 individuals (*see* CoP16-Prop-46 at 23). Therefore, while some Manta Ray populations are "large," relatively speaking, even these populations are still generally quite small, and they could thus not withstand high levels of mortality without collapsing.

The catch and decline statistics discussed in this Petition are very concerning, but they are based on limited data and reporting and actual directed and bycatch fishing is actually causing much more mortality (*see, e.g.,* CoP16-Prop-46 at 27-28 (citing many data deficient fisheries around the world (citations omitted). This is in large part due to the fact that illegal, unregulated, and unreported ("IUU") fishing is prevalent throughout the world (*see* NMFS, 2013 at 66-69).[21] This means that catch estimates and reports will generally greatly underestimate catch and that these statistics should thus be treated as absolute minimums. The fishery exploitation of these species is ongoing and they can only recover from the loss of individuals slowly (*see* Section III. F. "Reproduction and Lifespan," *supra*; Section IV. E. 4. "K-Selected," *infra*). As a result, the observed and inferred population declines from this section have continued since the end of the data sets that they are based on. Because small populations are more vulnerable to collapse from even moderate depletion, the overestimation inherent in these small population estimates may be severe. In addition, because there is a lack of historical baseline data, these datasets will ignore these species' declines that occurred before data recording began. Because these populations are generally isolated with little genetic exchange, population declines are unlikely to be buffered by immigration of new individuals and local extirpations are likely to be permanent with recolonization being unlikely (*see* CoP16-Prop-46 at 2-3, 5, 6, 7 (citations omitted); Marshall, *et al.*, 2011 – 1 at 7, 8, 10; Marshall, *et al.*, 2011 – 2 at 6, 8, 10; CMS, 2014 at 3; Medeiros, *et al.*, 2015 at 2 (citations omitted); Graham, *et al.*, 2012 at 4; Kyne, *et al.*, 2012 at 134; *but see* Germanov & Marshall, 2014 at 7 (indicating that reef manta rays may be able to move between islands in some close populations meaning that populations that were not

[21] Note that Manta Rays, and indeed all rays, were excluded from the National Ocean Council Committee on IUU Fishing and Seafood Fraud's list of at-risk species. *See* 80 Fed. Reg. 66,867, 66,876-79 (October 30, 2015). The species that are on this list will be traced, to some degree, to help ensure that they come from legal fisheries. However, because Manta Rays are not on the list, this tracing mechanism will not apply to them.

subjected to large barriers to movement (i.e. distance, depth, intervening threats, etc.) may exhibit some level of exchange)). This makes preventing declines and extirpations in the first instance of the utmost importance to the conservation of these species. Failing to adequately conserve these species early on will greatly increase their extinction risk.

The recent differentiation of these species complicates separating much of the available population trend information beyond the genus level. As a result, the following sections will begin by providing the general population trend information that is available for all Manta Rays (if any), followed by species-specific information (if any) attributed to the relevant species. However, NMFS should be aware that, especially for pre-2009 sources, species attribution may be incorrect and, in attempting to attribute trend information to species, NMFS will sometimes have to compare the geographic source of the trend information to these species' ranges.

1. Cross-Regional Trend Information

a. Giant Manta Ray

"Declines of *M. birostris* have been reported at known aggregation sites throughout their migratory range. Likewise, reports from fishermen, traders and retailers indicate that *M. birostris* gills are becoming harder to source, with prices escalating as the supply continues to dwindle." (Heinrichs, *et al.*, 2011 at 14). Some populations have already been fished to commercial extinction (*see* CoP16-Prop-46 at 7 (citations omitted)), and the remaining populations are all very small and will be extremely susceptible to decline from excessive mortality (*see* Figure 15, *infra*; Section III. F. "Reproduction and Lifespan," *supra*; Section IV. E. 4. "K-Selected," *infra*). The lack of sufficient historical baseline data means that all estimates of decline will be conservative, and NMFS should consider this when assessing threats to the species (*see* CMS, 2014 at 4).

Region	Species	Recorded Individuals	Subpopulation Estimate	Reference
Mozambique	*M. birostris*	180	600	Marshall 2009 & 2012 pers. comm.
Egypt	*M. birostris*	60	-	Marine Megafauna Foundation unpubl.
Republic of Maldives	*M. birostris*	63	-	G. Stevens, pers. comm.
Thailand	*M. birostris*	75	-	Kashiwagi *et al.* 2011
Raja Ampat, Indonesia	*M. birostris*	72	-	MMP & The Manta Trust, unpubl.
Isla de la Plata, Ecuador	*M. birostris*	~ 650	-	M. Harding, pers. comm.
Brazil	*M. birostris*	60	-	Laje Viva Institute unpubl., Luiz et al. 2008
Mexico (Revillagigedos Is.)	*M. birostris*	412	-	R. Rubin & K. Kumli, pers. comm.
Mexico (Isla Holbox)	*M. birostris*	> 200	-	R. Graham, pers. comm.

Figure 15. Giant manta ray recorded individuals and population estimates for all populations where this information is available (CoP16-Prop-46 at 23).

b. Reef Manta Ray

"While there are no historical baseline population data, recent declines have been reported in key *M. alfredi* range states." (CMS, 2014 at 4). This is problematic because reef manta ray populations appear, in most cases, to be small, numbering less than 1,000 individuals (*see* CMS, 2014 at 3).

> Photo-identification studies at aggregation sites . . . have produced sighting records of approximately 100 to less than 700 individuals, despite some being active for many decades. The one exception is the Maldives with 3,300 individuals identified throughout the 26 atolls that make up the archipelago.

(CMS, 2014 at 3-4). The reef manta ray "is believed to have small, genetically independent, island-associated stocks. With little exchange between members of neighboring stocks, a fishery could deplete a single stock quite rapidly with little chance of recovery." (Heinrichs, *et al.*, 2011 at 14). These factors have already led to the likely commercial extinction of at least two reef manta ray populations (*see* CoP16-Prop-46 at 7, 25 (citations omitted)) and make the excessive mortality and resulting declines that this species is facing even more alarming.

Region	Species	Recorded Individuals	Subpopulation Estimate	Reference
Southern Mozambique	*M. alfredi*	685	890	Marshall *et al*. 2011a, Marshall unpubl., Marshall 2009
Republic of Maldives	*M. alfredi*	2,410	5,000	G. Stevens, in prep.,
Bali, Indonesia	*M. alfredi*	135	-	IMP & The Manta Trust, unpubl.
Komodo, Indonesia	*M. alfredi*	150	-	KMP & The Manta Trust, unpubl.
Raja Ampat, Indonesia	*M. alfredi*	231	-	MMP & The Manta Trust, unpubl.
Ryukyu Archipelago, Japan	*M. alfredi*	368	-	Kashiwagi *et al*. 2011
Yap, Micronesia	*M. alfredi*	100	~100	Marshall *et al*. 2011a
Guam	*M. alfredi*	35	-	J. Hartup, pers. comm.
Palau	*M. alfredi*	170	-	J. Denby & M. Etpison, pers. comm.
East Coast, Australia	*M. alfredi*	620	-	L. Couturier, pers. comm.
Ningaloo Reef, Australia	*M. alfredi*	676	1,200-1,500	McGregor 2009
Bora Bora, French Polynesia	*M. alfredi*	93	-	M. De Rosemont, pers. comm.
Maui, Hawaii	*M. alfredi*	323	350	M. Deakos, pers. comm.
Kona, Hawaii	*M. alfredi*	181	-	MPRF 2011

Figure 16. Reef manta ray recorded individuals and population estimates for all populations where this information is available (CoP16-Prop-46 at 23).

2. Pacific Ocean

Though Manta Ray decline statistics in the Pacific Ocean are often undifferentiated (*see* Figure 17, *infra*), species can often be inferred by location. For example, the Sea of Cortez records from Figure 17, *infra* appear to refer exclusively to giant manta rays and the Okinawa Island reference appears to refer exclusively to reef manta rays (*see* Figure 8, *supra*; Figure 9, *supra*).

Okinawa Island, Japan	*Manta spp.*	1980: 50 1990: 30	1997 14-15	71%	17 years	Homma *et al.* 1999	Local dive professional detailed sightings data (T. Itoh)
Sea of Cortez, Mexico	*Manta spp.*	1980s	1990s	Population collapse	~ 10 years	Homma *et al.* 1999; Notarbartolo-di-Sciara 1995	Mobulid researcher fishery observations
Sea of Cortez, Mexico	*Manta spp.*	1981 3-4 per dive	1991-2 0 in 2 yrs		~ 10 years	H. Hall, pers. comm.	Underwater filmmaker observations from 1981 and 1991-2 film projects
Sea of Cortez, Mexico	*Manta spp.*	1980 On every major reef	1990 Rarely seen		~ 10 years	M. McGettigan, SeaWatch 2000	Scuba diving / recreational fishing operator observations

Figure 17. Reported Manta Ray decline statistics (all reported at the genus level only) for the Pacific Ocean populations where this information exists (CoP16-Prop-46 at 25).

a. Giant Manta Ray

One study assessing population trends over 21 years in one of the world's oldest marine protected areas ("MPAs"), Cocos Island National Park, Costa Rica, found very large giant manta ray declines (*see* White, *et al.*, 2015 at 1). After correcting for variation among observers and abiotic factors, this study found that giant manta rays had declined by 89% (95% confidence interval 85%-92%) in the MPA over the last two decades (White, *et al.*, 2015 at 1, 9). This is particularly concerning as this large decline occurred both within an MPA and in under on generation period (25 years for *Manta spp.*) (*see* CoP16-Prop-46 at 3). "These declines likely stem from the multination fisheries in the eastern tropical Pacific . . ." (White, *et al.*, 2015 at 10 (citation omitted)). The declines may also have been tempered to some degree by the species' location within this MPA, meaning that the species' decline during this time period throughout the rest of the eastern tropical Pacific is likely at least as extreme, if not more so.

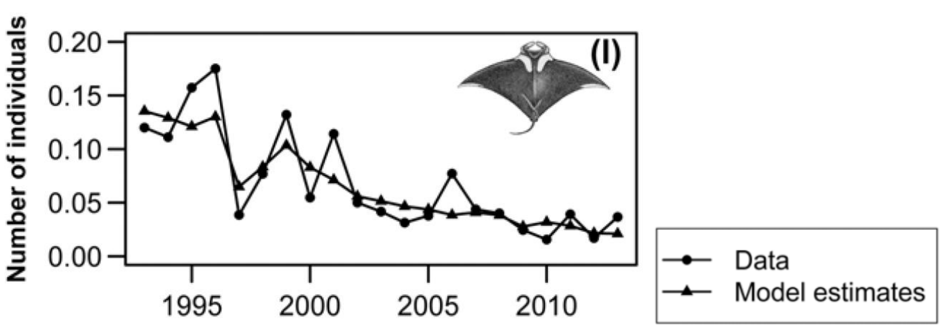

Figure 18. Observed data and model estimates of mean yearly number of individuals or mean probability of occurrence for giant manta rays at Cocos Island, 1993–2013 (White, *et al.*, 2015 at 8).

The other available information on giant manta ray population trends in the Pacific Ocean support this inference of large, ocean-wide declines. Mexico was one of the first countries to commercially fish for Manta Rays when, in the early 1980s, "fishermen in the Sea of Cortez switched from subsistence and bycatch fishing of the [then-]locally abundant [giant manta ray] to directed target fisheries." (Stevens, 2011 at 7). "Prior to the commencement of these fisheries, [giant manta rays] reportedly could be found around every major reef in this area and were a lucrative attraction to dive businesses." (CoP16-Prop-46 at 7 (citations omitted)). However, fishing for these easy targets quickly led to plummeting populations (Stevens, 2011 at 7). "Within just a decade populations of the large mobulid ray species within the Sea of Cortez were virtually wiped out, and the fishery collapsed." (Stevens, 2011 at 7). "Filmmaker Howard Hall reported seeing three to four [giant] manta rays on every dive in the Sea of Cortez during a 1981 project, and did not see one manta during two years of filming for a later project in 1991-2." (CoP16-Prop-46 at 7). "Even today, after nearly two decades of protection [in the Sea of Cortez], very few mantas are recorded . . . and those that are still fall victim to illegal fishing or bycatch." (Stevens, 2011 at 7; *see also* CoP16-Prop-46, at 7 ("This population has still not recovered more than twenty years after its collapse.") (citation omitted)). The species is now considered commercially extinct in the Sea of Cortez (CoP16-Prop-46 at 7 (citations omitted)).

Approximately 150 Manta Rays[22] are also taken annually in the Pacific by Peru in directed fisheries (CoP16-Prop-46 at 27 (citation omitted)). There was also a directed Manta Ray fishery[23] in Ecuador, at least until recently, and illegal fishing for other marine species in Ecuador indicates that illegal fishing for giant manta rays has likely continued since that time (*see* Marshall, *et al.*, 2011 – 1 at 13; Section IV. D. 1. c. "Ecuador," *infra*). While population trend data from these South American fisheries is lacking, experience at all other locations where Manta Rays are exploited indicates that this catch will be driving serious giant manta ray declines at local, as well as likely regional, levels.

b. Reef Manta Rays

Sightings of Manta Rays[24] at Okinawa Island fell from 50 in 1980 to 30 in 1990 to 14-15 in 1997 (CoP16-Prop-46 at 7 (citation omitted); *see also* Marshall, *et al.*, 2011 – 2 at 7 (citation omitted)). This represented a 70+% decline for this population in just 17 years (CoP16-Prop-46 at 7 (citation omitted)). "Opportunistic hunting of a small *M. alfredi* population has [also] recently been reported in the islands of Tonga and Micronesia. Because of their isolation and low numbers, such local subpopulations of *M. alfredi* are extremely vulnerable to any fishing pressure." (CMS, 2014 at 6; *see also* CoP16-Prop-46 at 9). Though population trend data in these latter fisheries is lacking, experience at all other locations where Manta Rays are exploited should be used to infer serious declines in these populations as well.

3. Indo-Pacific

Manta Ray catch in this region has declined, suggesting serial depletion and spurring fishermen to travel farther to find Manta Rays to kill (Marshall, *et al.*, 2011 – 2 at 7 (citation omitted)). While decline statistics are sometimes lacking, those that do exist show serious, ongoing declines that are threatening these species with extinction.

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22 Almost certainly giant manta rays based on location (*see* Figure 8, *supra*; Figure 9, *supra*).
23 Almost certainly giant manta rays based on location (*see* Figure 8, *supra*; Figure 9, *supra*).
24 Almost certainly reef manta rays based on location (*see* Figure 8, *supra*; Figure 9, *supra*).

Area	Species	Year 1 Landings	Year 2 Landings	% Decline	Time Period	Source(s)	Methodology
Lamakera, Indonesia	*Manta spp.*	2001: 1,500	2010: 648	57% despite increased effort	9 years	Dewar 2002; Setiasih *et. al* in prep.	Structured community interviews 2002 and 2011. Comparison of fishing effort parameters
Tanjung Luar, Lombok, Indonesia	*Manta spp.*	2001-2005: 331	2007-2012 146	56% despite increased effort; large size declines	6-7 years	White *et al.* 2006; Setiasih *et al.* in prep.	Market surveys and fishermen / dealer interviews 2001-5 (~47 survey days); 2007-12 (33 survey days)
Bohol Sea, Philippines	*Manta spp.*	1960's: 100	1997: 50	50%	~ 30 years	Alava *et al.* 2002	Standardized questionnaire to artisanal fishermen to assess catch and effort previous year and 30 years prior
Sulu Sea, Philippines	*Manta spp.*	End 1980's	1996	50% - 67%	7 years	Michiyo Ishitani, pers. comm. 1996	Scuba diver sightings data

Figure 19. Reported Manta Ray decline statistics (all reported at the genus level only) for the Indo-Pacific populations where this information exists (CoP16-Prop-46 at 24). However, the Lamakera and Lombok fisheries appear to, at least primarily, catch giant manta rays (*see* Heinrichs, *et al.*, 2011 at 33; CoP16-Prop-46 at 8 (citations omitted)) even though both giant and reef manta rays are present in Indonesian waters;[25] the Bohol Sea fishery likely catches only giant manta rays; and the Sulu Sea fishery likely catches only reef manta rays (*see* Figure 8, *supra*; Figure 9, *supra*; *see also generally* Verdote & Ponzo, 2014 (indicating that reef manta rays are present, but comparatively quite rare, in the Bohol Sea, with the first specimens reported in 2014)).

Manta Ray catch information from Indonesia is based on limited data and reporting and actual directed and bycatch fishing is causing much more mortality than is being reported (*see* CoP16-Prop-46 at 27 (citing many data deficient fisheries around the world (citations omitted)).[26] As a result of this overfishing, the Indonesian target Manta Ray fishery has experienced significant declines in both number and size of Manta Rays caught over the past decade despite evidence of increased directed fishing effort over this time period (CoP16-Prop-46 at 8 (citations omitted)). For instance, where

[25] NMFS should consider whether this is a result of identification issues or whether these two fisheries truly do target only giant manta rays.

[26] Both giant and reef manta rays are present in Indonesian waters meaning that most fisheries statistics that are not provided to the species level will likely represent at least a somewhat mixed-species catch (*see* Figure 8, *supra*; Figure 9, *supra*).

Manta Rays were historically fished by indigenous villagers in East Flores and Lembata, Indonesia, catch went from a high of 360 individuals in 1969 to 0 in 1996 (Marshall, *et al.*, 2011 – 2 at 7). The villagers attribute this decline, and seemingly possible extirpation, to the Taiwanese commercial fishing vessels that began operating out of the village in the 1990s (*see* Marshall, *et al.*, 2011 – 2 at 7). In Kalimantan, Indonesia, often referred to as the "World Capitol of Mantas," a diver operator "reported that staff members had seen manta rays in a fish market on the mainland and also reported that manta ray sightings had become increasingly rare." (CoP16-Prop-46 at 8 (citations omitted)). "Fishermen and traders in Lombok also reported in 2011 that *Manta* spp. landed today are much smaller[27] and some noted that since 2010 they have begun to focus on [m]obulids as a primary target." (CoP16-Prop-46 at 8 (citations omitted)). This decrease in size can be expected to continue with ongoing overexploitation.

In addition to Indonesian removals, at least 100 Manta Rays[28] are also taken from the South China Sea by China in directed fisheries every year (CoP16-Prop-46 at 27 (citation omitted)).[29] While population trend data from this fishery is lacking, experience at all other locations where Manta Rays are exploited indicates that this catch will be driving species decline.

a. Giant Manta Ray

The species-specific data for the giant manta ray in the Indo-Pacific shows large declines. The population in the Bohol Sea experienced a 50% decline from the 1960s to 1997 following directed fisheries there (*see* CoP16-Prop-46 at 8, 24 (citations omitted); Figure 19, *supra*). "Despite legal protection since 2003, mantas are now reported to be rare in the Philippines, especially around the Bohol Sea where the fishery was focused." (CoP16-Prop-46 at 8 (citations omitted)). This is likely attributable to the illegal landings and trade of Manta Rays that has continued in the Philippines (*see* CoP16-Prop-46 at 11, 12 (citation omitted); CMS, 2014 at 7 (citations omitted)). "Traders in Hong Kong continue to report the Philippines as a supplier of dried gill rakers, indicating that an active gill raker trade may still continue in the Philippines." (Heinrichs, 2011, at 34). This illegal trade is unmonitored and no mechanisms have been implemented to regulate it (CoP16-Prop-46 at 11). As such, it will continue to drive the declines that were observed up to 1997.

"In Lombok, surveys from 2007 to 2012 estimated annual landings of 143 *M. birostris*, compared with 331 during 2001-2005 surveys (57% decline in 6-7 years)." (CoP16-Prop-46 at 8 (citations omitted)). In addition, annual landing estimates in Lamakera for 2010 showed a 56% decline from nine years earlier (660 giant manta rays in 2010 versus 1,500 in 2001) (CoP16-Prop-46 at 8 (citations omitted); *see also* Figure 19, *supra* (57% decline)). Fishing effort in Lamakera had expanded from 30 boats in 2001 to 40 boats in 2011 and "[o]ther factors associated with fishing effort were consistent, with the same type of gear and boats used and similar fishing areas and seasons." (CoP16-Prop-46 at 8 (citations omitted)). This indicates that the declines observed here during this time period likely underestimate the species' actual declines as increased effort would be expected to bring in additional catch in the absence of declines (*see* CoP16-Prop-46 at 8; *see also* Section III. G. 3. "Indo-

[27] To the extent that these "smaller" individuals include juveniles, this exacerbates the unsustainable nature of the fishery and indicates that population collapse and extirpation may be imminent.
[28] Both giant and reef manta rays are present in the South China Sea (*see* Figure 8, *supra*; Figure 9, *supra*).
[29] This is a minimum estimate because it only includes landings from one processing plant (*see* CoP16-Prop-46 at 27) and therefore likely underestimates China's actual annual Manta Ray catch.

Pacific," *supra*). Indeed, commercial extinction is now suspected in Lamakera's nearshore Manta Ray population (CoP16-Prop-46 at 7 (citations omitted)). This Indonesian overfishing also seems to be causing giant manta rays to decline in Australia (Heinrichs, *et al.*, 2011 at 15), which shows the spillover effects that extensive overfishing can have on this species. In fact, in Western Australia, where the species receive some level of protection (*see* Marshall, *et al.*, 2011 – 2 at 7), Manta Ray researchers "report dramatically decreased sightings of *M. birostris* over the past ten years. Where large seasonal groups of *M. birostris* were once seen migrating north up the coast, sightings are now rare." (CoP16-Prop-46 at 8; *see also* Heinrichs, *et al.*, 2011 at 15 (attributing these declines to Indonesian overfishing)). Overfishing is thus having regional, as well as more localized, impacts on giant manta ray populations in the Indo-Pacific.

b. Reef Manta Ray

"Sightings data by scuba divers suggest that the local population of [reef manta rays] in the Sulu Sea off Palawan Island (Philippines) fell by one half to two-thirds in seven years from the end of the 1980s. Despite legal protection since 2003, mantas are now reported to be rare in the Philippines . . ." (CoP16-Prop-46 at 8 (citations omitted)). The failure of this protection to stem the reef manta ray's ongoing decline is likely due to at least two causes. First, the aforementioned legal protection actually only applies to giant manta rays, and, second, this protection has failed to halt illegal Manta Ray landings, regardless of species (*see* CoP16-Prop-46 at 32 (law covers giant manta rays only); Verdote & Ponzo, 2014 at 2 (law covers giant manta rays only); CoP16-Prop-46 at 11, 12 (illegal landings) (citation omitted); CMS, 2014 at 7 (illegal landings) (citations omitted)). As such, the fact that reef manta ray declines have continued here in the absence of effective protections is unsurprising.

In addition to declines in the Philippines, "[l]ocal dive operators and park rangers in Komodo National Park, near Lamakera, also report a decline in abundance of [reef manta rays] in the park." (CoP16-Prop-46 at 8 (citation omitted)),[30] and commercial extinction of Lamakera's nearshore population is suspected (CoP16-Prop-46 at 7 (citations omitted)). Therefore, the species-specific population trend information for reef manta rays in Indonesia also shows both large declines and the regional influence of reef manta ray fisheries.

4. Indian Ocean

The available Indian Ocean data shows widespread Manta Ray overfishing and large declines. An estimated 1,055 Manta Rays are taken in directed fisheries every year in Sri Lanka alone (CoP16-Prop-46 at 27 (citations omitted)).[31] However, fishermen have reported declining catch over the past five to ten years as targeted fishing pressure has increased (CoP16-Prop-46 at 8 (citations omitted)). India takes an additional 690 Manta Rays per year in directed fisheries (CoP16-Prop-46 at 27 (citations omitted)).[32] Overfishing of mobulids in India has caused a corresponding decline in

[30] These reef manta ray declines near Lamakera indicate that attribution of all Manta Ray catch in Lamakera to giant manta rays may be incorrect (*see* Section III. G. 3. A. "Giant Manta Ray," *supra*). These declines would seem to imply landings of reef manta rays, and consequent decline of reef manta ray populations, as well.

[31] Both giant and reef manta rays exist off the coast of Sri Lanka (*see* Figure 8, *supra*; Figure 9, *supra*), however catch appears to be composed, at least primarily, of giant manta rays (CoP16-Prop-46 at 7).

[32] Both giant and reef manta rays exist off the coast of India (*see* Figure 8, *supra*; Figure 9, *supra*).

catch "in several regions, including Kerala, along the Chennai and Tuticorin coasts and Mumbai, despite increased fishing effort. Prior to 1998 *Manta* spp. (suspected *M. alfredi*) were landed abundantly at Kalpeni, Lakshadweep Islands in a directed harpoon fishery, but a local dive operator reports that this fishery is no longer operating and *Manta* sightings around these islands are now rare." (CoP16-Prop-46 at 8 (citations omitted)). As a result, Manta Rays may now be commercially extinct in the Lakshadweep Islands as well (*see* CoP16-Prop-46 at 25 (citation omitted)). "In Madagascar, scuba divers and fishermen report a large decline in *Manta* spp.[33] sightings over the past 10 years." (CoP16-Prop-46 at 8, 25 (citations omitted)). In addition to directed catch, there are 56 reported Manta Ray bycatch landings per year in the Indian Ocean (CoP16-Prop-46 at 27 (citations omitted)). However, all of these catch statistics are based on limited data and reporting and actual directed and bycatch fishing is causing much more mortality than this in the Indian Ocean (*see, e.g.,* CoP16-Prop-46 at 27 (citing many data deficient fisheries around the world (citations omitted)).

S. Mozambique	*M. alfredi*	2003 6.8 / dive	2011 .6 / dive	86%	8 years	Rohner *et al.* in press	Scuba diver sightings data - adjusted to exclude environmental factors.
Thailand Similan-Surin Islands	*Manta spp.*	2006-7 59	2011-12 14	76%	5 years	R. Parker, pers. Comm..	Local dive professional detailed sightings data (per season)
Sri Lanka	*M. birostris*	2000	2011	Unspecified	5 – 10 years	Fernando & Stevens in prep, Anderson *et al.* 2010	Market surveys and structured fishermen interviews
Ningaloo, W. Australia	*M. birostris*	2001 Large seasonal groups	2011 Rare	Large decline	10 years	F. McGregor, pers. comm.	Manta researchers' sightings observations
Madagascar	*Manta spp.*	2001	2011	Large decline	~ 10 years	R. Graham, pers. comm. 2011	Scuba diver and fishermen sighting observations
India, Lakshadweep Islands	*Manta spp.*	1998 Directed fishery	2011 No fishery; diver sightings rare	Poss. comm. extinction	~ 10 years	Pillai 1998; S. Pujari, pers. comm. 2011	Report of Central Marine Fisheries Res. Inst.; Dive operator observations.

Figure 20. Reported Manta Ray decline statistics (some reported at the genus level only) for the Indian Ocean populations where this information exists (CoP16-Prop-46 at 24-25).

[33] Both giant and reef manta rays exist off the coast of Madagascar (*see* Figure 8, *supra*; Figure 9, *supra*).

a. Giant Manta Ray

"Dive operators in the Similan Islands, Thailand, have witnessed increased fishing for *Manta* spp.,[34] even in Thai National Marine Parks, and have reported consistent declines in *Manta* spp. sightings from 59 during the 2006-7 season down to 14 during the 2011-12 season (76% decline)." (CoP16-Prop-46 at 8 (citations omitted)). The available data indicates that Mozambique may be the only location in the Indian Ocean where giant manta rays have remained relatively stable in the short term (*see* CoP16-Prop-46 at 8 (citation omitted)). This stability appears to be due to the fact that fishermen in this area largely target the reef manta ray to the exclusion of the giant manta ray. However, the precipitous reef manta ray declines in Mozambique will likely force the fishermen to increase targeting of giant manta rays very soon, if they have not begun to do so already (*see* Section III. G. 4. B. "Reef Manta Ray," *infra*). Sri Lanka has also reported giant manta ray declines (*see* Figure 20, *supra* (unspecified declines)), which is unsurprising given that 95% of the giant manta rays caught there are juveniles (CoP16-Prop-46 at 7).

b. Reef Manta Ray

Fishermen in Mozambique appear to preferentially target reef manta rays, even though both giant and reef manta rays are present in these waters. "In Mozambique, it is estimated that 20 to 50 *M. alfredi* are taken by subsistence fishermen annually in/along a ~100 [kilometer] area/length of coast (<5% of the total coastline)." (CoP16-Prop-46 at 8). However, because this study only covered a very small area of coastline, actual harvest is likely much larger. One recent study attempted to distinguish true Manta Ray population trends from environmentally driven short-term fluctuations over an eight-year period in Mozambique (CoP16-Prop-46 at 8 (citation omitted)). This study ultimately indicated a pronounced decrease in abundance of reef manta rays, with an 86% decline in reef manta ray sightings (Rohner, *et al.*, 2013 at 162). The Mozambique reef manta ray fishery is expanding and can be expected to cause further declines (*see* CoP16-Prop-46 at 8). In addition, the 8-year data period in this study may obscure historical losses taking place before the data set began (*see* CoP16-Prop-46 at 8). 8 years is, after all, well below the species' generation time (*see* CMS, 2014 at 4 (estimating generation time as 25 years for *Manta* spp.) (citation omitted)).

5. Atlantic Ocean

The information on Manta Rays in Mexico, Guyana, and Suriname appears to be entirely attributable to giant and/or Caribbean manta rays (*see* Figure 8, *supra*; Figure 9, *supra*; Section III. D. "Habitat and Range," *supra*). Mexican illegal Manta Ray fishing in the Atlantic, at least in part, occurs on the Yucatan Peninsula (CMS, 2014 at 6; CoP16-Prop-46 at 9 (citation omitted)) and is likely impacting the giant and/or Caribbean manta ray population(s) there, including the approximately 100 Isla Holbox individuals based on their Yucatan Peninsula location (*see* Marshall, *et al.*, 2011 – 1 at 11 (citation omitted); CoP16-Prop-46 at 9; Heinrichs, *et al.*, 2011 at 11, 34 (citation omitted); CMS, 2014 at 6 (citation omitted)). In addition, 127 Manta Rays were located in a marine fauna survey in Guyana (*see* Mannocci, *et al.*, 2013 at 212) and 10 were located in a survey on the coast of Suriname (though these studies did not attempt to estimate a population number based on these occurrences) (*see* De Boer, *et al.*, 2015 at 4). Due to the giant manta ray's sympatric occurrence with the Caribbean manta ray in these locations (*see* Figure 8, *supra*; Figure 9, *supra*), Defenders is unable to determine whether these records refer to giant or Caribbean manta rays or both. However, because of both

[34] Likely giant manta rays (*see* Figure 8, *supra*).

species' low reproductive potential and limited numbers in these waters, it is highly likely that *any* Manta Ray fishing in these waters, including the illegal Mexican fishing, would cause significant, and potentially catastrophic, population declines.

In addition to these populations, more than 70 individuals have been recorded in the Flower Garden Banks National Marine Sanctuary in the United States (*see* Figure 21, *infra*; *see also* Heinrichs, *et al.*, 2011 at 11 (citation omitted)). References to the giant manta ray in a 1989 study may also actually refer to Caribbean manta rays as the study took place in shallow waters within the species' current known range and observed the species in aggregations (*see* Notarbartolo-di-Sciara & Hillyer, 1989 Abstract; *see also* Section III. D. "Habitat and Range," *supra*). This study indicated that the species was common at that time in the Venezuelan Caribbean Sea between Puerto la Cruz and Isla Margarita (*see* Notarbartolo-di-Sciara & Hillyer, 1989 Abstract). Any reduction in how common the species is in those waters now should be taken as evidence of a population decline.

Region	Species	Recorded Individuals	Subpopulation Estimate	Reference
Flower Garden Banks, US	*M. c.f. birostris*	> 70	-	Graham *et al* 2008 & unpubl.

Figure 21. Caribbean manta ray recorded individuals for the only population where this information is available (CoP16-Prop-46 at 23).

There are also targeted seasonal and year-round fisheries for Manta Rays operating in Ghana that, based on their location, are targeting giant and/or reef manta rays (*see* Marshall, *et al.*, 2011 – 1 at 11 (citation omitted); CoP16-Prop-46 at 9; Heinrichs, *et al.*, 2011 at 34; CMS, 2014 at 6 (citation omitted); Figure 8, *supra*; Figure 9, *supra*). Information on targeted fishing in other West African countries is unavailable but may occur due to the heavy fishing that occurs on these coasts, giant and reef manta rays aggregations that are known there, and the poor reporting of catch in this region (*see* CoP16-Prop-46 at 20; Figure 8, *supra*). In fact, *37% of the catch off the coast of West Africa* is a result of IUU fishing, the highest regional estimate of illegal fishing worldwide (NMFS, 2013 at 67 (citations omitted)). Because these species are extremely susceptible to overexploitation, this targeted fishing is likely causing the affected populations to decline wherever they are fished in this region. This is particularly problematic for the reef manta ray as it is only known to occur in two locations (both off the northwest African coast) in the Atlantic Ocean (*see* CoP16-Prop-46 at 20). These locations are a great distance from any other populations and recolonization following extirpation would thus be extremely unlikely. The scarcity of reef manta rays in the Atlantic Ocean means that excessive mortality could easily extirpate populations with little chance of recovery or recolonization (*see* Figure 8, *supra*; Section III. D. "Habitat and Range," *supra*).

IV. IDENTIFIED THREATS TO THE PETITIONED SPECIES: FACTORS FOR LISTING

The three Manta Rays are threatened by all five ESA listing factors. *See* 16 U.S.C. § 1553(a)(1). As discussed in Section II. F. "Best Available Scientific and Commercial Data," *supra*, NMFS cannot deny listing merely because there is little information available if the best *available* information indicates that the Manta Rays are endangered or threatened under any one, or any combination, of the five ESA listing factors. *See* 16 U.S.C. § 1533(b)(1)(A); 50 C.F.R. § 424.11(b). The following information represents the best available science regarding the Manta Rays and shows that they warrant listing. *See* 16 U.S.C. § 1533(b)(3)(A). NMFS should view these threats both individually and cumulatively when assessing the Manta Rays' status to determine whether the synergistic impact of these threats is greater than their individual additive impacts (*see* Section IV. E. 6. "Synergistic Effects," *infra*). NMFS should also be aware that, until the recent split of the genus *Manta*, all Manta Rays were classified as giant manta rays, and that the Manta Ray species share highly similar biological and behavioral characteristics and face very similar threats (CMS, 2014 at 4 (citations omitted)). As a result, species-specific threat data should also be used to inform consideration of threats to the other closely-related species.

A. The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range

The threats discussed in this section apply to all Manta Ray populations to varying degrees. Defenders has provided species-specific and location-specific data where possible and NMFS should assess the extent to which these threats likely harm these species in their respective ranges.

1. Coral Reef Loss

Manta Rays rely on coral reefs throughout their ranges for many critical life history stages. Therefore, threats to coral reefs represent serious threats to Manta Rays (*see, e.g.,* Heinrichs, *et al.*, 2011 at 14 (citation omitted)). NMFS is well aware of the threats to coral reefs worldwide (*see* Figure 22, *infra*) and should recognize the consequent threat to Manta Rays when assessing the status of these species.

Scale	Proximate Threat	Importance
Global	Ocean Warming	High
Local	Disease	High
Global	Ocean Acidification	Med-High
Local	Reef Fishing—Trophic Effects	Medium
Local	Sedimentation	Low-Medium
Local	Nutrients	Low-Medium
Global	Sea-Level Rise	Low-Medium
Local	Toxins	Low
Global	Changing Ocean Circulation	Low
Global	Changing Storm Tracks/Intensities	Low
Local	Predation	Low
Local	Reef Fishing—Habitat Impacts /Destructive Fishing Practices	Low
Local	Ornamental Trade	Low
Local	Natural Physical Damage	Low
Local	Human-induced Physical Damage	Negligible-Low
Local	Aquatic Invasive Species	Negligible-Low
Local	Salinity	Negligible
Local	African/Asian Dust	Negligible
Global	Changes in Insolation	Probably Negligible

Figure 22. NOAA's ranking of threats to coral existence (NOAA, 2011 at 86).

"The individual coral animals, known as polyps, have a tubular body and central mouth ringed by stinging tentacles, which can capture food. Living within their body tissues are microscopic algae (zooxanthellae) that need sunlight to survive. These algae convert sunlight into sugars, which produces energy to help sustain their coral hosts. These same algae also provide the corals with their vibrant colors." (Burke, *et al.*, 2012 at 7). The reef ecosystems formed by these tiny animals are among the most biologically rich and productive ecosystems on earth (Burke, *et al.*, 2012 at 5). Though they cover about 0.2% percent of the marine environment, they are home to an amazing 25% of all marine life (NOAA, Undated at 1). These incredible areas of intensely focused biodiversity are built by the actions of many tiny individual corals living in colonies and depositing their communal limestone skeletons (Burke, *et al.*, 2012 at 7). Over thousands of years these combined skeletons form vast reef systems that are home to corals and innumerable other species of flora and fauna (*see* Burke, *et al.*, 2012 at 7). If these corals were to die, their deaths would bring about the deaths of the reef ecosystems that depend on them (*see* Hoegh-Guldberg, 2006 at 3).

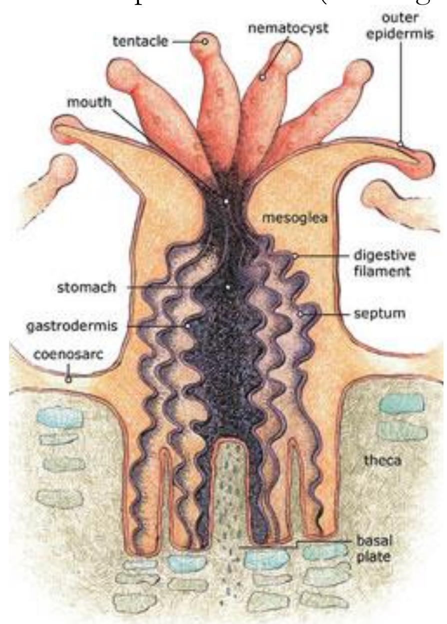

Figure 23. Anatomy of a coral polyp (NOAA).

Corals and coral reefs are severely threatened by a variety of impacts, many stemming from, or intensified by, anthropogenic climate change. As a result of these threats, corals have experienced shocking declines all over the world. According to a recent report on the health of coral reefs, "more than 60 percent of the world's reefs are under immediate threat from one or more local sources," "almost 40 percent of coral reefs have experienced water temperatures warm enough to induce severe coral bleaching" since 1998, and in Southeast Asia (an important area for Manta Rays (*see* Figure 8, *supra*; Figure 9, *supra*)) 95 percent of reefs are threatened (*see* Burke, *et al.*, 2012 at 12). This threat is palpable as an estimated 19 percent of the world's reefs had already been lost by 2008 (Wilkinson, 2008 at 5). An additional 15% of the world's reefs are also seriously threatened with loss by 2018-2028 years and another 20% are under threat of loss by 2028-2048 (Wilkinson, 2008 at 5). However, even these stark numbers may underrepresent likely losses as the unpredictable nature of global climate change may cause even faster losses (Wilkinson, 2008 at 5).

In addition to information on the loss of coral reefs in general,

> Caribbean coral reefs have suffered massive losses of corals since the early 1980s due to a wide range of human impacts including explosive human population growth, overfishing, coastal pollution, global warming, and invasive species. The

> consequences include widespread collapse of coral populations, increases in large seaweeds (macroalgae), outbreaks of coral bleaching and disease, and failure of corals to recover from natural disturbances such as hurricanes. Alarm bells were set off by the 2003 publication in the journal *Science* that live coral cover had been reduced from more than 50% in the 1970s to just 10% [then]. This dramatic decline was closely followed by widespread and severe coral bleaching in 2005, which was in turn followed by high coral mortality due to disease at many reef locations. Healthy corals are increasingly rare on the intensively studied reefs of the Florida reef tract, US Virgin Islands, and Jamaica. Moreover, two of the formerly most abundant species, the elkhorn coral *Acropora palmata* and staghorn coral *Acropora cervicornis*, have been added to the United States Endangered Species List. Concerns have mounted to the point that many NGOs have given up on Caribbean reefs and moved their attentions elsewhere.

(Jackson, *et al.*, 2014 at 11; *see also* NOAA, 2011 at 93 (citing a study indicating 80% coral declines in the Caribbean over this time period) (citation omitted)). This loss of Caribbean coral reefs will be very problematic for both the giant manta rays and Caribbean manta rays that are dependent on these ecosystems.

Because the Manta Rays are highly dependent on coral reefs for a number of their life history stages, and because Caribbean and reef manta rays appear to be reliant on them throughout their lifetimes, the loss of these reefs would be a tremendous threat to their continued survival (*see* CMS, 2014 at 6). These reefs provide food, cleaning stations, and reproductive areas for the Manta Rays and their loss would disrupt these life history needs (*see* CMS, 2014 at 4 (citation omitted); Heinrichs, *et al.*, 2011 at 14 ("Coral reef degradation could negatively impact manta and mobula rays by disrupting feeding aggregations, cleaning station behavior, or disrupting reproductive behavior.")).

Figure 24. Reef manta ray at a cleaning station, maintaining a near stationary position atop a coral patch for several minutes while being cleaned by cleaner fish (Jaine, *et al.*, 2012 at 4).

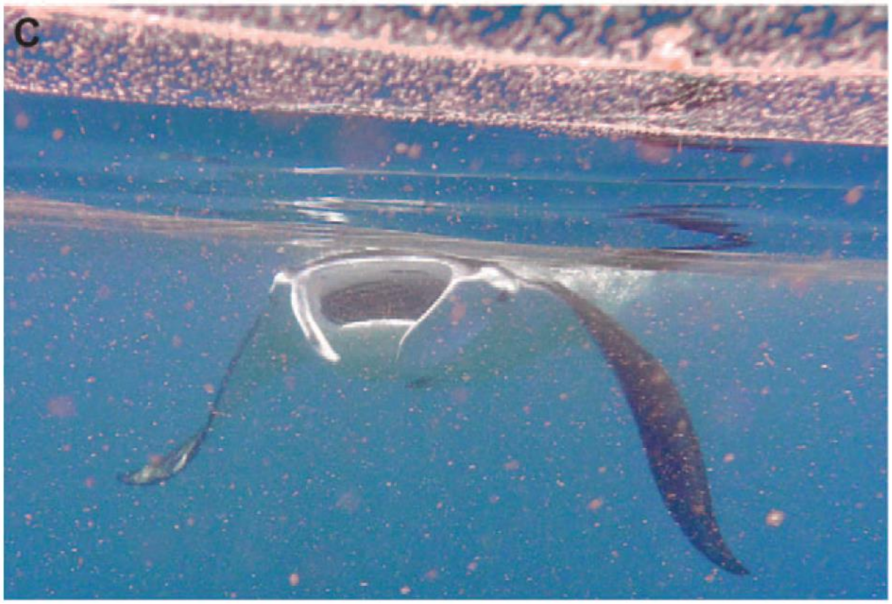

Figure 25. Reef manta ray ram feeding above a coral reef, swimming against the tidal current with its mouth open and sieving zooplankton from the water (Jaine, *et al.*, 2012 at 4).

a. Bleaching

"Corals are, quite obviously, central to coral reef ecosystems," and vice versa (*see* Hoegh-Guldberg, 2006 at 3). As discussed above, corals' symbiotic algae help nourish the animals and give the corals their color (Karl, *et al.*, 2009 at 84). However, "[c]oral bleaching occurs when [this symbiotic algae] (zooxanthellae) become[s] increasingly vulnerable to damage by light at higher than normal temperatures. The resulting damage leads to the expulsion of these important organisms from the coral host. Corals tend to die in great numbers immediately following coral bleaching events, which may stretch across thousands of square kilometers of ocean." (Hoegh-Guldberg, 2006 at Executive Summary). These bleaching events have been increasing both in terms of intensity and extent due to worldwide anthropogenic climate change that is the result of rising CO_2 levels and will continue to cause severe damage to corals and coral reefs (Hoegh-Guldberg, 2006 at Executive Summary). As of 2009, these events have led to the death or severe damage of about one-third of the world's corals (Karl, *et al.*, 2009 at 84). "After corals die, reefs quickly degrade and the structures corals build erode. This provides . . . fewer habitats for fish and other marine life," including Manta Rays (*see* NOAA, 2015 – 2 at 1).

Many corals are physiologically optimized to their local long-term seasonal variations in temperatures and an increase of only 1-2º C above the normal local seasonal maximum can induce bleaching (*see* NOAA, 2011 at 31). While some coral species are relatively resistant to the effects of bleaching, "there is general agreement that thermal stress has led to accelerated bleaching and mass mortality during the past 25 years." (NOAA, 2011 at 31). Based on NOAA's own data, a recent analysis of global thermal stress and reported coral bleaching events for the 10-year period from 1998 to 2007 shows that bleaching is a widespread threat that has already had significant effects on most coral reefs around the world. For instance, the Indian Ocean, home of many giant and reef manta ray populations (*see* Figure 8, *supra*; Figure 9, *supra*), recently experienced an extensive mass bleaching event in 2010 that halted and potentially reversed recovery from the 1998 mass bleaching event in the same region (NOAA, 2011 at 31).

The rapidity of the 2010 mass coral bleaching following previous bleaching event raises the likelihood that anthropogenic climate change has already passed the point at which mass bleaching events will begin to happen too frequently for reefs to recover (NOAA, 2011 at 31). The accelerating frequency of bleaching events and the slow recovery rate of coral species are thus likely to result in significant mortality rates and reef decline in general (NOAA, 2011 at 32). Even though corals do have some capacity to adapt to rising temperatures, they are unlikely to be able to adapt sufficiently to prevent further widespread bleaching and mortality (NOAA, 2011 at 32).

This threat is not limited to the Indian Ocean, as widespread thermal stress resulting in coral bleaching has been documented in various parts of the world during the years 1983, 1987, 1995, 1998, 2005, and 2015 as well (*see* NOAA, 2011 at 32; NOAA, 2015 – 2 at 1-3). In fact, NOAA declared the third documented global coral bleaching event on October 8, 2015 (NOAA, 2015 – 2 at 1). This event has already caused extensive bleaching across Hawaii with conditions promoting bleaching moving into the Caribbean and likely lasting into 2016 (NOAA, 2015 – 2 at 1 (citation omitted)). Bleaching was also occurring in the Florida Keys and South Florida in August 2015, but was diminishing as of early October, and was expected to cause bleaching in the Indian and southeastern Pacific Oceans beginning in 2016 (NOAA, 2015 – 2 at 1). "NOAA estimates that by the end of 2015, almost 95 percent of U.S. coral reefs will have been exposed to ocean conditions that can cause corals to bleach." (NOAA, 2015 – 2 at 1).

When bleaching events occur, coral disease often also emerges and causes further harm to the already-weakened corals (Harvey, 2015 at 1). As of October 2015, the Floridian reefs were experiencing a particularly widespread outbreak of a disease (white plague) that eats away at live coral tissue and can kill large swaths of reef (Harvey, 2015 at 1-2). These disease outbreaks make it much harder for the corals to recover from bleaching events and thereby exacerbate the threats that bleaching events pose (Harvey, 2015 at 2). Preliminary review of some corals in the Florida Keys show up to a 60% loss of live tissue from this 2015 bleaching/disease event alone with 2016 expected to be another bad bleaching year for the region (Harvey, 2015 at 2-3). This is extremely problematic for the Manta Rays that rely on these reefs (*see* Figure 8, *supra*; Figure 9, *supra*).

These bleaching events are causing massive and unprecedented coral die-offs across the globe, are often followed by disease outbreaks that cause further harm to the corals, and are recurring too quickly for the corals to recover between events. As a result, coral reefs, and Manta Rays as species dependent on reef systems for either year-round habitat or life history events, are seriously threatened by coral bleaching.

b. Ocean Acidification

Ocean acidification is one of the primary threats facing corals and is the direct result of anthropogenic increases in atmospheric CO_2 levels (NOAA, 2011 at 25). Following the Industrial Revolution, "[a]tmospheric CO_2 has increased rapidly from its preindustrial level of 280 [parts per million] to over 390 [parts per million]." (NOAA, 2011 at 25). This dramatic increase in CO_2 levels has not only warmed the planet significantly but is also changing ocean chemistry through acidification (NOAA, 2011 at 25).

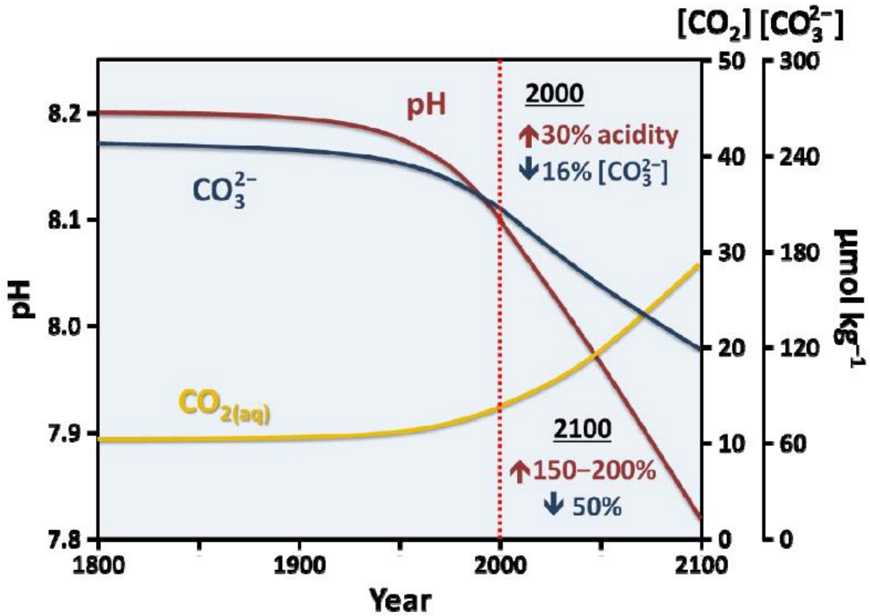

Figure 26. Projected changes in ocean chemistry from increased atmospheric CO_2 (NOAA, 2011 at 36).

As the level of atmospheric CO_2 has continued to rise, there has been a concurrent increase in the relative level of CO_2 in the ocean (NOAA, 2011 at 36). An important result of this increase in oceanic CO_2 levels is a reduction in the overall pH balance of the ocean (acidification), which in turn has several important, negative effects on corals and the reefs they build and inhabit (*see generally* NOAA, 2011 at 36-46).

So far, "[a]bout one-third of the carbon dioxide emitted by human activities has been absorbed by the ocean, resulting in a decrease in the ocean's pH." (Karl, *et al.*, 2009 at 151). "The effects [of this pH decrease] on reef-building corals are likely to be particularly severe during this century. Coral calcification rates are likely to decline by more than 30 percent under a doubling of atmospheric carbon dioxide concentrations, with erosion outpacing reef formation at even lower concentrations. In addition, the reduction in pH also affects photosynthesis, growth, and reproduction." (Karl, *et al.*, 2009 at 151).

First among the adverse consequences of oceanic acidification is a reduction in the ability of corals to create the calcite crystals that form their skeletons and ultimately the reefs they live on (NOAA, 2011 at 40). One study showed a decrease in calcification rates in branching corals of 11% to as high as 37% (NOAA, 2011 at 40). This will reduce the structural stability of corals and reefs, resulting both from increases in bioerosion and decreases in reef cementation (NOAA, 2011 at 45). Corals themselves may be able to persist in the absence of a carbonate skeleton, but a lack of accretion and increased erosion would essentially eliminate coral reefs and much of the ecosystem goods and services they provide (NOAA, 2011 at 45). This decline in calcification rates is expected to increase as CO_2 emissions also increase over the next century with more catastrophic results as early as mid-century when doubling of preindustrial CO_2 concentrations are predicted (NOAA, 2011 at 40, 45).

Ocean acidification will hamper, and potentially eventually halt and reverse, calcification of reef building corals if ocean pH continues to drop as predicted. There is no reliable indication that emissions of CO_2 will be reduced sufficiently to avoid this outcome, and, therefore, this eventuality becomes more and more likely as time goes on. This will result in more destroyed coral reef habitat that the corals will have no way of rebuilding. Therefore, ocean acidification represents a severe threat to the Manta Rays' coral reef habitats throughout the globe.

2. Plastics

Though the only study to specifically quantity the plastics ingested by Manta Rays is currently underway (Germanov, 2015 at 7), the available data indicates that ingestion of plastic debris, including microplastics, may pose a significant threat to Manta Rays (*see, e.g.,* Heinrichs, *et al.*, 2011 at 14; Germanov, 2015 at 2; CMS, 2014 at 6, 7 (citation omitted)). "[A]nnual plastic production has increased dramatically from 1.5 million [tons] in the 1950s to approximately 280 million [tons] in 2011." (Wright, *et al.*, 2013 at 1 (citation omitted)). A recent study determined that 275 million metric tons ("MMT") of plastic waste was generated in 192 coastal countries in 2010, with 4.8 to 12.7 MMT entering the ocean that year alone (Jambeck, *et al.*, 2015 at 768).[35] Due to its persistence and the amount of plastic waste that is mismanaged[36] worldwide, it has become omnipresent in the oceans (*see generally* Jambeck, *et al.*, 2015).

a. Plastic Marine Debris

One recent study reported that plastics compose 60-80% of marine debris (Gilfillan, 2009 at 123 (citation omitted)), and Eriksen, *et al.*, 2014 estimated that 5.25 trillion plastic particles, weighing about 269,000 tons, are currently floating in the world's oceans (*see* Eriksen, *et al.*, 2014 at 1, 7; Germanov, 2015 at 10 (citing Eriksen, *et al.*, 2014)). 70% of the net tows from this study yielded density estimates of 1,000–100,000 pieces of plastic per square kilometer and 16% resulted in even higher counts of up to 890,000 pieces of plastic per square kilometer (Eriksen, *et al.*, 2014 at 7). 92.3% of the tows from this study contained plastics across all tow durations (Eriksen, *et al.*, 2014 at 7). However, this study was careful to note that these "estimates are highly conservative, and may be considered minimum estimates." (Eriksen, *et al.*, 2014 at 11).

[35] This estimate is limited as it only accounts for land-based waste and does not consider losses from fishing activities or at-sea vessels, input from natural disasters, and other sources (Jambeck, *et al.*, 2015 at 770).

[36] Mismanaged waste is the sum of inadequately managed waste plus 2% littering (Jambeck, *et al.*, 2015 at 769).

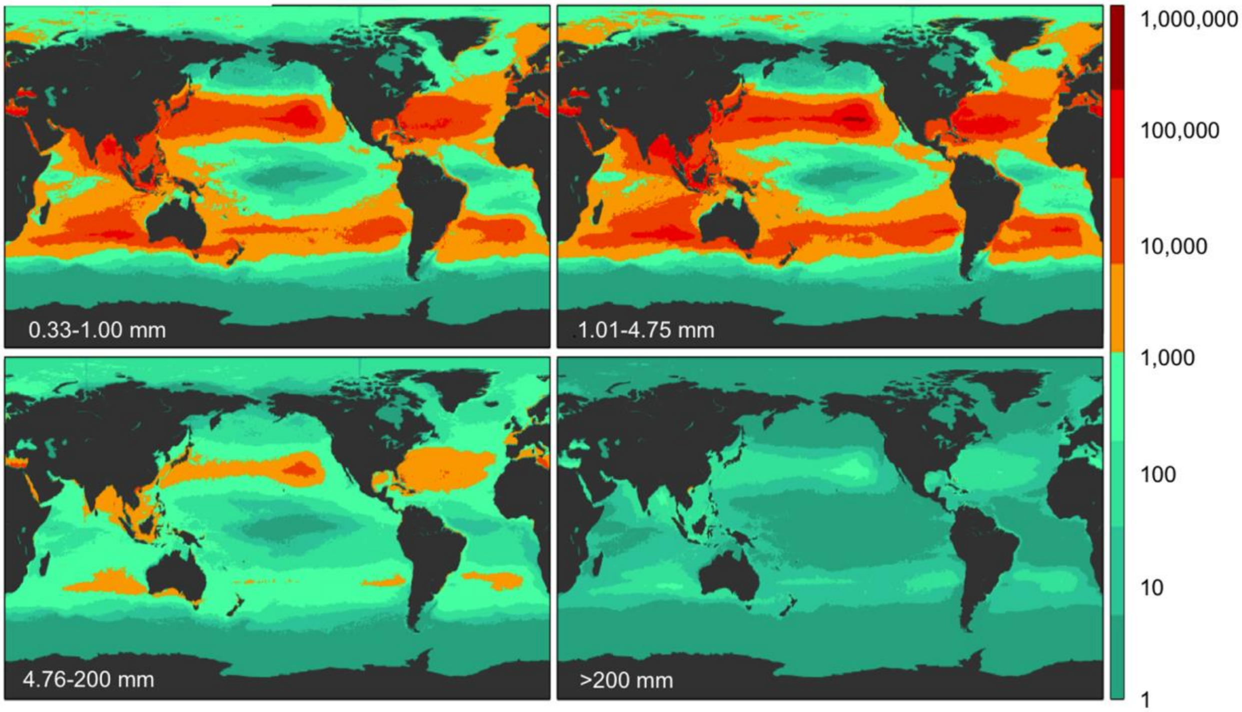

Figure 27. Model results for global plastic density (pieces per square kilometer) in four size classes (0.33–1.00 millimeters, 1.01–4.75 millimeters, 4.76–200 millimeters, and >200 millimeters) (Eriksen, *et al.*, 2014 at 8).

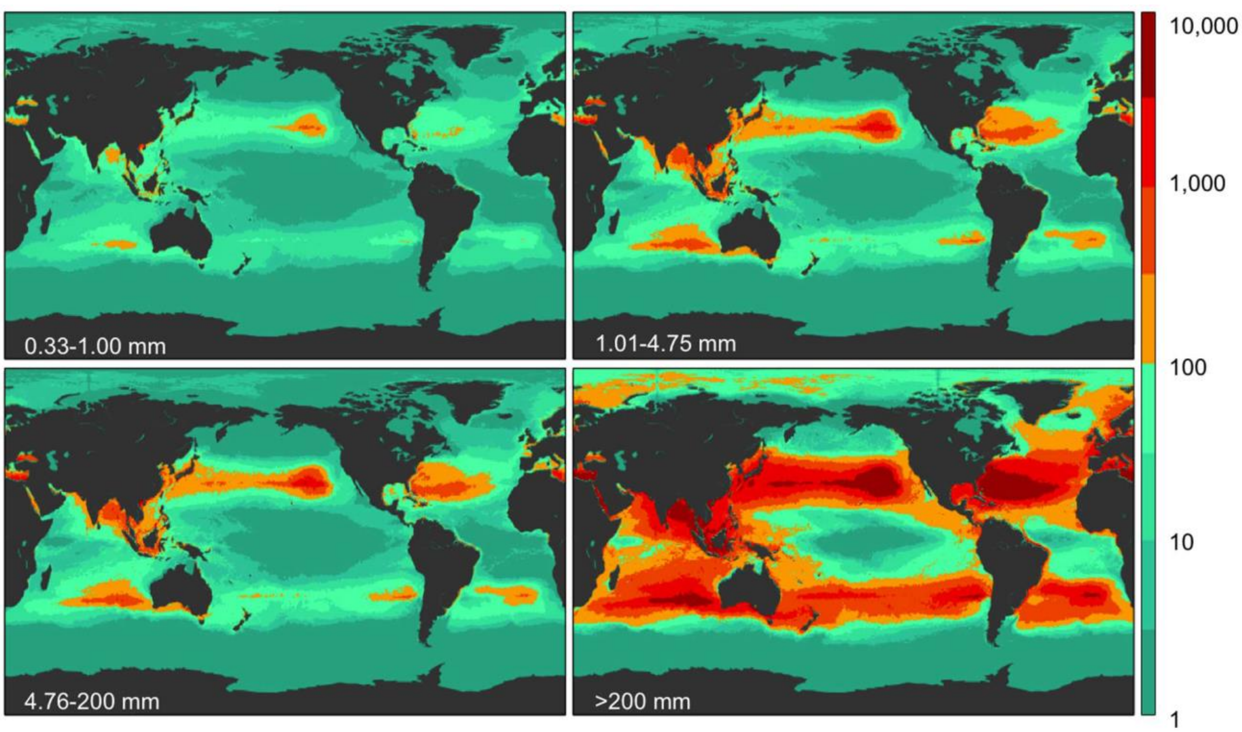

Figure 28. Model results for global weight density (grams per square kilometer) in four size classes (0.33–1.00 millimeters, 1.01–4.75 millimeters, 4.76–200 millimeters, and >200 millimeters) (Eriksen, *et al.*, 2014 at 9).

b. Microplastics

Eriksen, *et al.*, 2014 determined that "[t]he vast majority of the[] plastics [observed in the aforementioned study] were small fragments." (Eriksen, *et al.*, 2014 at 7). The majority of these "small fragments" would be considered microplastics (*see* Figure 27, *supra* (indicating that the majority of these pieces were under 5 millimeters)). The current general consensus definition of the term microplastics is any piece of plastic smaller than 5 millimeters in diameter (*see* Cole, *et al.*, 2013 at 1; Germanov, 2015 at 9). "Microplastics consist of synthetic polymer products manufactured to be of a small size, such as exfoliates in cosmetics,[37] and those items derived from the fragmentation of larger plastic debris, for example polyester fibers from fabrics, polyethylene fragments from plastic bags and polystyrene particles from buoys and floats." (Cole, *et al.*, 2013 at 1 (citations omitted)). However, microplastics also appear, in some cases, to escape from production facilities and enter the ocean before they even make their way into consumer products (*see* Cole, *et al.*, 2013 at 2).

> Typically, high-density plastics (e.g., polyvinyl chlorides, polyester) settle out of the water column, whereas low-density plastics (e.g., polyethylene, polystyrene) remain buoyant, although freshwater inputs, storms, and biofilm formation may result in vertical mixing. Floating plastic debris is susceptible to local and ocean currents resulting in higher-than-average waterborne microplastic concentrations in areas of confluence.

(Cole, *et al.*, 2013 at 1 (citations omitted); *see also* Gilfillan, 2009 at 123 (citation omitted)). "Additionally, the buoyancy of smaller pieces of plastic increases the likelihood for mixing with surface food sources." (Boerger, *et al.*, 2010 at 2275). "Perpetual fragmentation of plastic litter, coupled with the increasing popularity of household products containing microscopic plastic exfoliates, suggests marine plastic debris is becoming, on average, smaller over time." (Cole, *et al.*, 2013 at 8 (citations omitted)). This data indicates that microplastics will become an increasingly prevalent portion of the mix of plastic waste in the ocean over time.

c. Vectors of Manta Ray Plastic Consumption

"Planktivores[, like Manta Rays], filter feeders and suspension feeders inhabiting the upper water column are likely to encounter positively buoyant, low-density plastics, such as PE . . . on the sea surface." (Wright, *et al.*, 2013 at 3). A recent study assessing plastic consumption by small planktivorous fish found that "[a]pproximately 35% of the fish examined had plastic pieces in their guts." (Boerger, *et al.*, 2010 at 2276). This study found a total of 1375 pieces of plastic in the fish guts, ranging from 1 to 83 pieces per fish and averaging 2.1 pieces (±5.78) per fish (Boerger, *et al.*, 2010 at 2276). There was a trend where the average number of plastic pieces generally increased with fish size (Boerger, *et al.*, 2010 at 2276). However, it is not clear how long this plastic had been in the fish guts, complicating conclusions on gut residency times versus consumption (Boerger, *et al.*, 2010 at 2277).

As one of the ocean's largest planktivores (*see* Section III. C. "Physical Characteristics," *supra*), consumption of plastic pieces by Manta Rays while they are feeding on zooplankton can be expected

[37] Studies indicate that 1-10% of these products (by weight) may consist of microplastic beads (*see* Germanov, 2015 at 11).

to be much larger than for these small planktivorous fish (*see* Germanov, 2015 at 7). Therefore, this data indicates that direct plastic consumption while feeding on zooplankton likely introduces large amounts of plastic into the Manta Rays' digestive systems (*see* Wright, *et al.*, 2013 at 2 (indicating that planktivores "could passively ingest microplastics during normal feeding [behavior] or mistake particles for natural prey.")). As extremely large and long-lived species, Manta Rays will necessarily consume larger quantities of plastic and will retain that plastic for longer periods, due to their longer lifespans, assuming they cannot adequately rid themselves of it after ingestion (*see* Section III. C. "Physical Characteristics," *supra*; Section III. F. "Reproduction and Lifespan," *supra*).

In addition to direct Manta Ray plastic consumption, when plastic fragments into smaller pieces, this increases the potential for smaller marine organisms, including zooplankton, to ingest it (Boerger, *et al.*, 2010 at 2275 (citation omitted)). "A key factor contributing to the bioavailability of microplastics is their small size, making them available to lower trophic organisms. Many of these organisms exert limited selectivity between particles and capture anything of appropriate size." (Wright, *et al.*, 2013 at 2 (citation omitted)). Manta Rays feed on zooplankton with a preference for copepods (*see* Section III. E. "Feeding," *supra*; *see also* Manta Trust, Undated at 1). Therefore, the consumption of these zooplankton by Manta Rays will result in ingestion of the plastics that the zooplankton have ingested.

A recent study found that 13 of 15 zooplankton species tested demonstrated the capacity to ingest microplastics (Cole, *et al.*, 2013 at 5). In addition, all four of the copepods tested were able to ingest microplastics (Cole, *et al.*, 2013 at 5). While the plastic in this study was typically egested within hours, the plastic stayed in the zooplankton's digestive system for up to 7 days in the absence of food (Cole, *et al.*, 2013 at 6). Because microplastics in the environment are often fibrous or irregularly shaped and the plastics in this study were bead-shaped, the microplastics that zooplankton actually experience in the ocean may be more likely to "become entangled within the intestinal tract, potentially resulting in a nonbiodegradable gut-blockage and greater gut-retention times [than those observed in this study]." (Cole, *et al.*, 2013 at 7; *see also* Wright, *et al.*, 2013 at 6). This greater gut retention time has been observed in other species with "fish and sea bird dissections [in fact demonstrating] that marine wildlife can retain a range of plastic detritus within their stomachs near-indefinitely." (Cole, *et al.*, 2013 at 7 (citations omitted)). These blockages retain the plastics within the organism, leaving them available for accumulation up the food chain if they are a prey species (*see* Wright, *et al.*, 2013 at 5-6). Longer retention periods have also been observed where microplastics pass from the contaminated species' gut to its circulatory system (*see* Wright, *et al.*, 2013 at 6 (up to 48 days for the bivalve *Mytilus edulis*)). In addition to ingested microplastics, microplastics were also often found adhered to live zooplankton's external surfaces and shed carapaces in addition to attaching to the carapaces of dead zooplankton in "vast numbers" (Cole, *et al.*, 2013 at 6). If Manta Rays were to eat plastic-contaminated zooplankton and/or carapaces, they would also be ingesting the plastic they are contaminated with. This is therefore another important vector of Manta Ray plastic ingestion.

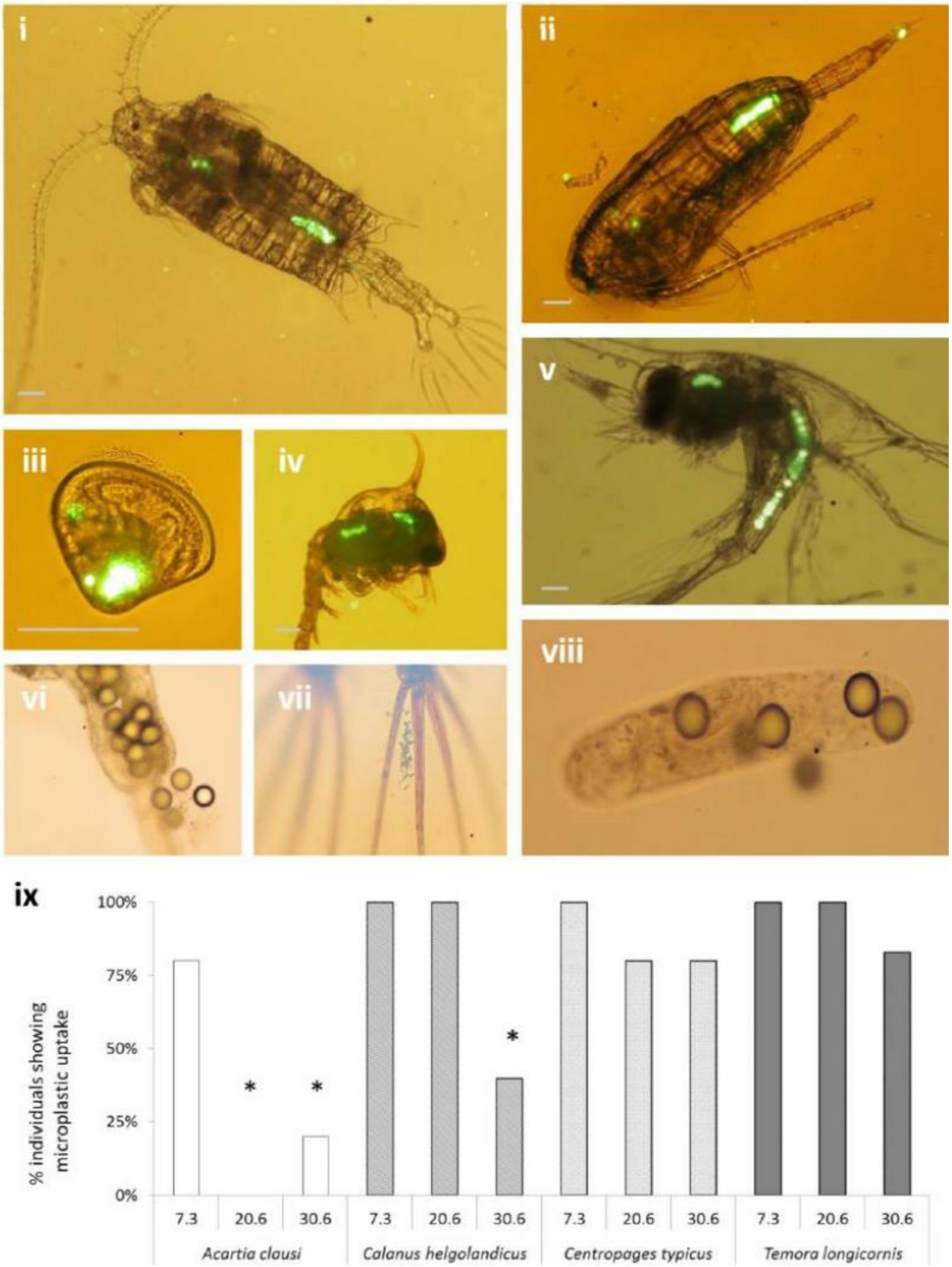

Figure 29. Microplastics of different sizes can be ingested, egested and adhere to a range of zooplankton, as visualized using fluorescence microscopy: (i) the copepod *Centropages typicus* containing 7.3 micrometer ("µm") polystyrene ("PS") beads (dorsal view); (ii) the copepod *Calanus helgolandicus* containing 20.6 µm PS beads (lateral view); (iii) a D-stage bivalve larvae containing 7.3 µm PS beads (dorsal view); (iv) a Brachyuran (decapod) larvae (zoea stage) containing 20.6 µm PS beads (lateral view); (v) a Porcellanid (decapod) larvae, containing 30.6 µm PS beads (lateral view); (vi) 30.6 µm PS beads in the posterior-gut of the copepod *Temora longicornis* during egestion, (vii) 1.4 µm PS beads trapped between the filamental hairs of the furca of *C. typicus*; (viii) a *T. longicornis* fecal pellet containing 30.6 µm PS beads; (ix) proportion of copepods (*Acartia clausi*, *Calanus helgolandicus*, *Centropages typicus*, and *Temora longicornis*) with microplastics in their guts following 24 hours of

exposure to 7.4, 20.6, and 30.6 µm polystyrene beads. *denotes statistically significant ($P \leq 0.05$) lower consumption of larger beads compared with that of 7.3 µm beads. Scale bar (gray line): 100 µm (Cole, *et al.*, 2013 at 4).

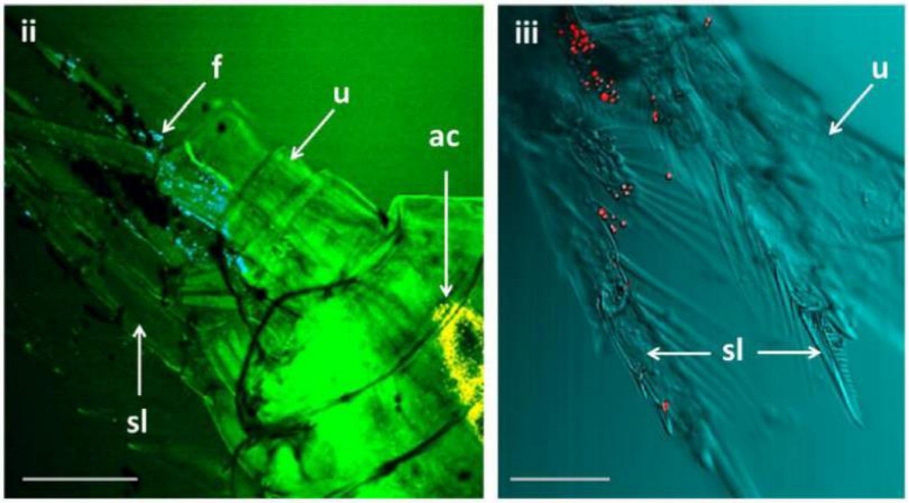

Figure 30. Coherent anti-Stokes Raman scattering ("CARS") microscopy: (ii) 3.4 µm microplastics accumulated in the alimentary canal ("ac") of the copepod *Temora longicornis* (yellow dots); beads further adhered to the exterior of the copepod's urosome ("u"), furca ("f") and posterior swimming legs ("sl") (blue dots); (iii) 3.4 µm microplastics (red dots) adhered to the external surface of the posterior swimming legs of *T. longicornis*. Scale bar [gray line]: 50 µm (Cole, *et al.*, 2013 at 5).

In addition to the aforementioned species, ingestion of plastic has been widely documented in vertebrate species including turtles, seabirds, marine mammals, and fish (*see* Boerger, *et al.*, 2010 at 2275; *see also* Wright, *et al.*, 2013 at 7-8 (discussing seals, whales, and fish) (citations omitted). Recent studies have indicated that "many more organisms ingest small plastic particles than previously thought, either directly or indirectly, i.e. via their prey organisms. Numerous species ingest microplastics, and thereby make it available to higher-level predators . . ." (Eriksen, *et al.*, 2014 at 11 (citations omitted)). In fact over 250 marine vertebrates are believed to be impacted by plastic ingestion (Wright, *et al.*, 2013 at 2 (citation omitted)). Studies of fur seals and Hooker's sea lions, for example, have found microplastics in their feces from the fish that they consume (Wright, *et al.*, 2013 at 7 (citations omitted)). A significant increase in the observed prevalence of these plastic pieces over the term of one of these studies was likely caused by the increasing abundance of plastic debris in the marine environment (Wright, *et al.*, 2013 at 8). In addition, "[m]ono-(2-ethylhexyl) phthalate (MEHP) contamination of the blubber of the Mediterranean fin whale [(*Balaenoptera physalus*)] has recently been suggested as an indication that microplastic ingestion occurs, either from the water column or via a planktonic vector." (Wright, *et al.*, 2013 at 8).

"There is compelling evidence that microplastics . . . negatively impact upon marine biota." (Cole, *et al.*, 2013 at 1 (citation omitted)). Plastics, including microplastics, can harm marine creatures through three primary vectors: 1) leaching of toxins that are part of the plastics' production; 2) leaching of toxins that the plastics have accumulated from the surrounding waters; and 3) blockages and abrasion resulting from the ingestion of non-digestible plastics.

d. Toxins in Plastics

"The chemicals that plastics contain . . . are known to adversely affect organisms." (Germanov, 2015 at 12). "[A]dditives incorporated into a plastic during manufacture to improve its properties (e.g., phthalates for malleability and polybrominated diphenyl ethers (PDE) for heat resistance) might leach out of weathered plastic debris . . ." (Cole, *et al.*, 2013 at 1; *see also* Cole, *et al.*, 2013 at 8; Wright, *et al.*, 2013 at 2 (monomers and plastic additives may leach out of ingested plastics) (citations omitted)). This leaching has been observed in other species and these contaminants might be considered endocrine-disruptors, carcinogenic, or toxic, with repercussions for growth, sexual development, fecundity, morbidity, and mortality (Cole, *et al.*, 2013 at 8 (citations omitted); Wright, *et al.*, 2013 at 2 (leaching of these additives could cause carcinogenesis and endocrine disruption) (citations omitted)). This toxicity could be exacerbated by trophic-transfer up the food chain "with the potential for bioaccumulation and therefore adverse health consequences in higher trophic organisms [like Manta Rays]." (Cole, *et al.*, 2013 at 8).

e. Accumulated Toxins

"[P]lastics are known to concentrate toxins and through ingestion, large filter feeders may become contaminated." (Germanov, 2015 at 2). "Adsorption of persistent organic pollutants onto plastic and their transfer into the tissues and organs through ingestion is impacting marine megafauna as well as lower trophic-level organisms and their predators." (Eriksen, *et al.*, 2014 at 2 (citations omitted); *see also* Boerger, *et al.*, 2010 at 2277 (citations omitted)). "[T]he large surface area to volume ratio and hydrophobic properties of microplastics leave them susceptible to the accumulation of hydrophobic organic contaminants (HOCs) which could dissociate post-ingestion." (Cole, *et al.*, 2013 at 1 (citation omitted)). These adsorbed compounds include dichlorodiphenyltrichloroethane ("DDT"), polychlorinated biphenyls ("PCBs"), polybrominated diphenyl ethers ("PBDEs"), and polycyclic aromatic hydrocarbons ("PAHs") (*see* Cole, *et al.*, 2013 at 8; Wright, *et al.*, 2013 at 8 (citations omitted); Germanov, 2015 at 12 (citing Wright, *et al.*, 2013)). When ingested, these chemicals pose a variety of threats to Manta Rays as they are "endocrine-disruptors, carcinogenic, or toxic, with repercussions for growth, sexual development, fecundity, morbidity, and mortality." (Cole, *et al.*, 2013 at 8 (citations omitted); *see also* Gelsleichter & Walker, 2010 at 492-97, 498-506 (discussing the negative effects of these various chemicals on elasmobranchs)). The trophic transfer of these contaminants up the food chain from zooplankton to Manta Rays could result in bioaccumulation, biomagnification, and resultant adverse health consequences (*see* Cole, *et al.*, 2013 at 8; Wright, *et al.*, 2013 at 2, 8). In fact, "the sorption of toxicants to plastic while traveling through the environment, ha[s] led some researchers to claim that synthetic polymers in the ocean should be regarded as hazardous waste." (Eriksen, *et al.*, 2014 at 2 (citations omitted)). As these plastics and their resultant chemicals concentrate up the food web, they will cause a larger degree of contamination in Manta Rays and thereby increase the negative effects that these species experience as a result of their contamination (*see* Wright, *et al.*, 2013 at 7-8).

f. Blockages and Abrasion

The persistence of plastics means that they may accumulate within organisms, resulting in physical harm, such as "internal and/or external abrasions and ulcers; and blockages of the digestive tract, which can result in satiation, starvation and physical deterioration. In turn this can lead to reduced reproductive fitness, drowning, diminished predator avoidance, impairment of feeding ability, . . . and ultimately death." (Wright, *et al.*, 2013 at 5 (citations omitted); *see also* Wright, *et al.*, 2013 at 2, 7).

These impacts could have population-level effects on the Manta Rays (*see* Boerger, *et al.*, 2010 at 2277). Prolonged gut retention times also may affect the amount of toxins leached from the plastics and may therefore exacerbate the aforementioned toxicity threats (*see* Cole, *et al.*, 2013 at 7-8).

g. Plastic Prevalence in Manta Ray Habitat

Using 2010 statistics, the top 20 countries in terms of mismanaged plastic waste account for an incredible 83% of total global mismanaged plastic waste (Jambeck, *et al.*, 2015 at 770). "Total annual waste generation is mostly a function of population size, with the top waste-producing countries having some of the largest coastal populations." (Jambeck, *et al.*, 2015 at 770). Even where relatively small percentages of plastic waste are mismanaged, total output can be large as a result of large coastal populations and high per capita waste production (Jambeck, *et al.*, 2015 at 770). Indonesia, an important Manta Ray range state, is ranked second worldwide in mismanaged plastic waste (*see* Figure 31, *infra*). This waste is estimated as totaling 3.22 MMT, up to 40% of which enters the oceans (Germanov, 2015 at 7; Figure 31, *infra*). One scientist theorized that part of the reason for Indonesia's high amount of waste is the fact that it is typically unsafe to drink tap water there. This necessitates buying bottled water, which ultimately contributes to the plastic waste issue when the plastic water bottles become mismanaged waste (*see* Germanov, 2015 at 7). In addition to Indonesia, the majority of the remaining top 20 countries are also known Manta Ray range states, indicating that vast amounts of mismanaged plastic waste are entering these species' habitats every year (*compare* Figure 31, *infra*; Section III. D. "Habitat and Range," *supra*). This problem appears to be particularly severe in Southeast Asia, indicating serious threats to Manta Rays in the Indian Ocean and Indo-Pacific specifically (*see* Figure 32, *infra*).

Rank	Country	Econ. classif.	Coastal pop. [millions]	Waste gen. rate [kg/ppd]	% plastic waste	% mismanaged waste	Mismanaged plastic waste [MMT/year]	% of total mismanaged plastic waste	Plastic marine debris [MMT/year]
1	China	UMI	262.9	1.10	11	76	8.82	27.7	1.32–3.53
2	Indonesia	LMI	187.2	0.52	11	83	3.22	10.1	0.48–1.29
3	Philippines	LMI	83.4	0.5	15	83	1.88	5.9	0.28–0.75
4	Vietnam	LMI	55.9	0.79	13	88	1.83	5.8	0.28–0.73
5	Sri Lanka	LMI	14.6	5.1	7	84	1.59	5.0	0.24–0.64
6	Thailand	UMI	26.0	1.2	12	75	1.03	3.2	0.15–0.41
7	Egypt	LMI	21.8	1.37	13	69	0.97	3.0	0.15–0.39
8	Malaysia	UMI	22.9	1.52	13	57	0.94	2.9	0.14–0.37
9	Nigeria	LMI	27.5	0.79	13	83	0.85	2.7	0.13–0.34
10	Bangladesh	LI	70.9	0.43	8	89	0.79	2.5	0.12–0.31
11	South Africa	UMI	12.9	2.0	12	56	0.63	2.0	0.09–0.25
12	India	LMI	187.5	0.34	3	87	0.60	1.9	0.09–0.24
13	Algeria	UMI	16.6	1.2	12	60	0.52	1.6	0.08–0.21
14	Turkey	UMI	34.0	1.77	12	18	0.49	1.5	0.07–0.19
15	Pakistan	LMI	14.6	0.79	13	88	0.48	1.5	0.07–0.19
16	Brazil	UMI	74.7	1.03	16	11	0.47	1.5	0.07–0.19
17	Burma	LI	19.0	0.44	17	89	0.46	1.4	0.07–0.18
18*	Morocco	LMI	17.3	1.46	5	68	0.31	1.0	0.05–0.12
19	North Korea	LI	17.3	0.6	9	90	0.30	1.0	0.05–0.12
20	United States	HIC	112.9	2.58	13	2	0.28	0.9	0.04–0.11

*If considered collectively, coastal European Union countries (23 total) would rank eighteenth on the list

Figure 31. Waste estimates for 2010 for the top 20 countries ranked by mass of mismanaged plastic waste (in MMT per year). Total mismanaged plastic waste was calculated for populations within 50 kilometers of the coast in the 192 countries considered. "HIC" denotes high income; "UMI" denotes upper middle income; "LMI" denotes lower middle income; "LI" denotes low income; and "ppd" stands for person per day (Jambeck, *et al.*, 2015 at 769).

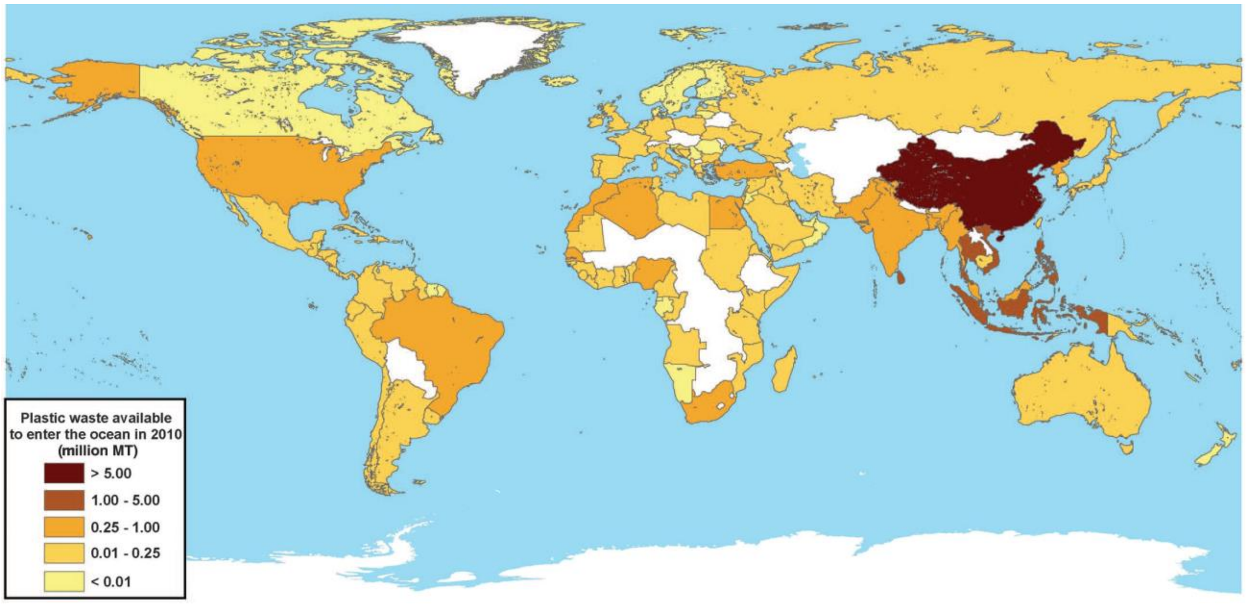

Figure 32. Shading represents the estimated mass of mismanaged plastic waste (in MMT) generated in 2010 by populations living within 50 kilometers of the coast. Countries where an estimate was not made are shaded white (Jambeck, *et al.*, 2015 at 769).

"Assuming no waste management infrastructure improvements, the cumulative quantity of plastic waste available to enter the marine environment from land is predicted to increase by an order of magnitude by 2025." (Jambeck, *et al.*, 2015 at 770). This increase will be most severe in developing countries as a result of population growth, waste generation rates for 2025 that are consistent with economic growth, and a projected increase in plastic in the waste stream." (Jambeck, *et al.*, 2015 at 770 (citation omitted)). This indicates that this plastic waste will continue to accumulate in these Manta Rays' habitat in the future and that it thus represents a growing threat to these species (*see* Figure 31, *supra* (indicating that only one of the top 20 countries for mismanaged plastic waste is "high income"); *cf.* Figure 32, *supra*; Figure 8, *supra*; Figure 9, *supra* (indicating that many of the countries in the Manta Rays habitats are amongst the top 20, or are otherwise prolific producers of mismanaged plastic waste)).

3. Climate Change (Effects in Addition to Coral Reef Loss)

A recent study estimates that mobulid rays, including Manta Rays, "are the pelagic species most vulnerable to climate change, since plankton, a primary food source, may be adversely affected by the disruption of ecological processes brought about by changing sea temperatures." (CMS, 2014 at 7 (citation omitted); Heinrichs, *et al.*, 2011 at 14 (citation omitted)). In fact, climate change is already impacting Manta Ray populations by influencing weather and the periodicity and severity of El Niño Southern Oscillation events.

> In the Republic of Maldives, over the past two years, despite intensive directed research, there has not been a single recorded pregnancy amongst a subpopulation of over 870 individually identified mature female *M. alfredi*. This [complete lack of documented] pregnancies correlates directly with un-seasonally weak monsoonal winds in the region, which should drive the nutrient upwellings that lead to the rich productivity of the Archipelago upon which the manta ray directly depend. These

> broad scale fluctuations in the productivity of the Maldivian waters are reflected in catch rates of the local tuna fishery, which have been linked to wider climatic patterns such as the El Niño Southern Oscillation (ENSO).

(CMS, 2014 at 7; Dulvy, *et al.*, 2014 at 5 (citation omitted)). "Similar patterns of skipped reproduction have been noted in Japanese waters." (Dulvy, *et al.*, 2014 at 5 (citation omitted)). This is highly concerning as these species already exhibit extremely low fecundity (*see* Section III. F. "Reproduction and Lifespan," *supra*; Section IV. E. 4. "K-Selected," *infra*).

"Ultimately the only clear solution to [climate change] will be a concerted and successful global effort to reduce atmospheric greenhouse gas emissions and to stabilize atmospheric concentrations [of those gases] somewhere around or below current levels." (Burke, *et al.*, 2012 at 31). However, these efforts have thus far been unsuccessful. *See* 76 Fed. Reg. 18,684, 18,694 (April 5, 2011). With global temperatures already rising, no imminent solution to global climate change, and the negative effects on Manta Rays that the lack of such a solution entails, climate change represents a significant manmade habitat threat that will increase the extinction pressure that the Manta Rays face.

4. Water Pollution

"*Manta* spp. are also likely to be susceptible to oil spills and pollution because of their wide ranging near-shore habitat preferences." (CMS, 2014 at 7 (citations omitted)). As a result, water pollution will degrade the Manta Rays' habitat and make it less safe for these species.

5. Fisheries and Resultant Marine Debris

Fisheries in Manta Ray habitats exert a variety of threats on these species in addition to subjecting them to bycatch and directed fishing (treated in Section IV. B. "Overutilization for Commercial, Recreational, Scientific or Educational Purposes," *infra*). For instance, boats also contribute free-floating marine debris, including ghost nets and other detritus, to the oceans that threaten Manta Rays (*see* CMS, 2014 at 6, 7 (citation omitted)). Entanglement in marine debris can wound Manta Rays, decrease fitness or contribute to unnatural mortality (Marshall, *et al.*, 2011 – 1 at 10, 12 (citation omitted); Marshall, *et al.*, 2011 – 2 at 10 (citations omitted); Heinrichs et al, 2011 at 14; *see also* Section IV. A. 2. "Plastics," *supra* (indicating some of the harms that this debris can pose to Manta Rays)). For example, an increase in fishing for Manta Rays in the Similan Islands, Thailand has caused steep declines in Manta Ray sightings and has led to "a significantly higher proportion of individuals with net and line injuries than anywhere else in the world, except for mainland Ecuador (due to illegal fishing for wahoo in a major *M. birostris* aggregation area)." (Heinrichs, *et al.*, 2011 at 34; *see also* Heinrichs, *et al.*, 2011 at 34 ("In a major *M. birostris* aggregation area where illegal drift gillnet and longline fisheries targeting wahoo are still prevalent, researchers have observed large numbers of manta rays with life threatening or debilitating injuries from entanglement."). "This photographic evidence strongly supports anecdotal reports that fishing is having a major impact on the manta ray population in the area." (Heinrichs, *et al.*, 2011 at 34). In addition, a study of 290 reef manta rays in Maui, Hawaii revealed that "[t]wenty-eight individuals (10%) had an amputated or disfigured, non-functioning cephalic fin." (Deakos, *et al.*, 2011 at 254). These injuries were "most likely due to entanglement in monofilament line." (Deakos, *et al.*, 2011 at 257).

> All amputated cephalic fins had straight edge cuts, consistent with being severed with line. Some deformed cephalic fins had straight cuts halfway through the fin, most

likely due to having shed the line before the fin was completely severed. Shark predation as the cause of cephalic fin damage seems unlikely, as of the 70 individuals with shark attack scars [in this study], 65 had scars either on the posterior part of their body or on the wing tip. Only 5 individuals possessed attack scars anterior to the midline of the body.

(Deakos, *et al.*, 2011 at 257). "Considering the function of the cephalic fins to guide food into the [Manta Ray's] mouth during feeding, an animal reduced to a single cephalic fin would likely suffer a reduction in feeding efficiency." (Deakos, *et al.*, 2011 at 257; *see also* Heinrichs, *et al.*, 2011 at 14; Section III. C. "Physical Characteristics," *supra*; Section III. E. "Feeding," *supra*). In addition, "[e]ight individuals had physical evidence of entanglement in fishing line. These included 2 individuals with fish hooks embedded in the cephalic fin, 2 with monofilament line wrapped around the cephalic fin, 2 with clear injuries where line had begun to cut partway through the cephalic fin and 2 with visible scars from line that had been wrapped around the cephalic or pectoral fin." (Deakos, *et al.*, 2011 at 254). However, this entanglement can also cause much less cryptic mortality where it traps the Manta Ray and causes it to drown (Heinrichs, *et al.*, 2011 at 14 (citation omitted)). As a result, "entanglement in fishing lines is a significant threat." (Deakos, *et al.*, 2011 at 257). In fact, Deakos, *et al.*, 2011 determined that entanglement with monofilament line was the "greatest immediate threat" to the Maui population (Deakos, *et al.*, 2011 at 258). These impacts thus clearly make the Manta Rays' habitats more dangerous.

B. Overutilization for Commercial, Recreational, Scientific or Educational Purposes[38]

1. Overutilization for Commercial Purposes[39]

By far the greatest threat to Manta Rays is from directed and bycatch fisheries (*see* Heinrichs, *et al.*, 2011 at 14; CMS, 2014 at 5; CoP16-Prop-46 at 8; Marshall, *et al.*, 2011 – 1 at 10). The United States formally recognized that Manta Rays are being overutilized for commercial purposes when it supported a proposal to list the entire *Manta* genus under Appendix II of CITES in 2013 (*see* USFWS, 2013 at 2). The United States explained that the Manta Rays' life history makes them very vulnerable to exploitation and that, "[i]n recent years, [Manta Ray] fishing has expanded in many places throughout their range, primarily in response to the emerging international market for their gill plates." (USFWS, 2013 at 2). Therefore, consistent with, and in furtherance of, the United States' determination that all Manta Rays warrant CITES listing, and in recognition of the continued and growing threats to these species, including overutilization causing unsustainable Manta Ray population declines, NMFS should list the three Manta Ray species under the ESA.

While local subsistence fishing of Manta Rays for meat has likely occurred for centuries, overexploitation of these species has recently skyrocketed (Heinrichs, *et al.*, 2011 at 4; CMS, 2014 at

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[38] The Information from Section III. G. "Population Trend," *supra* is incorporated here by reference rather than restated in its entirety.

[39] Although several of the other threats to Manta Rays also have a commercial component as they are often driven by profit, this section will focus on threats from fishing as it has the clearest commercial nexus (i.e. it is intended to catch fish, including many times Manta Rays, generally to be sold as a commodity).

5). This change is a result of the growing international trade in Manta Ray gill plates,[40] which "is driving overexploitation [that is] elevating their extinction risk. The high value of gill plates [for alleged medicinal purposes] and the international nature of the trade are driving roving bandit dynamics, [incentivizing] serial depletion and a globalized tragedy of the commons." (Dulvy, *et al.*, 2014 at 2 (citations omitted)). "Many bycatch and small subsistence fisheries have transformed into targeted export industries in response to the gill raker trade." (Heinrichs, *et al.*, 2011 at 16; *see also* Marshall, *et al.*, 2011 – 2 at 10). Their high value is also likely causing opportunistic target fisheries to spring up throughout the Manta Rays' ranges and an increased retention of bycaught individuals (*see* CMS, 2014 at 6; CoP16-Prop-46 at 10). "For example, fishermen in Sri Lanka used to avoid setting their nets where [Manta Rays] were known to occur, and any rays caught incidentally were released, often alive, at sea. Following the rapid growth of the gill plate trade over the past decade, however, fishermen now land all" Manta Rays (CoP16-Prop-46 at 10 (citation omitted)).

The market for Manta Ray gill plates has only recently emerged and is based on spurious claims that ingestion of these gill plates can cause resultant health benefits.

> The dried rakers are crushed into a powder which is added to a soup or broth, along with crushed pipefishes, ginseng and other ingredients, to be used as a treatment for a variety of ailments. The gill rakers are marketed as being; anti-inflammatory, clearing away heat and toxic material, and eliminating stasis to activate blood circulation.[41] There is absolutely no scientific proof to back up these claims, and there are not even any records in the traditional Chinese medicinal texts which list manta or mobula rays gills as being used in this way. So it appears as though this is a fairly new product, clever marketing of a readily available and cheap bycatch source from the fisheries. Marketed as a "medicine" on the basis that because mobulid rays are capable of filtering the water to catch their food, their gill rakers when consumed can also filter and remove toxins from our human bodies.

(Stevens, 2011 at 8).

A high percentage of the Manta Rays that are landed worldwide are entering the gill plate trade with the high value of their parts internationally being a primary driver of fisheries for these species (CoP16-Prop-46 at 11). As much as 99% of the global market for Manta Ray and mobula gill plates passes through Guangzhou, China (Heinrichs, *et al.*, 2011 at 4). Approximately 21,000 kilograms of dried Manta Ray gill plates (valued at $5 million) are now traded annually (Dulvy, *et al.*, 2014 at 2 (citations omitted)). Though a mature giant manta rays can yield up to 7 kilograms of dried gill plates, which can retail for as much as $680 per kilogram in China, the traded gill plates may come from the generally smaller reef manta rays and often do not come from mature individuals (*see, e.g.,* Dulvy, *et al.*, 2014 at 2 (citations omitted); Heinrichs, *et al.*, 2011 at 4; CoP16-Prop-46 at 7 (95% of giant manta ray individuals landed in Sri Lanka are immature) (citation omitted)). As a result, the Manta Ray gill plate trade appears to rely on the killing of more than 4,500 Manta Rays per year (*see* Dulvy, *et al.*, 2014 at 2 (citations omitted)). This is shocking given that Manta Ray populations are

[40] These gill plates, also often referred to as gill rakers, are the prebranchial appendages that Manta Rays use to filter planktonic food from the water (CoP16-Prop-46 at 3). This Petition will use these two terms interchangeably as the various source material uses both terms.
[41] They have also been promoted as a cure for a wide variety of ailments including chicken pox and cancer (*see* Heinrichs, *et al.*, 2011 at 4; CMS, 2014 at 5; CoP16-Prop-46 at 8).

typically very small with by far the largest being estimated at only 5,000 individuals (*see* CoP16-Prop-46 at 23). Therefore, annual Manta Ray harvest for the gill plate trade alone may now eclipse, or nearly eclipse, the number of Manta Rays in the *largest* of the very few identified populations.

The international character of the demand for Manta Ray gill plates is made clear by the fact that "[t]here is no documented domestic use of [Manta Ray] gill plates in the three largest [Manta Ray] fishing range States (Indonesia, Sri Lanka and India)." (CoP16-Prop-46 at 10 (citations omitted)). The gill plates, and other high value products, are instead exported for processing elsewhere (CoP16-Prop-46 at 10 (citations omitted)).[42] According to the IUCN, the rising demand for gill plates is "seriously threatening the survival" of Manta Rays (IUCN, 2013 at 1).

While the market for gill plates is largely driving fishing pressure (*see, e.g.,* Heinrichs, *et al.*, 2011 at 16; Dulvy, *et al.*, 2014 at 2; Stevens, 2011 at 8), Manta Ray meat is often sold as food, sold as animal feed, used as shark bait or attractant in Mexico, exported, or simply discarded (*see* CoP16-Prop-46 at 3, 10 (citations omitted); Marshall, *et al.*, 2011 – 1 at 9). The Manta Rays' livers are sold for medicine; their cartilage is traded internationally for use in nutritional supplements or as a cheap substitute for, or filler in, shark fin soup; and their skins are traded internationally for use in leather products (*see* CoP16-Prop-46 at 3, 10 (citations omitted); Marshall, *et al.*, 2011 – 1 at 9; Heinrichs, *et al.*, 2011 at 16, 34; Deakos, *et al.*, 2011 at 246 (citations omitted)). These "[s]econdary markets . . . , as well as traditional hunts, also play an important role in the perpetuation of some fisheries." (Heinrichs, *et al.*, 2011 at 16). However, "[a]nalysis reveals that without the gill plate trade, income from directed fisheries for manta and mobula rays may not even cover the cost of fuel in many range states." (Heinrichs, *et al.*, 2011 at 16).

While even the documented number of Manta Ray landings would likely be unsustainable, the vast majority of catch and international trade in Manta Rays is unregulated and unmonitored (CoP16-Prop-46 at 11; CMS, 2014 at 5; Heinrichs, *et al.*, 2011 at 4, 18). Taking IUU fishing and subsistence fisheries into account would drive the total number of Manta Rays taken per year much higher. "For example, there are numerous anecdotal reports of large numbers of mobulas landed in parts of Mexico, despite laws prohibiting their harvest and no available landings data." (Heinrichs, *et al.*, 2011 at 18 (citation omitted); *see also* NMFS, 2013 at 66-69). In addition, catch records "cannot be quantified fully, due to a lack of species and product-specific codes, catch, landings, and trade data." (CoP16-Prop-46 at 10).

Rays are among the most susceptible marine taxa to fisheries exploitation, and Manta Rays, as the largest rays, are especially vulnerable to overexploitation, extirpation, and extinction (Deakos, *et al.*, 2011 at 245-46; *see also* Section IV. E. 4. "K-Selected," *infra*). As a result, it is unsurprising that this overfishing has resulted in Manta Ray declines across known aggregation sites (Heinrichs, *et al.*, 2011 at 14). "Regional [reef manta ray] subpopulations appear to be small and localized declines are unlikely to be mitigated by immigration, because of large geographic distance between most of these small, isolated populations that is greater than the maximum distance travelled observed in satellite

[42] Landings from China (South China Sea) are not exported for processing (CoP16-Prop-46 at 10; Heinrichs, *et al.*, 2011 at 34). They are instead processed in a Chinese shark processing facility that sells gill plates directly to buyers in Guangdong (CoP16-Prop-46 at 10 (citation omitted); Heinrichs, *et al.*, 2011 at 34). At this plant, "the meat is ground up for fishmeal and the cartilage is processed to make chondroitin sulfate supplements." (CoP16-Prop-46 at 10; *see also* Heinrichs, *et al.*, 2011 at 34). At least 100 Manta Rays are processed here annually (Heinrichs, *et al.*, 2011 at 34).

tagging studies." (CoP16-Prop-46 at 9 (citations omitted)). "Other more mobile rays that cross open ocean, like *M. birostris*, can also be vulnerable to multiple fisheries – as both targets and bycatch – in the high seas between their aggregation sites." (Heinrichs, *et al.*, 2011 at 14 (citation omitted)). This is particularly concerning given that Manta Ray populations are generally very small (generally 50-350 individuals) with only the two largest populations estimated as exceeding 1,000 individuals (*see* Section III. G. "Population Trend," *supra*). These factors, and the fact that all utilization and trade of Manta Rays comes from wild caught animals, indicates that their exploitation is unsustainable (*see* CoP16-Prop-46 at 10). As a result of this unsustainable exploitation, fishermen, traders and retailers indicate that Manta Ray gill plates are becoming harder to source and that prices are escalating as the supply continues to dwindle (Heinrichs, *et al.*, 2011 at 14).

The relationship of these Manta Ray fisheries to the fisheries that have been decimating shark populations over the past several decades is clear (*see* Heinrichs, *et al.*, 2011 at 16). For instance, as shark populations have continued to decline, fishermen are now using cartilage derived from Manta Rays as a cheap substitute for, or filler in, shark fin soup and as a cheap substitute for shark cartilage in nutritional supplements (*see* Deakos, *et al.*, 2011 at 246 (citations omitted); Heinrichs, *et al.*, 2011 at 16, 34; CoP16-Prop-46 at 10 (citations omitted)). In addition, "[e]stablished shark fin trade networks have exploited the opportunity to profit from gill rakers, especially as shark populations have declined." (Heinrichs, *et al.*, 2011 at 4). In fact, "shark population declines . . . have boosted mobulid fisheries . . ." (Heinrichs, *et al.*, 2011 at 16). In addition, "[t]here are also recent reports of mantas being 'gilled' (gills removed and the carcasses discarded) at sea." (CMS, 2014 at 2; *see also* CoP16-Prop-46 at 10 (citation omitted)). This shows the influence that shark fishing and finning practices are having on Manta Ray fishermen and shows that the unsustainable practices that have been crippling shark populations worldwide (overfishing, finning, etc.) are quickly being adopted by the unsustainable Manta Ray fisheries. This trend of shark fishermen adapting to shark losses by increasingly targeting Manta Rays can be expected to continue as sharks, and subsequently Manta Rays, continue to be increasingly overexploited and suffer population declines.

Species-specific commercial overutilization data is provided where possible, though the ongoing differentiation in the *Manta* genus necessitates general treatment in many cases (*see, e.g.,* Heinrichs, *et al.*, 2011 at 18; Section III. B. "Taxonomy," *supra*; Section III. D. "Habitat and Range," *supra*).

a. Directed Fishing

Manta Rays are subjected to significant fishing pressure throughout their global warm water range in the Atlantic, Pacific, and Indian Oceans and throughout their key range states in both commercial and artisanal fisheries (*see* CoP16-Prop-46 at 3; Heinrichs, *et al.*, 2011 at 4, 16; CMS, 2014 at 5-7). "Historically, subsistence fishing for [Manta Rays] occurred in isolated locations with simple gear, restricting the distance and time fishers could travel to hunt. In recent years, however, fishers have begun targeting [Manta Rays] with modern fishing gear while expanding fishing range and season." (Heinrichs, *et al.*, 2011 at 16; CMS, 2014 at 6 (citations omitted); CoP16-Prop-46 at 9 (citations omitted)). These species are currently killed or captured by a variety of gears including harpooning, netting, and trawling (Marshall, *et al.*, 2011 – 1 at 10; *see also* CoP16-Prop-46 at 8 (citations omitted)). Manta Rays "are easy to target because of their large size, slow swimming speed, aggregative [behavior], predictable habitat use, and lack of human avoidance." (Marshall, *et al.*, 2011 – 1 at 10; *see also* CoP16-Prop-46 at 8). "Of particular concern is the exploitation of this species from within critical habitats, well-known aggregation sites, and migratory pathways, where numerous individuals can be targeted with relatively high catch-per-unit-effort." (CoP16-Prop-46 at 9 (citations omitted)).

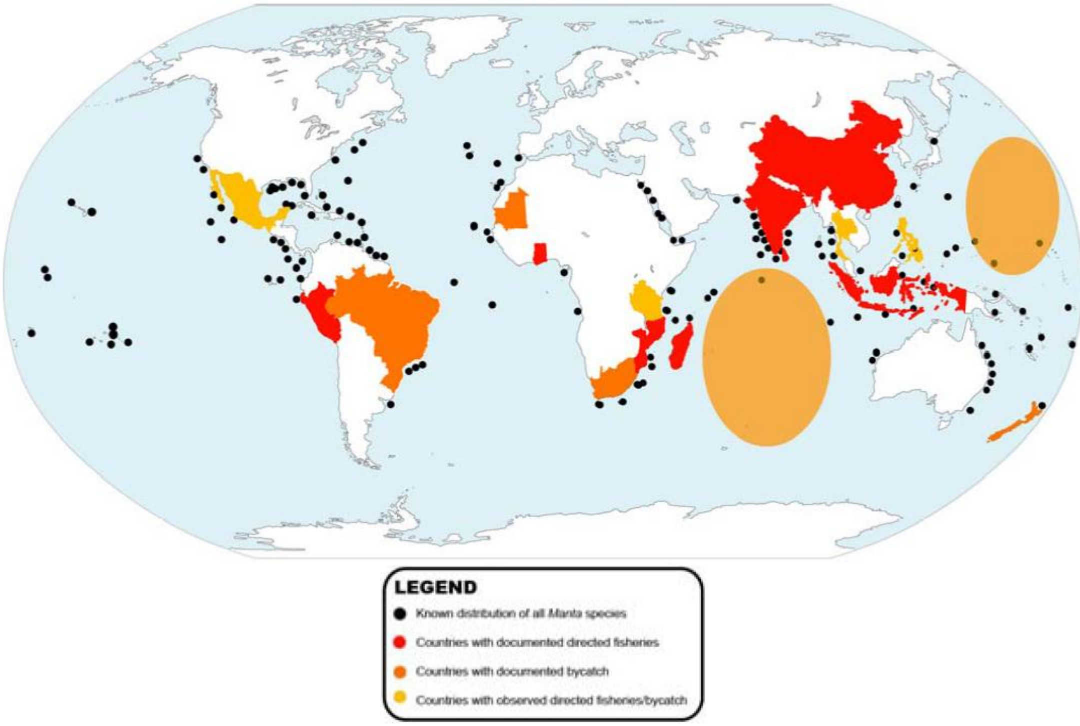

Figure 33. Manta Ray fisheries map (CoP16-Prop-46 at 29).

> When manta rays are spotted in [Lamakera, Indonesia],[43] villagers go out en-masse, aided by mobile phones to facilitate communications on the locations of the sightings. As soon as a boat gets into range of a manta, a crewmember plunges a steel, barbed spearhead attached to a long bamboo shaft into the manta ray's back. A rope is connected to the barbed spearhead, which releases from the shaft and line is given out for the manta ray to run . . . [After the manta ray tires, t]hey insert long knives into the head region and then push a long metal rod into the brain or heart to kill the animal. The body is secured with ropes and gaffs and the entire crew hauls the manta ray onboard, where they cut off the pectoral fins, remove the gills and cut off the head.

(Heinrichs, 2011, at 33). This process is likely similar in other directed Manta Ray fisheries utilizing harpoons as well.

Currently, Sri Lanka, India, Indonesia, Peru, and China appear to have the largest targeted Manta Ray fisheries (Heinrichs, *et al.*, 2011 at 16; *see also* CMS, 2014 at 6; Heinrichs, *et al.*, 2011 at 4; CoP16-Prop-46 at 3).[44] In fact, these top 5 fisheries represent more than 95% of all known mobulid landings (Heinrichs, *et al.*, 2011 at 16). In addition to Manta Ray targeting in the top five Manta Ray fishing nations' waters, targeted fishing is also occurring in the waters of numerous other nations, including Mexico, Thailand, the Philippines, Tonga, Micronesia, and several locations in Africa,

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[43] Both giant and reef manta rays are present in these waters (*see* Figure 8, *supra*; Figure 9, *supra*), though this fishery appears to, at least primarily, target giant manta rays (*see* Heinrichs, *et al.*, 2011 at 18).

[44] Both giant and reef manta rays are present in Sri Lankan, Indian, Indonesian, and Chinese waters, but only giant manta rays are present in Peruvian waters (*see* Figure 8, *supra*; Figure 9, *supra*).

including Mozambique, Ghana, Tanzania, Madagascar, and Somalia (*see* Heinrichs, *et al.*, 2011 at 16; CoP16-Prop-46 at 9 (citation omitted); CMS, 2014 at 6 (citations omitted)).[45] However, detailed and accurate fisheries data from these locations is typically lacking. "Anecdotal evidence suggests that even more [targeted] fisheries likely exist in isolated coastal regions throughout the Atlantic and Pacific." (Heinrichs, *et al.*, 2011 at 16). In addition, the high demand for these species in international trade likely stimulate directed and opportunistic fisheries elsewhere as well (CMS, 2014 at 6).

The directed Manta Ray fisheries target these species "in what is certain to be unsustainable numbers" and have caused significant population declines in areas including Mexico, the Philippines, Indonesia, India, Sri Lanka, and other parts of Southeast Asia (*see* Marshall, *et al.*, 2011 – 1 at 5; Deakos, *et al.*, 2011 at 246; Heinrichs et al, 2011, at 16; CoP16-Prop-46 at 7 (citation omitted); *see also* Section III. G. "Population Trend," *supra*). This includes declines of 56% to 86% over six to eight years (well under one generation period) in areas with targeted fisheries (CoP16-Prop-46 at 7 (citations omitted); *see also* Section III. G. "Population Trend," *supra*). In fact, in several cases this fishing pressure has already driven Manta Ray populations to commercial extinction (*see* CMS, 2014 at 6 (citations omitted); CoP16-Prop-46 at 9 (citations omitted)), with more commercial extinctions likely in the future as a result of similar pressures.

In addition to taxonomic difficulties that complicate attribution of catch to the relevant Manta Ray species, the fisheries in Manta Ray range states are also often engaged in IUU fishing (*see* NMFS, 2013 at 66-69). Information on IUU shark fishing is more readily available than information on IUU Manta Ray fishing and can be used as a proxy for IUU Manta Ray fishing. Because both sharks and Manta Rays are subjected to similar fishing pressures (worldwide overfishing to support trade in a single body part: fins and gill plates respectively) and are often provided with the same protections (CITES Appendix II listing and/or location in MPAs), IUU shark fishing data is helpful for inferring the IUU Manta Ray fishing that is occurring in the same areas despite existing protections.[46] In addition, shark fishermen are switching their efforts to Manta Ray fishing as shark populations continue to be depleted; this further supports the applicability of IUU shark fishing information to IUU Manta Ray fishing as the same criminal actors are now targeting Manta Rays in the same areas they have always fished (*see* Heinrichs, *et al.*, 2011 at 4, 16). All references to IUU shark fishing in this Petition should thus be viewed as reliable proxy data for IUU Manta Ray fishing. The prevalence of this IUU fishing indicates that the number of Manta Rays caught and the fisheries identified in this section will necessarily be underestimates of the actual fishing pressure that these species are facing. Defenders has attempted to account for these difficulties to the extent possible in the Petition, but some data issues necessarily still remain.

i. Pacific Ocean

There is significant targeting of Manta Rays occurring in the Pacific Ocean including documented directed giant manta ray fisheries in Peru (one of the top five Manta Ray fishing nations), Ecuador,

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[45] Both giant and Caribbean manta rays are present in Mexican waters; both giant and reef manta rays are present in Thai, Filipino, and African waters; and only reef manta rays are present in Tonga and Micronesia (*see* Figure 8, *supra*; Figure 9, *supra*).

[46] Note that, because IUU fishing is occurring in spite of existing protections in the areas discussed in this Petition, this IUU fishing is also relevant to Section IV. D. "The Inadequacy of Existing Regulatory Mechanisms," *infra*.

and Mexico and reef manta ray fisheries in Tonga and Micronesia (*see* Heinrichs, *et al.*, 2011 at 16; CoP16-Prop-46 at 9 (citation omitted); CMS, 2014 at 6 (citations omitted); Marshall, *et al.*, 2011 – 1 at 11-12; Figure 8, *supra*; Figure 9, *supra*). These fisheries will be addressed in more detail in the species-specific sections below.

In addition to documented and observed fisheries, undocumented, opportunistic hunting of Manta Ray individuals also likely occurs in Pacific small island nations due to the high value of these species' gill plates (CoP16-Prop-46 at 9). 34% of all of the catch in the Western and Central Pacific is estimated to be from IUU fishing (NMFS, 2013 at 68 (citation omitted)).

> in 2007, a Taiwanese-flagged tuna boat was seized in Palau for IUU fishing and had 94 shark bodies and 650 fins onboard. In 2008, a Chinese-flagged fishing vessel was arrested by the Federated States of Micronesia . . . National Police for fishing within [its] EEZ. Based on the number of fins found onboard, there should have been a corresponding 9,000 bodies, however only 1,776 finned shark bodies were counted.

(NMFS, 2013 at 68).

> [Additionally, in 2012,] thousands of pounds of shark products were confiscated in the Marshall Islands, with the Marshall Islands Marine Resource Authority fining a Japanese tuna transshipment vessel $125,000 for having sharks on board in a designated shark sanctuary. In Palau, a Taiwanese vessel was spotted by Palau law enforcement officials fishing and finning sharks in its protected waters, and was fined $65,000 and banned from Palauan waters for a year. Unfortunately, like most of these Pacific Island countries, Palau is small, and patrolling its large oceanic territory is difficult without adequate resources. Currently, Palau has only one patrol boat to enforce fishing regulations in 604,000 [square kilometers (roughly 233,206 square miles)] of ocean waters.

(NMFS, 2013 at 69 (citations omitted)). This prevalence of IUU fishing in the Western and Central Pacific is an additional, ongoing overutilization threat to Manta Rays, especially as shark fishermen appear to be switching their efforts to targeting Manta Rays as they deplete the shark stocks that they previously relied on (*see* Heinrichs, *et al.*, 2011 at 4, 16).

1. Giant Manta Ray

Giant manta rays continue to be exploited in the Pacific Ocean. Targeted giant manta ray fisheries with significant catch exist in Peru and in the Gulf of California (*see* CoP16-Prop-46 at 3; Marshall, *et al.*, 2011 – 1 at 11). In Peru, one source estimated that the target fishery takes approximately 150 giant manta rays per year (CoP16-Prop-46 at 9). However, an NGO assessed the mobulid fisheries along the north coast of Peru in the Tumbes & Piura regions in March and September of 2011 and found higher levels of exploitation (Heinrichs, *et al.*, 2011 at 32). "One family of fishermen (one boat crewed by a father and his grown sons) directly targets *M. birostris*, while two other fishermen are said to occasionally target mantas. The family estimates annual total landings of 100 to 120 *M. birostris,* with other targeted and incidental catches estimated at 50 to 100 [giant] manta rays, for a total of 100 to 220 *M. birostris*." (Heinrichs, *et al.*, 2011 at 32). These estimates are based on limited data and interviews, so it is likely that they underestimate total catch in this region. Because other Manta Ray fishermen are likely excluded from these numbers, they should be treated as an absolute minimum estimate of catch at the time. This study explains that the interviewed family expressed a willingness to participate in future conservation programs for manta rays (Heinrichs, *et al.*, 2011 at 32). However, it does not say whether this participation was ever forthcoming or whether any of the other actors engaged in Manta Ray exploitation were also receptive to such participation. As a result, there is no evidence that exploitation of the species in these waters has decreased at present. There also appears to be a directed giant manta ray fishery in Ecuador that has been operational since the mid-1980s (*see* Marshall, *et al.*, 2011 – 1 at 11-12). In the Gulf of California, artisanal pelagic gillnet fishermen retain giant manta rays as bait and utilize landed specimens for personal consumption and sale (Marshall, *et al.*, 2011 – 1 at 11; *see also* Section III. G. 2. a. "Giant Manta Ray," *supra*). This fishery has virtually eliminated this population and the species is now considered commercially extinct in the Sea of Cortez (*see* Section III. G. 2. a. "Giant Manta Ray," *supra*).

There is evidence that Indonesia, the top shark fishing nation in the world and one of the biggest fishers of Manta Rays, undertook at least some of its IUU fishing activities in and around Australia's EEZ in the western Pacific (NMFS, 2013 at 66-67; *see also* Figure 34, *infra*; Heinrichs, *et al.*, 2011 at 16; *see also* CMS, 2014 at 6; Heinrichs, *et al.*, 2011 at 4; CoP16-Prop-46 at 3). This IUU fishing appears to be the primary cause of the dramatic giant manta ray declines that have been observed in Western Australia (CoP16-Prop-46 at 8; Heinrichs, *et al.*, 2011 at 15). However, having depleted these Australian waters, the Indonesian fishermen have since moved their efforts elsewhere (NMFS, 2013 at 67). These other waters likely include, at least in part, other areas in the western Pacific due to their relative proximity to Indonesia and Indonesia's history of targeting this area of the Pacific. It is also likely that Indonesia will resume its extensive IUU fishing of already-fished areas if stocks improve (*see* NMFS, 2013 at 67 (indicating that decrease in IUU fishing is related to decrease in available fish) (citation omitted); Heinrichs, *et al.*, 2011 at 15 (indicating that decline of Manta Rays on Australia's west coast is likely due to Indonesian fishermen targeting these species)).

High levels of IUU fishing have also been reported in the Eastern Pacific off the coasts of Central and South America, an area inhabited by giant manta rays (*see* NMFS, 2013 at 69; Figure 8, *supra*; Figure 9, *supra*).

> In the [Eastern Tropical Pacific], there is evidence of illegal fishing by both local fisherman and industrial longliners within many of the marine protected areas. For example, in Cocos Island National Park, off Costa Rica, a "no take" zone was established in 1992, yet populations of [scalloped hammerheads][47] continued to decline by an estimated 71% from 1992-2004.[48] In Ecuador, concern over illegal fishing around the Galapagos Islands prompted a 2004 ban on the exportation of [shark] fins but only resulted in the establishment of new illegal trade routes and continued exploitation of . . . sharks. In 2007, a sting operation by the Ecuadorian Environmental Police and the Sea Shepherd Conservation Society resulted in a seizure of 19,018 shark fins that were being smuggled over the border on buses from Ecuador to Peru. The fins were believed to come from protected sharks in the Galapagos Islands.[49] More

[47] Note that the scalloped hammerhead is also listed under CITES Appendix II (*see* CoP16-Prop-43).
[48] Giant manta rays also declined by 89% in this MPA over this time period (*see* White, *et al.*, 2015 at 9; Section IV. D. 2. c. "Costa Rica," *infra*). "These declines likely stem from the multination fisheries in the eastern tropical Pacific . . ." (White, *et al.*, 2015 at 10 (citation omitted)).
[49] NMFS should consider this illegal trade when assessing the adequacy of Ecuador's Manta Ray protections (*see* Section IV. D. 1. C. "Ecuador," *infra*).

> recently, in November 2011, Colombian environmental authorities reported a large shark massacre in the Malpelo wildlife sanctuary . . . The divers counted a total of 10 illegal Costa Rican trawler boats in the wildlife sanctuary and estimated that as many as 2,000 sharks may have been killed for their fins.

(NMFS, 2013 at 69). Again, the prevalence of IUU fishing in this area of the giant manta ray's habitat (*see* Figure 8, *supra*; Figure 9, *supra*), in addition to substantial reported, legal catch, exacerbates the overutilization threat to the giant manta ray in the Eastern Pacific Ocean. This is especially true as shark fishermen are becoming increasingly reliant on Manta Ray fishing as shark populations continue to plummet (*see* Heinrichs, *et al.*, 2011 at 4, 16). Therefore, directed fisheries are a significant threat to giant manta rays in the Pacific Ocean.

2. Reef Manta Ray

There appear to be no reef manta ray records, historical or current, from the west coasts of the United States and Central and South America (*see* CoP16-Prop-46 at 20). However, there are several small reef manta ray populations on Pacific islands (*see* CoP16-Prop-46 at 20; Figure 8, *supra*; Figure 9, *supra*). "Local fishermen are known to opportunistically target animals belonging to [these] small *M. alfredi* populations around islands throughout the western and central Pacific." (Heinrichs, *et al.*, 2011 at 18). For example, opportunistic reef manta ray hunting was recently reported from the islands of Tonga and Micronesia (*see* CoP16-Prop-46 at 9 (citation omitted); CMS, 2014 at 6 (citations omitted)). "Because of their isolation and low numbers, these local populations of *M. alfredi* are extremely vulnerable to any fishing pressure." (Heinrichs, *et al.*, 2011 at 18; *see also* CoP16-Prop-46 at 9; CMS, 2014 at 6). Sightings of Manta Rays[50] in the small Okinawa Island, Japan population fell by more than 70% in just 17 years (CoP16-Prop-46 at 7 (citation omitted)). While the cause of this decline is unclear, fishing for the species is likely the most plausible explanation. Small, island-associated populations represent the species' entire Pacific Ocean range, and ongoing targeting will cause localized extirpations with little hope of recolonization. Therefore, directed fisheries of any size are an exceptional threat to reef manta rays in the Pacific.

ii. Indo-Pacific

Indonesia is the country with the largest reported Manta Ray landings in the world (*see* CoP16-Prop-46 at 3; Heinrichs, *et al.*, 2011 at 33). Directed Manta Ray and mobula fisheries exist in Lombok, Lamakera, Lamalera, other villages in Alor, Cilicap, Kedonganan, and perhaps in many other areas (*see* Heinrichs, *et al.*, 2011 at 33; CoP16-Prop-46 at 9 (citations omitted); CMS, 2014 at 6 (citations omitted)). With the birth of a market for Manta Ray gill rakers, fisheries in Indonesia transitioned from bycatch fisheries to directed fisheries (Marshall, *et al.*, 2011 – 1 at 10). Now most fisheries are targeted, having arisen or greatly increased in the last decade (CoP16-Prop-46 at 9). When motorized boats replaced traditional dugout canoes in Lamakera, Manta Ray catch rates increased by an order of magnitude above historic levels (CoP16-Prop-46 at 9 (citation omitted); CMS, 2014 at 6 (citation omitted)). This trend is likely similar in all other areas that have improved their fishing gear in this way.

The Indonesian fisheries appear to primarily catch giant manta rays (though reef manta rays are also present in the catch) with fisheries in Lamakera and Lombok apparently landing only giant manta

[50] Almost certainly reef manta rays based on location (*see* Figure 8, *supra*; Figure 9, *supra*).

rays (*see* Marshall, *et al.*, 2011 – 1 at 10; Heinrichs, *et al.*, 2011 at 18, 33). Mobulid rays are also targeted in large trap nets set in important migratory channels in areas including the Tangkoko Nature Reserve in the Manado region of North Sulawesi, Indonesia (*see* Marshall, *et al.*, 2011 – 2 at 10 (citation omitted); White, *et al.*, 2006 at 8). From March 1996 to February 1997 the fishery in Tangkoko caught a reported 1,424 Manta Rays (species unclear) (Marshall, *et al.*, 2011 – 2 at 10; *see* White, *et al.*, 2006 at 8). While this practice was briefly banned, "it started back up illegally in late 1997 and fishing efforts have moved to new unmonitored locations." (Marshall, *et al.*, 2011 – 2 at 10-11; *see also* White, *et al.*, 2006 at 8). Indigenous villagers in East Flores and Lembata, Indonesia indicate that their Manta Ray catch went from a high of 360 individuals in 1969 to 0 in 1996 (Marshall, *et al.*, 2011 – 2 at 7). They blame foreign commercial fishing vessels for this seeming fishery collapse (*see* Marshall, *et al.*, 2011 – 2 at 7). Declines caused by fishing have also been observed by divers in Kalimantan, Indonesia (CoP16-Prop-46 at 8 (citations omitted)).

China is also thought to target significant number of Manta Rays in the South China Sea, but there is only limited data available from this fishery (*see* CoP16-Prop-46 at 3, 27 (citation omitted)). One study estimates that these landings are approximately 100 Manta Rays (species unclear) per year (*see* CoP16-Prop-46 at 9 (citation omitted)). However, this study is based on information from a single processing plant and thus likely underestimates China's actual Manta Ray catch (*see* CoP16-Prop-46 at 27).

In addition to known and/or reported catch, the Indo-Pacific is also subjected to rampant IUU catch. In particular, Indonesia, which is one of the largest Manta Ray fishing nations in the world (*see* Heinrichs, *et al.*, 2011 at 16; *see also* CMS, 2014 at 6; Heinrichs, *et al.*, 2011 at 4; CoP16-Prop-46 at 3), fishes extensively in these waters (NMFS, 2013 at 66). "In fact, Indonesian small-scale fisheries, which account for around 90% of the total fisheries production [in the Indian Ocean], are not required to have fishing permits . . ." (NMFS, 2013 at 66 (internal citations omitted)). Indonesian vessels also likely lack refrigeration, increasing the incentive to gill Manta Rays caught by those ships (*see* NMFS, 2013 at 66 (citation omitted) (lack of refrigeration encourages shark finning); CMS, 2014 at 2 (gilling has been reported); *see also* CoP16-Prop-46 at 3 (gilling has been reported) (citations omitted)).

As a result of the fishermen's lack of oversight, much, likely at least 44%, of their shark fishing effort in this region remains unreported (NMFS, 2013 at 66). In fact, in early October 2015, the Indonesian government seized 3,000 oceanic whitetip shark fins from Soekarno-Hatta Airport in Indonesia that were destined for the Hong Kong fin markets (SCMP, 2015 at 1). These oceanic whitetip sharks were all caught around Java Island, Indonesia and their fins were worth one billion Indonesian rupiah, and several times that once they reach Hong Kong (SCMP, 2015 at 1). The oceanic whitetip shark, like the Manta Rays, is listed under Appendix II of CITES (*see* CoP16-Prop-42). This massive illegal shark catch from Indonesian waters offers further proof that significant illegal fishing is occurring here despite attempts at international protection and other protective efforts and, by extension, offers further support for the proposition that IUU fishing will continue to be a threat to Manta Rays in the Indo-Pacific as long as a market for their gill plates exists. The article reporting the illegal oceanic whitetip fin seizure explains, "[e]fforts to crack down on the illegal trade have been hampered by weak law enforcement and a failure to offer poor fishermen alternative ways of earning a living." (SCMP, 2015 at 2). These weaknesses are equally applicable to IUU Manta Ray fishing.

Unsustainable fishing practices have been forcing Indonesian fishermen to continually seek areas that have not yet been depleted in this region before moving on when the fishery inevitably declines there (NMFS, 2013 at 66). As discussed previously, Manta Ray fisheries have also been driven in part by the collapse in shark populations, driving fishermen to increasingly target Manta Rays (CoP16-Prop-46 at 9 (citation omitted); CMS, 2014 at 6 (citation omitted)). As shark populations continue to decline in these areas and continue to crash in new areas, targeting of Manta Rays and retention of bycaught individuals should be expected to increase as well, dooming them to the same fate as the decimated shark populations (*see* Heinrichs, *et al.*, 2011 at 4, 16). This is already apparent in the fact that population declines in this region have caused fishermen to travel farther away to find Manta Rays to kill (Marshall, *et al.*, 2011 – 2 at 7 (citation omitted)).

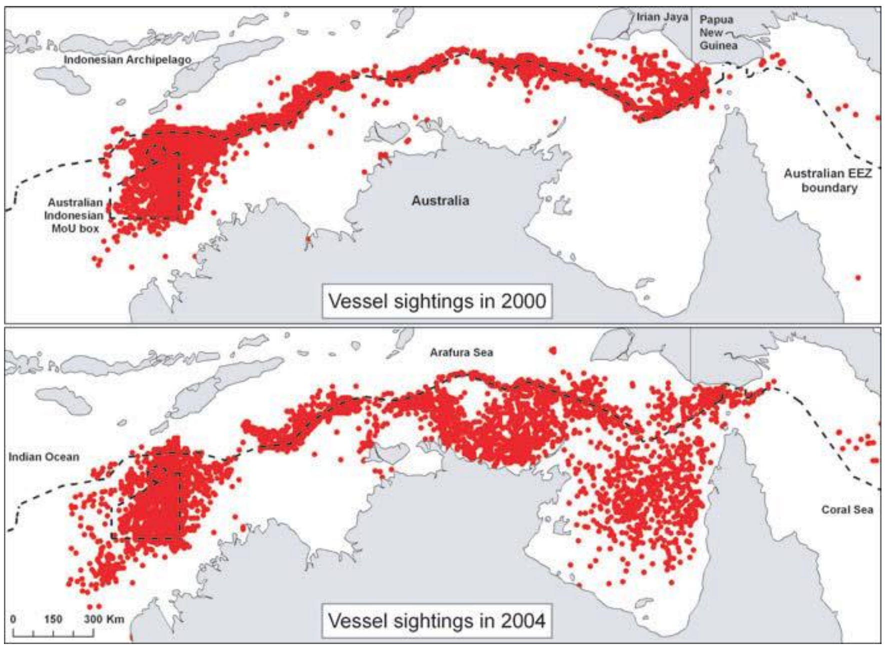

Figure 34. Sightings of IUU fishing vessels bordering and within the Australian EEZ in 2000 and 2004 in the Indo-Pacific and western Pacific (NMFS, 2013 at 67 (citation omitted)).

The unreliability of the catch records throughout the Indo-Pacific and the apparent ongoing catch of Manta Rays even where that practice has been made illegal in these waters indicate that the IUU catch of Manta Rays is a serious threat in the Indo-Pacific. This IUU catch not only harms these species, but will also hamper any monitoring or conservation efforts that are proposed in these waters. As such, IUU catch multiplies the difficulties associated with known and/or reported catch.

1. Giant Manta Ray

As discussed in Section IV. B. 1. a. ii. "Indo-Pacific," *supra*, much of the Indonesian fisheries' catch is composed of giant manta rays with some of these fisheries seemingly landing only giant manta rays (*see also* White, *et al.*, 2006 at 8 (Lamakera has shifted from catching whales to targeting mobulid rays with the most abundant mobulid ray caught being the giant manta ray); Heinrichs, *et al.*, 2011 at 18). The available Indonesian decline statistics are in spite of increased fishing effort in the Indonesian fisheries, indicating that declines are even higher than these fisheries statistics would suggest (*see* Section III. G. 3. "Indo-Pacific," *supra*).

> Lamakera's annual catch for 2010 based on all sources interviewed was 660 manta rays (*M. birostris*) and 330 mobula rays (*M. tarapacana*), for a combined catch of 990 mobulids. The catch trend appears to have declined significantly since [2002 catch] estimates of 1,050 to 2,400 manta rays landed each year, a strong indication that overfishing has significantly depleted manta ray populations that migrate along this corridor.

(Heinrichs, *et al.*, 2011 at 33). In fact, ongoing fishing, and consequent declines, here caused the likely commercial extinction of Lamakera's nearshore population (CoP16-Prop-46 at 7 (citations omitted)). In addition, an assessment of the Manta Ray fishery in Lombok was conducted in

> Tanjung Luar market over six visits during varying seasons in 2007, 2009, 2010 and 2011. Both fishermen and the local processing facility reported that manta and mobula ray catches had declined dramatically in recent years and that the average manta ray size was now less than half of what it used to be. Based on these surveys, approximately 300 manta rays (*M. birostris*) and 1,000 mobula rays (various species) are landed annually in this port. A survey conducted in Tanjung Luar from 2001 to 2005 reported landings of ~ 1,600 mobulids per year and sales of adult manta rays from 4.4 [meters] to 4.8 [meters disc width], confirming the fishermen's reports of decreases in both numbers and size of manta rays landed over the past few years. Fishermen and processors indicated that the gills were the primary value, with manta gills more valuable than the smaller mobula gills. Trade routes point to Chinese buyers in Surabaya and Jakarta. The rest of the animal is of nominal value and without the gill raker revenue, the income from meat and skin sales would not even cover the fuel expended to hunt these animals.

(Heinrichs, *et al.*, 2011 at 33; *see also* CoP16-Prop-46 at 8 (indicating smaller Manta Rays and increased targeting in Lombok) (citations omitted)). Surveys of giant manta ray landings in Lombok, Indonesia "from 2007 to 2012 estimated annual landings of 143 *M. birostris*, compared with 331 during 2001-2005 surveys (57% decline in 6-7 years)." (CoP16-Prop-46 at 8 (citations omitted)). This confirmed fishermen's reports of decreases in both numbers and size of Manta Rays over the preceding years (*see* Heinrichs, *et al.*, 2011 at 33; *see also* CoP16-Prop-46 at 8 (indicating smaller Manta Rays and increased targeting in Lombok) (citations omitted)). "Fishermen and processors [in Lombok] indicated that the gills were the primary value, with manta gills more valuable than the smaller mobula gills. Trade routes point to Chinese buyers in Surabaya and Jakarta. The rest of the animal is of nominal value and without the gill raker revenue, the income from meat and skin sales would not even cover the fuel expended to hunt these animals." (Heinrichs, *et al.*, 2011 at 33). Additionally, part of Indonesia's Manta Ray landings come from its drift gillnet fishery where Manta Rays are a common part of the catch (Marshall, *et al.*, 2011 – 1 at 10). Giant manta rays from four sites that are part of the drift gillnet fishery made up 13.7% of the 544 ton biomass of mobulid rays in this catch (Marshall, *et al.*, 2011 – 1 at 10). Though no trend information is provided, this large catch is almost certainly unsustainable and will thus be driving population declines.

The available data indicates that targeted fishing is seriously threatening giant manta rays in Indonesia and has already caused massive population declines there (*see* Section III. G. 3.

Indo-Pacific, *supra*). While profit from the gill plate trade is the primary motivator of this giant manta ray targeting, tradition also plays a role in the exploitation of Manta Rays (Heinrichs, *et al.*, 2011 at 33). "The excitement of the hunt and of returning with a large conquered sea animal was evident in recent investigations. The advent of the gill raker trade, however, transformed this fishery from a small-scale artisanal practice to a large-scale commercial enterprise." (Heinrichs, *et al.*, 2011 at 33). The growth of this fishery and the profits and enjoyment that these fishermen experience indicate that this practice is likely to continue without outside involvement. This is no longer an artisanal practice, and the threats that the United States recognized when it supported CITES listing of these species have only continued to grow as Manta Ray fishing continues to become an even more commercialized trade activity. This Indonesian overfishing appears to be having regional, as well as the obvious local, effects as dramatic giant manta ray declines in Western Australia are blamed on pressure from Indonesian fishermen (*see* CoP16-Prop-46 at 8).

There is also a targeted giant manta ray fishery in the Philippines, even though it is now legally prohibited (*see* CoP16-Prop-46 at 9 (citation omitted); CMS, 2014 at 6 (citation omitted)). Pamilacan Island in the Bohol Sea has a long history of hunting Manta Rays (likely all giant manta rays (*see* Figure 8, *supra*; Figure 9, *supra*; Heinrichs, *et al.*, 2011 at 34; *see also generally* Verdote & Ponzo, 2014 (indicating that reef manta rays are present, but comparatively quite rare, in the Bohol Sea, with the first specimens reported in 2014))).

> Following the passage of a ban on catching dolphins and whales in late 1992, whaling communities in the Bohol Sea area shifted more of their efforts to whale sharks and manta rays, and in 1998 twenty six villages were involved in manta and mobula ray fisheries. During the 1995-6 season, 1,000 manta and mobula rays were landed. Interviews with fishermen during a 1996 survey revealed that manta ray catches had declined by 50% over the past 30 years.
>
> Today the ban on catching and selling of manta rays is still in place, but enforcement varies and the cultural practice of eating manta ray meat persists in some areas. Traders in Hong Kong continue to report the Philippines as a supplier of dried gill rakers, indicating that an active gill raker trade may still continue in the Philippines.

(Heinrichs, *et al.*, 2011 at 34). This indicates an ongoing threat to the species in the Philippines as well.

2. Reef Manta Ray

Several Indonesian fisheries target reef manta rays (either as their primary Manta Ray target or in addition to targeting giant manta rays) (*see* Section IV. B. 1. a. ii. "Indo-Pacific," *supra*). In addition to these aforementioned fisheries,

> Directed fisheries for manta rays [also] exist in the Alor region of eastern Indonesia. A study of this fishery in 2002 (during the fishing season from May-October) revealed that the traditional whale shark[51] fishery had shifted its focus to manta rays (predominately Reef Manta Ray), which were being harvested for trade to Asian

[51] Note that the whale shark is listed under CITES Appendix II as well (*see* CoP12-Prop-35).

> markets, specifically Hong Kong. Estimated annual catch was thought to be 1,500 individuals (range 1,050–2,400 mantas). This was a considerable increase from the traditional 200–300 manta rays taken annually in historical fisheries in the area.

(Marshall, *et al.*, 2011 – 2 at 11 (citation omitted)). Furthermore, while the Lamakera fishery has been characterized as landing only giant manta rays (*see, e.g.,* Heinrichs, *et al.*, 2011 at 33), "[l]ocal dive operators and park rangers in Komodo National Park, near Lamakera, also report a decline in abundance of [reef manta rays] in the park." (CoP16-Prop-46 at 8 (citation omitted)). This indicates that this fishery is likely removing reef manta rays in addition to the recorded removals of giant manta rays. Finally, there is also a Filipino reef manta ray fishery operating in the Sulu Sea (*see* Figure 19, *supra*; Figure 8, *supra*; Figure 9, *supra*). This fishery caused a 50-67% decline in the reef manta ray population there over a mere 7 year period (*see* Section III. G. 3. "Indo-Pacific," *supra*).

iii. Indian Ocean

The Indian Ocean is home to many nations with directed Manta Ray fisheries. In fact, two of the three countries with the largest Manta Ray landings (Sri Lanka and India) are in the Indian Ocean and the third (Indonesia) is in the Indo-Pacific (*see* CoP16-Prop-46 at 3). While Sri Lanka appears to primarily target giant manta rays, the nation may be forced to switch species and begin targeting reef manta rays as giant manta ray populations plummet (*see* Heinrichs, *et al.*, 2011 at 32 (giant manta ray targeting, including heavy targeting of immature individuals, and population declines in Sri Lanka); CoP16-Prop-46 at 9 (citation omitted)). India has the world's second largest elasmobranch fishery (Heinrichs, *et al.*, 2011 at 32 (citation omitted)). This fishery alone has reported landings of 70,000 tons of elasmobranchs per year, which represents 10% of the entire global elasmobranch catch (Heinrichs, *et al.*, 2011 at 32 (citation omitted)). The extent of mobulid landings from this fishery is unclear, but sources indicate significant (approximately 690 reported Manta Ray individuals per year) Manta Ray landings from the Indian coastal trawl, gillnet, and longline fisheries (*see* Heinrichs, *et al.*, 2011 at 32; CoP16-Prop-46 at 9 (citation omitted)). "Given the vast size of the Indian trawl and gillnet fleets targeting sharks, skates and rays, and limited fisheries oversight, the landings of mobulids in these fisheries may be significantly underreported." (Heinrichs, *et al.*, 2011 at 32). With at least one reef manta ray population present off the west coast of India and several others in the Indian Ocean, reef manta rays likely account for some of this catch (*see* CoP16-Prop-46 at 20). Furthermore, Manta Ray fishing occurs in Madagascar and scuba divers and fishermen have reported a large decline in Manta Ray[52] sightings there over the past 10 years (*see* CoP16-Prop-46 at 8, 25 (citations omitted); Heinrichs, *et al.*, 2011 at 16).

In addition to this data, IUU fishing in the Indian Ocean increases this overutilization threat.

> In 2008, off the coast of Africa, a Namibian-flagged fishing vessel was found fishing illegally in Mozambican waters, with 43 [metric tons] of sharks and 4 [metric tons] of shark fins onboard. In 2009, a Taiwanese-flagged fishing trawler was found operating illegally in the South Africa EEZ with 1.6 [metric tons] of shark fins onboard without the corresponding carcasses. Also in 2009, 250 trawlers were found to be poaching sharks in coastal areas in the Bay of Bengal with the purpose of smuggling the sharks to Myanmar and Bangkok by sea. There are also reports of traders exploiting shark

[52] Both giant and reef manta rays exist off the coast of Madagascar (*see* Figure 8, *supra*; Figure 9, *supra*).

> populations in the Arabian Gulf due to the lack of United Arab Emirates enforcement of finning regulations.
>
> In Somalia, it is estimated that around 700 foreign-owned vessels are operating in Somali waters without proper licenses, and participating in unregulated fishing for highly-valued species like sharks, tunas, and lobsters.

(NMFS, 2013 at 68 (citation omitted)). Ultimately IUU fishing accounts for *32% of all catch in the Indian Ocean* (NMFS, 2013 at 68 (citation omitted)). As a result, unsustainable practices are occurring virtually unchecked in the Indian Ocean. In addition, as shark populations continue to decline, increasing effort will be transferred to fishing for Manta Rays and their declines will continue to intensify.

1. Giant Manta Ray

Sri Lanka alone lands an estimated 1,055 giant manta rays per year (Heinrichs, *et al.*, 2011 at 32; CoP16-Prop-46 at 9 (citation omitted)).[53] This unsustainable targeting makes Sri Lanka responsible for 55% of known *global* Manta Ray and mobula landings per year (Heinrichs, *et al.*, 2011 at 32). This is particularly problematic because, whereas the majority of identified populations are composed of mature Manta Rays, the giant manta ray landings in Sri Lanka consist of 95% immature individuals, thus further decreasing the fishery's sustainability (CoP16-Prop-46 at 7 (citation omitted)). This high catch rate of juveniles indicates that there appears to be a nearshore giant manta ray nursery area off the coast of Sri Lanka (Heinrichs, *et al.*, 2011 at 32). "It is extremely rare to observe juvenile *M. birostris* in the wild, and if this area is indeed an important aggregation site for juvenile *M. birostris*, it would be the first of its kind reported anywhere in the world." (Heinrichs, *et al.*, 2011 at 32). This high catch rate of immature individuals of a K-selected species means that population collapse and extirpation are imminent. This is supported by the fact that fishermen have reported declining catch in Sri Lanka over the past three to ten years as targeted fishing pressure has increased (CoP16-Prop-46 at 8 (citations omitted); Heinrichs, *et al.*, 2011 at 32).

The observed declines in Sri Lanka coincide with the increase in the gill plate trade over this period, and it is clear that the gill plate trade is driving overexploitation there (Heinrichs, *et al.*, 2011 at 32).

> Historically in Sri Lanka, mobulid rays were caught primarily as by-catch or were avoided altogether by the fishermen, due to their propensity to destroy or entangle fishing nets and because their meat is hard to keep fresh for long periods at sea. While the middlemen in the mobulid supply chain still take the bulk of local profits, recent massive increases in gill raker demand, and dwindling supplies of other more desirable catches (such as sharks, tuna and billfish), now give fishermen ample incentive to actively target mobulids.

(Heinrichs, *et al.*, 2011 at 32). This makes it clear that the gill plate trade has fundamentally changed Sri Lankan fishermen's interactions with Manta Rays and has vastly increased their overutilization in these waters in a very short period of time.

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[53] While assessment of Manta Ray landing data has often been complicated by the recent division of the genus, no reef manta rays have been observed in investigations of this fishery (Heinrichs, *et al.*, 2011 at 18). This indicates that these landings may in fact all be giant manta rays.

In addition to the high levels of catch in Sri Lanka, its neighbor India has the world's second largest elasmobranch fishery (Heinrichs, *et al.*, 2011 at 32 (citation omitted)). However, Manta Ray landings from fisheries targeting sharks, rays, and skates in this nation appears to be highly underreported (Heinrichs, *et al.*, 2011 at 32). For example, though "well-organized harpoon fisheries for *M. birostris* [are] reported on both east and west coasts of India," there are *no* landings data available, which indicates "significant landings not accounted for in the fisheries data." (*see* Heinrichs, *et al.*, 2011 at 32). While the available fishery reports clearly are not comprehensive, they do account for a minimum of 690 giant manta rays landed per year in India (*see* Heinrichs, *et al.*, 2011 at 32; *see also* CoP16-Prop-46 at 9 (citation omitted)). This overfishing has already caused declines in at least several parts of the country (*see* Section III. G. 4. "Indian Ocean," *supra*; CoP16-Prop-46 at 8 (citations omitted)).

Thailand also has a targeted fishery for Manta Rays (CoP16-Prop-46 at 9 (citation omitted); CMS, 2014 at 6 (citation omitted)). Manta Ray fishing has sharply increased in the Similan Islands and Andaman Sea, even in Thai national marine parks, and has resulted in steep declines in Manta Ray sightings in recent years (Heinrichs, *et al.*, 2011 at 34).[54] This extensive fishing is also causing injury and disfigurement to individuals that are not successfully captured and killed as photo identification surveys indicate "a significantly higher proportion of individuals with net and line injuries [here] than anywhere else in the world, except for mainland Ecuador . . ." (Heinrichs, *et al.*, 2011 at 34). This photographic evidence strongly supports the reports of fishing causing major impacts to Manta Rays in Thailand (Heinrichs, *et al.*, 2011 at 34). While detailed fisheries data is lacking, these facts provide strong evidence of giant manta ray overfishing and consequent decline in Thailand (*see* Heinrichs, *et al.*, 2011 at 34).

Several locations in Africa also have directed Manta Ray fisheries (*see* CoP16-Prop-46 at 9 (citation omitted); CMS, 2014 at 6 (citation omitted)). While data from these fisheries and their catch of giant manta rays is limited, the fishery in Mozambique does target giant manta rays in addition to reef manta rays (*see* Marshall, *et al.*, 2011 – 1 at 11). Regardless of the current extent of giant manta ray targeting here, as the reef manta ray population in Mozambique is quickly depleted (*see* Section III. G. "Population Trend," *supra*), the fishery's switch to more targeting of giant manta rays is imminent if it is not already underway.

2. Reef Manta Ray

Reef manta ray fisheries exist in several location in Africa, "including Tanzania and Mozambique, where annual landings of ~35 *M. alfredi* are reported from less than 5% of the coastline, but fisheries are widespread." (CoP16-Prop-46 at 9 (citation omitted); *see also, e.g.,* CMS, 2014 at 6 (citation omitted)). The species is caught in artisanal fisheries in these waters, typically with harpoons, but also in nets with motorized boats (Marshall, *et al.*, 2011 – 1 at 11 (citation omitted)). The reef manta ray population in Mozambique was already reduced by 86% from 2003-2011 (*see, e.g.,* CoP16-Prop-46 at 24 (citation omitted)), indicating that the targeting of this species in these waters is unsustainable and has already caused an extensive population decline there.

> This reef manta ray population is naturally small, as demonstrated in the superpopulation estimate of 802 individuals . . ., with annual population estimates

[54] Likely giant manta rays (*see* Figure 8, *supra*).

> ranging from 149 to 454 rays between 2003 and 2007. As this species has a conservative life history strategy with a low level of recruitment, fishing pressure is likely to substantially impact this population.

(Rohner, *et al.*, 2013 at 162-63 (citations omitted)).

While Sri Lanka appears to primarily target giant manta rays, they may be forced to switch species and begin targeting reef manta rays as giant manta ray populations plummet, if such a switch has not already begun (*see* Heinrichs, *et al.*, 2011 at 32 (giant manta ray targeting, including heavy targeting of immature individuals, and population declines in Sri Lanka); CoP16-Prop-46 at 9 (citation omitted)). Finally, though much of the Indian Manta Ray fishing may be focused on giant manta rays, "[p]rior to 1998 *Manta* spp. (suspected *M. alfredi*) were landed abundantly at Kalpeni, Lakshadweep Islands in a directed harpoon fishery, but a local dive operator reports that this fishery is no longer operating and *Manta* sightings around these islands are now rare." (CoP16-Prop-46 at 8 (citations omitted)). As a result, Manta Rays may now be commercially extinct in the Lakshadweep Islands (*see* CoP16-Prop-46 at 25 (citation omitted)). These latter sources indicate that, even in nations that may focus fishing efforts on one species, here the giant manta ray, catch of other Manta Ray species in their waters are nearly inevitable where they have sympatric ranges.

iv. Atlantic Ocean

There is a seasonal targeted Manta Ray (species unclear) fishery off Dixcove, Ghana (*see* CoP16-Prop-46 at 9 (citation omitted); Marshall, *et al.*, 2011 – 1 at 11 (citation omitted); Heinrichs, *et al.*, 2011 at 34; CMS, 2014 at 6). However, there is also a year round large mesh drift gillnet fishery targeting tuna, sharks, billfish, Manta Rays (species unclear), and dolphins there, indicating that Manta Ray fishing in fact occurs year-round (Heinrichs, *et al.*, 2011 at 34). Information on targeted fishing in other West African countries is unavailable, but likely occurs due to the heavy fishing throughout these coastal areas and the poor reporting of catch in this region. In fact, *37% of the catch off the coast of West Africa* is a result of IUU fishing, the highest regional estimate of illegal fishing worldwide (NMFS, 2013 at 67 (citations omitted)). Because these species are extremely susceptible to overexploitation, this targeted fishing is likely causing population declines wherever it occurs in this region.

1. Giant Manta Ray

Because the giant manta ray often occurs in sympatry with Caribbean and reef manta rays in the Atlantic, species-specific fishing information is less clear for the species here than elsewhere in its range. However, the giant manta ray's range is allopatric with both the reef and Caribbean manta rays in Brazil (*see* Figure 8, *supra*; Figure 9, *supra*).

> In Belém, Brazil, in May 2012, the Brazilian Institute of Environmental and Renewable Natural Resources (IBAMA) seized around 7.7 [metric tons] of illegally obtained dried shark fins intended for export to China. A few months later, IBAMA confiscated more than 5 [metric tons] of illegal shark fins in Rio Grande do Norte, suggesting current regulations and enforcement are not adequate to deter or prevent illegal shark finning. In fact, it is estimated that illegal fishing constitutes 32 percent of the Southwest Atlantic region's catch (based on estimates of illegal and unreported catch averaged over the years of 2000 – 2003).

(NMFS, 2013 at 69 (internal citations omitted)). This extensive Brazilian IUU shark catch indicates that IUU giant manta ray catch is likely here as well.

2. Giant and/or Caribbean Manta Rays

Mexico is undertaking significant IUU fishing activities in the Gulf of Mexico[55] that threaten the ability of fisheries managers to provide for sustainable fisheries in the Atlantic (*see* NMFS, 2013 at 68-69 (internal citations omitted)).

> In the U.S., reports of IUU fishing by Mexico, a top shark fishing nation accounting for nearly 4.1% of the global shark catch, has been ongoing for the past decade. Since the mid-1990s, the United States Coast Guard . . . has documented Matamoros Mexican vessels illegally fishing in the area surrounding South Padre Island, Texas. The Mexican IUU fishermen use gillnet and longline gear for shark and red snapper, which are believed to be more prevalent in the U.S. EEZ off Texas than in the Mexican EEZ near Matamoros. The sharks, the majority of which are blacktips and hammerheads, are finned and the fins sold. Based on data from 2000-2005, [one study] estimated that Mexican fishermen are illegally catching anywhere from 3 to 56% of the total U.S. commercial shark quota, and between 6 and 108% of the Gulf of Mexico regional commercial quota.

(NMFS, 2013 at 68 (internal citation omitted)). Though this threat may have decreased to some degree in recent years, it is likely to continue at some level into the future. Additionally, it is likely to impact Manta Rays as they are bycaught, opportunistically targeted, or as these fishermen switch to targeting Manta Rays when their target shark species become too rare to support the fishery (*see* Heinrichs, *et al.*, 2011 at 4, 16).

In addition to this Gulf of Mexico IUU fishing, giant and/or Caribbean manta rays are also targeted in the Mexican Caribbean (*see* CoP16-Prop-46 at 9 (citations omitted); CMS, 2014 at 6 (citations omitted); Marshall, *et al.*, 2011 – 1 at 8). These fisheries appear to be largely focused on using the species' meat as shark bait and take place on the Yucatan Peninsula (*see* CoP16-Prop-46 at 9 (citations omitted); CMS, 2014 at 6 (citations omitted); Marshall, *et al.*, 2011 – 1 at 8). While this use was recently prohibited, illegal fishing still appears to be occurring in these waters (*see* CoP16-Prop-46 at 9 (citations omitted); CMS, 2014 at 6 (citations omitted); Marshall, *et al.*, 2011 – 1 at 8). Because these species are incredibly susceptible to population depletions from exploitation, and because populations here are very small (the Isla Holbox population is estimated at just 100 individuals (*see* Marshall, *et al.*, 2011 – 1 at 7 (citation omitted))), this ongoing targeting is likely driving ongoing declines in these waters.[56]

[55] The Gulf of Mexico is home to both giant and Caribbean manta rays (*see* Figure 8, *supra*; Figure 9, *supra*).

[56] It is also possible that using Manta Ray meat as shark attractant exacerbates the shark attack threat that these species face in these waters as it habituates sharks to eating Manta Rays more than they would under natural conditions (*see* Section IV. C. 1. "Shark Attacks," *infra*). Therefore, this threat may act synergistically with the shark attack threat that Manta Rays face here.

This Caribbean IUU fishing threat is also not just limited to Mexico. In fact, the ACP Fish II program (a program financed by the European Development Fund on behalf of ACP (African, Caribbean, and Pacific Group of states) countries) explained that, in the Caribbean,

> IUU fishing is one of the biggest threats to fisheries management for member states and the problem is compounded by large ocean space relative to land area, the migratory nature of some fisheries resources, and the lack of financial and technical resources for surveillance and enforcement. The extent of IUU fishing in this region is not quantified, nor is there the capacity to fully assess its extent throughout the region. However, the capacity to detect IUU fishing varies among countries.

(ACP Fish II, 2013 at 2).

The extent of IUU fishing in the Caribbean indicates that targeting and bycatch of Manta Rays there is in excess of what is expressed in the available data. The rampant IUU fishing in this region harms giant and Caribbean manta rays and will continue to do so into the future. This data indicates that both legal and IUU fishing represent serious overutilization threats to giant and Caribbean manta rays in the Atlantic Ocean.

3. Reef Manta Ray

Overfishing in the Atlantic is particularly problematic for the reef manta ray as it only has two recorded populations (both off the northwest African coast) in the entire Atlantic Ocean (*see* CoP16-Prop-46 at 20). These locations are a great distance from any other populations and recolonization following extirpation would be extremely unlikely. The scarcity of reef manta rays in the Atlantic Ocean means that even comparatively light pressure could extirpate populations with little chance of recovery or recolonization (*see* Figure 8, *supra*; Figure 9, *supra*; Section III. D. "Habitat and Range," *supra*). Therefore, the aforementioned African fisheries, both reported and IUU, are a severe threat to the species in the Atlantic (*see* CoP16-Prop-46 at 9 (citation omitted); Marshall, *et al.*, 2011 – 1 at 11 (citation omitted); Heinrichs, *et al.*, 2011 at 34; CMS, 2014 at 6; NMFS, 2013 at 67 (citations omitted)).

b. Bycatch[57]

Though many bycatch fisheries have transformed into targeted export fisheries with the advent of the gill plate trade (Heinrichs, *et al.*, 2011 at 16; CMS, 2014 at 2), Manta Rays are still extensively bycaught throughout their ranges as well (*see* Marshall, *et al.*, 2011 – 1 at 11; Marshall, *et al.*, 2011 – 2 at 11; Heinrichs, *et al.*, 2011 at 16; CoP16-Prop-46 at 3). Manta Ray bycatch occurs throughout the Atlantic, Pacific, and Indian Oceans and in myriad fisheries in those oceans (CoP16-Prop-46 at 3, 9; CMS, 2014 at 5-6). These fisheries catch Manta Rays in gillnets, longlines, trawls, and purse seines (they are also inadvertently captured in bather protections nets that are part of shark control programs) throughout their distributions (*see* Marshall, *et al.*, 2011 – 1 at 5, 11; Marshall, *et al.*, 2011 – 2 at 11; Heinrichs, *et al.*, 2011 at 16; CMS, 2014 at 7; CoP16-Prop-46 at 3, 9). Unfortunately, it also

[57] The IUU fishing information from Section IV. B. 1. a. "Directed Fishing," *supra* is incorporated here by reference rather than restated in order to avoid redundancy. NMFS should consider the effect that IUU fishing is having on the bycatch threat to the giant, reef, and Caribbean manta rays when making its listing determinations for these species.

appears that the intensive "dolphin safe tuna" conservation campaigns that were intended to reduce dolphin bycatch, increased the bycatch of Manta Rays (Heinrichs, *et al.*, 2011 at 16).

Bycatch in both coastal and international high seas fisheries poses a significant threat to these species (Heinrichs, *et al.*, 2011 at 16). However, mobulid bycatch is rarely recorded and, when recorded, is rarely classified to species (Heinrichs, *et al.*, 2011 at 16 (citations omitted)). Bycatch, if recorded at all, is instead recorded under broad categories such as "Other," "Rays," or "Batoids" (CoP16-Prop-46 at 9 (citations omitted); CMS, 2014 at 7 (citations omitted)). In fact, visual identification field guides for Manta Rays have only recently been published (CoP16-Prop-46 at 10 (citation omitted); CMS, 2014 at 7 (citation omitted)). As such, Manta Rays have generally been overlooked in most fisheries reports and the impact of bycatch on Manta Rays remains largely underestimated (*see* CoP16-Prop-46 at 10 (citations omitted); CMS, 2014 at 7 (citations omitted); Heinrichs, *et al.*, 2011 at 16 (citations omitted)).

Country/Region	Reference	Ref Year	International Trade	Annual Manta spp.	Total Mobulids
Brazil	Perez and Wahlrich 2005	2001	DD	DD	809
Mauritania	Zeeberg *et al.* 2006	2001-04	DD	DD	620
Indian Ocean	Pianet *et al* 2010	2003-08	DD	36[1]	361
New Zealand	Paulin *et al.* 1982	1975-81	DD	DD	39
South Africa	Young 2001	2001	DD	20	20
W. Central Pacific	Molony 2005	1994-04	DD	DD	1,500
Total Estimate				**56**	**3,349**

Figure 35. Estimated annual landings in several bycatch fisheries from the available catch data (expressed in number of individuals taken annually) (CoP16-Prop-46 at 27). Note that every fishery is data deficient as to international trade, and all but one is classified as data deficient as to Manta Ray bycatch. This chart therefore clearly underestimates the actual total Manta Ray bycatch (*see, e.g.,* CoP16-Prop-46 at 27-28 (noting that at least 8 countries have directed and/or bycatch fisheries for these species, but that there is little or no data from them); NMFS, 2013 at 66-69 (discussing instances and prevalence of IUU fishing throughout the world)).

The losses that these Manta Rays experience are "exacerbated by the[ir] exceptionally conservative life history . . ., which severely constrains their ability to recover from a depleted state." (CoP16-Prop-46 at 9; *see also* Section IV. E. 4. "K-Selected," *infra*). As a result, these species have undergone heavy declines with sustained pressure from bycatch and directed fishing being isolated as the main cause of those declines (CoP16-Prop-46 at 7 (citation omitted)). While bycatch retention is a major factor driving population declines, Manta Rays appear to have above-average capture survivorship where they are released. One study assessed the at-haulback condition of 14 mobulids in the Indian Ocean and 130 mobulids in the Atlantic Ocean that had been caught on longlines and found that 100% and 98.5% were alive at haulback respectively (Coelho, *et al.*, 2011 at 6). A later study assessed 145 mobulids caught in the Atlantic longline fishery and found that the survivorship number had increased slightly with this larger sample size to 98.6% alive at haulback (Coelho, *et al.*, 2012 at 314). In addition, a study assessing bycatch in a northwest African trawler fishery indicated that Manta Ray bycatch could be vastly reduced by installation of an excluder device (*see* Zeeberg, *et al.*, 2006 at 186, 194). Therefore, fishing practices can be regulated in ways that avoid retention, and bycatch in the first instance, and that would have clear benefits to Manta Rays. However, these regulations are not currently in place and bycatch thus remains a significant threat to these species.

i. Pacific Ocean

1. Giant Manta Ray

Bycatch data from the Pacific Ocean is scarce, but there is evidence of giant manta ray bycatch in Ecuador (*see* Marshall, *et al.*, 2011 – 1 at 11-12; *see also* Figure 8, *supra*; Figure 9, *supra*). This data includes the fact that Ecuador has the highest proportion of giant manta ray individuals with damage from fishing equipment of any place in the world (*see* Heinrichs, *et al.*, 2011 at 34). The source of this harm is an illegal trawl fishery for wahoo (*Acanthocybium solandri*) that occurs in a major giant manta ray aggregation area within the Machalillia National Park boundaries (*see* Heinrichs, *et al.*, 2011 at 34; Marshall, *et al.*, 2011 – 1 at 11-12 (citation omitted)). Because this fishery coincides with the seasonal aggregation of giant manta rays in this area, it injures many individuals and almost certainly kills many as well (*see* Marshall, *et al.*, 2011 – 1 at 12; *see also* Section IV. A. 5. "Fisheries and Resultant Marine Debris," *surpra*). In addition, "[f]isheries bycatch data collected from the U.S. tuna purse seine fishery in the central-western Pacific in 1999 listed the Giant Manta Ray[58] amongst the species caught with a set frequency of 1.5%. A total of 18 mantas were caught (1.14 [tons]) during the observed period, 100% of which was discarded." (Marshall, *et al.*, 2011 – 1 at 12 (citation omitted)). This low weight for such a large number of Manta Rays may indicate that all, or mostly all, juveniles were caught by this fishery (*see* Section III. F. "Reproduction and Lifespan," *supra*). Additionally, although 100% of the Manta Rays recorded in this study were discarded, it is not clear whether they were injured or dead at the time they were discarded. Regardless, because this information is from 1999, it is unlikely that a similar pattern of 100% discards would be practiced now because the gill plate trade has increased the value of these species greatly. As a result, this source of bycatch is likely negatively affecting Manta Rays in this part of their range. This data indicates that bycatch is an additional threat to giant manta rays in the Pacific Ocean.

2. Reef Manta Ray

Manta Rays, likely reef manta rays, are bycaught in purse seines from associated sets in the waters of Papua New Guinea (Marshall, *et al.*, 2011 – 2 at 11; *see also* Figure 8, *supra*; Figure 9, *supra*). "Catch rates monitored from 1995 until 2006 showed a distinct and significant rise in the number of manta rays caught (both [tons per year and kilograms per day]) in these fisheries in 2001, which steadily rose until 2005/2006, when sharp declines were noticed in the catch." (Marshall, *et al.*, 2011 – 2 at 11 (citation omitted)). "On average, from 1994 until 2006, manta rays comprised 1.8% of non-target catch from the surveyed purse seiners in the waters of Papua New Guinea." (Marshall, *et al.*, 2011 – 2 at 11 (citation omitted)). This indicates significant reef manta ray bycatch that likely drove, or at least contributed to, the observed declines. Therefore, bycatch is an additional threat to the reef manta ray in the Pacific Ocean.

[58] Note that this study is pre-differentiation and that reef manta rays are also located in the central-western Pacific (*see* Section III. B. "Taxonomy," supra; Figure 8, *supra*; figure 9, *supra*). Therefore, some or all of these records could refer to captured reef manta rays as well.

ii. Indo-Pacific

1. Giant Manta Ray

In addition to extensive targeting of giant manta rays in the Indo-Pacific, Manta Rays (predominantly giant manta rays) are also captured as bycatch in local Indonesian gillnet fisheries for Tuna and have been observed at markets in Pelabuhanratu in West Java, Cilacap in Central Java, and Kedonganan in Bali (Heinrichs, *et al.*, 2011 at 33; Marshall, *et al.*, 2011 – 1 at 10). Giant manta rays appear to account for approximately 14% of the mobulid landings from these bycatch fisheries (White, *et al.*, 2006 at 1).[59] This translates to removal of an average annual biomass of 544 tons of giant manta rays in bycatch, and this study only looked at four sites (Marshall, *et al.*, 2011 – 1 at 10). The combined overfishing in this region has caused declines in numbers and reductions in the size of individuals in Indonesia (Heinrichs, *et al.*, 2011 at 33; *see also* Section III. G. 3. "Indo-Pacific," *supra*).

2. Reef Manta Ray

Manta Rays are also regularly caught as bycatch in drift nets in Malabuhan, Siatian Negro Island, Philippines (Marshall, *et al.*, 2011 – 2 at 11 (citation omitted)). Due to this location being on the Sulu Sea, these are likely mostly or all reef manta rays (*see* Figure 8, *supra*; Figure 9, *supra*). This area has experienced severe reef manta ray population declines that are exacerbated by this bycatch threat (*see* III. G. "Population Trend," *supra*).

iii. Indian Ocean

1. Giant Manta Ray

"Manta rays (predominately the Giant Manta Ray) are taken in significant numbers as bycatch in the Pakistani, Indian and Sri Lankan gillnet fisheries, where they are used as shark bait, for human consumption and their branchial filaments are sold to Asian buyers." (Marshall, *et al.*, 2011 – 1 at 11 (citations omitted); *see also* Kishor, *et al.*, 2014 at 2). There are also Indian records of giant manta rays being caught incidentally in purse seines (Kishor, *et al.*, 2014 at 2). While one study recorded landings of 5 giant manta rays from the Indian purse seine fleet at one harbor over a period of just 5 days in 2014, the study assessing this data said that only 25 giant manta ray landings had been recorded off the Indian coast *ever* (*see* Kishor, *et al.*, 2014 at 2-3). This indicates likely vast underreporting, with these 2014 records being serendipitous observations by scientists that would have otherwise likely gone unreported. When a mature female captured during this time was cut open, a young female pup measuring 170 centimeters disc width and weighing 22 kilograms was removed from its womb (Kishor, *et al.*, 2014 at 3). This indicates that pregnant females appear to use this area and may be removed at this vital life history stage, thus further reducing the species' reproductive potential in this area.

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[59] However, some portion of this may be reef manta rays as the relevant study is pre-differentiation of the species.

Sl. No.	Date	Number of rays landed by purse seiner	Total weight (kg)
1.	18/05/14	2	2400
2.	19/05/14	1	780
3.	20/05/14	1	570
4.	22/05/14	1	650

Figure 36. Observed giant manta ray landings (date, numbers, and combined weight) at a single harbor in India over several days in 2014 (Kishor, *et al.*, 2014 at 3).

Giant manta rays are also caught as bycatch or killed "in fisheries along the west coast of Thailand and Myanmar, including within the Similans National Park where evidence suggests that a high proportion of individuals visiting the area have been entangled by fishing line or nets. Incidental kills have also been reported in fishing nets, tackle and ghost nets." (Marshall, *et al.*, 2011 – 1 at 11 (citation omitted)). Therefore bycatch is a serious threat to giant manta rays in the Indian Ocean.

2. Reef Manta Ray

Manta Rays (predominantly reef manta rays, but giant and reef manta rays are present) are incidentally caught in protective shark nets off the beaches of KwaZulu-Natal, South Africa throughout the year with a peak (49% of the total annual catch) in the summer months (Marshall, *et al.*, 2011 – 1 at 11 (citation omitted)). Manta Rays account for "16.9% of the total historical batoid catches from these nets, with a mean annual catch of 60 individuals and an overall 33.7% mortality rate." (Marshall, *et al.*, 2011 – 1 at 11 (citation omitted)). In addition to the aforementioned mixed bycatch from Pakistan, India, and Sri Lanka (*see* Section IV. B. 1. b. iii. 1. "Giant Manta Ray," *supra*), this data indicates significant reef manta ray bycatch mortality in the Indian Ocean.

iv. Atlantic Ocean

Information taken from the Mauritanian EEZ, which would be consistent with both giant and reef manta ray populations (*see* CoP16-Prop-46 at 20; *see also* Figure 8, *supra*; Figure 9, *supra*), indicates that Manta Rays are extensively caught in the industrial trawler fisheries off Northwest Africa (*see* Zeeberg, *et al.*, 2006 at 190). Observer data indicates that 4 Manta Rays were bycaught in 30 observed net hauls in October 2001 with a total estimated mortality for the fleet for that month of 58 Manta Rays (*see* Zeeberg, *et al.*, 2006 at 190). Observer data indicates that 4 Manta Rays were bycaught in 245 observed net hauls from July 2002 to November 2002 with a total estimated mortality for the fleet for that period of 66.1 Manta Rays, though this may have been an underestimate due to several months of low observer coverage where no Manta Rays were observed, which could skew the results (*see* Zeeberg, *et al.*, 2006 at 190). Observer data indicates that 4 Manta Rays were bycaught in 148 observed net hauls from September 2003 to November 2003 with a total estimated mortality for the fleet for that period of 36.6 Manta Rays (*see* Zeeberg, *et al.*, 2006 at 190). Observer data indicates that 111 Manta Rays were bycaught in 912 observed net hauls from July 2004 to November 2004 with a total estimated mortality for the fleet for that period of 563.3 Manta Rays (*see* Zeeberg, *et al.*, 2006 at 190). Where reporting was based on a higher number of observed hauls, the bycatch numbers were much higher indicating that the earlier numbers likely have a tendency to underestimate the number of captures, and therefore mortalities (*see* Zeeberg, *et al.*, 2006 at 190 (showing that only an average of 7.8% of the hauls were observed from July to November

2002 whereas 42% were from July to November 2004 when much higher bycatch was observed and much higher mortality was estimated).

These high bycatch and mortality estimates led Zeeberg, *et al.*, 2006 to conclude that turtles and Manta Rays "may be the species primarily threatened by [these] trawler fisheries." (Zeeberg, *et al.*, 2006 at 192). The authors indicated that "[e]xtrapolation from [their] observations . . . indicates annual removal of between 120 and 620 mature mantas, which is unlikely to be sustainable." (Zeeberg, *et al.*, 2006 at 192). This study indicated that an excluder could vastly reduce this bycatch rate, but such a device does not appear to currently be in use in this fishery (Zeeberg, *et al.*, 2006 at 186, 194).

Figure 37. Manta Ray entangled in a trawler net after a commercial set in the Mauritanian EEZ (Zeeberg, *et al.*, 2006 at 188). Injuries to the Manta Ray are clear and, even if it were released at this stage, survival seems highly unlikely.

Between 40 and 70 international trawlers enter this area to fish every year with some fleets operating nearly year-round (*see* Zeeberg, *et al.*, 2006 at 186). Some of these boats are amongst the largest fishing vessels in the world with between 9,000 and 18,000 installed horse power for trawling and freezing (*see* Zeeberg, *et al.*, 2006 at 186). They operate within one mile of each other and are often accompanied by dozens of other trawlers all together yielding more than 500,000 tons of small pelagic fish per year (Zeeberg, *et al.*, 2006 at 186). "With these figures the Northwest African shelf is fully exploited and ranks amongst the most productive and most intensively fished areas in the world." (Zeeberg, *et al.*, 2006 at 186 (citation omitted)). The danger to bycatch species, with the giant and reef manta rays being the pertinent species here, is thus obvious.

An assessment of bycatch in the Portuguese longline fleet from the Atlantic Ocean indicates that Manta Rays[60] are bycaught in this fishery as well. This study used data from four locations in the Atlantic, the temperate Northeast Atlantic, the tropical Northeast Atlantic, the equatorial Atlantic, and the Southern Atlantic (*see* Coelho, *et al.*, 2012 at 313). Though the Manta Rays have a

[60] Likely giant and/or reef manta rays based on the location (*see* Figure 8, *supra*; Figure 9, *supra*).

constrained range in these waters, the study still noted capture of 145 Manta and Devil Rays (Coelho, *et al.*, 2012 at 314). This indicates that this fishery is another source of significant bycatch.

1. Giant Manta Ray

In addition, "[a]lthough manta rays are not directly targeted by fisheries in southeastern Brazil, several reports of Giant Manta Rays being captured as bycatch show that local fishing poses a threat to manta rays." (Marshall, *et al.*, 2011 – 1 at 12 (citation omitted); *see also* Passadore, *et al.*, 2015 at 2 (indicating that pelagic longline bycatch pressure is high in Uruguay and adjacent international waters over the continental shelf and that it affects threatened rays, which presumably at least includes giant manta rays) (citations omitted)). "The Brazilian government is currently promoting a policy to boost commercial fisheries in the area, through financial incentives, raising concerns on the future of that manta ray population." (Marshall, *et al.*, 2011 – 1 at 12). In addition to these removals, reports of individual giant manta rays entangled in ghost nets are also common from this area (Marshall, *et al.*, 2011 – 1 at 12 (citation omitted)).

One other source of bycatch is the European purse seine fishery operating on the west coast of Africa (*see* Amandè, *et al.*, 2010 at 356). A 2010 study examined observer data from this fleet that was collected from 2003-2007 (*see* Amandè, *et al.*, 2010 at 353). The observer programs represented a total of 27 trips and 2.9% coverage of this fishery. These observers recorded bycatch of 11 giant manta rays and 3 unidentified rays over this time period (17.8% and 4.9% of all rays caught during this time period and 28.3% and 1.4% of rays by weight caught during this time period respectively) (*see* Amandè, *et al.*, 2010 at 356).[61] This study indicates that a significant number of Manta Rays are caught in this fishery (*see* Amandè, *et al.*, 2010 at 356) and that this number could greatly increase depending on where effort is concentrated (*see* Figure 38, *infra*).

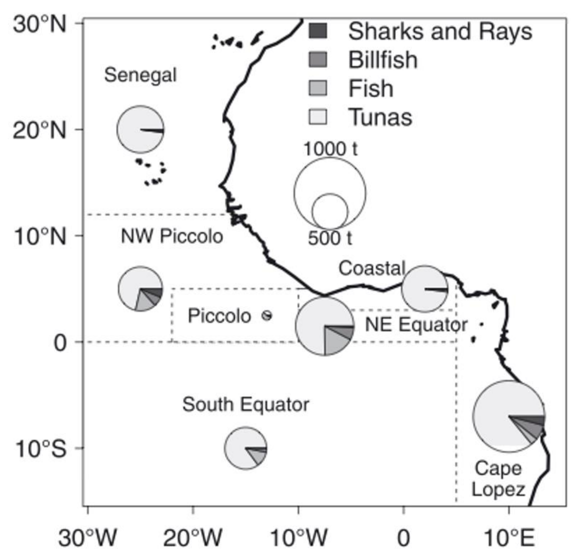

Figure 38. Spatial variability of bycatch (weight is indicated by circle size) by species group and area (Amandè, *et al.*, 2010 at 358).

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[61] Though this study identifies the catch as being composed of giant manta rays, the catch locations are equally plausible as reef manta ray locations (*see* Figure 8, *supra*; Figure 9, *supra*). As a result, some of the giant manta ray catch and/or some of the unidentified ray catch may refer to reef manta rays.

Finally,

> Surveys made of the bycatch from 52 sets from the shark drift net fishery off Georgia and east Florida, USA from 1992–1995 included 148 rays, 14 of which were recorded as being the Giant Manta Ray. Another study of the bycatch in the directed shark drift gillnet fishery off the east coast of Florida and Georgia, which was set 4.8 [kilometers] offshore in EEZ waters from 1998–1999, revealed that manta rays are still occasionally caught in this fishery.

(Marshall, *et al.*, 2011 – 1 at 12 (citations omitted); *see also* Beerkircher, *et al.*, 2002 at 42-43 (indicating that rays account for 2.5% of the elasmobranch catch in the pelagic longline fishery off the southeastern United States and that some of these rays are Manta Rays)).[62] This indicates that there are several sources of significant giant manta ray bycatch in the Atlantic Ocean

2. Reef Manta Ray

Data on reef manta ray bycatch in the Atlantic Ocean is scarce, likely due to the species' relative absence from the Atlantic. In fact, there are only two confirmed reef manta ray populations in the entire Atlantic (both in northwest Africa) with other nearby populations being attributed to Manta Rays at the genus level or to giant manta rays (*see, e.g.,* CoP16-Prop-46 at 20). However, information taken from the aforementioned fisheries off the African coast, which would be consistent with both reef and giant manta ray populations, indicates that bycatch is likely harming reef manta rays in these locations as well, even if it is as-yet-unreported (*see* Section IV. B. 1. b. iv. "Atlantic Ocean," *supra*; Section IV. B. 1. b. iv. 1. "Giant Manta Ray," *supra*).

2. Overutilization for Recreational Purposes[63]

Various "swim with the mantas" operations are proving to be very lucrative throughout the world (*see* O'Malley, *et al.*, 2013 at 1, 8 (citations omitted); Deakos, *et al.*, 2011 at 257). These operations often provide significant financial benefits to communities where few alternative sources of income exist (O'Malley, *et al.*, 2013 at 1 (citations omitted)). In fact, a recent study estimated that the direct expenditures on Manta Ray dives for a group of 23 countries was in excess of $73 million per year with ten countries (Japan, Indonesia, Maldives, Mozambique, Thailand, Australia, Mexico, United States, Federated States of Micronesia, and Palau) accounting for 93% of this revenue (O'Malley, *et al.*, 2013 at 4).[64] While this direct expenditure figure is already very high, the direct economic impact

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[62] Though these U.S. coastal records likely refer to capture of Caribbean manta rays or a combination of giant and Caribbean manta rays (*see* Figure 8, *supra*; Figure 9, *supra*), they are included here because the source attributed them to the giant manta ray.

[63] Because these three species are physically very similar and often inhabit overlapping habitat, impacts from this threat likely comparable. As such, all three species will be treated together.

[64] In fact, Manta Ray tourism in Coral Bay, Western Australia alone was estimated to involve a total of 10,000 people annually as of 2009 (Venables, 2013 at 17-18). However, the increase in tourism to the marine park where these dive businesses operate indicates that this number has likely increased significantly since that time (Venables, 2013 at 18). In addition, this number is dwarfed by the estimated 143,000 swim with the mantas dives and 14,000 snorkels that tourists made annually in the Maldives from 2006-2008 (Anderson, *et al.*, 2010 at 15). "On occasion[, at the most popular Manta

of Manta Ray tourism was estimated at an even higher $140 million annually (O'Malley, *et al.*, 2013 at 5). The demand for ecotourism focused on marine megafauna is growing with significant growth in global tourism generally also expected over the next twenty years (O'Malley, *et al.*, 2013 at 9-10 (citations omitted)). On top of this expected growth, excursions involving Manta Rays have already become so popular that tourists in the Maldives are willing to pay more for these trips than for trips involving sharks or turtles (O'Malley, *et al.*, 2013 at 1 (citation omitted) and more tourists in Australia are going on Manta Ray tours than whale shark tours (O'Malley, *et al.*, 2013 at 1 (citations omitted)).

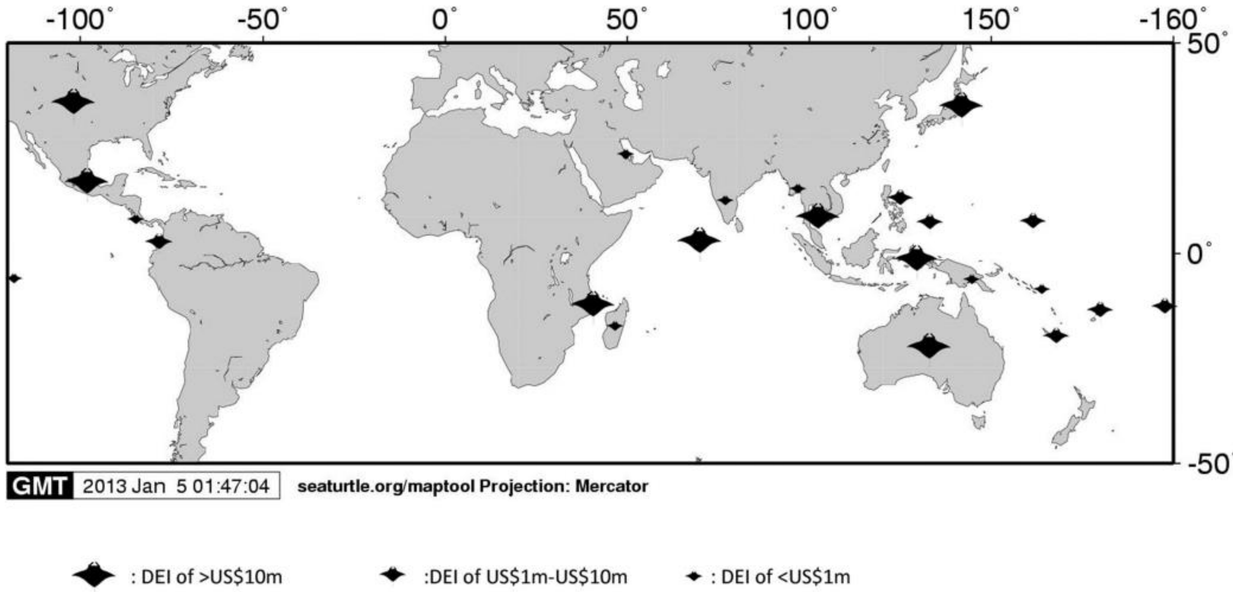

Figure 39. Global distribution and direct economic impact ("DEI") of Manta Ray tourism. DEI comprises estimated tourist expenditures on Manta Ray dives and associated expenditures, such as lodging, food, and local transportation, which can be attributed to Manta Ray diving (O'Malley, *et al.*, 2013 at 5).

The projected growth in these swim with the mantas programs is on top of the enormous growth that has already occurred. For example, in the early 1990s in Coral Bay, Western Australia, a single vessel conducted opportunistic interactions with Manta Rays while in transit from whale shark interactions (Venables, 2013 at 17). In the following years, a dedicated Manta Ray interaction vessel with a capacity of 12 passengers began conducting intermittent Manta Ray tours (Venables, 2013 at 17). By 2003 there were five dedicated Manta Ray tour vessels that were operating daily with a combined maximum capacity of 102 passengers (Venables, 2013 at 17). Currently, upgrades to these five vessels allow them to accommodate up to 139 passengers per day (Venables, 2013 at 17 (citation omitted)). Because it is unregulated, this growth will likely continue (Venables, 2013 at 17).

Ray dive sites in the Maldives,] there can be 10 or more boats present and over 100 divers and snorkelers in the water at once." (Anderson, *et al.*, 2010 at 25).

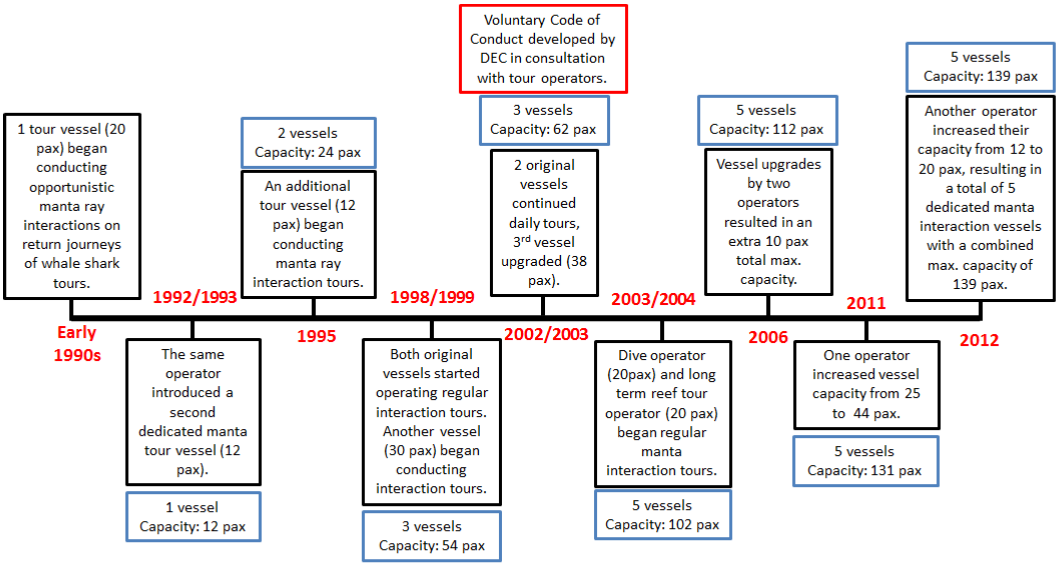

Figure 40. Timeline of events relating to the Manta Ray tourism industry operating out of Coral Bay, Western Australia. Note that, in addition to these dedicated Manta Ray boats, two more vessels (each licensed to carry 20 passengers) intermittently conduct Manta Ray interaction tours outside of the whale shark season (July to March) (Venables, 2013 at 18).

While these tourism opportunities may be beneficial to the local economies, they are harmful to Manta Rays where they are not properly managed. This is in part due to the strong site fidelity that these species exhibit at specific feeding locations and cleaning stations that allow these species to be reliably located by tourism operators (*see* Deakos, *et al.*, 2011 at 246 (citation omitted); Heinrichs, *et al.*, 2011 at 14 (citation omitted)). For instance, tourism, including in-water interactions and recreational boat traffic, if not properly managed, are likely to affect use of and visitation rates to critical cleaning and feeding habitats (Marshall, *et al.*, 2011 – 2 at 10 (citations omitted); Deakos, *et al.*, 2011 at 257; Heinrichs, *et al.*, 2011 at 14 (citation omitted)). One study noted that 64.29% of Manta Rays that were observed on a cleaning station left the immediate area and did not return within the observation period in response to photo identification attempts or tour vessel or swim group interaction (Venables, 2013 at 59).

> Cleaning stations are considered critical locations for manta rays, as cleaning is important for maintaining their health and body condition through the removal of ectoparasites, mucus and dead or infected tissue from the body surface by cleaner fish; disturbance of cleaning [behavior] may therefore result in a reduction in individual health due to higher parasite loads and slower wound healing processes. The departure of individuals as a response to interactions, although perhaps only temporary, suggests that continued disturbance could lead to the abandonment of particular cleaning stations by more sensitive individuals.

(Venables, 2013 at 70; *see also* Rohner, *et al.*, 2013 at 163 ("Cleaning is an important daily activity and reef manta rays spend particularly long periods at cleaning stations in the present study area [(Mozambique)]. Approximately 76% of individuals bear bite wounds of predatory sharks, and removal of dead tissue around injuries is thought to facilitate wound healing and prevent secondary infection.") (citations omitted); Section IV. C. 1. "Shark Attacks," *infra*).

In addition, other natural behaviors may also be adversely affected by excessive tourism-related activities (Marshall, *et al.*, 2011 – 2 at 10 (citations omitted)). One of these that has been observed in response to swimmer interactions is alteration in behavior state from feeding to a non-feeding behavior, often cruising (*see* Venables, 2013 at 69). "Repeated disturbance of foraging activity can potentially have harmful effects on individual and population health, as a decrease in the time spent foraging may lead to reduced food intake, and consequently a reduction in energy acquisition." (Venables, 2013 at 69).

> The impacts of marine wildlife tourism have been described as cumulative rather than catastrophic, meaning that a single disturbance which seems relatively insignificant at the time can accumulate incrementally into a significant impact when repeatedly experienced over an on-going period of time. Short-term disturbances have been linked to biologically significant impacts on focal populations of cetaceans in other marine tourism industries, such as declines in abundance due to long-term habitat displacement from areas of high tourism pressure and boat traffic, and a substantial decrease in energy intake due to disturbance of foraging [behaviors].

(Venables, 2013 at 72-73 (citations omitted)). Therefore, because these tourism impacts are ongoing, their negative effects on impacted Manta Ray populations will only continue to grow.

Concerns over the potential negative effects of tourism led Graham, *et al.*, 2012 to posit that "[t]he greatest impact on the [Yucatan Peninsula aggregation of Caribbean Manta Rays] in the next decade . . . may come from the region's expanding and largely unregulated marine megafauna tourism industry." (Graham, *et al.*, 2012 at 4). In fact many Manta Rays in this area already exhibit boat injuries, indicating that the vessels used to transfer tourists to and from these locations are inadvertently striking Manta Rays (Marshall, *et al.*, 2011 – 1 at 13; *see also* Section IV. E. 5. "Heavy Maritime Traffic," *infra*). In addition, in Bora Bora, French Polynesia, Manta Rays were entirely displaced from a cleaning station site due to prolonged coastal development and the presence of divers, snorkelers, vessels, and jet skis with only a reduced number returning after 2-3 years (Venables, 2013 at 14, 70 (citation omitted); Deakos, *et al.*, 2011 at 257 (citation omitted); *see also* Anderson, *et al.*, 2010 at 25 (indicating that excessive divers in the Maldives may be causing Manta Rays to avoid certain locations there); Rohner, *et al.*, 2013 at 165 (indicating that Manta Rays are less common at the relevant aggregation site during hours where there is a relatively high amount of ecotourism boat traffic and diver numbers close to the reefs)).

Venables, 2013 studied the impact of tourist interactions with Manta Rays in Coral Bay, Western Australia to assess the effects that this interaction has on the Manta Rays. This study consisted of 91 interactions between swim groups and Manta Rays, 98 interactions between tour vessels and Manta Rays, and 77 Manta Ray photo identification attempts (Venables, 2013 at iii). Venables, 2013 observed clear behavioral responses from 34.1% (31 of 91), 15.5%, and 48.1% of these interaction types respectively (Venables, 2013 at iii). The Manta Rays exhibited a variety of behavioral responses, with many displaying several behavioral responses to a given interaction (Venables, 2013 at 49).

> The most frequent form of response [to swim group interactions] was an increase in speed, which was exhibited on 17 occasions. Ten manta rays changed their [behavioral] state from feeding to a non-feeding [behavior] such as cruising or searching for food, and five left the area of a cleaning station. On two occasions a

pair of manta rays that was feeding or swimming together split apart and swam in separate directions, two changed swimming direction in order to turn away from the swim group, two rapidly increased their swimming speed and fled from the immediate area, and on two occasions a male decreased the distance between himself and a female (from approximately 1 - 2 [meters] behind the female to <50 [centimeters]) while engaged in a mating chain. On five occasions during an interaction the manta ray exhibited what was considered to be an inquisitive response, which involved the manta ray turning so that its ventral surface faced the swim group for between 15 and 30 seconds, enabling the manta ray to properly see the group, then resuming its original [behavior].

(Venables, 2013 at 49).

While responses to a swim groups were observed during one third of interactions in this study,

> this proportion has the potential to increase without further management, particularly considering the prospective growth of the industry. The forms of [behavioral] responses observed ranged from seemingly minor short-term disturbances to the disruption of feeding and cleaning [behaviors]. It is the cumulative nature of disturbances which is the major cause for concern, as short-term disturbances have the potential to accumulate incrementally or synergistically over time, developing into biologically significant impacts on the population.

(Venables, 2013 at 95 (citation omitted)). As a result, dive tourism is clearly threatening these species in these waters, and in other waters that are subjected to similar pressures (*see also* Couturier, *et al.*, 2011 at 633 ("The species is likely to be vulnerable to unregulated diving tourism along the *east coast* of Australia.") (emphasis added)).

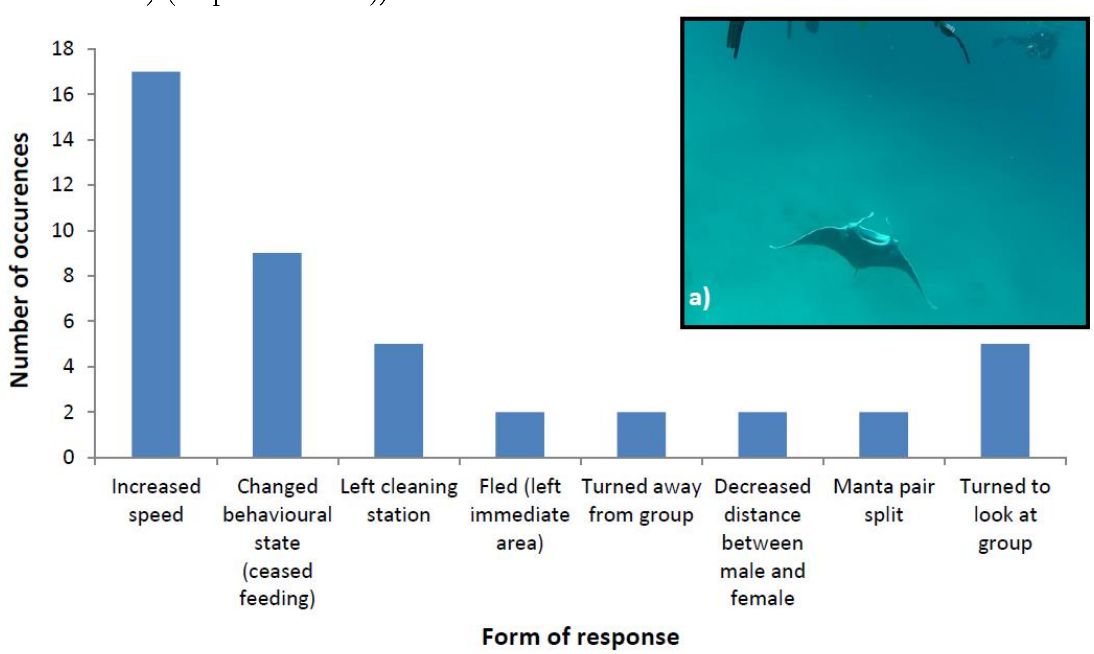

Figure 41. Number of occurrences of different forms of behavioral responses of Manta Rays to swim group interactions, a) Photo inset showing a Manta Ray turning upside down to face its ventral surface towards a swim group (Venables, 2013 at 50).

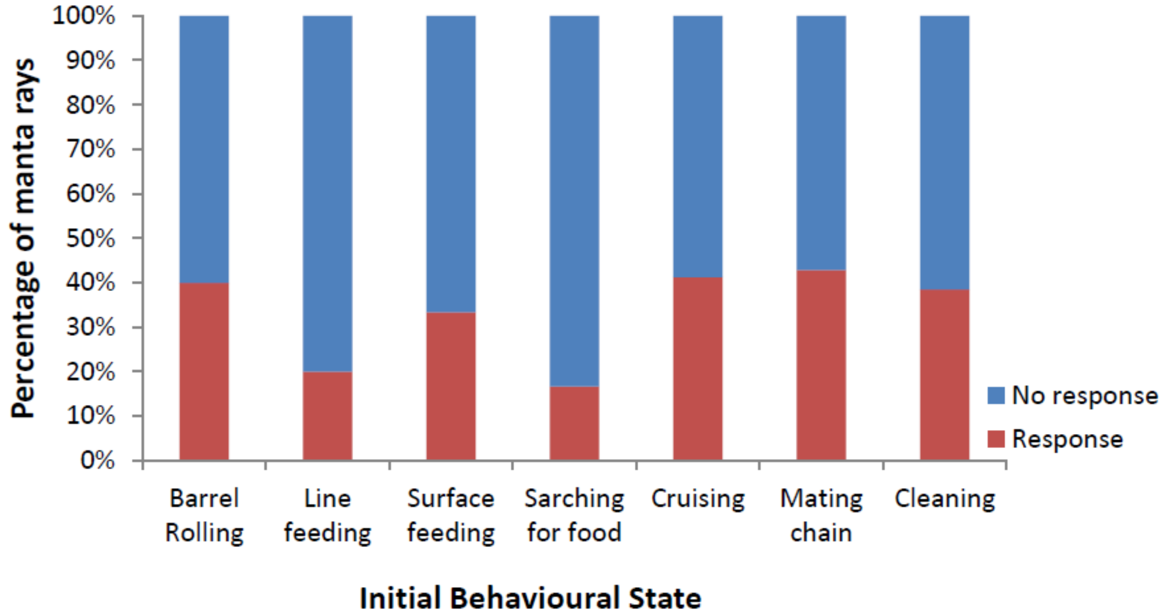

Figure 42. Behavioral response rate of Manta Rays to swim group interactions depending on their initial behavioral state (Venables, 2013 at 52).

Manta Rays also appeared to be adversely affected by photo identification attempts, seemingly even more so than by divers who were not equipped with photographic equipment (*see* Figure 43, *infra*; Figure 44, *infra*).

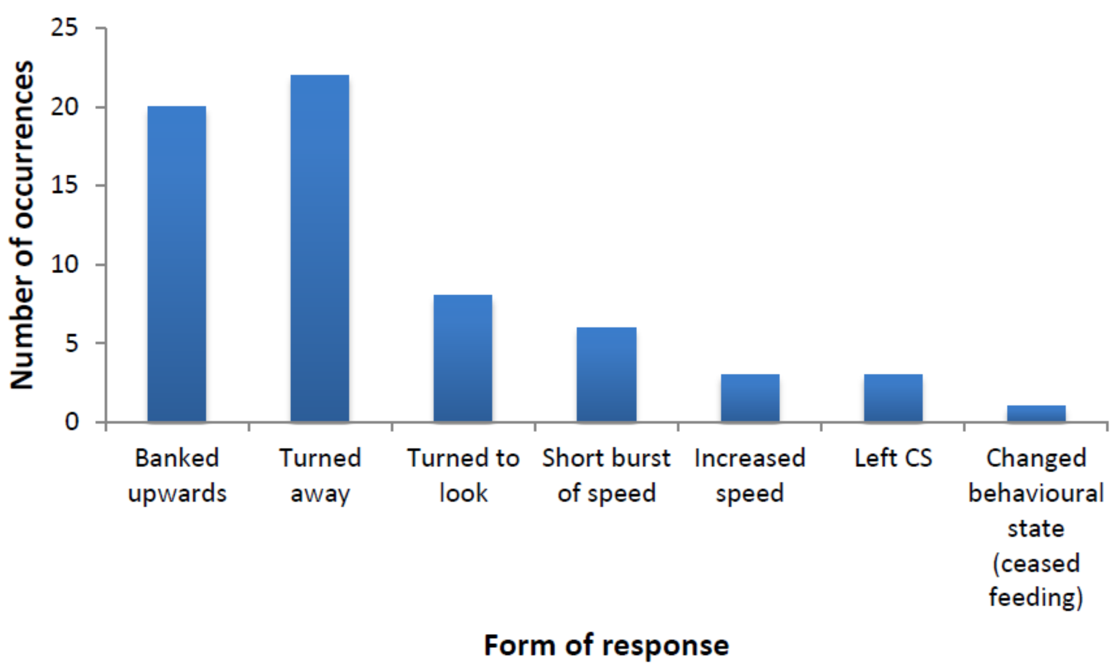

Figure 43. Number of occurrences of different forms of behavioral responses exhibited by Manta Rays to photo identification attempts (Venables, 2013 at 56).

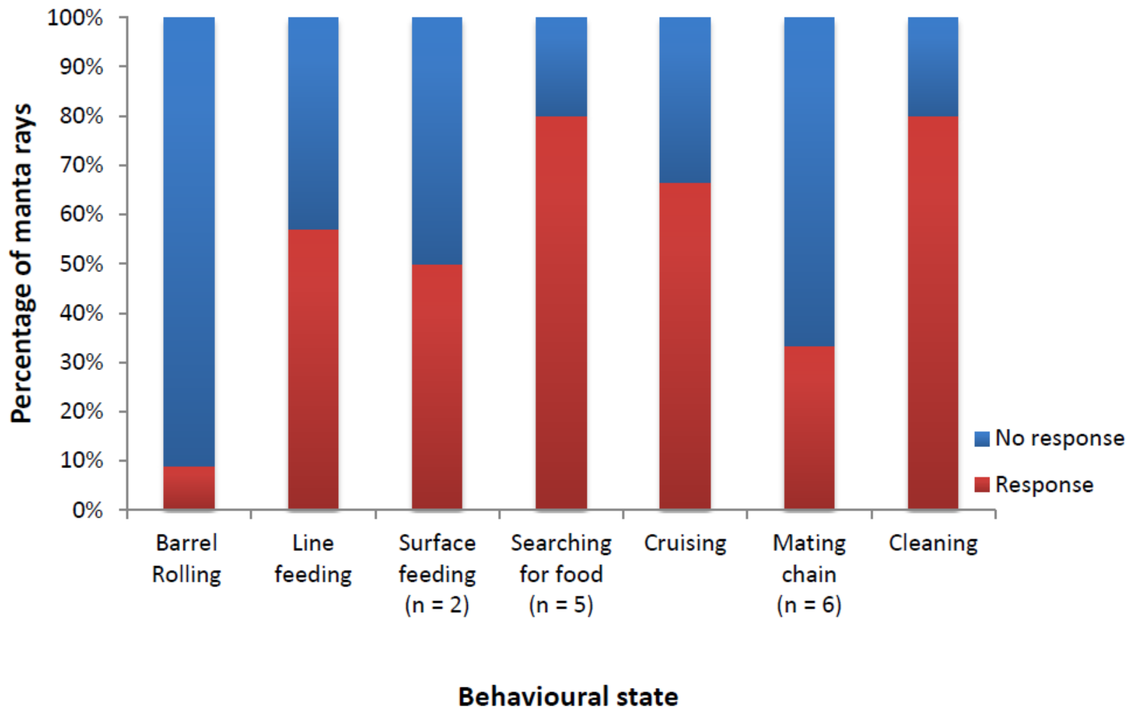

Figure 44. Response rate of Manta Rays to photo identification attempts depending on their behavioral state at the time of the attempt (Venables, 2013 at 58).

In addition to these impacts from mere diver and other recreationist presence, coming close to or touching the Manta Rays can also cause them undue stress (Heinrichs, *et al.*, 2011 at 14 (citation omitted)). For instance, even though most divers in the Maldives are told not to touch the Manta Rays, some still do touch them regardless (Anderson, *et al.*, 2010 at 25). In addition to stress, these practices can also cause physical harm to these species. A study of the "interaction between tourists and a wild population of southern stingrays *Dasyatus americana* resulted in higher parasite loads, higher injury rates and suppression of the immune system in the stingrays, putting their longterm survival at serious risk." (Deakos, *et al.*, 2011 at 257). Similar physical effects likely impact Manta Rays that are subject to extensive interaction with tourists (*see also* NOAA, 2012 at 8, 64 (indicating that divers touching Manta Rays can harm them by injuring their skin and/or causing them to alter their natural behaviors to avoid the divers)). Note also that mooring or anchor lines for tourist boats could also harm these species as could boat strikes caused by increased traffic in Manta Ray aggregation areas (*see* Section IV. E. 5. "Heavy Maritime Traffic," *infra*; CoP16-Prop-46 at 9; CMS, 2014 at 7).

The likelihood of these effects is very high with even tour operators noting concern about overcrowding at some Manta Ray tourism sites (O'Malley, *et al.*, 2013 at 8). In fact, Manta Ray sightings have already decreased at some very crowded sites (O'Malley, *et al.*, 2013 at 8). However, in other areas where human-Manta Ray interactions are less invasive, impacts appear to be minimal so far (*see* O'Malley, *et al.*, 2013 at 8 (citation omitted)).

Scientifically sound codes of conduct, "combined with educational and interpretive briefings, have been demonstrated to minimize tourists' impacts on the environment and marine life while also enhancing their enjoyment of the experience . . ." (O'Malley, *et al.*, 2013 at 8 (citation omitted)).

However, at present there are no formal Manta Ray interaction codes of conduct implemented and enforced by government or other management agencies in any part of the world (*see* O'Malley, *et al.*, 2013 at 8 (citation omitted); Venables, 2013 at 14-15), and only a patchwork of voluntary standards exist (Venables, 2013 at 14-15). While these voluntary standards are a good start, they are not sufficient to protect the Manta Rays as, even where tour operators were compliant with the voluntary standard in place in Australia, approximately one third of all Manta Ray interactions elicited a response from the creatures, indicating that their natural behaviors had been disrupted by the tourists (Venables, 2013 at 67).

In addition to recreational impacts from these less-consumptive uses of Manta Rays, these species are also threatened by sport fishing (*see* CoP16-Prop-46 at 9 (citation omitted); CMS, 2014 at 7 (citation omitted)). Not only can sport fishing cause injuries from hooks and line, but it also results in increased boat traffic, which increases the likelihood of boat strikes and entanglement in mooring or anchor lines (*see* CoP16-Prop-46 at 7 (citation omitted); CMS, 2014 at 7 (citation omitted); Section IV. E. 5. "Heavy Maritime Traffic," *infra*). As a result, sport fishing represents an additional threat to these species wherever it occurs in their habitat.

3. Overutilization for Scientific or Educational Purposes

"Recent success in Japan's manta ray captivity program has sparked global interest from aquariums looking to add manta rays to their exhibits." (Deakos, *et al.*, 2011 at 257 (citation omitted)).[65] Now, giant, reef, and Caribbean manta rays have been caught and transported to aquariums for use in large display tanks in at least five different countries (the United States, the Bahamas, Portugal, Japan (at least three aquariums have specimens there), and South Africa) (*see* CoP16-Prop-46 at 10; Marshall, *et al.*, 2011 – 2 at 9; Ari, 2014 at 181-82). However, Manta Rays still typically have relatively low survival times in captivity (*see* CoP16-Prop-46 at 10 (citing a source that lists survival times as being from 1 to 1,943 days in captivity); Marshall, *et al.*, 2011 – 2 at 9 (citing a source that provides days of survival for captive manta rays as 3; 1; 1,943+; 5; 13; 644+; 299+). "Although few [Manta Rays currently] live in captivity, the unmonitored removal of these species from the wild for the public aquarium trade may negatively impact small and geographically isolated populations." (Heinrichs, *et al.*, 2011 at 14). "In certain aggregation areas where manta rays are easily accessible, and where no regulatory protection exists, populations, especially those that are small and geographically isolated, may be exposed to indiscriminant non-sustainable extraction of individuals for profit." (Deakos, *et al.*, 2011 at 257). For instance, there are at least three Caribbean manta rays in captivity (Ari, 2014 at 181), though the only counted population consists of around 70 individuals from the Flower Garden Banks in the United States (*see* Figure 21, *supra*; *see also* Heinrichs, *et al.*, 2011 at 11 (citation omitted)). If these captive specimens were taken from this small population, for example, then this source of overutilization alone could have reduced the population by at least 4%. "Currently there are no active release programs underway at aquariums where specimens are being housed." (Marshall, *et al.*, 2011 – 2 at 9). The Manta Rays' long generation times and small population sizes coupled with the unregulated nature of these removals, and their apparent increasing popularity, indicate that this threat will likely continue to contribute to the decline of these species in the future (*see* Section IV. E. 4. "K-Selected," *infra*).

[65] The use of captive Manta Rays in aquariums and other display tanks could also be considered overutilization for recreational purposes, and should be considered under that section as well, but Defenders included this information separately here given that these specimens may be being used to further the understanding of these species by both scientists and the general public.

C. Disease or Predation

1. Shark Attacks

Manta Rays appear to be very susceptible to sharks attacks and injuries as a result of shark attacks are thus very common (*see* Deakos, *et al.*, 2011 at 254; Mourier, 2012 at 3; Marshall & Bennett, 2010 at 1).[66] In fact, the injuries from these attacks, including scars, wounds, and shortened tails are so common that they are often used to differentiate individuals in photo-identification studies (Couturier, *et al.*, 2011 at 629 (citations omitted)). The prevalence of these injuries varies significantly by location, but is very high in many locations. These shark attacks can result in immediate mortality or in effects such as delayed mortality, decreased fitness, or reduced or eliminated reproductive ability (*see* Marshall & Bennett, 2010 at 1, 7). Though predation by a native predator typically would not cause the extinction of a prey species, Manta Rays are not only subjected to natural mortality. Manta Ray populations are already depleted and are being subjected to ongoing fishing, habitat harms, and other threats (*see, e.g.,* Section III. G. "Population Trend," *supra*; Section IV. A. "The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range," *supra*; Section IV. B. 1. "Overutilization for Commercial Purposes," *supra*). When their limited reproductive ability is taken into account (*see* Section III. F. "Reproduction and Lifespan," *supra*; Section IV. E. 4. "K-Selected," *infra*), any additional mortality or reduction in reproductive success will exacerbate the threats that they are already subjected to. In addition, the overutilization threats that the Manta Rays are facing may be acting synergistically with this threat where Manta Rays are used as shark bait or attractant (*see* Marshall, *et al.*, 2011 – 1 at 9 (meat is used as shark attractant in Mexico); Graham, *et al.*, 2012 at 4 (same); Marshall, *et al.*, 2011 – 1 at 11 (Manta Rays used as shark bait in Pakistani, Indian and Sri Lankan gillnet fisheries) (citations omitted)). To the extent that this use habituates sharks to eating Manta Ray flesh, and thus increases their predation of these species, it is causing unnatural predation mortality. As a result, predation by sharks is causing cumulative and synergistic impacts to Manta Rays that are exacerbating the other threats that they are facing. Therefore, predation by sharks is a serious threat to all Manta Ray species.[67]

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[66] The fact that the majority of species-specific information on shark attacks relates to the reef manta ray is unsurprising because giant manta rays are generally more cryptic than reef manta rays and Caribbean manta rays were only very recently described and are thus far poorly studied. The available data does show that many giant manta ray individuals show distinctive injuries that are attributed to sharks (*see* Mourier, 2012 at 3 (French Polynesia)). In fact, one study found that approximately 35% of giant manta rays were affected by shark bite injuries (*see* Rohner, *et al.*, 2013 at 163 (citation omitted)). Additionally, there is no reason to think that giant and Caribbean manta rays would be targeted less frequently, would experience differing effects when they are attacked, or would respond to those effects differently. Therefore, the available information discussing shark attacks on reef manta rays should also be taken as evidence of a threat to giant and Caribbean manta rays as well.

[67] In addition to attacks on free-swimming Manta Ray individuals, there is also evidence that sharks attack individuals that are entangled in nets and mooring lines, thus increasing the mortality, or damage, from these activities where the Manta Rays might have otherwise survived or escaped largely unharmed (*see* Marshall & Bennett, 2010 at 1-2; *see also* Deakos, *et al.*, 2011 at 257; Section IV. A. 5. "Fisheries and Resultant Marine Debris," *supra*; Section IV. E. 5. "Heavy Maritime Traffic," *infra*).

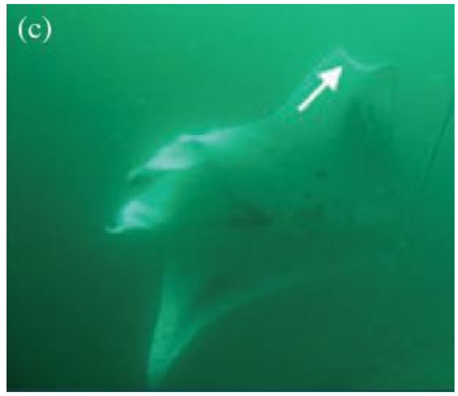

Figure 45. Reef manta ray with a distinctive shark bite on its wing (Mourier, 2012 at 4).

Approximately 1 in 4 observed reef manta ray individuals (24%) in Maui, Hawaii has visible injuries from shark attacks (Deakos, *et al.*, 2011 at 254, 256). "Although males and females were equally likely to possess these injuries, adult males were 10 times more likely to have these injuries compared with juvenile males." (Deakos, *et al.*, 2011 at 254). This may be due to differential habitat preferences amongst age classes, longer exposure times over individuals' lifetimes, or a greater likelihood of older, larger individuals surviving shark attacks as fatal attacks on juveniles would typically go undetected in a photo-identification study such as this (Deakos, *et al.*, 2011 at 256-57). When juveniles are discounted, 30% of the males in this population had shark-related injuries (Deakos, *et al.*, 2011, at 254). The effects of this predation on the species in this area is thus likely to be severe.

In Mozambique, an incredible 283 of the 371 reef manta rays observed between May 2003 and March 2006 (76.3%) exhibited shark bite wounds (Rohner, *et al.*, 2013 at 163; Marshall & Bennett, 2010 at 3). In total, 571 bite injuries were observed on the 283 individuals that had any bite injuries (Marshall & Bennett, 2010 at 1). The number of bite injuries varied from one to seven, with a mean of 1.54 ± 1.37 bite wounds across the population (Marshall & Bennett, 2010 at 1, 3). However, the scar-bearing rays exhibited a mean 2.02 ± 1.22 bite marks per individual (Marshall & Bennett, 2010 at 3). "The frequency of the entire population with two or more bites was 42.6% whereas for predatory scar bearing rays . . . it was 55.8%." (Marshall & Bennett, 2010 at 3). While this shows that many reef manta rays were bitten multiple times, it also may show an increased susceptibility to predation by sharks for individuals that have already suffered one attack. In addition, 25% of observed individuals with healing wounds had two or more bites that were in similar stages of healing (Marshall & Bennett, 2010 at 6). "Multiple healing wounds on *M. alfredi* may simply reflect the susceptibility of injured rays to further predatory attacks from sharks other than the initial attacker, particularly if the initial injuries were severe, debilitating (e.g. damage to an eye), or acted as an attractant (e.g. trailing blood) making an individual more conspicuous or attractive to predators." (Marshall & Bennett, 2010 at 6). "Fresh wounds occurred throughout the year, with no obvious seasonality. The bull shark *Carcharhinus leucas* and tiger shark *Galeocerdo cuvier* are suggested as the primary mediators of attacks, although up to 11 other shark species are listed as potential attackers." (Marshall & Bennett, 2010 at 1).

While these numbers are already very high, "[o]ther minor marks, such as scrapes or pigment [discoloration] – although common – were not included in the analysis as they were generally superficial, not always quantifiable (i.e. number of bite attempts) or of indeterminable origin." (Marshall & Bennett, 2010 at 2 (citation omitted)). The inability to account for fatal attacks, the many bite marks on some individuals, and the decision not to count injuries that could not be definitively attributed to shark attacks thus indicate that shark attacks are even more common in this area than these very high statistical rates would imply (*see* Marshall & Bennett, 2010 at 7 ("Data from our study do suggest, however, that individual *M. alfredi* in this region will likely be the victim of a shark attack during the course of its lifetime, but cannot be determined what proportion of these attacks would result in fatalities.").

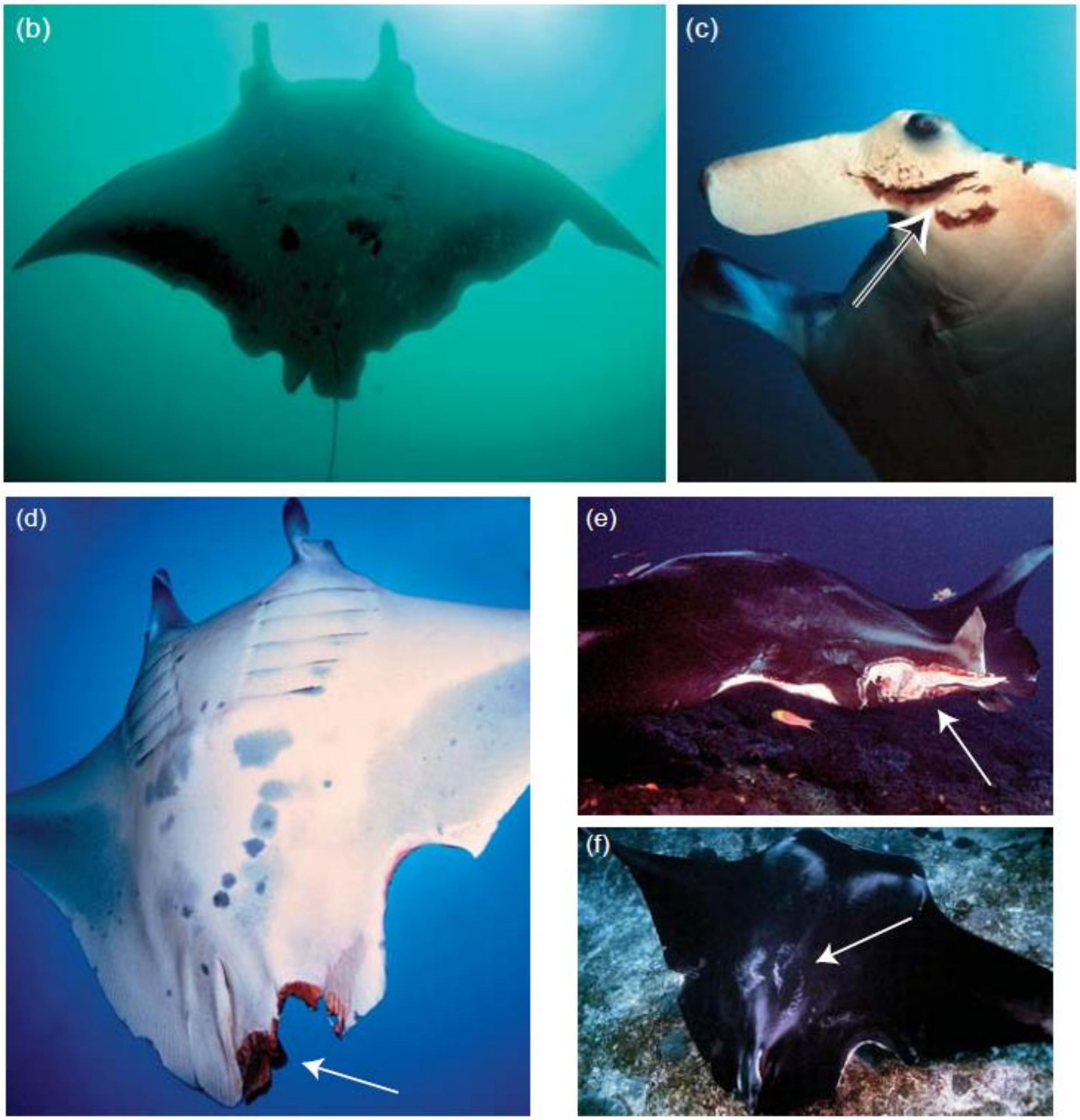

Figure 46. (b) multiple healed shark bite marks along the trailing edges of pectoral fins; (c) fresh shark bite wound on the face; (d) fresh bite wound to the trailing edge of the pectoral and pelvic fin; (e) large healing wounds; (f) healed bite marks to the trailing edge of the pectoral fins with arrow showing multiple superficial scars and scratches on the dorsal surface (quite possibly from shark attacks, but not included in the shark attack data for this study) (Marshall & Bennett, 2010 at 3).

The wounds that these Manta Rays receive, though they may partially heal, are permanent and remain visible and similar in shape and size to the original wound for the rest of the individual's life (Marshall & Bennett, 2010 at 2-3). These permanent wounds thus have the potential to reduce the affected individuals' fitness in both reproductive and other essential areas. One way in which shark attacks eliminate or impair reproductive ability is a result of where nearly all bite wounds are located. The vast majority of shark attacks on Manta Rays appear to be from sharks attacking the Manta Rays from the rear (*see, e.g.,* Marshall & Bennett, 2010 at 3 (finding over 96.3% of bite injuries occurring on the posterior section of the body); *see also* Deakos, *et al.*, 2011 at 257 (noting that 65 of 70 of the Manta Rays that exhibited shark bite wounds had them on the posterior sections of their body or wing tips, suggesting attacks typically occur from behind or from the side)). As a result, "the trailing section of the body at times appear[s] severely mutilated." (Marshall & Bennett, 2010 at 4). Sharks appear to use this strategy to avoid visual detection because Manta Rays, "with their laterally placed eyes and elongated pectoral fins, may have a blind spot posteriorly, making approaches from the rear potentially easier for predators." (Marshall & Bennett, 2010 at 6). However, this attack pattern is problematic for Manta Rays as this is where these species' genitals are located, with the calcified claspers of mature males in fact extending beyond the length of the pelvic fin and being especially exposed to attack and removal (*see* Deakos, *et al.*, 2011 at 249; *see also* Figure 47, *infra*; Figure 48, *infra*). As a result, many of these attacks affect these species' pelvic fin region and can damage the males' claspers, with injuries ranging from superficial abrasions to complete amputation of one or both claspers (Marshall & Bennett, 2010 at 4, 7). "The loss of both claspers would render a male ray reproductively non-functional. Serious or debilitating injuries may also have an [effect] on a male's ability to participate in mating activity." (Marshall & Bennett, 2010, at 7 (citation omitted)).

Figure 47. Photo of an immature male with an arrow pointing at its uncalcified claspers (Mourier, 2012 at 4). The location of these claspers, at the rear of the Manta Rays, makes these species' genitals susceptible to maiming by shark bites from behind.

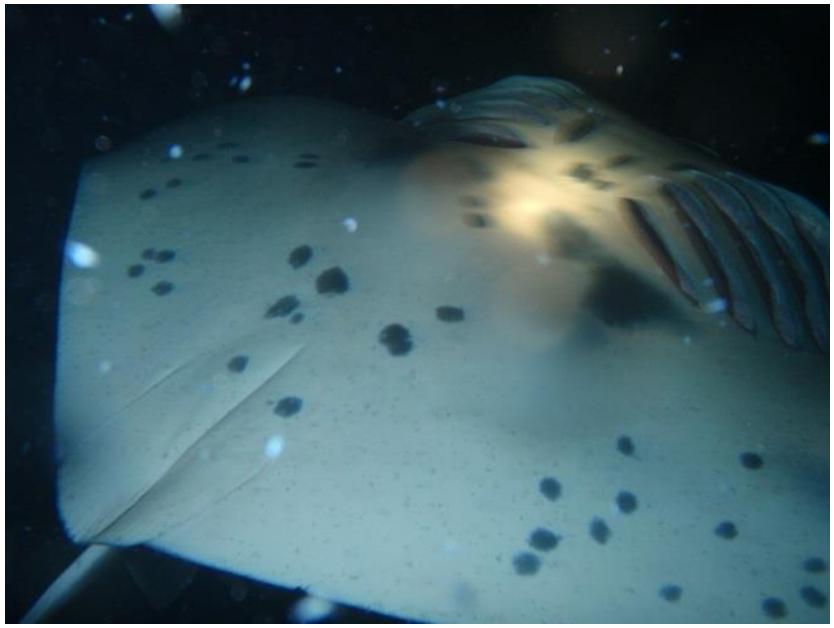

Figure 48. Another view of a Manta Ray's terminal claspers (Photo Credit: Rosa Indenbaum)

> In addition to male rays, many female rays in [the Mozambique population] also sustained gross injuries to the pelvic fin region, resulting in disfigurement and the formation of extensive scar tissue around the cloaca. In extreme cases, such extensive disfigurement may hamper or prevent clasper insertion during mating attempts or even inhibit waste excretion. During the relatively short study period, two pregnant females that survived major shark attacks (evidenced by severe fresh injuries) were documented days after their attacks. During these re-sighting events the females were no longer pregnant and may have aborted their pups (mid-term) as a result of either their attack or extensive injuries. Manta rays that have been harpooned or caught in nets have been documented to abort their pups during the traumatic and often fatal events, a [behavior] that is also common in other batoids. Furthermore, [a 1989 study] reported that serious injuries to organisms may delay the mean age at first reproduction or prevent females from mating while recovering. Thus, whereas a shark attack or the resulting bite injuries may not always end in a fatality, the injuries inflicted by sharks may still negatively impact an individual's health, their ability to reproduce, or their reproductive [behavior].

(Marshall & Bennett, 2010, at 7 (citations omitted)). Many of the shark bite wounds that have been observed on Manta Rays are likely having a negative impact on their reproductive ability and general fitness (Marshall & Bennett, 2010 at 1). With shark attack wounds being so common, this will necessarily drive these species' reproductive ability down even further and will make them less able to replace lost individuals.

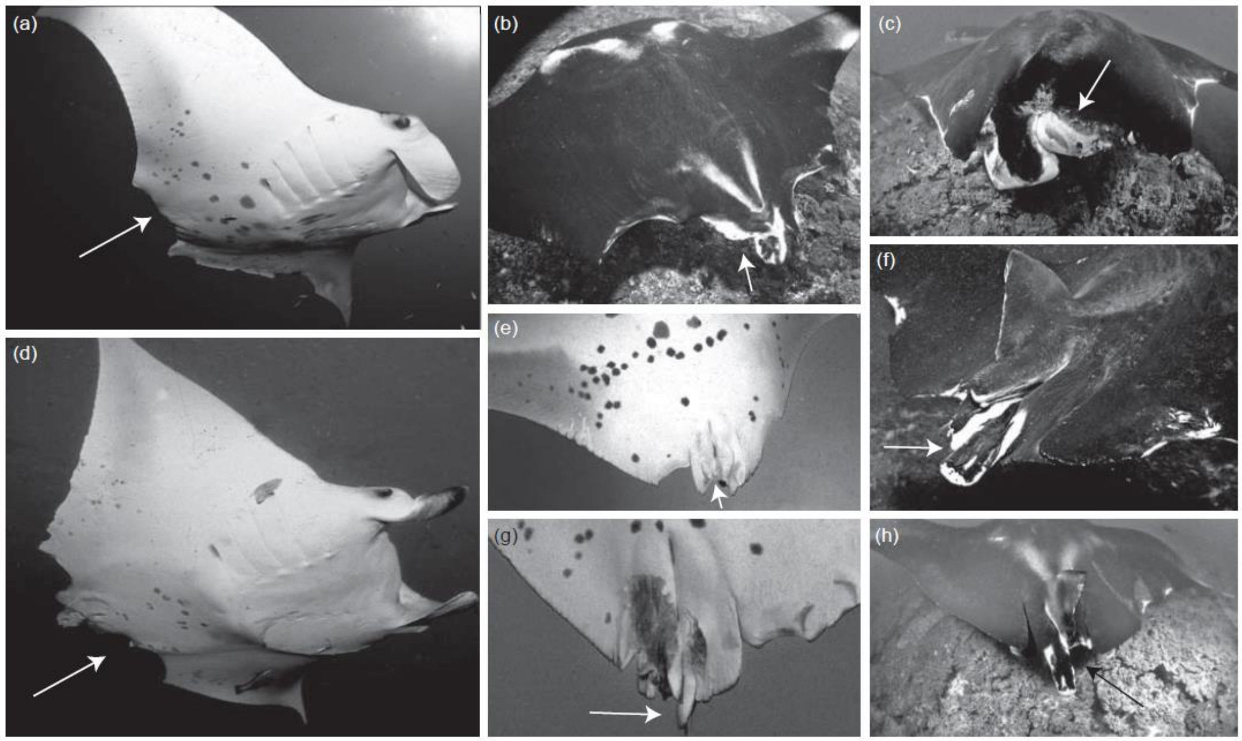

Figure 49. Injuries to the trailing edge of the pectoral and pelvic fins; (a–d) extensive injuries to female *M. alfredi* including the almost complete removal of pelvic fin area; (e–h) injuries to the trailing edges of male rays including the disfigurement or complete amputation of one or both claspers (Marshall & Bennett, 2010 at 5).

The extensive shark predations that these species face are likely at least part of the impetus for these species' frequent visits to reef-based cleaning stations as "removal of dead tissue around injuries [at the cleaning stations] is thought to facilitate wound healing and prevent secondary infection." (Rohner, *et al.*, 2013 at 163 (citation omitted)). Because the prevalence of these bite wounds appears to be an important driver of visits to reef-based cleaning stations, it is likely to cause increased aggregation in these areas, which will exacerbate the overutilization threats discussed in this Petition (*see* Section IV. B. 1. a. "Directed Fishing," *supra*; Section IV. B. 2. "Overutilization for Recreational Purposes," *supra*; Section IV. E. 1. "Aggregations, Site Fidelity, and Susceptibility to Localized Threats," *infra*). Furthermore, as coral reefs continue to decline, the cleaning stations will disappear as well (*see* Section IV. A. 1. "Coral Reef Loss," *supra*), hampering the Manta Rays' ability to heal from shark attacks. Therefore, this shark predation threat is likely to act synergistically with other threats to increase their cumulative impact on these species.

2. Orca Attacks

Orcas in Papua New Guinea waters have been observed feeding on Manta Rays (Visser & Bonoccorso, 2003 at 150).[68] The observed depredation was described as an orca emerging from deep water with an intact 2.1 meter Manta Ray upside down in its mouth, which it then shook, "tor[e] to pieces," and ate (Visser & Bonoccorso, 2003 at 152). There was also an additional, less

[68] This study refers to the species affected as giant manta rays, but it is a pre-differentiation study, so this may refer to reef manta rays instead.

detailed record of another Manta Ray predation in Papua New Guinea from this study (*see* Visser & Bonoccorso, 2003 at 165). In addition to these records from Papua New Guinea, orcas have been recorded feeding on Manta Rays in at least one other location (the Galápagos Islands) (*see* Visser & Bonoccorso, 2003 at 169 (citation omitted)). Regardless of the somewhat limited reports of orcas feeding on Manta Rays, there is no reason to assume that orcas would not opportunistically engage in this behavior wherever they co-occur with any of the Manta Ray species. Therefore, orca predation will potentially affect these species in all areas where Manta Ray and orca ranges are sympatric.

As with predation by sharks (*see* Section IV. C. 1. "Shark Attacks," *supra*), orca predation, though likely not an extinction threat on its own, is potentially causing cumulative and synergistic impacts to Manta Rays that are exacerbating the other threats that they are facing. Because Manta Ray populations are already depleted, they are still being overutilized, and they have limited ability to replace lost individuals (*see* Section III. G. "Population Trend," *supra*; Section IV. B. 1. "Overutilization for Commercial Purposes," *supra*; Section III. F. "Reproduction and Lifespan," *supra*; Section IV. E. 4. "K-Selected," *infra*), any additional mortality caused by orcas will harm Manta Ray populations. Therefore, predation by orcas is a serious threat to all Manta Ray species.

3. Parasites

Manta Rays often utilize cleaning stations where they solicit smaller fish to remove parasitic copepods from their body surface (*see, e.g.,* Deakos, *et al.*, 2011 at 247; Jaine, *et al.*, 2015 at 5; Rohner, *et al.*, 2013 at 155). These cleaning activities can take a considerable amount of time with some Manta Rays observed at these cleaning stations for up to 8 hours per day (*see* Rohner, *et al.*, 2013 at 155; Jaine, *et al.*, 2015 at 5). In fact, this appears to be the primary reason that Manta Rays visit certain inshore localities (*see* Jaine, *et al.*, 2015 at 5). This indicates that Manta Rays expend a significant amount of time and energy ridding themselves of parasites. Not only does that show that parasite infestation is a problem for these species in itself, and one which they go to great lengths to remedy, it also drives these species to inshore aggregation locations where they are increasingly susceptible to overutilization for a variety of purposes (*see* Section IV. B. 1. a. "Directed Fishing," *supra*; Section IV. B. 2. "Overutilization for Recreational Purposes," *supra*; Section IV. B. 3. "Overutilization for Scientific or Educational Purposes," *supra*; Section IV. E. 1. "Aggregations, Site Fidelity, and Susceptibility to Localized Threats," *infra*). Furthermore, as coral reefs continue to decline, the cleaning stations will disappear as well (*see* Section IV. A. 1. "Coral Reef Loss," *supra*), hampering the Manta Rays' ability to remove these parasites. Therefore, parasite prevalence is likely to act synergistically with other threats to increase the cumulative impacts on these Manta Ray species.

D. The Inadequacy of Existing Regulatory Mechanisms

The regulatory mechanisms, both species-specific and otherwise, that currently exist to protect Manta Rays are inadequate. This is in part due to the fact that

> There are no population assessments, official monitoring programs, or fisheries management measures for *Manta spp.* for the range States with the largest fisheries. Regional Fishery Management Organizations (RFMOs) have not adopted any binding measures specific to *Manta spp.* Incidental landings and discards are rarely recorded at the species level. *Manta spp.* are legally protected in a few countries and in some small

> Marine Protected Areas, and [some of the species are protected to some extent under two international agreements].

(*See* CoP16-Prop-46 at 3; CMS, 2014 at 2; CITES, 2014 at 1-3). However, these haphazard protections still leave these species vulnerable to many threats in many places. These threats include habitat threats like plastics and climate change and ongoing predation and parasitism that exacerbates the other threats that these species face (*see* Section IV. A. 1. "Coral Reef Loss," *supra*; Section IV. A. 2. "Plastics," *supra*; Section IV. A. 3. "Climate Change (Effects in Addition to Coral Reef Loss)," *supra*; Section IV. C. "Disease or Predation," *supra*). Additionally, IUU fishing is prevalent throughout the world (*see* NMFS, 2013 at 66-69). As a result, this IUU fishing will reduce the adequacy of every regulatory mechanism that could otherwise protect Manta Rays. NMFS should thus consider the effect of this IUU fishing on the adequacy of each regulatory mechanism whether it is explicitly addressed in the section discussing that regulatory mechanism or not. This section will detail the Manta Ray protections that exist and explain their inadequacy.

1. National Protection

Defenders strongly supports national measures for the conservation of species, and is in fact petitioning for one in the present case by requesting that NMFS list these three Manta Ray species under the ESA. However, none of the national measures that are currently in place are adequate to protect these Manta Rays and none displaces the need for ESA protections.

For instance, while some countries have banned capturing or killing Manta Rays, several of these laws define "Manta Ray" as *Manta birostris* (CMS, 2014 at 8). Where Manta Ray is defined in this way it would exclude protections for reef and Caribbean manta rays (*see* CMS, 2014 at 8). In addition, the national fishing bans that some countries have enacted can only offer protection in limited areas and will suffer enforcement related issues as long as a market for Manta Ray products exists. This is evidenced by the fact that, where Manta Ray fishing is prohibited in national EEZs, illegal fishing still occurs with these nations typically having little ability to effectively enforce their prohibitions (*see* CoP16-Prop-46 at 12 (discussing illegal fishing of Manta Rays in Mexico, the Philippines, and Komodo Marine Park, near Lamakera, Indonesia); *see also, e.g.,*, Stevens, 2011 at 7; Marshall, *et al.*, 2011 – 2 at 10-11; White, *et al.*, 2006 at 8; CoP16-Prop-46 at 9 (citations omitted); CMS, 2014 at 6 (citations omitted); Marshall, *et al.*, 2011 – 1 at 8). Because IUU fishing occurs extensively throughout the world, any attempted protections will necessarily be compromised by these illegal activities (*see* NMFS, 2013 at 66-69). In addition, existing regulatory mechanisms often provide protection from only certain threats, while leaving these species exposed to a variety of other sources of stress, exploitation, and/or death.

The various enforcement, and other, issues that countries have had protecting these species on national and local levels indicate the need for measures to prevent countries, including the United States, from providing financial incentives to capture and kill Manta Rays. By helping to remove the financial incentive to harvest Manta Rays, the United States can help prevent their ongoing overexploitation. By listing the Manta Rays under the ESA, the United States can help protect these species in its waters; prevent importation of these species into, and exportation of these species out of, the country; increase awareness of the plight of these species; and take other actions, such as recovery planning, which will provide conservation benefits to these species. The existing national and local regulatory protections currently in place for these species, which are discussed below, do not adequately provide these crucial benefits. Though the regulatory mechanisms discussed below often implicate the concerns addressed in this introductory section, repetition of these issues will typically be largely omitted, and instead should be treated as incorporated by reference, to avoid redundancy.

a. Australia (Western Only)

Both giant and reef manta rays are protected from fishing and harassment in Western Australia in marine parks only (CMS, 2014 at 9; Heinrichs, *et al.*, 2011 at 30). This appears to indicate that these species can be fished and harassed in all other areas in Western Australia and even in marine parks throughout the rest of the country. This is very problematic.

In addition, this protection appears to be insufficient even in the limited areas that it covers as Australian Manta Ray populations have been decimated by Indonesian fisheries (*see* Heinrichs, *et al.*, 2011 at 15). Manta Ray researchers "report dramatically decreased sightings of *M. birostris* over the past ten years. Where large seasonal groups of *M. birostris* were once seen migrating north up the coast, sightings are now rare." (CoP16-Prop-46 at 8). Because IUU fishing occurs extensively throughout the world, and in the waters around Australia specifically, Australia's attempted protections will necessarily be compromised by these illegal activities (*see* NMFS, 2013 at 66-69).

In response to unsustainable practices driving population declines in waters that they previously targeted, Indonesian fishermen began illegally targeting waters off North Australia in 2001, with a peak in spotted IUU fishing vessels occurring in late 2005 and early 2006 (*see* NMFS, 2013 at 66-67). "Since 2006, there has been a decline in IUU fishing in Australian waters, thought to be due to exhaustion of stocks in easily accessible regions near the Australian EEZ . . ." (NMFS, 2013 at 67 (citation omitted)). However, it is likely that Indonesia will resume its extensive IUU fishing of already-fished areas if stocks improve as they appear to move their fishing efforts around this region, depleting areas and then moving to new locations (*see* NMFS, 2013 at 66, 67 (indicating that decrease in IUU fishing is related to decrease in available fish and that the move into Australian waters was driven by fish depletions elsewhere) (citation omitted)). Indonesian IUU fishing will continue to undermine any protections that Australia attempts to offer to Manta Rays as much, likely at least 44%, of their shark fishing effort, and by extension likely their Manta Ray fishing effort as well, in this region remains unreported (*see* NMFS, 2013 at 66; *see also* Figure 34, *supra* (showing Indonesian IUU fishing in and around the Australian EEZ)).

Therefore, not only does Australia's current regulatory mechanism cover a limited area and protect Manta Rays from only some of the threats that they are facing, but it also has proven insufficient to protect these species from even the limited scope of threats that it covers. While this regulatory mechanism likely represents some level of protection, it is clearly inadequate to halt these species' precipitous declines, even in Australian waters.

b. Brazil

In 2013, "the directed fishing and marketing of species, products and by-products of [mobulids were] prohibited in Brazilian waters and national territory." (Medeiros, *et al.*, 2015 at 2 (citation omitted)). However, while laudable, this protection is likely to be difficult to enforce in Brazil. For example,

> In Belém, Brazil, in May 2012, the Brazilian Institute of Environmental and Renewable Natural Resources (IBAMA) seized around 7.7 [metric tons] of illegally obtained dried shark fins intended for export to China. A few months later, IBAMA confiscated more than 5 [metric tons] of illegal shark fins in Rio Grande do Norte, suggesting current regulations and enforcement are not adequate to deter or prevent illegal shark finning. In fact, it is estimated that illegal fishing constitutes 32 percent of the Southwest Atlantic region's catch (based on estimates of illegal and unreported catch averaged over the years of 2000 – 2003).

(NMFS, 2013 at 69 (internal citations omitted)). This indicates the difficulty that Brazil has had in halting illegal harvesting of prohibited marine products in the past and indicates that enforcement difficulties of the mobulid ban are also likely. In addition, these fact make it clear that illegal trade routes to China, the major consumer of Manta Ray gill rakers (*see, e.g.,* Heinrichs, *et al.*, 2011 at 4 (as much as 99% of the global market for manta and mobula gill rakers passes through Guangzhou, China alone)), are already established. Furthermore, even if Brazil were successful in stopping Brazilian fishermen from targeting Manta Rays, this entire region undertakes massive IUU fishing (*see* NMFS, 2013 at 69) and other nations would likely continue to harvest Manta Rays in spite of Brazil's ban, both within Brazilian waters and outside of them. As such, enforcement difficulties will greatly reduce the effectiveness of this ban. This protection would also not prevent bycatch or any of the other threats that these species face and it is therefore inadequate to protect these species even in the limited area that it covers.[69]

c. Ecuador

Defenders applauds Ecuador for taking a leadership role in protecting Manta Rays (in addition to its national protection discussed here, Ecuador also submitted a successful proposal to list giant manta rays on Appendices I and II of the Convention on Migratory Species of Wild Animals ("CMS") (Heinrichs, *et al.*, 2011 at 34; *see also* Section IV. D. 5. b. "CMS," *infra*)). Recently-passed Ecuadorian national legislation prohibits directed fishing for giant manta rays in the nation's waters (Marshall, *et al.*, 2011 – 1 at 13).[70] Bycaught individuals must also be returned to their natural environment immediately and the species cannot be retained (alive or dead, in whole or in part) or kept for human consumption or owned, sold, or transported in Ecuador (Marshall, *et al.*, 2011 – 1 at 13). This law was a response to a directed mobulid fishery driven by Peruvian buyers ordering these

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[69] For example, there is evidence that diving in the Brazilian giant manta ray aggregation site during the "Manta Ray season" is a popular attraction and that local dive agencies advertise trips based around the species during that time (*see* Luiz, *et al.*, 2009 at 96). Because recreational diving can disturb the species at aggregation sites (*see* Section IV. B. 2. "Overutilization for Recreational Purposes," *supra*), and because this disturbance would not be addressed by the Brazilian law (Medeiros, *et al.*, 2015 at 2 (indicating that the law only prohibits directed fishing and marketing of the species) (citation omitted)), the Brazilian law does not adequately protect the species from this, and any other non-directed catch and/or sale, threats.

[70] Note that, while this protection seems to only apply to the giant manta ray, this is likely not problematic as reef manta rays have not been reported from Ecuador (*see* CoP16-Prop-46 at 32). However, if reef manta rays are present in Ecuador, then this would be an additional weakness of this law.

species for export (Marshall, *et al.*, 2011 – 1 at 13).[71] This protection appears to have had some success decreasing landings (Heinrichs, *et al.*, 2011 at 34).[72]

Despite Ecuador's commendable efforts, these protections are insufficient to protect the species. Ecuador has had an ongoing problem with illegal fisheries operating in its waters (*see* NMFS, 2013 at 69). Not only does this increase the likelihood that illegal, directed fishing for giant manta rays will continue here despite their legal protection, but it also increases the likelihood that these species will be harmed incidentally by other unsustainable fishing practices in Ecuador. For instance, "[i]n a major *M. birostris* aggregation area [in Ecuador] where illegal drift gillnet and longline fisheries targeting wahoo are still prevalent, researchers have observed large numbers of manta rays with life threatening or debilitating injuries from entanglement [with the illegal wahoo fishing gear]." (Heinrichs, *et al.*, 2011 at 34 (citation omitted)). This illegal fishery is particularly problematic because it occurs in an important giant manta ray aggregation area and coincides with the giant manta ray aggregation season (*see* Marshall, *et al.*, 2011 – 1 at 11-12; Heinrichs, *et al.*, 2011 at 34). Additionally, a 2004 Ecuadorian ban on the exportation of shark fins resulted in the establishment of new, illegal trade routes to Peru and continued exploitation of sharks in Ecuadorian waters (NMFS, 2013 at 69). In fact, a 2007 sting operation intercepted 19,018 shark fins that were being smuggled over the border on buses from Ecuador to Peru (NMFS, 2013 at 69). This indicates that illegal trade routes already exist that would facilitate smuggling of illegally caught Manta Rays out of Ecuador. Finally, though fishing may have decreased in Ecuador, "these same animals are [still] targeted when they migrate south to Peru." (Heinrichs, *et al.*, 2011 at 32). The enforcement issues and illegal trade routes, as well as the other threats to the species that are outside of the scope of Ecuador's giant manta ray fishing ban, will necessarily limit the effectiveness of the protections that they have provided to the giant manta ray. As a result, these protections are inadequate.

d. Honduras

Honduras implemented a full ban on fishing for all elasmobranchs in 2010 (Heinrichs, *et al.*, 2011 at 30). This is an excellent measure and Defenders commends Honduras on passing this strong legislation. While the effective enforcement of this ban is unclear, because it only applies in Honduras it will necessarily be insufficient to adequately protect the giant manta rays that are present there, especially when those giant manta rays cross the border into other countries or move into international waters, even if it is adequately enforced in Honduras (*see* CoP16-Prop-46 at 21). In addition, it appears that this protection would only apply to a single population of Manta Rays (either giant or Caribbean manta rays based on the location) because only one population exists in Honduran waters (*see* CoP16-Prop-46 at 20; Figure 8, *supra*; Figure 9, *supra*). This regulatory mechanism is therefore unable to have the species-level effects that these imperiled Manta Ray species need to avoid extinction.

e. Indonesia

Indonesia will have significant enforcement issues with any protections that it seeks to implement because of the extreme amount of IUU fishing that takes place in its waters and because it has one

[71] It is unclear whether this fishery is the same as the small directed fishery that existed in Ecuador since the 1980s (*see* Marshall, *et al.*, 2011 – 1 at 11).
[72] In addition to the directed fishery referenced in this paragraph, Manta Rays have been incidentally captured in Ecuador over the years as well (Marshall, *et al.*, 2011 – 1 at 11).

of the largest Manta Ray fisheries in the world (*see* NMFS, 2013 at 66; CoP16-Prop-46 at 10 (citations omitted)). "In fact, Indonesian small-scale fisheries, which account for around 90% of the total fisheries production [in the Indian Ocean], are not required to have fishing permits . . ." (NMFS, 2013 at 66 (internal citations omitted)). Indonesian vessels also typically lack refrigeration, increasing the incentive to gill Manta Rays caught by those ships (*see* NMFS, 2013 at 66 (citation omitted) (lack of refrigeration encourages shark finning); CMS, 2014 at 2 (gilling); *see also* CoP16-Prop-46 at 3 (gilling) (citations omitted)). As a result of the fishermen's lack of oversight, much, likely at least 44%, of their shark fishing effort in this region remains unreported (NMFS, 2013 at 66). This lack of reporting is likely comparable for Manta Ray fishing.

One example of Indonesia's enforcement difficulties is its attempted protection of Manta Rays and other species in the Tangkoko Nature Reserve. Large net traps that were set in migratory channels for pelagic fish and marine mammals in the Tangkoko Nature Reserve caught 1,424 Manta Rays (in addition to many more sharks, whales, turtles, dugongs, and other species) between March 1996 and February 1997 (White, *et al.*, 2006 at 8 (citation omitted)).[73] In response to pressure from local activists and international exposure through the media, the use of these nets was banned in this area (White, *et al.*, 2006 at 8). However, they were almost immediately being used illegally again as early as September 1997 and are likely still being used today, both here and in new unmonitored locations (Marshall, *et al.*, 2011 – 2 at 10-11; *see also* White, *et al.*, 2006 at 8).

Indonesia passed much more comprehensive, species-specific legislation in 2014, prohibiting catch of both giant and reef manta rays in its territorial waters (Germanov & Marshall, 2014 at 1 (citation omitted); CMS, 2014 at 6, 15). However, due to Indonesia's history of enforcement difficulties, the strong financial incentives to continue targeting and/or retaining these species, and the prevalence of IUU fishing in Indonesia's waters, it is a virtual certainty that extensive targeting of these species and retention of bycaught individuals will continue. These concerns led Germanov & Marshall, 2014 to state that, despite this regulation, "[i]n reality . . . it may be a long time before all manta ray fisheries in Indonesia are completely shut down." (Germanov & Marshall, 2014 at 8).

Even if these measures were effective, they would likely just displace the Indonesian fishing pressure to other nearby waters that are unprotected and may be comparatively less exploited (*see, e.g.,* Figure 34, *supra* (showing extensive Indonesian IUU fishing in and around the Australian EEZ after overexploitation of fisheries in Indonesian waters forced Indonesian fishermen to exploit new areas)). Unsustainable fishing practices have been forcing Indonesian fishermen to continually seek areas that have not yet been depleted in this region before moving on when the fishery inevitably declines in the new area as well (NMFS, 2013 at 66). These practices, and resultant shark declines, have also caused these fishermen to begin targeting Manta Rays in increasing numbers, dooming them to the same face as the decimated shark populations (*see* Heinrichs, *et al.*, 2011 at 4, 16). There is no reason to believe that targeting of Manta Rays will not follow the same nomadic overexploitation path.

The apparent ongoing catch of Manta Rays even where that practice has been made illegal in Indonesian waters and the historical pattern of shark targeting here indicate that IUU catch and unsustainable fishing practices will severely hamper Indonesia's protective efforts for Manta Rays. This indicates that even the ostensibly sweeping protection that Indonesia has afforded to these

[73] Again, note that this is likely a large underestimate as this covers only reported landings and Indonesian landings are typically unreported (*see, e.g.,* NMFS, 2013 at 66-67).

species is inadequate to protect them against the threats that they face, both in Indonesia and beyond.

f. Maldives

In June 1995 the Republic of Maldives banned the export of all ray species and their body parts (CMS, 2014 at 15; Marshall, *et al.*, 2011 – 1 at 12; Marshall, *et al.*, 2011 – 2 at 11). However, this export ban does not include a total ban on ray catching "in recognition of the traditional rights of fishermen." (Anderson, *et al.*, 2010 at 23 (citation omitted)). In addition to the export ban, these species are provided with indirect protection because "most types of net fishing (including pelagic gillnetting, trawling, and purse seining) have long been banned, to protect the interests of the traditional pole and line tuna fishermen." (Anderson, *et al.*, 2010 at 23). At least as of 2010, a major Manta Ray fishery does not appear to have developed in the Maldives (Anderson, *et al.*, 2010 at 23).

Defenders commends the Maldivian government's foresight and success in preventing large-scale export-based fishing of these species. However, the lack of a total ban on fishing does weaken the effectiveness of this protection. In addition, it appears that the Manta Rays that are in the Maldives are much less fecund than elsewhere in their range. The Manta Rays there appear to have the latest age at maturity (15 years or more) and the longest reproductive periodicity (one pup every seven years) of any known Manta Ray population (*see* CMS, 2014 at 3 (citations omitted); Section III. F. "Reproduction and Lifespan," *supra*). To further complicate this issue, environmental factors have led to a complete cessation of pregnant females in the Maldives in recent years (*see* Dulvy, *et al.*, 2014 at 12 (citation omitted)).

> In the Republic of Maldives, over the past two years, despite intensive directed research, there has not been a single recorded pregnancy amongst a subpopulation of over 870 individually identified mature female *M. alfredi*. This [complete lack of documented] pregnancies correlates directly with un-seasonally weak monsoonal winds in the region, which should drive the nutrient upwellings that lead to the rich productivity of the Archipelago upon which the manta ray directly depend. These broad scale fluctuations in the productivity of the Maldivian waters are reflected in catch rates of the local tuna fishery, which have been linked to wider climatic patterns such as the El Niño Southern Oscillation (ENSO).

(CMS, 2014 at 7; Dulvy, *et al.*, 2014 at 5 (citation omitted)). "Similar patterns of skipped reproduction have been noted in Japanese waters." (Dulvy, *et al.*, 2014 at 5 (citation omitted)). Therefore, even where these species are not subjected to extensive targeted fishing, lack of reproduction can drive population declines as well. A recent study estimates that mobulid rays, including Manta Rays, "are the pelagic species most vulnerable to climate change, since plankton, a primary food source, may be adversely affected by the disruption of ecological processes brought about by changing sea temperatures." (CMS, 2014 at 7 (citation omitted); Heinrichs, *et al.*, 2011 at 14 (citation omitted)). As emissions continue and climate change progresses, this threat will only become more serious and further harm these species. The protection against export in the Maldives cannot stem this threat.

Further, the law has major shortcomings because it only protects against directed fisheries that would export captured individuals. It does not prevent bycatch, targeted catch for local consumption, or any of the other threats that these species face. These other threats include disruptive tourism practices that can harm Manta Rays by interrupting their essential life history activities, subjecting them to increased risk of boat strikes and mooring line entanglements, and subjecting them to other threats brought about by excessive tourism (*see* Section IV. B. 2. "Overutilization for Recreational Purposes," *supra*). Because swim with the mantas programs are already extremely popular in the Maldives, with their popularity expected to continue growing (*see* Section IV. B. 2. "Overutilization for Recreational Purposes," *supra*), this is a very real threat to these species that is not addressed by the export ban. Finally, because the Maldives is surrounded by many countries with very active Manta Ray fisheries and because it is located in the Indian Ocean, where IUU fishing is rampant, it is likely that it will experience at least some violations of its law by foreign fishermen, especially as Manta Ray populations quickly decline and/or become extirpated from surrounding areas (*see* Section IV. B. 1. a. ii. "Indo-Pacific," *supra*; Section IV. B. 1. a. iii. "Indian Ocean," *supra*; Section III. G. 3. "Indo-Pacific," *supra*; Section III. G. 4. "Indian Ocean," *supra*). These facts indicate that the Maldives' regulation of Manta Ray catch is inadequate to protect these species.

g. Mexico

Killing or capturing *giant manta rays* in Mexican waters and possession or trade in that species has been illegal in Mexico since 2007 (Marshall, *et al.*, 2011 – 1 at 12-13). However, this is problematic because it appears that this protection would only apply to giant manta rays and not Caribbean manta rays (also present in Mexican waters) (*see* CoP16-Prop-46 at 32; Heinrichs, *et al.*, 2011 at 34; Figure 8, *supra*; Figure 9, *supra*). This law would therefore leave Mexican fishermen free to kill, capture, possess, and trade Caribbean manta rays in any number without violating the law. In addition to its limited applicability, this law also seems to have been inadequately enforced to date as illegal Manta Ray fishing has been reported in Mexico (*see* Graham, *et al.*, 2012 at 4 (citation omitted); CMS, 2014 at 9 (citations omitted)). This targeted capture, and bycatch, is particularly problematic for the Caribbean manta ray as it appears to take place on the Yucatan Peninsula, an important aggregation area for the species, with killed individuals used for food and shark bait (Graham, *et al.*, 2012 at 4 (citing a report of illegal fishing from a fisherman in Quintana Roo (a Mexican state on the Yucatan Peninsula that borders the most southern extent of the Mexican Caribbean)); *see also* CMS, 2014 at 6; CoP16-Prop-46 at 9 (citation omitted)). "Bycatch [in Mexico more generally] may [also] be significant due to the high volume of commercial fisheries using drift gillnets and longlines." (Heinrichs, *et al.*, 2011 at 34). Though less information on illegal catch exists for Mexico's Pacific coast, this may be due to decimation of the giant manta ray population there as evidenced by the commercial extinction of the species in the Sea of Cortez (*see* CoP16-Prop-46 at 7 (citations omitted)). Ultimately, attempts at conservation in Mexico appear to have been problematic thus far.

In addition to this Manta Ray-specific data, it is also clear that Mexican IUU fishing in general is rampant in the giant and Caribbean manta rays' Mexican habitat. As discussed in Section IV. B. 1. a. iv. 2. "Giant and/or Caribbean Manta Rays, *supra*, illegal fishing by Mexican vessels in the Gulf of Mexico has been occurring around South Padre Island, Texas since at least the mid-1990s (*see* NMFS, 2013 at 68). This IUU fishing includes illegal shark finning with fishermen catching anywhere from 3 to 56% of the total U.S. commercial shark quota, and between 6 and 108% of the Gulf of Mexico regional commercial quota (*see* NMFS, 2013 at 68). Because these fisheries are taking place in giant and Caribbean manta ray habitat (*see* Figure 8, *supra*; Figure 9, *supra*) and there has been a documented trend towards shark fishermen targeting Manta Rays as shark populations are reduced (*see* Heinrichs, *et al.*, 2011 at 4, 16), it is highly likely that these IUU fishermen are also targeting, and/or retaining bycaught, giant and Caribbean manta rays as part of this fishery. In addition, though the available IUU fishing data relates to fishing in U.S. waters, the extent of this known IUU fishing indicates that Mexican fishermen are also likely engaging in significant additional, but as yet unknown, IUU fishing in Mexican and surrounding waters as well, further decreasing the adequacy of Mexico's ban.

h. New Zealand

The giant manta ray is protected in New Zealand (Heinrichs, *et al.*, 2011 at 30; Wildlife Act, 1953, at 132; *see also* CoP16-Prop-46 at 32).[74] However, it appears that there is only one population of giant manta rays in New Zealand and that this population is at the far southern extreme of the species' range (CoP16-Prop-46 at 20). Because it is so far south, this is likely marginal, temporary habitat, indicating that few individuals likely use this area. To the extent that this protection only covers a relatively small number of individuals at certain times of the year, it will have little impact on extinction risk. Though Defenders compliments New Zealand on its strong protection of this species, it appears unlikely that it will have significant effects on the conservation of the species as a whole. In addition, to the extent that New Zealand is subject to similar pressures from outside actors as Australia is (*see* Section IV. D. 1. a. "Australia (Western Only)," *supra*), then it may experience poaching, perhaps in severe, population-level amounts, in violation of this law. Finally, though this law prohibits targeting and retention of bycaught giant manta rays, it seems that it would not protect against many of the habitat, predation, and other threats that the species faces. As a result, this regulation appears to be inadequate to protect the species, even in the limited area that it covers. In the absence of evidence to the contrary of these assertions, NMFS should not assume the adequacy of this law.

i. Philippines

The Philippines has banned the catching and selling of giant manta rays whether dead or alive, in any state or form, whether raw or processed (Verdote & Ponzo, 2014 at 2). This ban was initially passed in 1998, but was lifted in 1999 due to pressure from fishermen and a lack of data (Marshall, *et al.*, 2011 – 1 at 12; Marshall, *et al.*, 2011 – 2 at 12). The ban was later re-established (Marshall, *et al.*, 2011 – 1 at 12; Marshall, *et al.*, 2011 – 2 at 12), but it only covers giant manta rays and is inapplicable to reef manta rays (*see* CoP16-Prop-46 at 32 (giant manta rays only); Verdote & Ponzo, 2014 at 2 (giant manta rays only)). This is problematic because both giant and reef manta rays are present in the Philippines (CoP16-Prop-46 at 32). The source of this omission appears to be the facts that this law was passed prior to the separation of giant and reef manta rays and because "formal investigation into *M. alfredi* presence [in the Philippines] only began in 2013." (*See* CoP16-Prop-46 at 32; Verdote & Ponzo, 2014 at 2). This law therefore leaves reef manta rays completely unprotected in the Philippines.

While the inapplicability of this law to reef manta rays is clearly problematic, it appears that this law has been insufficient to protect either species in practice. Despite this protection, illegal landings and trade of Manta Rays have continued to be reported from the Philippines (CoP16-Prop-46 at 11, 12 (citation omitted); CMS, 2014 at 7 (citations omitted)). "Traders in Hong Kong continue to

[74] Note that, while this protection seems to only apply to the giant manta ray, this is likely not problematic as reef manta rays have not been reported from New Zealand (*see* CoP16-Prop-46 at 32). However, if reef manta rays are present in New Zealand, then this would be an additional weakness of this law.

report the Philippines as a supplier of dried gill rakers, indicating that an active gill raker trade may still continue in the Philippines." (Heinrichs, *et al.*, 2011 at 34; *see also* CoP16-Prop-46 at 11).

In addition, Manta Rays "are now reported to be rare in the Philippines, especially around the Bohol Sea where the fishery was focused." (Marshall, *et al.*, 2011 – 1 at 12; Marshall, *et al.*, 2011 – 2 at 12). This indicates that more proactive measures are likely needed to restore these species. These protections should address threats in excess of those addressed by the current ban to holistically protect these species from the variety of threats that they face. Ultimately this ban is inadequate to protect the Manta Rays.

2. MPAs

Several countries have developed MPAs that offer some level of protection to Manta Rays located therein. However, while Defenders commends the creation of these MPAs, they can only offer protection in these limited areas and will suffer enforcement related issues as long as a market for Manta Ray products exists. Examples of illegal fishing and ongoing Manta Ray population declines have been documented in various protected areas including Isla del Coco off Costa Rica and the Komodo Marine Park near Lamakera, Indonesia (*see* NMFS, 2013 at 68-69; White, *et al.*, 2015 at 8-10; CoP16-Prop-46 at 12). While MPAs are vital to marine biodiversity conservation, they cannot be assumed to be sufficient regulatory protections for overexploited species and, indeed, in most cases are entirely insufficient, even on a local level, to protect Manta Rays.

"In general usage, MPA is a broad umbrella term for 'any area of intertidal or sub-tidal terrain, together with its overlying waters, and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment.'" (Breen, *et al.*, 2015 at 75 (citation omitted)). While MPAs, where adequately enforced, may offer some level of protection from initial capture, such localized protections can indirectly cause harm to species if impacts to biodiversity are merely displaced (*see* Baum, *et al.*, 2003 at 391). "In some models, for example, undesirable effects of MPAs can occur, such as the redistribution of fishing effort to previously pristine habitats . . ." (Breen, *et al.*, 2015 at 80 (citation omitted)). "Clearly [then], if [MPAs] are to be effective, their placement is of critical importance . . ." (*see* Baum, *et al.*, 2003 at 391). However, "MPAs are often the conservation of a political opportunity rather than any unique biological feature and rarely has sufficient science come into the planning." (Dulvy, 2013 at 359 (citation omitted)). The idea is often to "get what you can where you can annoy as few people as possible." (Dulvy, 2013 at 359 (citations omitted)). Therefore, "MPAs are alluring because there is no apparent need for science to guide their designation because the concept of ring-fencing or banking biodiversity is intuitive to anyone, hence easy to sell as the least-complicated 'magic bullet' solution." (Dulvy, 2013 at 359 (citation omitted)). This lack of careful siting is a significant weakness of MPAs and reduces their conservation value.

The level of protection in MPAs also varies from nearly complete no entry zones to areas of only partial protection (e.g. MPAs that focus only on benthic species or only on limiting one type of fishing gear or activity) (Devillers, *et al.*, 2014 at 2, 7 (citation omitted); Dulvy, 2013 at 359). In fact, "[m]any marine protected areas are not sanctuaries in the sense that the animals inside are safe from fishing (and other damaging activities) . . . and this important subtlety is often not readily apparent to the general public." (Dulvy, 2013 at 359). Currently only a small percentage of MPAs are no take zones, estimated as covering only 0.1% of the world's oceans, and thus the majority still allow some degree of exploitation (Devillers, *et al.*, 2014 at 2, 7 (citation omitted)). As a result, "MPA effectiveness can be variable, depending on the objectives of management, appropriateness of zoning, and levels of compliance, and marine ecosystem types are very unevenly represented within MPAs." (Devillers, *et al.*, 2014 at 2 (citation omitted)). Where Manta Rays are present in MPAs still allowing some exploitation or without adequate enforcement, their safety cannot be assured. In addition, because all three Manta Ray species undertake daily diurnal migrations (using inshore environments like shallow reef cleaning stations and coastal feeding grounds during daylight hours and deeper water/offshore habitats in the evening hours), migrations into heavily fished offshore waters will put these species at risk even if they are adequately protected in inshore habitats, or vice versa for offshore MPAs and inshore fishing (*see* CMS, 2014 at 5). These MPAs, even where otherwise sufficient, can only protect these species when they are within the MPA. Because Manta Rays will often have ranges that extend beyond MPA boundaries, this will reduce the effectiveness of any MPAs that do exist.

While many MPAs are located in national waters, mostly covering continental shelves and equivalent areas, there has been a recent trend in creating large, remote MPAs, which raises questions about whether this type of MPA is sufficient to protect global marine biodiversity (Devillers, *et al.*, 2014 at 2 (citations omitted)). While these inshore and large, remote MPAs overlap some Manta Ray habitat (*see* CoP16-Prop-46 at 13 ("Some *Manta spp.* critical habitats occur inside marine protected areas, but there is little or no comprehensive protection for most coastal and high seas habitats.")), these MPAs will often not have a significant effect on fishing pressure for Manta Rays because they are generally designed to avoid impacting extractive uses of the oceans. Marine reserves are residual where their location intentionally mirrors areas that are least appealing for extractive uses, including fishing (Devillers, *et al.*, 2014 at 4 (citation omitted)). "Residual reservation arises from an implicit or explicit policy of locating MPAs to minimize the opportunity costs to those people engaged in extractive uses of the land and sea, even though many of the important threats to . . . marine biodiversity arise from those extractive uses." (Devillers, *et al.*, 2014 at 4 (citation omitted)). This risks the perverse outcome that "protection avoids the more heavily used and costly areas (in financial and/or political terms) and is not afforded to biodiversity most in need of protection." (Devillers, *et al.*, 2014 at 5 (citation omitted)). Current large MPAs show a clear bias towards protecting areas that are already subjected to below-average fishing pressure (Devillers, *et al.*, 2014 at 8, 17 (citation omitted)). As such, they will have little effect on catch, even if it is possible to somehow police restrictions in these massive areas of the ocean (Devillers, *et al.*, 2014 at 16 ("Too often, the establishment of protected areas is seen as equivalent to effective protection, and very often this conflation of ideas is mistaken. Protected areas fail in their basic purpose to the extent that they are residual to extractive uses. A strong focus on minimizing the opportunity costs of MPAs, combined with limited biological data and highly generalized conservation objectives, entails the considerable risk of pushing 'protection' into residual parts of the ocean.")).

While effective MPAs can be extraordinarily successful, "there are surprisingly few clear examples of MPA success." (Dulvy, 2013 at 359 (citations omitted)). Where MPAs offer little or no additional protection, they can actually facilitate additional reductions in biodiversity. This is because, where these MPAs offer insufficient protections, they become "paper parks," "promis[ing] much hope but . . . deliver[ing] little more than a false sense of security or veneer of success." (Dulvy, 2013 at 359; *see also* Breen, *et al.*, 2015 at 79). "One possible risk is that the paper park alone is perceived to be a conservation success, in terms of protecting species and sustaining fisheries. After all why do we need more conservation when there is an MPA there already?" (Dulvy, 2013 at 360 (citation omitted); *see also* Devillers, *et al.*, 2014 at 22 ("[R]eaching targets defined by the extent of MPAs, or even targets related to representation of marine features, can give governments, NGOs and the public a false sense of achievement for conservation, with potentially perverse outcomes for marine biodiversity.")). Therefore, to the extent that these MPAs are unsuccessful, they may actually represent a net conservation loss for the Manta Rays. These complications counsel for creation of additional MPAs with strong protections as a complement to other regulatory mechanisms and against reliance on MPAs alone as a means to restore and protect biodiversity in general and Manta Rays in particular. ESA protection should be a part of this complementary protection scheme. Though the protected areas discussed below often implicate the concerns addressed in this introductory section, repetition of these issues will be largely omitted, and instead should be treated as incorporated by reference, to avoid redundancy.

a. Australia (Western Only)

Both giant and reef manta rays are protected from fishing and harassment in Western Australia in marine parks (CMS, 2014 at 9; Heinrichs, *et al.*, 2011 at 30; Marshall, *et al.*, 2011 – 1 at 13). Defenders incorporates its discussion of the weaknesses of this protection from Section IV. D. 1. a. "Australia (Western Only)," *supra* here by reference to avoid repetition. In addition to the aforementioned weaknesses, it does not appear that these marine parks were designed to protect Manta Rays, so they are likely not sited in a way that is ideal for the protection of these species and may not cover them when they migrate (seasonally or otherwise). Not only does this regulation cover a limited area and protect from only some of the threats that these species are facing, but it also has proven insufficient to protect these species from even the limited threats that it covers. While it likely represents some level of protection, it is clearly inadequate to halt these species' precipitous declines in this region.

b. Brazil

In Brazil, the best known giant manta ray aggregation site happens to be inside an established MPA (Marshall, *et al.*, 2011 – 1 at 13). "However, it is a tiny fraction of the range of this species, as they migrate during most of the year and other unprotected aggregation sites are likely to exist." (Marshall, *et al.*, 2011 – 1 at 13). In addition, it is unclear what level of protection they are afforded in this MPA and how effective the enforcement of protections in this MPA are. This is a valid concern because IUU catch is prevalent, both in Brazil and in the Southwest Atlantic regionally (NMFS, 2013 at 69 (citations omitted)). Therefore, though the species appear to receive some protection in this MPA, it is inadequate to protect the species in Brazilian waters or, of course, elsewhere.

c. Costa Rica

Costa Rica is home to one of the world's oldest MPAs, the Cocos Island National Park, which is a small, uninhabited island 550 kilometers from mainland Costa Rica in the eastern tropical Pacific (White, *et al.*, 2015 at 2 (citations omitted)).

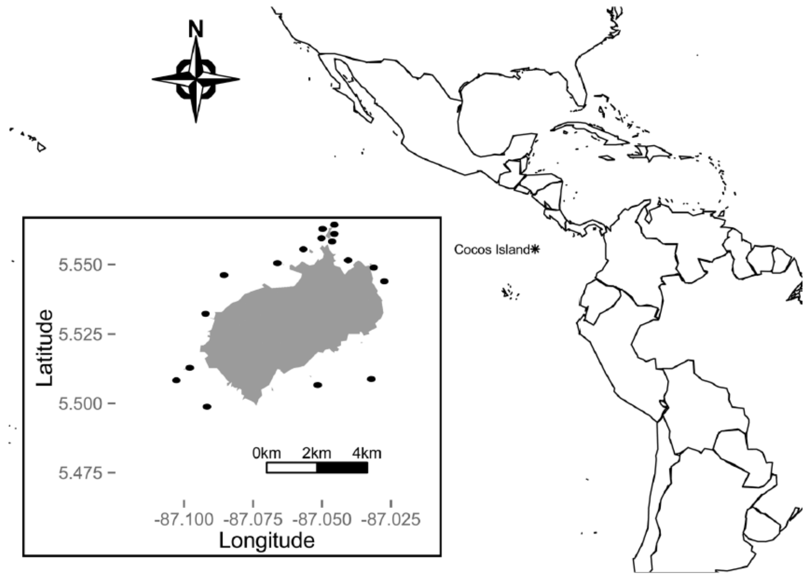

Figure 50. Cocos Island MPA location (White, *et al.*, 2015 at 3).

This area is presently protected to a distance of 22.2 kilometers from the island's shores (White, *et al.*, 2015 at 2 (citations omitted)).

> Although Cocos Island has been protected for over 20 years, with a permanent ranger station in place since 1992, funding for monitoring and enforcement has been limited. Since 2003, however, in conjunction with the Costa Rican Coast Guard, the Mar-Viva Foundation, a regional nonprofit nongovernmental organization (NGO), has patrolled the island. However, illegal fishing of large elasmobranchs still occurs within the park's waters. More broadly, sharks and rays are heavily fished both legally and illegally as targets and bycatch throughout the eastern tropical Pacific.

(White, *et al.*, 2015 at 2 (citations omitted)). In addition, Costa Rican ships have been caught engaged in large shark massacres in a nearby Columbian wildlife sanctuary (NMFS, 2013 at 69). "The divers [that exposed this massacre] counted a total of 10 illegal Costa Rican trawler boats in the wildlife sanctuary and estimated that as many as 2,000 sharks may have been killed for their fins." (NMFS, 2013 at 69). This indicates that Costa Rican IUU catch is problematic in this region and that IUU catch within the MPA itself has been driving population numbers down in recent years.

A very recent study "examined data collected by a small group of divers over the past 21 years at [Cocos Island and] used mixed effects models to determine trends in relative abundance, or probability of occurrence, of 12 monitored elasmobranch species while accounting for variation among observers and from abiotic factors. Eight of 12 species declined significantly over the past 2 decades." (White, *et al.*, 2015 at 1). This study "documented decreases in relative abundance for 6 species, including the iconic scalloped hammerhead shark (*Sphyrna lewini*) (−45%), whitetip reef shark (*Triaenodon obesus*) (−77%), mobula ray (*Mobula* spp.) (−78%), and manta ray (*Manta birostris*) (−89%), and decreases in the probability of occurrence for 2 other species." (White, *et al.*, 2015 at 1). To be clear, despite having been protected in this MPA for the entire duration of the data set, the giant manta ray had declined by 89% (95% CI 85%–92%) at Cocos Island over 21 years (White, *et al.*, 2015 at 9). These declines were attributed to the "the multination fisheries in the eastern tropical

Pacific because [giant manta rays] have a large home range and low rebound potential." (White, *et al.*, 2015 at 10 (citation omitted)). This makes them less able to withstand overexploitation.

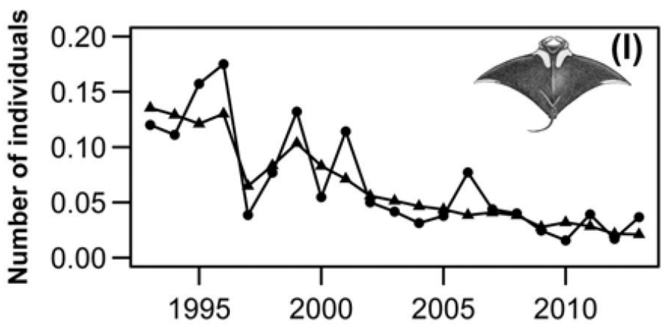

Figure 51. Observed data and model estimates of mean yearly number of individuals or mean probability of occurrence for manta rays at Cocos Island 1993-2013 (White, *et al.*, 2015 at 8).

> Although management efforts have increased in the past decade, illegal fishing still occurs within the island's waters. It is unclear if the Cocos Island MPA is even properly designed to protect . . . large and wide-ranging species. Conservation efforts at Cocos Island cannot be focused simply on expanding the protected area; rather, efforts should be put toward increasing enforcement and management. Costa Rica's efforts to increase their MPA coverage are admirable, but the establishment of MPAs cannot be the end point. Explicit plans and dedicated funding for monitoring and enforcement must be in place to prevent the creation of a network of paper parks. These plans need to include using both theory about MPAs and empirical data. Further, there must be stronger penalties for noncompliance with MPA rules to offset the potential gains of illegal fishing.

(White, *et al.*, 2015 at 10).

In addition to these overutilization threats, the MPA is also substantially affected every 4–9 years by El Niño Southern Oscillation ("ENSO") events (White, *et al.*, 2015 at 2 (citations omitted)). These events will therefore continue to periodically harm the species and exacerbate the overutilization threat they face here. The MPA is completely unable to mitigate the negative effects of these events. With these shortcomings and the giant manta ray's decline in the MPA in mind, it is clear that the Cocos Island MPA is not currently adequate to protect the species, either inside or outside of its boundaries.

d. Indonesia

In order to protect its burgeoning Manta Ray tourism industry from its Manta Ray fisheries, which are some of the most aggressive in the world, Indonesia has designated three Manta Ray sanctuaries (Germanov & Marshall, 2014, at 1). These sanctuaries are Raja Ampat, West Manggarai (which includes the Komodo National Park), and Nusa Penida (Germanov & Marshall, 2014, at 1). However, even if protections were adequately enforced in these MPAs, and they likely are not (*see, e.g.,* Section IV. B. 1. a. ii. "Indo Pacific," *supra*; Section IV. D. 1. e. "Indonesia," *supra*; Section IV. D. 2. d. iv. "Tangkoko Nature Reserve," *infra*; Marshall, *et al.*, 2011 – 2 at 10-11 (discussing illegal fishing situation at Tangkoko) (citation omitted); White, *et al.*, 2006 at 8 (discussing illegal fishing situation at Tangkoko)), these reserves would still be inadequate to protect these species. This is largely due to the fact that evidence indicates that these species often migrate out of these sanctuaries and into harm's way (Germanov & Marshall, 2014 at 1, 7-8 (citations omitted)). For example, by using photo identification information, one study showed that Manta Rays "migrated between regional sanctuaries such as Nusa Penida, the Gili Islands,[75] and the Komodo National Park (up to 450 [kilometers] straight-line distance). The areas between these sanctuaries are heavily fished and trafficked by ships, and when manta rays travel through these regions they risk being fished and injured by ship strikes." (Germanov & Marshall, 2014 at 1; *see also* Section IV. E. 5. "Heavy Maritime Traffic," *infra*). These sanctuaries therefore are failing to protect these species' migratory routes, leaving them open to threats when they leave the MPAs' protections (Germanov & Marshall, 2014 at 7-8). This study highlights "the need to work towards more comprehensive regional protection for these species in an area that is currently fraught with anthropogenic threats." (Germanov & Marshall, 2014 at 7). Therefore, these MPAs are inadequate to protect Manta Rays either within or outside their borders.

In addition, as discussed above, though "[r]ecent legislation has shown that Indonesia is taking the right steps forward to safeguarding their manta rays by prohibiting fishing throughout their entire exclusive economic zone (an area of over 6 million square kilometers)[, i]n reality . . . it may be a long time before all manta ray fisheries in Indonesia are completely shut down." (Germanov & Marshall, 2014 at 8). Therefore, this legislation's positive impact on the effectiveness of the sanctuaries addressed here should not be overestimated. Manta Ray fishing is ongoing and adequate enforcement of this prohibition unfortunately seems to still be far off. The concerns addressed in this introductory section will be largely omitted from the discussion of the individual sanctuaries, and instead should be treated as incorporated by reference, to avoid redundancy.

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[75] While Defenders has little information on the Gili Islands MPA, Defenders does know that it is very small and is composed of just a few islands off the coast of Lombok (*see* James Jay Tutchton Personal Comments October 10, 2015 (observations from a visit that he made to this location); *see also* Figure 53, *infra*). The MPA's small size, in combination with the information provided in this section (Section IV. D. 2. d. "Indonesia"), indicates that it would suffer from the same inadequacies that the other sanctuaries discussed in this section suffer from. In addition, the Gili Islands MPA does not appear to be a Manta Ray sanctuary, which indicates that it was likely not designed with the Manta Rays' needs in mind and which will further limit its efficacy. The Gili Islands MPA is therefore also inadequate to protect the Manta Rays from the many threats that they face in Indonesian waters.

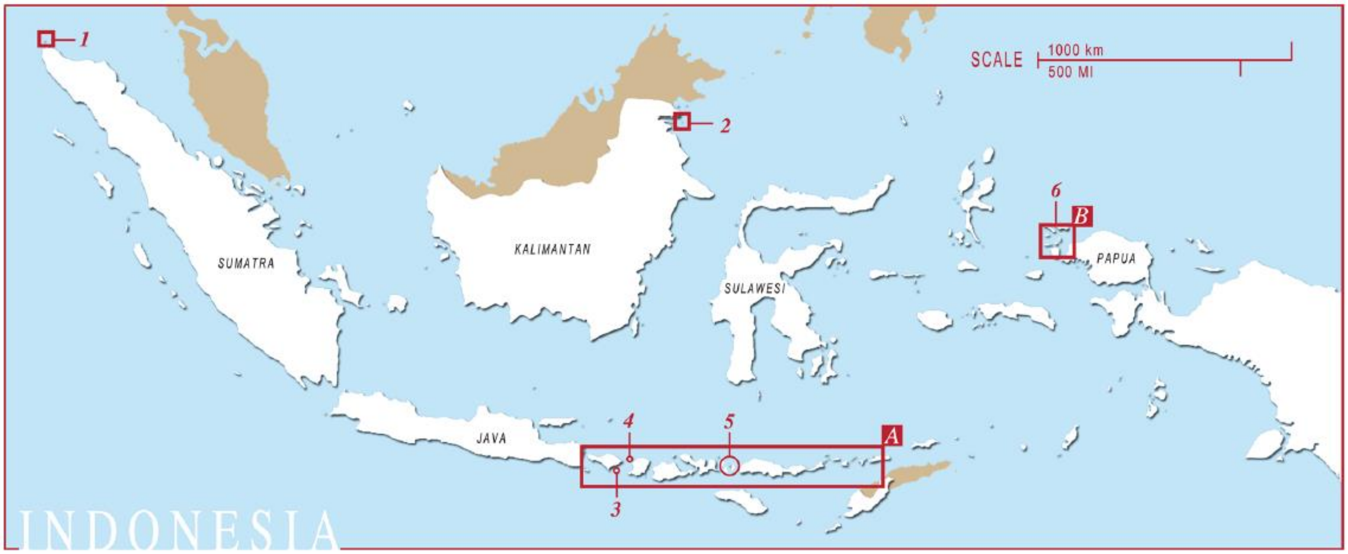

Figure 52. Map of Indonesia with the locations of reef manta ray encounters used in a study of reef manta ray migration in red. The Raja Ampat sanctuary is number 6, the West Manggarai and Komodo National Park sanctuary is number 5, and the Nusa Penida sanctuary is number 3 (Germanov & Marshall, 2014 at 2).

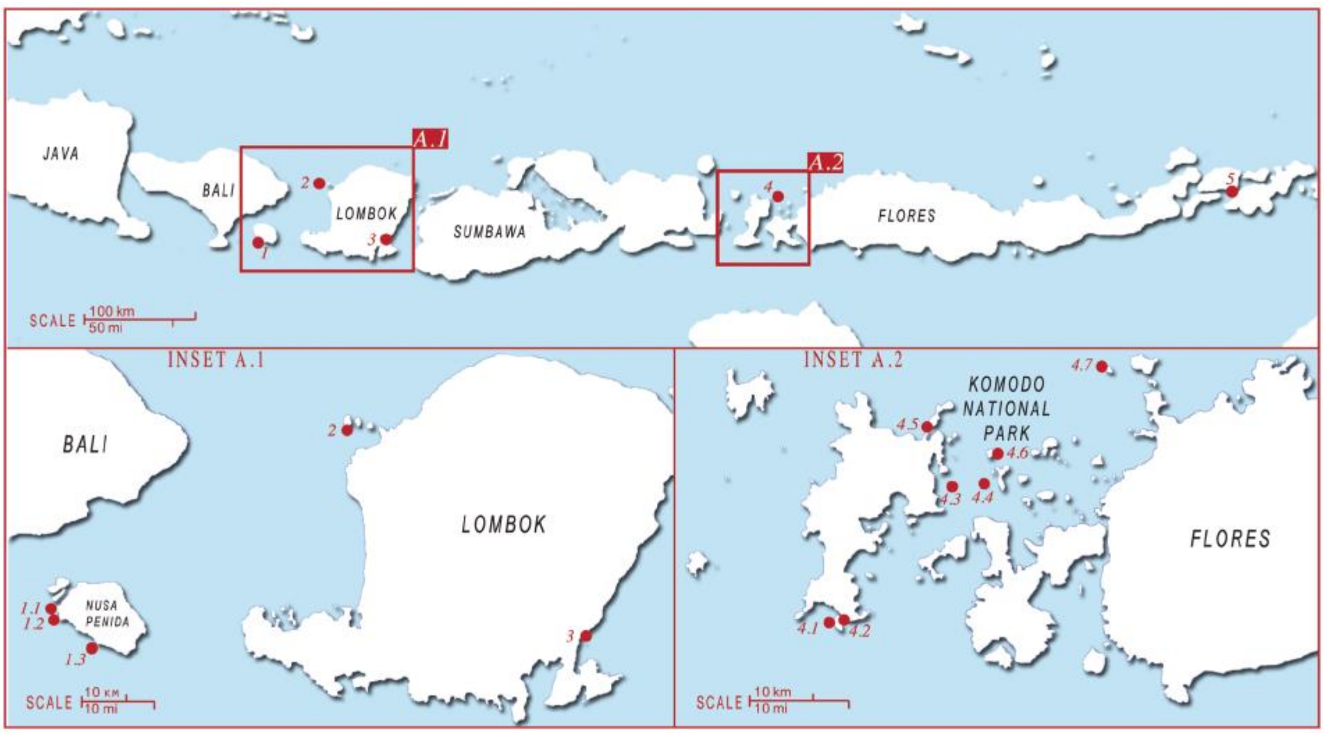

Figure 53. The connectivity area encompassing the Nusa Penida and the West Manggarai & Komodo sanctuaries and the nearby commercial Manta Ray landing ports. Sanctuaries and Manta Ray fishing ports are numbered as follows: (1) Nusa Penida, (2) Gili Islands (MPA only), (3) Tanjung Luar fishing port, (4) Komodo National Park, (5) Lamakera fishing port. Inset A.1 shows Manta Ray monitoring sites in Nusa Penida (1.1-1.3), Gili Islands (2), and the nearby Tanjung Luar fishing port (3). Inset A.2 shows Manta Ray monitoring sites in West Manggarai and Komodo National Park (Germanov & Marshall, 2014 at 3).

i. Raja Ampat

Raja Ampat is the largest of the three Indonesian Manta Ray sanctuaries at 11,655 square kilometers (*see* Germanov & Marshall, 2014 at 1). However, despite its size, it still does not adequately protect Manta Rays. This is because a documented migration route requires Manta Rays "to pass through the busy shipping corridor located between Mansuar and Mansfield Islands in the [Raja Ampat] region." (Germanov & Marshall, 2014 at 7). This indicates a siting issue with the sanctuary that outs migrating Manta Rays in danger and means that the sanctuary fails to adequately protect Manta Rays. Raja Ampat also, despite its size, only has a known population of 100 identified reef manta rays (*see* Germanov & Marshall, 2014 at 3). Because 30% of these individuals were re-sighted, an average of 3.1 times per individual, this number may approximate the total population for this area (*see* Germanov & Marshall, 2014 at 4). Therefore, even if this sanctuary were otherwise acceptable, it would protect a relatively small number of Manta Rays.

ii. West Manggarai (including Komodo National Park)

West Manggarai (including the Komodo Marine Park) is the second largest Indonesian Manta Ray sanctuary at 7,000 square kilometers (Germanov & Marshall, 2014 at 1). However, recent studies have reported Manta Ray straight line movements greater than 380 kilometers (Germanov & Marshall, 2014 at 1-2 (citations omitted)). This is problematic because "[m]ajor fishing grounds and known manta ray landing ports, Tanjung Luar, Lombok[,] and Lamakera, are within 380 [kilometers] of [this sanctuary]." (Germanov & Marshall, 2014 at 2 (citations omitted)). In fact, one of Indonesia's most productive Manta Ray landing ports, Tanjung Luar, lies directly between the West Manggarai and Nusa Penida sanctuaries, potentially affecting Manta Rays that attempt to migrate between these protected areas (*see* Germanov & Marshall, 2014 at 7-8). "Given their migratory ability, it is reasonable to assume that *M. alfredi* using [Nusa Penida], the Gili Islands, and [West Manggarai (including Komodo National Park)] regions are at risk from targeted fishing when traveling outside of these discrete protected sanctuaries." (Germanov & Marshall, 2014 at 8; *see also* Dewar, *et al.*, 2008 at 18 (discussing adequacy of Komodo National Park before West Manggarai was established and determining that its proximity to areas of heavy fishing, including Lamalera and Lamakera, was problematic for this species when it migrated beyond the Park's boundaries)). In addition, Manta Rays "(primarily *M. alfredi*) are also targeted in the Komodo Marine Park, near Lamakera, Indonesia, despite regulations forbidding fishing." (CMS, 2014 at 9 (citation omitted)). These weaknesses indicate the inadequacy of this sanctuary.

iii. Nusa Penida

Nusa Penida is by far the smallest of the Indonesian Manta Ray sanctuaries (*see* Germanov & Marshall, 2014 at 1). At just 200 square kilometers, it is less than 3% the size of West Manggarai and roughly 1.7% the size of Raja Ampat (*see* Germanov & Marshall, 2014 at 1). This makes Manta Ray migrations out of the sanctuary not only a certainty, but likely a necessity. This is problematic because, as with West Manggarai, "[m]ajor fishing grounds and known manta ray landing ports, Tanjung Luar, Lombok[,] and Lamakera, are within 380 [kilometers of Nusa Penida]." (Germanov & Marshall, 2014 at 2 (citations omitted)). In fact, one of Indonesia's most productive Manta Ray landing ports, Tanjung Luar, lies directly between the West Manggarai and Nusa Penida sanctuaries, potentially affecting Manta Rays that attempt to migrate between these protected areas (*see* Germanov & Marshall, 2014 at 7-8). "Given their migratory ability, it is reasonable to assume that *M. alfredi* using [Nusa Penida], the Gili Islands, and [West Manggarai (including Komodo National

Park)] regions are at risk from targeted fishing when traveling outside of these discrete protected sanctuaries." (Germanov & Marshall, 2014 at 8). In addition, Manta Rays "transiting from Nusa Penida to the Gili Islands would likely be crossing the Lombok Strait, a heavily used shipping corridor between the islands of Bali and Lombok." (Germanov & Marshall, 2014 at 7). They would be threatened by a heavily increased risk of ship strikes while traveling through this area (*see* Section IV. E. 5. "Heavy Maritime Traffic," *infra*). These weaknesses indicate the inadequacy of this sanctuary.

iv. Tangkoko Nature Reserve

The Tangkoko Nature Reserve was not created as part of Indonesia's Manta Ray sanctuary scheme and therefore is likely not designed to protect Manta Rays. In addition to this weakness it has also been the source of unsustainable past (legal) and present (illegal) Manta Ray fishing activities. Large trap nets have been set in an important migratory channel in the Tangkoko Nature Reserve since at least the mid-1990s (*see* White, *et al.*, 2006 at 8 (citation omitted)).

> The catches from these nets between March 1996 and February 1997 were reported to include 1424 manta rays, 18 whale sharks, 312 other sharks, 4 minke whales, 326 dolphins, 577 pilot whales, 789 marlin, 84 turtles, and 9 dugongs. Although the use of these nets was prohibited after pressure from a few local activists and international exposure through the media, they were again being used, albeit illegally, as early as September 1997 . . .

(White, *et al.*, 2006 at 8 (citation omitted)). In addition to the illegal use of these nets in the same place, fishing efforts have also moved to new unmonitored locations in this area (Marshall, *et al.*, 2011 – 2 at 10-11; *see also* White, *et al.*, 2006 at 8). The ongoing exploitation in the Tangkoko Nature Reserve and the Indonesian government's lack of ability, or perhaps will, to enforce these prohibitions indicates the inadequacy of this regulatory mechanism.

e. Maldives

Of 32 MPAs in Maldives, five were designated specifically because of the seasonal presence of Manta Rays (Anderson, *et al.*, 2010 at 23). However, because these protected areas are also heavily-trafficked dive sites, Manta Rays in these areas still risk excessive disturbance by divers (*see* Section IV. B. 2. "Overutilization for Recreational Purposes," *supra*).

Atoll	Site	Area	Date Established
Baa	Hanifaru	303 Ha	June 6, 2009
Lhaviyani	Fushifaru Thila	4 Ha	October 1, 1995
North Malé	Rasfari	835 Ha	October 1, 1995
South Malé	Guraidhoo Channel	88 Ha	October 1, 1995
South Alifu	Madivaru (=Faruhuruvalhi)	60 Ha	October 21, 1999

Figure 54. Protected Manta Ray dive sites (Anderson, *et al.*, 2010 at 24).

In addition, as discussed in Section IV. D. 1. f. "Maldives," *supra*, because the Maldives is surrounded by many countries with very active Manta Ray fisheries and because it is located in the

Indian Ocean, where IUU fishing is rampant, it is likely that it will experience at least some illegal fishing in and around these MPAs by foreign fishermen, especially as Manta Ray populations quickly decline and/or become extirpated from surrounding areas (*see* Section IV. B. 1. a. ii. "Indo-Pacific," *supra*; Section IV. B. 1. a. iii. "Indian Ocean," *supra*; Section III. G. 3. "Indo-Pacific," *supra*; Section III. G. 4. "Indian Ocean," *supra*). Finally, though the Maldives has a Manta Ray export ban, this export ban does not include a total ban on ray catching "in recognition of the traditional rights of fishermen." (Anderson, *et al.*, 2010 at 23 (citation omitted)). Therefore, Maldivian fishermen can still fish for Manta Rays outside of these sanctuaries leaving these species open to this threat when they stray from the existing reserves. Because these species tend to migrate, threats outside of these relatively small reserves are likely to harm Manta Ray individuals who may spend part of their lives within them.

f. Mexico

Manta Rays are protected in two Mexican MPAs, the Revillagigedo biosphere (likely giant manta rays based on the nearshore Pacific island location (*see* CoP16-Prop-46 at 20)) and the Yum Balam protected area (likely Caribbean manta rays based on the Isla Holbox location (*see* Figure 8, *supra*; Marshall, *et al.*, 2011 – 2 at 13). However, "[e]nforcement for [the fishing closure in the Revillagigedo biosphere] has been somewhat suspect as many fishing boats have been observed and caught deploying longlines, gillnets and seines within the biosphere, which extends as a 12 mile buffer around each of the islands in the archipelago." (Marshall, *et al.*, 2011 – 2 at 13). In addition, Manta Rays in Yum Balam appear to be being affected by the newly-growing tourism industry in this area, "with many individuals exhibiting boat injuries." (Marshall, *et al.*, 2011 – 2 at 13). However, perhaps more importantly, most Manta Ray locations in the area of Yum Balam are further than 20 kilometers offshore (92% of all locations) and only 11.5% of locations occurred within MPAs (Graham, *et al.*, 2012 at 4). This indicates a siting issue for the MPA that reduces its effectiveness in protecting Manta Rays. This siting issue led Graham, *et al.*, 2012 to conclude that this MPA

> does not encompass the movements of manta rays tracked in this study. Further, it seems that manta ray aggregations coincide with some of the Caribbean's busiest shipping lanes, whose impact on manta rays is as yet unknown. Despite legal protection in Mexican waters, occasional targeted and bycatch capture of manta rays still takes place [in the vicinity of the Yucatan Peninsula] to be used for food and as bait in the shark fishery.

(Graham, *et al.*, 2012 at 4). Graham, *et al.*, 2012 determined that their "data suggest that manta rays are foraging over large spatial scales (~100 [kilometers] long), too far offshore and too wide ranging to be included within existing MPA networks." (Graham, *et al.*, 2012 at 5). As a result of these siting and enforcement issues, Manta Rays will continue to be subjected to overexploitation both within and outside these MPAs in Mexican waters and these MPAs are thus inadequate to protect these species.

g. Thailand

"Dive operators in the Similan Islands, Thailand, have witnessed increased fishing for *Manta* spp., even in Thai National Marine Parks, and have reported consistent declines in *Manta* spp. sightings from 59 during the 2006-7 season down to 14 during the 2011-12 season (76% decline)." (CoP16-Prop-46 at 8 (citation omitted)). This indicates that the protections in the Thai National Marine

Parks are inadequate and/or are inadequately enforced to protect Manta Rays, even within their borders. These species exhibited a 76% decline in just 5 years despite the existence of these parks, which is a clear indication that protections must be bolstered.

h. United States

The Flower Garden Banks National Marine Sanctuary ("FGB") is located in the northwestern Gulf of Mexico from 70-115 miles off the coast of Texas and Louisiana (NOAA, 2012 at 7). It is a protected area made up of three small, but exceptionally biodiverse banks (East Flower Garden Bank, West Flower Garden Bank, and Stetson Bank). "East Flower Garden Bank [(Figure 56, *infra*)] is a pear-shaped dome, 5.4 by 3.2 miles (8.7 by 5.1 [kilometers]) in size, capped by 250 acres (1 square [kilometer]) of coral reef that rise to within 55 feet (17 [meters]) of the surface. West Flower Garden Bank [(Figure 57, *infra*)] is an oblong-shaped dome, 6.8 by 5 miles (11 by 8 [kilometers]) in size, which includes 100 acres (0.4 square [kilometers]) of coral reef area starting 59 feet (18 [meters]) below the surface." (NOAA, 2012 at 19). Stetson Bank is much smaller than the other two banks (*compare* Figure 56, *infra*; Figure 57, *infra*; Figure 58, *infra*). "Environmental conditions at Stetson Bank, which include more extreme fluctuations in temperature and turbidity, do not support the growth of reef forming corals like those found at East and West Flower Garden Banks. Divers have described Stetson as having a 'moonscape' appearance, with distinct pinnacles that push out of the seafloor for 1,500 feet (457 [meters]) along the northwest face of the bank." (NOAA, 2012 at 21). These pinnacles do support coral growth (NOAA, 2012 at 21-22). Manta Rays are transient visitors of these banks, using them throughout the year for feeding and mating purposes (NOAA, 2012 at 63). Accounts differ, but between 58 and roughly 70 Manta Rays (likely all Caribbean manta rays or possibly a mix of Caribbean and giant manta rays (*see* Figure 8, *supra*; Figure 9, *supra*) have been identified here (*see* NOAA, 2012 at 63; CoP16-Prop-46 at 23).

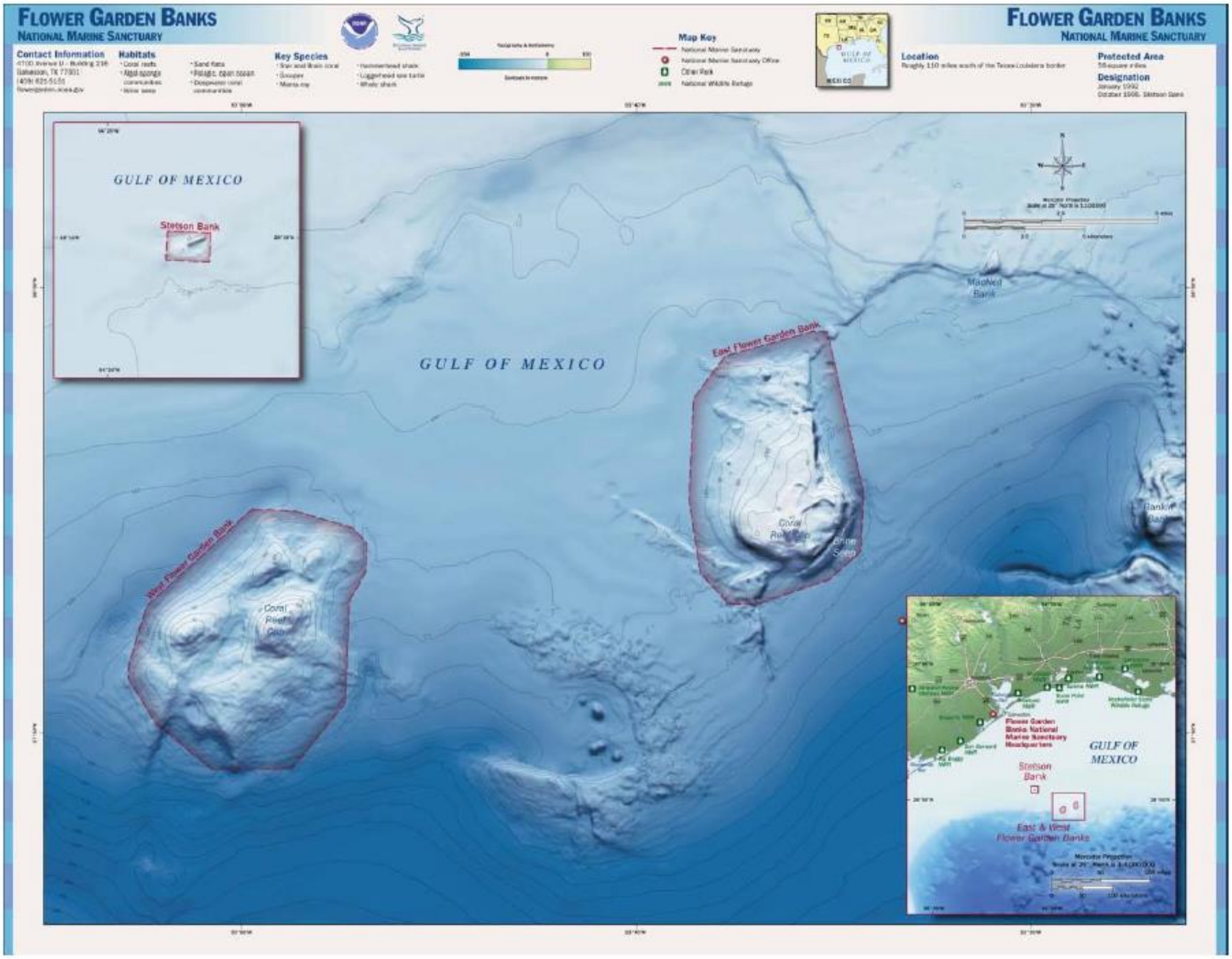

Figure 55. Flower Garden Banks Marine Sanctuary in the Gulf of Mexico (NOAA, 2012 at 2).

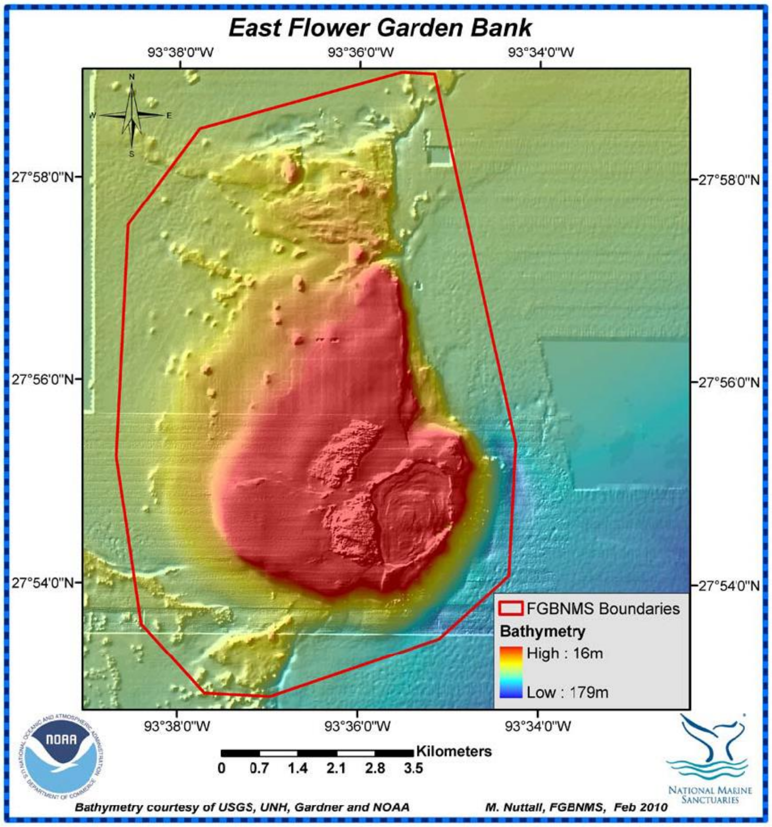

Figure 56. Map of East Flower Garden Bank (NOAA, 2012 at 20).

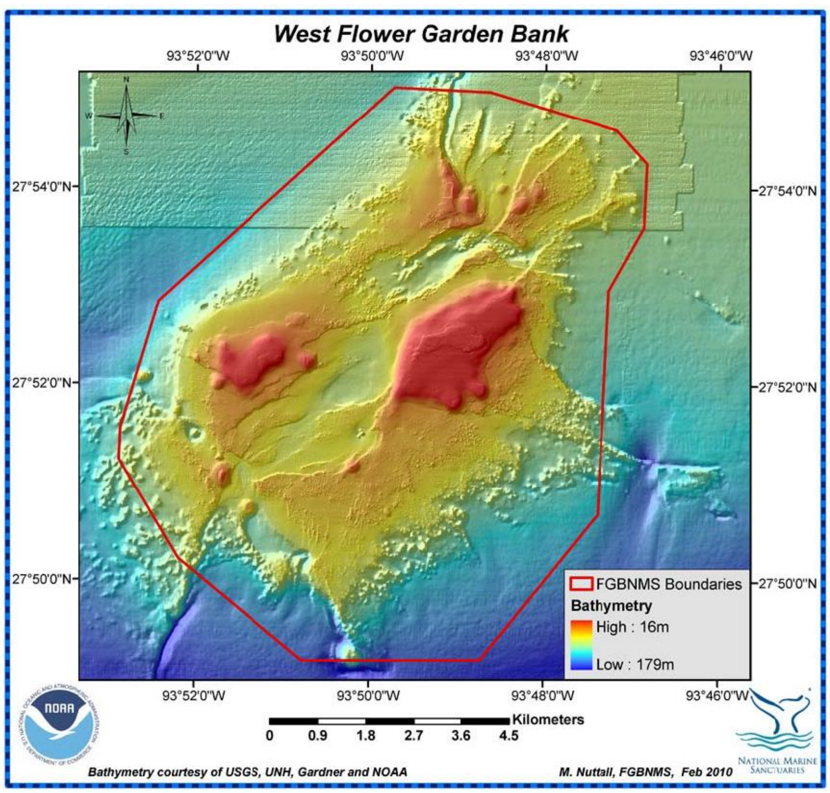

Figure 57. Map of West Flower Garden Bank (NOAA, 2012 at 21).

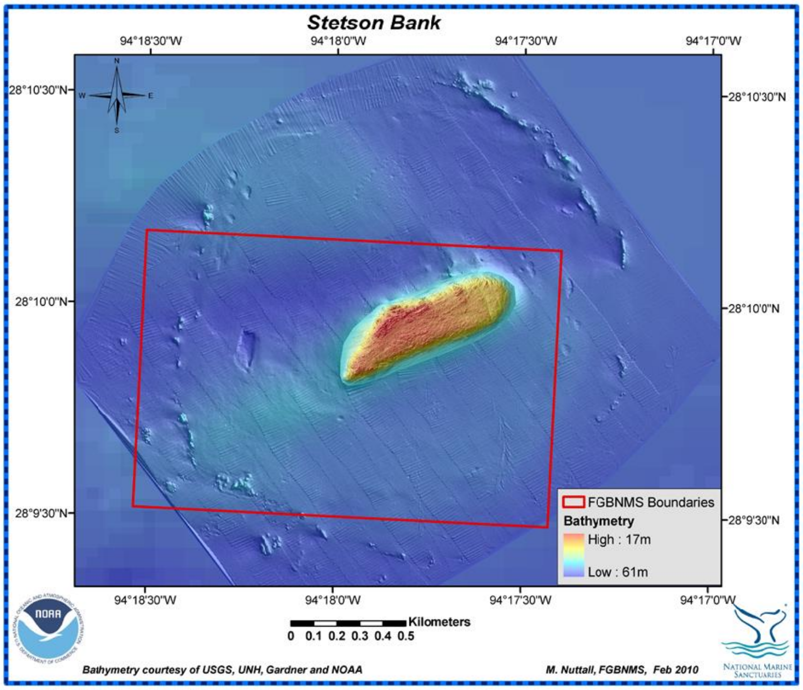

Figure 58. Map of Stetson Bank (NOAA, 2012 at 22).

However, the banks that make up FGB are only three among dozens of similar banks in the northern Gulf of Mexico (*see* NOAA, 2012 at 16; Figure 59, *infra*). In discussing potential future expansion of FGB, NOAA indicated that numerous banks and associated features in the northwestern Gulf of Mexico "have unique or unusual structural features, and may be ecologically linked to each other. Many of these geological and biological features exist outside current sanctuary boundaries . . . These features may be highly vulnerable to certain anthropogenic impacts that alter the physical, chemical, biological, or acoustic environment." (NOAA, 2012 at 8). NOAA recommends considering designation of these as marine sanctuaries or inclusion of them in FGB (NOAA, 2012 at 8). The present lack of inclusion of these features represents a weakness in this regulatory mechanism and will leave Manta Rays open to harm when they inevitably stray outside of these small, unconnected protected areas.

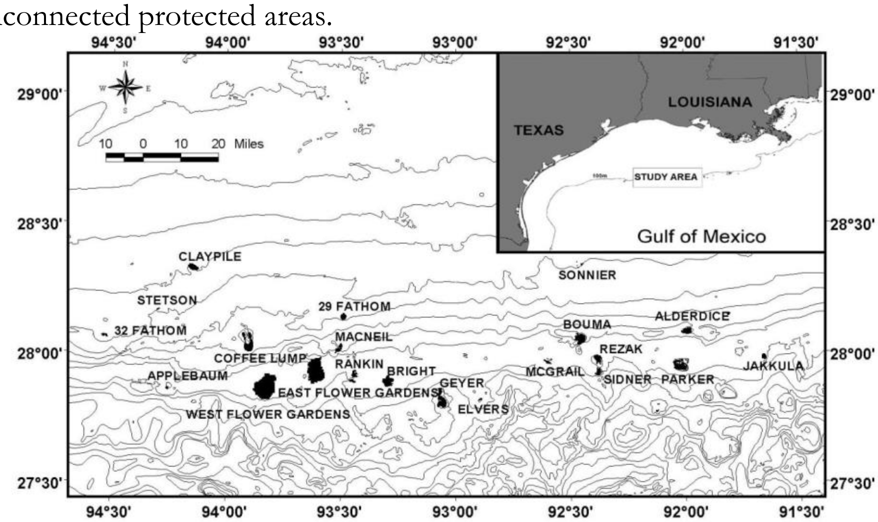

Figure 59. Selected reefs and banks of the northwestern Gulf of Mexico (NOAA, 2012 at 16).

Diving and fishing are still allowed in FGB with no research area yet in place to assess the magnitude of threats from these activities (*see* NOAA, 2012 at 8). Recreational diving brings an estimated 2,500 to 3,000 divers to FGB each year (NOAA, 2012 at 23).

> Potential impacts on sanctuary resources from visitation by SCUBA divers are an ongoing concern. Anecdotally, divers have noted damage to the coral reef likely caused by recreational and research divers. Additionally, some marine animals such as [Manta Rays] and whale sharks may be negatively affected by interactions with divers who attempt to attract and touch the animals.

(NOAA, 2012 at 8; *see also* Section IV. B. 2. "Overutilization for Recreational Purposes," *supra*).

> Divers can physically harm [Manta Rays] by attracting, touching, riding or pursuing the animals, which can then expose the animals to other potential injuries. In particular, people can cause injury to the skin of the animal through touching. The animals may actively avoid diver interactions by changing direction or diving, and may exhibit stress behavior such as violent shuddering. When these types of responses occur, [Manta Rays] expend energy that could otherwise be used for feeding and other natural activities.

(NOAA, 2012 at 64; *see also* Section IV. B. 2. "Overutilization for Recreational Purposes," *supra*).

NOAA characterizes recreational and commercial fishing as "common and economically important activities in the northwestern Gulf of Mexico." (NOAA, 2012 at 23). While several types of fishing gear are prohibited in FGB, conventional hook and line fishing, both recreational and commercial, is allowed there (NOAA, 2012 at 23).

> Fishing activities may negatively affect and threaten the natural living resources of [FGB]. The influence of fishing activities within the sanctuary is not well documented, but concerns exist about both direct and indirect fishing-related impacts on marine ecosystems. Direct results of fishing can result in reduced fish biomass, while indirect impacts include secondary effects on species interactions, habitat alteration/damage, reduced marine biodiversity, and economic impacts. Specific concerns include targeted fishing efforts on particular fish species, focused fishing during spawning aggregations, injury to corals and other organisms by lost and discarded fishing gear, and discarded fishing bycatch.

(NOAA, 2012 at 9). NOAA has thus far been unable to quantify the impacts of these activities on resources in FGB (*see* NOAA, 2012 at 23).

Because diving and fishing have negatively affected Manta Rays in other locations where greater information is available (*see generally* Section III. G. "Population Trend," *supra*; Section IV. B. 1. "Overutilization for Commercial Purposes," *supra*; Section IV. B. 2. "Overutilization for Recreational Purposes," *supra*), these practices are likely at least somewhat harmful to these species in FGB. In the absence of ESA listing, NOAA has attempted to ameliorate these threats to Manta Rays in FGB through creating regulations governing the use of FGB (*see* NOAA, 2012 at 64). These regulations prohibit the killing, injuring, attracting, touching, or disturbing of Manta Rays in FGB (*see* NOAA, 2012 at 124, 126). However, these regulations have several weaknesses. First, "the mere presence of human beings (e.g., swimmers, divers, boaters, kayakers) is exempted from" the definition of the terms disturb and disturbing (*see* NOAA, 2012 at 124). While this exemption is unsurprising as NOAA manages FGB for multiple uses (*see* NOAA, 2012 at 15, 19, 69), it reduces the effectiveness of this protection and will also complicate NOAA's enforcement of it and the public's attempts to comply with it. Currently it is unclear when "mere presence" becomes pursuit, chasing away, or "any other activity that disrupts or has the potential to disrupt" Manta Rays, which are all prohibited by the regulations (NOAA, 2012 at 124). Divers will often attempt to swim closer to the Manta Rays to more clearly observe them and this regulation makes the legality of such potentially disturbing activity unclear. In addition, "the incidental and unintentional injury to a [Manta Ray] as a result of fishing with conventional hook and line gear is exempted from [all of these] prohibition[s]." (NOAA, 2012 at 126). Because fishing is allowed in FGB, incidental catch is inevitable and, under these regulations, is entirely legal. These regulations do not even appear to require that an incidentally caught Manta Ray be returned to the water unharmed and/or as quickly as possible. This is clearly problematic.

In addition to diving and fishing impacts, FGB is also located adjacent to a major shipping lane for shipping and transport headed to the Port of Houston, one of the busiest ports in the nation (NOAA, 2012 at 23). Direct damage to coral reefs from anchoring seems to have been reduced by regulation, but sewage discharge, gray water effluent, marine debris, exhaust emissions, ballast water release, and occasional towing cable impacts are still threats to FGB from this shipping activity (NOAA, 2012 at 23). In addition to shipping vessels, FGB is also visited and/or transited by smaller vessels, including charter fishing and diving boats, shrimp trawlers, and service boats and barges associated with oil and gas activities in the area (NOAA, 2012 at 23). These vessels have also damaged FGB resources in the past, contribute pollution and marine debris to these waters, and require mooring buoys to be placed on the banks to avoid anchor damage (NOAA, 2012 at 9, 23, 56). Because Manta Rays are likely adversely affected by these marine debris, water quality, and mooring buoy issues and have been documented with extensive ship strike injuries in other locations (*see* Section IV. A. 2. "Plastics," *supra*; Section IV. A. 4. "Water Pollution," *supra*; Section IV. A. 5. "Fisheries and Resultant Marine Debris," *supra*; Section IV. E. 5. "Heavy Maritime Traffic," *infra*), they are likely negatively affected by the heavy use of this area by shipping, and other, vessels when they are in FGB, and even more so when they inevitably leave FGB's protections.

FGB also faces threats from land-based pollution.

> The quality of coastal waters of the northern Gulf of Mexico is in decline due to pollutants associated with discharge of major river systems (such as the Mississippi and Atchafalaya) and general coastal runoff throughout the region. Predominant current patterns direct much of this water away from [FGB], but minor changes in circulation patterns could bring contaminated water to the sanctuary.

(NOAA, 2012 at 9; *see also* NOAA, 2012 at 16, 56). Therefore, this discharge has the ability to influence FGB at some times and will also continue to influence the Manta Rays' non-FGB habitat in the northern Gulf of Mexico.

NOAA explains that "[i]t is well documented that most fishery stocks for which there are stock assessments in the northern Gulf of Mexico have undergone or are still undergoing overfishing." (NOAA, 2012 at 85-86). Therefore, "[i]t is logical to assume that fish populations within [FGB] have also been similarly affected by the general decline of fish stocks throughout the Gulf of

Mexico." (NOAA, 2012 at 86). Though NOAA hopes to conduct studies to evaluate this assumption, "[t]here is [also] a perception by some long-time observers that the number and size of certain prominent fish species [in FGB] have declined in recent years." (NOAA, 2012 at 53; 85-86). This adds additional credence to NOAA's inference. In addition, though the precise status of use of FGB is not clear, observations indicate that the level of fishing activity has been increasing in recent years (NOAA, 2012 at 9-10). These fish population decreases and increases in observed fishing are likely harming Manta Rays, both inside and outside of FGB.

Even where the measures that FGB is managed under may be helpful, NOAA explains that the level of understanding and appreciation of FGB is, in many cases, "inadequate to produce changes in individual attitudes, behaviors and/or community decision-making processes that affect the health of sanctuary resources." (NOAA, 2012 at 8). In addition to these knowledge issues, NOAA also has its own enforcement difficulties. "Enforcement is logistically difficult due to the distance of [FGB] from shore and limited access to the site. The sanctuary relies heavily on assistance from the U.S. Coast Guard . . . and the NOAA Office for Law Enforcement . . . for enforcement efforts." (NOAA, 2012 at 9). The FGB staff is attempting to supplement this enforcement with FGB's own ship, is developing a voluntary incident reporting system, "and is seeking to improve enforcement coordination with federal and state agencies to better address enforcement needs within the sanctuary." (NOAA, 2012 at 9). However, the status of these efforts and their effectiveness is not known at this time and should not be assumed.

Until the various threats to Manta Rays in FGB are adequately managed and the regulations related to those threats are adequately enforced, the existence of FGB cannot be sufficient to protect Manta Rays with its borders. In addition, FGB makes up a fraction of the greater banks, and non-banks, of habitat in this region that are utilized by Manta Rays. As such, Manta Rays located elsewhere do not receive FGB's protections, even where they are migrating between the three protected banks. As a result, while FGB is surely beneficial to biodiversity and is an excellent step in the right direction for conservation in this region of the Gulf of Mexico, it is currently inadequate to protect Manta Rays there.

i. Yap

"Yap's Manta Ray Sanctuary and Protection Act 2008 establishes a sanctuary, which covers 8,234 square miles, taking in 16 islands and 145 islets and atolls, out to 12 miles offshore, specifically protecting its primarily reef manta ray population and its habitat." (CMS, 2014, at 9; *see also* Marshall, *et al.*, 2011 – 2 at 12). Defenders has very little information on this sanctuary apart from its existence. However, small island nations often have difficulty enforcing such protections because their composition, many small islands spread over a large distance, means that the prohibitions cover a vast area of ocean that is sparsely populated by humans, and thus sparsely covered by enforcement personnel. Therefore, where a market still exists for the prohibited products, as it does for Manta Ray gill plates, illegal fishing can often occur with little concern for the regulations. For instance, Palau, another small island nation, has caught at least one violator of its shark fishing ban (NMFS, 2013 at 69). However, even this single catch is impressive given that Palau only has one patrol boat to enforce its fishing regulations in roughly 233,206 square miles of ocean; a Sisyphean task for enforcement personnel (NMFS, 2013 at 69). In addition to enforcement issues, this protection does not appear to prevent incidental capture of Manta Rays which can often kill or injure them. Finally, even if this sanctuary were sufficient to stop directed overutilization of Manta Rays, it will not protect them from the other threats that they face, which is particularly concerning because Yap has a very small (estimated at approximately 100 individuals) Manta Ray population that will be inherently vulnerable to decline and extirpation (*see* CoP16-Prop-46 at 23 (citation omitted); *see also* Section IV. E. 2. "Genetic Isolation," *infra*; Section IV. E. 3. "Small Populations," *infra*). As a result this sanctuary is inadequate to protect Manta Rays.

3. State Protection

While the United States has thus far not provided Manta Rays with national protection, two U.S. states and two U.S. territories have provided these species with some level of local protection. While Defenders commends these actors for recognizing the threats that Manta Rays face and for acting to protect them, all such protections will have similar issues as those experienced by national protections; the most important of which is their limited scope of applicability. Because these states and territories have limited authority, the protections they institute will cover a much smaller area than if the United States were to protect these species. Were the United States to protect these species, it would serve as a complement to these existing protections and would greatly strengthen them. While these localized protections are undoubtedly helpful, without national protection they are unfortunately inadequate to protect these species.

a. Commonwealth of the Northern Mariana Islands ("CNMI")

In 2008, CNMI passed Public Law No. 15-124, which makes it illegal for anyone to "knowingly or with wanton disregard for the consequences of his act, feed, take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or in any manner any RAY, alive or dead, or any part thereof, without being permitted to do so . . ." in CNMI waters (2008 N. Mar. I. Pub. L. 15-124; *see also* CoP16-Prop-46 at 32). Ray is defined as any animal in the Order *Myliobatifonnes*, specifically including giant manta rays (*Manta birostris*) (2008 N. Mar. I. Pub. L. 15-124).[76] The exceptions to this protection include taking rays for scientific or educational purposes or taking them incidentally through fishing with a hook and line if they are immediately returned to the water. Defenders applauds CNMI for providing Manta rays with this strong national protection and also for protecting them at the regional level as part of the Micronesian regional ban on possession or sale of Manta Rays (*see* Section IV. D. 4. b. "Micronesia," *infra*). However, though no population estimate appears to exist for CNMI, it likely is home to few Manta Rays. This is because the Manta Ray populations in Micronesia all appear to be very small (Yap ~100, Guam 35, Palau 170) (*see* CoP16-Prop-46 at 23). Therefore, CNMI's protections will likely have little impact on these species' extinction risks. In addition, as discussed in Section IV. D. 2. i. "Yap," *supra*, small islands will often have difficulties enforcing their regulations due to limited resources and large, relative to land mass, oceanic areas to patrol. This increases the likelihood that CNMI may have enforcement issues for its prohibitions.

b. Florida

In Florida, it is illegal to harvest, possess, land, purchase, sell, or exchange any species from the genus *Manta* or any part of these species. FLA. ADMIN. CODE r. 68B-44.008. However, these

[76] Although this law was passed pre-differentiation and therefore does not provide specifically for protection of reef manta rays (which do inhabit CNMI (*see* CoP16-Prop-46 at 21)), this is likely immaterial because it applies to all animals in the Order *Myliobatifonnes*, which would include all Manta Rays regardless of species.

prohibitions do not apply to lawful harvest in federal waters when such harvest is transported directly through state waters with gear appropriately stowed. *Id.* While Defenders commends Florida for recognizing the endangerment of these Manta Rays and taking steps to protect these species in its waters, this protection is inadequate. First, this protection only applies to Manta Rays captured in Florida's state waters, which only extend out to 3 nautical miles in the Atlantic and 9 nautical miles from shore in the Gulf of Mexico (Florida Fish and Wildlife Conservation Commission, Undated at 1). Therefore, Manta Rays outside of this narrow strip of a single state's coastline are not protected, as evidenced by the ability to land these species in Florida if they are caught outside the state's waters. This is particularly problematic because it is clear that Manta Rays utilize the waters outside of Florida's jurisdiction. For instance, FGB, discussed *supra*, is well into federal waters and is a known Manta Ray aggregation site (*see* NOAA, 2012 at 7). Additionally, a survey of bycatch from the shark drift net fishery off Georgia and east Florida from 1992–1995 included 14 Manta Rays, and another study of the bycatch in the directed shark drift gillnet fishery off the east coast of Florida and Georgia, which was set 4.8 kilometers offshore in federal waters from 1998–1999, revealed that manta rays are still caught in this fishery (Marshall, *et al.*, 2011 – 1 at 12 (citations omitted); *see also* Beerkircher, *et al.*, 2002 at 42-43 (indicating that rays account for 2.5% of the elasmobranch catch in the pelagic longline fishery off the southeastern United States and that some of these rays are Manta Rays)). This indicates that Manta Rays will still be harmed by fisheries outside of Florida's jurisdiction even if Florida's protections were perfectly implemented and enforced. However, evidence indicates that illegal Mexican fishing is occurring in and around Florida's waters, which will further hamper the efficacy of this protection (*see* NMFS, 2013 at 68). Therefore, while Florida's efforts are undoubtedly a step in the right direction, they are inadequate to protect the Manta Rays in its vicinity.

c. Guam

In Guam, it is unlawful to possess or sell Manta Rays or their parts except as permitted by the government for educational and research purposes. Guam Pub. L. 31-10 (2011). In addition, possession for subsistence purposes and capture where the Manta Ray is immediately returned to the water are also exempted. *Id.* Defenders commends Guam for recognizing the threats to these species and taking steps to protect them. However, while these various exemptions clearly limit the application of this law, its greatest limitation is in the number of Manta Rays that it can protect. This is because Guam is estimated to be home to only 35 Manta Rays (CoP16-Prop-46 at 23). Because it is home to so few Manta Rays, even the most robust protections would likely have little impact on these species' extinction risks.

d. Hawaii

Knowingly killing or capturing Manta Rays within Hawaiian waters has been illegal since 2009 (Marshall, *et al.*, 2011 – 1 at 12; Marshall, *et al.*, 2011 – 2 at 11). "There have never been fisheries for manta rays in Hawaii, but this Bill will protect all Manta species living in or passing through the island group from future fishing pressure." (Marshall, *et al.*, 2011 – 1 at 12; Marshall, *et al.*, 2011 – 2 at 11). Again, Defenders commends Hawaii on this protection. Unfortunately though, this measure would not prevent bycatch or any of the other threats that these species face in Hawaiian waters. This is problematic because Manta Rays face a variety of threats from causes other than directed catch in Hawaiian waters. For instance, "[i]n Maui, Hawaii, 10% of the [Manta Ray] population has amputated or non-functioning cephalic fins, most likely caused from entanglement in monofilament fishing line." (Marshall, *et al.*, 2011 – 2 at 10 (citation omitted); Deakos, *et al.*, 2011 at 254, 257).

"Considering the function of the cephalic fins to guide food into the mouth during feeding, an animal reduced to a single cephalic fin would likely suffer a reduction in feeding efficiency." (Deakos, *et al.*, 2011 at 257). In addition, "[e]ight individuals had physical evidence of entanglement in fishing line. These included 2 individuals with fish hooks embedded in the cephalic fin, 2 with monofilament line wrapped around the cephalic fin, 2 with clear injuries where line had begun to cut partway through the cephalic fin and 2 with visible scars from line that had been wrapped around the cephalic or pectoral fin." (Deakos, *et al.*, 2011 at 254). This provides further evidence that "entanglement in fishing lines is a significant threat." (Deakos, *et al.*, 2011 at 257). In fact, Deakos, *et al.*, 2011 determined that entanglement with monofilament line was the "greatest immediate threat" to the species in Maui, with entanglement in new mooring lines for unregulated swim with the Manta Rays programs representing "near future" threats (Deakos, *et al.*, 2011 at 258). This line entanglement can also cause much less cryptic mortality where it traps the Manta Ray and causes it to drown (Heinrichs, *et al.*, 2011 at 14 (citation omitted); Deakos, *et al.*, 2011 at 257). "Two manta ray entanglements in mooring lines were documented on video in Hawaii. The first was reported inside Molokini Crater, Maui, on 12 June 2007, and the second off Kona, Hawaii, on 19 June 2009. Both manta rays perished and were consumed by sharks immediately thereafter." (Deakos, *et al.*, 2011 at 257 (internal citations omitted)). These interactions with maritime traffic and fisheries clearly threaten Manta Rays by making their habitat much more dangerous.

In addition to anthropogenic threats, approximately 1 in 4 observed reef manta ray individuals (24%) in Maui, Hawaii show injuries from shark attacks (Deakos, *et al.*, 2011 at 254, 256). When juveniles are discounted, 30% of the males in this population had shark-related injuries (Deakos, *et al.*, 2011, at 254). This predation will reduce these species' fitness, reproductive ability, and survival chances and will also exacerbate the other threats that they face (*see* Section IV. C. 1. "Shark Attacks," *supra*).

While Hawaii's protections are a step in the right direction, it is clear that they do not protect Manta Rays from many of the threats that are most seriously affecting these species in its waters.

4. Regional Protection

a. European Union ("EU")

Giant manta rays are protected in the EU (*see* CoP16-Prop-46 at 12, 32). However, apart from one giant manta ray aggregation that occurs near Portugal, no Manta Rays appear to be present in any EU waters (*see* Figure 8, *supra*; Figure 10, *supra*). Therefore this protection is likely mostly a symbolic recognition of threats to the species.

b. Micronesia

Micronesia has prohibited the possession, sale, distribution, and trade of Manta Rays and Manta Ray parts since the end of 2012 (CoP16-Prop-46 at 32). Defenders commends Micronesia on recognizing the threats to these species and by acting to protect them. Unfortunately, the Manta Ray populations in this region all appear to be very small (Yap ~100, Guam 35, Palau 170) (CoP16-Prop-46 at 23). Therefore, these protections may only cover about 300 individuals in total. Because this prohibition will not prevent all threats to these species and because it covers a limited number of individuals, it is unlikely that it will have a significant effect on these species' extinction risks. It may also face enforcement difficulties with these small island nations attempting to enforce these prohibitions over vast tracts of ocean (*see* Section IV. D. 2. i. "Yap," *supra*).

5. International Protection

a. CITES

In March 2013, at the 2013 CITES Conference of the Parties Meeting in Bangkok, Thailand, the CITES Parties agreed to list the genus *Manta* under Appendix II (*see generally* CITES, 2013; CITES, 2014 at 1-3). The United States supported the proposal that ultimately led to this listing (*see* USFWS, 2013 at 2). The United States explained that the Manta Rays' life history makes them very vulnerable to exploitation and that "[i]n recent years, manta ray fishing has expanded in many places throughout their range, primarily in response to the emerging international market for their gill plates." (USFWS, 2013 at 2). Though Defenders applauds this listing and the United States' recognition of the threats that Manta Rays face, the Appendix II listing offers insufficient protection to Manta Rays as it still allows trade in these species and does not protect Manta Rays from the other, non-trade threats that they face. Therefore, consistent with, and in furtherance of, the United States' determination that all Manta Rays warrant CITES listing, and in recognition of the continued and growing threats to these species, including overutilization causing unsustainable Manta Ray population declines, NMFS should list these three Manta Ray species under the ESA.

An Appendix II listing is not a trade ban and instead acts as a regulation on the trade of these species that does occur. Appendix II listing simply requires that exporting countries provide a permit that states that the exported Manta Ray gill plates, skins, and carcasses came from sustainably harvested populations. This is problematic because there is currently no clear standard for these so-called "non-detriment findings," which are used to determine whether killings of covered species would threaten sustainable populations (*see generally* CITES, Undated – 1). Even if there were some way to determine what a sustainable population means it would be difficult to demonstrate there are any stable or sustainably harvested Manta Ray populations because of the limited population information and these species' extremely slow generation times (*see, e.g.,* Section III. F. "Reproduction and Lifespan," *supra*; Section III. G. "Population Trend," *supra*; Section IV. E. 3. "Small Populations," *infra*; Section IV. E. 4. "K-Selected," *infra*). Furthermore, development of a reliable non-detriment finding requires sufficient capacity to complete these complex findings. Due to the lack of adequate scientific capacity in many CITES member countries, the lack of adequate population and other biological information relating to these Manta Rays, and the lack of a standardized frameworks for making non-detriment findings, these determinations will necessarily be inconsistent and unreliable.

In addition, there are several loopholes that can be used to avoid adequately protecting CITES-listed species, particularly when there is an illegal market for those species. Part of the problem is that Appendix II only requires a permit for exports of species listed therein. Therefore, it does not require a country to demonstrate that domestically-consumed Manta Rays that were caught in its waters came from sustainable populations (*see* CITES, Undated – 2 at 1-2). Furthermore, the fact that only an export permit, and not an import permit, is required for international trade means there is one less level of scrutiny that those wishing to smuggle Manta Ray products internationally must meet (*see* CITES, Undated – 2 at 1-2). Thus, fishermen from one country could kill Manta Rays in international waters and take them directly to any importing country. If they were to do so without returning to their country of origin they would completely avoid any permitting procedure under Appendix II of CITES. Furthermore, in addition to countries that are not parties to CITES, and are therefore not bound by its restrictions Guyana entered reservations to the Manta Rays' listing and will therefore be exempt from even the limited requirements contained therein (*see* CITES, 2014 at

2; CITES, 2015 at 5). This is problematic because Guyana appears to be the southern limit of the Caribbean manta ray's range and an area where the species likely occurs in sympatry with the giant manta ray (*see* Figure 8, *supra*; Figure 9, *supra*). As such, this nation could continue to exploit both species and could also serve as a conduit for giant and Caribbean manta rays caught elsewhere for fishermen that hope to avoid the CITES requirements. Additionally, Haiti (Caribbean manta ray), Kiribati (reef manta ray), Marshall Islands (reef manta ray), Timor-Leste (very close to both reef and giant manta ray populations), Tonga (known hunters of small reef manta ray population in their waters), and Tuvalu (reef manta ray) are Manta Ray range states that are not parties to CITES (CoP16-Prop-46 at 9, 21; Figure 8, *supra*; Figure 9, *supra*; https://cites.org/eng/cms/index.php/component/cp/). As such, they would also not be bound by this Appendix II listing.[77]

Furthermore, it appears that several populations are facing sufficient threats to warrant an Appendix I listing and that current levels of fishery pressure are expected to drive the entire species down to 15-20% of baseline (the guideline for Appendix I listing) by 2023 (CoP16-Prop-46 at 1, 3). However, even if the Manta Rays were listed under a more restrictive Appendix I listing, CITES does not represent an adequate replacement for ESA listing. NMFS acknowledged the insufficient effect of Appendix I listings in its determination for the listing of the largetooth sawfish under the ESA, when it stated that illegal foreign trade of the species continued "in spite of the CITES listing and national laws, due to lack of enforcement." 76 Fed. Reg. 40,822, 40,832 (July 12, 2011); NOAA, Undated at 3.

Finally, Because CITES only focuses on trade threats, it offers insufficient protection from the other, non-trade threats that Manta Rays face, including habitat threats and bycatch (*see* Section IV. A. "The present or threatened destruction, modification, or curtailment of its habitat or range," *supra*; Section IV. B. 1. b. "Bycatch," *supra*). As such, the CITES listing is an inadequate regulatory mechanism for protection of Manta Rays.

b. CMS[78]

The giant manta ray is listed under CMS Appendices I and II (IUCN, 2011 – 1 at 1-2). However, "Until also listed in the Annex to the CMS Memorandum of Understanding [("MOU")] on Migratory Sharks, [giant manta rays] will not be specifically considered under the MoU Conservation Action Plan. Furthermore, many [giant manta ray] fishing States have yet to sign the CMS Shark MoU." (CoP16-Prop-46 at 12). In addition, the reef manta ray and Caribbean manta ray are not listed under the CMS appendices. The Government of Fiji submitted a proposal for the inclusion of the reef manta ray and any other putative species of Manta Rays in CMS Appendices I and II in 2014, but the proposal is still pending (*see* CMS, 2014 at 1, 3; CMS, 2015 at 1-4). Finally, the CMS provisions do not bind parties and instead encourage them to take conservation actions. This is unfortunately not the basis of a strong protection and will allow actors to continue causing harm to and population declines of these species. As a result, the CMS listings for the giant manta ray are not sufficient to protect any of these three species.

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[77] The ongoing exploitation of oceanic whitetips, as discussed in Section IV. B. 1. a. ii. "Indo-Pacific," *supra*, is a clear example of CITES Appendix II listing failing to adequately conserve listed species subject to trade threats. This failure further supports Defenders' claims as to the inadequacy of CITES listing for the Manta Rays.

[78] NMFS should note that the United States is not a party to the CMS.

E. Other Natural or Manmade Factors Affecting its Continued Existence

1. Aggregations, Site Fidelity, and Susceptibility to Localized Threats

Aggregations of Manta Rays have been reported in various locations around the world (*see* Venables, 2013 at 10, 15; Graham, *et al.*, 2012 at 1; Medeiros, *et al.*, 2015 at 2 (both giant and reef manta rays) (citation omitted); Notarbartolo-di-Sciara & Hillyer, 1989 at 1 (likely Caribbean manta rays based on location)). These aggregations can be very large and may include hundreds of individuals (*see* Graham, *et al.*, 2012 at 1; Venables, 2013 at 10, 15; Manta Trust, Undated at 3; Notarbartolo-di-Sciara & Hillyer, 1989 at 1 (likely Caribbean manta rays based on location)). These aggregations are typically seasonal and often appear to be related to food availability from high productivity events such as mass coral spawnings or upwelling events (*see* Venables, 2013 at 10, 15 (citations omitted); Jaine, *et al.*, 2012 at 5 (citations omitted); Heinrichs, *et al.*, 2011 at 14 (citations omitted); Notarbartolo-di-Sciara & Hillyer, 1989 at 1). However, Manta Rays also aggregate at cleaning stations where cleaner fish remove ectoparasites from their body surfaces and clean wounds and infections (*see* Venables, 2013 at 10 (citations omitted); Heinrichs, *et al.*, 2011 at 14 (citations omitted); Graham, *et al.*, 2012 at 1). Other times these aggregations are the location of mating trains and courtship interactions (Venables, 2013 at 15; Graham, *et al.*, 2012 at 1). In addition to these periodic aggregations, Manta Rays also exhibit site fidelity (*see* Dewar, *et al.*, 2008 at 16; Venables, 2013 at 10 (citations omitted); Medeiros, *et al.*, 2015 at 2 (both giant and reef manta rays) (citation omitted); Graham, *et al.*, 2012 at 4; Notarbartolo-di-Sciara & Hillyer, 1989 at 1 (likely Caribbean manta rays based on location); Deakos, *et al.*, 2011 at 256). This means that individuals will repeatedly return to a preferred feeding or cleaning site over extended periods of time (*see* Venables, 2013 at 10 (citations omitted)).

Unfortunately, these aspects of the Manta Rays' life history make them very vulnerable to a variety of threats (*see, e.g.,* CoP16-Prop-46 at 1-2). The primary threat that is exacerbated by these tendencies is overfishing. Because fishermen can reliably locate these species at specific times of year and/or in specific areas, they become a very easy target for exploitation (*see* O'Malley, *et al.*, 2013 at 2; CoP16-Prop-46 at 1-2). This ease of targeting is increased by Manta Rays' tendency to often feed near the surface, their slow swimming speeds, very large size (which makes them quite conspicuous), and their general lack of human avoidance, all of which make them easy to capture by net or harpoon (O'Malley, *et al.*, 2013 at 2; Heinrichs, *et al.*, 2011 at 14 (citation omitted); CMS, 2014 at 5; CoP16-Prop-46 at 8). Targeting aggregations or other critical habitats allows numerous individuals to be captured and killed easily with a high catch per unit effort (Marshall, *et al.*, 2011 – 1 at 5; Marshall, *et al.*, 2011 – 2 at 5). Such practices are highly unsustainable and represent a severe threat to these species (*see* Marshall, *et al.*, 2011 – 1 at 10; CMS, 2014 at 5). For example, the large, targeted catch in Sri Lanka, appears to be targeting the first giant manta ray nursey area reported anywhere in the world (Heinrichs, *et al.*, 2011 at 17). Targeting this aggregation is essentially the least sustainable practice imaginable for a large, slow growing species like the giant manta ray. As a result, the targeting of this aggregation is of particular conservation concern (*see* Heinrichs, *et al.*, 2011 at 17). However, targeting any of these critical areas (aggregations, areas that Manta Rays exhibit site fidelity for, nursey grounds, or other critical areas of habitat) makes the populations that are reliant on them vulnerable to rapid localized depletions and even extirpation (Heinrichs, *et al.*, 2011 at 14 (citation omitted)). The usage of these aggregation areas also leaves these species open to impacts from diving tourism (*see* Section IV. B. 2. "Overutilization for Recreational Purposes," *supra*), localized threats like pollution (*see, e.g.,* Section IV. A. 4. "Water Pollution," *supra*), and any other threat that is exacerbated by the ability to easily locate these species or by their fidelity to and reliance on certain locations.

2. Genetic Isolation

Reef manta rays, and potentially the other manta ray species as well, are "believed to have small, genetically independent, island-associated stocks. With little exchange between members of neighboring stocks, a fishery could deplete a single stock quite rapidly with little chance of recovery." (Heinrichs, *et al.*, 2011 at 14 (citation omitted)). This acts synergistically with the other threats discussed in this petition to increase the Manta Rays' level of endangerment.

3. Small Populations

Manta Rays typically have very small populations (*see, e.g.,* Mourier, 2012 at 2-3 (survey in the Marquesas Islands that identified only 66 reef manta rays and 11 giant manta rays). Therefore, even relatively light fishing pressure can remove a relatively high percentage of existing individuals (*see* CMS, 2014 at 6 ("Opportunistic hunting of a small *M. alfredi* population has recently been reported in the islands of Tonga and Micronesia. Because of their isolation and low numbers, such local subpopulations of *M. alfredi* are extremely vulnerable to any fishing pressure.") (citations omitted); Rohner, *et al.*, 2013 at 163 (citations omitted)). For instance, although only 20-50 reef manta rays are reportedly killed in Mozambique each year in one area of coastline, this population is estimated to include only 802 individuals, with annual population estimates ranging from 149 to 454 rays between 2003 and 2007 (Rohner, *et al.*, 2013 at 162-63 (citation omitted)). Though this fishery was only observed for a period of 8 years, it exhibited an astonishing 86% decline over that short time period (CoP16-Prop-46 at 8), indicating that even removal of a relatively low number of individuals can decimate Manta Ray populations very quickly. "Small, isolated populations can be at serious risk of rapid and unrecoverable decline, and the frequent occurrence of large aggregations of manta rays within a small area makes them even more vulnerable to localized anthropogenic impacts." (Deakos, *et al.*, 2011 at 258 (citation omitted)). In short, Manta Rays' small population sizes exacerbate the threats to these species' continued existence.

4. K-Selected

Manta Rays have an increased susceptibility to extinction because they are "K-selected" or "K-strategy" species (*see, e.g.,* Goble & Freyfogle, 2010 at 1058-60; Section III. C. "Physical Characteristics," *supra*; Section III. F. "Reproduction and Lifespan," *supra*; CoP16-Prop-46 at 3, 4, 9; CMS, 2014 at 5; Marshall, *et al.*, 2011 – 1 at 5; Dulvy, *et al.*, 2014 at 1-13).

> Mobulid rays live for a long time and reproduce infrequently. They are large animals with few natural predators that have long gestation periods which result in the birth of just a single pup (most of the time), which themselves are likely to take over a decades to reach sexual maturity. As a result of these life history strategies, and like many other large marine animals, manta ray populations simply cannot survive or sustain any commercial fisheries for an extended period of time. Any target fishery which annually removes even a relatively small percentage of the breeding adults results in a rapid decline in the overall population within just a few years, as the remaining mature individuals simply cannot breed fast enough to replace the [losses]. This is why, even with complete protection from anthropogenic threats, an overfished

> population of manta rays will take decades to recover to its natural state. A situation which, in the realities of today's global fisheries management and protective enforcement (or lack thereof), is never likely to happen to these populations which have already been overfished.

(Stevens, 2011 at 8). In fact, the Manta Ray has the second lowest maximum intrinsic rate of population increase of any known species (Dulvy, *et al.*, 2014 at 9).[79] This is particularly significant because the authors used some conservative estimates for factors affecting maximum intrinsic rate of population increase that may indicate that the Manta Rays' maximum intrinsic rate of population increase is even lower than measured (*see, e.g.,* Dulvy, *et al.*, 2014 at 7, 11, 12 (using a maximum size of 600 centimeters disc width, even though there is evidence that they consistently can reach maximum sizes of over 700 centimeters disc width, with anecdotal reports of up to 910 centimeters disc width; assuming, admittedly likely incorrectly, that juvenile survival rate is equivalent to adult survival rate; and applying a one pup per year reproductive rate estimate, which they admit is likely unrealistic in real world conditions) (citations omitted); *see also* Figure 60, *infra* (showing the extreme effect that changing variables can have on maximum intrinsic rate of population increase)). Therefore, Manta Rays could be the species with the lowest maximum intrinsic rate of population increase studied to date. "The very low productivity of manta rays mean that even a moderate level of fishing mortality of $F = 0.2$ (survival = 0.81) would reduce a small population of 100 individuals to fewer than 10 within less than a generation span (11 years)." (Dulvy, *et al.*, 2014 at 13; *see also* Dulvy, *et al.*, 2014 at 4 ("Recent work using a simple life history model suggests manta rays are intrinsically sensitive and have low capacity to rebound from even low levels of fishing mortality.") (citation omitted); Heinrichs, *et al.*, 2011 at 14 ("With little exchange between members of neighboring stocks, a fishery could deplete a single stock quite rapidly with little chance of recovery.")).

[79] The maximum intrinsic rate of population increase is a measure of a species' maximum ability to replenish itself. Therefore, annual mortalities in a population of a species that are in excess of its maximum intrinsic rate of population increase would cause ongoing population declines that would lead to eventual extinction of the population. This number is therefore very useful when determining the maximum amount of fishing a species can withstand and their general resilience to fishing. A lower maximum intrinsic rate of population increase indicates that the species will replace lost individuals more slowly and that it can therefore withstand an increasingly small amount of fishing or other mortality.

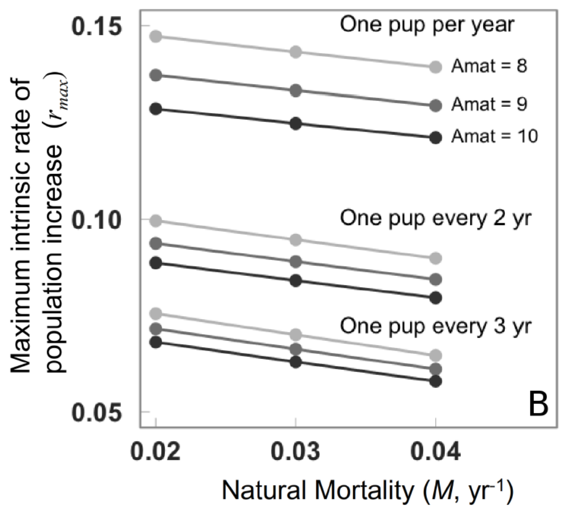

Figure 60. Sensitivity of Manta Ray maximum intrinsic rate of population increase to variation in natural mortality rate, age at maturity, and annual reproductive rate (Dulvy, *et al.*, 2014 at 8).

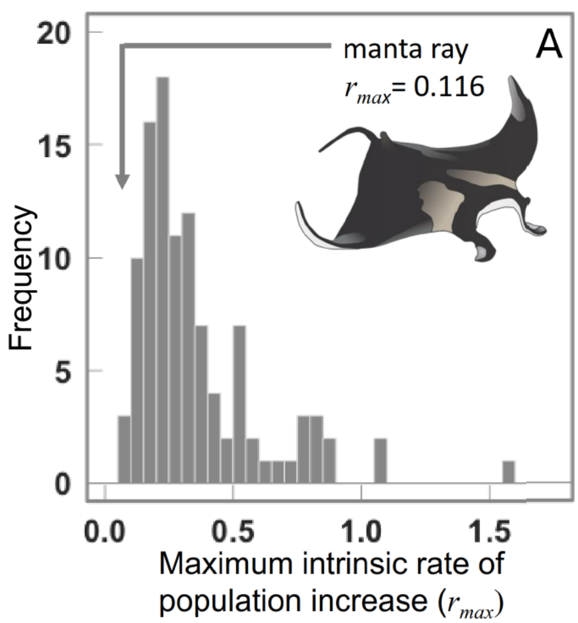

Figure 61. Maximum intrinsic rate of population increase for 106 chondrichthyans, with an arrow pointing to the Manta Ray (Dulvy, *et al.*, 2014 at 8). This shows that the Manta Ray is amongst the lowest of any of the chondrichthyans assessed.

> K-strategy species are more extinction prone than are r-strategy species. The very efficiency with which K-strategy species exploit their environment is a liability *during periods of rapid or chaotic change.* The larger body size of individuals of a K-strategy species - while giving an advantage in interspecific competition and in defense against predators and allowing individuals to exploit a larger area - means that there are fewer individuals . . . At the same time, lower reproduction rates make it more difficult both for the species to recover if its population becomes depressed and for it to adapt to a changed environment because fewer offspring contain less genetic variability. Thus,

> the very "fittedness" of K-strategy species to a particular environment - which is advantageous during periods of stability - becomes a serious handicap when the habitat changes more rapidly than genes can be substituted in a population - and in species that reproduce slowly, genes are substituted slowly.

(Goble & Freyfogle, 2010 at 1059-60 (emphasis in original)).

Manta Rays are currently experiencing the type of rapid, chaotic change that makes their K-selected life history patterns a liability. This is because Manta Rays are being fished and removed from their habitat and otherwise harmed and killed at a rate greater than they can replenish their numbers (*see, e.g.,* Section III. G. "Population Trend," *supra*; Section IV. B. "Overutilization for Commercial, Recreational, Scientific, or Educational Purposes," *supra*). As a result of these pressures, many of the Manta Rays' physical attributes and reproductive adaptations have gone from being beneficial to creating increased risk of species extinction. Because these species do not replenish themselves as quickly as smaller, shorter-lived, r-selected species, they are, therefore, more vulnerable when individuals are removed from the population or species reproduction is otherwise disrupted. Additionally, removal of individuals may be especially problematic because it may mean removing Manta Rays before they have a chance to propagate. Removing the individuals before they can reproduce means that there is a substantial risk that the population will rapidly collapse. Therefore, the Manta Rays' K-selected life history patterns are also contributing to their endangerment.

5. Heavy Maritime Traffic

Heavy maritime traffic in Manta Ray habitats exert a variety of threats on these species in addition to subjecting them to bycatch and directed fishing (treated in Section IV. B. "Overutilization for Commercial, Recreational, Scientific or Educational Purposes," *infra*). For instance, boat strikes can wound Manta Rays and decrease the fitness of individuals and/or contribute to non-natural mortality (Marshall, *et al.*, 2011 – 1 at 10 (citation omitted); Marshall, *et al.*, 2011 – 2 at 10 (citations omitted); Heinrichs, *et al.*, 2011 at 14; *see also* Section IV. B. 2. "Overutilization for Recreational Purposes," *supra* (reporting ship strikes and other impacts from vessels carrying tourists)). This is problematic because, in some regions, areas with high Manta Ray densities overlap with areas of heavy maritime traffic. For instance, in the Caribbean, "[a]reas with high relative densities of manta ray locations overlap[] with dominant shipping routes within the region." (Graham, *et al.*, 2012 at 4; *see also* Graham, *et al.*, 2012 at 4 ("Further, it seems that manta ray aggregations coincide with some of the Caribbean's busiest shipping lanes, whose impact on manta rays is as yet unknown." (internal citation omitted)). In addition, the main aggregation site for giant manta rays in Brazil is located close to Port Santos, which is Latin America's largest seaport (Marshall, *et al.*, 2011 – 1 at 12). Because coastal areas in particular will also be extensively used by a variety of boats, from shipping vessels to cruise ships to personal watercraft and other private recreational boats, ships strikes from these various vessels are highly likely.

Mooring and boat anchor line entanglement can also harm Manta Rays (*see* Marshall, *et al.*, 2011 – 1 at 10 (citation omitted); Marshall, *et al.*, 2011 – 2 at 10 (citations omitted); Heinrichs, *et al.*, 2011 at 14 (citation omitted); CoP16-Prop-46 at 9; Deakos, *et al.*, 2011 at 254; CMS, 2014 at 7). These threats can be cryptic (i.e. wounding Manta Rays, decreasing fitness, or contributing to non-natural mortality), or they can be more readily apparent, such as where they cause the individual to drown (*see* Deakos, *et al.*, 2011 at 257; Marshall, *et al.*, 2011 – 1 at 10 (citation omitted); Marshall, *et al.*, 2011 – 2 at 10 (citations omitted); Heinrichs, *et al.*, 2011 at 14 (citation omitted)). "Two manta ray entanglements in mooring lines were documented on video in Hawaii. The first was reported inside Molokini Crater, Maui, on 12 June 2007, and the second off Kona, Hawaii, on 19 June 2009. Both manta rays perished and were consumed by sharks immediately thereafter." (Deakos, *et al.*, 2011 at 257 (internal citations omitted)). As the numbers of boats and/or fishing pressure in an area increases, so does the likelihood that they will negatively impact Manta Rays (*see* Heinrichs, *et al.*, 2011 at 14 (citation omitted)). Deakos, *et al.*, 2011 indicated that entanglement in new mooring lines for unregulated swim with the mantas programs represents a "near future" threat to the Maui population (Deakos, *et al.*, 2011 at 258). These interactions with maritime traffic thus clearly threaten Manta Rays.

6. Synergistic Effects

The synergistic effects of aforementioned threats could conspire to cause the extinction of these Manta Ray species. "Like interactions within species assemblages, synergies among stressors form self-reinforcing mechanisms that hasten the dynamics of extinction." (Brook, *et al.*, 2008 at 457 (internal citations omitted)). These Manta Rays are already at risk as low-fecundity or K-selected species, rendering them more vulnerable to synergistic impacts of multiple threats.

> Traits such as ecological specialization and low population density act synergistically to elevate extinction risk above that expected from their additive contributions, because rarity itself imparts higher risk and specialization reduces the capacity of a species to adapt to habitat loss by shifting range or changing diet. Similarly, interactions between environmental factors and intrinsic characteristics make large-bodied, long-generation and low-fecundity species particularly predisposed to anthropogenic threats given their lower replacement rates.

(Brook, *et al.*, 2008 at 455 (internal citations omitted)). Therefore, although some stressors in isolation, such as natural predation by sharks and orcas (*see* Section IV. C. 1. "Shark Attacks," *supra*; Section IV. C. 2. "Orca Attacks," *supra*), may not, on their own, significantly increase the extinction pressure that these species face, the synergistic impacts of multiple threats to the Manta Rays, including shark and orca predation, likely increase the extinction pressure that they face.

V. CRITICAL HABITAT

This Petition requests that NMFS designate critical habitat for these three Manta Ray species in U.S. waters concurrently with a final ESA listing. *See* 16 U.S.C. § 1533(b)(6)(C). The definitions of the terms "critical habitat" and "conservation" indicate that, in designating critical habitat, NMFS must consider these species' ultimate recovery, and not just survival, as a primary purpose of critical habitat designation. *See* 16 U.S.C. § 1532(5)(A) (defining critical habitat to include both occupied and unoccupied habitat that is "essential for the *conservation* of the species.") (emphasis added); 16 U.S.C. § 1532(3) (defining "conservation" as "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this chapter are longer necessary."). Accordingly, the critical habitat designation for these Manta Rays should include all of the area currently or potentially inhabited by these species, including the important aggregation sites for these species on the southeastern coast of the United States, in the Gulf of Mexico, in Hawaii, and in the Pacific Island Territories, and a sufficient amount of other potentially suitable habitat in U.S. waters, to allow these species to recover from their endangered, or threatened, status.

VI. Conclusion

These Manta Ray species merit listing as endangered, or alternatively as threatened, species under the ESA. These species are declining throughout their entire ranges, or at least throughout a significant portion of their ranges, and continue to face overwhelming threats from targeted fishing and bycatch retention, largely to support the gill plate trade. They are also overutilized for recreational purposes because divers clamor to their important aggregation locations to view these majestic creatures, often interrupting important life history stages in the process. These Manta Rays are losing habitat from coral reef disappearance and climate change, marine debris, water pollution, and incidental impacts of fisheries are making their remaining habitat much less hospitable. They are extensively targeted by sharks and orcas with often fatal results. Even where these predations do not prove fatal, the Manta Rays are often mutilated, resulting in decreased fitness and decreased, or oftentimes totally removed, reproductive potential. They are heavily parasitized by copepods, forcing them to spend inordinate amounts of time and energy working to rid themselves of these infestations. These attempts to shed parasites, in addition to feeding and mating purposes, cause them to aggregate in predictable locations, which contributes to fishermen's ease in targeting them. This is very problematic because these species' size and other characteristics make them easy to find and kill and their low reproductive ability means that they have extremely limited ability to replace lost individuals. Their genetic isolation and small populations mean that population declines can be steep with extirpations being a very real possibility inside of a decade for some populations. These species currently receive inadequate regulatory protections throughout their ranges and require ESA listing to ensure their survival. Without adequate protection, the combined threats to these species will likely cause their extinction. Defenders therefore requests that NMFS list the giant manta ray, reef manta ray, and Caribbean manta ray throughout their ranges as endangered, or alternatively as threatened, species under the ESA. If NMFS determines that certain populations of these species qualify as DPSs, but that these species do not qualify as endangered or threatened throughout all or a significant portion of their ranges, then Defenders requests that NMFS list those DPSs as either endangered, or alternatively as threatened, DPSs under the ESA. Should NMFS list these species, then Defenders requests that NMFS concurrently designate critical habitat for them in U.S. waters as required by law.

On behalf of Defenders, thank you for your time and attention to this Petition, and we look forward to hearing from you shortly. If you have any questions, please feel free to reach us through the contact information contained in the signature blocks below.

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