## III. Data

*OMB Control Number:* 0648–0353.

*Form Number:* None.

*Type of Review:* Regular submission (extension of a current information collection).

*Affected Public:* Business or other for-profit organizations; individuals or households.

*Estimated Number of Respondents:* 1,692.

*Estimated Time per Response:* 15 minutes per buoy.

*Estimated Total Annual Burden Hours:* 3,138.

*Estimated Total Annual Cost to Public:* $16,920.

## IV. Request for Comments

Comments are invited on: (a) Whether the proposed collection of information is necessary for the proper performance of the functions of the agency, including whether the information shall have practical utility; (b) the accuracy of the agency's estimate of the burden (including hours and cost) of the proposed collection of information; (c) ways to enhance the quality, utility, and clarity of the information to be collected; and (d) ways to minimize the burden of the collection of information on respondents, including through the use of automated collection techniques or other forms of information technology.

Comments submitted in response to this notice will be summarized and/or included in the request for OMB approval of this information collection; they also will become a matter of public record.

Dated: June 27, 2013.

**Gwellnar Banks,**

*Management Analyst, Office of the Chief Information Officer.*

[FR Doc. 2013–15938 Filed 7–2–13; 8:45 am]

**BILLING CODE 3510–22–P**

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# DEPARTMENT OF COMMERCE

## National Oceanic and Atmospheric Administration

**RIN 0648–XC744**

## Endangered and Threatened Species; Notice of Intent To Prepare a Recovery Plan for Pacific Eulachon

**AGENCY:** National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Commerce.

**ACTION:** Notice of intent to prepare a recovery plan; request for information.

**SUMMARY:** The National Marine Fisheries Service (NMFS) is announcing its intent to prepare a recovery plan for Pacific eulachon (*Thaleichthys pacificus*) (eulachon) and requests information from the public. NMFS is required by the Endangered Species Act of 1973 (ESA), as amended to develop plans for the conservation and survival of federally listed species, i.e., recovery plans.

**DATES:** To allow adequate time to conduct a review of information submitted, all information must be received no later than August 2, 2013.

**ADDRESSES:** Information may be submitted by any of the following methods:

- *Via email: EulachonRecovery.nwr@noaa.gov* (No files larger than 5MB can be accepted).
- *Via U.S. mail:* Robert Anderson, National Marine Fisheries Service, 1201 NE Lloyd Blvd., Suite 1100, Portland, OR 97232 ATTN: Eulachon Recovery Coordinator.
- *Hand delivered:* National Marine Fisheries Service, 1201 NE Lloyd Blvd., Suite 1100, Portland, OR 97232 ATTN: Eulachon Recovery Coordinator. Business hours are 8 a.m. to 5 p.m. Monday through Friday, except Federal holidays.
- *Via fax:* 503–230–5441. Please include the following on the cover page of the fax ''ATTN: Eulachon Recovery Coordinator.''

**FOR FURTHER INFORMATION CONTACT:** Robert Anderson, Eulachon Recovery Coordinator, (503) 231–2226.

**SUPPLEMENTARY INFORMATION:**

NMFS is charged with the recovery of eulachon, a species listed under the Endangered Species Act of 1973 (ESA). Recovery means that listed species and their ecosystems are restored, and their future secured, so that the protections of the ESA are no longer necessary. The ESA specifies that recovery plans must include: (1) A description of management actions necessary to achieve the plan's goals for the conservation and survival of the species; (2) objective, measurable criteria which, when met, would result in the species being removed from the list; and (3) estimates of the time and costs required to achieve the plan's goal and the intermediate steps towards that goal. Section 4(f) of the ESA, as amended in 1988, requires that public notice and an opportunity for public review and comment be provided during recovery plan development. We are soliciting relevant information on eulachon and their freshwater/marine habitats.

Such information should address the following ESA listing factors: (1) Destruction or modification of habitat; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; or (5) other natural or human factors; and information on (a) strategies and/or actions to address limiting factors and threats; (b) estimates of the time and cost to implement recovery actions; (c) critical knowledge gaps and/or uncertainties that need to be resolved to better inform recovery efforts; and (d) research, monitoring and evaluation needs to address knowledge gaps and uncertainties, or to assess the species' status, limiting factors and threats relative to recovery goals. Upon completion, the proposed Recovery Plan will be available for public review and comment through the publication of a **Federal Register** Notice.

### Preliminary Conservation Strategy

We have developed a Recovery Outline for eulachon as a preliminary conservation strategy that will guide recovery actions in a systematic, cohesive way until a recovery plan is available. The Recovery Outline may be accessed at *http://www.nwr.noaa.gov/protected_species/other/eulachon_columbia_river_smelt/pacific_eulachon.html.*

**Authority:** 16 U.S.C. 1531 *et seq.*

Dated: June 28, 2013.

**Angela Somma,**

*Chief, Endangered Species Division, Office of Protected Resources, National Marine Fisheries Service.*

[FR Doc. 2013–15965 Filed 7–2–13; 8:45 am]

**BILLING CODE 3510–22–P**

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# DEPARTMENT OF COMMERCE

## National Ocean and Atmospheric Administration

**[Docket No. 120807313–3560–02]**

**RIN 0648–XC154**

## Endangered and Threatened Wildlife; 12-Month Finding on Petitions To List the Northeastern Pacific Ocean Distinct Population Segment of White Shark as Threatened or Endangered Under the Endangered Species Act

**AGENCY:** National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

**ACTION:** Notice of 12-month finding and availability of status review documents.

**SUMMARY:** We, NMFS, announce a 12-month finding on two petitions to list the northeastern Pacific (NEP) population of white sharks

(*Carcharodon carcharias*) as threatened or endangered under the Endangered Species Act (ESA). We have completed a status review of the NEP white shark population in response to these petitions using the best available scientific and commercial data. Based on this review, we have determined that the NEP white shark population qualifies as a distinct population segment (DPS) under the ESA and does not warrant listing under the ESA. Based on the considerations described in this notice, we conclude that the NEP white shark DPS is neither in danger of extinction throughout all or a significant portion of its range nor likely to become so within the foreseeable future.

**DATES:** This finding was made on July 3, 2013.

**ADDRESSES:** The status review documents for the NEP white shark population are available by submitting a request to the Assistant Regional Administrator, Protected Resources Division, Southwest Regional Office, 501 W. Ocean Blvd., Suite 4200, Long Beach, CA 90802, Attention: White Shark 12-month Finding. The documents are also available electronically at: *http://swr.nmfs.noaa.gov/.*

**FOR FURTHER INFORMATION CONTACT:** Craig Wingert, NMFS, Southwest Regional Office, (562) 980–4021 or Marta Nammack, NMFS, Office of Protected Resources, (301) 427–8469.

**SUPPLEMENTARY INFORMATION:**

## Background

On June 25, 2012, we received a petition from WildEarth Guardians to list the NEP population of the white shark as threatened or endangered and to designate critical habitat for the population under the ESA. On August 13, 2012, we received a second petition, filed jointly by Oceana, Center for Biological Diversity and Shark Stewards, to list the NEP white shark population under the ESA and to designate critical habitat for the population. Both petitions presented much of the same or related factual information on the biology and ecology of white sharks, and raised several identical or similar issues related to potential factors affecting the NEP population of this species. On September 28, 2012, we published a positive 90-day finding (77 FR 59582) announcing that both petitions presented substantial scientific or commercial information indicating that the petitioned action may be warranted. In our 90-day finding, we also announced the initiation of a status review of the NEP white shark population and requested information to inform our decision on whether this population constituted a DPS and warrants listing as threatened or endangered under the ESA.

## ESA Statutory Provisions

The ESA defines ''species'' to include any subspecies or DPS of any vertebrate species which interbreeds when mature (16 U.S.C. 1532(16)). The U.S. Fish and Wildlife Service (FWS) and NMFS have adopted a joint policy describing what constitutes a DPS under the ESA (61 FR 4722). The joint DPS policy identifies two criteria for making a determination that a population is a DPS: (1) The population must be discrete in relation to other conspecific populations; and (2) the population must be significant to the taxon to which it belongs.

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; or (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 ESA. If a population segment is found to be discrete under one or both of the above conditions, its biological and ecological significance to the taxon to which it belongs is evaluated. Factors that can be considered in evaluating significance may include, but are not limited to: (1) Persistence of the discrete population segment in an ecological setting unusual or unique for the taxon; (2) evidence that the 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; and (4) evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics.

Section 3 of the ESA defines an endangered species as ''any species which is in danger of extinction throughout all or a significant portion of its range'' 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.'' Thus, we interpret an ''endangered species'' to be one that is presently in danger of extinction. A ''threatened species,'' on the other hand, is not presently in danger of extinction, but is likely to become so in the foreseeable future (that is, at a later time). In other words, the primary statutory difference between a threatened and endangered species is the timing of when a species may be in danger of extinction, either presently (endangered) or in the foreseeable future (threatened). The ESA requires us to determine whether a species is endangered or threatened throughout all or a significant portion of its range because of any of the following five factors: (1) The present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) the inadequacy of existing regulatory mechanisms; or (5) other natural or manmade factors affecting its continued existence.

The ESA does not define the term ''significant portion of its range'' in the definitions for threatened and endangered species. NMFS and U.S. Fish and Wildlife Service (FWS; together the Services) have proposed a ''Draft Policy on Interpretation of the Phrase 'Significant Portion of Its Range' in the Endangered Species Act's Definitions of 'Endangered Species' and 'Threatened Species' '' (76 FR 76987; December 9, 2011), which is consistent with our past practice as well as our understanding of the statutory framework and language related to this term. While the Draft Policy remains in draft form, the Services are to consider the interpretations and principles contained in the Draft Policy as non-binding guidance in making individual listing determinations, while taking into account the unique circumstances of the species under consideration. The Draft Policy provides that: (1) If a species is found to be endangered or threatened in only a significant portion of its range, the entire species is listed as endangered or threatened, respectively, and the Act's protections apply across the species' entire range; (2) a portion of the range of a species is ''significant'' if its contribution to the viability of the species is so important that, without that portion, the species would be in danger of extinction; (3) the range of a species is considered to be the general geographical area within which that species can be found at the time FWS or NMFS makes any particular status determination; and (4) if the species is not endangered or threatened throughout all of its range, but it is endangered or threatened within a significant portion of its range, and the population in that significant portion is a valid DPS, we will list the DPS rather than the entire taxonomic species or subspecies.

Section 4(b)(1)(A) of the ESA requires us to make listing determinations based solely on the best scientific and commercial data available after conducting a review of the status of the species (or DPS) and after taking into account efforts being made to conserve the species. In evaluating the efficacy of conservation efforts we rely on the Services' joint ''Policy for Evaluating of Conservation Efforts'' (''PECE''; 68 FR 15100; March 28, 2003). The PECE provides guidance to the Services on how to consider conservation efforts that have not been implemented, or have been implemented but not yet demonstrated to be effective.

**Status Review and Biological Review Team**

As part of our comprehensive status review of the NEP white shark population, we formed a biological review team (BRT) comprised of Federal scientists from NMFS' Southwest Fisheries Science Center (SWFSC) having scientific expertise in shark biology and ecology, genetics, population estimation and modeling, fisheries management and conservation biology. We asked the BRT to compile and review the best available scientific and commercial information, and then to: (1) determine whether the NEP white shark population satisfied the criteria for being a DPS under the joint DPS policy; and (2) evaluate the extinction risk of the population, taking into account both threats to the population and its biological status.

In conducting its review, the BRT considered a wide range of scientific information from the literature, unpublished documents, personal communications with researchers working on white sharks in the NEP and relevant technical information submitted to NMFS. The BRT recognized that there is considerable uncertainty regarding many aspects of white shark biology, abundance, trends in abundance and threats in the NEP. To address this uncertainty, the BRT explicitly defined issues that were uncertain and used a structured expert decision making (SEDM) approach to evaluate the plausibility of different scenarios after taking into account the best available data on the species, including information on white sharks from other geographic areas where necessary. The BRT prepared a report containing information on the biology, ecology and habitat use of white sharks in the NEP; information on whether the population constitutes a DPS under the ESA; and its assessment of the population's risk of extinction based on the best available information (Dewar *et al.,* 2013). The BRT report was subjected to independent peer review as required by the Office of Management and Budget Final Information Quality Bulletin for Peer Review (M–05–03; December 16, 2004).

**NEP White Shark Life History, Ecology, Distribution and Population Structure**

White sharks in the NEP belong to the species *Carcharodon carcharias.* The white shark is a circumglobal species that lives in coastal regions as well as the open ocean (Compagno, 2001) and is most frequently observed in inshore temperate continental waters of the Western North Atlantic, Mediterranean Sea, southern Africa, southern and Western Australia, and the NEP. Young-of-the-year (in their first year of life, YOY) and juvenile white sharks in the NEP are thought to prefer shallow coastal waters, primarily in the southern California Bight (SCB) and the west coast of Baja California (Dewar *et al.,* 2001, Weng *et al.,* 2007b). Adult and subadult white sharks in the NEP are most commonly observed near pinniped rookeries, but also range far from shore, spending protracted periods in pelagic habitats (Klimley, 1985; Bonfil *et al.,* 1994; Domeier and Nasby-Lucas, 2007; Jorgensen *et al.,* 2010).

*Growth and Reproduction*

Life history information related to growth and reproduction is relatively limited for the NEP white shark population, and therefore the BRT compiled the best available information for the species throughout its global range to characterize these life history parameters (Dewar *et al.,* 2013). YOY white sharks range from 1.2 to 1.75 m in total length (TL) (Francis, 1996). Juvenile white sharks range from 1.75 to 3.0 m TL and subadult white sharks range from 3.0 m TL up to the sizes at which males, as inferred from total length (3.6 to 3.8 m TL) and calcification of their claspers, and females (4.5 to 5.0 m TL) mature (Cailliet *et al.,* 1985; Francis, 1996; Pratt, 1996; Winter and Cliff, 1999; Malcolm *et al.,* 2001).

A number of studies have used vertebral bands to construct von Bertalanffy growth curves for white sharks (Cailliet *et al.* 1985; Wintner and Cliff 1999; Malcolm *et al,.* 2001). These curves demonstrate that the growth of white sharks in the NEP (Cailliet *et al,* 1985) is similar to that for white sharks found off South Africa and Australia (Wintner and Cliff, 1999 and Malcolm *et al.,* 2001, respectively). Francis (1996) summarized data for pregnant female white sharks from around the globe and reported that size at maturity ranged from 4.5–5.0 m TL, which is similar to that reported by others (Malcolm *et al.,* 2001; Domeier and Nasby-Lucas, 2013). Length of gestation is uncertain, but is thought to be longer than a year and is estimated to be 18 months (Francis 1996; Mollet *et al.,* 2000; Domeier and Nasby-Lucas, 2013). Consistent with the long gestation period, the frequency of pupping has been suggested to range between 2–3 years. The most quantitative information on pupping frequency comes from a photo identification (ID) study conducted at Guadalupe Island, Mexico, which estimated that females pup every 2.2 years (Nasby-Lucas and Domeier, 2012). Mollet *et al.* (2000) reported that the average litter size of female white sharks was 8.9 pups.

*Foraging Ecology*

Information on white shark foraging ecology comes from stomach content analysis and visual observations of larger shark feeding events (Klimley, 1985; Compagno *et al.,* 1997; Skomal *et al.,* 2012). Stomach contents of YOY and juvenile white sharks off southern California were found to include a range of bony fishes, cartilaginous fishes and crustaceans (Klimley, 1985). As white sharks reach a larger size (i.e., about 3 m TL), their diet expands to include marine mammals (Klimley, 1985). The most important prey items include pinnipeds (i.e., seals, sea lions, and elephant seals) and fishes (including other sharks and rays) while less common prey items include marine reptiles (mostly sea turtles), larger cephalopods, gastropods, and crustaceans. White sharks have also been observed to scavenge large and small cetaceans (Compagno *et al.,* 1997).

*Distribution and Habitat Use*

Klimley (1985) found that YOY white sharks were caught south of Point Conception, California, whereas juveniles were caught both north and south of Point Conception. Based on this information, Klimley (1985) hypothesized that the SCB was a nursery area for white sharks. A more recent analysis of fishery interactions with white sharks in Southern California by Lowe *et al.* (2012) supports the notion that the SCB is a nursery area. These studies as well as those by Domeier (2012) indicate YOY first appear in incidental catch records in April and peak in abundance in August. Both YOY and juvenile white sharks are caught predominantly in near-shore waters less than 50m in depth (Klimley, 1985; Lowe *et al.,* 2012). YOY and juvenile white sharks have also been incidentally caught off the coast of Baja California in near-shore habitats (Santana-Morales *et al.,* 2012), and juveniles have been incidentally caught in the Sea of Cortez (Galván-Magaña *et al.,* 2010).

Recent tagging studies indicate that YOY white sharks remain between Point Conception and Sebastián Vizcaíno Bay in Baja California (Dewar *et al.,* 2004; Weng *et al.,* 2007b; Weng *et al,.* 2012). Weng *et al.* (2007b) also reported that YOY white sharks exhibited seasonal movements between California coastal waters in the summer and the coastal waters of northern Baja California in the fall, but this was based on very limited data. Weng *et al.* (2007b) tagged a total of 4 YOY and the tags only recorded data for 1–2 months before falling off. Two of the tagged individuals lost their tags in California in August and September and the other two individuals lost their tags in the fall in Baja California. Although there is evidence of seasonal movement, it is uncertain what portion of the YOY population moves to Mexico and whether or not they return to the SCB. Additional and longer tag deployments on YOY white sharks may reveal more extensive movements within the nursery area. Weng *et al.* (2012) also released 5 tagged YOY following a period of captivity at Monterey Bay Aquarium, some of which did not go to Mexico while some were tracked moving to Cabo San Lucas and into the Gulf of California.

Klimley (1985) reported that sub-adult and adult white sharks were caught predominantly north of Point Conception with the largest concentration of sharks found off Central California near pinniped rookeries from Tomales Bay to Monterey Bay. The majority of attacks on humans and pinnipeds also occurred within these same areas, as well as in river mouths and harbors (McCosker and Lea, 1996). Klimley (1985) found that more females were caught south of Point Conception and hypothesized that females migrated south to give birth, suggesting that the area south of Point Conception is a nursery area.

Klimley (1985) reported that white sharks occurred as far north as the southern end of Queen Charlotte Island off British Columbia. Martin (2005) examined available records of subadult and adult white shark sightings, captures, and strandings from 1961–2004 in British Columbia and Alaska and found they were most frequently present in the summer and fall months, that El Nino events did not impact the frequency of sightings or captures, and that there was no discernable trend in the species' presence over the years examined. The southern extent of the white shark range in the NEP appears to be Mexico. Adult and subadult white sharks have been documented by sightings and in incidental fishery catches within the Sea of Cortez (Galván-Magaña *et al.,* 2010; Castro, 2012), with adults being most common from December to May and less common from June to October. Beginning in the late 1990s, subadult and adult white sharks were observed in increasing numbers at Guadalupe Island offshore from the Pacific coast of Baja California and by the early 2000s their presence was sufficiently predictable to support a commercial cage diving industry in the fall months. The western extent of the white shark's range in the NEP appears to be the Hawaiian Islands. White shark teeth have been found among artifacts in the Hawaiian Islands suggesting their historical presence in the area, but the species is rarely caught or observed there (Dewar *et al.,* 2013). From 1926 to 2011 there were 14 confirmed observations of subadult or adult white sharks in the vicinity of the Hawaiian Islands (Taylor, 1985; Weng and Honebrink, 2013). No YOY or juvenile white sharks have been captured in the Hawaiian Islands, suggesting it is unlikely to be a nursery area. Electronic tagging studies also indicate that some white sharks migrate offshore from the aggregation sites in central California and Guadalupe Island to waters near the Hawaiian Islands (Domeier and Nasby-Lucas, 2008; Jorgensen *et al.,* 2010).

The majority of adult white shark activity in the NEP is observed at coastal sites and islands that serve as pinniped rookeries (Dewar et al., 2013). The Southeast Farallon Islands off central California serve as a rookery for a number of different pinniped species (northern elephant seals, California sea lions, northern fur seals, Steller sea lions and harbor seals) and have been one of the most predictable sites for observing white sharks in the NEP. Other sites where white sharks have been predictably observed in central California include Tomales Point, Point Reyes and Año Nuevo Island. Similarly, Guadalupe Island offshore Baja California in Mexico has recently become an important aggregation site for white sharks. The consistent presence of white sharks at these aggregation sites has provided the opportunity for researchers to conduct photo-ID studies because of the unique identifying characteristics exhibited by white sharks and their predictable occurrence over time.

Anderson *et al.* (1996) initiated a photo-ID study of white sharks at Southeast Farallon Island in 1987, which was subsequently expanded to include coastal areas near Tomales Point in 1988. The study found that the same individuals returned to these areas repeatedly, with males typically returning on an annual basis and females on a semi-annual basis. Males were sighted nearly twice as often as females, though this ratio is most likely biased because it is easier to confirm the presence of male claspers rather than their absence. One specific male white shark has been found to occur at Southeast Farallon Island over a period of 22 years (Anderson *et al.,* 2010). Based on photo-ID studies conducted at Guadalupe Island, Domeier and Nasby-Lucas (2007) and Nasby-Lucas and Domeier (2012) found that adult male and female white sharks exhibit patterns of occurrence similar to those found for white sharks in central California, with males returning annually and mature females typically returning on a semi-annual basis. As was the case in central California, they also observed more males than females; however, the sex ratio shifted during fall months as males and females arrived at different times.

Studies using pop-up satellite archival tags (PSAT) have shown that sharks tagged at both Southeast Farallon Island and Guadalupe Island undertake long range migrations to an offshore focal area (OFA) in the NEP located approximately midway between the west coast of North America and the Hawaiian Islands and then return to the aggregation sites where they were originally tagged in the fall (Boustany *et al.,* 2005; Weng *et al.,* 2007a; Domeier and Nasby-Lucas, 2008; Jorgensen *et al.,* 2010). A relatively small number of white sharks tagged at these two aggregation sites move as far west as the Hawaiian Islands (Domeier and Nasby-Lucas, 2008; Jorgensen *et al.,* 2010). This OFA has been termed either the white shark café or the Shared Offshore Foraging Area by different research groups (Domeier, 2012; Jorgensen *et al.,* 2012).

Researchers have also used smart position and temperature (SPOT) tags to document white shark movements from both the central California and Guadalupe Island aggregation sites. SPOT tag data for white sharks from Guadalupe Island confirm that females typically do not return to the aggregation site on a yearly cycle and instead remain offshore for about 15 months, which is presumed to be associated with their 18-month gestation cycle (Domeier and Nasby-Lucas, 2012). After spending 15 months offshore, 4 tagged females returned to coastal waters between April and August when YOY are seasonally present, suggesting that they may have migrated there to give birth. Two of the females were tracked into the Sea of Cortez in June and July when white sharks are rare according to information presented in Galván-Magaña *et al.* (2010), and two were tracked to the Pacific coast of Baja California near Sebastián Vizcaíno Bay (Domeier and Nasby-Lucas, 2013). All four females then returned to the Guadalupe Island aggregation site between late September and early October after the normal return time for male white sharks.

Analysis of both types of satellite tag data suggests that there is sexual segregation of white sharks in the OFA, with males from the aggregation sites in central California and at Guadalupe Island using a smaller and more predictable offshore area and females roaming over a larger and less predictable area (Jorgensen *et al.,* 2009; Domeier and Nasby-Lucas, 2012). The habitat function of the OFA and the coastal aggregation sites is a source of disagreement between different researchers and centers around whether the OFA or the coastal aggregation sites are used for mating. Jorgensen *et al.* (2010 and 2012) argue the OFA is a mating area and Domeier (2011) and Domeier and Nasby-Lucas (2013) argue the coastal aggregation sites are used for mating.

To complement data obtained from the PSAT and SPOT tagging studies, researchers in central California have used an acoustic array to document the movements of white sharks in and around the known sites where white sharks aggregate. Acoustic tracking data for white sharks tagged in central California showed that upon their return to the coast from offshore, tagged white sharks were detected by receivers at a number of central California locations. Tracking data during the coastal aggregation period (August through February) suggest that white sharks preferred a limited number of key hotspots and that some individual sharks showed a distinct preference for specific sites (Dewar *et al.,* 2013).

Despite their long-range offshore movements, satellite tagged white sharks from central California have not been tracked moving to Guadalupe Island or vice versa. However, a female white shark that was SPOT tagged at Guadalupe Island was found to migrate offshore and return back to the coast to an area just off Point Conception (M. Domeier, MCSI, personal communication) and a small number of acoustically tagged white sharks have been found to move between the two areas (Jorgensen *et al.,* 2012; S. Jorgensen, Monterey Bay Aquarium, personal communication as cited in Dewar *et al.,* 2013).

*Genetic Information on White Shark Population Structure and Population Size*

Genetic data provide valuable insight into white shark population structure and connectivity between populations in different ocean basins, as well as historical abundance. A comparison of mitochondrial DNA (mtDNA) samples taken from white shark populations in central California, South Africa and Australia/New Zealand showed strong clustering of samples from California with those from Australia/New Zealand. The analysis also provided evidence that the NEP white shark population forms a unique monophyletic clade (i.e., a group evolved from a single common ancestral form) that was derived relatively recently from the Australia/New Zealand population. It has been hypothesized that the NEP white shark population was founded by Australia/New Zealand migrants during the Late Pleistocene (~150,000 years ago) and that subsequent strong homing behavior and reproductive site fidelity has maintained the separation between the two populations (Jorgensen *et al.,* 2009).

The pattern of genetic diversity observed in white shark samples suggests the population has undergone a rapid demographic expansion since it colonized the NEP (Dewar *et al.,* 2013). Although the overall number of genetic samples is relatively low for all geographic areas, observations that the NEP white shark population lineage is monophyletic and that no shared haplotypes have been observed between samples from different regions strongly indicates the NEP population is genetically distinct (Dewar *et al.,* 2013). However, because only mtDNA data are presently available and this genetic material is inherited maternally, the available genetic information only reflects patterns of female gene flow and behavior. Future use of nuclear DNA markers is needed to determine whether male mediated gene flow follows a similar pattern (Dewar *et al.,* 2013).

The number of haplotypes (i.e., specific genetic sequences that are inherited from the maternal parent's haploid mitochondrial genome) expected in a given population depends, among other things, on its effective population size (Dewar et al., 2013). For populations that are naturally low in abundance, the number of haplotypes is expected to be low and normally there would be no truly rare haplotypes (defined by the BRT as haplotypes found at frequencies equal to or less than 5 percent). In shark and cetacean populations with a low number of haplotypes (e.g., 1–5 haplotypes), the abundance of females in the population is in the low hundreds of individuals or less (see Table 2.2 in Dewar *et al.,* 2013). In contrast, higher haplotype diversity is consistent with a population that is currently large or was larger in the past, but has suffered a significant decline in the last few generations (Hoelzel *et al.,* 1993, as cited in Dewar *et al.,* 2013). Based on an evaluation of the available genetic information on white sharks from central California (see Jorgensen *et al.,* 2010), the BRT found that the number of haplotypes and the number of low frequency haplotypes in the NEP white shark population were relatively high (Dewar *et al.,* 2013). The BRT compiled information on haplotype diversity and population abundance for a range of marine mammal and shark species that were long-lived, slow reproducers and not characterized by strong social structure, and compared this information to the haplotype numbers and diversity observed for white sharks in the NEP (see Table 2.2 in Dewar *et al.,* 2013). Based on this comparison, the haplotypic diversity of the NEP white shark population is comparable to that of other species where the abundance of females is in the high hundreds to low thousands of individuals. Given the relationship between haplotype diversity and female abundance and the observed haplotype diversity for white sharks in the NEP, the BRT suggested that the NEP white shark population is either much more abundant than indicated by recent estimates based on photo-ID data from central California and Guadalupe Island (Chapple *et al.,* 2011; Sosa-Nishizaki *et al.,* 2012) or that the population was historically larger and has declined substantially in the last few generations.

The BRT addressed the potential for a substantial decline in the NEP white shark population over the past two generations (i.e., approximately 40 years) by conducting a Monte Carlo modeling exercise that imposed a relatively high level of fisheries-related mortality on a white shark population to determine if it was feasible to induce a 90 percent population decline over two generations (see Appendix B in Dewar *et al.,* 2013). The modeled scenarios assumed starting white shark populations consisting of only 500 and 1,000 adult females and imposed fishery-mortality rates that were high in comparison to current estimated rates. Under these scenarios, fisheries mortality caused population declines, but the modeling results indicate that present day abundance of female white sharks would still number several hundred individuals. Based on this analysis, the BRT determined that: (1) The NEP white shark population is not likely to have undergone a dramatic decline in abundance over the past two generations (40 years); and (2) the population's haplotypic diversity reflects a present day adult female population that is much larger than suggested by current population estimates (see Appendix B in Dewar *et al.,* 2013).

**NEP White Shark DPS Determination**

The BRT evaluated the best available information for the NEP white shark population to determine whether it meets the discreteness and significance criteria in the joint DPS policy (see ESA Statutory Provisions section). All relevant information related to the discreteness and significance criteria was thoroughly discussed by the BRT and arguments were developed for and against each factor that was considered. The BRT used a SEDM approach for expressing uncertainty about how different type of information (e.g., behavior, genetics, etc.) related to the discreteness and significance criteria (Dewar *et al.,* 2013).

*Discreteness*

Based on a careful review of the best available information, the BRT concluded that the NEP white shark population is markedly separated from other populations of the same taxon as a consequence of behavioral characteristics (Dewar *et al.,* 2013). Information supporting this conclusion includes: (1) The site fidelity exhibited by NEP white sharks from the two studied aggregation sites (i.e., central California and Guadalupe Island); (2) tagging information that shows movement of white sharks only within the NEP; and (3) the lack of shared mtDNA haplotypes between the NEP white shark population and white shark populations from other areas (e.g., Australia/New Zealand and South Africa) which suggests little movement of sharks or gene flow among these areas. All of the available tagging and photo-ID data from the two known aggregation sites in the NEP indicate that subadult and adult males and females exhibit consistent migration patterns with individuals moving between the aggregation sites and an offshore pelagic habitat located between the Hawaiian Islands and the North American mainland. Similarly, tagging studies of YOY and juvenile white sharks in the NEP also indicate that their movements are restricted to the coastal waters of North America. Results from genetic studies using mtDNA markers indicate that the NEP white shark population does not share any haplotypes with populations in other regions suggesting there is little to no gene flow between the NEP population and populations in other regions. The available mtDNA data are only indicative of female-mediated gene flow, and therefore additional information is needed to confirm that males do not move from the NEP to other areas such as Australia or New Zealand. Accordingly, the BRT found that the available evidence strongly supports a finding that NEP white sharks are markedly separate from white shark populations in other regions based on a consideration of behavioral factors (Dewar *et al.,* 2013).

*Significance*

The BRT evaluated the available information relating to the possible significance of the NEP white shark population and focused on two factors: (1) Genetic differences between the NEP white shark population and other populations found in the Pacific and Atlantic Oceans; and (2) whether the loss of the NEP white shark population would create a significant gap in the species' global range. Based on a thorough evaluation of the available information, the BRT found that the NEP white shark population is significant to the global taxon based on both of these two factors (Dewar *et al.,* 2013).

The BRT evaluated the genetic differences between the NEP white shark population and populations found in other regions by comparing the results of mtDNA analysis of white shark samples from Central California (the NEP white shark population), Japan, Australia/New Zealand and South Africa. A comparison of these data revealed that the NEP white shark population does not share mtDNA haplotypes with populations from any other area, suggesting it represents a unique monophyletic clade. The level of mtDNA differentiation between populations suggests that less than one migrant per generation migrates between areas and that enough time has passed to allow white sharks to adapt to habitat conditions in the NEP. Although the mtDNA data provide information only about potential female movement and gene flow among regions, many of the individuals analyzed from the NEP white shark population were adult males with haplotypes indicating that they were of NEP origin and photographic histories showing that they were repeatedly observed at the aggregation sites in the NEP. The BRT identified some issues with the available genetic data (e.g., small sample sizes for most genetic studies, the use of only maternally inherited markers, etc.), but concluded based on a SEDM assessment that the data show marked genetic differences between the NEP white shark population and other white shark populations that were analyzed (Dewar *et al.,* 2013).

The BRT also evaluated the range of the NEP white shark population in comparison with the species' global distribution to assess whether the loss of the NEP population would constitute a significant gap in the species' range (Dewar *et al.,* 2013). The BRT determined that the NEP white shark population occupies approximately half of the North Pacific Ocean and concluded that this area represents a significant part of the taxonomic species' global range. Based on these considerations, the BRT concluded that loss of the NEP white shark population would constitute a significant gap in the taxonomic species' global range (Dewar *et al.,* 2013).

*Conclusion*

Based on a consideration of the best available information, the BRT found that the NEP white shark population is: (1) Discrete to the global taxon because it is markedly separated from other white shark populations based on behavioral factors; and (2) significant to the global taxon based on evidence that the population differs markedly in its genetic characteristics from other populations and because loss of the population would result in a significant gap in the range of the global taxon. We concur with the BRT's findings, and therefore conclude that the NEP white shark population constitutes a DPS under the ESA.

**Significant Portions of the NEP White Shark Population's Geographic Range**

As part of its status review, the BRT evaluated whether there were portions of the NEP white shark population's geographic range that could potentially constitute a significant portion of its range. Although several portions of the geographic range occupied by the NEP white shark population are biologically important (e.g., central California and Guadalupe Island aggregation sites, SCB and northern Baja coastal nursery habitat, offshore pelagic habitat), the BRT focused on evaluating whether there were important threats to the population that were concentrated in specific areas that might constitute a significant portion of the range of the population. Based on its threats evaluation, the BRT concluded that fisheries bycatch is the main threat to the population and the largest known current threat is the bycatch of YOY and juvenile white sharks in gillnet fisheries that occur in the coastal waters of the SCB and northern Baja California (see Evaluation of Threats section). Within this geographic area, which is considered to be the nursery area for YOY and juvenile white sharks in the NEP, most documented fisheries bycatch occurs along the Baja California coast from the U.S.-Mexico border to Sebastián Vizcaíno Bay, but there is also bycatch of YOY and juveniles in the SCB. Recent tagging studies (Weng *et al.,* 2007b; Weng *et al.,* 2012) have tracked some YOY white sharks moving from the SCB to coastal Mexican waters including Sebastian Vizcaino Bay and the Sea of Cortez, suggesting that the nursery habitat in the SCB is connected to the nursery habitat in northern Baja California. Because this nursery habitat is used by the entire NEP white shark population, the BRT concluded that fishery bycatch impacts in the nursery habitat affect the entire population rather than any specific population segment. Similarly, adult and subadult white sharks tagged at the known coastal aggregation sites in central California and at Guadalupe Island undertake seasonal offshore migrations and males and females use common areas in the NEP between the Hawaiian Islands and the coast of North America. While occupying this offshore habitat, adult and subadult white sharks from throughout the range of the NEP population are exposed to similar threats. Based on these considerations, the BRT determined that the most significant threats to the population affect the NEP population as a whole rather than any specific segments of the population. As a consequence, the BRT found, and we concur, that there are no identifiable portions of the NEP white shark population that constitute a significant portion of the population's range. Accordingly, the BRT's extinction risk assessment was based on the NEP white shark population throughout its entire range.

## Assessment of NEP White Shark Extinction Risk

The BRT considered a wide range of information in assessing the extinction risk of the NEP white shark population including: (1) Potential threats to the population; (2) direct and indirect information regarding trends in population abundance; (3) population abundance estimates and factors that bias abundance estimates; and (4) population modeling to assess the risks associated with fisheries bycatch on the population under a range of population levels. The following discussion summarizes information considered by the BRT, the results of its analyses, and its overall extinction risk conclusions (see Dewar *et al.,* 2013).

### *Evaluation of Threats*

The BRT identified and compiled information on a range of potential threats to the NEP white shark population (Dewar *et al.,* 2013). These included several fisheries (i.e., high seas driftnet fishery; coastal set net fisheries off of California; gillnet fisheries in Mexico and recreational fisheries off of California); depletion of white shark prey resources; potential small population effects; disease and predation; habitat degradation (i.e., environmental contamination) and climate change effects (i.e., ocean acidification and ocean warming). Following a review of this information, the BRT assessed the severity of each threat to the population and how certain each threat was likely to occur. In making this assessment, the BRT considered the current and foreseeable future risks of each threat to the population, and in some cases also assessed the historical risks of some threats where information was available to do so. The BRT also grouped individual threats into specific threat categories (e.g., habitat destruction, overutilization, etc.) which were then evaluated in terms of their overall risk (e.g., none, low, moderate and high) to the NEP white shark population. Where appropriate, we incorporated the BRT's analysis and findings about threats in our evaluation of the five factors that must be considered in accordance with section 4(a)(1) of the ESA. More detailed information regarding the threats assessment can be found in Dewar *et al.* (2013).

In summary, the BRT found that threats associated with habitat degradation, disease and predation, and small population size effects are currently a low risk to the NEP white shark population and are likely to remain low in the foreseeable future. The BRT found that high-seas driftnet fisheries and coastal gillnet fisheries were a moderate threat to the population in the past, but that the magnitude of this threat has diminished substantially in recent years. However, the BRT found that white shark mortality associated with coastal gillnet fisheries off southern California and Baja California were of concern and considered this threat to be a moderate risk to the NEP white shark population now and in the foreseeable future. For several other threats (e.g., disease and global warming related effects), the BRT concluded that the available information to assess the threats for the population was limited, and therefore, it expressed a relatively high degree of uncertainty in its assessments of those threats. Overall, the BRT concluded that bycatch of white sharks in coastal gillnet fisheries was currently the main threat to the population and was likely to remain so in the foreseeable future.

### *Evaluation of Trend Information*

Trend information is considered highly informative in assessing a population's risk of extinction (Musick *et al.,* 1999); therefore, the BRT summarized and evaluated direct and indirect information related to trends in the abundance of the NEP white shark population from a variety of different sources. These information sources included: (1) White shark catch and effort data for coastal gillnet fisheries in southern California; (2) white shark abundance estimates at Guadalupe Island; (3) white shark attack frequency on marine mammals; and (4) information regarding possible range expansion of the population.

Population trends can be evaluated by examining trends in catch-per-unit-effort (CPUE). For analysis of CPUE, the BRT used white shark catch data and effort data for the California set gillnet fishery, which has accounted for a large majority of the bycatch of white sharks in California waters since the early 1980s (Dewar *et al.,* 2013). Across the entire time series of available logbook data (1981–2011), CPUE in this fishery appears to have declined from the early 1980s through the mid-1990s and generally increased since that time. The period of increasing CPUE since the mid-1990s also coincided with a steady decline in fishing effort as a result of changes in fishery regulations. The BRT was concerned that increasing CPUE during the 2000s could be caused by increased reporting rates associated with the Monterey Bay Aquarium white shark scientific collection program, which beginning in 2002 incentivized fishermen to report their catches, but concluded that increased reporting did not fully account for the observed trend in CPUE (Dewar *et al.,* 2013). The BRT was also concerned that the increase in CPUE during the 2000s could also have been caused by an increase in the average soak time per set (i.e., the amount of time fishing nets are left in the water to fish before being retrieved) in recent years. The BRT used multiple linear regression analysis to examine the potential impact of soak time per set on CPUE over time for the period from 1994–2001 and found there was a significant increase in CPUE over that period and that soak time was not a significant contributing factor (Dewar *et al.,* 2013).

The white shark photo-ID study conducted at Guadalupe Island provided the BRT with an opportunity to examine trends in white shark abundance at that site over the period from 2001–2011. As discussed in Dewar *et al.* (2013), the BRT's re-analysis of photo-ID data for white sharks observed at Guadalupe Island allowed for the estimation of annual population abundance over this period. The time series of annual abundance estimates from this analysis showed there was an increasing trend in male abundance from 2001–2011, with the number of males approximately doubling, from about 40 males in 2001 to over 90 males in 2011. Over the same time period, females increased in abundance for the first several years of the study, and then their abundance level stabilized after 2006. The BRT believed that abundance of females may have been underestimated in the years after 2007 because sampling effort decreased in those years for the months of November and December when females were still present at Guadalupe Island.

Observations of white shark attacks on marine mammals have been documented at Southeast Farallon Island since the 1980s, providing a relatively long time series of information. Over the last 30 years researchers working at the islands have published a number of papers reporting an increase in white shark abundance based on the increased incidence of attacks on pinnipeds. Ainley *et al.* (1996) suggested that white shark populations were increasing in abundance in association with the increase in northern elephant seals (*Mirounga angustirostris*) at Southeast Farallon Island and they also reported an increase in the size of white sharks. Elephant seals were first seen at the Islands in the 1970s after which the presence of white sharks increased (Lowry, 1994). At a 1996 white shark symposium Pyle *et al.* (1996) and Klimley and Anderson (1996) concluded that the white shark population at Southeast Farallon Island was increasing, given the increased number of observed attacks on pinnipeds, even after taking into account the increased abundance of pinnipeds during the 1970s and 1980s. Brown *et al.* (2010) recently found that variation in the number of white shark attacks on northern elephant seals was correlated with the number of elephant seals present during their autumn haul-out to give birth, mate and molt. Their estimated shark abundance index explained very little of the annual variation in shark attacks, possibly indicating a stable shark population or that their index does not accurately reflect annual variation in shark abundance.

White shark attacks on marine mammals in other locations have also increased. At San Miguel Island, which is the westernmost of the northern Channel Islands, annual surveys of pinniped populations have been ongoing for several decades to monitor their abundance (Jeff Harris, SWFSC, personal communication as cited in Dewar *et al.,* 2013). Based on these surveys, the Channel Islands now support a population of over 100,000 California sea lions (*Zalophus californianus*). While it is only in the last couple years that there is evidence of attacks by white sharks on pinnipeds near the Channel Islands, the increase in shark-inflicted wounds is dramatic. In 2010 and in prior decades there were essentially no observed shark-inflicted wounds on California sea lions; however, in 2011 there were approximately 136 recorded bite marks, and in 2012 there were over 300 recorded bite marks (Jeff Harris, personal communication as cited in Dewar *et al.,* 2013). The bite wounds were observed primarily in the summer (June–August) on juveniles and females, although the occurrence of scars early in the year suggest that attacks may occur year round. Not all bite wounds have been validated to be from white sharks, but the size and shape of the wounds are consistent with those from white sharks (Dewar *et al.,* 2013). The only other potential predator that could cause such wounds is a large mako shark, but this species is rarely observed or caught in this region and has not been observed near pinniped rookeries (Dewar *et al.,* 2013).

In addition to pinnipeds, white shark bite marks have been observed on southern sea otters (*Enhydra lutris nereis*) in coastal central California. Researchers at the U.S. Geological Survey Western Ecological Research Center (USGS–WERC) have reported a dramatic increase in the number of southern sea otter mortalities linked to white shark bites over the past 5 years, particularly in the region between Estero Bay and Pismo Beach, but also in Monterey Bay and areas north of Santa Cruz. Overall, the proportion of beach-cast sea otter carcasses in which shark bites are considered the primary cause of death has increased 3–4 fold from the long-term average, and shark-bite trauma has now become the single most frequently observed cause of death (USGS–WERC, unpublished data). Although definitive evidence for the species of shark responsible for the trauma is only available for 10–20 percent of carcasses (i.e., where tooth fragments or tooth scrapes on bone are found), the evidence suggests that white sharks rather than other shark species are responsible for the observed mortality. A range of factors is likely impacting southern sea otter population trends in California; however, increased incidence of shark-bite mortality is thought to be linked to sea otter population declines in some areas.

In addition to trends in abundance and other indicators, information suggesting range expansion or contraction can provide insight into the status of a population. For example, the increase in the number of white sharks observed annually at Guadalupe Island since the early 1990s suggests the NEP population may be expanding its use of near-shore aggregation sites. The increased numbers of white shark bite marks on sea lions and southern sea otters in areas south of Monterey Bay also suggests an increased presence of white sharks in this region. While the coastal waters from the Channel Islands to Monterey Bay are clearly within the historical range of white sharks along the coast of California, the majority of white shark activity in the past 10 years has been reported in central California and at Guadalupe Island. There is no evidence to indicate that the increased abundance of white sharks at Guadalupe Island or in the region between the Channel Islands and Monterey Bay is due to sharks leaving the known aggregation sites in central California where they are typically found (Dewar *et al.,* 2013).

Based on a SEDM assessment, the BRT concluded that the available trend information indicates that the NEP white shark population is most likely stable or increasing rather than decreasing (Dewar *et al.,* 2013). The BRT also indicated that a stable or increasing NEP white shark population was consistent with: (1) the increased abundance of white shark prey resources (i.e., marine mammal and fish populations) over the past several decades; and (2) changes in the near-shore set gillnet and high seas drift gillnet fisheries over the past several decades that have reduced fisheries-related impacts on the population. The BRT expressed some uncertainty about its assessment of white shark population trends because of the absence of historical information on abundance, uncertainty about female mortality levels, and uncertainty about whether changes in the range of the population are indicative of an overall increase in population size. Despite these uncertainties, the BRT found that the NEP white shark population is most likely stable or increasing (Dewar *et al.,* 2013).

*Abundance Estimates at Aggregation Sites*

Chapple *et al.* (2011) and Sosa-Nishizaki *et al.* (2012) analyzed white shark photo-ID data from central California (i.e., Farallon Islands and Tomales Point) and Guadalupe Island, respectively, using mark recapture methods to estimate the numbers of white sharks at the two aggregation sites. The combined abundance estimates from these two studies total approximately 339 subadult and adult white sharks. The BRT re-analyzed the original photo-ID data from these studies, as well as additional data provided by the researchers who had conducted the studies. The objectives of this re-analysis were to: (1) Examine both original data sets as well as the new data for white sharks from both sites; (2) evaluate potential bias in the population estimates by examining population demographics at both sites, including a key modeling assumption that all individuals have an equal probability of being captured (in this case photo-identified); (3) examine trends in abundance at Guadalupe Island, which had a much longer time series of data; and (4) calculate minimum estimates of the numbers of adult female white sharks and the male-to-female sex ratio at the two sites for use in extinction risk modeling.

The central California dataset used in the re-analysis was the same as that used by Chapple *et al.* (2011), but included updated information about the sex of many individuals that was previously unknown. The Guadalupe Island dataset included 2 more years of data than were used by Sosa-Nishizaki *et al.* (2012), as well as information on the number of days of sampling effort per month over the 11-year study. The BRT conducted its mark recapture analysis of data for both sites using open models, which allowed the populations to change either through emigration, immigration or mortality. Detailed methods and information about models used in the analysis are provided in Dewar *et al.* (2013).

The BRT's analysis indicated that the majority of white sharks at both aggregation sites were mature and that the sex ratio was strongly biased in favor of males at both sites (i.e., 1.6 to 1 at Guadalupe Island and 3.8 to 1 at the central California sites), although there were significant seasonal changes in the sex ratio at Guadalupe Island (Dewar *et al.,* 2013). Estimates of mature adults at the two aggregation sites ranged from approximately 85 percent in central California to 90 percent at Guadalupe Island. A total of 131 white sharks were recorded by photo-ID studies at the central California sites from 2006–2008. Re-analysis of the data by the BRT generated a 3-year super-population estimate (i.e., an estimate of all the individuals that were observed at the site during the study, including those that have died or emigrated from the site) of 166 white sharks, which is comparable to the open population model estimate of 156 white sharks reported by Chapple *et al.* (2011) and within the confidence limits of the larger closed population model estimate of 219 white sharks that they also reported (Dewar *et al.,* 2013). A total of 142 white sharks were recorded by photo-ID studies at Guadalupe Island from 2001–2011 and the BRT's re-analysis of these data generated a super-population estimate of 154 white sharks for the study period, which is higher than the estimate of 120 white sharks reported by Sosa-Nishizaki *et al.* (2012), presumably because additional data were analyzed. The BRT's analysis of the Guadalupe Island data also provided annual estimates of white shark abundance, which demonstrated an increasing trend in abundance over the study period, with males nearly doubling in abundance and females initially increasing in abundance followed by a period of stable numbers (see Evaluation of Trend Information section).

*Evaluation of Bias in White Shark Sex Ratios and Adult Population Size*

The BRT's estimates of white shark abundance at the central California and Guadalupe Island aggregation sites were within the bounds of those previously estimated by Chapple *et al.* (2011) and Sosa-Nishizaki *et al.* (2012). However, the BRT was concerned about potential sources of bias associated with these abundance estimates based on its examination of demographic and other data, and concluded that they were unlikely to represent a realistic estimate of the abundance of subadult and adult white sharks in the entire NEP population. Therefore, the BRT undertook an effort to more carefully evaluate bias in the estimated sex ratios at the two sites and bias in estimation of the total NEP population abundance. This information was then used to develop a range of plausible population abundance levels for the NEP white shark population that were subsequently used in the BRT's extinction risk modeling.

*Sex Ratio Bias*

Males dominate the available photo-ID data from the central California and Guadalupe Island aggregation sites, and therefore the sex ratios at both sites are highly skewed in favor of males. Given the apparent skew in the sex ratios at both aggregation sites and concerns about bias in the photo-ID studies, the BRT concluded that the direct empirical estimates of female abundance at the two sites likely underestimated the actual abundance of females, both at the sites and in the NEP population as a whole. The BRT identified several possible reasons for the observed sex ratio skew which also suggest the actual abundance of white sharks in the NEP has been underestimated.

First, white sharks may exhibit sexual segregation as do some other sharks in the family Lamnidae (e.g., salmon and mako sharks). In nearly all places where white sharks have been surveyed, the sex ratio of pups both in utero and in the environment is close to parity or 1:1 (Dewar *et al.,* 2013), but the sex ratio of older life stages (i.e., juvenile, subadult and adult) is skewed in favor of males (e.g., on the U.S. east coast, Casey and Pratt, 1985; and in New Zealand, C. Duffy, personal communication with Heidi Dewar in Dewar *et al.,* 2013). A recent study in South Africa found a skewed male-to-female sex ratio of 3 to 1 with both seasonal and spatial shifts in the sex ratios of juvenile and subadult white sharks over relatively small spatial scales (Robbins, 2007). In the NEP, sexual segregation is also apparent offshore, with females making more dispersed offshore movements than males, which have a more focused distribution (Jorgensen *et al.,* 2010; Domeier and Nasby-Lucas, 2012). Second, some females may not be sampled at the central California and Guadalupe Island aggregation sites because they arrive later in the season after most of the photo-ID sampling effort has ended. Due largely to weather conditions, the majority of the sampling effort at these sites occurs opportunistically over a period of 2 to 4 months in the late summer and fall, which does not cover the entire period that white sharks are present. Based on work at Guadalupe Island, the observed male-to-female sex ratio shifts from 8 to 1 in August to 0.9 to 1 in November (Nasby-Lucas and Domeier, 2012), indicating that sampling at different times can influence estimates of the observed sex ratio in the local population. Third, it is possible that some females at the aggregation sites are simply not available to be sampled for behavioral reasons (see Sosa-Nishizaki *et al.,* 2012). Lastly, mature females have a presumed 18-month gestation period and many do not return each year to the aggregation sites. At the central California sites, for example, this behavior combined with the relatively short time series of available data may have resulted in poor estimation of the capture probability for females and consequently an underestimate of female abundance.

Because of the likely sex ratio bias associated with the white shark population estimates at the central California and Guadalupe Island aggregation sites, the BRT undertook a SEDM assessment to evaluate the relative plausibility of different sex ratio alternatives at each site. For each site, the least skewed alternative the BRT considered was a male to female sex ratio of 1 to 1 and the most skewed alternative was the sex ratio derived empirically from the BRT's mark-recapture analysis of the available data. Intermediate sex ratio alternatives were also considered for each aggregation site. Based on this assessment, the BRT concluded that the actual sex ratios at both sites were most likely not as strongly skewed in favor of males as suggested by the photo-ID data and that there are more females in these populations than suggested by mark-recapture analysis of the photo-ID data (Dewar *et al.,* 2013). The most important factor influencing the BRT's assessment was the timing of the sampling season at both sites relative to the late arrival of females, which would result in under sampling of females.

*Population Abundance Bias*

The BRT concluded that there are several factors which bias the estimation of white shark abundance in the NEP and that also indicate there are more adult female white sharks, and hence a larger overall NEP population, than have been estimated at the central California and Guadalupe Island aggregation sites (Dewer *et al.,* 2013).

First, the abundance estimates for the central California and Guadalupe Island aggregation sites do not include all white sharks in those areas. For example, abundance estimates at the central California sites do not include white sharks at other locations that are documented to be hotspots, such as Año Nuevo State Park. There is a long history of white shark activity at this location, which is the site of the largest mainland breeding colony of northern elephant seals. In addition, acoustic tagging studies in central California (Jorgensen *et al.,* 2010) have shown that some individual white sharks exhibit site fidelity to particular coastal sites such that they were unlikely to have been observed by the photo-ID studies conducted at the Southeast Farallon Island or Tomales Point sites. Similarly, photo-ID studies of white sharks have been conducted only at one of several locations around Guadalupe Island where they are known to occur, suggesting that not all white sharks at the island have been observed by the photo-ID studies.

Second, white sharks may occupy unknown or previously unoccupied areas in the NEP. For example, there appears to be an increased occurrence of white sharks near the northern Channel Islands in southern California and in some portions of central California. Other potential aggregation sites where pinnipeds are known to be common and white sharks may occur include the Coronado Islands and Cedros Island in Mexico, both of which are areas where Mexican fishermen have reported large white sharks (Sosa-Nishizaki, personal communication cited in Dewar *et al.,* 2013). White sharks have also been reported in areas away from the main aggregation sites off Alaska, British Columbia, Washington, Oregon, California, Baja California and the Gulf of California (Klimley, 1985; Martin, 2005; Galván-Magaña *et al.,* 2010). Although some white sharks tagged at the two aggregation sites have been observed to visit other coastal sites (S. Jorgensen, personal communication in Domeier and Nasby-Lucas, 2012), the data are limited and information on the extent of coastal areas used by white sharks tagged at these sites is still unknown.

Third, recent data using isotopes to characterize the diet of different life stages of white sharks suggest that not all adult white sharks transition to preying on marine mammals (Kim *et al.,* 2012), and thus these individuals may not be as likely to occur near pinniped aggregations and be available for observation.

Fourth, based on catch, attack and stranding data, some white sharks do not appear to undergo annual offshore migrations (Ainley *et al.,* 1985; Klimley, 1985). Very few satellite-tagged white sharks have remained along the coast, suggesting that white sharks not undergoing offshore migrations may represent a portion of the NEP that is not being sampled. It is possible that many of the white sharks remaining along the coast are subadults rather than adults, but the possibility that some adults remain in coastal areas year round cannot be ruled out.

Lastly, the high diversity of mtDNA haplotypes found in the NEP white shark population suggests the population may be much larger than indicated by the mark-recapture estimates for the central California and Guadalupe Island aggregation sites (see Genetic Information on White Shark Population Structure and Population Size section).

The BRT used a SEDM assessment to evaluate different levels of possible bias associated with extrapolating the adult female population estimates from the two aggregation sites to an overall adult female abundance estimate for the NEP white shark population. The BRT considered four levels of potential bias in this assessment: (1) No bias because all white sharks in the NEP are available for sampling at the central California and Guadalupe Island aggregation sites; (2) a bias indicating there are approximately 20 percent more adult females in the NEP population than estimated by the mark-recapture studies at the aggregation sites because a small portion of the population is not available for observation at those sites; (3) a bias indicating there are approximately two times more adult females in the NEP population than estimated by the mark-recapture studies at the two sites because white sharks occur at other sites or areas that are not sampled and/or because the timing of sampling at the aggregation sites misses a key portion of the population; and (4) a bias indicating there are up to 10 times more adult female white sharks in the NEP population than estimated by the mark-recapture studies, as suggested by the high haplotype diversity and the fact that most white sharks in the NEP population are not available for sampling at the aggregation sites.

Based on its assessment, the BRT concluded that the abundance of female white sharks in the NEP population is most likely at least 2 times larger and possibly much larger than the combined abundance estimate for the central California and Guadalupe Island aggregation sites. Several factors influenced the BRT's evaluation and conclusion regarding abundance bias. First, there are areas where white sharks are consistently observed, such as Año Nuevo State Park and possibly the Channel Islands, which have not been sampled. Second, the BRT thought it was plausible that some females never visit either of the two known aggregation sites. Finally, the high level of haplotypic diversity in white sharks from the NEP indicates that the population is likely much larger than indicated by the population estimates for the two aggregation sites alone (see Genetic Information on White Shark Population Structure and White Shark Population Size section).

*Female Abundance Estimates for Fisheries Risk Assessment Modeling*

The BRT developed a range of plausible adult female abundance levels for the NEP white shark population for use in modeling the extinction risk associated with fisheries impacts. As described in Dewar *et al.* (2013), the BRT developed 48 estimates of female abundance for the NEP white shark population using the 12 combinations of sex ratio bias (i.e., four at the central California sites and three at Guadalupe Island) and four levels of population abundance bias that were evaluated by SEDM. Each of the female abundance estimates was weighted by the SEDM assessments for sex ratio and abundance bias and then grouped into four adult female abundance levels as follows: (1) Less than 125 adult females; (2) 125–200 adult females; (3) 200–400 adult females; and (4) greater than 400 adult females. The fisheries risk assessment modeling evaluated each of these female abundance levels as well as the minimum population estimate of 47 adult females derived from the BRT's re-analysis of photo-ID data at the central California and Guadalupe Island aggregation sites (Dewar *et al.,* 2013). The sum of the weights for individual female abundance estimates within each of the four abundance levels represented the BRT's assessment of the most likely adult female abundance level in the NEP white shark population as a whole. Based on this analysis, the BRT concluded that the adult female abundance in the NEP was most likely in the range of 200–400 adult individuals (see Dewar *et al.,* 2013 for more detailed information).

The BRT reassessed the most likely adult female abundance a second time after the initial extinction risk modeling indicated that the minimum population estimate of 47 adult females was unrealistic given current estimates of fishery mortality for YOY and juvenile white sharks. Based on this second SEDM assessment, which changed the weights assigned to each of the 48 adult female abundance estimates, the BRT concluded that the adult female abundance in the NEP was at least in the range of 200–400 adult females and most likely greater than 400 adult females (Dewar *et al.,* 2013).

*Fisheries Risk Assessment Modeling*

The BRT conducted population modeling to assess how fisheries-related mortality would impact NEP white shark population growth rates and how changes in population growth rates would affect adult female population abundance over time. A brief summary of the BRT's analytical approach is presented below with more detailed information presented in Dewar *et al.* (2013).

**Analytical Approach**

The BRT's fisheries risk assessment modeling for the NEP white shark population was based on: (1) Estimates of the maximum potential productivity of the population (i.e., intrinsic population growth rate) using information on key vital parameters of white sharks (i.e., reproduction and survival rates); (2) estimates of adult female white shark population abundance (see Female Abundance Estimates for Fisheries Risk Modeling section); and (3) estimates of current YOY, juvenile and adult white shark mortality in U.S and Mexican gillnet fisheries. Estimates of adult female abundance in the NEP white shark population, rather than total population abundance estimates, were used in the modeling because female reproduction (i.e., pup production) is a key factor controlling population growth rate and the purpose of the analysis was to evaluate how estimated fisheries mortality affects white shark population growth rates and population abundance over time.

Estimates of potential population productivity are fundamental to modeling how threats such as fisheries-related mortality may impact population growth because populations with higher potential productivity can sustain higher levels of mortality. Annual rates of population growth can be calculated using information on a species' vital rates (i.e., age-specific reproduction and survival rates) assuming the relative proportion of the population in different age classes is stable. Using a variety of information sources, the BRT developed estimates of age-specific reproduction and survival rates for female white sharks and then used this information to develop estimates of the population's maximum growth rate.

As discussed in the Female Abundance Estimates for Fisheries Risk Assessment Modeling section, the BRT defined four adult female abundance levels for the NEP white shark population based on its assessment of sex ratio and abundance bias. Extinction risk modeling analyzed adult female abundance within these four abundance levels, as well the minimum adult female abundance estimate (i.e., 47 adult females) derived from the BRT's mark-recapture analysis of photo-ID data from the two aggregation sites.

**Modeling Analysis**

The BRT developed estimates of YOY and juvenile white shark fishery-related mortality using current fishery bycatch estimates in U.S. and Mexican gillnet fisheries. Because the BRT did not have estimates of actual adult female white shark bycatch, a SEDM assessment was used to evaluate potential levels of adult female mortality in U.S. and Mexican nearshore fisheries, as well as high seas IUU fishing. Based on available information informing potential fisheries-related mortality levels for adult females (see Appendix H in Dewar *et al.,* 2013), the BRT evaluated adult female mortality levels ranging from 0 to 10 adults females per year. Based on its assessment, the BRT concluded that adult female mortality was most likely between 1 and 5 adult females per year. Fishery-related mortality for each life stage (i.e., YOY, juveniles and adults) was incorporated into the modeling analysis.

The BRT used the information on maximum population growth rates, estimates of adult female population abundance, and fishery mortality to model the impact of fishery bycatch on the adult female population in the NEP in three stages. First, bycatch rates and mortality rates for YOY and juvenile white sharks were calculated for each of the four adult female abundance levels defined by the BRT. These rates were then used to calculate how the estimated fisheries mortality for each of the four adult female abundance levels impacted the maximum population growth rate and the probability of population decline over time. Second, estimates of adult female mortality were added to the YOY and juvenile mortality estimates for each of the four adult female abundance levels and the impact on the maximum population growth rate and probability of population decline were re-calculated. Finally, the maximum population growth rates for each of the four adult female abundance levels were reduced by the estimated fishery mortality for all life stages and then used to project adult female population abundance into the future using a stochastic age-structured density-dependent growth model. These modeling results were then used to calculate the probability that adult female abundance would decline below defined population abundance thresholds over specific time horizons.

**Definition of Risk Categories and Foreseeable Future**

The BRT defined four levels of overall extinction risk (i.e., high, medium, low and very low) for its analysis. The specific criteria for each level of extinction risk were based on the current estimated abundance of the NEP white shark population, white shark population trajectories over specific time horizons, and the probability of a white shark population decline below specified thresholds. To evaluate population trajectories, the BRT used a range of time horizons (i.e., 40, 60 and 100 years) that were based on the white shark generation time (~20 years). The 40-year time horizon (or two white shark generations) was defined by the BRT as the foreseeable future for the white shark risk assessment and the 60-year (3 white shark generations) and 100-year (5 white shark generations) time horizons were used for different levels of risk. The BRT also defined two white shark population abundance levels corresponding to ''near extinction'' (50 mature individuals) and ''dangerously small'' (250 mature individuals), which are discussed in more detail in Dewar *et al.,* (2013). The two highest risk categories have criteria that are intended to address risks faced by a declining population and risks faced by small populations, both of which are indicators that a species is potentially at a high risk of extinction.

The BRT considered the foreseeable future in its analysis to be the timeframe over which predictions about the future status of the NEP white shark population could reliably be made. In quantifying the foreseeable future (40 years), as well as other timeframes used in the analysis, the BRT considered several factors to be particularly relevant. First, overutilization (i.e., fishery related mortality) is the most significant potential threat to the population. Second, the primary life history stage or age category suffering mortality in the U.S. and Mexican gill net fisheries that impact the population are YOY individuals. Third, white sharks are long-lived species. Given these factors, the BRT concluded that the definition of foreseeable future should be based on white shark generation time since fishery impacts on YOY individuals will influence population abundance and risk on that timeframe. The BRT concluded that it was appropriate to address the threat from overutilization (i.e., fishery mortality) over longer timeframes (60 and 100 years) based on other precedents for defining and assessing extinction risk (Dewar *et al.,* 2013).

Based on these considerations, the BRT defined the following extinction risk levels for evaluating the status of the NEP white shark population:

*High Risk:* The population is at high risk if it has a 5 percent chance of falling below 50 mature individuals (25 mature females) in 60 years (3 generations) or the current population is less than 250 mature individuals (125 mature females).

*Medium Risk:* The population is at medium risk if it has a 5 percent chance of falling below 50 mature individuals (25 mature females) in 100 years (5 generations) or the population has a 5 percent chance of falling below 250 mature individuals (125 mature females) in 40 years.

*Low Risk:* The population does not meet the criteria for medium or high risk, but the probability of a net population decline within 100 years ($N_{t=100} < N_{t=0}$) is greater than 10 percent.

*Very low Risk:* The population does not meet any of the above criteria for high, medium, or low risk and the population has a high probability of being stable or increasing.

**Modeling Results**

The BRT's estimation of YOY and juvenile mortality and its impact on maximum population growth rates for the minimum adult female abundance estimate from the aggregation sites and the four adult female abundance levels that were defined resulted in two key findings. First, the estimates of annual YOY and juvenile fishery-related mortality for the minimum population estimate of 47 adult females were equal to or greater than the total number of pups and 1-year-old individuals that would be expected to be produced by a population with that number of adult females. The BRT found this result to be unrealistic and concluded that the actual adult female abundance in the NEP population must be substantially higher than the population estimates based on photo-ID data from the two aggregation sites. For this reason, the BRT excluded this minimum adult female population abundance estimate from all further analysis. Second, the analysis indicated that there was a low or negligible probability that a NEP white shark population having at least 125–200 adult females would decline, given the estimated YOY and juvenile mortality from fisheries.

The BRT's estimation of the combined fisheries mortality for YOY, juvenile and adult females for the four adult female abundance levels and its impact on maximum population growth rates resulted in several findings. First, there was a high probability that a white shark population having less than 125 adult females would decline, given the estimated YOY and juvenile mortality and any level of adult female mortality. Second, there was a small or trivial probability that a white shark population having at least 125–200 adult females would decline to near extinction within 60 to 100 years, given the estimated YOY and juvenile mortality and a low level (1 or 2 individuals per year) of adult female mortality. If adult female mortality were higher (in excess of five individuals), which the BRT felt was less plausible, then the probability of adult female population decline would be higher. Third, there was a very low probability that a white shark population having at least 200 adult females would decline given the combined fishery mortality estimates for all life stages.

Overall, the BRT's modeling results indicate that if the NEP white shark population presently has 200 or more adult females, there is a low to very low risk of extinction associated with fisheries mortality on adult females, YOY, and juvenile white sharks over any of the time periods that were analyzed. If adult female abundance is actually lower than 200 adult females, the risk to the population would range from medium to high depending on the current population size and mortality of adult females. Detailed modeling results are presented in Dewar *et al.* (2013).

*Overall BRT Extinction Risk Conclusions*

The BRT conducted a final SEDM assessment to evaluate overall extinction risk for the NEP white shark population that considered all information from the status review report. This information included the assessment of threats to the population, direct and indirect indicators of population trends, information on population abundance, including updated mark-recapture analysis, genetic information related to population size, the evaluation of factors biasing the available population abundance estimates, and the results of extensive population modeling to assess risks associated with fisheries bycatch mortality. Based on this information and uncertainty about the future, the BRT allocated plausibility points among the four risk categories previously defined (see Definition of Risk Categories and Foreseeable Future section). The BRT allocated the vast majority of its plausibility points in the low and very low risk categories (86 percent of plausibility points—see Table 4.17 in

Dewar *et al.,* 2013) indicating that the NEP white shark population is currently considered to be larger than 250 mature individuals (see Female Abundance Estimates for Fisheries Risk Assessment Modeling section), that the population is likely to be stable or increasing in abundance (see Evaluation of Trend Information section), and that the population is not likely to fall below critical population thresholds in the foreseeable future (40 years) or beyond (60 and 100 years) (see Fisheries Risk Assessment Modeling section). Based on its overall risk assessment and the results of this SEDM assessment, the BRT concluded that the NEP white shark population is likely to be at a low to very low risk of extinction and is likely to remain so in the foreseeable future.

The level of extinction risk facing a population depends on information about its abundance, trends in abundance or other population indicators, potential threats to the population over time and uncertainty about the future. Fisheries-related mortality was the only factor the BRT found to be a potentially important threat to the NEP white shark population. The BRT acknowledged that other threats such as physiological effects of contaminants in the environment or the trophic implications of ocean acidification from climate change could adversely affect the population, but these threats were considered to have relatively minor population-level effects within the foreseeable future compared to direct fisheries-related mortality. The BRT concluded that depletion of white shark prey (e.g., pinnipeds and various fish species) from human activities may have had historical impacts on the NEP white shark population, but because pinniped populations have increased substantially over the last several decades and many fish stocks preyed upon by white sharks have similarly recovered or are in the process of recovering, this factor is no longer a threat and is not likely to become one in the foreseeable future.

The BRT concluded that the available information informing trends in abundance of the NEP white shark population is most consistent with a stable or increasing population. White shark CPUE has increased since the mid-1990s in the U.S. west coast set gillnet fishery, which would be expected for an increasing population. This period of increasing CPUE coincides with fishery management changes (i.e., high seas drift gillnet ban, time-area closures for gillnet fisheries offshore California, protection for white sharks by the State of California) and declining fishing effort that have reduced the potential for fishery interactions with white sharks. Increasing abundance of white sharks at Guadalupe Island and the increased incidence of white shark attacks on marine mammals at different sites along the California coast also suggest that the NEP white shark population is increasing.

Modeling conducted by the BRT to assess the risks from U.S. and Mexican fisheries-related mortality on the NEP white shark population indicate that the population is likely at a low to very low risk of extinction and is likely to remain so in the foreseeable future if the population includes more than 200 or more adult females. As discussed below, the BRT determined that the current population includes at least 200 adult females. However, the BRT's modeling results indicate that if there are fewer than 200 adult females in the population, then the population would be at a higher risk of extinction.

The BRT indicated that there were several lines of evidence suggesting that the NEP white shark population includes at least 200 adult females. The most important evidence comes from its analysis of fisheries mortality. Based on its analysis, the BRT concluded that the level of YOY and juvenile bycatch mortality estimated for U.S. gillnet fisheries and reported for Mexican gillnet fisheries is inconsistent with the NEP white shark population being smaller than several hundred females. If adult female abundance is presently less than 200 individuals, then the estimated fisheries bycatch would correspond to removing on the order of 20 to 70 percent of the estimated annual pup production, which the BRT considered highly unlikely for several reasons. First, population removal rates for sharks in fisheries using more selective fishing gear than gillnets (e.g., pelagic longlines) are probably less than 20 percent (Worm *et al.,* 2013). Second, for populations of marine mammals and sea turtles known or suspected to be declining because of high bycatch mortality, the mortality rate on age classes affected by gillnet bycatch is typically less than 10 percent. Third, even a 20 percent mortality rate on YOY and juveniles seems unlikely given that most of the estimated fishery mortality comes from a small number of fishermen (i.e., artisanal fishermen) that operate in only a relatively small portion of the population's nursery habitat (e.g., Sebastián Vizcaíno Bay). Although YOY white sharks have been found to move from the SCB to nursery habitat in Baja California, and thus could subject more of the YOY population to fishery impacts in Mexico, the available information regarding such movements is limited and there is no information indicating what portion of the population undertakes such movements. Based on these considerations, the BRT concluded that if the U.S. and Mexican gillnet fisheries are removing less than 20 percent of the annual pup production, as seems most likely, the estimated level of YOY and juvenile bycatch from fisheries is most consistent with a NEP white shark population that includes at least several hundred adult females. Finally, the BRT found that the available information on the haplotyic diversity for the NEP white shark population was most consistent with a NEP white shark population numbering several hundred or more adult females (see Genetic Information on White Shark Population Structure and Population Size section).

If the current adult female abundance of white sharks in the NEP exceeds 200 individuals, as the BRT has concluded is most likely the case, then the empirical estimates of subadult and adult white shark abundance at the central California and Guadalupe Island aggregation sites do not represent an accurate estimate of abundance for the entire NEP population (Dewar *et al.,* 2013). The BRT determined that this underestimate of the NEP population abundance could be explained by a combination of highly plausible factors including: (1) Under sampling of females at the aggregation sites due to a temporal mismatch of sampling effort with respect to the timing of female arrival at the sites; (2) under sampling of females relative to males at the aggregation sites because of spatial-behavioral factors (see Soza-Nishizaki *et al.,* 2012); (3) under sampling of males and/or females at the aggregation sites because of strong site fidelity or area preferences by one or both sexes around pinniped rookery areas (see Jorgensen *et al.,* 2010) and the use of fixed sampling locations; and (4) under sampling of both males and females that do not use the surveyed aggregation areas (e.g., individuals that use other pinniped rookery areas or do not feed substantially on marine mammal prey).

**Summary of Factors Affecting the NEP White Shark Population**

Section 4(a)(1) of the ESA and our implementing regulations (50 CFR part 424) state that we must determine whether a species is endangered or threatened because of any one or a combination of the following factors: (1) The present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; or (5) other natural or man-made factors affecting its continued existence. This section summarizes findings regarding threats to the NEP white shark population. Additional information regarding threats to the population can be found in the BRT's status review report (Dewar *et al.,* 2013) and a report prepared by NMFS' Southwest Region (NMFS, 2013).

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

Potential threats to the habitat of the NEP white shark population include pollution, depletion of white shark prey species, ocean acidification, and ocean warming associated with climate change. Each of these threats is discussed in the following sections.

*Pollution*

The SCB is important habitat for the NEP white shark population and serves mainly as a nursery area for YOY and juvenile white sharks. The SCB has a history of pollution due to discharges from publicly owned treatment works as well as non-point sources; however, pollutant inputs to this area from all sources have decreased since the 1970s despite increasing urbanization and human population growth along the southern California coast (Raco-Rands, 1999, cited in Schiff *et al.,* 2000). Pollutants introduced into the SCB include heavy metals (e.g., mercury), chlorinated hydrocarbons (e.g., pesticides), petroleum hydrocarbons (e.g., polycyclic aromatic hydrocarbons or PAHs), nutrients, and bacteria (Schiff *et al.,* 2000). Although banned from use in the 1970s, legacy pollutants such as DDT and PCBs remain in the SCB sediments (Schiff *et al.,* 2000) and have likely been distributed throughout the area by water and sediment transport (Schiff *et al.,* 2000).

Mull *et al.* (2012) observed high levels of mercury, DDT and PCBs in the tissues of YOY and juvenile white sharks caught in the SCB. According to Mull *et al.* (2013), the high contaminant levels observed in white sharks from the SCB are thought to be linked to maternal offloading. Although the observed contaminants could potentially impair the physiological and reproductive development of white sharks, there is no information indicating that contaminants such as organochlorines adversely impact sharks (Fowler *et al.,* 2005; Mull *et al.,* 2012). In addition, no hepatic lesions or other visible effects have been observed in white sharks in the SCB (K. Lyons, CSULB, personal communication cited in Dewar *et al.,* 2013).

These contaminants may also affect the prey species used by various life stages of the NEP white shark population. Adult white sharks are typically characterized as marine mammal predators (e.g., northern elephant seals, harbor seals, California sea lions), but they also prey upon a variety of bony fish species (ranging from benthic rockfish and flatfish to large pelagic species such as swordfish and bluefin tuna), other elasmobranchs, cephalopods, crustaceans, and even some bird species (Fowler *et al.,* 2005). Both marine mammal populations and some fish species in the SCB have been found to have high tissue levels of contaminants such as mercury, DDT, and PCBs, but impacts of the contamination on these populations is unclear. Since the 1970s the incidence of fish diseases linked to these contaminants has declined, most likely due to reductions in pollutant input into the SCB (Schiff *et al.,* 2000) and there is strong evidence that most fish species preyed upon by white sharks have been increasing in abundance (Dewar *et al.,* 2013). Although pinniped species in the SCB continue to have high tissue concentrations of DDTs and PCBs (Blasius and Goodmanlowe, 2008), their populations have exhibited dramatic increases in abundance over the past several decades (Schiff *et al.,* 2000; Carretta *et al.,* 2013), suggesting that contaminants have had little impact on the populations.

Overall, contaminants continue to be present in the SCB and are found in white sharks and their prey species, and thus have the potential to affect the health of white sharks. However, the potential threat from contamination has likely decreased over time as a result of substantial reductions in pollutant inputs into the SCB since the 1970s. Potential impacts to the NEP white shark population from this contamination remain uncertain.

Another source of pollution that may affect the NEP white shark population is marine debris. Marine debris is known to concentrate in an area of the North Pacific Ocean referred to as the ''Great Pacific Garbage Patch'', but this area has a limited overlap with the offshore habitat used seasonally by male and female white sharks. Debris may also be a concern in other areas used by white sharks, including the SCB, as well as the aggregation areas in central California and at Guadalupe Island offshore Baja California. The main risks of marine debris to white sharks are entanglement and ingestion. Plastics are of particular concern because they make up a large portion of the marine debris in the oceans (Moore *et al.,* 2001; Derraik, 2002), can be transported over long distances, decompose slowly, cannot be digested, and have been found to accumulate pollutants such as PCBs, DDTs, and polycyclic aromatic hydrocarbons (Moore *et al.,* 2001; Rios *et al.,* 2010).

The BRT found no evidence that white sharks observed off Guadalupe Island or caught in southern California gillnet fisheries were reported to be entangled in marine debris, and therefore concluded that the risk of entanglement was likely to be low (Dewar *et al.,* 2013). Compagno (2001) indicated that inedible garbage has occasionally been found in the stomachs of white sharks (referring to the global population, not the NEP population), but that white sharks are not generally known to ingest debris. The BRT noted that sharks are capable of evacuating their stomachs and have been observed to swallow satellite tags and spit them back up (Dewar *et al.,* 2013). These capabilities are likely to help white sharks minimize the impacts of ingesting marine debris. It is not known to what extent white sharks are feeding when they are offshore and in the area that overlaps with the garbage patch. Stable isotope analysis of dermal and muscle tissue samples taken from small to large white sharks at coastal aggregation sites in central California indicates that white sharks feed when offshore, but at a lower rate than in coastal habitats (Carlisle *et al.,* 2012). It is also possible that the primary purpose of these offshore migrations is reproduction (Jorgensen *et al.,* 2010 and 2012; Carlisle *et al.,* 2012). Without specific information about the extent to which white sharks forage in offshore waters and what they are feeding on, it is difficult to evaluate the potential risk of ingestion of marine debris by white sharks in offshore waters. Overall, marine debris may pose a potential risk to NEP white sharks via entanglement or ingestion, but the risk is likely to be low (Dewar *et al.,* 2013).

*Depletion of Prey Resources Due to Human Exploitation*

Several species of pinnipeds including northern elephant seals, California sea lions, Pacific harbor seals and Guadalupe fur seals are an important part of the diet of white sharks in the NEP. Historically, these species were subject to human exploitation, and on the west coast of

North America they were hunted to near extinction (Townsend, 1931 as cited in NMFS, 2000; NMFS, 2007) or greatly reduced in abundance (NMFS, 2011a). These species have been protected since 1972 under the Marine Mammal Protection Act (MMPA) and are no longer subject to harvest. Population trends for these species began increasing in the 1950s and 1960s and have continued to increase under MMPA protections (NMFS, 2000; Gallo-Reynoso *et al.,* 2005; NMFS, 2007; 2011a; 2011b; Carretta *et al.,* 2013). The most recent stock assessments estimate that northern elephant seals have almost reached their carrying capacity for pups per year and that harbor seals may be at carrying capacity. Guadalupe fur seals that are found mainly at Guadalupe Island have been increasing at an average rate of about 13.7 percent each year (NMFS, 2000). Thus, even though human exploitation significantly reduced these pinniped species in the past, they have been increasing in abundance over the past several decades and are not thought to be currently limiting the NEP white shark population (Dewar *et al.,* 2013).

The NEP white shark population also forages on a diversity of other species that may be affected by human exploitation, including a wide range of bony fishes, elasmobranchs (sharks, skates and rays) and invertebrates (Klimley, 1985; Compagno, 2001). Many of these prey species are either targeted directly in fisheries or are caught incidentally in fisheries and have been reduced in abundance. For example, gillnet fisheries targeting white seabass, angel sharks and California halibut offshore of California expanded in the 1970s, leading to declines in their abundance, as well as the abundance of other species, in the 1980s and 1990s. The State of California responded to these population declines by adopting regulations in 1994 that prohibited the use of gillnets in California state waters (i.e., within 3 nautical miles of shore). As a result of these regulatory changes, populations of many of these species have increased in abundance, including white seabass, leopard shark and soupfin shark (Dewar *et al.,* 2013).

As part of its threats evaluation, the BRT evaluated the potential risks to YOY and juvenile white sharks in the NEP resulting from the depletion of known and potential prey species (Dewar *et al.,* 2013). The BRT reviewed available stock assessment information for 23 species of fish and invertebrates either confirmed as white shark prey or as species that occur in YOY and juvenile habitats. The BRT found that many of the prey species have recovered from past overfishing and are currently considered to be healthy. Based on the status of these prey species and information suggesting that the white shark population as well as other species (e.g., pinnipeds, leopard sharks, soupfin sharks, and giant seabass) that use these prey species are increasing, the BRT concluded that these species are not limiting the NEP white shark population (Dewar *et al.,* 2013).

Overall, harvest activities historically affected the abundance of several fish and invertebrate prey resources that are known to be used by or are potentially used by the NEP white shark population. Many of these species experienced declines in abundance from the 1970s through the 1990s, but have since recovered. Based on the BRT's assessment of the white shark's fish and invertebrate prey resources, we conclude that prey species are not currently limiting the NEP white shark population.

*Ocean Acidification*

Ocean acidification (i.e., a reduction in the pH of ocean waters due to the uptake of increased atmospheric carbon dioxide) has been identified as a potential concern for the nearshore waters of the California Current System (Gruber *et al.,* 2012), an area which includes the nursery habitat and coastal aggregation sites for the NEP white shark population. Gruber *et al.* (2012) predicted that by 2050 oceanic uptake of carbon dioxide will lower the pH and the saturation state of aragonite (a mineral form of calcium carbonate used by calcifying organisms) in this area to levels well below the natural range. These predicted changes could affect fish species and the marine food web in the NEP as well as white sharks. For example, recent studies have shown that high carbon dioxide and low pH levels in seawater can impair olfactory responses and homing ability in clownfish (Munday *et al.,* 2009) and can lead to metabolic depression (Cruz-Neto and Steffensen, 1997) or cardiac failure (Ishimatsu *et al.,* 2004) in some other fish species. However, the extent of such impacts on individual species and how they may compensate for any impacts is uncertain. For example, some fish species may experience metabolic responses to elevated carbon dioxide levels at the cellular level, but are able to compensate for those responses on the organismic level, rendering them less sensitive to the effects of ocean acidification (Portner, 2008). No information is available regarding the impacts of low pH on sharks, and therefore, any potential effects on the NEP white shark population are highly speculative at this time (Dewar *et al.,* 2013). Finally, it is difficult to extrapolate the effects of ocean acidification to the ecosystem level, such as changes in prey availability or changes in predator-prey relationships, particularly for a top-level predator such as the white shark that utilizes a broad range of prey (see Foraging Ecology section).

*Climate Change*

Climate change is predicted to result in increased sea surface temperatures (SST) and associated shifts in the distribution and habitat of marine species. Hazen *et al.* (2012) predicted SST changes in the NEP ranging from less than 1°C to 6°C between 2001 and 2100, with the largest temperature changes occurring in the North Pacific Transition Zone (at approximately 43° N latitude) and minimal changes (less than 1°C) occurring in the California Current System.

Based on model predictions from Hazen *et al.* (2012), adult and subadult white shark and elephant seal habitat is predicted to increase by approximately 7 percent and 5 percent, respectively, between 2001 and 2100, whereas California sea lion habitat is predicted to decrease by approximately 0.5 percent. The actual impact of climate change on the ecosystem is certainly more complicated than can be predicted by climate change models, but several factors suggest that white sharks have a greater capacity to adapt to, and could potentially benefit from, climate-related impacts to environmental conditions in the California Current System. First, white sharks are likely better able to adapt to climate-related changes due to their diverse diet and broad thermal tolerance (see O'Connor *et al.* 2009; Harley 2011; and Parmesan, 2006 cited in Hazen *et al.,* 2012). Second, the relatively small increases in SST predicted by Hazen *et al.* (2012) may allow white sharks to expand their habitat. For example, tagging studies show that YOY white sharks can use a broad range of water temperatures and spend more time in areas with warmer temperatures (Dewar *et al.,* 2004; Weng *et al.,* 2007a; Weng *et al.,* 2007b; see also Klimley *et al.,* 2002). Tagged YOY and juvenile NEP white sharks spent much of their time in the warmer surface waters of the mixed layer, but made excursions to cooler waters below the thermocline, potentially for benthic foraging (Dewar *et al.,* 2004; Weng *et al.,* 2007b). YOY white sharks seemed to use the upper thermocline, whereas older juvenile white sharks made deeper dives to cooler waters, indicating an expansion in thermoregulatory ability and thermal tolerance as they grow older (Dewar *et al.,* 2004; Weng *et al.,* 2007b). The potential for climate change to increase SSTs and deepen the thermocline in the California Current System (King *et al.,* 2011) may expand foraging habitat and opportunities for young NEP white sharks. However, climate-related changes in the distribution of prey resources could also result in potential mismatches between predator and prey distributions (Hazen *et al.,* 2012).

The model predictions in Hazen *et al.* (2012) represent only one analysis of how climate change may affect the NEP white shark population and do not account for factors such as species interactions, food web dynamics, and fine-scale habitat use patterns that need to be considered to more comprehensively assess the effects of climate change on this ecosystem. The complexity of ecosystem processes and interactions complicate the interpretation of modeled climate change predictions and the potential impacts on populations such as the NEP white shark population. Thus, the potential impacts from climate change on the NEP white shark population and its habitat are highly uncertain, but the diverse diet and broad thermal tolerance of white sharks suggest the population has the capability to adapt to some level of climate-related SST change. The BRT also noted that the potential impacts of global warming and climate change on NEP white sharks are speculative at this time (Dewar *et al.,* 2013).

*Analysis of the Present or Threatened Destruction, Modification, or Curtailment of the Habitat or Range*

Habitat used by the NEP white shark population has been modified by the threats identified and discussed in this section. However, consistent with the BRT's assessment of threats (Dewar *et al.,* 2013), we do not find evidence indicating that the impacts of pollution, depletion of prey species, ocean acidification, or climate change are a significant threat to the NEP white shark population. Although legacy pollutants remain in the SCB, pollutant inputs to this area have decreased since the 1970s as a result of improved discharge management (Raco-Rands, 1999 as cited in Schiff *et al.,* 2000). White shark prey resources have substantially increased in abundance over the last several decades due to protections for marine mammals and improved fisheries management (Dewar *et al.,* 2013). The effects of ocean acidification and climate change now and in the foreseeable future remain highly uncertain, but the best available information indicates that habitat used by the NEP white shark population is not likely to be substantially impacted or that the white shark population will be able to compensate for any habitat changes. Overall, the best available information suggests that identified threats related to the destruction, modification or curtailment of white shark habitat in NEP are not contributing to increasing the population's risk of extinction now or in the foreseeable future.

**B. Overutilization for Commercial, Recreational, Scientific or Educational Purposes**

Potential threats to the NEP white shark population from overutilization for commercial, recreational, scientific or educational purposes include bycatch in a range of fisheries, international trade, ecotourism and scientific research. Each of these potential threats is discussed in the following sections.

*High Seas Driftnet Fisheries*

As part of its threats evaluation, the BRT considered historical interactions between high seas driftnet fisheries and white sharks (Dewar *et al.,* 2013). From the 1970s to the early 1990s there were large scale drift gillnet fisheries in the North Pacific Ocean targeting salmon, flying squid, tuna and billfish that had significant amounts of shark bycatch. The salmon fishery was located west of 180°W and is not likely to have interacted with white sharks from the NEP population. The areas used by the fisheries targeting flying squid, tuna and billfish were centered farther west and only overlapped with a small portion of the pelagic habitat used by NEP white sharks around the Hawaiian Islands, primarily west of the OFA area (Dewar *et al.,* 2013). Catch of white sharks was reported in both the flying squid and large mesh drift gill net fisheries targeting tuna and billfish, but the available data are scarce and it is uncertain what population of white sharks was impacted by the fisheries (Dewar *et al.,* 2013). Because of concerns about the bycatch of many species, including sharks, the high seas drift net fisheries were phased out in 1992 following a United Nations resolution banning their use. It is uncertain whether any unregulated driftnet fishing occurs in the NEP; however, a survey of NMFS personnel involved in international affairs and Illegal, Unreported and Unregulated (IUU) fishing did not yield any information indicating these fisheries continue to operate in waters east of the Hawaiian Islands (Dewar *et al.,* 2013).

*Hawaii Long-Line Fisheries*

Based on the best available information, there is limited interaction between long line fisheries based in the Hawaiian Islands and white sharks. Observer data for the shallow set swordfish fishery based in Hawaii includes seven records of white sharks captured from 1997–2008. The records were not verifiable (i.e., no photographs, etc., were taken) and were considered suspect by NMFS personnel familiar with the observer database (Dewar *et al.,* 2013).

*U.S. West Coast Commercial Fisheries*

Previous reports have described white shark bycatch in California fisheries (Klimley, 1985; Lowe *et al.,* 2012). Data compiled for these studies from logbook records, landing receipts, fishery observer reports and scientific research studies indicate that historically most white sharks have been caught in gillnet fisheries. In general, most of the white shark bycatch in California gillnet fisheries occurred in southern California and consisted of YOY and juvenile sharks; however, both juveniles and adults were historically caught north of Point Conception when set and drift gillnet fisheries more commonly operated in those areas. Based on these studies, catches of white sharks were sporadic throughout the 1970s, followed by an increase in the 1980s as the small and large mesh net fisheries expanded. White shark catches subsequently decreased, reaching a low in 1994 when white sharks were protected by the State of California and gill and trammel nets were banned within 3 nmi of the mainland and 1 nmi of the Channel Islands (Lowe *et al.,* 2012).

As part of its threats evaluation and risk assessment, the BRT compiled and analyzed U.S. gillnet fisheries catch and effort data for white sharks from several sources including logbooks, Pacific Fisheries Information Network landing records, fishery observer records, and the Monterey Bay Aquarium scientific white shark collection program (Dewar *et al.,* 2013). Based on this analysis, most reported catches of white sharks were in the coastal set gillnet and large-mesh drift net fisheries prior to the mid-1990s. Reported catch numbers peaked during the mid-1980s and declined steadily thereafter as fishing effort decreased as a result of changes in fishing regulations and implementation of the 1994 near-shore set gillnet ban in California. The set gillnet fisheries operated primarily over the continental shelf and as a consequence of the 1994 ban they were restricted to just a few areas in the SCB including the Ventura

Flats, Channel Islands, Huntington Flats, and Oceanside where the continental shelf extends beyond the 3 nmi closure area. A time-area closure was implemented for the large mesh drift gillnet fleet in 2001 that essentially eliminated this fishery from near-shore waters north of Morro Bay. Since 1999 only one white shark capture has been reported in the drift gillnet fishery. Most catch of white sharks now occurs in the set gillnet fishery which has reported increasing catches since the mid-2000s. Lowe *et al.,* (2012) suggested that the increased number of YOY and juvenile white sharks caught since the mid-2000s could be the result of past reductions in fishery mortality that led to an increasing white shark population and associated YOY and juvenile production. The BRT found that CPUE of white sharks in gillnet fisheries was substantially higher over the period from 2002–2011 compared with the period from 1990–2001 (Dewar *et al.,* 2013) and noted that these findings are consistent with the increase in white shark abundance suggested by Lowe *et al.* (2012).

*Recreational Fisheries*

Interactions between recreational fisheries off California and white sharks are known to occur, but there is relatively little documentation of such interactions. From 1980–2011, 7 white sharks were reported in logbooks from commercial passenger fishing vessels and 1 white shark was reported caught by a private angler (CDFW, 2013). White sharks are occasionally caught off public fishing piers in southern California and two citations were issued by CDFW for illegal take of juvenile white sharks off piers in 2012 (CDFW, 2013).

*Mexican Fisheries*

As part of its threats evaluation, the BRT reviewed available information on the catch of white sharks in Mexico including recently published information and unpublished information from researchers in Baja California (Dewar *et al.,* 2013). Information on white shark bycatch from the Pacific coast of the Baja Peninsula and from the Gulf of California has been reported by several researchers (Galván-Magaña *et al.* 2010; Castro, 2012; Santana-Morales *et al* 2012).

Santana-Morales *et al.* (2012) summarized the results of white shark catch records from various fisheries for the period from 1999–2010 and found that 80 percent of the white sharks taken were YOY and that most were caught in Sebastián Vizcaíno Bay during the summer. More recent efforts to quantify catch of white sharks have been conducted by researchers who have worked directly with local fish distributors operating in Sebastián Vizcaíno Bay (Sosa-Nishizaki, personal communication cited in Dewar *et al.,* 2013). Although there are potential problems associated with the identification of white sharks in Baja California because of the way shark species are processed, this approach allowed the researchers to work directly with the point of contact for all fishermen in the area. According to Sosa-Nishizaki (personal communication cited in Dewar *et al.,* 2013), distributors reported receiving 186 white sharks in 2011 from fishermen operating in Baja California, with the vast majority having been caught in Sebastián Vizcaíno Bay. To reduce impacts on sharks, the Mexican government prohibited shark fishing along the Pacific coast of Mexico from June 1—July 31 in 2012, and, beginning in 2013, has expanded the closure to include the month of May. The reported catch of white sharks in 2012 was substantially reduced by this action and further catch reductions are possible with the expanded closure. White sharks are also caught along the Pacific coast of the southern portion of the Baja California peninsula, but that information has not been quantified.

White sharks are known to be caught on fishing gear in the Gulf of California, but incidental catch records are not well quantified. Galván-Magaña *et al.* (2010) reported that small numbers of adult, subadult and juvenile white sharks were caught in the Gulf of California based on records from 1964 to 2010. To date there is only one record of a YOY white shark being captured in the Gulf of California (Sosa-Nishizaki, personal communication cited in Dewar *et al.,* 2013), although large females are documented to come into this area.

As previously discussed (see Fisheries Risk Assessment Modeling section), the BRT conducted population modeling using white shark catch and mortality data to assess the impact of mortality from U.S. and Mexican fisheries on white shark population growth rates and changes in adult female population abundance over time (Dewar *et al.,* 2013). Based on the results of this modeling analysis, the BRT concluded that the NEP white shark population is at a very low to low risk from the U.S. and Mexican fisheries if the population includes at least 200 adult females as the BRT believes is likely to be the case (Dewar *et al.,* 2013).

*International Trade*

International trade of white shark fins, jaws, and teeth for consumption or as trophies or curios has been identified as a threat to white shark populations worldwide (CITES, 2004; Clarke *et al.,* 2004; Fowler *et al.,* 2005; Shivji *et al.,* 2006) and the high value of these white shark products may act as an incentive for poaching and illegal trade (Compagno, 2001). The extent of international trade in white shark products is difficult to determine (Clarke *et al.,* 2004); however, genetic analysis of confiscated white shark fins in a law enforcement case on the U.S. East coast confirmed the illegal trade of white shark fins (Shivji *et al.,* 2005). This case provides evidence for illegal trade impacts on the global population of white sharks, and therefore, it is possible that white sharks from the NEP may be part of this trade. However, there is no information currently available to assess whether white sharks from the NEP are part of this illegal trade and there are no documented cases of illegal trade in white shark parts in California (CDFW, 2013).

*Ecotourism Activities*

White shark ecotourism activities, including cage diving, shark watching operations, and filming, are known to be conducted off the Farallon Islands in central California and at Guadalupe Island off Baja California (CITES, 2004; DOF, 2004 and 2006; Domeier and Nasby-Lucas, 2006; NOAA, 2008). While ecotourism provides benefits to white sharks as a non-consumptive use that raises public awareness of the species, there is the potential for these activities to harass white sharks and alter their natural behaviors (CITES, 2004; Fowler *et al.,* 2005; Laroche *et al.,* 2007; NOAA, 2008). White sharks are believed to hunt by swimming at depth so that they can spot pinnipeds in the water above them without being seen; however, ecotourism activities often try to attract white sharks to the surface by setting out bait or decoys and keep them at the surface for as long as possible (Fowler *et al.,* 2005; Laroche *et al.,* 2007). Frequent or cumulative encounters with humans and vessels due to these activities could result in altered behavior (e.g., conditioning of sharks to associate vessels with food rewards), changes to feeding strategies (e.g., increased time spent at the surface versus swimming at depth), and increased or decreased residency times in the area (Laroche *et al.,* 2007). Laroche *et al.* (2007) conducted an experimental study to examine the effects of chumming activities on white shark behavior in South Africa and observed only minor, short-term changes in behavior; however, the study was limited in scope and may not apply to all ecotourism operations.

Regulations on ecotourism activities have been adopted in some areas to address the potential impacts of these activities on white sharks. In 2002, the State of Hawaii banned shark feeding in state marine waters due to concerns that such activities were altering the natural behavior of sharks as well as altering the environment and potentially increasing the risk of shark attacks (Fowler *et al.,* 2005). In 2008, the Gulf of the Farallones National Marine Sanctuary adopted regulations to prohibit attracting white sharks within the Sanctuary's waters and to prohibit approaching within 50 m of any sharks in waters within 2 nmi of the Farallon Islands. These regulations are meant to minimize the disturbance of white sharks and interference with their natural behaviors from ecotourism activities (primarily cage diving) and scientific research activities conducted around the Farallon Islands (NOAA, 2008). A similar prohibition on attracting white sharks was adopted for the Monterey Bay National Marine Sanctuary, although cage diving operations are not known to occur in waters off Monterey Bay (NOAA, 2008).

Commercial cage diving operations began off Guadalupe Island in 2002 (Domeier and Nasby-Lucas, 2006) and visit the same sites each year (Sosa-Nishizaki *et al.,* 2012). According to Sosa-Nishizaki (personal communication to Susan Wang, NMFS, 2013), Mexico limits commercial cage diving to 6 vessels at 3 locations and requires all vessels to have permits, licenses, and adhere to a code of conduct designed to protect white sharks at the island. The code of conduct prohibits fishing for white sharks, approaching within 50m of white sharks foraging on marine mammals, the use of decoys to attract white sharks, and the feeding or touching of white sharks. The code of conduct does allow use of bait with several restrictions.

Overall, ecotourism activities have the potential to disturb and alter the natural behavior of NEP white sharks, but the potential impacts of such activities are poorly understood and at least one study suggests that the impacts may be minor. Regulations currently exist for waters around the Hawaiian Islands, Farallon Islands and Guadalupe Island that likely minimize disturbance of white sharks from ecotourism activities.

*State-Permitted Scientific Research Activities in California*

In California, the take of white sharks is prohibited except as permitted for scientific or educational purposes. Reports submitted by CDFW permit holders from 2007 through 2011 indicate that a total of 107 white sharks were tagged and released alive and that six white sharks were retained for live display (CDFW, 2013). Thus, a relatively large number of white sharks have been captured and handled as part of state-permitted research activities in California since 2007.

Effective March 1, 2013, the California Fish and Game Commission designated white sharks as a candidate species for listing under the California Endangered Species Act (CESA), thereby initiating a formal review of the species' status. As a candidate species, white sharks in California are afforded the full legal protection of a listed species under CESA and their take is prohibited except as expressly permitted under CESA. On March 1, 2013, the State revoked all previously issued scientific collection permits and notified researchers that they must obtain new permits under CESA in order to continue their scientific research and collection activities. The CDFW is currently reviewing research reports and working with former permit holders to evaluate their past research activities in order to assess the overall effects of past research on white sharks in California waters and the extent of targeted fishing for white sharks in association with this research (CDFW, 2013).

*Analysis of Overutilization for Commercial, Recreational, Scientific, or Educational Purposes*

High seas drift net fisheries may have had historical impacts on the NEP white shark population, but those impacts are likely to have been limited because those fisheries did not overlap extensively with the offshore habitat used by the population. Those fisheries were banned in the early 1990s and we have no current information indicating that there are illegal high seas fisheries in the offshore areas used by the NEP white shark population. Historically and at present, various types of gillnet fisheries along the U.S west coast, primarily in southern California, have taken white sharks. However, white shark catch and mortality associated with these fisheries have declined substantially since the late 1980s and early 1990s as fishing effort declined as a result of protections implemented by the State of California (e.g., State protection of white sharks, changes in fishing regulations, and a ban on gillnet fishing in much of southern California). Recent evidence indicates that CPUE of white sharks in southern California has actually increased in recent years despite reduced fishing effort, suggesting that the white shark population may be increasing (Dewar *et al.,* 2013). Various artisanal fisheries in Mexico also take white sharks, primarily along the northern coast of Baja California which is part of the NEP white shark's nursery habitat for YOY and juvenile sharks. Recent information suggests that this area currently has the highest level of white shark catch and mortality, but reported catches were substantially reduced after Mexico implemented a seasonal (June and July) ban on shark fishing on the Pacific coast of Mexico in 2012. This ban was expanded to include the month of May beginning in 2013 and thus white shark catch levels may be reduced even more in the future. The BRT conducted extinction risk modeling to evaluate the present and future risks of U.S. and Mexican fishery mortality on the NEP white shark population and found the estimated mortality levels are sustainable and that risks to the population are low to very low (Dewar *et al.,* 2013). Other activities, such as international trade in white sharks, ecotourism and scientific collection of white sharks, most likely have minimal impacts on the NEP white shark population. Overall, the best available information indicates that these threats are not contributing substantially to the population's risk of extinction now or in the foreseeable future.

**C. Disease and Predation**

Limited information is available for white sharks regarding disease and predation. Although common parasites such as large copepods and intestinal cestodes have been found in white sharks, it is not known how these parasites affect individual animals or populations (Compagno, 2001). Young white sharks caught off the coast of southern California have been found to have high concentrations of mercury and organochlorines (DDT and PCBs) in their liver and muscle tissues, but the potential impacts on the health of white sharks are unknown (Mull *et al.,* 2012). Exposure to contaminants such as DDT and PCBs has been linked to increased incidence of diseases in certain fish species within the SCB (Mearns and Sherwood, 1977; Cross, 1988; Stull, 1995; Allen *et al.,* 1998; all cited in Schiff *et al.,* 2000), but no such linkages have yet been studied or documented in white sharks.

Little is known about predation on white sharks by other species; however, given the species' size and status as a top-level predator it is likely that predation on any life history stage is relatively low (Dewar et al., 2013). The BRT concluded that the most likely predators of white sharks are killer whales and other larger sharks (Dewar *et al.,* 2013). There is one confirmed predation event on a white shark indicating that at least smaller white sharks may be vulnerable to predation by large predatory marine mammals. In 1997, fishermen and researchers observed an adult transient killer whale kill and partially ingest an intermediate-sized white shark (likely a subadult) near the Southeast Farallon Islands (Pyle *et al.,* 1999). Pyle *et al.* (1999) suggested that the white shark killed in this event was likely attracted to the surface by a recently killed pinniped carcass because white sharks at this site typically are near the bottom rather than the surface (Goldman *et al.,* 1996, cited in Pyle *et al.,* 1999). In November 2000 another predation event was observed around the Farallon Islands involving a killer whale and a ''large prey item'' that could have been a white shark (Pyle and Anderson, unpublished observations cited in Weng *et al.,* 2007). Other predation events such as these may occur, but are not well documented in the literature most likely because of their rarity. Compagno (2001) suggested that large pinnipeds and other large shark species may kill or injure white sharks, but except for occasional seal bite marks on sharks there is little evidence of such behavior.

*Analysis of Disease and Predation*

The best available information indicates that the effects of disease, predation and competition on the NEP white shark population are limited. The BRT concluded that disease and predation are low-level threats to the population (Dewar *et al.,* 2013). Overall, there is no information indicating that these factors are contributing to increasing the population's risk of extinction or that they are likely to do so in the foreseeable future.

**D. The Inadequacy of Existing Regulatory Mechanisms**

Existing regulatory mechanisms include Federal, state, and international regulations and management measures. Below, we describe the current domestic and international regulatory mechanisms that affect the NEP white shark population, followed by an evaluation of their adequacy.

*U.S. Federal Regulations*

Federal regulations that provide protection for white sharks in the NEP include white shark-specific regulations under the West Coast Highly Migratory Species Fishery Management Plan (HMS FMP) and in west coast National Marine Sanctuaries, as well as general shark protections under the Shark Finning Prohibition Act of 2000 and the Shark Conservation Act of 2010.

Under the West Coast HMS FMP white sharks are a prohibited species, meaning that their retention is prohibited and they must be released immediately if caught (PFMC, 2011; NMFS, 2011). This prohibition applies to all U.S. vessels that fish for highly migratory species using authorized gear (e.g., large mesh drift gillnet, deep-set longline, tuna troll and purse seine) within the U.S. exclusive economic zone and the state waters of California, Oregon and Washington, as well as U.S. vessels fishing for highly migratory species on the high seas that land their fish in California, Oregon or Washington (PFMC, 2011).

The large mesh drift gillnet fishery for swordfish and thresher shark is one of the federally-managed fisheries authorized under the West Coast HMS FMP. Based on logbook records, bycatch of white sharks in this fishery has steadily declined since the early 1980s with only one individual reported caught since 2000 (Dewar *et al.,* 2013). This reduction in bycatch is most likely due to changes in the management of the fishery over time, including a delay in the start of the fishing season, gear changes, and a time/area closure that largely eliminated the fishery from areas north of Morro Bay (Dewar et al., 2013). Prior to adoption of the West Coast HMS FMP, the State of California was responsible for the management of the large mesh drift gillnet fishery and implemented a series of restrictions which provided additional protections for white sharks. All of these regulations have been incorporated into the FMP for this fishery.

Other measures that have been implemented to reduce the bycatch of marine mammals and sea turtles in the drift gillnet fishery are also likely to have reduced interactions with white sharks in the NEP. For example, the Pacific Offshore Cetacean Take Reduction Plan requires the use of extenders to lower drift gillnets in the water column to avoid cetaceans swimming near the surface, which likely reduces potential interactions with small white sharks that typically spend the majority of their time near the surface of the water column (Dewar *et al.,* 2013). Similarly, the Pacific Leatherback Conservation Area (PLCA), which prohibits use of drift gillnet gear over a large area off central California from August 15 to November 15 and over a large portion of the SCB from June 1 to August 31 during declared El Niño events to protect loggerhead sea turtles, is likely to provide some level of protection to adult and subadult white sharks in these areas and at these times.

The Gulf of the Farallones National Marine Sanctuary (GFNMS) and Monterey Bay National Marine Sanctuary (MBNMS) have prohibited efforts to attract white sharks. The GFNMS also prohibits vessels from approaching within 50 m of any white shark anywhere within 2 nmi around the Farallon Islands. The Sanctuaries adopted these prohibitions primarily to regulate adventure tourism activities (e.g., commercial white shark viewing enterprises such as cage diving operations), filming, and scientific research activities that can disturb white sharks and interrupt their natural feeding and daily activities (NOAA, 2008). Although there is no prohibition on approaching white sharks within the GFNMS outside of the 2 nmi boundary around the islands, the area inside this boundary is where white sharks are most prevalent when they are feeding, and thus, interactions with white sharks are reduced by this action (NOAA, 2008). The Sanctuaries have issued permits to allow some white shark approach or attraction activities for legitimate research or educational purposes. These permitted activities are reviewed on a case-by-case basis and are subject to reporting requirements and other terms and conditions as deemed necessary to protect Sanctuary resources.

The Shark Finning Prohibition Act of 2000 amended the Magnuson-Stevens Fishery Conservation and Management Act (MSA) to prohibit the practice of shark finning (i.e., removing the fins of a shark, including the tail, and discarding the carcass of the shark at sea) by any person under U.S. jurisdiction. This Act also amended the MSA to prohibit having custody, control, or possession of shark fins aboard a fishing vessel without the corresponding carcass or landing shark fins without the corresponding carcass; however, a provision does permit some level of shark finning to occur. In 2011, the Shark Conservation Act of 2010 was signed into law to further strengthen the prohibitions on shark finning under the MSA as well as under the High Seas Driftnet Fishing Moratorium Protection Act. These amendments to the MSA clarify that it is illegal for all vessels to have custody of, transfer, or land a shark fin unless it is naturally attached to the corresponding shark carcass, but it does allow some retention of shark fins after the sharks have been landed (NMFS, 2011). The 2010 Act also amended the High Seas Driftnet Act to include shark conservation measures, including measures to prohibit shark finning at sea in international agreements negotiated by the United States. (NMFS, 2011). These provisions under the MSA and the High Seas Driftnet Act provide some protections for white sharks in domestic and international waters by regulating shark finning activities.

*State Regulations*

State fisheries regulations vary by state and by fishery from general shark management measures to specific protections for white sharks. Below is an overview of state regulations that may affect the NEP white shark population, but with a focus on California regulations, as the majority of fishery interactions with white sharks along the west coast of the U.S. occur offshore California.

In 1994, white sharks received special protected status in the State of California by the addition of Sections 5517 and 8599 to the State's Fish and Game Code (CDFW, 2013). Section 5517 prohibited the take of white sharks, except by special permit from the CDFW. Section 8599 prohibited commercial take of white sharks except for scientific and educational purposes under State-issued scientific collection permits, but did allow for the incidental take of white sharks by round haul or gillnet and the sale of any live-landed white sharks for scientific or live display purposes under scientific collection permits. On March 1, 2013, the State of California accepted a petition to list white sharks under the CESA. This action conferred candidate species status to white sharks while the State undertakes a year-long status review of the NEP population. As a candidate species, white sharks have full legal protection under CESA, which includes a prohibition on the take of white sharks in fisheries and for scientific or educational purposes. While a candidate for listing under CESA, the take of white sharks is only allowed in fisheries or for scientific purposes pursuant to a special CESA permit and to date no such permits have been issued by CDFW. It is uncertain what the outcome of the status review will be or whether the State will list white sharks under CESA, but white sharks will continue to have legal protection as a candidate species until the State renders its listing decision.

Changes to commercial fishing regulations in California since the 1980s have provided additional protection for white sharks and reduced fishery interactions and bycatch. The majority of reported captures of white sharks off California have occurred in coastal gill net fisheries (Lowe *et al.,* 2012). Since 1994, gillnet use has been banned in the Marine Resources Protection Zone in southern California which includes all state waters south of Point Arguello (i.e. areas inside 3 nmi from the mainland coast) and waters less than 70 fathoms (fm) deep or within 1 nmi of the California Channel Islands. Since 2000, gillnet use has also been prohibited in waters shallower than 60 fm along the California coast between Point Arguello and Point Reyes, which has effectively restricted gill net use to a few limited areas in southern California. These actions have served to reduce or eliminate gill net fishing effort and thereby reduce interactions with white sharks in California. Seasonal closures and the timing of gill net fisheries that continue to exist in southern California for white seabass and California halibut are also likely to reduce fishery interactions with white sharks (CDFW, 2013). As a result of these area and time closures in southern California, current gill net fishing effort overlaps with less than a third of the available YOY white shark habitat based on satellite tagging studies (Chris Lowe, California State University, Long Beach, personal communication cited in Dewar *et al.,* 2013).

In Oregon, the take of white sharks is prohibited in sport fisheries and they must be released immediately and unharmed if taken. In contrast, the take of white sharks is not specifically prohibited or regulated in commercial fisheries. Washington and Alaska do not have fishing regulations that specifically address white sharks, but include white sharks in general bottomfish or shark categories for which fishing is regulated. Hawaii does not have fishing regulations that specifically address white sharks, but prohibits the feeding of sharks within the State's marine waters. California, Oregon, Washington, and Hawaii have all adopted shark finning prohibitions making it unlawful to possess, sell, offer for sale, trade, or distribute shark fins, and this may provide some protection for white sharks in the NEP.

*International Authorities*

Canada and Mexico, the two other nations within the range of the NEP white shark population, have each adopted regulations that directly and/or indirectly provide protections for white sharks. In addition, the status of the global population of white sharks (including the NEP population) has been assessed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the International Union for Conservation of Nature (IUCN), and the Convention on the Conservation of Migratory Species of Wild Animals (CMS). Several international authorities have also addressed protections applicable to all shark species that may provide some protection for the NEP white shark population. We briefly describe these protections below.

In Canada, the Atlantic population of white sharks was listed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2006 and under the Species At Risk Act (SARA) in 2011 (Environment Canada, 2011; SARA Annual Report for 2011; *http://www.sararegistry.gc.ca/virtual_sara/files/reports/LEP-SARA_2011_eng.pdf),* whereas the Pacific population of white sharks was listed as ''Data Deficient'' by COSEWIC in 2006 (COSEWIC, 2006) and is currently not listed under SARA. Data deficient is a category that applies when the available information is insufficient to resolve a species' eligibility for assessment or to permit an assessment of the species' risk of extinction. White sharks in the NEP were listed as data deficient primarily due to their rarity in Canadian waters and the lack of abundance trend information for Pacific Canadian waters and adjacent U.S. waters (COSEWIC, 2006). Although Canada does not have any Federal or provincial laws that explicitly protect white sharks on the Pacific Coast, hook-and-line fisheries on Canada's Pacific Coast are prohibited from keeping any species of shark except for dogfish (COSEWIC, 2006), and this likely provides some protection for the NEP white shark population.

Mexico listed white sharks as a threatened species in 2001 (NORM–059–ECOL–2001) based on a review of available literature and data analysis, but this action did not provide any specific protections to the species. Since then, Mexico has adopted regulations for the protection of white sharks and sharks in general. In 2007, Mexico published an Official Norm (DOF, 2007; NOM–029–PESC 2006) on responsible shark and ray fishing that prohibits the catch and retention of white sharks, whether alive or dead, whole or in part. The Official Norm also prohibits the landing of shark fins unless the shark bodies are also on board fishing vessels, prohibits any increases in the total allowable fishing effort for sharks and rays, and establishes various gear and area restrictions for fisheries targeting sharks and rays (DOF, 2007; Barreira, 2008). Despite the prohibition on catch and retention, studies have documented the catch and retention of white sharks in fisheries off Baja California (Cartamil *et al.,* 2011; Santana-Morales *et al.,* 2012). In 2012, Mexico adopted a seasonal ban on fishing for all shark species in national waters of the Pacific Ocean from June through July beginning in 2012 and between May through July each subsequent year (DOF, 2012). This ban is expected to provide increased protection for YOY and juvenile white sharks by reducing their interactions with coastal gillnet fisheries. Based on limited information, for example, this seasonal ban reduced the documented catch and retention of YOY and juveniles by approximately 50 percent in 2012 (Sosa-Nishizaki, personal communication cited in Dewar *et al.,* 2013), although it is possible that not all white shark catches were reported. Expansion of the shark fishing ban to include the month of May starting in 2013 is expected to further reduce impacts to white sharks in these coastal gillnet fisheries, but more effective monitoring of the fisheries and enforcement of this ban are needed to ensure that impact reductions are realized.

Other than the white shark catch information that was considered by the BRT in its fisheries risk assessment modeling (Dewar *et al.,* 2013), there do not appear to be any estimates of total white shark bycatch in Mexico. Improved collection and reporting of white shark catch data are needed to better evaluate impacts to the population and the effectiveness of Mexican fisheries regulations for white sharks. Regulation and enforcement of gillnet fisheries that interact with and take white sharks in Mexico is important because coastal waters of northern Baja California are part of the nursery area for the NEP white shark population and some portion of the YOY and juvenile component of the population uses this habitat (Weng *et al.,* 2007; Chris Lowe, California State University, Long Beach, personal communication, 2012; Dewar *et al.,* 2013).

Under CITES, species may be listed in three appendices: Appendix I (species threatened with extinction), Appendix II (species not necessarily threatened with extinction, but that might become so unless trade is subject to regulation), or Appendix III (species protected in at least one country that has asked for assistance from other Parties to CITES for help in controlling international trade). CITES requires countries to regulate and monitor trade in products from species listed in the appendices using a permitting system that has different requirements depending upon the Appendix in which a species is listed. In 2004, white sharks were listed under Appendix II of CITES, meaning that international trade in white shark specimens must be authorized by export permits or re-export certificates. Granting of these permits or certificates is based on an evaluation of whether certain conditions are being met, including a determination that trade will not be detrimental to the species' survival in the wild.

The IUCN Red List is an assessment of a species' extinction risk on a worldwide basis. Listing a species on the IUCN Red List does not provide any regulatory protections for the species, but serves as an evaluation of the species' status. The global population of white shark species was assessed and categorized as ''vulnerable'' in 1996, 2000 and 2009, meaning that the species was considered to be facing a high risk of extinction in the wild (IUCN, 2001). The criteria for assessing whether a species should be listed on the IUCN Red List are different than the standards for making a determination that a species warrants listing as threatened or endangered under the ESA, and hence, the ''vulnerable'' assessment for the global white shark species does not directly inform our analysis of extinction risk for the NEP white shark population.

The Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention) is an intergovernmental treaty under the United Nations Environment Programme. Migratory species may be listed under Appendix I (species categorized as being in danger of extinction throughout all or a significant portion of their range) or Appendix II (species that need or would significantly benefit from international cooperation) of the CMS. The CMS supports protection and conservation of the species listed under the appendices through legally binding treaties (called Agreements) and non-legally binding Memoranda of Understanding (MOU). The United States, Mexico, and Canada are not Parties to the CMS, but the United States is a signatory to some MOUs under the CMS. In 2002, the global population of white sharks was listed under both Appendix I and II of the CMS, and in 2010 the CMS adopted a non-binding MOU on the Conservation of Migratory Sharks to improve the conservation status of white sharks and other shark species listed under the appendices. This MOU, to which the United States is a signatory, does not provide regulatory protections for these shark species, but encourages Signatories to adopt and implement measures to protect the species and its habitat. Measures include prohibitions on shark finning activities, prohibitions on take of the species, and implementation of National Plans of Action for sharks, as called for under the United Nations Food and Agriculture Organization's (FAO) 1999 International Plan of Action for sharks.

In 1999, the FAO adopted the International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks) to ensure the conservation and management of sharks and their long-term sustainable use (FAO, 1999). Under the IPOA-Sharks, members and non-members of the FAO are encouraged to develop national plans of action to address shark conservation and management needs, including sustainable management and monitoring of shark catches in fisheries; minimization of incidental catch, waste, and discards; and assessments of threats to shark populations (FAO, 1999). The United States, Mexico and Canada, as well as several other nations, have each adopted and implemented a National Plan of Action for the Conservation and Management of Sharks under the IPOA-Sharks. These plans may provide some conservation benefit to the NEP white shark population by improving the management of shark fisheries and conservation of shark species in these nations; however, the effectiveness of such plans has not yet been demonstrated (Lack and Sant, 2011).

International efforts have also focused on minimizing waste and discards through the regulation or prohibition of shark finning activities. Two regional entities in the Pacific Ocean, the Western and Central Pacific Fisheries Commission (WCPFC) and the Inter-American Tropical Tuna Commission (IATTC), have adopted resolutions to regulate shark fishing and shark finning activities among member and cooperating non-member nations (including the United States, Mexico and Canada). The WCPFC and IATTC resolutions state that members and cooperating non-member nations shall require full utilization of retained catches of sharks and shall prohibit vessels from having on board shark fins that total more than 5 percent of the weight of sharks on board (IATTC, 2005; WCPFC, 2010). The resolutions also call on member and cooperating non-member nations to encourage the live release of sharks in their fisheries when they are caught incidentally and not used for food. The WCPFC Convention Area encompasses waters around the Hawaiian Islands and the IATTC Convention Area encompasses offshore waters used by the NEP white shark population, including the OFA.

*Analysis of Inadequacy of Existing Regulatory Mechanisms*

Protective efforts have been implemented under both U.S. Federal and state authorities since the early 1990s to reduce impacts on the NEP white shark population, including prohibitions on take of white shark in fisheries and more protective fishery regulations (e.g., time and area closures, etc.). These efforts have reduced fishing effort in areas used by white sharks, particularly in the SCB, and this has substantially reduced fishery impact on the NEP white shark population. We conclude that these regulatory measures provide adequate protection to the NEP white shark population from fishery impacts in U.S. waters and in State waters offshore California where the species is most abundant. However, protective efforts could be improved for white sharks in State waters offshore Oregon and Washington, and observer coverage of gillnet fisheries in California could be expanded to provide more information about white shark bycatch.

White sharks are also protected in Mexico, and fishery regulations have been implemented since the early 2000s to reduce fishery impacts. Nevertheless, white sharks, primarily YOY and juveniles, continue to be caught and retained in gillnet fisheries along the coast of Baja California, primarily by fishermen operating from remote artisanal fishing camps. Enforcement of the existing regulations needs to be improved, but monitoring fishing activities in remote artisanal fishing camps is difficult. In addition to improved enforcement, additional monitoring of the fisheries is necessary as are efforts to educate the fishing community about shark species identification and shark conservation. A seasonal shark fishing ban recently adopted by Mexico resulted in a reduction in the reported catch of white sharks along the Baja California coast in 2012, but enforcement is necessary to ensure that fishermen comply with the ban and the ban needs to be evaluated over time to assess its long-term effectiveness in reducing impacts to white sharks.

The recently-adopted prohibitions on attracting and approaching white sharks in the GFNMS and MBNMS provide a high level of protection for white sharks by reducing human interactions and the potential disruption of natural behaviors from activities such as cage diving operations, shark viewing operations, and scientific research. In waters off Guadalupe Island, where ecotourism operations have been conducted since the early 2000s, Mexico requires permits for commercial cage operations, limits the number of permits and the locations where permit holders can operate, and requires that permit holders adhere to a code of conduct designed to protect white sharks at the island. The code of conduct prohibits fishing for white sharks, approaching within 50m of white sharks foraging on marine mammals, the use of decoys to attract white sharks, and the feeding or touching of white sharks.

In 1994, California prohibited the take of white sharks except as permitted for scientific or educational purposes. Under these scientific collection permits, researchers often collaborated with fishermen to obtain white sharks incidentally caught in commercial fisheries for tagging and other studies. Because white sharks are now a candidate species for listing under the CESA, all scientific collection permits have been revoked and the CDFW is currently reviewing this program to evaluate the effects of state-permitted research activities on NEP white sharks. It is uncertain if and when permits will be issued under CESA and whether or not additional restrictions will be placed on permit holders.

We conclude that existing Federal and State regulatory mechanisms provide adequate protection of the NEP white shark population. Federal and State regulations, particularly in California, have reduced impacts to white sharks from fisheries and other activities in nursery habitat and other areas where they aggregate and forage. However, regulatory mechanisms for fisheries in Mexico, primarily those related to monitoring, enforcement, and education of fishermen, need to be improved to ensure that existing regulations are implemented, to evaluate the effectiveness of existing regulations and to determine if additional regulations are needed. The BRT evaluated the impact of U.S. and Mexican fisheries on the NEP white shark population under the current regulatory regime and concluded the population is at a low to very low risk from these fisheries if the population includes at least 200 adult females as seems most plausible (Dewar *et al.,* 2013). Overall, the best available information indicates that existing regulatory mechanisms are adequate and that they are not contributing to increasing the population's risk of extinction now or in the foreseeable future.

**E. Other Natural or Man-Made Factors Affecting the Population's Continued Existence**

*Natural Factors*

Because of concerns raised about the possible small size of the NEP white shark population, the BRT evaluated the population's vulnerability to the risks often associated with small populations (Dewar *et al.,* 2013). These risks include increased difficulty finding mates, loss of genetic diversity, demographic stochasticity (variation in productivity), and stochastic and catastrophic events. The BRT generally found that the behavior and life history characteristics of white sharks are likely to mitigate these small population risks. For example, the offshore migratory behavior and aggregation of subadults and adults at coastal sites with pinniped colonies increases the probability that individuals will find mates for reproduction, even if the number of individuals in the population is relatively small. The BRT found that the NEP white shark population has a high level of genetic diversity based on a relatively high number of unique mtDNA haplotypes (Jorgensen *et al.,* 2010) and suggested that giving birth to live young and the practice of multiple paternity increases the effective size of the population and contributes to maintaining this genetic diversity (Hoekert *et al.,* 2002). Because white sharks give birth to large, live young, their survival is increased, which contributes to decreasing the population's vulnerability to demographic stochasticity. Finally, the BRT noted that several characteristics of the NEP white shark population indicate that NEP white sharks should be resilient to catastrophic and stochastic events, including their migratory behavior, the population's broad offshore distribution, and the large degree of spatial separation between life stages as well as between adult males and females. Overall, the BRT's analysis indicated that even if the NEP white shark population is relatively small, its size is not likely to contribute significantly to the population's risk of decline or extinction (Dewar *et al.,* 2013).

*Manmade Factors—Bioaccumulation of Contaminants*

The bioaccumulation of contaminants by white sharks in the SCB is a potential risk to the NEP white shark population. Life history factors, including a long life span, a high trophic position, and a large lipid-rich liver, make white sharks susceptible to bioaccumulation (Mull *et al.,* 2012). As described previously (see

Present or threatened destruction, modification, or curtailment of habitat or range), DDT and PCBs still exist in the SCB due to inputs through the 1970s, despite cessation of the production and use of these pesticides since the 1970s (Schiff *et al.,* 2000). Although the input of pollutants into the SCB has declined since the 1970s, inputs by other sources (e.g., surface runoff from urban and agricultural watersheds) have remained steady or increased over time (Schiff *et al.,* 2000).

Mull *et al.* (2012) observed high concentrations of mercury, DDT, and PCBs in the liver and muscle tissues of YOY and juvenile white sharks caught in the SCB. The observed concentrations were 50 times higher than those observed in juvenile white sharks from South Africa (Schlenk *et al.,* 2005) and in other species of sharks sampled from other parts of the world (Mull *et al.,* 2012). Despite these high contaminant loads, deleterious physiological effects have not been documented in elasmobranchs (Mull *et al.,* 2012). The high contaminant concentrations found in the tissues of young white sharks from the SCB suggest the potential for physiological effects, but such effects are unclear. The elevated selenium levels in the muscle tissues of the young SCB white sharks suggest a physiological response to counteract the elevated muscle mercury concentrations (Mull *et al.,* 2012). In other species, uptake of selenium has been observed to counteract the toxicity of increased muscle mercury concentrations (Wiener *et al.,* 2003). In addition, hepatic lesions and other visible physical effects of high contaminant loads have not been observed in young NEP white sharks (Lyons, personal communication cited in Dewar *et al.,* 2013).

Overall, high contaminant concentrations have been observed in the tissues of young NEP white sharks, but the physiological effects of these high levels are not known. The high contaminant concentrations could indicate bioaccumulation from feeding in the SCB (Mull *et al.,* 2012) and/or maternal transfer of contaminants (Adams and McMichael, 1999; Maz-Courrau *et al.,* 2012; personal communication with Lyons, cited in Dewar *et al.,* 2013). There is no information indicating that the NEP white shark population is being adversely affected at the population level as a result of contaminant bioaccumulation, and the BRT concluded that the risks of contaminants to the population was low overall (Dewar *et al.,* 2013).

*Competition*

In the 2 months immediately following an observed killer whale predation event on a white shark at the Southeast Farallon Islands, sightings of white sharks in the area dropped significantly compared with the frequency of sightings in previous years (Pyle *et al.,* 1999). Although changes in prey abundance or environmental factors may have caused this decline in sightings, it is possible that it may have been the result of competitive displacement or predator avoidance (Pyle *et al.,* 1999). Competitive displacement of white sharks by killer whales is possible given the overlap in the two species' distribution and prey, but interactions between the two species are poorly understood (Compagno, 2001).

*Analysis of Other Natural or Manmade Factors*

Overall, the best available information regarding natural or manmade factors affecting the NEP white shark population do not indicate that these factors are contributing significantly to the risk of extinction for this population

**Additional Information Received**

Oceana, Center for Biological Diversity, and Shark Stewards sent an email to the Secretary on May 23, 2013, attaching four 2013 white shark publications to ensure that we were aware of them. The BRT reviewed the first three publications (Domeier and Nasby-Lucas (2013); Mull *et al.* (2013); and Weng and Honebrink (2013)) before finalizing its status review report, so they were already considered. We have reviewed the fourth publication (Semmens *et al.* (2013)), and while we find the estimate of metabolic needs for white sharks interesting, metabolic and feeding rate estimates are not relevant to the question of whether the NEP white shark DPS is at risk of extinction. We have determined that prey are at low risk of being depleted or unavailable to the NEP white shark DPS, given improving stocks of fishes and marine mammals, and there is no evidence that food availability is affecting the DPS, so specific energetic requirements are not particularly relevant to our determination.

**Listing Determination**

Based on our comprehensive status review including the BRT's findings (Dewar *et al.,* 2013), which we agree with, our analysis of the five factors under Section 4(a)(1) of the ESA, and our review of public comments on the 90-day finding, we reached the following conclusions: (1) The NEP white shark population meets the discreteness and significance criteria of the joint NMFS–FWS DPS policy, and therefore, is a DPS under the ESA; (2) there are no identifiable portions of the NEP white shark DPS that constitute a significant portion of its range, and therefore, we evaluated the status of the DPS as a whole; (3) the total abundance of the NEP white shark DPS is uncertain, but information and analysis presented by the BRT (Dewar *et al.,* 2013) indicates the population abundance is larger than the minimum estimates based on photo-ID studies at the central California and Guadalupe Island aggregation sites (Chapple *et al.,* 2011 and Sosa-Nishizaki *et al.,* 2012) and most likely includes at least 200 adult females; (4) the available information informing abundance trends suggests the NEP white shark DPS is most likely increasing or stable; (5) the main current and foreseeable future threat to the NEP white shark DPS is fishery-related mortality from U.S. and Mexican gillnet fisheries located in coastal waters of southern California and Baja California; (6) fisheries risk assessment modeling conducted by the BRT indicates the NEP white shark DPS is at a low to very low risk of extinction from U.S. and Mexican gillnet fisheries-related impacts and is likely to remain so in the foreseeable future; (6) the NEP white shark DPS is at a low to very low overall risk of extinction and is likely to remain so in the foreseeable future based on a consideration of the DPS' current biological status (i.e., current abundance includes at least 200 adult females and population is likely increasing in abundance or stable) and known threats, including fishery-related mortality; (7) identified threats related to habitat destruction or modification, disease and predation, or other natural and manmade factors are not considered significant and are not contributing to increasing the extinction risk of the DPS; and (8) existing regulatory mechanisms throughout the range of the NEP white shark DPS are adequately addressing threats to the population, although improvements are needed in Mexico to monitor and reduce fishery impacts.

Based on these findings, we conclude that the NEP white shark DPS is not currently in danger of extinction throughout all or a significant portion of its range nor is it likely to become so within the foreseeable future. Accordingly, the NEP white shark DPS does not meet the definition of a threatened or endangered species and our listing determination is that the NEP white shark DPS does not warrant listing as threatened or endangered at this time.

### References

A complete list of all references cited herein is available upon request (see **FOR FURTHER INFORMATION CONTACT**).

### Authority

The authority for this action is the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*).

Dated: June 28, 2013.

**Alan D. Risenhoover,**

*Director, Office of Sustainable Fisheries, performing the functions and duties of the Deputy Assistant Administrator for Regulatory Programs, National Marine Fisheries Service.*

[FR Doc. 2013–16039 Filed 7–2–13; 8:45 am]

**BILLING CODE 3510–22–P**

## DEPARTMENT OF COMMERCE

### United States Patent and Trademark Office

### Submission for OMB Review; Comment Request

The United States Patent and Trademark Office (USPTO) will submit to the Office of Management and Budget (OMB) for clearance the following proposal for collection of information under the provisions of the Paperwork Reduction Act (44 U.S.C. Chapter 35).

*Agency:* United States Patent and Trademark Office (USPTO).

*Title:* Legal Processes.

*Form Number(s):* None.

*Agency Approval Number:* 0651–0046.

*Type of Request:* Revision of a currently approved collection.

*Burden:* 88 hours annually.

*Number of Respondents:* 299 responses per year.

*Avg. Hours per Response:* The USPTO estimates that it will take the public approximately 5 minutes (0.08 hours) to 6 hours to gather the necessary information, prepare the appropriate documents, and submit the information in this collection to the USPTO.

*Needs and Uses:* This collection covers information requirements related to civil actions and claims involving current or former employees of the United States Patent and Trademark Office (USPTO). The rules for these legal processes may be found under 37 CFR Part 104, which outlines procedures for service of process, demands for employee testimony and production of documents in legal proceedings, reports of unauthorized testimony, employee indemnification, and filing claims against the USPTO under the Federal Tort Claims Act (28 U.S.C. 2672). The public uses this collection to serve a summons or complaint on the USPTO, demand employee testimony or documents related to a legal proceeding, or file a claim against the USPTO under the Federal Tort Claims Act. Respondents may petition the USPTO to waive or suspend the rules for legal processes in extraordinary situations. This collection is also necessary so that current and former USPTO employees may properly forward service and demands to the Office of General Counsel, report unauthorized testimony, and request indemnification. No forms are provided by the USPTO for submitting the information in this collection.

*Affected Public:* Individuals or households; businesses or other for-profits; not-for-profit institutions; and the Federal Government.

*Frequency:* On occasion.

*Respondent's Obligation:* Required to obtain or retain benefits.

*OMB Desk Officer:* Nicholas A. Fraser, email: *Nicholas_A._Fraser@omb.eop.gov*.

Once submitted, the request will be publicly available in electronic format through the Information Collection Review page at *www.reginfo.gov.*

Paper copies can be obtained by:

- *Email: InformationCollection@uspto.gov*. Include ''0651–0046 copy request'' in the subject line of the message.
- *Mail:* Susan K. Fawcett, Records Officer, Office of the Chief Information Officer, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313–1450.

Written comments and recommendations for the proposed information collection should be sent on or before August 2, 2013 to Nicholas A. Fraser, OMB Desk Officer, via email to *Nicholas_A._Fraser@omb.eop.gov,* or by fax to 202–395–5167, marked to the attention of Nicholas A. Fraser.

Dated: June 28, 2013.

**Susan K. Fawcett,**

*Records Officer, USPTO, Office of the Chief Information Officer.*

[FR Doc. 2013–15953 Filed 7–2–13; 8:45 am]

**BILLING CODE 3510–16–P**

## DEPARTMENT OF DEFENSE

### Department of the Army; Corps of Engineers

### Withdrawal Of Notice of Intent To Prepare a Draft Supplemental Environmental Impact Statement for the Federal Flood Control Project For Hunting Bayou, Harris County, TX

**AGENCY:** Department of the Army, U.S. Army Corps of Engineers, DoD.

**ACTION:** Notice of intent; Withdrawal.

**SUMMARY:** The U.S. Army Corps of Engineers (Corps), Galveston District, is issuing this notice to advise Federal, state, and local government agencies and the public that the Corps is withdrawing its Notice of Intent to prepare a Supplemental Environmental Impact Statement (SEIS) for the reformulation of a new flood damage reduction plan for the Hunting Bayou watershed in Houston, Harris County, TX.

**FOR FURTHER INFORMATION CONTACT:** Carolyn Murphy, Chief, Environmental Section at (409) 766–3044 or by mail at U.S. Army Corps of Engineers, P.O. Box 1229, Galveston, TX 77553–1229. Email address: *carolyn.e.murphy@usace.army.mil.*

**SUPPLEMENTARY INFORMATION:** The Corps of Engineers published a notice of intent to prepare a Supplemental Environmental Impact Statement in the August 30, 2002 issue of the **Federal Register** (67 FR 55824). Since that time, public and resource agency involvement through meetings, changes in plan formulation, and re-evaluation of the project have reduced the magnitude and extent of proposed flood damage reduction remedies and associated environmental impacts to the point that an SEIS is no longer necessary or required. Therefore the Corps has decided to document, evaluate, and further coordinate project impacts in an Environmental Assessment.

**Diana Laird,**

*Chief, Planning and Environmental Branch.*

[FR Doc. 2013–16030 Filed 7–2–13; 8:45 am]

**BILLING CODE 3710–58–P**