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50 CFR Parts 17, 223, and 224

Endangered and Threatened Species; Proposed Listing of Nine Distinct Population Segments of Loggerhead Sea Turtles as Endangered or Threatened; Proposed Rule

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Parts 223 and 224

[Docket No. 100104003–0004–01]

RIN 0648–AY49

Endangered and Threatened Species; Proposed Listing of Nine Distinct Population Segments of Loggerhead Sea Turtles as Endangered or Threatened

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce; United States Fish and Wildlife Service (USFWS), Interior.

ACTION: Proposed rules; 12-month petition findings; request for comments.

SUMMARY: We (NMFS and USFWS; also collectively referred to as the Services) have determined that the loggerhead sea turtle (*Caretta caretta*) is composed of nine distinct population segments (DPSs) that qualify as "species" for listing as endangered or threatened under the Endangered Species Act (ESA), and we propose to list two as threatened and seven as endangered. This also constitutes the 12-month findings on a petition to reclassify loggerhead turtles in the North Pacific Ocean as a DPS with endangered status and designate critical habitat, and a petition to reclassify loggerhead turtles in the Northwest Atlantic as a DPS with endangered status and designate critical habitat. We will propose to designate critical habitat, if found to be prudent and determinable, for the two loggerhead sea turtle DPSs occurring within the United States in a subsequent **Federal Register** notice.

DATES: Comments on this proposal must be received by June 14, 2010. Public hearing requests must be received by June 1, 2010.

ADDRESSES: You may submit comments, identified by the RIN 0648–AY49, by any of the following methods:

- *Electronic Submissions:* Submit all electronic public comments via the Federal eRulemaking Portal.
- *Mail:* NMFS National Sea Turtle Coordinator, Attn: Loggerhead Proposed Listing Rule, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Room 13657, Silver Spring, MD 20910 or USFWS National Sea Turtle Coordinator, U.S. Fish and Wildlife Service, 7915 Baymeadows Way, Suite 200, Jacksonville, FL 32256.
- *Fax:* To the attention of NMFS National Sea Turtle Coordinator at 301–713–0376 or USFWS National Sea Turtle Coordinator at 904–731–3045.

Instructions: All comments received are a part of the public record and will generally be posted to *http://www.regulations.gov* without change. All Personal Identifying Information (for example, name, address, *etc.*) voluntarily submitted by the commenter may be publicly accessible. Do not submit Confidential Business Information or otherwise sensitive or protected information.

NMFS and USFWS will accept anonymous comments (enter N/A in the required fields, if you wish to remain anonymous). Attachments to electronic comments will be accepted in Microsoft Word, Excel, WordPerfect, or Adobe PDF file formats only. The proposed rule is available electronically at *http://www.nmfs.noaa.gov/pr.*

FOR FURTHER INFORMATION CONTACT: Barbara Schroeder, NMFS (ph. 301–713–1401, fax 301–713–0376, e-mail *barbara.schroeder@noaa.gov*), Sandy MacPherson, USFWS (ph. 904–731–3336, e-mail *sandy_macpherson@fws.gov*), Marta Nammack, NMFS (ph. 301–713–1401, fax 301–713–0376, e-mail *marta_nammack@noaa.gov*), or Emily Bizwell, USFWS (ph. 404–679–7149, fax 404–679–7081, e-mail *emily_bizwell@fws.gov*). Persons who use a Telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 1–800–877–8339, 24 hours a day, 7 days a week.

SUPPLEMENTARY INFORMATION:

Public Comments Solicited

We solicit public comment on this proposed listing determination. We intend that any final action resulting from this proposal will be as accurate and as effective as possible and informed by the best available scientific and commercial information. Therefore, we request comments or information from the public, other concerned governmental agencies, the scientific community, industry, or any other interested party concerning this proposed rule. We are seeking information and comments on whether the nine proposed loggerhead sea turtle DPSs qualify as DPSs and, if so, whether they should be classified as threatened or endangered as described in the "Listing Determinations Under the ESA" section provided below. Specifically, we are soliciting information in the following areas relative to loggerhead turtles within the nine proposed DPSs: (1) Historical and current population status and trends, (2) historical and current distribution, (3) migratory movements and behavior, (4) genetic population structure, (5) current or planned activities that may adversely impact loggerhead turtles, and (6) ongoing efforts to protect loggerhead turtles. We are also soliciting information and comment on the status and effectiveness of conservation efforts and the approach that should be used to weigh the risk of extinction of each DPS. Comments and new information will be considered in making final determinations whether listing of each DPS is warranted and if so whether it is threatened or endangered. We request that all data, information, and comments be accompanied by supporting documentation such as maps, bibliographic references, or reprints of pertinent publications.

Background

We issued a final rule listing the loggerhead sea turtle as threatened throughout its worldwide range on July 28, 1978 (43 FR 32800). On July 12, 2007, we received a petition to list the "North Pacific populations of loggerhead sea turtle" as an endangered species under the ESA. NMFS published a notice in the **Federal Register** on November 16, 2007 (72 FR 64585), concluding that the petitioners (Center for Biological Diversity and Turtle Island Restoration Network) presented substantial scientific information indicating that the petitioned action may be warranted. Also, on November 15, 2007, we received a petition to list the "Western North Atlantic populations of loggerhead sea turtle" as an endangered species under the ESA. NMFS published a notice in the **Federal Register** on March 5, 2008 (73 FR 11849), concluding that the petitioners (Center for Biological Diversity and Oceana) presented substantial scientific information indicating that the petitioned action may be warranted.

On March 12, 2009, the petitioners (Center for Biological Diversity, Turtle Island Restoration Network, and Oceana) sent a 60-day notice of intent to sue to the Services for failure to make 12-month findings on the petitions. The statutory deadlines for the 12-month findings were July 16, 2008, for the North Pacific petition and November 16, 2008, for the Northwest Atlantic petition. On May 28, 2009, the petitioners filed a Complaint for

Declaratory and Injunctive Relief to compel the Services to complete the 12-month findings. On October 8, 2009, the petitioners and the Services reached a settlement in which the Services agreed to submit to the **Federal Register** a 12-month finding on the two petitions on or before February 19, 2010. On February 16, 2010, the United States District Court for the Northern District of California modified the February 19, 2010 deadline to March 8, 2010.

In early 2008, NMFS assembled a Loggerhead Biological Review Team (BRT) to complete a status review of the loggerhead sea turtle. The BRT was composed of biologists from NMFS, USFWS, the Florida Fish and Wildlife Conservation Commission, and the North Carolina Wildlife Resources Commission. The BRT was charged with reviewing and evaluating all relevant scientific information relating to loggerhead population structure globally to determine whether DPSs exist and, if so, to assess the status of each DPS. The findings of the BRT, which are detailed in the "Loggerhead Sea Turtle (*Caretta caretta*) 2009 Status Review under the U.S. Endangered Species Act" (Conant *et al.,* 2009; hereinafter referred to as the Status Review), addressed DPS delineations, extinction risks to the species, and threats to the species. The Status Review underwent independent peer review by nine scientists with expertise in loggerhead sea turtle biology, genetics, and modeling. The Status Review is available electronically at *http://www.nmfs.noaa.gov/pr/species/statusreviews.htm.*

This **Federal Register** document announces 12-month findings on the petitions to list the North Pacific populations and the Northwest Atlantic populations of the loggerhead sea turtle as DPSs with endangered status and includes a proposed rule to designate nine loggerhead DPSs worldwide.

Policies for Delineating Species Under the ESA

Section 3 of the ESA defines "species" as including "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." The term "distinct population segment" is not recognized in the scientific literature. Therefore, the Services adopted a joint policy for recognizing DPSs under the ESA (DPS Policy; 61 FR 4722) on February 7, 1996. Congress has instructed the Secretary of the Interior or of Commerce to exercise this authority with regard to DPSs "* * * sparingly and only when the biological evidence indicates such action is warranted." The DPS Policy requires the consideration of two elements when evaluating whether a vertebrate population segment qualifies as a DPS under the ESA: (1) The discreteness of the population segment in relation to the remainder of the species or subspecies to which it belongs; and (2) the significance of the population segment to the species or subspecies 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 (an organism or group of organisms) as a consequence of physical, 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 (*i.e.,* inadequate regulatory mechanisms).

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. This consideration may include, but is not limited to: (1) Persistence of the discrete population segment in an ecological setting unusual or unique for the taxon; (2) evidence that loss of the discrete population segment would result in a significant gap in the range of a taxon; (3) evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historic range; or (4) evidence that the discrete population segment differs markedly from other population segments of the species in its genetic characteristics.

Listing Determinations Under the ESA

The ESA defines an endangered species as one that is in danger of extinction throughout all or a significant portion of its range, and a threatened species as one that is likely to become endangered in the foreseeable future throughout all or a significant portion of its range (sections 3(6) and 3(20), respectively). The statute requires us to determine whether any species is endangered or threatened 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 (section 4(a)(1)(A–E)). We are to make this determination based solely on the best available scientific and commercial data available after conducting a review of the status of the species and taking into account any efforts being made by States or foreign governments to protect the species.

Biology and Life History of Loggerhead Turtles

A thorough account of loggerhead biology and life history may be found in the Status Review, which is incorporated here by reference. The following is a succinct summary of that information.

The loggerhead occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans (Dodd, 1988). However, the majority of loggerhead nesting is at the western rims of the Atlantic and Indian Oceans. The most recent reviews show that only two loggerhead nesting aggregations have greater than 10,000 females nesting per year: Peninsular Florida, United States, and Masirah Island, Oman (Baldwin *et al.,* 2003; Ehrhart *et al.,* 2003; Kamezaki *et al.,* 2003; Limpus and Limpus, 2003; Margaritoulis *et al.,* 2003). Nesting aggregations with 1,000 to 9,999 females nesting annually are Georgia through North Carolina (United States), Quintana Roo and Yucatan (Mexico), Brazil, Cape Verde Islands (Cape Verde), Western Australia (Australia), and Japan. Smaller nesting aggregations with 100 to 999 nesting females annually occur in the Northern Gulf of Mexico (United States), Dry Tortugas (United States), Cay Sal Bank (The Bahamas), Tongaland (South Africa), Mozambique, Arabian Sea Coast (Oman), Halaniyat Islands (Oman), Cyprus, Peloponnesus (Greece), Zakynthos (Greece), Crete (Greece), Turkey, and Queensland (Australia). In contrast to determining population size on nesting beaches, determining population size in the marine environment has been very localized. A summary of information on distribution and habitat by ocean basin follows.

Pacific Ocean

Loggerheads can be found throughout tropical to temperate waters in the Pacific; however, their breeding grounds include a restricted number of sites in the North Pacific and South Pacific. Within the North Pacific, loggerhead nesting has been documented only in Japan (Kamezaki *et al.,* 2003), although low level nesting may occur outside of Japan in areas surrounding the South China Sea (Chan *et al.,* 2007). In the South Pacific, nesting beaches are restricted to eastern Australia and New Caledonia and, to a much lesser extent, Vanuatu and Tokelau (Limpus and Limpus, 2003).

Based on tag-recapture studies, the East China Sea has been identified as the major habitat for post-nesting adult females (Iwamoto *et al.,* 1985; Kamezaki *et al.,* 1997; Balazs, 2006), while satellite tracking of juvenile loggerheads indicates the Kuroshio Extension Bifurcation Region to be an important pelagic foraging area for juvenile loggerheads (Polovina *et al.,* 2006). Other important juvenile turtle foraging areas have been identified off the coast of Baja California Sur, Mexico (Pitman, 1990; Peckham and Nichols, 2006).

Nesting females tagged on the coast of eastern Australia have been recorded foraging in New Caledonia; Queensland, New South Wales, and Northern Territory, Australia; Solomon Islands; Papua New Guinea; and Indonesia (Limpus and Limpus, 2003). Foraging Pacific loggerheads originating from nesting beaches in Australia are known to migrate to Chile and Peru (Alfaro-Shigueto *et al.,* 2004, 2008a; Donoso and Dutton, 2006; Boyle *et al.,* 2009).

Indian Ocean

In the North Indian Ocean, Oman hosts the vast majority of loggerhead nesting. The majority of the nesting in Oman occurs on Masirah Island, on the Al Halaniyat Islands, and on mainland beaches south of Masirah Island all the way to the Oman-Yemen border (IUCN—The World Conservation Union, 1989a, 1989b; Salm, 1991; Salm and Salm, 1991). In addition, nesting probably occurs on the mainland of Yemen on the Arabian Sea coast, and nesting has been confirmed on Socotra, an island off the coast of Yemen (Pilcher and Saad, 2000). Limited information exists on the foraging habitats of North Indian Ocean loggerheads; however, foraging individuals have been reported off the southern coastline of Oman (Salm *et al.,* 1993). Satellite telemetry studies of post-nesting migrations of loggerheads nesting on Masirah Island, Oman, have revealed extensive use of the waters off the Arabian Peninsula, with the majority of telemetered turtles traveling southwest, following the shoreline of southern Oman and Yemen, and circling well offshore in nearby oceanic waters (Environment Society of Oman and Ministry of Environment and Climate Change, Oman, unpublished data). A minority traveled north as far as the western Persian (Arabian) Gulf or followed the shoreline of southern Oman and Yemen as far west as the Gulf of Aden and the Bab-el-Mandab.

The only verified nesting beaches for loggerheads on the Indian subcontinent are found in Sri Lanka. A small number of nesting females use the beaches of Sri Lanka every year (Deraniyagala, 1939; Kar and Bhaskar, 1982; Dodd, 1988); however, there are no records indicating that Sri Lanka has ever been a major nesting area for loggerheads (Kapurusinghe, 2006). No confirmed nesting occurs on the mainland of India (Tripathy, 2005; Kapurusinghe, 2006). The Gulf of Mannar provides foraging habitat for juvenile and post-nesting adult turtles (Tripathy, 2005; Kapurusinghe, 2006).

In the East Indian Ocean, western Australia hosts all known loggerhead nesting (Dodd, 1988). Nesting distributions in western Australia span from the Shark Bay World Heritage Area northward through the Ningaloo Marine Park coast to the North West Cape and to the nearby Muiron Islands (Baldwin *et al.,* 2003). Nesting individuals from Dirk Hartog Island have been recorded foraging within Shark Bay and Exmouth Gulf, while other adults range much farther (Baldwin *et al.,* 2003).

In the Southwest Indian Ocean, loggerhead nesting occurs on the southeastern coast of Africa, from the Paradise Islands in Mozambique southward to St. Lucia in South Africa, and on the south and southwestern coasts of Madagascar (Baldwin *et al.,* 2003). Foraging habitats are only known for post-nesting females from Tongaland, South Africa; tagging data show these loggerheads migrating eastward to Madagascar, northward to Mozambique, Tanzania, and Kenya, and southward to Cape Agulhas at the southernmost point of Africa (Baldwin *et al.,* 2003; Luschi *et al.,* 2006).

Atlantic Ocean

In the Northwest Atlantic, the majority of loggerhead nesting is concentrated along the coasts of the United States from southern Virginia through Alabama. Additional nesting beaches are found along the northern and western Gulf of Mexico, eastern Yucatan Peninsula, at Cay Sal Bank in the eastern Bahamas (Addison and Morford, 1996; Addison, 1997), on the southwestern coast of Cuba (F. Moncada-Gavilan, personal communication, cited in Ehrhart *et al.,* 2003), and along the coasts of Central America, Colombia, Venezuela, and the eastern Caribbean Islands. In the Southwest Atlantic, loggerheads nest in significant numbers only in Brazil. In the eastern Atlantic, the largest nesting population of loggerheads is in the Cape Verde Islands (L.F. Lopez-Jurado, personal communication, cited in Ehrhart *et al.,* 2003), and some nesting occurs along the West African coast (Fretey, 2001).

As post-hatchlings, Northwest Atlantic loggerheads use the North Atlantic Gyre and enter Northeast Atlantic waters (Carr, 1987). They are also found in the Mediterranean Sea (Carreras *et al.,* 2006; Eckert *et al.,* 2008). In these areas, they overlap with animals originating from the Northeast Atlantic and the Mediterranean Sea (Laurent *et al.,* 1993, 1998; Bolten *et al.,* 1998; LaCasella *et al.,* 2005; Carreras *et al.,* 2006; Monzon-Arguello *et al.,* 2006; Revelles *et al.,* 2007; Eckert *et al.,* 2008). The oceanic juvenile stage in the North Atlantic has been primarily studied in the waters around the Azores and Madeira (Bolten, 2003). In Azorean waters, satellite telemetry data and flipper tag returns suggest a long period of residency (Bolten, 2003), whereas turtles appear to be moving through Madeiran waters (Dellinger and Freitas, 2000). Preliminary genetic analyses indicate that juvenile loggerheads found in Moroccan waters are of western Atlantic origin (M. Tiwari, NMFS, and A. Bolten, University of Florida, unpublished data). Other concentrations of oceanic juvenile turtles exist in the Atlantic (*e.g.,* in the region of the Grand Banks off Newfoundland). Genetic information indicates the Grand Banks are foraging grounds for a mixture of loggerheads from all the North Atlantic rookeries (LaCasella *et al.,* 2005; Bowen *et al.,* 2005), and a large size range is represented (Watson *et al.,* 2004, 2005).

After departing the oceanic zone, neritic juvenile loggerheads in the Northwest Atlantic inhabit continental shelf waters from Cape Cod Bay, Massachusetts, south through Florida, The Bahamas, Cuba, and the Gulf of Mexico (neritic refers to the inshore marine environment from the surface to the sea floor where water depths do not exceed 200 meters).

Habitat preferences of Northwest Atlantic non-nesting adult loggerheads in the neritic zone differ from the juvenile stage in that relatively enclosed, shallow water estuarine habitats with limited ocean access are less frequently used. Areas such as Pamlico Sound and the Indian River Lagoon in the United States, regularly used by juvenile loggerheads, are only rarely frequented by adults. In comparison, estuarine areas with more open ocean access, such as Chesapeake Bay in the U.S. mid-Atlantic, are also regularly used by juvenile loggerheads, as well as by adults primarily during warmer seasons. Shallow water habitats with large expanses of open ocean access, such as Florida Bay, provide year-round resident foraging areas for significant numbers of male and female adult loggerheads. Offshore, adults primarily inhabit continental shelf waters, from New York south through Florida, The Bahamas, Cuba, and the Gulf of Mexico. The southern edge of the Grand Bahama Bank is important habitat for loggerheads nesting on the Cay Sal Bank in The Bahamas, but nesting females are also resident in the bights of Eleuthera, Long Island, and Ragged Islands as well as Florida Bay in the United States, and the north coast of Cuba (A. Bolten and K. Bjorndal, University of Florida, unpublished data). Moncada *et al.* (in press) reported the recapture in Cuban waters of five adult female loggerheads originally flipper tagged in Quintana Roo, Mexico, indicating that Cuban shelf waters likely also provide foraging habitat for adult females that nest in Mexico.

In the Northeast Atlantic, satellite telemetry studies of post-nesting females from Cape Verde identified two distinct dispersal patterns; larger individuals migrated to benthic foraging areas off the northwest Africa coast and smaller individuals foraged primarily oceanically off the northwest Africa coast (Hawkes *et al.,* 2006). Monzon-Arguello *et al.* (2009) conducted a mixed stock analysis of juvenile loggerheads sampled from foraging areas in the Canary Islands, Madeira, Azores, and Andalusia and concluded that while juvenile loggerheads from the Cape Verde population were distributed among these four sites, a large proportion of Cape Verde juvenile turtles appear to inhabit as yet unidentified foraging areas.

In the South Atlantic, relatively little is known about the at-sea behavior of loggerheads originating from nesting beaches in Brazil. Recaptures of tagged juvenile turtles and nesting females have shown movement of animals up and down the coast of South America (Almeida *et al.,* 2000; Marcovaldi *et al.,* 2000; Laporta and Lopez, 2003; Almeida *et al.,* 2007). Juvenile loggerheads, presumably of Brazilian origin, have also been captured on the high seas of the South Atlantic (Kotas *et al.,* 2004; Pinedo and Polacheck, 2004) and off the coast of Atlantic Africa (Bal *et al.,* 2007; Petersen, 2005; Petersen *et al.,* 2007) suggesting that loggerheads of the South Atlantic may undertake transoceanic developmental migrations (Bolten *et al.,* 1998; Peckham *et al.,* 2007).

Mediterranean Sea

Loggerhead turtles are widely distributed in the Mediterranean Sea. However, nesting is almost entirely confined to the eastern Mediterranean basin, with the main nesting concentrations in Cyprus, Greece, and Turkey (Margaritoulis *et al.,* 2003). Preliminary surveys in Libya suggested nesting activity comparable to Greece and Turkey, although a better quantification is needed (Laurent *et al.,* 1999). Minimal to moderate nesting also occurs in other countries throughout the Mediterranean including Egypt, Israel, Italy (southern coasts and islands), Lebanon, Syria, and Tunisia (Margaritoulis *et al.,* 2003). Recently, isolated nesting events have been recorded in the western Mediterranean basin, namely in Spain, Corsica (France), and in the Tyrrhenian Sea (Italy) (Tomas *et al.,* 2002; Delaugerre and Cesarini, 2004; Bentivegna *et al.,* 2005).

Important neritic habitats have been suggested for the large continental shelves of: (1) Tunisia-Libya, (2) northern Adriatic Sea, (3) Egypt, and (4) Spain (Margaritoulis, 1988; Argano *et al.,* 1992; Laurent and Lescure, 1994; Lazar *et al.,* 2000; Gomez de Segura *et al.,* 2006; Broderick *et al.,* 2007; Casale *et al.,* 2007b; Nada and Casale, 2008). At least the first three constitute shallow benthic habitats for adults (including post-nesting females). Some other neritic foraging areas include Amvrakikos Bay in western Greece, Lakonikos Bay in southern Greece, and southern Turkey. Oceanic foraging areas for small juvenile loggerheads have been identified in the south Adriatic Sea (Casale *et al.,* 2005b), Ionian Sea (Deflorio *et al.,* 2005), Sicily Strait (Casale *et al.,* 2007b), and western Mediterranean (Spain) (*e.g.,* Camiñas *et al.,* 2006). In addition, tagged juvenile loggerheads have been recorded crossing the Mediterranean from the eastern to the western basin and vice versa, as well as in the Eastern Atlantic (Argano *et al.,* 1992; Casale *et al.,* 2007b).

Reproductive migrations have been confirmed by flipper tagging and satellite telemetry. Female loggerheads, after nesting in Greece, migrate primarily to the Gulf of Gabès and the northern Adriatic (Margaritoulis, 1988; Margaritoulis *et al.,* 2003; Lazar *et al.,* 2004; Zbinden *et al.,* 2008). Loggerheads nesting in Cyprus migrate to Egypt and Libya, exhibiting fidelity in following the same migration route during subsequent nesting seasons (Broderick *et al.,* 2007). In addition, directed movements of juvenile loggerheads have been confirmed through flipper tagging (Argano *et al.,* 1992; Casale *et al.,* 2007b) and satellite tracking (Rees and Margaritoulis, 2009).

Overview of Information Used To Identify DPSs

In the Status Review, the BRT considered a vast array of information to assess whether there are any loggerhead population segments that satisfy the DPS criteria of both discreteness and significance. First, the BRT examined whether there were any loggerhead population segments that were discrete. Data relevant to the discreteness question included physical, ecological, behavioral, and genetic data. Given the physical separation of ocean basins by continents, the BRT evaluated these data by ocean basin (Pacific Ocean, Indian Ocean, and Atlantic Ocean). This was not to preclude any larger or smaller DPS delineation, but to aid in data organization and assessment. The BRT then evaluated genetic information by ocean basin. The genetic data consisted of results from studies using maternally inherited mitochondrial DNA (mtDNA) and biparentally inherited nuclear DNA microsatellite markers. Next, tagging data (both flipper and PIT tags) and telemetry data were reviewed. Additional information, such as potential differences in morphology, was also evaluated. Finally, the BRT considered whether the available information on loggerhead population segments was bounded by any oceanographic features (*e.g.,* current systems) or geographic features (*e.g.,* land masses).

In accordance with the DPS policy, the BRT also reviewed whether the population segments identified in the discreteness analysis were significant. If a population segment is considered discrete, its biological and ecological significance must then be considered. NMFS and USFWS must consider available scientific evidence of the discrete segment's importance to the taxon to which it belongs. Data relevant to the significance question include morphological, ecological, behavioral, and genetic data, as described above. The BRT considered the following factors, listed in the DPS policy, in determining whether the discrete population segments were significant: (a) Persistence of the discrete segment in an ecological setting unusual or unique for the taxon; (b) evidence that loss of the discrete segment would result in a significant gap in the range of the taxon; (c) evidence that the discrete segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historical range; and (d) evidence that the discrete segment differs markedly from other populations of the species in its genetic characteristics.

A discrete population segment needs to satisfy only one of these criteria to be considered significant. The DPS policy also allows for consideration of other factors if they are appropriate to the biology or ecology of the species. As described below, the BRT evaluated the available information and considered items (a), (b) and (d), as noted above, to be most applicable to loggerheads.

Discreteness Determination

As described in the Status Review, the loggerhead sea turtle is present in all tropical and temperate ocean basins, and has a life history that involves nesting on coastal beaches and foraging in neritic and oceanic habitats, as well as long-distance migrations between and within these areas. As with other globally distributed marine species, today's global loggerhead population has been shaped by a sequence of isolation events created by tectonic and oceanographic shifts over geologic time scales, the result of which is population substructuring in many areas (Bowen *et al.,* 1994; Bowen, 2003). Globally, loggerhead turtles comprise a mosaic of populations, each with unique nesting sites and in many cases possessing disparate demographic features (*e.g.,* mean body size, age at first reproduction) (Dodd, 1988). However, despite these differences, loggerheads from different nesting populations often mix in common foraging areas during certain life stages (Bolten and Witherington, 2003), thus creating unique challenges when attempting to delineate distinct population segments for management or listing purposes.

Bowen *et al.* (1994) examined the mtDNA sequence diversity of loggerheads across their global distribution and found a separation of loggerheads in the Atlantic-Mediterranean basins from those in the Indo-Pacific basins since the Pleistocene period. The divergence between these two primary lineages corresponds to approximately three million years (2 percent per million years; Dutton *et al.,* 1996; Encalada *et al.,* 1996). Geography and climate appear to have shaped the evolution of these two matriarchal lineages with the onset of glacial cycles, the appearance of the Panama Isthmus creating a land barrier between the Atlantic and eastern Pacific, and upwelling of cold water off southern Africa creating an oceanographic barrier between the Atlantic and Indian Oceans (Bowen, 2003). Recent warm temperatures during interglacial periods allowed bi-directional invasion by the temperate-adapted loggerheads into the respective basins (Bowen *et al.,* 1994; J.S. Reece, Washington University, personal communication, 2008). Today, it appears that loggerheads within a basin are effectively isolated from populations in the other basin, but some dispersal from the Tongaland rookery in the Indian Ocean into feeding and developmental habitat in the South Atlantic is possible via the Agulhas Current (G.R. Hughes, unpublished data, cited in Bowen *et al.,* 1994). In the Pacific, extensive mtDNA studies show that the northern loggerhead populations are isolated from the southern Pacific populations, and that juvenile loggerheads from these distinct genetic populations do not disperse across the equator (Hatase *et al.,* 2002a; Dutton, 2007, unpublished data).

Mitochondrial DNA data indicate that regional turtle rookeries within an ocean basin have been strongly isolated from one another over ecological timescales (Bowen *et al.,* 1994; Bowen and Karl, 2007). These same data indicate strong female natal homing and suggest that each regional nesting population is an independent demographic unit (Bowen and Karl, 2007). It is difficult to determine the precise boundaries of these demographically independent populations in regions, such as the eastern U.S. coast, where rookeries are close to each other and range along large areas of a continental coastline. There appear to be varying levels of connectivity between proximate rookeries facilitated by imprecise natal homing and male mediated gene flow (Pearce, 2001; Bowen, 2003; Bowen *et al.,* 2005). Regional genetic populations often are characterized by allelic frequency differences rather than fixed genetic differences.

Through the evaluation of genetic data, tagging data, telemetry, and demography, the BRT determined that there are at least nine discrete population segments of loggerhead sea turtles globally. These discrete population segments are markedly separated from each other as a consequence of physical, ecological, behavioral, and oceanographic factors, and given the genetic evidence, the BRT concluded that each regional population identified is discrete from other populations of loggerheads. Information considered by the BRT in its delineation of discrete population segments is presented below by ocean basin.

Pacific Ocean

In the North Pacific Ocean, the primary loggerhead nesting areas are found along the southern Japanese coastline and Ryukyu Archipelago (Kamezaki *et al.,* 2003), although low level nesting may occur outside Japan in areas surrounding the South China Sea (Chan *et al.,* 2007). Loggerhead turtles hatching on Japanese beaches undertake extensive developmental migrations using the Kuroshio and North Pacific Currents (Balazs, 2006; Kobayashi *et al.,* 2008), and some turtles reach the vicinity of Baja California in the eastern Pacific (Uchida and Teruya, 1988; Bowen *et al.,* 1995; Peckham *et al.,* 2007). After spending years foraging in the central and eastern Pacific, loggerheads return to their natal beaches for reproduction (Resendiz *et al.,* 1998; Nichols *et al.,* 2000) and remain in the western Pacific for the remainder of their life cycle (Iwamoto *et al.,* 1985; Kamezaki *et al.,* 1997; Sakamoto *et al.,* 1997; Hatase *et al.,* 2002c).

Despite the long-distance developmental movements of loggerheads in the North Pacific, current scientific evidence, based on genetic analysis, flipper tag recoveries, and satellite telemetry, indicates that individuals originating from Japan remain in the North Pacific for their entire life cycle, never crossing the equator or mixing with individuals from the South Pacific (Hatase *et al.,* 2002a; LeRoux and Dutton, 2006; Dutton, 2007, unpublished data). This apparent, almost complete separation of two adjacent populations most likely results from: (1) The presence of two distinct Northern and Southern Gyre (current flow) systems in the Pacific (Briggs, 1974), (2) near-passive movements of post-hatchlings in these gyres that initially move them farther away from areas of potential mixing among the two populations along the equator, and (3) the nest-site fidelity of adult turtles that prevents turtles from returning to non-natal nesting areas.

Pacific loggerheads are further partitioned evolutionarily from other loggerheads throughout the world based on additional analyses of mtDNA. The haplotypes (a haplotype refers to the genetic signature, coded in mtDNA, of an individual) from both North and South Pacific loggerheads are distinguished by a minimum genetic distance (d) equal to 0.017 from other conspecifics, which indicates isolation of approximately one million years (Bowen, 2003).

Within the Pacific, Bowen *et al.* (1995) used mtDNA to identify two genetically distinct nesting populations in the Pacific—a northern hemisphere population nesting in Japan and a southern hemisphere population nesting primarily in Australia. This study also suggested that some loggerheads sampled as bycatch in the North Pacific might be from the Australian nesting population (Bowen *et al.,* 1995). However, more extensive mtDNA rookery data from Japan (Hatase *et al.,* 2002a) taken together with preliminary results from microsatellite (nuclear) analysis confirms that loggerheads inhabiting the North Pacific actually originate from nesting beaches in Japan (P. Dutton, NMFS, unpublished data). LeRoux *et al.* (2008) reported additional genetic variation in North Pacific loggerheads based on analyses using new mtDNA primers designed to target longer mtDNA sequences, and suggested finer scale population structure in North Pacific loggerheads may be present.

Although these studies indicate genetic distinctness between loggerheads nesting in Japan versus those nesting in Australia, Bowen *et al.* (1995) did identify individuals with the common Australian haplotype at foraging areas in the North Pacific, based on a few individuals sampled as bycatch in the North Pacific. More recently, Hatase *et al.* (2002a) detected this common haplotype at very low frequency at Japanese nesting beaches. However, the presence of the common Australian haplotype does not preclude the genetic distinctiveness of Japanese and Australian nesting populations, and is likely the result of rare gene flow events occurring over geologic time scales.

The discrete status of loggerheads in the North Pacific is further supported by results from flipper tagging in the North Pacific. Flipper tagging of loggerheads has been widespread throughout this region, occurring on adults nesting in Japan and bycaught in the coastal pound net fishery (Y. Matsuzawa, Sea Turtle Association of Japan, personal communication, 2006), juvenile turtles reared and released in Japan (Uchida and Teruya, 1988; Hatase *et al.,* 2002a), juvenile turtles foraging near Baja California, Mexico (Nichols, 2003; Seminoff *et al.,* 2004), and juvenile and adult loggerheads captured in and tagged from commercial fisheries platforms in the North Pacific high seas (NMFS, unpublished data). To date, there have been at least three transPacific tag recoveries showing east-west and west-east movements (Uchida and Teruya, 1988; Resendiz *et al.,* 1998; W.J. Nichols, Ocean Conservancy, and H. Peckham, Pro Peninsula, unpublished data) and several recoveries of adults in the western Pacific (Iwamoto *et al.,* 1985; Kamezaki *et al.,* 1997). However, despite the more than 30,000 marked individuals, not a single tag recovery has been reported outside the North Pacific.

A lack of movements by loggerheads south across the equator has also been supported by extensive satellite telemetry. As with flipper tagging, satellite telemetry has been conducted widely in the North Pacific, with satellite transmitters being placed on adult turtles departing nesting beaches (Sakamoto *et al.,* 1997; Japan Fisheries Resource Conservation Association, 1999; Hatase *et al.,* 2002b, 2002c), on adult and juvenile turtles bycaught in pound nets off the coast of Japan (Sea Turtle Association of Japan, unpublished data), on headstarted juvenile turtles released in Japan (Balazs, 2006), on juvenile and adult turtles bycaught in the eastern and central North Pacific (*e.g.,* Kobayashi *et al.,* 2008), and on juvenile turtles foraging in the eastern Pacific (Nichols, 2003; Peckham *et al.,* 2007; J. Seminoff, NMFS, unpublished data). Of the nearly 200 loggerheads tracked using satellite telemetry in the North Pacific, none have moved south of the equator. These studies have demonstrated the strong association loggerheads show with oceanographic mesoscale features such as the Transition Zone Chlorophyll Front or the Kuroshio Current Bifurcation Region (Polovina *et al.,* 2000, 2001, 2004, 2006; Etnoyer *et al.,* 2006; Kobayashi *et al.,* 2008). Kobayashi *et al.* (2008) demonstrated that loggerheads strongly track these zones even as they shift in location, suggesting that strong habitat specificity during the oceanic stage also contributes to the lack of mixing. Telemetry studies in foraging areas of the eastern Pacific, near Baja California, Mexico (Nichols, 2003; Peckham *et al.,* 2007; H. Peckham, Pro Peninsula, unpublished data) and Peru (J. Mangel, Pro Delphinus, unpublished data) similarly showed a complete lack of long distance north or south movements.

The North Pacific population of loggerheads appears to occupy an ecological setting distinct from other loggerheads, including those of the South Pacific population. This is the only known population of loggerheads to be found north of the equator in the Pacific Ocean, foraging in the eastern Pacific as far south as Baja California Sur, Mexico (Seminoff *et al.,* 2004; Peckham *et al.,* 2007) and in the western Pacific as far south as the Philippines (Limpus, 2009) and the mouth of Mekong River, Vietnam (Sadoyama *et al.,* 1996). Pelagic juvenile turtles spend much of their time foraging in the central and eastern North Pacific Ocean. The Kuroshio Extension Current, lying west of the international date line, serves as the dominant physical and biological habitat in the North Pacific and is highly productive, likely due to unique features such as eddies and meanders that concentrate prey and support food webs. Juvenile loggerheads originating from nesting beaches in Japan exhibit high site fidelity to an area referred to as the Kuroshio Extension Bifurcation Region, an area with extensive meanders and mesoscale eddies (Polovina *et al.,* 2006). Juvenile turtles also were found to correlate strongly with areas of surface chlorophyll a levels in an area known as the Transition Zone Chlorophyll Front, an area concentrating surface prey for loggerheads (Polovina *et al.,* 2001; Parker *et al.,* 2005; Kobayashi *et al.,* 2008). Another area found ecologically unique to the North Pacific population of loggerheads, likely because of the high density of pelagic red crabs (*Pleuronocodes planipes*), is located off the Pacific coast of the Baja California Peninsula, Mexico, where researchers have documented a foraging area for juvenile turtles based on aerial surveys and satellite telemetry (Seminoff *et al.,* 2006; Peckham *et al.,* 2007). Tag returns show post-nesting females migrating into the East China Sea off South Korea, China, and the Philippines, and the nearby coastal waters of Japan (Iwamoto *et al.,* 1985; Kamezaki *et al.,* 1997, 2003). Clearly, the North Pacific population of loggerheads is uniquely adapted to the ecological setting of the North Pacific Ocean and serves as an important part of the ecosystem it inhabits.

In summary, loggerheads inhabiting the North Pacific Ocean are derived primarily, if not entirely, from Japanese beaches (although low level nesting may occur outside Japan in areas surrounding the South China Sea), with the possible exception of rare waifs over evolutionary time scales. Further, nesting colonies of Japanese loggerheads are found to be genetically distinct based on mtDNA analyses, and when compared to much larger and more genetically diverse loggerhead populations in the Atlantic and Mediterranean, Pacific loggerheads have likely experienced critical bottlenecks (in Hatase *et al.,* 2002a), underscoring the importance of conservation and management to retain this genetically distinct population.

In the South Pacific Ocean, loggerhead turtles nest primarily in Queensland, Australia, and, to a lesser extent, New Caledonia and Vanuatu (Limpus and Limpus, 2003; Limpus *et al.,* 2006; Limpus, 2009). Loggerheads from these rookeries undertake an oceanic developmental migration, traveling to habitats in the central and southeastern Pacific Ocean where they may reside for several years prior to returning to the western Pacific for reproduction. Loggerheads in this early life history stage differ markedly from those originating from western Australia beaches in that they undertake long west-to-east migrations, likely using specific areas of the pelagic environment of the South Pacific Ocean. An unknown portion of these loggerheads forage off Chile and Peru, and preliminary genetic information from foraging areas in the southeastern Pacific confirms that the haplotype frequencies among juvenile turtles in these areas closely match those found at nesting beaches in eastern Australia (Alfaro-Shigueto *et al.,* 2004; Donoso and Dutton, 2006, 2007; Boyle *et al.,* 2009). Large juvenile and adult loggerheads generally remain in the western South Pacific, inhabiting neritic and oceanic foraging sites during non-nesting periods (Limpus *et al.,* 1994; Limpus, 2009).

Loggerheads from Australia and New Caledonia apparently do not travel north of the equator. Flipper tag recoveries from nesting females have been found throughout the western Pacific, including sites north of Australia, the Torres Straight, and the Gulf of Carpentaria (Limpus, 2009). Of approximately 1,000 (adult and juvenile; male and female) loggerheads that have been tagged in eastern Australian feeding areas, only two have been recorded nesting outside of Australia; both traveled to New Caledonia (Limpus, 2009). Flipper tagging programs in Peru and Chile tagged approximately 500 loggerheads from 1999 to 2006, none of which have been reported from outside of the southeastern Pacific (Alfaro-Shigueto *et al.,* 2008a; S. Kelez, Duke University Marine Laboratory, unpublished data; M. Donoso, ONG Pacifico Laud—Chile, unpublished data). Limited satellite telemetry data from 12 turtles in the area show a similar trend (J. Mangel, Pro Delphinus, unpublished data).

The spatial separation between the North Pacific and South Pacific loggerhead populations has contributed to substantial differences in the genetic profiles of the nesting populations in these two regions. Whereas the dominant mtDNA haplotypes among loggerheads nesting in Japan are CCP2 and CCP3 (equivalent to B and C respectively in Bowen *et al.,* 1995 and Hatase *et al.,* 2002a; LeRoux *et al.,* 2008; P. Dutton, NMFS, unpublished data), loggerheads nesting in eastern Australia have a third haplotype (CCP1, previously A) which is dominant (98 percent of nesting females) (Bowen *et al.,* 1994; FitzSimmons *et al.,* 1996; Boyle *et al.,* 2009). Further, preliminary genetic analysis using microsatellite markers (nuclear DNA) indicates genetic distinctiveness between nesting populations in the North versus South Pacific (P. Dutton, NMFS, personal communication, 2008).

The separateness between nesting populations in eastern Australia (in the South Pacific Ocean) and western Australia (in the East Indian Ocean) is less clear, although these too are considered to be genetically distinct from one another (Limpus, 2009). For example, mtDNA haplotype CCP1, which is the overwhelmingly dominant haplotype among eastern Australia nesting females (98 percent), is also found in western Australia, although at much lower frequency (33 percent) (FitzSimmons *et al.,* 1996, 2003). The remaining haplotype for both regions was the CCP5 haplotype. Further, FitzSimmons (University of Canberra, unpublished data) found significant differences in nuclear DNA microsatellite loci from females nesting in these two regions. Estimates of gene flow between eastern and western Australian populations was an order of magnitude less than gene flow within regions. These preliminary results based on nuclear DNA indicate that male-mediated gene flow between eastern and western Australia may be insignificant, which, when considered in light of the substantial disparity in mtDNA haplotype frequencies between these two regions, provides further evidence of population separation.

At present, there is no indication from genetic studies that the loggerhead turtles nesting in eastern Australia are distinct from those nesting in New Caledonia. Of 27 turtles sequenced from New Caledonia, 93 percent carried the CCP1 haplotype and the remaining had the CCP5 haplotype; similar to eastern Australia (Boyle *et al.,* 2009).

The South Pacific population of loggerheads occupies an ecological setting distinct from other loggerheads, including the North Pacific population; however, less is known about the ecosystem on which South Pacific oceanic juvenile and adult loggerheads depend. Sea surface temperature and chlorophyll frontal zones in the South Pacific have been shown to dramatically affect the movements of green turtles, *Chelonia mydas* (Seminoff *et al.,* 2008) and leatherback turtles, *Dermochelys coriacea* (Shillinger *et al.,* 2008), and it is likely that loggerhead distributions are also affected by these mesoscale oceanographic features.

Loggerheads in the South Pacific are substantially impacted by periodic environmental perturbations such as the El Niño Southern Oscillation (ENSO). This 3- to 6-year cycle within the coupled ocean-atmosphere system of the tropical Pacific brings increased surface water temperatures and lower primary productivity, both of which have profound biological consequences (Chavez *et al.,* 1999). Loggerheads are presumably adversely impacted by the reduced food availability that often results from ENSO events, although data on this subject are lacking. Although ENSO may last for only short periods and thus not have a long-term effect on loggerheads in the region, recent studies by Chaloupka *et al.* (2008) suggested that long-term increases in sea surface temperature within the South Pacific may influence the ability of the Australian nesting population to recover from historic population declines.

Loggerheads originating from nesting beaches in the western South Pacific are the only population of loggerheads to be found south of the equator in the Pacific Ocean. As post-hatchlings, they are generally swept south by the East Australian Current (Limpus *et al.,* 1994), spend a large portion of time foraging in the oceanic South Pacific Ocean, and some migrate to the southeastern Pacific Ocean off the coasts of Peru and Chile as juvenile turtles (Alfaro-Shigueto *et al.,* 2004; Donoso *et al.,* 2000; Boyle *et al.,* 2009). As large juveniles and adults, these loggerheads' foraging range encompasses the eastern Arafura Sea, Gulf of Carpentaria, Torres Strait, Gulf of Papua, Coral Sea, and western Tasman Sea to southern New South Wales including the Great Barrier Reef, Hervey Bay, and Moreton Bay. The outer extent of this range includes the coastal waters off eastern Indonesia northeastern Papua New Guinea, northeastern Solomon Islands, and New Caledonia (in Limpus, 2009).

In summary, all loggerheads inhabiting the South Pacific Ocean are derived from beaches in eastern Australia and a lesser known number of beaches in southern New Caledonia, Vanuatu, and Tokelau (Limpus and Limpus, 2003; Limpus, 2009). Furthermore, nesting colonies of the South Pacific population of loggerheads are found to be genetically distinct from loggerheads in the North Pacific and Indian Ocean.

Given the information presented above, the BRT concluded, and we concur, that two discrete population segments exist in the Pacific Ocean: (1) North Pacific Ocean and (2) South Pacific Ocean. These two population segments are markedly separated from each other and from population segments within the Indian Ocean and Atlantic Ocean basins as a consequence of physical, ecological, behavioral, and oceanographic factors. Information supporting this conclusion includes genetic analysis, flipper tag recoveries, and satellite telemetry, which indicate that individuals originating from Japan remain in the North Pacific for their entire life cycle, never crossing the equator or mixing with individuals from the South Pacific (Hatase *et al.,* 2002a; LeRoux and Dutton, 2006; Dutton, 2007, unpublished data). This apparent, almost complete separation most likely results from: (1) The presence of two distinct Northern and Southern Gyre (current flow) systems in the Pacific (Briggs, 1974), (2) near-passive movements of post-hatchlings in these gyres that initially move them farther away from areas of potential mixing along the equator, and (3) the nest-site fidelity of adult turtles that prevents turtles from returning to non-natal nesting areas. The separation of the Pacific Ocean population segments from population segments within the Indian Ocean and Atlantic Ocean basins is believed to be the result of land barriers and oceanographic barriers. Based on mtDNA analysis, Bowen *et al.* (1994) found a separation of loggerheads in the Atlantic-Mediterranean basins from those in the Indo-Pacific basins since the Pleistocene period. Geography and climate appear to have shaped the evolution of these two matriarchal lineages with the onset of glacial cycles, the appearance of the Panama Isthmus creating a land barrier between the Atlantic and eastern Pacific, and upwelling of cold water off southern Africa creating an oceanographic barrier between the Atlantic and Indian Oceans (Bowen, 2003).

Indian Ocean

Similar to loggerheads in the Pacific and Atlantic, loggerheads in the Indian Ocean nest on coastal beaches, forage in neritic and oceanic habitats, and undertake long-distance migrations between and within these areas. The distribution of loggerheads in the Indian Ocean is limited by the Asian landmass to the north (approximately 30° N latitude); distributions east and west are not restricted by landmasses south of approximately 38° S latitude.

Historical accounts of loggerhead turtles in the Indian Ocean are found in Smith (1849), who described the species in South Africa, and Deraniyagala (1933, 1939) who described Indian Ocean loggerheads within the subspecies *C. c. gigas.* Hughes (1974) argued that there was little justification for this separation.

In the North Indian Ocean, Oman hosts the vast majority of loggerhead nesting. The largest nesting assemblage is at Masirah Island, Oman, in the northern tropics at 21° N latitude (Baldwin *et al.,* 2003). Other key nesting assemblages occur on the Al Halaniyat Islands, Oman (17° S latitude) and on Oman's Arabian Sea mainland beaches south of Masirah Island to the Oman-Yemen border (17–20° S latitude) (IUCN—The World Conservation Union, 1989a, 1989b; Salm, 1991; Salm and Salm, 1991; Baldwin *et al.,* 2003). In addition, nesting probably occurs on the mainland of Yemen on the Arabian Sea coast, and nesting has been confirmed on Socotra, an island off the coast of Yemen (Pilcher and Saad, 2000).

Outside of Oman, loggerhead nesting is rare in the North Indian Ocean. The only verified nesting beaches for loggerheads on the Indian subcontinent are found in Sri Lanka (Deraniyagala, 1939; Kar and Bhaskar, 1982; Dodd, 1988; Kapurusinghe, 2006). Reports of regular loggerhead nesting on the Indian mainland are likely misidentifications of olive ridleys (*Lepidochelys olivacea*) (Tripathy, 2005; Kapurusinghe, 2006). Although loggerheads have been reported nesting in low numbers in Myanmar, these data may not be reliable because of misidentification of species (Thorbjarnarson *et al.,* 2000).

Limited information exists on foraging locations of North Indian Ocean loggerheads. Foraging individuals have been reported off the southern coastline of Oman (Salm *et al.,* 1993) and in the Gulf of Mannar, between Sri Lanka and India (Tripathy, 2005; Kapurusinghe, 2006). Satellite telemetry studies of post-nesting migrations of loggerheads nesting on Masirah Island, Oman, have revealed extensive use of the waters off the Arabian Peninsula, with the majority of telemetered turtles (15 of 20) traveling southwest, following the shoreline of southern Oman and Yemen, and circling well offshore in nearby oceanic waters (Environment Society of Oman and Ministry of Environment and Climate Change, Oman, unpublished data). A minority traveled north as far as the western Persian (Arabian) Gulf (3 of 20) or followed the shoreline of southern Oman and Yemen as far west as the Gulf of Aden and the Bab-el-Mandab (2 of 20). These preliminary data suggest that post-nesting migrations and adult female foraging areas may be centered within the region (Environment Society of Oman and Ministry of Environment and Climate Change, Oman, unpublished data). No tag returns or satellite tracks indicated that loggerheads nesting in Oman traveled south of the equator.

In the East Indian Ocean, western Australia hosts all known loggerhead nesting (Dodd, 1988). Nesting distributions in western Australia span from the Shark Bay World Heritage Area northward through the Ningaloo Marine Park coast to the North West Cape and to the nearby Muiron Islands (Baldwin *et al.,* 2003). Nesting individuals from Dirk Hartog Island have been recorded foraging within Shark Bay and Exmouth Gulf, while other adults range into the Gulf of Carpentaria (Baldwin *et al.,* 2003). At the eastern extent of this apparent range, there is possible overlap with loggerheads that nest on Australia's Pacific coast (Limpus, 2009). However, despite extensive tagging at principal nesting beaches on Australia's Indian Ocean and Pacific coasts, no exchange of females between nesting beaches has been observed (Limpus, 2009).

Loggerhead nesting in the Southwest Indian Ocean includes the southeastern coast of Africa from the Paradise Islands in Mozambique southward to St. Lucia in South Africa, and on the south and southwestern coasts of Madagascar (Baldwin *et al.,* 2003). Foraging habitats are only known for the Tongaland, South Africa, adult female loggerheads. Returns of flipper tags describe a range that extends eastward to Madagascar, northward to Mozambique, Tanzania, and Kenya, and southward to Cape Agulhas at the southernmost point of Africa (Baldwin *et al.,* 2003). Four post-nesting loggerheads satellite tracked by Luschi *et al.* (2006) migrated northward, hugging the Mozambique coast and remained in shallow shelf waters off Mozambique for more than 2 months. Only one post-nesting female from the Southwest Indian Ocean population (South Africa) has been documented migrating north of the equator (to southern Somalia) (Hughes and Bartholomew, 1996).

The available genetic information relates to connectivity and broad evolutionary relationships between ocean basins. There is a lack of genetic information on population structure among rookeries within the Indian Ocean. Bowen *et al.* (1994) described mtDNA sequence diversity among eight loggerhead nesting assemblages and found one of two principal branches in the Indo-Pacific basins. Using additional published and unpublished data, Bowen (2003) estimated divergence between these two lineages to be approximately three million years. Bowen pointed out evidence for more recent colonizations (12,000–250,000 years ago) between the Indian Ocean and the Atlantic-

Mediterranean. For example, the sole mtDNA haplotype (among eight samples) identified by Bowen *et al.* (1994) at Masirah Island, Oman, is known from the Atlantic and suggests some exchange between oceans some 250,000 years ago. The other principal Indian Ocean haplotype reported by Bowen *et al.* (1994) was seen in all loggerheads sampled (n=15) from Natal, South Africa. Encalada *et al.* (1998) reported that this haplotype was common throughout the North Atlantic and Mediterranean, thus suggesting a similar exchange between the Atlantic and Indian Oceans as recently as 12,000 years ago (Bowen *et al.,* 1994). Bowen (2003) speculated that Indian-Atlantic Ocean exchanges took place via the temperate waters south of South Africa and became rare as the ocean shifted to cold temperate conditions in this region.

To estimate loggerhead gene flow in and out of the Indian Ocean, J.S. Reece (Washington University, personal communication, 2008) examined 100 samples from Masirah Island, 249 from Atlantic rookeries (from Encalada *et al.,* 1998), and 311 from Pacific rookeries (from Hatase *et al.,* 2002a and Bowen *et al.,* 1995). Reece estimated that gene flow, expressed as number of effective migrants, or exchanges of breeding females between Indian Ocean rookeries and those from the Atlantic or Pacific occurred at the rate of less than 0.1 migrant per generation. Reece estimated gene flow based on coalescence of combined mtDNA and nuclear DNA data to be approximately 0.5 migrants per generation. These unpublished results, while somewhat theoretical, may indicate that there is restricted gene flow into and out of the Indian Ocean. The low level of gene flow most likely reflects the historical connectivity over geological timescales rather than any contemporary migration, and is consistent with Bowen's hypothesis that exchange occurred most recently over 12,000–3,000,000 years ago, and has been restricted over recent ecological timescales.

The discrete status of three loggerhead populations in the Indian Ocean is primarily supported by observations of tag returns and satellite telemetry. The genetic information currently available based on mtDNA sequences does not allow for a comprehensive analysis of genetic population structure analysis for Indian Ocean rookeries, although Bowen *et al.* (1994) indicated the Oman and South African rookeries are genetically distinct, and once sequencing studies are completed for these rookeries, it is likely that they will also be genetically distinct from the rookeries in western Australia. Based on multiple lines of evidence, discrete status is supported for the North Indian Ocean, Southeast Indo-Pacific Ocean, and Southwest Indian Ocean loggerhead populations. Although there is not a sufficiently clear picture of gene flow between these regions, significant vicariant barriers likely exist between these three Indian Ocean populations that would prevent migration of individuals on a time scale relative to management and conservation efforts. These vicariant barriers are the oceanographic phenomena associated with Indian Ocean equatorial waters, and the large expanse between continents in the South Indian Ocean without suitable benthic foraging habitat.

Given the information presented above, the BRT concluded, and we concur, that three discrete population segments exist in the Indian Ocean: (1) North Indian Ocean, (2) Southeast Indo-Pacific Ocean, and (3) Southwest Indian Ocean. These three population segments are markedly separated from each other and from population segments within the Pacific Ocean and Atlantic Ocean basins as a consequence of physical, ecological, behavioral, and oceanographic factors. Information supporting this conclusion is primarily based on observations of tag returns and satellite telemetry. The genetic information currently available based on mtDNA sequences does not allow for a comprehensive analysis of genetic population structure for Indian Ocean rookeries; however, the Oman and South African rookeries are genetically distinct, and once sequencing studies are completed for these rookeries, it is likely that they will also be determined genetically distinct from the rookeries in western Australia (Bowen *et al.* 1994). Furthermore, significant vicariant barriers (*i.e.,* oceanographic phenomena associated with Indian Ocean equatorial waters, and the large expanse between continents in the South Indian Ocean without suitable benthic foraging habitat) likely exist between these three Indian Ocean populations that would prevent migration of individuals on a time scale relative to management and conservation efforts. The separation of the Indian Ocean population segments from population segments within the Pacific Ocean and Atlantic Ocean basins is believed to be the result of land barriers and oceanographic barriers. Based on mtDNA analysis, Bowen *et al.* (1994) found a separation of loggerheads in the Atlantic-Mediterranean basins from those in the Indo-Pacific basins since the Pleistocene period. Geography and climate appear to have shaped the evolution of these two matriarchal lineages with the onset of glacial cycles, the appearance of the Panama Isthmus creating a land barrier between the Atlantic and eastern Pacific, and upwelling of cold water off southern Africa creating an oceanographic barrier between the Atlantic and Indian Oceans (Bowen, 2003). In the East Indian Ocean, although there is possible overlap with loggerheads that nest on Australia's Indian Ocean and Pacific Ocean coasts, extensive tagging at the principal nesting beaches on both coasts has revealed no exchange of females between these nesting beaches (Limpus, 2009).

Atlantic Ocean and Mediterranean Sea

Within the Atlantic Ocean, loss and re-colonization of nesting beaches over evolutionary time scales has been influenced by climate, natal homing, and rare dispersal events (Encalada *et al.,* 1998; Bowen and Karl, 2007). At times, temperate beaches were too cool to incubate eggs and nesting could have succeeded only on tropical beaches. Thus, the contemporary distribution of nesting is the product of colonization events from the tropical refugia during the last 12,000 years. Apparently, turtles from the Northwest Atlantic colonized the Mediterranean and at least two matrilines were involved (Schroth *et al.,* 1996); these rookeries became isolated from the Atlantic populations in the last 10,000 years (Encalada *et al.,* 1998). A similar colonization event appears to have populated the Northeast Atlantic (C. Monzon-Arguello, Instituto Canario de Ciencias Marinas—Spain, personal communication, 2008).

Nesting in the western South Atlantic occurs primarily along the mainland coast of Brazil from Sergipe south to Rio de Janeiro, with peak concentrations in northern Bahia, Espírito Santo, and northern Rio de Janeiro (Marcovaldi and Chaloupka, 2007). In the eastern South Atlantic, diffuse nesting may occur along the mainland coast of Africa (Fretey, 2001), with more than 200 loggerhead nests reported for Rio Longa beach in central Angola in 2005 (Brian, 2007). However, other researchers have been unable to confirm nesting by loggerheads in the last decade anywhere along the south Atlantic coast of Africa, including Angola (Fretey, 2001; Weir *et al.,* 2007). There is the possibility that reports of nesting loggerheads from Angola and Namibia (Márquez M., 1990; Brian, 2007) may have arisen from misidentified olive ridley turtles (Brongersma, 1982; Fretey, 2001). At the current time, it is not possible to confirm that regular, if any, nesting of loggerheads occurs along the Atlantic coast of Africa, south of the equator.

Genetic surveys of loggerheads have revealed that the Brazilian rookeries have a unique mtDNA haplotype (Encalada *et al.,* 1998; Pearce, 2001). The Brazilian mtDNA haplotype, relative to North Atlantic haplotypes, indicates isolation of South Atlantic loggerheads from North Atlantic loggerheads on a scale of 250,000–500,000 years ago, and microsatellite DNA results show divergence on the same time scale (Bowen, 2003). Brazil's unique haplotype has been found only in low numbers in foraging populations of juvenile loggerheads of the North Atlantic (Bass *et al.,* 2004). Other lines of evidence support a deep division between loggerheads from the South Atlantic and from the North Atlantic, including: (1) A nesting season in Brazil that peaks in the austral summer around December-January (Marcovaldi and Laurent, 1996), as opposed to the April–September nesting season in the southeastern United States in the northern hemisphere (Witherington *et al.,* 2009); and (2) no observations of tagged loggerheads moving across the equator in the Atlantic, except a single case of a captive-reared animal that was released as a juvenile from Espírito Santo and was recaptured 3 years later in the Azores (Bolten *et al.,* 1990). Post-nesting females from Espírito Santo, Brazil, moved either north or south along the coast, but remained between 10° S latitude and 30° S latitude (Projeto TAMAR, unpublished data).

Relatively little is known about the at-sea behavior of loggerheads originating from nesting beaches in Brazil. Recaptures of tagged juvenile turtles and nesting females have shown movement of animals up and down the coast of South America (Almeida *et al.,* 2000; Marcovaldi *et al.,* 2000; Laporta and Lopez, 2003; Almeida *et al.,* 2007). Juvenile loggerheads, presumably of Brazilian origin, have also been captured on the high seas of the South Atlantic (Kotas *et al.,* 2004; Pinedo and Polacheck, 2004) and off the coast of Atlantic Africa (Petersen, 2005; Petersen *et al.,* 2007; Weir *et al.,* 2007) suggesting that, like their North Pacific and Northwest Atlantic counterparts, loggerheads of the South Atlantic may undertake transoceanic developmental migrations (Bolten *et al.,* 1998; Peckham *et al.,* 2007).

The mean size of reproductive female loggerheads in Brazil is 92.9 cm straight carapace length (SCL), which is comparable to the size of nesting females in the Northwest Atlantic, but larger than nesting females in the Northeast Atlantic and Mediterranean (Tiwari and Bjorndal, 2000; Margaritoulis *et al.,* 2003; Varo Cruz *et al.,* 2007). Egg size and mass of Brazilian loggerheads are smaller than those from the Northwest Atlantic, but larger than those of the Mediterranean (Tiwari and Bjorndal, 2000).

Within the Northwest Atlantic, the majority of nesting activity occurs from April through September, with a peak in June and July (Williams-Walls *et al.,* 1983; Dodd, 1988; Weishampel *et al.,* 2006). Nesting occurs within the Northwest Atlantic along the coasts of North America, Central America, northern South America, the Antilles, and The Bahamas, but is concentrated in the southeastern United States and on the Yucatan Peninsula in Mexico (Sternberg, 1981; Ehrhart, 1989; Ehrhart *et al.,* 2003; NMFS and USFWS, 2008). Many nesting beaches within the Northwest Atlantic have yet to be sampled for genetic analysis. Five recovery units (subpopulations) have been identified based on genetic differences and a combination of geographic distribution of nesting densities and geographic separation. These recovery units are: Northern Recovery Unit (Florida/Georgia border through southern Virginia), Peninsular Florida Recovery Unit (Florida/Georgia border through Pinellas County, Florida), Northern Gulf of Mexico Recovery Unit (Franklin County, Florida, through Texas), Greater Caribbean Recovery Unit (Mexico through French Guiana, The Bahamas, Lesser Antilles, and Greater Antilles), and Dry Tortugas Recovery Unit (islands located west of Key West, Florida) (NMFS and USFWS, 2008). There is limited exchange of nesting females among these recovery units (Encalada *et al.,* 1998; Foote *et al.,* 2000; J. Richardson personal communication cited in NMFS, 2001; Hawkes *et al.,* 2005). Based on the number of haplotypes, the highest level of loggerhead mtDNA genetic diversity in the Atlantic has been observed in females of the Greater Caribbean Recovery Unit that nest at Quintana Roo, Mexico (Encalada *et al.,* 1999; Nielsen *et al.,* in press). However, genetic diversity should be evaluated further using haplotype and nucleotide diversity calculated similarly for each recovery unit. Genetic data are not available for all the nesting assemblages in the region, including a key nesting assemblage in Cuba. New genetic markers have recently been developed, including primers that produce additional mtDNA sequence data (Abreu-Grobois *et al.,* 2006; LeRoux *et al.,* 2008), and an array of microsatellite markers (Shamblin *et al.,* 2008) that will enable finer resolution of population boundaries.

Loggerheads in the Northwest Atlantic display complex population structure based on life history stages. Based on mtDNA, oceanic juveniles show no structure, neritic juveniles show moderate structure, and nesting colonies show strong structure (Bowen *et al.,* 2005). In contrast, a survey using microsatellite (nuclear DNA) markers showed no significant population structure among nesting populations (Bowen *et al.,* 2005), indicating that while females exhibit strong philopatry, males may provide an avenue of gene flow between nesting colonies in this region. However, the power to detect structure with the nuclear markers used in this study may have been limited due to the few markers used and small sample sizes. Nevertheless, Bowen *et al.* (2005) argued that male-mediated gene flow within the Northwest Atlantic does not detract from the classification of breeding areas as independent populations (*e.g.,* recovery units) because the production of progeny depends on female nesting success. All Northwest Atlantic recovery units are reproductively isolated from populations within the Northeast Atlantic, South Atlantic, and Mediterranean Sea.

As oceanic juveniles, loggerheads from the Northwest Atlantic use the North Atlantic Gyre and often are associated with *Sargassum* communities (Carr, 1987). They also are found in the Mediterranean Sea. In these areas, they overlap with animals originating from the Northeast Atlantic and the Mediterranean Sea (Laurent *et al.,* 1993, 1998; Bolten *et al.,* 1998; Bowen *et al.,* 2005; LaCasella *et al.,* 2005; Carreras *et al.,* 2006; Monzon-Arguello *et al.,* 2006; Revelles *et al.,* 2007). In the western Mediterranean, they tend to be associated with the waters off the northern African coast and the northeastern Balearic Archipelago, areas generally not inhabited by turtles of Mediterranean origin (Carreras *et al.,* 2006; Revelles *et al.,* 2007; Eckert *et al.,* 2008). As larger neritic juveniles, they show more structure and tend to inhabit areas closer to their natal origins (Bowen *et al.,* 2004), but some do move to and from oceanic foraging grounds throughout this life stage (Mansfield, 2006; McClellan and Read, 2007), and some continue to use the Mediterranean Sea (Casale *et al.,* 2008a; Eckert *et al.,* 2008). Adult populations are highly structured with no overlap in distribution among adult loggerheads from the Northwest Atlantic, Northeast Atlantic, South Atlantic, and

Mediterranean. Carapace epibionts suggest the adult females of different subpopulations use different foraging habitats (Caine, 1986). In the Northwest Atlantic, based on satellite telemetry studies and flipper tag returns, non-nesting adult females from the Northern Recovery Unit reside primarily off the east coast of the United States; movement into the Bahamas or the Gulf of Mexico is rare (Bell and Richardson, 1978; Williams and Frick, 2001; Mansfield, 2006; Turtle Expert Working Group, 2009). Adult females of the Peninsular Florida Recovery Unit are distributed throughout eastern Florida, The Bahamas, Greater Antilles, the Yucatan Peninsula of Mexico, and the Gulf of Mexico, as well as along the Atlantic seaboard of the United States (Meylan, 1982; Meylan *et al.,* 1983; Foley *et al.,* 2008; Turtle Expert Working Group, 2009). Adult females from the Northern Gulf of Mexico Recovery Unit remained in the Gulf of Mexico, including off the Yucatan Peninsula of Mexico, based on satellite telemetry and flipper tag returns (Foley *et al.,* 2008; Turtle Expert Working Group, 2009; M. Lamont, Florida Cooperative Fish and Wildlife Research Unit, personal communication, 2009; M. Nicholas, National Park Service, personal communication, 2009).

Nesting in the Northeast Atlantic is concentrated in the Cape Verde Archipelago, with some nesting occurring on most of the islands, and the highest concentration on the beaches of Boa Vista Island (Lopez-Jurado *et al.,* 2000; Varo Cruz *et al.,* 2007; Loureiro, 2008). On mainland Africa, there is minor nesting on the coasts of Mauritania to Senegal (Brongersma, 1982; Arvy *et al.,* 2000; Fretey, 2001). Earlier reports of loggerhead nesting in Morocco (Pasteur and Bons, 1960) have not been confirmed in recent years (Tiwari *et al.,* 2001). Nesting has not been reported from Macaronesia (Azores, Madeira Archipelago, The Selvagens Islands, and the Canary Islands), other than in the Cape Verde Archipelago (Brongersma, 1982). In Cape Verde, nesting begins in mid June and extends into October (Cejudo *et al.,* 2000), which is somewhat later than when nesting occurs in the Northwest Atlantic.

Based on an analysis of mtDNA of 196 nesting females from Boa Vista Island, the Cape Verde nesting assemblage is genetically distinct from other studied rookeries (C. Monzon-Arguello, Instituto Canario de Ciencias Marinas—Spain, personal communication, 2008; Monzon-Arguello *et al.,* 2009). The results also indicate that despite the close proximity of the Mediterranean, the Boa Vista rookery is most closely related to the rookeries of the Northwest Atlantic.

The distribution of juvenile loggerheads from the Northeast Atlantic is largely unknown but they have been found on the oceanic foraging grounds of the North Atlantic (A. Bolten, University of Florida, personal communication, 2008, based on Bolten *et al.,* 1998 and LaCasella *et al.,* 2005; Monzon-Arguello *et al.,* 2009; M. Tiwari, NMFS, and A. Bolten, University of Florida, unpublished data) and in the western and central Mediterranean (A. Bolten, University of Florida, personal communication, 2008, based on Carreras *et al.,* 2006), along with small juvenile loggerheads from the Northwest Atlantic. The size of nesting females in the Northeast Atlantic is comparable to those in the Mediterranean (average 72–80 cm SCL; Margaritoulis *et al.,* 2003) and smaller than those in the Northwest Atlantic or the South Atlantic; 91 percent of the nesting turtles are less than 86.5 cm curved carapace length (CCL) (Hawkes *et al.,* 2006) and nesting females average 77.1 cm SCL (Cejudo *et al.,* 2000). Satellite-tagged, post-nesting females from Cape Verde foraged in coastal waters along northwest Africa or foraged oceanically, mostly between Cape Verde and the African shelf from Mauritania to Guinea Bissau (Hawkes *et al.,* 2006).

In the Mediterranean, nesting occurs throughout the central and eastern basins on the shores of Italy, Greece, Cyprus, Turkey, Syria, Lebanon, Israel, the Sinai, Egypt, Libya, and Tunisia (Sternberg, 1981; Margaritoulis *et al.,* 2003; SWOT, 2007). Sporadic nesting also has been reported in the western Mediterranean on Corsica (Delaugerre and Cesarini, 2004), southwestern Italy (Bentivegna *et al.,* 2005), and on the Spanish Mediterranean coast (Tomas *et al.,* 2003, 2008). Nesting in the Mediterranean is concentrated between June and early August (Margaritoulis *et al.,* 2003).

Within the Mediterranean, a recent study of mitochondrial and nuclear DNA in nesting assemblages from Greece to Israel indicated genetic structuring, philopatry by both females and males, and limited gene flow between assemblages (Carreras *et al.,* 2007). Genetic differentiation based on mtDNA indicated that there are at least four independent nesting subpopulations within the Mediterranean and usually they are characterized by a single haplotype: (1) Mainland Greece and the adjoining Ionian Islands, (2) eastern Turkey, (3) Israel, and (4) Cyprus. There is no evidence of adult female exchange among these four subpopulations (Carreras *et al.,* 2006). In studies of the foraging grounds in the western and central Mediterranean, seven of the 17 distinct haplotypes detected had not yet been described, indicating that nesting beach data to describe the natal origins of juveniles exploiting the western Mediterranean Sea are incomplete (Carreras *et al.,* 2006; Casale *et al.,* 2008a). Gene flow among the Mediterranean rookeries estimated from nuclear DNA was significantly higher than that calculated from mtDNA, consistent with the scenario of female philopatry maintaining isolation between rookeries, offset by male-mediated gene flow. Nevertheless, the nuclear data show there was a higher degree of substructuring among Mediterranean rookeries compared to those in the Northwest Atlantic (Bowen *et al.,* 2005; Carreras *et al.,* 2007).

Small oceanic juveniles from the Mediterranean Sea use the eastern basin (defined as inclusive of the central Mediterranean, Ionian, Adriatic, and Aegean Seas) and the western basin (defined as inclusive of the Tyrrhenian Sea) along the European coast (Laurent *et al.,* 1998; Margaritoulis *et al.,* 2003; Carreras *et al.,* 2006; Revelles *et al.,* 2007). Larger juveniles also use the eastern Atlantic and the eastern Mediterranean, especially the Tunisia-Libya shelf and the Adriatic Sea (Laurent *et al.,* 1993; Margaritoulis *et al.,* 2003; Monzón-Argüllo *et al.,* 2006; Revelles *et al.,* 2007). Adults appear to forage closer to the nesting beaches in the eastern basin; most tag recoveries from females nesting in Greece have occurred in the Adriatic Sea and off Tunisia (Margaritoulis *et al.,* 2003; Lazar *et al.,* 2004).

Loggerheads nesting in the Mediterranean were significantly smaller than loggerheads nesting in the Northwest Atlantic and the South Atlantic. Within the Mediterranean, straight carapace lengths ranged from 58 to 95 cm SCL (Margaritoulis *et al.,* 2003). Greece's loggerheads averaged 77–80 cm SCL (Tiwari and Bjorndal, 2000; Margaritoulis *et al.,* 2003), whereas Turkey's loggerheads averaged 72–73 cm SCL (Margaritoulis *et al.,* 2003). The Greece turtles also produced larger clutches (relative to body size) than those produced by Florida or Brazil nesters (Tiwari and Bjorndal, 2000). The authors suggested that sea turtles in the Mediterranean encounter environmental conditions significantly different from those experienced by populations elsewhere in the Atlantic Ocean basin.

Given the information presented above, the BRT concluded, and we concur, that four discrete population segments exist in the Atlantic Ocean/ Mediterranean: (1) Northwest Atlantic Ocean, (2) Northeast Atlantic Ocean, (3) South Atlantic Ocean, and (4) Mediterranean Sea. These four population segments are markedly separated from each other and from population segments within the Pacific Ocean and Indian Ocean basins as a consequence of physical, ecological, behavioral, and oceanographic factors. Information supporting this conclusion includes genetic analysis, flipper tag recoveries, and satellite telemetry. Genetic studies have shown that adult populations are highly structured with no overlap in distribution among adult loggerheads in these four population segments (Bowen *et al.,* 1994; Encalada *et al.,* 1998; Pearce, 2001; Carerras *et al.,* 2007; C. Monzon-Arguello, Instituto Canario de Ciencias Marinas-Spain, personal communication, 2008; Monzon-Arguello *et al.,* 2009). Although loggerheads from the Northwest Atlantic, Northeast Atlantic, and Mediterranean Sea population segments may comingle on oceanic foraging grounds as juveniles, adults are apparently isolated from each other; they also differ demographically. Data from satellite telemetry studies and flipper tag returns have shown that nesting females from the Northwest Atlantic return to the same nesting areas; they reveal no evidence of movement of adults south of the equator or east of 40° W longitude. Similarly, there is no evidence of movement of Northeast Atlantic adults south of the equator, west of 40° W longitude, or east of the Strait of Gibraltar, a narrow strait that connects the Atlantic Ocean to the Mediterranean Sea. Also, there is no evidence of movement of adult Mediterranean Sea loggerheads west of the Strait of Gibraltar. With regard to South Atlantic loggerheads, there have been no observations of tagged loggerheads moving across the equator in the Atlantic, except a single case of a captive-reared animal that was released as a juvenile from Espírito Santo and was recaptured 3 years later in the Azores (Bolten *et al.,* 1990). The separation of the Atlantic Ocean/ Mediterranean Sea population segments from population segments within the Indian Ocean and Pacific Ocean basins is believed to be the result of land barriers and oceanographic barriers. Based on mtDNA analysis, Bowen *et al.* (1994) found a separation of loggerheads in the Atlantic-Mediterranean basins from those in the Indo-Pacific basins since the Pleistocene period. Geography and climate appear to have shaped the evolution of these two matriarchal lineages with the onset of glacial cycles, the appearance of the Panama Isthmus creating a land barrier between the Atlantic and eastern Pacific, and upwelling of cold water off southern Africa creating an oceanographic barrier between the Atlantic and Indian Oceans (Bowen, 2003).

Significance Determination

As stated in the preceding section, the BRT identified nine discrete population segments. As described below by ocean basin, the BRT found that each of the nine discrete population segments is biologically and ecologically significant. They each represent a large portion of the species range, sometimes encompassing an entire hemispheric ocean basin. The range of each discrete population segment represents a unique ecosystem, influenced by local ecological and physical factors. The loss of any individual discrete population segment would result in a significant gap in the loggerhead's range. Each discrete population segment is genetically unique, often identified by unique mtDNA haplotypes, and the BRT indicated that these unique haplotypes could represent adaptive differences; the loss of any one discrete population segment would represent a significant loss of genetic diversity. Therefore, the BRT concluded, and we concur, that these nine population segments are both discrete from other conspecific population segments and significant to the species to which they belong, *Caretta caretta.*

The geographic delineations given below for each discrete population segment were determined primarily based on nesting beach locations, genetic evidence, oceanographic features, thermal tolerance, fishery bycatch data, and information on loggerhead distribution and migrations from satellite telemetry and flipper tagging studies. With rare exception, adults from discrete population segments remain within the delineated boundaries. In some cases, juvenile turtles from two or more discrete population segments may mix on foraging areas and therefore, their distribution and migrations may extend beyond the geographic boundaries delineated below for each discrete population segment (*e.g.,* juvenile turtles from the Northwest Atlantic Ocean, Northeast Atlantic Ocean, and Mediterranean Sea discrete population segments share foraging habitat in the western Mediterranean Sea).

Pacific Ocean

The BRT considered 60° N latitude and the equator as the north and south boundaries, respectively, of the North Pacific Ocean population segment based on oceanographic features, loggerhead sightings, thermal tolerance, fishery bycatch data, and information on loggerhead distribution from satellite telemetry and flipper tagging studies. The BRT determined that the North Pacific Ocean discrete population segment is biologically and ecologically significant because the loss of this population segment would result in a significant gap in the range of the taxon, and the population segment differs markedly from other population segments of the species in its genetic characteristics. The North Pacific Ocean population segment encompasses an entire hemispheric ocean basin and its loss would result in a significant gap in the range of the taxon. There is no evidence or reason to believe that female loggerheads from South Pacific nesting beaches would repopulate the North Pacific nesting beaches should those nesting assemblages be lost (Bowen *et al.,* 1994; Bowen, 2003). Tagging studies show that the vast majority of nesting females return to the same nesting area. As summarized by Hatase *et al.* (2002a), of 2,219 tagged nesting females from Japan, only five females relocated their nesting sites. In addition, flipper tag and satellite telemetry research, as described in detail in the Discreteness Determination section above, has shown no evidence of north-south movement of loggerheads across the equator. This discrete population segment is genetically unique (*see* Discreteness Determination section above) and the BRT indicated that these unique haplotypes could represent adaptive differences; thus, the loss of this discrete population segment would represent a significant loss of genetic diversity. Based on this information, the BRT concluded, and we concur, that the North Pacific Ocean population segment is significant to the taxon to which it belongs, and, therefore, that it satisfies the significance element of the DPS policy.

The BRT considered the equator and 60° S latitude as the north and south boundaries, respectively, and 67° W longitude and 139° E longitude as the east and west boundaries, respectively, of the South Pacific Ocean population segment based on oceanographic features, loggerhead sightings, thermal tolerance, fishery bycatch data, and information on loggerhead distribution from satellite telemetry and flipper tagging studies. The BRT determined that the South Pacific Ocean discrete population segment is biologically and ecologically significant because the loss of this population segment would result in a significant gap in the range of the taxon, and the population segment differs markedly from other population segments of the species in its genetic characteristics. The South Pacific Ocean population segment encompasses an entire hemispheric ocean basin, and its loss would result in a significant gap in the range of the taxon. The South Pacific Ocean population is the only population of loggerheads found south of the equator in the Pacific Ocean and there is no evidence or reason to believe that female loggerheads from North Pacific nesting beaches would repopulate the South Pacific nesting beaches should those nesting assemblages be lost (Bowen *et al.,* 1994; Bowen, 2003). In addition, flipper tag and satellite telemetry research, as described in detail in the Discreteness Determination section above, has shown no evidence of north-south movement of loggerheads across the equator. The BRT also stated that it does not expect that recolonization from Indian Ocean loggerheads would occur in eastern Australia within ecological time frames. Despite evidence of foraging in the Gulf of Carpentaria by adult loggerheads from the nesting populations in eastern Australia (South Pacific Ocean population segment) and western Australia (Southeast Indo-Pacific Ocean population segment), the nesting females from these two regions are considered to be genetically distinct from one another (Limpus, 2009). In addition to a substantial disparity in mtDNA haplotype frequencies between these two populations, FitzSimmons (University of Canberra, unpublished data) found significant differences in nuclear DNA microsatellite loci between females nesting in these two regions, indicating separation between the South Pacific Ocean and the Southeast Indo-Pacific Ocean population segments. Long-term studies show a high degree of site fidelity by adult females in the South Pacific, with most females returning to the same beach within a nesting season and in successive nesting seasons (Limpus, 1985, 2009; Limpus *et al.,* 1994). This has been documented as characteristic of loggerheads from various rookeries throughout the world (Schroeder *et al.,* 2003). This discrete population segment is genetically unique and the BRT indicated that these unique haplotypes could represent adaptive differences. Thus, the loss of this discrete population segment would represent a significant loss of genetic diversity. Based on this information, the BRT concluded, and we concur, that the South Pacific Ocean population segment is significant to the taxon to which it belongs, and, therefore, that it satisfies the significance element of the DPS policy.

Indian Ocean

The BRT considered 30° N latitude and the equator as the north and south boundaries, respectively, of the North Indian Ocean population segment based on oceanographic features, loggerhead sightings, thermal tolerance, fishery bycatch data, and information on loggerhead distribution from satellite telemetry and flipper tagging studies. The BRT determined that the North Indian Ocean discrete population segment is biologically and ecologically significant because the loss of this population segment would result in a significant gap in the range of the taxon, and the population segment differs markedly from other population segments of the species in its genetic characteristics. The North Indian Ocean population segment encompasses an entire hemispheric ocean basin, and its loss would result in a significant gap in the range of the taxon. Genetic information currently available for Indian Ocean populations indicates that the Oman rookery in the North Indian Ocean and the South African rookery in the Southwest Indian Ocean are genetically distinct, and once sequencing studies are completed for these rookeries, it is likely that they will also be determined to be genetically distinct from the western Australia rookeries in the Southeast Indo-Pacific Ocean (Bowen *et al.,* 1994). In addition, oceanographic phenomena associated with Indian Ocean equatorial waters exist between the North Indian Ocean population segment and the two population segments in the South Indian Ocean, which likely prevent migration of individuals across the equator on a time scale relative to management and conservation efforts (Conant *et al.,* 2009). Therefore, there is no evidence or reason to believe that female loggerheads from the Southwest Indian Ocean or Southeast Indo-Pacific Ocean would repopulate the North Indian Ocean nesting beaches should those populations be lost (Bowen *et al.,* 1994; Bowen, 2003). Based on this information, the BRT concluded, and we concur, that the North Indian Ocean population segment is significant to the taxon to which it belongs, and, therefore, that it satisfies the significance element of the DPS policy.

The BRT considered the equator and 60° S latitude as the north and south boundaries, respectively, and 20° E longitude at Cape Agulhas on the southern tip of Africa and 80° E longitude as the east and west boundaries, respectively, of the Southwest Indian Ocean population segment based on oceanographic features, thermal tolerance, fishery bycatch data, and information on loggerhead distribution from satellite telemetry and flipper tagging studies. The BRT determined that the Southwest Indian Ocean discrete population segment is biologically and ecologically significant because the loss of this population segment would result in a significant gap in the range of the taxon, and the population segment differs markedly from other population segments of the species in its genetic characteristics. The Southwest Indian Ocean population segment encompasses half of an hemispheric ocean basin, and its loss would result in a significant gap in the range of the taxon. Genetic information currently available for Indian Ocean populations indicates that the Oman rookery in the North Indian Ocean and the South African rookery in the Southwest Indian Ocean are genetically distinct, and once sequencing studies are completed for these rookeries, it is likely that they will also be determined to be genetically distinct from the western Australia rookeries in the Southeast Indo-Pacific Ocean (Bowen *et al.,* 1994). In addition, vicariant barriers (*i.e.,* oceanographic phenomena associated with Indian Ocean equatorial waters, and the large expanse between continents in the South Indian Ocean without suitable benthic foraging habitat) likely exist between the three Indian Ocean populations that would prevent migration of individuals between populations on a time scale relative to management and conservation efforts (Conant *et al.,* 2009). Therefore, there is no evidence or reason to believe that female loggerheads from the North Indian Ocean or Southeast Indo-Pacific Ocean would repopulate the Southwest Indian Ocean nesting beaches should those populations be lost (Bowen *et al.,* 1994; Bowen, 2003). There is also no evidence of movement of adult Southwest Indian Ocean loggerheads west of 20° E longitude at Cape Agulhas, the southernmost point on the African continent, or east of 80° E longitude within the Indian Ocean. Based on this information, the BRT concluded, and we concur, that the Southwest Indian Ocean population segment is significant to the taxon to which it belongs, and, therefore, that it satisfies the significance element of the DPS policy.

The BRT considered the equator and 60° S latitude as the north and south boundaries, respectively, and 139° E longitude and 80° E longitude as the east and west boundaries, respectively, of the Southeast Indo-Pacific Ocean population segment based on oceanographic features, thermal tolerance, fishery bycatch data, and information on loggerhead distribution from satellite telemetry and flipper tagging studies. The BRT determined that the Southeast Indo-Pacific Ocean discrete population segment is biologically and ecologically significant because the loss of this population segment would result in a significant gap in the range of the taxon, and the population segment differs markedly from other population segments of the species in its genetic characteristics. The Southeast Indo-Pacific Ocean population segment encompasses half of an hemispheric ocean basin, and its loss would result in a significant gap in the range of the taxon. Genetic information currently available for Indian Ocean populations indicates that the Oman rookery in the North Indian Ocean and the South African rookery in the Southwest Indian Ocean are genetically distinct, and once sequencing studies are completed for these rookeries, it is likely that they will also be determined to be genetically distinct from the western Australia rookeries in the Southeast Indo-Pacific Ocean (Bowen *et al.,* 1994). In addition, vicariant barriers (*i.e.,* oceanographic phenomena associated with Indian Ocean equatorial waters, and the large expanse between continents in the South Indian Ocean without suitable benthic foraging habitat) likely exist between the three Indian Ocean populations that would prevent migration of individuals between populations on a time scale relative to management and conservation efforts (Conant *et al.,* 2009). Therefore, there is no evidence or reason to believe that female loggerheads from the North Indian Ocean or Southwest Indian Ocean would repopulate the Southeast Indo-Pacific Ocean nesting beaches should those populations be lost (Bowen *et al.,* 1994; Bowen, 2003). There is also no evidence of movement of adult Southeast Indo-Pacific Ocean loggerheads west of 80° E longitude within the Indian Ocean. Despite evidence of foraging in the Gulf of Carpentaria by adult loggerheads from the nesting populations in eastern Australia (South Pacific Ocean population segment) and western Australia (Southeast Indo-Pacific Ocean population segment), the nesting females from these two regions are considered to be genetically distinct from one another (Limpus, 2009). In addition to a substantial disparity in mtDNA haplotype frequencies between these two regions, FitzSimmons (University of Canberra, unpublished data) found significant differences in nuclear DNA microsatellite loci from females nesting in these two regions, indicating separation between the South Pacific Ocean population segment and the Southeast Indo-Pacific Ocean population segment. Based on this information, the BRT concluded, and we concur, that the Southeast Indo-Pacific Ocean population segment is significant to the taxon to which it belongs, and, therefore, that it satisfies the significance element of the DPS policy.

Atlantic Ocean and Mediterranean Sea

The BRT considered 60° N latitude and the equator as the north and south boundaries, respectively, and 40° W longitude as the east boundary of the Northwest Atlantic Ocean population segment based on oceanographic features, loggerhead sightings, thermal tolerance, fishery bycatch data, and information on loggerhead distribution from satellite telemetry and flipper tagging studies. The BRT determined that the Northwest Atlantic Ocean discrete population segment is biologically and ecologically significant because the loss of this population segment would result in a significant gap in the range of the taxon, and the population segment differs markedly from other population segments of the species in its genetic characteristics. The Northwest Atlantic Ocean population segment encompasses half of an hemispheric ocean basin, and its loss would result in a significant gap in the range of the taxon. Genetic studies have shown that adult populations are highly structured with no overlap in distribution among adult loggerheads from the Northwest Atlantic, Northeast Atlantic, South Atlantic, and Mediterranean Sea (Bowen *et al.,* 1994; Encalada *et al.,* 1998; Pearce, 2001; Carerras *et al.,* 2007; C. Monzon-Arguello, Instituto Canario de Ciencias Marinas—Spain, personal communication, 2008; Monzon-Arguello *et al.,* 2009). There is no evidence or reason to believe that female loggerheads from the Northeast Atlantic, Mediterranean Sea, or South Atlantic nesting beaches would repopulate the Northwest Atlantic nesting beaches should these populations be lost (Bowen *et al.,* 1994; Bowen, 2003). Data from satellite telemetry studies and flipper tag returns, as described in detail in the Discreteness Determination section above, have shown that the vast majority of nesting females from the Northwest Atlantic return to the same nesting area; they reveal no evidence of movement of adults south of the equator or east of 40° W longitude. This discrete population segment is genetically unique (*see* Discreteness Determination section above) and the BRT indicated that these unique haplotypes could represent adaptive differences; thus, the loss of this discrete population segment would represent a significant loss of genetic diversity. Based on this information, the BRT concluded, and we concur, that the Northwest Atlantic Ocean population segment is significant to the taxon to which it belongs, and, therefore, that it satisfies the significance element of the DPS policy.

The BRT considered 60° N latitude and the equator as the north and south boundaries, respectively, and 40° W longitude as the west boundary of the Northeast Atlantic Ocean population segment. The BRT considered the boundary between the Northeast Atlantic Ocean and Mediterranean Sea population segments as 5°36′ W longitude (Strait of Gibraltar). These boundaries are based on oceanographic features, loggerhead sightings, thermal tolerance, fishery bycatch data, and information on loggerhead distribution from satellite telemetry and flipper tagging studies. The BRT determined that the Northeast Atlantic Ocean discrete population segment is biologically and ecologically significant because the loss of this population segment would result in a significant gap in the range of the taxon, and the population segment differs markedly from other population segments of the species in its genetic characteristics. The Northeast Atlantic Ocean population segment encompasses half of an hemispheric ocean basin, and its loss would result in a significant gap in the range of the taxon. Genetic studies have shown that adult populations are highly structured with no overlap in distribution among adult loggerheads from the Northwest Atlantic, Northeast Atlantic, South Atlantic, and Mediterranean Sea (Bowen *et al.,* 1994; Encalada *et al.,* 1998; Pearce, 2001; Carerras *et al.,* 2007; C. Monzon-Arguello, Instituto Canario de Ciencias Marinas—Spain, personal communication, 2008; Monzon-Arguello *et al.,* 2009). There is no evidence or reason to believe that female loggerheads from the Northwest Atlantic, Mediterranean Sea, or South Atlantic nesting beaches would repopulate the Northeast Atlantic nesting beaches should these populations be lost (Bowen *et al.,* 1994; Bowen, 2003). There is also no evidence of movement of Northeast Atlantic adults west of 40° W longitude or east of the Strait of Gibraltar (5°36′ W longitude). This discrete population segment is genetically unique (*see* Discreteness Determination section above) and the BRT indicated that these unique haplotypes could represent adaptive differences; thus, the loss of this discrete population segment would represent a significant loss of genetic diversity. Based on this information, the BRT concluded, and we concur, that the Northeast Atlantic Ocean population segment is significant to the taxon to which it belongs, and, therefore, that it satisfies the significance element of the DPS policy.

The BRT considered the Mediterranean Sea west to 5°36′ W longitude (Strait of Gibraltar) as the boundary of the Mediterranean Sea population segment based on oceanographic features, loggerhead sightings, thermal tolerance, fishery bycatch data, and information on loggerhead distribution from satellite telemetry and flipper tagging studies. The BRT determined that the Mediterranean Sea discrete population segment is biologically and ecologically significant because the loss of this population segment would result in a significant gap in the range of the taxon, and the population segment differs markedly from other population segments of the species in its genetic characteristics. The Mediterranean Sea population segment encompasses the entire Mediterranean Sea basin, and its loss would result in a significant gap in the range of the taxon. Genetic studies have shown that adult populations are highly structured with no overlap in distribution among adult loggerheads from the Northwest Atlantic, Northeast Atlantic, South Atlantic, and Mediterranean Sea (Bowen *et al.,* 1994; Encalada *et al.,* 1998; Pearce, 2001; Carerras *et al.,* 2007; C. Monzon-Arguello, Instituto Canario de Ciencias Marinas—Spain, personal communication, 2008; Monzon-Arguello *et al.,* 2009). There is no evidence or reason to believe that female loggerheads from the Northwest Atlantic, Northeast Atlantic, or South Atlantic nesting beaches would repopulate the Mediterranean Sea nesting beaches should these populations be lost (Bowen *et al.,* 1994; Bowen, 2003). As previously described, adults from the Mediterranean Sea population segment appear to forage closer to the nesting beaches in the eastern basin, and most flipper tag recoveries from females nesting in Greece have occurred in the Adriatic Sea and off Tunisia (Margaritoulis *et al.,* 2003; Lazar *et al.,* 2004). There is no evidence of movement of adult Mediterranean Sea loggerheads west of the Strait of Gibraltar (5°36’ W longitude). This discrete population segment is genetically unique (*see* Discreteness Determination section above) and the BRT indicated that these unique haplotypes could represent adaptive differences; thus, the loss of this discrete population segment would represent a significant loss of genetic diversity. Based on this information, the BRT concluded, and we concur, that the Mediterranean Sea population segment is significant to the taxon to which it belongs, and, therefore, that it satisfies the significance element of the DPS policy.

The BRT considered the equator and 60° S latitude as the north and south boundaries, respectively, and 20° E longitude at Cape Agulhas on the southern tip of Africa and 67° W longitude as the east and west boundaries, respectively, of the South Atlantic Ocean population segment based on oceanographic features, loggerhead sightings, thermal tolerance, fishery bycatch data, and information on loggerhead distribution from satellite telemetry and flipper tagging studies. The BRT determined that the South Atlantic Ocean discrete population segment is biologically and ecologically significant because the loss of this population segment would result in a significant gap in the range of the taxon, and the population segment differs markedly from other population segments of the species in its genetic characteristics. The South Atlantic Ocean population segment encompasses an entire hemispheric ocean basin, and its loss would result in a significant gap in the range of the taxon. Genetic studies have shown that adult populations are highly structured with no overlap in distribution among adult loggerheads from the Northwest Atlantic, Northeast Atlantic, South Atlantic, and Mediterranean Sea (Bowen *et al.,* 1994; Encalada *et al.,* 1998; Pearce, 2001; Carerras *et al.,* 2007; C. Monzon-Arguello, Instituto Canario de Ciencias Marinas-Spain, personal communication, 2008; Monzon-Arguello *et al.,* 2009). There is no evidence or reason to believe that female loggerheads from the Northwest Atlantic, Northeast Atlantic, or Mediterranean Sea nesting beaches would repopulate the South Atlantic nesting beaches should these populations be lost (Bowen *et al.,* 1994; Bowen, 2003). This discrete population segment is genetically unique (*see* Discreteness Determination section above) and the BRT indicated that these unique haplotypes could represent adaptive differences; thus, the loss of this discrete population segment would represent a significant loss of genetic diversity. Based on this information, the BRT concluded, and we concur, that the South Atlantic Ocean population segment is significant to the taxon to which it belongs, and, therefore, that it satisfies the significance element of the DPS policy.

In summary, based on the information provided in the Discreteness Determination and Significance Determination sections above, the BRT identified nine loggerhead DPSs distributed globally: (1) North Pacific Ocean DPS, (2) South Pacific Ocean DPS, (3) North Indian Ocean DPS, (4) Southeast Indo-Pacific Ocean DPS, (5) Southwest Indian Ocean DPS, (6) Northwest Atlantic Ocean DPS, (7) Northeast Atlantic Ocean DPS, (8) Mediterranean Sea DPS, and (9) South Atlantic Ocean DPS. We concur with the findings and application of the DPS policy described by the BRT and conclude that the nine DPSs identified by the BRT warrant delineation as DPSs (*i.e.,* they are discrete and significant).

Significant Portion of the Range

We have determined that the range of each DPS contributes meaningfully to the conservation of the DPS and that populations that may contribute more or less to the conservation of each DPS throughout a portion of its range cannot be identified due to the highly migratory nature of the listed entity.

The loggerhead sea turtle is highly migratory and crosses multiple domestic and international geopolitical boundaries. Depending on the life stage, they may occur in oceanic waters or along the continental shelf of landmasses, or transit back and forth between oceanic and neritic habitats. Protection and management of both the terrestrial and marine environments is essential to recovering the listed entity. Management measures implemented by any State, foreign nation, or political subdivision likely would only affect individual sea turtles during certain stages and seasons of the life cycle. Management measures implemented by any State, foreign nation, or political subdivision may also affect individuals from multiple DPSs because juvenile turtles from disparate DPSs can overlap on foraging grounds or migratory corridors (*e.g.,* Northwest Atlantic, Northeast Atlantic, and Mediterranean Sea DPSs). The "significant" term in "significant portion of the range" refers to the contribution of the population(s) in a portion of the range to the conservation of the listable entity being considered. The BRT was unable to identify any particular portion of the range of any of the DPSs that was more significant to the DPS than another portion of the same range because of the migratory nature of the loggerhead turtle and the fact that different life stages undergo threats and benefit from conservation efforts throughout the geographic range of each DPS. The next section describes our evaluation of the status of each DPS throughout its range.

Status of the Nine Loggerhead DPSs

Abundance estimates across all life stages do not exist for the nine DPSs. Within the global range of the species, and within each DPS, the primary data available are collected on nesting beaches, either as counts of nests or counts of nesting females, or a combination of both (either direct or extrapolated). Information on abundance and trends away from the nesting beaches is limited or non-existent, primarily because these data are, relative to nesting beach studies, logistically difficult and expensive to obtain. Therefore, the primary information source for directly evaluating status and trends of the nine DPSs is nesting beach data.

North Pacific Ocean DPS

In the North Pacific, loggerhead nesting is essentially restricted to Japan where monitoring of loggerhead nesting began in the 1950s on some beaches, and expanded to include most known nesting beaches since approximately 1990. Kamezaki *et al.* (2003) reviewed census data collected from most of the Japanese nesting beaches. Although most surveys were initiated in the 1980s and 1990s, some data collection efforts were initiated in the 1950s. Along the Japanese coast, nine major nesting beaches (greater than 100 nests per season) and six "submajor" beaches (10–100 nests per season) were identified. Census data from 12 of these 15 beaches provide composite information on longer-term trends in the Japanese nesting assemblage. Using information collected on these beaches, Kamezaki *et al.* (2003) concluded a substantial decline (50–90 percent) in the size of the annual loggerhead nesting population in Japan in recent decades. Snover (2008) combined nesting data from the Sea Turtle Association of Japan and data from Kamezaki *et al.* (2002) to provide a recent 18-year time series of nesting data from 1990–2007. Nesting declined from an initial peak of approximately 6,638 nests in 1990–1991, followed by a steep decline to a low of 2,064 nests in 1997. During the past decade, nesting increased gradually to 5,167 nests in 2005, declined and then rose again to a high of just under 11,000 nests in 2008. Estimated nest numbers for 2009 are on the order of 7,000–8,000 nests. While nesting numbers have gradually increased in recent years and the number for 2009 is similar to the start of the time series in 1990, historical evidence indicates that there has been a substantial decline over the last half of the 20th century.

South Pacific Ocean DPS

In the South Pacific, loggerhead nesting is almost entirely restricted to eastern Australia (primarily Queensland) and New Caledonia, with the majority of nesting occurring in eastern Australia, a population that has been well studied. The size of the annual breeding population (females only) has been monitored at numerous rookeries in Australia since 1968 (Limpus and Limpus, 2003), and these data constitute the primary measure of the current status of the DPS. The total nesting population for Queensland was approximately 3,500 females in the 1976–1977 nesting season (Limpus, 1985; Limpus and Reimer, 1994). Little more than two decades later, Limpus and Limpus (2003) estimated this nesting population at less than 500 females in the 1999–2000 nesting season. There has been a marked decline in the number of females breeding annually since the mid-1970s, with an estimated 50 to 80 percent decline in the number of breeding females at various Australian rookeries up to 1990 (Limpus and Reimer, 1994) and a decline of approximately 86 percent by 1999 (Limpus and Limpus, 2003). Comparable nesting surveys have not been conducted in New Caledonia however. Information from pilot surveys conducted in 2005, combined with oral history information collected, suggest that there has been a decline in loggerhead nesting (Limpus *et al.,* 2006). Based on data from the pilot study, only 60 to 70 loggerheads nested on the four surveyed New Caledonia beaches during the 2004–2005 nesting season (Limpus *et al.,* 2006).

Studies of eastern Australia loggerheads at their foraging areas provide some information on the status of non-breeding loggerheads of the South Pacific Ocean DPS. Chaloupka and Limpus (2001) determined that the resident loggerhead population on coral reefs of the southern Great Barrier Reef declined at 3 percent per year from 1985 to the late 1990s. The observed decline was hypothesized as a result of recruitment failure, given few anthropogenic impacts and constant high annual survivorship measured at this foraging habitat (Chaloupka and Limpus, 2001). Concurrently, a decline in new recruits was measured in these foraging areas (Limpus and Limpus, 2003).

North Indian Ocean DPS

The North Indian Ocean hosts the largest nesting assemblage of loggerheads in the eastern hemisphere; the vast majority of these loggerheads nest in Oman (Baldwin *et al.,* 2003). Nesting occurs in greatest density on Masirah Island; the number of emergences ranges from 27–102 per km nightly (Ross, 1998). Nesting densities have complicated the implementation of standardized nesting beach surveys, and more precise nesting data have only been collected since 2008. Extrapolations resulting from partial surveys and tagging in 1977–1978 provided broad estimates of 19,000–60,000 females nesting annually at Masirah Island, while a more recent partial survey in 1991 provides an estimate of 23,000 nesting females at Masirah Island (Baldwin, 1992; Ross, 1979, 1998; Ross and Barwani 1982). A reinterpretation of these estimates, assuming 50 percent nesting success (as compared to 100 percent in the original estimates), resulted in an estimate of 20,000 to 40,000 females nesting annually (Baldwin *et al.,* 2003). Reliable trends in nesting cannot be determined due to the lack of standardized surveys at Masirah Island prior to 2008. In 2008, about 50,000 nests were estimated based on daily surveys of the highest density nesting beaches and weekly surveys on all remaining island nesting beaches. Even using the low end of the 1977–1978 estimates of 20,000 nesting females at Masirah, this suggests a significant decline in the size of the nesting population and is consistent with observations by local rangers that the population has declined dramatically in the last three decades (E. Possardt, FWS, personal communication, 2008). If the higher estimates are accurate then the decline would be greater than 70 percent.

In addition to the nesting beaches on Masirah Island, over 3,000 nests per year have been recorded in Oman on the Al-Halaniyat Islands and, along the Oman mainland of the Arabian Sea, approximately 2,000 nests are deposited annually (Salm, 1991; Salm *et al.,* 1993). In Yemen, on Socotra Island, 50–100 loggerheads were estimated to have nested in 1999 (Pilcher and Saad, 2000). A time series of nesting data based on standardized surveys is not available to determine trends for these nesting sites.

Loggerhead nesting is rare elsewhere in the northern Indian Ocean and in some cases is complicated by inaccurate species identification (Shanker, 2004; Tripathy, 2005). A small number of nesting females use the beaches of Sri Lanka every year; however, there are no records that Sri Lanka has ever been a major nesting area for loggerheads (Kapurusinghe, 2006). Loggerheads have been reported nesting in low numbers in Myanmar; however, these data may not be reliable because of misidentification of species (Thorbjarnarson *et al.,* 2000).

Southeast-Indo Pacific Ocean DPS

In the eastern Indian Ocean, loggerhead nesting is restricted to western Australia (Dodd, 1988), and this nesting population is the largest in Australia (Wirsing *et al.,* unpublished data, cited in Natural Heritage Trust, 2005). Dirk Hartog Island hosts about 70–75 percent of nesting individuals in the eastern Indian Ocean (Baldwin *et al.,* 2003). Surveys have been conducted on the island for the duration of six nesting seasons between 1993/1994 and 1999/2000 (Baldwin *et al.,* 2003). An estimated 800–1,500 loggerheads nest annually on Dirk Hartog Island beaches (Baldwin *et al.,* 2003).

Fewer loggerheads (approximately 150–350 per season) are reported nesting on the Muiron Islands; however, more nesting loggerheads are reported here than on North West Cape (approximately 50–150 per season) (Baldwin *et al.,* 2003). Although data are insufficient to determine trends, evidence suggests the nesting population in the Muiron Islands and North West Cape region was depleted before recent beach monitoring programs began (Nishemura and Nakahigashi, 1990; Poiner *et al.,* 1990; Poiner and Harris, 1996).

Southwest Indian Ocean DPS

In the Southwest Indian Ocean, the highest concentration of nesting occurs on the coast of Tongaland, South Africa, where surveys and management practices were instituted in 1963 (Baldwin *et al.,* 2003). A trend analysis of index nesting beach data from this region from 1965 to 2008 indicates an increasing nesting population between the first decade of surveys, which documented 500–800 nests annually, and the last 8 years, which documented 1,100–1,500 nests annually (Nel, 2008). These data represent approximately 50 percent of all nesting within South Africa and are believed to be representative of trends in the region. Loggerhead nesting occurs elsewhere in South Africa, but sampling is not consistent and no trend data are available. The total number of females nesting annually in South Africa is estimated between 500–2,000 (Baldwin *et al.,* 2003). In Mozambique, surveys have been instituted much more recently; likely less than 100 females nest annually and no trend data are available (Baldwin *et al.,* 2003). Similarly, in Madagascar, loggerheads have been documented nesting in low numbers, but no trend data are available (Rakotonirina, 2001).

Northwest Atlantic Ocean DPS

Nesting occurs within the Northwest Atlantic along the coasts of North America, Central America, northern South America, the Antilles, and The Bahamas, but is concentrated in the southeastern U.S. and on the Yucatan Peninsula in Mexico (Sternberg, 1981; Ehrhart, 1989; Ehrhart *et al.,* 2003; NMFS and FWS, 2008). Collectively, the Northwest Atlantic Ocean hosts the most significant nesting assemblage of loggerheads in the western hemisphere and is one of the two largest loggerhead nesting assemblages in the world. NMFS and FWS (2008), Witherington *et al.* (2009), and TEWG (2009) provide comprehensive analyses of the status of the nesting assemblages within the Northwest Atlantic Ocean DPS using standardized data collected over survey periods ranging from 10 to 23 years. The results of these analyses, using different analytical approaches, were consistent in their findings—there has been a significant, overall nesting decline within this DPS.

NMFS and FWS (2008) identified five recovery units (nesting subpopulations) in the Northwest Atlantic Ocean: the Northern U.S. (Florida/Georgia border to southern Virginia); Peninsular Florida (Florida/Georgia border south through Pinellas County, excluding the islands west of Key West, Florida); Dry Tortugas (islands west of Key West, Florida); Northern Gulf of Mexico (Franklin County, Florida, west through Texas); and Greater Caribbean (Mexico through French Guiana, The Bahamas, Lesser and Greater Antilles). Declining trends in the annual number of nests were documented for all recovery units for which there were adequate data. The most significant declining trend has been documented for the Peninsular Florida Recovery Unit, where nesting declined 26 percent over the 20-year period from 1989–2008, and declined 41 percent over the period 1998–2008 (NMFS and FWS, 2008; Witherington *et al.,* 2009). The most standardized nest count from this recovery unit in 2009 recorded the fourth lowest loggerhead nesting in the 21-year monitoring period, reinforcing the assessment of nesting decline (B. Witherington, FWC, personal communication, 2010). The Peninsular Florida Recovery Unit represents approximately 87 percent of all nesting effort in the Northwest Atlantic Ocean DPS (Ehrhart *et al.,* 2003). The Northern U.S. Recovery Unit is the second largest recovery unit within the DPS and is declining significantly at 1.3 percent annually since 1983 (NMFS and FWS, 2008). The Greater Caribbean Recovery Unit is the third largest recovery unit within the Northwest Atlantic Ocean DPS, with the majority of nesting at Quintana Roo, Mexico. TEWG (2009) reported a greater than 5 percent annual decline in loggerhead nesting from 1995–2006 at Quintana Roo.

In an effort to evaluate loggerhead population status and trends beyond the nesting beach, NMFS and FWS (2008) and TEWG (2009) reviewed data from in-water studies within the range of the Northwest Atlantic Ocean DPS. NMFS and FWS (2008), in the Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle, summarized population trend data reported from nine in-water study sites, located between Long Island Sound, New York, and Florida Bay, Florida, where loggerheads were regularly captured and where efforts were made to provide local indices of abundance. The study periods for these nine sites varied. The earliest began in 1987, and the most recent were initiated in 2000. None included annual sampling. Results reported from four of the studies indicated no discernible trend, two studies reported declining trends, and two studies reported increasing trends. Trends at one study site, Mosquito Lagoon, Florida, indicated either no trend (all data) or a declining trend (more recent data), depending on whether all sample years were used or only the more recent, and likely more comparable sample years, were used. TEWG (2009) used raw data from six of the aforementioned nine in-water study sites to conduct trend analyses. Results from three of the four sites located in the southeast U.S. showed an increasing trend in the abundance of loggerheads, one showed no discernible trend, and the two sites located in the northeast U.S. showed a decreasing trend in abundance of loggerheads. Both NMFS and FWS (2008) and TEWG (2009) stress that population trend results currently available from in-water studies must be viewed with caution given the limited number of sampling sites, size of sampling areas, biases in sampling, and caveats associated with the analyses.

Northeast Atlantic Ocean DPS

In the northeastern Atlantic, the Cape Verde Islands support the only large nesting population of loggerheads in the region (Fretey, 2001). Nesting occurs at some level on most of the islands in the archipelago with the largest nesting numbers reported from the island of Boa Vista where studies have been ongoing since 1998 (Lazar and Holcer, 1998; Lopez-Jurado *et al.*, 2000; Fretey, 2001; Varo Cruz *et al.*, 2007; Loureiro, 2008; M. Tiwari, NMFS, personal communication, 2008). On Boa Vista Island, 833 and 1,917 nests were reported in 2001 and 2002 respectively from 3.1 km of beach (Varo Cruz *et al.*, 2007) and between 1998 and 2002 the local project had tagged 2,856 females (Varo Cruz *et al.*, 2007). More recently, in 2005, 5,396 nests and 3,121 females were reported from 9 km of beach on Boa Vista Island (Lopez-Jurado *et al.*, 2007). From Santiago Island, 66 nests were reported from four beaches in 2007 and 53 nests from five beaches in 2008 (*http://tartarugascaboverde.wordpress.com/santiago*). Due to limited data available, a population trend cannot currently be determined for the Cape Verde population; however, available information on the directed killing of nesting females suggests that this nesting population is under severe pressure and likely significantly reduced from historic levels. Loureiro (2008) reported a reduction in nesting from historic levels at Santiago Island, based on interviews with elders. Elsewhere in the northeastern Atlantic, loggerhead nesting is non-existent or occurs at very low levels. In Morocco, anecdotal reports indicated high numbers of nesting turtles in southern Morocco (Pasteur and Bons, 1960), but a few recent surveys of the Atlantic coastline have suggested a dramatic decline (Tiwari *et al.*, 2001, 2006). A few nests have been reported from Mauritania (Arvy *et al.*, 2000) and Sierra Leone (E. Aruna, Conservation Society of Sierra Leone, personal communication, 2008). Some loggerhead nesting in Senegal and elsewhere along the coast of West Africa has been reported; however, a more recent and reliable confirmation is needed (Fretey, 2001).

Mediterranean Sea DPS

Nesting occurs throughout the central and eastern Mediterranean in Italy, Greece, Cyprus, Turkey, Syria, Lebanon, Israel, the Sinai, Egypt, Libya, and Tunisia (Sternberg, 1981; Margaritoulis *et al.*, 2003; SWOT, 2007). In addition, sporadic nesting has been reported from the western Mediterranean, but the vast majority of nesting (greater than 80 percent) occurs in Greece and Turkey (Margaritoulis *et al.*, 2003). The documented annual nesting of loggerheads in the Mediterranean averages about 5,000 nests (Margaritoulis *et al.*, 2003). There is no discernible trend in nesting at the two longest monitoring projects in Greece, Laganas Bay (Margaritoulis, 2005) and southern Kyparissia Bay (Margaritoulis and Rees, 2001). However, the nesting trend at Rethymno Beach, which hosts approximately 7 percent of all documented loggerhead nesting in the Mediterranean, shows a highly significant declining trend (1990–2004) (Margaritoulis *et al.*, 2009). In Turkey, intermittent nesting surveys have been conducted since the 1970s with more consistent surveys conducted on some beaches only since the 1990s, making it difficult to assess trends in nesting. Ilgaz *et al.* (2007) reported a declining trend at Fethiye Beach from 1993–2004, this beach represents approximately 10 percent of loggerhead nesting in Turkey (Margaritoulis *et al.*, 2003).

South Atlantic Ocean DPS

In the South Atlantic nesting occurs primarily along the mainland coast of Brazil from Sergipe south to Rio de Janeiro, with peak concentrations in northern Bahia, Espírito Santo, and northern Rio de Janeiro with peak nesting along the coast of Bahia (Marcovaldi and Chaloupka, 2007). Prior to 1980, loggerhead nesting populations in Brazil were considered severely depleted. Recently, Marcovaldi and Chaloupka (2007) reported a long-term, sustained increasing trend in nesting abundance over a 16-year period from 1988 through 2003 on 22 surveyed beaches containing more than 75 percent of all loggerhead nesting in Brazil. A total of 4,837 nests were reported from these survey beaches for the 2003–2004 nesting season (Marcovaldi and Chaloupka, 2007).

Summary of Factors Affecting the Nine Loggerhead DPSs

Section 4 of the ESA (16 U.S.C. 1533) and implementing regulations at 50 CFR part 424 set forth procedures for adding species to the Federal List of Endangered and Threatened Species. Under section 4(a) of the Act, we must determine if a species is threatened or endangered because of any of the following five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence.

We have described the effects of various factors leading to the decline of the loggerhead sea turtle in the original listing determination (43 FR 32800; July 28, 1978) and other documents (NMFS and USFWS, 1998, 2007, 2008). In making this finding, information regarding the status of each of the nine loggerhead DPSs is considered in relation to the five factors provided in section 4(a)(1) of the ESA. The reader is directed to section 5 of the Status Review for a more detailed discussion of the factors affecting the nine identified loggerhead DPSs. In section 5.1., a general description of the threats that occur for all DPSs is presented under the relevant section 4(a)(1) factor. In section 5.2, threats that are specific to a particular DPS are presented by DPS under each section 4(a)(1) factor. That information is incorporated here by reference; the following is a summary of that information by DPS.

North Pacific Ocean DPS

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

Terrestrial Zone

Destruction and modification of loggerhead nesting habitat in the North Pacific result from coastal development and construction, placement of erosion control structures and other barriers to nesting, beachfront lighting, vehicular and pedestrian traffic, sand extraction, beach erosion, beach sand placement, beach pollution, removal of native vegetation, and planting of non-native vegetation (NMFS and USFWS, 1998). Beaches in Japan where loggerheads nest are extensively eroded due to dredging and dams constructed upstream, and are obstructed by seawalls as well. Unfortunately, no quantitative studies have been conducted to determine the impact to the loggerhead nesting populations (Kamezaki *et al.*, 2003). However, it is clear that loggerhead nesting habitat has been impacted by erosion and extensive beach use by tourists, both of which have contributed to unusually high mortality of eggs and pre-emergent hatchlings at many Japanese rookeries (Matsuzawa, 2006).

Maehama Beach and Inakahama Beach on Yakushima in Kagoshima Prefecture account for approximately 30 percent of loggerhead nesting in Japan (Kamezaki *et al.*, 2003), making Yakushima an important area for nesting beach protection. However, the beaches suffer from beach erosion and light pollution, especially from passing cars, as well as from tourists encroaching on the nesting beaches (Matsuzawa, 2006). Burgeoning numbers of visitors to beaches may cause sand compaction and nest trampling. Egg and pre-emergent hatchling mortality in Yakushima has been shown to be higher in areas where public access is not restricted and is mostly attributed to human foot traffic on nests (Kudo *et al.*, 2003). Fences have been constructed around areas where the highest densities of nests are laid; however, there are still lower survival rates of eggs and pre-emergent hatchlings due to excessive foot traffic (Ohmuta, 2006).

Loggerhead nesting habitat also has been lost at important rookeries in Miyazaki due in part to port construction that involved development of a groin of 1 kilometer from the coast into the sea, a yacht harbor with breakwaters and artificial beach, and an airport, causing erosion of beaches on both sides of the construction zone. This once excellent nesting habitat for loggerheads is now seriously threatened by erosion (Takeshita, 2006).

Minabe-Senri beach, Wakayama Prefecture is a "submajor" nesting beach (in Kamezaki *et al.*, 2003), but is one of the most important rookeries on the main island of Japan (Honshu). Based on unpublished data, Matsuzawa (2006) reported hatching success of unwashed-out clutches at Minabe-Senri beach to be 24 percent in 1996, 50 percent in 1997, 53 percent in 1998, 48 percent in 1999, 62 percent in 2000, 41 percent in 2001, and 34 percent in 2002.

Neritic/Oceanic Zones

Threats to habitat in the loggerhead neritic and oceanic zones in the North Pacific Ocean include fishing practices, channel dredging, sand extraction, marine pollution, and climate change. Fishing methods not only incidentally capture loggerheads, but also deplete invertebrate and fish populations and thus alter ecosystem dynamics. In many cases loggerhead foraging areas coincide with fishing zones. For example, using aerial surveys and satellite telemetry, juvenile foraging hotspots have recently been identified off the coast of Baja California, Mexico; these hotspots overlap with intensive small-scale fisheries (Peckham and Nichols, 2006; Peckham *et al.*, 2007, 2008). Comprehensive data currently are unavailable to fully understand how intense harvesting of fish resources changes neritic and oceanic ecosystems. Climate change also may result in future trophic changes, thus impacting loggerhead prey abundance and/or distribution.

In summary, we find that the North Pacific Ocean DPS of the loggerhead sea turtle is negatively affected by ongoing changes in both its terrestrial and marine habitats as a result of land and water use practices as considered above in Factor A. Within Factor A, we find that coastal development and coastal armoring on nesting beaches in Japan are significant threats to the persistence of this DPS.

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

In Japan, the use of loggerhead meat for food is not popular except historically in local communities such as Kochi and Wakayama prefectures. In addition, egg collection was common in the coastal areas during times of hunger and later by those who valued loggerhead eggs as revitalizers or aphrodisiacs and acquired them on the black market (in Kamezaki *et al.*, 2003; Takeshita, 2006). Currently, due in large part to research and conservation efforts throughout the country, egg harvesting no longer represents a problem in Japan (Kamezaki *et al.*, 2003; Ohmuta, 2006; Takeshita, 2006). Laws were enacted in 1973 to prohibit egg collection on Yakushima, and in 1988, the laws were extended to the entire Kagoshima Prefecture, where two of the most important loggerhead nesting beaches are protected (Matsuzawa, 2006).

Despite national laws, in many other countries where loggerheads are found migrating through or foraging, the hunting of adult and juvenile turtles is still a problem, as seen in Baja California Sur, Mexico (Koch *et al.*, 2006). Sea turtles have been protected in Mexico since 1990, when a Federal law decreed the prohibition of the "extraction, capture and pursuit of all species of sea turtle in Federal waters or from beaches within national territory * * * [and a requirement that] * * * any species of sea turtle incidentally captured during the operations of any commercial fishery shall be returned to the sea, independently of its physical state, dead or alive" (in Garcia-Martinez and Nichols, 2000). Despite the ban, studies have shown that sea turtles continue to be caught, both indirectly in fisheries and by a directed harvest of juvenile turtles. Turtles are principally hunted using nets, longlines, and harpoons. While some are killed immediately, others are kept alive in pens and transported to market. The market for sea turtles consists of two types: the local market (consumed locally) and the export market (sold to restaurants in Mexico cities such as Tijuana, Ensenada, and Mexicali, and U.S. cities such as San Diego and Tucson). Consumption is highest during holidays such as Easter and Christmas (Wildcoast/Grupo Tortuguero de las Californias, 2003).

Based on a combination of analyses of stranding data, beach and sea surveys, tag-recapture studies, and extensive interviews, all carried out between June 1994 and January 1999, Nichols (2003) conservatively estimated the annual take of sea turtles by various fisheries and through direct harvest in the Baja California, Mexico, region. Sea turtle mortality data collected between 1994 and 1999 indicated that over 90 percent of sea turtles recorded dead were either green turtles (30 percent of total) or loggerheads (61 percent of total), and signs of human consumption were evident in over half of the specimens. These studies resulted in an estimated 1,950 loggerheads killed annually, affecting primarily juvenile size classes. The primary causes for mortality were the incidental take in a variety of fishing gears and direct harvest for consumption and [illegal] trade (Nichols, 2003).

From April 2000 to July 2003 throughout the Bahia Magdalena region (including local beaches and towns), researchers found 1,945 sea turtle carcasses, 44.1 percent of which were loggerheads. Of the sea turtle carcasses found, slaughter for human consumption was the primary cause of death for all species (63 percent for loggerheads). Over 90 percent of all turtles found were juvenile turtles (Koch *et al.*, 2006). As the population of green turtles has declined in Baja California Sur waters, poachers have switched to loggerheads (H. Peckham, Pro Peninsula, personal communication, 2006).

In summary, overutilization for commercial purposes in both Japan and Mexico likely was a factor that contributed to the historic declines of this DPS. Current illegal harvest of loggerheads in Baja California for human consumption continues as a significant threat to the persistence of this DPS.

C. Disease or Predation

The potential exists for diseases and endoparasites to impact loggerheads found in the North Pacific Ocean. As in other nesting locations, egg predation also exists in Japan, particularly by raccoon dogs (*Nyctereutes procyonoides*) and weasels (*Mustela itatsi*); however, quantitative data do not exist to evaluate the impact on loggerhead populations (Kamezaki *et *al.*, 2003). Loggerheads in the North Pacific Ocean also may be impacted by harmful algal blooms.

In summary, although nest predation in Japan is known to occur, quantitative data are not sufficient to assess the degree of impact of nest predation on the persistence of this DPS.

D. Inadequacy of Existing Regulatory Mechanisms

International Instruments

The BRT identified several regulatory mechanisms that apply to loggerhead sea turtles globally and within the North Pacific Ocean. The reader is directed to sections 5.1.4. and 5.2.1.4. of the Status Review for a discussion of these regulatory mechanisms. Hykle (2002) and Tiwari (2002) have reviewed the effectiveness of some of these international instruments. The problems with existing international treaties are often that they have not realized their full potential, do not include some key countries, do not specifically address sea turtle conservation, and are handicapped by the lack of a sovereign authority to enforce environmental regulations. The ineffectiveness of international treaties and national legislation is oftentimes due to the lack of motivation or obligation by countries to implement and enforce them. A thorough discussion of this topic is available in a special 2002 issue of the Journal of International Wildlife Law and Policy: International Instruments and Marine Turtle Conservation (Hykle 2002).

National Legislation and Protection

Fishery bycatch that occurs throughout the North Pacific Ocean is substantial (*see* Factor E). Although national and international governmental and non-governmental entities on both sides of the North Pacific are currently working toward reducing loggerhead bycatch, and some positive actions have been implemented, it is unlikely that this source of mortality can be sufficiently reduced in the near future due to the challenges of mitigating illegal, unregulated, and unreported fisheries, the lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies.

In addition to fishery bycatch, coastal development and coastal armoring on nesting beaches in Japan continues as a substantial threat (*see* Factor A). Coastal armoring, if left unaddressed, will become an even more substantial threat as sea level rises. Recently, the Japan Ministry of Environment has supported the local non-governmental organization conducting turtle surveys and conservation on Yakushima in establishing guidelines for surveys and minimizing impacts by humans encroaching on the nesting beaches. As of the 2009 nesting season, humans accessing Inakahama, Maehama, and Yotsuse beaches at night must comply with the established rules (Y. Matsuzawa, Sea Turtle Association of Japan, personal communication, 2009).

In summary, our review of regulatory mechanisms under Factor D demonstrates that although regulatory mechanisms are in place that should address direct and incidental take of North Pacific Ocean loggerheads, these regulatory mechanisms are insufficient or are not being implemented effectively to address the needs of loggerheads. We find that the threats from the inadequacy of existing regulatory mechanisms for fishery bycatch (Factor E) and coastal development and coastal armoring (Factor A) are significant relative to the persistence of this DPS.

E. Other Natural or Manmade Factors Affecting its Continued Existence

Incidental Bycatch in Fishing Gear

Incidental capture in artisanal and commercial fisheries is a significant threat to the survival of loggerheads in the North Pacific. Sea turtles may be caught in pelagic and demersal longlines, drift and set gillnets, bottom and mid-water trawling, fishing dredges, pound nets and weirs, haul and purse seines, pots and traps, and hook and line gear.

Based on turtle sightings and capture rates reported in an April 1988 through March 1989 survey of fisheries research and training vessels and extrapolated to total longline fleet effort by the Japanese fleet in 1978, Nishemura and Nakahigashi (1990) estimated that 21,200 turtles, including greens, leatherbacks, loggerheads, olive ridleys, and hawksbills, were captured annually by Japanese tuna longliners in the western Pacific and South China Sea, with a reported mortality of approximately 12,300 turtles per year. Using commercial tuna longline logbooks, research vessel data, and questionnaires, Nishemura and Nakahigashi (1990) estimated that for every 10,000 hooks in the western Pacific and South China Sea, one turtle is captured, with a mortality rate of 42 percent. Although species-specific information on the bycatch is not available, vessels reported that 36 percent of the sightings of turtles in locations that overlap with these commercial fishing grounds were loggerheads.

Caution should be used in interpreting the results of Nishemura and Nakahigashi (1990), including estimates of sea turtle take rate (per number of hooks) and resultant mortality rate, and estimates of annual take by the fishery, for the following reasons: (1) The data collected were based on observations by training and research vessels, logbooks, and a questionnaire (*i.e.*, hypothetical), and do not represent actual, substantiated logged or observed catch of sea turtles by the fishery; (2) the authors assumed that turtles were distributed homogeneously; and (3) the authors used only one year (1978) to estimate total effort and distribution of the Japanese tuna longline fleet. Although the data and analyses provided by Nishemura and Nakahigashi (1990) are conjectural, longliners fishing in the Pacific have significantly impacted and, with the current level of effort, probably will continue to have significant impacts on sea turtle populations.

Foreign high-seas driftnet fishing in the North Pacific Ocean for squid, tuna, and billfish ended with a United Nations moratorium in December 1992. Except for observer data collected in 1990–1991, there is virtually no information on the incidental take of sea turtle species by the driftnet fisheries prior to the moratorium. The high-seas squid driftnet fishery in the North Pacific was observed in Japan, Korea, and Taiwan, while the large-mesh fisheries targeting tuna and billfish were observed in the Japanese fleet (1990–1991) and the Taiwanese fleet (1990). A combination of observer data and fleet effort statistics indicate that 2,986 loggerhead turtles were entangled by the combined fleets of Japan, Korea, and Taiwan from June 1990 through May 1991, when all fleets were monitored. Of these incidental entanglements, an estimated 805 loggerheads were killed (27 percent mortality rate) (Wetherall, 1997). Data on size composition of the turtles caught in the high-seas driftnet fisheries also were collected by observers. The majority of loggerheads measured by observers were juvenile (Wetherall, 1997). The cessation of high-seas driftnet fishing in 1992 should have reduced the incidental take of marine turtles. However, nations involved in driftnet fishing may have shifted to other gear types (*e.g.*, pelagic or demersal longlines, coastal gillnets); this shift in gear types could have resulted in either similar or increased turtle bycatch and associated mortality.

These rough mortality estimates for a single fishing season provide only a narrow glimpse of the impacts of the driftnet fishery on sea turtles, and a full assessment of impacts would consider the turtle mortality generated by the driftnet fleets over their entire range. Unfortunately, comprehensive data are lacking, but the observer data do indicate the possible magnitude of turtle mortality given the best information available. Wetherall *et al.* (1993) speculate that the actual mortality of sea turtles may have been between 2,500 and 9,000 per year, with most of the mortalities being loggerheads taken in the Japanese and Taiwanese large-mesh fisheries.

While a comprehensive, quantitative assessment of the impacts of the North Pacific driftnet fishery on turtles is impossible without a better understanding of turtle population abundance, genetic identities, exploitation history, and population dynamics, it is likely that the mortality inflicted by the driftnet fisheries in 1990 and in prior years was significant (Wetherall *et al.*, 1993), and the effects may still be evident in sea turtle populations today. The high mortality of juvenile turtles and reproductive adults in the high-seas driftnet fishery has probably altered the current age structure (especially if certain age groups were more vulnerable to driftnet fisheries) and therefore diminished or limited the reproductive potential of affected sea turtle populations.

Extensive ongoing studies regarding loggerhead mortality and bycatch have been administered off the coast of Baja California Sur, Mexico. The location and timing of loggerhead strandings documented in 2003–2005 along a 43-kilometer beach (Playa San Lazaro) indicated bycatch in local small-scale fisheries. In order to corroborate this, in 2005, researchers observed two small-scale fleets operating closest to an area identified as a high-use area for loggerheads. One fleet, based out of Puerto Lopez-Mateos, fished primarily for halibut using bottom set gillnets, soaking from 20 to 48 hours. This fleet consisted of up to 75 boats in 2005, and, on a given day, 9 to 40 vessels fished the deep area (32–45 meter depths). During a 2-month period, 11 loggerheads were observed taken in 73 gillnet day-trips, with eight of those loggerheads landed dead (observed mortality rate of 73 percent). The other fleet, based in Santa Rosa, fished primarily for demersal sharks using bottom-set longlines baited with tuna or mackerel and left to soak for 20 to 48 hours. In 2005, the fleet numbered only five to six vessels. During the seven daylong bottom-set longline trips observed, 26 loggerheads were taken, with 24 of them landed dead (observed mortality rate of 92 percent). Based on these observations, researchers estimated that in 2005 at least 299 loggerheads died in the bottom-set gillnet fishery and at least 680 loggerheads died in the bottom-set longline fishery. This annual bycatch estimate of approximately 1,000 loggerheads is considered a minimum and is also supported by shoreline mortality surveys and informal interviews (Peckham *et al.*, 2007).

These results suggest that incidental capture at Baja California Sur is one of the most significant sources of mortality identified for the North Pacific loggerhead population and underscores the importance of reducing bycatch in small-scale fisheries.

In the U.S. Pacific, longline fisheries targeting swordfish and tuna and drift gillnet fisheries targeting swordfish have been identified as the primary fisheries of concern for loggerheads. Bycatch of loggerhead turtles in these fisheries has been significantly reduced as a result of time-area closures, required gear modifications, and hard caps imposed on turtle bycatch, with 100 percent observer coverage in certain areas.

The California/Oregon (CA/OR) drift gillnet fishery targets swordfish and thresher shark off the west coast of the United States. The fishery has been observed by NMFS since July 1990 and currently averages 20 percent. From July 1990 to January 2000, the CA/OR drift gillnet fishery was observed to incidentally capture 17 loggerheads (12 released alive, 1 injured, and 4 killed). Based on a worst-case scenario, NMFS estimated that a maximum of 33 loggerheads in a given year could be incidentally taken by the CA/OR drift gillnet fleet. Sea turtle mortality rates for hard-shelled species were estimated to be 32 percent (NMFS, 2000).

In 2000, analyses conducted under the mandates of the ESA showed that the CA/OR drift gillnet fishery was taking excessive numbers of sea turtles, such that the fishery "jeopardized the continued existence of" loggerheads and leatherbacks. In this case, the consulting agency (NMFS) was required to provide a reasonable and prudent alternative to the action (*i.e.*, the fishery). In order to reduce the likelihood of interactions with loggerhead sea turtles, NMFS has regulations in place to close areas to drift gillnet fishing off southern California during forecasted or occurring El Niño events from June 1 through August 31, when loggerheads are likely to move into the area from the Pacific coast of Baja California following a preferred prey species, pelagic red crabs.

Prior to 2000, the Hawaii-based longline fishery targeted highly migratory species north of Hawaii using gear largely used by fleets around the world. From 1994–1999, the fishery was estimated to take between 369 and 501 loggerheads per year, with between 64 and 88 mortalities per year (NMFS, 2000). Currently, the Hawaii-based shallow longline fishery targeting swordfish is strictly regulated such that an annual take of 17 loggerheads is authorized for the fishery, beginning in 2004, when the fishery was re-opened after being closed for several years. In 2004 and 2005, the fishing year was completed without reaching the turtle take levels (1 and 10 loggerheads were captured, respectively, with fleets operating with 100 percent observer coverage). However, in 2006, 17 loggerheads were taken, forcing the fishery to be shut down early. In 2007, 15 loggerheads were taken by the fishery. Most loggerheads were released alive (NMFS-Pacific Islands Regional Office, Observer Database Public Web site, 2008).

Recent investigations off the coast of Japan, particularly focused off the main islands of Honshu, Shikoku, and Kyushu, have revealed a major threat to the more mature stage classes of loggerheads (approximately 70–80 cm SCL) due to pound net fisheries set offshore of the nesting beaches and in the coastal foraging areas. While pound nets constitute the third largest fishery in terms of metric tons of fish caught in Japan, they account for the majority of loggerhead bycatch by Japanese fisheries. Open-type pound nets studied in an area off Shikoku were shown to take loggerheads as the most prevalent sea turtle species caught but had lower mortality rates (less than 15 percent), primarily because turtles could reach the surface to breathe. Middle layer and bottom-type pound nets in particular have high rates of mortality (nearly 100 percent), because the nets are submerged and sea turtles are unable to reach the surface. Estimates of loggerhead mortality in one area studied between April 2006 and September 2007 were on the order of 100 individuals. While the fishing industry has an interest in changing its gear to open-type, it is very expensive, and the support from the Japanese government is limited (T. Ishihara, Sea Turtle Association of Japan, personal communication, 2007). Nonetheless, the BRT recognizes that coastal pound net fisheries off Japan may pose a significant threat to the North Pacific population of loggerheads.

Quantifying the magnitude of the threat of fisheries in the North Pacific Ocean on loggerhead sea turtles is very difficult given the low level of observer coverage or investigations into bycatch conducted by countries that have large fishing fleets. Efforts have been made to quantify the effect of pelagic longline fishing on loggerheads, and annual estimates of bycatch were on the order of over 10,000 sea turtles, with as many as 2,600 individual loggerheads killed annually through immediate or delayed mortality as a result of interacting with the gear (Lewison *et al.*, 2004).

Other Manmade and Natural Impacts

Similar to other areas of the world, climate change and sea level rise have the potential to impact loggerheads in the North Pacific Ocean. For example, Matsuzawa *et al.* (2002) found heat-related mortality of pre-emergent hatchlings in Minabe Senri Beach and concluded that this population is vulnerable to even small temperature increases resulting from global warming because sand temperatures already exceed the optimal thermal range for incubation. Recently, Chaloupka *et al.* (2008) used generalized additive regression modeling and autoregressive-prewhitened cross-correlation analysis to consider whether changes in regional ocean temperatures affect long-term nesting population dynamics for Pacific loggerheads from primary nesting assemblages in Japan and Australia. Researchers chose four nesting sites with a generally long time series to model, two in Japan (Kamouda rookery, declining population, and Yakushima rookery, generally increasing in the last 20 years), and two in Australia (Woongarra rookery, generally declining through early 1990s and beginning to recover, and Wreck Island rookery, which is generally declining). Analysis of 51 years of mean annual sea surface temperatures around two core foraging areas off Japan and eastern Australia, showed a general warming of the oceans in these regions. In general, nesting abundance for all four rookeries was inversely related to sea surface temperatures; that is, higher sea surface temperatures during the previous year in the core foraging area resulted in lower summer season nesting at all rookeries. Given that cooler ocean temperatures are generally associated with increased productivity and that female sea turtles generally require at least 1 year to acquire sufficient fat stores for vitellogenesis to occur in the foraging grounds, as well as the necessary energy required for migration, any lag in productivity due to warmer temperatures has physiological basis. Over the long term, warming ocean temperatures could therefore lead to lower productivity and prey abundance, and thus reduced nesting and recruitment by Pacific loggerheads (Chaloupka *et al.,* 2008).

Other anthropogenic impacts include boat strikes, ingestion of and entanglement in marine debris, and entrainment in coastal power plants.

Natural environmental events, such as cyclones and hurricanes, may affect loggerheads in the North Pacific Ocean. Typhoons also have been shown to cause severe beach erosion and negatively affect hatching success at many loggerhead nesting beaches in Japan, especially in areas already prone to erosion. For example, during the 2004 season, the Japanese archipelago suffered a record number of typhoons and many nests were drowned or washed out. Extreme sand temperatures at nesting beaches also create highly skewed female sex ratios of hatchlings or threaten the health of hatchlings. Without human intervention to protect clutches against some of these natural threats, many of these nests would be lost (Matsuzawa, 2006).

In summary, we find that the North Pacific Ocean DPS of the loggerhead sea turtle is negatively affected by both natural and manmade impacts as described above in Factor E. Within Factor E, we find that fishery bycatch that occurs throughout the North Pacific Ocean, including the coastal pound net fisheries off Japan, coastal fisheries impacting juvenile foraging populations off Baja California, Mexico, and undescribed fisheries likely affecting loggerheads in the South China Sea and the North Pacific Ocean, is a significant threat to the persistence of this DPS.

South Pacific Ocean DPS

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

Terrestrial Zone

Destruction and modification of loggerhead nesting habitat in the South Pacific result from coastal development and construction, placement of erosion control structures and other barriers to nesting, beachfront lighting, vehicular traffic, beach erosion, beach pollution, removal of native vegetation, and planting of non-native vegetation (NMFS and USFWS, 1998; Limpus, 2009).

Removal or destruction of native dune vegetation, which enhances beach stability and acts as an integral buffer zone between land and sea, results in erosion of nesting habitat. Preliminary studies on nesting beaches in New Caledonia include local oral histories that attribute the decrease in loggerhead nesting to the removal of vegetation for construction purposes and subsequent beach erosion (Limpus *et al.,* 2006).

Beach armoring presents a barrier to nesting in the South Pacific. On the primary nesting beach in New Caledonia, a rock wall was constructed to prevent coastal erosion, and sea turtle nesting attempts have been unsuccessful. Local residents are seeking authorization to extend the wall further down the beach (Limpus *et al.,* 2006).

Neritic/Oceanic Zones

Threats to habitat in the loggerhead neritic and oceanic zones in the South Pacific Ocean include fishing practices, channel dredging, sand extraction, marine pollution, and climate change. Climate change, for instance, may result in future trophic changes, thus impacting loggerhead prey abundance and/or distribution.

In summary, we find that the South Pacific Ocean DPS of the loggerhead sea turtle is negatively affected by ongoing changes in both its terrestrial and marine habitats as a result of land and water use practices as considered above in Factor A. Within Factor A, we find that coastal armoring and removal of native dune vegetation on nesting beaches are significant threats to the persistence of this DPS.

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

Legislation in Australia outlaws the harvesting of loggerheads by indigenous peoples (Limpus *et al.,* 2006). Despite national laws, in many areas the poaching of eggs and hunting of adult and juvenile turtles is still a problem, and Limpus (2009) suggests that the harvest rate of loggerheads by indigenous hunters, both within Australia and in neighboring countries, is on the order of 40 turtles per year. Preliminary studies suggest that local harvesting in New Caledonia constitutes about 5 percent of the nesting population (Limpus *et al.,* 2006). Loggerheads also are consumed after being captured incidentally in high-seas fisheries of the southeastern Pacific (Alfaro-Shigueto *et al.,* 2006), and occasionally may be the product of illegal trade throughout the region.

In summary, current illegal harvest of loggerheads in Australia and New Caledonia for human consumption, as well as the consumption of loggerheads incidentally taken in high-seas fisheries, continues as a significant threat to the persistence of this DPS.

C. Disease or Predation

The potential exists for diseases and endoparasites to impact loggerheads found in the South Pacific. While the prevalence of fibropapillomatosis in most loggerhead populations is thought to be small, an exception is in Moreton Bay, Australia, where 4.4 percent of the 320 loggerheads captured exhibited the disease during 1990–1992 (Limpus *et al.,* 1994). A subsequent study also found a high prevalence of fibropapillomatosis in the area (Quackenbush *et al.,* 2000).

Predation on nests and hatchlings by terrestrial vertebrates is a major problem at loggerhead rookeries in the South Pacific. At mainland rookeries in eastern Australia, for example, the introduced fox (*Vulpes vulpes*) has been the most significant predator on loggerhead eggs (Limpus, 1985, 2009). Although this has been minimized in recent years (to less than 5 percent; Limpus, 2009), researchers believe the earlier egg loss will greatly impact recruitment to this nesting population in the early 21st century (Limpus and Reimer, 1994). Predation on hatchlings by crabs and diurnal birds is also a threat (Limpus, 2009). In New Caledonia, feral dogs pose a predation threat to nesting loggerheads, and thus far no management has been implemented (Limpus *et al.,* 2006).

In summary, nest and hatchling predation likely was a factor that contributed to the historic decline of this DPS. Although current fox predation levels in eastern Australia are greatly reduced from historic levels, predation by other species still occurs, and predation by feral dogs in New Caledonia has not been addressed. In addition, a high prevalence of the fibropapillomatosis disease exists in Moreton Bay, Australia. Therefore, predation and disease are believed to be a significant threat to the persistence of this DPS.

D. Inadequacy of Existing Regulatory Mechanisms

International Instruments

The BRT identified several regulatory mechanisms that apply to loggerhead sea turtles globally and within the South Pacific Ocean. The reader is directed to sections 5.1.4. and 5.2.2.4. of the Status Review for a discussion of these regulatory mechanisms. Hykle (2002) and Tiwari (2002) have reviewed the effectiveness of some of these international instruments. The problems with existing international treaties are often that they have not realized their full potential, do not include some key countries, do not specifically address sea turtle conservation, and are handicapped by the lack of a sovereign authority to enforce environmental regulations. The ineffectiveness of international treaties and national legislation is oftentimes due to the lack of motivation or obligation by countries to implement and enforce them. A thorough discussion of this topic is available in a special 2002 issue of the Journal of International Wildlife Law and Policy: International Instruments and Marine Turtle Conservation (Hykle, 2002).

National Legislation and Protection

Fishery bycatch that occurs throughout the South Pacific Ocean is substantial (*see* Factor E). Although national and international governmental and non-governmental entities on both sides of the South Pacific are currently working toward reducing loggerhead bycatch, and some positive actions have been implemented, it is unlikely that this source of mortality can be sufficiently reduced in the near future due to the challenges of mitigating illegal, unregulated, and unreported fisheries, the continued expansion of artisanal fleets in the southeastern Pacific, the lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies.

In addition to fishery bycatch, coastal armoring and erosion resulting from the removal of native dune vegetation on nesting beaches continues as a substantial threat (*see* Factor A). Coastal armoring, if left unaddressed, will become an even more substantial threat as sea level rises.

In summary, our review of regulatory mechanisms under Factor D demonstrates that although regulatory mechanisms are in place that should address direct and incidental take of South Pacific Ocean loggerheads, these regulatory mechanisms are insufficient or are not being implemented effectively to address the needs of loggerheads. We find that the threat from the inadequacy of existing regulatory mechanisms for fishery bycatch (Factor E) and coastal armoring and removal of native dune vegetation (Factor A) is significant relative to the persistence of this DPS.

E. Other Natural or Manmade Factors Affecting its Continued Existence

Incidental Bycatch in Fishing Gear

Incidental capture in artisanal and commercial fisheries is a significant threat to the survival of loggerheads throughout the South Pacific. The primary gear types involved in these interactions include longlines, driftnets, set nets, and trawl fisheries. These are employed by both artisanal and industrial fleets, and target a wide variety of species including tunas, sharks, sardines, swordfish, and mahi mahi.

In the southwestern Pacific, bottom trawling gear has been a contributing factor to the decline in the eastern Australian loggerhead population (Limpus and Reimer, 1994). The northern Australian prawn fishery (NPF) is made up of both a banana prawn fishery and a tiger prawn fishery, and extends from Cape York, Queensland (142° E) to Cape Londonberry, Western Australia (127° E). The fishery is one of the most valuable in all of Australia and in 2000 comprised 121 vessels fishing approximately 16,000 fishing days (Robins *et al.,* 2002a). In 2000, the use of turtle excluder devices (TEDs) in the NPF was made mandatory, due in part to several factors: (1) Objectives of the Draft Australian Recovery Plan for Marine Turtles, (2) requirement of the Australian Environment Protection and Biodiversity Conservation Act for Commonwealth fisheries to become ecologically sustainable, and (3) the 1996 U.S. import embargo on wild-caught prawns taken in a fishery without adequate turtle bycatch management practices (Robins *et al.,* 2002a). Data primarily were collected by volunteer fishers who were trained extensively in the collection of scientific data on sea turtles caught as bycatch in their fishery. Prior to the use of TEDs in this fishery, the NPF annually took between 5,000 and 6,000 sea turtles as bycatch, with a mortality rate of an estimated 40 percent due to drowning, injuries, or being returned to the water comatose (Poiner and Harris, 1996). Since the mandatory use of TEDs has been in effect, the annual bycatch of sea turtles in the NPF has dropped to less than 200 sea turtles per year, with a mortality rate of approximately 22 percent (based on recent years). This lower mortality rate also may be based on better sea turtle handling techniques adopted by the fleet. In general, loggerheads were the third most common sea turtle taken in this fishery.

Loggerheads also are taken by longline fisheries operating out of

Australia (Limpus, 2009). For example, Robins *et al.* (2002b) estimate that approximately 400 turtles are killed annually in Australian pelagic longline fishery operations. Of this annual estimate, leatherbacks accounted for over 60 percent of this total, while unidentified hardshelled turtles accounted for the remaining species. Therefore, the effect of this longline fishery on loggerheads is unknown.

Loggerheads also have been the most common turtle species captured in shark control programs in Australia (Kidston *et al.,* 1992; Limpus, 2009). From 1998–2002, a total of 232 loggerheads was captured with 195 taken on drum lines and 37 taken in nets, both with a low level of direct mortality (Limpus, 2009).

In the southeastern Pacific, significant bycatch has been reported in artisanal gillnet and longline shark and mahi mahi fisheries operating out of Peru (Kelez *et al.,* 2003; Alfaro-Shigueto *et al.,* 2006) and, to a lesser extent, Chile (Donoso and Dutton, 2006). The fishing industry in Peru is the second largest economic activity in the country, and, over the past few years, the longline fishery has rapidly increased. Currently, nearly 600 longline vessels fish in the winter and over 1,300 vessels fish in the summer. During an observer program in 2003/2004, 588 sets were observed during 60 trips, and 154 sea turtles were taken as bycatch. Loggerheads were the species most often caught (73.4 percent). Of the loggerheads taken, 68 percent were entangled and 32 percent were hooked. Of the two fisheries, sea turtle bycatch was highest during the mahi mahi season, with 0.597 turtles/1,000 hooks, while the shark fishery caught 0.356 turtles/1,000 hooks (Alfaro-Shigueto *et al.,* 2008b). A separate study by Kelez *et al.* (2003) reported that approximately 30 percent of all turtles bycaught in Peru were loggerheads. In many cases, loggerheads are kept on board for human consumption; therefore, the mortality rate in this artisanal longline fishery is likely high because sea turtles are retained for future consumption or sale.

Data on loggerhead bycatch in Chile are limited to the industrial swordfish fleet. Since 1990, fleet size has ranged from 7 to 23 vessels with a mean of approximately 14 vessels per year. These vessels fish up to and over 1,000 nautical miles along the Chilean coast with mechanized sets numbering approximately 1,200 hooks (M. Donoso, ONG Pacifico Laud—Chile, personal communication, 2007). Loggerhead bycatch is present in Chilean fleets; however, the catch rate is substantially lower than that reported for Peru (P. Dutton, NMFS, and M. Donoso, ONG Pacifico Laud—Chile, unpublished data).

Other Manmade and Natural Impacts

Other threats such as debris ingestion, boat strikes, and port dredging also impact loggerheads in the South Pacific, although these threats have been minimized in recent years due to a variety of legislative actions (Limpus, 2009). Loggerhead mortality resulting from dredging of channels in Queensland is a persistent, albeit minor problem. From 1999–2002, the average annual reported mortality was 1.7 turtles per year (range = 1–3) from port dredging operations (Limpus, 2009). Climate change and sea level rise have the potential to impact loggerheads in the South Pacific Ocean, yet the impact of these threats has not been quantified.

Natural environmental events, such as cyclones or hurricanes, may affect loggerheads in the South Pacific Ocean. These types of events may disrupt loggerhead nesting activity, albeit on a temporary scale. Chaloupka *et al.* (2008) demonstrated that nesting abundance of loggerheads in Australia was inversely related to sea surface temperatures, and suggested that a long-term warming trend in the South Pacific may be adversely impacting the recovery potential of this population.

In summary, we find that the South Pacific Ocean DPS of the loggerhead sea turtle is negatively affected by both natural and manmade impacts as described above in Factor E. Within Factor E, we find that fishery bycatch that occurs throughout the South Pacific Ocean is a significant threat to the persistence of this DPS.

North Indian Ocean DPS

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

Terrestrial Zone

Destruction and modification of loggerhead nesting habitat in the North Indian Ocean result from coastal development and construction, beachfront lighting, vehicular and pedestrian traffic, beach pollution, removal of native vegetation, and planting of non-native vegetation (E. Possardt, USFWS, personal observation, 2008).

The primary loggerhead nesting beaches of this DPS are at Masirah Island, Oman, and are still relatively undeveloped but now facing increasing development pressures. Newly paved roads closely paralleling most of the Masirah Island coast are bringing newly constructed highway lights (E. Possardt, USFWS, personal observation, 2008) and greater access to nesting beaches by the public. Light pollution from the military installation at Masirah Island also is evident at the most densely nested northern end of the island and is a likely cause of hatchling misorientation and nesting female disturbance (E. Possardt, USFWS, personal observation, 2008). Beach driving occurs on most of the major beaches outside the military installation. This vehicular traffic creates ruts that obstruct hatchling movements (Mann, 1977; Hosier *et al.,* 1981; Cox *et al.,* 1994; Baldwin, 1992), tramples nests, and destroys vegetation and dune formation processes, which exacerbates light pollution effects. Free ranging camels, sheep, and goats overgraze beach vegetation, which impedes natural dune formation (E. Possardt, USFWS, personal observation, 2008). Development of a new hotel on a major loggerhead nesting beach at Masirah Island is near completion and, although not yet approved, there are plans for a major resort at an important loggerhead nesting beach on one of the Halaniyat Islands. Armoring structures common to many developed beaches throughout the world are not yet evident on the major loggerhead nesting beaches of this DPS.

Neritic/Oceanic Zones

Threats to habitat in the loggerhead neritic and oceanic zones in the North Indian Ocean include fishing practices, channel dredging, sand extraction, marine pollution, and climate change. Fishing methods not only incidentally capture loggerheads, but also deplete invertebrate and fish populations and thus alter ecosystem dynamics. In many cases loggerhead foraging areas coincide with fishing zones. There has been an apparent growth in artisanal and commercial fisheries in waters surrounding Masirah Island (Baldwin, 1992). Climate change also may result in future trophic changes, thus impacting loggerhead prey abundance and/or distribution.

In summary, we find that the North Indian Ocean DPS of the loggerhead sea turtle is negatively affected by ongoing changes in both its terrestrial and marine habitats as a result of land and water use practices as considered above in Factor A. Within Factor A, we find that coastal development, beachfront lighting, and vehicular beach driving on nesting beaches in Oman are significant threats to the persistence of this DPS.

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

The use of loggerhead meat for food in Oman is not legal or popular. However, routine egg collection on Masirah Island does occur (Baldwin, 1992). The extent of egg collection as estimated by Masirah rangers and local residents is approximately 2,000 clutches per year (less than 10 percent).

In summary, although the collection of eggs for human consumption is known to occur, it does not appear to be a significant threat to the persistence of this DPS.

C. Disease or Predation

The potential exists for diseases and endoparasites to impact loggerheads found in the North Indian Ocean. Natural egg predation on Oman loggerhead nesting beaches undoubtedly occurs, but is not well documented or believed to be significant. Predation on hatchlings by Arabian red fox (*Vulpes vulpes arabica*), ghost crabs (*Ocypode saratan*), night herons (*Nycticorax nycticorax*), and gulls (*Larus* spp.) likely occurs. While quantitative data do not exist to evaluate these impacts on the North Indian Ocean loggerhead population, they are not likely to be significant.

In summary, although nest predation is known to occur and hatchling predation is likely, quantitative data are not sufficient to assess the degree of impact of nest predation on the persistence of this DPS.

D. Inadequacy of Existing Regulatory Mechanisms

International Instruments

The BRT identified several regulatory mechanisms that apply to loggerhead sea turtles globally and within the North Indian Ocean. The reader is directed to sections 5.1.4. and 5.2.3.4. of the Status Review for a discussion of these regulatory mechanisms. Hykle (2002) and Tiwari (2002) have reviewed the effectiveness of some of these international instruments. The problems with existing international treaties are often that they have not realized their full potential, do not include some key countries, do not specifically address sea turtle conservation, and are handicapped by the lack of a sovereign authority to enforce environmental regulations. The ineffectiveness of international treaties and national legislation is oftentimes due to the lack of motivation or obligation by countries to implement and enforce them. A thorough discussion of this topic is available in a special 2002 issue of the Journal of International Wildlife Law and Policy: International Instruments and Marine Turtle Conservation (Hykle 2002).

National Legislation and Protection

Impacts to loggerheads and loggerhead nesting habitat from coastal development, beachfront lighting, and vehicular beach driving on nesting beaches in Oman is substantial (*see* Factor A). In addition, fishery bycatch that occurs throughout the North Indian Ocean, although not quantified, is a likely substantial (*see* Factor E). Threats to nesting beaches are likely to increase, which would require additional and widespread nesting beach protection efforts (Factor A). Little is currently being done to monitor and reduce mortality from neritic and oceanic fisheries in the range of the North Indian Ocean DPS; this mortality is likely to continue and increase with expected additional fishing effort from commercial and artisanal fisheries (Factor E). Reduction of mortality would be difficult due to a lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies.

In summary, our review of regulatory mechanisms under Factor D demonstrates that although regulatory mechanisms are in place that should address direct and incidental take of North Indian Ocean loggerheads, these regulatory mechanisms are insufficient or are not being implemented effectively to address the needs of loggerheads. We find that the threat from the inadequacy of existing regulatory mechanisms for fishery bycatch (Factor E) and coastal development, beachfront lighting, and vehicular beach driving (Factor A) is significant relative to the persistence of this DPS.

E. Other Natural or Manmade Factors Affecting Its Continued Existence

Incidental Bycatch in Fishing Gear

The magnitude of the threat of incidental capture of sea turtles in artisanal and commercial fisheries in the North Indian Ocean is difficult to assess. A bycatch survey administered off the coast of Sri Lanka between September 1999 and November 2000 reported 5,241 total turtle entanglements, of which 1,310 were loggerheads, between Kalpitiya and Kirinda (Kapurusinghe and Saman, 2001; Kapurusinghe and Cooray, 2002). Sea turtle bycatch has been reported in driftnet and set gillnets, longlines, trawls, and hook and line gear (Kapurusinghe and Saman, 2001; Kapurusinghe and Cooray, 2002; Lewison *et al.,* 2004).

Quantifying the magnitude of the threat of fisheries on loggerheads in the North Indian Ocean is difficult given the low level of observer coverage or investigations into bycatch conducted by countries that have large fishing fleets. Efforts have been made to quantify the effects of pelagic longline fishing on loggerheads globally (Lewison *et al.,* 2004). While there were no turtle bycatch data available from the North Indian Ocean to use in their assessment, extrapolations that considered bycatch data for the Pacific and Atlantic basins gave a conservative estimate of 6,000 loggerheads captured in the Indian Ocean in the year 2000. Interviews with rangers at Masirah Island reveal that shark gillnets capture many loggerheads off nesting beaches during the nesting season. As many as 60 boats are involved in this fishery with up to 6 km of gillnets being fished daily from June through October along the Masirah Island coast. Rangers reported one example of 17 loggerheads in one net (E. Possardt, USFWS, personal communication, 2008).

Other Manmade and Natural Impacts

Other anthropogenic impacts, such as boat strikes and ingestion or entanglement in marine debris, as well as entrainment in coastal power plants, likely apply to loggerheads in the North Indian Ocean. Similar to other areas of the world, climate change and sea level rise have the potential to impact loggerheads in the North Indian Ocean. This includes beach erosion and loss from rising sea levels, skewed hatchling sex ratios from rising beach incubation temperatures, and abrupt disruption of ocean currents used for natural dispersal during the complex life cycle. Climate change impacts could have profound long-term impacts on nesting populations in the North Indian Ocean, but it is not possible to quantify the potential impacts at this point in time.

Natural environmental events, such as cyclones, tsunamis, and hurricanes, affect loggerheads in the North Indian Ocean. For example, during the 2007 season, Oman suffered a rare typhoon. In general, however, severe storm events are episodic and, although they may affect loggerhead hatchling production, the results are generally localized and they rarely result in whole-scale losses over multiple nesting seasons.

In summary, we find that the North Indian Ocean DPS of the loggerhead sea turtle is negatively affected by both natural and manmade impacts as described above in Factor E. Within Factor E, we find that fishery bycatch that occurs throughout the North Indian Ocean, although not quantified, is a likely a significant threat to the persistence of this DPS.

Southeast-Indo Pacific Ocean DPS

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

Terrestrial Zone

The primary loggerhead nesting beaches for this DPS occur in Australia on Dirk Hartog Island and Murion Islands (Baldwin *et al.,* 2003), which are undeveloped. Dirk Hartog Island is soon to become part of the National Park System.

Neritic/Oceanic Zones

Threats to habitat in the loggerhead neritic and oceanic zones in the Southeast-Indo Pacific Ocean include fishing practices, channel dredging, sand extraction, marine pollution, and climate change. Fishing methods not only incidentally capture loggerheads, but also deplete invertebrate and fish populations and thus alter ecosystem dynamics. In many cases, loggerhead foraging areas coincide with fishing zones. Climate change also may result in future trophic changes, thus impacting loggerhead prey abundance and/or distribution.

In summary, we find that the Southeast Indo-Pacific Ocean DPS of the loggerhead sea turtle is negatively affected by ongoing changes in its marine habitats as a result of land and water use practices as considered above in Factor A. However, sufficient data are not available to assess the significance of these threats to the persistence of this DPS.

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

Legislation in Australia outlaws the harvesting of loggerheads by indigenous peoples (Limpus *et al.,* 2006). Dirk Hartog Island and Murion Islands are largely uninhabited, and poaching of eggs and turtles is likely negligible.

In summary, harvest of eggs and turtles is believed to be negligible and does not appear to be a threat to the persistence of this DPS.

C. Disease or Predation

The potential exists for diseases and endoparasites to impact loggerheads found in the Southeast Indo-Pacific Ocean. On the North West Cape and the beaches of the Ningaloo coast of mainland Australia, a long established feral European red fox (*Vulpes vulpes*) population preyed heavily on eggs and is thought to be responsible for the lower numbers of nesting turtles on the mainland beaches (Baldwin *et al.,* 2003). The fox populations have been eradicated on Dirk Hartog Island and Murion Islands (Baldwin *et al.,* 2003).

In summary, nest predation likely was a factor that contributed to the historic decline of this DPS. However, foxes have been eradicated on Dirk Hartog Island and Murion Islands, and current fox predation levels on mainland beaches in western Australia are greatly reduced from historic levels. Therefore, predation no longer appears to be a significant threat to the persistence of this DPS.

D. Inadequacy of Existing Regulatory Mechanisms

International Instruments

The BRT identified several regulatory mechanisms that apply to loggerhead sea turtles globally and within the Southeast Indo-Pacific Ocean. The reader is directed to sections 5.1.4. and 5.2.4.4. of the Status Review for a discussion of these regulatory mechanisms. Hykle (2002) and Tiwari (2002) have reviewed the effectiveness of some of these international instruments. The problems with existing international treaties are often that they have not realized their full potential, do not include some key countries, do not specifically address sea turtle conservation, and are handicapped by the lack of a sovereign authority to enforce environmental regulations. The ineffectiveness of international treaties and national legislation is oftentimes due to the lack of motivation or obligation by countries to implement and enforce them. A thorough discussion of this topic is available in a special 2002 issue of the Journal of International Wildlife Law and Policy: International Instruments and Marine Turtle Conservation (Hykle 2002).

National Legislation and Protection

Fishery bycatch that occurs throughout the Southeast Indo-Pacific Ocean, although not quantified, is a likely substantial (*see* Factor E). With the exception of efforts to reduce loggerhead bycatch in the northern Australian prawn fishery, little is currently being done to monitor and reduce mortality from neritic and oceanic fisheries in the range of the Southeast Indo-Pacific Ocean DPS. This mortality is likely to continue and increase with expected additional fishing effort from commercial and artisanal fisheries (Factor E). Although national and international governmental and non-governmental entities are currently working toward reducing loggerhead bycatch, and some positive actions have been implemented, it is unlikely that this source of mortality can be sufficiently reduced in the near future due to the challenges of mitigating illegal, unregulated, and unreported fisheries, the continued expansion of artisanal fleets, the lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies.

In summary, our review of regulatory mechanisms under Factor D demonstrates that although regulatory mechanisms are in place that should address direct and incidental take of Southeast Indo-Pacific Ocean loggerheads, these regulatory mechanisms are insufficient or are not being implemented effectively to address the needs of loggerheads. We find that the threat from the inadequacy of existing regulatory mechanisms for fishery bycatch (Factor E) is significant relative to the persistence of this DPS.

E. Other Natural or Manmade Factors Affecting Its Continued Existence

Incidental Bycatch in Fishing Gear

The extent of the threat of incidental capture of sea turtles in artisanal and commercial fisheries in the Southeast Indo-Pacific Ocean is unknown. Sea turtles are caught in pelagic and demersal longlines, gillnets, trawls, seines, and pots and traps (Environment Australia, 2003). There is evidence of significant historic bycatch from prawn fisheries, which may have depleted nesting populations long before nesting surveys were initiated in the 1990s (Baldwin *et al.,* 2003).

Quantifying the magnitude of the threat of fisheries on loggerheads in the Southeast Indo-Pacific Ocean is very difficult given the low level of observer coverage or investigations into bycatch conducted by countries that have large fishing fleets. Efforts have been made to quantify the effects of pelagic longline fishing on loggerheads globally (Lewison *et al.,* 2004). While there were no turtle bycatch data available from the Southeast Indo-Pacific Ocean to use in their assessment, extrapolations that considered bycatch data for the Pacific and Atlantic basins gave a conservative estimate of 6,000 loggerheads captured in the Indian Ocean in the year 2000. Loggerheads are known to be taken by Japanese longline fisheries operating off of Western Australia (Limpus, 2009). The effect of the longline fishery on loggerheads in the Indian Ocean is largely unknown (Lewison *et al.,* 2004).

The northern Australian prawn fishery (NPF) is made up of both a banana prawn fishery and a tiger prawn fishery, and extends from Cape York, Queensland (142° E) to Cape Londonberry, Western Australia (127° E). The fishery is one of the most valuable in all of Australia and in 2000 comprised 121 vessels fishing approximately 16,000 fishing days (Robins *et al.,* 2002a). In 2000, the use of turtle excluder devices in the NPF was made mandatory, due in part to several factors: (1) Objectives of the Draft Australian Recovery Plan for Marine Turtles, (2) requirement of the Australian Environment Protection and Biodiversity Conservation Act for Commonwealth fisheries to become ecologically sustainable, and (3) the 1996 U.S. import embargo on wild-caught prawns taken in a fishery without adequate turtle bycatch management practices (Robins *et al.,* 2002a). Data primarily were collected by volunteer fishers who were trained extensively in the collection of scientific data on sea turtles caught as bycatch in their fishery. Prior to the use of TEDs in this fishery, the NPF annually took between 5,000 and 6,000 sea turtles as bycatch, with a mortality rate of an estimated 40 percent, due to drowning, injuries, or being returned to the water comatose (Poiner and Harris, 1996). Since the mandatory use of TEDs has been in effect, the annual bycatch of sea turtles in the NPF has dropped to less than 200 sea turtles per year, with a mortality rate of approximately 22 percent (based on recent years). This lower mortality rate also may be based on better sea turtle handling techniques adopted by the fleet. In general, loggerheads were the third most common sea turtle taken in this fishery.

Loggerheads also have been the most common turtle species captured in shark control programs in Pacific Australia (Kidston *et al.,* 1992; Limpus, 2009); however, the Western Australian demersal longline fishery for sharks has no recorded interaction with loggerheads. From 1998–2002, a total of 232 loggerheads were captured, with 195 taken on drum lines and 37 taken in nets, both with a low level of direct mortality (Limpus, 2009).

Other Manmade and Natural Impacts

Other anthropogenic impacts, such as boat strikes and ingestion or entanglement in marine debris, likely apply to loggerheads in the Southeast Indo-Pacific Ocean. Similar to other areas of the world, climate change and sea level rise have the potential to impact loggerheads in the Southeast Indo-Pacific Ocean. This includes beach erosion and loss from rising sea levels, skewed hatchling sex ratios from rising beach incubation temperatures, and abrupt disruption of ocean currents used for natural dispersal during the complex life cycle. Climate change impacts could have profound long-term impacts on nesting populations in the Southeast Indo-Pacific Ocean, but it is not possible to quantify the potential impacts at this point in time.

Natural environmental events, such as cyclones and hurricanes, may affect loggerheads in the Southeast Indo-Pacific Ocean. In general, however, severe storm events are episodic and, although they may affect loggerhead hatchling production, the results are generally localized and they rarely result in whole-scale losses over multiple nesting seasons.

In summary, we find that the Southeast Indo-Pacific Ocean DPS of the loggerhead sea turtle is negatively affected by both natural and manmade impacts as described above in Factor E. Within Factor E, we find that fishery bycatch, particularly from the northern Australian prawn fishery, was a factor that contributed to the historic decline of this DPS. Although loggerhead bycatch has been greatly reduced in the northern Australian prawn fishery, bycatch that occurs elsewhere in the Southeast Indo-Pacific Ocean, although not quantified, is likely a significant threat to the persistence of this DPS.

Southwest Indian Ocean DPS

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

Terrestrial Zone

All nesting beaches within South Africa are within protected areas (Baldwin *et al.*, 2003). In Mozambique, nesting beaches in the Maputo Special Reserve (approximately 60 km of nesting beach) and in the Paradise Islands are within protected areas (Baldwin *et al.*, 2003; Costa *et al.*, 2007). There are no protected areas for loggerheads in Madagascar (Baldwin *et al.*, 2003).

Neritic/Oceanic Zones

Threats to habitat in the loggerhead neritic and oceanic zones in the Southwest Indian Ocean DPS include fishing practices, channel dredging, sand extraction, marine pollution, and climate change. Fishing methods not only incidentally capture loggerheads, but also deplete invertebrate and fish populations and thus alter ecosystem dynamics. In many cases, loggerhead foraging areas coincide with fishing zones. Climate change also may result in future trophic changes, thus impacting loggerhead prey abundance and/or distribution.

In summary, we find that the Southwest Indian Ocean DPS of the loggerhead sea turtle is negatively affected by ongoing changes in its marine habitats as a result of land and water use practices as considered above in Factor A. However, sufficient data are not available to assess the significance of these threats to the persistence of this DPS.

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

In the Southwest Indian Ocean, on the east coast of Africa, subsistence hunting by local people is a continued threat to loggerheads (Baldwin *et al.*, 2003). Illegal hunting of marine turtles and egg harvesting remains a threat in Mozambique as well (Louro *et al.*, 2006).

In summary, harvest of loggerheads and eggs for human consumption on the east coast of Africa, although not quantified, is likely a significant threat to the persistence of this DPS.

C. Disease or Predation

The potential exists for diseases and endoparasites to impact loggerheads found in the Southwest Indian Ocean. Side striped jackals (*Canis adustus*) and honey badgers (*Melivora capensis*) are known to depredate nests (Baldwin *et al.*, 2003).

In summary, although nest predation is known to occur, quantitative data are not sufficient to assess the degree of impact of nest predation on the persistence of this DPS.

D. Inadequacy of Existing Regulatory Mechanisms

International Instruments

The BRT identified several regulatory mechanisms that apply to loggerhead sea turtles globally and within the Southwest Indian Ocean. The reader is directed to sections 5.1.4. and 5.2.5.4. of the Status Review for a discussion of these regulatory mechanisms. Hykle (2002) and Tiwari (2002) have reviewed the effectiveness of some of these international instruments. The problems with existing international treaties are often that they have not realized their full potential, do not include some key countries, do not specifically address sea turtle conservation, and are handicapped by the lack of a sovereign authority to enforce environmental regulations. The ineffectiveness of international treaties and national legislation is oftentimes due to the lack of motivation or obligation by countries to implement and enforce them. A thorough discussion of this topic is available in a special 2002 issue of the Journal of International Wildlife Law and Policy: International Instruments and Marine Turtle Conservation (Hykle, 2002).

National Legislation and Protection

Fishery bycatch that occurs throughout the Southwest Indian Ocean, although not quantified, is likely substantial (*see* Factor E). This mortality is likely to continue and may increase with expected additional fishing effort from commercial and artisanal fisheries. Reduction of mortality would be difficult due to a lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies.

In summary, our review of regulatory mechanisms under Factor D demonstrates that although regulatory mechanisms are in place that should address direct and incidental take of Southwest Indian Ocean loggerheads, these regulatory mechanisms are insufficient or are not being implemented effectively to address the needs of loggerheads. We find that the threat from the inadequacy of existing regulatory mechanisms for fishery bycatch (Factor E) is significant relative to the persistence of this DPS.

E. Other Natural or Manmade Factors Affecting Its Continued Existence

Incidental Bycatch in Fishing Gear

The full extent of the threat of incidental capture of sea turtles in artisanal and commercial fisheries in the Southwest Indian Ocean is unknown. Sea turtles are caught in demersal and pelagic longlines, trawls, gillnets, and seines (Petersen, 2005; Louro *et al.*, 2006; Petersen *et al.*, 2007, 2009; Costa *et al.*, 2007; Fennessy and Isaksen, 2007). There is evidence of significant historic bycatch from prawn fisheries, which may have depleted nesting populations long before nesting surveys were initiated in the 1990s (Baldwin *et al.*, 2003).

Quantifying the magnitude of the threat of fisheries on loggerheads in the Southwest Indian Ocean is very difficult given the low level of observer coverage or investigations into bycatch conducted by countries that have large fishing fleets. Efforts have been made to quantify the effects of pelagic longline fishing on loggerheads globally (Lewison *et al.*, 2004). While there were no turtle bycatch data available from the Southwest Indian Ocean to use in their assessment, extrapolations that considered bycatch data for the Pacific and Atlantic basins gave a conservative estimate of 6,000 loggerheads captured in the Indian Ocean in the year 2000. The effect of the longline fishery on loggerheads in the Indian Ocean is largely unknown (Lewison *et al.*, 2004).

Other Manmade and Natural Impacts

Other anthropogenic impacts, such as boat strikes and ingestion or entanglement in marine debris, likely apply to loggerheads in the Southwest Indian Ocean. Similar to other areas of the world, climate change and sea level rise have the potential to impact loggerheads in the Southwest Indian Ocean. This includes beach erosion and loss from rising sea levels, skewed hatchling sex ratios from rising beach incubation temperatures, and abrupt disruption of ocean currents used for natural dispersal during the complex life cycle. Climate change impacts could have profound long-term impacts on nesting populations in the Southwest Indian Ocean, but it is not possible to quantify the potential impacts at this point in time.

Natural environmental events, such as cyclones, tsunamis and hurricanes, may affect loggerheads in the Southwest Indian Ocean. In general, however, severe storm events are episodic and, although they may affect loggerhead hatchling production, the results are generally localized and they rarely result in whole-scale losses over multiple nesting seasons.

In summary, we find that the Southwest Indian Ocean DPS of the loggerhead sea turtle is negatively affected by both natural and manmade impacts as described above in Factor E. Within Factor E, we find that fishery bycatch that occurs throughout the Southwest Indian Ocean, although not quantified, is likely a significant threat to the persistence of this DPS.

Northwest Atlantic Ocean DPS

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

Terrestrial Zone

Destruction and modification of loggerhead nesting habitat in the Northwest Atlantic results from coastal development and construction, placement of erosion control structures and other barriers to nesting, placement of nearshore shoreline stabilization structures, beachfront lighting, vehicular and pedestrian traffic, beach erosion, beach sand placement, removal of native vegetation, and planting of non-native vegetation (NMFS and USFWS, 2008).

Numerous beaches in the southeastern United States are eroding due to both natural (*e.g.*, storms, sea level changes, waves, shoreline geology) and anthropogenic (*e.g.*, construction of armoring structures, groins, and jetties; coastal development; inlet dredging) factors. Such shoreline erosion leads to a loss of nesting habitat for sea turtles.

In the southeastern United States, numerous erosion control structures (*e.g.*, bulkheads, seawalls, soil retaining walls, rock revetments, sandbags, geotextile tubes) that create barriers to nesting have been constructed. The proportion of coastline that is armored is approximately 18 percent (239 km) in Florida (Clark, 1992; Schroeder and Mosier, 2000; Witherington *et al.*, 2006), 9 percent (14 km) in Georgia (M. Dodd, GDNR, personal communication, 2009), 12 percent (29 km) in South Carolina (D. Griffin, SCDNR, personal communication, 2009), and 3 percent (9 km) in North Carolina (M. Godfrey, North Carolina Wildlife Resources Commission, 2009). These estimates of armoring extent do not include structures that are also barriers to sea turtle nesting but do not fit the definition of armoring, such as dune crossovers, cabanas, sand fences, and recreational equipment. Jetties have been placed at many ocean inlets along the U.S. Atlantic coast to keep transported sand from closing the inlet channel. Witherington *et al.* (2005) found a significant negative relationship between loggerhead nesting density and distance from the nearest of 17 ocean inlets on the Atlantic coast of Florida. The effect of inlets in lowering nesting density was observed both updrift and downdrift of the inlets, leading researchers to propose that beach instability from both erosion and accretion may discourage loggerhead nesting.

Stormwater and other water source runoff from coastal development, including beachfront parking lots, building rooftops, roads, decks, and draining swimming pools adjacent to the beach, is frequently discharged directly onto Northwest Atlantic beaches and dunes either by sheet flow, through stormwater collection system outfalls, or through small diameter pipes. These outfalls create localized erosion channels, prevent natural dune establishment, and wash out sea turtle nests (Florida Fish and Wildlife Conservation Commission, unpublished data). Contaminants contained in stormwater, such as oils, grease, antifreeze, gasoline, metals, pesticides, chlorine, and nutrients, are also discharged onto the beach and have the potential to affect sea turtle nests and emergent hatchlings. The effects of these contaminants on loggerheads are not yet understood. As a result of natural and anthropogenic factors, beach nourishment is a frequent activity, and many beaches are on a periodic nourishment schedule. On severely eroded sections of beach, where little or no suitable nesting habitat previously existed, beach nourishment has been found to result in increased nesting (Ernest and Martin, 1999). However, on most beaches in the southeastern United States, nesting success typically declines for the first year or two following construction, even though more nesting habitat is available for turtles (Trindell *et al.*, 1998; Ernest and Martin, 1999; Herren, 1999).

Coastal development also contributes to habitat degradation by increasing light pollution. Both nesting and hatchling sea turtles are adversely affected by the presence of artificial lighting on or near the beach (Witherington and Martin, 1996). Experimental studies have shown that artificial lighting deters adult female turtles from emerging from the ocean to nest (Witherington, 1992). Witherington (1986) also noted that loggerheads aborted nesting attempts at a greater frequency in lighted areas. Because adult females rely on visual brightness cues to find their way back to the ocean after nesting, those turtles that nest on lighted beaches may become disoriented (unable to maintain constant directional movement) or misoriented (able to maintain constant directional movement but in the wrong direction) by artificial lighting and have difficulty finding their way back to the ocean. In some cases, misdirected nesting females have crawled onto coastal highways and have been struck and killed by vehicles (FFWCC, unpublished data).

Hatchlings exhibit a robust sea-finding behavior guided by visual cues (Witherington and Bjorndal 1991; Salmon *et al.*, 1992; Lohmann *et al.*, 1997; Witherington and Martin, 1996; Lohmann and Lohmann, 2003); direct and timely migration from the nest to sea is critical to their survival. Hatchlings have a tendency to orient toward the brightest direction as integrated over a broad horizontal area. On natural undeveloped beaches, the brightest direction is commonly away from elevated shapes (*e.g.*, dune, vegetation, *etc.*) and their silhouettes and toward the broad open horizon of the sea. On developed beaches, the brightest direction is often away from the ocean and toward lighted structures. Hatchlings unable to find the ocean, or delayed in reaching it, are likely to incur high mortality from dehydration, exhaustion, or predation (Carr and Ogren, 1960; Ehrhart and Witherington, 1987; Witherington and Martin, 1996). Hatchlings lured into lighted parking lots or toward streetlights are often crushed by passing vehicles (McFarlane, 1963; Philibosian, 1976; Peters and Verhoeven, 1994; Witherington and Martin, 1996). Uncommonly intense artificial lighting can even draw hatchlings back out of the surf (Daniel and Smith, 1947; Carr and Ogren, 1960; Ehrhart and Witherington, 1987).

Reports of hatchling disorientation events in Florida alone describe several hundred nests each year and are likely to involve tens of thousands of hatchlings (Nelson *et al.*, 2002); however, this number calculated is likely a vast underestimate. Independent of these reports, Witherington *et al.* (1996) surveyed hatchling orientation at nests located at 23 representative beaches in six counties around Florida in 1993 and 1994 and found that, by county, approximately 10 to 30 percent of nests showed evidence of hatchlings disoriented by lighting. From this survey and from measures of hatchling production (Florida Fish and Wildlife Conservation Commission, unpublished data), the number of hatchlings disoriented by lighting in Florida is calculated in the range of hundreds of thousands per year.

In the United States, vehicular driving is allowed on certain beaches in northeast Florida (Nassau, Duval, St. Johns, and Volusia Counties), northwest Florida (Walton and Gulf Counties), Georgia (Cumberland, Little Cumberland, and Sapelo Islands), North Carolina (Fort Fisher State Recreation Area, Carolina Beach, Freeman Park, Onslow Beach, Emerald Isle, Indian Beach/Salter Path, Pine Knoll Shores, Atlantic Beach, Cape Lookout National Seashore, Cape Hatteras National Seashore, Nag's Head, Kill Devil Hills, Town of Duck, and Currituck Banks), Virginia (Chincoteague NWR and Wallops Island), and Texas (the majority of beaches except for a highly developed section of South Padre Island and Padre Island National Seashore, San Jose Island, Matagorda Island, and Matagorda Peninsula where driving is not allowed or is limited to agency personnel, land owners, and/or researchers). Beach driving has been found to reduce the quality of loggerhead nesting habitat in several ways. In the southeastern U.S., vehicle ruts on the beach have been found to prevent or impede hatchlings from reaching the ocean following emergence from the nest (Mann, 1977; Hosier *et al.*, 1981; Cox *et al.*, 1994; Hughes and Caine, 1994). Sand compaction by vehicles has been found to hinder nest construction and hatchling emergence from nests (Mann, 1977). Vehicle lights and vehicle movement on the beach after dark results in reduced habitat suitability, which can deter females from nesting and disorient hatchlings. Additionally, vehicle traffic on nesting beaches contributes to erosion, especially during high tides or on narrow beaches where driving is concentrated on the high beach and foredune.

Neritic/Oceanic Zones

Threats to habitat in the loggerhead neritic and oceanic zones in the Northwest Atlantic Ocean include fishing practices, channel dredging, sand extraction, oil exploration and development, marine pollution, and climate change. Fishing methods not only incidentally capture loggerheads, but also deplete invertebrate and fish populations and thus alter ecosystem dynamics. Although anthropogenic disruptions of natural ecological interactions have been difficult to discern, a few studies have been focused on the effects of these disruptions on loggerheads. For instance, Youngkin (2001) analyzed gut contents from hundreds of loggerheads stranded in Georgia over a 20-year period. His findings point to the probability of major effects on loggerhead diet from activities such as shrimp trawling and dredging. Lutcavage and Musick (1985) found that horseshoe crabs strongly dominated the diet of loggerheads in Chesapeake Bay in 1980–1981. Subsequently, fishermen began to harvest horseshoe crabs, primarily for use as bait in the eel and whelk pot fisheries, using several gear types. Atlantic coast horseshoe crab landings increased by an order of magnitude (0.5 to 6.0 million pounds) between 1980 and 1997, and in 1998 the Atlantic States Marine Fisheries Commission implemented a horseshoe crab fishery management plan to curtail catches (Atlantic States Marine Fisheries Commission, 1998). The decline in horseshoe crab availability has apparently caused a diet shift in juvenile loggerheads, from predominantly horseshoe crabs in the early to mid-1980s to blue crabs in the late 1980s and early 1990s, to mostly finfish in the late 1990s and early 2000s (Seney, 2003; Seney and Musick, 2007). These data suggest that turtles are foraging in greater numbers in or around fishing gears and on discarded bycatch (Seney, 2003).

Periodic dredging of sediments from navigational channels is carried out at large ports to provide for the passage of large commercial and military vessels. In addition, sand mining (dredging) for beach renourishment and construction projects occurs in the Northwest Atlantic along the U.S., Mexico, Central American, Colombia, and Venezuela coasts. Although directed studies have not been conducted, dredging activities, which occur regularly in the Northwest Atlantic, have the potential to destroy or degrade benthic habitats used by loggerheads. Channelization of inshore and nearshore habitat and the subsequent disposal of dredged material in the marine environment can destroy or disrupt resting or foraging grounds (including grass beds and coral reefs) and may affect nesting distribution by altering physical features in the marine environment (Hopkins and Murphy, 1980). Oil exploration and development on live bottom areas may disrupt foraging grounds by smothering benthic organisms with sediments and drilling muds (Coston-Clements and Hoss, 1983). The effects of benthic habitat alteration on loggerhead prey abundance and distribution, and the effects of these potential changes on loggerhead populations, have not been determined but are of concern. Climate change also may result in trophic changes, thus impacting loggerhead prey abundance and/or distribution.

In summary, we find that the Northwest Atlantic Ocean DPS of the loggerhead sea turtle is negatively affected by ongoing changes in both its terrestrial and marine habitats as a result of land and water use practices as considered above in Factor A. Within Factor A, we find that coastal development, beachfront lighting, and coastal armoring and other erosion control structures on nesting beaches in the United States are significant threats to the persistence of this DPS. We also find that anthropogenic disruptions of natural ecological interactions as a result of fishing practices, channel dredging, and oil exploration and development are likely a significant threat to the persistence of this DPS.

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

Deliberate hunting of loggerheads for their meat, shells, and eggs is reduced from previous exploitation levels, but still exists. In the Caribbean, 12 of 29 (41 percent) countries/territories allow the harvest of loggerheads (NMFS and USFWS, 2008; *see* Appendix 3; A. Bolten, University of Florida, personal communication, 2009); this takes into account the September 2009 ban on the harvest of sea turtles in The Bahamas. Loggerhead harvest in the Caribbean is generally restricted to the non-nesting season with the exception of St. Kitts and Nevis, where turtle harvest is allowed annually from March 1 through September 30, and the Turks and Caicos Islands, where turtle harvest is allowed year-round. Most countries/territories that allow harvest have regulations that favor the harvest of large juvenile and adult turtles, the most reproductively valuable members of the population. Exceptions include the Cayman Islands, which mandates maximum size limits, and Haiti and Trinidad and Tobago, which have no size restrictions. All North, Central, and South American countries in the Northwest Atlantic have enacted laws that mandate complete protection of loggerheads from harvest in their territorial waters with the exception of Guyana. Despite national laws, in many countries the poaching of eggs and hunting of adult and juvenile turtles still occurs at varying levels (NMFS and USFWS, 2008; *see* Appendix 3).

In summary, harvest of loggerheads in the Caribbean for human consumption has been and continues to be a significant threat to the persistence of this DPS.

C. Disease or Predation

The potential exists for diseases and endoparasites to impact loggerheads found in the Northwest Atlantic. Viral diseases have not been documented in free-ranging loggerheads, with the possible exception of sea turtle fibropapillomatosis, which may have a viral etiology (Herbst and Jacobson, 1995; George, 1997). Although fibropapillomatosis reaches epidemic proportions in some wild green turtle populations, the prevalence of this disease in most loggerhead populations is thought to be small. An exception is Florida Bay where approximately 9.5 percent of the loggerheads captured exhibit fibropapilloma-like external lesions (B. Schroeder, NMFS, personal communication, 2006). Mortality levels and population-level effects associated with the disease are still unknown. Heavy infestations of endoparasites may cause or contribute to debilitation or mortality in loggerhead turtles. Trematode eggs and adult trematodes were recorded in a variety of tissues including the spinal cord and brain of debilitated loggerheads during an epizootic in South Florida, USA, during late 2000 and early 2001. These endoparasites were implicated as a possible cause of the epizootic (Jacobson *et al.*, 2006). Although many health problems have been described in wild populations through the necropsy of stranded turtles, the significance of diseases on the ecology of wild loggerhead populations is not known (Herbst and Jacobson, 1995).

Predation of eggs and hatchlings by native and introduced species occurs on almost all nesting beaches throughout the Northwest Atlantic. The most common predators at the primary nesting beaches in the southeastern United States are ghost crabs (*Ocypode quadrata*), raccoons (*Procyon lotor*), feral hogs (*Sus scrofa*), foxes (*Urocyon cinereoargenteus* and *Vulpes vulpes*), coyotes (*Canis latrans*), armadillos (*Dasypus novemcinctus*), and red fire ants (*Solenopsis invicta*) (Stancyk, 1982; Dodd, 1988). In the absence of well managed nest protection programs, predators may take significant numbers of eggs; however, nest protection programs are in place at most of the major nesting beaches in the Northwest Atlantic.

Non-native vegetation has invaded many coastal areas and often outcompetes native plant species. Exotic vegetation may form impenetrable root mats that can invade and desiccate eggs, as well as trap hatchlings. The Australian pine (*Casuarina equisetifolia*) is particularly harmful to sea turtles. Dense stands have taken over many coastal areas throughout central and south Florida. Australian pines cause excessive shading of the beach that would not otherwise occur. Studies in Florida suggest that nests laid in shaded areas are subjected to lower incubation temperatures, which may alter the natural hatchling sex ratio (Marcus and Maley, 1987; Schmelz and Mezich, 1988; Hanson *et al.*, 1998). Fallen Australian pines limit access to suitable nest sites and can entrap nesting females (Austin, 1978; Reardon and Mansfield, 1997). The shallow root network of these pines can interfere with nest construction (Schmelz and Mezich, 1988). Davis and Whiting (1977) reported that nesting activity declined in Everglades National Park where dense stands of Australian pine took over native dune vegetation on a remote nesting beach. Beach vitex (*Vitex rotundifolia*) is native to countries in the western Pacific and was introduced to the horticulture trade in the southeastern United States in the mid-1980s and is often sold as a "dune stabilizer." Its presence on North Carolina and South Carolina beaches has a negative effect on sea turtle nesting as its dense mats interfere with sea turtle nesting and hatchling emergence from nests (Brabson, 2006). This exotic plant is crowding out the native species, such as sea oats and bitter panicum, and can colonize large areas in just a few years. Sisal, or century plant (*Agave americana*), is native to arid regions of Mexico. The plant was widely grown in sandy soils around Florida in order to provide fiber for cordage. It has escaped cultivation in Florida and has been purposely planted on dunes. Although the effects of sisal on sea turtle nesting are uncertain, thickets with impenetrable sharp spines are occasionally found on developed beaches.

Harmful algal blooms, such as a red tide, also affect loggerheads in the Northwest Atlantic. In Florida, the species that causes most red tides is *Karenia brevis*, a dinoflagellate that produces a toxin (Florida Marine Research Institute, 2003) and can cause mortality in birds, marine mammals, and sea turtles. During four red tide events along the west coast of Florida, sea turtle stranding trends indicated that these events were acting as a mortality factor (Redlow *et al.*, 2003). Furthermore, brevetoxin concentrations supportive of intoxication were detected in biological samples from dead and moribund sea turtles during a mortality event in 2005 and in subsequent events (Fauquier *et al.*, 2007). The population level effects of these events are not yet known.

In summary, nest and hatchling predation likely was a factor that contributed to the historic decline of this DPS. Although current predation levels in the United States are greatly reduced from historic levels, predation still occurs in the United States, as well as in Mexico, and can be significant in the absence of well managed protection efforts. Although diseases and parasites are known to impact loggerheads in this DPS, the significance of these threats is not known. Overall, however, predation and disease are believed to be a significant threat to the persistence of this DPS.

D. Inadequacy of Existing Regulatory Mechanisms

International Instruments

The BRT identified several regulatory mechanisms that apply to loggerhead sea turtles globally and within the Northwest Atlantic Ocean (Conant *et al.,* 2009). Hykle (2002) and Tiwari (2002) have reviewed the effectiveness of some of these international instruments. The problems with existing international treaties are often that they have not realized their full potential, do not include some key countries, do not specifically address sea turtle conservation, and are handicapped by the lack of a sovereign authority to enforce environmental regulations.

National Legislation and Protection

Fishery bycatch that occurs throughout the North Atlantic Ocean is substantial (*see* Factor E). Although national and international governmental and non-governmental entities on both sides of the North Atlantic are currently working toward reducing loggerhead bycatch, and some positive actions have been implemented, it is unlikely that this source of mortality can be sufficiently reduced across the range of the DPS in the near future because of the diversity and magnitude of the fisheries operating in the North Atlantic, the lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies.

In summary, our review of regulatory mechanisms under Factor D demonstrates that although regulatory mechanisms are in place that should address direct and incidental take of Northwest Atlantic Ocean loggerheads, these regulatory mechanisms are insufficient or are not being implemented effectively to address the needs of loggerheads. We find that the threat from the inadequacy of existing regulatory mechanisms for fishery bycatch (Factor E) and coastal development, beachfront lighting, and coastal armoring and other erosion control structures on nesting beaches in the United States (Factor A) is significant relative to the persistence of this DPS.

E. Other Natural or Manmade Factors Affecting Its Continued Existence

Incidental Bycatch in Fishing Gear

Bycatch of loggerheads in commercial and recreational fisheries in the Northwest Atlantic is a significant threat facing the species in this region. A variety of fishing gears that incidentally capture loggerhead turtles are employed including gillnets, trawls, hook and line, longlines, seines, dredges, pound nets, and various types of pots/traps. Among these, gillnets, longlines, and trawl gear contribute to the vast majority of bycatch mortality of loggerheads annually throughout their range in the Atlantic Ocean and Gulf of Mexico (Epperly *et al.,* 1995; NMFS, 2002, 2004, 2007, 2008; Lewison *et al.,* 2003, 2004; Richards, 2007; NMFS, unpublished data). Considerable effort has been expended since the 1980s to document and address fishery bycatch, especially in the United States and Mexico. Observer programs have been implemented in some fisheries to collect turtle bycatch data, and efforts to reduce bycatch and mortality of loggerheads in certain fishing operations have been undertaken and implemented or partially implemented. These efforts include developing gear solutions to prevent or reduce captures or to allow turtles to escape without harm (*e.g.,* TEDs, circle hooks and bait combinations), implementing time and area closures to prevent interactions from occurring (*e.g.,* prohibitions on gillnet fishing along the mid-Atlantic coast during the critical time of northward migration of loggerheads), implementation of careful release protocols (*e.g.,* requirements for careful release of turtles captured in longline fisheries), prohibitions of gillnetting in some U.S. State waters), and/or modifying gear (*e.g.,* requirements to reduce mesh size in the leaders of pound nets in certain U.S. coastal waters to prevent entanglement).

The primary bycatch reduction focus in the Northwest Atlantic, since the 1978 ESA listing of the loggerhead, has been on bycatch reduction in shrimp trawls. The United States has required the use of turtle excluder devices (TEDs) throughout the year since the mid-1990s, with modifications required and implemented as necessary (52 FR 24244; June 29, 1987; 57 FR 57348; December 4, 1992). Most notably, in 2003, NMFS implemented new requirements for TEDs in the shrimp trawl fishery to ensure that large loggerheads could escape through TED openings (68 FR 8456; February 21, 2003). Significant effort has been expended to transfer this technology to other shrimping fleets in the Northwest Atlantic; however, not all nations where loggerheads occur require the device be used. Enforcement of TED regulations is difficult and compliance is not believed to be complete. Because

TEDs are not 100 percent effective, a significant number of loggerheads are estimated to still be killed annually in shrimp trawls throughout the Northwest Atlantic. In the U.S. Southeast food shrimp trawl fishery, NMFS estimated the annual mortality of loggerheads in the Gulf of Mexico and southeastern U.S. Atlantic Ocean as 3,948 individuals (95 percent confidence intervals, 1,221–8,498) (NMFS, 2002). Shrimping effort in the southeastern United States has reportedly declined; a revised estimate of annual loggerhead mortality for the Gulf of Mexico segment of the Southeast food shrimp trawl fishery is 647 individuals (NMFS, unpublished data).

Other trawl fisheries operating in Northwest Atlantic waters that are known to capture sea turtles include, but are not limited to, summer flounder, calico scallop, sea scallop, blue crab, whelk, cannonball jellyfish, horseshoe crab, and mid-Atlantic directed finfish trawl fisheries and the *Sargassum* fishery. In the United States, the summer flounder fishery is the only trawl fishery (other than the shrimp fishery) with Federally mandated TED use (in certain areas). Loggerhead annual bycatch estimates in 2004 and 2005 in U.S. mid-Atlantic scallop trawl gear ranged from 81 to 191 turtles, depending on the estimation methodology used (Murray, 2007). Estimated average annual bycatch of loggerheads in other mid-Atlantic Federally managed bottom otter trawl fisheries during 1996–2004 was 616 turtles (Murray, 2006). The harvest of *Sargassum* by trawlers can result in incidental capture of post-hatchlings and habitat destruction (Schwartz, 1988; Witherington, 2002); however, this fishery is not currently active.

Dredge fishing gear is the predominant gear used to harvest sea scallops off the mid- and northeastern United States Atlantic coast. Turtles can be struck and injured or killed by the dredge frame and/or captured in the bag where they may drown or be further injured or killed when the catch and heavy gear are dumped on the vessel deck. Total estimated bycatch of loggerhead turtles in the U.S. sea scallop dredge fishery operating in the mid-Atlantic region (New York to North Carolina) from June through November is on the order of several hundred turtles per year (Murray, 2004, 2005, 2007). The impact of the sea scallop dredge fishery on loggerheads in U.S. waters of the Northwest Atlantic remains a serious concern.

Incidental take of oceanic-stage loggerheads in pelagic longline fisheries has recently received significant attention (Balazs and Pooley, 1994; Bolten *et al.*, 1994, 2000; Aguilar *et al.*, 1995; Laurent *et al.*, 1998; Long and Schroeder, 2004; Watson *et al.*, 2005). Large-scale commercial longline fisheries operate throughout the pelagic range of the Northwest Atlantic loggerhead, including the western Mediterranean. The largest size classes in the oceanic stage are the size classes impacted by the swordfish longline fishery in the Azores (Bolten, 2003) and on the Grand Banks off Newfoundland (Watson *et al.*, 2005), and this is likely the case for other nation's fleets operating in the region, including but not limited to, the European Union, United States, Japan, and Taiwan. The demographic consequences relative to population recovery of the increased mortality of these size classes have been discussed (Crouse *et al.*, 1987; *see* also Heppell *et al.*, 2003 and Chaloupka, 2003). Estimates derived from data recorded by the international observer program (IOP) suggest that thousands of mostly juvenile loggerheads have been captured in the Canadian pelagic longline fishery in the western North Atlantic since 1999 (Brazner and McMillan, 2008). NMFS (2004) estimates that 635 loggerheads (143 lethal) will be taken annually in the U.S. pelagic longline fishery.

Incidental capture of neritic-stage loggerheads in demersal longline fishing gear has also been documented. Richards (2007) estimated total annual bycatch of loggerheads in the Southeast U.S. Atlantic and U.S. Gulf of Mexico commercial directed shark bottom longline fishery from 2003–2005 as follows: 2003: 302–1,620 (CV 0.45); 2004: 95–591 (CV 0.49); and 2005: 139–778 (CV 0.46). NMFS (2009) estimated the total number of captures of hardshell turtles in the U.S. Gulf of Mexico reef fish fishery (demersal longline fishery) from July 2006–December 2008 as 861 turtles (95 percent confidence intervals, 383–1934). These estimates are not comprehensive across this gear type (*i.e.*, pelagic and demersal longline) throughout the Northwest Atlantic Ocean. Cumulatively, the bycatch and mortality of Northwest Atlantic loggerheads in longline fisheries is significant.

Gillnet fisheries may be the most ubiquitous of fisheries operating in the neritic range of the Northwest Atlantic loggerhead. Comprehensive estimates of bycatch in gillnet fisheries do not yet exist and, while this precludes a quantitative analysis of their impacts on loggerhead populations, the cumulative mortality of loggerheads in gillnet fisheries is likely high. In the U.S. mid-Atlantic, the average annual estimated bycatch of loggerheads from 1995–2006 was 350 turtles (CV= 0.20., 95 percent confidence intervals over the 12-year period: 234 to 504) (Murray, 2009). In the United States, some States (*e.g.*, South Carolina, Georgia, Florida, Louisiana, and Texas) have prohibited gillnets in their waters, but there remain active gillnet fisheries in other U.S. States, in U.S. Federal waters, Mexico waters, Central and South America waters, and the Northeast Atlantic.

Pound nets are fixed gear composed of a series of poles driven into the bottom upon which netting is suspended. Pound nets basically operate like a trap with the pound constructed of a series of funnels leading to a bag that is open at the top, and a long leader of netting that extends from shallow to deeper water where the pound is located. In some configurations, the leader is suspended from the surface by a series of stringers or vertical lines. Sea turtles incidentally captured in the open top pound, which is composed of small mesh webbing, are usually safe from injury and may be released easily when the fishermen pull the nets (Mansfield *et al.*, 2002). However, sea turtle mortalities have been documented in the leader of certain pound nets. Large mesh leaders (greater than 12-inch stretched mesh) may act as a gillnet, entangling sea turtles by the head or foreflippers (Bellmund *et al.*, 1987) or may act as a barrier against which turtles may be impinged (NMFS, unpublished data). Nets with small mesh leaders (less than 8 inches stretched mesh) usually do not present a mortality threat to loggerheads, but some mortalities have been reported (Morreale and Standora, 1998; Epperly *et al.*, 2000, 2007; Mansfield *et al.*, 2002). In 2002, the United States prohibited, in certain areas within the Chesapeake Bay and at certain times, pound net leaders having mesh greater than or equal to 12 inches and leaders with stringers (67 FR 41196; June 17, 2002). Subsequent regulations have further restricted the use of certain pound net leaders in certain geographic areas and established pound net leader gear modifications (69 FR 24997; May 5, 2004; 71 FR 36024; June 23, 2006).

Pots/traps are commonly used to target crabs, lobsters, whelk, and reef fishes. These traps vary in size and configuration, but all are attached to a surface float by means of a vertical line leading to the trap. Entanglement and mortality of loggerheads has been documented in various pot/trap fisheries in the U.S. Atlantic and Gulf of Mexico. Data from the U.S. Sea Turtle Stranding and Salvage Network indicate that 82 loggerheads (dead and rescued alive) were documented by the stranding network in various pot/trap gear from 1996–2005, of these approximately 30–40 percent were adults and the remainder juvenile turtles (NMFS, unpublished data). Without intervention it is likely that the majority of the live, entangled turtles would die. Additionally, documented strandings represent only a portion of total interactions and mortality. Recently, a small number of loggerhead entanglements also have been recorded in whelk pot bridles in the U.S. Mid-Atlantic (M. Fagan, Virginia Institute of Marine Science, personal communication, 2008). However, no dedicated observer programs exist to provide estimates of take and mortality from pot/trap fisheries; therefore, comprehensive estimates of loggerhead interactions with pot/trap gear are not available, but the gear is widely used throughout the range of the DPS, and poses a continuing threat.

Other Manmade and Natural Impacts

Propeller and collision injuries from boats and ships are becoming more common in sea turtles. In the U.S. Atlantic, from 1997 to 2005, 14.9 percent of all stranded loggerheads were documented as having sustained some type of propeller or collision injuries (NMFS, unpublished data). The incidence of propeller wounds observed in sea turtles stranded in the United States has risen from approximately 10 percent in the late 1980s to a record high of 20.5 percent in 2004 (NMFS, unpublished data). In the United States, propeller wounds are greatest in Southeast Florida; during some years, as many as 60 percent of the loggerhead strandings found in these areas had propeller wounds (Florida Fish and Wildlife Conservation Commission, unpublished data). As the number of vessels increases, in concert with increased coastal development, especially in nearshore waters, propeller and vessel collision injuries are also expected to rise.

Several activities associated with offshore oil and gas production, including oil spills, water quality (operational discharge), seismic surveys, explosive platform removal, platform lighting, and noise from drillships and production activities, are known to impact loggerheads (National Research Council, 1996; Minerals Management Service, 2000; Gregg Gitschlag, NMFS, personal communication, 2007; Viada *et al.*, 2008). Currently, there are 3,443 Federally regulated offshore platforms in the Gulf of Mexico dedicated to natural gas and oil production. Additional State-regulated platforms are located in State waters (Texas and Louisiana). There are currently no active leases off the Atlantic coast.

Oil spills also threaten loggerheads in the Northwest Atlantic. Two oil spills that occurred near loggerhead nesting beaches in Florida were observed to affect eggs, hatchlings, and nesting females. Approximately 350,000 gallons of fuel oil spilled in Tampa Bay in August 1993 and was carried onto nesting beaches in Pinellas County. Observed mortalities included 31 hatchlings and 176 oil-covered nests; an additional 2,177 eggs and hatchlings were either exposed to oil or disturbed by response activities (Florida Department of Environmental Protection *et al.*, 1997). Another spill near the beaches of Broward County in August 2000 involved approximately 15,000 gallons of oil and tar (National Oceanic and Atmospheric Administration and Florida Department of Environmental Protection, 2002). Models estimated that approximately 1,500 to 2,000 hatchlings and 0 to 1 adults were injured or killed. Annually about 1 percent of all sea turtle strandings along the U.S. east coast have been associated with oil, but higher rates of 3 to 6 percent have been observed in South Florida and Texas (Teas, 1994; Rabalais and Rabalais, 1980; Plotkin and Amos, 1990).

In addition to the destruction or degradation of habitat, periodic dredging of sediments from navigational channels can also result in incidental mortality of sea turtles. Direct injury or mortality of loggerheads by dredges has been well documented in the southeastern and mid-Atlantic United States (National Research Council, 1990). Solutions, including modification of dredges and time/area closures, have been successfully implemented to reduce mortalities and injuries in the United States (NMFS, 1991, 1995, 1997; Nelson and Shafer, 1996).

The entrainment and entrapment of loggerheads in saltwater cooling intake systems of coastal power plants has been documented in New Jersey, North Carolina, Florida, and Texas (Eggers, 1989; National Research Council, 1990; Carolina Power and Light Company, 2003; FPL and Quantum Resources, Inc., 2005; Progress Energy Florida, Inc., 2003). Average annual incidental capture rates for most coastal plants from which captures have been reported amount to several turtles per plant per year. One notable exception is the St. Lucie Nuclear Power Plant located on Hutchinson Island, Florida. During the first 15 years of operation (1977–1991), an average of 128 loggerheads per year was captured in the intake canal with a mortality rate of 6.4 percent. During 1991–2005, loggerhead captures more than doubled (average of 308 per year), while mortality rates decreased to 0.3 percent per year (FPL and Quantum Resources, Inc., 2005).

Although not a major source of mortality, cold stunning of loggerheads has been reported at several locations in the United States, including Cape Cod Bay, Massachusetts (Still *et al.*, 2002); Long Island Sound, New York (Meylan and Sadove, 1986; Morreale *et al.*, 1992); the Indian River system, Florida (Mendonca and Ehrhart, 1982; Witherington and Ehrhart, 1989); and Texas inshore waters (Hildebrand, 1982; Shaver, 1990). Cold stunning is a phenomenon during which turtles become incapacitated as a result of rapidly dropping water temperatures (Witherington and Ehrhart, 1989; Morreale *et al.*, 1992). As temperatures fall below 8–10° C, turtles may lose their ability to swim and dive, often floating to the surface. The rate of cooling that precipitates cold stunning appears to be the primary threat, rather than the water temperature itself (Milton and Lutz, 2003). Sea turtles that overwinter in inshore waters are most susceptible to cold stunning, because temperature changes are most rapid in shallow water (Witherington and Ehrhart, 1989).

Another natural factor that has the potential to affect recovery of loggerhead turtles is aperiodic hurricanes. In general, these events are episodic and, although they may affect loggerhead hatchling production, the results are generally localized and they rarely result in whole-scale losses over multiple nesting seasons. The negative effects of hurricanes on low-lying and/or developed shorelines may be longer-lasting and a greater threat overall.

Similar to other areas of the world, climate change and sea level rise have the potential to impact loggerheads in the Northwest Atlantic. This includes beach erosion and loss from rising sea levels, repeated inundation of nests, skewed hatchling sex ratios from rising beach incubation temperatures, and abrupt disruption of ocean currents used for natural dispersal during the complex life cycle.

In summary, we find that the Northwest Atlantic Ocean DPS of the loggerhead sea turtle is negatively affected by both natural and manmade impacts as described above in Factor E. Within Factor E, we find that fishery bycatch that occurs throughout the North Atlantic Ocean, particularly bycatch mortality of loggerheads from gillnet, longline, and trawl fisheries throughout their range in the Atlantic Ocean and Gulf of Mexico, is a significant threat to the persistence of this DPS. In addition, boat strikes are becoming more common and are likely also a significant threat to the persistence of this DPS.

Northeast Atlantic Ocean DPS

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

Terrestrial Zone

Destruction and modification of loggerhead nesting habitat in the Northeast Atlantic result from coastal development and construction, placement of erosion control structures and other barriers to nesting, beachfront lighting, vehicular and pedestrian traffic, sand extraction, beach erosion, and beach pollution (Formia *et al.*, 2003; Loureiro, 2008).

In the Northeast Atlantic, the only loggerhead nesting of note occurs in the Cape Verde Islands. The Cape Verde government's plans to develop Boa Vista Island, the location of the main nesting beaches, could increase the terrestrial threats to loggerheads (van Bogaert, 2006). Sand extraction on Santiago Island, Cape Verde, may be responsible for the apparent decrease in nesting there (Loureiro, 2008). Both sand extraction and beachfront lighting have been identified as serious threats to the continued existence of a nesting population on Santiago Island (Loureiro, 2008). Scattered and infrequent nesting occurs in western Africa, where much industrialization is located on the coast and population growth rates fluctuate between 0.8 percent (Cape Verde) and 3.8 percent (Côte D'Ivoire) (Abe *et al.*, 2004; Tayaa *et al.*, 2005). Land mines on some of the beaches of mainland Africa, within the reported historical range of nesting by loggerheads (*e.g.*, the Western Sahara region), would be detrimental to nesters and are an impediment to scientific surveys of the region (Tiwari *et al.*, 2001). Tiwari *et al.* (2001) noted a high level of human use of many of the beaches in Morocco—enough that any evidence of nesting activity would be quickly erased. Garbage litters many developed beaches (Formia *et al.*, 2003). Erosion is a problem along the long stretches of high energy ocean shoreline of Africa and is further exacerbated by sand mining and harbor building (Formia *et al.*, 2003); crumbling buildings claimed by the sea may present obstructions to nesting females.

Neritic/Oceanic Zones

Threats to habitat in the loggerhead neritic and oceanic zones in the Northeast Atlantic Ocean include fishing practices, marine pollution and climate change. Ecosystem alterations have occurred due to the tremendous human pressure on the environment in the region. Turtles, including loggerheads, usually are included in ecosystem models of the region (*see* Palomares and Pauly, 2004). In the Canary Current Large Marine Ecosystem (LME), the area is characterized by the Global International Waters Assessment as severely impacted in the area of modification or loss of ecosystems or ecotones and health impacts, but these impacts are decreasing (*http://www.lme.noaa.gov*). The Celtic-Biscay Shelf LME is affected by alterations to the seabed, agriculture, and sewage (Valdés and Lavin, 2002). The Gulf of Guinea has been characterized as severely impacted in the area of solid wastes by the Global International Waters Assessment; this and other pollution indicators are increasing (*http://www.lme.noaa.gov*). Marine pollution, such as oil and debris, has been shown to negatively impact loggerheads and represent a degradation of the habitat (Orós *et al.*, 2005, 2009; Calabuig Miranda and Liria Loza, 2007). Climate change also may result in future trophic changes, thus impacting loggerhead prey abundance and/or distribution.

Additionally, fishing is a major source of ecosystem alteration of the neritic and oceanic habitats of loggerhead turtles in the region. Fishing effort off the western African coast is increasing and record low biomass has been recorded for exploited resources, representing a 13X decline in biomass since 1960 (*see* Palomares and Pauly, 2004). Throughout the North Atlantic, fishery landings fell by 90 percent during the 20th century, foreboding a trophic cascade and a change in food-web competition (Pauly *et al.,* 1998; Christensen *et al.,* 2003). For a description of the exploited marine resources in the region, *see* Lamboeuf (1997). The Celtic-Biscay Shelf LME, the Iberian Coastal Ecosystem LME, the Canary Current LME, and the Guinea Current LME all are severely overfished, and effort now is turning to a focus on pelagic fisheries, whereas historically there were demersal fisheries. The impacts continue to increase in the Guinea Current LME despite efforts throughout the region to reduce fishing pressure (*http://www.lme.noaa.gov*).

The threats to bottom habitat for loggerheads include modification of the habitat through bottom trawling. Trawling occurs off the European coast and the area off Northwest Africa is one of the most intensively trawled areas in the world (Zeeberg *et al.,* 2006). Trawling has been banned in the Azores, Madeira, and Canary Islands to protect cold-water corals (Lutter, 2005). Although illegal, trawling also occurs in the Cape Verde Islands (Lopez-Jurado *et al.,* 2003). The use of destructive fishing practices, such as explosives and toxic chemicals, has been reported in the Canary Current area, causing serious damage to both the resources and the habitat (Tayaa *et al.,* 2005).

In summary, we find that the Northeast Atlantic Ocean DPS of the loggerhead sea turtle is negatively affected by ongoing changes in both its terrestrial and marine habitats as a result of land and water use practices as considered above in Factor A. Within Factor A, we find that sand extraction and beachfront lighting on nesting beaches are significant threats to the persistence of this DPS. We also find that anthropogenic disruptions of natural ecological interactions as a result of fishing practices and marine pollution are likely a significant threat to the persistence of this DPS.

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

Deliberate hunting of loggerheads for their meat, shells, and eggs still exists and remains the most serious threat facing nesting turtles in the Northeast Atlantic. Historical records indicate turtles were harvested throughout Macaronesia (*see* Lopez-Jurado, 2007). Intensive exploitation has been cited for the extirpation of the loggerhead nesting colony in the Canary Islands (Lopez-Jurado, 2007), and heavy human predation on nesting and foraging animals occurred on Santiago Island, Cape Verde, the first in the Archipelago to be settled (Loureiro, 2008), as well as on Sal and Sao Vicente islands (Lopez-Jurado, 2007). Nesting loggerheads and eggs are still harvested at Boa Vista, Cape Verde (Cabrera *et al.,* 2000; Lopez-Jurado *et al.,* 2003). In 2007, over 1,100 (36 percent) of the nesting turtles were hunted, which is about 15 percent of the estimated adult female population (Marco *et al.,* in press). In 2008, the military protected one of the major nesting beaches on Boa Vista where in 2007 55 percent of the mortality had occurred; with the additional protection, only 17 percent of the turtles on that beach were slaughtered (Roder *et al.,* in press). On Sal Island, 11.5 percent of the emergences on unprotected beaches ended with mortality, whereas mortality was 3 percent of the emergences on protected beaches (Cozens *et al.,* in press). The slaughter of nesting turtles is a problem wherever turtles nest in the Cape Verde Islands and may approach 100 percent in some places (C. Roder, Turtle Foundation, Münsing, Germany, personal communication, 2009; Cozens, in press). The meat and eggs are consumed locally as well as traded among the archipelago (C. Roder, Turtle Foundation, Münsing, Germany, personal communication, 2009). Hatchlings are collected on Sal Island, but this activity appears to be rare on other islands of the archipelago (J. Cozens, SOS Tartarugas, Santa Maria, Sal Island, Cape Verde, personal communication, 2009). Additionally, free divers target turtles for consumption of meat, often selectively taking large males (Lopez-Jurado *et al.,* 2003). Turtles are harvested along the African coast and, in some areas, are considered a significant source of food and income due to the poverty of many residents along the African coast (Formia *et al.,* 2003). Loggerhead carapaces are sold in markets in Morocco and Western Sahara (Fretey, 2001; Tiwari *et al.,* 2001; Benhardouze *et al.,* 2004).

In summary, overutilization for human consumption likely was a factor that contributed to the historic decline of this DPS. Current harvest of loggerhead turtles and eggs for human consumption in both Cape Verde and along the African coast, as well as the sale of loggerhead carapaces in markets in Africa, are a significant threat to the persistence of this DPS.

C. Disease or Predation

The potential exists for diseases and endoparasites to impact loggerheads found in the Northeast Atlantic Ocean. Spontaneous diseases documented in the Northeast Atlantic include pneumonia, hepatitis, meningitis, septicemic processes, and neoplasia (Orós *et al.,* 2005). Pneumonia could result from the aspiration of water from forced submergence in fishing gear. The authors also reported nephritis, esophagitis, nematode infestation, and eye lesions. Fibropapillomatosis does not appear to be an issue in the Northeast Atlantic.

Nest depredation by ghost crabs (*Ocypode cursor*) occurs in Cape Verde (Lopez-Jurado *et al.,* 2000). The ghost crabs feed on both eggs and hatchlings. Arvy *et al.* (2000) reported predation of loggerhead eggs in two nests in Mauritania by golden jackals (*Canis aureus*); a loggerhead turtle creating a third nest also had been killed, with meat and eggs eaten, but the predator was not identified.

Loggerheads in the Northeast Atlantic also may be impacted by harmful algal blooms, which have been reported infrequently in the Canary Islands and the Iberian Coastal LME (Ramos *et al.,* 2005; Akin-Oriola *et al.,* 2006; Amorim and Dale, 2006; Moita *et al.,* 2006; *http://www.lme.noaa.gov*).

In summary, although disease and predation are known to occur, quantitative data are not sufficient to assess the degree of impact of these threats on the persistence of this DPS.

D. Inadequacy of Existing Regulatory Mechanisms

International Instruments

The BRT identified several regulatory mechanisms that apply to loggerhead sea turtles globally and within the Northeast Atlantic Ocean. The reader is directed to sections 5.1.4. and 5.2.7.4. of the Status Review for a discussion of these regulatory mechanisms. Hykle (2002) and Tiwari (2002) have reviewed the effectiveness of some of these international instruments. The problems with existing international treaties are often that they have not realized their full potential, do not include some key countries, do not specifically address sea turtle conservation, and are handicapped by the lack of a sovereign authority to enforce environmental regulations. The ineffectiveness of international treaties and national legislation is oftentimes due to the lack of motivation or obligation by countries to implement and enforce them. A thorough discussion of this topic is available in a special 2002 issue of the Journal of International Wildlife Law and Policy: International Instruments and Marine Turtle Conservation (Hykle 2002).

National Legislation and Protection

Ongoing directed lethal take of nesting females and eggs (Factor B), low hatching and emergence success (Factors A, B, and C), and mortality of juvenile and adult turtles from fishery bycatch (Factor E) that occurs throughout the Northeast Atlantic Ocean is substantial. Currently, conservation efforts to protect nesting females are growing, and a reduction in this source of mortality is likely to continue in the near future. Although national and international governmental and non-governmental entities in the Northeast Atlantic are currently working toward reducing loggerhead bycatch, and some positive actions have been implemented, it is unlikely that this source of mortality can be sufficiently reduced across the range of the DPS in the near future because of the lack of bycatch reduction in high seas fisheries operating within the range of this DPS, lack of bycatch reduction in coastal fisheries in Africa, the lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies.

In summary, our review of regulatory mechanisms under Factor D demonstrates that although regulatory mechanisms are in place that should address direct and incidental take of Northeast Atlantic Ocean loggerheads, these regulatory mechanisms are insufficient or are not being implemented effectively to address the needs of loggerheads. We find that the threat from the inadequacy of existing regulatory mechanisms for harvest of turtles and eggs for human consumption (Factor B), fishery bycatch (Factor E), and sand extraction and beachfront lighting on nesting beaches (Factor A) is significant relative to the persistence of this DPS.

E. Other Natural or Manmade Factors Affecting its Continued Existence

Incidental Bycatch in Fishing Gear

Loggerhead turtles strand throughout the Northeast Atlantic (Fretey, 2001; Tiwari *et al.,* 2001; Duguy *et al.,* 2004, 2005; Witt *et al.,* 2007), and there are indications that the turtles become entangled in nets and monofilament and swallow hooks in the region (Orós *et al.,* 2005; Calabuig Miranda and Liria Loza, 2007). On the European coasts, most stranded loggerheads are small (mean of less than 30 cm SCL), but a few are greater than 60 cm SCL (Witt *et al.,* 2007). Similarly, Tiwari *et al.* (2001) and Benhardouze *et al.* (2004) indicated that the animals they viewed in Morocco and Western Sahara were small juveniles and preliminary genetic analyses of stranded turtles indicate that they are of western Atlantic origin (M. Tiwari, NMFS, and A. Bolten, University of Florida, unpublished data), whereas Fretey (2001) reported that loggerheads captured and stranded in Mauritania were both juvenile and adult-sized animals.

Incidental capture of sea turtles in artisanal and commercial fisheries is a threat to the survival of loggerheads in the Northeast Atlantic. Sea turtles may be caught in a multitude of gears deployed in the region: Pelagic and demersal longlines, drift and set gillnets, bottom and mid-water trawling, weirs, haul and purse seines, pots and traps, cast nets, and hook and line gear (*see* Pascoe and Gréboval, 2003; Bayliff *et al.,* 2005; Tayaa *et al.,* 2005; Dossa *et al.,* 2007). Fishing effort off the western African coast has been increasing (*see* Palomares and Pauly, 2004). Impacts continue to increase in the Guinea Current LME, but, in contrast, the impacts are reported to be decreasing in the Canary Current LME (*http://www.lme.noaa.gov*). Throughout the region, fish stocks are depleted and management authorities are striving to reduce the fishing pressure.

In the Northeast Atlantic, loggerheads, particularly the largest size classes in the oceanic environment (most of which are small juveniles), are captured in surface longline fisheries targeting swordfish (*Ziphias gladius*) and tuna (*Thunnus* spp.) (Ferreira *et al.,* 2001; Bolten, 2003). Bottom longlines in Madeira Island targeting black-scabbard (*Aphanopus carbo*) capture and kill small juvenile loggerhead turtles as the fishing depth does not allow hooked turtles to surface (Dellinger and Encarnaçâo, 2000; Delgado *et al.,* in press).

In United Kingdom and Irish waters, loggerhead bycatch is uncommon but has been noted in pelagic driftnet fisheries (Pierpoint, 2000; Rogan and Mackey, 2007). Loggerheads have not been captured in pelagic trawls, demersal trawls, or gillnets in United Kingdom and Irish waters (Pierpoint, 2000), but have been captured in nets off France (Duguy *et al.,* 2004, 2005).

International fleets of trawl fisheries operate in Mauritania and have been documented to capture sea turtles, including loggerheads (Zeeberg *et al.,* 2006). Despite being illegal, trawling occurs in the Cape Verde Islands and has the potential to capture and kill loggerhead turtles; one piece of abandoned trawl net washed ashore with eight live and two dead loggerheads (Lopez-Jurado *et al.,* 2003). Longlines, seines, and hook and line have been documented to capture loggerheads 35–73 cm SCL off the northwestern Moroccan coast (Benhardouze, 2004).

Other Manmade and Natural Impacts

Other anthropogenic impacts, such as boat strikes and ingestion or entanglement in marine debris, also apply to loggerheads in the Northeast Atlantic. Propeller and boat strike injuries have been documented in the Northeast Atlantic (Oros *et al.,* 2005; Calabuig Miranda and Liria Loza, 2007). Exposure to crude oil is also of concern. Loggerhead strandings in the Canary Islands have shown evidence of hydrocarbon exposure as well as ingestion of marine debris, such as plastic and monofilament (Oros *et al.,* 2005; Calabuig Miranda and Liria Loza, 2007), and in the Azores and elsewhere plastic debris is found both on the beaches and floating in the waters (Barrerios and Barcelos, 2001; Tiwari *et al.,* 2001). Pollution from heavy metals is a concern for the seas around the Iberian Peninsula (European Environmental Agency, 1998) and in the Guinea Current LME (Abe *et al.,* 2004). Bioaccumulation of metals in loggerheads has been measured in the Canary Islands and along the French Atlantic Coast (Caurant *et al.,* 1999; Torrent *et al.,* 2004). However, the consequences of long-term exposure to heavy metals are unknown (Torrent *et al.,* 2004).

Natural environmental events, such as climate change, could affect loggerheads in the Northeast Atlantic. Similar to other areas of the world, climate change and sea level rise have the potential to impact loggerheads in the Northeast Atlantic, and the changes may be further exacerbated by the burning of fossil fuels and deforestation. These effects include flooding of nesting beaches, shifts in ocean currents, ecosystem shifts in prey distribution and abundance, and a shift in the sex ratio of the population if rookeries do not migrate concurrently (*e.g.,* northward in the case of global warming) or if nesting phenology does not change (*see* Doody *et al.,* 2006). Tropical and sub-tropical storms occasionally strike the area and could have a negative impact on nesting, although such an impact would be of limited duration.

In summary, we find that the Northeast Atlantic Ocean DPS of the loggerhead sea turtle is negatively affected by both natural and manmade impacts as described above in Factor E. Within Factor E, we find that fishery bycatch that occurs throughout the Northeast Atlantic Ocean, particularly bycatch mortality of loggerheads from longline and trawl fisheries, is a significant threat to the persistence of this DPS.

Mediterranean Sea DPS

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

Terrestrial Zone

In the Mediterranean, some areas known to host nesting activity in the past have been lost to turtles (*e.g.,* Malta) or severely degraded (*e.g.,* Israel) (Margaritoulis *et al.,* 2003). Destruction and modification of loggerhead nesting habitat in the Mediterranean result from coastal development and construction, placement of erosion control structures and other barriers to nesting, beachfront lighting, vehicular and pedestrian traffic, sand extraction, beach erosion, beach sand placement, beach pollution, removal of native vegetation, and planting of non-native vegetation (Baldwin, 1992; Margaritoulis *et al.,* 2003). These activities may directly impact the nesting success of loggerheads and survivability of eggs and hatchlings. Nesting in the Mediterranean almost exclusively occurs in the Eastern basin, with the main concentrations found in Cyprus, Greece, Turkey, and Libya (Margaritoulis *et al.,* 2003; Laurent *et al.,* 1999); therefore, the following threats to the nesting habitat are concentrated in these areas.

The Mediterranean experiences a large influx of tourists during the summer months, coinciding with the nesting season. Margaritoulis *et al.* (2003) stated that extensive urbanization of the coastline, largely a result of tourism and recreation, is likely the most serious threat to loggerhead nesting areas. The large numbers of tourists that use Mediterranean beaches result in an increase in umbrellas, chairs, garbage, and towels, as well as related hotels, restaurants, and stationary (*e.g.,* street lights, hotels) and moving (*e.g.,* cars) lighting, all which can impact sea turtle nesting success (Demetropoulos, 2000). Further, the eastern Mediterranean is exposed to high levels of pollution and marine debris, in particular the nesting beaches of Cyprus, Turkey, and Egypt (Camiñas, 2004).

Construction and infrastructure development also have the potential to alter nesting beaches and subsequently impact nesting success. The construction of new buildings on or near nesting beaches has been a problem in Greece and Turkey (Camiñas, 2004). The construction of a jetty and waterworks around Mersin, Turkey, has contributed significantly to the continuous loss of adjacent beach (Camiñas, 2004).

Beach erosion and sand extraction also pose a problem for sea turtle nesting sites. The noted decline of the nesting population at Rethymno, Island of Crete, Greece, is partly attributed to beach erosion caused by construction on the high beach and at sea (*e.g.,* groins) (Margaritoulis *et al.,* 2009). A 2001 survey of Lebanese nesting beaches found severe erosion on beaches where previous nesting had been reported, and in some cases the beaches had disappeared completely (Venizelos *et al.,* 2005). Definitive causes of this erosion were found to be sand extraction, offshore sand dredging, and sediment removal from river beds for construction and military purposes. Beach erosion also may occur from natural changes, with the same deleterious effects to loggerhead nesting.

On Patara, Turkey, beach erosion and subsequent inundation by waves and shifting sand dunes are responsible for about half of all loggerhead nest losses (Camiñas, 2004). Erosion can further be exacerbated when native dune vegetation, which enhances beach stability and acts as an integral buffer zone between land and sea, is degraded or destroyed. This in turn often leaves insufficient nesting opportunities above the high tide line, and nests may be washed out. In contrast, the planting or invasion of less stabilizing, non-native plants can lead to increased erosion and degradation of suitable nesting habitat. Finally, sand extraction has been a serious problem on Mediterranean nesting beaches, especially in Turkey (Türkozan and Baran, 1996), Cyprus (Godley *et al.,* 1996; Demetropoulos and Hadjichristophorou, 1989), and Israel (Levy, 2003).

While the most obvious effect of nesting beach destruction and modification may be to the existence of the actual nests, hatchlings are also threatened by habitat alteration. In the Mediterranean, disorientation of hatchlings due to artificial lighting has been recorded mainly in Greece (Rees, 2005; Margaritoulis *et al.,* 2007, 2009), Turkey (Türkozan and Baran, 1996), and Lebanon (Newbury *et al.,* 2002). Additionally, vehicle traffic on nesting beaches may disrupt the natural beach environment and contribute to erosion, especially during high tides or on narrow beaches where driving is concentrated on the high beach and foredune. On Zakynthos Island in Greece, Venizelos *et al.* (2006) reported that vehicles drove along the beach and sand dunes throughout the tourist season on East Laganas and Kalamaki beaches, leaving deep ruts in the sand, disturbing sea turtles trying to nest, and impacting hatchlings trying to reach the sea.

Neritic/Oceanic Zones

Threats to habitat in the loggerhead neritic and oceanic zones in the Mediterranean Sea include fishing practices, channel dredging, sand extraction, marine pollution, and climate change. Trawling occurs throughout the Mediterranean, most notably in areas off Albania, Algeria, Croatia, Egypt, France, Greece, Italy, Libya, Morocco, Slovenia, Spain, Tunisia, and Turkey (Gerosa and Casale, 1999; Camiñas, 2004; Casale, 2008). This fishing practice has the potential to destroy bottom habitat in these areas. Fishing methods affect neritic zones by not only impacting bottom habitat and incidentally capturing loggerheads but also depleting fish populations, and thus altering ecosystem dynamics. For example, depleted fish stocks in Zakynthos, Greece, likely contributed to predation of adult loggerheads by monk seals (*Monachus monachus*) (Margaritoulis *et al.,* 1996). Further, by depleting fish populations, the trophic dynamics will be altered, which may then in turn affect the ability of loggerheads to find prey resources. If loggerheads are not able to forage on the necessary prey resources, their long-term survivability may be impacted. Climate change also may result in future trophic changes, thus impacting loggerhead prey abundance and/or distribution.

Marine pollution, including direct contamination and structural habitat degradation, can affect loggerhead neritic and oceanic habitat. As the Mediterranean is an enclosed sea, organic and inorganic wastes, toxic effluents, and other pollutants rapidly affect the ecosystem (Camiñas, 2004). The Mediterranean has been declared a "special area" by the MARPOL Convention, in which deliberate petroleum discharges from vessels are banned, but numerous repeated offenses are still thought to occur (Pavlakis *et al.,* 1996). Some estimates of the amount of oil released into the region are as high as 1,200,000 metric tons (Alpers, 1993). Direct oil spill events also occur as happened in Lebanon in 2006 when 10,000 to 15,000 tons of heavy fuel oil spilled into the eastern Mediterranean (United Nations Environment Programme, 2007).

Destruction and modification of loggerhead habitat also may occur as a result of other activities. For example, underwater explosives have been identified as a key threat to loggerhead habitat in internesting areas in the Mediterranean (Margaritoulis *et al.,* 2003). Further, the Mediterranean is a site of intense tourist activity, and corresponding boat anchoring also may impact loggerhead habitat in the neritic environment.

In summary, we find that the Mediterranean Sea DPS of the loggerhead sea turtle is negatively affected by ongoing changes in both its terrestrial and marine habitats as a result of land and water use practices as considered above in Factor A. Within Factor A, we find that coastal development, placement of barriers to nesting, beachfront lighting, and erosion resulting from sand extraction, offshore sand dredging, and sediment removal from river beds are significant threats to the persistence of this DPS.

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

Mediterranean turtle populations were subject to severe exploitation until the mid-1960s (Margaritoulis *et al.,* 2003). Deliberate hunting of loggerheads for their meat, shells, and eggs is reduced from previous exploitation levels, but still exists. For example, Nada and Casale (2008) found that egg collection (for individual consumption) still occurs in Egypt. In some areas of the Mediterranean, like on the Greek Island of Zakynthos, nesting beaches are protected (Panagopoulou *et al.,* 2008), so egg harvest by humans in those areas is likely negligible.

Exploitation of juveniles and adults still occurs in some Mediterranean areas. In Tunisia, clandestine trade for local consumption is still recorded, despite prohibition of the sale of turtles in fish markets in 1989 (Laurent *et al.,* 1996). In Egypt, turtles are sold in fish markets despite prohibitive laws; of 71 turtles observed at fish markets in 1995 and 1996, 68 percent were loggerheads (Laurent *et al.,* 1996). Nada (2001) reported 135 turtles (of which 85 percent were loggerheads) slaughtered at the fish market of Alexandria in 6 months (December 1998–May 1999). Based on observed sea turtle slaughters in 1995 and 1996, Laurent *et al.* (1996) estimated that several thousand sea turtles were probably killed each year in Egypt. More recently, a study found that the open selling of sea turtles in Egypt generally has been curtailed due to enforcement efforts, but a high level of intentional killing for the black market or for direct personal consumption still exists (Nada and Casale, 2008). Given the high numbers of turtles caught in this area, several hundred turtles are currently estimated to be slaughtered each year in Egypt (Nada and Casale, 2008). This estimate likely includes both juvenile and adult loggerheads, as Egyptian fish markets have been documented selling different sized sea turtles. While the mean sea turtle size was 65.7 cm CCL (range 38–86.3 cm CCL; n=48), 37.5 percent of observed loggerhead samples were greater than 70 cm CCL (Laurent *et al.,* 1996).

In summary, overutilization for commercial purposes likely was a factor that contributed to the historic declines of this DPS. Current illegal harvest of loggerheads in Egypt for human consumption continues as a significant threat to the persistence of this DPS.

C. Disease or Predation

The potential exists for diseases and endoparasites to impact loggerheads found in the Mediterranean. Endoparasites in loggerheads have been studied in the western Mediterranean. While the composition of the gastrointestinal community of sea turtles is expected to include digeneans, nematodes, and aspidogastreans, loggerheads in the Mediterranean were found to harbor only four digenean species typical of marine turtles (Aznar *et al.,* 1998). There have been no records of fibropapillomatosis in the Mediterranean. While there is the potential for disease in this area, information on the prevalence of such disease is lacking.

In the Mediterranean Sea, loggerhead hatchlings and eggs are subject to depredation by wild canids (*i.e.,* foxes (*Vulpes vulpes*), golden jackals (*Canis aureus*)), feral/domestic dogs, and ghost crabs (*Ocypode cursor*) (Margaritoulis *et al.,* 2003). Predators have caused the loss of 48.4 percent of loggerhead clutches at Kyparissia Bay, Greece (Margaritoulis, 1988), 70–80 percent at Dalyan Beach, Turkey (Erk'akan, 1993), 36 percent (includes green turtle clutches) in Cyprus (Broderick and Godley, 1996), and 44.8 percent in Libya (Laurent *et al.,* 1995). A survey of the Syrian coast in 1999 found 100 percent nest predation, mostly due to stray dogs and humans (Venizelos *et al.,* 2005). Loggerhead eggs are also depredated by insect larvae in Cyprus (McGowan *et al.,* 2001), Turkey (Özdemir *et al.,* 2004), and Greece (Lazou and Rees, 2006). Ghost crabs have been reported preying on loggerhead hatchlings in northern Cyprus and Egypt, suggesting 66 percent of emerging hatchlings succumb to this mortality source (Simms *et al.,* 2002). Predation also has been influenced by anthropogenic sources. On Zakynthos, Greece, a landfill site next to loggerhead nesting beaches has resulted in an artificially high level of seagulls (*Larus* spp.), which results in increased predation pressure on hatchlings (Panagopoulou *et al.,* 2008). Planting of non-native plants also can have a detrimental effect on nests in the form of roots invading eggs (*e.g.,* tamarisk tree (*Tamarix* spp.) roots invading eggs in Zakynthos, Greece) (Margaritoulis *et al.,* 2007).

Predation on adult and juvenile loggerheads has also been documented in the Mediterranean. Predation of nesting loggerheads by golden jackals has been recorded in Turkey (Peters *et al.,* 1994). During a 1995 survey of loggerhead nesting in Libya, two nesting females were found killed by carnivores, probably jackals (Laurent *et al.,* 1997). Off the sea turtle nesting beach of Zakynthos, Greece, adult loggerheads were found being predated upon by Mediterranean monk seals (*Monachus monachus*). Of the eight predated turtles observed or reported, 62.5 percent were adult males (Margaritoulis *et al.,* 1996). Further, stomach contents were examined from 24 Mediterranean white sharks (*Carcharodon carcharias*), and 17 percent contained remains of marine turtles, including two loggerheads, one green, and one unidentifiable turtle (Fergusson *et al.,* 2000). One of the loggerhead turtles ingested was a juvenile with a carapace length of approximately 60 cm (length not reported as either SCL or CCL). Fergusson *et al.* (2000) report that white shark interactions with sea turtles are likely rare east of the Ionian Sea, and while the impact of shark predation on turtle populations is unknown, it is probably small compared to other sources of mortality.

The Mediterranean is a low-productivity body of water, with high water clarity as a result. However, harmful algal blooms do occur in this area (*e.g.,* off Algeria in 2002), and the problem is particularly acute in enclosed ocean basins such as the Mediterranean. In the northern Adriatic Sea, fish kills have occurred as a result of noxious phytoplankton blooms and anoxic conditions (Mediterranean Sea LME). While fish may be more susceptible to these harmful algal blooms, loggerheads in the Mediterranean also may be impacted by such noxious or toxic phytoplankton to some extent.

In summary, nest and hatchling predation likely was a factor that contributed to the historic decline of this DPS. Current nest and hatchling predation on several Mediterranean nesting beaches is believed to be a significant threat to the persistence of this DPS.

D. Inadequacy of Existing Regulatory Mechanisms

International Instruments

The BRT identified several regulatory mechanisms that apply to loggerhead sea turtles globally and within the Mediterranean Sea. The reader is directed to sections 5.1.4. and 5.2.8.4. of the Status Review for a discussion of these regulatory mechanisms. Hykle (2002) and Tiwari (2002) have reviewed the effectiveness of some of these international instruments. The problems with existing international treaties are often that they have not realized their full potential, do not include some key countries, do not specifically address sea turtle conservation, and are handicapped by the lack of a sovereign authority to enforce environmental regulations. The ineffectiveness of international treaties and national legislation is oftentimes due to the lack of motivation or obligation by countries to implement and enforce them. A thorough discussion of this topic is available in a special 2002 issue of the Journal of International Wildlife Law and Policy: International Instruments and Marine Turtle Conservation (Hykle 2002).

National Legislation and Protection

Fishery bycatch that occurs throughout the Mediterranean Sea (*see* Factor E), as well as anthropogenic threats to nesting beaches (Factor A) and eggs/hatchlings (Factors A, B, C, and E), is substantial. Although conservation efforts to protect some nesting beaches are underway, more widespread and consistent protection is needed. Although national and international governmental and non-governmental entities in the Mediterranean Sea are currently working toward reducing loggerhead bycatch, it is unlikely that this source of mortality can be sufficiently reduced across the range of the DPS in the near future because of the lack of bycatch reduction in commercial and artisanal fisheries operating within the range of this DPS, the lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies.

In summary, our review of regulatory mechanisms under Factor D demonstrates that although regulatory mechanisms are in place that should address direct and incidental take of Mediterranean Sea loggerheads, these regulatory mechanisms are insufficient or are not being implemented effectively to address the needs of loggerheads. We find that the threat from the inadequacy of existing regulatory mechanisms for fishery bycatch (Factor E) and impacts to nesting beach habitat (Factor A) is significant relative to the persistence of this DPS.

E. Other Natural or Manmade Factors Affecting Its Continued Existence

Other anthropogenic and natural factors affecting loggerhead survival include incidental bycatch in fisheries, vessel collisions, marine pollution, climate change, and cyclonic storm events. Fishing practices alone have been estimated to result in over 150,000 sea turtle captures per year, with approximately 50,000 mortalities (Casale, 2008).

The only estimation of loggerhead survival probabilities in the Mediterranean was calculated by using capture-mark-recapture techniques from 1981–2003 (Casale *et al.,* 2007c). Of the 3,254 loggerheads tagged, 134 were recaptured at different sites throughout the Mediterranean. Most recaptured animals were juveniles (mean 54.4 cm CCL; range 25–88 cm CCL), but the study did not delineate between juvenile life stages. This research estimated a loggerhead annual survival probability of 0.73(95 percent confidence interval; 0.67–0.78), recognizing that there are methodological limitations of the technique used. Nonetheless, Casale *et al.* (2007a) stated that assuming a natural survivorship no higher than 0.95 and a tag loss rate of 0.1, a range of 0.1–0.2 appears reasonable for the additional human induced mortality (from all sources).

Incidental Bycatch in Fishing Gear

Incidental capture of sea turtles in artisanal and commercial fisheries is a significant threat to the survivability of loggerheads in the Mediterranean. Sea turtles may be caught in pelagic and demersal longlines, drift gillnets, set gillnets and trammel nets, bottom and mid-water trawls, seines, dredges, traps/pots, and hook and line gear. In a 2004 FAO Fisheries Report, Camiñas (2004) stated that the main fisheries affecting sea turtles in the Mediterranean Sea (at that time) were Spanish and Italian longline, North Adriatic Italian, Tunisian, and Turkish trawl, and Moroccan and Italian driftnet. Available information on sea turtle bycatch by gear type is discussed below. There is growing evidence that artisanal/small vessel fisheries (set gillnet, bottom longline, and part of the pelagic longline fishery) may be responsible for a comparable or higher number of captures with higher mortality rates than the commercial/large vessel fisheries (Casale, 2008) as previously suggested by indirect clues (Casale *et al.,* 2005a).

Mediterranean fish landings have increased steadily since the 1950s, but the FAO 10-year capture trend from 1990–1999 shows stable landings (Mediterranean LME, *http://www.lme.noaa.gov*). However, stable fish landings may result from stable fishing effort at the same catch rates, or higher fishing effort at lower catch rates. As fish stocks in the Mediterranean are being depleted (P. Casale, MTSG–IUCN Italy, personal communication, 2009), fishing effort in some areas may be increasing to catch the available fish. This trend has not yet been verified throughout the Mediterranean, but fishing pressures may be increasing even though landings appear stable.

Longline Fisheries

In the Mediterranean, pelagic longline fisheries targeting swordfish (*Ziphias gladius*) and albacore (*Thunnus alalunga*) may be the primary source of loggerhead bycatch. It appears that most of the incidental captures occur in the western and central portions of the area (Demetropoulos and Hadjichristophorou, 1995). The most severe bycatch in the Mediterranean occurs around the Balearic Islands where 1,950–35,000 juveniles are caught annually in the surface longline fishery (Mayol and Castelló Mas, 1983; Camiñas, 1988, 1997; Aguilar *et al.,* 1995). Specifically, the following regions have reported annual estimates of total turtle bycatch from pelagic longlines: Spain—17,000 to 35,000 turtles (Aguilar *et al.,* 1995; Camiñas *et al.,* 2003); Italy (Ionian Sea)—1,084 to 4,447 turtles (Deflorio *et al.,* 2005); Morocco—3,000 turtles (Laurent, 1990); Greece—280 to 3,310 turtles (Panou *et al.,* 1999; Kapantagakis and Lioudakis, 2006); Italy (Lampedusa)—2,100 turtles (Casale *et al.,* 2007a); Malta—1,500 to 2,500 turtles (Gramentz, 1989); South Tunisia (Gulf of Gabès)—486 turtles (Jribi *et al.,* 2008); and Algeria—300 turtles (Laurent, 1990).

For the entire Mediterranean pelagic longline fishery, an extrapolation resulted in a bycatch estimate of 60,000 to 80,000 loggerheads in 2000 (Lewison *et al.,* 2004). Further, a more recent paper used the best available information to estimate that Spain, Morocco, and Italy have the highest level of sea turtle bycatch, with over 10,000 turtle captures per year for each country, and Greece, Malta, Libya, and Tunisia each catch 1,000 to 3,000 turtles per year (Casale, 2008). Available data suggest the annual number of loggerhead sea turtle captures by all Mediterranean pelagic longline fisheries may be greater than 50,000 (Casale, 2008). Note that these are not necessarily individual turtles, as the same sea turtle can be captured more than once.

Mortality estimates in the pelagic longline fishery at gear retrieval appear to be lower than in some other types of gear (*e.g.,* set gillnet). Although limited to observations of direct mortality at gear retrieval, Carreras *et al.* (2004) found mortality to be low (0–7.7 percent) in the longline fishery off the Balearic Islands, and Jribi *et al.* (2008) reported 0 percent direct mortality in the southern Tunisia surface longline fishery. These estimates are consistent with those found in other areas; direct mortality was estimated at 4.3 percent in Greece (n=23), 0 percent in Italy (n=214), and 2.6 percent in Spain (n=676) (Laurent *et al.,* 2001). However, considering injured turtles and those released with hooks, the potential for mortality is likely much higher. Based upon observations of hooked loggerhead turtles in captivity, Aguilar *et al.* (1995) estimated 20–30 percent of animals caught in longline gear may eventually die. More recently, Casale *et al.* (2008b) found, given variations in hook position affecting survivability, the mortality rate of turtles caught by pelagic longlines may be higher than 30 percent, which is greater than previously thought (17–42 percent; Lewison *et al.,* 2004). Considering direct and post-release mortality, Casale (2008) used a conservative approach to arrive at 40 percent for the average mortality from Mediterranean pelagic longlines. The result is an estimated 20,000 turtles killed per year by pelagic longlines (Casale, 2008).

In general, most of the turtles captured in the Mediterranean surface longline fisheries are juvenile animals (Aguilar *et al.,* 1995; Panou *et al.,* 1999; Camiñas *et al.,* 2003; Casale *et al.,* 2007a; Jribi *et al.,* 2008), but some adult loggerhead bycatch is also reported. Considering data from many Mediterranean areas and research studies, the average size of turtles caught by pelagic longlines was 48.9 cm CCL (range 20.5–79.2 cm CCL; n=1868) (Casale, 2008). Specifically, in the Spanish surface longline fishery, 13 percent of estimated carapace sizes (n=455) ranged from 75.36 to 107 cm CCL, considered to be adult animals (Camiñas *et al.,* 2003), and in the Ionian Sea, 15 percent of a total 157 loggerhead turtles captured in swordfish longlines were adult animals (estimated size at greater than or equal to 75 cm) (Panou *et al.,* 1999).

Bottom longlines are also fished in the Mediterranean, but specific capture rates for loggerheads are largely unknown for many areas. The countries with the highest number of documented captures (in the thousands per year) are Tunisia, Libya, Greece, Turkey, Egypt, Morocco, and Italy (Casale, 2008). Available data suggest the annual number of loggerhead sea turtle captures (not necessarily individual turtles) by all Mediterranean demersal longliners may be greater than 35,000 (Casale, 2008). Given available information and using a conservative approach, mortality from bottom longlines may be at least equal to pelagic longline mortality (40 percent; Casale, 2008). The result is an estimated 14,000 turtles killed per year in Mediterranean bottom longlines (Casale, 2008). It is likely that these animals represent mostly juvenile loggerheads, Casale (2008) reported an average turtle size of 51.8 cm CCL (n=35) in bottom longlines based on available data throughout the Mediterranean.

Artisanal longline fisheries also have the potential to take sea turtles. A survey of 54 small boat (4–10 meter length) artisanal fishermen in Cyprus and Turkey resulted in an estimated minimum bycatch of over 2,000 turtles per year, with an estimated 10 percent mortality rate (Godley *et al.,* 1998a). These small boats fished with a combination of longlines and trammel/gillnets. However, note that it is likely that a proportion (perhaps a large proportion) of the turtle bycatch estimated in this study are green turtles.

Set Net (Gillnet) Fisheries

As in other areas, sea turtles have the potential to interact with set nets (gillnets or trammel nets) in the Mediterranean. Mediterranean set nets refer to gillnets (a single layer of net) and trammel nets, which consist of three layers of net with different mesh size. Casale (2008) estimated that the countries with the highest number of loggerhead captures (in the thousands per year) are Tunisia, Libya, Greece, Turkey, Cyprus, and Croatia. Italy, Morocco, Egypt, and France likely have high capture rates as well. Available information suggests the annual number of loggerhead captures by Mediterranean set nets may be greater than 30,000 (Casale, 2008).

Due to the nature of the gear and fishing practices (*e.g.,* relatively long soak times), incidental capture in gillnets is among the highest source of direct sea turtle mortality. An evaluation of turtles tagged then recaptured in gillnets along the Italian coast found 14 of 19 loggerheads (73.7 percent) to be dead (Argano *et al.,* 1992). Gillnets off France were observed to capture six loggerheads with a 50 percent mortality rate (Laurent, 1991). Six loggerheads were recovered in gillnets off Croatia between 1993 and 1996; 83 percent were found dead (Lazar *et al.,* 2000). Off the Balearic Islands, 196 sea turtles were estimated to be captured in lobster trammel nets in 2001, with a CPUE of 0.17 turtles per vessel (Carreras *et al.,* 2004). Mortality estimates for this artisanal lobster trammel net fishery ranged from 78 to 100 percent. Given this mortality rate and the number of turtles reported in lobster trammel nets, Carreras *et al.* (2004) estimate that a few thousand loggerhead turtles are killed annually by lobster trammel nets in the whole western Mediterranean. Considering data throughout the entire Mediterranean, as well as a conservative approach, Casale (2008) considered mortality by set nets to be 60 percent, with a resulting estimate of 16,000 turtles killed per year. Most of these animals are likely juveniles; Casale (2008) evaluated available set net catch data throughout the Mediterranean and found an average size of 45.4 cm CCL (n=74).

As noted above, artisanal set net fisheries also may capture numerous sea turtles, as observed off Cyprus and Turkey (Godley *et al.,* 1998a).

Driftnet Fisheries

Historically, driftnet fishing in the Mediterranean caught large numbers of sea turtles. An estimated 16,000 turtles were captured annually in the Ionian Sea driftnet fishery in the 1980s (De Metrio and Megalofonou, 1988). The United Nations established a worldwide moratorium on driftnet fishing effective in 1992, but unregulated driftnetting continued to occur in the Mediterranean. For instance, a bycatch estimate of 236 loggerhead turtles was developed for the Spanish swordfish driftnet fishery in 1994 (Silvani *et al.,* 1999). While the Spanish fleet curtailed activity in 1994, the Moroccan, Turkish, French, and Italian driftnet fleets continued to operate. Tudela *et al.* (2005) presented bycatch rates for driftnet fisheries in the Alboran Sea and off Italy. The Moroccan Alboran Sea driftnet fleet bycatch rate ranged from 0.21 to 0.78 loggerheads per haul, whereas the Italian driftnet fleet had a lower bycatch rate of 0.046 to 0.057 loggerheads per haul (Di Natale, 1995; Caminas, 1997; Silvani *et al.,* 1999). The use of driftnets in the Mediterranean continues to be illegal: the General Fisheries Commission for the Mediterranean prohibited driftnet fishing in 1997; a total ban on driftnet fishing by the European Union fleet in the Mediterranean went into effect in 2002; and the International Commission for the Conservation of Atlantic Tunas (ICCAT) banned driftnets in 2003. Nevertheless, there are an estimated 600 illegal driftnet vessels operating in the Mediterranean, including fleets based in Algeria, France, Italy, Morocco, and Turkey (Environmental Justice Foundation, 2007). In particular, the Moroccan fleet, operating in the Alboran Sea and Straits of Gibraltar, comprises the bulk of Mediterranean driftnetting, and has been found responsible for high bycatch, including loggerhead turtles (Environmental Justice Foundation, 2007; Aksissou *et al.,* in press). Driftnet fishing in the Mediterranean, and accompanying threats to loggerhead turtles, continues to occur.

Trawl Fisheries

Sea turtles are known to be incidentally captured in trawls in Albania, Algeria, Croatia, Egypt, France, Greece, Italy, Libya, Morocco, Slovenia, Spain, Tunisia, and Turkey (Gerosa and Casale, 1999; Camiñas, 2004; Casale, 2008). Laurent *et al.* (1996) estimated that approximately 10,000 to 15,000 sea turtles (most of which are loggerheads) are captured by bottom trawling in the entire Mediterranean. More recently, Casale (2008) compiled available trawl bycatch data throughout the Mediterranean and reported that Italy and Tunisia have the highest level of sea turtle bycatch, potentially over 20,000 captures per year combined, and Croatia, Greece, Turkey, Egypt, and Libya each catch more than 2,000 turtles per year. Further, Spain and Albania may each capture a few hundred sea turtles per year (Casale, 2008). Available data suggest the annual number of sea turtle captures by all Mediterranean trawlers may be greater than 40,000 (Casale, 2008). Note that these are capture events and not necessarily individual turtles.

Although juveniles are incidentally captured in trawl gear in many areas of the Mediterranean (Casale *et al.,* 2004, 2007a; Jribi *et al.,* 2007), adult turtles are also found. In Egypt, 25 percent of loggerheads captured in bottom trawl gear (n=16) were greater than or equal to 70 cm CCL, and in Tunisia, 26.2 percent (n=62) were of this larger size class (Laurent *et al.,* 1996). Off Lampedusa Island, Italy, the average size of turtles caught by bottom trawlers was 51.8 cm CCL (range 22–87 cm CCL; n=368), and approximately 10 percent of the animals measured greater than 75 cm CCL (Casale *et al.,* 2007a). For all areas of the Mediterranean, Casale (2008) reported that medium to large turtles are generally caught by bottom trawl gear (mean 53.9 cm CCL; range 22–87 cm CCL; n=648).

While there is a notable interaction rate in the Mediterranean, it appears that the mortality associated with trawling is relatively low. Incidents of mortality have ranged from 3.3 percent (n=60) in Tunisia (Jribi *et al.,* 2007) and 3.3 percent (n=92) in France (Laurent, 1991) to 9.4 percent (n=32) in Italy (Casale *et al.,* 2004). Casale *et al.* (2004) found that mortality would be higher if all comatose turtles were assumed to die. It also should be noted that the mortality rate in trawls depends on the duration of the haul, with longer haul durations resulting in higher mortality rates (Henwood and Stuntz, 1987; Sasso and Epperly, 2006). Jribi *et al.* (2007) stated that the low recorded mortality in the Gulf of Gabès is likely due to the short haul durations in this area. Based on available information from multiple areas of the Mediterranean, and assuming that comatose animals die if released in that condition, the overall average mortality rate for bottom trawlers was estimated to be 20 percent (Casale, 2008). This results in at least 7,400 turtles killed per year by bottom trawlers in all of the Mediterranean, but the number is likely more than 10,000 (Casale, 2008).

Mid-water trawling may have less total impact on sea turtles found in the Mediterranean than some other gear types, but interactions still occur. Casale *et al.* (2004) found that while no turtles were caught on observed mid-water trawl trips in the North Adriatic Sea, vessel captains reported 13 sea turtles captured from April to September. Considering total fishing effort, these reports resulted in a minimum total catch estimate of 161 turtles/year in the Italian mid-water trawl fishery. Off Turkey, 71 loggerheads were captured in mid-water trawls from 1995–1996, while 43 loggerheads were incidentally taken in bottom trawls (Oruç, 2001). In this same study, of a total 320 turtles captured in mid-water trawls (loggerheads and greens combined), 95 percent were captured alive and apparently healthy. While the total catch numbers throughout the Mediterranean have not been estimated, mid-water trawl fisheries do present a threat to loggerhead sea turtles.

Other Gear Types

Seine, dredge, trap/pot, and hook and line fisheries operate in Mediterranean waters and may affect loggerhead turtles, although incidental captures in these gear types are largely unknown (Camiñas, 2004). Artisanal fisheries using a variety of gear types also have the potential for sea turtle takes, but the effects of most artisanal gear types on sea turtles have not been estimated.

Other Manmade and Natural Impacts

Other anthropogenic threats, such as interactions with recreational and commercial vessels, marine pollution, and intentional killing, also impact loggerheads found in the Mediterranean. Propeller and collision injuries from boats and ships are becoming more common in sea turtles, although it is unclear as to whether the events are increasing or just the reporting of the injuries. Speedboat impacts are of particular concern in areas of intense tourist activity, such as Greece and Turkey. Losses of nesting females from vessel collisions have been documented in Zakynthos and Crete in Greece (Camiñas, 2004). In the Gulf of Naples, 28.1 percent of loggerheads recovered from 1993–1996 had injuries attributed to boat strikes (Bentivegna and Paglialonga, 1998). Along the Greece coastline from 1997–1999, boat strikes were reported as a seasonal phenomenon in stranded turtles (Kopsida *et al.,* 2002), but numbers were not presented.

Direct or indirect disposal of anthropogenic debris introduces potentially lethal materials into loggerhead foraging habitats. Unattended or discarded nets, floating plastics and bags, and tar balls are of particular concern (Camiñas, 2004; Margaritoulis, 2007). Monofilament netting appears to be the most dangerous waste produced by the fishing industry (Camiñas, 2004). In the Mediterranean, 20 of 99 loggerhead turtles examined from Maltese fisheries were found contaminated with plastic or metal litter and hydrocarbons, with crude oil being the most common pollutant (Gramentz, 1988). Of 54 juvenile loggerhead turtles incidentally caught by fisheries in Spanish Mediterranean waters, 79.6 percent had debris in their digestive tracts (Tomas *et al.,* 2002). In this study, plastics were the most frequent type of marine debris observed (75.9 percent), followed by tar (25.9 percent). However, an examination of stranded sea turtles in Northern Cyprus and Turkey found that only 3 of 98 animals were affected by marine debris (Godley *et al.,* 1998b).

Pollutant waste in the marine environment may impact loggerheads, likely more than other sea turtle species. Omnivorous loggerheads stranded in Cyprus, Greece, and Scotland had the highest organochlorine contaminant concentrations, as compared to green and leatherback turtles (Mckenzie *et al.,* 1999). In northern Cyprus, Godley *et al.* (1999) found heavy metal concentrations (mercury, cadmium, and lead) to be higher in loggerheads than green turtles. Even so, concentrations of contaminants from sea turtles in Mediterranean waters were found to be comparable to other areas, generally with levels lower than concentrations shown to cause deleterious effects in other species (Godley *et al.,* 1999; Mckenzie *et al.,* 1999). However, lead concentrations in some Mediterranean loggerhead hatchlings were at levels known to cause toxic effects in other vertebrate groups (Godley *et al.,* 1999).

As in other areas of the world, intentional killing or injuring of sea turtles has been reported to occur in the Mediterranean. Of 524 strandings in Greece, it appeared that 23 percent had been intentionally killed or injured (Kopsida *et al.,* 2002). While some turtles incidentally captured are used for consumption, it has been reported that some fishermen kill the sea turtles they catch for a variety of other reasons, including non-commercial use, hostility, prejudice, recovery of hooks, and ignorance (Laurent *et al.,* 1996; Godley *et al.,* 1998a; Gerosa and Casale, 1999; Casale, 2008).

Natural environmental events also may affect loggerheads in the Mediterranean. Cyclonic storms that closely resemble tropical cyclones in satellite images occasionally form over the Mediterranean Sea (Emanuel, 2005). While hurricanes typically do not occur in the Mediterranean, researchers have suggested that climate change could trigger hurricane development in this area in the future (Gaertner *et al.,* 2007). Any significant storm event that may develop could disrupt loggerhead nesting activity and hatchling production, but the results are generally localized and rarely result in whole-scale losses over multiple nesting seasons.

Similar to other areas of the world, climate change and sea level rise have the potential to impact loggerheads in the Mediterranean. Over the long term, Mediterranean turtle populations could be threatened by the alteration of thermal sand characteristics (from global warming), resulting in the reduction or cessation of female hatchling production (Camiñas, 2004). Further, a significant rise in sea level would restrict loggerhead nesting habitat in the eastern Mediterranean.

In summary, we find that the Mediterranean Sea DPS of the loggerhead sea turtle is negatively affected by both natural and manmade impacts as described above in Factor E. Within Factor E, we find that fishery bycatch that occurs throughout the Mediterranean Sea, particularly bycatch mortality of loggerheads from pelagic and bottom longline, set net, driftnet, and trawl fisheries, is a significant threat to the persistence of this DPS. In addition, boat strikes are becoming more common and are likely also a significant threat to the persistence of this DPS.

South Atlantic Ocean DPS

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

Terrestrial Zone

Destruction and modification of loggerhead nesting habitat in the South Atlantic result from coastal development and construction, placement of erosion control structures and other barriers to nesting, beachfront lighting, vehicular and pedestrian traffic, sand extraction, beach erosion, beach sand placement, beach pollution, removal of native vegetation, and planting of non-native vegetation (D'Amato and Marczwski, 1993; Marcovaldi and Marcovaldi, 1999; Naro-Maciel *et al.,* 1999; Marcovaldi *et al.,* 2002b, 2005; Marcovaldi, 2007).

The primary nesting areas for loggerheads in the South Atlantic are in the states of Sergipe, Bahia, Espírito Santo, and Rio de Janeiro in Brazil (Marcovaldi and Marcovaldi, 1999). These primary nesting areas are monitored by Projeto TAMAR, the national sea turtle conservation program in Brazil. Since 1980, Projeto TAMAR has worked to establish legal protection for nesting beaches (Marcovaldi and Marcovaldi, 1999). As such, human activities, including sand extraction, beach nourishment, seawall construction, beach driving, and artificial lighting, that can negatively impact sea turtle nesting habitat, as well as directly impact nesting turtles and their eggs and hatchlings during the reproductive season, are restricted by various State and Federal laws (Marcovaldi and Marcovaldi, 1999; Marcovaldi *et al.*, 2002b, 2005). Nevertheless, tourism development in coastal areas in Brazil is high, and Projeto TAMAR works toward raising awareness of turtles and their conservation needs through educational and informational activities at their Visitor Centers that are dispersed throughout the nesting areas (Marcovaldi *et al.*, 2005).

In terms of non-native vegetation, the majority of nesting beaches in northern Bahia, where loggerhead nesting density is highest in Brazil (Marcovaldi and Chaloupka, 2007), have coconut plantations dating back to the 17th century backing them (Naro-Maciel *et al.*, 1999). It is impossible to assess whether this structured habitat has resulted in long-term changes to the loggerhead nesting rookery in northern Bahia.

Neritic/Oceanic Zones

Human activities that impact bottom habitat in the loggerhead neritic and oceanic zones in the South Atlantic Ocean include fishing practices, channel dredging, sand extraction, marine pollution, and climate change (*e.g.*, Ibe, 1996; Silva *et al.*, 1997). General human activities have altered ocean ecosystems, as identified by ecosystem models (*http://www.lme.noaa.gov*). On the western side of the South Atlantic, the Brazil Current LME region is characterized by the Global International Waters Assessment as suffering severe impacts in the areas of pollution, coastal habitat modification, and overexploitation of fish stocks (Marques *et al.*, 2004). The Patagonian Shelf LME is moderately affected by pollution, habitat modification, and overfishing (Mugetti *et al.*, 2004). On the eastern side of the South Atlantic, the Benguela Current LME has been characterized as moderately impacted in the area of overfishing, with future conditions expected to worsen by the Global International Waters Assessment (Prochazka *et al.*, 2005). Climate change also may result in future trophic changes, thus impacting loggerhead prey abundance and/or distribution.

In summary, we find that the South Atlantic Ocean DPS of the loggerhead sea turtle is negatively affected by ongoing changes in its marine habitats as a result of land and water use practices as considered above in Factor A. However, sufficient data are not available to assess the significance of these threats to the persistence of this DPS.

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

Deliberate hunting of loggerheads for their meat, shells, and eggs is reduced from previous exploitation levels, but still exists. Limited numbers of eggs are taken for human consumption in Brazil, but the relative amount is considered minor when compared to historical rates of egg collection (Marcovaldi and Marcovaldi, 1999; Marcovaldi *et al.*, 2005; Almeida and Mendes, 2007). Use of sea turtles including loggerheads for medicinal purposes occasionally occurs in northeastern Brazil (Alves and Rosa, 2006). Use of bycaught loggerheads for subsistence and medicinal purposes is likely to occur in southern Atlantic Africa, based on information from central West Africa (Fretey, 2001; Fretey *et al.,* 2007).

In summary, the harvest of loggerheads in Brazil for their meat, shells, and eggs likely was a factor that contributed to the historic decline of this DPS. However, current harvest levels are greatly reduced from historic levels. Although harvest is known to still occur in Brazil and southern Atlantic Africa, it no longer appears to be a significant threat to the persistence of this DPS.

C. Disease or Predation

The potential exists for diseases and endoparasites to impact loggerheads found in the South Atlantic Ocean. There have been five confirmed cases of fibropapillomatosis in loggerheads in Brazil (Baptistotte, 2007). There is no indication that this disease poses a major threat for this species in the eastern South Atlantic (Formia *et al.*, 2007).

Eggs and nests in Brazil experience depredation, primarily by foxes (Marcovaldi and Laurent, 1996). Nests laid by loggerheads in the southern Atlantic African coastline, if any, likely experience similar predation pressures to those on nests of other species laid in the same area (*e.g.*, jackals depredate green turtle nests in Angola; Weir *et al.*, 2007).

Loggerheads in the South Atlantic also may be impacted by harmful algal blooms (Gilbert *et al.*, 2005).

In summary, although disease and predation are known to occur, quantitative data are not sufficient to assess the degree of impact of these threats on the persistence of this DPS.

D. Inadequacy of Existing Regulatory Mechanisms

International Instruments

The BRT identified several regulatory mechanisms that apply to loggerhead sea turtles globally and within the South Atlantic Ocean. The reader is directed to sections 5.1.4. and 5.2.9.4. of the Status Review for a discussion of these regulatory mechanisms. Hykle (2002) and Tiwari (2002) have reviewed the effectiveness of some of these international instruments. The problems with existing international treaties are often that they have not realized their full potential, do not include some key countries, do not specifically address sea turtle conservation, and are handicapped by the lack of a sovereign authority to enforce environmental regulations. The ineffectiveness of international treaties and national legislation is oftentimes due to the lack of motivation or obligation by countries to implement and enforce them. A thorough discussion of this topic is available in a special 2002 issue of the Journal of International Wildlife Law and Policy: International Instruments and Marine Turtle Conservation (Hykle 2002).

National Legislation and Protection

Fishery bycatch that occurs throughout the South Atlantic Ocean is substantial (*see* Factor E). Although national and international governmental and non-governmental entities on both sides of the South Atlantic are currently working toward reducing loggerhead bycatch in the South Atlantic, it is unlikely that this source of mortality can be sufficiently reduced across the range of the DPS in the near future because of the diversity and magnitude of the commercial and artisanal fisheries operating in the South Atlantic, the lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies.

In summary, our review of regulatory mechanisms under Factor D demonstrates that although regulatory mechanisms are in place that should address direct and incidental take of South Atlantic Ocean loggerheads, these regulatory mechanisms are insufficient or are not being implemented effectively to address the needs of loggerheads. We find that the threat from the inadequacy of existing regulatory mechanisms for fishery bycatch (Factor E) is significant relative to the persistence of this DPS.

E. Other Natural or Manmade Factors Affecting Its Continued Existence

Incidental Bycatch in Fishing Gear

Incidental capture of sea turtles in artisanal and commercial fisheries is a significant threat to the survivability of loggerheads in the South Atlantic. Sea turtles may be caught in pelagic and demersal longlines, drift and set gillnets, bottom and mid-water trawling, fishing dredges, pound nets and weirs, haul and purse seines, pots and traps, and hook and line gear. In the western South Atlantic, there are various efforts aimed at mitigating bycatch of sea turtles in various fisheries. In Brazil, there is the *National Action Plan to Reduce Incidental Capture of Sea Turtles in Fisheries*, coordinated by Projeto TAMAR (Marcovaldi *et al.*, 2006). This action plan focuses on both artisanal and commercial fisheries, and collects data directly from fishers as well as on-board observers. Although loggerheads have been observed as bycatch in all fishing gear and methods identified above, Marcovaldi *et al.* (2006) have identified longlining as the major source of incidental capture of loggerhead turtles. Reports of loggerhead bycatch by pelagic longlines come mostly from the southern portion of the Brazilian Exclusive Economic Zone, between 20° S and 35° S latitude. Bugoni *et al.* (2008) reported a loggerhead bycatch rate of 0.52 juvenile turtles/1000 hooks by surface longlines targeting dolphinfish. Pinedo *et al.* (2004) reported seasonal variation in bycatch of juvenile loggerheads (and other sea turtle species) by pelagic longlines in the same region of Brazil, with the highest rates (1.85 turtles/1000 hooks) in the austral spring. Kotas *et al.* (2004) reported the highest rates of loggerhead bycatch (greater than 10 turtles/1000 hooks) by pelagic longlines in the austral summer/fall months. A study based on several years found that the highest rate of loggerhead bycatch in pelagic longlines off Uruguay and Brazil was in the late austral summer month of February: 2.72 turtles/1000 hooks (Lopez-Medilaharsu *et al.*, 2007). Sales *et al.* (2008) reported a loggerhead bycatch rate of 0.87/1000 hooks near the Rio Grande Elevacao do Rio Grande, about 600 nautical miles off the coast of southern Brazil. In Uruguayan waters, the primary fisheries with loggerhead bycatch are bottom trawlers and longlines (Domingo *et al.,* 2006). Domingo *et al.* (2008) reported bycatch rates of loggerheads of 0.9–1.3/1000 hooks by longline deployed south of 30° S latitude. In waters off Argentina, bottom trawlers also catch some loggerheads (Domingo *et al.*, 2006).

In the eastern South Atlantic, sea turtle bycatch in fisheries has been documented from Gabon to South Africa (Fretey, 2001). Limited data are available on bycatch of loggerheads in coastal fisheries, although loggerheads are known (or strongly suspected) to occur in coastal waters from Gabon to South Africa (Fretey, 2001; Bal *et al.*, 2007; Weir *et al.*, 2007). Coastal fisheries implicated in bycatch of loggerheads and other turtles include gillnets, beach seines, and trawlers (Bal *et al.*, 2007).

In the high seas, longlines are used by fishing boats targeting tuna and swordfish in the eastern South Atlantic. A recent study by Honig *et al.* (2008) estimates 7,600–120,000 sea turtles are incidentally captured by commercial longlines fishing in the Benguela Current LME; 60 percent of these are loggerheads. Petersen *et al.* (2007, 2009) reported that the rate of loggerhead bycatch in South African longliners was around 0.02 turtles/1000 hooks, largely in the Benguela Current LME. In the middle of the South Atlantic, loggerhead bycatch by longlines was reported to be low, relative to other regions in the Atlantic (Mejuto *et al.*, 2008).

Other Manmade and Natural Impacts

Other anthropogenic impacts, such as boat strikes and ingestion or entanglement in marine debris, also apply to loggerheads in the South Atlantic. Bugoni *et al.* (2001) have suggested the ingestion of plastic and oil may contribute to loggerhead mortality on the southern coast of Brazil. Plastic marine debris in the eastern South Atlantic also may pose a problem for loggerheads and other sea turtles (Ryan, 1996). Similar to other areas of the world, climate change and sea level rise have the potential to impact loggerheads in the South Atlantic.

Oil reserve exploration and extraction activities also may pose a threat for sea turtles in the South Atlantic. Seismic surveys in Brazil and Angola have recorded sea turtle occurrences near the seismic work (Gurjao *et al.*, 2005; Weir *et al.*, 2007). While no sea turtle takes were directly observed on these surveys, increased equipment and presence in the water that is associated with these activities also increases the likelihood of sea turtle interactions (Weir *et al.*, 2007).

Natural environmental events may affect loggerheads in the South Atlantic. However, while a rare hurricane hit Brazil in March 2004, typically hurricanes do not occur in the South Atlantic (McTaggart-Cowan *et al.*, 2006). This is generally due to higher windspeeds aloft, preventing the storms from gaining height and therefore strength.

In summary, we find that the South Atlantic Ocean DPS of the loggerhead sea turtle is negatively affected by both natural and manmade impacts as described above in Factor E. Within Factor E, we find that fishery bycatch, particularly bycatch mortality of loggerheads from pelagic longline fisheries, is a significant threat to the persistence of this DPS.

Extinction Risk Assessments

In addition to the status evaluation and listing factor analysis provided above, the BRT conducted two independent analyses to assess extinction risks of the nine identified DPSs. These analyses provided additional insights into the status of the nine DPSs. The first analysis used the diffusion approximation approach based on time series of counts of nesting females (Lande and Orzack, 1988; Dennis *et al.*, 1991; Holmes, 2001; Snover and Heppell, 2009). This analysis provided a metric (susceptibility to quasi-extinction or SQE) to determine if the probability of a population's risk of quasi-extinction is high enough to warrant a particular listing status (Snover and Heppell, 2009). The term "quasi-extinction" is defined by Ginzburg *et al.* (1982) as the minimum number of individuals (often females) below which the population is likely to be critically and immediately imperiled. The diffusion approximation approach is based on stochastic projections of observed trends and variability in the numbers of mature females at various nesting beaches. The second approach used a deterministic stage-based population model that focused on determining the effects of known anthropogenic mortalities on each DPS with respect to the vital rates of the species. Anthropogenic mortalities were added to natural mortalities and possible ranges of population growth rates were computed as another metric of population health. Because this approach is based on matrix models, the BRT referred to it as a threat matrix analysis. This approach focused on how additional mortalities may affect the future growth and recovery of a loggerhead turtle DPS. The first approach (SQE) was solely based on the available time-series data on the numbers of nests at nesting beaches, whereas the second approach (threat matrix analysis) was based on the known biology of the species, natural mortality rates, and anthropogenic mortalities, independent of observed nesting beach data.

The BRT found that for three of five DPSs with sufficient data to conduct the SQE analysis (North Pacific Ocean, South Pacific Ocean, and Northwest Atlantic Ocean), these DPSs were at risk of declining to levels that are less than 30 percent of the current numbers of nesting females (quasi-extinction thresholds < 0.30). The BRT found that for the other two DPSs with sufficient data to conduct the SQE analysis (Southwest Indian Ocean and South Atlantic Ocean), the risk of declining to any level of quasi-extinction is negligible using the SQE analysis because of the observed increases in the nesting females in both DPSs. There were not enough data to conduct the SQE analysis for the North Indian Ocean, Southeast Indo-Pacific Ocean, Northeast Atlantic Ocean, and Mediterranean Sea DPSs.

According to the threat matrix analysis using experts' opinions in the matrix model framework, the BRT determined that all loggerhead turtle DPSs have the potential to decline in the future. Although some DPSs are indicating increasing trends at nesting beaches (Southwest Indian Ocean and South Atlantic Ocean), available information about anthropogenic threats to juvenile and adult loggerheads in neritic and oceanic environments indicate possible unsustainable additional mortalities. According to the threat matrix analysis, the potential for future decline is greatest for the North Indian Ocean, Northwest Atlantic Ocean, Northeast Atlantic Ocean, Mediterranean Sea, and South Atlantic Ocean DPSs.

The BRT's approach to the risk analysis presented several important points. First, the lack of precise estimates of age at first reproduction hindered precise assessment of the status of any DPS. Within the range of possible ages at first reproduction of the species, however, some DPSs could decline rapidly regardless of the exact age at first reproduction because of high anthropogenic mortality.

Second, the lack of precise estimates of anthropogenic mortalities resulted in a wide range of possible status using the threat matrix analysis. For the best case scenario, a DPS may be considered healthy, whereas for the worst case scenario the same DPS may be considered as declining rapidly. The precise prognosis of each DPS relies on obtaining precise estimates of anthropogenic mortality and vital rates.

Third, the assessment of a population without the information on natural and anthropogenic mortalities is difficult. Because of the longevity of the species, loggerhead turtles require high survival rates throughout their life to maintain a population. Anthropogenic mortality on the species occurs at every stage of their life, where the exact magnitude of the mortality is often unknown. As described in the Status Review, the upper end of natural mortality can be computed from available information.

Nesting beach count data for the North Pacific Ocean DPS indicated a decline of loggerhead turtle nesting in the last 20 years. The SQE approach reflected the observed decline. However, in the threat matrix analysis, the asymptotic population growth rates (λ) with anthropogenic mortalities ranged from less than one to greater than one, indicating a large uncertainty about the future of the DPS. Fishery bycatch along the coast of the Baja Peninsula and the nearshore waters of Japan are the main known sources of mortalities. Mortalities in the high-seas, where a large number of juvenile loggerhead turtles reside (Kobayashi *et al.*, 2008), from fishery bycatch are still unknown.

The SQE approach indicated that, based on nest count data for the past 3 decades, the South Pacific Ocean DPS is at risk and thus likely to decline in the future. These results were based on recently published nesting census data for loggerhead turtles at index beaches in eastern Australia (Limpus, 2009). The threat matrix analysis provided uncertain results: in the case of the lowest anthropogenic threats, the South Pacific Ocean DPS may recover, but in the worst-case scenario, the DPS may substantially decline in the future. These results are largely driven by the ongoing threats to juvenile and adult loggerheads from fishery bycatch that occur throughout the South Pacific Ocean and the uncertainty in estimated mortalities.

For the North Indian Ocean DPS, there were no nesting beach data available to conduct the SQE analysis. The threat matrix analysis indicated a decline of the DPS in the future, primarily as a result of fishery bycatch in neritic habitats. Cumulatively, substantial threats may exist for eggs/hatchlings. Because of the lack of precise estimates of bycatch, however, the range of possible λ values was large.

Similar to the North Indian Ocean DPS, no nesting beach data were available for the Southeast Indo-Pacific Ocean DPS. The level of anthropogenic mortalities is low for the Southeast Indo-Pacific Ocean DPS, based on the best available information, resulting in relatively large $P\lambda$ (the proportion of λ values greater than 1) and a narrow range. The greatest threats for the Southeast Indo-Pacific Ocean DPS exist for the first year of the life stages (eggs and hatchlings).

For the Southwest Indian Ocean DPS, the SQE approach, based on a 37-year time series of nesting female counts at Tongaland, South Africa (1963–1999), indicated this segment of the population, while small, has increased, and the likelihood of quasi-extinction is negligible. The threat matrix analysis, on the other hand, provided a wide range of results: in the best case scenario, the DPS would grow slowly, whereas in the worst case scenario, the DPS would decline in the future. The results of the threat matrix analysis were driven by uncertainty in anthropogenic mortalities in the neritic environment and the eggs/hatchlings stage.

Within the Northwest Atlantic Ocean DPS, four of the five identified recovery units have adequate time series data for applying the SQE analysis; these were the Northern, Peninsular Florida, Northern Gulf of Mexico, and Greater Caribbean Recovery Units. The SQE analysis indicated differences in SQEs among these four recovery units. Although the Northern Gulf of Mexico Recovery Unit indicated the worst result among the four recovery units assessed the length of the time series was shortest (12 data points). The other three recovery units, however, appeared to show similar declining trends, which were also indicated through the SQE approach. The threat matrix analysis indicated a likely decline of the DPS in the future. The greatest threats to the DPS result from cumulative fishery bycatch in neritic and oceanic habitats.

Sufficient nesting beach data for the Northeast Atlantic Ocean DPS were not available to conduct the SQE analysis. The high likelihood of the predicted decline of the Northeast Atlantic Ocean DPS from the threat matrix analysis is largely driven by the ongoing harvest of nesting females, low hatchling and emergence success, and mortality of juvenile and adult turtles from fishery bycatch throughout the Northeast Atlantic Ocean. The threat matrix analysis indicated a consistently pessimistic future for the DPS.

Representative nesting beach data for the Mediterranean Sea DPS were not available to conduct the SQE analysis. The threat matrix analysis indicated the DPS is likely to decline in the future. The primary threats are fishery bycatch in neritic and oceanic habitats.

The two approaches for determining risks to the South Atlantic Ocean DPS provided different, although not incompatible, results. The SQE approach indicated that, based on nest count data for the past 2 decades, the population was unlikely to decline in the future. These results were based on recently published nesting beach trend analyses by Marcovaldi and Chaloupka (2007) and this QET analysis was consistent with their conclusions. However, the SQE approach was based on past performance of the DPS, specifically only nesting beach data, and did not address ongoing or future threats to segments of the DPS that might not have been or might not yet be reflected by nest count data. The threat matrix approach indicated that the South Atlantic Ocean DPS is likely to decline in the future. These results were largely driven by the ongoing mortality threats to juvenile turtles from fishery bycatch that occurs throughout the South Atlantic Ocean. Although conservation efforts by national and international groups in the South Atlantic are currently working toward mitigating bycatch in the South Atlantic, it is unlikely that this source of mortality can be greatly reduced in the near future, largely due to inadequate funding and knowledge gaps that together inhibit implementation of large-scale management actions (Domingo *et al.*, 2006).

Conservation Efforts

When considering the listing of a species, section 4(b)(1)(A) of the ESA requires us to consider efforts by any State, foreign nation, or political subdivision of a State or foreign nation to protect the species. Such efforts would include measures by Native American Tribes and organizations. Also, Federal, Tribal, State, and foreign recovery actions (16 U.S.C. 1533(f)), and Federal consultation requirements (16 U.S.C. 1536) constitute conservation measures. In addition to identifying these efforts, under the ESA and our policy implementing this provision (68 FR 15100; March 28, 2003) we must evaluate the certainty of an effort's effectiveness on the basis of whether the effort or plan establishes specific conservation objectives; identifies the necessary steps to reduce threats or factors for decline; includes quantifiable performance measures for the monitoring of compliance and effectiveness; incorporates the principles of adaptive management; is likely to be implemented; and is likely to improve the species' viability at the time of the listing determination.

North Pacific Ocean DPS

NMFS has formalized two conservation actions to protect foraging loggerheads in the North Pacific Ocean, both of which were implemented to reduce loggerhead bycatch in U.S. fisheries. Prior to 2001, the Hawaii-based longline fishery had annual interaction levels of 300 to 500 loggerhead turtles. The temporary closure of the shallow-set swordfish fishery in 2001 in large part over concerns of turtle interactions brought about the immediate need to develop effective solutions to reduce turtle interactions while maintaining the viability of the industry. Since the reopening of the swordfish sector in 2004, the fishery has operated under strict management measures, including the use of large circle hooks and fish bait, restricted annual effort, annual caps on loggerhead interactions (17 annually), and 100 percent onboard observer coverage (50 CFR 665.3). As a result of these measures, loggerhead interactions in the swordfish fishery have been reduced by over 90 percent (Gilman *et al.*, 2007). Furthermore, in 2003, NMFS implemented a time/area closure in southern California during forecasted or existing El Niño-like conditions to reduce the take of loggerheads in the California/Oregon drift gillnet fishery (68 FR 69963, December 16, 2003). While this closure has not been implemented since the passage of these regulations due to the lack of conditions occurring in the area, such a closure is expected to reduce interactions between the large-mesh gillnet fishery and loggerheads by over 70 percent.

Loggerhead interactions and mortalities with coastal fisheries in Mexico and Japan are of concern and are considered a major threat to North Pacific loggerhead recovery. NMFS and U.S. non-governmental organizations have worked with international entities to: (1) Assess bycatch mortality through systematic stranding surveys in Baja California Sur, Mexico; (2) reduce interactions and mortalities in two bottom-set fisheries in Mexico; (3) conduct gear mitigation trials to reduce bycatch in Japanese pound nets; and (4) convey information to fishers and other stakeholders through participatory activities, events and outreach.

In 2003, the Grupo Tortuguero's ProCaguama (Operation Loggerhead) was initiated to partner directly with fishermen to assess and mitigate their bycatch while maintaining fisheries sustainability in Baja California, Mexico. ProCaguama's fisher-scientist team discovered the highest turtle bycatch rates documented worldwide and has made considerable progress in mitigating anthropogenic mortality in Mexican waters (Peckham *et al.*, 2007, 2008). As a result of the 2006 and 2007 tri-national fishermen's exchanges run by ProCaguama, Sea Turtle Association of Japan, and the Western Pacific Fisheries Management Council, in 2007 a prominent Baja California Sur fleet retired its bottom-set longlines. Prior to this closure, the longline fleet interacted with an estimated 2,000 loggerheads annually, with nearly all (approximately 90 percent) of the takes resulting in mortalities (Peckham *et al.*, 2008). Because this fishery no longer exists, conservation efforts have resulted in the continued protection of nearly 2,000 juvenile loggerheads annually.

Led by the Mexican wildlife service (Vida Silvestre), a Federal loggerhead bycatch reduction task force was organized in 2008 to ensure loggerheads the protection they are afforded by Mexican law. The task force is comprised of Federal and State agencies, in addition to non-governmental organizations, to solve the bycatch problem, meeting ProCaguama's bottom-up initiatives with complementary top-down management and enforcement resources. In 2009, while testing a variety of potential solutions, ProCaguama's fisher-scientist team demonstrated the commercial viability of substituting bycatch-free hook fishing for gillnet fishing. Local fishers are interested in adoption of this gear because the technique results in higher quality catch offering access to higher-value markets and potentially higher sustainability with zero bycatch. From 2010 forward ProCaguama, in coordination with the task force, will engineer a market-based bycatch solution consisting of hook substitution, training to augment ex-vessel fish value, development of fisheries infrastructure, linkage of local fleets with regional and international markets, and concurrent strengthening of local fisheries management.

The U.S. has also funded non-governmental organizations to convey bycatch solutions to local fishers as well as to educate communities on the protection of all sea turtles (*i.e.,* reduce directed harvest). Over 3,500 coastal citizens are reached through festivals and local outreach activities, over 45 local leaders and dozens of fishermen are empowered to reduce bycatch and promote sustainable fishing, and 15 university and high school students are trained in conservation science. The effectiveness of these efforts is difficult to quantify without several post-outreach years of documenting reductions in sea turtle strandings, directed takes, or bycatch in local fisheries.

Due to concerns of high adult loggerhead mortality in mid-water pound nets, as documented in 2006, Sea Turtle Association of Japan researchers began to engage the pound net operators in an effort to study the impact and reduce sea turtle bycatch. This work was expanded in 2008 with U.S. support and, similar to outreach efforts in Mexico, is intended to engage local fishermen in conservation throughout several Japanese prefectures. Research opportunities will be developed with and for local fishermen in order to assess and mitigate bycatch.

Since 2003, with the assistance of the U.S., the Sea Turtle Association of Japan and, in recent years with the Grupo Tortuguero, has conducted nesting beach monitoring and management at several major loggerhead nesting beaches, with the intent of increasing the number of beaches surveyed and protected. Due to logistical problems and costs, the Sea Turtle Association of Japan's program had been limited to five primary rookeries. At these areas, hatchling production has been augmented through: (1) Relocation of doomed nests; and (2) protection of nests *in situ* from trampling, desiccation, and predation. Between 2004 and 2008, management activities have been successful with over 160,000 hatchlings released from relocated nests that would have otherwise been lost to inundation or erosion, with many more hatchlings produced from *in situ* nests.

The U.S. plans to continue supporting this project in the foreseeable future, increasing relocation activities at other high-density nesting beaches, implementing predator control activities to reduce predation by raccoon dogs and raccoons, and assessing the effects of light pollution at a major nesting beach (Maehama Beach). Determination of hatching success will also be initiated at several key nesting beaches (Inakahama, Maehama, Yotsuse, and Kurio, all in Yakushima) to provide information to support the removal of armoring structures and to evaluate the success of relocation and other nest protection activities. Outreach and education activities in coastal cities will increase public awareness of problems with foot traffic, light pollution, and armoring.

Egg harvest was common in Japan until the 1970s, when several of the major nesting areas (notably Yakushima and Miyazaki) led locally based efforts to ban or eliminate egg harvest. As a result, egg harvest at Japanese nesting beaches was eliminated by the early 1980s.

The establishment of the Sea Turtle Association of Japan in 1990 created a network of individuals and organizations conducting sea turtle monitoring and conservation activities in Japan for the first time. The Sea Turtle Association of Japan also served to standardize data collection methods (for tagging and measuring). The Association greatly depends on its members around Japan to gather nesting data as well as to conduct various conservation measures.

Shoreline erosion and bycatch are some of the major concerns dealt by the Sea Turtle Association of Japan today. Much of Japan's coastline is "armored" using concrete structures to prevent and minimize impacts to coastal communities from natural disasters. These structures have resulted in a number of nesting beaches losing sand suitable for sea turtle nesting, and nests are often relocated to safe areas or hatcheries to protect them from further erosion and inundation. In recent years, a portion of the concrete structures at a beach in Toyohashi City, Aichi Prefecture, was experimentally removed to create better nesting habitat. The Sea Turtle Association of Japan, along with various other organizations in Japan, are carrying out discussions with local and Federal government agencies to develop further solutions to the beach erosion issue and to maintain viable nesting sites. Beach erosion and armament still remain one of the most significant threats to nesting beaches in Japan.

While conservation efforts for the North Pacific Ocean DPS are substantive and improving and may be reflected in the recent increases in the number of nesting females, they still remain inadequate to ensure the long-term viability of the population. For example, while most of the major nesting beaches are monitored, some of the management measures in place are inadequate and may be inappropriate. On some beaches, hatchling releases are coordinated with the tourist industry or nests are being trampled on or are unprotected. The largest threat on the nesting beach, reduced availability of habitat due to heavy armament and subsequent erosion, is just beginning to be addressed but without immediate attention may ultimately result in the demise of the highest density beaches. Efforts to reduce loggerhead bycatch in known coastal fisheries off Baja California, Mexico, and Japan is encouraging, but concerns remain regarding the mortalities of adult and juvenile turtles in mid-water pound nets and the high costs that may be involved in replacing and/or mitigating this gear. With these coastal fishery threats still emerging, there has not yet been sufficient time—or a nationwide understanding of the threat—to develop appropriate conservation strategies or work to fully engage with the government of Japan. Greater international cooperation and implementation of the use of circle hooks in longline fisheries operating in the North Pacific Ocean is necessary, as well as understanding fishery related impacts in the South China Sea. Further, it is suspected that there are substantial impacts from illegal, unreported, and unregulated fishing, which we are unable to mitigate without additional fisheries management efforts and international collaborations. While conservation projects for this population have been in place since 2004 for some important areas, efforts in other areas are still being developed to address major threats, including fisheries bycatch and long-term nesting habitat protection.

South Pacific Ocean DPS

The New Caledonia Aquarium and NMFS have collaborated since 2007 to address and influence management measures of the regional fishery management organization. Their intent is to reduce pelagic fishery interactions with sea turtles through increased understanding of pelagic habitat use by

South Pacific loggerheads using satellite telemetry, oceanographic analysis, and juvenile loggerheads reared at the Aquarium. NMFS augments this effort by supporting animal husbandry, education and outreach activities coordinated through the New Caledonia Aquarium to build capacity, and public awareness regarding turtle conservation in general.

The U.S. has collaborated on at-sea conservation of sea turtles with Chile under the U.S.-Chile Fisheries Cooperation Agreement, and with Peru under a collaboration with El Instituto del Mar del Peru and local non-governmental organizations. Research from this collaboration showed that loggerheads of southwestern Pacific stock origin interact with commercial and artisanal longline fisheries off the South American coast. NMFS has supported efforts by Chile to reduce bycatch and mortality by placing observers on vessels who have been trained and equipped to dehook, resuscitate, and release loggerheads. Chile also has closed the northernmost sector since 2002, where the loggerheads interactions occur, to longline fishing (Miguel Donoso, Pacifico Laud, personal communication, 2009). Local non-governmental organizations, such as Pacifico Laud (Chile), Associacion Pro Delphinus (Peru), and Areas Costeras y Recursos Marinos (Peru), have been engaged in outreach and conservation activities promoting loggerhead bycatch reduction, with support from NMFS.

Coastal trawl fisheries also threaten juvenile and adult loggerheads foraging off eastern Australia, particularly the northern Australian prawn fishery (estimated to take between 5,000 and 6,000 turtles annually in the late 1980s/early 1990s). However, since the introduction and requirement for these fisheries to use turtle excluder devices in 2000, that threat has been drastically reduced, to an estimated 200 turtles/year (Robins *et al.,* 2002a). Turtle excluder devices were also made mandatory in the Queensland East Coast trawl fisheries (2000), the Torres Strait prawn fishery (2002), and the Western Australian prawn and scallop fisheries (2002) (Limpus, 2009).

Predation of loggerhead eggs by foxes was a major threat to nests laid in eastern Australia through the late 1970s, particularly on Mon Repos and Wreck Rock. Harassment by local residents and researchers, as well as baiting and shooting, discouraged foxes from encroaching on the nesting beach at Mon Repos so that by the mid-1970s, predation levels had declined to trivial levels. At Wreck Rock, fox predation was intense through the mid-1980s, with a 90–95 percent predation rate documented. Fox baiting was introduced at Wreck Rock and some adjacent beaches in 1987, and has been successful at reducing the predation rate to low levels by the late 1990s (Limpus, 2009). To reduce the risk of hatchling disorientation due to artificial lighting inland of the nesting beaches adjacent to Mon Repos and Heron Island, low pressure sodium vapor lights have been installed or, where lighting has not been controlled, eggs are relocated to artificial nests on nearby dark beaches. Limpus (2009) reported that hatchling mortality due to altered light horizons on the Woongara coast has been reduced to a handful of clutches annually.

While most of the conservation efforts for the South Pacific Ocean DPS are long-term, substantive, and improving, given the low number of nesting females, the declining trends, and major threats that are just beginning to be addressed, they still remain inadequate to ensure the long-term viability of the population. The use of TEDs in most of the major trawl fisheries in Australia has certainly reduced the bycatch of juvenile and adult turtles, as has the reduction in fox predation on important nesting beaches. However, the intense effort by longline fisheries in the South Pacific, particularly from artisanal fleets operating out of Peru, and its estimated impact on this loggerhead population, particularly oceanic juveniles, remains a significant threat that is just beginning to be addressed by most participating countries, including the regional fishery management council(s) that manage many of these fleets. Modeling by Chaloupka (2003) showed the impact of this fleet poses a greater risk than either fox predation at major nesting beaches (90 percent egg loss per year during unmanaged periods) or past high mortalities in coastal trawl fisheries. The recent sea turtle conservation resolution by the Western and Central Pacific Fisheries Commission, requiring longline fleets to use specific gear and collect information on bycatch, is encouraging but took effect in January 2010, so improvement in the status of this population may not be realized for many years. Potentially important pelagic foraging habitat in areas of high fishing intensity remains poorly studied but is improving through U.S. and international collaborations. While a comprehensive conservation program for this population has been in place for important nesting beaches, efforts in other areas are still being developed to address major threats, including fisheries bycatch.

North Indian Ocean DPS

The main threats to North Indian Ocean loggerheads are fishery bycatch and nesting beach habitat loss and degradation. Royal Decree 53/81 prohibits the hunting of turtles and eggs in Oman. The Ministry of Environment and Climate Affairs (MECA) and Environmental Society of Oman (ESO) are collaborating to carry out a number of conservation measures at Masirah Island for the nesting loggerhead population. First and foremost are standardized annual nesting surveys to monitor population trends. Standardized surveys were first implemented in 2008. Less complete nesting surveys have been conducted in some previous years beginning in 1977, but the data have yet to be adequately analyzed to determine their usefulness in determining population size and trends. Nine kilometers of nesting habitat within the Masirah Air Force Base is largely protected from tourist development but remains subject to light pollution from military operations. The remaining 50 kilometers of loggerhead nesting beaches are not protected from egg harvest, lighting, or beach driving. Currently, MECA is in the process of developing a protected area proposal for Masirah Island that will address needed protection of nesting beaches, including protection from egg collection and beach driving. In the meantime, development is continuing and it is uncertain how much, when, and if nesting habitat will receive adequate protection. MECA is beginning to regulate artificial lighting in new development. In 2010, a major outreach effort in the form of a Turtle Celebration Day is planned at Masirah Island to raise greater awareness of the local communities about the global importance of the Masirah Island loggerhead nesting population and to increase community involvement in conservation efforts. Nesting surveys are also being conducted on the Halaniyat Islands. There are no specific efforts underway to designate Halaniyat nesting beaches as Protected Areas in the face of proposed development plans. Although important management actions are underway on the nesting beaches, their effectiveness has yet to be determined and the potential for strong habitat protection and restoration of degraded nesting habitat remains uncertain. At present, hatchling production is not measured.

The only research that has been conducted on the nesting population to date was a study of internesting and post-nesting movements conducted in 2006 when 20 nesting females were instrumented with satellite transmitters. This research identified important inter-seasonal foraging grounds but is considered incomplete, and additional nesting females will be satellite tagged in 2010–2012 to assess clutch frequency, interactions with local fisheries, and inter-nesting and post-nesting movements. In 2009, efforts to investigate loggerhead bycatch in gillnet fisheries at Masirah were initiated, and some fisherman have agreed to cooperate and document bycatch in 2010.

While conservation efforts for the North Indian Ocean loggerhead DPS are substantive and improving, they still remain inadequate to ensure the long-term viability of the population. For example, there is currently no assessment of hatchling production on the main nesting beaches, no efforts underway to restore the largely degraded nesting habitat on the major nesting beaches, and little understanding or knowledge of foraging grounds for juveniles or adults and the extent of their interactions with fisheries. There is no information on bycatch from fisheries off the main nesting beaches other than reports that this bycatch occurs. A comprehensive conservation program for this population is under development, but is incomplete relative to fisheries bycatch and long-term nesting habitat protection.

Southeast Indo-Pacific Ocean DPS

The level of anthropogenic mortalities is low for the Southeast Indo-Pacific Ocean DPS, based on the best available information. However, there are many known opportunities for conservation efforts that would aid recovery. Some significant conservation efforts are underway.

One of the principal nesting beaches for this DPS, Australia's Dirk Hartog Island, is part of the Shark Bay World Heritage Area and was recently announced to become part of Australia's National Park System. This designation may facilitate monitoring of nesting beaches and enforcement of prohibitions on direct take of loggerheads and their eggs. Loggerheads are listed as Endangered under Australia's Environment Protection and Biodiversity Conservation Act of 1999.

Conservation efforts on nesting beaches have included invasive predator control. On the North West Cape and the beaches of the Ningaloo coast of mainland Australia, a long established feral European red fox (*Vulpes vulpes*) population preyed heavily on eggs and is thought to be responsible for the lower numbers of nesting turtles on the mainland beaches (Baldwin *et al.,* 2003). Fox populations have been eradicated on Dirk Hartog Island and Murion Islands (Baldwin *et al.,* 2003), and threat abatement plans have been implemented for the control of foxes (1999) and feral pigs (2005).

The international regulatory mechanisms described in Section 5.1.4. of the Status Review apply to loggerheads found in the Southeast Indo-Pacific Ocean. In addition, loggerheads of this DPS benefit from the Indian Ocean-South-East Asian Marine Turtle Memorandum of Understanding (IOSEA). Efforts facilitated by IOSEA have focused on reducing threats, conserving important habitat, exchanging scientific data, increasing public awareness and participation, promoting regional cooperation, and seeking resources for implementation. Currently, there are 30 IOSEA signatory states.

In 2000, the use of turtle excluder devices in the Northern Australian Prawn Fishery (NPF) was made mandatory. Prior to the use of TEDs in this fishery, the NPF annually took between 5,000 and 6,000 sea turtles as bycatch, with a mortality rate estimated to be 40 percent (Poiner and Harris, 1996). Since the mandatory use of TEDs has been in effect, the annual bycatch of sea turtles in the NPF has dropped to less than 200 sea turtles per year, with a mortality rate of approximately 22 percent (based on recent years). Beginning progress has been made to measure the threat of incidental capture of sea turtles in other artisanal and commercial fisheries in the Southeast Indo-Pacific Ocean (Lewison *et al.,* 2004; Limpus, 2009), however, the data remain inadequate for stock assessment.

As in other DPSs, persistent marine debris poses entanglement and ingestion hazards to loggerheads. In 2009, Australia's Department of the Environment, Water, Heritage and the Arts published a threat abatement plan for the impacts of marine debris on vertebrate marine life.

In spite of these conservation efforts, considerable uncertainty in the status of this DPS lies with inadequate efforts to measure bycatch in the region, a short time-series of monitoring on nesting beaches, and missing vital rates data necessary for population assessments.

Southwest Indian Ocean DPS

The Southwest Indian Ocean DPS is small but has experienced an increase in numbers of nesting females. Although there is considerable uncertainty in anthropogenic mortalities, especially in the water, the DPS may have benefitted from important conservation efforts at the nesting beaches.

All principal nesting beaches, centered in South Africa, are within protected areas (Baldwin *et al.,* 2003). In Mozambique, nesting beaches in the Maputo Special Reserve (approximately 60 kilometers of nesting beach) and in the Paradise Islands are also within protected areas (Baldwin *et al.,* 2003; Costa *et al.,* 2007).

The international regulatory mechanisms described in Section 5.1.4. of the Status Review apply to loggerheads found in the Southwest Indian Ocean. In addition, loggerheads of this DPS benefit from the Indian Ocean-South-East Asian Marine Turtle Memorandum of Understanding (IOSEA) and the Nairobi Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region.

In spite of these conservation efforts, caution in the status of this DPS lies with its small population size, inadequate efforts to measure bycatch in the region, and missing vital rates data necessary for population assessments.

Northwest Atlantic Ocean DPS

The main threats to Northwest Atlantic Ocean loggerheads include fishery bycatch mortality, particularly in gillnet, longline, and trawl fisheries; nesting beach habitat loss and degradation (*e.g.,* beachfront lighting, coastal armoring); and ingestion of marine debris during the epipelagic lifestage. In addition, mortality from vessel strikes is increasing and likely also a significant threat to this DPS.

Mortality resulting from domestic and international commercial fishing ranks among the most significant threats to Northwest Atlantic loggerheads. Fishing gear types include gillnets, trawls, hook and line (*e.g.,* longlines), seines, dredges, and various types of pots/traps. Among these, gillnets, longlines, and trawl gear collectively result in tens of thousands of Northwest Atlantic loggerhead deaths annually throughout their range (*see* for example, Lewison *et al.,* 2004; NMFS, 2002, 2004).

Considerable effort has been expended since the 1980s to document and reduce commercial fishing bycatch mortality. NMFS has implemented observer programs in many Federally managed and some State-managed fisheries to collect turtle bycatch data and estimate mortality. NMFS, working with industry and other partners, has reduced bycatch in some fisheries by developing technological solutions to prevent capture or to allow most turtles to escape without harm (*e.g.,* TEDs), by implementing time and area closures to prevent interactions from occurring (*e.g.,* prohibitions on gillnet fishing along the mid-Atlantic coast during the periods of high loggerhead abundance), and by modifying gear (*e.g.,* requirements to reduce mesh size in the leaders of pound nets to prevent entanglement, requirements to use large circle hooks with certain bait types in segments of the pelagic longline fishery). NMFS is currently working to implement a coastwide, comprehensive strategy to reduce bycatch of sea turtles in State and Federal fisheries in the U.S. Atlantic and Gulf of Mexico. This approach was developed to address sea turtle bycatch issues on a per-gear basis, with a goal of developing and implementing coastwide solutions for reducing turtle bycatch inshore, nearshore, and offshore.

The development and implementation of TEDs in the shrimp trawl fishery is arguably the most significant conservation accomplishment for Northwest Atlantic loggerheads in the marine environment since their listing. In the southeast U.S. and Gulf of Mexico, TEDs have been mandatory in shrimp and flounder trawls for over a decade. However, TEDs are not required in all trawl fisheries, and significant loggerhead mortality continues in some trawl fisheries. In addition, enforcement of TED regulations depends on available resources, and illegal or improperly installed TEDs continue to contribute to mortality.

Gillnets of various mesh sizes are used extensively to harvest fish in the Atlantic Ocean and Gulf of Mexico. All size classes of loggerheads in coastal waters are prone to entanglement in gillnets, and, generally, the larger the mesh size the more likely that turtles will become entangled. State resource agencies and NMFS have been addressing this issue on several fronts. In the southeast U.S., gillnets are prohibited in the State waters of South Carolina, Georgia, Florida, and Texas and are restricted to fishing for pompano and mullet in saltwater areas of Louisiana. Reducing bycatch of loggerheads in the remaining State and Federally regulated gillnet fisheries of the U.S. Atlantic and Gulf of Mexico has not been fully accomplished. NMFS has addressed the issue for several Federally managed fisheries, such as the large-mesh gillnet fishery (primarily for monkfish) along the Atlantic coast, where gillnets larger than 8-inch stretched mesh are now regulated in North Carolina and Virginia through rolling closures timed to match the northward migration of loggerheads along the mid-Atlantic coast in late spring and early summer. The State of North Carolina, working with NMFS through the ESA section 10 process, has been making some progress in reducing bycatch of loggerheads in gillnet fisheries operating in Pamlico Sound. The large mesh driftnet fishery for sharks off the Atlantic coast of Florida and Georgia remains a concern as do gillnet fisheries operating elsewhere in the range of the DPS, including Mexico and Cuba.

Observer programs have documented significant bycatch of loggerheads in the U.S. longline fishery operating in the Atlantic Ocean and Gulf of Mexico. In recent years, NMFS has dedicated significant funding and effort to address this bycatch issue. In partnership with academia and industry, NMFS has funded and conducted field experiments in the Northwest Atlantic Ocean to develop gear modifications that eliminate or significantly reduce loggerhead bycatch. As a result of these experiments, NMFS now requires the use of circle hooks fleet wide and larger circle hooks in combination with whole finfish bait in the Northeast Distant area (69 FR 40734, June 1, 2004).

The incidental capture and mortality of loggerheads by international longline fleets operating in the North Atlantic Ocean and Mediterranean Sea is of great concern. The U.S. has been attempting to work through Regional Fisheries Management Organizations, such as the International Commission for the Conservation of Atlantic Tunas, to encourage member nations to adopt gear modifications (*e.g.,* large circle hooks) that have been shown to significantly reduce loggerhead bycatch. To date, limited success in reducing loggerhead bycatch has been achieved in these international forums.

Although numerous efforts are underway to reduce loggerhead bycatch in fisheries, and many positive actions have been implemented, it is unlikely that this source of mortality can be sufficiently reduced across the range of the DPS in the near future because of the diversity and magnitude of the fisheries operating in the North Atlantic, the lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies.

In the southeast U.S., nest protection efforts have been implemented on the majority of nesting beaches, and progress has been made in reducing mortality from human-related impacts on the nesting beach. A key effort has been the acquisition of Archie Carr National Wildlife Refuge in Florida, where nesting densities often exceed 600 nests per km (1,000 nests per mile). Over 60 percent of the available beachfront acquisitions for the Refuge have been completed as the result of a multi-agency land acquisition effort. In addition, 14 additional refuges, as well as numerous coastal national seashores, military installations, and State parks in the Southeast where loggerheads regularly nest are also provided protection. However, despite these efforts, alteration of the coastline continues, and outside of publicly owned lands, coastal development and associated coastal armoring remains a serious threat.

Efforts are also ongoing to reduce light pollution on nesting beaches. A significant number of local governments in the southeast U.S. have enacted lighting ordinances designed to reduce the effects of artificial lighting on sea turtles. However, enforcement of the lighting ordinances varies considerably.

With regard to marine debris, the MARPOL Convention (International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978) is the main international convention that addresses prevention of pollution (including oil, chemicals, harmful substances in packaged form, sewage, and garbage) of the marine environment by ships from operational or accidental causes. However, challenges remain to implementation and enforcement of the MARPOL Convention, and on its own the Convention does not suffice to prevent all instances of marine pollution.

The seriousness of the threat caused by vessel strikes to loggerheads in the Atlantic and Gulf of Mexico cannot be overstated. This growing problem is particularly difficult to address. In some cases, NMFS, through section 7 of the ESA, has worked with the U.S. Coast Guard in an attempt to reduce the probability of vessel strikes during permitted offshore race events. However, most vessel strikes occur outside of these venues and the growing number of licensed vessels, especially inshore and nearshore, exacerbates the conflict.

A number of regulatory instruments at international, regional, national, and local levels have been developed that provide legal protection for loggerhead sea turtles globally and within the Northwest Atlantic Ocean. The Status Review identifies and includes a discussion of these regulatory instruments (Conant *et al.,* 2009). The problems with existing international treaties are often that they have not realized their full potential, do not include some key countries, do not specifically address sea turtle conservation, and are handicapped by the lack of a sovereign authority to enforce environmental regulations.

In summary, while conservation efforts for the Northwest Atlantic Ocean loggerhead DPS are substantive and improving, they remain inadequate to ensure the long-term viability of the population.

Northeast Atlantic Ocean DPS

Since 2002, all sea turtles and their habitats in Cape Verde have been protected by law (Decreto-Regulamentar n° 7/2002). The reality, however, is that the laws are not respected or enforced and that in recent years until 2008 up to 25–30 percent of nesting females were illegally killed for meat each year on the nesting beaches. Egg collection is also a serious threat on some of the islands. Other major threats include developments and commensurate light pollution behind one important nesting beach on Boa Vista and the most important nesting beach on Sal, as well as sand mining on many of the islands. Other planned and potential developments on these and other islands present future threats. Bycatch and directed take in coastal waters is likely a significant mortality factor to the population given the importance of the coastal waters as loggerhead foraging grounds and the extensive fisheries occurring there. Adult females nesting in Cape Verde have been found foraging along the mainland coast of West Africa as well as in the oceanic environment, thereby making them vulnerable to impacts from a wide range of fisheries (Hawkes *et al.,* 2006). Unfortunately, law enforcement on the nesting beaches and in the marine environment is lacking in Cape Verde.

Conservation efforts in Cape Verde began in the mid 1990s and focused on efforts to raise local, national, and international awareness of the importance of the Cape Verdian loggerhead population and the ongoing slaughter of nesting females. A field camp set up by the non-governmental organization Natura 2000 in 1999 on the 10-kilometer Ervatao Beach, the single most important nesting beach at Boa Vista, grew out of this initial effort. This camp established a presence to deter poaching and gather data on nesting and poaching activity. In 2008, The Turtle Foundation, another non-governmental organization began to work at Porto Ferreira Beach, the second most important nesting area on Boa Vista. The non-governmental organization SOS Tartarugas began conservation work on the important nesting beaches of Sal in 2008. In May 2009, USFWS funded a workshop in Cape Verde to bring together representatives from the three non-governmental organizations and the universities involved with loggerhead conservation in Cape Verde and government representatives from the Ministry of Environment, Military and Municipalities to discuss the threats, current conservation efforts, and priority actions needed. A Sea Turtle Network was established to better coordinate and expand conservation efforts throughout the Cape Verdean islands.

Natura 2000 has continued its efforts on Ervatao Beach and in 2009 assumed responsibility for work on Porto Ferreira Beach. Natura 2000 has reduced poaching to about 5 percent on these two important beaches, which represent 75 percent of the nesting on Boa Vista. The Turtle Foundation also conducts extensive public outreach on sea turtle conservation issues. The Turtle Foundation covered four other important beaches in 2009 with the assistance of the Cape Verdian military and likewise believes poaching was reduced to about 5 percent of nesting females on the beaches covered. The University of Algarve established a research project on Santiago Island in 2007; activities included nest monitoring and protection, collecting biological data and information on poaching, and outreach through the media and to the government representatives (Loureiro, 2008). This project minimized its efforts in 2009. The Turtle Foundation continued to focus its primary efforts on patrolling beaches to protect nesting females on Boa Vista with the assistance of the military. SOS Tartarugas has also been doing regular monitoring of beaches with support from the military, extensive public outreach on light pollution behind nesting beaches, and relocating nests to a hatchery to alleviate hatchling disorientation and misorientation, as well as assisting with training of turtle projects on the islands of Maio and Sao Nicolau.

In the last 2 years, new efforts to better coordinate and expand projects being conducted by the three non-governmental organizations, as well as engage the national and municipal governments, are dramatically decreasing the poaching of nesting turtles and with sustained and planned efforts may be able to reduce it to less than 1 percent in the next few years. The issues of light pollution, sand mining on nesting beaches, long-term protection of even the most important nesting beaches, law enforcement, and bycatch have not even begun to be addressed. While there is definite improvement in a once gloomy situation as recent as 2 years ago, the future of the population is tenuous.

Mediterranean Sea DPS

The main threats to Mediterranean Sea loggerheads include fishery bycatch, as well as pollution/debris, vessel collisions, and habitat destruction impacting eggs and hatchlings at nesting beaches. There are a number of existing international regulatory mechanisms specific to the Mediterranean Sea that contain provisions for the protection to sea turtles. The most important with respect to sea turtles are the Barcelona Convention for the Protection of the Mediterranean Sea against Pollution (and the associated Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean); the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention); the Convention on the Conservation of Migratory Species of Wild Animals (CMS) (Bonn Convention); and the Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (EC Habitats Directive). More information on these mechanisms can be found at Conant *et al.* (2009), but a few specific applications are noted below.

Under the framework of the Barcelona Convention (to which all Mediterranean countries are parties), the Action Plan for the Conservation of Mediterranean Marine Turtles was adopted in 1989 and updated in 1999 and 2007. The objective of the Action Plan is the recovery of sea turtle populations through (1) appropriate protection, conservation, and management of turtle habitats, including nesting, feeding, wintering, and migrating areas; and (2) improvement of scientific knowledge by research and monitoring. Coordination of this Action Plan occurs through the Regional Activity Centre for Specially Protected Areas (RAC/SPA). To help implement the Action Plan objectives, the RAC/SPA has published guidelines for designing legislation and regulations to protect turtles; developing and improving rescue centers; and handling sea turtles by fishermen. To assess the degree of implementation of the Action Plan, RAC/SPA sent a survey to the National Focal Points for Specially Protected Areas (Demetropoulos, 2007). Of the 16 country responses received, 14 countries have enacted some form of legislation protecting sea turtles and more than half of the responders noted their participation in tagging programs, development of public awareness programs, and beach inventories. The area with the fewest positive responses was the implementation of measures to reduce incidental catch (n=5). The 2007 Action Plan includes a revised list of important priority measures and an Implementation Timetable (UNEP MAP RAC/SPA 2007). The deadline for many of the actions is as soon as possible (*e.g.,* enforce legislation to eliminate deliberate killing, prepare National Action Plan), while others are 3 to 4 years after adoption (*e.g.,* restoration of damaged nesting habitats, implementation of fishing regulations in key areas). If all parties adopt all of the measures in the identified time period, there will be notable sea turtle conservation efforts in place in the Mediterranean. However, while priority actions for implementing the Action Plan have been adopted to some extent at both regional and national levels, the degree of expected implementation by each signatory and corresponding level of sea turtle protection are still relatively uncertain. As such, these efforts do not currently sufficiently mitigate the threats to and improve the status of loggerheads in the Mediterranean, and without specific commitment from each of the Barcelona Convention signatories, it is difficult to determine if the efforts will do so in the near future.

Under the Bern Convention, sea turtles are on the "strictly protected" list. Article 6 of this Convention notes the following prohibited acts for these strictly protected fauna species: all forms of deliberate capture and keeping and deliberate killing; the deliberate damage to or destruction of breeding or resting sites; the deliberate disturbance of wild fauna; and the deliberate destruction or taking or keeping of eggs from the wild. Most Mediterranean countries, with the exception of Algeria, Egypt, Israel, Lebanon, Libya, and Syria, are parties to this Convention, so these international protection measures are in place.

It is apparent that the international framework for sea turtle protection is present in the Mediterranean, but the efficacy of these actions is uncertain. The measures in most of these Conventions have been in place for years, and the threats to loggerhead turtles remain. As such, while laudable, the enforcement and follow up of many of these articles needs to occur before the sea turtle protection goals of the Conventions are achieved.

Most Mediterranean countries have developed national legislation to protect sea turtles and/or nesting habitats (Margaritoulis, 2007). These initiatives are also likely captured in the country responses to the survey detailed in Demetropoulos (2007) as discussed above. National protective legislation generally prohibits international killing, harassment, possession, trade, or attempts at these (Margaritoulis *et al.,* 2003). Some countries have site specific legislation for turtle habitat protection. In 1999, a National Marine Park was established on Zakynthos in western Greece, with the primary aim to provide protection to loggerhead nesting areas (Dimopoulos, 2001). Zakynthos represents approximately 43 percent of the average annual nesting effort of the major and moderate nesting areas in Greece (Margaritoulis *et al.,* 2003) and about 26 percent of the documented nesting effort in the Mediterranean (Touliatou *et al.,* 2009). It is noteworthy for conservation purposes that this site is legally protected. While park management has improved over the last several years, there are still some needed measures to improve and ensure sufficient protection at this Park (Panagopoulou *et al.,* 2008; Touliatou *et al.,* 2009).

In Turkey, five nesting beaches (Belek, Dalyan, Fethiye, Goksu Delta, and Patara) were designated Specially Protected Area status in the context of the Barcelona Convention (Margaritoulis *et al.,* 2003). Based on the average annual number of nests from the major nesting sites, these five beaches represent approximately 56 percent of nesting in Turkey (World Wildlife Fund, 2005). In Cyprus, the two nesting beaches of Lara and Toxeftra have been afforded protection through the Fisheries Regulation since 1989 (Margaritoulis, 2007), and Alagadi is a Specially Protected Area (World Wildlife Fund, 2005). Of the major Cyprus nesting sites included in the 2005 World Wildlife Fund Species Action Plan, the nesting beaches afforded protection represent 51 percent of the average annual number of nests in Cyprus. Note, however, that the annual nesting effort in Cyprus presented in Margaritoulis *et al.* (2003) includes additional sites, so the total proportion of protected nesting sites in Cyprus is much lower, potentially around 22 percent. In Italy, a reserve to protect nesting on Lampedusa was established in 1984 (Margaritoulis *et al.,* 2003). In summary, Mediterranean loggerhead nesting primarily occurs in Greece, Libya, Turkey, and Cyprus, and a notable proportion of nesting in those areas is protected through various mechanisms. It is important to recognize the success of these protected areas, but as the protection has been in place for some time and the threats to the species remain (particularly from increasing tourism activities), it is unlikely that the conservation measures discussed here will change the status of the species as outlined in Conant *et al.* (2009).

Protection of marine habitats is at the early stages in the Mediterranean, as in other areas of the world. Off Zakynthos, the National Marine Park established in 1999 also included maritime zones. The marine area of Laganas Bay is divided into three zones controlling maritime traffic from May 1 to October 31: Zone A—no boating activity; Zone B—speed limit of 6 knots, no anchoring; Zone C—speed limit of 6 knots. The restraints on boating activity are particularly aimed at protecting the internesting area surrounding the Zakynthos Laganas Bay nesting area. However, despite the regulations, there has been insufficient enforcement (especially of the 6 knot speed limit), and a high density of speedboats and recorded violations within the marine area of the Park have been reported. In 2009, 13 of 28 recorded strandings in the area of the National Marine Park bore evidence of watercraft injuries and fishing gear interactions, and four live turtles were found with fishing gear lines/hooks. Another marine zone occurs in Cyprus; off the nesting beaches of Lara and Toxeftra, a maritime zone extends to the 20 meter isobath as delineated by the Fisheries Regulation (Margaritoulis, 2007).

The main concern to loggerheads in the Mediterranean includes incidental capture in fisheries. While there are country specific fishery regulations that may limit fishing effort to some degree (to conserve the fishery resource), little, if anything, has been undertaken to reduce sea turtle bycatch and associated mortality in Mediterranean fisheries. Given the lack of conservation efforts to address fisheries and the limited in-water protection provided to turtles to reduce the additional impacts of vessel collisions and pollution/debris interactions, it is unlikely that the status of the species will change given the measures discussed here.

It should be reiterated that it appears that international and national laws are not always enforced or followed. This minimizes the potential success of these conservation efforts. For example, in Egypt, international and national measures to protect turtles were not immediately adhered to, but in recent years, there has been a notable effort to enforce laws and regulations that prohibit the trade of sea turtles at fish markets. However, the illegal trade of turtles in the Alexandria fish market has persisted and a black market has been created (Nada and Casale, 2008). This is an example of ineffective sea turtle protection and continuing threat to the species, even with conservation efforts in place.

South Atlantic Ocean DPS

The only documented and confirmed nesting locations for loggerhead turtles in the South Atlantic occur in Brazil, and major nesting beaches are found in the states of Rio de Janeiro, Espirito Santo, Bahia, and Sergipe (Marcovaldi and Marcovaldi, 1999). Protection of nesting loggerheads and their eggs in Brazil is afforded by national law that was established in 1989 and most recently reaffirmed in 2008. Illegal practices, such as collecting eggs or nesting females for consumption or sale, are considered environmental crimes and are punishable by law. Other State or Federal laws have been established in Brazil to protect reproductive females, incubating eggs, emergent hatchlings, and nesting habitat, including restricting nighttime lighting adjacent to nesting beaches during the nesting/hatching seasons and prohibiting vehicular traffic on beaches. Projeto TAMAR, a semi-governmental organization, is responsible for sea turtle conservation in Brazil. In general, nesting beach protection in Brazil is considered to be effective and successful for loggerheads and other species of nesting turtles (*e.g.,* Marcovaldi and Chaloupka, 2007; da Silva *et al.,* 2008; Thome *et al.,* 2008). Efforts at protecting reproductive turtles, their nests, hatchlings and their nesting beaches have been supplemented by the establishment of Federally mandated protected areas that include major loggerhead nesting populations: Reserva Biologica de Santa Isabel (established in 1988 in Sergipe) and Reserva Biologica de Comboios (established in 1984 in Espirto Santo); at the State level, Environmental Protection Areas have been established for many loggerhead nesting beaches in Bahia and Espirito Santo (Marcovaldi *et al.,* 2005). In addition, Projeto TAMAR has initiated several high-profile public awareness campaigns, which have focused national attention on the conservation of loggerheads and other marine turtles in Brazil.

Loggerhead turtles of various sizes and life stages occur throughout the South Atlantic, although density/observations are more limited in equatorial waters (Ehrhart *et al.,* 2003). Within national waters of specific countries, various laws and actions have been instituted to mitigate threats to loggerheads and other species of sea turtles; less protection is afforded in the high seas of the South Atlantic. Overall, the principal in-water threat to loggerheads in the South Atlantic is incidental capture in fisheries. In the southwest Atlantic, the South Atlantic Association is a multinational group that includes representatives from Brazil, Uruguay, and Argentina, and meets biannually to share information and develop regional action plans to address threats including bycatch (*http://www.tortugasaso.org/*). At the national level, Brazil has developed a national plan for the reduction of incidental capture of sea turtles that was initiated in 2001 (Marcovaldi *et al.,* 2002a). This national plan includes various activities to mitigate bycatch, including time-area restrictions of fisheries, use of bycatch reduction devices, and working with fishermen to successfully release live-captured turtles. In Uruguay, all sea turtles are protected from human impacts, including fisheries bycatch, by presidential decree (Decreto presidencial 144/98). The Karumbe conservation project in Uruguay has been working on assessing in-water threats to loggerheads and marine turtles for several years (*see http://www.seaturtle.org/promacoda*), with the objective of developing mitigation plans in the future. In Argentina, various conservation organizations are working toward assessing bycatch of loggerheads and other sea turtle species in fisheries, with the objective of developing mitigation plans for this threat (*see http://www.prictma.com.ar*). Overall, more effort to date has been expended on evaluating and assessing levels of fisheries bycatch of loggerhead turtles, than concretely reducing bycatch in the Southwest Atlantic, but this information is necessary for developing adequate mitigation plans. In the southeastern Atlantic, efforts have been directed toward assessing the distribution and levels of bycatch of loggerheads in coastal waters of southwestern Africa (Weir *et al.,* 2007; Petersen *et al.,* 2007, 2009). Bycatch of loggerheads has been documented in longline fisheries off the Atlantic coasts of Angola, Namibia, and South Africa (Petersen *et al.,* 2007), and several authors have highlighted the need to develop regional mitigation plans to reduce bycatch of loggerheads and other sea turtle species in coastal waters (Formia *et al.,* 2003; Weir *et al.,* 2007; Petersen *et al.,* 2009). On the high seas of the South Atlantic, little is known about exact bycatch levels, but there are some areas of higher concentration of longline effort that are likely to result in loggerhead bycatch (Lewison *et al.,* 2004).

Overall, conservation efforts for loggerhead turtles in the South Atlantic are dichotomous. On the nesting beaches (almost exclusively in Brazil), conservation actions are successful at protecting nesting females and their clutches, resulting in large numbers of hatchlings being released each year. In contrast, fisheries bycatch in coastal and oceanic waters remains a serious threat, despite regional emphasis on assessing bycatch rates in various fisheries on both sides of the South Atlantic. Comprehensive management actions to reduce or eliminate bycatch mortality are lacking in most areas, which is likely to result in a decline of this DPS in the future.

Finding

Regarding the petitions to (1) reclassify loggerhead turtles in the North Pacific Ocean as a DPS with endangered status and designate critical habitat and (2) reclassify loggerhead turtles in the Northwest Atlantic as a DPS with endangered status and designate critical habitat, we find that both petitioned entities qualify as DPSs (North Pacific Ocean DPS and Northwest Atlantic Ocean DPS, respectively) as described in this proposed rule. We also find that seven additional loggerhead sea turtle DPSs exist. We have carefully considered the best scientific and commercial data available regarding the past, present and future threats faced by the these nine loggerhead sea turtle DPSs. We believe that listing the North Pacific Ocean, South Pacific Ocean, North Indian Ocean, Southeast Indo-Pacific Ocean, Northwest Atlantic Ocean, Northeast Atlantic Ocean, and Mediterranean Sea DPSs of the loggerhead sea turtle as endangered and the Southwest Indian Ocean and South Atlantic Ocean DPSs as threatened is warranted for the reasons described below for each DPS.

North Pacific Ocean DPS

In the North Pacific, loggerhead nesting is essentially restricted to Japan where monitoring of loggerhead nesting began in the 1950s on some beaches, and expanded to include most known nesting beaches since approximately 1990. While nesting numbers have gradually increased in recent years and the number for 2009 is similar to the start of the time series in 1990, historical evidence indicates that there has been a substantial decline over the last half of the 20th century. In addition, based on nest count data for nearly the past 2 decades, the North Pacific population of loggerheads is small. The

SQE approach described in the Status of the Nine DPSs section suggested that the North Pacific Ocean DPS appears to be declining, is at risk, and is thus likely to decline in the future. The stage-based deterministic modeling approach suggested that the North Pacific Ocean DPS would grow slightly, but in the worst-case scenario, the model indicates that the population would be likely to substantially decline in the future. These results are largely driven by the mortality of juvenile and adult loggerheads from fishery bycatch that occurs throughout the North Pacific Ocean, including the coastal pound net fisheries off Japan, coastal fisheries impacting juvenile foraging populations off Baja California, Mexico, and undescribed fisheries likely affecting loggerheads in the South China Sea and the North Pacific Ocean (Factor E). Although national and international governmental and non-governmental entities on both sides of the North Pacific are currently working toward reducing loggerhead bycatch, and some positive actions have been implemented, it is unlikely that this source of mortality can be sufficiently reduced in the near future due to the challenges of mitigating illegal, unregulated, and unreported fisheries, the lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies. In addition to fishery bycatch, coastal development and coastal armoring on nesting beaches in Japan continues as a substantial threat (Factor A). Coastal armoring, if left unaddressed, will become an even more substantial threat as sea level rises. It is highly uncertain whether the actions identified in the Conservation Efforts section above will be fully implemented in the near future or that they will be sufficiently effective. Therefore, we believe that the North Pacific Ocean DPS is in danger of extinction throughout all of its range, and propose to list this DPS as endangered.

South Pacific Ocean DPS

In the South Pacific, loggerhead nesting is almost entirely restricted to eastern Australia (primarily Queensland) and New Caledonia. In eastern Australia, there has been a marked decline in the number of females breeding annually since the mid-1970s, with an estimated 50 to 80 percent decline in the number of breeding females at various Australian rookeries up to 1990 and a decline of approximately 86 percent by 1999. Comparable nesting surveys have not been conducted in New Caledonia, however. Information from pilot surveys conducted in 2005, combined with oral history information collected, suggest that there has been a decline in loggerhead nesting (*see* the Status of the Nine DPSs section above for additional information). Similarly, studies of eastern Australia loggerheads at their foraging areas revealed a decline of 3 percent per year from 1985 to the late 1990s on the coral reefs of the southern Great Barrier Reef. A decline in new recruits was also measured in these foraging areas. The SQE approach described in the Status of the Nine DPSs section suggested that, based on nest count data for the past 3 decades, the population is at risk and thus likely to decline in the future. The stage-based deterministic modeling approach provided a wide range of results: In the case of the lowest anthropogenic mortality rates (or the best case scenario), the deterministic model suggests that the South Pacific Ocean DPS will grow slightly, but in the worst-case scenario, the model indicates that the population is likely to substantially decline in the future. These results are largely driven by mortality of juvenile and adult loggerheads from fishery bycatch that occurs throughout the South Pacific Ocean (Factor E). Although national and international governmental and non-governmental entities on both sides of the South Pacific are currently working toward reducing loggerhead bycatch, and some positive actions have been implemented, it is unlikely that this source of mortality can be sufficiently reduced in the near future due to the challenges of mitigating illegal, unregulated, and unreported fisheries, the continued expansion of artisanal fleets in the southeastern Pacific, the lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies. It is highly uncertain whether the actions identified in the Conservation Efforts section above will be fully implemented in the near future or that they will be sufficiently effective. Therefore, we believe that the South Pacific Ocean DPS is in danger of extinction throughout all of its range, and propose to list this DPS as endangered.

North Indian Ocean DPS

In the North Indian Ocean, nesting occurs in greatest density on Masirah Island. Reliable trends in nesting cannot be determined due to the lack of standardized surveys at Masirah Island prior to 2008. However, a reinterpretation of the 1977–1978 and 1991 estimates of nesting females was compared to survey information collected since 2008 and results suggest a significant decline in the size of the nesting population, which is consistent with observations by local rangers that the population has declined dramatically in the last three decades. Nesting trends cannot be determined elsewhere in the northern Indian Ocean where loggerhead nesting occurs because the time series of nesting data based on standardized surveys is not available. The SQE approach described in the Status of the Nine DPSs section is based on nesting data; however, an adequate time series of nesting data for this DPS was not available. Therefore, we could not use this approach to evaluate extinction risk. The stage-based deterministic modeling approach indicated the North Indian Ocean DPS is likely to decline in the future. These results are driven by cumulative mortality from a variety of sources across all life stages. Threats to nesting beaches are likely to increase, which would require additional and widespread nesting beach protection efforts (Factor A). Little is currently being done to monitor and reduce mortality from neritic and oceanic fisheries in the range of the North Indian Ocean DPS; this mortality is likely to continue and increase with expected additional fishing effort from commercial and artisanal fisheries (Factor E). Reduction of mortality would be difficult due to a lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies. It is highly uncertain whether the actions identified in the Conservation Efforts section above will be fully implemented in the near future or that they will be sufficiently effective. Therefore, we believe that the North Indian Ocean DPS is in danger of extinction throughout all of its range, and propose to list this DPS as endangered.

Southeast Indo-Pacific Ocean DPS

In the Southeast Indo-Pacific Ocean, loggerhead nesting is restricted to western Australia, with the greatest number of loggerheads nesting on Dirk Hartog Island. Loggerheads also nest on the Muiron Islands and North West Cape, but in smaller numbers. Although data are insufficient to determine trends, evidence suggests the nesting population in the Muiron Islands and North West Cape region was depleted before recent beach monitoring programs began. The SQE approach described in the Status of the Nine DPSs section is based on nesting data; however, an adequate time series of nesting data for this DPS was not available; therefore, we could not use this approach to evaluate extinction risk. The stage-based deterministic modeling approach provided a wide range of results: In the case of the lowest anthropogenic mortality rates, the deterministic model suggests that the Southeast Indo-Pacific Ocean DPS will grow slightly, but in the worst-case scenario, the model indicates that the population is likely to substantially decline in the future. These results are largely driven by mortality of juvenile and adult loggerheads from fishery bycatch that occurs throughout the region, as can be inferred from data from Australia's Pacific waters (Factor E). Although national and international governmental and non-governmental entities are currently working toward reducing loggerhead bycatch, and some positive actions have been implemented, it is unlikely that this source of mortality can be sufficiently reduced in the near future due to the challenges of mitigating illegal, unregulated, and unreported fisheries, the continued expansion of artisanal fleets, the lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies. It is highly uncertain whether the actions identified in the Conservation Efforts section above will be fully implemented in the near future or that they will be sufficiently effective. Therefore, we believe that the Southeast Indo-Pacific Ocean DPS is in danger of extinction throughout all of its range, and propose to list this DPS as endangered.

Southwest Indian Ocean DPS

In the Southwest Indian Ocean, the highest concentration of nesting occurs on the coast of Tongaland, South Africa, where surveys and management practices were instituted in 1963. A trend analysis of index nesting beach data from this region from 1965 to 2008 indicates an increasing nesting population between the first decade of surveys and the last 8 years. These data represent approximately 50 percent of all nesting within South Africa and are believed to be representative of trends in the region. Loggerhead nesting occurs elsewhere in South Africa, but sampling is not consistent and no trend data are available. Similarly, in Madagascar, loggerheads have been documented nesting in low numbers, but no trend data are available. The SQE approach described in the Status of the Nine DPSs section, based on a 37-year time series of nesting female counts at Tongaland, South Africa (1963–1999), indicated this segment of the population, while small, has increased, and the likelihood of quasi-extinction is negligible. We note that the SQE approach we used is based on past performance of the DPS (nesting data from 1963–1999) and does not fully reflect ongoing and future threats to all life stages within the DPS. The stage-based deterministic modeling approach provided a wide range of results: In the case of the lowest anthropogenic mortality rates, the deterministic model suggests that the Southwest Indian Ocean DPS will grow slightly, but in the worst-case scenario, the model indicates that the population is likely to substantially decline in the future. These results are largely driven by mortality of juvenile loggerheads from fishery bycatch that occurs throughout the Southwest Indian Ocean (Factor E). This mortality is likely to continue and may increase with expected additional fishing effort from commercial and artisanal fisheries. Reduction of mortality would be difficult due to a lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies. It is highly uncertain whether the actions identified in the Conservation Efforts section above will be fully implemented in the near future or that they will be sufficiently effective. We have determined that although the Southwest Indian Ocean DPS is likely not currently in danger of extinction throughout all of its range, the extinction risk is likely to increase in the future. Therefore, we believe that the Southwest Indian Ocean DPS is likely to become an endangered species within the foreseeable future throughout all of its range, and propose to list this DPS as threatened.

Northwest Atlantic Ocean DPS

Nesting occurs within the Northwest Atlantic along the coasts of North America, Central America, northern South America, the Antilles, and The Bahamas, but is concentrated in the southeastern U.S. and on the Yucatan Peninsula in Mexico. The results of comprehensive analyses of the status of the nesting assemblages within the Northwest Atlantic Ocean DPS using standardized data collected over survey periods ranging from 10 to 23 years and using different analytical approaches were consistent in their findings—there has been a significant, overall nesting decline within this DPS. The SQE approach described in the Status of the Nine DPSs section suggested that, based on nest count data for the past 2 decades, the population is at risk and thus likely to decline in the future. These results are based on nesting data for loggerheads at index/standardized nesting survey beaches in the USA and the Yucatan Peninsula, Mexico. The stage-based deterministic modeling indicated the Northwest Atlantic Ocean DPS is likely to decline in the future, even under the scenario of the lowest anthropogenic mortality rates. These results are largely driven by mortality of juvenile and adult loggerheads from fishery bycatch that occurs throughout the North Atlantic Ocean (Factor E). Although national and international governmental and non-governmental entities on both sides of the North Atlantic are currently working toward reducing loggerhead bycatch, and some positive actions have been implemented, it is unlikely that this source of mortality can be sufficiently reduced across the range of the DPS in the near future because of the diversity and magnitude of the fisheries operating in the North Atlantic, the lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies. It is highly uncertain whether the actions identified in the Conservation Efforts section above will be fully implemented in the near future or that they will be sufficiently effective. Therefore, we believe that the Northwest Atlantic Ocean DPS is in danger of extinction throughout all of its range, and propose to list this DPS as endangered.

Northeast Atlantic Ocean DPS

In the Northeast Atlantic Ocean, the Cape Verde Islands support the only large nesting population of loggerheads in the region. Nesting occurs at some level on most of the islands in the archipelago with the largest nesting numbers reported from the island of Boa Vista where studies have been ongoing since 1998. Due to limited data available, a population trend cannot currently be determined for the Cape Verde population; however, available information on the directed killing of nesting females suggests that this nesting population is under severe pressure and likely significantly reduced from historic levels. In addition, based on interviews with elders, a reduction in nesting from historic levels at Santiago Island has been reported. Elsewhere in the northeastern Atlantic, loggerhead nesting is non-existent or occurs at very low levels. The SQE approach described in the Status of the Nine DPSs section is based on nesting data. However, we had insufficient nest count data over an appropriate time series for this DPS and could not use this approach to evaluate extinction risk. The stage-based deterministic modeling approach indicated the Northeast Atlantic Ocean DPS is likely to decline in the future, even under the scenario of the lowest anthropogenic mortality rates. These results are largely driven by the ongoing directed lethal take of nesting females and eggs (Factor B), low hatching and emergence success (Factors A, B, and C), and mortality of juveniles and adults from fishery bycatch (Factor E) that occurs throughout the Northeast Atlantic Ocean. Currently, conservation efforts to protect nesting females are growing, and a reduction in this source of mortality is likely to continue in the near future. Although national and international governmental and non-governmental entities in the Northeast Atlantic are currently working toward reducing loggerhead bycatch, and some positive actions have been implemented, it is unlikely that this source of mortality can be sufficiently reduced across the range of the DPS in the near future because of the lack of bycatch reduction in high seas fisheries operating within the range of this DPS, lack of bycatch reduction in coastal fisheries in Africa, the lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies. It is highly uncertain whether the actions identified in the Conservation Efforts section above will be fully implemented in the near future or that they will be sufficiently effective. Therefore, we believe that the Northeast Atlantic Ocean DPS is in danger of extinction throughout all of its range, and propose to list this DPS as endangered.

Mediterranean Sea DPS

Nesting occurs throughout the central and eastern Mediterranean in Italy, Greece, Cyprus, Turkey, Syria, Lebanon, Israel, the Sinai, Egypt, Libya, and Tunisia. In addition, sporadic nesting has been reported from the western Mediterranean, but the vast majority of nesting (greater than 80 percent) occurs in Greece and Turkey. There is no discernible trend in nesting at the two longest monitoring projects in Greece, Laganas Bay and southern Kyparissia Bay. However, the nesting trend at Rethymno Beach, which hosts approximately 7 percent of all documented loggerhead nesting in the Mediterranean, shows a highly significant declining trend (1990–2004). In Turkey, intermittent nesting surveys have been conducted since the 1970s with more consistent surveys conducted on some beaches only since the 1990s, making it difficult to assess trends in nesting. A declining trend (1993–2004) has been reported at Fethiye Beach, which represents approximately 10 percent of loggerhead nesting in Turkey. The SQE approach described in the Status of the Nine DPSs section is based on nesting data; however, region-wide nesting data for this DPS were not available. Therefore, we could not use this approach to evaluate extinction risk. The stage-based deterministic modeling approach indicated the Mediterranean Sea DPS is likely to decline in the future, even under the scenario of the lowest anthropogenic mortality rates. These results are largely driven by mortality of juvenile and adult loggerheads from fishery bycatch that occurs throughout the Mediterranean Sea (Factor E), as well as anthropogenic threats to nesting beaches (Factor A) and eggs/hatchlings (Factors A, B, C, and E). Although conservation efforts to protect some nesting beaches are underway, more widespread and consistent protection is needed. Although national and international governmental and non-governmental entities in the Mediterranean Sea are currently working toward reducing loggerhead bycatch, it is unlikely that this source of mortality can be sufficiently reduced across the range of the DPS in the near future because of the lack of bycatch reduction in commercial and artisanal fisheries operating within the range of this DPS, the lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies. It is highly uncertain whether the actions identified in the Conservation Efforts section above will be fully implemented in the near future or that they will be sufficiently effective. Therefore, we believe that the Mediterranean Sea DPS is in danger of extinction throughout all of its range, and propose to list this DPS as endangered.

South Atlantic Ocean DPS

In the South Atlantic nesting occurs primarily along the mainland coast of Brazil from Sergipe south to Rio de Janeiro. Prior to 1980, loggerhead nesting populations in Brazil were considered severely depleted. More recently, a long-term, sustained increasing trend in nesting abundance has been observed over a 16-year period from 1988 through 2003 on 22 surveyed beaches containing more than 75 percent of all loggerhead nesting in Brazil. The SQE approach described in the Status of the Nine DPSs section suggested that, based on nest count data for the past 2 decades, the population is unlikely to decline in the future. These results are consistent with Marcovaldi and Chaloupka's (2007) nesting beach trend analyses. We note that the SQE approach is based on past performance of the DPS (nesting data) and does not fully reflect ongoing and future threats to all life stages within the DPS. The stage-based deterministic modeling approach indicated the South Atlantic Ocean DPS is likely to decline in the future, even under the scenario of the lowest anthropogenic mortality rates. This result is largely driven by mortality of juvenile loggerheads from fishery bycatch that occurs throughout the South Atlantic Ocean (Factor E). Although national and international governmental and non-governmental entities on both sides of the South Atlantic are currently working toward reducing loggerhead bycatch in the South Atlantic, it is unlikely that this source of mortality can be sufficiently reduced across the range of the DPS in the near future because of the diversity and magnitude of the commercial and artisanal fisheries operating in the South Atlantic, the lack of comprehensive information on fishing distribution and effort, limitations on implementing demonstrated effective conservation measures, geopolitical complexities, limitations on enforcement capacity, and lack of availability of comprehensive bycatch reduction technologies. It is highly uncertain whether the actions identified in the Conservation Efforts section above will be fully implemented in the near future or that they will be sufficiently effective. We have determined that although the South Atlantic Ocean DPS is not currently in danger of extinction throughout all of its range, the extinction risk is likely to increase substantially in the future. Therefore, we believe that the South Atlantic Ocean DPS is likely to become an endangered species within the foreseeable future throughout all of its range, and propose to list this DPS as threatened.

Critical Habitat

Section 4(b)(2) of the ESA requires us to designate critical habitat for threatened and endangered species "on the basis of the best scientific data available and after taking into consideration the economic impact, the impact on national security, and any other relevant impact, of specifying any particular area as critical habitat." This section grants the Secretary of the Interior or of Commerce discretion to exclude an area from critical habitat if he determines "the benefits of such exclusion outweigh the benefits of specifying such area as part of the critical habitat." The Secretary may not exclude areas if exclusion "will result in the extinction of the species." In addition, the Secretary may not designate as critical habitat any lands or other geographical areas owned or controlled by the Department of Defense, or designated for its use, that are subject to an integrated natural resources management plan under section 101 of the Sikes Act (16 U.S.C. 670a), if the Secretary determines in writing that such a plan provides a benefit to the species for which critical habitat is proposed for designation (*see* section 318(a)(3) of the National Defense Authorization Act, Pub. L. 108–136).

The ESA defines critical habitat under section 3(5)(A) as: "(i) the specific areas within the geographical area occupied by the species, at the time it is listed * * *, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed * * *, upon a determination by the Secretary that such areas are essential for the conservation of the species."

Once critical habitat is designated, section 7 of the ESA requires Federal agencies to ensure they do not fund, authorize, or carry out any actions that will destroy or adversely modify that habitat. This requirement is in addition to the other principal section 7 requirement that Federal agencies ensure their actions do not jeopardize the continued existence of listed species.

The Services have not designated critical habitat for the loggerhead sea turtle. Critical habitat will be proposed, if found to be prudent and determinable, in a separate rulemaking.

Peer Review

In December 2004, the Office of Management and Budget (OMB) issued a Final Information Quality Bulletin for Peer Review, establishing minimum peer review standards, a transparent process for public disclosure of peer review planning, and opportunities for public participation. The OMB Bulletin, implemented under the Information Quality Act (Pub. L. 106–554), is intended to enhance the quality and credibility of the Federal government's scientific information, and applies to influential or highly influential scientific information disseminated on or after June 16, 2005. We obtained independent peer review of the scientific information compiled in the 2009 Status Review (Conant *et al.,* 2009) that supports this proposal to list nine DPSs of the loggerhead sea turtle as endangered or threatened.

On July 1, 1994, the Services published a policy for peer review of scientific data (59 FR 34270). The intent of the peer review policy is to ensure that listings are based on the best scientific and commercial data available. Prior to a final listing, we will solicit the expert opinions of three qualified specialists, concurrent with the public comment period. Independent specialists will be selected from the academic and scientific community, Federal and State agencies, and the private sector.

References

A complete list of the references used in this proposed rule is available upon request (*see* **ADDRESSES**).

Classification

National Environmental Policy Act

Proposed ESA listing decisions are exempt from the requirement to prepare an environmental assessment (EA) or environmental impact statement (EIS) under the National Environmental Policy Act of 1969 (NEPA) (NOAA Administrative Order 216–6.03(e)(1); *Pacific Legal Foundation* v. *Andrus,* 675 F. 2d 825 (6th Cir. 1981)). Thus, we have determined that the proposed listing determinations for the nine loggerhead DPSs described in this notice are exempt from the requirements of NEPA.

Information Quality Act

The Information Quality Act directed the Office of Management and Budget to issue government wide guidelines that "provide policy and procedural guidance to Federal agencies for ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by Federal agencies." Under the NOAA guidelines, this action is considered a Natural Resource Plan. It is a composite of several types of information from a variety of sources. Compliance of this document with NOAA guidelines is evaluated below.

- *Utility:* The information disseminated is intended to describe a management action and the impacts of that action. The information is intended to be useful to State and Federal agencies, non-governmental organizations, industry groups and other interested parties so they can understand the management action, its effects, and its justification.
- *Integrity:* No confidential data were used in the analysis of the impacts associated with this document. All information considered in this document and used to analyze the proposed action, is considered public information.
- *Objectivity:* The NOAA Information Quality Guidelines standards for Natural Resource Plans state that plans be presented in an accurate, clear, complete, and unbiased manner. NMFS and USFWS strive to draft and present proposed management measures in a clear and easily understandable manner with detailed descriptions that explain the decision making process and the implications of management measures on natural resources and the public. This document was reviewed by a variety of biologists, policy analysts, and attorneys from NMFS and USFWS.

Administrative Procedure Act

The Federal Administrative Procedure Act (APA) establishes procedural requirements applicable to informal rulemaking by Federal agencies. The purpose of the APA is to ensure public access to the Federal rulemaking process and to give the public notice and an opportunity to comment before the agency promulgates new regulations.

Coastal Zone Management Act

Section 307(c)(1) of the Federal Coastal Zone Management Act of 1972 requires that all Federal activities that affect any land or water use or natural resource of the coastal zone be consistent with approved State coastal zone management programs to the maximum extent practicable. NMFS and FWS have determined that this action is consistent to the maximum extent practicable with the enforceable policies of approved Coastal Zone Management Programs of Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, California, Oregon, Washington, Hawaii, Puerto Rico, and the U.S. Virgin Islands. Letters documenting our determination, along with the proposed rule, are being sent to the coastal zone management program offices of these States. A list of the specific State contacts and a copy of the letters are available upon request.

Executive Order 13132 Federalism

Executive Order (E.O.) 13132, otherwise known as the Federalism E.O., was signed by President Clinton on August 4, 1999, and published in the **Federal Register** on August 10, 1999 (64 FR 43255). This E.O. is intended to guide Federal agencies in the formulation and implementation of "policies that have Federal implications." Such policies are regulations, legislative comments or proposed legislation, and other policy statements or actions that have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. In addition, E.O. 13132 requires Federal agencies to have a process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications. A Federal summary impact statement is also required for rules that have federalism implications.

Pursuant to E.O. 13132, the Assistant Secretary for Legislative and Intergovernmental Affairs will provide notice of the proposed action and request comments from the appropriate official(s) in Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, California, Oregon, Washington, Hawaii, Puerto Rico, and the U.S. Virgin Islands.

Environmental Justice

Executive Order 12898 requires that Federal actions address environmental justice in decision-making process. In particular, the environmental effects of the actions should not have a disproportionate effect on minority and low-income communities. The proposed listing determinations are not expected to have a disproportionate effect on minority or low-income communities.

Executive Order 12866, Regulatory Flexibility Act, and Paperwork Reduction Act

As noted in the Conference Report on the 1982 amendments to the ESA, economic impacts shall not be considered when assessing the status of a species. Therefore, the economic analysis requirements of the Regulatory Flexibility Act are not applicable to the listing process. In addition, this rule is exempt from review under E.O. 12866. This proposed rule does not contain a collection-of-information requirement for the purposes of the Paperwork Reduction Act.

List of Subjects

50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

50 CFR Part 223

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

50 CFR Part 224

Administrative practice and procedure, Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Dated: March 8, 2010.

Eric C. Schwaab,

Assistant Administrator for Fisheries, National Marine Fisheries Service.

Dated: March 3, 2010.

Daniel M. Ashe,

Acting Director, U.S. Fish and Wildlife Service.

For the reasons set out in the preamble, 50 CFR parts 17, 223, and 224 are proposed to be amended as follows:

PART 17—ENDANGERED AND THREATENED WILDLIFE AND PLANTS

1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 16 U.S.C. 1531–1544; 16 U.S.C. 4201–4245; Pub. L. 99–625, 100 Stat. 3500; unless otherwise noted.

2. In § 17.11(h) remove the entry for "Sea turtle, loggerhead", and add nine entries for "Sea turtle, loggerhead" in its place, to read as follows:

§ 17.11 Endangered and threatened wildlife.

* * * * *

(h) * * *

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
*	*	*	*	*	*	*	
Sea turtle, loggerhead, Mediterranean Sea.	*Caretta caretta*	Mediterranean Sea Basin..	Mediterranean Sea east of 5°36′ W. Long.	E		NA	NA
Sea turtle, loggerhead, North Indian Ocean.	*Caretta caretta*	North Indian Ocean Basin..	North Indian Ocean north of the equator and south of 30° N. Lat.	E		NA	NA
Sea turtle, loggerhead, North Pacific Ocean.	*Caretta caretta*	North Pacific Ocean Basin..	North Pacific north of the equator and south of 60° N. Lat.	E		NA	NA

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
Sea turtle, loggerhead, Northeast Atlantic Ocean.	*Caretta caretta*	Northeast Atlantic Ocean Basin..	Northeast Atlantic Ocean north of the equator, south of 60° N. Lat., east of 40° W. Long., and west of 5°36′ W. Long.	E		NA	NA
Sea turtle, loggerhead, Northwest Atlantic Ocean.	*Caretta caretta*	Northwest Atlantic Ocean Basin..	Northwest Atlantic Ocean north of the equator, south of 60° N. Lat., and west of 40° W. Long.	E		NA	NA
Sea turtle, loggerhead, South Atlantic Ocean.	*Caretta caretta*	South Atlantic Ocean Basin..	South Atlantic Ocean south of the equator, north of 60° S. Lat., west of 20° E. Long., and east of 67° W. Long.	T		NA	NA
Sea turtle, loggerhead, South Pacific Ocean.	*Caretta caretta*	South Pacific Ocean Basin..	South Pacific south of the equator, north of 60° S. Lat., west of 67° W. Long., and east of 139° E. Long.	E		NA	NA
Sea turtle, loggerhead, Southeast Indo-Pacific Ocean.	*Caretta caretta*	Southeast Indian Ocean Basin; South Pacific Ocean Basin as far east as 139° E Long..	Southeast Indian Ocean south of the equator, north of 60° S. Lat., and east of 80° E. Long.; South Pacific Ocean south of the equator, north of 60° S. Lat., and west of 139° E. Long.	E		NA	NA
Sea turtle, loggerhead, Southwest Indian Ocean.	*Caretta caretta*	Southwest Indian Ocean Basin..	Southwest Indian Ocean north of the equator, south of 30° N. Lat., west of 20° E. Long., and east of 80° E. Long.	T		NA	NA
*	*	*	*	*	*	*	

PART 223—THREATENED MARINE AND ANADROMOUS SPECIES

3. The authority citation for part 223 continues to read as follows:

Authority: 16 U.S.C. 1531 1543; subpart B, § 223.201–202 also issued under 16 U.S.C. 1361 *et seq.;* 16 U.S.C. 5503(d) for § 223.206(d)(9).

4. Amend the table in § 223.102 by redesignating paragraph (b)(3) as paragraph (b)(4), and by removing the existing paragraph (b)(2), and by adding a new paragraph (b)(2) and (b)(3) to read as follows:

§ 223.102 Enumeration of threatened marine and anadromous species.

* * * * *

(b) * * *

Species[1]		Where listed	Citation(s) for listing determination(s)	Citation(s) for critical habitat designation(s)
Common name	Scientific name			
*	*	* * *	*	*
(2) Sea turtle, loggerhead, South Atlantic Ocean DPS.	*Caretta caretta*	South Atlantic Ocean south of the equator, north of 60° S. Lat., west of 20° E. Long., and east of 67° W. Long..	[INSERT FR CITATION WHEN PUBLISHED AS A FINAL RULE].	NA
(3) Sea turtle, loggerhead, Southwest Indian Ocean DPS.	*Caretta caretta*	Southwest Indian Ocean north of the equator, south of 30° N. Lat., west of 20° E. Long., and east of 80° E. Long..	[INSERT FR CITATION WHEN PUBLISHED AS A FINAL RULE].	NA

Species[1]		Where listed	Citation(s) for listing determination(s)	Citation(s) for critical habitat designation(s)
Common name	Scientific name			
* *	*	*	* *	*

[1] Species includes taxonomic species, subspecies, distinct population segments (DPSs) (for a policy statement, *see* 61 FR 4722, February 7, 1996), and evolutionarily significant units (ESUs) (for a policy statement, *see* 56 FR 58612, November 20, 1991).

PART 224—ENDANGERED MARINE AND ANADROMOUS SPECIES

5. The authority citation for part 224 continues to read as follows:

Authority: 16 U.S.C. 1531–1543 and 16 U.S.C. 1361 *et seq.*

6. Amend § 224.101 by revising paragraph (c) to read as follows:

§ 224.101 Enumeration of endangered marine and anadromous species.

* * * * *

(c) *Sea turtles.* The following table lists the common and scientific names of endangered sea turtles, the locations where they are listed, and the citations for the listings and critical habitat designations.

Species[1]		Where listed	Citation(s) for listing determination(s)	Citation(s) for critical habitat designation(s)
Common name	Scientific name			
(1) Sea turtle, loggerhead, Mediterranean Sea DPS.	*Caretta caretta*	Mediterranean Sea east of 5°36′ W. Long	[INSERT FR CITATION WHEN PUBLISHED AS A FINAL RULE].	NA
(2) Sea turtle, loggerhead, North Indian Ocean DPS.	*Caretta caretta*	North Indian Ocean north of the equator and south of 30° N. Lat.	[INSERT FR CITATION WHEN PUBLISHED AS A FINAL RULE].	NA
(3) Sea turtle, loggerhead, North Pacific Ocean DPS.	*Caretta caretta*	North Pacific north of the equator and south of 60° N. Lat.	[INSERT FR CITATION WHEN PUBLISHED AS A FINAL RULE].	NA
(4) Sea turtle, loggerhead, Northeast Atlantic Ocean DPS.	*Caretta caretta*	Northeast Atlantic Ocean north of the equator, south of 60° N. Lat., east of 40° W. Long., and west of 5°36′ W. Long.	[INSERT FR CITATION WHEN PUBLISHED AS A FINAL RULE].	NA
(5) Sea turtle, loggerhead, Northwest Atlantic Ocean DPS.	*Caretta caretta*	Northwest Atlantic Ocean north of the equator, south of 60° N. Lat., and west of 40° W. Long.	[INSERT FR CITATION WHEN PUBLISHED AS A FINAL RULE].	NA
(6) Sea turtle, loggerhead, South Pacific Ocean DPS.	*Caretta caretta*	South Pacific south of the equator, north of 60° S. Lat., west of 67° W. Long., and east of 139° E. Long.	[INSERT FR CITATION WHEN PUBLISHED AS A FINAL RULE].	NA
(7) Sea turtle, loggerhead, Southeast Indo-Pacific Ocean DPS.	*Caretta caretta*	Southeast Indian Ocean south of the equator, north of 60° S. Lat., and east of 80° E. Long.; South Pacific Ocean south of the equator, north of 60° S. Lat., and west of 139° E. Long.	[INSERT FR CITATION WHEN PUBLISHED AS A FINAL RULE].	NA

[1] Species includes taxonomic species, subspecies, distinct population segments (DPSs) (for a policy statement, *see* 61 FR 4722, February 7, 1996), and evolutionarily significant units (ESUs) (for a policy statement, *see* 56 FR 58612, November 20, 1991).

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