Loggerhead Sea Turtle
(*Caretta caretta*)
North Indian Ocean DPS, Southwest Indian Ocean DPS, Southeast Indo-Pacific Ocean DPS, South Pacific Ocean DPS, South Atlantic Ocean DPS, Northeast Atlantic Ocean DPS, and Mediterranean Sea DPS
5-Year Review:
Summary and Evaluation

2021

National Marine Fisheries Service
Office of Protected Resources
Silver Spring, Maryland
and
U.S. Fish and Wildlife Service
Division of International Conservation - IA
Falls Church, Virginia

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5-YEAR REVIEW

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1 GENERAL INFORMATION

1.1 Reviewers

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1.2 Methodology

The purpose of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 *et seq*.), is to provide a means to conserve the ecosystems upon which endangered and threatened species depend, to provide a program for the conservation of endangered and threatened species, and to take appropriate steps to recover endangered and threatened species. Under the ESA, the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS), together "we" or "the Services," share responsibility to conserve sea turtles as described in the Memorandum of Understanding Defining the Roles of USFWS and NMFS in Joint Administration of the Endangered Species Act of 1973 as to Sea Turtles, established in 1977 and revised in 2015. In general, NMFS has jurisdiction for sea turtles in the marine environment, USFWS has jurisdiction for sea turtles in the terrestrial habitat, and the Services commit to working together as necessary to conserve and recover listed sea turtles. One of our responsibilities under the ESA is to conduct a review of each listed species at least every 5 years to determine whether its endangered or threatened status should be changed or removed (i.e., 5-year review, 16 U.S.C. 1533(c)(2)). The ESA requires us to make these determinations solely on the basis of the best scientific and commercial data available (16 U.S.C. 1533(b)(1)(A)). Under the ESA, the definition of species includes any subspecies of fish or wildlife or plants, and any distinct population segment (i.e., DPS) of any species of vertebrate fish or wildlife which interbreeds when mature (16 U.S.C. 1532). In 2011, after a status review of the species (the Status Review; Conant *et al*. 2009), the Services identified nine loggerhead sea turtle DPSs (76 FR 58868; September 22, 2011), in accordance with the Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the ESA (i.e., the DPS Policy; 61 FR 4722, February 7, 1996). On December 26, 2019, we initiated this 5-year review for the seven foreign DPSs: the North Indian Ocean DPS, Southwest Indian Ocean DPS, Southeast Indo-Pacific Ocean DPS, South Pacific Ocean DPS, South Atlantic Ocean DPS, Northeast Atlantic Ocean DPS, and Mediterranean Sea DPS (84 FR 70958).

To compile the best available scientific and commercial data on the DPSs, we first reviewed the Status Review (Conant *et al*. 2009), which was based on the best available scientific and commercial data available at that time. We then searched for relevant new information on the foreign DPSs, their biology and habitat, and threats to their continued existence. Specifically, we searched for published literature in NMFS' scientific literature database, and by using the following scientific search engines: Clarivate's Web of Science, ScienceDirect, BioOne Complete, ProQuest's Aquatic Sciences and Fisheries Abstracts, JSTOR, EBSCO Academic Search and Environment Complete, and Google Scholar. We solicited relevant information from other Federal agencies, States, Territories, Tribes, foreign governments, academia, nonprofit organizations, industry groups, and individuals by publishing a request in the Federal Register (84 FR 70958; December 26, 2019). Though we did not receive any responses to our Federal Register notice that were specific to the foreign DPSs, we compiled, reviewed, and evaluated available data. We did not conduct new empirical studies because the ESA requires the use of the best *available* scientific and commercial information.

After compiling the data, we reviewed newly available information relevant to the DPS determination, following the DPS Policy. Under this policy, a DPS must be discrete and significant relative to its species. We asked whether the new data supported or refuted our previous determinations of discreteness and significance.

Next, we considered the biology and habitat of the DPSs. We identified information that has become available since the publication of the Status Review in 2009. We also reviewed the best available information on abundance and trends, population demographics, genetics, and spatial distribution.

We also assessed threats to each DPS by identifying and evaluating the ESA section 4(a)(1) factors (i.e., the five factor analysis; 16 U.S.C. 1533(a)(1)):

1. Present or threatened destruction, modification, or curtailment of habitat or range
2. Overutilization for commercial, recreational, scientific, or educational purposes
3. Disease or predation
4. Inadequacy of existing regulatory mechanisms
5. Other natural or manmade factors affecting its continued existence

Because the current abundance and trends are influenced by past threats, we focused on present threats. For each factor, we evaluated its likely impact and magnitude, as well as the DPS's vulnerability and exposure, if such data were available.

We synthesized the above information to assess the status of each foreign DPS. We identified the factors that weighed most heavily in our evaluation. We also described areas of high confidence, remaining uncertainties, and their relevance to our overall assessment. Based on this information, we provide a recommendation on the status of each of the seven foreign DPSs.

1.3 Background

1.3.1 Federal Register Notice

FR notice: 84 FR 70958
Date published: December 26, 2019
Purpose: NMFS gave notice of our initiation of a 5-year review of the seven foreign DPSs as well as the Northwest Atlantic Ocean DPS, which will be considered in a separate 5-year review. We requested relevant information from the public but received no information relevant to the seven foreign DPSs.

1.3.2 Listing History

Original Listing
FR notice: 43 FR 32800
Date listed: July 28, 1978
Entity listed: Loggerhead sea turtle (*Caretta caretta*)
Classification: Threatened

Revised Listing
FR notice: 76 FR 58868
Date listed: September 22, 2011
Entity listed & classification: Loggerhead sea turtle (*Caretta caretta*): endangered Mediterranean Sea DPS, endangered Northeast Atlantic Ocean DPS, endangered South Pacific Ocean DPS, endangered North Indian Ocean DPS, threatened South Atlantic DPS, threatened Southeast Indo-Pacific Ocean DPS, and threatened Southwest Indian Ocean DPS.

1.3.3 Associated rulemakings

4(d) Rules
FR notice: 43 FR 32800
Date: July 28, 1978
Purpose: Applied section 9 prohibitions (16 U.S.C. 1538) to threatened sea turtles and identified exceptions

FR notice: 76 FR 58868
Date: September 22, 2011
Purpose: Continues to apply existing take prohibitions and exceptions to those DPSs listed as threatened sea turtle species, including Southeast Indo-Pacific Ocean, Southwest Indian Ocean, and South Atlantic Ocean DPSs.

1.3.4 Review History

- In 1985, NMFS conducted the first 5-year review of the species, concluding that of 52 nesting populations evaluated throughout the Atlantic, Pacific, and Indian Oceans, 33 were thought to be declining, 18 were unknown, and only one – the U.S. southeast Atlantic – was thought to be increasing. Although the United States had implemented protective regulations and commercial harvest of eggs had decreased, many threats continued both domestically and abroad. NMFS determined that information was insufficient to assess whether a change in status was warranted.

- In 1991, USFWS conducted a 5-year review of many species, including the loggerhead sea turtle (56 FR 56882, November 6, 1991). USFWS requested new or additional information on the species and indicated that it would propose a change in status if warranted by the data received. Following the review, USFWS did not recommend a change in status.

- In 1995, the Services conducted a joint 5-year review (Plotkin 1995). Though we identified a need for further study of U.S. loggerhead population structure, we did not recommend a change in the status of the species.

- In 2007, we conducted a joint 5-year review on the loggerhead sea turtle (NMFS and USFWS 2007). We identified new information on statistically significant genetic population structure within and among ocean basins, based on the analyses of tissue samples collected at nesting beaches and foraging grounds. In addition, new information on age at first reproduction and survival rates suggested discreteness among populations. Though we did not recommend a change in status at that time, we recommended further analysis and review to apply the DPS Policy to the species (NMFS and USFWS 2007).

- On July 16, 2007, the Center for Biological Diversity and the Turtle Island Restoration Network petitioned us to identify the North Pacific loggerhead population as a DPS, list it as endangered, and designate critical habitat. On November 16, 2007, we found that the petition presented substantial scientific information indicating that the petitioned actions may be warranted (72 FR 64585). Also, on November 15, 2007, we received a petition from the Center for Biological Diversity and Oceana to list the "Western North Atlantic populations of loggerhead sea turtle" as an endangered species under the ESA. NMFS concluded that the petitioners presented substantial scientific and commercial information indicating that the petitioned action may be warranted (73 FR 11849; March 5, 2008). Therefore, we conducted the Status Review on the entire species (Conant *et al*. 2009).

- On December 26, 2019, NMFS gave notice of our initiation of a 5-year review of the seven foreign DPSs; we requested relevant information from the public. (84 FR 70958). Separate 5-year reviews of the North Pacific Ocean and Northwest Atlantic Ocean DPSs will be conducted.

1.3.5 Species' Recovery Priority Number

Not applicable.

1.3.6 Recovery Plan

A recovery plan was not prepared for these seven foreign DPSs in accordance with NMFS' June 10, 2019 finding that a recovery plan would not promote their conservation. The finding was based on the DPSs' occurrence outside of U.S. territorial waters and Exclusive Economic Zone (EEZ).

2 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

__x__ **Yes**
_____ **No**

2.1.2 Is the species under review listed as a DPS?

___x_ **Yes**
_____ **No**

2.1.3 Was the DPS listed prior to 1996?

______**Yes**
__x__**No**

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy?

__x__**Yes**
______**No**

After reviewing the 2009 Status Review and genetic, flipper tagging, bycatch, and satellite tracking data that have become available since its publication, we found the available data continue to support the discreteness and significance of each of the seven DPSs reviewed here.

The International Union for Conservation of Nature (IUCN) Marine Turtle Specialist Group convened a Burning Issues Working Group (meeting in August 2008 and September 2009) and developed a Regional Management Units (RMU) framework to evaluate and prioritize conservation status of marine turtles worldwide. Global marine turtle experts collated and integrated available studies on loggerhead biogeography, nesting sites, population abundances and trends, population genetics, and satellite telemetry, concluding in the identification of 10 loggerhead RMUs (Wallace *et al.* 2010). The authors refer to NMFS' 2009 Status Review under the Endangered Species Act (Conant *et al.* 2009) noting that the two independent analyses had very similar processes, and outcomes were nearly in complete agreement. The nine DPSs designated by NMFS and USFWS align with nine of the RMUs designated by Wallace *et al*., and their designation of the Northeastern Indian Ocean population as a putative RMU (defined as a region where nesting sites are known though no other information on genetics or distribution is available) is the only significant difference between the two.

New information specific to the discreteness and significance of each foreign loggerhead DPS is summarized by ocean basin below.

Indian Ocean: Flipper tagging and satellite tracking data continue to support the discreteness of the Southwest Indian Ocean, North Indian Ocean, and Southeast Indo-Pacific Ocean DPSs by demonstrating that they are geographically isolated from one another. Loggerheads nesting in the iSimangaliso Wetland Park in South Africa have been shown through satellite tracking to migrate to foraging grounds along the coast of Mozambique, Madagascar, and the Cape of Good Hope (Harris *et al.* 2018; Robinson *et al.* 2018). Recaptures of loggerheads tagged in the Park have also been recovered farther north along the coasts of Tanzania, Kenya and Somalia (de Wet 2012). The North Indian Ocean population nests predominantly in Oman, and adults migrate to forage in the Gulf of Aden, the Gulf of Oman, the Arabian Gulf, and the Gulf of Kutch (Rees *et al.* 2010). Satellite tracking of 18 juveniles by-caught in the waters of Reunion Island revealed that nine of those juveniles migrated north to waters off Yemen and Oman, while 3 others migrated south to the latitude of South Africa (Dalleau *et al.* 2014). As the size of turtles indicated that they were close to sexual maturity, these juveniles were likely returning to their natal waters, and therefore juveniles originating in the North Indian Ocean may conduct trans-equatorial movement (Dalleau *et al.* 2014). Though much remains to be understood about the spatial distribution and behavior of juveniles, demographic separation between the North Indian Ocean DPS and the Southwest Indian Ocean DPS is demonstrated by genetic structuring described in the following paragraph. In the Southeast Indo-Pacific, loggerheads nest on the shores of western Australia from Steep Point to the Muiron Islands (Reinhold and Whiting 2014) and forage in the coastal waters of Australia from Shark Bay to the Torres Strait in the north, as well as Indonesia (Hamann *et al.* 2013). These new studies continue to support the discreteness of the Southwest Indian Ocean, North Indian Ocean, and Southeast Indo-Pacific Ocean DPSs.

As discussed in the Status Review, genetic data (i.e., population-level genetic differences, also called "genetic divergence" and "population structure") provide evidence for the discreteness of the Southwest Indian Ocean DPS, North Indian Ocean DPS, and Southeast Indo-Pacific Ocean DPS. The use of expanded mitochondrial DNA (mtDNA) control region sequences (~800 bp) to better resolve haplotype sharing in the Atlantic and western Indian Oceans supports the genetic distinction of the following six populations: Northwest Atlantic Ocean, Northeast Atlantic Ocean, South Atlantic Ocean, Mediterranean Sea, Southwest Indian Ocean, and North Indian Ocean (Shamblin *et al.* 2014). The geographic distribution of haplotype frequencies accounted for most of the genetic differentiation between these populations (Shamblin *et al.* 2014). In the Southwest Indian Ocean, the major South African rookery population was found to only contain haplotype CC-A2.1, though this haplotype has also been identified at differing frequencies across all Atlantic and Mediterranean rookeries and additional genetic markers should be explored (Shamblin *et al.* 2014). Individuals nesting in Oman (North Indian Ocean DPS) were shown to be fixed for haplotype CC-A11.6, a variant of CC-A11 that had not previously been detected among Atlantic rookeries (Shamblin *et al.* 2014). No recent data are available on the genetic distinction of the Southeastern Indo-Pacific DPS, and therefore we continue to rely on the information reviewed in the 2009 status assessment: a majority (67%) of loggerheads nesting in Western Australia are of the CC-P5 haplotype, and the CC-P1 haplotype makes up the remainder of the population (Fitzsimmons *et al.* 1996). Available genetic analyses indicate that loggerheads of eastern and western Australia constitute different genetic stocks (Limpus 2008). We conclude that relevant new information continues to support the genetic discreteness of the Southwest Indian Ocean, North Indian Ocean, and Southeast Indo-Pacific Ocean populations from all other loggerheads.

Loggerhead nests have been documented in very low numbers on beaches of Sri Lanka, and this nesting subpopulation has been identified as a putative RMU by Wallace *et al*. (2010). Marine turtle surveys carried out in 2014 by Sri Lanka's National Aquatic Resources Research and Development Agency identified 14 loggerhead nests, accounting for only 0.42% of the total marine turtle nests documented (Jayathilaka *et al.* 2017). Data on where these nesting loggerheads forage is not available, though there is one record of a loggerhead being caught by fishermen in coastal Myanmar, and it is thought that these loggerheads likely forage in coastal waters of the Bay of Bengal (Hamann *et al.* 2013). Further research is needed to determine the genetic makeup of the Sri Lanka nesting loggerheads and their phylogenetic relationship with other nesting populations in the

Indian Ocean (Fitzsimmons and Limpus 2014). We did not find any new evidence that would allow us to make a positive finding on the discreteness or significance of this nesting population.

We find that the most current genetic, flipper tagging, and tracking data continue to support the discreteness determination for the Southwest Indian Ocean, North Indian Ocean, and Southeast Indo-Pacific Ocean DPSs. If any of these DPSs were extirpated, it is unlikely that the nesting areas or foraging areas would be repopulated by other loggerhead turtles. Therefore, we find that the Southwest Indian Ocean, North Indian Ocean, and Southeast Indo-Pacific Ocean DPSs are each significant to the species because each individual loss would result in a significant gap in the range of the species. We find that new relevant information continues to support the discreteness and significance of the Southwest Indian Ocean, North Indian Ocean, and Southeast Indo-Pacific Ocean DPSs under the DPS Policy.

Pacific Ocean: Loggerheads of the South Pacific Ocean population are known to nest in eastern Australia and New Caledonia and forage in waters of New South Wales, New Caledonia, the Solomon Islands, Papua New Guinea, Indonesia, and the Gulf of Carpentaria (Hamann *et al.* 2013). This population also undertakes trans-oceanic migrations to forage in waters off Peru, Chile (Boyle *et al.* 2009), and in lower numbers, Ecuador (Alava 2008). Tracking studies provide evidence that some of these pelagic-living juveniles reside in waters off of South America for an extended period of time, potentially for decades (Mangel *et al.* 2011). South Pacific loggerheads have low haplotype diversity, with only CC-P1 and CC-P5 reported, as well as low nucleotide diversity (Boyle *et al.* 2009). CC-P1 is the dominant haplotype in both eastern Australian (98%) and New Caledonian (93%) rookeries, which are genetically distinct from north Pacific loggerhead rookeries (F_{st}=0.82, p=0.00001) but not distinct from one another (F_{st}=-0.019; p=0.19) (Boyle *et al.* 2009).

Based on the geographic isolation and genetic differentiation of this population in relation to other loggerheads, we find that the most current available data continues to support the discreteness determination for the South Pacific Ocean DPS. If this DPS was extirpated, it is unlikely that the nesting areas would be repopulated by other loggerhead turtles. Therefore, the best available information continues to support the significance of the South Pacific Ocean DPS to the remainder of the species because its loss would result in a significant gap in the range of the species. Based on the best available scientific data, we conclude that the South Pacific Ocean DPS continues to meet the discreteness and significance criteria of the DPS Policy.

Atlantic Ocean and Mediterranean Sea: Satellite tracking and fishery bycatch data show that loggerhead turtles occur throughout the Mediterranean Sea, with a nesting population in the eastern Mediterranean (largely in Greece, Turkey, Cyprus and Libya) (Casale and Margaritoulis 2010; Casale 2015a; Casale *et al.* 2018). Nesting also occurs at lower levels along the Mediterranean coasts of Egypt, Israel, Italy, Lebanon, Syria, and Tunisia (Casale *et al.* 2018). Adult females and males generally migrate away from nesting beaches to neritic foraging habitat such as the northern Adriatic Sea and the continental shelf off of Tunisia and Libya, though they also forage in offshore oceanic waters (Luschi and Casale 2014). Juvenile loggerheads originating from Atlantic nesting populations also enter the Mediterranean Sea to forage, mainly occurring in the western-most part (Carreras *et al.* 2011).

Recent tracking studies of the Northeast Atlantic population support previous range designations and reinforce the discreteness of this population. Initial tracking studies of male loggerheads tagged off of Boa Vista, Cape Verde reveal that this population is using both oceanic waters to the east of Cape Verde and neritic waters off Mauritania to forage (Varo-Cruz *et al.* 2013). Satellite tracking of post-nesting females at Boa Vista, Cape Verde show that oceanic foraging behavior is associated with highly productive areas of upwelling and intense thermal front activity off the coast of Northwest Africa (Scales *et al.* 2015).

The South Atlantic Ocean population nests along the coast of Brazil ranging from cool temperate climates in the south to tropical climates in the north (Marcovaldi and Chaloupka 2007). Juvenile oceanic loggerheads originating from the Brazilian nesting beaches are known, through bycatch records, to forage in the Elevação do Rio Grande seamount offshore of Brazil, though this foraging ground is known to host juveniles of other populations as well (Shamblin *et al.* 2014). Satellite tracking also revealed high use areas for juveniles in the exclusive economic zones of Brazil, Uruguay, and Argentina and adjacent international waters (Barceló *et al.* 2013). Adult females have high fidelity to neritic foraging grounds on the northern coast of Brazil (Marcovaldi *et al.* 2010).

The use of expanded mtDNA control region sequences (~800 bp) to better resolve haplotype sharing in the Atlantic and western Indian Oceans supported the distinction of the following six populations: Northwest Atlantic Ocean, Northeast Atlantic Ocean, South Atlantic Ocean, Mediterranean Sea, Southwest Indian Ocean, and North Indian Ocean (Shamblin *et al.* 2014). The geographic distribution of haplotype frequencies accounted for most of the genetic differentiation between these populations (Shamblin *et al.* 2014).

Though loggerheads from Atlantic nesting populations commonly enter the western Mediterranean Sea to forage, recent studies provide evidence that Mediterranean populations are genetically and demographically separate from Atlantic populations. Microsatellite data from 56 individuals sampled in the western Mediterranean (all of haplotype CC-A1, representative of the Atlantic stock) was compared to that of 112 individuals genotyped by Carreras *et al.* (2007) sampled from nesting sites in the eastern Mediterranean. Mediterranean nesting populations were found to be genetically differentiated from Atlantic nesting populations (F_{ST}=0.029, $p<0.05$), showing that possible mating events between individuals of the two populations are not enough to homogenize the two areas (Carreras *et al.* 2011). This could be due to the low probability of encounter as relative abundance of individuals of both populations are highly variable in western Mediterranean feeding grounds, as well as the fact that most of the individuals found at shared feeding grounds are juveniles (Carreras *et al.* 2011). The dominant haplotype of loggerheads in the Mediterranean nesting population is CC-A2.1, though there is significant population structure among rookeries (Yilmaz *et al.* 2011).

Pairwise comparisons of mitochondrial DNA showed significant differences between the Cape Verde population and all other known Atlantic and Mediterranean rookeries (F_{ST} = 0.745; $P<0.000$) supporting their genetic distinction from other loggerhead populations

(Monzón-Argüello *et al.* 2010). Expanded mitochondrial control region sequences reveal further differentiation between the Northeastern and Northwestern Atlantic populations. Using 817 bp control region haplotypes, Shamblin *et al*. (2012) found CC-A1.1 to be the dominant CC-A1 variant in southeastern USA nesting populations, which is markedly absent from Cape Verdean nesting populations. CC-A1.4, dominant in Mexican rookeries, was a minor haplotype in Cape Verde rookeries. The dominant variant in Cape Verde, CC-A1.3, was found at low frequencies in few Florida rookeries as well as Quintana Roo, Mexico (Shamblin *et al.* 2012). Overall, haplotype frequencies in Cape Verde were significantly different from all sampled management units in the Northwestern Atlantic nesting population (South Carolina and Georgia, central eastern Florida, southeastern Florida, Cay Sal in the Bahamas and Dry Tortugas in Florida, Cuba, Isla Cozumel and Quintana Roo in Mexico, southwestern Florida, central western Florida, and northwestern Florida) (Shamblin *et al.* 2012).

The South Atlantic nesting population shows endemic haplotypes CC-A4.1, CC-A4.2, and CC-A4.3 and is genetically distinct from all other Atlantic and Indian Ocean populations (Shamblin *et al.* 2014; Medeiros *et al.* 2019).

We find that the best available data, summarized above, continues to support the discreteness determinations of the Mediterranean Sea DPS, the Northeast Atlantic Ocean DPS, and the South Atlantic Ocean DPS. If any of these DPSs were extirpated, it is unlikely that their nesting areas would be repopulated by other loggerhead turtles. Therefore, each of the three foreign DPSs in this ocean basin are significant to the species because each individual loss would result in a significant gap in the range of the species. Based on the best available data, we conclude that the Mediterranean Sea DPS, the Northeast Atlantic Ocean DPS, and the South Atlantic Ocean DPS continue to meet the discreteness and significance criteria of the DPS Policy.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

_____**Yes**
_x___**No**

2.3 Updated Information and Current Species Status

2.3.1 Updated information applicable to all foreign DPSs

2.3.1.1 Biology and Life History

Loggerheads exhibit a complex life cycle that contains several life stages (i.e., hatchling, juvenile, and adult), occurring across wide-spread and diverse habitats. Multiple foraging strategies at juvenile and adult life stages indicate the importance of several different habitat types and locations to this highly migratory species.

After emerging from their nests, hatchlings crawl toward the sea using light cues, specifically the light differential between darker silhouette of the dune and vegetation landward and the brighter open ocean horizon (Kawamura *et al.* 2009; Berry *et al.* 2013). Once the hatchlings enter the sea, they begin a swim frenzy toward offshore currents, swimming almost continuously for the first 24 hours (Salmon and Wyneken 1987). They likely imprint on the magnetic signature of the coastal area so that they can return to their natal waters and beaches to mate and nest as adults (Lohmann and Lohmann 2019). Post-frenzy, small juveniles appear to use both passive drift and active swimming to remain in productive surface pelagic habitats (Briscoe *et al.* 2016; Mansfield *et al.* 2017).

Juveniles forage and grow in pelagic habitats until reaching carapace lengths of approximately 40-60 cm, at which point they will either remain in oceanic habitats to forage and mature, recruit to neritic habitats where their development continues, or move between the two habitats (Hawkes *et al.* 2006). Oceanic habitats provide low abundance, nutrient-poor pelagic food resources such as *Sargassum* and gelatinous zooplankton, while neritic habitats provide higher quality and quantity benthic prey, including fish, molluscs, and crustaceans (Snover *et al.* 2010; Peckham *et al.* 2011; Hatase *et al.* 2015).

Loggerheads reach reproductive maturity around 80 cm curved carapace length (CCL) and approximately 30 years of age, though this varies by DPS (Snover 2002; Tucek *et al.* 2014). As adults, loggerheads make frequent migrations between foraging habitat (either neritic or oceanic) and natal breeding areas; though reproductive remigration intervals vary by DPS, females typically return to nest every 2-4 years (Schroeder *et al.* 2003). In certain populations, including the Northeast Atlantic DPS, oceanic foraging habitats are used by smaller adults while larger adults use neritic foraging habitat, though this differentiation is not found everywhere (North Indian Ocean DPS, for example) (Rees *et al.* 2010). Specific demographic information for each DPS, if known, is reported in the following sections.

Recent studies shed light on the effects of temperature, moisture, sand type and other variables on egg development and hatchling success. Sea turtles possess temperature-dependent sex determination in which sand temperatures prevailing during the middle third of the incubation period determine the gender of hatchling sea turtles (Mrosovsky and Yntema 1980; Yntema and Mrosovsky 1982). The pivotal temperature (i.e., the incubation temperature that produces equal numbers of males and females) in loggerheads is approximately 29°C (Yntema and Mrosovsky 1979; Mrosovsky 1988; Marcovaldi *et al.* 1997). Incubation temperatures near the upper end of the tolerable range produce only female hatchlings while incubation temperatures near the lower end of the range produce only male hatchlings (Yntema and Mrosovsky 1980). Incubation temperatures over 33°C are considered lethal (Matsuzawa *et al.* 2002), though there are some discrepancies in the literature due to duration of exposure to high temperatures and variations between populations (reviewed by Howard *et al.* 2014). Results from Usategui-Martin *et al*. (2019) suggest that loggerhead eggs originating in different regions may vary in their optimal temperature range. Kobayashi *et al*. (2018) provide evidence that in addition to determining sex, warmer incubation temperatures (31°C) produced hatchlings with higher initial swimming performance, lower sustained swimming performance, and lower growth rates during the first three weeks of life than those exposed to cooler incubation temperatures (27.5°C).

Sand moisture levels have been shown to play a role in this relationship as well. Recent studies provide evidence that high moisture levels result in high male production, even in temperatures expected to produce more females (Lolavar and Wyneken 2017). Additionally, high and low moisture levels narrow the transitional range of temperatures (TRT), or the temperatures over which the sex ratio changes from all male to all female, compared to medium moisture sand (Lolavar and Wyneken 2020). Finally, eggs exposed to high sand moisture produced hatchlings with larger initial mass, straight carapace length (SCL) and straight carapace width (SCW), as well as faster SCW growth, compared to eggs in drier conditions (Erb *et al.* 2018). Incubation in fine-grain sand produced hatchlings with significantly higher crawling and swimming performance compared to those incubated in coarse sand (Saito *et al.* 2019). These recent findings are critically important in understanding how climate change may affect loggerhead populations.

2.3.1.2 Taxonomic classification or changes in nomenclature:

The taxonomic classification for the loggerhead sea turtle has not changed since the species' status was last reviewed. It remains as follows:

Kingdom: Animalia
Phylum: Chordata
Class: Reptilia
Order: Testudines
Family: Cheloniidae
Genus: *Caretta*
Species: *caretta*
Common name: Loggerhead sea turtle

2.3.1.3 Five-factor analysis threats applicable to all DPSs

Section 4(a)(1) of the ESA requires the Services to determine whether a species is endangered or threatened because of any of the following factors (or threats) alone or in combination: 1) the present or threatened destruction, modification, or curtailment of its habitat or range; 2) overutilization for commercial, recreational, scientific, or educational purposes; 3) disease or predation; 4) inadequacy of existing regulatory mechanisms to address identified threats; or 5) other natural or human factors.

In this section, we address threats that apply to all seven loggerhead DPSs reviewed in this document. Specific descriptions and quantifications of threats are presented in the following sections by DPS. We first describe each factor and its effect on the DPS. If possible, we identify whether the threats are likely to influence abundance, trends, spatial distribution, and/or diversity of the DPS. Finally, when possible we characterize the magnitude of the threat.

Present or threatened destruction, modification or curtailment of its habitat or range:

Terrestrial
Destruction and modification of nesting habitat continues to impact all loggerhead DPSs through the following mechanisms relating to coastal development: artificial light pollution, beach erosion, coastal armoring structures such as seawalls, vehicular and pedestrian traffic, and beach debris.

Artificial light pollution at nesting beaches has been shown to negatively impact female nesting behavior, resulting in fewer nesting attempts, nesting in darker but less suitable habitat, more extensive beach crawls, and disorientation when returning to the water (Silva *et al.* 2017). Light pollution also affects hatchlings by significantly disorienting or misorienting their crawl from nest to sea (Berry *et al.* 2013). Hatchlings that undertake disoriented crawls are more likely to experience exhaustion both on the beach and once they reach the swimming frenzy stage offshore, and increased mortality may result (Ehrhart and Witherington 1987; Witherington and Martin 1996). Increased exposure to light pollution due to coastal development has the potential to directly and significantly affect loggerhead reproduction and recruitment with population-level impacts.

The use of coastal armoring structures to control beach erosion and storm damage temporarily protects coastal property but eventually causes narrowing and degradation of beaches (Pilkey and Wright 1988; Fletcher *et al.* 1997). Seawalls have been shown to cause reduced nesting success in loggerheads, with fewer animals emerging to nest in front of seaward walls (Rizkalla and Savage 2011). Additionally, nests laid in front of seawalls were more likely to be washed away in storms (Rizkalla and Savage 2011). An experimental study showed that the presence of a physical barrier led females to nest significantly closer to water than turtles that did not encounter a barrier, in a zone that normally receives a small portion of nests and is at greatest risk of egg morality from inundation and erosion (Witherington *et al.* 2011). Beachfront armoring, which is expected to increase in the future in the face of climate change associated sea level rise and more frequent storm activity, poses an increasing threat to the loggerhead's reproductive success (Rizkalla and Savage 2011).

Ruts and imprints from vehicular and pedestrian traffic on beaches impede the ability of hatchlings to reach the sea (Mann 1978; Hosier *et al.* 1981). Vehicles commonly leave long tracks parallel to the sea, serving to divert hatchlings far distances before they are able to find a break in the barrier (Hosier *et al.* 1981). Depth and number of vehicle tracks significantly influence the ability of hatchlings to find the ocean, and the detrimental effect is amplified in loose or coarse-grained sand (Lamont *et al.* 2002). Resulting extended crawls can lead to increased mortality due to stress, exhaustion, and predation (Hosier *et al.* 1981; Lamont *et al.* 2002). An additional effect of vehicular and traffic is sand compaction, which hinders nest construction and reduces hatching emergence success (Mann 1978).

Debris on nesting beaches can pose a threat to loggerhead hatchlings by increasing the time they take to reach the ocean after emerging from the nest. An experimental assessment of the effect of debris on loggerhead hatchlings found that high density debris (6 items per m^2) significantly increased crawl time compared to control, low, and medium density debris (0, 1.2, and 2.76 items per m^2 respectively) (Aguilera *et al.* 2018). As described above, extended crawls can lead to increased mortality through numerous mechanisms. In addition, the presence of microplastic fragments (<5 mm) in sand has been shown to increase permeability by generally increasing grain size, decrease thermal diffusivity resulting in slower warming, and increase heat capacity resulting in lower maximum temperatures; even in sand cores containing 1.5% plastic fragments, maximum temperatures were reduced by 0.75°C (Carson *et al.* 2011). Though the effects of microplastics on sand and sea turtle nests are not completely understood, the presence of microplastics on nesting beaches has the potential to impact both hatching success and hatchling sex (Carson *et al.* 2011; Beckwith and Fuentes 2018).

Marine

Marine pollution, including marine debris and bioaccumulative contaminants, modifies loggerhead foraging and migratory habitat and is one of the main anthropogenic threats to sea turtles (D'Ilio *et al.* 2011; Schuyler *et al.* 2016). In every region of the world where sea turtle gastrointestinal tracts have been examined, ingested marine debris was present (Schuyler *et al.* 2014). Duncan *et al*. (2019) found microplastic (particles <5mm) ingestion to be universal across loggerheads sampled from the Atlantic, Mediterranean, and Pacific Oceans as 100% of individuals examined had ingested synthetic particles. Microplastics may be ingested through exposure to contaminated seawater or sediments, or through consumption of contaminated filter-feeding organisms (Duncan *et al.* 2019). Loggerheads primarily ingest larger plastic and marine debris mistaken for or associated with prey items (Wedemeyer-Strombel *et al*. 2015). In ex situ experimental trials, foraging loggerheads responded similarly to the odors of prey items and biofouled plastic, consistent with the hypothesis that the scent of biofouled plastic stimulates foraging behavior and contributes to turtles' detrimental (and potentially fatal) interactions with marine debris (Pfaller *et al.* 2020). Loggerheads appear to tolerate some level of ingestion of plastic debris and are often able to defecate these items, though deaths due to debris ingestion occur when the debris blocks, tears, twists, or otherwise compromises the digestive tract (Bjorndal *et al.* 1994; Tomás *et al.* 2002; Lazar and Gracan 2011; Hoarau *et al.* 2014). Ingestion of plastics likely has sub-lethal effects such as dietary dilution, disruption of metabolism, and absorption of toxins, which may reduce the overall fitness of an individual (Hoarau *et al.* 2014). Population-level impacts are unquantified and unknown because most incidents of ingestion or entanglement are never observed.

In addition to ingesting marine debris, loggerheads can become entangled in lost or discarded fishing gear, such as gillnets and crab pots (NOAA Marine Debris Program 2015), often resulting in death or injury (Wilcox *et al.* 2016). Though fisheries-based materials are responsible for the majority of sea turtle entanglement, land-based materials such as polythene-sheeting, balloon strings, and non-fishing rope/lines pose threats of entanglement as well (Duncan *et al.* 2017).

The presence of inorganic and persistent organic pollutants in the marine environment threatens loggerheads globally (D'Ilio *et al.* 2011). Loggerheads generally show higher loads of metal contaminants compared to other turtle species, which could be due to greater exposure through their carnivorous diet (Sakai *et al.* 2000; D'Ilio *et al.* 2011). This is concerning as these contaminants are highly persistent and can be toxic in all living organisms (Storelli *et al.* 2005). Though further research is needed to determine the specific effects of heavy metal contamination on loggerhead individuals, populations, and their ecosystems (Yipel *et al.* 2017), effects may be lethal, and non-lethal effects increase the probability of mortality (Balazs 1985; Carr 1987; McCauley and Bjorndal 1999; Witherington 2002). Sources of pollutants include herbicides, pesticides, oil spills, and other chemicals resulting from shipping, dredging, and marine explosives (Francour *et al*.1999; Lee Long *et al*. 2000; Margaritoulis *et al*. 2003; Waycott *et al*. 2005). Oil spills and resulting clean-up efforts can have acute toxic effects on loggerhead turtles at all life stages through inhalation, ingestion, and direct contact. Long-term, wide-spread effects on reproduction, foraging and migration due to habitat degradation can also occur (Deep Water Horizon Natural Resource Damage Assessment Trustees 2016; Lauritsen *et al.* 2017).

Effects of marine pollution on loggerheads of all DPSs range from reduced foraging to mortality, but population-level impacts are often unquantified and unknown.

<u>Overutilization for commercial, recreational, scientific, or educational purposes:</u> Though greatly reduced from historical levels, adult loggerhead turtles and their eggs are harvested to be eaten or sold as meat in many countries as reviewed by DPS in subsequent sections. Primary targets of harvest are nesting females and eggs laid on nesting beaches, therefore removing both the most valuable life stage (reproductively mature females) as well as offspring that would recruit to the next generation.

<u>Disease or predation:</u> Native and introduced species prey on loggerhead eggs and hatchlings on nesting beaches, reducing the productivity of affected DPSs. In the marine environment, predators such as sharks have been known to prey on loggerheads of several life stages (Bornatowski *et al.* 2012; Delorenzo *et al.* 2015). Specific predators and levels of predation, if known, are reported by DPS in the following sections.

Population level effects of loggerhead diseases largely remain unknown. Fibropapillomatosis, a disease characterized by internal and/or external tumors that may interfere with swimming, vision, or normal organ function, has been documented in loggerheads of multiple DPSs though it is more frequently observed in green turtles (*Chelonia mydas*) (Herbst 1994). Endoparasites such as nematodes, tapeworms, and trematodes are commonly observed, and heavy infestations of endoparasites may cause or contribute to debilitation or mortality in sea turtles, though the level of harm is poorly understood (Greiner 2013). Loggerheads are also known to host ectoparasites such as copepods and leeches, which can cause skin lesions and potentially transmit other disease (Rodenbusch, Marks*, et al.* 2012; Crespo-Picazo *et al.* 2017). Disease-related information specific to each DPS is described below.

<u>Inadequacy of existing regulatory mechanisms:</u> The highly migratory life history of loggerhead turtles exposes them to threats not only across different marine habitats, but also across different countries and jurisdictions. Inadequate regulatory measures can leave loggerheads vulnerable to a wide range of anthropogenic impacts, including direct injury or death, disruption of necessary behaviors such as nesting, and altered marine and terrestrial habitats. For this reason, regulatory mechanisms at the local, national, regional and international levels all play a critical role in loggerhead conservation and recovery. A summary of regulatory mechanisms and conservation efforts that apply to all seven foreign DPSs is provided below. Regional, national, or local mechanisms and conservation efforts are described by DPS in the following sections. Altogether, we find that while a number of international regulatory tools are aimed at sea turtle conservation and have provided conservation benefits to the species globally, threats such as substantial fisheries bycatch and coastal development continue to threaten loggerhead populations through direct take, reduction of suitable habitat, and reduced reproductive success. Additional or strengthened international regulatory measures are needed to ensure that loggerhead populations persist.

Convention on the Conservation of Migratory Species of Wild Animals (CMS)
CMS is an environmental treaty of the United Nations aiming to conserve migratory species and their habitats and migration routes. CMS establishes obligations for each State joining the Convention and promotes collaboration among range states. Loggerheads are listed as an Appendix I species under CMS, meaning that they are threatened with extinction; CMS Parties work to strictly protect these species by conserving or restoring their habitat, mitigating obstacles to migration, and reducing or eliminating other threats. As of August 2020, there are 131 Parties to CMS.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
CITES is an international convention that aims to ensure that international trade in animals and plants does not threaten their survival. CITES affords varying degrees of protection to over 37,000 species and is legally binding for Parties. The loggerhead is listed globally on Appendix I of CITES, meaning that trade in specimens of loggerhead is permitted only in exceptional circumstances. CITES

only regulates international trade, and does not regulate take or trade within a country. There are 183 Parties to CITES as of August 2020.

Convention on Biological Diversity (CBD)
CBD is an international instrument with three main objectives: the conservation of biological diversity, the sustainable use of the components of biological diversity, and the fair and equitable sharing of benefits arising out of the utilization of genetic resources. Through its Marine and Coastal Biodiversity Program, Parties are encouraged to implement comprehensive ocean health policies, establish coastal zone management programs, enforce controls on destructive fishing practices, and protect important breeding and nursing areas. As of August 2020, there are 196 Parties to CBD.

FAO Guidelines to Reduce Sea Turtle Mortality in Fishing Operations
The Food and Agriculture Organization (FAO) of the United Nations provided technical guidelines to reduce sea turtle mortality in marine fisheries. These recommendations were endorsed by the FAO Committee on Fisheries (COFI), which called for the immediate implementation by member nations and Regional Fishery Management Organizations (RFMOs). These RFMO measures are now required of cooperating and non-party members.

United Nations Convention on the Law of the Sea (UNCLOS)
Aside from its provisions defining ocean boundaries, the convention establishes general obligations for safeguarding the marine environment through mandating sustainable fishing practices and protecting freedom of scientific research on the high seas. As of September 2020, there are 168 Parties to the Convention.

United Nations Resolution 46/215 on Large-Scale Pelagic Driftnet Fishing
In 1991, the United Nations called for the elimination of all high seas driftnets by 1992. Additional information is available at
http://www.un.org/documents/ga/res/44/a44r225.htm.

The International Convention for the Prevention of Pollution from Ships (MARPOL)
The MARPOL Convention is a combination of two treaties adopted in 1973 and 1978 to prevent pollution of the marine environment by ships from operational or accidental causes. The 1973 treaty covered pollution by oil, chemicals, harmful substances in packaged form, sewage, and garbage. The 1978 MARPOL Protocol was adopted at the Conference on Tanker Safety and Pollution Prevention and included standards for tanker design and operation. The 1978 Protocol incorporated the 1973 Convention as it had not yet been in force and is known as the International Convention for the Prevention of Marine Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78). The 1978 Convention went into force in 1983 (Annexes I and II). The Convention includes regulations aimed at preventing and minimizing accidental and routine operations pollution from ships. Amendments passed since have updated the

convention. To date there are six Annexes with Annexes I and II being mandatory for State Parties and the others being voluntary:

- Annex I Regulations for the Prevention of Pollution by Oil
- Annex II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk
- Annex III Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form
- Annex IV Prevention of Pollution by Sewage from Ships
- Annex V Prevention of Pollution by Garbage from Ships
- Annex VI Prevention of Air Pollution from Ships.

Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention)
The World Heritage Convention was signed in 1972 and, as of 2019, 194 states are parties to the Convention. The instrument requires parties to take effective and active measures to protect and conserve habitat of threatened species of animals and plants of scientific or aesthetic value. As of September 2020, 50 marine and coastal heritage sites have been designated, including sites of critical importance to loggerheads such as Shark Bay and Ningaloo Coast in Australia, the iSimangaliso Wetland Park in South Africa, and the Socotra Archipelago in Yemen.

Ramsar Convention on Wetlands
The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. As of 2019, there are 171 Contracting Parties to the Convention, with over 2,300 wetland sites. In 2018 a resolution was passed to enhance conservation of coastal marine turtle habitats and the designation of key areas as Ramsar Sites.

<u>Other natural or manmade factors affecting its continued existence</u>: Other factors affecting the continued existence of all loggerhead DPSs include fisheries bycatch and anthropogenic climate change.

Bycatch
At present, one of the greatest threats to the survival and recovery of most loggerhead DPSs is bycatch in commercial and artisanal fisheries. Bycatch occurs in oceanic and coastal waters across numerous types of commercial and artisanal fishing gear, including pelagic and demersal longlines, drift and set nets (e.g., gillnets, pound nets, trammel nets), bottom, surface, and mid-water trawling, purse seines, pots and traps, and hook and line gear. Illegal, unreported, and unregulated (IUU) fishing is a threat to sea turtles worldwide, with 26 million tons of fish caught annually, valued at $10 to 23 billion U.S. dollars (http://www.fao.org/iuu-fishing/en/), though impacts to loggerheads are difficult to quantify. While some fisheries have significantly reduced their bycatch of loggerheads, bycatch continues to pose a major threat to all loggerhead DPSs,

reducing overall abundance (i.e., loss of individuals) and productivity (i.e., loss of reproductive potential). Descriptions of the threat posed by fisheries bycatch specific to each DPS are found in the following sections.

Climate change

Climate change, ocean oscillations, and catastrophic events have large-scale impacts on loggerhead nesting and foraging success. Climate change is characterized by increasing temperatures (air and sea surface), ocean acidification, changing major ocean currents, and sea level rise. Such changes are likely to result in the increased frequency and severity of ocean oscillations and catastrophic events. Impacts to all DPSs include increased erosion of nesting beaches, inundation of nests, temperature-linked nest failure, and temperature-linked sex bias. The availability and location of prey is also likely to change. Such issues are likely to intensify in the future, creating a growing threat to the viability of all DPSs.

To evaluate the impact of climate change on the DPSs, we used the best available data, which includes the Intergovernmental Panel on Climate Change (IPCC) Special Report on Oceans and Cryosphere (IPCC 2019). The Revised Guidance for Treatment of Climate Change in NMFS' ESA Decisions (NMFS 2016) requires us to use climate indicator values projected under the IPCC Representative Concentration Pathway (RCP) 8.5 when data are available. RCP8.5 reflects a continued increase of greenhouse gas emissions and assumes that few mitigation measures will be implemented.

The IPCC (2019) reports the following consequences of climate change on sea turtles with high confidence, which is an evaluation of the underlying evidence and agreement in the conclusion. Loss of sandy beaches, due to sea level rise and storm events, reduces available nesting habitat (Fish *et al*. 2005; Fuentes *et al*. 2010; Reece *et al*. 2013; Katselidis *et al*. 2014; Patino-Martinez *et al*. 2014; Pike *et al*. 2015; Marshall *et al*. 2017). Storms, waves, and sea level rise are likely to increase erosion and sediment loss. Changes in beach morphology, dune scarping, vegetation loss, and reduction in beach area are likely to reduce the availability of sea turtle nesting sites, and the potential for landward migration of the beach profile is limited due to human development. Temperature directly affects important sea turtle life history traits, including: hatchling size, sex, viability, and performance (Hays *et al*. 2003; Pike 2014; Dudley *et al*. 2016; Santos *et al*. 2017). One of the greatest concerns is the effect of temperature on hatchling sex ratio because sex is determined by incubation temperature (Santidrián Tomillo *et al*. 2014; Patrício *et al*. 2017). Changes in ocean temperature indirectly impact sea turtles by altering the abundance and distribution of their prey (Polovina 2005; Polovina *et al*. 2011; Doney *et al*. 2012; Sydeman *et al*. 2015; Briscoe *et al*. 2017; Woodworth-Jefcoats *et al*. 2017). Additionally, sea turtles require habitat associated with bathymetric features that aggregate their prey, and the persistence and location of these features are linked to variations in climate (Bjorndal *et al*. 2017; Santora *et al*. 2017). The IPCC (2019) states with high confidence that climate change is likely to alter foraging success, juvenile recruitment, breeding phenology, growth rates, and population stability.

The melting of glaciers and ice sheets is the primary driver of sea level rise, which has accelerated in recent years (very high confidence; IPCC 2019). By 2100 (relative to 2005), global mean seal level is projected to rise 0.84 m with a likely range of 0.61 to 1.1 m, where likely refers to 66 to 100 percent probability (IPCC 2019). A recent study indicates that the rate of ice loss from the Greenland Ice Sheet has accelerated since the 1990s, supporting our application of the RCP8.5 predictions of sea level rise (Shepherd *et al*. 2019). Sea level rise is a threat to the DPSs due to the loss of available nesting habitat, reducing productivity and eventually abundance.

In addition to sea level rise, climate change is likely to result in an increase in wave heights and storm events (IPCC 2019). Extreme sea level events are associated with tropical cyclones, which have increased in intensity (high confidence; IPCC 2019). These cyclones result in coastal storm surges, high water events, and coastal floods. These sea level extreme events are very likely (90 to 100 percent probability) to increase significantly over the 21st century (IPCC 2019). Increases in cyclones and extreme waves, combined with sea level rise, are likely to exacerbate extreme sea level events (high confidence; IPCC 2019). Immediate impacts to loggerheads include nest loss and reduced productivity; long-term effects include the loss of nesting habitat and reduced abundance.

Global mean surface temperature change (relative to the pre-industrial era, 1850 to 1900) is projected to increase by a mean temperature of 4.3°C (likely range, 3.2 to 5.4 °C) under RCP8.5 (IPCC 2019). Rising sand temperatures elevate the incubation temperature of nests, reducing hatching success rates (Howard *et al.* 2014) and creating female-biased sex ratios (Matsuzawa 2006; Hawkes *et al.* 2007). Female-biased hatchling ratios may be mitigated to an extent as survival rates and male production are both higher at cooler temperatures, and because males have been shown to remigrate more frequently to breed than females, (Hays *et al.* 2017). Any mitigating effect would be eliminated at very high temperatures, for instance 35°C, at which almost no male hatchlings would be produced (Hays *et al.* 2017). Lolavar and Wyneken (2020) demonstrated that moisture content does not alter pivotal temperatures, though high moisture content creates a narrower transitional range of temperature. Therefore, it is unclear if high moisture levels alleviate the effect of increasing sand temperatures on sex ratios.

Increasing mean sea surface temperature (SST) has negative implications for loggerhead foraging and nesting behavior. In the Pacific, Chaloupka *et al*. (2008) found an inverse correlation between nesting abundance and mean annual SST in the core foraging area the year prior to nesting. Mazaris *et al*. (2009) found similar results in the Mediterranean: warmer foraging ground SST caused earlier onset of nesting within the same year, and over the long term (2 year prior), increased SST led to decreased nesting. As cooler foraging habitat SST is associated with increased prey abundance and breeding capacity, increasing temperatures could cause a negative change in prey abundance and affect the magnitude and timing of loggerhead nesting (Chaloupka *et al.* 2008). Therefore, increasing SST is a major risk factor that could lead to a long-term decrease in prey availability and reduced nesting and recruitment for loggerheads unless they are able to adapt by shifting their foraging habitat to cooler regions (Chaloupka *et al*. 2008).

It is very likely that the ocean has taken up 20 to 30 percent of total anthropogenic carbon dioxide emissions since the 1980s, leading to ocean acidification rates of 0.017 to 0.027 per decade since the late 1980s (IPCC 2019). It is virtually certain that continued carbon uptake through 2100 will exacerbate ocean acidification (IPCC 2019). Loggerhead turtles are foraging generalists, meaning that they forage on a wide variety of prey. However, their prey often include shell-forming (i.e., calcifying) organisms, which requires the synthesis of calcium carbonate from the calcium and carbonate ions found in seawater. In a more acidic environment, a greater amount of hydrogen ions compete for the available carbonate ions. Thus, ocean acidification may reduce the abundance of calcifying organisms; however, some organisms (e.g., corals, echinoderms, and molluscs) appear to be more vulnerable to these changes than others (e.g., crustaceans; Wittmann and Pörtner 2013).

In sum, climate change is a major threat to loggerheads globally. The erosion of nesting habitat, inundation of nests, and reduction of hatching success due to increased incubation temperature will reduce productivity in the short-term and abundance in the long-term. Changes to ocean temperatures and circulation will change migratory paths, reduce prey availability, and alter the location and predictability of prey accumulation. Ocean acidification and oxygen depletion will further stress prey populations and reduce availability. These changes are likely to reduce productivity by lengthening time to maturity and remigration intervals. In the next sections, we evaluate the extent to which the effects described above threaten specific loggerhead DPSs.

2.3.2 North Indian Ocean DPS

2.3.2.1 DPS Introduction

The North Indian Ocean DPS of the loggerhead turtle was listed as an endangered species on September 22, 2011 (76 FR 58868). The 2009 Status Review concluded that the DPS was at risk of extinction at the time of publication despite its large abundance (between 10,000 and 13,520 nesting females per year at Masirah Island at the time of the Status Review). This determination was based on evidence of substantial nesting population declines since the late 1970s, cumulative mortality from various sources across all life stages, and a lack of monitoring, implementation of effective conservation measures, and enforcement capabilities.

As described in the listing, turtles of the DPS originate from the North Indian Ocean north of the equator and south of 30° N. Lat. (76 FR 58868). This DPS nests in Oman and Yemen and forages in the Gulf of Aden, the Gulf of Oman, the Arabian Gulf, and the Gulf of Kutch (Rees *et al.* 2010). New studies show that juveniles of this DPS may cross the equator (see section 2.3.2.4).

2.3.2.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Data suggest that Masirah Island in the Sultanate of Oman hosts over 90% of the nests for this DPS, with diffuse nesting occurring in other parts of Oman and Socotra Island, Yemen (Casale 2015b). Track-count surveys on Masirah Island from 1977-1979 and 1991 estimated an abundance of between 20,000 and 40,000 nesting females each year, though this estimate was based on a clutch frequency of four nests per female annually (Perran Ross unpublished reports, as cited in Tucker *et al.* 2018). The use of satellite telemetry data from 2010-2012 found that females of this population have a mean clutch frequency of approximately 5.4 nests, which is 36% higher than the assumed reproductive values used previously, for a -27% correction to historical population estimates (Tucker *et al.* 2018). Nest counts at Masirah Island between 2010-2014 averaged 64,561 nests per year (Witherington *et al*. in press, as cited in Casale 2015b). Approximately 5,000 nests per year have been estimated in other nesting sites of Oman (Salm 1991) and about 50-100 females nest annually in Socotra Island, Yemen (Pilcher and Saad 2000). Using these data, Casale (2015b) estimated a total of 70,000 nests laid annually for the DPS. Based on this estimate, a remigration interval of 2.8 years, and a clutch frequency of 5.4 nests per female (Tucker *et al.* 2018), Casale (2015b) reported an adult female abundance of over 35,000 females, of which about 13,000 nest each year. Most recent nest counts at Masirah Island between 2008 and 2016 averaged 55,202 nests per year, and it is estimated that between 10,223 and 11,500 females nest each year (Willson *et al.* 2020).

Between the periods 1985-1996 and 2008-2016, documented nest counts on Masirah Island experienced a statistically significant decline of 79% (Willson *et al.* 2020). This decline is considered rapid as it occurred within the timeframe of a single loggerhead generation (Willson *et al.* 2020). As little to no management has been put in place to reduce the existing threats to this subpopulation, Casale (2015b) projects that the subpopulation would decline 92% by the year 2043 (less than one generation), supporting its IUCN status of critically endangered.

2.3.2.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

Loggerheads in the Masirah Island rookery show very low mtDNA diversity, among the lowest ever surveyed compared to other similarly sized rookeries, though nuclear DNA (nDNA) diversity at four microsatellite loci was shown to be high (Reece *et al.* 2016). These results suggest geographic isolation of maternally-inherited mtDNA through natal homing, as well as substantial male-mediated gene flow between other rookeries in Oman and Yemen (Reece *et al.* 2016).

Reece *et al*. (2016) conclude that this male-mediated gene flow allows for an overall genetically diverse rookery; no other rookeries in Oman or Yemen have been characterized for genetic diversity.

2.3.2.4 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):

Masirah Island hosts over 90% of nests for the DPS on 83 km of beach, though limited nesting has been observed on at least 178 other beaches in Oman and Yemen (Casale 2015b; Willson *et al.* 2020). Nesting areas for the DPS outside of Masirah Island are scattered and host very limited nesting. We find that the highly concentrated nesting on Masirah Island increases the DPS's risk of extinction due to environmental perturbations or catastrophic events.

Distribution in marine foraging and migratory habitat is quite large, occurring from the Gulf of Aden to the Arabian Gulf and exceeding 20,000 km^2 (Casale 2015b). In the inter-nesting period, females nesting at Masirah Island display behavioral polymorphism, either remaining in shallow waters close to the nesting area, or traveling back and forth hundreds of kilometers between these coastal waters and oceanic waters northeast of Masirah Island (Rees *et al.* 2010; Tiwari *et al.* 2018). After completing their nesting period, females at Masirah Island showed long-term use of an oceanic migratory corridor between Socotra Island, Yemen, and the mainland (Rees *et al.* 2010; Tiwari *et al.* 2018). Less is known about the spatial behavior of males of this DPS.

New satellite-tracking data provide evidence that juveniles may use waters of the southern Indian Ocean for foraging and development. A portion of juvenile loggerheads bycaught off the coast of Reunion Island were shown to migrate to coastal waters of Yemen and Oman (Dalleau *et al.* 2014). As the size of turtles indicated that they were close to sexual maturity, these juveniles were likely returning to their natal waters, leading the authors to conclude that juveniles originating in the North Indian Ocean may conduct trans-equatorial movement. Dalleau *et al.* (2014) suggest that hatchlings from Oman may drift eastward with the South-Equatorial Counter Current (SECC) and join the South-Equatorial Current (SEC) to drift westward toward the Mascarene archipelago, though further study is needed to confirm this

2.3.2.5 Five-factor analysis (threats, conservation measures, and regulatory mechanisms):

<u>Present or threatened destruction, modification or curtailment of its habitat or range</u>: Rapid coastal development, light pollution, entanglement of discarded fishing nets on the beach, and vehicle use on nesting beaches threaten loggerhead nesting habitat in Oman (Hamann *et al.* 2013; Reece *et al.* 2016; Willson *et al.* 2020). Introduced goats contribute to defoliation of dunes and loss of dune structure, which in turn increases exposure to urban lighting, disorienting nesting

adults and hatchlings (Reece *et al.* 2016). Though the effects of these threats have not been quantified for this DPS, it is likely that they negatively impact reproductive success and productivity of the DPS by directly damaging nests and reducing hatching success.

Though not quantified or explicitly reported in recent literature, other habitat-related threats facing loggerheads globally also have the potential to affect this DPS to an unknown degree, including the following: marine debris ingestion and entanglement, bioaccumulation of contaminants, increased pedestrian traffic and use of nesting beaches, and erosion of nesting beaches. Impacts of these threats are summarized in section 2.3.1.3.

<u>Overutilization for commercial, recreational, scientific, or educational purposes:</u> Egg harvest in Oman is described as a low-level threat to this DPS by Hamann *et al*. (2013) based on anecdotal data. There are recent reports of unquantified but increasing poaching of eggs for the purpose of feeding camels (E. Possardt, USFWS, personal communication 2020). Egg harvest reduces the DPS's productivity by reducing the amount of offspring that are able to recruit to the next generation.

<u>Disease or predation:</u> Egg predation is listed as a main threat to the nesting population of Oman by Hamann *et al.* (2013). The threat is described anecdotally, and we did not find other literature quantifying predation or identifying main predators, though the 2009 Status Review states that hatchlings are likely preyed upon by Arabian red fox (*Vulpes vulpes arabica*), ghost crabs (*Ocypode saratan*), night herons (*Nycticorax nycticorax*), and gulls (*Larus spp*.). Overall, predation threatens the DPS, though studies of nest and hatchling success are urgently needed to determine the magnitude of the threat to the DPS (E. Possardt, USFWS, personal communication 2020). We found no new information regarding the threat of disease and conclude that disease does not appear to threaten the DPS.

<u>Inadequacy of existing regulatory mechanisms</u>: An overview of regulatory mechanisms that apply to loggerhead sea turtles globally is provided in section 2.3.1.3. The following mechanism occur within the range of the North Indian Ocean DPS.

Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA)
IOSEA puts in place a framework for states, territories, and stakeholders of the Indian Ocean and South-East Asian region to work together towards the conservation of marine turtle populations and their habitats. This objective is achieved through collective implementation of the associated Conservation and Management Plan, which focuses on reducing threats, conserving habitat, exchanging scientific information, increasing public awareness, and promoting regional cooperation. This agreement is conducted under the auspices of the Convention on the Conservation of Migratory Species of Wild Animals (CMS)

and is a non-binding agreement. There are currently 35 signatories to IOSEA, including Oman and Yemen.

Nairobi Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region
The Nairobi Convention was signed in 1985 and came into force in 1996. The Convention covers 10 States, including five island States in the Western Indian Ocean. The Contracting Parties are Comoros, France (La Reunion), Kenya, Madagascar, Mauritius, Mozambique, Seychelles, Somalia, Tanzania and the Republic of South Africa. This instrument "provides a mechanism for regional cooperation, coordination and collaborative actions, and enables the Contracting Parties to harness resources and expertise from a wide range of stakeholders and interest groups towards solving interlinked problems of the coastal and marine environment." Additional information is available at http://www.unep.org/NairobiConvention.

Loggerheads are protected under Oman Royal Decree No. 6/2003 (The Law of Nature Conservation and Wildlife) which prohibits killing, hunting, or smuggling listed wildlife and their genetic material. Though Oman has established nature reserves for nesting green turtles (Ras al Jinz Turtle Reserve) and hawksbill turtles (Daymaniyat Island Reserve), no such protections currently exist for loggerheads nesting on Masirah Island. Loggerhead and other sea turtle nesting beaches are included in a proposed Protected Area for Masirah Island, which has nearly completed the inter-Ministerial approval and review process and is awaiting official designation by Royal Decree (E. Possardt, USFWS, personal communication 2020).

There is little to no protection against impacts of bycatch in migratory, foraging, and inter-nesting habitats, and coastal development and egg collection and predation are managed only at some sites (Hamann *et al.* 2013). Cumulative mortality resulting from these activities has caused the DPS's nesting population to rapidly decline, and as they continue to carry on largely unabated, we expect the DPS's abundance and productivity to decline further. For this reason, we find that existing regulatory mechanisms are insufficient for the conservation of this DPS.

<u>Other natural or manmade factors affecting its continued existence</u>:
Bycatch
Loggerhead bycatch in a number of fisheries is the primary threat to this DPS. In 2013 the Environment Society of Oman (ESO) initiated the Sea Turtle Conservation and Sustainable Fishing Project on Masirah Island, funded through the U.S. Fish and Wildlife Service Marine Turtle Conservation Fund (http://www.eso.org.om/index/list3.php?categoryId=804). This study resulted in an estimate of up to 9,742 turtles bycaught each year by the skiff fleet, 98% of which are bycaught in nets and 35% of which are bycaught specifically in driftnets. The bycatch mortality rate is estimated to be 4,918 turtles per year for

skiffs (inshore fleets) and 238 turtles per year for the dhow fishery (larger offshore fleets). Annual mortality of loggerheads is estimated to be 2,000, which corresponds to 20% of the nesting female population. Though this study is based on interviews and introduces some uncertainty, the removal of such a large proportion of this DPS each year indicates that bycatch in Oman poses a major threat to this DPS. As this bycatch takes place off of the primary nesting location for the DPS, it likely removes reproductively mature males and females from the population and undoubtedly has contributed to the decline in loggerhead nesting at Masirah Island.

Other fisheries in the North Indian Ocean also threaten the DPS. In Somalian waters, Hamann *et al.* (2013) cite the lack of fishery protection vessels and lack of monitoring due to political instability and pirate attacks as reasons for the high-level threat posed by bycatch in longline fisheries and nets there. Eritrean shrimp and fish trawls pose a lower threat to the DPS: between 1994-2004, 3,342 sea turtles were bycaught, only 30 of which were loggerheads (Teclemariam *et al.* 2007). Historically, demersal and mid-water trawling off Oman was responsible for loggerhead bycatch, though demersal trawling in Oman's waters became illegal in 2011 through Ministerial Decision No 20/2009 (Willson *et al.* 2020). The shrimp trawl fishery in the waters of Bahrain is also responsible for low levels of loggerhead bycatch (Abdulqader and Miller 2012). The Reunion Island longline fishing fleet likely poses a low to moderate threat to juveniles in this area as gears are set deeper than 40 m, reducing interactions with loggerheads (Dalleau *et al.* 2014). Despite this, mortality of juveniles due to bycatch off Reunion could be reducing recruitment into the adult nesting population (Willson *et al.* 2020).

Climate change

Climate change and sea level rise have the potential to affect this DPS as described in section 2.3.1.3. Analysis of GIS data reveals that Oman is highly vulnerable to sea level rise, with low-lying coastal areas such as those in the Al-Sharquiya region (including Masirah Island) expected to have some of the greatest amount of inundated land areas (Al-Buloshi *et al.* 2014). Inundation of low-lying nesting beaches reduces the amount of suitable nesting area, reducing reproductive success and productivity of the population. The impact of sea level rise on the DPS is especially concerning as an estimated 90% of its nesting takes place on Masirah Island. With a very small proportion of the DPS located in other geographic areas, the vast majority of the population remains vulnerable to sea level rise, reducing the DPS's resilience to nest inundation.

Increased storm activity associated with climate change (see section 2.3.1.3) also impacts loggerheads in the North Indian Ocean. The Environment Society of Oman reports that storm surge and flooding from the Ashoba Cyclone in 2015 destroyed significant numbers of nests laid before the cyclone occurred, and resulted in reduced available nesting habitat (http://www.eso.org.om/index/list3.php?categoryId=337). Other strong cyclones to hit Oman in recent years include Gonu, the strongest tropical cyclone on record in the Arabian Sea in 2007 (Fritz *et al.* 2010), and Phet in 2010, both of which caused significant damage and exposed the coastline's vulnerability to storm surge and flooding (Al-Buloshi *et al.* 2014). Assessments of the impacts of the cyclones in 2010 and 2015 revealed that flooding and erosion resulting from the cyclones accounted for damage to 17% of the nesting season's clutches (Environment Society of Oman unpublished observations, 2015, as cited by Willson *et al.* 2020). As the timing of recent cyclone events coincides with the nesting season for the Masirah rookery (Environment Society of Oman unpublished observations, 2015, as cited by Willson *et al.* 2020), increased storm activity presents a major threat to the productivity of the DPS.

In all, we conclude that the combination of sea level rise and more intense storm events pose a high level threat to the DPS, especially with 90% of nesting concentrated on Masirah Island.

2.3.2.6 Synthesis:

The North Indian Ocean DPS of the loggerhead turtle was listed as an endangered species on September 22, 2011 (76 FR 58868). We conducted this 5-year review to evaluate the best available information and to determine whether to recommend a change in the status of the DPS.

The best available abundance data are gathered at nesting beaches. The most recent surveys and analyses (2008-2016) show that the major rookery at Masirah Island has an annual nesting female abundance of between 10,223 and 11,500, and an average of 55,202 nests each year (Willson *et al.* 2020). Comparison of the periods 1985-1996 to 2008-2016, Masirah Island has experienced a statistically significant rapid decline of 79% (Willson *et al.* 2020). Loggerheads of Masirah Island have high nDNA diversity due to male-mediated gene flow (Reece *et al.* 2016). Their nesting distribution is narrow, with 90% of nesting occurring on Masirah Island. This increases the DPS's risk of extinction because a narrowly distributed DPS is more likely to go extinct due to environmental perturbations or catastrophic events than one that is widely distributed. Though this DPS has relatively high abundance and adequate genetic diversity, it has dramatically declined in recent decades and is expected to continue declining in the face of numerous severe threats across all life stages.

The main imminent threat to this DPS is fisheries bycatch. Additional threats include climate change, coastal development, predation, and egg harvest, though not all of these are well quantified. Adequate protections for the DPS have not been established, and therefore the DPS continues to decline.

Fisheries bycatch poses the greatest threat to the DPS and little to no management measures have been implemented to reduce this threat. Skiff and dhow net fisheries in Oman are responsible for high levels of loggerhead bycatch, with mortality estimated at the equivalent of 20% of the nesting female population annually (http://www.eso.org.om/index/list3.php?categoryId=804). IUU fisheries in Somalian waters, while unquantified, are likely to pose a high threat to the DPS due to lack of monitoring. Trawls and longline fisheries in the North Indian Ocean pose more minor threats. Annual mortality across the DPS as a result of bycatch is likely in the thousands. Fisheries bycatch reduces both abundance and productivity of the DPS by removing those individuals (i.e., adults and large juveniles) that survived decades of development and have the greatest potential to contribute to future generations. Bycatch mortality in net fisheries off the high density nesting beaches of Masirah Island removes individuals (likely reproductive males and nesting females) at such high levels that these fisheries severely reduce the reproductive capacity of the DPS, undoubtedly contributing to the dramatic declines in nesting observed over the last few decades.

Climate change also threatens the DPS. Sea level rise is likely to reduce availability and increase erosion rates of nesting beaches, particularly on low-lying areas of Al-Sharquiya, including Masirah Island (Al-Buloshi *et al.* 2014). Increased storm frequency and intensity are likely to result in altered nesting beaches and decreased nest hatching success. Tropical cyclones in recent years have resulted in substantial nest loss and decreased suitable nesting area on Masirah Island. Increasing air and sea surface temperatures are strongly correlated to elevated sand temperatures, which can lead to skewed hatchling sex ratios and embryonic mortality. Temperature changes and sea level rise are likely to change ocean currents and the movements of hatchlings, juveniles, and adults. Ocean acidification is likely to affect their forage-base. For this DPS, climate change (particularly sea level rise and increased storm activity) is a major threat compounded by the fact that 90% of nesting occurs on Masirah Island.

Coastal development, predation, and harvest of eggs, though not well quantified, likely reduce productivity of the DPS. Increased development of coastlines affects both nesting and hatching success through artificial light pollution as well as direct damage to nests from vehicles, and the threat is likely to be high. Predation on nesting beaches is also an unknown and possibly significant threat that reduces hatchling production and recruitment to oceanic and neritic life stages. Egg harvest also reduces hatchling production, and poses an unquantified threat to the DPS.

Synthesizing the best available data, we conclude that the status of the DPS has not changed since it was listed as endangered in 2011. The 2009 Status Review concluded that the DPS was at risk of extinction at the time of publication despite its relatively large abundance (between 10,000 and 13,520 nesting females per year at Masirah Island). This determination was based on substantial declines in the nesting population since the late 1970s, cumulative mortality from various sources across all life stages, and a lack of monitoring, implementation of effective conservation measures, and enforcement capabilities. Since the Status Review, the nesting population has experienced further decline. Numerous threats (fisheries bycatch, climate change, habitat loss and modification, overutilization, and predation) continue to endanger the DPS, which is estimated to have declined 79% over a recent 20-year period (between 1985-1996 and 2008-2016). The severity of these threats, the dramatic continued nesting declines, and the highly concentrated nesting distribution put this DPS at risk of extinction now, rather than the foreseeable future. We conclude that the status of the species should remain endangered.

2.3.3 Southwest Indian Ocean DPS

2.3.3.1 DPS Introduction:

The Southwest Indian Ocean DPS of the loggerhead turtle was listed as a threatened species on September 22, 2011 (76 FR 58868). The 2009 Status Review concluded that the DPS was not at immediate risk of extinction, though the extinction risk would likely increase in the foreseeable future. This was based on the determination that although abundance had been increasing over a 37-year time scale, the DPS remained small (in South Africa, between 1,100 and 1,500 nests annually from 2000-2008; between 500-2,000 total females) and would continue to be threatened by high, and potentially increasing, mortality from fisheries bycatch with minimal monitoring or management.

As described in the listing, turtles of the DPS originate from the Southwest Indian Ocean south of the equator, north of 60° S. Lat., west of 80° E. Long., and east of 20° E. Long (76 FR 58868). Loggerheads of this DPS nest on beaches of southeastern Africa, including South Africa, Mozambique, and southern Madagascar (Nel and Casale 2015). Marine habitats include waters of the Agulhas Current, the southern extent of the Somali Current, and potentially the south-east Atlantic Ocean (Nel and Casale 2015). The range of this DPS is known to extend to Tanzania, Kenya, and southern Somalia based on flipper tag returns (de Wet 2012).

2.3.3.2 Abundance, population trends, demographic features, or demographic trends:

South Africa hosts approximately 80% of nesting sites for this DPS, and Mozambique hosts the remaining 20%; very minor nesting can also be found in Madagascar (Nel and Casale 2015). The KwaZulu-Natal region of South Africa hosts one of the longest-running sea turtle conservation and monitoring programs in the world. A series of protected areas established in 1963 restrict human access to nesting and non-nesting sea turtles and coastal habitat (Nel *et al.* 2013). Subsistence harvest of nesting loggerheads ceased with the onset of these conservation measures, leading to a significant increase in number of loggerhead nests (Nel *et al.* 2013). In the 12.8 km index area, nest counts grew from 250 in the 1965-1966 season to >1,700 in the 2009-2010 season (Nel *et al.* 2013). In the 2013-2014 and 2014-2015 seasons, nest counts were 3,828 and 3,890 respectively (Nel 2016). Using an average number of 3.7 clutches per female (Nel *et al.* 2013), the number of annual nesting females is estimated at 635-1,035 and 658-1,051 for the two seasons (Nel 2016).

In Mozambique, the 2016-2017 nesting season included an expanded monitoring effort in which 288 km of beach (10.4% of coastline) were patrolled, compared to 127 km (4.6% of coastline) in previous seasons. A total of 1,971 tracks and 931 nests were recorded during this season (Fernandes *et al.* 2017). During the 2017-

2018 season, 1,935 tracks and 823 nests were recorded (Fernandes *et al.* 2018). The effective population estimate for nesting females at Ponta do Ouro do Santa Maria (90 km of coastline) is estimated to be between 276 and 428 based on genetic analysis (IOSEA 2019a).

In Madagascar, though nesting numbers have been low historically, nesting has declined as a result of consumption of eggs and nesting females. Larger numbers of loggerhead nests were found in the south-east during the 1970s, though only 23 nests were observed in the 2001-2002 season. A minimum of 11 loggerhead nests throughout Madagascar were estimated in 2017 (Humber *et al.* 2017).

Using nest counts from South Africa and Mozambique as well as average number of clutches per female (3.7) and average remigration interval (years between consecutive nesting seasons; 3.0) (Nel *et al.* 2013), the total number of adult females is estimated at 3,730 and average number of nesting females each year is 1,240 for this DPS (Nel and Casale 2015). Recent trends reported in the 2015 IUCN Red List Assessment for this subpopulation show positive trends for both nesting locations: 2.9% annually in South Africa (1965 through 2013) and 8.7% annually in Mozambique (1994 through 2013) (Nel and Casale 2015). Recent increases in monitoring effort in Mozambique, differing time scales, and incomplete data reduce our confidence in this trend. Overall, we conclude that though the abundance of the DPS is increasing, abundance remains small.

South African females reach sexual maturity at an average age of 36.2 years and size of 83.7 cm SCL (Tucek *et al.* 2014).

2.3.3.3 Genetics, genetic variation, or trends in genetic variation:

The South African rookery shows very low haplotype diversity and is fixed for haplotype CC-A2.1 (Shamblin *et al.* 2014).

2.3.3.4 Spatial distribution, trends in spatial distribution, or historic range:

The DPS nests over a relatively small geographic area of about 300 km of coastline (Nel and Casale 2015). Due to extremely limited nesting on Madagascar, Nel and Casale (2015) only consider the DPS to have two "locations" (defined as geographically or ecologically distinct areas in which a single threatening event can rapidly affect all individuals), South Africa and Mozambique, leaving it vulnerable to extinction due to environmental perturbations or catastrophic events. As the DPS's marine distribution includes the entire Agulhas Current, the southern extent of the Somali Current (Indian Ocean) and possibly the South East Atlantic Ocean, it is considered quite large (exceeding 20,000 km^2) (Nel and Casale 2015).

Satellite tracking reveals that loggerheads nesting at iSimangaliso Wetland Park World Heritage Site remain an average of 9 km from the shoreline during their internesting period (Harris *et al.* 2015). As they remain so close to shore during this time, the contiguous Maputaland and St. Lucia Marine Reserves afford protection to 95% of loggerhead sea-use during internesting (Harris *et al.* 2015). After the nesting season, loggerheads complete long-distance migrations to foraging areas (Robinson *et al.* 2018). Three distinct migration corridors were used by 20 loggerhead turtles tagged in iSimangaliso: (1) following the coast northwards into Southern Mozambique; (2) moving northeast across the Mozambique Channel to northern Madagascar; and (3) southwards in the Agulhas Current to the Agulhas Banks (Harris *et al.* 2018). The most commonly used (>80%) was the corridor to Mozambique (Harris *et al.* 2018). Other foraging habitats are thought to be used by the DPS based on recaptures of tagged loggerheads farther north along the coasts of Tanzania, Kenya and Somalia (de Wet 2012).

2.3.3.5 Five-factor analysis:

Present or threatened destruction, modification or curtailment of its habitat or range:

Terrestrial

Urban, agricultural, and tourism-driven habitat degradation pose a low-level threat to the population in South Africa (Hamann *et al.* 2013). Two-thirds of the nesting for this DPS takes place within well-managed protected areas, therefore threats from terrestrial habitat degradation are controlled and insignificant (Nel and Casale 2015). Additionally, dune structure is largely intact and acts to protect nesting beaches from effects of climate change-induced sea level rise and resulting nest inundation (Nel and Casale 2015).

Marine

Despite strong protections for terrestrial habitat in the Southwest Indian Ocean, marine habitat for this DPS faces present and threatened destruction and modification through both marine debris and oil and gas extraction. In a 2014 study of by-caught loggerheads in the Southwest Indian Ocean, 51.4% of specimens (n=74) had ingested marine debris (Hoarau *et al.* 2014). A study of post-hatchling turtles stranded along the South African coast shows that the incidence of plastic ingestion in 2015 (60%) was significantly higher than in the late 1960s and early 1970s (12%) (Ryan *et al.* 2016). Plastic was found to kill 11 of the 40 stranded post-hatchlings by blocking digestive tracts or bladders, and contributed to the deaths of five other turtles (Ryan *et al.* 2016). More research is needed to assess the sub-lethal effects of plastic ingestion on sea turtles, though it is likely that long-term demographic consequences such as declining growth rates and fecundity put this population at risk, especially when confronting multiple other threats (Hoarau *et al.* 2014).

Oil and gas extraction occurs in the EEZs of countries of southern Africa and there is overlap between areas used by the industry and known migratory routes of loggerheads (Harris *et al.* 2018). Due to the risk of oil spills, leaks, noise and light pollution, seismic surveys, and potential for increased boat strikes, oil and gas extraction poses a moderate threat to loggerheads of this DPS (Harris *et al.* 2018). An oil spill along the coasts of southern Mozambique and northeast South Africa could be catastrophic to this DPS as the region is used by over 80% of these loggerheads for critical behaviors such as nesting and migrating (Harris *et al.* 2018). Bioaccumulation of pollutants from anthropogenic sources is already known to occur in this DPS. Pollutants such as copper and strontium were found in loggerhead eggshells to exceed toxic levels of concern, and other metal and metalloid contaminants were found to be greater in loggerhead eggs than in leatherback eggs likely due to differing life histories (Du Preez *et al.* 2018). Effects on hatching success have not been recently quantified, and it is not clear how this threat impacts the overall productivity of the DPS.

Overutilization for commercial, recreational, scientific, or educational purposes: Harvest of loggerhead eggs occurs at high levels on the western coast of Madagascar and on minor nesting beaches of central Mozambique, and occurs at low levels on the Ponto do Ouro cost of Mozambique and in South Africa (Hamann *et al.* 2013). Prolific direct take and opportunistic retention of bycaught marine turtles occurs in Madagascar mainly as part of the local domestic trade in meat, eggs, and plastron ligaments (Williams 2020). The marine turtle fishery in the Bay of Ranobe, Madagascar, catches and sells loggerheads and is expected to continue to do so due to the high market value of large marine turtles (Golding *et al.* 2017). The illegal harvest of adult turtles for sale and consumption has also been documented in Mozambique (Fernandes *et al.* 2017; Fernandes *et al.* 2018). Harvest directly reduces abundance, and also reduces productivity as eggs and nesting females (with high reproductive value) are removed from the population. Targeted removal of nesting females in a population with less than 1,500 nesting females per year is concerning, though as the amount of loggerheads harvested each year is unclear, we conclude that illegal harvest poses a moderate to high level threat.

Disease or predation: In a study of South African nest success in the 2009-2010 and 2010-2011 seasons, 8.6% of loggerhead nests were completely predated and recorded predators included ants, honey badgers, monitor lizards, mongooses, and domestic dogs (de Wet 2012). Partial predation occurred in 7.6% of nests and predators included ants and ghost crabs (de Wet 2012). Predation reduces the productivity of the DPS by decreasing hatching success. We did not find any new information on the threat of disease and it does not appear to pose a threat to the DPS.

Inadequacy of existing regulatory mechanisms: An overview of regulatory mechanisms that apply to loggerhead sea turtles globally is provided in section 2.3.1.3. The following mechanisms occur within the range of the Southwest Indian Ocean DPS.

Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA)
South Africa, Mozambique, Madagascar, Tanzania and Kenya are all signatories to IOSEA. Additional information on this instrument can be found in section 2.3.2.4.

Nairobi Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region
Additional information on this instrument can be found in section 2.3.2.4.

African Convention on the Conservation of Nature and Natural Resources (Algiers Convention)
Adopted in September 1968, the contracted states were "to undertake to adopt the measures necessary to ensure conservation, utilization and development of soil, water, floral and faunal resources in accordance with scientific principles and with due regard to the best interests of the people". It was followed by the 1972 Stockholm Conference on the Human Environment and led to the establishment of environmental ministries in African nations and the creation of the United Nations Environment Programme (UNEP) headquartered in Nairobi. The Algiers Convention recently has undergone revision (not yet in force) and its objectives are to enhance environmental protection, foster conservation and sustainable use of natural resources, and harmonize and coordinate policies in these fields with a view to achieving ecologically rational, economically sound, and socially acceptable development policies and programs. Additional information is available at https://au.int/en/treaties/african-convention-conservation-nature-and-natural-resources-revised-version.

The National Environmental Management Act (NEMA) (Act 107 of 1998)
NEMA is the overarching environmental legislation of South Africa and includes six Specific Environmental Management Acts, including the Biodiversity Act (Act 10 of 2004) and the Protected Areas Act (Act 57 of 2003). The Biodiversity Act (NEM:BA) ensures the management and protection of species and ecosystems. All sea turtles are protected under the Threatened or Protected Marine Species Regulations under NEM:BA with specific protections granted to turtles, including prohibiting harassment and harvest, and requiring permits to undertake any activity involving turtles (including research). The Protected Areas Act (NEM:PAA) provides for the protection and conservation of ecologically viable areas representative of biological diversity (IOSEA 2019b).

Marine Living Resources Act (Act 18 of 1998)
The Marine Living Resources Act is aimed at regulating the long-term sustainable use of marine living resources in South Africa. It address local and commercial fisheries, and bans the use of driftnets. Additional information is available at http://extwprlegs1.fao.org/docs/pdf/saf15984.pdf.

According to Mozambique's 2019 National Report to IOSEA (IOSEA 2019a), the following legislative instruments address sea turtle conservation: Law of the Environment (Law 20/97), Regulation on the Environmental Impact Assessment Process (Decree 45/2004), Law of Tourism (Law 4/2004), Regulation on Maritime Fisheries (Decree 16/96), Land Law (Law 19/97 and its Regulations - Decree 66/98), Regulation of the Forest and Wildlife Law (Decree 12/2002), Sporting and Recreational Fishing Regulations (Decree 51/99), General

Regulation on Maritime Fisheries (Decree 43/2003), Regulation for the Prevention of Pollution and Protection of the Marine and Coastal Environment (Decree 45/2006).

The iSimangaliso Wetland Park is protected as a UNESCO World Heritage Site, and South Africa's World Heritage Convention Act (1999) affords this site the necessary legal protections (https://whc.unesco.org/en/list/914/). Protected areas in Mozambique include Quirimbas National Park, Bazaruto Archipelago National Park, Cabo São Sebastião Total Protection Zone, Romene National Reserve, and Ponta do Ouro Partial Marine Reserve (Fernandes *et al.* 2018). Protected areas effectively manage main nesting sites of the DPS from egg predation and collection as well as coastal development (Hamann *et al.* 2013). Bycatch in some inter-nesting and foraging habitat is managed, though there is little to no management of bycatch in migration zones (Hamann *et al.* 2013). In an analysis of protections afforded to loggerheads of this DPS, Nel *et al.* (2013) conclude that coastal marine protected areas can be effective in protecting high densities of turtles and sensitive life stages, though they are insufficient for the long term health of the population. It is possible that decreased fishing effort in the prawn trawl fishery contributed to the recovery of the Southwest Indian Ocean DPS as even with protections in nesting areas, abundance did not peak until pressure from this fishery decreased (Nel *et al.* 2013). Therefore, population growth rates could be increased if offshore threats were reduced (Nel *et al.* 2013). Based on the best available information, we conclude that although nesting habitat for this DPS is well-managed through regulatory mechanisms, threats in the marine habitat (bycatch and marine pollution) are not adequately regulated.

<u>Other natural or manmade factors affecting its continued existence</u>:
Bycatch
Bycatch in longline fisheries, gillnets, and in bather protection nets pose the greatest quantified threat to loggerheads in South Africa (Hamann *et al.* 2013; Nel and Casale 2015). A recent study of loggerhead migratory corridors and fishing pressure found that coastal artisanal fisheries, including gillnet and beach seine fisheries, pose the greatest threat to these loggerheads, though the lack of data on artisanal fisheries prevents accurate quantification of this threat (Harris *et al.* 2018). Bycatch data for tuna and swordfish longline fisheries off South Africa from 1998 to 2005 showed that loggerheads were the most common turtle species caught, making up 60% of the by-caught turtles at a rate of 0.02 captures per 1,000 set hooks (Petersen *et al.* 2009). The shallow-water prawn trawl fishery is also responsible for loggerhead bycatch off KwaZulu-Natal, though estuarine degradation led to the decline in fishing effort over the last decades and loggerhead bycatch has dropped from an estimated 230 individuals per year in the early 1990s to 40 individuals per year in 2003-2006 (De Wet, NMMU, unpublished data as cited in Nel *et al.* 2013).

Bather protection nets, installed in South African waters in 1952 to protect humans from shark encounters, were responsible for catching an average of 40.9

loggerheads each year between 1981 and 2008 (Brazier *et al.* 2012). Loggerhead mortality associated with bather protection nets varied from 53.2% to 70.6% (Brazier *et al.* 2012) meaning that on average, between 20 and 28 loggerheads are killed in these nets each year. From 2002 to 2014, an average of 41.4 loggerheads were caught each year in bather protection nets, of which 26.4 were released on average (Nel 2016). As the loggerheads caught in bather protection nets are likely reproductively mature males and females returning to mate and nest, we conclude that these nets reduce both abundance and productivity of the DPS.

Climate change
Climate change and sea level rise have the potential to affect this DPS as described in section 2.3.1.3. An analysis of the KwaZulu-Natal coast's vulnerability to erosion and extreme weather events found that 50% of turtle nesting sites had very high vulnerability (Palmer *et al.* 2011). Climate change could have profound long term impacts on nesting populations in the Southwest Indian Ocean, but specific impacts to the DPS are not quantified in the available literature.

2.3.3.6 Synthesis:

The Southwest Indian Ocean DPS of the loggerhead turtle was listed as a threatened species on September 22, 2011 (76 FR 58868). We conducted this 5-year review to evaluate the best available information and to determine whether to recommend a change in the status of the DPS.

The best available abundance data are gathered at nesting beaches. The most recent surveys and analyses show that the DPS has an annual nesting female abundance of approximately 1,240 and a total adult females abundance of 3,730 (Nel and Casale 2015). Over 45 nesting seasons, index and monitored areas in South Africa saw an increase in number of nests due to implementation of conservation measures (Nel *et al.* 2013) increasing at a rate of about 2.9% annually between 1965 through 2013 (Nel and Casale 2015). Nesting beaches in Mozambique, making up about 20% of the DPS, have recently seen an increase in monitoring activity and do not have consistent historical abundance data. Therefore, we have moderate confidence in the trend. The population remains small. Small abundance contributes to the extinction risk of the DPS because small populations are more likely than large ones to be extirpated as a result of stochastic events and threats.

The main threat to this DPS is fisheries bycatch. Additional threats include climate change, marine pollution, and harvest for human consumption, though not all threats are well quantified. Two-thirds of nesting beaches are managed within protected areas, though adequate management for the DPS in the marine environment has not been put in place.

Fisheries bycatch in commercial and artisanal fleets, as well as bather protection nets, poses the greatest threat to the DPS. Coastal artisanal fisheries using a number of gear types are responsible for high levels of loggerhead bycatch, while commercial longline fisheries, commercial trawl fisheries, and bather protection nets pose more minor threats. Fisheries bycatch reduces abundance and productivity of the DPS by removing those individuals (i.e., adults and large juveniles) that survived decades of development and have the greatest potential to contribute to future generations.

Marine pollution threatens the DPS by reducing abundance and potentially productivity. High levels of plastic ingestion and bioaccumulation of contaminants in this DPS can cause mortality, and very likely sub-lethal effects that are not fully understood in loggerheads. Areas of oil exploration and extraction overlap with high-use migratory corridors of this DPS and the industry poses a moderate threat, though effects of an oil spill could be devastating.

Egg harvest occurs at high levels on the western coast of Madagascar and on minor nesting beaches of central Mozambique, while poaching of nesting females takes place in Mozambique and Madagascar. Opportunistic bycatch retention as well as prolific directed take of marine turtles in Madagascar continues. Targeted removal of nesting females in a population with less than 1,500 nesting females per year is concerning, though as the amount of turtles poached each year is unclear, we conclude that illegal harvest poses a moderate to high level threat.

Climate change also threatens the DPS, though specific effects on the DPS have not been quantified. Sea level rise is likely to reduce the availability and increase the erosion rates of nesting beaches. Increased storm frequency and intensity are likely to result in altered nesting beaches and decreased egg and hatchling success. Dune structure on nesting beaches is largely intact, therefore continuing to offer protection from nest inundation, though an analysis of the KwaZulu-Natal coast's vulnerability to erosion and extreme weather events found that 50% of turtle nesting sites had very high vulnerability (Palmer *et al.* 2011). Increasing air and sea surface temperatures are strongly correlated to elevated sand temperatures, which can lead to skewed hatchling sex ratios and embryonic mortality. Temperature changes and sea level rise are likely to change ocean currents and the movements of hatchlings, juveniles, and adults. Ocean acidification is likely to affect their forage-base. Overall, climate change is a major long-term threat that is likely to rival fisheries bycatch in magnitude in the near future.

Synthesizing the best available data, we conclude that the status of the DPS has not changed since it was listed as threatened in 2011. The 2009 Status Review concluded that the DPS was not at immediate risk of extinction, though the extinction risk would likely increase in the foreseeable future. This was based on the determination that although abundance had been increasing over a 37-year time scale, the DPS remained small (in South Africa, between 1,100 and 1,500 nests annually from 2000-2008; between 500-2,000 total females) and would continue to be threatened by high, and potentially increasing, mortality from fisheries bycatch with minimal monitoring or management. Though new data shows that nesting has continued to increase, the population remains small with less than 1,500 females nesting per year. The increasing nesting trend, while important and encouraging, is not of adequate magnitude to alter the threatened listing status of the DPS as intense (fisheries bycatch and climate change) and numerous (habitat loss and modification, overutilization) threats continue to impact this DPS, some of which are likely to increase in the future. We conclude that the status of the species should remain threatened.

2.3.4 Southeast Indo-Pacific Ocean DPS

2.3.4.1 DPS Introduction:

The Southeast Indo-Pacific Ocean DPS of the loggerhead turtle was listed as a threatened species on September 22, 2011 (76 FR 58868). The 2009 Status Review concluded that the DPS was at risk of extinction at the time of publication as the DPS was found to be likely to substantially decline in the future due to mortality of juveniles and adults from fisheries bycatch, the challenges of IUU fishing, continued expansion of artisanal fishing fleets, and the lack of monitoring, implementation of effective conservation measures, and enforcement capabilities. However, after receiving comments from the public on the proposed rule to list the Southeast Indo-Pacific Ocean DPS as an endangered species, NMFS determined that though the nesting population was small, the DPS was not at immediate risk of extinction, but was likely to become so in the foreseeable future throughout all of its range. This was based on consideration of recent protections for primary nesting areas on Dirk Hartog Island and the Muiron Islands, reduced predation, and reduced bycatch from the prawn trawl fishery.

As described in the listing, turtles of the DPS originate from the 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 141° E. Long. (76 FR 58868). Loggerheads of this DPS nest on the shores of western Australia from Steep Point in the south to the Muiron Islands in the north (Reinhold and Whiting 2014), and forage in the coastal waters of Australia from Shark Bay to the Torres Strait in the north, as well as Indonesia (Hamann *et al.* 2013).

2.3.4.2 Abundance, population trends, demographic features, or demographic trends:

Much remains unknown regarding the population demographics of the Western Australia nesting population (Tedeschi *et al.* 2015). The largest rookery is found on Dirk Hartog Island, located in the Shark Bay Marine Park and World Heritage Area, where previous surveys in the 1990s estimated the annual nesting population to be between 800-1,500 females (Baldwin *et al.* 2003). Further surveys with trained teams patrolling all beaches tagged 1,400 turtles in a two-week peak nesting period, indicating greater nesting numbers than previously estimated (Reinhold and Whiting 2014). Currently, Dirk Hartog Island is estimated to host approximately 1,000 to 3,000 nesting females annually (Hamann *et al.* 2013; Reinhold and Whiting 2014).

On the North West Cape, The Ningaloo Turtle Program has been regularly monitoring sea turtle nesting along the Ningaloo Coast since 2002. Clutches laid on Bungelup Beach in Ningaloo Marine Park have ranged from 700 to 1,200 from 2004 to 2008 (Trocini 2013). Based on surveys in the 2013-2014, 2014-2015, and 2015-2016 seasons, the Ningaloo region is estimated to host between 991 and 2,763 nesting females each year (Whiting 2016). Loggerhead nesting trend analysis in 2016 showed that although there is large annual variation in the number of estimated nests in the Ningaloo region, there has not been a significant long-term increase or decrease in nesting abundance (Coote *et al.* 2018).

Nocturnal observations of nesting in the 2015-2016 season revealed that diurnal nest counts had underestimated the Gnaraloo Bay nesting population; using a nest detection bias correction, Gnaraloo Bay is estimated to host 85 nesting females and 405 nests each year (Thomson *et al.* 2016). Surveys from the 2008-2009 nesting season through the 2017-2018 nesting season in Gnaraloo Bay estimate the presence of between 60-120 females and 200-450 nests each season as the remigration interval for females is yet unknown (Hattingh *et al.* 2018).

The beaches on the North and South Muiron Islands were surveyed for one week during the peak-nesting season in 2017-2018. The study suggests that the Muiron Islands may be as important as the mainland for loggerheads with nesting density on the South Muiron Island similar to Bungelup Beach in the North West Cape (Rob and Barnes 2018).

In summary, Casale *et al.* (2015) estimate that total adult female abundance ranges from 3,500-8,750 using a female remigration interval of 3.5 years. We therefore conclude that abundance is small. Consistent annual nest counts, long-term historical monitoring data, and knowledge of key demographic information for this DPS are lacking (Casale *et al.* 2015). While long-term nest monitoring data does not exist for this population as a whole, the number of loggerhead emergences along the beaches of Gnaraloo Bay has significantly decreased between the 2008-2009 season and the 2015-2016 season (Thomson *et al.* 2016). Though the number of nests observed has not decreased significantly in this timeframe, Thomson *et al*. (2016) suggest that a biologically significant decline in the use of Gnaraloo Bay rookery has occurred and is masked by low nest detection probability in the surveys from previous years. Data are insufficient to support a conclusive population trend at this time, but we will review the trend as new information becomes available.

2.3.4.3 Genetics, genetic variation, or trends in genetic variation:

The majority (67%) of loggerheads nesting in Western Australia are of the CC-P5 haplotype, and the CC-P1 haplotype makes up the remainder of the population (Fitzsimmons *et al.* 1996). These two haplotypes are only one base pair different, and mtDNA variation is low (Dutton *et al.* 2002). We found no new information on the genetics or genetic variation for this DPS.

2.3.4.4 Spatial distribution, trends in spatial distribution, or historic range:

The total length of monitored nesting beaches (Dirk Hartog Island, Ningaloo, Muiron Islands, and Gnaraloo) is 64 km, and low-level nesting occurs on unmonitored nesting beaches totaling roughly 450 km (Casale *et al.* 2015).

Though the majority of nesting occurs on Dirk Hartog Island, the DPS uses multiple monitored nesting locations which may reduce the DPS's risk of extinction due to environmental perturbations or catastrophic events.

The DPS forages in a large marine area extending the length of coastal Western Australia to Indonesia, exceeding 20,000 km^2 (Casale *et al.* 2015). Loggerheads on foraging grounds of Shark Bay show high site fidelity over many years and often to very small sites (often <5km^2) (Thomson *et al.* 2012). Olson *et al.* (2012) also found that males foraging in Shark Bay exhibited fidelity to small foraging areas, though some males transited to a second foraging site for up to several months. Satellite tracking of females nesting in Gnaraloo Bay showed two migratory patterns to foraging areas: half migrated south towards Shark Bay and the other half migrated north and then east, ending between Onslow and Darwin on the Australian coast (Strydom *et al.* 2017). Similarly, loggerheads tagged after nesting at Ningaloo Reef showed three migratory patterns: remaining at Ningaloo reef within 50 km of the nesting beach, travelling 400 km south towards Shark Bay, and travelling northeast into neritic habitats off Pilbara, Kimberley, and Cape York coast (Mau *et al.* 2013).

2.3.4.5 Five-factor analysis:

<u>Present or threatened destruction, modification or curtailment of its habitat or range:</u>

Terrestrial

Vehicle traffic over mainland beaches modify nesting habitat by compacting nests and creating ruts that are difficult for hatchlings to traverse (Hamann *et al.* 2013). Additionally, industrial coastal development and associated light pollution threaten nesting females and hatchlings; the use of satellite imagery showed that an estimated 34% of nesting sites in western Australia are potentially exposed to artificial light pollution (Kamrowski *et al.* 2012). These threats reduce the productivity of the DPS by reducing nesting and hatching success.

Marine

Modification of the marine habitat, including threats described in section 2.3.1.3 such as marine debris and bioaccumulation of contaminants likely continue to threaten this DPS in the marine environment. A loggerhead tagged at Ningaloo Reef was found to move into the impact zone of the 2009 Montara Oil Spill in the Timor Sea (Mau *et al.* 2013). The Ningaloo Coast has been assessed to be high risk for oil spills over one metric ton (originating from ships at sea and in port, small commercial vessels, offshore production and drilling, and shore-based spills) and a very high environmental sensitivity, resulting in a high environmental risk index (Det Norske Veritas 2011). Additionally, plastic contamination levels in the surface waters of the North West Shelf region were found to be high, reaching concentrations of 15,500-23,611 pieces per km^2 (Reisser *et al.* 2013). Contamination by plastics and oil spills in known migratory corridors for this DPS is concerning, though it is unclear to what degree the population is impacted.

Overutilization for commercial, recreational, scientific, or educational purposes: Sea turtles can be hunted by indigenous peoples with a recognized Native Title in Australia, though as most indigenous hunters preferentially target green turtles, loggerheads do not appear to be impacted by traditional harvest at the population level (Limpus 2008). The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017a) indicates that while the take of meat is generally limited to female green turtles, eggs of all species are utilized, and categorizes the threat of harvest to this DPS as moderate.

Disease or predation: Predation threatens loggerheads nesting on mainland Western Australia beaches, while those nesting on islands such as Dirk Hartog Island are not heavily impacted by this threat. Historical predation by introduced red foxes (*Vulpes vulpes*) is very likely, at least in part, responsible for the current small population sizes in mainland Western Australia (Limpus 2008) and if not controlled, can continue to pose a threat to loggerhead nests on the mainland (Hamann *et al.* 2013). Though feral pigs (*Sus scrofa*) may predate on loggerhead eggs (Commonwealth of Australia 2017b), feral pig predation is not reported in recent studies of monitored nests.

Studies during the 2006-2007 and 2007-2008 nesting seasons at Bungelup Beach, Cape Range National Park, showed that 82.4% of monitored nests were partially or completely predated, and 28% were lost to predation (i.e. >80% egg loss); predators included ghost crabs (*Ocypode spp.*), monitor lizards (*Varanus giganteus*) and introduced foxes (*Vulpes vulpes*) (Trocini 2013). During both seasons, ghost crabs were responsible for 60% of observed predation events, while foxes and monitor lizards were each responsible for about one fifth of predation events (Trocini 2013). Over 40% of monitored eggs at Bungelup Beach were lost to predation, while predation minimally affected monitored nests on Dirk Hartog Island (Trocini 2013).

The Gnaraloo Feral Animal Control Program was initiated in 2008 to protect the Gnaraloo loggerhead rookery from predation by foxes as well as feral cats and dogs (Hattingh *et al.* 2018). This program has ensured 100% protection of nests in the Gnarloo Bay Rookery from feral predators from the 2010-2011 nesting season through the most recently reported season, 2017-2018 (an estimated 310,000 eggs total) (Hattingh *et al.* 2018). Native predators such as golden ghost crabs (*Ocypode convexa*) and running ghost crabs (*O. ceratophthalma*) still have a major impact on Gnarloo rookeries and during the 2017-2018 nesting season were responsible for disturbing or predating on 90.4% of monitored nests (Hattingh *et al.* 2018).

The available data indicate that predation threatens loggerheads of mainland Western Australia by reducing hatching success and therefore productivity of the DPS. Overall, as the largest rookery on Dirk Hartog Island is minimally affected by the threat, we consider predation a moderate threat to the DPS.

Fibropapillomatosis and a novel Haemosporidian parasite have been observed in loggerheads of Western Australia, though neither appear to pose a threat to the DPS (Trocini 2013).

Inadequacy of existing regulatory mechanisms: An overview of regulatory mechanisms that apply to loggerhead sea turtles globally is provided in section 2.3.1.3. The following mechanisms occur within the range of the Southeast Indo-Pacific Ocean DPS.

Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA)
Australia and Indonesia are signatories to IOSEA. Additional information on this instrument can be found in section 2.3.2.4.

Loggerheads are protected under Australia's Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) as an endangered species, marine species, and migratory species. The EPBC Act provides a legal framework to protect and manage nationally and internationally important species, ecological communities and heritage spaces (Department of the Environment 2020). In May 2017, the New South Wales and Queensland Environment Ministers jointly issued the national Recovery Plan for Marine Turtles in Australia, which provides for research and management actions needed to support the recovery and long-term survival of marine turtles (Department of the Environment 2020). Under the EPBC Act, the Australian government adopted three threat abatement plans (TAP) providing guidelines to mitigate three threats to loggerheads in Australia: predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*) (2017), the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018), and predation by the European red fox (2008) (Department of the Environment 2020).

Two World Heritage Sites in Western Australia protect loggerhead nesting sites from human use and development: the Shark Bay World Heritage Site, which includes Dirk Hartog Island National Park, protects the major rookery located here (Reinhold and Whiting 2014), and the Ningaloo Coast World Heritage site stretches along the 260-km Ningaloo Reef and includes Gnaraloo Bay rookeries (Thomson *et al.* 2016).

Other natural or manmade factors affecting its continued existence:
Bycatch
Bycatch from longline, trawl, and lobster fisheries threaten Southeast Indo-Pacific loggerheads, though the impact of fisheries interactions do not appear well quantified (Hamann *et al.* 2013). Sea turtle bycatch from coastal otter trawls was identified as a major threat and listed as a Key Threatening Process (KTP) under the EPBC Act in 2001. The compulsory use of turtle excluder devices (TEDs) in the prawn and scallop fisheries of Western Australia in 2002, however, significantly reduced levels of bycatch in trawl fisheries (Limpus 2008; Burke *et al.* 2012). Tuna and billfish longlines along the west coast reported 0.0013-0.022 turtles bycaught per 1,000 hooks each year from the years 2000 through 2013, and though loggerheads were identified, much of the bycatch was not identified to species (Riskas *et al.* 2016). The Northern Territory pelagic gillnet fishery off Darwin, where at least some portion of this DPS is known to forage, reported

relatively high levels of turtle bycatch (0.0157-0.476 turtles/boat day) and though several loggerheads were identified, the majority of the bycatch was unidentified (Riskas *et al.* 2016).

Climate change
Climate change and sea level rise have the potential to affect this DPS as described in section 2.3.1.3. In a recent study of the effects of a seagrass die-off in Shark Bay induced by an extreme climate event, loggerheads did not show a significant decrease in abundance, likely due to their generalist diet (Nowicki *et al.* 2019). Loggerheads increased their use of shallow foraging habitat, suggesting that they may temporarily benefit from seagrass die-offs through reduced foraging effort and increased foraging success (Nowicki *et al.* 2019). However, loggerheads in Shark Bay feed on a range of molluscs and crabs (Lester *et al*. 1980, as cited in Limpus 2008), some of which (such as saucer scallops (*Amusium balloti*) and blue swimmer crabs (*Portunus armatus*)), were documented to experience a significant decline after the extreme climate event (Caputi *et al.* 2014). Though loggerheads may benefit in the short-term from such events, long-term impacts to their prey and habitat are likely to be negative.

Modeling shows that geographic locations of suitable nesting habitat in Western Australia will change due to increased temperature and flood risk by the end of the century (Butt *et al.* 2016). Under RCP8.5, maximum surface air temperatures in the Pilbara region are projected to increase past the point of successful egg survival (>33°C) between October and April by 2100, and suitable nesting habitat is likely to shift southwards as temperatures rise (Butt *et al.* 2016). These more southern beaches in the Gascoyne region are at higher risk for sea level rise-related flooding, though they offer conservation opportunities as there is relatively low urbanization pressure here (Butt *et al.* 2016).

The main source of nest loss on Dirk Hartog Island during the 2006-2007 and 2007-2008 nesting seasons was inundation and beach erosion associated with two recent cyclones; of 31 disturbed or lost nests, 48.4% were disturbed by flooding (Trocini 2013). In Gnarloo Bay Rookery, despite the absence of major storms, 40% of sampled nests in the 2017-2018 nesting season were inundated by high tides or storm surges at least once (Hattingh *et al.* 2018). As sea level rise and the frequency and intensity of storm events will increase with climate change, the reproductive success of this major rookery will become increasingly threatened.

2.3.4.6 Synthesis:

The Southeast Indo-Pacific Ocean DPS of the loggerhead turtle was listed as a threatened species on September 22, 2011 (76 FR 58868). We conducted this 5-year review to evaluate the best available information and to determine whether to recommend a change in the status of the DPS.

The best available abundance data are gathered at nesting beaches. Overall this DPS has an estimated annual nesting female abundance of between 1,000 and 3,000 and a total adult female abundance of between 3,500 and 8,750 (Casale *et* *al.* 2015), though annual nest counts are not conducted consistently, even at major nesting sites. The population trend is unclear as long-term census data across the range of the DPS is not available. The DPS's small abundance contributes to the extinction risk of the DPS because small populations are more likely than large ones to be extirpated as a result of stochastic events and threats.

The main threats to the DPS include fisheries bycatch, climate change, and predation at mainland nesting areas. Other threats include modification of marine and terrestrial habitat through coastal development and marine pollution. The DPS's largest rookery on Dirk Hartog Island is protected as a World Heritage Site and though threats from predation and human use and development are low there, erosion and flooding due to climate change and associated sea level rise pose major threats to nesting success.

Bycatch in longline, trawl, and gillnet fisheries threatens the DPS, though the threat is not well quantified. Fisheries bycatch reduces abundance and likely productivity of the DPS by removing those individuals (i.e., adults and large juveniles) that survived decades of development and have the greatest potential to contribute to future generations.

Climate change also threatens the DPS. Sea level rise is likely to reduce the availability and increase the erosion rates of nesting beaches. Increased storm frequency and intensity are likely to result in altered nesting beaches and decreased egg and hatchling success. Storm surge and flooding have been observed to reduce nesting success through inundation of nests in Western Australia, even in the absence of strong storms. Increasing air and sea surface temperatures are strongly correlated to elevated sand temperatures, which can lead to skewed hatchling sex ratios and embryonic mortality. Temperature changes and sea level rise are likely to change ocean currents and the movements of hatchlings, juveniles, and adults. Ocean acidification is likely to affect their forage-base. Climate change is a major threat that is likely to rival fisheries bycatch in the near future.

Egg predation by multiple native and non-native predators occurs at high levels on mainland rookeries of the DPS, reducing productivity by decreasing hatching success. Though active management of this threat is ongoing, predation continues to cause significant egg loss.

Synthesizing the best available data, we conclude that the status of the DPS has not changed since it was listed as threatened in 2011. The 2009 Status Review concluded that the DPS was at risk of extinction at the time of publication due to mortality of juveniles and adults from fisheries bycatch, the challenges of IUU fishing, continued expansion of artisanal fishing fleets, and the lack of monitoring, implementation of effective conservation measures, and enforcement capabilities. However, after receiving comments from the public on the proposed rule to list the Southeast Indo-Pacific Ocean DPS as an endangered species, NMFS determined that though the nesting population was small, the DPS was not at immediate risk of extinction, but was likely to become so in the foreseeable future throughout all of its range. This was based on the consideration of recent protections for major nesting areas on Dirk Hartog Island and the Muiron Islands, reduced predation, and reduced bycatch from the prawn trawl fishery. We conclude that the population remains small, and historical nesting data across the range of the DPS are not available, making population trends unclear. Though conservation efforts such as protection of nesting areas, predator control and mandatory use of TEDs have been effective, numerous intense threats (predation on mainland beaches, bycatch in longline fisheries, habitat modification, and climate change) continue to affect this DPS and are likely to increase in the future. We conclude that the status of the species should remain threatened.

2.3.5 South Pacific Ocean DPS

2.3.5.1 DPS Introduction:

The South Pacific Ocean DPS of the loggerhead turtle was listed as an endangered species on September 22, 2011 (76 FR 58868). The 2009 Status Review concluded that the DPS was at risk of extinction at the time of publication based on low nesting abundance data, the observed marked decline in the nesting population since the mid-1970s, and high levels of juvenile and adult mortality due to fisheries bycatch throughout the South Pacific Ocean.

As described in the listing, turtles of the DPS originate from the South Pacific south of the equator, north of 60° S. Lat., west of 67° W. Long., and east of 141° E. Long. (76 FR 58868). Nesting occurs primarily in eastern Australia and New Caledonia. Juveniles and sub-adults migrate to forage off South America, and are known to occur in pelagic waters as far south as 32°S off the coast of Chile, and are concentrated between 15°S and 25°S between southern Peru and northern Chile (Donoso and Dutton 2010; Mangel *et al.* 2011). Data on size and temporal and spatial distribution of post-hatchlings in the South Pacific suggest that these loggerheads are associated with the South Pacific gyre and that the east Australian current and Tasman Front play a role in their movement across the South Pacific Ocean (Boyle *et al.* 2009).

After migrating back to the western South Pacific Ocean to reproduce, loggerheads are known to forage in 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, eastern Indonesia, north-eastern Papua New Guinea (Trobriand Islands and Woodlark Islands), north-eastern Solomon Islands and New Caledonia (Limpus 2008 and references therein). Along the Queensland coast, satellite telemetry and mark-recapture records show that adult loggerheads can exhibit residency in specific foraging areas for up to 23 years (Shimada *et al.* 2016). Within these long-term home ranges, loggerheads shift foraging areas seasonally, potentially in association with seasonal distributions of seagrass beds where invertebrate prey species may be found (Shimada *et al.* 2016).

2.3.5.2 Abundance, population trends, demographic features, or demographic trends:

Seven rookeries in eastern Australia serve as long-term index sites for the entire DPS: Woongarra Coast and Heron Island have annual census information from the late 1960s to 2014; Wreck Island, Lady Musgrave Island, Northwest Island, and Wreck Rock beaches have census data from 1970s to 2014; and Tyron Island has census counts from 1977 and 1996 (Limpus *et al.* 2013). Mon Repos on the Woongarra coast, near Bundaberg, is currently the most significant nesting beach for the DPS (Great Barrier Reef Marine Park Authority 2019). Other key nesting locations are Wreck, Erskine and Tryon islands and Wreck Rock beaches in the southern reef. As nesting sites with long-term monitoring are all located in Queensland, they represent index sites for the entire South Pacific Ocean population. The Queensland annual nesting population for the 1976-1977 breeding season was estimated at approximately 3,500 females, which declined to less than 500 females in the 1999-2000 breeding season (Limpus *et al.* 2013). After the establishment of Woongarra Marine Park, trawling closures, and closure of nesting areas to research and tourism disturbance failed to slow the decline, the compulsory use of turtle excluder devices (TEDs) in certain fisheries began in the early 2000s (Limpus *et al.* 2013). The reduced trawl bycatch mortality resulting from the use of TEDs reversed the downward trend beginning in 2001, though the nesting population remained substantially reduced from mid-1970s abundance (Limpus *et al.* 2013). The annual nesting population increased to approximately 700 females by 2010 according to the Queensland Turtle Conservation Project (as referenced by Limpus and Casale (2015)). During the 2011-2012 season, nesting numbers declined at three major index nesting beaches and the breeding population as a whole was understood to be in a new state of decline, with nesting population size under 700 females per year (Limpus and Casale 2015). Recent increases have been recorded at the Woongarra Coast nesting population from 302 nesting females in 2011 to 421 nesting females in 2017 (Great Barrier Reef Marine Park Authority 2019). Nesting for this DPS also takes place in New Caledonia, where initial studies suggest that nesting females numbered between 60 and 70 in the 2004-2005 season, and that numbers are declining (Limpus *et al.* 2006). The beach of La Roche Percée in New Caledonia has an estimated annual population of between 50 and 80 individuals (Read *et al.* 2018). We conclude that abundance is small.

The South Pacific Ocean DPS has experienced a decline of >80% since the mid-1970s (Limpus and Casale 2015) and though the declining trend has been reversed in turtles nesting on the Woongarra Coast, considerable concerns remain (Great Barrier Reef Marine Park Authority 2019). Over the last 20 years, recruitment of oceanic juveniles to foraging areas in southern Queensland have declined, and despite management actions by the Australian and Queensland governments, overall rates of recruitment to Australian coastal waters are approaching zero (Great Barrier Reef Marine Park Authority 2019). Future abundance and productivity declines are expected as older turtles naturally die and recruitment to reproductive maturity is reduced (Limpus and Casale 2015; Great Barrier Reef Marine Park Authority 2019).

2.3.5.3 Genetics, genetic variation, or trends in genetic variation:

Loggerheads of this DPS have been shown to have very low haplotype and nucleotide diversity: estimated haplotype diversity was 0.095 for eastern Australian rookeries and 0.133 for the New Caledonian rookery (Boyle *et al.* 2009).

2.3.5.4 Spatial distribution, trends in spatial distribution, or historic range:

Though the total length of nesting beach for the DPS is approximately 1,000 km, about 80% of nesting on eastern Australia occurs on less than 30 km of beach across 5 monitored nesting locations (Limpus and Casale 2015). Foraging and migratory distribution is large, spanning the entire South Pacific Ocean (Limpus and Casale 2015).

2.3.5.5 Five-factor analysis:

<u>Present or threatened destruction, modification or curtailment of its habitat or range:</u>

Terrestrial

Light pollution poses a moderate threat to nesting females and hatchlings in eastern Australia. A study using satellite images and nesting data found that approximately 44% of this population is potentially exposed to artificial light pollution (Kamrowski *et al.* 2012). A study of hatchlings emerging from beaches on the Woongarra Coast, Queensland, indicated that when the moon was not visible, artificial lighting from sources adjacent to the beach disrupted natural sea-finding behavior (Berry *et al.* 2013). Even "turtle-friendly" amber and red LED lights were shown to disrupt the sea-finding ability of hatchlings from the Woongarra Coast, with a larger effect on moonless nights (Robertson *et al.* 2016).

Beach armoring can reduce adult turtle access to nesting habitat with resulting reduced hatching success, and though largely unquantified, armoring is known to occur on nesting beaches in New Caledonia and southeast Queensland (CMS 2014).

Sugarcane herbicides have been detected at nest depth in sand samples from Mon Repos beach, meaning that loggerhead nests may be acutely and chronically exposed to these contaminants (Allan *et al.* 2017). Though bioassays do not link the herbicides to acute toxicity in loggerhead cells, other wildlife has shown sub-lethal adverse effects with chronic exposure to herbicides, and therefore more research is needed on the long-term effects of exposure on loggerhead eggs (Allan *et al.* 2017).

Draining of swamps adjacent to the nesting beaches at Mon Repos for expansion of sugarcane fields led to lowering of the water table. The resulting reduction in moisture retention in the soil and sand led to decreased hatching success of up to 20% in drought years (CMS 2014).

Marine

Marine debris modifies the marine habitat of this DPS and poses threats of entanglement and ingestion (Hamann *et al.* 2013). In a study of the stomach contents of post-hatchlings stranded in southeastern Queensland (mean CCL 6.4cm), 57% were found to have ingested synthetic marine debris, including plastic, Styrofoam, or nylon cord or string (Boyle and Limpus 2008). Though the sample size was small (n=7), Boyle *et al*. found the high frequency of occurrence concerning.

<u>Overutilization for commercial, recreational, scientific, or educational purposes</u>: Harvest for consumption has been documented in Fiji, New Caledonia, and Australia, though take for this purpose is considered minor in Australia and is unquantified for Fiji and New Caledonia (Hamann *et al.* 2013). Sea turtles can be hunted by indigenous peoples with a recognized Native Title in Australia, though as most indigenous hunters preferentially target green turtles, loggerheads do not appear to be impacted by traditional harvest at the population level (Limpus 2008).

<u>Disease or predation</u>: Predation by the introduced European red fox (*Vulpes vulpes*) has been controlled through baiting at many nesting locations, though minor nests between Burnett River and Deepwater Creek remain vulnerable to this threat (Hamann *et al.* 2013). In more recent years, native goannas (*Varanus panoptes* and *V. varius*) have become a primary predator of turtle eggs and hatchlings (Lei and Booth 2017; Hof *et al.* 2019). Though goannas have likely been preying on loggerhead nests since before European settlement, the present rate of predation would not allow for long-term persistence of turtles at Wreck Rock and is therefore likely higher than historical levels (Lei *et al.* 2017). Lower historical levels of goanna predation could be due to historical hunting pressure from native people, and after European settlement, predation on goannas by introduced foxes (Lei *et al.* 2017). Recent camera trap studies find yellow-spotted goannas (*V. panoptes*) to be the primary predator at loggerhead nests on Wreck Rock beach (Lei and Booth 2017; Hof *et al.* 2019). Predation occurred in 45.8% (2013-2014) (Hof *et al.* 2019), 17% (2015-2016) and 58% (2014-2015) of monitored nests (Lei and Booth 2017). Aluminum excluder devices were found to effectively reduce predation of loggerhead nests at Wreck Rock Beach while letting hatchlings pass through, though deployment of these devices may not be feasible for beaches with high numbers of nests (Hof *et al.* 2019). Nest predation impacts this population by significantly reducing recruitment of hatchlings, leading to additional declines in abundance and reproduction in the future (Hof *et al.* 2019).

We found no new information on the threat of disease, and therefore conclude that disease does not threaten the survival of this DPS.

<u>Inadequacy of existing regulatory mechanisms</u>: An overview of regulatory mechanisms that apply to loggerhead sea turtles globally is provided in section

2.3.1.3. The following mechanisms occur within the range of the South Pacific Ocean DPS.

Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA)
Australia, Papua New Guinea, and Indonesia are signatories to IOSEA. Additional information on this instrument can be found in section 2.3.2.4.

Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC)
IAC is an international treaty providing the legal framework for the protection, conservation, and recovery of sea turtles and the habitats on which they depend. It is the only binding multi-national agreement for sea turtles and is open to all countries in North, Central, and South America, and the Caribbean. As of 2020, there are 16 Contracting Parties including Ecuador, Chile, and Peru. Additional information is available at http://www.iacseaturtle.org/.

Inter-American Tropical Tuna Commission (IATTC)
IATTC is an international commission responsible for the conservation and management of tuna and other marine resources in the eastern Pacific Ocean. In 2007, the Resolution to Mitigate the Impact of Tuna Fishing Vessels on Sea Turtles (Resolution C-07-03) was adopted. Under this resolution, parties agree to implement FAO guidelines to reduce bycatch, injury, mortality of sea turtles in fishing operations and to ensure safe handling of captured sea turtles to improve their survival. Peru, Ecuador, and Chile are members of IATTC. Additional information is available at https://www.iattc.org/PDFFiles/Resolutions/IATTC/_English/C-07-03_Sea%20turtles.pdf.

Memorandum of Understanding on ASEAN Sea Turtle Conservation and Protection
The objectives of this MOU, initiated by the Association of South East Asian Nations (ASEAN), are to promote the protection, conservation, replenishing, and recovery of sea turtles and their habitats based on the best available scientific evidence, taking into account the environmental, socio-economic and cultural characteristics of the Parties. It currently has 10 signatory states in the South East Asian Region: Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. Additional information is available at http://www.aseansec.org/6185.htm.

Convention for the Protection of the Marine Environment and Coastal Area of the South-East Pacific (Lima Convention)
This Convention's signatories include all countries along the Pacific Rim of South America from Panama to Chile. Among other resource management components, this Convention established a protocol for the conservation and management of protected marine resources. Stemming from this Convention is the Commision

Permanente del Pacifico Sur (CPPS) that has developed a Marine Turtle Action Plan for the Southeast Pacific that outlines a strategy for protecting and recovering marine turtles in this region.

Convention for the Protection of Natural Resources and Environment of the South Pacific Region (Noumea Convention)
In force since 1990, this Convention includes 12 Parties from throughout the Southwest Pacific Ocean: Australia, Cook Islands, Federated States of Micronesia, Fiji, France, Marshall Islands, Nauru, New Zealand, Papua New Guinea, Samoa, Solomon Islands, and the United States. This Convention is relevant only for the Exclusive Economic Zones of Party nations, and does not have jurisdiction in international waters. Relevant to marine turtles are the associated Protocol for the Prevention of Pollution of the South Pacific Region by Dumping (reduction of marine debris), and the Action Plan for Managing the Natural Resources and Environment of the South Pacific Region, which occurs under the auspices of the South Pacific Regional Environment Programme (SPREP). Australia is the only party to not ratify both Protocols. Additional information is available at https://www.sprep.org/convention-secretariat/noumea-convention.

The loggerhead turtle is listed as Endangered on Queensland's Nature Conservation Act 1992. Loggerheads are also protected under Australia's Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) as an endangered species, marine species, and migratory species. The EPBC Act provides a legal framework to protect and manage nationally and internationally important species, ecological communities and heritage spaces (Department of the Environment 2020). In May 2017, the New South Wales and Queensland Environment Ministers jointly made the national Recovery Plan for Marine Turtles in Australia, which provides for research and management actions needed to support the recovery and long-term survival of marine turtles (Department of the Environment 2020). Under the EPBC Act, the Australian government adopted three threat abatement plans (TAP) providing guidelines to mitigate three threats to loggerheads in Australia: predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*) (2017), the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018), and predation by the European red fox (2008) (Department of the Environment 2020).

More than 80% of nesting for this DPS occurs in protected areas of Conservation Parks and National Parks (Limpus 2008). Important foraging areas are also protected, such as the Great Barrier Reef Marine Park, the Great Barrier Reef World Heritage Site, and Moreton Bay Marine Park (Department of the Environment 2020). Despite protection for nesting and foraging areas, other threats described in this section continue to threaten the DPS.

Ecuador prohibits capture, processing, domestic sale, and export of marine turtles under Ministerial Agreement No. 212 1990, and requires the use of TEDs in shrimp trawlers under Ministerial Agreement No. 121 1996. In Peru, Ministerial Resolution No. 103-95-PE prohibits the directed take of sea turtles and lists the loggerhead turtle as endangered as of 2014 on the list of classification and categorization of endangered wildlife species. Despite national protections, bycatch in the eastern South Pacific Ocean remains a major threat to the DPS. For more information on regulatory mechanisms by country, see the summary in the Single Species Action Plan for the Loggerhead Turtle (*Caretta caretta*) in the South Pacific Ocean (CMS 2014).

<u>Other natural or manmade factors affecting its continued existence:</u>
Bycatch
Fisheries bycatch across the entire South Pacific Ocean is considered the largest cause of mortality for this DPS (Hamann *et al.* 2013). Small-scale fisheries in Peru including longlines, bottom-set nets and driftnets targeting sharks and dolphinfish have the potential to severely impact the South Pacific Ocean DPS (Alfaro-Shigueto *et al.* 2011). From 2000 to 2009, observation data showed that loggerheads were the main bycatch species in small-scale longliners in Southern Peru, with an annual mean catch rate of 1.42 loggerheads per set in the dolphinfish longline fishery (0.63 per 1000 hooks) and 1.23 loggerheads pet set in the shark longline fishery (0.33 per 1000 hooks) (Alfaro-Shigueto *et al.* 2011). Though most are captured and released alive, data on post-release mortality is scarce and the impacts to the population are not well understood (Alfaro-Shigueto *et al.* 2011). Satellite tracked loggerheads bycaught in Peruvian waters spent 75% of the post-capture tracking duration within areas known to be fished by the Peruvian longline fleet, leaving them vulnerable to additional fisheries interactions (Mangel *et al.* 2011). Based on tracks, even severe injuries sustained from capture did not appear to be fatal (Mangel *et al.* 2011).

Loggerhead bycatch in the Chilean commercial swordfish longline fishery from 2001-2005 occurred at an average annual rate of 0.0056 per 1000 hooks and all were released alive (Donoso and Dutton 2010). Bycatch in purse-seine fisheries and through entanglement in floating fish-aggregating devices (FADs) off Ecuador is low (Alava 2008).

In Australia, loggerheads are incidentally caught in several fisheries, though bycatch mortality is often poorly quantified. The eastern tuna and billfish pelagic longline fishery reports interactions with turtles at rates of 0.0006-0.0045 turtles per 1000 hooks annually; loggerheads make up an unknown portion of this bycatch as the majority was not identified to species (Riskas *et al.* 2016). Though the compulsory use of TEDs in the 2000s greatly reduced bycatch in trawl fisheries (Limpus 2008), sea turtles (all species) are still caught in the Northern Prawn Fishery bottom trawls and Queensland otter trawls at rates of 0.0005-0.0014 and 0.0036-0.343 turtles/boat day, respectively (Riskas *et al.* 2016). Loggerhead bycatch in Queensland is concentrated in the net-based fisheries in the sub-tropical Mapstone region, located off the southeastern-most shores of Queensland, though was reported along the entire coast up to the eastern Torres Strait (Riskas *et al.* 2016).

Queensland Shark Control Program drumlines and/or nets were responsible for the death of 35 loggerhead turtles since 2001 (roughly 1.8/year) (Blount 2019). Loggerheads were the most commonly captured sea turtle species and made up about 40% of the marine turtle mortalities due to bycatch in shark protection nets and drumlines (Blount 2019).

Boat strikes

Boat strikes also pose a threat to the DPS (Hamann *et al.* 2013). In Queensland, most marine turtle-vessel collisions occur in Moreton Bay (Meager and Limpus 2012) which is an ecologically important feeding area for loggerhead turtles (Limpus 2008). Designated "Go Slow Zones" aim to reduce collisions with turtles and dugongs by regulating travel speeds in waters 5 meters deep or shallower, though a substantial amount of habitat occurs outside of the Go Slow Zones (Shimada *et al.* 2017). Shimada *et al*. found that if all shallow zones of Moreton Bay were designated as Go Slow Zones, nearly one half of loggerhead habitat here would be protected from vessel operation; shallow zones plus a buffer of 1.2, 2.4, or 3.6 km could offer protection to at least 80%, 90%, or 95% of their habitat (2017). In 2011, more than half of all recorded anthropogenic mortalities for marine turtles in the Queensland database of sick, injured, debilitated or dead marine life (StrandNet) were due to interactions with vessels (Meager and Limpus 2012), and therefore poses a moderate to high threat to this DPS.

Climate change

Climate change and sea level rise have the potential to affect this DPS as described in section 2.3.1.3. As in the Southeast Indo-Pacific Ocean DPS, climate change is projected to shift geographic locations of suitable nesting habitat due to increased temperature and flood risk by the end of the century (Butt *et al.* 2016). Maximum surface air temperatures in Queensland nesting areas are projected to increase to 32.82°C in October through April under the RCP8.5 projection, remaining just within the temperature threshold for successful incubation (33°C) (Butt *et al.* 2016). This would, however, highly skew hatchling sex ratios towards mostly, if not all, females. Temperatures at nesting areas further south into New South Wales are likely to be more suitable for successful hatching, though beaches further south are at higher risk for sea level rise-related flooding than their more northern current range (Butt *et al.* 2016).

2.3.5.6 Synthesis:

The South Pacific Ocean DPS of the loggerhead turtle was listed as an endangered species on September 22, 2011 (76 FR 58868). We conducted this 5-year review to evaluate the best available information and to determine whether to recommend a change in the status of the DPS.

The best available abundance data are gathered at nesting beaches. The most recent comprehensive surveys and analyses show that the DPS has a nesting female abundance of less than 700 per year (Limpus and Casale 2015). Recent increases in nesting females have been recorded in the Woongarra Coast nesting population from 302 nesting females in 2011 to 421 nesting females in 2017 (Great Barrier Reef Marine Park Authority 2019). The DPS has experienced a decline of more than 80% since the 1970s despite active management and though the declining trend has been reversed in turtles nesting on the Woongarra Coast, considerable concerns remain. Causes of recent declines are not completely understood, though low recruitment of oceanic juveniles to the coastal neritic stage is thought to be a contributing factor. This would implicate bycatch as the major threat, although high levels of ingested plastics is also problematic. In addition to the major observed declines within the last ten years, small abundance contributes to the extinction risk of the DPS because small populations are more likely than large ones to be extirpated as a result of stochastic events and threats. Further, the DPS has been shown to possess very low haplotype and nucleotide diversity (Boyle *et al.* 2009), therefore the DPS may not retain adequate genetic diversity for adaptation

Fisheries bycatch poses the greatest threat to the DPS and occurs across the South Pacific Ocean. Longline, bottom-set net and driftnet fisheries off Peru and Chile incidentally catch oceanic juveniles that spend many years of early life foraging in South American waters. Loggerheads are bycaught by both commercial and small-scale fleets in the southeastern Pacific. Trawls, longlines, and net fisheries pose threats to large juveniles and adults in coastal and pelagic waters off eastern Australia, though the impact is poorly quantified. Bycatch in shark control nets and drumlines represents a minor threat. Fisheries bycatch reduces both abundance and productivity of the DPS by removing those individuals (i.e., adults and large juveniles) that survived decades of development and have the greatest potential to contribute to future generations.

Climate change also threatens the DPS. Sea level rise is likely to reduce the availability and increase the erosion rates of nesting beaches. Increased storm frequency and intensity are likely to result in altered nesting beaches and decreased egg and hatchling success. Increasing air and sea surface temperatures are strongly correlated to elevated sand temperatures, which can lead to skewed hatchling sex ratios and embryonic mortality. Geographic locations of suitable nesting habitat are projected to shift due to increased temperature and flood risk in eastern Australia by the end of the century (Butt *et al.* 2016). Maximum surface air temperatures in Queensland nesting areas are projected to be increase to 32.82°C in October through April under the RCP8.5 projection, remaining just within the temperature threshold for successful incubation (33°C) (Butt *et al.* 2016). Temperature changes and sea level rise are likely to change ocean currents and the movements of hatchlings, juveniles, and adults. Ocean acidification is likely to affect their forage-base. Climate change is a major threat that is likely to rival fisheries bycatch in magnitude in the near future.

Other threats to the DPS include coastal development, predation, boat strikes, and debris ingestion. Increased development of coastlines affects both nesting and hatching success through artificial light pollution as well as direct damage to nests from vehicles. Predation by goannas, though actively managed at many nesting sites, continues to contribute to decreased hatching success as protection of all nests is not possible. Boat strikes appear to pose moderate threats to loggerheads in shallow foraging areas that overlap with areas of human use. Ingestion of marine debris has rarely been observed to directly cause mortality, though it is likely to reduce individual fitness, potentially leading to population-level effects.

Synthesizing the best available data, we conclude that the status of the DPS has not changed since it was listed as endangered in 2011. The 2009 Status Review concluded that the DPS was at risk of extinction at the time of publication based on low nesting abundance data, the observed marked decline in the nesting population since the mid-1970s, and high levels of juvenile and adult mortality due to fisheries bycatch throughout the South Pacific Ocean. Since the Status Review, nesting abundances have declined and only very recently shown increases at Woongarra Coast. This recent increase in nesting females, while important and encouraging, is not of adequate magnitude or duration to alter the listing status of the DPS as it remains small and faces intense (fisheries bycatch and climate change) and numerous (habitat loss and modification, overutilization, and predation) threats. The low abundance, low genetic diversity, and combined effect of multiple threats put this DPS at risk of extinction now, rather than the foreseeable future. We conclude that the status of the species should remain endangered.

2.3.6 South Atlantic Ocean DPS

2.3.6.1 DPS Introduction:

The South Atlantic Ocean DPS of the loggerhead turtle was listed as a threatened species on September 22, 2011 (76 FR 58868). The 2009 Status Review concluded that the DPS was not at immediate risk of extinction, though the extinction risk would likely increase in the foreseeable future. This was based on the determination that although the DPS exhibited increasing nesting trends starting in 1988, it would likely decline in the foreseeable future largely due to mortality of juvenile loggerheads from fishery bycatch occurring throughout the South Atlantic Ocean.

As described in the listing, turtles of the DPS originate from the South Atlantic Ocean south of the equator, north of 60° S. Lat., west of 20° E. Long., and east of 67° W. Long. (76 FR 58868). Nesting occurs in Brazilian states of Rio de Janeiro, Espirito Santo, Bahia, and Sergipe. Foraging occurs at different locations in waters of the South Atlantic Ocean, dependent on life stage and foraging strategy, including the exclusive economic zones of Brazil, Uruguay, Argentina, and adjacent international waters (Carranza *et al.* 2011; Barceló *et al.* 2013; Velez-Rubio *et al.* 2013; Scherer *et al.* 2014).

2.3.6.2 Abundance, population trends, demographic features, or demographic trends:

All nesting sites for the DPS are found in Brazil, the majority of which (>75%) are found on the northern coasts of Bahia and Espirito Santo (Montero *et al.* 2019). Surveys across 13 index sites between 2000-2001 and 2004-2005 indicated the presence of approximately 4,428 nests each year (Casale and Marcovaldi 2015). Nest abundance at these same sites from the 2008-2009 breeding season through the 2012-2013 season is estimated at 7,540 nests each year (Casale and Marcovaldi 2015). The IUCN Red List reports the average annual number of nests to be 7,700, and using the average figures of four nests per female (Marcovaldi and Chaloupka 2007) and a remigration interval of 2 years, the annual female nesting population is estimated at 1,925 and the total adult female population is estimated at 3,848 (Casale and Marcovaldi 2015). The trends at all but one of these index sites were positive, and the overall trend for the subpopulation is positive from 2001 to 2013 (70%) (Casale and Marcovaldi 2015). More recent nesting numbers are available from IAC Annual Reports for Brazil, though only from six nesting beaches that differ from the 13 index beaches discussed above. These nesting sites (Farol, Comboios, Povoação, Interlagos, Guarajuba, and Praia do Forte) had combined nest counts of 4,519 in 2019, 4,283 in 2018, 4,883 in 2017, 6,612 in 2016, and 4,456 in 2015 (reports available at http://www.iacseaturtle.org/informes.htm) indicating a fairly stable trend at these beaches.

South Atlantic loggerheads mature at an average age of 32 years (Petitet *et al.* 2012). Oceanic juvenile turtles range from 47 to 65.5 cm CCL and neritic turtles were largely found to exceed 70 cm CCL (Petitet *et al.* 2012).

2.3.6.3 Genetics, genetic variation, or trends in genetic variation:

In the South Atlantic Ocean population, the use of 380 bp haplotypes supported differentiation between northern (Bahia and Sergipe) and southern (Espirito Santo and Rio de Janeiro) nesting stocks (Reis *et al.* 2009). The use of expanded (~800 bp) mtDNA haplotypes, however, found Espirito Santo, Rio de Janeiro, and Northern Brazil (Bahia and Sergipe) to be three genetically distinct management units (Shamblin *et al.* 2014).

2.3.6.4 Spatial distribution, trends in spatial distribution, or historic range:

Nesting beaches for this DPS total approximately 711 km of linear coastline, with 13 index nesting sites (Casale and Marcovaldi 2015). For this reason we find that the relatively large and diverse nesting distribution reduces the DPS's vulnerability to environmental perturbations or catastrophic events.

The DPS also has a large marine distribution. Satellite tracking, bycatch, and stranding data reveal high-use foraging areas for juveniles and adults in the exclusive economic zones of Brazil, Uruguay, Argentina, and adjacent international waters (Carranza *et al.* 2011; Barceló *et al.* 2013; Velez-Rubio *et al.* 2013; Scherer *et al.* 2014). Turtles likely reside in these areas due to the high availability of benthic and pelagic prey, though they may only represent a portion of their range as juveniles have been captured in longline and trawl fisheries in the Rio Grande Rise (Barceló *et al.* 2013). Females nesting in Bahia migrate to foraging grounds on the northern coast of Brazil with high density in the state of Ceará, and remained at these sites until subsequent nesting migrations after an average of 700 days (Marcovaldi *et al.* 2010). Females nesting in Bahia showed fidelity between internesting ranges and nesting beaches, with most females remaining in waters adjacent to the nesting beaches at which they were tagged for an average of 33.6 days (Marcovaldi *et al.* 2010). Loggerheads of this DPS show strong seasonality in their movements, moving towards the equator in colder seasons and farther south in warmer seasons (Barceló *et al.* 2013; Carman *et al.* 2016).

Satellite tracking of larger juveniles (mean 59.4 cm CCL) incidentally caught in gillnets confirmed strong foraging site fidelity to Rio de la Plata estuary, as evidenced by remaining in the area for a significant portion of foraging time as well as returning in subsequent years (Carman *et al.* 2016).

Oceanic-stage juveniles (mean 18 cm SCL) have been shown through satellite tracking to be largely influenced by the seasonally shifting bifurcation of the South Equatorial Current into the Brazil Current and the Northern Brazil Current (Mansfield *et al.* 2017). Those released at Praia do Forte early in the hatching season were transported southwards, and those released later in the season after the bifurcation had shifted south were transported northwards (Mansfield *et al.* 2017). Mansfield *et al.* (2017) suggest that the long nesting season allows young to be exposed to differing migratory routes, which may serve to increase population resiliency against anthropogenic threats or environmental conditions.

2.3.6.5 Five-factor analysis:

<u>Present or threatened destruction, modification or curtailment of its habitat or range</u>:

Terrestrial

Tourism-related coastal development in the important nesting areas along the northern coast of Bahia poses a growing threat to loggerheads. Increased development and tourist activity put loggerheads at risk through artificial lighting, beach driving, shoreline armoring, pollution, and erosion (Lopez *et al.* 2015). While a specific law regulating artificial light at main nesting beaches in Brazil has been in place since 1995, limited enforcement resources and high levels of development can undermine the regulation (López-Mendilaharsu *et al.* 2020). The proportion of loggerhead nesting areas in Brazil exposed to light pollution has increased between 1992-1996 and 2008-2012; the northern nesting populations of Bahia and Sergipe experienced a 57.6% increase in light pollution over this time period, while the southern nesting populations of Espirito Santo and Rio de Janeiro experienced a 71.6% increase (Colman *et al.* 2020). In 2008-2012, 58.2% of the northern loggerhead nesting areas are exposed to light pollution, while 64.6% of the southern loggerhead nesting areas are exposed, and when taking nesting density into account, 73.6% and 71.4% of reproductive hotspots are exposed for the northern and southern areas respectively (Colman *et al.* 2020). Modelling suggests that the northern loggerhead areas were significantly affected by light, though the fact that both light pollution and sea turtle nesting populations are increasing in Brazil shows that to some extent, turtles are able to tolerate artificial light (Colman *et al.* 2020). As coastal development increases, light pollution poses an increasing threat to loggerhead reproduction and recruitment.

Marine

Ingestion of plastic marine debris has both lethal and sublethal effects in sea turtles, including internal lesions, gastrointestinal blockage, weakness, emaciation, and buoyancy problems, which may lead to death (Rizzi *et al.* 2019). In southern Brazil, 29.2% of loggerheads sampled were found to have ingested plastic marine litter, most frequently in the form of hard fragments and fishing lines (Rizzi *et al.* 2019). Interestingly, there was a significant negative correlation observed between number of ingested plastic items and loggerhead size, with 70% of individuals with CCL less than 70 cm ingesting at least one item, whereas turtles with CCL greater than or equal to 70 cm were not found to have ingested plastic items, or to have eliminated them (Rizzi *et al.* 2019). In a study of stranded sea turtles along the coast of Rio de Janeiro state, necropsied loggerheads that had ingested plastic showed partial or total obstruction of intestines, perforated ulcers, and hemorrhagic lesions (Tagliolatto *et al.* 2019). Ingestion of plastic marine debris likely poses a moderate threat to this DPS.

Loggerhead eggs and hatchlings sampled at Guanabara Beach, Anchieta, Espirito Santo, were contaminated with heavy metals that may be associated with anthropogenic activities such as industrial discharge and infrastructure development in the region (Souza *et al.* 2018). Metal concentrations were generally found to be higher in loggerheads than green turtles sampled in the same region, likely due to their carnivorous diet allowing for bioaccumulation (Souza *et al.* 2018). It is not clear how this threat impacts the overall productivity of the DPS.

<u>Overutilization for commercial, recreational, scientific, or educational purposes</u>: Historically, eggs and nesting females were harvested at high levels (Marcovaldi and dei Marcovaldi 1999). The complete prohibition of all loggerhead harvest by the government of Brazil, as well as monitoring and conservation efforts started in the 1980s, largely eliminated this threat (Marcovaldi and Chaloupka 2007; Casale and Marcovaldi 2015; Lopez *et al.* 2015).

<u>Disease or predation:</u> Though several instances of disease-related mortality (Rodenbusch, Almeida*, et al.* 2012; Domiciano *et al.* 2014) and parasitism (Rodenbusch, Marks*, et al.* 2012; Ribeiro *et al.* 2017) have been documented, disease does not appear to pose a threat to the DPS.

Egg predation by native crab-eating foxes (*Cerdocyon thous*) is known to occur in Bahia, where Projeto TAMAR (Brazilian National Sea Turtle Conservation Program) staff monitor and manage this threat though the use of mesh grids and flags placed over nests (Longo *et al.* 2009; Gandu *et al.* 2013). In some areas, foxes have begun to attack nests immediately after being laid (before daily nest surveys), and therefore night surveys are needed to reduce the impact of predators during the peak of nesting season (López-Mendilaharsu *et al.* 2020). Recently, predation of nests by armadillos (*Dasypus novemcinctus* and *Euphractus sexcinctus*) and South American coatis (*Nasua nasua*) have become more common (Gandu *et al.* 2013; López-Mendilaharsu *et al.* 2020). Between 2009-2012, of 526 nests monitored in Costa do Sauípe station, Bahia, 167 were predated; armadillos were responsible for 153 of these nest predations while foxes were responsible for the remaining 14 (Gandu *et al.* 2013). Sharks may also prey on loggerheads of this DPS at low levels, though stranding data makes it difficult to determine whether sharks mainly prey on or scavenge loggerheads (Bornatowski *et al.* 2012). López-Mendilaharsu *et al.* (2020) estimate that predation by exotic and native predators are each responsible for the equivalent of 132 adult female mortalities each year, and we therefore consider predation a threat to the productivity of the species.

Inadequacy of existing regulatory mechanisms: An overview of regulatory mechanisms that apply to loggerhead sea turtles globally is provided in section 2.3.1.3. The following mechanisms occur within the range of the South Atlantic Ocean DPS.

Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC)
IAC is an international treaty providing the legal framework for the protection, conservation, and recovery of sea turtles and the habitats on which they depend. It is the only binding multi-national agreement for sea turtles and is open to all countries in North, Central, and South America, and the Caribbean. As of 2020, there are 16 Contracting Parties including Brazil, Argentina and Uruguay. Additional information is available at http://www.iacseaturtle.org/.

The Brazilian government established the National Marine Turtle Conservation Program in Brazil (Projeto TAMAR) in 1980 and enacted legislation prohibiting the harvest of loggerheads and their eggs in the late 1980s (Marcovaldi and dei Marcovaldi 1999). Projeto TAMAR was initially established to record the abundance, distribution, seasonality, and primary threats to turtle survival in Brazil, (Marcovaldi and dei Marcovaldi 1999) and they currently aim to protect and recover Brazilian sea turtle populations through both research and involvement of local communities (Marcovaldi *et al.* 2005). Its fifteen stations cover 1,100 km of Brazil's coastline, and with most nesting areas showing increased abundance, Projeto TAMAR is recognized as having a successful long-term conservation strategy that also incorporates human and social issues (Marcovaldi *et al.* 2005). Loggerheads are listed as endangered in the Brazilian Official Redlist (Lista Oficial da Fauna Brasileira Ameaçada de Extinção, Instrução Normativa no 3, 27 de maio de 2003) and Brazil implements a National Action Plan to Conserve Sea Turtles. Several regulatory mechanisms targeting bycatch are also in place, including mandatory use of circle hooks for pelagic longline vessels targeting tuna and swordfish (Portaria Interministerial No. 74, November 2017), and mandatory use of TEDs (Instrução Normativa MMA No. 31, de 13 de Dezembro de 2004) though enforcement and compliance is low (IAC 2019a).

In Argentina, sea turtles are protected under the Fauna National Law (Law No. 22.421/1981) and the Federal Fishing Regime and Regulatory Decree (Law No.

24.922/1997). Resolution SAyDS 513/2007 prohibits hunting, capture, and trade of sea turtles. In September 2015, the Environment Federal Council (COFEMA) approved the National Action Plan for the Conservation of Sea Turtles in the Republic of Argentina and the National Action Program to Reduce Sea Turtle Interaction with Marine Debris in Argentina. In 2018, Argentina adopted the National Action Plan to Reduce Sea Turtle Interactions with fisheries in the Republic of Argentina (IAC 2019b).

Though international and national legal mechanisms exist to reduce fisheries bycatch, incidental capture continues due to weak enforcement and implementation of mitigation measures (González-Carman *et al.* 2012). González-Carman *et al*. (2012) review existing regulatory mechanisms and suggest several actions to reduce turtle bycatch in the southwest Atlantic, including the following: placing on-board observers in specific trawl fishing fleets, testing mitigation measures such as TEDs and lower profile gillnets, establishing marine and coastal protected areas connected by known turtle migration paths, creating a marine turtle regional management plan for the southwest Atlantic Ocean, and better estimating bycatch rates, survival rates, and areas of high bycatch.

<u>Other natural or manmade factors affecting its continued existence:</u>
Bycatch
Industrial bottom trawling in Brazil's EEZ is associated with high levels of sea turtle bycatch. Self-reporting by trained vessel captains revealed a CPUE (turtles per towing hour) of 0.0029, of which adult and sub-adult loggerheads were most common (N=22) (Guimaraes *et al.* 2018). Compared to other sea turtle catches in trawl fisheries worldwide, this region represents the sixth highest turtle CPUE, and it is possible that bycatch may have been underreported (Guimaraes *et al.* 2018). Trawling is responsible for a high number of loggerhead mortalities: López-Mendilaharsu *et al.* (2020) estimate that throughout the region, 3,000 neritic juveniles and 300 neritic adults are killed as trawl bycatch each year, equating the total estimated annual mortality to the loss of 942 adult females based on the reproductive value of these life stages to the population.

Loggerhead turtles are also bycaught in pelagic longline fisheries targeting various species of sharks, tuna, and swordfish throughout the South Atlantic (Sales *et al.* 2010). Between 2004 and 2008, fishing fleets in areas over isobaths 200 to 2000 m within the Brazilian EEZ, as well as the Rio Grande rise and waters in between, had loggerhead capture rates (individuals per 1000 hooks) of 1.605 using J-style hooks and 0.727 using circle hooks (Sales *et al.* 2010). In a study of 310 Portuguese longline sets in the South Atlantic between 2008 and 2012, loggerhead bycatch per unit of effort was 1.505 per 1000 J-style hooks; most were hooked by mouth and 63% were released alive (Santos *et al.* 2013). The use of mackerel bait in the place of squid, as well as changing to circle hooks, significantly decreased this rate of bycatch (Santos *et al.* 2013). The Uruguayan pelagic longline fishery is also responsible for loggerhead bycatch, which was reduced (though not significantly) with the use of circle hooks rather than J-style hooks (Domingo *et al.* 2012). Between 2002-2013, observer data from the

Taiwanese deep-set longline fishery found that though loggerhead bycatch rates (ranging from 0-0.0239 per 1000 hooks) were lower than in coastal longline fisheries, mortality was higher as Taiwanese fleets took over 20 hours to complete a set (Huang 2015). Longline fleets from Japan, Spain, and other countries also operate in the South Atlantic, and therefore management to reduce bycatch depends on agreements signed within regional fisheries management organizations such as ICCAT (López-Mendilaharsu *et al.* 2020).

The number of loggerheads captured by longline vessels varies spatially, and is much higher in southern waters (south of 20°S) (López-Mendilaharsu *et al.* 2020). Though the number of loggerheads (mostly juveniles) bycaught in longline fisheries is very high, many turtles are released alive and therefore total mortality is not as high as in other fisheries (López-Mendilaharsu *et al.* 2020). López-Mendilaharsu *et al.* (2020) estimate that longline bycatch in the southwest Atlantic Ocean is responsible for mortality of 3,000 oceanic juveniles, 30 oceanic adults and 30 neritic juveniles, equating the total estimated annual mortality to the loss of 118 adult females based on the reproductive value of these life stages to the population.

The driftnet fishery off Santa Catarina and Sao Paulo targeting hammerhead sharks (*Sphyrna lewini* and *S. zygaena*) bycaught loggerheads at a rate of 0.0262 individuals per km of net between 2002-2008 (Fiedler *et al.* 2012).

A study of stranded sea turtles along the coast of Rio de Janeiro state showed that among stranded loggerheads with a determinable cause of death, fisheries interactions contributed to about 86% of the mortalities, with longline and trawl gear having the greatest impact (Tagliolatto *et al.* 2019).

Loggerheads stranded between 1995-2014 on the Rio Grande do Sul coast showed evidence of interactions with pelagic longlines, bottom trawls, and gillnets (Monteiro *et al.* 2016). In the majority of cases, loggerheads show no visible signs of capture in gill net or trawl fisheries, though examination of the spatial and temporal overlap between strandings and fisheries activity provides evidence that fisheries bycatch makes up a significant portion of strandings and that the bottom pair and double-rigged trawl fisheries are responsible for most loggerhead strandings in this region (Monteiro *et al.* 2016). The number of strandings has risen over the last ten years at a rate higher than nesting abundance in the region, and it is likely that increased fishing effort or spatial overlap of trawl fisheries and loggerheads is to blame (Monteiro *et al.* 2016). As most of the stranded loggerheads were large juveniles with high reproductive potential, this could lead to a future decline in nesting abundance as the cohort matures (Monteiro *et al.* 2016).

In sum, fisheries bycatch throughout the southwest Atlantic Ocean is the main threat facing the DPS. High mortality of juveniles and subadults reduces the productivity of the DPS, and the effects on nesting numbers may not be seen for several years until these cohorts mature (López-Mendilaharsu *et al.* 2020).

Climate change
Climate change presents various threats to loggerheads throughout their life cycle. Increased precipitation alone and in combination with increased air temperatures during incubation were shown to have the greatest effect on hatchlings in this DPS using modeling of extreme (RCP 8.5) and conservative (RCP 4.5) climate change scenarios (Montero *et al.* 2019). Currently, a strong female hatchling bias (94%) is observed at northern loggerhead beaches in Bahia and Sergipe, while a more balanced hatchling sex ratio is observed at southern beaches in Espirito Santo and Rio de Janeiro (53% female) (Marcovaldi *et al.* 2016). As climate change progresses, warmer nesting beaches such as Bahia will experience reduced hatchling success while cooler beaches will experience an increase in hatchling success by 2100 as they are not close to the thermal threshold for hatchling incubation (Montero *et al.* 2019). As climate change continues to progress and temperature and precipitation begin to reach negative thresholds, it is likely that hatchling production will begin to decrease (Montero *et al.* 2019). Effects of both precipitation and temperature will depend on environmental conditions of each nesting beach and how close current moisture and temperature levels are to thresholds for incubation (Montero *et al.* 2019).

Monsinjon *et al.* (2019) found that at Praia do Forte, Bahia, nesting onset shifted 7.1 days earlier in response to a 1°C SST increase at an important foraging site. Further research is needed to fully understand whether such phenological changes will allow loggerheads to nest in optimal incubation temperatures for hatching success.

2.3.6.6 Synthesis:
The South Atlantic Ocean DPS of the loggerhead turtle was listed as a threatened species on September 22, 2011 (76 FR 58868). We conducted this 5-year review to evaluate the best available information and to determine whether to recommend a change in the status of the DPS.

The best available abundance data are gathered at nesting beaches. The most recent surveys and analyses for all 13 index beaches show that the DPS has an annual nesting female abundance of approximately 1,925 and a total adult female abundance of 3,848 (Casale and Marcovaldi 2015). The DPS has a positive trend and abundance is estimated to have increased 70% between 2001 and 2013, with all but one index site increasing (Casale and Marcovaldi 2015). More recent nest counts from six nesting beaches in Brazil show stable counts from 2015-2019 (reports available at http://www.iacseaturtle.org/informes.htm). The relatively large and diverse nesting distribution of the DPS reduces its risk of extinction due to environmental perturbations or catastrophic events.

The main threat to this DPS is fisheries bycatch. Additional threats include climate change, marine pollution, coastal development, and predation.

Fisheries bycatch in longline, trawl, and driftnet fisheries in the EEZs of Brazil, Uruguay, and Argentina, as well as in international waters, pose the greatest threat to the DPS. Fisheries bycatch reduces abundance and likely productivity of the

DPS by removing those individuals (i.e., adults and large juveniles) that survived decades of development and have the greatest potential to contribute to future generations. Though international and national legal mechanisms exist to reduce fisheries bycatch, incidental capture continues due to weak enforcement and implementation of mitigation measures.

Climate change also threatens the DPS. Sea level rise is likely to reduce the availability and increase the erosion rates of nesting beaches. Increased storm frequency and intensity are likely to result in altered nesting beaches and decreased egg and hatchling success. Increasing air and sea surface temperatures are strongly correlated to elevated sand temperatures, which can lead to skewed hatchling sex ratios and embryonic mortality. Currently, a strong female hatchling bias (94%) is observed at northern nesting beaches in Bahia and Sergipe, while a more balanced hatchling sex ratio is observed at southern beaches in Espirito Santo and Rio de Janeiro (53% female) (Marcovaldi *et al.* 2016). Temperature changes and sea level rise are likely to change ocean currents and the movements of hatchlings, juveniles, and adults. Ocean acidification is likely to affect their forage-base. Climate change is a major threat that is likely to rival fisheries bycatch in magnitude in the near future.

Marine pollution threatens the DPS by reducing abundance and potentially productivity. High levels of plastic ingestion and bioaccumulation of contaminants in this DPS can cause mortality, and very likely sub-lethal effects that are not fully understood in loggerheads. Effects of coastal development associated with the tourism industry, such as artificial lighting and erosion, are increasing and can be expected to pose greater threats to the productivity of the DPS in the future. Egg predation by foxes, armadillos, and coatis continues to occur despite monitoring efforts, posing a moderate threat to the DPS's productivity.

Synthesizing the best available data, we conclude that the status of the DPS has not changed since it was listed as threatened in 2011. The listing was based on the Status Review Team's determination that although the DPS exhibited increasing nesting trends starting in 1988, it would likely decline in the foreseeable future largely due to mortality of juvenile loggerheads from fishery bycatch occurring throughout the South Atlantic Ocean. Though nesting has continued to increase, the population remains small: at the time of the Status Review, nesting abundance was estimated at 6,800 nests per year, and is now estimated at 7,700 nests per year. The increasing nesting trend, while important and encouraging, is not of adequate magnitude to alter the threatened listing status of the DPS as it remains small and faces intense (fisheries bycatch and climate change) and numerous (habitat loss and modification, overutilization) threats that are likely to increase in the future. High mortality of juveniles and sub-adults caught as bycatch at foraging grounds is yet not reflected in current nesting abundances; therefore, it is important to be cautious as positive trends observed at nesting beaches may change in the future when these cohorts mature (López-Mendilaharsu *et al.* 2020). We conclude that the status of the species should remain threatened.

2.3.7 Northeast Atlantic Ocean DPS

2.3.7.1 DPS Introduction:

The Northeast Atlantic Ocean DPS of the loggerhead turtle was listed as an endangered species on September 22, 2011 (76 FR 58868). The 2009 Status Review concluded that the DPS was at risk of extinction at the time of publication despite moderately large nesting abundance (12,028 nests in 2008, 20,102 nests in 2009, and 9,174 nests in 2010 reported from approximately 68 km of beach on Boa Vista Island). This determination was based on evidence of significant declines from historical abundances, intense harvest of nesting females, low hatching and emergence success, and mortality from fisheries bycatch.

As described in the listing, turtles of the DPS originate from the Northeast Atlantic Ocean north of the equator, south of 60° N. Lat., and east of 40° W. Long., except in the vicinity of the Strait of Gibraltar where the eastern boundary is 5°36′ W. Long. (76 FR 58868). Nesting occurs primarily on the Cape Verde Archipelago. Foraging occurs at different locations in waters of the Northeast Atlantic Ocean, dependent on life stage and foraging strategy. Adult females of this DPS are predominately oceanic foragers settling in highly productive areas between the Cape Verde Archipelago and the West African mainland and avoiding oligotrophic areas to the west of Cape Verde (Hawkes *et al.* 2006; Eder *et al.* 2012; Scales *et al.* 2015). Neritic-foraging females forage over the African continental shelf from Mauritania to Sierra Leone (Hawkes *et al.* 2006; Pikesley *et al.* 2015). Adult males tagged off Boa Vista use both oceanic and neritic waters off Senegal and Mauritania as foraging areas (Varo-Cruz *et al.* 2013).

2.3.7.2 Abundance, population trends, demographic features, or demographic trends:

Available data indicate that the Cape Verde Archipelago is the main rookery for this population, with few loggerhead turtle nests reported from Mauritania and Guinea (Casale and Marco 2015). The Archipelago hosts an estimated 95% of the population's nests, and beaches on the eastern half of the island of Boa Vista host between 80% and 85% of all nests (Marco *et al.* 2012). On Boa Vista, nest counts for the years 2007-2009 were estimated at 13,955, 12,028, and 19,950 respectively. Using a remigration interval of 2.4 years and clutch frequency of 3 to 5 nests per individual (Varo-Cruz *et al.* 2007), the adult female population has been estimated at 8,900, with a mean of 3,700 females nesting each year (Marco *et al.* 2012). More recently, nest counts on Joao Barrosa beach, Boa Vista reportedly increased from approximately 4,000 in 2017 to 14,000 in 2018 (Marco et al. 2018).Though monitoring has traditionally been focused on Boa Vista, recent expansion of nesting surveys reveals that other significant nesting areas exist, and that the overall nesting population may have been previously underestimated. For instance, significant nesting populations occur on the island of Santa Luzia, with 1,810 nests observed in 2012 and 555 nests observed in 2013 (Rocha *et al.* 2015). On the island of Maio, 382 nests were recorded in 2008 (Cozens *et al.* 2011) and nearly 2,000 were reported in 2012 (Martins *et al.* 2013). The annual number of nests on the island of Sal increased from 506 in 2008 to 7,771 in 2017 (Laloë *et al.* 2020). Annual nest numbers for the whole of Cape

Verde were most recently estimated at 43,500 (Inforpress 2018, as cited in Laloë *et al.* 2020)

Laloë *et al.* (2020) report a 15-fold increase in nest numbers over a 10-year period for an observed rate of change of 25% per year, though the lack of consistent, long-term monitoring at nesting beaches (Casale and Marco 2015) reduces our confidence in this trend. The reasons behind the increase in nest numbers are uncertain, but reduced take of turtles on land and at sea may be a contributing factor (Laloë *et al.* 2020). Marco *et al.* (2018) express concern for the status of the DPS as the recapture rates of females remain very low, which indicates high mortality. Additional monitoring is needed to determine comprehensive long-term trends for the population.

2.3.7.3 Genetics, genetic variation, or trends in genetic variation:

In the Northeast Atlantic population, comparisons using 380 bp segments of the mtDNA control region and 12 microsatellite loci showed no significant genetic differentiation between females nesting on three different islands of the Cape Verde Archipelago (mtDNA $F_{ST} = 0.001$, P>0.02; nDNA $F_{ST} = 0.001$, P>0.126) (Monzón-Argüello *et al.* 2010). However, a more recent study using a 720 bp fragment of the mtDNA control region and eight microsatellite loci found high and significant genetic differentiation between four islands of the Archipelago, with strong genetic structuring in islands towards the west and slightly weaker structuring in the eastern islands that have higher nesting density (Stiebens *et al.* 2013). This differing result is likely due to the extended sampling scheme used by Stiebens *et al.* (2013), which also included nesting locations that had not been previously sampled. Through the sequencing of major histocompatibility complex (MHC), genetic variation and adaptive capacity of the DPS was found to be high (Stiebens *et al.* 2013).

2.3.7.4 Spatial distribution, trends in spatial distribution, or historic range:

The vast majority of nesting occurs on Cape Verde Archipelago, where the total length of known nesting beaches is 212 km (Casale and Marco 2015). Abella Perez *et al.* (2016) reports that about 50% of the coast of Boa Vista is free from development, most of which is concentrated in the north-west of the island. On Santiago Island, however, the sand extraction and tourism industries have contributed to reductions in the number of suitable loggerhead nesting sites and quality of existing nesting sites (Loureiro 2008). As both the total area of nesting distribution and number of nesting locations are low, and amount and quality of suitable nesting habitat is declining in certain areas, we find that the DPS's risk of extinction due to environmental perturbations or catastrophic events is increased.

Juvenile feeding grounds of this loggerhead population have been identified using genetic markers in the eastern Atlantic, and include the waters of France, Azores, Madeira and Canary Islands, as well as the western Mediterranean (Monzón-Argüello *et al.* 2010; Carreras *et al.* 2011). Adult females of this DPS are predominately oceanic foragers settling in highly productive areas between the Cape Verde Archipelago and the West African mainland, and avoiding oligotrophic areas to the west of Cape Verde (Hawkes *et al.* 2006; Eder *et al.*

2012; Scales *et al.* 2015). Neritic-foraging females are estimated to make up about 14% of the population (Eder *et al.* 2012) and are known to forage over the African continental shelf from Mauritania to Sierra Leone (Hawkes *et al.* 2006; Pikesley *et al.* 2015). Adult males tagged off Boa Vista use both oceanic and neritic waters off Senegal and Mauritania as foraging areas (Varo-Cruz *et al.* 2013). While Pikesley *et al*. (2015), Varo-Cruz *et al*. (2013) and Eder *et al*. (2012) suggest that neritic male and female adults are larger than oceanic adults, a new study using stable isotope analysis reports that CCL is not a good predictor of foraging strategy (Cameron *et al.* 2019). Overall, marine distribution for the DPS is quite large (Casale and Marco 2015).

2.3.7.5 Five-factor analysis:

<u>Present or threatened destruction, modification or curtailment of its habitat or range</u>:

Terrestrial

As described in section 2.3.1.3, debris on nesting beaches can negatively affect loggerhead hatchlings by extending crawl times from nest to ocean. In a preliminary study of marine debris on three beaches of Boa Vista Island (Laiedo Texeira, Calheta do Pau, and Nho Martin), fiber debris (likely from fishing activities) was most commonly found, followed by plastic (Aguilera *et al.* 2018). Further research is required to determine to what extent debris on nesting beaches affects loggerhead hatchlings in Cape Verde.

As tourism-related coastal development increases on the shores of Cape Verde, especially on the islands of Boa Vista and Sal, artificial lighting is becoming a greater concern for nesting females and hatchlings (Silva *et al.* 2017). Nesting activity on Sal from 2008-2010 showed a decreasing trend in areas of high tourism activity or construction, which is concentrated on the southern and southwestern coasts (Taylor and Cozens 2010). Over the 3 studied nesting seasons the ratio of nests to false crawls decreased on the disturbed Tortuga Beach from an average of 28-30% to 17.86%, indicating an increased proportion of false crawls, and the number of nests relocated due to light pollution increased by 23.76% (Taylor and Cozens 2010). On Santiago Island, sand extraction and construction for the tourism industry has reduced the number of beaches suitable for turtle nesting from 53 to 18 in recent years (Loureiro 2008). With more resorts under construction and tourism expected to increase, threats of disturbance by visitors, sand compaction, and light pollution will likely decrease the amount of suitable nesting habitat (Taylor and Cozens 2010) and influence productivity of the DPS.

Marine

Anthropogenic pollutants such as polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and organochlorine pesticides (OCPs) were present in female loggerheads nesting on Boa Vista and were linked to potential negative health consequences (Camacho, Luzardo*, et al.* 2013). The presence of PAHs may be associated with oil production and spills off Mauritania, Senegal, Gambia, Guinea-Bissau, Guinea, and Sierra Leone (Camacho, Luzardo*, et al.*

2013). Compared to loggerheads stranded in the Canary Islands (Northwest Atlantic Ocean DPS), loggerheads nesting on Cape Verde had lower levels of contaminants (Camacho, Boada*, et al.* 2013).

Overutilization for commercial, recreational, scientific, or educational purposes: Nesting females are intensely hunted on Cape Verde, and despite recent protection laws and community-based efforts, a serious threat to the population is posed by poachers (Marco *et al.* 2012). The killing and consumption of sea turtles in Cape Verde is prohibited, and in 2015 the government of Cape Verde approved a decree to make turtle harvest a criminal, rather than civil, offense (Hancock *et al.* 2017). Non-governmental organizations provide beach protection and raise awareness, and though many Cape Verdeans are aware of the laws, they continue to consume turtle meat (Hancock *et al.* 2017). Marco *et al*. (2012) estimated that in the years 2007-2009, nesting females were harvested at rates of 36%, 18%, and 5% respectively. In 2012, the island of Maio had the highest number of turtles killed (152) and nests poached in Cape Verde, though with nightly monitoring instituted in 2013, the total number of females killed was reduced by 75% (38 individuals harvested) and only 2% of nests were poached (Dutra and Koenen 2014). Despite an apparent decrease in active harvesters, sellers, and consumption, overuse for trade and consumption remains a major threat to this DPS as demand for turtle meat remains high (Hancock *et al.* 2017). In fact, Hancock *et al*. (2017) report that there has been a shift from subsistence harvest to commercial harvest on Boa Vista, potentially driven by increasing demand for turtle meat in the cities of Praia and Sal Rei. Based on interviews with fishermen, Hancock *et al.* (2017) estimate that at least 50-114 loggerheads are harvested each year by fishermen on Boa Vista and Santiago combined. We will continue to monitor this threat and its impact on abundance and productivity to determine whether its mitigation has been sufficient to alter the status of the DPS.

Disease or predation: Ghost crab (*Ocypode cursor*) predation on loggerhead eggs is one of the main natural threats to this population (Marco *et al.* 2015). On Boa Vista nesting beaches, more than 98% of nests are attacked by ghost crabs, which can predate up to 50% of eggs on some important nesting beaches (Marco *et al.* 2015). Relocation of nests to hatcheries and use of plastic mesh cages was shown to significantly reduce predation, though these measures can be extremely costly (Marco *et al.* 2015).

The fungus *Fusarium solani* was found to cause egg mortality on Boa Vista, sometimes resulting in 100% mortality in infected nests (Sarmiento-Ramirez *et al.* 2010). Though the threat posed to the population by fungal infection is not quantified, it is clear that it poses a high risk in affected areas.

Inadequacy of existing regulatory mechanisms: An overview of regulatory mechanisms that apply to loggerhead sea turtles globally is provided in section 2.3.1.3. The following mechanisms occur within the range of the Northeast Atlantic Ocean DPS.

African Convention on the Conservation of Nature and Natural Resources (Algiers Convention)
Additional information on this instrument can be found in section 2.3.3.4.

Convention on the Conservation of Migratory Species of Wild Animals, Memorandum of Understanding Concerning Conservation Measures for Marine Turtles of the Atlantic Coast of Africa (Abidjan Memorandum)
This MOU became effective in 1999 under the auspices of the Convention on the Conservation of Migratory Species of Wild Animals (CMS). The MOU area covers 26 Range States along the Atlantic coast of Africa extending approximately 14,000 km from Morocco to South Africa. The goal of this MOU is to improve the conservation status of marine turtles along the Atlantic Coast of Africa. It aims at safeguarding six marine turtle species – including the loggerhead turtle – that are estimated to have rapidly declined in numbers during recent years due to excessive exploitation (both direct and incidental) and the degradation of essential habitats. This includes the projection of hatchlings through adults with particular attention paid to the impacts of fishery bycatch and the need to include local communities in the development and implementation of conservation activities. However, despite this agreement, killing of adult turtles and harvesting of eggs remains rampant in many areas along the Atlantic African coast. Additional information is available at https://www.cms.int/atlantic-turtles/en/page/agreement-text-8.

The Convention for the Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (Abidjan Convention)
The Abidjan Convention covers the marine environment, coastal zones, and related inland waters from Mauritania to Namibia. The Abidjan Convention countries are Angola, Benin, Cameroon, Cape Verde, Congo, Cote d'Ivoire, Democratic Republic of Congo, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mauritania, Namibia, Nigeria, Sao Tome and Principe, Senegal, Sierra Leone, and Togo. The Abidjan Convention is an agreement for the protection and management of the marine and coastal areas that highlights sources of pollution, including pollution from ships, dumping, land-based sources, exploration and exploitation of the sea-bed, and pollution from or through the atmosphere. The Convention also identifies where co-operative environmental management efforts are needed. These areas of concern include coastal erosion, specially protected areas, combating pollution in cases of emergency, and environmental impact assessment. The Action Plan and the Abidjan Convention were adopted by the Governments in 1981; the Convention entered into force in 1984. Western Sahara and Morocco are not signatories of the Abidjan Convention.

Cape Verde protects loggerhead through national laws penalizing the harvest and consumption of marine turtles, and in 2015, environmental authorities authorized a decree to reinforce this law by making harvest a criminal rather than civil offense (Hancock *et al.* 2017). As such, Cape Verde prohibits the intentional capture, detention, and killing of live turtles, purchase or sale of live or dead turtles and by-products, as well as consumption of meat, eggs, or by-products of marine turtles (Hancock *et al.* 2017). In May 2018, the government of Cape Verde approved a law criminalizing the capture of sea turtles, the consumption or commercialization of any of their parts, and the destruction or alteration of their nesting habitat (Patino-Martinez *et al.* 2019). Despite targeted interventions, illegal harvest of marine turtles on nesting beaches and waters surrounding Cape Verde persists, likely due to lack of surveillance and enforcement on land and at sea (Hancock *et al.* 2017).

<u>Other natural or manmade factors affecting its continued existence:</u>
Bycatch
Several loggerheads stranded on the Mauritanian coast were observed to have swallowed longline fishing hooks, indicating a potential effect of artisanal and industrial fishing fleets in the Mauritanian EEZ on loggerheads foraging in these areas (Hama *et al.* 2019). There are no official data on incidental catch of sea turtles in Mauritanian waters, however (Hama *et al.* 2019).

Around the island of Maio, Cape Verde, artisanal fishermen and semi-industrial fishing fleets originating from Praia, Santiago, report loggerhead bycatch (Lopes *et al.* 2016). Turtle bycatch was reported by 31% of artisanal fishermen using mainly hook and line, and by 33% of semi-industrial fishermen, using purse seines and surface longlines (Lopes *et al.* 2016). Loggerheads are the most commonly reported turtle bycaught by both artisanal (76% of bycaught turtles) and semi-industrial (46% of bycaught turtles) fishermen (Lopes *et al.* 2016).

Portuguese longline vessels operating in waters surrounding the Cape Verde Archipelago bycaught 22 loggerheads over 202 experimental longline sets, though most were released alive (Coelho *et al.* 2015). Cape Verdean fishermen who are seasonally recruited to work on Spanish and Portuguese fishing vessels in Cape Verdean waters were interviewed between 2011 and 2012 (Melo and Melo 2013). Fishermen reported that turtles are regularly captured (mean 4.2 per longline set) and most are presumed to be loggerheads based on their size (Melo and Melo 2013). Most turtles were dead at the time of retrieval, but for those still alive, regular practice was to kill the turtles for meat, release turtles with hooks remaining, or to make an effort to free turtles from hooks (Melo and Melo 2013). Further, 29% of interviewees reported that turtle meat was illegally sold in Cape Verdean ports (Melo and Melo 2013). Though further quantification of the threat is needed, bycatch seems to be occur fairly frequently and due to the local consumption of turtle meat, there seems to be an incentive to retain bycaught turtles.

Overall, both oceanic and neritic loggerheads of this DPS are at risk of being bycaught in industrial trawl and longline fisheries, as well as artisanal fisheries

(Pikesley *et al.* 2015). The spatial distribution of the DPS over many EEZs and the sale of fisheries access agreements to Distant Water Fleets by many west African countries makes enforcement, management, and monitoring of fisheries affecting these loggerheads quite difficult (Pikesley *et al.* 2015).

Climate change

Rising surface air temperatures associated with climate change have the potential to significantly affect hatchling production as loggerheads exhibit temperature dependent sex determination. Recent studies find that hatchling sex ratios in this DPS are highly skewed: on Boa Vista, 79.15% female hatchlings were produced between 2005 and 2008 (Abella Perez *et al.* 2016), and a current ratio of 84% females is estimated across all rookeries in Cape Verde (Tanner *et al.* 2019). Satellite-tracking studies suggest that males may remigrate yearly, potentially helping to re-balance operational sex ratios (Varo-Cruz *et al.* 2013). Even so, the DPS's female-biased sex ratios are of concern as climate change may create a scenario where incubation temperatures rise to the point that the DPS produces zero male hatchlings.

Under low emissions conditions predicted by the IPCC (leading to a rise in surface air temperature of 1.8°C by 2090-2099), future hatchling sex ratios across Cape Verde are expected to become extremely skewed with over 99% females produced (Tanner *et al.* 2019). Under the medium emissions scenario (increase of 2.8°C), male hatchling production would reach 0.01% and under the high emissions scenario (increase of 3.4°C), male production would stop altogether (Tanner *et al.* 2019).

Tanner *et al.* (2019) and Abella Perez *et al.* (2016) argue that to some degree, loggerheads of this DPS may be able to adapt to climate change through altered nesting seasons, nesting sites, or nest depths. For instance, if females in Boa Vista modify their nesting phenology to begin nesting one month earlier over the next century, with an increase of 2°C, 96.15% female hatchlings would be produced; if turtles began nesting two months earlier in April, 71.27% female hatchlings would be produced (Abella Perez *et al.* 2016). Abella Perez *et al.* (2016) suggests that since loggerheads nesting in Boa Vista currently nest in the warmest part of the island and during the warmest part of the year (June through October), loggerheads could shift nesting both temporally and spatially to adapt to increasing temperatures (Abella Perez *et al.* 2016). Though there is potential for loggerheads to adapt to rising temperatures, Abella Perez *et al.* also note that it is not possible to ascertain the time scale at which these adaptations could occur. Additionally, earlier nesting has been shown to reduce the length of the nesting season, potentially leading to reduced productivity (Pike *et al.* 2006). In all, we conclude that the DPS currently has highly female-biased hatchling sex ratios (84% female) that will likely become further skewed due to climate change in the future. Though adaptation to climate change is possible, it is unclear how long it will take loggerheads to adapt or what the consequences of those adaptations will be on the productivity of the population.

2.3.7.6 Synthesis:

The Northeast Atlantic Ocean DPS of the loggerhead turtle was listed as an endangered species on September 22, 2011 (76 FR 58868). We conducted this 5-year review to evaluate the best available information and to determine whether to recommend a change in the status of the DPS.

The best available abundance data are gathered at nesting beaches. Annual nest counts for the whole of Cape Verde were most recently estimated at 43,500 (Inforpress 2018, as cited in Laloë *et al.* 2020). Though the DPS has shown recent nest count increases, consistent long-term monitoring data is not available across the population (Casale and Marco 2015) and islands other than Boa Vista have only recently become recognized as important nesting sites (Rocha *et al.* 2015). The DPS has a limited nesting distribution, which increases its risk of extinction because a narrowly distributed DPS is more likely to go extinct due to environmental perturbations or catastrophic events than one that is widely distributed.

The main threat to the DPS is overutilization due to harvest for human consumption. Other threats include fisheries bycatch, climate change, habitat degradation at nesting beaches, pollution, and predation.

Nesting females and eggs are poached at high levels in Cape Verde for human consumption. Even with outreach and awareness campaigns, increased monitoring, and recent legislation strengthening protections against harvest, poaching continues to endanger the DPS. Females nesting on Boa Vista were poached at rates of 5-36% per year between 2007 and 2009 (Marco *et al.* 2012). Based on interviews with fishermen, Hancock et al. (2017) estimate that at least 50-114 loggerheads are harvested each year by fishermen on Boa Vista and Santiago combined. Additional protections went into effect in 2015 and 2018, though poaching continues because demand remains high and has potentially increased in urban areas (Hancock *et al.* 2017). We do not yet have adequate data to determine whether such changes have been sufficient to reduce this threat and alter the status of this DPS. Poaching adults decreases both abundance and productivity of the DPS by removing large proportions of reproductive females from the population; poaching of eggs reduces the amount of viable offspring that will be produced. As this traditional practice has been occurring over a long time period and demand continues to be high despite interventions, we conclude that the negative effect on productivity is and will continue to be high.

Bycatch in artisanal and industrial fisheries using a variety of gear threatens the DPS. Compounding the effects of mortality and injury from bycatch is the incentive for fishermen to keep, rather than release, incidentally caught loggerheads due to the existence of the illegal market for turtle meat. Fisheries bycatch reduces abundance and productivity of the DPS by removing those individuals (i.e., adults and large juveniles) that survived decades of development and have the greatest potential to contribute to future generations.

Climate change also threatens the DPS. Sea level rise is likely to reduce the availability and increase the erosion rates of nesting beaches. Increased storm frequency and intensity are likely to result in altered nesting beaches and decreased egg and hatchling success. Increasing air and sea surface temperatures are strongly correlated to elevated sand temperatures, which can lead to skewed hatchling sex ratios and embryonic mortality. Currently, the DPS has a strongly female-biased hatchling sex ratio estimated at about 84% female; by 2100 under a high emissions scenario, male production is predicted to stop entirely in Cape Verde (Tanner *et al.* 2019). Temperature changes and sea level rise are likely to change ocean currents and the movements of hatchlings, juveniles, and adults. Ocean acidification is likely to affect their forage-base. Climate change is a major threat that is likely to rival harvest for human consumption in magnitude in the near future.

Egg predation by ghost crabs occurs at high levels, reducing productivity of the DPS by decreasing hatching success. Though active management of this threat is ongoing, mitigation is expensive and therefore limited. Increasing coastal development driven by the tourism industry reduces quantity and quality of suitable nesting beaches and exposes the DPS to artificial light pollution, reducing hatching success and therefore productivity. Additionally, anthropogenic contaminants and marine debris affect the DPS and have been linked to negative health effects, though they are not fully understood.

Synthesizing the best available data, we conclude that the status of the DPS has not changed since it was listed as endangered in 2011. The 2009 Status Review concluded that the DPS was at risk of extinction at the time of publication despite moderately large nesting abundance (12,028 nests in 2008, 20,102 nests in 2009, and 9,174 nests in 2010 reported from approximately 68 km of beach on Boa Vista Island). This determination was based on evidence of significant declines from historical abundances, intense harvest of nesting females, low hatching and emergence success, and mortality from fisheries bycatch. The population currently has moderate abundance, and population trends appear to be increasing though historical nesting data across the range of the DPS are not available. Poaching of nesting females, the most reproductively valuable members of the population, continues to pose a severe threat due to continued demand for turtle meat. Reduction of harvest of nesting females for meat is currently dependent on active nightly patrols by conservation projects on most of the main nesting beaches. Numerous additional threats (fisheries bycatch, predation, climate change, and habitat modification) continue to endanger this DPS, several of which are expected to increase (habitat modification through coastal development, climate change). Though mortality of females on beaches has been reduced, there is no evidence that mortality at sea has decreased (Marco *et al.* 2018). In addition, the recapture rates of adult females remains low, indicating that high mortality is continuing (Marco *et al.* 2018). The DPS's narrow nesting distribution and the combined effect of several continuous and intense threats to the most reproductively valuable members of the population put this DPS at risk of extinction now, rather than the foreseeable future. We conclude that the status of the species should remain endangered.

2.3.8 Mediterranean Sea DPS

2.3.8.1 DPS Introduction:

The Mediterranean Sea DPS of the loggerhead turtle was listed as an endangered species on September 22, 2011 (76 FR 58868). The 2009 Status Review concluded that the DPS was at risk of extinction at the time of publication because despite abundance of 7,200 nests per year, modeling showed that the DPS would likely decline in the foreseeable future, even under the scenario of the lowest anthropogenic mortality rates. This result was driven by high levels of mortality from fisheries bycatch, threats to nesting beaches, and ineffective protection of loggerheads even with some conservation efforts in place.

As described in the listing, turtles of the DPS originate from the Mediterranean Sea east of 5°36′ W. Long. (76 FR 58868). More than 96% of clutches are laid in Greece, Turkey, Libya and Cyprus, with minor nesting occurring along the Mediterranean coasts of Egypt, Israel, Italy, Tunisia, Lebanon and Syria (Casale *et al.* 2018). Nesting occurs in the eastern Mediterranean Basin, primarily in Cyprus, Greece, Turkey and Libya. Foraging occurs at different locations in waters of the Mediterranean Sea, dependent on life stage and foraging strategy. Primary neritic foraging habitat is located in the northern Adriatic Sea and the continental shelf off of Tunisia and Libya (Zbinden *et al.* 2011; Luschi and Casale 2014). Adults show high behavioral plasticity and also forage in offshore oceanic waters in different seasons and years (Luschi and Casale 2014; Luschi *et al.* 2017). A more complete discussion of spatial distribution can be found in section 2.3.8.4.

2.3.8.2 Abundance, population trends, demographic features, or demographic trends:

More than 96% of clutches of this DPS are laid in Greece, Turkey, Libya and Cyprus (Casale *et al.* 2018). Recent nest estimates, accounting for unsurveyed beaches in Libya and unmonitored nests on minor or unknown Mediterranean nesting beaches, consider 7,250 as a minimum, 8,300 as most likely, and 8,800 as a maximum number of nests per year for the entire DPS (Casale and Heppell 2016). Casale and Heppell estimate total population size for the DPS using a simulated demographic structure, taking into account the following parameters: number of nests per year, remigration interval, number of nests per female per season, sex ratio, age at maturity, eggs per nest, hatchlings to sea per egg, and adult survival (2016). Using the most likely values of 8,300 nests per year and 1.9 nests per female per breeding season (Casale and Heppell 2016), approximately 4,370 females nest each year. By using an average remigration interval of 2.3 (Casale and Heppell 2016), the total female population can be estimated at about 10,000 individuals. A similar estimate of adult female abundance (9,963) is reported in Casale's IUCN Red List Assessment for Mediterranean loggerheads (2015a). Casale and Heppell (2016) estimate a total abundance of 15,843 adults

(95% CI: 6,915−31,958), which includes males, and a total population abundance of between 1,197,087 and 2,2364,843. This estimate incorporated numerous assumptions and should therefore be viewed as an attempt to convey the order of magnitude of abundance rather than an exact figure (Casale and Heppell 2016).

Across 16 rookeries in four countries (Greece, Turkey, Cyprus and Israel), time series data comparisons show an overall positive population trend (7% from historical nesting to current nesting), though time series data varied widely (for instance, while available data from Zakynthos, Greece spanned 1984-2012, data from Dalaman, Turkey only spanned 2002-2013) (Casale 2015a). Trends varied across the examined rookeries, and all but one index site in Greece had negative trends (Casale 2015a). The 16 examined index sites host 3,200 nests per year, constituting less than 50% of the entire subpopulation (Casale 2015a). For these reasons, and as long-term monitored sites have likely benefited from long-term protection and therefore may not be representative of the whole population, the trend should be interpreted cautiously. Another trend estimate comparing abundance at 21 rookeries before and including 1999, and from 2000 on, indicates a positive trend, noting that the results should be taken with an abundance of caution as nest count quality across the population is poor (Casale *et al.* 2018). Comparison of two sets of bycatch data collected 20 years apart from longliners in the Gulf of Taranto, Ionian Sea, shows higher rates of loggerhead bycatch in recent years (Casale, Aprea*, et al.* 2012). Cautious interpretation of this data suggests that turtle populations in this area are not declining (Casale, Aprea*, et al.* 2012). Overall, the Mediterranean DPS appears to have an increasing trend based on the general agreement of recent analyses.

Tagging studies in Laganas Bay, Zakynthos, Greece reveal a mean remigration interval of 2.3 years for female loggerheads while tracking data show that males remigrate every year (Hays *et al.* 2010). Though hatchling sex ratios have been estimated at 70% female and 30% male (2.33:1), operational sex ratio is closer to 1:1 as mature males visit the breeding site approximately two to three times more often than mature females (Hays *et al.* 2010; Hays *et al.* 2014). The juvenile sex ratio in the Tyrrhenian Sea is approximately 1.56:1 females to males (Maffucci *et al.* 2013). Mediterranean loggerheads have been reported to reach maturity between 14.9 and 28.5 years and a CCL of 66.5 to 84.7 cm (Casale, Conte*, et al.* 2011). Based on the mean size of nesting loggerheads of 80 cm, Casale and Heppell estimate that age at maturity ranges from 21-34 years, with an average of 25 years (2016).

2.3.8.3 Genetics, genetic variation, or trends in genetic variation:

The Mediterranean Sea DPS contains seven genetically distinct management units identified through mtDNA markers: (1) Calabria, Italy, (2) Rethymno (Crete, Greece) (3) western Turkey, (4) western Greece, (5) Dalyan & Dalaman Turkey, (6) Libya and Tunisia, and (7) the remaining eastern basin rookeries (central and eastern Turkey, Lebanon, Israel and Cyprus) (Shamblin *et al.* 2014). Based on nDNA, both female and male loggerheads demonstrate strong philopatry, though genetic similarity between distant nesting areas provides evidence of some male-mediated gene flow (Clusa *et al.* 2018). Thus the DPS is made up of several low abundance subpopulations, rather than a single population of moderate abundance.

2.3.8.4 Spatial distribution, trends in spatial distribution, or historic range: Satellite tracking of male and female adult and juvenile loggerheads in the Mediterranean provides new insight into their spatial behavior. More than 96% of clutches are laid in Greece, Turkey, Libya and Cyprus, with minor nesting occurring along the Mediterranean coasts of Egypt, Israel, Italy, Tunisia, Lebanon and Syria (Casale *et al.* 2018). Recent sporadic nesting has been observed in the western Mediterranean along the coasts of western Italy, Spain, and France; these nests represent an ongoing colonization, possibly as a response to rising air temperatures (Carreras *et al.* 2018). The total length of known nesting beaches for the DPS is 1,490 km with many known nesting locations (Casale 2015a). We find that though the nesting beaches in the Mediterranean are mainly separate and relatively short (as opposed to a continuous stretch) the large distribution and diversity of nesting locations reduce the DPS's vulnerability to extinction due to environmental perturbations or catastrophic events.

Generally, adult females and males migrate away from nesting beaches in the central and eastern Mediterranean to neritic foraging habitat, often showing fidelity to small areas; two main destinations for such migrations are the northern Adriatic Sea and the continental shelf off of Tunisia and Libya (Zbinden *et al.* 2011; Luschi and Casale 2014). Though this pattern is quite common, loggerhead adults show high behavioral plasticity and also forage in offshore oceanic waters in different seasons and years (Luschi and Casale 2014; Luschi *et al.* 2017). Adult males have been tracked from Zakynthos, the largest known Mediterranean nesting rookery, to the following oceanic and neritic foraging grounds to which they show high fidelity in subsequent years: the north and central Adriatic Sea, central Ionian Sea, Izmir Bay, Turkey, and Amvrakikos Gulf, Greece (Schofield *et al.* 2010). Each foraging area may host turtles from numerous nesting areas, for example large juvenile and adult loggerheads foraging in Amvrakikos Gulf were shown through satellite tracking, flipper tag returns, and genetic analyses to originate from rookeries in Zakynthos, Turkey, Cyprus and Libya (Rees *et al.* 2017). Waters off Tunisia are important foraging habitat for adult males from Greek and Libyan rookeries (Casale *et al.* 2013) as well as females from Greek rookeries (Zbinden *et al.* 2011). Females nesting in North Cyprus have been tracked to foraging grounds in coastal waters of Italy, Turkey, Syria, Lebanon, Israel, Egypt, Libya, Tunisia, and the Tunisian plateau (Snape *et al.* 2016; Haywood *et al.* 2020). The home range of neritic foragers is estimated to be approximately 10 km^2 while that of oceanic foragers is approximately 1,000 km^2, likely due to distribution of prey in each area (Schofield *et al.* 2010).

The spatial behavior of juveniles is much more varied than that of adults. Movement of small juveniles in their first years of life (often called the "lost years" due to extreme difficulty of observation) have been simulated through particle dispersal in the Mediterranean. Hatchlings from the Levantine (eastern-most) and south-central Mediterranean are likely to stay in the same areas, while those from Ionian areas disperse to the Ionian, Adriatic, and south-central zones (Casale and Mariani 2014). Satellite tracking of post-hatchlings from nesting beaches on the Mediterranean cost of Spain (outside the typical nesting range for the DPS) reveals that they spend the majority of their time in oceanic habitats, largely avoid neritic zones, and may passively drift or show directional swimming based on local conditions (Abalo-Morla *et al.* 2018). Larger juveniles (47-70 cm CCL) tagged in the northern Adriatic showed a wide variety of movements across the Mediterranean including seasonally migrating between two foraging grounds with high fidelity and wandering for long periods seemingly without a specific destination (Casale, Affronte*, et al.* 2012). Recent studies suggest that though larger juveniles do show directional swimming, their movements are largely influenced by ocean flows with passive drifting occurring at large temporal and spatial scales (Cardona and Hays 2018).

2.3.8.5 Five-factor analysis:

<u>Present or threatened destruction, modification or curtailment of its habitat or range</u>:

Terrestrial

Tourism-driven coastal development continues to modify loggerhead nesting habitat in the Mediterranean through the construction and presence of resorts, restaurants, and other businesses along the coast (Casale *et al.* 2018). In Zakynthos rookeries, existing management protocols reduce possible tourist-turtle nesting area overlap from 36% to 7% (Katselidis *et al.* 2013). Beaches with steep inclines have higher risk of damage from tourists as nests are likely to be located closer to the water in these areas, and closing steeper nesting beaches to visitors would reduce this risk of disturbance (Katselidis *et al.* 2013). Light pollution on Zakynthos nesting beaches was shown to significantly affect loggerhead hatchlings, potentially reducing recruitment from this rookery by more than 7% (Dimitriadis *et al.* 2018). Monitoring of loggerhead nesting activities on Dalaman-Sarigerme beach, Turkey, from 2002-2008 revealed that turtle nests were more highly concentrated in undeveloped sections of beach compared to the developed sections, and that turtles are shifting their nesting sites to those that are undisturbed (Kaska *et al.* 2010).

Microplastics (<5 mm) are present in the sand of nesting beaches in Cyprus down to nesting depths of 60 cm (Duncan *et al.* 2018). The top 2 cm of sand had a mean of roughly 45,500 particles per cubic meter and abundance of fragments decreased with greater depth (Duncan *et al.* 2018). As described in section 2.3.1.3, effects of microplastics on loggerhead nests are not completely understood, though it is likely that hatching success and sex ratios may be altered (Duncan *et al.* 2018).

Marine

The prevalence of marine debris in the Mediterranean Sea poses threats of entanglement and ingestion to loggerheads of this DPS. The high surface plastic load in the Mediterranean Basin (estimated between 1,000 and 3,000 tons) is likely due to high anthropogenic pressure and the hydrodynamics of the semi-enclosed basin (Cózar *et al.* 2015). Loggerheads have a higher probability of exposure to marine debris in the Adriatic Sea where across all seasons, floating plastic was found in areas with high probabilities of turtle presence (Arcangeli *et al.* 2019). In other areas such as the Sicily-Sardinia Channel, areas used by sea turtles had higher amounts of marine litter during the spring and summer (Arcangeli *et al.* 2019).

Marine debris ingestion occurs with high frequency in Mediterranean loggerheads. In a study of dead loggerheads found on the western Italian Coast between 2011 and 2014, 85% of the individuals (n=120) were found to have ingested marine debris, which was mainly detected in the intestine and stomach (Matiddi *et al.* 2017). In a study of stranded and bycaught loggerheads (mainly juveniles) collected between 1995 and 2016 in the waters of northeast Spain, debris items had been ingested by 78.1% of turtles analyzed (n=155) (Domenech *et al.* 2019). Despite high occurrence of ingestion, Domenech *et al*. found little evidence that this debris caused obstructions or perforations in the gut (Domenech *et al.* 2019). In the central Mediterranean, Casale *et al*. (2016) found an 80% debris ingestion rate in turtles caught by pelagic longlines while turtles caught by trawl nets only had a 14% debris ingestion rate, suggesting that foraging behavior (epipelagic vs. benthic) is related to plastic ingestion. Similar to other studies, debris ingestion led to mortality in very few cases and sublethal effects were unclear (Casale *et al.* 2016). In the Adriatic, ingested marine debris was present in about 35% of stranded or bycaught dead individuals (n=54) with soft plastics making the largest portion of ingested debris (Lazar and Gracan 2011).

Chemical pollutants have been observed in the blood and tissues of loggerheads of the Mediterranean Sea. Organic (polychlorinated biphenyls, organochlorine pesticides, and polycyclic aromatic hydrocarbons) and inorganic (mercury and zinc) compound contamination is significantly higher in Adriatic loggerheads than in Atlantic loggerheads sampled in the Canary Islands (Bucchia *et al.* 2015). Heavy metals have been reported in loggerheads stranded on the coast of Turkey (Yipel *et al.* 2017) as well as the southeastern coast of Spain, where cadmium levels were found to be associated with diet rather than age (García-Fernández *et al.* 2009). Loggerheads stranded in eastern Spain showed contamination by a high diversity of pesticides, several of which are not permitted for use in the European Union, though health effects are not clear (Novillo *et al.* 2017).

<u>Overutilization for commercial, recreational, scientific, or educational purposes</u>: Despite national and international prohibitions on capturing and consuming turtle meat, sea turtles remain a targeted species in Egyptian fisheries and are consumed and traded most commonly in Alexandria (Nada and Casale 2011). In interviews conducted in 2007, fishermen identified loggerheads as the most commonly caught species, and 34% of community members and 37% of fishermen reported that they consume turtle meat (Nada and Casale 2011). Based on reported

consumption and an estimation of approximately 7,000 turtles caught per year, there is potential that several hundred turtles are slaughtered for consumption each year in Egypt (Nada and Casale 2011). Most turtles caught as bycatch or killed for consumption were reported to be of large size. The removal of hundreds of presumably adult loggerheads reduces the reproductive capacity of the population, decreasing productivity as well as abundance; we therefore consider this a major threat to the DPS.

Disease or predation: Across nesting sites of the Mediterranean, predation of eggs and hatchlings by mammals such as feral dogs (*Canis lupus familiaris*), foxes (*Vulpes vulpes*), and jackals (*Canis aureus*), and at lower levels badgers (*Meles meles*) and martens (*Martes foina bunites*), poses a threat to loggerheads (Casale *et al.* 2018 and references therein). Predation levels range from 38% to 80% in unprotected nests (Casale and Margaritoulis 2010). Ghost crab predation has been reported in Egypt (Casale and Margaritoulis 2010) and other invertebrates such as larvae of *Pimela sp.* and *Elater sp*. are reported to infest nests on Alata Beach, Turkey at a rate of 31.25% (Aymak *et al.* 2017). In the marine environment, Mediterranean monk seals (*Monachus monachus*) have been documented to prey on loggerheads in Laganas Bay (Margaritoulis and Touliatou 2011).

Various parasites are known to infect loggerheads of the Mediterranean. Gastrointestinal parasites range in prevalence due to a number of factors including feeding habits and migration patterns; neritic-foraging loggerheads sampled in the Adriatic were found to have a 70% prevalence (Gracan *et al.* 2012) while those sampled on the southern coasts of Italy had a 36.7% prevalence (Pace *et al.* 2019). Spirorchiidiasis was observed in 16.7% of examined loggerheads from the northern Adriatic Sea, and did not appear to cause death or significantly influence health of infected individuals (Marchiori *et al.* 2017). The copepod *Balaenophilus manatorum* has been shown to consume sea turtle skin, leading to skin lesions and even death of neonates (Crespo-Picazo *et al.* 2017). The influence of intestinal and external parasites on the demographics of the DPS could be of concern, especially in combination with other stressors.

Inadequacy of existing regulatory mechanisms: An overview of regulatory mechanisms that apply to loggerhead sea turtles globally is provided in section 2.3.1.3. The following mechanisms occur within the range of the Mediterranean Sea DPS.

Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean

This Protocol is under the auspices of the Barcelona Convention of 1976 for the Protection of the Mediterranean Sea against Pollution (amended in 1995). The Protocol has been in force since 1999 and includes general provisions to protect sea turtles and their habitats within the Mediterranean Sea. The Protocol requires Parties to protect, preserve, and manage threatened or endangered species, establish protected areas, and coordinate bilateral or multilateral conservation efforts. In the framework of the Barcelona Convention, to which all Mediterranean countries are parties, the Action Plan for the Conservation of Mediterranean Marine Turtles has been in effect since 1989. The main objectives of the Action Plan are to enhance the population of marine turtles, protect their critical habitats (including nesting, feeding, wintering, and migrating areas), and improve scientific knowledge by research and monitoring. In particular, the Action Plan has focused on promulgating education and training (especially among fishermen), establishing and improving rescue centers, promoting legislation guidelines, and improving research and monitoring of sea turtles. Unfortunately, little research on or implementation of fishing gear bycatch techniques to reduce sea turtle incidental captures has occurred. Additional information is available at http://www.rac-spa.org.

Convention for the Protection of the Marine Environment of the North-East Atlantic

Also called the OSPAR Convention, this 1992 instrument combines and updates the 1972 Oslo Convention against dumping waste in the marine environment and the 1974 Paris Convention addressing marine pollution stemming from land-based sources. The convention is managed by the OSPAR Commission, which is comprised of representatives from 15 signatory nations (Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and United Kingdom), as well as the European Commission, representing the European Community. The mission of the OSPAR Convention "…is to conserve marine ecosystems and safeguard human health in the North-East Atlantic by preventing and eliminating pollution; by protecting the marine environment from the adverse effects of human activities; and by contributing to the sustainable use of the seas." Loggerheads are included on the OSPAR List of Threatened and/or Declining Species and Habitats, which is used by the OSPAR Commission for setting priorities for work on the conservation and protection of marine biodiversity. Additional information is available at http://www.ospar.org.

Convention on the Conservation of European Wildlife and Natural Habitats

Also known as the Bern Convention, the goals of this instrument are to conserve wild flora and fauna and their natural habitats, especially those species and habitats whose conservation requires the cooperation of several States, and to promote such cooperation. The Convention was enacted in 1982 and currently includes 48 European and African States and the European Union. Sea turtles are included on the "strictly protected" list. Additional information is available at http://conventions.coe.int/Treaty/EN/Treaties/Html/104.htm.

Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (EC Habitats Directive)

The EC Habitats Directive was adopted by the European Community in May 1992, as the means by which the Community meets its obligations as a signatory of the Bern Convention. It aims to protect approximately 200 habitats and 1,000 animal and plant species listed in the Directive's Annexes, of which loggerhead sea turtles are included. The provisions in the Directive require Member States to introduce a range of measures including the protection of species listed in the Annexes, undertake surveillance of habitats and species, and produce a report every six years on the implementation of the Directive. The first complete set of country data was reported in 2007. The Directive led to the establishment of a network of Special Areas of Conservation that, together with the existing Special Protection Areas classified under the separate EC Birds Directive, form a network of protected areas known as Natura 2000. Additional information is available at http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm.

Council Regulation (EC) No. 1239/98 of 8 June 1998 Amending Regulation (EC) No. 894/97 Laying Down Certain Technical Measures for the Conservation of Fishery Measures (Council of the European Union)
This measure banned the use of driftnets by 1 January 2002 for European fleets. Fleets from other nations fishing in international waters can still use driftnets.

While numerous protected areas (Natura 2000 sites, Special Environmental Protected Areas, and National Marine Parks) offer conservation benefits to loggerhead nesting sites, existing regulatory mechanisms inadequately address the predominant threat facing loggerheads: fisheries bycatch (Casale *et al.* 2018). Though measures adopted by ICCAT and GFCM are implemented through legislation in several Mediterranean countries, enforcement remains an issue. Though fishing gear modifications exist and are known to be effective in reducing turtle bycatch, they are currently not mandated by legislation in any Mediterranean country.

Other natural or manmade factors affecting its continued existence:
Bycatch
Fisheries bycatch is the main threat facing loggerheads of this DPS (Casale and Heppell 2016; Casale *et al.* 2018). A minimum of 132,000 sea turtles (including Mediterranean loggerhead, Atlantic loggerheads, and Mediterranean green turtles) are estimated to be captured annually across the Mediterranean by pelagic longlines (57,000), bottom trawlers (39,000), set nets (23,000), and demersal longlines (13,000), resulting in at least 44,000 deaths each year (Casale 2011). These fisheries are estimated to have minimum mortality rates of 30%, 20%, 60% and 40% respectively (Casale 2011). Small and artisanal vessels using set net, demersal longline, or pelagic longlines likely cause more incidental or intentional deaths than large commercial vessels (Casale 2011). Turtles greater than 40 cm CCL or 7 years of age are at greatest risk of bycatch based on available data, though all size classes except those under 20 cm CCL are bycaught (Casale 2011; Casale and Heppell 2016).

Longline fisheries typically operate in open water and largely affect pelagic loggerheads, with mortality occurring due to lesions caused by ingested hooks (Casale *et al.* 2008). In the central Mediterranean, 1,508 longline vessels bycaught approximately 8,402 loggerheads resulting in 1,175 mortalities; the Ionian Sea and Siciliy Channel had high probabilities of loggerhead bycatch by longline (Lucchetti *et al.* 2017a). Of 482 live and dead loggerheads stranded along the Sicilian coast, 129 were found to have ingested hooks from longline fishing fleets, and hooks were largely observed in the esophagus, intestinal tract, stomach and mouth (Caracappa *et al.* 2018). Loggerheads are bycaught in the swordfish (*Xiphias gladius*) and albacore tuna (*Thunnus alalunga*) longline fisheries in the Gulf of Taranto, north Ionian Sea, at rates of 0.118 and 0.309 loggerheads per 1000 hooks, respectively (Casale, Aprea, *et al.* 2012). These bycatch rates from 1998-2001 (swordfish) and 1998-2003 (albacore) were significantly higher than the same fisheries with similar fishing practices in 1978-1979 (Casale, Aprea, *et al.* 2012). Spanish surface longlines in the western Mediterranean targeting swordfish, albacore, and bluefin tuna (*Thunnus thynnus*) had an estimated post-release mortality of about 1,800 loggerheads per year between 2000 and 2016; this estimate includes loggerheads of Atlantic origin as well as Mediterranean origin (Baez *et al.* 2019). Modifications to fishing gear and strategies have led to a significant decrease in bycatch mortality rates in the Spanish surface longline from 2008-2016 (Baez *et al.* 2019). Bottom longlines targeting grouper (*Epinepheleus aeneus* and *E. marginatus*) in the Gulf of Gabes, Tunisia, bycaught loggerheads at a rate of 0.333 turtles per 1000 hooks; direct mortality was estimated at 43.75% (Echwikhi *et al.* 2012).

Set nets are used by a high number of small vessels along the entire coast of the Mediterranean (Lucchetti *et al.* 2017b, a). Loggerhead bycatch in set nets typically takes place in coastal neritic habitat and mortality is due to long soak times and eventual drowning (Lucchetti *et al.* 2017b, a). Gill nets and trammel nets targeting thornback ray (*Raja clavata*), turbot (*Scophthalmus maximus*) and common sole (*Solea solea*) in the northern Adriatic Sea are estimated to catch 5,433 loggerheads each year with mortality between 21-22% for all net types (Lucchetti *et al.* 2017b). Trammel and gill net rates of catch were observed to be 0.7 and 0.5 loggerheads per km of net, respectively (Lucchetti *et al.* 2017b). Bottom-set gillnets in the northern Adriatic have bycatch mortality rates of approximately 30%, though bycatch was eliminated when nets were illuminated with UV-LED light (Virgili *et al.* 2018). Across the central Mediterranean, 22,467 set net vessels bycaught roughly 24,000 loggerheads in 2014, resulting in an estimated 5,744 deaths (Lucchetti *et al.* 2017a).

Bottom trawling affects loggerheads in continental shelf areas foraging on demersal prey (Lucchetti *et al.* 2017a) and mortality is due to forced submersion in nets and subsequent drowning (Lucchetti and Sala 2010). In the central Mediterranean, 8,375 trawling vessels bycaught approximately 20,000 turtles in 2014 with 3082 deaths (Lucchetti *et al.* 2017a). The Adriatic Sea appears to be a hotspot for loggerhead interactions with trawls (Lucchetti *et al.* 2017a). Between 2006 and 2018, the Italian midwater pair trawl in the northern central Adriatic Sea bycaught loggerheads at 0.03 individuals per hour, or 0.016 individuals per haul, and 90% were released alive without visible injuries (Pulcinella *et al.* 2019). The

Israeli trawl fishery is estimated to catch 1,315 turtles annually (including both loggerheads and green turtles), a catch rate of approximately 0.015 turtles per hour with an observed mortality rate of 47% (Levy *et al.* 2015).

Fish aggregating devices (FADs), traditionally used to attract fish by artisanal and commercial fishing vessels, pose additional threats of entanglement to loggerheads (Blasi *et al.* 2016). In the Aeolian Archipelago, Italy, loggerheads associate with FADs constructed using palm leaves and plastic bottles anchored to the sea floor, likely because the devices offer turtles easy access to food resources (Blasi *et al.* 2016). FAD loggerhead bycatch levels, including both direct entanglement and entanglement in debris likely originating from FADs, were found to be high (19.4%) (Blasi *et al.* 2016).

To determine the cumulative impact of fisheries bycatch to the Mediterranean loggerhead population, Casale and Heppell (2016) modeled population abundance and potential biological removal (PBR) for different life stages of Mediterranean loggerheads. PBR is defined in the Marine Mammal Protection Act as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. The approach is based on the concept that anthropogenic mortality should not exceed 50% of the potential maximum productivity rate of the population (Casale and Heppell 2016). As the available bycatch data aggregates three different turtle populations, the authors consider bycatch data in the eastern Mediterranean to represent the Mediterranean loggerhead population, while the western Mediterranean and the Levantine basin are largely populated by Atlantic loggerheads and Mediterranean green turtles, respectively (Casale and Margaritoulis 2010). Comparison of PBR to mortalities due to fisheries bycatch for Mediterranean loggerheads (approximately 29,500 deaths/year at minimum) indicate that current bycatch levels are unsustainable for this population (Casale and Heppell 2016). As index nesting beaches have not yet shown evidence of decline, the authors present three hypotheses to explain their results: (1) actual abundance and PBR are greater than estimated because of undiscovered major rookeries, for example in Libya; (2) actual abundance of juveniles and PBR are greater than estimated because the population is increasing (their model assumed a stable trend) and they have not recruited to the adult stage yet, implying a recent reduction of anthropogenic impact; and (3) juvenile abundance is actually decreasing due to recent increases in bycatch mortality, which hasn't been reflected in the adult population yet due to the long maturation of the species (Casale and Heppell 2016). Further study is needed to clarify the relationship between mortality due to fisheries bycatch and the population trend for the DPS.

Overall, despite uncertainties regarding the DPS's trend, the best available data presented above lead us to conclude that fisheries bycatch poses a major threat to the DPS. Mortalities from bycatch affect both juveniles and adults, therefore reducing abundance as well as productivity by removing reproductively mature individuals.

Climate change
Rising sea surface and air temperatures are predicted to affect loggerhead reproduction across the Mediterranean, including by skewing hatchling sex ratios (Fuller *et al.* 2013) and shifting the start of nesting season (Patel *et al.* 2016). Clutches laid on Cyprus are currently estimated to produce 89% females (Fuller *et al.* 2013). In Turkey, Dalyan Beach and Goksu Beach were found to produce 61% and 81% females, respectively (Sari and Kaska 2015). Nesting beaches in Zakynthos, Greece produced an average of 59.5% female hatchlings between 1994 and 2010, and modeled predictions of future hatchling production indicate that with a temperature increase of 4.6°C by 2100, zero male hatchlings will be produced at Zakynthos beaches by 2038 (Katselidis *et al.* 2012). As temperatures are predicted to rise in the future due to climate change, beaches producing higher proportions of male hatchlings will become critical areas for conservation (Fuller *et al.* 2013). IPCC global climate models indicate that by 2100, Greece will experience a temperature increase of 3-5°C, which could in turn shift the start of nesting season 50-74 days earlier (Patel *et al.* 2016). Though this phenological shift may help to temporarily maintain nesting success, future projected temperature increases, precipitation decreases, and foraging area deterioration are likely to reduce nesting success in the Mediterranean (Patel *et al.* 2016). Almpanidou *et al*. (2017) also found that phenological shifts in the timing of nesting could serve as an effective adaptive strategy in the face of rising temperatures, though they may be less adequate for adapting to projected precipitation changes.

Mediterranean loggerheads nesting on Zakynthos exhibited changes in reproductive phenology with increased foraging ground SST (Mazaris *et al.* 2009). In the mid-term, number of clutches laid decreased, and in the short-term, nesting started earlier, though SST at breeding grounds likely play a larger role in onset of nesting (Mazaris *et al.* 2009). Further study of SST and reproduction revealed that loggerhead populations nesting at higher latitudes were significantly more influenced by inter-annual variability in SST, with warmer springs causing earlier onset nesting (Mazaris *et al.* 2013). Overall, climate change and increased SST may decrease loggerhead reproductive output and these effects will likely be more prominent in poleward populations.

Climate change and associated sea level rise is expected to negatively affect loggerhead sea turtles by inundating nests and reducing amount of beach available for nesting through erosion and flooding (Varela *et al.* 2019). At the major rookery of Alagadi, Northern Cyprus, losses of 36.5%-44.1%, 43.3%-49.4%, and 62.1%-67.4% of loggerhead clutches were projected for 0.48 meters, 0.63 m, and 1.2 m sea level rise, respectively (Varela *et al.* 2019). On Zakynthos, even under the most conservative sea level rise projections of 0.2 m over the next 100 years, approximately 38% of nesting beach area would be lost (Katselidis *et al.* 2014).

Under 0.2 m, 0.6 m, 0.9 m, and 1.3 m sea level rise scenarios, roughly 13%, 45%, 68% and 88% of currently used nesting area would be lost (Katselidis *et al.* 2014). Adaptation to sea level rise is also limited as two-thirds of this nesting habitat is backed by natural cliffs or development, restricting a landward nesting shift (Katselidis *et al.* 2014).

2.3.8.6 Synthesis:

The Mediterranean Sea DPS of the loggerhead turtle was listed as an endangered species on September 22, 2011 (76 FR 58868). We conducted this 5-year review to evaluate the best available information and to determine whether to recommend a change in the status of the DPS.

The best available abundance data are gathered at nesting beaches. Annual nesting female abundance for the DPS is approximated at 4,370, and the total adult female population is roughly 10,000, based on a recent analysis of available nesting data by Casale and Heppell (2016). We consider the abundance to be moderate. The population trend appears to be increasing, though we have low confidence in this trend as there is great variation in both observed nesting trends across rookeries and levels of monitoring effort and protection across all nesting beaches. Though certain nesting populations have shown positive trends, this is a direct result of continuous and intense conservation efforts and the status of the DPS would rapidly decline if these were removed (Casale *et al.* 2018).

The main threat to the DPS is fisheries bycatch. Harvest for human consumption is also a major threat because it removes hundreds of adult turtles from the population. Other threats include climate change, habitat degradation at nesting beaches, marine pollution, and predation.

Across the Mediterranean, bycatch in artisanal and industrial fisheries using a variety of gear types poses a major threat to the DPS. Small and artisanal vessels using set net, demersal longline, or pelagic longlines likely cause more incidental or intentional deaths than large commercial vessels (Casale 2011). Casale and Heppell (2016) estimate that fisheries bycatch is responsible for a minimum of 29,500 Mediterranean loggerhead deaths each year and conclude that current bycatch levels are unsustainable for this population (Casale and Heppell 2016). Though the authors are unclear on why the unsustainable levels of bycatch haven't resulted in evidence of decline at index nesting beaches, we conclude that mortality due to fisheries bycatch poses a major threat to the DPS. Fisheries bycatch reduces abundance and likely productivity of the DPS by removing those individuals (i.e., adults and large juveniles) that survived decades of development and have the greatest potential to contribute to future generations.

Though largely controlled by international and national legislation, human consumption continues in Egypt. Because it results in a loss of hundreds of adult loggerheads each year, overexploitation likely poses a major threat to the DPS.

Climate change also threatens the DPS. Sea level rise is likely to reduce the availability and increase the erosion rates of nesting beaches. For example, at the major rookery of Zakynthos, even under the most conservative sea level rise projections of 0.2 m over the next 100 years, approximately 38% of nesting beach area would be lost (Katselidis *et al.* 2014). Increased storm frequency and intensity are likely to result in altered nesting beaches and decreased egg and hatchling success. Increasing air and sea surface temperatures are strongly correlated to elevated sand temperatures, which can lead to skewed hatchling sex ratios and embryonic mortality. Many Mediterranean nesting areas currently have female-biased hatchling sex ratios, and Zakynthos beaches are modeled to start producing zero male hatchlings by 2038 under a scenario of a 4.6°C temperature increase by 2100 (Katselidis *et al.* 2012). Temperature changes and sea level rise are likely to change ocean currents and the movements of hatchlings, juveniles, and adults. Ocean acidification is likely to affect their forage-base. Climate change is a major threat that is likely to rival fisheries bycatch in magnitude in the near future.

Increasing coastal development driven by the tourism industry exposes nesting females and hatchlings to artificial light pollution as well as disruption by tourists, reducing hatching success and therefore productivity. High inputs of anthropogenic contaminants have been linked to negative health effects, though they are not fully understood. High levels of marine debris in the Mediterranean threaten the DPS through entanglement and ingestion of this debris, which can have lethal and sub-lethal effects likely impacting the productivity of the DPS. Egg predation by a variety of predators occurs at significant levels on unprotected nests, reducing productivity by decreasing hatching success.

Synthesizing the best available data, we conclude that the status of the DPS has not changed since it was listed as endangered in 2011. The 2009 Status Review concluded that the DPS was at risk of extinction at the time of publication because despite abundance of 7,200 nests per year, modeling showed that the DPS would likely experience future declines, even under the scenario of the lowest anthropogenic mortality rates. This result was driven by high levels of mortality from fisheries bycatch, threats to nesting beaches, and ineffective protection of loggerheads even with some conservation efforts in place. The population continues to show moderate abundance, and while population trends appear to be increasing, we have low confidence in the quality of nesting data across the range of the DPS. Since the Status Review, intense and numerous threats (fisheries bycatch, climate change, habitat modification, harvest for human consumption) have continued to endanger this DPS. The severity of these threats, specifically the removal of unsustainably high levels of reproductively valuable individuals through fisheries bycatch and human consumption, continue to put this DPS at risk of extinction now, rather than the foreseeable future. Though there is uncertainty regarding the nesting population trend and the impact of fisheries bycatch on the trend as discussed by Casale and Heppell (2016), we do not currently have enough information to support changing the status of the DPS. We conclude that the status of the species should remain endangered.

3 RESULTS

3.1 Recommended Classification

_____**Downlist to Threatened**
_____**Uplist to Endangered**
_____**Delist** *(Indicate reason for delisting per 50 CFR 424.11):*
_____*Extinction*
_____*Species does not meet the definition of an endangered or threatened species*
_____*Listed entity does not meet the definition of a species*
__*x*__**No change is needed**

4 RECOMMENDATONS FOR FUTURE ACTIONS

We recommend the following actions prior to the next 5-year review:

- Continue and/or implement consistent monitoring of index beaches for each DPS to better understand abundance, trends, and population demographics;
- Protect nesting beach habitat through long-term nesting beach protection and practices that maintain these beaches as natural environments;
- Maintain prohibitions on the directed harvest of turtles and collection of eggs for consumption or other human use;
- Prevent disturbance to nests, hatchlings, and nesting females by implementing programs to reduce the effects of artificial lighting and human beach use such as driving;
- Promote best management practices for nesting beach conservation and education projects;
- Improve monitoring and reporting of legal and illegal harvest of turtles;
- Continue efforts to reduce fisheries bycatch and expand efforts where needed;
- Promote safe handling and release techniques for bycaught turtles;
- Assess the impacts of climate change and when necessary for loggerhead conservation, incorporate ecologically sound techniques to alleviate impacts.

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U.S. FISH AND WILDLIFE SERVICE 5-YEAR REVIEW of

Loggerhead Sea Turtle (Caretta caretta): North Indian Ocean DPS, Southwest Indian Ocean DPS, Southeast Indo-Pacific Ocean DPS, South Pacific Ocean DPS, South Atlantic Ocean DPS, Northeast Atlantic Ocean DPS, and Mediterranean Sea DPS

Current Classification: Endangered (North Indian Ocean DPS, South Pacific Ocean DPS, Northeast Atlantic DPS, and Mediterranean Sea DPS) and Threatened (Southwest Indian Ocean DPS, Southeast Indo-Pacific Ocean DPS, and South Atlantic Ocean DPS)

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_x__ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: N/A

Review Conducted By: Adrienne Lohe (NMFS OPR), Earl Possardt (USFWS IA)

LEAD OFFICE APPROVAL:

The Regional Director or the Assistant Regional Director, if authority has been delegated to the Assistant Regional Director, must sign all 5-year reviews.

Lead Regional Director, Fish and Wildlife Service

Approve GARY FRAZER Digitally signed by GARY FRAZER Date: 2021.02.05 12:22:50 -05'00' Date _________

The Lead Region must ensure that other regions within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. Written concurrence from other regions is required.

Cooperating Regional Director, Fish and Wildlife Service

__Concur __ Do Not Concur

Signature____ Date_______

NATIONAL MARINE FISHERIES SERVICE
5-YEAR REVIEW
Loggerhead Sea Turtle (Caretta caretta): North Indian Ocean DPS, Southwest Indian Ocean DPS, Southeast Indo-Pacific Ocean DPS, South Pacific Ocean DPS, South Atlantic Ocean DPS, Northeast Atlantic Ocean DPS, and Mediterranean Sea DPS

Current Classification: Endangered (North Indian Ocean DPS, South Pacific Ocean DPS, Northeast Atlantic DPS, and Mediterranean Sea DPS) and Threatened (Southwest Indian Ocean DPS, Southeast Indo-Pacific Ocean DPS, and South Atlantic Ocean DPS)

Recommendation resulting from the 5-Year Review

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__x_ No change is needed

Review Conducted By: Adrienne Lohe (NMFS OPR), Earl Possardt (USFWS IA)

LEAD OFFICE APPROVAL:

Director, Office of Protected Resources, NOAA Fisheries

Approve: WIETING.DONNA.S.1365710607 Digitally signed by WIETING.DONNA.S.1365710607 Date: 2021.02.16 09:42:57 -05'00' Date: ________

HEADQUARTERS APPROVAL:

Assistant Administrator, NOAA Fisheries

DOREMUS.PAUL.N.1365829221 Digitally signed by DOREMUS.PAUL.N.1365829221 Date: 2021.02.24 15:51:34 -05'00' Concur _____ Do Not Concur

Signature DOREMUS.PAUL.N.1365829221 Digitally signed by DOREMUS.PAUL.N.1365829221 Date: 2021.02.24 15:52:14 -05'00' Date_______