NOAA. **NATIONAL MARINE FISHERIES SERVICE**
ENDANGERED SPECIES ACT
BIOLOGICAL OPINION

Agency: U.S. Environmental Protection Agency

Activity Considered: Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll *a* for the Chesapeake Bay and Its Tidal Tributaries F/NER/2003/00961

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Date Issued: April 19, 2004

Approved by: [signature]

This constitutes the National Marine Fisheries Service's (NOAA Fisheries) biological opinion (BO) on the impacts of the Environmental Protection Agency's (EPA) issuance of Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll *a* for the Chesapeake Bay and Its Tidal Tributaries on threatened and endangered species in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). This BO is based in part upon NOAA Fisheries' independent evaluation of the following: information provided in the EPA's biological evaluation (BE), the document entitled *Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries*, scientific papers, the recovery plans for endangered and threatened species present in the action area and other available sources of information. A complete administrative record of this consultation will be kept at the NOAA Fisheries' Northeast Regional Office. Formal consultation was initiated on April 25, 2003.

BACKGROUND

The principal law governing pollution of the nation's surface waters is the Clean Water Act (CWA). This law was originally enacted in 1948 as the Federal Water Pollution Control Act but was completely revised in 1972. The CWA consists of two major components, the first authorizing federal financial assistance for municipal sewage treatment plant construction and the other being the regulatory requirements that apply to industrial and municipal dischargers. Prior to 1987, programs were primarily directed at point source pollution (wastes discharged from discrete sources such as pipes and outfalls). Amendments in 1987 and subsequent years have authorized measures to address nonpoint source (NPS) pollution including stormwater runoff. To achieve its objectives, the CWA states that all discharges into the nation's waters are unlawful, unless specifically authorized by a permit. Section 402 of the CWA authorizes the National Pollutant Discharge Elimination System (NPDES) Program, the primary permitting program of the CWA, which requires the discharger to attain technology-based effluent limits. The NPDES permit program incorporates numerical effluent limitations issued by EPA.

In 1987, the Administrator of the EPA, the governors of Maryland, Virginia and Pennsylvania, the Mayor of the District of Columbia (DC), and the Chair of a tri-state legislative body known as the

Chesapeake Bay Commission signed the Chesapeake Bay Agreement. A primary goal of that agreement was a 40 percent reduction of nutrients (nitrogen and phosphorous) entering the Bay tidal waters by the year 2000. In spite of these efforts, nutrient and sediment enrichment related water quality problems have persisted throughout the Chesapeake Bay and its tidal tributaries (US EPA 2003b). Section 303(d) of the CWA requires states to develop lists of waters that do not meet water quality standards and to develop total maximum daily loads[1] (TMDLs) to enable these waters to achieve water quality standards. Maryland's portion of the Chesapeake Bay and its tidal tributaries were listed on its 1996 and 1998 CWA Section 303(d) lists of impaired waters. In May 1999, EPA Region III identified Virginia's portion of the Chesapeake Bay and portions of several tidal tributaries on Virginia's 1998 CWA Section 303(d) list. Delaware's tidal portion of the Nanticoke River and the District of Columbia's tidal Anacostia and Potomac rivers have also been listed on the Section 303(d) list. Nutrients, along with sediments, were the primary cause of impairments to the Chesapeake Bay and its tidal tributaries on the Maryland and Virginia 303(d) lists. To meet the objectives of the CWA, the EPA's implementing regulations specify that states must adopt criteria that contain sufficient parameters to protect existing and designated uses. In 1999, the EPA determined that the Chesapeake Bay was not attaining water quality standards. TMDLs would be required unless the Bay meets water quality standards before 2010.

In 2000, a new agreement entitled *Chesapeake 2000* was adopted by the Chesapeake Bay Executive Council (Chesapeake Executive Council 2000). New York, Delaware and West Virginia were brought in as watershed partners committed to the Chesapeake Bay water quality goals. The *Chesapeake 2000* agreement calls for reducing nutrient and sediment pollution enough by 2010 to remove the Bay and its tidal tributaries from the EPA's list of impaired waters, thereby averting the need for TMDLs.

Chesapeake 2000 listed three specific actions as steps to achieve its water quality goals for nutrients and sediments:

1. by April 2003, define water quality conditions (criteria) necessary to protect aquatic living resources and assign load reductions for nitrogen, phosphorous and sediment to each major tributary

2. by April 2004, complete a public process to develop and begin implementation of revised "Tributary Strategies" to achieve and maintain the assigned loading goals

3. by 2005, the jurisdictions with tidal waters will use their best efforts to adopt new or revised water quality standards consistent with the defined water quality conditions.

The "water quality conditions necessary to protect aquatic living resources" are being defined through the development of EPA guidance for Chesapeake Bay specific water quality criteria for dissolved oxygen, water clarity and chlorophyll *a* under the direction of the Chesapeake Bay Program's Water Quality Steering Committee. The criteria are being published by EPA Region III as Chesapeake Bay specific water quality criteria guidance and are being issued pursuant to the

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[1] A TMDL represents the assimilative or carrying capacity of a waterbody, taking into consideration point and nonpoint sources of pollutants of concern, natural background and surface water withdrawals. A TMDL quantifies the amount of a pollutant a water body can assimilate without violating a state's water quality standards and allocates the load capacity to known point and nonpoint sources.

Chesapeake Bay Program's statutory mandate under Section 117(b)(2)(B) of the CWA to "implement and coordinate science, research, modeling, support services, monitoring, data collection and other activities that support the Chesapeake Bay Program." These criteria provide EPA's recommendations to the States of Virginia, Delaware and Maryland and DC for use in establishing water quality standards consistent with Section 303(c) of the CWA, focusing on the recovery of water quality and developing State specific water quality criteria for these three parameters, and are the subject of this consultation. As the States and DC complete their triennial review of water quality standards, EPA will review the States and DC's water quality programs in light of the criteria presented in the guidance document.

WATER QUALITY CONDITIONS IN CHESAPEAKE BAY

Historical

Over the last several years, efforts have been made to clean up the Chesapeake Bay. While the levels of toxins and industrial pollutants have decreased, leading to largely improved water quality conditions, the Chesapeake Bay still faces many problems and remains polluted. Excess nutrients, such as nitrogen and phosphorous are pollutants. Rain washes nutrients off streets, rooftops, lawns, farms and industrial sites into the streams and rivers that flow into the Bay. Nutrient pollution is the largest problem currently affecting the Chesapeake Bay. Excess nutrients cause rapid growth of algae blooms which cloud the water and reduce the amount of sunlight reaching the Bay's aquatic life. When the algae blooms die, oxygen is depleted as the algae decay. Nutrients and sediment flowing into the Bay have reduced oxygen levels below what is needed by much of the aquatic life in the Bay.

Water quality monitoring in the Chesapeake Bay began in 1984. There are recent indications of an improving trend for dissolved oxygen levels since 1985. The volume of mainstem Bay lower layer waters with reduced oxygen appears to be decreasing since the mid 1980s (with the exception of 1989 and 1996). However, poor dissolved oxygen conditions continue to remain in the Bay (Chesapeake Bay Foundation 2003a).

2001 to present

During 2001 and 2002, many parts of the Chesapeake Bay watershed experienced drought conditions. This decrease in precipitation resulted in less nutrient and sediment laden runoff from farm fields, suburban lawns, city streets and other paved areas. This reduced runoff led to some of the best water quality conditions seen since data collection began in 1984. In 2002, despite half of the lower layer waters in the Bay mainstem having oxygen levels below 5mg/L, there were no occurrences of anoxia (lack of oxygen) in mainstem waters, the first time this has been recorded since 1985.

The summer of 2003 marked one of the worst periods of poor water quality experienced in the Chesapeake Bay. Water quality monitoring data gathered during June and early July 2003 showed the development of a large area of oxygen-depleted water in the mainstem of the Chesapeake Bay, beginning at the Patapsco River near Baltimore and continuing more than 100 miles south to the mouth of the York River near Hampton Roads. This marks the most extensive oxygen-deprived conditions in nearly twenty years of water quality data collection. According to data gathered between July 7 and 9, 2003, approximately 40 percent of the water in the mainstem of Chesapeake Bay had low dissolved oxygen levels – less than 5mg/L. The summer 2003 conditions are speculated to have been caused by a buildup of excess nutrients on land, due to the reduced runoff in the previous two years. This buildup of nutrients on land combined with the higher than average precipitation levels in 2003 is likely to have led to the poor water quality in that summer. In addition, the cold winter of 2002-2003, which resulted in below average water temperatures, compounded low oxygen problems by preventing mixing of cold, dense bottom waters with warmer and lighter, oxygen-rich surface waters (Chesapeake Bay Foundation 2003). These conditions also led to lowered dissolved oxygen conditions in parts of the Patapsco, Chester, Patuxent, Potomac, Rappahannock, and York Rivers.

CONSULTATION HISTORY

The proposed action involves the EPA issuing guidance for Chesapeake Bay specific water quality criteria for dissolved oxygen, water quality and chlorophyll *a* to the States of Maryland, Delaware and Virginia and DC. EPA has also identified and described five habitats (or designated uses) that when adequately protected will ensure the protection of the living resources of the Bay and its tidal tributaries. The five uses provide the context in which EPA derived the Chesapeake Bay water quality criteria for dissolved oxygen, water clarity and chlorophyll *a*.

In January 2001, EPA sent a letter to NOAA Fisheries requesting comments on the list of federally listed threatened or endangered species and/or designated critical habitat for listed species under the jurisdiction of NOAA Fisheries. NOAA Fisheries responded in a letter dated January 8, 2001. In this letter, NOAA Fisheries indicated that the endangered and threatened species under our jurisdiction in the vicinity of the Chesapeake Bay and its tidal tributaries are: federally threatened loggerhead (*Caretta caretta*), and endangered Kemp's ridley (*Lepidochelys kempii*), green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*) and leatherback (*Dermochelys coriacea*) sea turtles; federally endangered North Atlantic right (*Eubalaena glacialis*), humpback (*Megaptera novaeangliae*), fin (*Balaenoptera physalus*), sei (*Balaenoptera borealis*) and sperm (*Physter macrocephalus*) whales; and federally endangered shortnose sturgeon (*Acipenser brevirostrum*). In this letter, NOAA Fisheries indicated to EPA that the revised dissolved oxygen criteria should evaluate the effects on shortnose sturgeon survival, foraging, reproduction and distribution from lowering the dissolved oxygen criteria in the Chesapeake Bay. NOAA Fisheries indicated it had concerns regarding the revisions of the current dissolved oxygen standard. NOAA Fisheries stated that while they recognized that seasonal fluctuations in dissolved oxygen concentrations occur and that bottom dissolved oxygen levels may be less than 5 mg/L during certain times of the year, lowering the standard for dissolved oxygen may contribute to habitat degradation. NOAA Fisheries stated its belief that maintaining the existing, more stringent standards with the understanding of potential natural fluctuation in dissolved oxygen levels would ensure the health of living resources in the Chesapeake Bay.

On December 20, 2002, EPA sent a letter to NOAA Fisheries requesting concurrence with EPA's conclusion that the proposed criteria and refined designated uses would not adversely affect listed species under NOAA Fisheries' jurisdiction. Included with this letter were a Biological Evaluation (BE) and a copy of the Draft Criteria document. In a January 7, 2003 letter, NOAA Fisheries replied to EPA and indicated that they concurred with EPA's conclusion as it applied to federally listed sea turtles and marine mammals but that NOAA Fisheries could not concur that the revised dissolved oxygen criteria would not adversely affect shortnose sturgeon. NOAA Fisheries provided several comments to EPA on the contents of the BE regarding the effects of the dissolved oxygen standards on shortnose sturgeon and indicated that EPA should revise the BE. Subsequent to receiving this letter, NOAA Fisheries and EPA staff communicated informally to revise the contents of the BE. In February 2003, several meetings and conference calls took place between EPA and

NOAA Fisheries staff. Included in these meetings was a discussion as to how the formal consultation would be conducted. The complicating factor was that while EPA was issuing the Criteria document as guidance to the states, the states were not obligated to adopt the criteria exactly as outlined in the Criteria document. It was determined between EPA and NOAA Fisheries staff that a programmatic approach would be taken in developing an appropriate biological opinion. In this scenario, EPA would consult with NOAA Fisheries on the effects of issuing the guidance document to the states and DC since EPA will evaluate the States and DC's revised water quality criteria in light of the Chesapeake Bay specific guidance. Then, when the states have developed their own criteria and submit it to EPA, EPA will consult again with NOAA Fisheries on the effects of EPA approving the particular criteria proposed by the states. This type of programmatic consultation is particularly appropriate as the discharges from each State and DC mix in the Chesapeake Bay and the water quality in the Bay and its tidal tributaries will be a result of the combined discharges of the various states and DC. The consultation that is the subject of this BO then serves as the first in a series of consultations that will take place between EPA and NOAA Fisheries on the effects of EPA issuing and approving ambient water quality criteria for the Chesapeake Bay and its tidal tributaries.

In April 2003, the EPA issued the final Regional Criteria Guidance document to the States of Maryland, Delaware and Virginia and DC. At this time, EPA indicated that they had not made any irreversible or irretrievable commitment of resources that would foreclose the formulation or implementation of any reasonable and prudent alternatives to avoiding jeopardizing endangered or threatened species.

On April 25, 2003, EPA submitted a final BE to NOAA Fisheries along with the final Regional Criteria Guidance document and a letter requesting that NOAA Fisheries initiate formal consultation on the effects if the issuance of the dissolved oxygen criteria on shortnose sturgeon. April 25, 2003 serves as the initiation of formal consultation for this BO.

NOAA Fisheries has communicated informally to the EPA that it concurs with EPA's determination that the issuance of the Chesapeake Bay specific criteria will not affect endangered and threatened whales and that the issuance of the criteria for water clarity and chlorophyll *a* are likely to beneficially affect federally listed sea turtles and the endangered shortnose sturgeon. However, NOAA Fisheries believes that the issuance of the dissolved oxygen criteria may affect shortnose sturgeon and sea turtles. The effect of EPA's issuance of the ambient water quality criteria on shortnose sturgeon and sea turtles will, therefore, be the subject of this consultation.

DESCRIPTION OF THE PROPOSED ACTION

The EPA has developed and issued the Regional Criteria Guidance document to the States of Virginia, Delaware and Maryland and DC in accordance with the water quality standards regulations (40 CFR Part B1). The Regional Criteria Guidance document presents EPA's regionally-based nutrient and sediment enrichment criteria expressed as dissolved oxygen, water clarity and chlorophyll *a* criteria, to be applied to the Chesapeake Bay and its tidal tributaries. EPA states in the Regional Criteria Guidance that these three water quality conditions provide the best and most direct measures of the effects of too much nutrient and sediment pollution on the Chesapeake Bay's aquatic living resources. Excess nutrients can lead to algae blooms. These algae blooms, when left uneaten by fish and shellfish, deplete dissolved oxygen, resulting in low dissolved oxygen concentrations. Decreased water clarity can be caused by excess sediment and algae blooms and can inhibit the growth of underwater Bay grasses. Measurements of chlorophyll *a* indicate levels of phytoplankton or algal biomass in the water column. Levels that are too high are indicative of algal blooms. The Regional Criteria Guidance is intended to assist the states of Maryland, Virginia and Delaware and DC in developing revised water quality standards to address nutrient and sediment-based pollution in waters in their respective jurisdictions.

As part of the Regional Criteria Guidance, EPA Region III has identified and described five habitats (also referred to as designated uses) in the Chesapeake Bay and its tidal tributaries. These five uses provide the context in which EPA Region III developed the criteria for dissolved oxygen, water clarity and chlorophyll *a*. The five designated uses are proposed to more fully reflect the different intended aquatic life uses of those tidal habitats. The five designated uses as stated in the Guidance document area:

- ***Migratory fish spawning and nursery***: Shall support the survival, growth and propagation of balanced indigenous populations of ecologically, recreationally and commercially important anadromous, semi-anadromous and tidal-fresh resident fish species, including the shortnose sturgeon, inhabiting spawning and nursery grounds from February 1 through May 31. This use is intended to protect migratory fish during the late winter to spring spawning and nursery season in tidal freshwater to low-salinity habitats. This use has been designated primarily in the upper reaches of many Bay tidal rivers and creeks and the upper mainstem Chesapeake Bay.

- ***Shallow-water bay grass***: Shall support the survival, growth and propagation of rooted, underwater bay grasses necessary for the propagation and growth of balanced, indigenous populations of ecologically, recreationally, and commercially important fish and shellfish species inhabiting open water habitats.

- ***Open-water fish and shellfish designated use***: Shall support the survival, growth and propagation of balanced, indigenous populations of ecologically, recreationally and commercially important fish and shellfish species inhabiting open water habitats. This use is focused on surface-water habitats in tidal creeks, rivers, embayments and the mainstem Bay, and is intended to protect diverse populations of sportfish and baitfish as well as shortnose sturgeon.

- ***Deep-water seasonal fish and shellfish designated use***: Shall support the survival, growth and propagation of balanced, indigenous populations of ecologically, recreationally, and commercially important fish and shellfish species inhabiting deep-water habitats from June through September. This use is intended to protect animals inhabiting the deeper transitional water-column and bottom habitats between the well-mixed surface waters and the very deep channels.

- ***Deep-channel seasonal refuge designated use***: Shall protect the survival of balanced, indigenous populations of ecologically important benthic infaunal and epifaunal worms and clams, which provide food for bottom-feeding fish and crabs from June through September.

In addition to designating these five uses for the Chesapeake Bay and its tidal tributaries, EPA has developed qualitative criteria for chlorophyll *a* and use-specific quantitative criteria for water clarity and dissolved oxygen.

Chlorophyll a

The EPA is providing the states and DC with a recommended narrative chlorophyll *a* criterion applicable to all Chesapeake Bay and tidal tributary waters. Maryland, Virginia, Delaware and DC do not currently have numeric chlorophyll *a* criteria. Chlorophyll *a* is an integrated measure of primary production as well as an indicator of water quality. The narrative chlorophyll *a* criteria states:

> Concentrations of chlorophyll *a* in free-floating microscopic aquatic plants (algae) shall not exceed levels that results in ecologically undesirable consequences - such as reduced water clarity, low dissolved oxygen, food supply imbalances, proliferation of species deemed potentially harmful to aquatic life or humans or aesthetically objectionable conditions – or otherwise render tidal waters unsuitable for designated uses.

Water Clarity

The States of Maryland, Delaware and Virginia do not currently have numeric water quality criteria for water clarity. The water clarity criteria reflect the different light requirements for underwater plant communities that inhabit low salinity versus higher salinity shallow water habitats throughout the Bay and tidal tributaries. The water clarity criteria apply to varying depths from 0.5 meters - 2 meters depending on the area. Areas where natural factors (e.g. strong currents, rocky bottoms) or permanent physical alterations to shoreline (e.g. shipping terminals) would prevent underwater bay grass growth are excluded from these criteria. Water clarity criteria are given for four salinity regimes (tidal fresh, oligohaline (low salinity 0.5-5ppt), mesohaline (moderately brackish 5-18ppt) and polyhaline(highly brackish 18-30ppt)) with accompanying temporal applications. Water quality criteria are given as percent light-through-water and as secchi depth (see Appendix A for summary of water clarity criteria).

Dissolved Oxygen

Current numeric state water quality criteria for the Chesapeake Bay and its tidal tributaries require 5 mg/l (equivalent to 5 parts-per-million (ppm)) dissolved oxygen concentrations at all times (instantaneous or daily minimum) throughout the year in all tidal Bay waters. EPA states in the Regional Criteria Guidance that there are portions of deep-water Chesapeake Bay and its tidal tributaries that can not achieve the current dissolved oxygen standards during the June 1 through September 30 timeframe due to natural and human-caused conditions (US EPA 2003b). EPA also states in the Regional Criteria Guidance that the aquatic life uses in the deep-water and deep-channel (summer only) habitats have not and will not require a 5 mg/L dissolved oxygen level for protection. EPA also states that migratory fish spawning and nursery habitats require higher levels of dissolved oxygen (>5mg/L) to sustain aquatic life use during the late winter to early summer time frame than provided by the current state water quality standards. The dissolved oxygen criteria vary significantly across the five designated uses (see Table 1).

Table 1. Dissolved oxygen criteria as stated in EPA's Regional Criteria Guidance (US EPA 2003b)

Designated Use	**Criteria Concentration/Duration**	**Temporal Application**
Migratory fish spawning and nursery use	7-day mean ≥ 6mg/L ; Instantaneous min. ≥5mg/L	February 1 – May 31
	Open water designated use criteria apply	June 1 – January 31
Shallow-water bay grass use	Open water designated use criteria apply	Year-round
Open-water fish and shellfish use	30 day mean ≥5.5 mg/L (0-0.5ppt salinity)	Year-round
	30 day mean ≥5mg/L (>0.5ppt salinity)	
	7 day mean ≥ 4mg/L	
	Instantaneous min. ≥ 3.2 mg/L*	*At temperatures >29°C, inst. min. = 4.3 mg/L
Deep-water seasonal fish and shellfish use	30 day mean ≥ 3 mg/L; 1 day mean ≥2.3mg/L ; instantaneous min. ≥ 1.7mg/L	June 1 – September 30
	Open water designated use criteria apply	October 1 – May 31
Deep-channel seasonal refuge use	Instantaneous min. ≥ 1 mg/L	June 1 – September 30
	Open water designated use criteria apply	October 1 – May 31

In addition to developing the above criteria, nutrient and sediment cap load allocations were developed to help in achieving the goals of the criteria. New York, Pennsylvania, Maryland, Delaware, Virginia, West Virginia, DC and the EPA agreed to cap annual nitrogen loads delivered to the Bay's tidal waters at 175 million pounds and annual phosphorous loads at 12.8 million pounds. It is estimated that these allocations will require reductions, from 2000 levels, in nitrogen pollution by 110 million pounds and phosphorous pollution by 6.3 million pounds. The Chesapeake Bay Program partners agreed to these load reductions based upon Chesapeake Bay Water Quality Model projections of attainment of published Bay dissolved oxygen criteria. Similarly, significant reductions in sediment loads have been agreed to by EPA, the States and DC.

Action Area

The action area for this consultation includes the Chesapeake Bay and its tidal tributaries. This includes waters under the jurisdiction of the States of Delaware, Maryland and Virginia as well as DC. The action area includes the mainstem of the Chesapeake Bay along with all tidal tributaries. The major rivers considered in this consultation are the Elizabeth, Appomattox, James, Pamunkey, Mattaponi, York, Rappahannock, Potomac, Patuxent, Susquehanna, Chester, Choptank, Nanticoke and Pocomoke.

STATUS OF AFFECTED SPECIES

This section will focus on the status of the listed species that are present within the action area, summarizing information necessary to establish the environmental baseline and to assess the effects of the proposed action. NOAA Fisheries has determined that the following endangered or threatened species may be present in the vicinity of the proposed action:

Cetaceans

Humpback whale (*Megaptera novaeangliae*)	Endangered
Fin whale (*Balaenoptera physalus*)	Endangered

Sea turtles

Loggerhead (*Caretta caretta*)	Threatened
Kemp's ridley (*Lepidochelys kempii*)	Endangered
Green (*Chelonia mydas*)	Endangered
Hawksbill (*Eretmochelys imbricata*)	Endangered
Leatherback (*Dermochelys coriacea*)	Endangered

Fish

Shortnose sturgeon (*Acipenser brevirostrum*)	Endangered

The Chesapeake Bay is not a high use area for whales. Transient individuals may be present in the area for brief periods during annual migrations or during the summer months, but no whales are known to be resident in this area. Because impacts to whales are considered unlikely, NOAA Fisheries has determined that this project is not likely to affect endangered whales under our jurisdiction and as such, the effects of this action on whales are not considered in further detail in this BO. No critical habitat has been designated for species under NOAA Fisheries' jurisdiction in the action area.

Background information on the range-wide status of sea turtles and a description of critical habitat can be found in a number of published documents. These sources include recent documents on the status of sea turtles (NOAA Fisheries and USFWS 1995), Recovery Plans for the loggerhead sea turtle (NOAA Fisheries and USFWS 1991a), leatherback sea turtle (NOAA Fisheries and USFWS 1992), green sea turtle (NOAA Fisheries and USFWS 1991b), and Kemp's ridley sea turtle (USFWS and NOAA Fisheries 1992), and status reports on Kemp's ridley and loggerhead sea turtles provided by the Turtle Expert Working Group(TEWG) (TEWG 1998 and 2000). Summary information on the biology of these species is provided below. While loggerhead, Kemp's ridley, Green, Hawksbill and Leatherback turtles all may be present in the Chesapeake Bay, loggerhead and Kemp's ridley are the two species of turtles most likely to be found in the Bay.

Loggerhead Sea Turtle

Loggerhead sea turtles occur throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans in a wide range of habitats. These include open ocean, continental shelves, bays, lagoons, and estuaries (NOAA Fisheries and USFWS 1995). It is the most abundant species of sea turtle in U.S. waters, commonly occurring throughout the inner continental shelf from Florida through Cape Cod, Massachusetts. The loggerhead sea turtle was listed as threatened under the ESA on July 28, 1978.

Pacific Ocean

In the Pacific Ocean, major loggerhead nesting grounds are generally located in temperate and subtropical regions with scattered nesting in the tropics. Within the Pacific Ocean, loggerhead sea turtles are represented by a northwestern Pacific nesting aggregation (located in Japan) and a smaller southwestern nesting aggregation that occurs in Australia (Great Barrier Reef and Queensland), New Caledonia, New Zealand, Indonesia, and Papua New Guinea. Based on available information, the Japanese nesting aggregation is significantly larger than the southwest Pacific nesting aggregation. Data from 1995 estimated the Japanese nesting aggregation at 1,000 female loggerhead turtles (Bolten *et al.* 1996). More recent estimates are unavailable; however, qualitative reports infer that the Japanese nesting aggregation has declined since 1995 and continues to decline (Tillman 2000). NOAA Fisheries has no recent, quantitative estimates of the size of the nesting aggregation in the southwest Pacific, but the nesting aggregation in Queensland, Australia, was as low as 300 females in 1997.

Pacific loggerhead turtles are captured, injured, or killed in numerous Pacific fisheries including Japanese longline fisheries in the western Pacific Ocean and South China Seas; direct harvest and commercial fisheries off Baja California, Mexico, commercial and artisanal swordfish fisheries off Chile, Columbia, Ecuador, and Peru; purse seine fisheries for tuna in the eastern tropical Pacific Ocean, and California/Oregon drift gillnet fisheries. In addition, the abundance of loggerhead turtles on nesting colonies throughout the Pacific basin have declined dramatically over the past 10 to 20 years. Loggerhead turtle colonies in the western Pacific Ocean have been reduced to a fraction of their former abundance by the combined effects of human activities that have reduced the number of nesting females and reduced the reproductive success of females that manage to nest (*e.g.*, due to egg poaching).

Atlantic Ocean

Loggerhead sea turtles are generally grouped by their nesting locations. Nesting is concentrated in the north and south temperate zones and subtropics. In the western Atlantic, most loggerhead sea turtles nest from North Carolina to Florida and along the gulf coast of Florida. The southeastern U.S. nesting aggregation is the second largest and represents about 35 percent of the nests of this species. From a global perspective, this U.S. nesting aggregation is, therefore, critical to the survival of this species.

Loggerheads commonly occur throughout the inner continental shelf from Florida through Cape Cod, Massachusetts although their presence varies with the seasons due to changes in water temperature (Braun and Epperly 1996; Epperly *et al.* 1995a, Epperly *et al.* 1995b; Schmid 1998; Shoop and Kenney 1992). Aerial surveys of loggerhead turtles north of Cape Hatteras indicate that they are most common in waters from 22 to 49 meters deep although they range from the beach to waters beyond the continental shelf (Shoop and Kenney 1992). The presence of loggerhead turtles in an area is also influenced by water temperature; water temperatures of $\geq$11° C are generally favorable to sea turtles.

Like other sea turtles, loggerhead hatchlings enter the pelagic environment upon leaving the nesting beach. Loggerhead sea turtles originating from the western Atlantic nesting aggregations are believed to lead a pelagic existence in the North Atlantic Gyre for as long as 7-12 years before settling into benthic environments where they opportunistically forage on crustaceans and mollusks (Wynne and Schwartz 1999). However, some loggerheads may remain in the pelagic environment for longer periods of time or move back and forth between the pelagic and benthic environment (Witzell 2002). Tagging studies have shown that loggerheads that have entered the benthic environment undertake routine migrations along the coast that are limited by seasonal water temperatures.

Although NOAA Fisheries has not formally recognized subpopulations of loggerhead sea turtles under the ESA, based on the most recent reviews of the best scientific and commercial data on the population genetics of loggerhead sea turtles and analyses of their population trends (TEWG 1998; TEWG 2000), NOAA Fisheries treats the loggerhead turtle nesting aggregations as nesting subpopulations whose survival and recovery is critical to the survival and recovery of the species. Natal homing to the nesting beach is believed to provide the genetic barrier between these nesting aggregations, preventing recolonization from turtles from other nesting beaches. Consequently, this BO will treat the five nesting aggregations of loggerhead sea turtles as subpopulations for the purposes of this analysis.

The loggerhead sea turtles in the action area of this consultation likely represent turtles that have hatched from any of the five western Atlantic nesting sites, but are probably composed primarily of turtles that hatched from the northern nesting group and the south Florida nesting group. Although genetic studies of benthic immature loggerheads on the foraging grounds have shown the foraging areas to be comprised of a mix of individuals from different nesting areas, there appears to be a preponderance of individuals from a particular nesting area in some foraging locations. In general, south Florida turtles are more prevalent on southern foraging grounds and their concentrations decline to the north. Conversely, loggerhead turtles from the northern nesting group are more prevalent on northern foraging grounds and less so in southern foraging areas (Table 2 in NOAA Fisheries SEFSC 2001; Bass *et al.* 1998).

Like other sea turtles, the movements of loggerheads are influenced by water temperature. Since they are limited by water temperatures, the majority of loggerhead sea turtles do not usually appear in the Chesapeake Bay until May, but some loggerheads may be present in the Bay as early as April 1. Loggerheads generally leave the action area by mid-November but may remain in the Northeast and mid-Atlantic waters until late November or December (Epperly *et al.* 1995; Keinath 1993; Morreale 1999; Shoop and Kenney 1992). Aerial surveys of loggerhead turtles north of Cape Hatteras indicate that they are most common in waters from 22 to 49 m deep, although they range from the beach to waters beyond the continental shelf (Shoop and Kenney 1992). There is limited information regarding the activity of these offshore turtles. Loggerhead sea turtles are primarily benthic feeders, opportunistically foraging on crustaceans and mollusks (Wynne and Schwartz 1999). Under certain conditions they may also scavenge fish, particularly if they are easy to catch (e.g., caught in nets; NOAA Fisheries and USFWS 1991).

Status and trend of loggerhead sea turtles
Based on the data available, it is difficult to estimate the size of the loggerhead sea turtle population in the U.S. or its territorial waters. There is, however, general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage. Nesting data collected on index nesting beaches in the U.S. from 1989-1998 represent the best dataset available to index the population size of loggerhead sea turtles. However, an important caveat for population trends analysis based on nesting beach data is that this may reflect trends in adult nesting females, but it may not reflect overall population growth rates. The number of nests in the northern subpopulation from 1989 to 1998 ranged from 4,370 to 7,887 with a 10-year average of 6,247 nests (TEWG 2000). The status of the northern population based on the number of loggerhead nests has been classified as stable or declining (TEWG 2000). NOAA Fisheries' 2001 Stock Assessment further examined nesting trends for the northern subpopulation (NOAA Fisheries SEFSC 2001). Three estimates were provided. Two of these indicate a decline in nesting while the third suggests an increase in nesting. However, those that indicate a decline (-3% and -5%) are

based on data collected from two different sites (Little Cumberland Island, Georgia (Frazer 1983) and South Carolina (TEWG 1998), respectively) prior to the implementation of Turtle Excluder Devices (TEDs). In addition, NOAA Fisheries' 2001 Stock Assessment notes that Little Cumberland Island is a highly erosional beach and nesting at Cape Island, South Carolina (the largest South Carolina nesting site) may have been affected by raccoon predation control in the first half of the 20^{th} century, suggesting that these sites are not representative of the overall northern subpopulation (NOAA Fisheries SEFSC 2001). A third method was employed to estimate changes in nesting activity over time for the northern subpopulation by using nesting data from selected beaches in a type of analysis known as meta-analysis. Depending on the statistical assumptions made for the meta-analysis, the pre-1990 growth rate for the northern subpopulation varies from 0 to -3% (NOAA Fisheries SEFSC 2001). The results appear to be more optimistic for the post 1990 period for which the rate of growth is estimated to be 2.8-2.9%. However, this latter estimate is considered a best-case scenario since the data used in the analysis were limited to nesting sites where surveys were believed to have been relatively constant over time by including only the years where consistent length of beach was surveyed and survey start dates were within a two week time period. This data was unavailable for Georgia, so the assumption that survey effort was constant in this area may not be true. In addition, the analysis did not consider each nesting beaches' relative contribution to the total nesting activity (NOAA Fisheries SEFSC 2001). Given the range of results for the meta-analysis (from -3% growth to 2.9% growth), the assumptions made for the analysis, and considering previous studies conducted at specific northern nesting sites, for the purposes of this Opinion, NOAA Fisheries considers the status of the northern subpopulation based on nesting trends to be stable, at best, or declining.

Another consideration adding to the vulnerability of the northern subpopulation is that NOAA Fisheries scientists estimate, using genetics data from Texas, South Carolina, and North Carolina in combination with juvenile sex ratios from those states, that the northern subpopulation produces 65% males, while the south Florida subpopulation is estimated to produce 80% females (NOAA Fisheries SEFSC 2001, Part I).

In comparison to the northern subpopulation, the south Florida subpopulation and the Yucatán subpopulation appear to be stable or increasing. The annual number of nests for the south Florida subpopulation during the period 1989-1998 ranged from 48,531 - 83,442 nests/year, with an average rate of increase over the time period of 3.6% per year (TEWG 2000). During the 1999 nesting season, 1705 loggerhead nests were recorded for Quintana Roo beaches (Villavicencio *et al.* 2000). Nesting appears to be stable or increasing (TEWG 2000).

Several published reports have presented the problems facing long-lived species that delay sexual maturity (Crouse *et al.* 1987; Crowder *et al.* 1994; Crouse 1999). In general, these reports concluded that animals that delay sexual maturity and reproduction must have high annual survival as juveniles through adults to ensure that enough juveniles survive to reproductive maturity and then reproduce enough times to maintain stable population sizes. This general rule applies to sea turtles, particularly loggerhead sea turtles, as the rule originated in studies of sea turtles (Crouse *et al.* 1987; Crowder *et al.* 1994; Crouse 1999).

The global status and trend of loggerhead turtles is difficult to summarize. In the Pacific Ocean, loggerhead turtles are represented by a northwestern Pacific nesting aggregation (located in Japan) and a smaller southwestern nesting aggregation that occurs in Australia (Great Barrier Reef and Queensland), New Caledonia, New Zealand, Indonesia, and Papua New Guinea. The abundance of loggerhead turtles on nesting colonies throughout the Pacific basin have declined dramatically over the past 10 to 20 years. Data from 1995 estimated the Japanese nesting aggregation at 1,000 female loggerhead turtles (Bolten *et al.* 1996), but it has probably declined since 1995 and continues to decline (Tillman 2000). The nesting aggregation in Queensland, Australia, was as low as 300 females in 1997.

NOAA Fisheries recognizes five subpopulations of loggerhead sea turtles in the western Atlantic based on genetic studies. Cohorts from three of these, the south Florida, Yucatán, and northern subpopulations, are known to occur within the action area of this consultation. Nest rates for the south Florida subpopulation have increased at a rate of 3.9 - 4.2% since 1990 (approximately 83,400 nests in 1998). Similarly, nesting for the Yucatán subpopulation appears to be stable or increasing (TEWG 2000). In contrast, based on nesting data from several sources (Frazer 1983, TEWG 1998, TEWG 2000, and NOAA Fisheries SEFSC 2001), NOAA Fisheries considers the northern subpopulation to be stable, at best, or declining.

Threats to loggerheads' recovery
All loggerhead subpopulations are faced with a multitude of natural and anthropogenic effects. Many anthropogenic effects occur as a result of activities outside of U.S. jurisdiction (*i.e.*, fisheries in international waters). For the purposes of this consultation, NOAA Fisheries will assume that the northern subpopulation of loggerhead sea turtles is declining (the conservative estimate) or stable (the optimistic estimate) and the south Florida and Yucatán subpopulations of loggerhead sea turtles are stable (the conservative estimate) or increasing (the optimistic estimate).

The five major subpopulations of loggerhead sea turtles in the northwest Atlantic (i.e., northern, south Florida, Florida panhandle, Yucatán, and Dry Tortugas) are all subject to fluctuations in the number of young produced annually because of human-related activities as well as natural phenomena. Loggerhead sea turtles face numerous threats from natural causes. For example, there is a significant overlap between hurricane seasons in the Caribbean Sea and northwest Atlantic Ocean (June to November), and the loggerhead sea turtle nesting season (March to November). Sand accretion and rainfall that result from these storms as well as wave action can appreciably reduce hatchling success. Other sources of natural mortality include cold stunning and biotoxin exposure.

The diversity of the sea turtle's life history leaves them susceptible to many human impacts, including impacts while they are on land, in the benthic environment, and in the pelagic environment. On their nesting beaches in the U.S., adult female loggerheads as well as hatchlings are threatened with beach erosion, armoring, and nourishment; artificial lighting; beach cleaning; increased human presence; recreational beach equipment; beach driving; coastal construction and fishing piers; exotic dune and beach vegetation; predation by species such as exotic fire ants, raccoons (*Procyon lotor*), armadillos (*Dasypus novemcinctus*), opossums (*Didelphus virginiana*); and poaching.

Loggerhead sea turtles are impacted by a different set of threats from human activities once they migrate to the ocean. In the North Atlantic, pelagic immature loggerhead sea turtles are exposed to a series of long-line fisheries which are a significant source of capture and mortality (Aguilar *et al.*1995; Bolten *et al.*1994; Crouse 1999; Yeung *et al.* 2000; Witzell 1999).

In waters off the coastal U.S., loggerhead sea turtles are exposed to a suite of fisheries in Federal and State waters including trawl, purse seine, hook and line, gillnet, pound net, longline, and trap fisheries. In addition to fishery interactions, loggerhead sea turtles face other threats in the marine environment, including the following: oil and gas exploration, development, and transportation; marine pollution; underwater explosions; hopper dredging, offshore artificial lighting; power plant entrainment and/or impingement; entanglement in debris; ingestion of marine debris; marina and dock construction and operation; boat collisions; and poaching.

Leatherback Sea Turtle

The leatherback is the largest living turtle and ranges farther than any other sea turtle species, exhibiting broad thermal tolerances (NOAA Fisheries and USFWS 1995). Leatherback turtles feed primarily on cnidarians (medusae, siphonophores) and tunicates (salps, pyrosomas) and are often found in association with jellyfish. These turtles are found throughout the action area of this consultation and, while predominantly pelagic, they occur in the Chesapeake Bay from April through November.

Although leatherbacks are a long lived species (> 30 years), they mature at a younger age than loggerhead turtles, with an estimated age at sexual maturity of about 13-14 years for females, and an estimated minimum age at sexual maturity of 5-6 years, with 9 years reported as a likely minimum (Zug and Parham 1996) and 19 years as a likely maximum (NOAA Fisheries SEFSC 2001). Based on a review of all sightings of leatherback sea turtles of <145 cm curved carapace length (ccl), Eckert (1999) found that leatherback juveniles remain in waters warmer than 26°C until they exceed 100 cm ccl.

Status and trends of Leatherback sea turtles

Nest counts are the only reliable population information available for leatherback turtles. Recent declines have been seen in the number of leatherbacks nesting worldwide (NOAA Fisheries and USFWS 1995). The 1995 status review notes that it is unclear whether this observation is due to natural fluctuations or whether the population is at serious risk. Globally, leatherback populations have been decimated worldwide. The population was estimated to number approximately 115,000 adult females in 1980 and only 34,500 by 1995 (Spotila *et al.*1996). The decline can be attributed to many factors including fisheries as well as intense exploitation of the eggs (Ross 1979). The status of the Atlantic population is unclear. In 1996, it was reported to be stable, at best (Spotila *et al.*1996), but numbers in the Western Atlantic at that time were reported to be on the order of 18,800 nesting females. The Western Atlantic population numbered about 15,000 nesting females in 2000, whereas current estimates for the Caribbean (4,000) and the Eastern Atlantic (i.e., off Africa, numbering ~ 4,700) have remained consistent with numbers reported by Spotila *et al.* in 1996 (Spotila pers. comm.).

The nesting population of leatherback sea turtles in the Suriname-French Guiana trans-boundary region has been declining since 1992 (Chevalier and Girondot 1998). Poaching and fishing gear interactions are believed to be the major contributors to the decline of leatherbacks in the area (Chevalier *et al.* in press, Swinkels *et al.* in press). While Spotila *et al.*(1996) indicated that turtles may have been shifting their nesting from French Guiana to Suriname due to beach erosion, analyses show that the overall area trend in number of nests has been negative since 1987 at a rate of 15.0 -17.3 % per year (NOAA Fisheries SEFSC 2001). If turtles are not nesting elsewhere, it appears that the Western Atlantic portion of the population is being subjected to mortality beyond sustainable levels, resulting in a continued decline in numbers of nesting females. Tag return data emphasize the global nature of the leatherback and the link between these South American nesters and animals found in U.S. waters. For example, a nesting female tagged May 29, 1990, in French Guiana was later recovered and released alive from the York River, VA. Another nester tagged in French Guiana on June 21, 1990, was later found dead in Palm Beach, Florida (STSSN database).

Threats to Leatherback recovery
Anthropogenic impacts to the leatherback population are similar to those discussed above for the loggerhead sea turtle. However, of the Atlantic turtle species, leatherbacks seem to be the most vulnerable to entanglement in fishing gear. This susceptibility may be the result of their body type (large size, long pectoral flippers, and lack of a hard shell), and their attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, and perhaps to the lightsticks used to attract target species in longline fisheries. Sea turtles entangled in fishing gear generally have a reduced ability to feed, dive, and surface to breathe or perform any other behavior essential to survival (Balazs 1985). They may be more susceptible to boat strikes if forced to remain at the surface, and entangling lines can constrict blood flow resulting in tissue necrosis. Entanglement in pot gear set for shellfish and finfish in the action area has been documented. Leatherbacks have also been documented entangled in crab pot gear in the Virginia Chesapeake Bay (e.g., 3 instances in 2002 alone).

Leatherbacks are taken as bycatch in several fisheries including the pelagic longline, coastal trawl, anchored gillnet, and pelagic gillnet. For instance, according to observer records, an estimated 6,363 leatherback sea turtles were caught by the U.S. Atlantic tuna and swordfish longline fisheries between 1992-1999, of which 88 were released dead (NOAA Fisheries SEFSC 2001). Leatherbacks are foul hooked by longline gear (*e.g.*, on the flipper or shoulder area) rather than mouth or throat hooked like loggerheads.

Kemp's Ridley Sea Turtle
The Kemp's ridley is the most endangered of the world's sea turtle species. Of the world's seven extant species of sea turtles, the Kemp's ridley has declined to the lowest population level. Kemp's ridleys nest primarily on Rancho Nuevo in Tamaulipas, Mexico (Pritchard 1969).

Kemp's ridley nesting occurs from April through July each year. Little is known about mating but it is believed to occur at or before the nesting season in the vicinity of the nesting beach. Once they leave the beach, neonates presumably enter the Gulf of Mexico where they feed on available sargassum and associated infauna or other epipelagic species (USFWS and NOAA Fisheries, 1992). Studies indicate that subadult Kemp's ridleys stay in shallow, warm, nearshore waters in the northern Gulf of Mexico until cooling waters force them offshore or south along the Florida coast (Renaud, NOAA Fisheries Galveston Laboratory, pers. comm.). Ogren (1988) suggests that the Gulf coast, from Port Aransas, Texas, through Cedar Key, Florida, represents the primary habitat for subadult ridleys in the northern Gulf of Mexico. However, at least some juveniles will travel northward as water temperatures warm to feed in productive coastal waters of Georgia through New England (USFWS and NOAA Fisheries, 1992).

Juvenile Kemp's ridleys use northeastern and mid-Atlantic coastal waters of the U.S. as primary developmental habitat during summer months, with shallow coastal embayments serving as important foraging grounds. Ridleys found in mid-Atlantic waters are primarily post-pelagic juveniles averaging 40 cm in carapace length, and weighing less than 20 kg (Terwilliger and Musick 1995). Next to loggerheads, they are the second most abundant sea turtle in mid-Atlantic waters, arriving in these areas during late May and June (Keinath *et al.*1987; Musick and Limpus 1997). The annual abundance of juvenile Kemp's ridley sea turtles in the Chesapeake Bay has been estimated to be 211 to 1,083 turtles (Musick and Limpus 1997). In the Chesapeake Bay, Kemps ridleys frequently forage in shallow embayments, particularly in areas supporting submerged aquatic vegetation (Lutcavage and Musick 1985; Bellmund *et al.*1987; Keinath *et al.*1987; Musick and Limpus 1997). Other studies have found that post-pelagic ridleys feed primarily on crabs, consuming a variety of species. Mollusks, shrimp, and fish are consumed less frequently (Bjorndal 1997).

Kemp's ridleys migrate to more southerly waters from September to November (Keinath *et al.*1987; Musick and Limpus 1997). Turtles that do not head south before water temperatures drop face the risk of cold-stunning. Although cold stunning can occur throughout the range of the species, cold stunning can be a significant natural cause of mortality for sea turtles in Cape Cod Bay and Long Island Sound. Cold stunned turtles have been reported on beaches in Cape Cod, New York and New Jersey (Morreale and Standora 1992). Although cold stun turtles can survive if found early enough, cold stunning events can represent a significant cause of natural mortality.

From telemetry studies, Morreale and Standora (1994) determined that Kemp's ridleys are sub-surface animals that frequently swim to the bottom while diving. The generalized dive profile showed that the turtles spend 56% of their time in the upper third of the water column, 12% in mid-water, and 32% on the bottom. In water shallower than 15 m (50 ft), the turtles dive to depth, but spend a considerable portion of their time in the upper portion of the water column. In contrast, turtles in deeper water dive to depth, spending as much as 50% of the dive on the bottom.

Status and trends of Kemp's ridley sea turtles
When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963), but the population has been drastically reduced from these historical numbers. However, the TEWG (1998; 2000) indicated that the Kemp's ridley population appears to be in the early stage of exponential expansion. Nesting data, estimated number of adults, and percentage of first time nesters have all increased from lows experienced in the 1970s and 1980s. Estimates of adult abundance indicate an estimate of 9,600 in 1966 with 1,050 in 1985 and 3,000 in 1995. The increased recruitment of new adults is illustrated in the proportion of neophyte, or first time nesters, which has increased from 6% to 28% from 1981 to 1989 and from 23% to 41% from 1990 to 1994.

The population model in the 1998 TEWG report projected that Kemp's ridleys could reach the intermediate recovery goal identified in the Recovery Plan of 10,000 nesters by the year 2020 if the assumptions of age to sexual maturity and age specific survivorship rates plugged into their model are correct. The TEWG (1998) identified an average Kemp's ridley population growth rate of 13% per year between 1991 and 1995. Total nest numbers have continued to increase. However, the 1996 and 1997 nest numbers reflected a slower rate of growth, while the increase in the 1998 nesting level has been much higher and decreased in 1999.

Threats to Kemp's ridleys' recovery
Like other turtle species, the severe decline in the Kemp's ridley population appears to have been heavily influenced by a combination of exploitation of eggs and impacts from fishery interactions. From the 1940's through the early 1960's, nests from Ranch Nuevo were heavily exploited (USFWS and NOAA Fisheries 1992), but beach protection in 1966 helped to curtail this activity

(USFWS and NOAA Fisheries 1992). Currently, anthropogenic impacts to the Kemp's ridley population are similar to those discussed above for other sea turtle species. Sea sampling coverage in the Northeast otter trawl fishery, pelagic longline fishery, and southeast shrimp and summer flounder bottom trawl fisheries have recorded takes of Kemp's ridley turtles. Information from fishers helped to demonstrate the high number of turtles taken in these shrimp trawls (USFWS and NOAA Fisheries 1992). Subsequently, NOAA Fisheries has worked with the industry to reduce turtle takes in shrimp trawls and other trawl fisheries, including the development and use of TEDs.

Kemp's ridleys may also be affected by large-mesh gillnet fisheries. In the spring of 2000, a total of five Kemp's ridley carcasses were recovered from the same North Carolina beaches where 277 loggerhead carcasses were found. Cause of death for most of the turtles recovered was unknown, but the mass mortality event was suspected to have been from a large-mesh gillnet fishery operating offshore in the preceding weeks. The five ridley carcasses found were likely to have been only a minimum count of the number of Kemp's ridleys that were killed or seriously injured as a result of the fishery interaction since it is unlikely that all of the carcasses washed ashore. It is possible that strandings of Kemp's ridley turtles in some years have increased at rates higher than the rate of increase in the Kemp's ridley population (TEWG 1998).

Green Sea Turtle
Green turtles are the largest chelonid (hard-shelled) sea turtle, with an average adult carapace of 91 cm SCL and weight of 150 kg. Based on growth rate studies of wild green turtles, greens have been found to grow slowly with an estimated age of sexual maturity ranging from 18 to 40 years (Balazs 1982; Frazer and Ehrhart 1985 in NOAA Fisheries and USFWS 1991a; B. Schroeder pers. comm.).

Green turtles are distributed circumglobally. In the western Atlantic, this species ranges from Massachusetts to Argentina, including the Gulf of Mexico and the Caribbean (Wynne and Schwartz, 1999). Green sea turtles use mid-Atlantic and northern areas of the western Atlantic Ocean as important summer developmental habitat. Green turtles are found in estuarine and coastal waters as far north as Long Island Sound, Chesapeake Bay, and North Carolina sounds (Musick and Limpus 1997). Limited information is available regarding the occurrence of green turtles in the Chesapeake Bay, although they are presumably present in very low numbers. Like loggerheads and Kemp's ridleys, green sea turtles that use northern waters during the summer must return to warmer waters when water temperatures drop, or face the risk of cold stunning. Cold stunning of green turtles may occur in southern areas as well (i.e., Indian River, Florida), as these natural mortality events are dependent on water temperatures and not solely geographical location.

In the continental U.S., green turtle nesting occurs on the Atlantic coast of Florida (Ehrhart 1979). Occasional nesting has been documented along the Gulf coast of Florida, at southwest Florida beaches, as well as the beaches on the Florida Panhandle (Meylan *et al.* 1995). Recently, green turtle nesting occurred on Bald Head Island, North Carolina just east of the mouth of the Cape Fear River, on Onslow Island, and on Cape Hatteras National Seashore. Increased nesting has also been observed along the Atlantic Coast of Florida, on beaches where only loggerhead nesting was observed in the past (Pritchard 1997). Recent population estimates for green turtles in the western Atlantic area are not available.

The remaining portion of the green turtle's life is spent on the foraging and breeding grounds. Juvenile green sea turtles occupy pelagic habitats after leaving the nesting beach. Pelagic juveniles are assumed to be omnivorous, but with a strong tendency toward carnivory during early life stages.

At approximately 20 to 25 cm carapace length, juveniles leave pelagic habitats and enter benthic foraging areas, shifting to a chiefly herbivorous diet (Bjorndal 1997). Green turtles appear to prefer marine grasses and algae in shallow bays, lagoons and reefs (Rebel 1974), but also consume jellyfish, salps, and sponges. Some of the principal feeding pastures in the western Atlantic Ocean include the upper west coast of Florida and the northwestern coast of the Yucatan Peninsula. In North Carolina, green turtles are known to occur in estuarine and oceanic waters and to nest in low numbers along the entire coast. The summer developmental habitat for green turtles also encompasses estuarine and coastal waters of Chesapeake Bay and as far north as Long Island Sound (Musick and Limpus 1997).

Threats to green turtles' recovery
In 1978, the green turtle was listed as threatened under the ESA, except for the breeding populations in Florida and on the Pacific coast of Mexico, which were listed as endangered (NOAA Fisheries and USFWS 1991a). Green turtles were traditionally highly prized for their flesh, fat, eggs, and shell, and directed fisheries in the United States and throughout the Caribbean are largely to blame for the decline of the species. In the Gulf of Mexico, green turtles were once abundant enough in the shallow bays and lagoons to support a commercial fishery. In 1890, over one million pounds of green turtles were taken in the Gulf of Mexico green sea turtle fishery (Doughty 1984). However, declines in the turtle fishery throughout the Gulf of Mexico were evident by 1902 (Doughty 1984).

Fibropapillomatosis, an epizootic disease producing lobe-shaped tumors on the soft portion of a turtle's body, has been found to infect green turtles, most commonly juveniles. The occurrence of fibropapilloma tumors, most frequently documented in Hawaiian green turtles, may result in impaired foraging, breathing, or swimming ability, leading potentially to death.

Green turtles continue to be heavily exploited by humans, with the degradation of nesting and foraging habitats, incidental capture in fisheries, and marine pollution acknowledged as serious hindrances to recovery. As with the other sea turtle species, fishery mortality accounts for a large proportion of annual anthropogenic mortality outside the nesting beaches, while other activities like dredging, pollution, and habitat destruction account for an unknown level of mortality. As with the other sea turtle species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like dredging, pollution, and habitat destruction account for an unknown level of other mortality. Sea sampling coverage in the pelagic driftnet, pelagic longline, southeast shrimp trawl, and summer flounder bottom trawl fisheries has recorded takes of green turtles. Stranding reports indicate that between 200-400 green turtles strand annually along the Eastern U.S. coast from a variety of causes, most of which are unknown (STSSN, unpublished data).

Hawksbill Sea Turtle
The hawksbill turtle is relatively uncommon in the waters of the continental United States. Hawksbills prefer coral reefs, such as those found in the Caribbean and Central America. However, there are accounts of hawksbills in south Florida and Texas. Most of the Texas records report small turtles, probably in the 1-2 year class range. Many captures or strandings are of individuals in an unhealthy or injured condition (Hildebrand 1982). The lack of sponge-covered reefs and the cold winters in the northern Gulf of Mexico probably prevent hawksbills from establishing a viable population in this area. Hawksbills feed primarily on a wide variety of sponges but also consume bryozoans, coelenterates, and mollusks. The Culebra Archipelago of Puerto Rico contains especially important foraging habitat for hawksbills. Nesting areas in the western North Atlantic