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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
Conducted by:	National Marine Fisheries Service Northeast Region — Gloucester, Mass.
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Approved by:	

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 This law was originally enacted in 1948 as the Federal Water Pollution Control Act but was completely revised in 1972.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 20th 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 include Puerto Rico and the Virgin Islands.

No takes of hawksbill sea turtles have been recorded in northeast or mid-Atlantic fisheries covered by the NEFSC observer program. In the north Atlantic, small hawksbills have stranded as far north as Cape Cod, Massachusetts (STSSN database). Many of these strandings were observed after hurricanes or offshore storms. Although there have been no reports of hawksbills in the Chesapeake Bay, one has been observed taken incidentally in a fishery just south of the Bay (Anonymous 1992). The occurrence of Hawksbill sea turtles in the Chesapeake Bay would be a rare occurrence.

Status of shortnose sturgeon rangewide

Shortnose sturgeon were listed as endangered on March 11, 1967 (32 FR 4001), and they remained on the endangered species list with the enactment of the ESA in 1973. A shortnose sturgeon recovery plan was published in December 1998, to promote the conservation and recovery of the species.

Although shortnose sturgeon are listed as endangered range-wide, in the final recovery plan NOAA Fisheries recognized 19 separate populations occurring in New Brunswick Canada (1); Maine (2); Massachusetts (1); Connecticut (1); New York (1); New Jersey/Delaware (1); Maryland and Virginia (1); North Carolina (1); South Carolina (4); Georgia (4); and Florida (2). NOAA Fisheries has not formally recognized distinct population segments (DPS)[2] of shortnose sturgeon under the ESA. Although little genetic information within and among shortnose sturgeon occurring in different river systems is known, life history studies indicate that shortnose sturgeon populations from different river systems are substantially reproductively isolated (Kynard 1997; see also Dadswell *et al.*1984; Gilbert 1989; NOAA Fisheries 1996; Walsh *et al.*2001; Grunwald *et al.*2002; Waldman *et al.*(in press); and Wirgin *et al.*(in press)) and, therefore, should be considered discrete. While genetic information may reveal that interbreeding does not occur between rivers that drain into a common estuary, at this time, such river systems are considered a single population compromised of breeding subpopulations (NOAA Fisheries 1998). Consequently, this BO will treat the nineteen separate populations of shortnose sturgeon as subpopulations (one of which occurs in the action area) for the purposes of this analysis.

Shortnose sturgeon occur in large rivers along the western Atlantic coast from the St. Johns River, Florida (possibly extirpated from this system), to the Saint John River in New Brunswick, Canada. Shortnose sturgeon are large, long lived fish species. The species is anadromous in the southern portion of its range (i.e., south of Chesapeake Bay), while northern populations are amphidromous (NOAA Fisheries 1998). Population sizes vary across the species' range. From available estimates, the smallest populations occur in the Cape Fear (~8 adults; Moser and Ross 1995) and Merrimack Rivers (~100 adults; M. Kieffer, United States Geological Survey, personal communication), while the largest populations are found in the Saint John (~100,000; Dadswell 1979) and Hudson Rivers (~61,000; Bain *et al.*1998). No reliable estimate of the size of the total species or the shortnose sturgeon population in the Northeastern United States exists. Shortnose sturgeon are benthic fish

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[2] The definition of species under the ESA includes any subspecies of fish, wildlife, or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature. To be considered a DPS, a population segment must meet two criteria under NOAA Fisheries policy. First, it must be discrete, or separated, from other populations of its species or subspecies. Second, it must be significant, or essential, to the long-term conservation status of its species or subspecies. This formal legal procedure to designate DPSs for shortnose sturgeon has not yet been completed.

that mainly occupy the deep channel sections of large rivers. They feed on a variety of benthic and epibenthic invertebrates including molluscs, crustaceans (amphipods, chironomids, isopods), and oligochaete worms (Vladykov and Greeley 1963; Dadswell 1979 *in* NOAA Fisheries 1998). Shortnose sturgeon are long-lived (30 years) and, particularly in the northern extent of their range, mature at late ages. In the north, males reach maturity at 5 to 10 years, while females mature between 7 and 13 years.

Shortnose sturgeon have similar lengths at maturity (45-55 cm fork length) throughout their range, but, because sturgeon in southern rivers grow faster than those in northern rivers, southern sturgeon mature at younger ages (Dadswell *et al.* 1984). Shortnose sturgeon reach sexual maturity between approximately 6 and 10 years of age. Based on limited data, females spawn every three to five years while males spawn approximately every two years. The spawning period is estimated to last from a few days to several weeks. Spawning begins from late winter/early spring (southern rivers) to mid to late spring (northern rivers) when the freshwater temperatures increase to 8-9°C. 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.

Total instantaneous mortality rates (Z) are available for the Saint John River (0.12 - 0.15; ages 14-55; Dadswell 1979), Upper Connecticut River (0.12; Taubert 1980b), and Pee Dee-Winyah River (0.08-0.12; Dadswell *et al.* 1984). Total instantaneous natural mortality (M) for shortnose sturgeon in the lower Connecticut River was estimated to be 0.13 (T. Savoy, Connecticut Department of Environmental Protection, personal communication). There is no recruitment information available for shortnose sturgeon because there are no commercial fisheries for the species. Estimates of annual egg production for this species are difficult to calculate because females do not spawn every year (Dadswell *et al.* 1984). Further, females may abort spawning attempts, possibly due to interrupted migrations or unsuitable environmental conditions (NOAA Fisheries 1998). Thus, annual egg production is likely to vary greatly in this species.

At hatching, shortnose sturgeon are blackish-colored, 7-11mm long and resemble tadpoles (Buckley and Kynard 1981). In 9-12 days, the yolk sac is absorbed and the sturgeon develops into larvae which are about 15mm total length (TL; Buckley and Kynard 1981). Sturgeon larvae are believed to begin downstream migrations at about 20mm TL. Laboratory studies suggest that young sturgeon move downstream in a 2-step migration; a 2-day migration by larvae followed by a residency period by young of the year (YOY), then a resumption of migration by yearlings in the second summer of life (Kynard 1997). Juvenile shortnose sturgeon (3-10 years old) reside in the interface between saltwater and freshwater in most rivers (NOAA Fisheries 1998).

In populations that have free access to the total length of a river (e.g., no dams within the species' range in a river: Saint John, Kennebec, Altamaha, Savannah, Delaware and Merrimack Rivers), spawning areas are located at the farthest upstream reach of the river (NOAA Fisheries 1998). Sturgeon spawn in upper, freshwater areas and feed and overwinter in both fresh and saline habitats. Shortnose sturgeon spawning migrations are characterized by rapid, directed and often extensive upstream movement (NOAA Fisheries 1998). Shortnose sturgeon typically leave the spawning grounds soon after spawning. Non-spawning movements include wandering movements in summer and winter (Dadswell *et al.* 1984; Buckley and Kynard 1985; O'Herron *et al.* 1993). Kieffer and

Kynard (1993) reported that post-spawning migrations were correlated with increasing spring water temperature and river discharge.

Juvenile shortnose sturgeon generally move upstream in spring and summer and move back downstream in fall and winter; however, these movements usually occur in the region above the saltwater/freshwater interface (Dadswell *et al.*1984; Hall *et al.* 1991). The species appears to be estuarine anadromous in the southern part of its range, but in some northern rivers, it is "freshwater amphidromous" (i.e., adults spawn in freshwater but regularly enter saltwater habitats throughout their life; Kieffer and Kynard 1993). Adult sturgeon occurring in freshwater or freshwater/tidal reaches of rivers in summer and winter often occupy only a few short reaches of the total length (Buckley and Kynard 1985). Summer concentration areas in southern rivers are cool, deep, thermal refugia, where adult and juvenile shortnose sturgeon congregate (Flourney *et al.*1992; Rogers and Weber 1994; Rogers and Weber 1995; Weber 1996). While shortnose sturgeon are occasionally collected near the mouths of rivers and often spend time in estuaries, they are not known to regularly participate in coastal migrations (Dadswell *et al.*1984).

In the northern extent of their range, shortnose sturgeon exhibit three distinct movement patterns. These migratory movements are associated with spawning, feeding, and overwintering activities. In spring, as water temperatures rise above 8°C, pre-spawning shortnose sturgeon move from overwintering grounds to spawning areas. Spawning occurs from mid/late March to mid/late May depending upon location and weather conditions. In populations that have free access to the total length of a river (e.g., no dams within the species' range in a river: Saint John, Kennebec, Altamaha, Savannah, Delaware, and Merrimack Rivers), spawning areas are located at the farthest accessible upstream reach of the river, often just below the fall line (NOAA Fisheries 1998). Shortnose sturgeon spawn in upper, freshwater sections of rivers and feed and overwinter in both fresh and saline habitats. Shortnose sturgeon are believed to spawn at discrete sites within the river (Kieffer and Kynard 1996). In the Merrimack River, males returned to only one reach during the four years of the telemetry study (Kieffer and Kynard 1996). Squires (1982) found that during the three years of the study in the Androscoggin River, adults returned to a 1-km reach below the Brunswick Dam and Kieffer and Kynard (1996) found that adults spawned within a 2-km reach in the Connecticut River for three consecutive years. Spawning occurs over channel habitats containing gravel, rubble, or rock-cobble substrates (Dadswell *et al.*1984; NOAA Fisheries 1998). Additional environmental conditions associated with spawning activity include decreasing river discharge following the peak spring freshet, water temperatures ranging from 8 - 12° C, and bottom water velocities of 0.4 to 0.7 m/sec (Dadswell *et al.*1984; NOAA Fisheries 1998). The eggs are separate when spawned but become adhesive within approximately 20 minutes of fertilization (Dadswell *et al.*1984). Between 8° and 12°C, eggs generally hatch after approximately 13 days. The larvae are photonegative, remaining on the bottom for several days. Buckley and Kynard (1981) found week old larvae to be photonegative and form aggregations with other larvae in concealment.

Adult shortnose sturgeon typically leave the spawning grounds soon after spawning. Non-spawning movements include rapid, directed post-spawning movements to downstream feeding areas in spring and localized, wandering movements in summer and winter (Dadswell *et al.*1984; Buckley and Kynard 1985; O'Herron *et al.*1993). Kieffer and Kynard (1993) reported that post-spawning migrations were correlated with increasing spring water temperature and river discharge. Young-of-the-year shortnose sturgeon are believed to move downstream after hatching (Dovel 1981) but remain within freshwater habitats. Older juveniles tend to move downstream in fall and winter as water temperatures decline and the salt wedge recedes. Juveniles move upstream in spring and feed mostly in freshwater reaches during summer.

The temperature preference for shortnose sturgeon is not known (Dadswell *et al.*1984) but shortnose sturgeon have been found in waters with temperatures as low as 2 to 3°C (Dadswell *et al.*1984) and as high as 34°C (Heidt and Gilbert 1978). In the northern part of its range (Chesapeake Bay and north), shortnose sturgeon are seldom found in shallow water once temperature exceeds 22°C (Dadswell 1975; Dovel 1978 as reported in Dadswell *et al.*1984). Studies in the St. John River in Canada (Dadswell *et al.*1984) demonstrated that the movement by shortnose sturgeon to deeper waters was prompted by surface temperatures greater than 21°C. Dadswell *et al.*(1984) reported that shortnose sturgeon experience distress and/or mortality at temperatures greater than 25°C. More recent studies (Flourney *et al.*1992; Campbell and Goodman 2003) indicate that temperatures above 28°C and 29°C respectively, adversely affect shortnose sturgeon. In the Altamaha River, temperatures of 28-30°C during summer months create unsuitable conditions and shortnose sturgeon are found in deep cool water refuges (Flourney *et al.*1992).

Shortnose sturgeon are known to occur at a wide range of depths. A minimum depth of 0.6m is necessary for the unimpeded swimming by adults. Shortnose sturgeon have been captured at depths of up to 25m but are generally found in waters less than 20m (Dadswell *et al.*1984; Dadswell 1979). The current literature on shortnose sturgeon includes reports of shortnose sturgeon at depths of 1-25 meters (Kieffer and Kynard 1993; Savoy and Shake 2000; Welsh *et al.*2000; Pottle and Dadswell 1979; Dadswell *et al.*1984; Dadswell 1979; Hastings 1983). Shortnose sturgeon typically occur in the deepest parts of rivers or estuaries where suitable oxygen and salinity values are present (Gilbert 1989).

Shortnose sturgeon have demonstrated tolerance to a wide range of salinities. Shortnose sturgeon have been documented in freshwater (Taubert 1980; Taubert and Dadswell 1980) and in waters with salinity of 30 parts-per-trillion (ppt) (Holland and Yeverton 1973; Saunders and Smith 1978). Shortnose sturgeon have generally been reported in salinities of 0-25ppt (Dadswell 1975, 1979; McLeave *et al.*1977; Kieffer and Kynard 1973; Squiers *et al.*1979). Distribution studies indicate that shortnose sturgeon prefer riverine and estuarine habitats over marine habitats (see Secor 2003). While shortnose sturgeon have been reported in coastal waters up to 31ppt, they typically occur within several kilometers of their natal estuaries (Dadswell *et al.*1984; Kynard 1997). Mcleave *et al.*(1977) reported adults moving freely through a wide range of salinities, crossing waters with differences of up to 10ppt within a two hour period. The tolerance of shortnose sturgeon to increasing salinity is thought to increase with age (Kynard 1996). Niklitschek 2001 reports that shortnose sturgeon did not show a preference between 8-15ppt salinity, but exhibited stress and reduced survival at 29ppt salinity.

Threats to shortnose sturgeon recovery
Shortnose sturgeon were originally listed as an endangered species by the USFWS on March 11, 1967 under the Endangered Species Preservation Act (32 FR 4001, Appendix 1). NOAA Fisheries later assumed jurisdiction for shortnose sturgeon under a 1974 government reorganization plan (38 FR 41370). Although the original listing notice did not cite reasons for listing the species, a 1973 Resource Publication (Appendix II in NOAA Fisheries 1998), issued by the US Department of Interior, stated that shortnose sturgeon were "in peril...gone in most of the rivers of its former range [but] probably not as yet extinct." Pollution and overfishing, including bycatch in the shad fishery, were listed as principal reasons for the species' decline.

The Shortnose Sturgeon Recovery Plan (NOAA Fisheries 1998) identifies habitat degradation or loss (resulting, for example, from dams, bridge construction, channel dredging, and pollutant discharges) and mortality (resulting, for example, from impingement on cooling water intake screens, dredging and incidental capture in other fisheries) as principal threats to the species' survival.

Several natural and anthropogenic factors continue to threaten the recovery of shortnose sturgeon. Shortnose sturgeon continue to be taken incidentally in fisheries along the east coast and are probably targeted by poachers throughout their range (Dadswell 1979; Dovel *et al.*1992; Collins *et al.*1996). Bridge construction and demolition projects may interfere with normal shortnose sturgeon migratory movements and disturb sturgeon concentration areas. Unless appropriate precautions are made, internal damage and/or death may result from blasting projects with powerful explosives. Hydroelectric dams may affect shortnose sturgeon by restricting habitat, altering river flows or temperatures necessary for successful spawning and/or migration and causing mortalities to fish that become entrained in turbines. Maintenance dredging of federal navigation channels and other areas can adversely affect or jeopardize shortnose sturgeon populations. Hydraulic dredges can lethally take sturgeon by entraining sturgeon in dredge dragarms and impeller pumps. Mechanical dredges have also been documented to lethally take shortnose sturgeon. In addition to direct effects, dredging operations may also impact shortnose sturgeon by destroying benthic feeding areas, disrupting spawning migrations, and filling spawning habitat with resuspended fine sediments. Shortnose sturgeon are susceptible to impingement on cooling water intake screens at power plants. Electric power and nuclear power generating plants can affect sturgeon by impinging larger fish on cooling water intake screens and entraining larval fish. The operation of power plants can have unforeseen and extremely detrimental impacts to water quality which can affect shortnose sturgeon. For example, the St. Stephen Power Plant near Lake Moultrie, South Carolina was shut down for several days in June 1991 when large mats of aquatic plants entered the plant's intake canal and clogged the cooling water intake gates. Decomposing plant material in the tailrace canal coupled with the turbine shut down (allowing no flow of water) triggered a low dissolved oxygen water condition downstream and a subsequent fish kill. The South Carolina Wildlife and Marine Resources Department reported that twenty shortnose sturgeon were killed during this low dissolved oxygen event.

Contaminants, including toxic metals, polychlorinated aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs) can have substantial deleterious effects on aquatic life including production of acute lesions, growth retardation, and reproductive impairment (Cooper 1989; Sinderman 1994). Ultimately, toxins introduced to the water column become associated with the benthos and can be particularly harmful to benthic organisms (Varanasi 1992) like sturgeon. Heavy metals and organochlorine compounds are known to accumulate in fat tissues of sturgeon, but their long term effects are not yet known (Ruelle and Henry 1992; Ruelle and Kennlyne 1993). Available data suggests that early life stages of fish are more susceptible to environmental and pollutant stress than older life stages (Rosenthal and Alderdice 1976).

During summer months, especially in southern areas, shortnose sturgeon must cope with the physiological stress of water temperatures that may exceed 28°C. Flourney *et al.*(1992) suspected that, during these periods, shortnose sturgeon congregate in river regions which support conditions that relieve physiological stress (i.e., in cool deep thermal refuges). In southern rivers where sturgeon movements have been tracked, sturgeon refrain from moving during warm water conditions and are often captured at release locations during these periods (Flourney *et al.* 1992; Rogers and Weber 1994; Weber 1996). The loss and/or manipulation of these discrete refuge habitats may limit or be limiting population survival, especially in southern river systems.

Pulp mill, silvicultural, agricultural, and sewer discharges, as well as a combination of non-point source discharges, which contain elevated temperatures or high biological demand, can reduce dissolved oxygen levels. According to the Recovery Plan for shortnose sturgeon (NOAA Fisheries 1998) low oxygen levels (below 5 mg/L) are known to be stressful to aquatic life, and presumably, sturgeon would be adversely affected by levels below this limit. Shortnose sturgeon may be less tolerant of low dissolved oxygen levels in high ambient water temperatures and show signs of stress in water temperatures higher than 28°C (Flourney *et al.* 1992). At these temperatures, concomitant low levels of dissolved oxygen may be lethal.

ENVIRONMENTAL BASELINE

Environmental baselines for BOs include the past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR 402.02). The environmental baseline for this BO includes the effects of several activities that may affect the survival and recovery of the endangered species in the action area. The activities that shape the environmental baseline in the action area of this consultation generally include the following: water quality impairment, scientific research, fisheries, bridge construction, dredging, and recovery activities associated with reducing the impacts from these activities.

Due to logistical difficulties associated with most marine activities and the significant amount of resources necessary to design effective monitoring programs, monitoring the effects of the various federal actions on threatened and endangered species has not been consistent for all species groups and all projects.

Federal Actions that have Undergone Formal or Early Section 7 Consultation

NOAA Fisheries has undertaken several ESA Section 7 consultations to address the effects of various federal actions on threatened and endangered species in the action area. Each of those consultations sought to develop ways of reducing the probability of adverse impacts of the action on listed species.

Vessel Operations

Potential adverse effects from federal vessel operations in the action area of this consultation include operations of the U.S. Navy (USN) and the U.S. Coast Guard (USCG), which maintain the largest federal vessel fleets, the EPA, the National Oceanic and Atmospheric Administration (NOAA), and the ACOE. NOAA Fisheries has conducted formal consultations with the USCG, the USN, and is currently in early phases of consultation with the other federal agencies on their vessel operations (e.g., NOAA research vessels).

Other than entanglement in fishing gear, effects of fishing vessels on listed species may involve disturbance or injury/mortality due to collisions or entanglement in anchor lines. Listed species may also be affected by fuel oil spills resulting from fishing vessel accidents. No direct adverse effects on listed species or critical habitat resulting from fishing vessel fuel spills have been documented. No collisions between commercial fishing vessels and listed species or adverse effects resulting from disturbance have been documented. However, the commercial fishing fleet represents a significant portion of marine vessel activity. In addition, commercial fishing vessels may be the only vessels active in some areas, particularly in cooler seasons. Therefore, the potential for collisions exists. Although entanglement in fishing vessel anchor lines has been documented historically, no information is available on the prevalence of such events. Given the current lack of information on prevalence or impacts of interactions, there is no basis to conclude that the level of interaction represented by any of the various fishing vessel activities discussed in this section would be detrimental to the recovery of listed species.

Bridge Construction/Demolition

According to the Shortnose Sturgeon Recovery Plan (NOAA Fisheries 1998), bridge construction and demolition projects may interfere with normal shortnose sturgeon migratory movements and disturb sturgeon concentration areas. As such, the Federal Highway Administration (FHWA) first consulted with NOAA Fisheries on the Woodrow Wilson Bridge Project in the Potomac River in spring, 2000. This ongoing project involves the construction of two new bridge structures crossing the Potomac and the demolition of the existing bridge. The applicants determined that prior to construction, dredging would be necessary to allow barges to navigate safely to the project site and also to provide a channel to access a potential construction staging area. Through an alternatives analysis, it was determined that the most viable option for the demolition of the existing bridge would entail the use of subaqueous explosives. During informal consultation, several measures to minimize the potential impacts to shortnose sturgeon were developed including: time of year restrictions for mechanical dredging (restricted from February 15 through October 15); time of year restrictions for blasting (restricted from February 15 through September 15); the construction of cofferdams to minimize the lethality zone surrounding the blast site; employment of scare charges; and recommendations on the blast design including maximum charge weights, stemming, and delays. In a letter dated February 24, 2000, NOAA Fisheries stated that the determination had been made that provided these conditions were adhered to, the Woodrow Wilson Bridge Project was not likely to adversely affect listed species under NOAA Fisheries jurisdiction.

In August 2001, it was observed that the driving of large diameter steel pipe piles in deep, open water produced shock waves damaging to fish swim bladders, which resulted in unexpected fish kills. The FHWA notified NOAA Fisheries, and it was determined at that time, that because the mortality was intermittent and minimal, the pile driving would be allowed to continue. In April 2002, the mortality increased, and fish mortality threshold recommendations were implemented. The FHWA consulted experts and tested various structures and procedures designed to minimize the effects of the pile driving. Pile driving ceased on July 30, 2002. However, recognizing that additional pile driving was necessary in spring 2003, the FHWA sent a letter to NOAA Fisheries on October 17, 2002 and requested that consultation be reinitiated. FHWA provided NOAA Fisheries with a supplement to the existing biological assessment (BA) on January 13, 2003.

FHWA tested a variety of measures to mitigate the effects of the pile driving. It was determined that the use of sheet pile cofferdams or cans surrounding the area in which the pile is driven in combination with a bubble curtain inside the containment structure (referred to as a contained air bubble curtain system or ABCS), minimizes the pressure waves produced. During the monitoring, it was determined that the use of the ABCS reduced pressures from 12 to 55 psi inside the cofferdam and six to 17 psi outside the cofferdam to levels well below the established mortality threshold (approximately 1.2 outside and 1.7 inside the cofferdam). NOAA Fisheries determined that the use of the ABCS for the remaining pile driving activities did not change the basis for the original not likely to adversely affect determination conveyed in NOAA Fisheries' February 24, 2000 letter. To date, these measures have proven effective as no shortnose sturgeon have been documented to have been taken by any bridge construction or demolition activities within the action area.

Operation of the Washington Aqueduct

According to the DC Water and Sewer Authority (WASA) (2000), the majority of point sources (e.g., wastewater treatment plants and industrial discharges) discharging directly to Potomac tidal waters are located in the DC metropolitan area. Due to the high rate of population growth in this area, organic carbon loads from wastewater more than tripled between 1913 and 1944 (WASA 2000). However, better treatment led to a 91% reduction over the next 40 years, and loads are now at pre-1913 levels. Section 305(b) of the CWA requires that states biennially prepare a list of the navigable waterbodies under their jurisdiction. This list describes the water quality in the navigable waterbody and provides an analysis of the extent to which all navigable waters of such State provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife, and allow recreational activities in and on the water. The Washington Aqueduct Outfalls 002, 003, and 004 are in the vicinity of segment 03. In the 305(b) assessment, the DC Department of Health (DOH) indicated that the overall use support, which includes waters considered to be safe for humans to swim and from which it is safe to consume fish, in each of the three segments is not supported due to pH, pathogens, and total toxics. The non-attainment sources are considered to be municipal point sources, urban runoff/storm sewer, natural sources, combined sewer overflows (CSO), and other urban runoff. The aquatic life support, however, is fully supported for the Potomac, which indicates that the dissolved oxygen concentrations, pH, and temperature ranges in each segment are adequate to sustain aquatic life.

Surveys conducted by DC DOH in segment 03 (an area which encompasses the region immediately below Washington Aqueduct Outfalls 002 through 004), revealed the presence of toxins in the sediment. Fish tissue samples for some species showed elevated levels of contaminants including chlordane and PCBs. Biological samples from selected sites in this segment suggest that the benthic community is severely stressed and this stressed condition may be attributed to urban storm water runoff from upstream and polluted streams, CSO events, and impacts from adjacent industrial facilities.

During this water quality study (performed by EA Engineering, Science and Technology, Inc.), additional research regarding background levels of total suspended solids (TSS) in the vicinity of the Aqueduct's outfalls. Records of TSS (measured at Little Falls upstream of the Aqueduct outfalls) covering a period of almost 20 years (1980-1999) indicated that the median suspended load in the Potomac River was 218,000 kg/day. The FHWA indicates in the Biological Assessment for the Woodrow Wilson Bridge Project that the average daily turbidity in the Potomac is 150 NTUs.

The NPDES permit issued by EPA to the Army Corps of Engineers for discharges resulting from the operation of the Washington Aqueduct has been the subject of section 7 consultation completed in July 2003. In the BO, NOAA Fisheries concluded that while a discharge from the Aqueduct is not likely to result in direct adverse affects to adult shortnose sturgeon, shortnose sturgeon eggs and larvae present in the vicinity of an Aqueduct discharge are likely to be adversely affected by the discharge. A discharge that occurs when eggs and/or larvae are present will likely result in direct injury and/or mortality of fish through entrapment under sediments, decreased dissolved oxygen concentrations, and adverse effects from the effluent. However, these effects are limited to the eggs and larvae that are present in the vicinity of the discharge, which is expected to occur from mid-March through mid-May. Indirect effects of a discharge on Chesapeake Bay shortnose sturgeon include the disruption of migratory movements and impaired recruitment, as the rapid change in turbidity associated with the sediment plume could result in adult shortnose sturgeon abandoning a spawning run and returning to downstream reaches of the river. While this could result in harassment of adult shortnose sturgeon, which is considered a take under the ESA, it is not anticipated as the timing of the one bypass discharge would have to be directly correlated with the limited duration of the spawning run. Environmental conditions suitable for shortnose sturgeon spawning may be available for only three to six days (Taubert 1980b; Buckley and Kynard 1985). Also, the plume that contains high TSS concentrations does not cover the entire river; thereby, leaving room for shortnose sturgeon to potentially avoid the disturbance. As such, NOAA Fisheries has concluded that the indirect effect of the Aqueduct discharge on the spawning migration of shortnose sturgeon is unlikely and, therefore, will not result in adverse effects to adult shortnose sturgeon. Given the fact that female shortnose sturgeon spawn once every three years, a discharge would affect the eggs of only 33 percent of the spawning age females, on average, in any given year. Those eggs would represent no more than 20 percent of the eggs spawned in a five-year permit cycle, on average. However, because shortnose sturgeon eggs and larvae are dispersed within the river (generally within a one to two km reach), only those eggs and larvae present within the zone of impact surrounding the outfalls (e.g., the area affected by the deposition of sediments, toxicity, and TSS) will suffer effects. Therefore, the eggs expected to suffer effects from a discharge would likely be less than 100 percent of the eggs deposited that particular year and less than 20 percent of all eggs spawned in the five year permit cycle.

Dredging

Maintenance dredging of federal navigation channels can adversely affect shortnose sturgeon populations. In particular, hydraulic dredges (e.g., hopper and pipeline) have been documented to lethally harm sturgeon by entraining fish in the dredge dragarms and impeller pumps, and mechanical dredges have been documented to take Atlantic sturgeon both in North Carolina and Maine. On April 30, 2003, a shortnose sturgeon was taken by a mechanical bucket dredge during maintenance dredging activities in the Bath Iron Works sinking basin in the Kennebec River, Maine. This take represents the first documented mortality of a shortnose sturgeon in a mechanical bucket dredge.

Dredging in the Chesapeake Bay has occurred in the past. The ACOE previously consulted with NOAA Fisheries on dredging in the Potomac River and on July 8, 1999, NOAA Fisheries concluded consultation on the Potomac River dredging finding that the project was not likely to adversely affect listed species under the jurisdiction of NOAA Fisheries. The ACOE completed maintenance dredging of the Potomac River Federal Navigation Channel on February 8, 2000. During this dredging iteration the only portions of the project that were dredged were the Alexandria waterfront, the Hunting Creek Channel, and the Mattawoman Bar. These sites are approximately 16 miles downstream of the Washington Aqueduct outfalls in the Potomac River. These areas were dredged to a depth of 24 feet plus one-foot allowable overdepth and a width of 200 feet. Approximately 970,000 cubic yards of material was removed via mechanical dredging and was placed in the Gunston Cove disposal site. No shortnose sturgeon were observed to have been taken as a result of this dredging.

Dredging also occurs regularly in Virginia waters of the Chesapeake Bay. Ongoing dredging projects that have been the subject of Section 7 consultation include the US Navy's Dam Neck

Annex beach renourishment project and numerous projects permitted by the ACOE including the Thimble Shoal Federal Navigation Channel project, the Atlantic Ocean Channel Federal Navigation Channel Project, and the Cape Henry Channel, York Spit Channel, York River Entrance Channel, and Rappahannock Shoal Channel project. Several sea turtles have been taken by dredges associated with these projects. No shortnose sturgeon have been taken in association with these projects with the exception of a shortnose sturgeon captured in a pre-dredge relocation trawl for the Thimble Shoals project in October, 2003.

Pollution

Within the action area, sea turtles and optimal sea turtle habitat most likely have been impacted by pollution. Marine debris (e.g., discarded fishing line or lines from boats) can entangle turtles in the water and drown them. Turtles commonly ingest plastic or mistake debris for food, as observed with the leatherback sea turtle. The leatherback's preferred diet includes jellyfish, but similar looking plastic bags are often found in the turtle's stomach contents (Magnuson *et al.*. 1990).

Chemical contaminants may also have an effect on sea turtle reproduction and survival. While the effects of contaminants on turtles is relatively unclear, pollution may be linked to the fibropapilloma virus that kills many turtles each year (NOAA Fisheries 1997). If pollution is not the causal agent, it may make sea turtles more susceptible to disease by weakening their immune systems. Furthermore, the Bay watershed is highly developed and may contribute to impaired water quality via stormwater runoff or point sources. In a characterization of the chemical contaminant effects on living resources in the Chesapeake Bay's tidal rivers, the mainstem Bay was not characterized due to the historically low levels of chemical contamination (Chesapeake Bay Program Office 1999).

Excessive turbidity due to coastal development and/or construction sites could influence sea turtle foraging ability. Turtles are not very easily affected by changes in water quality or increased suspended sediments, but if these alterations make habitat less suitable for turtles and hinder their capability to forage, eventually they would tend to leave or avoid these less desirable areas (Ruben and Morreale 1999).

Non-Federally Regulated Actions

Private and Commercial Vessel Operations

Private and commercial vessels operate in the action area of this consultation and also have the potential to interact with sea turtles. In addition, an unknown number of private recreational boaters frequent coastal waters; some of these are engaged in whale watching or sportfishing activities. These activities have the potential to result in lethal (through entanglement or boat strike) or non-lethal (through harassment) takes of listed species that could prevent or slow a species' recovery.

In addition to commercial traffic and recreational pursuits, private vessels participate in high speed marine events concentrated in the southeastern U.S. that are a particular threat to sea turtles. The magnitude of these marine events in the action area is not currently known. The STSSN also reports regular incidents of likely vessel interactions (e.g., propeller-type injuries) with sea turtles. Interactions with these types of vessels and sea turtles could occur in the action area, and it is possible that these collisions would result in mortality. Other than injuries and mortalities resulting from collisions, the effects of disturbance caused by vessel activity on listed species is largely unknown.

Non-Federally Regulated Fishery Operations

Very little is known about the level of take in fisheries that operate strictly in state waters. However, depending on the fishery in question, many state permit holders also hold federal licenses; therefore, Section 7 consultations on federal actions in those fisheries address some state-water activity. Impacts on sea turtles and shortnose sturgeon from state fisheries may be greater than those from federal activities in certain areas due to the distribution of these species. NOAA Fisheries is actively participating in a cooperative effort with the Atlantic States Marine Fisheries Commission (ASMFC) and member states to standardize and/or implement programs to collect information on level of effort and bycatch of protected species in state fisheries. When this information becomes available, it can be used to refine take reduction plan measures in state waters.

Shortnose sturgeon are taken incidentally in anadromous fisheries along the East coast and may be targeted by poachers (NOAA Fisheries 1998). Historically, the Chesapeake Bay and its tributaries supported a large, very productive commercial fishery for shortnose and Atlantic sturgeon. However, by the early 1900's, overfishing, pollution, and the construction of dams in several of the tributaries to the Bay resulted in a significant decline in both populations. Few shortnose or Atlantic sturgeon were reported as bycatch in Chesapeake Bay fisheries during the mid to late 1900's. Until the FWS Atlantic Sturgeon Reward Program documented a shortnose sturgeon in 1996 in the Potomac River, it was generally thought that this species had been extirpated from the Chesapeake Bay.

Shortnose sturgeon have been taken incidentally in other anadromous fisheries in the Chesapeake Bay and its tidal tributaries. Of the shortnose sturgeon taken in the FWS reward program, eighteen were taken in poundnets, 7 in fyke nets, 19 in gill nets, 8 in catfish traps, 1 in an eel pot and 1 in a hoop net. It is possible that shortnose sturgeon are subject to additional unreported incidental takes in similar gear types that are set throughout the action area. As evidenced by the FWS reward program, the incidental take of shortnose sturgeon in the Chesapeake Bay and its tributaries has been documented in both commercial and recreational fisheries.

Nearshore entanglements of turtles have been documented; however, information is not available on whether the vessels involved were permitted by the state or by NOAA Fisheries. Nearshore and inshore gillnet fisheries occur in state waters from Connecticut through North Carolina - areas where sea turtles also occur. Captures of sea turtles in these fisheries have been reported (NOAA Fisheries SEFSC 2001). Two 10-14 inch mesh gillnet fisheries, the black drum and sandbar shark gillnet fisheries, occur in Virginia state waters, along the tip of the eastern shore. These fisheries may take sea turtles given the gear type, but no interactions have been observed. NOAA Fisheries is currently undertaking efforts to observe these fisheries during the spring. Similarly, small mesh gillnet fisheries occurring in Virginia state waters are suspected to take sea turtles but no interactions have been observed. During May - June 2001, NOAA Fisheries observed 2 percent of the Atlantic croaker fishery and 12 percent of the dogfish fishery (which represent approximately 82% of Virginia's total small mesh gillnet landings from offshore and inshore waters during this time), and no turtle takes were observed.

NOAA Fisheries is concerned about the take of sea turtles in the pound net fishery in Virginia. Pound nets with large mesh and stringer leaders set in the Chesapeake Bay have been observed to lethally take turtles as a result of entanglement in the leader. Virginia sea turtle strandings during the spring are consistently high, and given the best available information, including observer reports, the nature and location of the turtle strandings, the type of fishing gear in the vicinity of the greatest number of strandings, and the known interactions between sea turtles and large mesh and stringer pound net leaders, pound nets were considered to be a likely contributor to high sea turtle strandings in 2001 (and likely every spring). In addition, there have been documented interactions between pound nets and shortnose sturgeon. Of the 54 shortnose sturgeon captures reported through the FWS Reward Program, seventeen were incidentally captured in pound nets.

A whelk fishery using pot/trap gear is known to occur in offshore Virginia. This fishery operates when sea turtles may be in the area. Sea turtles (loggerheads and Kemp's ridleys in particular) are believed to become entangled in the top bridle line of the whelk pot, given a few documented entanglements of loggerheads in whelk pots, the configuration of the gear, and the turtles' preference for the pot contents. Research is underway to determine the magnitude of these interactions and to develop gear modifications to reduce these potential entanglements. In New England waters, leatherbacks have been found entangled in whelk pot lines, so if leatherback turtles overlap with this gear in the action area, entanglement may occur. The blue crab fishery using pot/trap gear also occurs in the action area. The magnitude of interactions with these pots and sea turtles is unknown, but loggerheads and leatherbacks have been found entangled in this gear. For instance, in May and June 2002, three leatherbacks were documented entangled in crab pot gear in various areas of the Chesapeake Bay. Given the plethora of crab pot gear throughout the action area, it is possible that these interactions are more frequent than what has been documented.

Other Potential Sources of Impacts in the Action Area

A number of anthropogenic activities have likely directly or indirectly affected listed species in the action area. These sources of potential impacts include previous dredging projects, pollution, water quality, and sonic activities. However, the impacts from these activities are difficult to measure. Where possible, conservation actions are being implemented to monitor or study impacts from these elusive sources.

Close coordination is occurring through the Section 7 process on both dredging and disposal sites and vessel-related impacts. Whole sea turtles and sea turtle parts have been taken in hopper dredging operations in the vicinity of the action area. From 2000 to 2003, loggerhead and unidentified turtles were incidentally taken during maintenance dredging operations in Thimble Shoal Channel. These takes consisted of fresh dead turtles, but several of the incidents involved decomposed turtle flippers and/or carapace parts. The 2001 and 2002 dredging operations in Cape Henry and York Spit Channels have also incidentally taken sea turtles. As such, hopper dredging in the action area has resulted in the mortality of a number of sea turtles, most of which were loggerheads. Dredging in the surrounding area could have also influenced the distribution of sea turtles and/or disrupted potential foraging habitat.

Scientific Studies
As mentioned previously, there have been limited studies targeting the shortnose sturgeon population present in the Chesapeake Bay and its tributaries. The FWS conducted a sampling study sponsored by the ACOE between 1998 and 2000 in the Maryland waters of Chesapeake Bay to determine the occurrence of shortnose and Atlantic sturgeon in areas of proposed dredge-fill operations. This study included fishing at a total of 24 sites within the Bay, five of which were located in the middle Potomac River. During this study, no shortnose sturgeon were captured in the Potomac or Susquehanna rivers. An additional study by the FWS was performed in the Potomac River and included sampling at two areas in the vicinity of Little Falls, Virginia, which are

environments that are consistent with the preferred spawning habitat of shortnose sturgeon. No shortnose sturgeon were captured during this study. In December 2002, NOAA Fisheries provided funding to the FWS to perform a study to identify overwintering aggregations of shortnose sturgeon in the Potomac River. However, due to adverse winter river conditions, this study was limited to approximately 18 hours of sampling effort and did not yield any shortnose sturgeon captures. The FWS Atlantic Sturgeon Reward Program has documented the incidental captures of 50 shortnose sturgeon from various locations in the Bay over the six year duration of the program. The majority of these fish were tagged and tissue samples were taken from 36 fish in order to determine the genetic characteristics of the individuals. As a result of techniques associated with these sampling studies, a limited number of shortnose sturgeon have been subjected to capturing, handling, and tagging.

Contaminants and Water Quality

Contaminants including heavy metals, polycyclic aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs), can have serious, deleterious effects on aquatic life and are associated with the production of acute lesions, growth retardation, and reproductive impairment (Ruelle and Keenlyne 1993). Contaminants introduced into the water column or through the food chain, eventually become associated with the benthos where bottom dwelling species like shortnose sturgeon are particularly vulnerable.

Several characteristics of shortnose sturgeon life history including long life span, extended residence in estuarine habitats, and being a benthic omnivore, predispose this species to long term, repeated exposure to environmental contaminants and bioaccumulation of toxicants (Dadswell 1979). In the Connecticut River, coal tar leachate was suspected of impairing sturgeon reproductive success. Kocan *et al.*(1993) conducted a laboratory study to investigate the survival of sturgeon eggs and larvae exposed to PAHs, a by-product of coal distillation. Only approximately 5% of sturgeon embryos and larvae survived after 18 days of exposure to Connecticut River coal tar (i.e., PAHs) demonstrating that contaminated sediment is toxic to shortnose sturgeon embryos and larvae under laboratory exposure conditions (NOAA Fisheries 1998).

Although there is little information available on the levels of contaminants in shortnose sturgeon tissues, some research on other related species indicates that concern about the effects of contaminants on the health of sturgeon populations is warranted. Detectable levels of chlordane, DDE (1,1-dichloro-2, 2-bis(p-chlorophenyl)ethylene), DDT (dichlorodiphenyl-trichloroethane), and dieldrin, and elevated levels of PCBs, cadmium, mercury, and selenium were found in pallid sturgeon tissue from the Missouri River (Ruelle and Henry 1994). These compounds were found in high enough levels to suggest they may be causing reproductive failure and/or increased physiological stress (Ruelle and Henry 1994). In addition to compiling data on contaminant levels, Ruelle and Henry (1994) also determined that heavy metals and organochlorine compounds (i.e., PCBs) accumulate in fat tissues. Available data suggest that early life stages of fish are more susceptible to environmental and pollutant stress than older life stages (Rosenthal and Alderdice 1976). Although there have been few studies to assess the impact of contaminants on shortnose sturgeon, elevated levels of environmental contaminants, including chlorinated hydrocarbons, in several other fish species are associated with reproductive impairment (Cameron *et al.* 1992; Longwell *et al.* 1992), reduced egg viability (Von Westernhagen *et al.*. 1981; Hansen 1985; Mac and Edsall 1991), and reduced survival of larval fish (Berlin *et al.* 1981; Giesy *et al.*1986). Some researchers have speculated that PCBs may reduce the shortnose sturgeon's resistance to fin rot (Dovel *et al.*1992). In other fish species, reproductive impairment, reduced egg viability, and reduced survival of larval fish are associated with elevated levels of environmental contaminants including chlorinated hydrocarbons. A strong correlation that has been made between fish weight, fish fork length, and DDE concentration in pallid sturgeon livers indicates that DDE increase proportionally with fish size (NOAA Fisheries 1998).

Point source discharges (i.e., municipal wastewater, paper mill effluent, industrial or power plant cooling water or waste water) and compounds associated with discharges (i.e., metals, dioxins, dissolved solids, phenols, and hydrocarbons) contribute to poor water quality and may also impact the health of sturgeon populations. The compounds associated with discharges can alter the pH of receiving waters, which may lead to mortality, changes in fish behavior, deformations, and reduced egg production and survival. Agriculture and forestry occur within the Chesapeake Bay watershed, which potentially results in an increase in the amount of suspended sediment present in the river. Concentrated amounts of suspended solids discharged into a river system may lead to smothering of fish eggs and larvae and may result in a reduction in the amount of available dissolved oxygen.

Conservation and Recovery Actions

Sea Turtles

NOAA Fisheries has implemented a series of regulations aimed at reducing the potential for incidental mortality of sea turtles in commercial fisheries. In particular, NOAA Fisheries has required the use of TEDs in southeast U.S. shrimp trawls since 1989 and in summer flounder trawls in the Mid-Atlantic area (south of Cape Henry, Virginia) since 1992. It has been estimated that TEDs exclude 97% of the turtles caught in such trawls. These regulations have been refined over the years to ensure that TED effectiveness is maximized through proper placement and installation, configuration (e.g., width of bar spacing), floatation, and more widespread use.

On December 3, 2002, NOAA Fisheries published restrictions on the use of gillnets with larger than 8 inch stretched mesh, in federal waters (3-200 nautical miles) off of North Carolina and Virginia (67 FR 71895). These restrictions were implemented to reduce the impact of the monkfish and other large-mesh gillnet fisheries on endangered and threatened sea turtles in areas where sea turtles are known to concentrate.

Existing information indicates that pound nets with large mesh and stringer leaders as used in the Virginia Chesapeake Bay incidentally take sea turtles. Based on the available information, NOAA Fisheries determined that fishing with this gear is likely a contributor to spring sea turtle strandings in the Virginia Chesapeake Bay. To address the impact of pound nets on sea turtles, on June 17, 2002, NOAA Fisheries published an interim final rule that restricted the use of all pound net leaders of 12 inches or greater stretched mesh and all pound net leaders with stringers in Virginia waters of the mainstem Chesapeake Bay and tributaries from May 8 to June 30 each year (67 FR 41196).

On July 16, 2003, NOAA Fisheries published a temporary final rule prohibiting the use of all pound net leaders in the Virginia waters of the mainstream Chesapeake Bay through July 30, 2003 (68 FR 41942). This action followed new information on sea turtle interactions with pound net leaders in the Chesapeake Bay area. NOAA Fisheries is continuing to address these entanglements and has recently published a new proposed rule (69 FR 5810, February 6, 2004) for the use of pound net leaders in the Chesapeake Bay during the period May 6 - July 15 each year.

There is an extensive array of STSSN participants along the Atlantic and Gulf of Mexico coasts who not only collect data on dead sea turtles, but also rescue and rehabilitate live stranded turtles. Data collected by the STSSN are used to monitor stranding levels and compare them with fishing activity in order to determine whether additional restrictions on fishing operations are needed. These data are also used to monitor incidence of disease, study toxicology and contaminants, and conduct genetic studies to determine population structure. All of the states that participate in the STSSN are collecting tissue for and/or conducting genetic studies to better understand the population dynamics of sea turtle species. These states also tag live turtles when encountered (either via the stranding network through incidental takes or in-water studies). Tagging studies help provide an understanding of sea turtle movements, longevity, and reproductive patterns, all of which contribute to our ability to reach recovery goals for the species.

Status of Shortnose Sturgeon in the Chesapeake Bay

The NOAA Fisheries recovery plan (1998) indicates that shortnose sturgeon found in the Chesapeake Bay and its tributaries are considered part of the Chesapeake Bay population. Welsh *et al.*(1999) summarizes historical and recent evidence of shortnose sturgeon presence in the Chesapeake Bay. The first published account of shortnose sturgeon in the Chesapeake system was an 1876 record from the Potomac River reported in a general list of fishes of Maryland (Uhler and Lugger 1876). Other historical records of shortnose sturgeon in the Chesapeake include: the Potomac River (Smith and Bean 1899), the upper Bay near the mouth of the Susquehanna River in the early 1980's, and the lower Bay near the mouths of the James and Rappahannock rivers in the late 1970's (Dadswell *et al.*1984). The US Fish and Wildlife Service Reward Program for Atlantic Sturgeon began in 1996. Shortnose sturgeon have been incidentally captured via this program. As of May 2003, fifty-four shortnose sturgeon were captured via the reward program in the Chesapeake Bay and its tributaries – two from the Susquehanna Flats, eight from the Susquehanna River, two in the Bohemia River, six in the Potomac River, one in the Sassafras River, one in the Elk River, two south of the Bay Bridge near Kent Island, one near Howell Point, one just north of Hoopers Island, and two in Fishing Bay. The remaining shortnose sturgeon were captured in the upper Bay north of Hart-Miller Island. These fish were captured alive in either commercial gillnets, poundnets, fykenets, eel pots, hoop nets, or catfish traps.

Research conducted by the NYU School of Medicine involving mitochondrial DNA (mtDNA) analysis of shortnose sturgeon populations suggests that shortnose sturgeon captured in the upper Chesapeake Bay may have migrated from the Delaware River to the upper Chesapeake through the Chesapeake and Delaware Canal (Grunwald *et al.*2002). In this study, genetic comparisons were made among all shortnose sturgeon populations for which tissue samples were available. All population comparisons exhibited clear and significant differences in haplotype frequencies except for comparisons between the Upper/Lower Connecticut River and Delaware/Chesapeake. There were no unique haplotypes in the Chesapeake (Potomac) fish. Samples from four fish from the Potomac River were analyzed and results indicate that these fish exhibited the same haplotypes as fish found elsewhere in the Chesapeake and in the Delaware River. These results suggest that some or all of the sturgeon captured in the Chesapeake Bay and its tributaries may be transients from the Delaware population. However, mtDNA represents only a fraction (less than 1%) of the genetic material and is maternally inherited. In order to obtain conclusive results, it is necessary to look at nuclear DNA (nDNA), which represents greater than 99% of the genetic material and is biparentally inherited. The correct genetics standard is to analyze both mtDNA and nDNA in order to make a conclusive statement on the genetic distinctness of a population. Also, as noted in Grunwald *et al.*2002, the utility of mtDNA length-variant haplotypes and heteroplasmy as markers to distinguish populations and to make inferences regarding phylogenetic relationships has been debated (Stellwag and Rulifson 1995; Waldman and Wirgin 1995; Lunt *et al.*1998). As such, in the absence of stronger evidence to the contrary, NOAA Fisheries presumes that shortnose sturgeon captured in the Chesapeake Bay and its tributaries, including the Potomac River, are part of the Chesapeake Bay population, not the Delaware River population.

In addition to implementing the Reward Program for Atlantic sturgeon, the FWS conducted two sampling studies between 1998 and 2000 in the Maryland waters of the Potomac River to determine the occurrence of shortnose and Atlantic sturgeon in areas of proposed Army Corps of Engineers (ACOE) dredge-fill operations. A two-year bottom gillnetting study was conducted at five sites located in the middle Potomac River. This involved a total of 4,590 fishing hours between the sites. During this study, no shortnose sturgeon were captured. As part of the Potomac River sturgeon sampling study, the FWS also conducted an additional 77 hours of sampling at two other areas in the vicinity of Little Falls, Virginia (the downstream portion of the fall line in the upper tidal Potomac River). This region of the river contains environments that are consistent with the preferred spawning habitat of shortnose sturgeon. The sampling sites were located at the Chain Bridge and the deep hole downstream from the Chain Bridge known as Three Sisters. Anchored gillnets used at Three Sisters consisted of two one hundred foot nets. The anchored gillnets deployed at theChain Bridge consisted of two one hundred foot nets above the bridge and one three hundred foot net below the bridge. Gillnets used at these sites were set in a similar manner as gillnets used at the sites sampled in the middle Potomac River. The nets at Three Sisters were 3-hour sets and the nets around Chain Bridge were 24-hour sets. No shortnose sturgeon were documented during this study.

These FWS studies may not have been comprehensive enough to determine the presence or absence of sturgeon in the upper tidal Potomac River. A 2000 NOAA Fisheries report, entitled "A Protocol for Use of Shortnose and Atlantic Sturgeons" identified a minimum sampling protocol for use in north central rivers (Chesapeake drainages to the Merrimack River) to confirm shortnose sturgeon presence or absence. The FWS studies did not follow this desired protocol, which was published after the studies commenced. One factor was that the FWS sampling sites may have been too deep in areas with too strong a current to adequately document the presence of shortnose sturgeon. Also, the timing and duration of the sampling events and the type of nets employed may not have been appropriate for targeting shortnose sturgeon in this area. As a result, the lack of sturgeon discovered in the FWS gillnet study should not be used as a conclusive indicator of shortnose sturgeon absence in the upper tidal Potomac River.

In December 2002, NOAA Fisheries provided funding to the FWS to initiate a study to identify the over-wintering habitat, genetic stock composition, and movement of shortnose sturgeon in the Potomac River. The original intent of the project was to use broad-band acoustics to assist in determining possible concentrations of shortnose sturgeon on over-wintering grounds. As such, ground truthing was performed in mid-December, but unfortunately, it was not possible to gather the appropriate "classifiers" for shortnose sturgeon. In early January, FWS and NOAA Fisheries decided to forego the acoustics and sample areas characteristic of overwintering habitats, similar to those observed in the Delaware River. On January 15, 2003, Jim Cummins (Potomac Interstate Commission) accompanied the FWS to investigate potential sampling areas in the vicinity of Roosevelt Island. In mid-January, the Potomac River experienced severe icing, thereby, prohibiting sampling. The ice began to dissipate in the first week in February, but floating sheets were still present, making it impossible to gillnet. On February 14, 2003, the FWS was able to sample for the first time. This sampling was done at Roosevelt Island and consisted of three gillnets which were set for approximately six hours. The following week, the area was again subjected to freezing temperatures, thus freezing the river a second time. FWS made two more unsuccessful attempts to sample on March 4 and 17, 2003. On March 4, 2003, five gillnets were set in the vicinity of Fort Washington, MD for a total of about 7 ½ hours and on March 17, 2003, three gillnets were set near Three Sisters for a total of approximately 4 ½ hours. Due to the snow melt, large amounts of debris and water were flowing in the Potomac, and because of the large quantity of debris, the gillnets were not able to fish properly. Between March 15 and 22, 2003, temperatures rose to 8-10°C. At that temperature, shortnose sturgeon begin to migrate from the overwintering aggregations; therefore, attempts to locate the aggregations at that time would have been unsuccessful and sampling was suspended for the season.

While there is no direct evidence of sturgeon spawning in the tributaries to the Chesapeake Bay, there is reason to believe that spawning occurs in this system. Six adult sturgeon have recently been captured in downstream reaches of the Potomac River. Shortnose sturgeon appear to spend most of their lives in their natal rivers (NOAA Fisheries 1998). Therefore, sturgeon found in the lower Potomac may reasonably be expected to remain in the Potomac and spawn there. Research on other shortnose sturgeon populations indicates that this species typically spawns just below the limit of upstream passage, often the fall line. In the Potomac River, this upstream limit is likely Little Falls. In addition, research on other shortnose sturgeon populations indicates that shortnose sturgeon prefer to spawn in specific habitats that contain areas with high flow and cobble/gravel substrate. The habitat at and below Little Falls is consistent with this preferred spawning habitat. Therefore, for the purposes of this analysis, NOAA Fisheries has made the precautionary assumption that shortnose sturgeon are present and spawn near Little Falls.

Other tributaries of the Chesapeake Bay that appear to have suitable spawning habitat for Chesapeake Bay shortnose sturgeon include the Rappahannock, James, York, Susquehanna, Gunpowder and Patuxent Rivers (Pers. Comm. John Nichols, NOAA Fisheries, 2002). A FWS sampling study was also conducted in the upper Chesapeake Bay mainstem, lower Susquehanna River and Chesapeake/Delaware Canal during 1998 and 2000 in conjunction with a Section 7 consultation for the Baltimore Harbor and Channels Federal Navigation Project. This study involved bottom gillnetting at 19 sites within the upper Chesapeake Bay mainstem and lower Susquehanna River, and tracking of sonically tagged sturgeon within the upper Bay and the Canal. No shortnose sturgeon were captured at any of the 19 sites. There have been anecdotal reports made by watermen of shortnose sturgeon presence in Gunpowder Falls, which enters the Gunpowder River in Baltimore County, although there has not been any documentation of spawning activity (Pers. Comm. John Nichols, NOAA Fisheries, 2002). Shortnose sturgeon have been documented by the FWS Reward Program in the Susquehanna River (April 4, 1996; April 24, 1997; April 28, 1998; February 19, 1999; February 6 and 17, 2001; June 2, 2002) and near the mouth of the Rappahannock River (May 1998) (Spells 1998, unpublished report). No spawning activity has been documented in any of these tributaries to the Chesapeake Bay. However, to date, no directed sampling following the NOAA Fisheries Protocols has occurred to determine if a spawning population exists in any of these tributaries. As is the case with the Potomac River, the conservative assumption must therefore be made, that based on the documented presence of this species and suitable spawning habitat in these river systems, and given the life history attributes of shortnose sturgeon, NOAA Fisheries assumes for the purposes of this analysis that shortnose sturgeon from the Chesapeake Bay population are spawning in at least the Potomac, Susquehanna, Gunpowder, and Rappahannock River systems.

While no population estimate for any of the river systems or the Chesapeake Bay population as a whole have been made, the documented capture of 52 different shortnose sturgeon in the FWS Atlantic Sturgeon reward program indicate that the size of the Chesapeake Bay population on shortnose sturgeon is at least 52 adults. As such, at least 52 adult shortnose sturgeon are expected to be present in the action area.

Habitat suitability in the Chesapeake Bay

Based on the best available information (see above), shortnose sturgeon are generally expected to be present in areas of depths up to 25m, temperatures below 29°C, and salinities less than 29ppt. Based on these criteria, estimates can be made regarding the amount of available habitat for shortnose sturgeon in the Chesapeake Bay and its tidal tributaries. These calculations were made for the summer months when habitat is expected to be more limited than in winter months. Based on ten-year averages across the entire Bay area and using a model developed by EPA (US EPA 2003d, US EPA 2003e), 98.2% of the Bay will have suitable (<29°C) temperatures for shortnose sturgeon while 65.7% of the area will have temperatures below 22°C. For salinity, 99% of the Bay has salinity levels below 29ppt, while 94.4% will have salinity levels below 15ppt (US EPA 2003e). 99.4% of the Bay is shallower than 25m while 99.7% is shallower than 12m (US EPA 2003e). This information indicates that of depth, temperature and salinity, temperature is the limiting factor for shortnose sturgeon in the Chesapeake Bay in summer months (US EPA 2003d). Based on this same data, 95.6% of the Bay (averaged over space and time) can be expected to have depths less than 25m, temperatures below 29°C and salinities less than 29ppt (US EPA 2003d). This indicates that based on these factors, suitable shortnose sturgeon habitat is present in a large portion of the Chesapeake Bay system.

When the same analysis is completed for the bottom layer of the Chesapeake Bay system, where benthic organisms such as shortnose sturgeon are expected to be present, similar results are seen. Based on the ten-year averages and the same EPA model, 96.5% of the area will have suitable (<29°C) temperatures for shortnose sturgeon while only 63.9% of the area will have temperatures below 22°C (US EPA 2003e). For salinity, 98.3% of the bottom area of the entire Bay has salinity levels below 29ppt, while 93.8% will have salinity levels below 15ppt (US EPA 2003e). 99.1% of the bottom area of the Bay is less than 25m deep while 99.6% is less than 12m deep(US EPA 2003e). Based on this same data, 94% of the bottom area of the Bay (averaged over space and time) can be expected to have depths less than 25m, temperatures below 29°C and salinities less than 29ppt (US EPA 2003d). Based on this model, suitable shortnose sturgeon habitat is present in a large portion of the benthic area of the Chesapeake Bay system.

Potentially the greatest habitat limiting factor (besides temperature) to shortnose sturgeon presence in the Chesapeake Bay system is dissolved oxygen. Based on analysis of historic summer conditions in the Bay, EPA has determined that across the entire Bay (averaged over space and time), 76% of the Bay had monthly average dissolved oxygen levels of 5mg/L. By 2000, this had increased to 78.1%, evidence of the progress made towards restoring habitat in the Chesapeake Bay system. When the same analysis is done on the bottom layer of the Chesapeake Bay, historic average demonstrate that only 67.5% of the area had monthly average dissolved oxygen levels of 5mg/L, while by 2000 this had increased to 70.3%. While this demonstrates the improvements over the last several years, it also demonstrates the need for more appropriate water quality criteria and continuing efforts to restore the Bay habitat for aquatic life.

Summary and Synthesis of the Status of the Species and Environmental Baseline

In summary, the potential for activities that may have previously impacted listed species (dredging, vessel operations, military activities, commercial and state fisheries, etc.) to affect sea turtles remains throughout the action area of this consultation. However, recovery actions have been undertaken as described and continue to evolve. Although those actions have not been in place long enough for a detectable change in most listed species populations to have occurred, those actions are expected to benefit listed species in the foreseeable future. These actions should not only improve conditions for listed sea turtles, they are expected to reduce sources of human-induced mortality as well.

Shortnose sturgeon and their habitat in the Chesapeake Bay may be affected by several different factors including: impaired water quality from both point and non-point sources; incidental take in scientific studies and commercial and recreational fisheries; construction and demolition of bridges; and dredging activities. NOAA Fisheries has collaborated with various federal action agencies conducting work in the Chesapeake Bay to minimize the potential for these activities to adversely affect shortnose sturgeon.

EFFECTS OF THE ACTION

This section of a BO assesses the direct and indirect effects of the proposed action on threatened and endangered species or critical habitat, together with the effects of other activities that are interrelated or interdependent (50 CFR 402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR 402.02).

The purpose of this assessment is to determine if it is reasonable to expect that EPA's action will have direct or indirect effects on threatened and endangered species that will appreciably reduce their likelihood of both survival and recovery in the wild by reducing the reproduction, numbers or distribution of that species (which is the "jeopardy" standard established by 50 CFR 402.02).

For the purpose of the effects analysis for dissolved oxygen criteria, NOAA Fisheries will rely on the model developed by EPA and the results provided by EPA which illustrate the dissolved oxygen levels expected in the Bay when the nutrient and sediment reduction goals are met (which are necessary for attaining the dissolved oxygen criteria).

Summary of the Information Used to Assess the Effects to Shortnose Sturgeon

Shortnose sturgeon are known to be more sensitive to low dissolved oxygen levels than many other fish species and juvenile shortnose sturgeon are particularly sensitive to low dissolved oxygen levels. In comparison to other fishes, sturgeon have a limited behavioral and physiological capacity to respond to hypoxia (multiple references reviewed and cited in Secor and Niklitschek 2001, 2003). Other benthic fish species common in the Chesapeake Bay (spot *(Leiostomus xanthrus)*, hog-chokers *(Trinectes maculates)*, naked gobies (*Gabiosoma bosc)*) are all far more tolerant of low dissolved oxygen levels than sturgeons. For example, young of the year (YOY) spot can survive for longer than a week at 25°C with 2.4-3.0 mg/L dissolved oxygen with complete mortality at 0.8-1.0 mg/L (Phil *et al.*1981). Juvenile and adult hog-choker and naked gobies can tolerate several-day periods of 0.5-1.0 mg/L dissolved oxygen. Sturgeon basal metabolism, growth, consumption and survival are all very sensitive to changes in oxygen levels, which may indicate their relatively poor ability to oxyregulate.

The combination of stressful temperatures (greater than 28°C; see Flourney *et al.* 1992; Campbell and Goodman 2003) and low dissolved oxygen levels is known to be particularly detrimental to shortnose sturgeon juveniles and adults (Campbell and Goodman 2003; Niklitshek and Secor (in press)). In summer months, warmer temperatures amplify the effect of hypoxia on sturgeon (Coutant 1987). Deep waters with temperatures that sturgeon prefer tend to have dissolved oxygen concentrations below the minimum that sturgeon require forcing sturgeon to occupy unsuitable habitats or have a reduction in habitat (NOAA Fisheries 1998). In the Recovery Plan for shortnose sturgeon, it is stated that sturgeon are presumed to be adversely affected by dissolved oxygen levels below 5 mg/L (NOAA Fisheries 1998). This presumption has been supported by several studies on shortnose and Atlantic sturgeon (Campbell and Goodman 2003; Jenkins *et al.* 1993; Secor and Gunderson 1998; Niklitshek and Secor (in press)).

Several studies have been conducted to determine the effects of low dissolved oxygen levels on shortnose sturgeon. Campbell and Goodman (2003) conducted experiments to obtain information on the acute sensitivity of YOY shortnose sturgeon to low DO concentrations. Through this study the researchers were able to calculate the concentration of dissolved oxygen that is lethal to half the sturgeon in the study (LC50) at various temperatures. The results of this research found that the 24-hour LC50 for 77-day-old fish at 25°C was 2.6mg/L. For 104 and 174 day old fish, the 24 hour LC50 at 22°C was 2.2mg/L. This same LC50 (24, 48 and 72 hours) was found at 26°C for 134 day old fish. A twenty-four hour test with 100 day old fish at 29°C found an LC50 of 3.1mg/L. This is consistent with the finding that at higher temperatures, shortnose sturgeon are more sensitive to low dissolved oxygen concentrations.

Jenkins *et al.* (1993) examined the effects of different salinities and dissolved oxygen levels on juvenile shortnose sturgeon. The authors found that juvenile shortnose sturgeon experienced 86% mortality when exposed to dissolved oxygen concentrations of 2.5mg/L (equivalent to a LC86) at 22.5°C for six hours. Older sturgeon (>100 days) could tolerate dissolved oxygen concentrations of 2.5mg/L better, with only 20% mortality (equivalent to a LC20). Short-term exposure to 3.0mg/L resulted in 18-38% mortality for juveniles ranging 20-77 days old. At 22°C and 2.5mg/L dissolved oxygen, Jenkins *et al.* (1993) demonstrated that 86 percent of shortnose sturgeon less than 100 days old, died after only 6 hours of exposure. Older sturgeon (greater than 100 days old) fared slightly better with 20% mortality after 6 hours of exposure to the same conditions. Mortality of juveniles ≥77 days old at was dissolved oxygen levels ≥ 3.5mg/L was not significantly different than control levels.

Secor and Gunderson (1998) examined the effects of long-term hypoxia on Atlantic sturgeon. While Atlantic and shortnose sturgeon are not the same species, their habitat often overlaps and as the two species demonstrate similar tolerances to environmental factors, Atlantic sturgeon are often used as a surrogate species for shortnose sturgeon. However, research has demonstrated that shortnose sturgeon are actually more sensitive to dissolved oxygen concentrations than Atlantic sturgeon (however, shortnose sturgeon are more tolerant of high temperatures than Atlantic sturgeon (Niklitschek and Secor 2001)). In the Secor and Gunderson study, YOY Atlantic sturgeon (150-200 days old) exposed to dissolved oxygen concentrations of 3mg/L at 26°C experienced complete mortality in five out of six replicates (with six to eight fish in each replicate). The sixth replicate experienced 50% mortality under those conditions. Based on survival data presented in this study, a 96-hour LC50 of 2.89mg/L was estimated for Atlantic sturgeon at 26C. This is similar to the "high temperature" LC50 of 3.1mg/L calculated for shortnose sturgeon in Campbell and

Goodman 2003. Fish allowed to surface generally survived the first five days of exposure but died within 10 days. Fish not allowed to surface died within 30 hours. Surfacing behavior is thought to be done to convey relatively oxygen-rich water, located at the air-water interface, across the fish's gills. The sturgeon that died showed a perfusion of blood along the margins of their fins, indicative of oxygen deprivation. Sturgeon in the 3mg/L group experienced a threefold reduction in growth rate and a 50% reduction in routine respiration rate compared to sturgeon at 7mg/L.

Niklitshek and Secor (in press) modeled the major effects and interactions of temperature, dissolved oxygen and salinity on fish metabolism and production. Both shortnose and Atlantic sturgeon were used in this modeling as they both occur naturally in estuarine waters where a wide range of temperature, salinity and dissolved oxygen conditions are observed. The researchers determined the effects of these variables on food consumption and growth, respiration, activity cost, egestion (discharge from the body) and excretion. The results of this study indicated that temperature accounted for 50% of the variability in growth rates of shortnose sturgeon. Dissolved oxygen accounted for 29% of the variability in growth rates and salinity accounted for 21% of the growth variation. This study demonstrated that shortnose sturgeon were able to maintain food consumption and increase routine metabolism when temperatures approached 28°C (the maximum in this study). This study also discussed that the heightened sensitivity of metabolism to oxygen levels may be characteristic of sturgeons and has been ascribed to an inefficiently functioning oxyregulatory system. Klyashtorin (1982) concluded that ancestral morphological and physiological traits caused sturgeons to be less efficient in respiration than other fishes. These traits include less efficient gill ventilation, low cardiac performance (Agnisola *et al.* 1999) and lower affinity of hemoglobin to oxygen.

In addition to metabolic response, there is also evidence (Niklitschek 2001) that egestion levels for shortnose sturgeon juveniles increased significantly under hypoxia, indicating that consumed food was incompletely digested. Behavioral studies have also indicated that shortnose sturgeon are quite sensitive to oxygen and temperature conditions. Beyond escape and avoidance, sturgeon respond to hypoxia through increased ventilation, increased surfacing (to ventilate more oxygen-rich surface water), and decreased swimming and routine metabolism (Nonnettee *et al.* 1993; Croker and Cech 1997; Secor and Gunderson 1998; Niklitschek 2001).

Niklitschek 2001 and Secor and Niklitschek 2001 conducted laboratory studies on the bioenergetic and behavioral responses to hypoxia by juvenile Atlantic and shortnose sturgeon. In these studies, growth was substantially reduced at 40% oxygen saturation compared to normal oxygen saturation conditions (greater than or equal to 70% saturation) for both species at temperatures of 20°C and 27°C. Metabolic and feeding rates declined at oxygen levels below 60% oxygen saturation at 20°C and 27°C. In behavior studies, juveniles of both sturgeon species actively selected 70% or 100% oxygen saturation levels over 40% oxygen saturation levels. Based on these findings, a 60% saturation level (equivalent to 5mg/L at 25°C) was determined to be protective against non-lethal effects to shortnose sturgeon. This study also provides evidence that shortnose sturgeon are able to actively avoid low dissolved oxygen areas and that they will seek out more favorable conditions when available.

Field evidence also points to the effects of low dissolved oxygen on shortnose sturgeon, a documented low dissolved oxygen event in South Carolina led to the death of twenty shortnose sturgeon in 1991 (NOAA Fisheries 1998). These deaths were attributed to this low dissolved oxygen event, thus confirming that even outside of a lab setting, low dissolved oxygen concentrations can have lethal effects on shortnose sturgeon.

The improved population status of shortnose sturgeon in the Hudson River has been correlated with improved dissolved oxygen levels (Bain *et al.* 2000; Secor and Niklistschek 2001; Leslie *et al.* 1988; Carlson and Simpson 1987; Dovel *et al.* 1992). Prior to 1974, a pervasive hypoxic/anoxic summertime region overlapped with 40% of the tidal freshwater region of the Hudson River (equivalent to 40% of nursery habitat). These levels of pervasive hypoxia would have been lethal to shortnose sturgeon juveniles and few fish were documented in this river stretch during summer months (Leslie *et al.* 1988). By 1974, 80% of the regions wastewater was receiving secondary and tertiary treatment, and in less than two years the system recovered to normoxia. Monitoring data showed a dramatic faunal recovery in the number of fish species returning to the Albany Pool region (Leslie *et al.* 1988). From the time period of 1980 to 1995, there was a four-fold increase in the number of sub-adult and adult shortnose sturgeon in this river system.

While the Hudson River and the Chesapeake Bay geographically and geologically distinct systems, this example demonstrates the beneficial effect on shortnose sturgeon populations that can result from improved dissolved oxygen conditions. As such, the recent reductions in hypoxic conditions in the Hudson River and the dramatic increase in the number of shortnose sturgeon in this river system, supports the hypothesis that improved dissolved oxygen levels in the Chesapeake Bay system is likely to dramatically improve the chances of recovery for shortnose sturgeon in this system.

In summer months, as in most waterbodies, water temperatures are higher in the Chesapeake Bay compared to the rest of the year. Combined with the lowered dissolved oxygen levels that naturally accompany higher water temperatures, suitable habitat for many species of aquatic life experiences what has been popularized as the "habitat squeeze" (Coutant and Bension 1990). Shortnose sturgeon are particularly vulnerable to habitat squeeze due to their demersal lifestyle and unique sensitivity to hypoxia. Shortnose sturgeon rarely surface and depend almost exclusively on benthic substrates and bottom waters for spawning, feeding, migration and refuge from predation and stressful environments (i.e., high temperatures often associated with surface waters). Shortnose sturgeon are known to utilize deep channel habitats in summer months as thermal refugia (NOAA Fisheries 1998). Due to anthropogenic effects, hypoxia is more prevalent in the Chesapeake Bay today than in historical times (Officer *et al.* 1984; Cooper *et al.* 1991). This has resulted in a restriction of sturgeon summertime habitats due to avoidance and sub-lethal or lethal effects of hypoxic conditions. The fragmented distribution and decreased amount of suitable habitat for shortnose sturgeon imposed by summertime hypoxia has been stated to be a substantial hurdle to overcome in the restoration of Chesapeake Bay sturgeons (Secor and Niklitschek 2001). Thus, the setting of criteria for dissolved oxygen levels in the Chesapeake Bay presents a unique opportunity to address the anthropogenic effects that have led to increased summer hypoxia in the Chesapeake Bay. Continued summertime hypoxia in the Chesapeake Bay system is reasonably certain to substantially diminish population recovery and may lead to extirpation of this population of shortnose sturgeon (Secor and Niklitschek 2001).

For the purposes of the Regional Criteria Guidance document, EPA calculated dissolved oxygen criteria that would be protective of shortnose sturgeon at non-stressful (<29°C) and stressful (≥29°C) temperatures. The methodology used was based on EPA procedures and guidance developed in conjunction with EPA, NOAA Fisheries and FWS (see US EPA 2003a for a thorough description of methodology and calculations). Following these procedures, EPA calculated a LC50 for shortnose sturgeon under ambient conditions of non-stressful temperatures to be 2.33mg/L. Under stressful temperatures, the LC50 was calculated to be 3.1mg/L. These values were used with the EPA Virginian Province saltwater dissolved oxygen criteria acute data set to recalculate a Final Acute Value (FAV). The FAV calculated was 2.12mg/L. However, this is less protective than the 2.33mg/L value. EPA thus defaulted to the 2.33mg/L value and calculated a CMC of 3.2mg/L. Campbell and Goodman (2003) indicated that mortality for shortnose sturgeon occurs in the first 2-4 hours of a test. Therefore, using this value as an instantaneous value should protect shortnose sturgeon under ambient temperatures (<29°C). Using similar methodology, EPA calculated a high temperature (≥29°C) CMC for shortnose sturgeon of 4.3mg/L. To determine a criterion value that would also protect shortnose sturgeon from nonlethal effects, EPA considered the bioenergetic and behavioral responses seen in the Niklitschek 2001 and Secor and Niklitschek 2001 studies. As a result of these studies, a 60% oxygen saturation level was deemed protective for sturgeon. This corresponds to a 5mg/L dissolved oxygen concentration at 25°C. EPA therefore concludes that a 5mg/L dissolved oxygen criteria will protect against adverse affects to shortnose sturgeon, including growth effects (US EPA 2003a).

In summary, shortnose sturgeon are unusually sensitive to hypoxia in terms of their metabolic and behavioral responses. The critical concentration at which sturgeons metabolically respond to dissolved oxygen is higher or similar to that of rainbow trout, a species known to be extremely sensitive to dissolved oxygen levels. Bioenergetic and behavioral responses indicate that YOY juveniles (30 to 200 days old) will experience lost production in those habitats with less than 60% oxygen saturation. At 25°C, this corresponds to a 5mg/L concentration of dissolved oxygen. Acute and chronic lethal effects for shortnose sturgeon have been observed for levels less than 3.3mg/L at ambient temperatures. Therefore, based on the best available scientific literature and in conjunction with the criteria developed by EPA, at ambient temperatures (<29°C) and dissolved oxygen concentrations less than 3.2mg/L, shortnose sturgeon can be expected to experience mortality within a short period of time (2-4 hours of exposure). At stressful temperatures (≥29°C), shortnose sturgeon are more sensitive to hypoxia and mortality can be expected to occur after short term exposure (2-4 hours) of dissolved oxygen levels of less than 4.3mg/L. A dissolved oxygen concentration of 5mg/L is expected to protect shortnose sturgeon from adverse behavioral and bioenergetic effects such as metabolic changes, decreased foraging, increased egestion, decreased growth and increased surfacing behavior. These findings are consistent with the statement in the shortnose sturgeon recovery plan (NOAA Fisheries 1998) which states that shortnose sturgeon are expected to be adversely affected by levels of dissolved oxygen below 5mg/L.

Qualitative criteria for 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. As stated in Harding and Perry 1997, "chlorophyll a is a useful expression of phytoplankton biomass and is arguably the single most responsive indicator of N [nitrogen] and P [phosphorous] enrichment in this system [Chesapeake Bay]." Water clarity and dissolved oxygen are expected to improve when excess phytoplankton measured as chlorophyll *a* are significantly reduced, thus improving water quality and essential aquatic habitat in the waters of the Chesapeake Bay and its tidal tributaries (Natural Research Council 2001). In their BE, EPA states that the recommended chlorophyll *a* criteria will beneficially affect habitat, spawning areas and food sources that listed species depend on. The recommended chlorophyll *a* criteria are given to prevent reduced water clarity, low dissolved oxygen, food supply imbalances, and the proliferation of species deemed potentially harmful to aquatic life.

The recommended Chesapeake Bay chlorophyll *a* criteria provide concentrations characteristic of desired ecological trophic conditions and protective against water quality and ecological impairments (US EPA 2003a). When the chlorophyll a criteria are met, light levels and dissolved oxygen levels in the Chesapeake Bay system should improve (US EPA 2003b). The proposed chlorophyll *a* concentrations should be protective against these water quality impairments. The criteria should significantly improve water quality conditions in the Bay, particularly for underwater Bay grasses. NOAA Fisheries anticipates that these criteria will beneficially affect the food sources for several species of listed sea turtles and benefit the habitat of shortnose sturgeon and sea turtles.

Water Clarity Criteria

The recommended Chesapeake Bay water clarity criteria establish the minimum level of light penetration required to support the survival and continued propagation of underwater bay grasses in both lower and higher salinity communities (US EPA 2003b). Attaining water clarity at the proposed levels will improve underwater bay grass survival, growth and propagation, thus improving habitat to fully support a diverse shallow water habitat.

The loss of underwater bay grasses from the shallow waters of the Chesapeake Bay has been noted since the early 1960s (US EPA 2003b). The primary causes of the loss are nutrient over-enrichment and increased suspended sediments in the water and the associated reduction of light. The loss of underwater bay grass beds is a concern because these plants create rich habitats that support the growth of diverse fish and invertebrate populations. The endangered green sea turtle also feeds directly on sea grasses while other sea turtle species feed on shellfish which are dependent on the underwater grasses for habitat. The criteria for water clarity fully support the survival, growth and propagation of balanced, indigenous populations of ecologically important fish and shellfish inhabiting vegetated shallow-water habitats (US EPA 2003b). As the water clarity criteria will lead to increased water quality and an increased forage base for sea turtles, NOAA Fisheries believes that these criteria will beneficially affect listed sea turtles. While shortnose sturgeon are not directly dependent on underwater grasses, these grasses are an important part of the food chain making the protection of bay grasses beneficial to shortnose sturgeon as well. Shortnose sturgeon and sea turtles are expected to benefit from the improved water quality resulting from the adoption of the proposed water clarity criteria.

Dissolved Oxygen Criteria

Open Water Fish and Shellfish Designated Use Criteria

These criteria apply not only to the open water fish and shellfish designated use year-round but also to the shallow-water bay grass use year-round; the migratory fish spawning and nursery use from June 1 – January 31; the deep-water designated use from October 1 – May 31; and the deep-channel use from October 1 – May 31. The criteria include a 30 day mean >5.5mg/L in tidal habitats with 0-0.5ppt salinity, a 30 day mean of >5mg/L in tidal habitats with >0.5ppt salinity and a 7-day mean of 4mg/L. When water temperatures are greater than 29°C, the required instantaneous minimum is 4.3mg/L. At all other temperatures, an instantaneous minimum of >3.2 mg/L will apply. Based on models (US EPA 2003c) produced by EPA, 87.7% of the Open Water areas of the Chesapeake Bay historically attained 5mg/L monthly average dissolved oxygen levels in the summer months (June 1 – September 30). In 2000, 94.7% of the Open Water areas attained this monthly average. Models predict that upon achievement of the nutrient and sediment enrichment goals (to be achieved in

2010), 97.3% of the Open Water area will attain a 5mg/L monthly average in the summer months (US EPA 2003c). This monthly average is expected to be associated with a 15 minute instantaneous minimum of 3.2mg/L (Rich Batiuk, US EPA, pers. comm. 2003).

Protection of the shallow-water bay grasses through these dissolved oxygen criteria will ensure that these habitats are not degraded and that the prey base for sea turtles is protected and enhanced. Sea turtles therefore, are expected to benefit from these criteria. The areas subject to the Open Water criteria are essential for shortnose sturgeon. Protection of the open water areas year-round as well as the spawning and nursery areas in the summer is critical for the success of shortnose sturgeon recovery efforts in the Bay. Shortnose sturgeon may use the deep-water and deep-channel areas in the fall and winter months as overwintering areas, making protection of these habitats critical as well.

The 30 day mean for salinities of 0-0.5ppt salinity of ≥5.5mg/L dissolved oxygen, is expected to be protective of shortnose sturgeon and no adverse effects are expected to any life stage of shortnose sturgeon at this dissolved oxygen level. The 30 day mean for salinities of greater than 0.5ppt is set at ≥5mg/L and this is also expected to be protective of all life stages of shortnose sturgeon. Included in this set of criteria are a 7 day mean of ≥4mg/L and an instantaneous minimum (15 minutes) of ≥3.2mg/L. Studies on the effects of dissolved oxygen levels on shortnose sturgeon have demonstrated that dissolved oxygen levels of less than 5.0mg/L have resulted in adverse effects (behavioral and physiological; Niklitschek 2001; Secor and Niklitschek 2001). Shortnose sturgeon exposed to short term concentrations of dissolved oxygen of less than 3.3mg/L have been demonstrated to have lethal effects (Campbell and Goodman 2003; Jenkins *et al.* 1993). While adverse affects such as decreased feeding, egestion, decreased growth and other behavioral, metabolic and physiological changes may occur upon short term exposure to dissolved oxygen levels below 5mg/L, no lethal effects are expected to occur as a result of this short term exposure. At temperatures below 29°C, the instantaneous minimum of 3.2mg/L ensures that no lethal effects will occur as dissolved oxygen levels are not expected to fall below this level.

At temperatures known to be stressful to shortnose sturgeon, i.e., 29°C and above, the effects of low dissolved oxygen are seen more readily and adverse affects can be expected to occur at higher dissolved oxygen concentrations (Campbell and Goodman 2003). However, the instantaneous minimum of 4.3mg/L at these temperatures provides further insurance that there will be minimal adverse affects on shortnose sturgeon.

When dissolved oxygen levels are in the 3.2 – 5.0mg/L range, shortnose sturgeon are likely to experience some adverse behavioral and physiological effects and may avoid these low dissolved oxygen areas. However, the monthly average of 5.0mg/L and 5.5mg/L are fully protective of all life stages of shortnose sturgeon and will ensure that any adverse effects experienced are minimal and short lived and the instantaneous minimums of 3.2mg/L and 4.3mg/L ensure that no lethal effects are experienced. Shortnose sturgeon are likely to avoid the areas that are not attaining the 3.2mg/L instantaneous minimum criteria, however, based on the EPA model (US EPA 2003c) sufficient amounts of habitat with dissolved oxygen levels of at least 5mg/L are expected to be available (i.e., 94.3% of open-water habitat) and the displacement to other open water areas is not expected to have chronic effects on shortnose sturgeon.

In addition, the adoption of this criteria and the accompanying nutrient and sediment load reductions will lead to improved dissolved oxygen conditions in the Bay and an increase in available habitat for shortnose sturgeon in the summer months, therefore reducing the negative effects of the "habitat squeeze" as evidenced by the increased amount of area that will achieve a monthly average dissolved oxygen level of 5mg/L (i.e., 97.3% in 2010 vs. 87.7% historically). These criteria are expected to fully protect sea turtle forage items and should improve the forage base for sea turtles and beneficially affect sea turtles.

Migratory fish spawning and nursery use: February 1 – May 31

This designated use is expected to be the primary designated use for the upper reaches of many Bay tidal rivers and creeks and the upper mainstem Chesapeake Bay. This designated use is intended to be protective of migratory and resident tidal freshwater fish during the late winter to late spring spawning and nursery season in tidal freshwater and low-salinity habitats. The dissolved oxygen levels for this designated use are a 7-day mean of ≥6mg/L and an instantaneous minimum of ≥5mg/L. Shortnose sturgeon would be expected to be present in the upper reaches of these rivers and creeks and the mainstem Chesapeake Bay during this time period, as these areas may contain either overwintering and/or spawning and nursery habitat. Based on the best available scientific and commercial information, these dissolved oxygen criteria are expected to be fully protective of all life stages of shortnose sturgeon that may be present in the upper reaches of tidal rivers and creeks and the upper mainstem Chesapeake Bay during this time of year. Therefore, no adverse affects (see pp. 35-39) are expected to shortnose sturgeon in these areas when the target dissolved oxygen criteria are attained. These criteria are expected to be fully protective of sea turtle forage items and are not expected to negatively affect any listed sea turtles. These criteria ensure that during shortnose sturgeon spawning, sufficient dissolved oxygen levels will be present in spawning areas. These criteria are expected to beneficially affect shortnose sturgeon eggs and larvae as well as spawning adults.

Deep-water seasonal fish and shellfish use: June 1 – September 30

This use applies to the deeper transitional water-column and bottom habitats between the surface waters and the very deep channels. The deep water habitat is essential for shortnose sturgeon survival. Shortnose sturgeon typically occur in the deepest parts of rivers or estuaries where suitable oxygen and salinity values are present (Gilbert 1989). Not only is this the habitat where shortnose sturgeon are likely to forage, it is habitat that is used for refugia from the warmer temperatures that will occur seasonally at the surface and in shallower water habitat. In northern river systems, temperatures between 21-22°C have been reported to trigger movement of shortnose sturgeon away from shallow water areas (Dadswell 1975; Dovel 1978 as reported in Dadswell *et al.* 1984). This use is intended to protect bottom-feeding fish (US EPA 2003a); shortnose sturgeon are benthic omnivores and feed on the bottom. Shortnose sturgeon spend the majority of time in deeper water. The 30 day mean set for this use is ≥3mg/L, the one day mean is ≥2.3mg/L and the instantaneous minimum is ≥1.7mg/L. As evidenced above (see pp. 35-39), at non-stressful temperatures (below 29°C), adverse effects are expected to occur with dissolved oxygen levels below 5.0mg/L and lethal effects are expected to occur with dissolved oxygen levels below 3.2mg/L (US EPA 2003c).

While significant adverse affects may be expected to occur to shortnose sturgeon at dissolved oxygen levels below 3mg/L (see pp. 35-39; see also Campbell and Goodman 2003; Jenkins *et al.* 1993, Secor and Gunderson 1998), models developed and run by EPA reveal that when the nutrient and sediment load reductions are met, dissolved oxygen levels will be significantly above the criterion levels in a large portion of the deep water areas in the summer months (US EPA 2003c). For the June 1 – September 30 time frame, 52.2% of the deep water areas have historically had monthly average dissolved oxygen levels of 5mg/L. By 2000, this area had increased to 56.5%. By the time the 2010 goals are met, EPA predicts that 68.7% of the deep water area will have monthly average dissolved oxygen levels of 5mg/L (US EPA 2003c). By this date, 84.9% of the deep water use area will have monthly average dissolved oxygen levels of 4mg/L and 93.9% will have monthly average dissolved oxygen levels of 3mg/L (US EPA 2003c). When just the bottom layer of the deep water areas are modeled, similar trends are present. By 2010, 67.1% of the bottom layer of the deep water use area will have monthly average dissolved oxygen levels of 5mg/L, 89% will have monthly average dissolved oxygen levels of 4mg/L and 98.8% will have monthly average dissolved oxygen levels of 3mg/L (US EPA 2003c).

The analysis of the effects of the action is based on the results of the EPA model (US EPA 2003c), not the actual criteria. Based on this model, the majority of deep water habitat is expected to have monthly average dissolved oxygen levels of 5mg/L (US EPA 2003d). At this level, instantaneous minimums of 3.2mg/L are expected. As outlined in the open-water use section above, dissolved oxygen levels between 3.3mg/L and 5mg/L may adversely affect shortnose sturgeon, however as the monthly average of 5mg/L ensures that these low dissolved oxygen levels are not chronic, and therefore no chronic adverse affects are expected to occur. The availability of suitable habitat (dissolved oxygen levels above 3.2mg/L) should allow shortnose sturgeon to avoid the hypoxic areas and prevent lethal effects. Shortnose sturgeon are likely to avoid the areas that are not attaining the 3.2mg/L instantaneous minimum criteria (Niklitschek 2001 and Secor and Niklitschek 2001, Secor and Gunderson 1998), however, based on the EPA model sufficient amounts of habitat with adequate dissolved oxygen levels are expected to be available and the displacement to other areas is not expected to have chronic effects on shortnose sturgeon. Only 1.2% of the deep-water area is expected to have a monthly average of less than 3mg/L (US EPA 2003c). Based on the demonstrated ability of shortnose sturgeon to actively avoid hypoxic areas, shortnose sturgeon are expected to be able to avoid these areas and to have only limited exposure to these hypoxic areas. As 98.8% of the deep water area will have suitable dissolved oxygen levels, shortnose sturgeon are expected to be able to quickly relocate to an area with suitable dissolved oxygen levels, thus limiting their exposure to below the 2-4 hour threshold for mortality. In addition, as shortnose sturgeon have demonstrated a tendency to surface in response to hypoxic conditions, shortnose sturgeon can be reasonably expected to travel up in the water column where they are likely to be exposed to more suitable dissolved oxygen conditions (e.g., only 1.2% of deep water areas are expected to fail to meet a 3mg/L monthly average). As such, no shortnose sturgeon are expected to experience mortality due to exposure to hypoxic conditions in deep water areas.

In addition, the adoption of this criteria and the accompanying nutrient and sediment load reductions will lead to improved dissolved oxygen conditions in the deep water areas and an increase in available habitat for shortnose sturgeon in the summer months, therefore reducing the negative effects of the "habitat squeeze" as evidenced by the increased amount of area that will achieve a monthly average dissolved oxygen level of 5mg/L. These criteria are expected to fully protect sea turtle forage items and should improve the forage base for sea turtles and beneficially affect sea turtles. In addition, these criteria prevent the occurrence of anoxic areas in the deep water areas of the Chesapeake Bay, which will benefit both sea turtles and shortnose sturgeon.

Deep-channel seasonal refuge use: June 1 – September 30

The deep-channel seasonal refuge use is designated for the deep channels that occur within the mainstem Chesapeake Bay. Historic records indicate that this area naturally experiences low dissolved oxygen levels during the summer and that there may even be areas that are naturally anoxic for a period of time in the summer months (US EPA 2003a). In southern river systems, shortnose sturgeon are dependent on deep-channels as refugia from warm summer water temperatures (Flourney *et al.* 1982) and in northern river systems, temperatures between 21-22°C have been reported to trigger movement of shortnose sturgeon away from shallow water areas (Dadswell 1975; Dovel 1978 as reported in Dadswell *et al.*1984). Depending on temperature conditions in the Bay, shortnose sturgeon may seek out deep cool areas as thermal refugia. Sturgeon may also forage in these areas in addition to the deep water areas. The instantaneous minimum set for this area is ≥1mg/L. It is expected that any shortnose sturgeon exposed to dissolved oxygen levels of this level would not survive if exposed to this level for any significant (i.e, greater than 2-4 hours) period of time (Campbell and Goodman 2003; Jenkins *et al.* 1993; Secor and Gunderson 2003).

While lethal effects may be expected for shortnose sturgeon exposed to dissolved oxygen levels of less than 3.2mg/L for longer than 2-4 hours (Campbell and Goodman 2003; Jenkins *et al.* 1993; Secor and Gunderson 2003), shortnose sturgeon are expected to avoid these areas (Niklitschek 2001 and Secor and Niklitschek 2001; Secor and Gunderson 1998). Based on models developed and run by EPA (US EPA 2003c), the actual conditions in the deep channel areas once the 2010 goals are met will be significantly better than 1mg/L. When the 2010 goals are met, EPA predicts that 29.7% of the deep channel area will have monthly average dissolved oxygen levels of 5mg/L. By this date, 49.3% of the deep channel use area will have monthly average dissolved oxygen levels of 4mg/L and 71.1% will have monthly average dissolved oxygen levels of 3mg/L. When just the bottom layer of the deep channel areas are modeled, similar trends are present. By 2010, 33.2% of the bottom layer of the deep water use area will have monthly average dissolved oxygen levels of 5mg/L, 53.3% will have monthly average dissolved oxygen levels of 4mg/L and 74.6% will have monthly average dissolved oxygen levels of 3mg/L (US EPA 2003c). The models therefore indicate that shortnose sturgeon will not be completely displaced from deep channel habitat and that approximately one-third of this habitat will have dissolved oxygen levels that are protective of shortnose sturgeon. Only 25.4% of the deep-water area is expected to have a monthly average dissolved oxygen level of less than 3mg/L (US EPA 2003c). Based on the demonstrated ability of shortnose sturgeon to actively avoid hypoxic areas, shortnose sturgeon are expected to be able to avoid these areas and to have only limited exposure to these hypoxic areas. As 74.6% of the deep channel area will have suitable dissolved oxygen levels, shortnose sturgeon are expected to be able to quickly relocate to an area with suitable dissolved oxygen levels, thus limiting their exposure to below the 2-4 hour threshold for mortality. In addition, as shortnose sturgeon have demonstrated a tendency to surface in response to hypoxic conditions, shortnose sturgeon can be reasonably expected to travel up in the water column where they are likely to be exposed to more suitable dissolved oxygen conditions (e.g., only 0.1% of deep water areas are expected to fail to meet a 3mg/L monthly average and only 2.9% of open water areas are expected to fail to meet a 5mg/L monthly average). As such, no shortnose sturgeon are expected to experience mortality due to exposure to hypoxic conditions in deep water areas.

Shortnose sturgeon would be expected to avoid these low dissolved oxygen areas and would likely be displaced to the deep water areas. As deep water areas are expected to have sufficient dissolved oxygen levels and 99.4% of the deep water areas are expected to have temperatures less than 29°C, and 78.3% of the area is expected to have temperatures less than 22°C (US EPA 2003e), these areas should provide adequate refugia from warm water temperatures, allowing shortnose sturgeon to be less dependent on the deepest areas of the Chesapeake Bay (deep-channels) for thermal refugia.

Summary of effects of dissolved oxygen criteria on sea turtles

Several factors were considered when analyzing the effects of the dissolved oxygen criteria on sea turtles that are likely to be present in the action area. The turtle species most likely to be present in the Chesapeake Bay are the leatherback, loggerhead, Kemp's ridley and green sea turtles. Loggerhead turtles feed on benthic invertebrates such as gastropods, mollusks and crustaceans. Kemp's ridleys are largely cancrivirous (crab eating), with a preference for portunid crabs including blue crabs. Kemp's ridleys are also benthic feeders. Leatherbacks feed primarily on jellyfish while green turtles are herbivorous, feeding on seagrasses and algae. Green turtles appear to prefer marine grasses and algae in shallow bays, lagoons and reefs but also consume jellyfish, salps and sponges.

As all sea turtles are air breathers, dissolved oxygen levels do not directly affect their physiology or behavior. However, dissolved oxygen levels may affect the prey base for these species and may therefore affect the foraging behavior of these turtles. Sea turtles are expected to occur in the Chesapeake Bay primarily in the warmer summer months and their main activity at this time is foraging. An estimated 3,000 to 10,000 loggerhead turtles and an estimated 500 Kemp's ridley sea turtles use the Chesapeake Bay. Sea turtles enter the Bay as early as April 1 with the majority entering the Bay in May when water temperatures rise and depart between late September and early November. The area from the mouth of the Bay to the Potomac River serves as an important foraging area for juvenile loggerheads. Loggerhead sea turtles tend to forage along channel edges and tidal rivers while Kemp's ridley feed in the water flats. As the dissolved oxygen criteria have been designed to be protective of shellfish (open-water shellfish use and deep-water shellfish use), it is reasonably certain that the dissolved oxygen levels will be adequate so that there is no decrease in the prey base for these turtles (Kemp's ridley and Loggerhead) and foraging behavior will not be adversely affected. The dissolved oxygen criteria have also been designed to be protective of the shallow water bay grasses that green turtles are expected to consume. Therefore, there is not expected to be any adverse affect on the prey base for green turtles and foraging behavior will not be adversely affected. While there is no designated use that is designed to be protective of jellyfish, jellyfish are known to be tolerant of extremely low dissolved oxygen levels (Condon *et al.*2001) and the dissolved oxygen levels set by the Regional Guidance Criteria document are expected to be protective of jellyfish, which are the preferred prey of Leatherback turtles.

As the dissolved oxygen conditions in the Bay are expected to continually improve over the next several years until the nutrient and sediment enrichment goals are met, NOAA Fisheries anticipates that as habitat conditions improve in the Bay and habitat is restored, that there will be an increased forage base for sea turtles. Therefore, NOAA Fisheries believes that the dissolved oxygen criteria will beneficially affect endangered and threatened sea turtles that may be present in the Chesapeake Bay.

Summary of effects of dissolved oxygen criteria on shortnose sturgeon

While the size of the population of shortnose sturgeon in the Chesapeake Bay and its tidal tributaries is unknown, capture data from the FWS Atlantic sturgeon reward program indicates that there are at least 52 shortnose sturgeon (two of the shortnose sturgeon captured via the reward program were re-captures) in the Bay. Evidence also suggests that there is at least one spawning site (Potomac River). It is unknown whether this is the only spawning site in the Chesapeake Bay system or if sturgeon are spawning in other rivers within the Bay system as suspected. As stated above, for the purposes of this analysis, all life stages of shortnose sturgeon are expected to occur in the action area.

Based on the above effects analysis, it is reasonable to expect that if dissolved oxygen levels in the Chesapeake Bay and its tidal tributaries occurred at the levels modeled by EPA (US EPA 2003c) as a result of the 2010 sedimentation and nutrient reduction goals and accompanying dissolved oxygen criteria, no chronic adverse effects on the long term survival and recovery of the Chesapeake Bay population of shortnose sturgeon are expected to occur. While shortnose sturgeon may be temporarily displaced to suboptimal habitat (i.e., from deep channel to deep water or from one deep water area to another) due to short-term hypoxic conditions, the large amount of available habitat with adequate dissolved oxygen levels will ensure that the displacement does not result in chronic adverse effects or mortality. Based on the percentage of deep channel and deep water area that will have dissolved oxygen levels greater than 3mg/L (see above), shortnose sturgeon are expected to be able to quickly relocate to an area with suitable dissolved oxygen levels, thus limiting their exposure to below the 2-4 hour threshold for mortality. In addition, as shortnose sturgeon have demonstrated a tendency to surface in response to hypoxic conditions, shortnose sturgeon can be reasonably expected to travel up in the water column where they are likely to be exposed to more higher dissolved oxygen conditions As such, no shortnose sturgeon are expected to experience mortality due to exposure to hypoxic conditions in deep water areas.

In addition, the proposed criteria eliminate the possibility of completely anoxic zones and once achieved will reflect a significant improvement in habitat conditions in the Bay. While the Chesapeake Bay population of shortnose sturgeon remains endangered, the proposed dissolved oxygen criteria ensure that essential habitats will continue to be protected and that adequate habitat will be present so that recovery of this population can occur. The setting of criteria for dissolved oxygen levels in the Chesapeake Bay presents a unique opportunity to address the anthropogenic effects that have led to increased summer hypoxia and anoxia in the Chesapeake Bay. It has been stated that continued summertime hypoxia in the Chesapeake Bay system is reasonably certain to substantially diminish population recovery and may lead to extirpation of this population of shortnose sturgeon (Secor and Niklitschek 2001). However, the proposed dissolved oxygen criteria and accompanying nutrient and sediment load reductions will result in improved dissolved oxygen levels in the Chesapeake Bay system and should dramatically improve the chances of recovery for shortnose sturgeon in this system.

CUMULATIVE EFFECTS

Cumulative effects as defined in 50 CFR 402.02 include the effects of future State, tribal, local or private actions that are reasonably certain to occur within the action area considered in the biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

Several features of the shortnose sturgeon's natural life history, including delayed maturation, non-annual spawning (Dadswell *et al.* 1984, Boreman 1997) and long life-span, affect the rate at which recovery can proceed. The cumulative activities in the Chesapeake Bay and its tidal tributaries that could impact shortnose sturgeon recovery are recreational and commercial fisheries, contaminants and pollutants, and development and/or construction activities resulting in excessive water turbidity and habitat degradation.

Future recreational and commercial fishing activities in state waters may take several protected species. However, it is not clear to what extent these future activities would affect listed species differently than the current state fishery activities described in the Environmental Baseline section. As demonstrated by the data from the FWS Atlantic sturgeon reward program, shortnose sturgeon are taken in fishing gear. NOAA Fisheries expects these state water fisheries to continue in the future, and as such, the potential for interactions with listed species will also continue.

Sources of contamination in the action area include atmospheric loading of pollutants, stormwater runoff from coastal development, groundwater discharges, and industrial development. Chemical contamination may have an effect on listed species reproduction and survival. While the effects of contaminants on shortnose sturgeon are not well documented, pollution may also make sea turtles more susceptible to disease by weakening their immune systems.

Excessive turbidity due to coastal development and/or construction sites (e.g. bridge construction or demolition) could influence sturgeon spawning. Shortnose sturgeon require a clean rock or cobble substrate to deposit their eggs and unfavorable substrates could make it impossible for eggs to adhere to critical interstitial areas. Additionally, excessive turbidity could impair sturgeon foraging by making it difficult to locate prey.

These activities may affect shortnose sturgeon throughout the Chesapeake Bay and its tidal tributaries in the future.

INTEGRATION AND SYNTHESIS OF EFFECTS

Loggerhead, Kemps ridley, leatherback and green sea turtles are likely to be present in the action area. The occurrence of a hawksbill turtle in the area would be a rare occurrence. The effect of the dissolved oxygen levels on juvenile and adult turtles has been assessed. As turtles are air breathers, there are not likely to be any direct effects to sea turtles as a result of these dissolved oxygen criteria. The improved dissolved oxygen levels in the Bay are expected to positively affect the prey base of these turtles and listed turtles are expected to benefit from these proposed criteria as well as the water clarity and chlorophyll a criteria.

Shortnose sturgeon are endangered throughout their entire range. This species exists as nineteen separate populations that should be managed as such. The shortnose sturgeon residing in the Chesapeake Bay and its tributaries form one of these nineteen populations. Adult shortnose sturgeon are known to be present in the Chesapeake Bay and several of its tidal tributaries, as documented by the capture of fifty-two shortnose sturgeon via the FWS Atlantic Sturgeon Reward Program. The presence of all life stages within the action area itself has not been documented. While there is no direct evidence of sturgeon spawning in the tributaries to the Chesapeake Bay, there is reason to believe that they do so. Six adult sturgeon have recently been captured in downstream reaches of the Potomac River. Shortnose sturgeon appear to spend most of their lives in their natal rivers (NOAA Fisheries 1998). Therefore, sturgeon found in the lower Potomac may reasonably be expected to spawn there. Research on other shortnose sturgeon populations indicates that this species typically spawns just below the limit of upstream passage, often the fall line. In the Potomac River, this upstream limit is likely Little Falls. In addition, research on other shortnose sturgeon populations indicates that shortnose sturgeon prefer to spawn in specific habitats that contain areas with high flow and cobble/gravel substrate. The habitat at and below Little Falls is consistent with this preferred spawning habitat. Other tributaries of the Chesapeake Bay that appear to have suitable spawning habitat for Chesapeake Bay shortnose sturgeon include the Rappahannock, James, York, Susquehanna, Gunpowder and Patuxent Rivers (Pers. Comm. John Nichols, NOAA Fisheries, 2002). No spawning activity has been documented in any of these tributaries to the Chesapeake Bay. However, to date, no directed sampling following the NOAA Fisheries Protocols has occurred to determine if a spawning population exists in any of these tributaries. As is the case with the Potomac River, the conservative assumption must therefore be made, that based on the documented presence of this species and suitable spawning habitat in these river systems, and given the life history attributes of shortnose sturgeon, NOAA Fisheries assumes for the purposes of this analysis that shortnose sturgeon from the Chesapeake Bay population are also spawning in at least the Rappahannock, James, York, Susquehanna, Gunpowder and Patuxent river systems. Based on information on the distribution of shortnose sturgeon in other river systems, all life stages of shortnose sturgeon are expected to be present within the Chesapeake Bay and its tidal tributaries. Therefore, the effects to all life stages of shortnose sturgeon have been assessed.

As stated above, the water clarity and chlorophyll a criteria are expected to improve water quality conditions in the Bay and its tidal tributaries, beneficially affecting all native species of the Bay including shortnose sturgeon. While the dissolved oxygen levels authorized by this set of criteria may result in some short-term adverse affects to shortnose sturgeon, no chronic or lethal effects are expected. In addition, the adoption of the dissolved oxygen criteria will result in significantly improved water quality conditions in the Bay, elimination of anoxic zones and the improvement in the quality and quantity of habitat available to shortnose sturgeon as well as improving the chances for recovery of the Chesapeake Bay population of shortnose sturgeon and the long term sustainability of this population.

CONCLUSION

After reviewing the best available information on the status of endangered and threatened species under NOAA Fisheries jurisdiction, the environmental baseline for the action area, the effects of the action, and the cumulative effects, it is NOAA Fisheries' biological opinion that the EPA's approval of the dissolved oxygen criteria for Chesapeake Bay and its tidal tributaries is not likely to adversely affect loggerhead, leatherback, Kemp's ridley, green, or hawksbill sea turtles. Because no critical habitat is designated in the action area, none will be affected by the project.

The effects of the ambient water quality criteria for the Chesapeake Bay and its tidal tributaries have been analyzed on the Chesapeake Bay population of shortnose sturgeon. While the dissolved oxygen levels authorized by this set of criteria may result in some short-term adverse affects to shortnose sturgeon through displacement or other behavioral or physiological adjustments, no chronic effects are expected. No lethal effects are expected as a result of the dissolved oxygen criteria and significant protections are being provided to essential habitats including deep water and spawning and nursery habitats. In addition, the adoption of the dissolved oxygen criteria will result in significantly improved water quality conditions in the Bay, elimination of anoxic zones and the improvement in the quality and quantity of habitat available to shortnose sturgeon as well as improving the chances for shortnose sturgeon recovery in the Bay and improving the likelihood of long-term sustainability of this population.

NOAA Fisheries believes that the issuance of these criteria, as currently stated, would not reduce the reproduction, numbers and distribution of the Chesapeake Bay shortnose sturgeon population or the species as a whole in a way that appreciably reduces the likelihood of the species' survival and recovery in the wild. This conclusion is supported by the following: (1) no lethal takes of any life stage of shortnose sturgeon are anticipated to occur; (2) the demonstrated ability of shortnose sturgeon to avoid hypoxic areas and move to areas with suitable dissolved oxygen levels; (3) the availability of adequate habitat with not only suitable temperature, salinity and depth, but suitable dissolved oxygen levels; (4) the seasonal nature of the anticipated effects (i.e., no effects anticipated from October 1 – May 31 of any year); (5) adequate protection of essential spawning and nursery areas protecting not only spawning adults but eggs and larvae from hypoxic conditions; (6) the elimination of anoxic areas within the Bay (7) a large portion of the deep-water areas have low temperatures and adequate dissolved oxygen levels allowing shortnose sturgeon to be less dependent on the deepest areas of the Chesapeake Bay (deep-channels) for thermal refugia; and (8) the significant improvement in Bay water quality conditions and increased availability of suitable habitat for all life stages of shortnose sturgeon.

As such, it is NOAA Fisheries' biological opinion that the approval of these criteria by EPA may adversely affect the Chesapeake Bay population of endangered shortnose sturgeon through displacement to suboptimal habitat or other behavioral and metabolic responses to hypoxic conditions but is not likely to jeopardize the continued existence of the Chesapeake Bay population of shortnose sturgeon or the species as a whole.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively. "Take" is defined in Section 3 of the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by NOAA Fisheries to include "any act, which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering" (50 CFR 222.102). The term "harass" has not been defined by NOAA Fisheries; however, it is commonly understood to mean to annoy or bother. In addition, legislative history helps elucidate Congress' intent: "[take] includes harassment, whether intentional or not. This would allow, for example, the Secretary to regulate or prohibit the activities of birdwatchers where the effect of those activities might disturb the birds and make it difficult for them to hatch or raise their young" (HR Rep. 93-412, 1973). "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity (50 CFR 402.02). Under the terms of section 7(b)(4) and section 7(o)(2) of the ESA, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement (ITS).

The measures described below are non-discretionary, and must be undertaken by the EPA so that they become binding conditions for the exemption in Section 7(o)(2) to apply. The EPA has a continuing duty to regulate the activity covered by this ITS. If the EPA (1) fails to assume and implement the terms and conditions or (2) fails to adhere to the terms and conditions of the ITS through enforceable terms, the protective coverage of Section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the EPA must report the progress of the action and its impact on the species to the NOAA Fisheries as specified in this ITS [50 CFR §402.14(i)(3)].

According to the EPA *Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries* (Regional Criteria Guidance) document, the goal of this program is that states will adopt water quality standards consistent with the Regional Criteria Guidance and further implement those water quality standards so that nutrient and sediment load reductions will be achieved by 2010. At that time, EPA expects that the dissolved oxygen criteria will be met for all designated uses. This ITS accounts for take that will occur before the 2010 goals are met and after the goals are met. Unless NOAA Fisheries revokes, modifies or replaces this ITS, this ITS is valid for as long as the EPA's guidance document remains in effect. When the States and the District of Columbia seek EPA approval of their dissolved oxygen criteria, NOAA Fisheries will verify at that time that EPA's approval of the state water quality criteria will also be subject to this programmatic take statement. At that time, NOAA Fisheries may revise this ITS based on a particular State's implementation plan, for example to include additional terms and conditions to minimize the likelihood of take.

Amount and Extent of Take Anticipated

The proposed action is reasonably certain to result in incidental take of shortnose sturgeon. NOAA Fisheries is reasonably certain the incidental take described here will occur because (1) shortnose sturgeon are known to occur in the action area; and (2) shortnose sturgeon are known to be adversely affected by low dissolved oxygen levels as low dissolved oxygen levels cause them to: avoid areas, increase surfacing behavior, and undergo metabolic changes. Based on the evaluation of the best available information on shortnose sturgeon and their use of the Chesapeake Bay, NOAA Fisheries has concluded that the issuance of the dissolved oxygen criteria for seasonal deep water, deep channel and open water aquatic life uses is likely to result in take of shortnose sturgeon in the form of harassment of shortnose sturgeon, where habitat conditions (i.e., dissolved oxygen levels below those protective of shortnose sturgeon) will temporarily impair normal behavior patterns of shortnose sturgeon. This harassment will occur in the form of avoidance or displacement from preferred habitat and behavioral and/or metabolic compensations to deal with short-term hypoxic conditions. Neither lethal takes (see below) nor harm are anticipated in any Bay area due to the extent of available habitat in the Bay with dissolved oxygen levels protective of shortnose sturgeon and the demonstrated ability of shortnose sturgeon to avoid hypoxic areas and move to areas with suitable dissolved oxygen levels. Shortnose sturgeon displaced from hypoxic areas are expected to seek and find suitable alternative locations within the Bay. While shortnose sturgeon may experience temporary impairment of essential behavior patterns, no significant impairment resulting in injury (i.e., "harm") is likely due to: the temporary nature of any effects, the large amount of suitable habitat with adequate dissolved oxygen levels, and the ability of shortnose sturgeon to avoid hypoxic areas.

As outlined in the Biological Opinion, generally shortnose sturgeon are adversely affected upon exposure to dissolved oxygen levels of less than 5mg/L and lethal effects are expected to occur upon even moderate exposure to dissolved oxygen levels of less than 3.2mg/L. Because dissolved oxygen levels are known to be affected by various natural conditions (e.g., tides, hurricanes or other weather events including abnormally dry or wet years) beyond the control of EPA or the States and DC and can fluctuate greatly within any given period of time, a monthly average dissolved oxygen level has been determined to be the best measure of this habitat condition within the Bay. As indicated in the Biological Opinion, an area that achieves a 5mg/L monthly average will also achieve at least a 3.2mg/L instantaneous minimum dissolved oxygen level. As shortnose sturgeon are reasonably certain to be adversely affected by dissolved oxygen conditions below these levels, these levels can be used as a surrogate for take. As such, for purposes of this ITS, areas failing to meet a 5mg/L monthly average of dissolved oxygen will be a surrogate for take of shortnose sturgeon. As noted above, this take is likely to be as harassment. The amount of habitat failing to meet an instantaneous minimum of 3.2mg/L could be used as a surrogate for lethal take of shortnose sturgeon; however, due to limitations of the model developed by EPA (US EPA 2003c), the amount of habitat failing to reach a 3.2mg/L instantaneous minimum could not be modeled. However, an analysis of the likelihood of lethal take can be based on the amount of habitat failing to reach a 3mg/L monthly average (which would also likely be failing to meet a 3.2mg/L instantaneous minimum). While a small portion of the Bay will fail to meet the 3mg/L monthly average, shortnose sturgeon are likely to be able to avoid these areas. Lethal effects are only expected to occur after at least 2-4 hours of exposure to dissolved oxygen levels of ≤3.2mg/L, and this is not likely to occur given the mobility of shortnose sturgeon and the availability of suitable habitat. Therefore, no lethal take is expected to occur.

The probability of lack of attainment of dissolved oxygen levels protective of shortnose sturgeon when the 2010 sediment and nutrient reduction goals are met has been modeled by EPA (US EPA 2003c) and will be the basis for determining the extent of take anticipated. As such, take levels can be determined for each of the designated uses where take is anticipated (open water, deep-water and deep-channel). As indicated in the BO, take is likely to occur only in the summer months (June 1 – September 30). Based on the analysis in the accompanying BO, the area of the Bay designated uses that fail to meet a 5mg/L monthly average dissolved oxygen level can be used as a surrogate for take of shortnose sturgeon by harassment. As shortnose sturgeon are benthic fish, the modeling runs done for the bottom layer of the Bay have been used to determine the extent of take. To further refine this analysis, the "tolerate" habitat threshold has been used; that is, the estimate of area that will have temperatures ≤28°C, salinity ≤29ppt and depth <25m which can be reasonably expected to be the areas of the Bay where shortnose sturgeon may be present in the summer months (US EPA 2003d).

Despite the use of the best available scientific and commercial data, NOAA Fisheries cannot quantify the precise number of fish that are likely to be taken. Because both the distribution of shortnose sturgeon throughout the Bay and the numbers of fish that are likely to be in an area at any one time are highly variable, and because incidental take is indirect and likely to occur from effects to habitat, the amount of take resulting from harassment is difficult, if not impossible, to estimate. In addition, because shortnose sturgeon are aquatic species who spend the majority of their time on the bottom and because shortnose sturgeon are highly mobile while foraging in the summer months, the likelihood of discovering take attributable to this proposed action is very limited. In such circumstances, NOAA Fisheries uses a surrogate to estimate the extent of take. The surrogate must be rationally connected to the taking and provide an obvious threshold of exempted take which, if exceeded, provides a basis for reinitiating consultation. For this proposed action, the spatial and temporal extent of the area failing to meet dissolved oxygen standards protective of shortnose sturgeon provides a surrogate for estimating the amount of incidental take.

Extent of take from 2004-2009

Using data provided by EPA, the extent of take occurring from the time of the adoption of the guidance[3] can be estimated. As habitat conditions in the Bay are expected to improve over time as interim measures are achieved before the 2010 goals are met, it is reasonable to assume that this surrogate level of take will decrease over time. Using the EPA model of dissolved oxygen conditions in 2000 in the bottom layer of habitat that is rated "tolerate" (see above) the following conditions are observed:

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[3] Adoption of the guidance by the States and DC approval by EPA is expected to occur in 2004 and 2005.

Designated Use	**% of area failing to meet 5mg/L monthly average 2004-2009** (see US EPA 2003c)
Open Water	9.2
Deep Water	47.3
Deep Channel	78.3

Each year in the summer months, no more than the above percentages of the particular designated use areas are expected to fail to meet a 5mg/L monthly average dissolved oxygen level between 2004 and 2009. The extent of take will be limited to those percentages of each designated use area in the Bay. As such, for the period 2004 through 2009, NOAA Fisheries will consider take to have been exceeded when upon review of the annual monitoring data, NOAA Fisheries is able to determine that for the preceding summer, the dissolved oxygen data for any 30 days during the June 1 – September 30 time frame indicates that any of the designated use area failed to meet the above goals.

Extent of take in 2010 and beyond
Using the EPA model, the extent of take anticipated in 2010 and beyond can be determined. Using the EPA model of dissolved oxygen conditions anticipated when the 2010 nutrient and sediment reduction goals are met and using the bottom layer of habitat that is rated "tolerate" (see above) the following conditions are anticipated:

Designated Use	**% of area failing to meet 5mg/L monthly average in 2010 and beyond** (see US EPA 2003c)
Open Water	5.7
Deep Water	33.0
Deep Channel	65.9

As conditions are expected to be improving over time, no more than the above percentages of the particular habitats are expected to fail to meet a 5mg/L monthly average dissolved oxygen level in 2010 and beyond. As such, for the period of 2010 and beyond, NOAA Fisheries will consider take to have been exceeded when upon review of the annual monitoring data, NOAA Fisheries is able to determine that for the preceding summer, the dissolved oxygen data for any 30 days during the June 1 – September 30 time frame indicates that any of the designated use area failed to meet the above goals.

Effect of Take
In the accompanying biological opinion, NOAA Fisheries determined that this level of anticipated take is not likely to result in jeopardy to the species. This conclusion is supported by the following: (1) no lethal takes of any life stage of shortnose sturgeon are anticipated to occur; (2) the demonstrated ability of shortnose sturgeon to avoid hypoxic areas and move to areas with suitable dissolved oxygen levels; (3) the expectation that shortnose sturgeon displaced from hypoxic areas will seek and find suitable alternative locations within the Bay (4) the extent of available habitat with not only tolerable temperature, salinity and depth, but protective dissolved oxygen levels; (5) the seasonal nature of the anticipated take (i.e., no take anticipated from October 1 – May 31 of any year); (6) adequate protection of essential spawning and nursery areas protecting not only spawning adults but eggs and larvae from hypoxic conditions; (7) the elimination of anoxic areas within the

Bay; (8) a large portion of the deep-water areas have low temperatures and adequate dissolved oxygen levels allowing shortnose sturgeon to be less dependent on the deepest areas of the Chesapeake Bay (deep-channels) for thermal refugia; and (9) the significant improvement in Bay water quality conditions and increased availability of suitable habitat for all life stages of shortnose sturgeon.

Reasonable and prudent measures

Reasonable and prudent measures are those measures necessary and appropriate to minimize incidental take of a listed species. For this particular action, however, it is not possible to design reasonable and prudent measures that are necessary and appropriate to minimize take, because the best available science has demonstrated that the EPA criteria are the limit of feasibility based on current technology. The purpose of the reasonable and prudent measure below is to monitor environmental conditions in the Bay and to monitor the level of take associated with this action.

1. In order to monitor the level of incidental take, monitoring of dissolved oxygen and accompanying temperature conditions in the Bay must be completed each summer.

Terms and conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the EPA must comply with the following terms and conditions, which implement the reasonable and prudent measure described above and outline the required reporting requirements. These terms and conditions are non-discretionary.

1. By April 1 of each year (beginning in 2005), EPA shall provide an annual report to NOAA Fisheries outlining the progress towards nutrient and sediment load reductions, including a discussion of any best management practices or other strategies put in place to achieve the target nutrient and sediment load reductions.

2. EPA shall continue using the results of the Chesapeake Bay Interpolator to extrapolate measured data to assess water quality conditions in the Bay. The Chesapeake Bay Interpolator extrapolates water quality concentrations throughout the Chesapeake Bay and/or tributary rivers from water quality measured at point locations. The purpose of the Interpolator is to assess water quality concentrations at all locations in the 3-dimensional water volume or as a 2D layer. The results from the Interpolator will be used by EPA to develop an annual report (see below).

3. By April 1 of each year (beginning in 2005), EPA shall provide an annual report to NOAA Fisheries on water quality conditions in the Bay, including temperature, dissolved oxygen, depth and salinity. The data provided will express actual monitoring data in volumetric figures (cubic kilometers) as well as bottom habitat area (squared kilometers) extrapolated from the Chesapeake Bay Interpolator. This report should include information on the percent of each designated use that failed to meet the 5mg/L monthly average for June, July, August and September of the preceding year.

By April 30, 2010, EPA shall submit a report to NOAA Fisheries assessing the dissolved oxygen condition in the Bay which highlights the dissolved oxygen conditions in the Bay during the June 1 – September 30 time frame for each of the years 2004 through 2009. In this report, EPA will determine the percent of each designated use that failed to attain a 5mg/L monthly average. Included in this report will be an analysis of the likely causes of failures (i.e., weather events, point sources).

CONSERVATION RECOMMENDATIONS

Section 7(a) (1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. To further reduce the adverse effects to listed species, NOAA Fisheries recommends that EPA implement the following conservation recommendations:

1. Population information on all life stages is still sparse for the Chesapeake Bay and its tidal tributaries. EPA should support further studies to evaluate habitat and the use of the rivers and the Bay, in general, by shortnose sturgeon.

In order for NOAA Fisheries to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, NOAA Fisheries request notification of the implementation of any conservation recommendations.

REINITIATION OF CONSULTATION

This concludes formal consultation on the EPA's issuance of the Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll *a* for the Chesapeake Bay and Its Tidal Tributaries. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may not have been previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, Section 7 consultation must be reinitiated immediately.

NOAA Fisheries, U.S. Fish and Wildlife Service, and EPA are currently engaged in section 7 consultations on EPA's water quality standards and aquatic life criteria. Those consultations may reveal effects of EPA's program that NOAA Fisheries did not consider in this evaluation or they may change national water quality criteria and standards in ways that affect the water quality program in Virginia, Maryland, Delaware and DC. Either outcome might require NOAA Fisheries to reconsider the conclusions reached in this BO and reinitiate section 7 consultation. However, dissolved oxygen is not currently proposed to be considered under this national consultation. Please note that the EPA is required to complete Section 7 consultation with NOAA Fisheries when the States for which this criteria has been drafted seek EPA approval of their final water quality criteria. The federal action in that case will be EPA's approval of the State's water quality criteria.

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