UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930-2298

NOV 21 2006

Frank Gillespie, Director
Division of License Renewal
Office of Nuclear Reactor Program
United States Nuclear Regulatory Commission
Washington, DC 20555-0001

Re: Oyster Creek Nuclear Generating Station

Dear Mr. Gillespie,

Enclosed is NOAA's National Marine Fisheries Service's (NMFS) Biological Opinion (Opinion) on the impacts on endangered and threatened species of the Nuclear Regulatory Commission's proposal to renew the Operating License for the Oyster Creek Nuclear Generating Station (OCNGS) for an additional twenty years. This Opinion is based upon NMFS independent review of information submitted by the NRC, available information on past takes of sea turtles at the facility and the available scientific information. In this Opinion, NMFS concludes that the continued operation of the OCNGS under a renewed Operating License may adversely affect but is not likely to jeopardize the continued existence of endangered Kemp's ridley, green, or threatened loggerhead sea turtles. NMFS has concluded that the action will not affect leatherback or hawksbill sea turtles as these species are not known to occur in the action area for this consultation.

The Incidental Take Statement (ITS), pursuant to Section 7 (b)(4) of the ESA, exempts the annual take of up to 8 sea turtles at the facility each year. NMFS anticipates that of these 8 sea turtles, no more than 3 of these turtles are likely to be loggerheads and no more than 1 of these sea turtles are likely to be a green sea turtle. NMFS anticipates that up to 3 of the 8 sea turtles may be dead; of the dead sea turtles, no more than 1 is likely to be a green sea turtle and no more than 1 is likely to be a loggerhead. The ITS specifies reasonable and prudent measures necessary to minimize and monitor take of listed species, including requiring the transfer of all sea turtles to a NMFS approved rehabilitation facility. The measures of the ITS are non-discretionary and must be undertaken by NRC for the incidental take exemption to apply.

This Opinion concludes formal consultation for the continued operation of the OCNGS. Reinitiation of this consultation is required if: (1) the amount or extent of taking specified in the ITS is exceeded; (2) new information reveals effects of these actions that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) project activities are subsequently modified in a manner that causes an effect to the listed species that was not considered in this Biological Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. NMFS will consider the take level to be

exceeded, and reinitiation of consultation necessary, when *any* of the following situations occur in one calendar year:

- Capture of more than 1 green sea turtle (dead or alive); or,
- Capture of more than 3 live loggerhead sea turtles; or,
- Capture of more than 1 dead loggerhead sea turtle; or,
- Capture of more than 3 dead Kemp's ridley sea turtles; or,
- Capture of more than 8 total sea turtles.

As identified in the Opinion, NMFS Northeast Regional staff must be contacted within 24 hours of any interactions with a sea turtle.

It is NMFS understanding that OCNGS will operate under its current license until April 9, 2009. At the time NRC renews the license for OCNGS, NMFS will consider the September 22, 2005 Biological Opinion and ITS withdrawn and this Biological Opinion and ITS will become effective. Should you have any questions regarding this Biological Opinion or any consultation requirements, please contact Julie Crocker of my staff at (978)281-9300 x6530 or the Endangered Species Coordinator at (978) 281-9328. NMFS appreciates your assistance with the protection of threatened and endangered sea turtles. I look forward to continued cooperation with NRC during future Section 7 consultations.

Sincerely,

for Patricia A. Kurkul
Regional Administrator

cc: H. Nash, NRC
M. Browne, AmerGen
Williams, GCNE

File code: Section 7 NRC – Oyster Creek 2006
PCTS: F/NER/2006/05114

ENDANGERED SPECIES ACT SECTION 7 CONSULTATION
BIOLOGICAL OPINION

Agency: Nuclear Regulatory Commission

Activity: Proposed Renewal of an Operating License for the Creek Nuclear Generating Station on the Forked River and Oyster Creek, Barnegat Bay, New Jersey
PCTS: I/NER/2006/05114

Conducted by: NOAA's National Marine Fisheries Service
Northeast Regional Office

Date Issued: 11/22/06

Approved by: Chris Mantzouris for Patricia Kurkul

INTRODUCTION

This constitutes NOAA's National Marine Fisheries Service's (NMFS) biological opinion (Opinion) on the effects of the Nuclear Regulatory Commission's (NRC) proposed renewal of an Operating License pursuant to the Atomic Energy Act of 1954 as amended (68 Stat. 919) and Title II of the Energy Reorganization Act of 1974 (88 Stat. 1242) for the continued operation of the Oyster Creek Nuclear Generating Station (OCNGS) on threatened and endangered species in accordance with section 7 of the Endangered Species Act of 1973, as amended. Consultation was initiated on June 15, 2006.

This Opinion is based on information provided in the June 2006 Environmental Impact Statement, a March 29, 2005 Biological Assessment (BA), records from previous section 7 consultations on the operation of this facility and correspondence with Ms. Harriet Nash, NRC, and Mr. Malcolm Browne, AmerGen Energy Company, and other sources of information. A complete administrative record of this consultation will be kept on file at the NMFS Northeast Regional Office, Gloucester, Massachusetts.

BACKGROUND AND CONSULTATION HISTORY

The OCNGS began commercial operation in 1969. No observed takes of endangered or threatened species occurred at the OCNGS prior to 1992. However, between June 1992 and July 1994, 9 sea turtle impingements occurred at the OCNGS intake trash bars, including 5 loggerheads (4 individuals, 1 recapture), and 4 Kemp's ridleys (see Figures 1 and 2 and complete information in Appendix 1). In a letter dated November 2, 1993, NMFS stated that formal consultation on the operation of the OCNGS was necessary due to takes of threatened and endangered sea turtles. In a letter dated November 19, 1993, the NRC requested formal consultation. A BA was prepared by the OCNGS, reviewed and submitted by the NRC, and received by NMFS on January 25, 1995.

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A Biological Opinion (Opinion) on the effects of the operation of OCNGS on loggerhead, green, and Kemp's ridley sea turtles was signed on September 21, 1995. This Opinion concluded that the continued operation of this station may adversely affect listed turtles, but is not likely to jeopardize their continued existence. The accompanying Incidental Take Statement (ITS) exempted the annual take of 10 loggerhead (no more than 3 lethal), 3 Kemp's ridley (no more than 1 lethal), and 2 green (no more than 1 lethal) sea turtles. The incidental take exemption extended for a period of 5 years from the date of the Opinion (i.e., to September 21, 2000).

Between 1995 and 2000, there were nine takes of sea turtles associated with the OCNGS. Although no sea turtles were taken in 1995 or 1996, the level of incidental take exempted in the 1995 Opinion was met during three of these years: in 1997 with the lethal take of a Kemp's ridley turtle, in 1999 with the lethal take of a green turtle, and again in 2000 with the lethal take of a Kemp's ridley turtle. However, these takes did not trigger reinitiation of formal consultation on OCNGS as Section 7 consultation must be reinitiated if "the amount or extent of taking specified in the incidental take statement is *exceeded*" (50 CFR 402.16).

On August 3, 2000, NMFS was copied on a letter from the Acting Site Director of the OCNGS, Sander Levin, to the NRC, requesting the renewal of the Biological Opinion/Incidental Take Statement and submitting an updated BA. In a telephone conversation on August 24, 2000, NRC informed NMFS that they would be sending a letter requesting reinitiation of formal consultation. On September 18, 2000, four days before the previous incidental take statement was to expire, NRC requested reinitiation of formal consultation on the effects of the continued operation of the OCNGS on sea turtles and submitted a revised BA. In a letter dated October 6, 2000, NMFS acknowledged the receipt of the formal consultation request and the BA. At that time, NMFS requested additional information before formal consultation could proceed.

During a telephone discussion in December 2000, NRC and AmerGen staff informed NMFS that information was not available for several items requested in NMFS' October 6 letter (e.g., updated necropsy information). On January 23, 2001, the NRC submitted supplemental information and clarification on the BA as requested by NMFS. NRC also identified areas where data were lacking or unavailable. Consultation was completed with the issuance of an Opinion dated July 18, 2001. The accompanying ITS exempted the annual take of 5 loggerheads (no more than 3 lethal), 4 Kemp's ridley (no more than 3 lethal), and 2 green (no more than 1 lethal) sea turtles. A revised ITS was issued on August 29, 2001 in response to concerns raised by the AmerGen Energy Company in regards to some requirements in the terms and conditions; however, no changes were made to the numbers of exempted sea turtle takes.

On August 7, 2004, the OCNGS recorded its fifth incidental take of a Kemp's ridley sea turtle since the beginning of the year, exceeding the incidental take statement for the facility. This incidental take was followed by 3 more takes of Kemp's ridley sea turtles on September 11, September 12, and September 23, 2004 respectively. The amount of taking exempted by the ITS was exceeded, and in a letter dated August 26, 2004 NRC requested reinitiation of formal section

7 consultation for the continued operation of OCNGS. On April 28, 2005 NMFS received a BA, dated March 29, 2005 from the NRC.

On June 3, 2005 NMFS informed NRC that all the information necessary for a formal section 7 consultation and the preparation of a Biological Opinion had been received and reminded NRC that they were prohibited from making any irreversible or irretrievable commitments of resources that would prevent NMFS from proposing or the NRC from implementing any reasonable and prudent alternatives to avoid jeopardizing sea turtles. Also in this letter, NMFS recommended that the NRC continue to implement the requirements identified in the July 18, 2001 Opinion until consultation was concluded. During the consultation period, 2 Kemp's ridley sea turtles were impinged at the OCNGS.

Section 7 consultation concluded with the issuance of an Opinion dated September 22, 2005. This Opinion analyzed the effect of the continued operation of the OCNGS through the expiration of the current NRC license (April 2009). In this Opinion, NMFS concluded that the continued operation of the OCGNS was likely to adversely affect but not likely to jeopardize the continued existence of loggerhead, Kemp's ridley or green sea turtles. The ITS accompanying the 2005 Opinion exempted the annual take of 2 loggerheads (1 lethal), 8 Kemp's ridleys (4 lethal), and 1 green (alive or dead) annually as a result of the operation of the OCNGS.

In a letter dated June 9, 2006, NRC requested the initiation of Section 7 consultation on the effects of the operation of the OCNGS under a renewed NRC license. In this letter, NRC made the preliminary determination that the renewal of the Operating License would result in adverse effects to loggerhead, Kemp's ridley and green sea turtles. As noted above, the current NRC license expires on April 9, 2009. NRC is currently proposing to extend the term of the license for an additional 20 years, with the license expiring on April 9, 2029. In a letter dated July 7, 2006, NMFS informed NRC that all the information necessary for consultation had been received and that the date the June 9 letter had been received (June 15, 2006) would serve as the date of initiation of formal consultation. On September 19, 2006 a meeting was held at the OCNGS between AmerGen staff, New Jersey Department of Environmental Protection, NMFS and NRC. As a result of the need to incorporate information from that meeting into the Opinion being drafted, the consultation period was extended for 30 days. It should also be noted that during the consultation period, 6 sea turtles were impinged at the OCGNS (4 Kemp's ridleys (1 dead) and 2 live loggerheads). See Figures 1-3 for an illustration of the total number of sea turtles taken at OCNGS between 1992 and 2006.

	Kemp's ridley	Loggerhead	Green	**TOTAL**
1992	1	3*	0	**4**
1993	1	0	0	**1**
1994	2	2	0	**4**
1995	0	0	0	**0**
1996	0	0	0	**0**
1997	1	0	0	**1**
1998	0	1	0	**1**
1999	1	0	1	**2**
2000	2	2	1	**5**
2001	2	0	1	**3**
2002	2	0	0	**2**
2003	1	0	1	**2**
2004	8	0	0	**8**
2005	2	0	0	**2**
2006	4	2	0	**6**
TOTAL	**27**	**10**	**4**	**41**

Figure 1. Total number of sea turtles captured or impinged at OCNGS from 1992 – 2006. *Two individual loggerheads were captured in 1992; one was recaptured two days following release into the discharge canal.

Figure 2. Total (live and dead) number of sea turtles impinged or captured at OCNGS, 1992 - 2006.

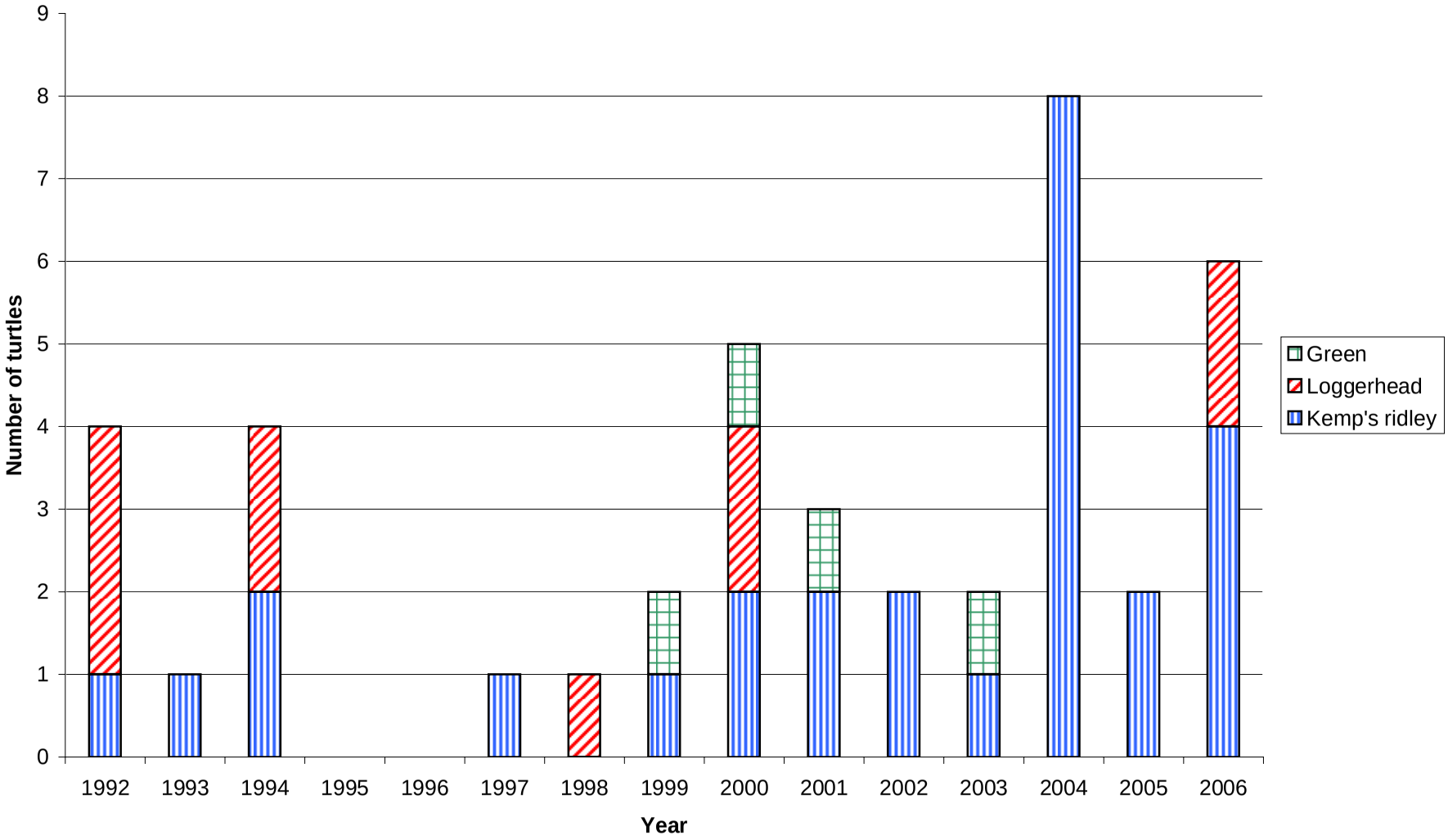


Figure 3. Number of dead sea turtles impinged at OCNGGS from 1992-2006

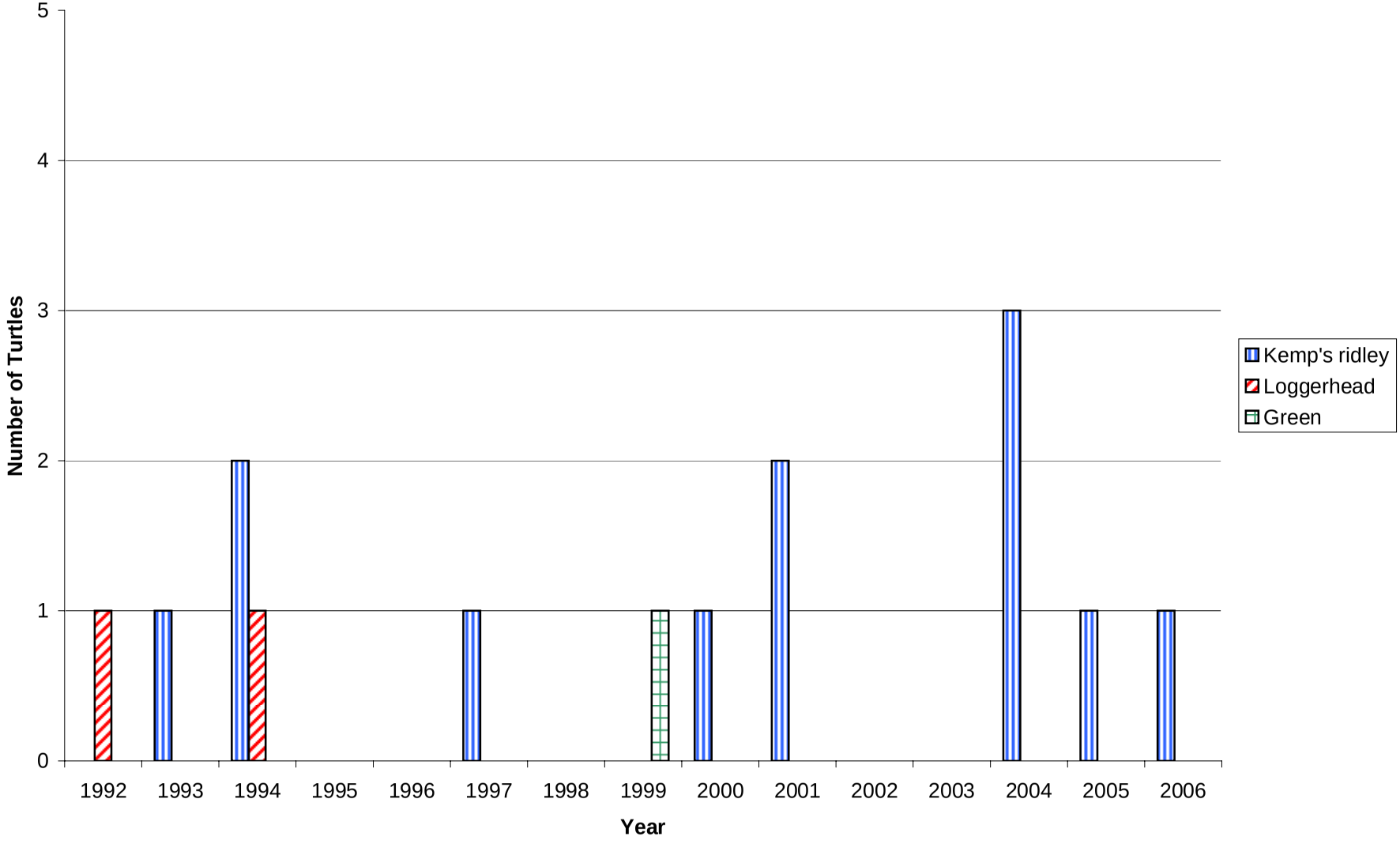
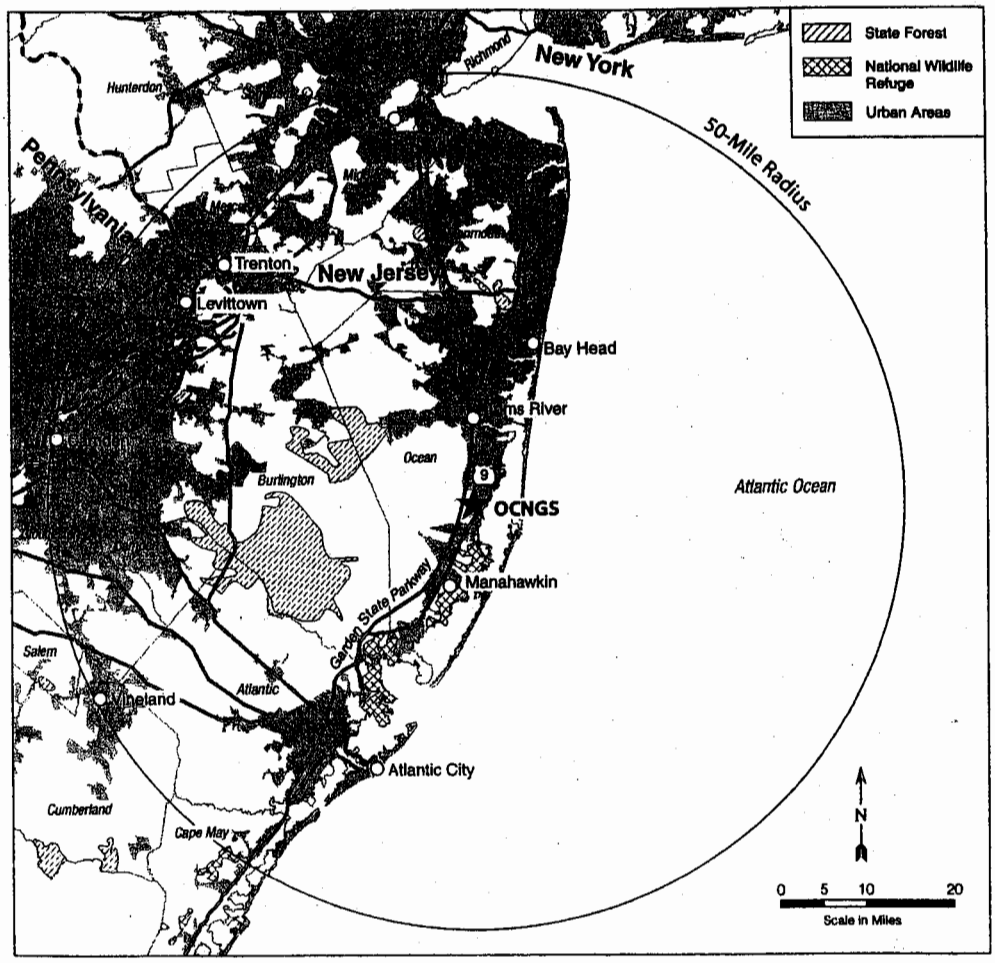
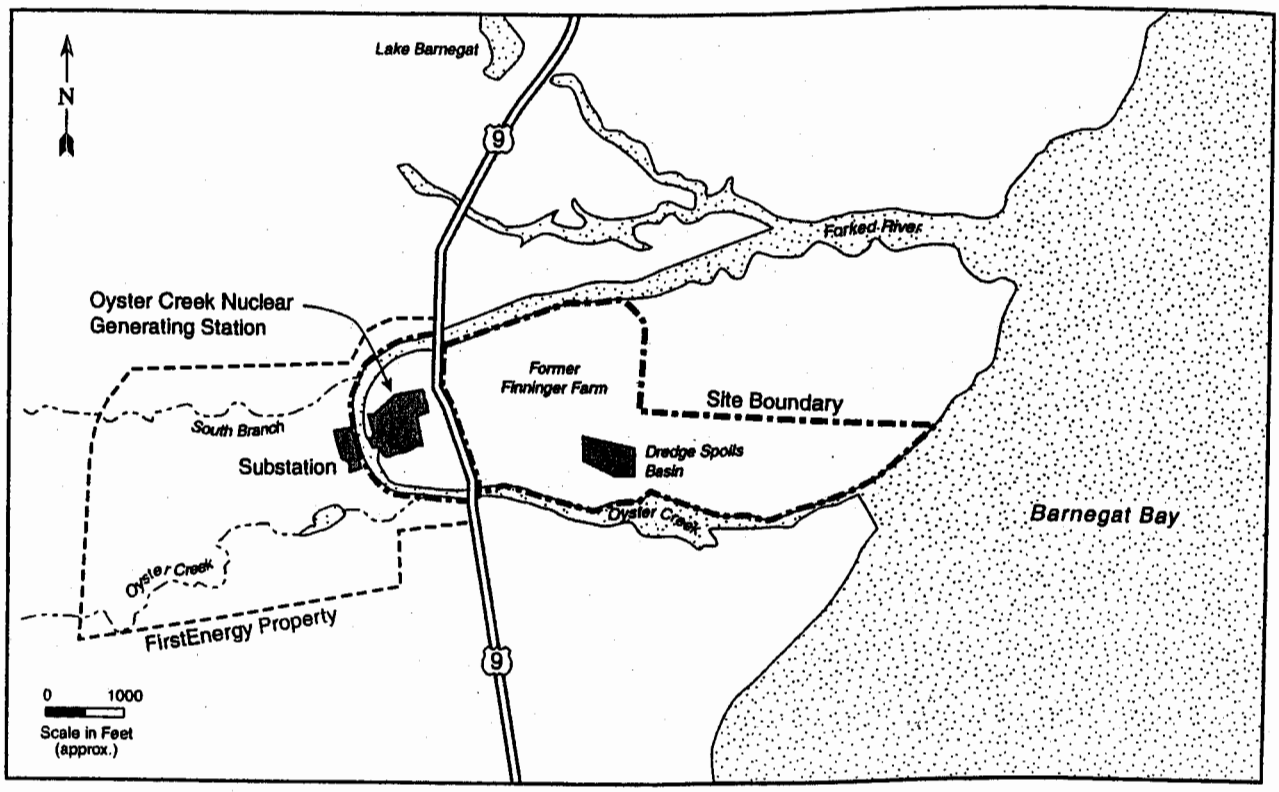


Figure 4. Location of OCNGS.





DESCRIPTION OF THE PROPOSED ACTION

The proposed activity is the continued operation of the Oyster Creek Nuclear Generating Station under the terms of a renewed license. NRC proposes to renew the OCGNS operating license for a period of an additional 20 years (through April 2029). The current NRC license was issued on April 9, 1989 and expires on April 9, 2009.

The OCNGS facility is located in Lacey Township, New Jersey and lies between the south branch of the Forked River and Oyster Creek. Both streams discharge into Barnegat Bay. The facility was constructed in the 1960s and became operational in December 1969. During construction, a semicircular canal was dredged between the two streams to create a horseshoe shaped cooling water system that consists of the lower reaches or the south branch of the Forked River, the man-made dredged canal and the lower reaches of Oyster Creek (see Figure 4 for a map of the facility). The facility currently operates under a license issued by the NRC on April 9, 1989 which is set to expire on April 9, 2009. When the plant is operational, the flow direction in the south fork of the Forked River is reversed, and all of the flow goes into the OCNGS.

OCNGS is a single unit plant with a boiling water nuclear reactor and steam turbine. The reactor has a design power level of 1930 megawatts thermal and a net power output of 640 megawatts electric. Plant cooling is provided by a once through system that draws water from Barnegat Bay via the south branch of the Forked River and a man-made intake canal and discharges heat back to Barnegat Bay via a man-made discharge canal and Oyster Creek. Two separate intake structures withdraw water from the intake canal, the circulating water system intake (CWS) and the dilution water system (DWS) intake.

The CWS provides cooling water for the main condensers and for safety-related heat exchangers and other equipment within the station. Water is drawn into the CWS from the intake canal (south fork of the Forked River) through six intake bays and is subsequently discharged into the discharge canal as heated effluent. During normal plant operation, four circulating water pumps withdraw a total of 1740 m^3/min of water. The maximum permissible average intake velocity for water approaching the CWS intake ports is 30 cm/sec. The maximum daily effluent temperature for cooling water discharge back to the discharge canal is 41.1°C.

The DWS is designed to minimize the thermal effects on the discharge canal and Barnegat Bay by thermally diluting the circulating water from the condenser with colder ambient temperature water. Water is pumped from the intake canal through the six intake bays and discharged directly into the discharge canal, where it mixes with and reduces the temperature of the heated effluent from the CWS. A maximum of two dilution pumps are operated at one time, but when ambient water temperature exceeds 30.5°C, usually only one dilution pump is put into operation. The average intake velocity for water in front of the DWS intake (with two pumps in operation) is approximately 73 cm/sec. As expected, the average intake velocity with one DWS pump in operation is notably less than 73 cm/sec.

The dimensions and structures at the CWS are nearly identical to those of the DWS. Several differences are that the intake velocity at the DWS is much higher than at the CWS, and the

CWS has a vertical traveling screen to filter small organisms. The intakes at both the CWS and DWS are screened by six sets of trash bars, which extend from the bottom of each intake bay to several feet above the water (7.3 m high and 3.3 m wide). The depth at the intake bays are approximately 4 to 6 meters deep. The trash bars are 0.95 cm wide steel bars set on 7.5 cm centers, and the openings between the trash bars are 6.6 cm wide. A trash rake assembly traverses the entire width of the intake on rails; it contains a trash hopper which transports the material removed from the bars to a debris container. Personnel cleaning the CWS and DWS intake trash racks from June to October observe the trash rake during the cleaning operation so that the rake may be stopped if a sea turtle is sighted. The trash bars are inspected at least once every four hours (i.e., three times during each 12-hour work shift) from June to October to remove debris and to monitor potential sea turtle takes. At the CWS, organisms smaller than 6.6cm travel through the openings onto a traveling screen system where they are washed from the screens and returned to the discharge canal on a slide system. At the DWS, small organisms travel with the dilution water into the discharge canal.

A floating debris/ice barrier is in place upstream of the CWS and DWS intake structures to divert floating debris (e.g., wood, eelgrass, ice) away from the CWS intake and towards the DWS intake. The barrier is intended to prevent excessive amounts of debris or ice from accumulating on the CWS traveling screen or trash bars. The wood floating barrier extends 60 cm below the surface.

Both intakes have sea turtle retrieval/rescue equipment on site in the event of a sea turtle impingement. At the CWS intake structure, a rescue sling suitable for lifting large sea turtles (in excess of 20 kg) is present. Long-handled dip nets are present at the CWS and DWS intake structures during June through October, and are suitable for retrieving the smaller turtles which are more likely to be found at the OCNGS. Both the rescue sling and the long-handled dip nets are only adequate for retrieving turtles from the water surface or within about 1 meter of the surface, as the use of either device requires that the sea turtle be visible from the surface.

Action Area

The action area is defined in 50 CFR 402.02 as “all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action.” The direct and indirect effects of the OCNGS are the intake of water into the CWS and DWS from the south fork of the Forked River, which causes a reversal of normal flow, and the discharge of warmed and chlorinated water into Oyster Creek and Barnegat Bay. The discharge plume occupies Oyster Creek and extends into a relatively large surface area of Barnegat Bay (estimated to be less than 1.6 km in an east-west direction by 5.6 km in a north-south direction, under all conditions). In general, elevated temperatures do not extend to the bottom of the Bay except in the area immediately adjacent to the mouth of Oyster Creek.

Therefore, the action area for this consultation includes the intake areas of both the DWS and CWS intakes at the OCNGS, the south fork of Forked River, Oyster Creek, and the region where the thermal plume extends into Barnegat Bay from Oyster Creek.

LISTED SPECIES IN BARNEGAT BAY

Several species of listed sea turtles under NMFS' jurisdiction occur in New Jersey waters and are likely to occur in Barnegat Bay. These species include loggerhead, Kemp's ridley and green sea turtles. Hawksbill and leatherback sea turtles may also occur in New Jersey waters but, as explained below, these species are not likely to occur in the action area for this consultation.

Leatherback sea turtles are widely distributed throughout the oceans of the world, and are found in waters of the Atlantic, Pacific, Caribbean, and the Gulf of Mexico (Ernst and Barbour 1972). In the U.S. Atlantic Ocean, leatherback turtles are found in northeastern waters during the warmer months. This species is found in coastal waters of the continental shelf and near the Gulf Stream edge (Lutcavage 1996). Leatherbacks are predominantly a pelagic species and feed on jellyfish, cnidarians and tunicates; leatherbacks will travel to nearshore areas when in pursuit of these prey species.

Estimated to number approximately 115,000 adult females globally in 1980 (Pritchard 1982) and only 34,500 by 1995 (Spotila *et al.* 1996), leatherback populations have been decimated worldwide, not only by fishery related mortality but, at least historically, due to intense exploitation of eggs on the beach (Ross 1979). The status of the leatherback population in the Atlantic is difficult to assess since major nesting beaches occur over broad areas within tropical waters outside the United States. Recent information suggests that Western Atlantic populations declined from 18,800 nesting females in 1996 (Spotila et al., 1996) to 15,000 nesting females by 2000 (Spotila, pers. comm).

Leatherbacks have been documented in waters off New Jersey and have also been found stranded on New Jersey coastal and estuarine beaches. Shoop and Kenney (1992) observed concentrations of leatherbacks during the summer off the south shore of Long Island and off New Jersey. Leatherbacks in these waters are thought to be following their preferred jellyfish prey. This aerial survey estimated the leatherback population for the northeastern U.S. at approximately 300-600 animals (from near Nova Scotia, Canada to Cape Hatteras, North Carolina).

The only direct access to Barnegat Bay from the Atlantic Ocean is through a single, narrow inlet, approximately 300 m wide. While leatherbacks could enter Barnegat Bay, it is improbable given that this species is rarely found in inshore waters. Furthermore, given this species' distribution and migratory and foraging patterns, it is also unlikely that this species will travel through the navigation channels to reach the OCNGS. No leatherback sea turtles have been observed in Barnegat Bay or at OCNGS. As a result, NMFS has determined that leatherback sea turtles are not likely to occur in the action area for this consultation. As such, this species will not be considered further in this Opinion.

The *hawksbill sea 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.

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.

There are accounts of hawksbills in south Florida and a number are encountered in Texas each year. Most of the Texas records report small turtles, probably in the 1-2 year class range. Many of the captures or strandings that are reported are of individuals in an unhealthy or injured condition. 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. In the north Atlantic, small hawksbills have stranded as far north as Cape Cod, Massachusetts. However, many of these strandings were observed after hurricanes or offshore storms. No takes of hawksbill sea turtles have been recorded in Northeast or mid-Atlantic fisheries covered by the Northeast Fisheries Science Center (NEFSC) observer program, but it should be noted that coverage has been limited in the past.

While hawksbills have occasionally been found in northern mid-Atlantic waters, it is improbable that this species will be present in the action area given its distribution, and migratory and foraging patterns. As a result, NMFS has determined that hawksbill sea turtles are not likely to occur in the action area for this consultation. As such, this species will not be considered further in this Opinion.

Species Likely To Occur in the Action Area

The following endangered or threatened species under NMFS' jurisdiction are likely to occur in the action area.

Sea Turtles

Loggerhead sea turtle (*Caretta caretta*)	Threatened
Green sea turtle[1] (*Chelonia mydas*)	Endangered[1]
Kemp's ridley sea turtle (*Lepidochelys kempi*)	Endangered

Loggerhead sea turtles

Loggerhead sea turtles are found in temperate and subtropical waters and inhabit pelagic waters, continental shelves, bays, estuaries and lagoons. Loggerhead sea turtles are the most abundant species of sea turtle in U.S. waters, commonly occurring throughout the inner continental shelf from Florida through Cape Cod, Massachusetts, and may occur as far north as Nova Scotia when oceanographic and prey conditions are favorable (NEFSC survey data 1999). The loggerhead was listed rangewide as threatened under the ESA on July 28, 1978.

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1 Pursuant to NMFS regulations at 50 CFR 223.205, the prohibitions of Section 9 of the Endangered Species Act apply to all green turtles, whether endangered or threatened.

Loggerhead sea turtles are generally grouped by their nesting locations. Nesting is concentrated in the north and south temperate zones and subtropics. Loggerheads generally avoid nesting in tropical areas of Central America, northern South America, and the Old World (National Research Council 1990). The largest known nesting aggregations of loggerhead sea turtles occur on Masirah and Kuria Muria Islands in Oman (Ross and Barwani 1982). However, the status of the Oman nesting beaches has not been evaluated recently, and their location in a part of the world that is vulnerable to extremely disruptive events (e.g. political upheavals, wars, and catastrophic oil spills) is cause for considerable concern (Meylan et al. 1995).

Pacific Ocean. In the Pacific Ocean, major loggerhead nesting grounds are generally located in temperate and subtropical regions with scattered nesting in the tropics. The abundance of loggerhead turtles on nesting colonies throughout the Pacific basin has declined dramatically over the past 10-20 years. Loggerhead sea turtles in the Pacific 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. 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). Genetic analyses of female loggerheads nesting in Japan indicate the presence of genetically distinct nesting colonies (Hatase *et al.* 2002). As a result, Hatase *et al.* (2002) suggest that the loss of one of these colonies would decrease the genetic diversity of loggerheads that nest in Japan, and recolonization of the site would not be expected on an ecological time scale. In Australia, long-term census data has been collected at some rookeries since the late 1960's and early 1970's, and nearly all data show marked declines in nesting populations since the mid-1980's (Limpus and Limpus 2003). No recent, quantitative estimates of the size of the nesting aggregation in the southwest Pacific is available, 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. 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., egg poaching).

Indian Ocean. Loggerhead sea turtles are distributed throughout the Indian Ocean, along most mainland coasts and island groups (Baldwin *et al.* 2003). In the southwestern Indian Ocean, loggerhead nesting has shown signs of recovery in South Africa where protection measures have been in place for decades. However, in other southwestern areas (*e.g.*, Madagascar and Mozambique) loggerhead nesting aggregations are still affected by subsistence hunting of adults

and eggs (Baldwin *et al*. 2003). The largest known nesting aggregation of loggerheads in the world occurs in Oman in the northern Indian Ocean. An estimated 20,000-40,000 females nest at Masirah, the largest nesting site within Oman, each year (Baldwin *et al*. 2003). All known nesting sites within the eastern Indian Ocean are found in Western Australia (Dodd 1988). As has been found in other areas, nesting numbers are disproportionate within the area with the majority of nesting occurring at a single location. This may, however, be the result of fox predation on eggs at other Western Australia nesting sites (Baldwin *et al*. 2003). Throughout the Indian Ocean, loggerhead sea turtles face many of the same threats as in other parts of the world including loss of nesting beach habitat, fishery interactions, and turtle meat and/or egg harvesting.

Mediterranean Sea. Nesting in the Mediterranean is confined almost exclusively to the eastern basin (Margaritoulis *et al*. 2003). The greatest number of nests in the Mediterranean are found in Greece with an average of 3,050 nests per year (Margaritoulis *et al*. 2003). There is a long history of exploitation for loggerheads in the Mediterranean (Margaritoulis *et al*. 2003). Although much of this is now prohibited, some directed take still occurs (Margaritoulis *et al*. 2003). Loggerheads in the Mediterranean also face the threat of habitat degradation, incidental fishery interactions, vessel strikes, and marine pollution (Margaritoulis *et al*. 2003).

Atlantic Ocean. In the Atlantic Ocean, 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; 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. Loggerheads have been observed in waters with surface temperatures of 7-30°C but water temperatures of at least 11°C are favorable to sea turtles (Epperly *et al.* 1995b; Shoop and Kenney 1992). As coastal water temperatures warm in the spring, loggerheads begin to migrate to North Carolina inshore waters (*e.g.*, Pamlico and Core Sounds) and also move up the coast (Braun-McNeill and Epperly 2004; Epperly *et al.* 1995a; Epperly *et al.* 1995b; Epperly *et al.* 1995c), occurring in Virginia foraging areas as early as April and on the most northern foraging grounds in the Gulf of Maine in June. The trend is reversed in the fall as water temperatures cool. The large majority leaves the Gulf of Maine by mid-September but some may remain in Mid-Atlantic and Northeast areas until late November. By December, loggerheads have migrated from inshore North Carolina waters and more northern coastal waters to waters offshore of North Carolina, particularly off of Cape Hatteras, and waters further south where the influence of the Gulf Stream provides temperatures favorable to sea turtles (Epperly *et al.* 1995b; Shoop and Kenney 1992).

In the western Atlantic, most loggerhead sea turtles nest from North Carolina to Florida and along the Gulf coast of Florida. In 1996, the Turtle Expert Working Group (TEWG) met on several occasions and produced a report assessing the status of the loggerhead sea turtle population in the western North Atlantic. 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 aggregations is considered to be critical to the survival of this species.

Based on analysis of mitochondrial DNA (mtDNA), which is maternally inherited, the TEWG theorized that nesting assemblages represent distinct genetic entities, and that there are at least four loggerhead subpopulations in the western North Atlantic separated at the nesting beach (TEWG 1998, 2000). A fifth subpopulation was identified in NMFS SEFSC 2001. As such, there are at least five western Atlantic subpopulations, divided geographically as follows: (1) a northern nesting subpopulation, occurring from North Carolina to northeast Florida at about 29°N (approximately 7,500 nests in 1998); (2) a south Florida nesting subpopulation, occurring from 29°N on the east coast to Sarasota on the west coast (approximately 83,400 nests in 1998); (3) a Florida Panhandle nesting subpopulation, occurring at Eglin Air Force Base and the beaches near Panama City, Florida (approximately 1,200 nests in 1998); (4) a Yucatán nesting subpopulation, occurring on the eastern Yucatán Peninsula, Mexico (TEWG 2000); and (5) a Dry Tortugas nesting subpopulation, occurring in the islands of the Dry Tortugas, near Key West, Florida (approximately 200 nests per year) (NMFS SEFSC 2001). Genetic analyses conducted at these nesting sites indicate that they are distinct subpopulations (TEWG 2000). 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. Fine-scale analysis of mtDNA work from Florida rookeries indicate that population separations begin to appear between nesting beaches separated by more than 50-100 km of coastline that does not host nesting (Francisco et al. 1999) and tagging studies are consistent with this result (Richardson 1982, Ehrhart 1979, LeBuff 1990, CMTTP: in NMFS SEFSC 2001). Nest site relocations greater than 100 km occur, but are rare (Ehrhart 1979; LeBuff 1974, 1990; CMTTP; Bjorndal et at. 1983: in NMFS SEFSC 2001). In addition, a recent study by Bowen *et al*. (2004) lends support to the hypothesis that juvenile loggerhead sea turtles exhibit homing behavior with respect to using foraging areas in the vicinity of their nesting beach. Therefore, coastal hazards that affect declining nesting populations may also affect the next generation of turtles when they are feeding in nearby habitats (Bowen *et al*. 2004).

Loggerheads from any of these nesting sites may occur within the action area. However, the majority of the loggerhead turtles in the action area are expected to have come from the northern nesting subpopulation and the south Florida nesting subpopulation with a smaller portion from the Yucatan subpopulation. Rankin-Baransky et. al. examined the genetic composition of loggerheads stranded in the Northeast and determined that 25% were from the northern nesting subpopulation, 59% from the south Florida subpopulation and 16% from the Yucatan subpopulation. Bass et al. (1995) reports that of the sea turtles foraging in Virginia waters, approximately half are from the northern nesting subpopulation and half from the south Florida nesting subpopulation with very few loggerheads from the Mexican subpopulation (less than .07%) occurring in Chesapeake Bay. As the action area for this consultation includes Mid-Atlantic waters, it is likely that loggerheads from these three subpopulations may occur in the action area. Loggerheads from other subpopulations have not been shown to occur in these waters in detectable numbers. As such, in this Opinion NMFS will consider effects of the action

on loggerheads from the northern subpopulation, the south Florida subpopulation and the Yucatan subpopulation.

Mating takes place in late March-early June, and eggs are laid throughout the summer, with a mean clutch size of 100-126 eggs in the southeastern U.S. Individual females nest multiple times during a nesting season, with a mean of 4.1 nests per individual (Murphy and Hopkins 1984). Nesting migrations for an individual female loggerhead are usually on an interval of 2-3 years, but can vary from 1-7 years (Dodd 1988). In the western Atlantic, most loggerhead sea turtles nest from North Carolina to Florida and along the gulf coast of Florida.

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). Loggerheads that have entered the benthic environment appear to undertake routine migrations along the coast that appear to be limited by seasonal water temperatures. Aerial surveys suggest that loggerheads (benthic immatures and adults) in U.S. waters are distributed in the following proportions: 54% in the southeast U.S. Atlantic, 29% in the northeast U.S. Atlantic, 12% in the eastern Gulf of Mexico, and 5% in the western Gulf of Mexico (TEWG 1998).

Loggerheads appear to concentrate in nearshore and southerly areas influenced by warmer Gulf Stream waters off North Carolina during November and December (Epperly et al. 1995a). Support for these loggerhead movements are provided by the collected work of Morreale and Standora (1998) who showed through satellite tracking that 12 loggerheads traveled along similar spatial and temporal corridors from Long Island Sound, New York, in a time period of October through December, within a narrow band along the continental shelf before taking up residence for one or two months south of Cape Hatteras.

A number of stock assessments (TEWG 1998; 2000; NMFS SEFSC 2001; Heppell *et al.* 2003) have examined the stock status of loggerheads in the waters of the U.S., but have been unable to develop any reliable estimates of absolute population size. Due to the difficulty of conducting comprehensive population surveys away from nesting beaches, nesting beach survey data are used to index the status and trends of loggerheads (USFWS and NMFS 2003).

Nesting beach surveys count the number of nests. As alluded to above, the number of nests laid are a function of the number of reproductively mature females in the population and the number of times that they nest per season. Between 1989 and 1998, the total number of nests laid along the U.S. Atlantic and Gulf coasts ranged from 53,014 to 92,182, annually with a mean of 73,751 (TEWG 2000). The south Florida nesting group is the largest known loggerhead nesting assemblage in the Atlantic and one of only two loggerhead nesting assemblages worldwide that has greater than 10,000 females nesting per year (USFWS and NMFS 2003; USFWS Fact

Sheet). Annual nesting totals have ranged from 48,531 - 83,442 annually over the past decade (USFWS and NMFS 2003). South Florida nests make up the majority (90.7%) of all loggerhead nests counted along the U.S. Atlantic and Gulf coasts during the period 1989-1998. The northern subpopulation is the second largest loggerhead nesting assemblage within the U.S. but much smaller than the south Florida nesting group. Of the total number of nests counted along the U.S. Atlantic and Gulf coasts during the period 1989-1998, 8.5% were attributed to the northern subpopulation. The number of nests for this subpopulation has ranged from 4,370 - 7,887 for the period 1989-1998, for an average of approximately 1,524 nesting females per year (USFWS and NMFS 2003). The remaining three subpopulations (the Dry Tortugas, Florida Panhandle, and Yucatán) are much smaller subpopulations. Annual nesting totals for the Florida Panhandle subpopulation ranged from 113-1,285 nests for the period 1989-2002 (USFWS and NMFS 2003). The Yucatán nesting group was reported to have had 1,052 nests in 1998 (TEWG 2000). Nest counts for the Dry Tortugas subpopulation ranged from 168 to 270 during the 9-year period from 1995-2003.

While nesting beach data is a useful tool for assessing sea turtle populations, the detection of nesting trends requires consistent data collection methods over long periods of time (USFWS and NMFS 2003). In 1989, a statewide sea turtle Index Nesting Beach Survey (INBS) program was developed and implemented in Florida, and similar standardized daily survey programs have been implemented in Georgia, South Carolina, and North Carolina (USFWS and NMFS 2003). Currently available nesting trend data for these subpopulations from the INBS program is still too limited to indicate statistically reliable trends (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Statewide and Index Nesting Beach Survey Programs; USFWS and NMFS 2003). Although not part of the INBS program, nesting survey data are also available for the Yucatán Peninsula, Mexico (USFWS and NMFS 2003). Similarly, nesting surveys for the Dry Tortugas subpopulation have been conducted as part of Florida's statewide survey program since 1995 (although the 2002 year was missed), but no conclusion on the nesting trend for the subpopulation can be made at this time given the relatively short period of survey effort (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Statewide Nesting Beach Survey Data). Similarly, although Zurita *et al.* (2003) did find significant increases in loggerhead nesting on seven beaches at Quintana Roo, Mexico, nesting survey effort overall has been inconsistent among the Yucatán nesting beaches and no trend can be determined for this subpopulation given the currently available data.

More reliable nesting trend information is available from some south Florida and northern subpopulation nesting beaches that have been surveyed for longer periods of time. Using the information gathered from these select south Florida and northern subpopulation nesting beaches, the Turtle Expert Working Group (TEWG) concluded that the south Florida subpopulation was increasing based on nesting data over the last couple of decades, and that the northern subpopulation was stable or declining (TEWG 2000). Trend data for these nesting beaches are expected to be reviewed and the information provided in a revised Loggerhead Sea Turtle Recovery Plan. However, preliminary review of nesting trend data from several sources for the northern and south Florida nesting beaches now suggest: (1) a declining trend in nesting for 11 beaches in North Carolina, South Carolina and Georgia of 2% annually over a 23 year

period (1982-2005) (Barbara Schroeder, NMFS, pers. comm.), (2) a declining trend of 3.3% annually for South Carolina beaches since 1980 (Barbara Schroeder, NMFS, pers. comm.), and (3) an overall decline in nesting of 29% for the south Florida subpopulation during the period 1989-2005 (A. Meylan, presentation at the 26th Annual Symposium on Sea Turtle Biology and Conservation, April 2006).

Nesting trend data must be interpreted cautiously when using it to assess population trends for sea turtles. In general, census of nesting females only reflects the number of reproductively active females (Zurita *et al*. 2003). Females and males that are not reproductively active may not reflect the same tendencies (Ross 1996). Without knowing the proportion of males to females and the age structure of the population, it is impossible to extrapolate the data from nesting beaches to the entire population (Zurita *et al*. 2003; Meylan 1982). In the case of loggerheads, there is currently insufficient information to determine whether the current impacts to mature females are experienced to the same degree amongst all age classes regardless of sex, and/or that the impacts that led to the current abundance of nesting females are affecting the current immature females to the same extent. Adding to the difficulties associated with using loggerhead nesting trend data as an indicator of subpopulation status is the late age to maturity for loggerhead sea turtles. Past literature gave an estimated age at maturity for loggerhead sea turtles of 21-35 years (Frazer and Ehrhart 1985; Frazer *et al.* 1994) with the benthic immature stage lasting at least 10-25 years. New data from tag returns, strandings, and nesting surveys suggested estimated ages of maturity ranging from 20-38 years and the benthic immature stage lasting from 14-32 years (NMFS SEFSC 2001). Given the late age to maturity, there is a greater risk that the factors affecting the number of currently nesting females are not the same as the factors affecting the number of loggerhead sea turtles in the other age classes. Multiple management actions have been implemented in the United States over the last 20 years or less that either directly or indirectly address the known sources of mortality for loggerhead sea turtles (*e.g.*, fishery interactions, power plant entrainment, destruction of nesting beaches, etc.).

In 2001, NMFS (SEFSC) reviewed and updated the stock assessment for loggerhead sea turtles of the western Atlantic (NMFS SEFSC 2001). The assessment reviewed and updated information on nesting abundance and trends, estimation of vital rates (including age to maturity), evaluation of genetic relationships between populations, and evaluation of available data on other anthropogenic effects on these populations since the TEWG reports (1998; 2000). In addition, the assessment also looked at the impact of the U.S. pelagic longline fishery on loggerheads with and without the proposed changes in the Turtle Excluder Device (TED) regulations for the shrimp fishery using a modified population model from Heppell *et al*. (2003)[2]. NMFS SEFSC (2001) modified the model developed by Heppell *et al*. (2003) to include updated vital rate information (*e.g.*, new estimates of the duration of life stages and time to maturity) and, unlike Heppell *et al*. (2003), also considered sex ratios other than 1:1 (NMFS SEFSC 2001).

2 Although Heppell *et al*. is a later publication, NMFS SEFSC 2001 is actually a more up-to-date version of the modeling approach. Due to differences in publication times, Heppell *et al*. (2003) was published after NMFS SEFSC 2001.

The latter is an important point since studies have suggested that the proportion of females produced by the northern subpopulation is only 35% while the proportion of females produced by the south Florida subpopulation is 80% (NMFS SEFSC 2001).

The assessment looked at the impact of the proposed changes in the Turtle Excluder Device (TED) regulations for the shrimp fishery, as well as the U.S. pelagic longline fishery on loggerheads. NMFS SEFSC (2001) constructed models based on a 30% decrease in small benthic juvenile mortality based on research findings of (existing) TED effectiveness (Crowder *et al*. 1995; NMFS SEFSC 2001; Heppell *et al*. 2003). Model runs were then compared with respect to the change in population status as a result of implementing the requirement for larger TEDs (Epperly *et al*. 2002) alone and also when combined with other changes in survival rate from the pelagic long line fishery. The results of the modeling indicated that the proposed change in the TED regulations which would allow larger benthic immature loggerheads and sexually mature loggerheads to escape from shrimp trawl gear would have a positive or at least stabilizing influence on the subpopulation in nearly all scenarios. Coupling the anticipated effect of the proposed TED changes with changes in the survival rate of pelagic immature loggerheads revealed that subpopulation status would be positive or at least stable. Coupling the anticipated effect of the proposed TED changes with changes in the survival rate of pelagic immature loggerheads revealed that subpopulation status would be positive or at least stable when pelagic immature survival was changed by 0 to +10% in all but the most conservative model scenarios.

Given the late age at maturity for loggerhead sea turtles and the normal fluctuations in nesting, changes in population size as a result of the larger TED requirements and measures to address pelagic immature survival in the U.S. Atlantic longline fishery for swordfish are unlikely to be evident in nesting beach censuses for many years to come. NMFS' SEFSC (2001) assessment was reviewed by three independent experts from the Center for Independent Experts, in 2001. As a result, NMFS SEFSC's stock assessment report, the reviews of it, and the body of scientific literature upon which these documents were derived represent the best available scientific and commercial information for Atlantic loggerheads.

Threats to loggerhead sea turtle recovery

The diversity of a sea turtle's life history leaves them susceptible to many natural and human impacts, including impacts while they are on land, in the benthic environment, and in the pelagic environment. Hurricanes are particularly destructive to sea turtle nests. Sand accretion and rainfall that result from these storms as well as wave action can appreciably reduce hatchling success. For example, in 1992, all of the eggs over a 90-mile length of coastal Florida were destroyed by storm surges on beaches that were closest to the eye of Hurricane Andrew (Milton *et al.* 1994). Reports suggest that extensive loggerhead nest destruction occurred in Florida and other southern states in 2004 due to damage from multiple hurricanes and storm events. Other sources of natural mortality include cold stunning and biotoxin exposure. For example, in the winter of 2004/2005, 2 loggerheads died due to cold stunning on Cape Cod beaches and in the winter of 2005/2006, six loggerheads were cold stunned, with 2 deaths (S. McNulty, NMFS, pers. comm.).

Anthropogenic factors that impact hatchlings and adult female turtles on land, or the success of nesting and hatching include: beach erosion, beach 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; and poaching. An increased human presence at some nesting beaches or close to nesting beaches has led to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs and an increased presence of native species (*e.g.*, raccoons, armadillos, and opossums) which raid and feed on turtle eggs. Although sea turtle nesting beaches are protected along large expanses of the northwest Atlantic coast (in areas like Merritt Island, Archie Carr, and Hobe Sound National Wildlife Refuges), other areas along these coasts have limited or no protection. Sea turtle nesting and hatching success on unprotected high density east Florida nesting beaches from Indian River to Broward County are affected by all of the above threats.

Sea turtles, including loggerhead sea turtles, are affected by a different set of anthropogenic threats in the marine environment. These include oil and gas exploration, coastal 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, poaching, and fishery interactions. In the pelagic environment loggerheads are exposed to a series of long-line fisheries that include the U.S. Atlantic tuna and swordfish longline fisheries, an Azorean long-line fleet, a Spanish long-line fleet, and various fleets in the Mediterranean Sea (Aguilar *et al.* 1995; Bolten *et al.* 1994; Crouse 1999). In the waters off the coastal U.S., loggerheads are exposed to a suite of fisheries in Federal and State waters including trawl, purse seine, hook and line, gillnet, pound net, longline, dredge, and trap fisheries.

Power plants can also pose a danger of injury and mortality for loggerheads. In Florida, thousands of sea turtles have been entrained in the St. Lucie Nuclear Power Plant's intake canal over the past several decades (Bresette *et al*. 2003). From May 1976 - November 2001, 7,795 sea turtles were captured in the intake canal (Bresette *et al*. 2003). Approximately 57% of these were loggerheads (Bresette *et al*. 2003). Procedures are in place to capture the entrained turtles and release them. This has helped to keep mortality below 1% since 1990 (Bresette *et al*. 2003). The Salem Nuclear Generating Station in New Jersey is also known to capture sea turtles although the numbers are far less than those observed at St. Lucie, FL. As is the case at St. Lucie, procedures are in place for checking for the presence of sea turtles and rescuing sea turtles that are found within the intake canals. Three loggerheads have been recovered from the Salem intakes since 2000, with one turtle released alive. Dredging activities also pose a danger of injury and mortality for loggerheads. Sea turtle deaths in dredging operations have been documented throughout the eastern U.S. At least 50 loggerheads have been documented to have been killed in northeast dredging projects since 1994, including 4 loggerheads killed during dredging operations in the ACOE Philadelphia District.

Summary of Status for Loggerhead Sea Turtles

The loggerhead sea turtle is listed throughout its range as threatened under the ESA. 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 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).

Loggerhead sea turtles also occur in the Indian Ocean and Mediterranean Sea. Nesting beaches in the southwestern Indian Ocean at Tongaland, South Africa have been protected for decades and sea turtle nesting shows signs of increasing (Baldwin *et al*. 2003). However, other southwestern Indian Ocean beaches are unprotected and both poaching of eggs and adults continues in some areas. The largest nesting aggregation of loggerhead sea turtles in the world occurs in Oman, principally on the island of Masirah. Oman does not have beach protection measures for loggerheads (Baldwin *et al*. 2003). Sea turtles in the area are affected by fishery interactions, development of coastal areas, and egg harvesting. In the eastern Indian Ocean, nesting is known to occur in western Australia. All known nesting sites within the eastern Indian Ocean are found in Western Australia (Dodd 1988). As has been found in other areas, nesting numbers are disproportionate within the area with the majority of nesting occurring at a single location. This may, however, be the result of fox predation on eggs at other Western Australia nesting sites (Baldwin *et al*. 2003).

There are at least five western Atlantic loggerhead subpopulations (NMFS SEFSC 2001; TEWG 2000; Márquez 1990). As noted above, cohorts from three of these populations, the south Florida, Yucatán, and northern subpopulations, are likely to occur in the action area for this consultation. The south Florida nesting group is the largest known loggerhead nesting assemblage in the Atlantic and one of only two loggerhead nesting assemblages worldwide that have greater than 10,000 females nesting per year (USFWS and NMFS 2003; USFWS Fact Sheet). The northern subpopulation is the second largest loggerhead nesting assemblage within the United States. The remaining three subpopulations (the Dry Tortugas, Florida Panhandle, and Yucatán) are much smaller subpopulations with nest counts ranging from roughly 100 - 1,000 nests per year.

Loggerheads are a long-lived species and reach sexual maturity relatively late; 20-38 years (NMFS SEFSC 2001). The INBS program helps to track loggerhead status through nesting beach surveys. However, given the cyclical nature of loggerhead nesting, and natural events that sometimes cause destruction of many nests in a nesting season, multiple years of nesting data are needed to detect relevant nesting trends in the population. The INBS program has not been in place long enough to provide statistically reliable information on the subpopulation trends for western Atlantic loggerheads. In addition, given the late age to maturity for loggerhead sea turtles, nesting data represents effects to female loggerheads that have occurred through the various life stages over the past couple of decades. Therefore, caution must be used when interpreting nesting trend data since they may not be reflective of the current subpopulation trend if effects to the various life stages have changed.

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, NMFS will assume that the southern Florida and northern subpopulations of loggerhead sea turtles are declining (the conservative estimate) or stable (the optimistic estimate), and the Yucatan subpopulation of loggerhead sea turtles is increasing (the optimistic estimate) or stable (the conservative estimate).

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; B. Schroeder pers. comm.). Green turtles are distributed circumglobally, and can be found in the Pacific and Atlantic Oceans. In 1978, the Atlantic population of the green sea 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. As it is difficult to differentiate between breeding populations away from the nesting beaches, all green sea turtles, in water, are considered endangered.

Pacific Ocean. In the Pacific Ocean, green sea turtles can be found along the west coast of the U.S., the Hawaiian Islands, Oceania, Guam, the Northern Mariana Islands, and American Samoa. Along the Pacific coast, green turtles have been reported as far north as British Columbia, but a large number of the Pacific coast sightings occur in northern Baja California and southern California (NMFS and USFWS 1996). The main nesting sites for the East Pacific green turtle are located in Michoacan, Mexico, and in the Galapagos Islands, Ecuador, with no known nesting of East Pacific green turtles occurring in the U.S. Between 1982 and 1989, the estimated nesting population in Michoacan ranged from a high of 5,585 females in 1982 to a low of 940 in 1984 (NMFS and USFWS 1996). Current population estimates are unavailable.

Atlantic Ocean. In the western Atlantic, green sea turtles range from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean (Wynne and Schwartz 1999). Green turtle occurrences are infrequent north of Cape Hatteras, but they do occur in mid-Atlantic and northeast waters (e.g., documented in Long Island Sound (Morreale 2003) and cold stunned in Cape Cod Bay, Massachusetts (NMFS unpub. data)). For example, in the winters of 2004/2005 and 2005/2006, a total of three green sea turtles were found coldstunned on Cape Cod beaches.

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). More 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). Certain Florida nesting beaches have been designated index beaches. Index beaches were established to standardize data collection methods and effort on key nesting beaches. The pattern of green turtle nesting shows

biennial peaks in abundance, with a generally positive trend during the ten years of regular monitoring since establishment of the index beaches in 1989, perhaps due to increased protective legislation throughout the Caribbean (Meylan et al. 1995). Recent population estimates for the western Atlantic area are not available.

While nesting activity is important in determining population distributions, the remaining portion of the green turtles 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 (Bjorndal 1985). At approximately 20 to 25 cm carapace length, juveniles leave pelagic habitats and enter benthic foraging areas, shifting to a chiefly herbivorous diet but may also consume jellyfish, salps, and sponges (Bjorndal 1997). 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. Additional important foraging areas in the western Atlantic include the Mosquito and Indian River Lagoon systems and nearshore wormrock reefs between Sebastian and Ft. Pierce Inlets in Florida, Florida Bay, the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean Coast of Panama, and scattered areas along Colombia and Brazil (Hirth 1971). 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).

Green turtles face many of the same natural threats as loggerhead and Kemp's ridley sea turtles. In addition, green turtles appear to be susceptible to fibropapillomatosis, an epizootic disease producing lobe-shaped tumors on the soft portion of a turtle's body. Juveniles are most commonly affected. The occurrence of fibropapilloma tumors may result in impaired foraging, breathing, or swimming ability, leading potentially to death.

Threats to sea turtle recovery

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).

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. 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 database). Sea sampling coverage

in the pelagic driftnet, pelagic longline, southeast shrimp trawl, and summer flounder bottom trawl fisheries has recorded takes of green turtles.

Summary of Status of Green Sea Turtles

The global status and trend of green sea turtles is difficult to summarize. In the Pacific Ocean, green turtles are frequent along a north-south band from 15°N to 5°S along 90°W, and between the Galapagos Islands and Central American coast (NMFS and USFWS 1996), but current population estimates are unavailable. Green turtles range in the western Atlantic from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean. Green turtles face many of the same natural and anthropogenic threats as loggerhead and Kemp's ridley sea turtles. In addition, green turtles are also susceptible to fibropapillomatosis which can result in death. In the continental U.S., green turtle nesting occurs on the Atlantic coast of Florida (Ehrhart 1979). Recent population estimates for the western Atlantic area are not available. However, the pattern of green turtle nesting shows biennial peaks in abundance, with a generally positive trend during the ten years of regular monitoring since establishment of index beaches in 1989. There is cautious optimism that the green sea turtle population is increasing in the Atlantic. For purposes of this consultation, NMFS will assume that the green sea turtle population is increasing (best case) or at worst is stable.

Kemp's Ridley Sea Turtles

The Kemp's ridley is considered the most endangered sea turtle species. Of the world's seven extant species of sea turtles, the Kemp's ridley has declined to the lowest population level. The Kemp's ridley sea turtle was listed as endangered throughout its range on December 2, 1970 under United States law. The Kemp's ridley is now protected under the ESA.

The only major nesting site for Kemp's ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963). 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 a recovery trajectory. Conservation efforts by Mexican and U.S. agencies have aided this species by eliminating egg harvest, protecting eggs and hatchlings, and reducing at-sea mortality through fishing regulations. Nesting data, estimated number of adults, and percentage of first time nesters have all increased from lows experienced in the 1970s and 1980s. From 1985 to 1999, the number of nests observed at Rancho Nuevo and nearby beaches has increased at a mean rate of 11.3% per year, allowing cautious optimism that the population is on its way to recovery. For example, data from nests at Rancho Nuevo, North Camp and South Camp, Mexico, have indicated that the number of adults declined from a population that produced 6,000 nests in 1966 to a population that produced 924 nests in 1978 and 702 nests in 1985, then increased to produce 1,940 nests in 1995 and about 3,400 nests in 1999. Total nests for the state of Tamaulipas and Veracruz in 2003 was 8,323 (E. Possardt, USFWS, pers. comm.); Rancho Nuevo alone documented 4,457 nests. Estimates of adult abundance followed a similar trend from an estimate of 9,600 in 1966 to 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 percent from 1981 to 1989 and from 23 to 41 percent from 1990 to 1994. The population model in the 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 population growth rate does not appear as steady as originally forecasted by the TEWG, but annual fluctuations, due in part to irregular internesting periods, are normal for other sea turtle populations. Also, as populations increase and expand, nesting activity would be expected to be more variable.

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. Hatchlings emerge after 45-58 days. 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 NMFS 1992). The presence of juvenile turtles along both the Atlantic and Gulf of Mexico coasts of the U.S., where they are recruited to the coastal benthic environment, indicates that post-hatchlings are distributed in both the Gulf of Mexico and Atlantic Ocean (TEWG 2000). The location and size classes of dead turtles recovered by the Sea Turtle Stranding and Salvage Network (STSSN) suggests that benthic immature developmental areas occur in many areas along the U.S. coast and that these areas may change given resource quality and quantity (TEWG 2000).

Juvenile Kemp's ridleys use northeastern and mid-Atlantic coastal waters of the U.S. Atlantic coastline 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 16 inches in carapace length, and weighing less than 44 pounds (Terwilliger and Musick 1995). Next to loggerheads, Kemp's ridleys are the second most abundant sea turtle in Virginia and Maryland waters, arriving in these areas during May and June (Keinath *et al.* 1987; Musick and Limpus 1997) and on northern foraging grounds in late June. In the Chesapeake Bay, where the juvenile population of Kemp's ridley sea turtles is estimated to be 211 to 1,083 turtles (Musick and Limpus 1997), ridleys frequently forage in submerged aquatic grass beds for crabs (Musick and Limpus 1997). Blue crabs and spider crabs are key components of the Kemp's ridley diet, as noted during examination of stranded sea turtle stomach contents (Seney 2003). Upon leaving the northern foraging grounds, including the Chesapeake Bay in autumn, juvenile ridleys migrate down the coast, passing Cape Hatteras in December and January (Musick and Limpus 1997). Larger juveniles from the Chesapeake Bay are joined there by juveniles of the same size from North Carolina sounds and smaller juveniles from New York and New England to form one of the densest concentrations of Kemp's ridleys outside of the Gulf of Mexico (Musick and Limpus 1997; Epperly *et al.* 1995a; Epperly *et al.* 1995b).

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.

Threats to Kemp's ridley recovery

Kemp's ridleys face many of the same natural threats as other sea turtle species, including destruction of nesting habitat from storm events, natural predators at sea, and oceanic events such as cold-stunning. Although cold-stunning can occur throughout the range of the species, it may be a greater risk for sea turtles that utilize the more northern habitats of Cape Cod Bay and Long Island Sound. For example, in the winter of 1999/2000, there was a major cold-stunning event where 218 Kemp's ridleys, 54 loggerheads, and 5 green turtles were found on Cape Cod beaches (R. Prescott, pers. comm.). In the winter of 2003/2004, 79 Kemp's ridleys were found cold stunned on Cape Cod beaches. In the winter of 2004/2005, 32 Kemp's ridleys were found, with 19 deaths. Numbers from the 2005/2006 season are still preliminary but indicate that 29 Kemp's ridleys were coldstunned, with 15 animals dying (S. McNulty, NMFS, pers. comm.). Annual cold stun events do not always occur at this magnitude; the extent of episodic major cold stun events may be associated with numbers of turtles utilizing Northeast waters in a given year, oceanographic conditions and the occurrence of storm events in the late fall. Although many cold-stun turtles can survive if found early enough and transferred to a rehabilitation facility, cold-stunning events can represent a significant cause of natural mortality.

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 1940s through the early 1960s, nests from Ranch Nuevo were heavily exploited (USFWS and NMFS 1992), but beach protection in 1966 helped to curtail this activity (USFWS and NMFS 1992). Following World War II, there was a substantial increase in the number of trawl vessels, particularly shrimp trawlers, in the Gulf of Mexico where adult Kemp's ridley turtles occur. Information from fishers helped to demonstrate the high number of turtles taken in these shrimp trawls (USFWS and NMFS 1992). Subsequently, NMFS has worked with the industry to reduce turtle takes in shrimp trawls and other trawl fisheries, including the development and use of TEDs. Sea sampling coverage in the Northeast otter trawl fishery, and southeast shrimp and summer flounder bottom trawl fisheries have recorded takes of Kemp's ridley turtles. Although changes in the use of shrimp trawls and other trawl gear have helped to reduce mortality of Kemp's ridleys, this species is also affected by other sources of anthropogenic impacts similar to those discussed above. For example, in the spring of 2000, a total of five Kemp's ridley carcasses were recovered from the same North Carolina beaches where 275 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 that were found are 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. Four Kemp's ridleys have been documented as killed during dredging operations in the Northeast US since 1994.

Summary of Status of Kemp's Ridley Sea Turtles
The only major nesting site for ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963). From 1985 to 1999, the number of nests observed at Rancho Nuevo and nearby beaches increased at a mean rate of 11.3% per year. Current totals exceed 3000 nests per year (TEWG 2000). Kemp's ridleys mature at an earlier age (7 - 15 years) than other chelonids, thus 'lag effects' as a result of unknown impacts to the non breeding life stages would likely have been seen in the increasing nest trend beginning in 1985 (USFWS and NMFS 1992).

The TEWG (1998) developed a population model to evaluate trends in the Kemp's ridley population through the application of empirical data and life history parameter estimates chosen by the TEWG. Model results identified three trends in benthic immature Kemp's ridleys. Benthic immatures are those turtles that are not yet reproductively mature but have recruited to feed in the nearshore benthic environment where they are available to nearshore mortality sources that often result in strandings. Benthic immature ridleys are estimated to be 2-9 years of age and 20-60 cm in length. Increased production of hatchlings from the nesting beach beginning in 1966 resulted in an increase in benthic ridleys that leveled off in the late 1970s. A second period of increase followed by leveling occurred between 1978 and 1989 as hatchling production was further enhanced by the cooperative program between the USFWS and Mexico's Instituto Nacional de Pesca to increase the nest protection and relocation program in 1978. A third period of steady increase, which has not leveled off to date, has occurred since 1990 and appears to be due to the greatly increased hatchling production and an apparent increase in survival rates of immature turtles beginning in 1990 due, in part, to the introduction of TEDs.

The population model in the 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. The population growth rate does not appear as steady as originally forecasted by the TEWG, but annual fluctuations, due in part to irregular inter-nesting periods, are normal for other sea turtle populations. Also, as populations increase and expand, nesting activity would be expected to be more variable.

One area for caution in the TEWG findings is that the area surveyed for ridley nests in Mexico was expanded in 1990 due to destruction of the primary nesting beach by Hurricane Gilbert. Because systematic surveys of the adjacent beaches were not conducted prior to 1990, there is no way to determine what proportion of the nesting increase documented since that time is due to the increased survey effort rather than an expanding ridley nesting range. The TEWG (1998) assumed that the observed increase in nesting, particularly since 1990, was a true increase rather than the result of expanded beach coverage. As noted by TEWG, trends in Kemp's ridley

nesting even on the Rancho Nuevo beaches alone suggest that recovery of this population has begun but continued caution is necessary to ensure recovery.

ENVIRONMENTAL BASELINE

Environmental baselines for biological opinions 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 Opinion includes the effects of several activities that may affect the survival and recovery of the listed species in the action area. The activities that shape the environmental baseline in the action area of this consultation generally include: dredging operations, water quality, scientific research, shipping and other vessel traffic and fisheries, and recovery activities associated with reducing those impacts.

Federal Actions that have Undergone Formal or Early Section 7 Consultation

The only project within the action area that has been subject to formal section 7 consultation has been the operation of the OCNGS. Details of these previous consultations were noted in the Background section (see page 1). The impact of the historical operation of the OCNGS on listed sea turtles is detailed below.

Impacts of the Historical Operation of the OCNGS

As noted above, the OCGNS was constructed in the 1960s and began generating power in 1969. No sea turtles were observed at the facility until 1992. However, between 1969 and 1992 there was no directed attempt to document sea turtles at the facility and the frequency and efficiency of monitoring the intakes prior to 1992 has not been determined. Since 1992 there have been a total of 41 recorded takes at the OCNGS (see Figures 1 and 2 above and Appendix 1 for details).

Between June 1992 and July 1994, 9 sea turtle impingements occurred at the OCNGS intake trash bars, including 5 loggerheads (1 recapture) and 4 Kemp's ridleys. Three of the loggerheads and 1 of the Kemp's ridleys were recovered alive. The remaining turtles were recovered dead from the intake trash bars. Of the 5 dead sea turtles, 3 were necropsied. Necropsy results for 2 of the 3 sea turtles indicated that they had died prior to becoming impinged at the intakes (1 loggerhead, 1 Kemp’s ridley), while the remaining turtle, a Kemp’s ridley, likely drowned at the intakes. Of the 2 sea turtles that were not necropsied, 1 of them displayed signs of injury or decomposition that indicated it may have died prior to becoming impinged on the intakes.

There were no sea turtle takes observed in 1995 or 1996. One Kemp’s ridley turtle was lethally taken in 1997. No necropsy was completed for this turtle; however, the lack of significant injuries or signs of decomposition indicate it likely died at the intakes. In 1998, one loggerhead was recovered alive.

Between 1999 and 2006 at total of 30 sea turtle impingements have been documented at the OCNGS intake structures. Of these 30 turtles, (22 Kemp’s ridley, 4 loggerheads, and 4 green),

21 of the turtles were recovered alive. Of the 9 dead sea turtles (8 Kemp's, 1 green), necropsy results are available for 3 Kemp's ridleys. Necropsy results indicate that 1 of the turtles likely died from drowning at the intakes while the other two sea turtles were likely dead prior to becoming impinged on the intakes. Of the remaining 6 dead sea turtles, only 1 of them had wounds which indicated it may have died prior to becoming impinged at the intakes.

In summary, there have been 41 total observed sea turtles at the OCNGS intakes since 1969, including 27 Kemp's ridleys, 10 loggerheads (which includes 1 recapture), and 4 greens. These numbers include fifteen dead sea turtles (12 Kemp's, 1 green, 2 loggerheads) that have been removed from the intakes at OCNGS since 1992. Based on the best available information, 9 (8 Kemps, 1 green) of the 15 dead sea turtles likely died from drowning or suffocation at the intakes while the remaining 6 sea turtles likely died prior to impingement at the intakes.

Since 1992, the number of sea turtles collected at the OCNGS intakes annually has ranged from zero (1995 and 1996) to a maximum of 8 in 2004. The number of loggerhead annual takes has ranged from zero to 3 (1992), the number of Kemp's ridley annual takes has been from zero to 8 (2004), and the number of green sea turtles collected annually on the intakes ranged from zero to 2 (2000). The number of mortalities has been as high of 3 in 1994 (1 loggerhead, 2 Kemp's ridleys) and 2004 (all Kemp's ridley), while in most other years it has been 1 or zero (with the exception of 2001 when 2 sea turtles were found dead).

The best available information indicates that the operation of OCNGS under the terms of the existing Operating License has had an effect on sea turtles in the action area. In addition to causing the death of at least 9 sea turtles since 1992, it has caused injury to 26 other sea turtles and has disrupted the migratory movements of these turtles. These turtles have also been subjected to the stress of removal from the water and transfer to a rehabilitation facility.

Non-Federally Regulated Actions

Contaminants and Water Quality

Point source discharges (i.e., municipal wastewater, 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 sea turtle populations.

Sources of contamination in the action area include atmospheric loading of pollutants, stormwater runoff from coastal development, groundwater discharges, and industrial development. Chemical contaminants may occur in the action area largely as a result of nonpoint source pollution. The Barnegat Bay Estuary Program has data on trace metals and radionuclides in the Barnegat Bay, but other toxic chemical contaminants may also occur in the action area including halogenated hydrocarbons and polycyclic aromatic hydrocarbons (PAHs). The Barnegat Bay estuary may be more susceptible to toxic chemical contaminants than may other estuaries because of its limited dilution capacity and flushing rate (Barnegat Bay Estuary Program 2001).

While the effects of contaminants on turtles are relatively unclear, pollutants may also make sea turtles more susceptible to disease by weakening their immune systems. Chemical contaminants may also have an effect on sea turtle reproduction and survival. Pollution may also be linked to the fibropapilloma virus that kills many turtles each year (NMFS 1997). If pollution is not the causal agent, it may make sea turtles more susceptible to disease by weakening their immune systems.

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).

Approximately 28% of the Barnegat Bay watershed is developed (residential, commercial, industrial, and institutional), while 46% is forested land. Barnegat Bay supports a thriving tourist industry, with boating, fishing, swimming, and hunting being top recreational activities. The developed land around the Bay may contribute to marine pollution which may in turn impact sea turtles. 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.

Private and Commercial Vessel Operations

Private and commercial vessels operate in the action area and have the potential to interact with sea turtles. An unknown number of private recreational boaters frequent coastal waters. 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. *Collisions with vessels*, from both commercial and recreational sources, is a potential contributor to sea turtle mortality in the action area. Fifty to 500 loggerheads and 5 to 50 Kemp's ridley turtles are estimated to be killed by vessel traffic per year in the U.S. (National Research Council 1990). Although some of these strikes may be post-mortem, the data show that vessel traffic is a substantial cause of sea turtle mortality. The Intracoastal Waterway traverses the length of Barnegat Bay, and numerous recreational boaters and commercial fishing boats travel this waterway. The Intracoastal Waterway is maintained at a depth of approximately 2 meters by the Army Corps of Engineers, but the greatest depths in Barnegat Bay of 3 to 4 meters occur along this area. Vessel traffic occurs in the action area, specifically in the thermal plume region that extends from Oyster Creek into Barnegat Bay. As turtles may be in the area where high vessel traffic occurs, the potential exists for collisions with vessels transiting from within the action area into the main waters of Barnegat Bay. At least 3 of the sea turtles impinged at OCNGS likely died due to injuries sustained from propeller wounds and/or a boat strike prior to becoming impinged. As these wounds were relatively fresh, they were likely sustained within the action area. Several other sea turtles had scars indicative of past interactions with boats or propellers; it is impossible to determine whether these interactions occurred within the action area.

Non-Federally Regulated Fishery Operations

Very little is known about the level of listed species 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 from state fisheries may be greater than those from federal activities in certain areas due to the distribution of these species. Nearshore entanglements of turtles have been documented; however, information is not currently available on whether the vessels involved were permitted by the state or by NMFS. NMFS 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.

A variety of commercial and recreational fisheries occur in the action area, producing valuable input into the local economy. Commercially important finfish and shellfish species occurring in the Barnegat Bay include the American eel, alewife, bluefish, striped bass, summer flounder, winter flounder, weakfish, blue crab, horseshoe crab, and hard clam (Barnegat Bay Estuary Program 2001). Several recreational fisheries exist in the action area as well, most notably for bluefish, striped bass, summer flounder, winter flounder, weakfish, black sea bass, and tautog. Fishing gear has been found to entangle and/or hook sea turtles, which can lead to mortality if the sea turtle cannot surface for air. Throughout their range, sea turtles have been taken in different types of gear, including gillnet, pound net, rod and reel, trawl, pot and trap, longline, and dredge gear. There have been no documented takes of sea turtles in any of the fisheries in Barnegat Bay, but it is not known to what degree the various fisheries interact with turtles. For example, one of the sea turtles impinged at OCNGS has 12 feet of line wrapped around its flipper and was trailing a plastic bucket tied to this line. It is not known whether this line and bucket were related to fishing operations in the action area. However, it is likely that sea turtles in the action area interact and are affected by commercial or recreational fisheries operating in the action area.

Reducing Threats to ESA-listed Sea Turtles

The STSSN is an extensive network of participants along the Atlantic and Gulf of Mexico coasts which not only collects data on dead sea turtles, but also rescues and rehabilitates live stranded turtles. Data collected by the STSSN are used to monitor stranding levels and identify areas where unusual or elevated mortality is occurring. 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 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. The Marine Mammal Stranding Center (MMSC), located in Brigantine, NJ which participates in the STSSN has routinely been involved in the necropsy of dead turtles and the tagging and release of live turtles which have been impinged or captured at the OCNGS.

Additionally, NMFS has developed and published as a final rule in the Federal Register (66 FR 67495, December 31, 2001), specific sea turtle handling and resuscitation techniques for sea turtles that are incidentally caught during scientific research or fishing activities. Persons participating in fishing activities or scientific research are required to take these measures to help prevent mortality of turtles caught in fishing or scientific research gear.

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

The purpose of the Environmental Baseline is to analyze the status of the species in the action area. Generally speaking, the status of sea turtle species overall is the same as the status of these species in the action area given their migratory nature. The loggerhead, Kemp's ridley, and green sea turtles likely to be found in the action area are typically small juveniles with the most abundant being the federally threatened loggerhead followed by the federally endangered Kemp's ridley, and green sea turtles. The available information on the impacts does not permit the specific itemization of the numbers of lethal and non-lethal interactions between sea turtles and various activities in the action area. However, available information also does not suggest that the types of activities falling with the definition the environmental baseline are unique to the action area, or that the aggregate impacts of those activities is unique compared to other areas. The lack of information also prevents an estimate of numbers of sea turtles of each species likely to be in the action area, although it is expected to be significantly less than the total population given the broad distribution of each species.

Impacts from actions occurring in the Environmental Baseline for the action area have the potential to impact sea turtles. Despite regulations on fisheries actions, improvements in dredge technologies and improvements in water quality, sea turtles still face numerous threats in this area, primarily from habitat alteration and interactions with fishing gear and dredging operations.

Summary of status of sea turtle species

As noted in the status of the species section, the majority of *loggerhead sea turtles* in the action area are likely to be from the south Florida nesting subpopulation, with the remainder from the northern Florida or Yucatan subpopulations. The South Florida nesting subpopulation is the largest known loggerhead nesting assemblage in the Atlantic. Nesting totals from beaches used by the South Florida subpopulation suggests that this subpopulation may be decreasing. The northern nesting subpopulation is the second largest loggerhead nesting assemblage in the Atlantic. Nesting data has led the TEWG to conclude that the northern subpopulation is likely declining and at best is stable. While researchers have documented significant increases in loggerhead nesting on seven beaches at Quintana Roo, Mexico, nesting survey effort overall has been inconsistent among the Yucatán nesting beaches and no trend can be determined for this subpopulation given the currently available data. No reliable estimate of the total number of loggerheads in any of the subpopulations or the species as a whole exists.

The *Kemp's ridley* is considered the most endangered sea turtle species with only one major nesting site remaining. While recent population estimates for this species are not available, patterns of Kemp's ridley nesting data suggests that this population is increasing or is at least stable.

Recent population estimates of the number of *green sea turtles* in the western Atlantic are unavailable. The pattern of nesting abundance for this species has shown a generally positive trend since monitoring began in 1989 suggesting that this population may be increasing or is at least stable.

Without more information on the status of these species, including reliable population estimates, it is difficult to speculate about the long term survival and recovery of these species. However, the best available information has led NMFS to make the determinations about species status as stated above.

EFFECTS OF THE ACTION

This section of a Opinion 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). This Opinion examines the likely effects (direct and indirect) of the proposed action on sea turtles in the action area and their habitat within the context of the species current status, the environmental baseline and cumulative effects.

The proposed action has the potential to affect threatened and endangered sea turtles in several ways: impingement at either the CWS or DWS intake trash racks; capture of free swimming sea turtles in the intake bays; altering the abundance or availability of sea turtle prey items; and altering water quality through the discharge of heated and chlorinated effluent.

Impingement and Capture of Sea Turtles

As explained above, 40 individual sea turtles have been taken at the OCNGS since 1992. Fifteen of these turtles have been found dead. Of the 25 live sea turtles, 11 were swimming freely in the intake bays and were removed from the water with a dip net while the remaining 15 were observed impinged on the trash rack and removed or discovered in the piles of debris removed from the trash rack by the mechanical rake. Nearly all of the sea turtles have evidence of interaction with the trash racks, including abrasions and bruising which suggests that even the live sea turtles were at least temporarily impinged on the rack or otherwise struggled to remove themselves from the area. There is currently no available data on the distribution of loggerheads, Kemp's ridleys and greens in the action area, in Barnegat Bay or in the coastal waters of New Jersey. This makes it impossible to determine that percentage of sea turtles in the action area that are affected by the operation of OCNGS. It is possible that sea turtles occur in the action area and are able to swim away from the intake bays without being detected and do not become impinged in the intake structure.

It is unclear why sea turtles enter the Forked River and encounter the OCNGS intake structures. In order to be present at the intake bays, live sea turtles must actively swim from Barnegat Bay

into the Forked River and continue downstream to the intake bays. As the current velocity does not increase until within several meters of the intakes, it does not appear that sea turtles are subject to inescapable currents in the Forked River which would draw them to the intakes. It has been hypothesized that sea turtles are attracted to the intake screens when prey items such as blue crabs and horseshoe crabs are gathered there. For example, in 1992, a loggerhead removed from the CWS intake bay was released into the discharge canal. Two days later this turtle was recaptured at the CWS intake. This sea turtle would have had to actively swim back to the CWS intake area which suggests that the turtle was attracted to either the ambient conditions in the south fork of the Forked River or to the conditions at the intake trash racks. However, it is possible that the return of this sea turtle to the intake was a coincidence and that the turtle was not particularly attracted to the intake area. While sea turtles have not been documented in the discharge canal, conditions in this area may also be attractive to sea turtles. The warm water discharge may increase the distribution of prey species to the area, and returns of live entrained organisms or dead fish and other material dumped from the traveling screens may provide food for the turtles or scavenging prey species.

As noted above, there was no program in place to monitor the intakes for sea turtles prior to 1992 and it is possible that some number of sea turtles have always occurred in the action area and that they went un-documented. While personnel did not monitor the intakes for sea turtles specifically, various impingement and entrainment observations and studies occurred prior to 1992; no sea turtles were recorded during this time. As the operation of the OCNGS has not changed appreciably since 1969 the onset of turtle captures in 1992 may be due to higher numbers of sea turtles in the action area or some change in ambient conditions that served to attract sea turtles to the intakes (e.g., prey availability). One possible explanation is that the Barnegat Inlet was deepened in 1992. In association with the deepening, the south jetty at the entrance of Barnegat Bay was re-aligned. The combination of these activities provided for a greater volume of water and tidal range in the Barnegat Bay and in the vicinity of Oyster Creek. It has been hypothesized that this change in conditions may have contributed to a greater number of turtles entering the action area.

If maintenance dredging of the Intracoastal Waterway and Barnegat Inlet make the Bay more accessible to turtles, the frequency of impingements at OCNGS may increase after each dredging episode and decrease as the Bay fills with sediment. While difficult to quantify, an increase in the occurrence of oceanic fronts may have also contributed to an increase in turtles in Barnegat Bay, as Polovina et al. (2000) suggest that turtles use oceanic fronts as migratory and foraging habitat. If a greater number of turtles are in the offshore New Jersey waters as a result of the oceanic patterns and they migrate through the Barnegat Inlet, more sea turtles may be found in the action area. Sea turtles may enter the Barnegat Bay with an increase in waves, winds and tidal prism. The yearly fluctuations may also be attributable to biological factors such as the abundance of prey organisms (e.g., blue crabs, horseshoe crabs) in the vicinity of Oyster Creek.

The sea turtles likely to occur in the action area are too large to pass through the intake trash bars, which are constructed with 6.6 cm wide openings. The BA states that any sea turtle that is smaller than the trash bar opening would pass through the CWS intake trash bars and be

transported safely to the water via the same traveling screen system that returns entrained fish and other small organisms. It is unlikely that turtles small enough to fit through the 6.6 cm wide opening will be in the vicinity of the OCNGS, because turtles of that size would not likely occur in inshore embayments, but rather in offshore currents (NMFS and USFWS 1992 and 1997).

As noted above both live and dead sea turtles have been found impinged at the OCNGS in the past, at both the DWS and CWS intakes. No sea turtles have been observed in the discharge canal. As water flow is away from this system, sea turtles would not be vulnerable to impingement or entrainment in the discharge canal. Sea turtles impinged at the intakes may suffocate or drown if they are unable to remove themselves from the trash bars and remain underwater for an extended period of time. At times when there is a heavy debris load at the intakes it may be more difficult for a sea turtle to remove itself from the trash bars. If sea turtles impinged on the trash bars are removed in time they may survive the impingement. Plant personnel estimated that many of the turtles that were taken at OCNGS had been impinged for up to 8 hours. In some natural situations, turtles may remain submerged for several hours. However, stress dramatically decreases the amount of time a turtle can stay submerged.

Under conditions of involuntary or forced submergence, sea turtles maintain a high level of energy consumption, which rapidly depletes their oxygen store and can result in large, potentially harmful internal changes (Magnuson et al. 1990). Those changes include a substantial increase in blood carbon dioxide, increases in epinephrine and other hormones associated with stress, and severe metabolic acidosis caused by high lactic acid concentrations. In forced submergence, a turtle becomes exhausted and then comatose; it will die if submergence continues. For example, trawl times for shrimpers in the southeast are limited by regulation to 55 minutes in the summer months and 75 minutes in the winter months, due to the fact that there is a strong positive correlation between tow time (i.e., forced submergence) and incidence of sea turtle death (Henwood and Stuntz 1987, Stebenau and Vietti 2000). Physical and biological factors that increase energy consumption, such as high water temperature and increased metabolic rates characteristic of small turtles, would be expected to exacerbate the harmful effects of forced submergence. Other factors, such as the level of dissolved oxygen in the water, the activity of the turtle and whether or not it has food in its stomach, may also affect the length of time it may stay submerged. It is likely that sea turtles impinged on the intake trash bars are already stressed; these conditions may increase the turtles' susceptibility to suffocation or drowning.

Nearly all of the sea turtles removed from OCNGS, including those recovered alive, have had evidence of injury sustained from contact with the trash bars. Typically this injury has been abrasions or bruising. Sea turtles may also be subject to injury from the operation of the trash rake which removes debris from the intake trash bars. The rake, a horizontal array of large curved tines, is lowered down into the bay to remove debris from the intake gratings. When the rake reaches the desired depth, the tines are deployed, curving downward to penetrate through the grate before the rake is raised. This process could cause serious injury to a turtle. Scrapes on a turtle's carapace could also result from interactions with the intake trash bars, or during rescue and retrieval by OCNGS personnel. Scrapes have been observed the carapace of several sea

turtles removed from the intakes. Additionally, two of the sea turtles have had puncture wounds near the base of their necks which may be indicative of interactions with the tines of the trash rake.

The maximum number of turtles collected at OCNGS in one year was eight Kemp's ridleys (in 2004). In other years, the number has ranged from zero to 6. Physical and biological factors may have played a role in attracting more turtles to the vicinity of OCNGS in 2004. As mentioned in the BA, oceanic water temperatures were slightly higher during 2004 than in previous years. The NRC states that based on information provided from the National Weather Service, the average ocean water temperatures during the summer of 2004 were 1.4^{o}C above normal. This increase in water temperature may have been a factor attracting juvenile sea turtles to the waters of the mid-Atlantic searching for foraging and developmental habitats. Therefore, the increased water temperatures observed in Atlantic waters during the summer of 2004 may be a factor contributing to the high number of Kemp's ridley sea turtles taken at OCNGS that year. It is interesting to note that only 2 sea turtles were found at the OCNGS in 2005. The number of sea turtles at the facility likely reflects annual environmental fluctuation in the action area, such as water temperature, the proximity of the Gulf Stream, storm activity, and the quality and quantity of prey in the area.

All of the sea turtles at OCNGS have been collected between June and October. This is consistent with the presumption that because of seasonal fluctuations of water temperatures, loggerhead, Kemp's ridley, and green sea turtles only occur in the action area during this time period. As sea turtles are only likely to occur in the action area from June through October, it is reasonable to anticipate that impacts of the OCNGS on listed species will only be observed from June through October. The majority of sea turtles have been collected in July, followed by September. This may be reflective of the migratory nature of these species as they move up the coast in early summer and move back down the coast in the fall. There does not seem to be any discernible pattern in month by month species distribution.

More Kemp's ridleys are caught at OCNGS than loggerheads and greens, which is noteworthy, as there are thought to be more loggerheads than Kemp's ridleys in New Jersey waters. Kemp's ridleys may be more likely to become impinged in the intake structures due to their physiology and behavioral characteristics. Swimming efficiency is likely related to the size of a turtle, with larger turtles having a stronger swimming ability than smaller turtles. As such, it is possible that because the Kemp's ridleys and greens found impinged at OCNGS are generally smaller than the loggerheads they were not able to effectively escape the intake velocity. Of the 41 turtles found at OCNGS from 1992 to 2006, 26 of these turtles were found alive, and 15 were dead. Of the 10 loggerheads taken, 8 were alive at the time of the take. The remaining 2 turtles had necropsies completed which indicated that the loggerheads died prior to becoming impinged on the intakes. Of the 4 green sea turtles, only 1 was dead. While necropsy results are not available for this turtle, the lack of apparent injury or infection suggest it likely drowned or suffocated due to impingement. Of the 26 Kemp's ridleys taken to date, 12 were dead when removed from the intakes. Necropsies conducted on 2 Kemp's ridleys indicate they likely died prior to impingement on the intakes. Of the 10 remaining dead Kemp's ridleys, necropsy results

confirmed that 2 died from suffocation or drowning at the intakes. The lack of noticeable injury or signs of decomposition suggest that 7 additional Kemp's also died from suffocation or drowning at the intakes. The remaining turtle was partially decomposed when removed from the intakes, suggesting that it died prior to becoming impinged. This information suggests that once at the intakes, Kemp's ridleys are more susceptible to death due to drowning or suffocation than loggerhead or green sea turtles.

The ability of a given turtle to swim against the current at either the CWS or DWS intake and the condition at time of capture could depend on the species, size, relative health of each individual, or the particular conditions associated with each take (e.g., water temperature, duration of submergence time, etc.). Kemp's ridleys cannot survive underwater as long as other sea turtle species, as they have been found to drown faster in trawl nets compared to other species (Magnuson et al. 1990). A turtle weakened by disease or injured by a boat strike would be more susceptible to impingement if the velocity at the intake is a factor in the likelihood of impingement. Many of the sea turtles found impinged on the intake trash bars at OCNGS have previously been victims of collision with propellers. In several cases the wounds appear to be fresh, which may be a contributing factor to the impingement, as the sea turtle would be weak.

The 10 individual loggerhead turtles incidentally captured at OCNGS had an average straight carapace length (SCL) of 43.05 cm. The 26 Kemp's ridleys and 4 green turtles had an average SCL of 27.8 cm and 29.8 cm, respectively. As discussed above, smaller sea turtles are subject to a greater amount of stress if caught in an intake, as they have a lower swimming ability. The smaller size of the Kemp's ridley sea turtles found at OCNGS in combination with the increased susceptibility to drowning noted by Magnuson et al. (1990) may explain why this species seems to be more vulnerable to death at the intakes than the other species.

As noted above, sea turtles have been collected and impinged at both the CWS and DWS intakes. Of the 41 sea turtles collected from 1992 to 2004, 25 (61%) have occurred at the DWS intake and 16 (39%) at the CWS intake. From 1992 to 2006, 6 of 10 loggerheads (60%) captured at OCNGS have been retrieved from the CWS intake, while only 9 of the 26 Kemp's ridleys (35%) have been found at the CWS intake. The loggerheads incidentally captured have been generally larger than the Kemp's ridleys, and the larger size of the loggerheads could result in more efficient swimming ability, allowing the animal to move around the floating ice/debris barrier and end up at the CWS intake. If Kemp's ridley and green turtles were found close to the surface and lacking the swimming ability or strength to dive beneath the floating ice/debris barrier, they would be channeled to the DWS intake. These species' prey are typically found on the bottom (e.g., crustaceans, marine grasses), which would suggest that they would not be on the surface if they were foraging.

Of the 15 dead sea turtles, 14 have been found at the DWS, with 56% of the sea turtles found at the DWS dead. This compares to approximately 6% of the sea turtles at the CWS found dead. This difference may be attributable to a number of factors but is most likely related to the presence of the debris/ice barrier which diverts floating debris away from the CWS intake and towards the DWS intake. A turtle that swims or drifts on the surface toward the OCNGS intakes

may be turned towards the DWS by the floating wooden debris/ice barrier. The orientation of the barrier may result in turtles at the surface being funneled toward the DWS. However, there are gaps on either end which a turtle could easily swim through and the barrier only extends 2 feet below the surface, so a healthy turtle could easily swim under the barrier and turn left towards the CWS intake. Additionally, the intake velocity at the DWS is considerably higher than that of the CWS intake. This could make it more difficult for sea turtles to free themselves from the trash bars and increase the likelihood of drowning once impinged. The presence of a greater amount of grasses and other debris at the DWS may also make it more difficult for sea turtles to free themselves from the trash bars and may make it more difficult for plant personnel to spot sea turtles here and remove them from the trash bars in time to prevent drowning. More Kemp's ridleys and greens have been found at the DWS than loggerheads, as these species have been found to have an overall smaller average carapace length than the loggerheads, they may be more susceptible to drowning due to their smaller size and lower swimming ability, especially when stressed. It is also likely that any previously dead sea turtles that float into the area would be diverted to the DWS intake and be discovered there.

As noted above, not all of the dead sea turtles collected at OCNGS died as a result of the operation of the facility. However, as only some of the dead sea turtles have been necropsied, it is difficult to definitively determine the cause of death for many of these turtles. As explained above, of the 15 dead sea turtles, necropsy results indicated that 4 of the sea turtles were dead prior to becoming impinged. Signs of decomposition and injury suggest that an additional 2 sea turtles may also have been dead prior to becoming impinged. The cause of death for the other 9 sea turtles is likely suffocation or drowning at OCNGS, with 2 of these confirmed by necropsy.

In addition to injury and mortality, impingement at the OCNGS intake could result in the interruption of migration and the eventual loss of nesting opportunities. Sea turtles migrate to northeastern waters when the waters warm in the late spring and early summer, returning south in the late fall. While turtles may be in the action area for foraging purposes, it is possible that turtles are migrating through the area in the spring on their way to more suitable foraging habitats in the Northeast, or in the fall on their way to overwintering areas. If interactions at the OCNGS impedes normal behaviors, this would affect typical sea turtle migration and/or foraging patterns. Most of the sea turtles found at OCNGS are juveniles and are not yet partaking in nesting. However, if impingement results in mortality, these animals would not nest in the future and would not subsequently contribute to the population.

The proposed action, renewal of the Operating License for the OCGNS for an additional 20 years, will not cause any operational changes at the CWS or DWS intakes that are likely to cause a different rate of impingement or capture of sea turtles than has been observed in the past. As noted above, the number of sea turtles in the action area is likely variable each year depending on environmental factors such as water temperature, weather patterns and prey availability and may also be related to dredging and shoaling actions in Barnegat Bay. Based on the best available information, NMFS anticipates that up to 8 sea turtles are likely to be impinged or collected at the OCNGS intakes each year. The majority of these sea turtles are likely to continue to be Kemp's ridleys; and, in some years, as was seen in 2004, all of the sea turtles at

OCNGS may be Kemp's ridleys. It is likely, based on past observations, that zero to 1 green sea turtle is likely to be collected at OCNGS each year and up to 2 loggerheads will be collected. However, NMFS anticipates that no more than 8 sea turtles will be impinged on the intakes or observed swimming in the intake bays and removed from the water.

Based on the observation of sea turtles captured at the facility in the past, it is likely that nearly all of the sea turtles captured will suffer from some degree of injury, likely abrasions and bruising, due to interactions with the trash bars. However, if rescued alive, these injuries are not expected to be life threatening and sea turtles are expected to make a complete recovery.

NMFS anticipates that sea turtles will continue to die due to suffocation and drowning caused by impingement on the trash bars. Based on numbers of sea turtles observed at OCNGS in the past, up to 3 dead sea turtles are likely to be removed from the facility each year. Over the license period, the majority of these dead sea turtles are likely to be Kemp's ridleys and in some years it is likely that all of the dead sea turtles will be Kemp's ridleys; however, in any year, up to 2 of these dead sea turtles may be loggerheads and 1 may be a green sea turtle. While NMFS recognizes that some number of previously dead sea turtles may become impinged on the intake trash bars each year, the difficulty in definitively determining a cause of death and the inconsistency in the applicant's ability to obtain necropsy results for dead sea turtles, makes it difficult to accurately predict the number of previously dead sea turtles that will become impinged on the intakes each year. As such, NMFS anticipates that the 3 dead sea turtles may, in some years, include sea turtles that died prior to becoming impinged on the OCNGS intakes.

Based on the analysis above, NMFS anticipates that over the course of the 20 year life of the license, up to 160 sea turtles may be impinged or removed from the intake area, with up to 60 of these sea turtles being dead.

Effects on Prey

Significant numbers of aquatic organisms besides sea turtles are also impinged at the CWS and DWS intakes and large volumes of small organisms are entrained at both intakes. It has been hypothesized that sea turtles are attracted to the intakes due to the high concentration of sea turtle forage items, particularly blue crabs, horseshoe crabs and sea grasses, which are found at the intakes.

In addition to concentrating sea turtle forage items at the intakes, the operation of the OCNGS intakes causes a large number of potential sea turtle prey items to be lost each year. Several of the species subject to impingement and entrainment at the OCNGS are potential prey for sea turtles, including blue crabs, hard clams and several shrimp species. Recent data on rates of impingement and entrainment are not available. However, studies reviewed by the NJ DEP (NJDEP draft NPDES permit 2005) indicate that the equivalent of 59,000 adult hard clams and 10,400 blue crabs are lost to impingement and entrainment each year. This represents a large number of organisms that are no longer available for sea turtles to prey upon in the action area. In addition to clams and crabs, several million shrimp and fish are also subject to impingement and entrainment at the facility each year. While the OCNGS causes the death of many thousands

of potential sea turtle forage items each year, the effect of this loss of prey on sea turtles in the action area is unknown; however, there is no evidence that sea turtles in the action area are affected by a reduction in the availability of forage items. For example, sea turtles removed from the intakes display no evidence of starvation or other indications of a lack of quality forage. Additionally, if sea turtles were limited by available forage items in the action area, it is likely that numbers of sea turtles at the OCNGS would be decreasing when in fact the numbers show an increasing trend. Based on the best available information, while the OCNGS reduces the amount of sea turtle forage items available for sea turtles in the action area, this loss appears to be insignificant to sea turtles in the action area.

Effects on Water Quality

The water quality of effluents discharged from the OCNGS is regulated through the New Jersey Pollution Discharge Elimination System (NJPDES) program. The NJDPES permit specifies the discharge standards and monitoring requirements for each discharge. Under this regulatory program, AmerGen treats wastewater effluents, collects and disposes of potential contaminants, and undertakes pollution prevention activities.

The NJPDES permit for this facility was last issued in 1994. This permit expired in 1999 and has been administratively extended each year. A draft permit was submitted for public comment in July 2005. To date, no action has been taken on the draft permit and the facility is still operating under the terms of the 1994 permit. As such, the effects of the OCGNS continuing to operate under the terms of the 1994 permit will be discussed below.

Impacts of chlorine used at the OCNGS

Low level, intermittent chlorination is used to control biofouling in the OCNGS service water system and circulating water systems. The main condenser cooling water is chlorinated for a maximum of two hours per day. The permitted maximum daily concentration of chlorine discharge is 0.2 mg/l or a maximum daily chlorine usage of 41.7 kg/day. The NRC has stated that the chlorine demand in the main condenser discharge consumes almost all remaining free chlorine and results in very little chlorine being released to the discharge canal (approximately 0.1 mg/l). The DWS does not have any chlorine discharges.

Chemical contaminants have been found in the tissues of sea turtles from certain geographical areas. While the effects of chemical contaminants on turtles are relatively unclear, they may have an effect on sea turtle reproduction and survival. Chemical contaminants may also affect the immune system, making sea turtles more susceptible to disease and other stresses. There is no information available on the effects of chlorination on sea turtles. It is also unknown as to whether the sea turtles impinged at OCNGS had appreciable levels of chlorine in their tissues. The necropsies conducted on the sea turtles found at the OCNGS did not assess the levels of contaminants in the tissue.

There are a number of studies that have examined the effects of Chlorine Produced Oxidants (also referred to as Total Residual Chlorine or TRC) on aquatic life (Post 1987; Buckley 1976); however, no directed studies that have examined the effects of CPO on sea turtles have been

conducted. The EPA has set the Criteria Maximum Concentration[3] for exposure to chlorine at 0.019mg/L.

As noted above, the daily maximum "end-of-pipe" concentration (i.e., the concentration of TRC in the effluent as it discharges into the receiving water) allowed by the permit is 0.2mg/L. The anticipated TRC level at the point of discharge is significantly higher than EPA's ambient water quality criteria and higher than chlorine levels known to be protective of aquatic life. The chlorinated water is mixed with unchlorinated water from the DWS system at the point of discharge and is rapidly diluted before it enters Barnegat Bay, the area where the highest number of sea turtles are likely to be present. It is also important to note that elevated chlorine levels are not known to occur at the CWS and DWS intakes where sea turtles are likely to be present for extended periods of time, but only at the discharges where sea turtles have not been observed. Based on the best available information, due to the rapid dilution of chlorinated effluent, the level of chlorination at the OCNGS is believed to have an insignificant effect on sea turtles in the action area.

The chlorine discharge may also have an effect on sea turtle forage items. Chlorine is used in the plant as a biocide, and the discharge of this chemical could kill sea turtle forage items or cause them to leave the area, thus reducing the number available to sea turtles. However, as explained above, there is no indication that sea turtles in the action area are limited by the amount of available forage. Additionally, blue crabs, one of the main forage items for sea turtles in the action area, are relatively insensitive to chlorine levels. For example, EPA has reported LC50 levels for blue crabs of 0.7 – 0.86mg/L (EPA 1986). Based on the best available information, while the discharge of chlorinated effluent may affect individual sea turtle forage items, the level of chlorination at the OCNGS is believed to have an insignificant effect on the ability for sea turtles to forage successfully in the action area.

Heated Effluent

Heated condenser cooling water discharged from the CWS and ambient temperature intake canal water discharged from the DWS meet and mix in the discharge canal and are returned to Barnegat Bay via this canal. This process results in heated discharge water mixing with the ambient water and elevating the normal water temperatures. The NJPDES permit for this facility limits the discharge of heated effluent to an instantaneous maximum of 41.1°C or 12.8°C above ambient. The temperature rise of the CWS discharge is typically about 11°C above ambient canal temperatures, while the DWS discharge is approximately 5.6^{o}C above ambient water temperatures when two dilution pumps are operating.

The impacts of the thermal plume in Barnegat Bay appear to be on the surface and relatively small, thus reducing the potential for negative affects to sea turtles. The cooling water discharged from OCNGS has been studied on several occasions to determine the distribution, geometry, and dynamic behavior of the thermal plume (OCNGS 2000). While the discharge temperature near OCNGS is high, the turbulent dilution mixing produces rapid temperature

3 CMC or acute criteria; defined in 40 CFR 131.36 as equals the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time (up to 96 hours) without deleterious effects

reductions. Little mixing with the heated discharge and ambient water occurs in Oyster Creek from the site of the discharge to the Bay, because of the relatively short residence time and the lack of turbulence or additional dilution. However, in Barnegat Bay, temperatures are rapidly reduced when mixing with ambient temperature Bay water occurs as well as heat rejection into the atmosphere. In Barnegat Bay, the plume occupies a relatively large surface area (estimated to be less than 1.6 km in an east-west direction by 5.6 km in a north-south direction, under all conditions) and in general, elevated temperatures do not extend to the bottom of the Bay except in the area immediately adjacent to the mouth of Oyster Creek. While the plume in Barnegat Bay is on the surface, it may impact sea turtles as they are coming up for air.

Excessive heat exposure (hyperthermia) is a stress to sea turtles but is a rare phenomenon when sea turtles are in the ocean (Milton and Lutz 2003). As such, limited information is available on the impacts of hyperthermia on sea turtles. Environmental temperatures above 40°C can result in stress for green sea turtles (Spotila et al. 1997). Sea turtle eggs exposed to temperatures to temperatures above 38°C typically fail to hatch (Bustard and Grehan 1967). As noted above, the daily maximum "end-of-pipe" temperature is 41.1°C. However, the maximum temperatures recorded in the discharge canal were 38°C during a dilution pump failure event in 2002. It is also important to note that elevated temperature is not known to occur at the CWS and DWS intakes where sea turtles are likely to be present for extended periods of time, but only at the discharges where sea turtles have not been observed. Based on the best available information, the discharge of heated effluent may affect sea turtles by attracting them to the area or increasing the amount of potential prey but does not likely cause any injury or mortality.

While sea turtles will not likely be killed by the elevated temperatures, temperature increases may affect normal distribution and foraging patterns. The thermal effluent discharged from the plant into Oyster Creek may represent an attraction for turtles. If turtles are attracted into Oyster Creek by this thermal plume, they could remain there late enough in the fall to become cold-stunned when they finally travel into Barnegat Bay at the start of their southern migration. Cold stunning occurs when water temperatures drop quickly and turtles become incapacitated. The turtles lose their ability to swim and dive, lose control of buoyancy, and float to the surface (Spotila et al. 1997). If sea turtles are concentrated around the heated discharge or in surrounding waters heated by the discharge (e.g., Oyster Creek or Barnegat Bay) and move outside of this plume into cooler waters (approximately less than 8-10°C), they could become cold stunned.
However, existing data from OCNGS and other power plants in the NMFS Northeast Region do not support the concern that warm water discharge may keep sea turtles in the area until surrounding waters are too cold for their safe departure. Data reported by the STSSN indicate that cold-stunning has occurred around mid-November in New York waters. No incidental captures of sea turtles have been reported at the OCNGS later than October, with the minimum recorded temperature at time of capture of 11.8°C, suggesting that sea turtles leave the action area before cold-stunning could potentially occur.

While cold stunning could still occur given the heated discharge and the water temperatures in New Jersey during certain times of the year (e.g., less than 10°C), NRC has identified certain

aspects of the OCNGS discharge that may make cold stunning less likely to occur. For example, the area where sea turtles could overwinter (and encounter acceptable water temperatures) is limited to the small area around the condenser discharge, prior to any mixing with the DWS flow. Winter water temperatures in the discharge canal, downstream of the area where the DWS and CWS flows mix, routinely fall below 7.2^{o}C. These temperatures in the discharge canal would not be suitable for sea turtle survival. Sea turtles generally are found in water temperatures greater than 10°C, but have occasionally been documented in colder waters. For example, in March 1999, a live loggerhead sea turtle was observed taken on a monkfish gillnet haul in North Carolina, in a water temperature of 8.6^{o}C. In any event, during the winter, the area where the water temperatures would be suitable for sea turtles is small and localized. Based on the best available information, there is no evidence that the discharge of heated effluent increases the vulnerability of sea turtles in the action area to cold stunning.

Effect on Sea Turtle Prey

Cold shock mortalities of fish have occurred at OCNGS when water temperatures have decreased in the fall. There is no evidence that sea turtles have been adversely affected by any mass mortality of fish or that sea turtle prey have been impacted by cold shock events. The number and severity of these events have been reduced as a result of the operation of the two dilution pumps in the fall, when ambient water temperatures began to drop, to decrease the attractiveness of the discharge canal as overwintering habitat. As mentioned, cold stunning of sea turtles has not been documented at OCNGS, but the measures to reduce cold shock mortalities of fish would also help reduce the potential for cold stunning of sea turtles.

Heat shock events have also been recorded at OCNGS. For example, on September 23, 2002, 5876 fish were killed. NRC reports that the mortality was attributed to heat shock because of an accidental shutdown of the dilution pumps during a routine electrical maintenance procedure. During that event, the water temperature in the discharge canal rose from approximately 32.8°C to 38.3°C within 3 hours of pump shutdown and the temperature at this location remained at 37.8°C for several hours until the dilution pump operation was restored. High temperatures recorded during this event are the highest temperatures on record for the action area. There is no evidence that any sea turtles were in the impact area during this event.

The thermal discharges from OCNGS may influence the distribution and survival of sea turtles' primary prey resources. Blue crab and horseshoe crab are found in the canal, generally during the warmer months, but the effect of the heated effluent on the distribution of these species is uncertain. Crustaceans may move elsewhere when conditions are unfavorable (e.g., elevated water temperatures), but there is no information at this time suggesting that this has occurred at OCNGS. It is probable that when sea turtles are foraging in the summer, the heated effluent will not have as great of an impact on the turtles as it would in the winter. Furthermore, the New Jersey DEP evaluated the impact of the OCNGS thermal plume on Barnegat Bay and concluded that the effects on fish distribution and abundance were small and localized (Summers et al. 1989 in OCNGS 2000). Thus, it appears that the preferred prey of loggerhead, Kemp's ridleys, and greens are impacted insignificantly, if at all, by the thermal discharge from OCNGS and that there are no significant impacts on the ability of sea turtles to forage due to this discharge.

CUMULATIVE EFFECTS

Cumulative effects, as defined in 50 CFR 402.02, are those effects of future state or private activities, not involving federal activities that are reasonably certain to occur within the action area of the federal action subject to consultation. 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.

Natural mortality of sea turtles, including disease (parasites), predation, and cold-stunning, occurs in mid-Atlantic waters. In addition to impingement in the OCNGS intakes, sources of human-induced effects on turtles in the action area include incidental takes in state-regulated fishing activities, vessel collisions, ingestion of plastic debris, and pollution. While the combination of these unrelated, non-federal activities in Barnegat Bay may adversely affect populations of endangered and threatened sea turtles.

NMFS believes that the fishing activities in Barnegat Bay will continue in the future, and as a result, sea turtles will continue to be impacted by fishing gear used in the action area. Throughout their range, sea turtles have been taken in different types of gear, including gillnet, pound net, rod and reel, trawl, pot and trap, longline, and dredge gear. Thus, it is likely that commercial and recreational fisheries in the action area will continue to impact sea turtles, albeit to an unknown extent.

Commercial and recreational vessels colliding with sea turtles will also continue in the future, and sea turtles will continue to be injured or killed from these interactions. Fifty to 500 loggerheads and 5 to 50 Kemp's ridley turtles are estimated to be killed by vessel traffic per year in the U.S. (National Research Council 1990). Although some of these strikes may be post-mortem, the data show that vessel traffic is a substantial cause of sea turtle mortality. As turtles will likely be in the area where high vessel traffic occurs, the potential for collisions with vessels transiting these waters exists. The MMSC in Brigantine, New Jersey, reports an increase in the number of turtles hit by boats in New Jersey inshore and nearshore waters, as determined from sea turtle stranding records.

Twenty-eight percent of the land around Barnegat Bay is developed. In the future, a larger amount of the watershed will likely be developed because Barnegat Bay supports a thriving tourist industry and more individuals are moving to the coast in general. An increase in boating, fishing, and general use of the Bay is also likely to occur. With this increase in development and utilization of the Bay, there is a greater potential for debris and pollutants to enter the waters of the action area. Sea turtles will continue to be impacted by pollution in the Bay and any increase in debris or pollutants would exacerbate this effect. 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. Storm water runoff and other sources of nonpoint source pollution may result in the waters containing chemical contaminants. The Barnegat Bay estuary may be more susceptible to toxic chemical contaminants than may other estuaries because of its limited dilution capacity and flushing rate (Barnegat Bay Estuary Program 2001). Chemical

contaminants may have an effect on sea turtle reproduction and survival, but the impacts are still relatively unclear.

INTEGRATION AND SYNTHESIS OF EFFECTS

NMFS has estimated that the proposed action, the renewal of the Operating License for the OCNGS for twenty years, is likely to result in the collection of up to 8 sea turtles a year due to impingement on the CWS and DWS intakes and capture by plant personnel. The sea turtles captured at the facility are likely to be loggerhead, Kemp's ridley and green sea turtles. All of the sea turtles removed from the intakes are likely to have been injured due to interactions with the trash bars. NMFS expects that no more than 2 of the sea turtles annually will be loggerheads (1 dead) and no more than 1 annually will be green (alive or dead). Further, NMFS anticipates that no more than 3 of Kemp's ridleys will be dead. As explained in the "Effects of the Action" section, effects of the facility on sea turtle prey items and the effect of the discharge of pollutants, including chlorine and heat, will be insignificant or discountable.

Kemp's ridley sea turtles. Kemp's ridleys are endangered throughout their entire range. As explained in the "Effects of the Action" section, NMFS has estimated that up to 8 Kemp's ridley sea turtles are likely to be collected, impinged and injured at the OCNGS each year, with no more than 3 dead Kemp's ridleys at the plant annually. The death of up to 3 Kemp's ridleys every year will reduce the number of Kemp's ridleys as compared to the number of Kemp's ridleys that would have been present in the absence of the proposed action. This level of capture, injury and mortality is likely to occur annually throughout the 20 year license period.

The most recent population estimate for Kemp's ridleys indicates that there were approximately 3,000 adults in 1995. While more recent population estimates do not exist, the size of the population is thought to be increasing, or at least stable, and as the 1995 estimate includes only adults, the size of the total population is likely significantly higher than 3,000. The action may injure up to 8 Kemp's ridleys a year and may kill up to 3 Kemp's ridleys a year, for a total of up to 160 injured and up to 60 killed over the twenty year life of the license. The loss of 3 Kemp's ridleys annually, or up to 60 over 20 years, represents a very small percentage of the species as a whole and is unlikely to have a detectable effect on the numbers or reproduction of Kemp's ridleys. While the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species, in general this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of Kemp's ridleys because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of Kemp's ridleys is likely to be increasing and at worst is stable.

This action is not likely to reduce distribution of Kemp's ridleys because the action will only temporarily disrupt migratory behaviors. In addition, as the action is not likely to have a detectable effect on the numbers or reproduction of Kemp's ridleys, it is unlikely to affect the distribution of sea turtles in U.S. waters or throughout the range of the species. For these

reasons, NMFS believes that there is not likely to be any detectable reduction in reproduction and distribution and only a small decrease in the numbers of Kemp's ridleys in the U.S. Atlantic. As such, there is not likely to be an appreciable reduction in the likelihood of survival and recovery in the wild of this species.

Loggerhead sea turtles. Loggerheads are threatened throughout their entire range. This species exists as five subpopulations in the western Atlantic that show limited evidence of interbreeding. As noted in the "Status of the Species" section (see p. 17), loggerheads in the action area are likely to be from the northern nesting subpopulation. Although the northern nesting subpopulation produces about 9 percent of the total loggerhead nests, they comprise more of the loggerhead sea turtles found in foraging areas from the northeastern U.S. to Georgia: between 25 and 59 percent of the loggerhead sea turtles in this area are from the northern subpopulation (Sears 1994, Norrgard 1995, Sears et al. 1995, Rankin-Baransky 1997, Bass et al. 1998). The northern subpopulation may be experiencing a significant decline (2.5 - 3.2% for various beaches) due to a combination of natural and anthropogenic factors, demographic variation, and a loss of genetic viability.

As explained in the "Effects of the Action" section, NMFS has estimated that up to 2 loggerhead sea turtles are likely to be captured or impinged and injured annually at the OCNGS, with no more than 1 dead loggerhead turtle at the facility annually, for a total of up to 40 injured and up to 20 killed over the twenty year life of the license.

The death of 1 loggerhead every year, or up to 20 over 20 years, will reduce the number of loggerheads from the respective subpopulation as compared to the number of loggerheads that would have been present in the absence of the proposed action. The deaths of these loggerheads would have the most impact if these turtles were all juvenile females from the northern subpopulation. While nearly all of the loggerheads affected by this action are likely to be juveniles, they are not all likely to be females from the northern subpopulation as not all of the turtles killed will be females and only 25-59% of the loggerheads in the action area are likely to be from the northern subpopulation. Based on the information outlined above, it is likely that less than half of the turtles in the action area will be from the south Florida subpopulation and the remainder from the northern Florida and Yucatan subpopulations.

There are at least five western Atlantic loggerhead subpopulations (NMFS SEFSC 2001; TEWG 2000; Márquez 1990). As noted above, cohorts from three of these populations, the south Florida, Yucatán, and northern subpopulations, are likely to occur in the action area for this consultation. The south Florida nesting group is the largest known loggerhead nesting assemblage in the Atlantic and one of only two loggerhead nesting assemblages worldwide that has greater than 10,000 females nesting per year (USFWS and NMFS 2003; USFWS Fact Sheet). Annual nesting totals have ranged from 48,531 - 83,442 annually over the past decade (USFWS and NMFS 2003). The northern subpopulation is the second largest loggerhead nesting assemblage within the U.S. but much smaller than the south Florida nesting group. The number of nests for this subpopulation has ranged from 4,370 - 7,887 for the period 1989-1998, for an average of approximately 1,524 nesting females per year (USFWS and NMFS 2003). The

Yucatán nesting group was reported to have had 1,052 nests in 1998 (TEWG 2000).

While reliable estimates of the total size of either subpopulation do not exist, as each subpopulation also includes juveniles and males, the size of each subpopulation is likely to be significantly larger than the number of nesting females.

The loss of 1 loggerhead every year, or up to 20 over the 20 year license, from any subpopulation represents a very small percentage of either the subpopulation or the species as a whole and is unlikely to have a detectable effect on the numbers or reproduction of the affected subpopulation. While the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species, in general this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of loggerheads because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, and in the case of the northern and south Florida subpopulations there are thousands of nesting females.

This action is not likely to reduce the distribution of loggerheads because the action will only temporarily disrupt migratory behaviors. In addition, as the action is not likely to have an appreciable effect on the numbers or reproduction of loggerheads, it is not likely to affect the distribution of sea turtles in the five subpopulations or throughout the range of the species. For these reasons, NMFS believes that there is not likely to be any reduction in reproduction and distribution and only a small decrease in the numbers of loggerheads in the western Atlantic subpopulations. As such, there is not likely to be an appreciable reduction in the likelihood of survival and recovery in the wild of the western Atlantic subpopulations or the species as a whole.

Green sea turtles. Green sea turtles are endangered throughout their entire range. As explained in the "Effects of the Action" section, NMFS has estimated that 1 green sea turtle is likely to be impinged or captured and injured or killed at the OCNGS each year, and up to 20 greens are likely to be injured or killed over the 20 year license period. The death of 1 green every year, or up to 20 over 20 years, will reduce the number of greens as compared to the number of greens that would have been present in the absence of the proposed action. This level of capture, injury and mortality is likely to occur annually throughout the 20 year license period.

Recent population estimates for the western Atlantic area are not available. However, the pattern of green turtle nesting shows biennial peaks in abundance, with a generally positive trend during the ten years of regular monitoring since establishment of index beaches in 1989. There is cautious optimism that the green sea turtle population is increasing in the Atlantic. For purposes of this consultation, NMFS will assume that the green sea turtle population is increasing (best case) or at worst is stable. The loss of 1 green sea turtle annually, and up to 20 over 20 years, represents a very small percentage of the species as a whole and is unlikely to have a detectable effect on the numbers or reproduction of greens. While the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers,

reproduction and distribution of the species, in general this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of greens because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of greens is likely to be increasing and at worst is stable.

This action is not likely to reduce the distribution of greens because the action will only temporarily disrupt migratory behaviors. In addition, as the action is not likely to have an appreciable effect on the numbers or reproduction of greens, it is not likely to affect the distribution of sea turtles throughout the range of the species. For these reasons, NMFS believes that there is not likely to be any reduction in reproduction and distribution and only a small decrease in the numbers of greens in the US Atlantic. As such, there is not likely to be an appreciable reduction in the likelihood of survival and recovery in the wild of the species as a whole.

If NRC did not renew the OCNGS Operating License, AmerGen would cease plant operations by the end of the current license (April 9, 2009) and initiate decommissioning of the plant. Decommissioning would involve removal of the intake structures and the elimination of water withdrawals and discharges. As such, if the Operating License was not renewed and the plant was decommissioned, the potential for direct and indirect effects on sea turtles would be eliminated. NRC has indicated that should the license not be renewed there would be a need for the development of an alternate source of electricity for the power users. To fill the energy deficit created by the decommissioning of the OCNGS, the site could be redeveloped as a coal-fired, natural-gas-fired or new nuclear power plant. Any of these types of plants could also be constructed at an alternative site. The magnitude of impacts to NMFS listed species would be determined by the type and location of any alternative facility and would have to be analyzed based on the particulars of the plan. As such, it is not possible to predict the impacts of redeveloping the OCNGS facility or an alternate site on threatened and endangered species under NMFS jurisdiction.

CONCLUSION

After reviewing the best available information on the status of endangered and threatened species under NMFS jurisdiction, the environmental baseline for the action area, the effects of the proposed action, interdependent and interrelated actions and the cumulative effects, it is NMFS' biological opinion that the proposed action may adversely affect but is not likely to jeopardize the continued existence of the loggerhead, Kemp's ridley or green sea turtles. No critical habitat is designated in the action area; therefore, none will be affected by the proposed action.

In the Incidental Take Statement accompanying this BO (see page 48), NMFS has determined that removal of sea turtles from the water and transfer of these sea turtles to an appropriate STSSN facility (such as the MMSC) is necessary and appropriate to ensure that sea turtles are monitored, rehabilitated and treated as necessary and that they are released back into the wild at

a suitable location. The effects of holding and transfer to the facility on listed species in the action area are outlined below.

Effects of holding and relocation to MMSC as required by the Incidental Take Statement
NMFS has estimated that up to 8 sea turtles are likely to be captured at the OCNGS annually. While removal from the water, taking measurements, holding the sea turtles and transferring the turtles to a rehabilitation facility will cause stress and temporarily disrupt normal foraging and migratory behaviors, once released into the wild these turtles are likely to rapidly resume normal behaviors. Sea turtles are typically transferred to MMSC within a couple of hours of capture. Only 1 sea turtle (a Kemp's ridley) has died at MMSC after transfer from OCNGS and a necropsy indicated that the sea turtle died from injuries and infection sustained prior to impingement at the intakes. NMFS has no information to suggest that the handling and transfer of sea turtles to a facility such as MMSC will have any significant adverse effects on sea turtles. Removal of sea turtles from the water at the OCNGS intakes will ensure that these turtles are not subject to additional injury or eventual death at the intakes and that they will be released into the wild at a suitable location. Additionally, the transfer of sea turtles to an appropriate facility ensures that any sea turtles needing medical attention can be properly cared for. Two sea turtles removed from OCNGS have been eventually sent to a rehabilitation center in Topsail, North Carolina for surgery to repair injuries either sustained at OCNGS or prior to impingement. As such, NMFS believes that the removal of sea turtles from the water at OCGNS and the transfer of these turtles to an appropriate stranding facility will have a net beneficial effect to these turtles.

Synthesis of effects of transfer to rehabilitation facility and other required monitoring activities
NMFS has estimated that 8 sea turtles are likely to be impinged or captured at the OCNGS intakes each year. Of these sea turtles, up to 3 may already be dead when they are removed from the water; however, in some years all of the sea turtles captured or impinged have been alive. NMFS anticipates that up to 8 sea turtles a year will be removed from the water, measured, weighed, held and transferred to an appropriate STSSN facility, such as the MMSC. While the measuring of sea turtles will cause additional handling of these individuals and may cause stress, this is likely to be temporary and there are no known lasting effects of taking these measurements. The holding of sea turtles and transport to a stranding facility will temporarily disrupt normal foraging and migratory behaviors; however, once returned to the wild these turtles are likely to rapidly resume normal behaviors. As such, the holding, measuring, handling and transfer of live sea turtles is not likely to have a significant adverse effect on these sea turtles. The handling, measuring and transfer of dead sea turtles will not have any additional effects on these turtles as they are already dead.

Kemp's ridley sea turtles
As noted above, NMFS has determined that the capture or impingement of up to 8 Kemp's ridley sea turtles annually over the course of the 20 year license, including the death of up to 3 of these turtles each year, is not likely to jeopardize the continued existence of this species. No additional deaths are likely to be attributable to measuring, handling or transfer. As explained

above, the measuring, handling and transfer is not likely to cause any long lasting or significant adverse effects to these turtles and is likely to have a net beneficial effect.

Loggerhead sea turtles
As noted above, NMFS has determined that the capture or impingement of up to 3 loggerhead sea turtles annually over the course of the 20 year license, including the death of 1 of these turtles each year, is not likely to jeopardize the continued existence of this species. No additional deaths are likely to be attributable to measuring, handling or transfer. As explained above, the measuring, handling and transfer is not likely to cause any long lasting or significant adverse effects to these turtles and is likely to have a net beneficial effect.

Green sea turtles
As noted above, NMFS has determined that the capture, impingement or death of 1 green sea turtle annually over the course of the 20 year license is not likely to jeopardize the continued existence of this species. No additional deaths are likely to be attributable to measuring, handling or transfer. As explained above, the measuring, handling and transfer is not likely to cause any long lasting or significant adverse effects to these turtles and is likely to have a net beneficial effect.

Conclusion of effects of holding and relocation
After reviewing the best available information on the status of endangered and threatened species under NMFS jurisdiction, the environmental baseline for the action area, the effects of the action, and the cumulative effects, it is NMFS' biological opinion that the monitoring, holding and relocation of sea turtles required by the Incidental Take Statement will have the beneficial effect of ensuring that these sea turtles are properly cared for and released back into the wild at a suitable location. Adding these procedures to the overall project is not likely to jeopardize the continued existence of the Kemp's ridley, loggerhead, or green sea turtles. Because no critical habitat is designated in the action area, none will be affected. NMFS has determined that the proposed action of renewing the operating license for the OCGNS and the measuring, holding and transfer of sea turtles as required by the Incidental Take Statement and the two actions together are not likely to jeopardize the continued existence of any threatened or endangered species. Overall, holding and relocation to an appropriate facility will be a net benefit to the sea turtles.

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 without special exemption. Take is defined 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 NMFS to include any act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), 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.

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

Amount or Extent of Take

The renewal of the operating license for the OCNGS will authorize the facility to continue operating for an additional 20 years. This action has the potential to directly affect Kemp's ridley, loggerhead and green sea turtles due to impingement at the CWS and DWS intakes. These interactions are likely to cause injury and/or mortality to the affected sea turtles. In addition, the removal of sea turtles from the water and transfer to a rehabilitation facility may cause stress and will disrupt the sea turtles normal foraging and migratory behaviors. Based on the distribution of sea turtles in the action area and information available on historic interactions between sea turtles and the OCNGS, NMFS anticipates that no more than 8 sea turtles are likely to be captured or impinged at the facility each year. NMFS anticipates that of these 8 sea turtles, no more than 3 of these turtles are likely to be loggerheads and no more than 1 of these sea turtles are likely to be a green. NMFS anticipates that up to 3 of these 8 sea turtles captured or impinged may be dead; of the dead sea turtles, no more than 1 is likely to be a green sea turtle and no more than 1 is likely to be a loggerhead. All of the sea turtles captured or impinged are likely to be injured due to interactions with the trash bars.

While the handling of decomposed turtles or turtle parts is considered to be a take, NMFS is most concerned with the takes that appear to be fresh dead sea turtles and therefore directly attributable to the operation of the OCNGS. NMFS recognizes that previously dead sea turtles may become impinged on the intakes at OCNGS and that some number of dead sea turtles taken at the facility may not necessarily be related to the operation of the facility itself. Due to the

difficulty in determining the cause of death of sea turtles found dead at the intakes and the inconsistency in the ability of NRC and the applicant to secure prompt necropsy results, the aforementioned anticipated level of take includes sea turtles that may have been dead prior to impingement on the OCNGS intakes.

NMFS believes this level of incidental take is reasonable given the seasonal distribution and abundance of these species in the action area, the level of take historically during dredging operations at projects nearby the action area, and the level of take of sea turtles during other relocation trawling operations. In the accompanying BO, NMFS determined that this level of anticipated take is not likely to result in jeopardy to the species.

In order to effectively monitor the effects of this action, it is necessary to examine the sea turtles that are captured at the facility. Monitoring provides information on the characteristics of the sea turtles encountered and may provide data which will help develop more effective measures to avoid future interactions with listed species. Additionally, as release of sea turtles back into the water at OCNGS is inappropriate as it would subject the sea turtles to additional stress and increase the likelihood of injury or mortality at the intakes, it is necessary to transfer the sea turtles to an appropriate STSSN facility. Currently, AmerGen has an agreement with the MMSC where upon capturing a sea turtle at the facility, AmerGen staff notifies MMSC and the turtle is transferred to MMSC care. NMFS believes that this procedure is necessary to effectively monitor the effects of the action and to ensure that the sea turtles are released back into the wild at an appropriate location. MMSC is authorized to care for, rehabilitate and release sea turtles pursuant to a Stranding Network Agreement and a permit issued by the USFWS pursuant to Section 10 of the ESA. As outlined below, NMFS is requiring NRC to ensure that AmerGen continue this arrangement with MMSC or another appropriate STSSN approved and permitted facility. However, as the handling and transport of sea turtles may affect individuals by subjecting them to extended holding times and stress, the effects of this action have been considered in the accompanying Opinion. In the Opinion, NMFS has determined that no more than 8 sea turtles annually (i.e., the total number likely to be captured during this action) are likely to be directly affected by measuring, holding and transport. Reasonable and prudent measures and implementing terms and conditions requiring this monitoring and transport are outlined below.

Reasonable and Prudent Measures
NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of endangered and threatened sea turtles:

1. OCNGS must implement a NMFS approved program to prevent, monitor, minimize, and mitigate the incidental take of sea turtles at the CWS and DWS intake structures.

2. All sea turtle impingements associated with the OCNGS and sea turtle sightings in the action area must be reported to NMFS.

3. All live sea turtles must be transported to an appropriate facility for necessary rehabilitation and release into the wild.

4. A necropsy of any dead sea turtles must be undertaken promptly to attempt to identify the cause of death, particularly whether the sea turtle died as a result of interactions with the intakes.

Terms and Conditions
In order to be exempt from prohibitions of section 9 of the ESA, NRC must comply with and ensure OCNGS complies with, the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. To implement RPM #1, the CWS and DWS (when operational) intake trash bars must be cleaned daily from June 1 to October 31.

    a. Cleaning must include the full length of the trash rack, i.e., down to the bottom of each intake bay. To lessen the possibility of injury to a turtle, the raking process must be closely monitored so that it can be stopped immediately if a turtle is sighted.

    b. Personnel must be instructed to look beneath surface debris before the rake is used to lessen the possibility of injury to a turtle.

    c. Personnel cleaning the racks must inspect all trash that is dumped to ensure that no sea turtles are present within the debris.

    d. An alternative method of daily cleaning of the full length of the trash racks must be developed for use between June 1 through October 31 when the trash rake is unavailable due to necessary repair or maintenance or is otherwise inoperable. If the trash rake will be inoperable for more than 24 hours, AmerGen or NRC must contact NMFS and explain what alternate arrangements have been made to ensure that the full length of the trash racks is cleaned at least once per 24 hours.

2. To implement RPM #1, inspection of CWS and DWS cooling water intake trash bars (and immediate area upstream) must continue to be conducted at least once every 4 hours (three times per 12-hour shift) from June 1 through October 31. NRC must ensure that inspections follow a set schedule so that they are regularly spaced rather than clumped. Inspections must occur at least three times during each 12 hour shift. A proposed schedule would be to schedule inspections 2 hours after the start of each shift and then every 4 hours during the shift. Times of inspections, including those when no turtles were sighted, must be recorded.

3. To implement RPM #1, lighting must be maintained at the intake bays to enable inspection personnel to see the surface of each intake bay and to facilitate safe handling of turtles which are discovered at night. Portable spotlights must be available at both the CWS and the DWS for times when extra lighting is needed.

4. To implement RPM #1, dip nets, baskets, and other equipment must be available at both the CWS and the DWS and must be used to remove smaller sea turtles from the OCNGS intake structures to reduce trauma caused by the existing cleaning mechanism. Equipment suitable for rescuing large turtles (e.g., rescue sling or other provision) must be available at OCNGS and readily accessible from the CWS and DWS.

5. To implement RPM #1, an attempt to resuscitate comatose sea turtles must be made according to the procedures described in Appendix II. These procedures must be posted in appropriate areas such as the intake bay areas for both the CWS and the DWS, any other area where turtles would be moved for resuscitation, and the CWS and DWS operator's office(s).

6. To implement RPM #1, OCNGS personnel must observe the canal area for sea turtles where and when possible (i.e., during the daylight hours). Any sea turtles sighted in the canal and in vicinity of OCNGS (not necessarily only near the intake structures) must be reported to NMFS within 24 hours of the observation (Pat Scida, Endangered Species Coordinator at (978) 281-9208 or FAX (978) 281-9394).

7. To implement RPM #2, if any live or dead sea turtles are taken at OCNGS, plant personnel must notify NMFS within 24 hours of the take (NMFS Endangered Species Coordinator at 978-281-9208). An incident report for sea turtle take (Appendix III) must also be completed by plant personnel and sent to the Endangered Species Coordinator via FAX (978-281-9394) within 24 hours of the take. Every sea turtle must be photographed. Information in Appendix IV will assist in identification of species impinged. All sea turtles that are sighted within the vicinity of OCNGS (including the intake and discharge structures) must also be recorded, and this information must be submitted in the annual report.

8. To implement RPM #2, an annual report of incidental takes must be submitted to NMFS by January 1 of each year. This report will be used to identify trends and further conservation measures necessary to minimize incidental takes of sea turtles. The report must include, as detailed above, all necropsy reports, incidental take reports, photographs (if not previously submitted), a record of all sightings in the vicinity of OCNGS, and a record of when inspections of the intake trash bars were conducted for the 24 hours prior to the take. The annual report must also include any potential measures to reduce sea turtle impingement or mortality at the intake structures. This annual report must also include information on arrangements made with a STSSN facility to handle sea turtles taken in the coming year. The report must also include all necropsy reports. At the time the report is submitted, NMFS will supply NRC and AmerGen with any information on

changes to reporting requirements (i.e., staff changes, phone or fax numbers, e-mail addresses) for the coming year.

9. To implement RPM #2, OCNGS personnel or NRC must notify NMFS when the OCNGS reaches 50% of the incidental take level for any species of sea turtle. At that time, NRC and NMFS will determine if additional measures are needed to minimize impingement at the CWS or DWS intake structures.

10. To implement RPM #3, a stranding/rehabilitation facility with the appropriate ESA authority must be contacted immediately following any live sea turtle take. Appropriate transport methods must be employed following the stranding facilities protocols, to transport the animal to the care of the stranding/rehabilitation personnel for evaluation, necessary veterinary care, tagging, and release in an appropriate location and habitat.

11. To implement RPM #4, all dead sea turtles must be necropsied by qualified personnel. The OCNGS must coordinate with a qualified facility or individual to perform the necropsies on sea turtles impinged at OCNGS, prior to the incidental turtle take, so that there is no delay in performing the necropsy or obtaining the results. The necropsy results must identify, when possible, the sex of the turtle, stomach contents, and the estimated cause of death. Necropsy reports must be submitted to the NMFS Northeast Region with the annual review of incident reports or, if not yet available, within 60 days of the incidental take.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the potential for and impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, the level of incidental take is exceeded, reinitiation of consultation and review of the reasonable and prudent measures are required. NRC must immediately provide an explanation of the causes of the taking and review with NMFS the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

In addition to Section 7(a)(2), which requires agencies to ensure that all projects will not jeopardize the continued existence of listed species, Section 7(a)(1) of the ESA places a responsibility on all federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered 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. As such, NMFS recommends that the NRC consider the following Conservation Recommendations:

1. The NRC and OCNGS should investigate methods to increase lighting and visibility at all trash racks, and implement these methods. At present, with use of portable spotlights and current lighting visibility is limited to approximately 1 meter below the water

surface. Improvement of visibility may allow personnel to detect sea turtles at the intakes sooner and minimize the chance of mortality.

2. The NRC and OCNGS should support tissue analysis of dead sea turtles removed from OCNGS to determine contaminant loads, including chlorine.

2. In conjunction with NMFS, the NRC should support and develop a research program to determine whether the plant provides features attractive to sea turtles (e.g., concentration of prey around intake structures, heated discharge). This program should investigate habitat use, diet, and local and long-term movements of sea turtles. Use of existing mark/recapture and telemetry methods should be considered in Barnegat Bay and associated waterways.

3. The NRC and OCNGS personnel should support and conduct underwater and surface videography or diving behavior telemetry studies of turtles at the intake bays, in the Forked River, in the Oyster Creek discharge canal, and in Barnegat Bay to determine how turtles use these waterways and their behavior in the intake bays. The surface videography could help identify sea turtles in Forked River prior to impingent in the intake structures.

4. The NRC and OCNGS personnel should support and conduct investigations on the variable environmental conditions which may contribute to or result in increased sea turtle taking (e.g. temperature changes, wind direction, influx of prey). Increased monitoring during favorable conditions for sea turtle presence near OCNGS should result from the investigations.

5. Historical benthic survey data should be reviewed and updated to identify sea turtles prey density and distribution at various sites in the action area and associated waterways. This information would clarify the potential for sea turtle prey to be attracted to the intake structures or area around OCNGS during times when turtles are likely to be in the action area.

6. The NRC and OCNGS personnel should support and conduct in-water assessments, abundance, and distribution surveys for sea turtles in Barnegat Bay, Forked River, and Oyster Creek. Information obtained from these surveys should include the number of turtles sighted, species, location, habitat use, time of year, and portions of the water column sampled.

REINITIATION OF CONSULTATION

This concludes formal consultation on the proposal by NRC to renew the Operating License for the Oyster Creek Nuclear Generating Station for an additional 20 years. 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. **LITERATURE CITED**

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APPENDIX I.

Incidental Take of Sea Turtles at Oyster Creek Nuclear Generating Station Intake Structures
January 1992 through October 2006

SEA TURTLE IMPINGEMENT							
Date/Time	*Species*	*Status*	*Length**	Weight	*Location*	*Temp*	*Details*
6/25/1992 1250 hrs	Cc	Dead	35.5 cm SCL	9.6 kg	Impinged on DWS trash bars, found upon routine inspection	21.6 C	Several deep gashes on side, appeared to be boat propeller wounds. MMSC necropsy concluded cause of death from propeller wounds, before impingement.
9/9/1992 1800 hrs	Cc	Alive	46.7 cm SCL	19.1 kg	Impinged on CWS trash bars, found upon routine inspection	25.6 C	Small wound with scar tissue behind head. Released into discharge canal.
9/11/1992 1400 hrs	Cc	Alive	46.7 cm SCL	19.1 kg	Impinged on CWS trash bars, found upon routine inspection	26.2 C	Small wound with scar tissue behind head. Considered to be the same turtle found on 9/9/92. Taken to MMSC, tagged, and released into ocean near Brigantine, NJ.
10/26/1992 0300 hrs	Lk	Alive	32.0 cm SCL	5.7 kg	Impinged on CWS trash bars, found upon routine inspection. Head out of water pointing upward.	11.3 C	Turtle found alive, moving about normally. Two scars from slash-like wounds on plastron. Not sure how long present at intake structure, but may have been there between 3 and 8 hours. Turtle taken to MMSC in Brigantine, NJ, then to North Carolina, with eventual release into the ocean off NC on October 31, 1992.
10/17/1993 1200 hrs	Lk	Dead	26.0 cm SCL	3.0 kg	Impinged on DWS trash bars, found upon routine inspection	16.7 C	Turtle found limp, immobile, no apparent breathing and resuscitation efforts were unsuccessful. Minor scrape marks on plastron may have occurred during removal from intake area. Not sure how long present at intake structure, but may have been there between 4 and 8 hours. Necropsy by Dr. Morreale found that drowning likely cause of death (fresh dead, no obvious trauma, empty stomach).
6/19/1994 1330 hrs	Cc	Alive	36.8 cm SCL	9.8 kg	Found in CWS Bay #4, swimming freely upstream of the trash bars	27.3 C	Turtle found alive, moving about normally. Within 3-4 hours of capture, turtle taken to MMSC in Brigantine, NJ, tagged, and released offshore.
7/1/1994 1000 hrs	Lk	Dead	27.7 cm SCL	3.6 kg	Found in DWS Bay #5 upon routine cleaning	25.7 C	Turtle found limp, immobile, no apparent breathing, strong odor of decomposition, and resuscitation efforts were unsuccessful. Not sure how long present at intake structure, but intake bay was cleaned the previous afternoon. Turtle sent to Cornell for necropsy but the results have not been received to date.

7/6/1994 0640 hrs	Cc	Dead	61.4 cm SCL	40.4 kg	Found in DWS Bay #4 upon routine cleaning of dilution intakes	26.9 C	Turtle found limp, immobile, no apparent breathing and resuscitation efforts were unsuccessful. Three old deep scars or slash-like propeller wounds on turtle, decomposition of all 4 appendages, large notch along turtle's marginal scutes. Not sure how long present at intake structure, but trash bars were cleaned 6 to 8 hours earlier. Necropsy by MMSC (R. Schoelkopf) found that turtle likely died 1 to 2 days before arriving at OCNGS, probably due to a long term illness.
7/12/1994 2240 hrs	Lk	Dead	26.7 cm SCL	3.3 kg	Found in DWS Bay #4 upon routine cleaning of dilution intakes	28.4 C	Turtle found limp, immobile, no apparent breathing and resuscitation efforts were unsuccessful. Not sure how long present at intake structure, but may have been there for several hours. Turtle sent to Cornell for necropsy but the results have not been received to date.
9/4/1997 0318 hrs	Lk	Dead	48.8 cm SCL	18.1 kg	Found in DWS Bay #6 upon routine cleaning of dilution intakes	22.9 C	Turtle found limp, immobile, no apparent breathing and resuscitation efforts were unsuccessful. Two dorsal scutes had damage, but no prominent scars of slashlike wounds. Not sure how long present at intake structure, but may have been there for up to several hours.
8/18/1998 0959 hrs	Cc	Alive	50.8 cm SCL	22.4 kg	Found live while routinely inspecting CWS Bay #4, swimming freely upstream of the trash bars	26.9 C	Turtle found alive, moving about normally. A 12 foot 1/4" polypropylene rope with a bucket attached to one end was wrapped around the right front flipper, and the flipper was atrophied and partially decayed. OCNGS was in full power operation with four circulating water pumps and 2 dilution pumps. Turtle taken to MMSC in Brigantine, NJ, then to Sea World in Orlando, FL, with eventual release into the ocean.
9/23/1999 0310 hrs	Lk	Alive	26.4 cm SCL	2.9 kg	Impinged on CWS trash bars, found upon routine inspection	19.6 C	Turtle found alive, moving about normally and with no apparent injury. OCNGS was in full power operation with four circulating water pumps and 2 dilution pumps. Turtle taken to MMSC in Brigantine, NJ, then to Virginia State Aquarium, with eventual release into the ocean.
10/23/1999 0200 hrs	Cm	Dead	27.0 cm SCL	2.8 kg	Found in DWS Bay #4 upon routine cleaning of dilution intakes	17.1 C	Turtle found limp, immobile, no apparent breathing and resuscitation efforts were unsuccessful. OCNGS was in full power operation with four circulating water pumps and 2 dilution pumps. Dilution trash racks were mechanically cleaned the previous day. Turtle sent to Cornell for necropsy, but results have not been received to date.
06/23/2000 0120 hrs	Cc	Alive	47.8cm SCL	17.2 kg	Found in front of trash bars in DWS Bay #1 intake	25.3 C	Live turtle very active and no visible wounds or injury. OCNGS was in full power operation with four circulating water pumps and 2 dilution pumps. Transferred to MMSC in Brigantine NJ, with eventual release into the ocean.

7/2/2000 1500 hrs	Lk	Dead	27.3 cm SCL	3.2 kg	Found floating into the trash bars in DWS Bay #1 intake on routine inspection of dilution trash racks	25.6 C	Turtle found limp, immobile, no apparent breathing and resuscitation efforts were unsuccessful. Two dorsal scutes had superficial scrape marks. OCNGS was in full power operation with four circulating water pumps and 2 dilution pumps. Dilution trash racks were mechanically cleaned the previous evening (2130 hrs). Turtle in freezer until necropsy can be completed.
8/3/2000 1525 hrs	Cm	Alive	29.2 cm SCL	3.4 kg	Found live in DWS Bay #4 intake upon routine inspection of dilution trash racks	28.8 C	Turtle found alive, moving about normally and with no apparent injury. Carapace covered in barnacles; several marginal scutes had dull grayish coloration (indicative of possible fungal infection). OCNGS was in full power operation with four circulating water pumps and 2 dilution pumps. Dilution trash racks mechanically cleaned earlier the same day. Turtle taken to MMSC in Brigantine, NJ, then to the Topsail Island Rehab Center, NC, with eventual release into the ocean on October 12, 2000.
8/28/2000 0112 hrs	Lk	Alive	26.2 cm SCL	2.9 kg	Found live in DWS Bay #1 intake upon routine inspection of dilution trash racks	26.5 C	Turtle found alive, moving about normally and with no apparent injury. OCNGS was in 72% power operation with four circulating water pumps and 2 dilution pumps. Dilution trash racks cleaned previous day and inspected earlier same night of capture. Turtle taken to MMSC in Brigantine, NJ, then to the Topsail Island Rehab Center, NC, with anticipated eventual release into the ocean.
9/18/2000 1310 hrs	Cc	Alive	57.2 cm SCL	26.5 kg	Found live while routinely inspecting CWS intake trash rack Bay #4	20.4 C	Turtle found alive, moving normally with no apparent injury. Majority of dorsal surface covered in barnacles; few scutes partially peeled. OCNGS was in full power operation with four circulating water pumps and 2 dilution pumps. Trash racks cleaned previous afternoon. Turtle taken to MMSC in Brigantine, NJ, and released into the ocean off Nags Head, NC in late September.
7/8/2001 1430 hrs	Cm (juv)	Alive	26.7 cm SCL	2.3 kg	Found live while routinely inspecting CWS Bay #4	26.7 C	Turtle found alive, swimming freely in Bay #4, moving normally with no apparent injury. Dorsal surface had several barnacles. OCNGS was in full power operations with four circulating water pumps and 2 dilution pumps. Trash racks cleaned the previous afternoon. Turtle taken to Marine Mammal Stranding Center in Brigantine, NJ. After confirming health and tagged, turtle released into nearshore waters near Brigantine.
7/22/2001 1744 hrs	Lk (juv)	Dead	26 cm SCL	2.9 kg	Impinged on DWS Bay #5 trash bars, found upon routine inspection	26.9 C	Turtle found with deep slice wound between head and carapace on left side of neck. OCNGS was in full power operation with four circulating water pumps and 2 dilution pumps. Trash racks cleaned at 330 hrs same day. Turtle in freezer until necropsy could be set up.
8/14/2001 0334 hrs	Lk	Dead	22.8 cm SCL; 21.4 cm SCW		Impinged on DWS Bay #6	27.8 C	Turtle appears fresh dead, no obvious prop wounds. Several scutes scraped on carapace centerline and posterior notch. Intake velocity was 73 cm/sec and OCNGS had 982 percent power generating capacity over previous 48 hrs. Trash racks cleaned at 245 hrs same day. Intake canal turbidity high.

6/29/2002 0200	Lk	Alive	25.4 cm SCL; 24.1 cm SCW	n/a	Found alive, swimming in CWS Bay #5 and #6 cooling water intake, upon routine inspection of trash racks. Removed with large dipnet.	26.2 C	Turtle alive and active, appears healthy. Fresh scar (?) on right side of carapace. OCNGS had 99.9% power. CWS trash racks cleaned ~4 hrs earlier (2200 6/28/02). Animal delivered to MMSC at 0455 hrs - wound determined to not be of significant concern (eating and appeared healthy). Turtle later died at MMSC, and necropsy performed. Found to be female, all tissues surrounding cracked area were necrotic.
7/3/2002 0755	Lk	Alive	34 cm SCL; 32.5 cm SCW	6 kg	Found alive, swimming in front of DWS Bay #5 intake trash bars, upon routine inspection. Removed with dipnet.	28.2 C	Turtle alive and active, appears healthy. One small scrape <1 cm long on dorsal scute. OCNGS had 100% power. Screen last inspected 7-3-02 0500 hrs. Animal delivered to MMSC at 1015 hrs; was swimming and eating well. Tagged (monellear #SSL127) and released on July 9 near Brigantine, NJ.
9/24/2003 1455	Lk	Alive	31.1 cm SCL; 30.5 cm SCW	11.5 lbs	Found alive, in intake pipe at DWS Bay #6.	73 F	Turtle alive and active, appears healthy. One lateral scute chipped (old); 2 scrapes on ventral surface. OCNGS had 100% power. Screen last inspected 9-23-03 1345 hrs. Animal picked up by MMSC at 1745 hrs; healthy and active. Tagged and released on 9-25 near Brigantine, NJ.
10/24/2003 0850	Cm (juv)	Alive	36.2 cm SCL; 30.5 cm SCW	6.9 kg	Found alive, against CWS Intake Bay #4.	53 F (11.7 C)	Turtle alive and alert, appears healthy but a bit lethargic. One scraped dorsal scute and one chipped lateral scute. Heavy algal growth on carapace. OCNGS had 98% power. Screen last inspected 10-24-03 0500 hrs. Animal picked up by MMSC at 1030 hrs; healthy and active. Held at MMSC and then transferred to VMSM for rehab and eventual release.
7/4/2004 1215 hrs	Lk	Dead	26.5 cm SCL; 25 cm SCW	5.4 kg	Found dead upon routine cleaning at DWS Bay #4 trash racks	25.6 C (78 F)	Turtle fresh dead, no obvious prop wounds or other injuries. Minor scrape/bruising on plastron near centerline. OCNGS had 100% percent power generating capacity over previous 48 hrs. Trash racks cleaned at 0800 hrs same day. Delivered to MMSC for necropsy at 1500 hrs: female; all internal organs healthy/unremarkable; stomach of crab parts; lungs appeared normal but sank in salt water solution and felt compressed. Probable cause of death--suffocation.
7/11/2004 1422 hrs	Lk	Alive	23 cm SCL; 22 cm SCW	1.8 kg	Upon routine cleaning, found swimming upstream of DWS Bay #5 trash racks. Turtle surfaced and dove, and personnel retrieved the animal.	81.5 F (27.5 C)	Turtle appeared in good condition. Some minor scrapes noted on ventral surface of carapace (plastron?). OCNGS had 100% power. Screen last inspected 7-11-04 at 1315 hrs. Animal taken to MMSC at 1623 hrs. Examined and released 2 days later off Brigantine, NJ.
7/16/2004 1100 hrs	Lk	Alive	28 cm SCL	3.1 kg	Found alive upon routine cleaning of DWS Bay #5 trash racks	76 F (22.4 C)	Turtle appeared in good condition. Some small scrapes noted on plastron. OCNGS had 100% power. Screen last inspected 7-16-04 at 0900 hrs. Animal taken to MMSC at 1300 hrs. Examined and released off Brigantine, NJ.
7/20/2004 1213 hrs	Lk	Dead	18.3 cm SCL	0.8 kg	Found dead upon routine cleaning of CWS Bay #1 trash racks	79.7 F (26.5 C)	Resuscitation attempted but unsuccessful. Small puncture wound 1.3 cm diameter in left rear surface of carapace. OCNGS had 100% power. Screen last inspected 7-19-04 at 2115 hrs. Taken to MMSC at 1000 on 7-21-04 for necropsy.
8/7/2004 0900 hrs	Lk	Alive	27 cm SCL	3.2 kg	Found alive upon routine cleaning of DWS Bay #5 trash racks	72.8 F (22.7 C)	Turtle appeared healthy and moving normally. Small bruise noted on plastron and healed scar from previous injury on left side of head in front of eye. OCNGS had 100% power. Screen last inspected 8-7-04 at 0515 hrs. Animal taken to MMSC on 8-7-04. Examined and subsequently released into ocean off Brigantine, NJ. **EXCEEDED ITS**

9/11/2004 1010 hrs	Lk	Dead	22.3 cm SCL; 22.9 cm SCW	2.2 kg	Found dead upon routine cleaning of DWS Bay #5 trash racks	24.3 C	Bruising to plastron and undersides of all 4 flippers. Small puncture wound to base of neck. Healed prop cut to rear of carapace. Animal taken to MMSC, then to U of Penn for necropsy. **EXCEEDED ITS**
9/12/2004 2329 hrs	Lk	Alive	21 cm SCL; 19.5 cm CW	1.4 kg	Found alive upon routine cleaning of CWS #5 trash racks	24.9 C	Active and eating on its own. Bruising to plastron and undersides of all 4 flippers. Missing left front flipper (clean amputation). Small bump on beak area of head. Turtle was taken to the MMSC in Brigantine, NJ, where it was examined, measured, fed and held for observation prior to release. The turtle was transported to the VMSM for tagging and release. **EXCEEDED ITS**
9/23/2004 2145 hrs	Lk	Alive	24.2 cm SCL	1.9 kg	Found alive swimming in CWS Bay #3 cooling water intake, upon routine inspection of trash racks.	21.9 C	Turtle appeared alert and responsive. Turtle was taken to the MMSC in Brigantine, NJ, where it was examined, measured, fed and held for observation prior to release. The turtle was transported to the VMSM for tagging and release. **EXCEEDED ITS**
7/4/2005 0905 hrs	Lk	Dead	23.2 cm SCL	1.4 kg	Found in DWS Bay #1 upon routine cleaning of dilution intakes	21.9 C	Turtle was found dead among . Turtle was taken to the MMSC in Brigantine, NJ, where it was examined, measured, the necropsy was preformed.- necropsy results: skill crushed by possible prop strike, right carapace near shoulder cracked possible prop or skeg wound. unable to determine if injuries were pre or post mortem. esophagus lined with black, gritty material. stomach and intestine empty. immature male
8/5/2005 0500 hrs	Lk	Alive	23.6 cm SCL	1.9 kg	Found alive swimming in CWS Bay #4 cooling water intake, upon routine inspection of trash racks.	28.2 C	Turtle appeared alert and responsive, wound observed on front left flipper. Turtle was taken to the MMSC in Brigantine, NJ, where it was examined, measured, fed and held for observation. The turtle was then sent to the Sea Turtle Rescue and Rehabilitiation Center in Topsail, NC for further rehab. On August 12, the turtle was trasported to the NC State Veterinary School for amputation of the wounded flipper. The turtle will undergo further rehab before being released
6/30/2006 1100 hrs	LK	Alive	27.3cm SCL, 25.8 cm SCW	3.5kg	Found among the vegetation and debris removed from Bay #1 of the DWS	25.6C	Active, scrapes on dorsal and ventral carapace. Transferred to MMSC and released on July 5.
7/17/2006 0935 hrs	LK	Alive	25.2 SCL, 24.00 SCW	2.63 kg	In water within Bay #5 of the DWS	26.7C	lethargic during tranport but became alert and responsive at MMSC. minor abrasions on carapace, plastron and head. severe bruising on neck and base of all four flippers. Abrasions and bruising on neck and flippers. Transferred to MMSC. Appears to be doing fine. tagged and released by MMSC on July 19
7/19/2006 2130hrs	LK	Alive	26.7 SCL, 24.8 SCW	3.2kg	Found among the vegetation and debris removed from Bay #1 of the CWS	28.1C	Algae on carapce and minor bruising on plastron. It was found late at night and was transferred to MMSC on 7/20 am. Released by MMSC on July 23
7/25/2006 0425hrs	LK	Dead	28.5cm SCL, 26cm SCW	3.3kg	Found dead among the vegetation and debris removed from Bay #4 of the DWS	27.9C	Dead and moderately decomposed. OC staff reported that several scutes broken, areas of brusing and crushing wounds to carapace and plastron. Necropsy conducted by MMSC - stomach and intestines full of crab claws and parts. moderately decomposed. carapace and plastron show evidence of being crushed, possibly post-mortem. carapace had a rough break and scutes peeling off. buried by MMSC

8/1/2006 0507hrs	CC	Alive	74 SCL, 65SWC	50.4kg	In water within Bay #1 of the CWS	29.4C	OC staff reported no visible wounds or bruising. numerous barnacles on carapace. transferred to MMSC - observed, doing well and released on August 2.
10/5/2006 0940hrs	CC	Alive	20.3 SCL		Found among the vegetation and debris removed from Bay #6 of the DWS	18.8C	dilution water intake bay 6 . Missing front right flipper but has scar tissue and is healed. Wound opened up from abrasion against trash rack. Transported to MMSC and then to Topsail for surgery to repair old wound.

APPENDIX II

Handling and Resuscitation Procedures Sea Turtles Found at OCNGS

Handling:
Do not assume that an inactive turtle is dead. The onset of rigor mortis and/or rotting flesh are often the only definite indications that a turtle is dead. Releasing a comatose turtle into any amount of water will drown it, and a turtle may recover once its lungs have had a chance to drain. There are three methods that may elicit a reflex response from an inactive animal:

- Nose reflex. Press the soft tissue around the nose which may cause a retraction of the head or neck region or an eye reflex response.
- Cloaca or tail reflex. Stimulate the tail with a light touch. This may cause a retraction or side movement of the tail.
- Eye reflex. Lightly touch the upper eyelid. This may cause an inward pulling of the eyes, flinching or blinking response.

General handling guidelines:

- Keep clear of the head.
- Adult male sea turtles of all species other than leatherbacks have claws on their foreflippers. Keep clear of slashing foreflippers.
- Pick up sea turtles by the front and back of the top shell (carapace). Do not pick up sea turtles by flippers, the head or the tail.
- If the sea turtle is actively moving, it should be retained at the OCNGS until transported by stranding/rehabilitation personnel to the nearest designated stranding/rehabilitation facility. The rehabilitation facility should eventually release the animal in the appropriate location and habitat for the species and size class of the turtle. Turtles should not be released where there is a risk of re-impingement at OCNGS.

Sea Turtle Resuscitation Regulations: (50 CFR 223.206(d)(1))
If a turtle appears to be comatose (unconscious), contact the designated stranding/rehabilitation personnel immediately. Once the rehabilitation personnel has been informed of the incident, attempts should be made to revive the turtle at once. Sea turtles have been known to revive up to 24 hours after resuscitation procedures have been followed.

- Place the animal on its bottom shell (plastron) so that the turtle is right side up and elevate the hindquarters at least 6 inches for a period of 4 up to 24 hours. The degree of elevation depends on the size of the turtle; greater elevations are required for larger turtles.
- Periodically, rock the turtle gently left to right and right to left by holding the outer edge of the shell (carapace) and lifting one side about 3 inches then alternate to the other side.
- Periodically, gently conduct one of the above reflex tests to see if there is a response.
- Keep the turtle in a safe, contained place, shaded, and moist (e.g., with a water-soaked towel over the eyes, carapace, and flippers) and observe it for up to 24 hours.
- If the turtle begins actively moving, retain the turtle until the appropriate rehabilitation personnel can evaluate the animal. The rehabilitation facility should eventually release the animal in a manner that minimizes the chances of re-impingement and potential harm to the animal (i.e., from cold stunning).
- Turtles that fail to move within several hours (up to 24) should be transported to a suitable facility for necropsy (if the condition of the sea turtle allows).

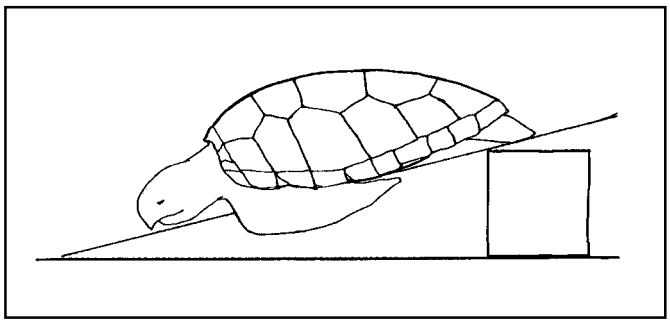
APPENDIX II, continued **(Handling and Resuscitation Procedures)**

Stranding/rehabilitation contact in New Jersey:
Bob Schoelkopf, Marine Mammal Stranding Center
P.O. Box 773
Brigantine, NJ
(609-266-0538)

Special Instructions for Cold-Stunned Turtles:

Comatose turtles found in the fall or winter (in waters less than 10 C) may be "cold-stunned". If a turtle appears to be cold-stunned, the following procedures should be conducted:

- Contact the designated stranding/rehabilitation personnel immediately and arrange for them to pick up the animal.
- Until the rehabilitation facility can respond, keep the turtle in a sheltered place, where the ambient temperature is cool and will not cause a rapid increase in core body temperature.



APPENDIX III

Incident Report of Sea Turtle Take - OCNGS

Photographs should be taken and the following information should be collected from all turtles (alive and dead) found in association with the OCNGS. Please submit all necropsy results (including sex and stomach contents) to NMFS upon receipt.

Observer's full name:_____
Reporter's full name:_____

Species Identification (Key attached):_____

Site of Impingement (CWS or DWS, Bay #, etc.):_____

Date animal observed:_____ Time animal observed: _____
Date animal collected:_____ Time animal collected:_____
Date rehab facility contacted: _____ Time rehab facility contacted: _____
Date animal picked up: _____ Time animal picked up: _____

Environmental conditions at time of observation (i.e., tidal stage, weather):
_____
_____

Date and time of last inspection of screen:_____
Water temperature (C) at site and time of observation:_____
Number of pumps operating at time of observation:_____
Average percent of power generating capacity achieved per unit at time of observation:_____
Average percent of power generating capacity achieved per unit over the 48 hours previous to observation:_____

Sea Turtle Information: *(please designate cm/m or inches)*

Fate of animal (circle one): dead alive
Condition of animal (*include comments on injuries, whether the turtle is healthy or emaciated, general behavior while at OCNGS*):_____
_____
_____
_____*(please complete attached diagram)*

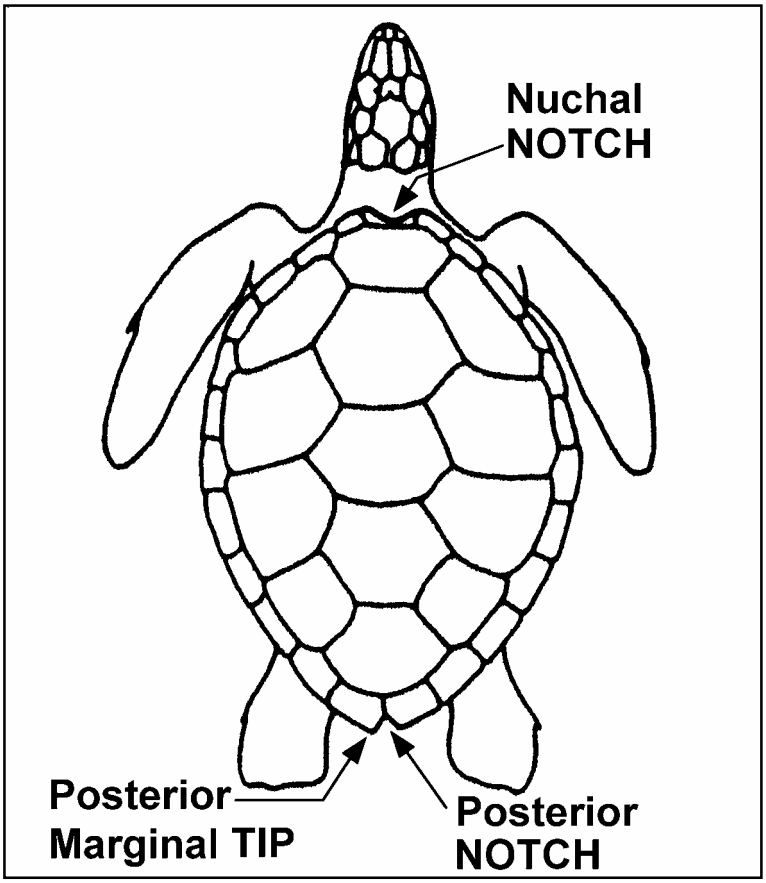
Carapace length - Curved:_____Straight:_____
Carapace width - Curved:_____Straight:_____

Existing tags?: YES / NO *Please record all tag numbers.* Tag # _____
Photograph attached: YES / NO

(please label *species, date, location of impingement* on back of photograph)

APPENDIX III, continued **(Incident Report of Sea Turtle Take)**

Draw wounds, abnormalities, tag locations on diagram and briefly describe below.



Description of animal:

All information should be sent to the following address:

National Marine Fisheries Service, Northeast Region
Protected Resources Division
Attention: Endangered Species Coordinator
One Blackburn Drive
Gloucester, MA 01930

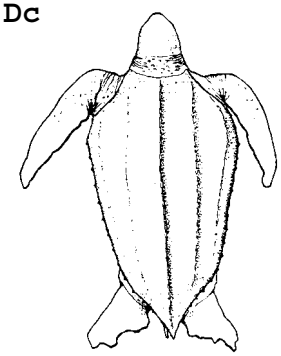
Phone: (978) 281-9328
FAX: (978) 281-9394

APPENDIX IV

Identification Key for Sea Turtles Found in Northeast U.S. Waters

SEA TURTLES

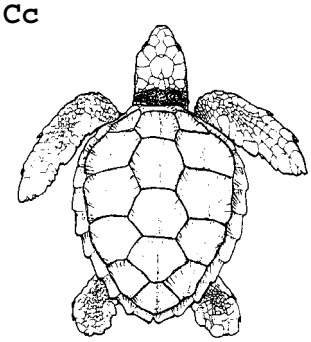
Dc



Leatherback (*Dermocheyls coriacea*)

Found in open water throughout the Northeast from spring through fall. Leathery shell with 5-7 ridges along the back. Largest sea turtle (4-6 feet). Dark green to black; may have white spots on flippers and underside.

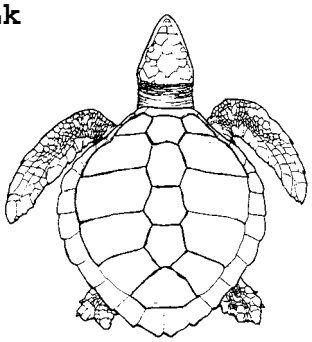
Cc



Loggerhead (*Caretta caretta*)

Bony shell, reddish-brown in color. Mid-sized sea turtle (2-4 feet). Commonly seen from Cape Cod to Hatteras from spring through fall, especially in southern portion of range. Head large in relation to body.

Lk



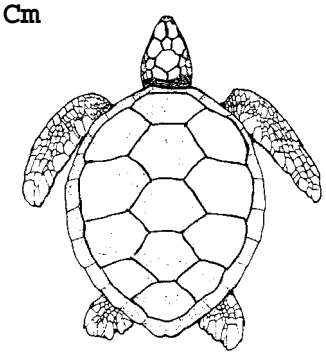
Kemp's ridley (*Lepidochelys kempi*)

Most often found in Bays and coastal waters from Cape Cod to Hatteras from summer through fall. Offshore occurrence undetermined. Bony shell, olive green to grey in color. Smallest

sea turtle in Northeast (9-24 inches). Width equal to or greater than length.

SEA TURTLES

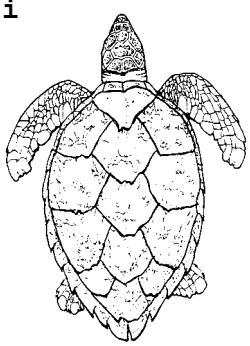
Cm



Green turtle (*Chelonia mydas*)

Uncommon in the Northeast. Occur in Bays and coastal waters from Cape Cod to Hatteras in summer. Bony shell, variably colored; usually dark brown with lighter stripes and spots. Small to mid-sized sea turtle (1-3 feet). Head small in comparison to body size.

Ei



Hawksbill (*Eretmochelys imbricata*)

Rarely seen in Northeast. Elongate bony shell with overlapping scales. Color variable, usually dark brown with yellow streaks and spots (tortoise-shell). Small to mid-sized sea turtle (1-3 feet). Head relatively small, neck long.