UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
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Ms. Elinor G. Adensam, Director
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

JUL 18

Dear Ms. Adensam:

Enclosed is the National Marine Fisheries Service's (NMFS) Biological Opinion on the impacts of the Oyster Creek Nuclear Generating Station (OCNGS), located near Forked River, New Jersey, on endangered and threatened species. This Biological Opinion was prepared pursuant to the inter-agency consultation requirements of Section 7 of the Endangered Species Act (ESA).

Based on our review of the OCNGS' Biological Assessment and supplementary information submitted by the Nuclear Regulatory Commission (NRC), and the available scientific information, NMFS concludes that the continued operation of the OCNGS 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 determined that the proposed action is likely to have no effect on endangered leatherback or hawksbill sea turtles.

The enclosed Biological Opinion provides an Incidental Take Statement (ITS) for threatened and endangered sea turtles, as well as reasonable and prudent measures and terms and conditions necessary for NRC to minimize impacts to these species. The ITS authorizes the annual take of five (5) loggerhead (no more than two (2) lethal), four (4) Kemp's ridley (no more than three (3) lethal), or two (2) green (no more than one (1) lethal) sea turtles for the continued operation of the OCNGS. The NMFS expects NRC to implement the reasonable and prudent measures and terms and conditions as outlined in the ITS. The measures of the ITS are non-discretionary and must be undertaken by NRC for the incidental take exemption to apply. For example, the OCNGS must establish an arrangement with a qualified facility or individual (with the appropriate ESA permit) to necropsy all dead sea turtles in suitable condition, prior to any incidental turtle take.

This Biological 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

Enclosure 1

habitat designated that may be affected by the identified actions. As identified in the Biological Opinion, NMFS Northeast Regional staff should be contacted immediately should an interaction with a sea turtle occur.

For further information regarding any consultation requirements, please contact Mary Colligan, Acting Assistant Regional Administrator for Protected Resources, NMFS Northeast Regional Office, at (978) 281-9116.

The 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,

Patricia A. Kurkul
Regional Administrator

cc: Brewer/Johnson, F/PR3
Malcolm Browne, AmerGen
Williams, GCNE
Riportella, F/NER-SH

File code: 1514-05(A) NRC – Oyster Creek

ENDANGERED SPECIES ACT SECTION 7 CONSULTATION

BIOLOGICAL OPINION

Agency: Nuclear Regulatory Commission

Activity: Continued operation of the Oyster Creek Nuclear Generating Station on the Forked River and Oyster Creek, Barnegat Bay, New Jersey (F/NER/2001/00658)

Conducted by: National Marine Fisheries Service, Northeast Regional Office

Date Issued: July 18, 2001

Approved by: [signature]

INTRODUCTION

This constitutes the National Marine Fisheries Service's (NMFS) biological opinion (Opinion) on the effects of the Nuclear Regulatory Commission's (NRC) 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 (ESA; 16 USC 1531 et seq.).

This Opinion is based on information provided in the July 2000 Biological Assessment (BA), correspondence with Mr. Jim Wilson, NRC, and Mr. Malcolm Browne, AmerGen Energy Company, and other sources of information. A complete administrative record of this consultation is on file at the NMFS Northeast Regional Office, Gloucester, Massachusetts.

CONSULTATION HISTORY

The OCNGS began commercial operation in 1969. No observed takes of endangered 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. 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 Biological Assessment was prepared by the OCNGS, reviewed and submitted by the NRC, and received by NMFS on January 25, 1995.

A Biological 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 permitted 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 Allowance extended for a period of 5 years from the date of the Opinion (i.e., to September 21, 2000).

After the 1995 Opinion was signed, there were nine takes of sea turtles associated with the OCNGS. The specifics of these takes are discussed in the following Effects of the Action section. The 1995 incidental take level 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. Section 7 consultation must be reinitiated if the amount or extent of take as specified in the incidental take statement is exceeded (not met). In the cover letter accompanying the 1995 BO, NMFS stated that reinitiation would be required if, during any one year, twelve sea turtles are taken and/or there is a lethal take of one Kemp's ridley OR one green turtle. However, reinitiation is not actually required unless the Incidental Take Statement is exceeded. The Incidental Take Statement in the Opinion authorized the annual lethal take of one Kemp's ridley and one green turtle, and it is this take statement that sets the authorized take level.

On August 3, 2000, the 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 shortly 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 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, such as updated sea turtle take details, necropsy results, and updated New Jersey stranding records, 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.

On February 2, 2001, NMFS informed NRC that all of the information necessary for a formal section 7 consultation and the preparation of a Biological Opinion had been received and reminded NRC not to make any irreversible or irretrievable commitment of resources that would prevent the NMFS from proposing or the NRC from implementing any reasonable and prudent alternatives to avoid jeopardizing sea turtles. Until consultation is concluded, NMFS recommended that the NRC continue to implement the requirements identified in the September 21, 1995, Opinion.

DESCRIPTION OF THE PROPOSED ACTION

The proposed activity is the continued operation of the Oyster Creek Nuclear Generating Station. OCNGS is located near the town of Forked River, midway between the south branch of the Forked River and Oyster Creek, New Jersey (Figure 1). The Forked River and Oyster Creek empty into Barnegat Bay. 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. The resultant warmed water is discharged via Oyster Creek into Barnegat Bay.

OCNGS consists of a boiling water nuclear reactor with an electrical capability of approximately 650 megawatts. Two separate intake structures withdraw water from the intake canal, the circulating water system intake (CWS) and the dilution water system (DWS).

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, and the maximum permissible average intake velocity for water approaching the CWS intake ports is 30 cm/sec. The maximum effluent temperature is 41.1 C.

The DWS minimizes 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 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 twice during each 8-hour work shift from June to October to remove debris and to monitor potential sea turtle takes.

A floating debris/ice barrier has been designed and installed 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, so that if a turtle is near the surface when approaching the floating barrier, it may be diverted towards the DWS unless it dives deeper and turns towards the CWS.

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 dipnets 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 dipnets 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 project area includes the area immediately surrounding the OCNGS, including the Forked River and Oyster Creek. For the purpose of this analysis, the action area also encompasses the entire Barnegat Bay.

STATUS OF SPECIES OR CRITICAL HABITAT

NMFS has determined that the action being considered in this Opinion is not expected to affect leatherback (*Dermochelys coriacea*) or hawksbill (*Eretmochelys imbricata*) sea turtles, which are listed as endangered under the ESA.

Leatherback sea turtle
Leatherbacks 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, but rarely in the inshore areas (Lutcavage 1996). Leatherbacks are predominantly a pelagic species and feed on jellyfish, cnidarians and tunicates.

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, primarily due to intense exploitation of the eggs (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, the action area, 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. As a result, it is highly unlikely that the action being considered in this Opinion will affect leatherback sea turtles.

Hawksbill sea turtle
The hawksbill turtle is relatively uncommon in the waters of the continental United States. Hawksbills prefer coral reefs, such as those found in the Caribbean and Central America.

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. Most of the Texas records report small turtles, probably in the 1-2 year class range. Many captures or strandings are of individuals in an unhealthy or injured condition. 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. Thus, it is highly unlikely that the action being considered in this Opinion will affect hawksbill sea turtles.

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

Threatened:
Loggerhead sea turtle (*Caretta caretta*)

Endangered:
Green sea turtle[1] (*Chelonia mydas*)
Kemp's ridley sea turtle (*Lepidochelys kempi*)

No critical habitat has been designated for species under NMFS' jurisdiction in the action area, so no critical habitat will be affected by the proposed project.

Loggerhead sea turtle

Loggerhead sea turtles occur throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans in a wide range of habitats. These include open ocean, continental shelves, bays, lagoons, and estuaries (NMFS and USFWS, 1995). It is the most abundant species of sea turtle in U.S. waters, commonly occurring throughout the inner continental shelf from Florida through Cape Cod, Massachusetts. NMFS Northeast Fisheries Science Center survey data (1999) has found that loggerheads may occur as far north as Nova Scotia when oceanographic and prey conditions are favorable. The loggerhead sea turtle was listed as threatened under the ESA on July 28, 1978, but is considered endangered by the World Conservation Union (IUCN).

[1]Green turtles in U.S. waters are listed as threatened except for the Florida breeding population which is listed as endangered. Due to the inability to distinguish between these populations away from the nesting beach, green turtles are considered endangered wherever they occur in U.S. waters.

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 occurs 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). 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, therefore, critical to the survival of this species.

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. Based on analysis of mitochondrial DNA, which the turtle inherits from its mother, 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. The subpopulations are divided geographically as follows: (1) a northern nesting subpopulation, occurring from North Carolina to northeast Florida, 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 (Márquez 1990; approximately 1,000 nests in 1998); and (5) a Dry Tortugas nesting subpopulation, occurring in the islands of the Dry Tortugas, near Key West, Florida (approximately 200 nests per year). 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. In addition, recent 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).

Although NMFS has not formally recognized subpopulations of loggerhead sea turtles under the ESA, based on the most recent reviews of the best scientific and commercial data on the population genetics of loggerhead sea turtles and analyses of their population trends (TEWG, 1998; TEWG 2000), NMFS treats the loggerhead turtle nesting aggregations as nesting subpopulations whose survival and recovery is critical to the survival and recovery of the species. Any action that appreciably reduced the likelihood that one or more of these nesting aggregations would survive and recover would appreciably reduce the species' likelihood of survival and recovery in the wild. Consequently, this biological opinion will treat the five nesting aggregations of loggerhead sea turtles as subpopulations (which occur in the action area) for the purposes of this analysis.

The loggerhead sea turtles in the action area of this consultation likely represent turtles that have hatched from any of the five western Atlantic nesting sites, but are probably composed primarily of turtles that hatched from the northern nesting group and the south Florida nesting group. Although genetic studies of benthic immature loggerheads on the foraging grounds have shown the foraging areas to be comprised of a mix of individuals from different nesting areas, there appears to be a preponderance of individuals from a particular nesting area in some foraging locations. For example, although the northern nesting group (North Carolina to northeast Florida) produces only about 9 percent of the loggerhead nests, loggerheads from this nesting area comprise between 25 and 59 percent of the loggerhead sea turtles found in foraging areas from the northeastern U.S. to Georgia (NMFS SEFSC 2001; Bass et al., 1998; Norrgard, 1995; Rankin-Baransky, 1997; Sears 1994, Sears et al., 1995). Loggerheads that forage from Chesapeake Bay southward to Georgia are nearly equally divided in origin between south Florida and the northern nesting group (TEWG, 1998). In the Carolinas, the northern subpopulation is estimated to make up from 25 to 28 percent of the loggerheads (NMFS SEFSC 2001; Bass *et al.* 1998). About 10 percent of the loggerhead sea turtles in foraging areas off the Atlantic coast of central Florida are from the northern subpopulation (Witzell, in prep). In the Gulf of Mexico, most of the loggerhead sea turtles in foraging areas will be from the South Florida subpopulation, although the northern subpopulation may represent about 10 percent of the loggerhead sea turtles in the Gulf (Bass, pers. comm.).

Similar mixing trends have been found for loggerheads in pelagic waters. In the Mediterranean Sea, about 45 - 47 percent of the pelagic loggerheads can be traced to the South Florida subpopulation and about 2 percent are from the northern subpopulation, while only about 51 percent originated from Mediterranean nesting beaches (Laurent et al., 1998). In the vicinity of the Azores and Madiera Archipelagoes, about 19 percent of the pelagic loggerheads are from the northern subpopulation, about 71 percent are from the South Florida subpopulation, and about 11 percent are from the Yucatán subpopulation (Bolten et al., 1998).

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. Turtles in this life history stage are called "pelagic immatures" and are best known from the eastern Atlantic near the Azores and Madeira and have been reported from the Mediterranean as well as the eastern Caribbean (Bjorndal et al., in press). Stranding records indicate that when pelagic immature loggerheads reach 40-60 cm straight-line carapace length (SCL) they move to coastal inshore and nearshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico. However, recent studies have suggested that not all loggerhead sea turtles follow the model of circumnavigating the North Atlantic Gyre as pelagic immatures, followed by permanent settlement into benthic environments. Some may not totally circumnavigate the north Atlantic before moving to benthic habitats, while others may either remain in the pelagic habitat longer than hypothesized or move back and forth between pelagic and coastal habitats (Witzell in prep.).

Benthic immatures have been found from Cape Cod, Massachusetts, to southern Texas, and occasionally strand on beaches in northeastern Mexico (R. Márquez-M., pers. comm.). Large benthic immature loggerheads (70-91 cm) represent a larger proportion of the strandings and in-water captures (Schroeder et al., 1998) along the south and western coasts of Florida as compared with the rest of the coast, but it is not known whether the larger animals are actually more abundant in these areas or just more abundant within the area relative to the smaller turtles. Given an estimated age at maturity of 17-35 years (Frazer and Ehrhart 1985; B. Schroeder, pers.

comm.), the benthic immature stage must be at least 10-25 years long. As discussed in the beginning of this section, adult loggerheads nest primarily from North Carolina southward to Florida with additional nesting assemblages in the Florida Panhandle and on the Yucatán Peninsula. Non-nesting, adult female loggerheads are reported throughout the U.S. and Caribbean Sea; however, little is known about the distribution of adult males who are seasonally abundant near nesting beaches during the nesting season. NMFS SEFSC (2001) analyses conclude that juvenile stages have the highest elasticity and maintaining or decreasing current sources of mortality in those stages will have the greatest impact on maintaining or increasing population growth rates.

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). Like other sea turtles, the movements of loggerheads are influenced by water temperature. Since they are limited by water temperatures, loggerhead sea turtles do not usually appear on the northern summer foraging grounds (e.g., in the action area) until June, but can be found in Virginia as early as April. The large majority leave the Gulf of Maine by mid-September but may remain in the Northeast and mid-Atlantic waters until as late as November or December (Epperly et al., 1995; Keinath 1993; Morreale 1999; Shoop and Kenney 1992). Loggerhead sea turtles are primarily benthic feeders, opportunistically foraging on crustaceans and mollusks (Wynne and Schwartz, 1999). Under certain conditions they may also scavenge fish, particularly if they are easy to catch (e.g., caught in nets; NMFS and USFWS, 1991).

Threats to loggerheads' recovery
The five major subpopulations of loggerhead sea turtles in the northwest Atlantic — northern, south Florida, Florida panhandle, Yucatán, and Dry Tortugas — are all subject to fluctuations in the number of young produced annually because of human-related activities as well as natural phenomena. Loggerhead sea turtles face numerous threats from natural causes. For example, there is a significant overlap between hurricane seasons in the Caribbean Sea and northwest Atlantic Ocean (June to November), and the loggerhead sea turtle nesting season (March to November). Sand accretion and rainfall that result from these storms as well as wave action can appreciably reduce hatchling success. In 1992, Hurricane Andrew affected turtle nests over a 90-mile length of coastal Florida; all of the eggs were destroyed by storm surges on beaches that were closest to the eye of this hurricane (Milton et al., 1992). On Fisher Island near Miami, Florida, 69 percent of the eggs did not hatch after Hurricane Andrew, probably because they were drowned by the storm surge. Nests from the northern nesting group were destroyed by hurricanes which made landfall in North Carolina in the mid to late 1990's. Other sources of natural mortality include cold stunning and biotoxin exposure.

The diversity of the sea turtle's life history leaves them susceptible to many human impacts, including impacts while they are on land, in the benthic environment, and in the pelagic environment. On their nesting beaches in the U.S., adult female loggerheads as well as hatchlings are threatened with beach erosion, armoring, and nourishment; artificial lighting; beach cleaning; increased human presence; recreational beach equipment; beach driving; coastal construction and fishing piers; exotic dune and beach vegetation; predation by species such as exotic fire ants, raccoons (*Procyon lotor*), armadillos (*Dasypus novemcinctus*), opossums (*Didelphus virginiana*); and poaching. Although sea turtle nesting beaches are protected along large expanses of the northwest Atlantic coast (in areas like Merrit Island, Archie Carr, and Hobe Sound National Wildlife Refuges), other areas along these coasts have limited or no protection and probably cause fluctuations in sea turtle nesting success. For example, Volusia County, Florida, allows motor vehicles to drive on sea turtle nesting beaches (the County has filed suit against the U.S. Fish and Wildlife Service to retain this right). 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.

Loggerhead sea turtles are impacted by a completely different set of threats from human activities once they migrate to the ocean. Pelagic immature loggerhead sea turtles from these four subpopulations circumnavigate the North Atlantic over several years (Carr 1987, Bjorndal et al. 1994). During that period, they 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). Observer records indicate that an estimated 6,544 loggerheads were captured by the U.S. Atlantic tuna and swordfish longline fleet between 1992-1998, of which an estimated 43 were dead (Yeung et al. in prep.). Logbooks and observer records indicated that loggerheads readily ingest hooks (Witzell 1999).

In waters off the coastal U.S., loggerhead sea turtles are exposed to a suite of fisheries in Federal and State waters including trawl, purse seine, hook and line, gillnet, pound net, longline, and trap fisheries. For example, loggerhead sea turtles have been captured in fixed pound net gear in the Long Island Sound, in pound net gear and trawls in summer flounder and other finfish fisheries in the mid-Atlantic and Chesapeake Bay, and in gillnet fisheries (e.g., monkfish, spiny dogfish) in the mid-Atlantic and elsewhere. The take of sea turtles, including loggerheads, in shrimp fisheries off the Atlantic coast have been well documented. It has previously been observed that loggerhead turtle populations along the southeastern Atlantic coast declined where shrimp fishing was intense off the nesting beaches but, conversely, did not appear to be declining where nearshore shrimping effort was low or absent (National Research Council 1990).

In addition to fishery interactions, loggerhead sea turtles also face other threats in the marine environment, including the following: oil and gas exploration, development, and transportation; marine pollution; underwater explosions; hopper dredging, offshore artificial lighting; power plant entrainment and/or impingement; entanglement in debris; ingestion of marine debris; marina and dock construction and operation; boat collisions; and poaching.

Status and trend of loggerhead sea turtles
Based on the data available, it is difficult to estimate the size of the loggerhead sea turtle population in the U.S. or its territorial waters. There is, however, general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage. Nesting data collected on index nesting beaches in the U.S. from 1989-1998 represent the best dataset available to index the population size of loggerhead sea turtles. However, an important caveat for population trends analysis based on nesting beach data is that this may reflect trends in adult nesting females, but it may not reflect overall population growth rates. Given this, 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. Since a female often lays multiple nests in any one season, the average adult female population of 44,780 was calculated using the equation [(nests/4.1) * 2.5]. These data provide an annual estimate of the number of nests laid per year while indirectly estimating both the number of females nesting in a particular year (based on an average of 4.1 nests per nesting female, Murphy and Hopkins (1984)) and of the number of adult females in the entire population (based on an average

remigration interval of 2.5 years; Richardson et al., 1978)). On average, 90.7% of these nests were of the south Florida subpopulation, 8.5% were from the northern subpopulation, and 0.8% were from the Florida Panhandle nest sites. There is limited nesting throughout the Gulf of Mexico west of Florida, but it is not known to what subpopulation the turtles making these nests belong. Based on the above, there are only an estimated approximately 3,800 nesting females in the northern loggerhead subpopulation. The status of this northern population based on number of loggerhead nests, has been classified as stable or declining (TEWG 2000). Another consideration adding to the vulnerability of the northern subpopulation is that NMFS scientists estimate, using genetics data from Texas, South Carolina, and North Carolina in combination with juvenile sex ratios from those states, that the northern subpopulation produces 65% males, while the south Florida subpopulation is estimated to produce 80% females (NMFS SEFSC 2001, Part I).

Several published reports have presented the problems facing long-lived species that delay sexual maturity (Crouse et al., 1987, Crowder et al., 1994, Crouse 1999). In general, these reports concluded that animals that delay sexual maturity and reproduction must have high annual survival as juveniles through adults to ensure that enough juveniles survive to reproductive maturity and then reproduce enough times to maintain stable population sizes. This general rule applies to sea turtles, particularly loggerhead sea turtles, as the rule originated in studies of sea turtles (Crouse et al., 1987, Crowder et al., 1994, Crouse 1999). Crouse (1999) concluded that relatively small decreases in annual survival rates of both juvenile and adult loggerhead sea turtles will adversely affect large segments of the total loggerhead sea turtle population. The survival of hatchlings seems to have the least amount of influence on the survivorship of the species, but historically, the focus of sea turtle conservation has been involved with protecting the nesting beaches. While nesting beach protection and hatchling survival are important, recovery efforts and limited resources might be more effective by focusing on the protection of juvenile and adult sea turtles.

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. Ninety percent of green turtles found in Long Island Sound are between 25 and 40 cm SCL, with the largest reported being 68 cm (Burke et al. 1991). 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 Ehrhard 1985 in NMFS and USFWS 1991a, B. Schroeder pers. comm.).

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

In the continental United States, 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). Certain Florida nesting beaches where most green turtle nesting activity occurs 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). Recently, green turtle nesting occurred on Bald Head Island, North Carolina just east of the mouth of the Cape Fear River, on Onslow Island, and on Cape Hatteras National Seashore. Increased nesting has also been observed along the Atlantic Coast of Florida, on beaches where only loggerhead nesting was observed in the past (Pritchard 1997). Recent population estimates for green turtles in the western Atlantic area are not available.

While nesting activity is obviously important in assessing population trends, the remaining portion of the green turtle's life is spent on the foraging and breeding grounds. Juvenile green sea turtles occupy pelagic habitats after leaving the nesting beach. Pelagic juveniles are assumed to be omnivorous, but with a strong tendency toward carnivory during early life stages. At approximately 20 to 25 cm carapace length, juveniles leave pelagic habitats and enter benthic foraging areas, shifting to a chiefly herbivorous diet (Bjorndal 1997). Green turtles appear to prefer marine grasses and algae in shallow bays, lagoons and reefs (Rebel 1974), but also consume jellyfish, salps, and sponges. Some of the principal feeding pastures in the western Atlantic Ocean include the upper west coast of Florida and the northwestern coast of the Yucatan Peninsula. 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).

Threats to green turtles' 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).

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

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

Kemp's ridley sea turtle

The Kemp's ridley is the most endangered of the world's sea turtle species. Of the world's seven extant species of sea turtles, the Kemp's ridley has declined to the lowest population level. Kemp's ridleys nest primarily on Rancho Nuevo in Tamaulipas, Mexico, where nesting females emerge synchronously during the day to nest in aggregations known as arribadas. Most of the population of adult females nest in this single locality (Pritchard 1969).

Kemp's ridley nesting occurs from April through July each year. Little is known about mating but it is believed to occur at or before the nesting season in the vicinity of the nesting beach. 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). Research conducted by Texas A&M University has resulted in the intentional live-capture of hundreds of Kemp's ridleys at Sabine Pass and the entrance to Galveston Bay. Between 1989 and 1993, 50 of the Kemp's ridleys captured were tracked (using satellite and radio telemetry) by biologists with the NMFS Galveston Laboratory. The tracking study was designed to characterize sea turtle habitat and to identify small and large scale migration patterns. Preliminary analysis of the data collected during these studies suggests that subadult Kemp's ridleys stay in shallow, warm, nearshore waters in the northern Gulf of Mexico until cooling waters force them offshore or south along the Florida coast (Renaud, NMFS Galveston Laboratory, pers. comm.). Ogren (1988) suggests that the Gulf coast, from Port Aransas, Texas, through Cedar Key, Florida, represents the primary habitat for subadult ridleys in the northern Gulf of Mexico. However, at least some juveniles will travel northward as water temperatures warm to feed in productive coastal waters of Georgia through New England (USFWS and NMFS, 1992).

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 40 cm in carapace length, and weighing less than 20 kg (Terwilliger and Musick 1995). Next to loggerheads, they are the second most abundant sea turtle in mid-Atlantic waters, arriving in these areas during late May and June (Keinath et al., 1987; Musick and Limpus, 1997). 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 shallow embayments, particularly in areas supporting submerged aquatic vegetation (Lutcavage and Musick 1985; Bellmund et al., 1987; Keinath et al., 1987; Musick and Limpus 1997). Other studies have found that post-pelagic ridleys feed primarily on crabs, consuming a variety of species. Mollusks, shrimp, and fish are consumed less frequently (Bjorndal 1997).

With the onset of winter and the decline of water temperatures, Kemp's ridleys migrate to more southerly waters from September to November (Keinath et al. 1987; Musick and Limpus 1997). Turtles that do not head south before water temperatures drop rapidly face the risk of cold-stunning. Cold stunning can be a significant natural cause of mortality for sea turtles in 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.). Annual cold stun events only occasionally 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. Cold stunned turtles have also been reported on beaches in New York and New Jersey (Morreale et al., 1992). Although cold stun turtles can survive if found early enough, cold stunning events can represent a significant cause of natural mortality.

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

Threats to Kemp's ridleys' recovery
Like other turtle species, the severe decline in the Kemp's ridley population appears to have been heavily influenced by a combination of exploitation of eggs and impacts from fishery interactions. From the 1940's through the early 1960's, nests from Ranch Nuevo were heavily exploited (USFWS and NMFS, 1992), but beach protection in 1966 helped to curtail this activity (USFWS and NMFS, 1992). Currently, anthropogenic impacts to the Kemp's ridley population are similar to those discussed above for other sea turtle species. Sea sampling coverage in the Northeast otter trawl fishery, pelagic longline fishery, and southeast shrimp and summer flounder bottom trawl fisheries have recorded takes of Kemp's ridley turtles. Following World War II, there was a substantial increase in the number of trawl vessels, particularly shrimp trawlers, in the Gulf of Mexico where the 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 Turtle Excluder Devices (TEDs).

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

Status and trends of Kemp's ridley sea turtles
When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963), but the population has been drastically reduced from these historical numbers. However, the TEWG (1998; 2000) indicated that the Kemp's ridley population appears to be in the early stage of exponential expansion. Nesting data, estimated number of adults, and percentage of first time nesters have all increased from lows experienced in the 1970's and 1980's. 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. 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% from 1981 to 1989 and from 23% to 41% from 1990 to 1994.

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 internesting 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 increases 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 and to meet the goals identified in the Kemp's Ridley Recovery Plan.

Sea turtles in the action area

There is limited information on the abundance and distribution of sea turtles in the action area. While sea turtles could enter inshore New Jersey waters through the Beach Haven Inlet, several hundred kilometers south of OCNGS, it is improbable that turtles in this area would migrate northward through the narrow intracoastal waterway to the Barnegat Bay. Thus, the Barnegat Inlet, approximately 300 m wide, is considered to be the only direct access for turtles to Barnegat Bay. A sea turtle entering Barnegat Bay must travel along narrow, shallow navigation channels and pass through the wooden support structures of three bridges in order to reach the OCNGS. While this route may seem difficult for migrating or foraging sea turtles, the presence of sea turtles on the CWS and DWS intake structures provides evidence that sea turtles do occur in the action area.

No turtles have been sighted during many years of biological sampling efforts in Barnegat Bay conducted by or for the OCNGS. These biological monitoring programs were intended to qualify and quantify the marine biota of Barnegat Bay, and were not specifically tailored to capture sea turtles. In any event, sampling occurred during all twelve months of the year, day and night, at the plant intake structures as well as the intake and discharge canals. Approximately 20,000 hours of impingement and entrainment sampling (24-54 hours/week) were conducted at the CWS intake from 1975-1985, and no turtles were observed. Additionally, in Barnegat Bay, Forked River, and Oyster Creek, otter trawl sampling was conducted, gillnet sampling (with mesh sizes of 38, 70, and 89 mm) was conducted at the surface to mid-depth, and stretch mesh (0.6 and 1.3 cm) seines sampled the entire water column in nearshore areas. From 1975-1985, nearly 3000 trawl samples, hundreds of gillnet samples, and more than 2000 seine samples were collected, but no sea turtles were captured.

The BA does list one reference of a loggerhead caught in an otter trawl during a 5-year survey of Great Bay and Little Egg Harbor (estuaries immediately south of Barnegat Bay) conducted by Rutgers University prior to 1993. While there have not been any sea turtles captured in sampling efforts in the Barnegat Bay, these studies were conducted before any turtles were captured at OCNGS. As a number of sea turtles have been observed captured at OCNGS over the last 9 years and the deepening of Barnegat Inlet has likely allowed more sea turtles to enter Barnegat Bay, the composition, numbers and distribution of sea turtles in the action area may have changed since the previous sampling efforts. It would be useful to conduct an in-water assessment of sea turtles in the action area, following the NMFS-approved in-water sampling protocol.

Stranded sea turtles occur on New Jersey beaches. Loggerheads are the most common species found stranded in New Jersey, followed by leatherbacks, Kemp's ridleys and greens. From 1980 to 1999, most of the sea turtle strandings in New Jersey coastal and estuarine waters have occurred from June to November, with September having the highest number of loggerhead and Kemp's ridley strandings, followed by August. From 1992 to 1999, 90 out of a total 313 loggerhead sea turtles stranded in New Jersey were found in Ocean County, the county in which OCNGS is located. However, data from the Sea Turtle Stranding and Salvage Network for Ocean County suggests that the majority of strandings occur on the ocean side of the barrier beaches, not in the inshore areas.

ENVIRONMENTAL BASELINE

By regulation, 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 which are contemporaneous with the consultation in process (50 CFR §402.02). The environmental baseline for this biological opinion includes the effects of several activities that affect the survival and recovery of threatened and endangered species in the action area. Within the action area, sea turtles and optimal turtle habitat may likely have been impacted by vessel collisions, previous dredging projects, fisheries, and pollution.

A potential contributor to sea turtle mortality in the action area is collisions with vessels, from both commercial and recreational sources. 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. As turtles may be in the area where high vessel traffic occurs, the potential for collisions with vessels transiting these waters exists.

Dredging activities have the ability to impact sea turtles by entraining and killing turtles and by disrupting their habitat. Sea turtle mortality in hopper dredging operations occurs when the turtles are sucked into the dredge draghead, pumped through the intake pipe and then killed as they cycle through the centrifugal pump and into the hopper. The depth of the Intracoastal Waterway, located in the action area, must be maintained for navigational purposes, resulting in dredging being conducted in the action area. The specific dredge used in dredging the Intracoastal Waterway is not available at the time of this consultation. However, previous dredging activities conducted to develop and maintain the channel may have impacted sea turtles. Furthermore, the Barnegat Inlet, the only tidal inlet in the vicinity of Oyster Creek which provides access to Barnegat Bay from the Atlantic Ocean (and the probable pathway for turtles moving to the OCNGS), was deepened during dredging operations in the early 1990s. Sea turtles were not documented at OCNGS until 1992, after the Barnegat Inlet was dredged, and it is likely that this deepening provided access for sea turtles to enter the action area. Thus, due to the dredging of Barnegat Inlet, sea turtles are now found in the vicinity of the OCNGS and are more likely to be impinged at the intakes. While there have been no takes documented in any dredging activities conducted in the action area, sea turtles may have been impacted by dredging operations, including direct injury or morality, the resuspension of sediments potentially containing contaminants, and the alteration of foraging habitat.

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. Thus, sea turtles may interact and be affected by any of these commercial or recreational fisheries.

Approximately 28% of the Barnegat Bay watershed is developed (residential, commercial, industrial, and institutional), while 46% is forested land. The 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.

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). These chemical contaminants may have an effect on sea turtle reproduction and survival. While the effects of contaminants on turtles is relatively unclear, pollutants may also make sea turtles more susceptible to disease by weakening their immune systems.

EFFECTS OF THE ACTION

In this section of a biological opinion, as required by the ESA and interagency section 7 regulations, NMFS assesses the direct and indirect effects of the proposed action on threatened and endangered species or critical habitat, together with the effects of other activities that are interrelated or interdependent (50 CFR §402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR §402.02). The purpose of this assessment is to determine if it is reasonable to expect the NRC's proposed action to have direct or indirect effects on threatened and endangered species that appreciably reduce their likelihood of both the survival and recovery in the wild [which is the "jeopardy" standard established by 50 CFR §402.02].

The proposed action is likely to adversely affect threatened and endangered sea turtles in four different ways: (1) impingement at either the CWS or DWS intake trash racks; (2) alteration of sea turtle distribution or sea turtle prey abundance from the thermal discharge; (3) cold stunning relating to the thermal discharge; and (4) impacts from the chlorine used at the OCNGS. Biological interactions result from disturbance of normal sea turtle foraging behavior and changes in the composition of the marine community. This Opinion assesses each of these four effects on the sea turtles' likelihood of surviving and recovering in the wild, but most of the discussion will focus on impingement, which is the greatest potential threat of OCNGS to sea turtles.

A) Impingement of Sea Turtles

Power plants with intake structures have the potential to impinge sea turtles, resulting in mortality if the turtles are not recovered within a sufficient amount of time. Both live and dead sea turtles have been found impinged at the OCNGS in the past, at both the DWS and CWS intakes. The problem with this impingement is that a turtle could be caught against the grate underwater by the current long enough to cause suffocation or drowning. 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. 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 and incidence of sea turtle death (Henwood and Stuntz 1987, Stebenau and Vietti 2000). 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. 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 stressed, and these conditions may increase the turtles' susceptibility to suffocation or drowning.

If a sea turtle is impinged on the intake trash bars, drowning will be the most likely cause of mortality or injury, but the sea turtle could also become injured by the operation of the facility. Debris are cleaned from the intake trash bars by a trash rake which is moved on a track from one bay to the next. 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.

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. Thus, if impingement impedes this migration, this would affect typical sea turtle migration and/or foraging patterns. Most of the sea turtles found at OCNGS are juveniles and are not 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.

Debris floating on the surface could make it more difficult to spot a turtle below, particularly if the turtle was flush against the grating. A small amount of debris may not be enough to block the flow and necessitate use of trash rakes, but could hide a turtle. In addition, visibility at the intake bays, which are 15 (DWS) to 18 (CWS) feet deep, is only 2-3 feet. Although at least one of the impinged turtles was found alive with its head out of the water, a turtle that is impinged at depth could remain out of sight until the trash rake was lowered to it. It is possible that a turtle could swim into the intake bay, encounter the grating, and swim down along the grating to a depth below the view of surface observers. If a turtle is feeding on the bottom of the intake canal, its first encounter with the intake grating could be at depth.

It is unclear why sea turtles enter the Forked River and encounter the OCNGS intake structures. Turtles could be attracted to the intake screens when prey items such as blue crabs and horseshoe crabs are gathered there. In 1992, one loggerhead turtle was recaptured 2 days after it was released into the discharge canal. This suggests that the turtle was attracted either to the ambient conditions in the south fork of the Forked River or to the conditions at the intake trash racks. Attractive features may be associated with the discharge as well as the intake. 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.

The diversion of the south fork of the Forked River may also create conditions which attract turtles to the OCNGS and therefore increase the likelihood of impingement. When the plant is operational, all flow in the south fork is diverted into the CWS and DWS intakes, so it is possible that impingements of turtles at the OCNGS could be the result of routing the entire south fork rather than of an attraction at the intake screens. The diversion also represents a reversal of flow in the south fork.

Though sea turtles are known to use New Jersey's coastal waters, no turtles were observed in Barnegat Bay in 20 years of sampling conducted by OCNGS up to 1992 and no turtles were observed taken at the plant during the first 23 years of operation. However, the frequency and efficiency of monitoring the intakes prior to 1992 has not been determined. Incidental captures of sea turtles at OCNGS CWS and DWS cooling water intakes were documented in June of 1992 by OCNGS Environmental Controls personnel and reported to NMFS according to reporting procedures established through informal consultation conducted between OCNGS, NRC, and NMFS. 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, but the cause of death was not established for all of the dead animals. From September 1995 to the present, 9 additional sea turtle impingements have been documented at the OCNGS intake trash bars, including 3 loggerheads, 4 Kemp's ridleys, and 2 greens. Thus, there have been 18 total observed takes at the OCNGS since 1969, including 8 Kemp's ridleys, 8 loggerheads (which includes 1 recapture), and 2 greens. The details of those takes are outlined in Appendix I.

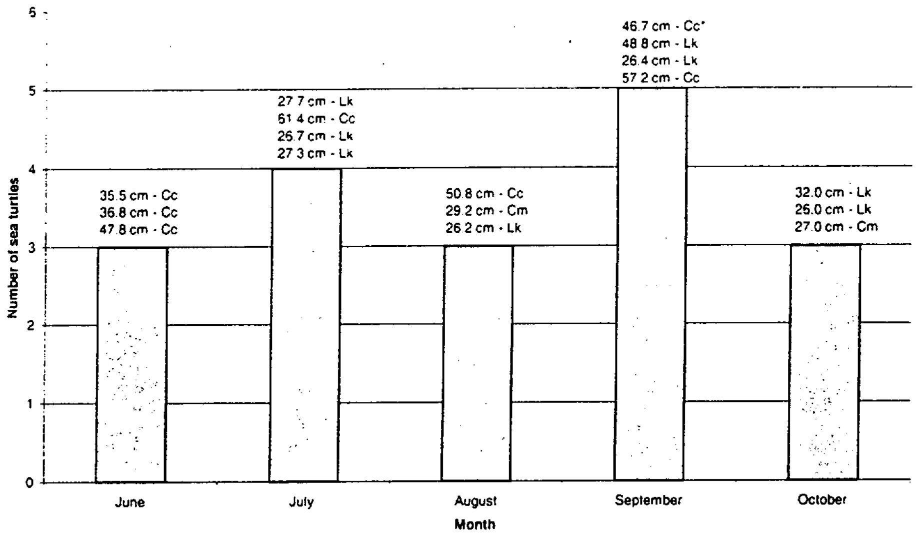
The number of sea turtles collected at the OCNGS CWS and DWS intakes per year has ranged from zero (from 1969 to 1991, 1995, 1996) to a maximum of five in 2000, with an average of slightly less than two turtles incidentally captured during any single year since 1992. The number of loggerhead takes has ranged from zero to two (in 1992, 1994, 2000) a year, and the number of Kemp's ridley annual takes has been from zero to two (in 1994, 2000). The number of green sea turtles collected annually on the intakes ranged from zero to two (in 2000).

As previously noted, the frequency and effectiveness of monitoring the intake trash bars prior to the first turtle impingement in 1992 is uncertain, and this may have played a role in the pattern of sea turtle impingements. However, the operation of the OCNGS has not changed appreciably since 1969, suggesting that the onset of turtle captures in 1992 is due to higher numbers of sea turtles in the project area. The deepening of Barnegat Inlet and associated waterway channels was completed immediately prior to 1992, when incidental captures of sea turtles began to occur at OCNGS. As the deepening of this inlet provided for a greater volume of water and tidal range in the Barnegat Bay and in the vicinity of Oyster Creek, a greater number of turtles may have been able to enter the Bay as a result of this deepening. If maintenance dredging of the Intracoastal waterway and Barnegat Inlet, which increases water volume, makes 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.

While four turtles were collected at OCNGS in 1994, more turtles have been captured in 2000 than in any other year and this number is much higher than the average since 1992 (approximately 2 turtles/year). Physical and biological factors may have played a role attracting more turtles to the vicinity of OCNGS in 2000, but there is no information on the documentation of more turtles in the action area or the physical or biological parameters that may have cause such an increase during this time period. Therefore, it is unclear why more sea turtles were captured in 2000 than in previous years.

All of the turtles have been collected at OCNGS from June through late October. This confirms the presumption that loggerhead, Kemp's ridley, and green sea turtles occur in the action area during this time period and that the impacts of the OCNGS on listed species will be higher during June through early November. Most of the turtles have been collected in September (including the recapture), followed by July (Figure 2). It does not appear that there is any pattern in the species caught in the different months. With the exception of June, when only loggerheads were captured, at least two different species were caught in any given month. While it has been thought that turtles are less active at night, thus increasing the likelihood of impingement at night, the results at OCNGS do not support this theory. There does not appear to be any difference in the time of day for which turtles were collected from 1992 to the present. However, these results should be interpreted with caution because in many of the cases the turtles could have been present at the intake structure between 3 to 8 hours.

FIGURE 2. Seasonal Occurrence, Species, and Straight Carapace Length of Sea Turtles found at OCNGS intakes



*This turtle was captured twice in the month of September

The loggerhead turtles incidentally captured at OCNGS had an average straight carapace length (SCL) of 47.9 cm. The incidentally captured eight Kemp's ridleys and two green turtles had an average SCL of 30.1 cm and 28.1 cm, respectively. Most of the sea turtles likely to occur in the project area are too large to pass through the intake trash bars, which are constructed with 6.6 cm wide openings. All of the turtles captured at OCNGS thus far have measured at least 26 cm SCL. 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 small turtles will be in the vicinity of the OCNGS, but if they were entrained in the facility, they could be subject to stress or drowning. The DWS intake trash bars are not equipped with traveling screens to return entrained organisms to the water.

That there have been slightly more Kemp's ridleys caught at OCNGS than loggerheads is noteworthy, as there are thought to be more loggerheads than Kemp's ridleys in New Jersey waters. Kemp's ridleys could 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. However, little information exists about the swimming behavior of turtles which can be used to make predictions about behavior at intake gratings or the ability to swim against various current velocities. Of the 10 live turtles found at OCNGS from 1992 to the 2000, two loggerheads (36.8 cm SCL and 50.8 cm SCL) were swimming freely upstream of the CWS intake bars. Of the 18 turtles found impinged at OCNGS, 56% (n=10) of these turtles were alive at the time of incidental capture (Appendix I). Of the eight loggerheads taken, 75% (n=6) were alive at the time of the take, while only 38% (n=3) of the eight Kemp's ridleys were taken alive. One of the two captured green turtles was alive. Nine of the ten live turtles were successfully released into the ocean, with the remaining turtle anticipated to be released in the near future. 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.

There is currently no available data on the distribution of loggerheads, Kemp's ridleys and greens in the action area. It is possible that small sea turtles occur in the vicinity of Oyster Creek and do not become impinged in the intake structure. There were no greens captured at OCNGS until 1999, when 1 was taken in 1999 and another in 2000. The green turtles were similar in size to the Kemp's ridleys that were taken. It is unclear why green sea turtles are being incidentally captured with greater frequency than in previous years.

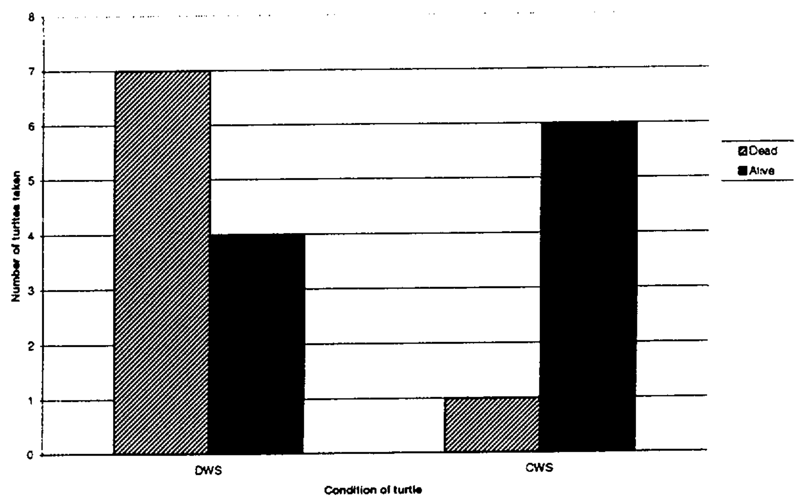
The cause of death for many of the turtles found at OCNGS is difficult to determine. Necropsy results are only available for three turtles, the two dead loggerheads and one Kemp's ridley. The cause of death for the loggerhead captured on June 25, 1992, was determined to be from boat propeller wounds, before impingement at the OCNGS. The Kemp's ridley captured on October 17, 1993, was found to have drowned at the DWS trash bars, given the lack of obvious trauma. This turtle was found to have no stomach contents, which is not surprising as turtles are expected to be migrating during this time of year. The necropsy performed on the loggerhead captured on July 6, 1994, concluded that the turtle did not die at the OCNGS due to the level of decomposition, apparent bacterial infection, and good condition of the lungs. However, the presence of blue crabs in both the esophagus and stomach suggest that this turtle was actively feeding prior to death. While necropsies have not been performed on the additional four dead Kemp's ridleys, the specimens appeared to be fresh dead, leading to speculation that the impingement at the OCNGS was responsible, at least in part, for the mortalities. The one dead green turtle was also captured in fresh condition, also suggesting that drowning was the cause of death. However, it is possible that the documented lethal take at OCNGS could be an overestimate of the number of turtles that were actually killed by the facility.

While there were more sea turtles captured at OCNGS in 2000 than in any other year, four of the five turtles were found alive. These turtles were (or are anticipated to be) released in apparent good condition into the Atlantic Ocean. With frequent and effective monitoring, sea turtles incidentally captured at either the DWS or CWS intake can be successfully released.

The specific intake location could be a factor in the number of turtles incidentally captured as well as the condition of the turtle. Of the eighteen incidental captures from 1992 to 2000, eleven (61%) have occurred at the DWS intake and seven (39%) at the CWS intake (Figure 3). There has also been a greater percentage of takes at the DWS in recent years; five of seven turtles (71%) have been found at the DWS intake since 1999, whereas six of eleven turtles (55%) were found there before 1999. However, the reason for this slight increase is unknown, as there has been no operational or mechanical change at either intake since that time which would explain the increase in takes at the DWS intake. It is also noteworthy that more sea turtles have been found dead than alive at the DWS (64%) as compared to those captured at the CWS (14%;

Figure 3). However, this could be attributable to a number of variables. For example, more Kemp's ridleys (and greens) have been found at the DWS and they may be more susceptible to drowning or less able to swim away from the high intake velocity given their small size in these waters. Additionally, the intake velocity at the DWS is higher than the CWS intake velocity, drawing in more water, which could contribute to a higher degree of mortality.

FIGURE 3. Condition and location of turtles found at OCNGS intakes



During normal operation at 100% power, the two dilution water pumps typically withdraw a total of 1968 m^3/min from the intake canal and the four circulating water pumps withdraw a total of an additional 1740 m^3/min. The cross sectional area of the DWS intake is smaller than that of the CWS intake, resulting in a higher average through-screen velocity at the DWS than at the CWS intake. The DWS pumps typically withdraw about 53% of the water pumped from the intake canal, while the DWS pumps withdraw approximately 47%. The ratio of water intake levels are similar to the ratio of turtle takes between the DWS and CWS. However, there is no information on the relative effects of suction at the trash racks on a turtle-shaped object for different current velocities. It may be much more difficult for a turtle to remove itself from a position parallel to the trash rack than from a perpendicular position at the surface.

The floating debris/ice barrier upstream of the intake structures was designed to divert floating debris away from the CWS intake and toward 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.

The intake velocity, amount of water withdrawl, and the floating debris/ice barrier are potential factors in the higher number of takes at the DWS as compared to the CWS. The differences between DWS and CWS could also be attributable to the turtle species. From 1992 to 2000, five of the eight loggerheads (63%) captured at OCNGS have been retrieved from the CWS intake, while only two of the eight Kemp's ridleys (25%) and neither of the green turtles have been found at the CWS intake. The biological characteristics of the individual and/or species (i.e., size, strong swimmer) could determine the resultant intake. The loggerheads incidentally captured have been generally larger than the Kemp's ridleys or greens, 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. There is no information to suggest that one sea turtle species would be more likely to be at the surface than another, and whether these sea turtles are found on the surface would depend on the activity. 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. If turtles are migrating they could be found near the surface. In water depths greater than 15 meters in New York, young Kemp's ridleys were found to spend the majority of their time in the upper portions of the water column and time spent on the surface increased with water depth (Morreale and Standora 1990). Barnegat Bay itself is relatively shallow, 1.2 m deep on average, and the depths at the intake bays are only approximately 4 to 6 meters deep.

B) Impacts of thermal discharge

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. Sea turtles may be affected directly or indirectly by these elevated temperatures, but it is important to note that no sea turtles have been observed in the vicinity of the OCNGS discharge.

The water flowing from the DWS and CWS is discharged through separate structures. However, sea turtle entrainment in the DWS and CWS discharge structures is unlikely. The discharge velocities are high (65-95 cm/sec), likely precluding a sea turtle from staying in the vicinity of the discharge for a significant amount of time. Given the velocity associated with these discharges, a sea turtle would have to actively swim against the current and stay in the vicinity of the discharge; this situation is unlikely to occur at OCNGS. The more notable impacts on sea turtles from the DWS and CWS discharges are likely due to the elevated temperatures of the discharges. The temperature rise of the CWS discharge is typically about 11° C above ambient canal temperatures, while the DWS discharge is approximately 5.6° C above ambient water temperatures when two dilution pumps are operating.

While sea turtles will not likely be killed by these elevated temperatures, temperature rises 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.

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, suggesting that sea turtles leave this site before cold-stunning would occur.

However, cold shock mortalities of fish have occurred at OCNGS when water temperatures have decreased in the fall. 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.

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), the BA identifies certain aspects of the OCNGS discharge that may make cold stunning less likely to occur. For example, the area where sea turtles may overwinter (and entertain 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° 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° C. In any event, during the winter, the area where the water temperatures would be suitable for sea turtles is small and localized.

Furthermore, the current is strong at the site of these discharges (65-95 cm/sec) and it is improbable that turtles would fight the current long enough to remain in the warmest portions of the effluent. Turtles that stay in this area would most likely have to undergo continuous swimming activity, and the food resources in this area would also have to be sufficient to maintain such activity. During the winter, it is unlikely that the prey will be sufficient to maintain this level of activity, but data are not available on the amount of prey in the discharge area in the winter. It is also relatively unlikely that sea turtles would be foraging in the action area during the colder months. Turtles present in the vicinity of Oyster Creek may not be foraging during the fall (or in the winter if they are present in the area), but instead, sea turtles are likely undergoing seasonal migrations during this time. Dr. Steve Morreale noted, in the report of the necropsy performed on the Kemp's ridley impinged on October 17, 1993, that the lack of food in the gut is typical of sea turtles that he has seen at that time of the year and is indicative of a behavioral change prior to migrating southward.

The impacts of the thermal plume in Barnegat Bay appear to be on the surface and relatively small, thus reducing the potential negative affect 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 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. However, turtles should be able to move around the plume into other areas of the Bay.

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, the heated effluent will not have as great of an impact on the turtles (i.e., from cold stunning) as it would in the winter. Furthermore, the New Jersey Department of Environmental Protection 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 with few or no regional consequences (Summers et al. 1989 in OCNGS 2000). Thus, it does not appear that the preferred prey of loggerhead, Kemp's ridleys, and greens are impacted to a great extent by the thermal discharge of the OCNGS.

C) 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 approximately 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, as limited by the New Jersey Pollutant Discharge Elimination System permit for the OCNGS. According to the BA, 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. 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 issues. The necropsies conducted on the sea turtles found at the OCNGS did not assess the levels of contaminants in the tissue.

The chlorine discharge may have some level of impact on sea turtles, but the effect is unquantifiable at this time. In any event, there is only a small quantity of chlorine applied to the CWS, the residual chlorine levels in the condenser discharge are near zero, and the condenser discharge is combined with unchlorinated DWS flow before entering the discharge canal. Any level of chlorine in the water would be further diluted as the discharge canal mixes with the Barnegat Bay, the area where sea turtles would most likely be present. This minimal level of chlorination in the discharge canal and in the proximity to the greatest number of sea turtles in the action area results in little potential impact to sea turtles.

D) Summary of effects

The greatest risk to sea turtles from the continued operation of the OCNGS is due to impingement at the DWS and CWS intakes, resulting in injury or mortality. Sea turtles that are impinged at the intakes may drown if they have been previously injured, are diseased or incapacitated, or if they are not removed from the intakes before they drown. The amount of time a sea turtle may remain underwater varies on a number of parameters, including the species of sea turtle, size and condition of the animal, and water temperature. In any event, sea turtles, both alive and dead, may become impinged at the OCNGS intakes. Turtles may also be injured by the process of debris cleaning by the trash rake or they may be affected by the heated discharge or chlorine levels in the water.

Loggerhead sea turtles

Like other sea turtles, loggerheads demonstrate slow growth, delayed maturity, and extended longevity to allow individuals to produce more offspring. As discussed in the Status of the Species section, more offspring may compensate for the high natural mortality in the early life stages; i.e., mortality rates of eggs and hatchling are generally high and decrease with age and growth. The risks of delayed maturity are that annual survival of the later life stages must be high in order for the population to grow. Population growth has been found to be highly sensitive to changes in annual survival of the juvenile and adult stages. Crouse (1999) reports, "Not only have large juveniles already survived many mortality factors and have a high reproductive value, but there are more large juveniles than adults in the population. Therefore, relatively small changes in the annual survival rate impact a large segment of the population, magnifying the effect."

The loggerhead sea turtles in the action area are likely to represent differing proportions of the four western Atlantic subpopulations. Although the northern breeding population 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. Twenty-five to 59 percent of the loggerhead sea turtles in this area are from the northern breeding population (Sears 1994, Norrgard 1995, Sears et al. 1995, Rankin-Baransky 1997, Bass et al. 1998). As described in the Status of the Species section, the TEWG (2000) estimated that there was a mean of 6,247 northern subpopulation nests in 1989 to 1998, translating into approximately 3,800 nesting females. This subpopulation may be experiencing a significant decline due to a combination of natural and anthropogenic factors, demographic variation, and a loss of genetic viability. It is likely that a large number of the loggerheads which may occur in the action area may originate from the northern breeding population. Loggerheads originating from the southern breeding population could also be in the vicinity of the OCNGS.

A total of 8 loggerhead impingements occurred at the OCNGS intake trash bars between January 1992 and December 2000, with an average of approximately 1 take per year. The maximum number of loggerheads taken annually was 3, but one of these takes was a recapture. Two loggerheads were captured in 2 separate years. The maximum number of loggerhead mortalities in any given year was 1, with an average of 0.2 mortalities per year over the 9 years where sea turtles were taken (range 0 to 1). Necropsy reports are not available for all the loggerhead mortalities, so it is not possible to adjust this rate to reflect mortalities which may have occurred prior to impingement. Given the level of previous impingement at the OCNGS, the status and distribution of loggerhead sea turtles, and the proposed operation of the facility with the mitigation measures in place, the anticipated loggerhead take associated with the continued operation of the OCNGS is five animals per year, with a maximum of two lethal.

NMFS anticipates that no more than five loggerheads (no more than two lethal) will be taken each year as a result of the continued operation of the OCNGS. Thus, the operation of the OCNGS could result in the take of up to 100 loggerheads (40 lethal) over the next twenty years. The death of two loggerheads every year would represent a loss of less than 0.05 percent of the estimated number of nesting females in the northern subpopulation. These are conservative estimates, however, since the loss of loggerhead turtles during the proposed activity are not likely limited to adult females, the only segment of the population, or subpopulation, for which NMFS has any population estimates. Although unlikely to occur, a worse case scenario could occur over the next twenty years if the anticipated 40 loggerheads killed were juvenile females from the northern subpopulation.

Given the low numbers of anticipated take (even under a worst case scenario) and the current loggerhead subpopulation sizes, the operation of the OCNGS is not expected to have a detectable effect on the numbers or reproduction of the affected subpopulations. Therefore, it is not expected to appreciably reduce the likelihood of survival and recovery of the species.

Kemp's ridley sea turtles
A total of 8 Kemp's ridley impingements occurred at the OCNGS intake trash bars between January 1992 and December 2000, with an average of approximately 1 take per year. The maximum number of Kemp's ridleys taken annually was 2, which was reached in 2 separate years. The maximum number of Kemp's ridley mortalities in any given year was 2, with an average of 0.6 mortalities per year over the 9 years where sea turtles were taken (range 0 to 2). Necropsy reports are not available for all the Kemp's ridley mortalities, so it is not possible to adjust this rate to reflect mortalities which may have occurred prior to impingement. Given the level of previous impingement at the OCNGS, the status and distribution of Kemp's ridley sea turtles, and the proposed operation of the facility with the mitigation measures in place, the anticipated Kemp's ridley take associated with the continued operation of the OCNGS is four animals per year, with a maximum of three lethal.

The biology of the Kemp's ridley also suggests that losses of juvenile turtles can have a magnified effect on the survival of this species. NMFS anticipates that no more than four Kemp's ridleys (no more than three lethal) will be taken each year as a result of the continued operation of the OCNGS. Thus, the operation of the OCNGS could result in the take of up to 80 Kemp's ridleys (60 lethal) over the next twenty years. The death of three Kemp's ridleys every year would also represent a loss of less than 0.1 percent of the population. As with loggerheads, these are conservative estimates since the loss of Kemp's ridleys during the proposed activity is not likely limited to adult females, the only segment of the population for which NMFS has any population estimates. Although unlikely to occur, a worse case scenario could occur over the next twenty years if all of the 60 Kemp's ridleys killed were juvenile females.

Given the low numbers of anticipated take (even under a worst case scenario) and the current population size, this loss is not expected to have a detectable effect on the numbers or reproduction of the affected population. Therefore, the operation of the OCNGS is not expected to appreciably reduce the likelihood of survival and recovery of the species.

Green sea turtles
A total of 2 green turtle impingements occurred at the OCNGS intake trash bars between January 1992 and December 2000, with an average of 0.2 takes per year. However, these two takes have

occurred since 1999. The maximum number of greens taken annually was 1, and the maximum number of green turtle mortalities in any given year was 1, with an average of 0.1 mortalities per year over the 9 years where sea turtles were taken (range 0 to 1). Necropsy reports are not yet available for the green turtle mortality, so it is not possible to adjust this rate to reflect mortality which may have occurred prior to impingement. Given the level of previous impingement at the OCNGS, the status and distribution of green sea turtles, and the proposed operation of the facility with the mitigation measures in place, the anticipated green turtle take associated with the continued operation of the OCNGS is two animals per year, with a maximum of one lethal.

Population estimates for the western Atlantic green sea turtles are not available. However, nesting beach data corrected on index beaches since 1989 have shown a general positive trend. NMFS anticipates that less than two greens (no more than one lethal) will be taken each year as a result of the continued operation of the OCNGS. Thus, the operation of the OCNGS could result in the take of up to 40 greens (20 lethal) over the next twenty years. At this time, the effects of the lethal incidental take of one green sea turtle a year on the population is not known, but this level of take is not likely to represent a significant loss to the population. Although unlikely to occur, a worst case scenario could occur over the next 20 years if all of the 20 green sea turtles killed were juvenile females. Given the low numbers of anticipated take (even under a worst case scenario) and the estimated population size, this loss is not expected to appreciably reduce the likelihood of survival and recovery of the species.

Based on the above rationale, NMFS anticipates that no more than five loggerheads (no more than two lethal), four Kemp's ridleys (no more than three lethal), or two greens (no more than one lethal), will be taken each year as a result of the operation of the OCNGS. To ensure that the analysis of effects in this biological opinion captures the long-term effects of this recurring activity, NMFS assumes that the operation of the OCNGS will occur over the next twenty years, from 2001 to 2021. The impacts to the species and long term anticipated incidental take will be evaluated on this time frame. Thus, the operation of the OCNGS could result in the take of up to 100 loggerhead (40 lethal), 80 Kemp's ridley (60 lethal), or 40 green (20 lethal) sea turtles over the next twenty years.

CUMULATIVE EFFECTS

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

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 mortality and/or harassment of 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 affect populations of endangered and threatened sea turtles, preventing or slowing a species' recovery, the magnitude of these effects is currently unknown.

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 Marine Mammal Stranding Center in Brigantine, New Jersey, reports an increase in the number of turtles hit by boats in New Jersey inshore 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. Stormwater 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

Sea turtles are known to use New Jersey's coastal waters. While loggerhead, Kemp's ridley and green sea turtles are known to occur in the action area, there has not been a recent study determining the distribution or abundance of turtles in Barnegat Bay, and the use of the action area by sea turtles has probably changed over the past 30 years. This theory can be substantiated by the level of documented impingements occurring at the OCNGS intake structures. From 1969 to 1992, there were no sea turtles observed captured at OCNGS. However, since 1992, 18 sea turtles have been impinged at either the CWS or the DWS intake structures of the OCNGS, including 8 Kemp's ridleys, 8 loggerheads (which includes 1 recapture), and 2 greens. This apparent increase in the number of sea turtles impinged at the OCNGS since 1992 has been explained by the deepening of Barnegat Inlet, the likely path for sea turtles entering Barnegat Bay from the Atlantic Ocean. As the depth of this inlet will continue to allow sea turtles to enter the action area, sea turtle impingement is expected in the future.

The operation of the OCNGS is likely to result in the lethal and non-lethal take of loggerhead, Kemp's ridley and green sea turtles. The monitoring measures and consistent use of resuscitation techniques employed by the OCNGS will ensure that these turtle takes are observed and reported, and the diligent implementation of these procedures and prompt discovery of impinged turtles may likely serve to capture more sea turtles alive than dead.

In the past, the maximum number of sea turtles taken annually was 5 (in 2000), and the maximum number of turtle mortalities in any given year was 3 (in 1994), with an average of 0.9 mortalities per year over the 9 years where sea turtles were taken (range 0 to 3). Of the 18 turtles found impinged at OCNGS, 10 of these turtles were alive at the time of the incidental capture. Most of the turtles found alive were loggerheads (6 of the 10). Necropsy reports are not available for all the turtle mortalities, so it is not possible to adjust the mortality rate to reflect mortalities which may have occurred prior to impingement. While two of the three turtles for which necropsies were performed were assumed to have died prior to impingement, it is not appropriate to apply this rationale to the rest of the dead turtles impinged at OCNGS.

The thermal discharge from the OCNGS may also directly and indirectly impact sea turtles, by altering their normal distribution and attracting turtles to the heated discharge (potentially resulting in a cold stun event), or modifying the distribution and abundance of prey resources in the action area. The use of chlorine to control biofouling at the OCNGS may also affect turtles, albeit to an unknown extent, if chlorine is found in the discharge.

Over the next twenty years, an unknown number of loggerhead, Kemp's ridley, and green sea turtles may be injured or killed by commercial or recreational fisheries, vessel collisions, ingestion of debris, or chemical contamination in the action area. Adverse effects to sea turtle habitat are also expected to continue. Since quantitative data on the extent of these impacts to turtle populations are lacking, a reliable cumulative assessment of these effects is not possible.

Based on information provided in the Effects of the Action section of this Opinion, NMFS anticipates that no more than 5 loggerheads (no more than 2 lethal), 4 Kemp's ridleys (no more than 3 lethal), or 2 greens (no more than 1 lethal), will be taken each year as a result of the operation of the OCNGS. Based on the current status of the species, anticipated continuation of current levels of injury and mortality from other human activities described in the environmental baseline and cumulative effects section of this Opinion, and previous takes at the OCNGS, this level of take is not expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the sea turtle populations considered in this opinion by reducing the numbers, distribution, or reproduction of the species.

CONCLUSION

After reviewing the current status of the species discussed herein, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the NMFS' biological opinion that the proposed action may adversely affect but is not likely to jeopardize the continued existence of endangered Kemp's ridley, green, or threatened loggerhead sea turtles. No critical habitat has been designated in the action area, therefore, none will be affected.

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.

Harass is defined by FWS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, 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 anticipated
NMFS anticipates that the continued operation of the OCNGS may result in the injury or mortality of loggerhead, Kemp's ridley, or green sea turtles. Based on previous levels of impingement, the distribution of sea turtle species, and the operation of the facility, NMFS anticipates that no more than five (5) loggerheads (no more than two (2) lethal), four (4) Kemp's ridleys (no more than three (3) lethal), or two (2) greens (no more than one (1) lethal), will be taken each year as a result of the operation of the OCNGS.

NMFS also expects that the OCNGS may take an additional unquantifiable number of previously dead loggerhead, Kemp's ridley and green sea turtles (turtles not killed as a result of plant operations) at the OCNGS intakes. The death of these turtles will not be considered related to plant operations and count towards the above referenced anticipated take level if: the dead or injured turtle is seen floating into the canal; the turtle can be determined to have been killed or injured by boat propellers and/or debris (such as discarded fishing equipment); if a turtle found on the intake trash bars from June 1 through October 31 (this is when daily inspections of the trash bars are done) is in an advanced state of decay; and any dead or injured turtle is found in the canal more than 30 meters away from the trash bars (NMFS assumes that it is unlikely that a turtle could be killed on the trash bars and then come loose and float against the flow and go into the main canal). All takes determined to be unrelated to OCNGS operations will be verified by the appropriate stranding/rehabilitation personnel.

Effect of the take
In the accompanying biological opinion, the NMFS determined that levels of anticipated take are not likely to result in jeopardy to loggerhead, Kemp's ridley, or green sea turtles.

Reasonable and Prudent Measures
The 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 have a NMFS approved program in place to prevent, monitor, minimize, and mitigate the incidental take of sea turtles in 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.

Terms and Conditions
In order to be exempt from prohibitions of section 9 of the ESA, NRC must comply 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. The Oyster Creek Nuclear Generating Station's 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, particularly at night. Turtles or turtle parts might be confused with horseshoe crabs caught on the racks in abundance.

    d. An alternative method of daily cleaning 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.

2. 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 (twice per 8-hour shift) from June 1 through October 31. Inspections must follow a set schedule so that they are regularly spaced rather than clumped. The proposed schedule of 1-2 hours into each 8-hour shift and 5-6 hours into each 8-hour shift must be followed. Times of inspections, including those when no turtles were sighted, must be recorded.

3. 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. 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. Each intake structure must have equipment suitable for rescuing large turtles as well (e.g., rescue sling or other provision).

5. If any live or dead sea turtles are taken at OCNGS, plant personnel must notify NMFS within 24 hours of the take (Carrie McDaniel at 978-281-9388 or Mary Colligan at 978-

281-9116). An incident report for sea turtle take (Appendix III) must also be completed by plant personnel and sent to Carrie McDaniel via FAX (978-281-9394) within 24 hours of the take. Every sea turtle incidental take 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.

6. 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).

7. All live sea turtles must be transported to a stranding/rehabilitation facility with the appropriate ESA authority by the stranding/rehabilitation personnel for evaluation, necessary veterinary care, tagging, and release in an appropriate location and habitat.

8. All dead sea turtles that are in adequate condition (i.e., relatively fresh dead) 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 1 year of the incidental take.

9. OCNGS personnel must also look for signs of sea turtles inside the canal and at a distance from the intake structures, 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 at (978) 281-9388 or FAX (978) 281-9394.

10. 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), 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.

11. The plant 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.

NMFS anticipates that no more than 5 loggerheads (no more than 2 lethal), 4 Kemp's ridleys (no more than 3 lethal), or 2 greens (no more than 1 lethal), will be taken each year as a result of the operation of the OCNGS. 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, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. When the incidental take has been reached/exceeded, the NRC must immediately provide an explanation of the causes of the taking and review with the NMFS the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. NMFS has determined that the continued operation of the OCNGS as proposed is not likely to jeopardize the continued existence of endangered and threatened sea turtles located in the project area. To further reduce the adverse effects of the dredging project on listed species, NMFS recommends that NRC implement the following conservation measures.

1. 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. Use of existing mark/recapture and telemetry methods should be considered in Barnegat Bay and associated waterways.

2. The NRC and OCNGS personnel should support and conduct underwater 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.

3. 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.

4. Historical benthic survey data should be reviewed and updated to identify sea turtle 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.

5. NRC should communicate with NMFS on an annual basis to review incidental takes of sea turtles at OCNGS, assess the status of sea turtles in the project area and associated waterways, and to reconsider the Reasonable and Prudent Measures and Terms and Conditions of this Opinion as appropriate.

REINITIATION OF CONSULTATION

This concludes formal consultation on the operation of the OCNGS. 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 affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat 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. In instances where the amount or extent of incidental take is exceeded, the NRC must immediately request initiation of formal section 7 consultation.

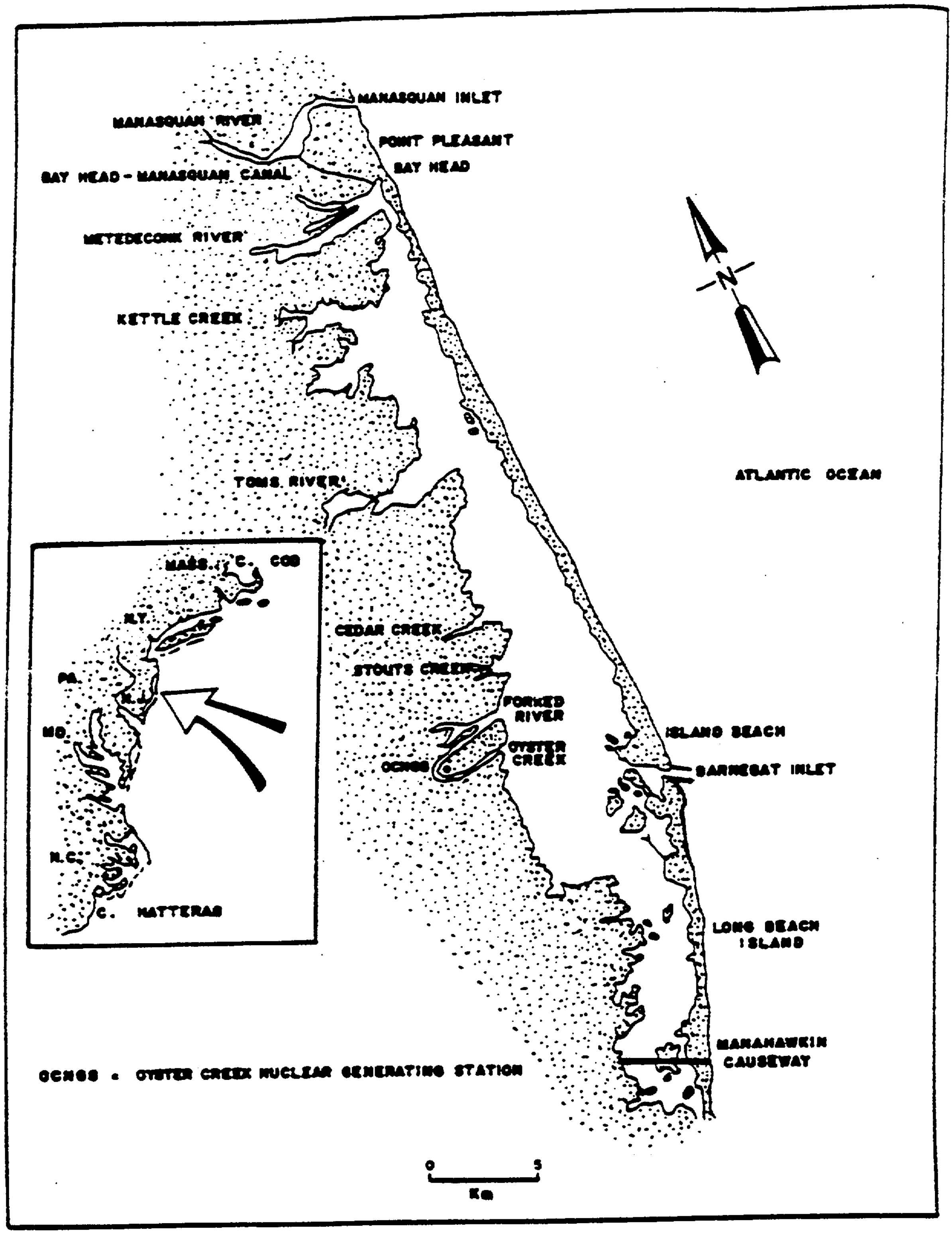


Figure 1. Map of Barnegat Bay, New Jersey and Oyster Creek NGS. Inset shows Barnegat Bay in relationship to the Mid-Atlantic Bight. (After Kennish and Lutz, 1984).

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APPENDIX I.

Incidental Take of Sea Turtles at Oyster Creek Nuclear Generating Station Intake Structures
January 1992 through December 2001

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	found at DWS intake trash bars	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	found live upon routine inspection of CWS trash bars	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	found live, impinged on CWS trash bars, 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	found live, impinged on CWS trash bars, 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	found impinged against DWS trash bars 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 live while routinely inspecting CWS intake 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 at Bay #5 of DWS upon routine cleaning of dilution intakes	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 at Bay #4 of DWS upon routine cleaning of dilution intakes	26.9 C	Turtle found limp, immobile, no apparent breathing and resuscitation efforts wer 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 at Bay #4 of DWS upon routine cleaning of dilution intakes	28.4 C	Turtle found limp, immobile, no apparent breathing and resuscitation efforts wer unsuccessful. Not sure how long present at intake structure, but may have bee 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 at Bay #6 of DWS upon routine cleaning of dilution intakes	22.9 C	Turtle found limp, immobile, no apparent breathing and resuscitation efforts wer 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 intake 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 t MMSC in Brigantine, NJ, then to Sea World in Orlando, FL, with eventual releas into the ocean.
9/23/1999 0310 hrs	Lk	Alive	26.4 cm SCL	2.9 kg	found live while routinely inspecting CWS intake, impinged against trash bars	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 Aquariu with eventual release into the ocean.
10/23/1999 0200 hrs	Cm	Dead	27.0 cm SCL	2.8 kg	found in the trash bars in Bay #4 of DWS on routine inspection of dilution intake	17.1 C	Turtle found limp, immobile, no apparent breathing and resuscitation efforts wer 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	removed from in front of trash bars in Bay #1 of DWS intake	25.3 C	Live turtle very active and no visible wounds or injury. OCNGS was in full powe operation with four circulating water pumps and 2 dilution pumps. Transferred t 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 Bay #1 of DWS 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 Bay #4 of DWS 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 Bay #1 of DWS 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.

*SCL=straight carapace length

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:

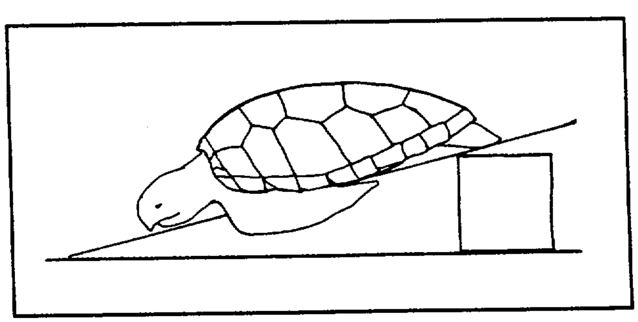
1) Nose reflex. Press the soft tissue around the nose which may cause a retraction of the head or neck region or an eye reflex response.
2) Cloaca or tail reflex. Stimulate the tail with a light touch. This may cause a retraction or side movement of the tail.
3) Eye reflex. Lightly touch the upper eyelid. 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 impingement:__________________

Intake velocity at site and time of impingement (ft/sec):__________________

Average percent of power generating capacity achieved per unit over the 48 hours previous to impingement: ______________________________________

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:____________

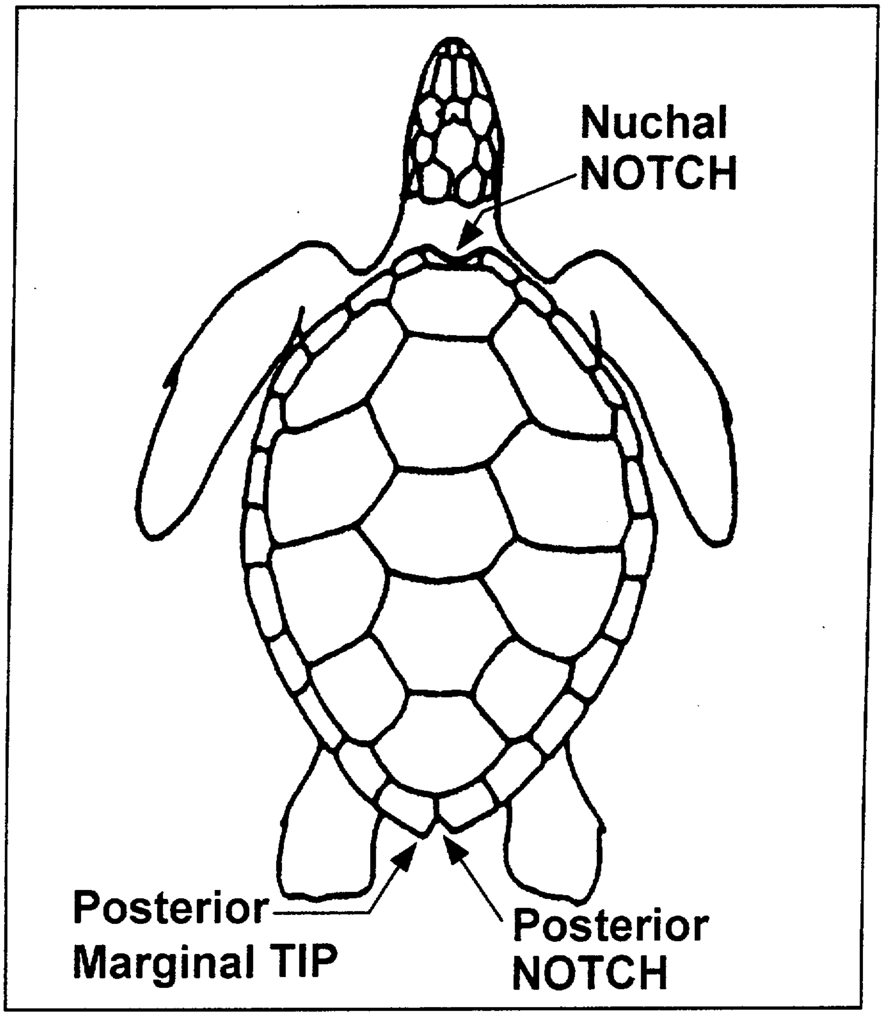
Existing tags?: YES / NO *Please record all tag numbers.* Tag # __________________
Photograph attached: YES / NO
(please label *species, date, location of impingement* on back of photograph)

All information should be sent to the following address:

National Marine Fisheries Service Northeast Region
Protected Resources Division
One Blackburn Drive
Gloucester, MA 01930
Attention: Carrie McDaniel

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

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

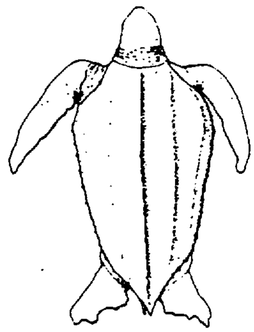


Description of animal:

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

SEA TURTLES

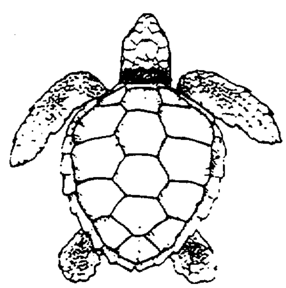
Dc



Leatherback (*Dermochelys 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.

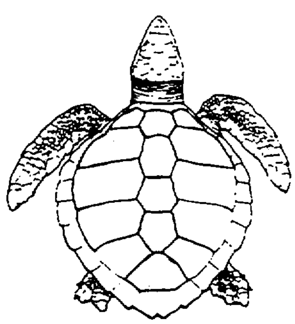
Cc



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



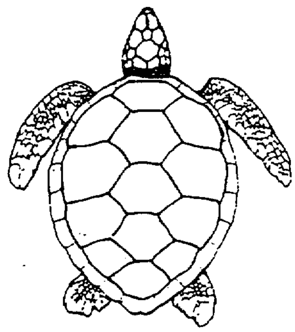
Kemp's ridley (*Lepidochelys kempi*)

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.

APPENDIX IV, continued (**Identification Key**)

SEA TURTLES

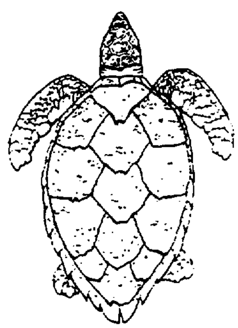
Cm



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.