Rec'd 4/24/99 50-302

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, Maryland 20910

Mr. Thomas H. Essig
Acting Chief
Generic Issues and
Environmental Projects Branch
Division of Reactor Program Management
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Mr. Essig:

This document transmits the National Marine Fisheries Services's (NMFS) biological opinion (BO) based on our review of the continued use of the cooling water intake system at the Crystal River Energy Complex (CREC). CREC is located near the Gulf of Mexico in Citrus County, Florida. This BO reviews the effects of this activity on species of sea turtles protected by the Endangered Species Act (ESA). In addition, the opinion concludes that the continued use of the intake system is not likely to adversely affect the Gulf sturgeon. This BO is prepared in accordance with section 7 of the ESA 1973 as amended (16 U.S.C. 1531 et seq.).

This biological opinion is based on information provided in the Nuclear Regulatory Commission's (NRC) biological assessment dated October 1, 1998 and three meetings among NMFS, NRC, and CREC personnel held in May 1998, April 1998, and March 1999. The biological assessment analyzed the impacts to sea turtles caused by operations at Florida Power Company's Crystal River Energy Complex. A complete administrative record of this consultation is on file at the NMFS Southeast Regional Office.

We look forward to further cooperation with you on other NRC activities to ensure the conservation and recovery of our threatened and endangered marine species.

Sincerely,

Hilda Diaz-Soltero

Hilda Diaz-Soltero
Director
Office of Protected Resources

Enclosure

Endangered Species Act - Section 7 Consultation
Biological Opinion

Agency:	United States Nuclear Regulatory Commission
Activity:	Cooling water intake system at the Crystal River Energy Complex
Consultation Conducted By:	National Marine Fisheries Service, Southeast Region

I. History of the Consultation

This consultation was initiated by the Nuclear Regulatory Commission (NRC) by a letter dated October 14, 1998, with an attached biological assessment (BA); received by the National Marine Fisheries Service (NMFS), Southeast Regional Office (SERO), Protected Resources Division on October 22, 1998. The consultation was initiated because Crystal River Energy Complex (CREC) has documented the take of sea turtles protected by the Endangered Species Act at the cooling water intake structures of the complex. There have been no previous consultations completed on the operations of CREC. The BA analyzes the effects of the cooling water system on species of sea turtles protected by the Endangered Species Act (ESA), at CREC. This biological opinion (BO) is based on information provided in the biological assessment; various telephone conversations and a May 13, 1998 meeting involving NMFS SERO, Florida Power Corporation (FPC), and NRC staff; an April 23, 1998 site visit by Mr. David Bernhart and Ms. Colleen Coogan of the SERO; a March 24, 1999 site visit by Mr. Bob Hoffman of the SERO; and other sources of information. A complete administrative record of this consultation is on file at the NMFS Southeast Regional Office.

II. Description of the Proposed Action

Action Area

The CREC is located on an approximate 5,000 acre site near the Gulf of Mexico in Citrus County, Florida. The Complex is approximately 7.5 miles northwest of the city of Crystal River, within the coastal salt marsh area of west central Florida. The action area consists of 3 of the 5 power plants (plants 1,2 and 3) that make up CREC, the 2.8 mile discharge canal, intake canal, and intake structures, which includes the bar racks, traveling screens, and sea water pump components. The intake canal is a dredged canal approximately 14 miles long with an average depth of 20 feet (the area of the intake canal has a natural rock bottom starting under the initial layer of sand and sediment. The depth of the sand and sediment layer varies greatly in the area.

The canal was dredged through the sand and sediment leaving a rock bottom that extends the length of the canal). The canal is bordered on both sides by land beginning from the plant site and extending 3 miles to the west. The canal then extends westward an additional 11 miles out into the Gulf of Mexico (map at attachment 1).

The Proposed Action

The CREC contains five separate power plants. Unit 1 is an approximately 400MW electric (MWe) coal-fueled plant. Unit 2 is an approximately 500 MWe coal-fueled plant. Unit 3 is an approximately 890 MWe pressurized water, nuclear-fueled plant. Units 4 and 5 are two coal-fueled plants at approximately 640 MWe each. This consultation will analyze the cooling water intake systems for units 1, 2, and 3.

The intake structures for units 1, 2, and 3 are concrete structures with bar racks, traveling screens, and seawater pump components. Surface water trash barriers are deployed in front of the bar racks to collect large floating debris. Water is drawn from the intake canal through the bar racks, through the traveling screens, into the pumps and flows through the plants condensers and auxiliary systems. The water is then discharged through an outfall into the discharge canal. The discharge canal directs water back to the Gulf of Mexico.

The intake bar racks prevent trash and large debris carried by the seawater from entering the intake structure. The seawater must pass through the bar racks which are made of steel bars spaced on 4 inch centers. The bar racks extend from well above the water line to the concrete base at the bottom of the intake canal. Debris and marine life smaller than the bar rack openings pass through the bar racks. The traveling screens effectively remove this floating or suspended debris from the intake water. Intake water passes through these screens, which suspend debris and solid materials onto the screens. The screens are conveyed upwards to an overlapping water spray system which washes these materials off the screens and into a debris trough. The traveling screen system is operated approximately three times a day.

Each of the three plants that use seawater to cool, have four large circulating pumps used to draw seawater into the plant. The water is then pumped through the condensers and out to the discharge canal. On units 1 and 2, the total design flow is 638,000 gallons per minute (g.p.m). Unit 3 design flow is 680,000 g.p.m. In addition, unit 3 has a low flow nuclear services water pumping system with a normal flow rate of approximately 10,000 g.p.m. Under emergency conditions, additional pumps would increase this flow up to approximately 20,000 g.p.m. From the discharge of the pumps the water flows to the main condensers; and for unit 3, an additional flow path exists for the nuclear services and decay heat cooling water heat exchangers. After the seawater passes through the tubes of the condenser and/or heat exchangers, the seawater is transported in underground pipes to the discharge canal. The discharge canal directs the water back to the Gulf of Mexico.

The bar racks are inspected 24 hours a day during times of high turtle concentrations in the intake canal (February through May) and once every two hours during other times of the year. If a turtle is stranded on the bar racks it is immediately recovered with dip nets. Healthy turtles are placed in a holding tank at the CREC Mariculture Center, where Mariculture Center Staff members determine the proper disposition of the turtle, in conjunction with Florida Department of Environmental Protection (FDEP) personnel. Non-healthy turtles are also taken to the Mariculture Center with disposition to be determined by FDEP. Dead turtles are sent to the Mariculture Center and picked up by FDEP.

III. Status of Listed Species and Critical Habitat

The following listed species under the jurisdiction of NMFS are known to occur in the Gulf of Mexico:

Endangered

Green sea turtle	*Chelonia mydas*
Leatherback sea turtle	*Dermochelys coriacea*
Hawksbill sea turtle	*Eretmochelys imbricata*
Kemp's ridley sea turtle	*Lepidochelys kempii*

Sperm whales (*Physeter macrocephalus*), occur in the Gulf of Mexico but are rare in state waters. Other endangered whales, including North Atlantic right whales (*Eubalaena glacialis)* and humpback whales (*Megaptera novaengliae*), have been observed occasionally in the Gulf of Mexico. The individuals observed have likely been inexperienced juveniles straying from the normal range of these stocks. NMFS does not believe that there are resident stocks of these species in the Gulf of Mexico, and these species are not likely to be adversely affected by projects in the Gulf.

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.

Threatened

Loggerhead sea turtle	*Caretta caretta*
Gulf Sturgeon	*Acipenser oxyrinchus desotoi*

No critical habitat for listed species under the jurisdiction of NMFS has been designated in the action area.

Biology and Distribution

Sea Turtles

Five species of sea turtles occur in Gulf of Mexico waters. Kemp's ridley and loggerhead turtles are the most common turtle species found in the Gulf as evidenced by strandings. However leatherbacks are not uncommon and hawksbill and green turtles occur regularly within stranding and incidental capture records. Historical accounts of the occurrence of sea turtles in Texas, Louisiana and Florida waters are consistent with current observations, although fluctuations in populations are apparent (Fuller, 1978, Cox and Mauermann, 1978, and Fuller and Tappan, 1986). Commercial fisheries remain the major known direct cause of sea turtle takes.

Green turtle (*Chelonia mydas*)

Green turtles are distributed circumglobally, mainly in waters between the northern and southern 20°C isotherms (Hirth, 1971). Green turtles were traditionally highly prized for their flesh, fat, eggs, and shell, and fisheries in the United States and throughout the Caribbean are largely to blame for the decline of the species.

In the western Atlantic, several major nesting assemblages have been identified and studied (Peters, 1954; Carr and Ogren, 1960; Parsons, 1962; Pritchard, 1969; Carr *et al.*, 1978). 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 of the Eglin Air Force Base on the Florida Panhandle (Meylan *et al., 1995*). Most documented green turtle nesting activity occurs on Florida index beaches, which 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 six years of regular monitoring since establishment of the index beaches in 1989 and for which data have been published, perhaps due to increased protective legislation throughout the Caribbean (Meylan *et al.*, 1995).

While nesting activity is obviously important in identifying population trends and distribution, the major portion of a green turtle's life is spent on the foraging grounds. Green turtles are herbivores, and appear to prefer marine grasses and algae in shallow bays, lagoons and reefs (Rebel, 1974). Some of the principal feeding pastures in the Gulf of Mexico include inshore south Texas waters, the upper west coast of Florida and the northwestern coast of the Yucatan Peninsula. Additional important foraging areas in the western Atlantic include the Indian River Lagoon System 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). The preferred food sources in these areas are *Cymodocea, Thalassia, Zostera, Sagittaria, and Vallisneria* (Babcock 1937; Underwood, 1951; Carr, 1952; 1954).

Green turtles were once abundant enough in the shallow bays and lagoons of the Gulf to support a commercial fishery, which landed over one million pounds of green turtle in 1890 (Doughty, 1984). Doughty (1984) reported the decline in the turtle fishery throughout the Gulf of Mexico by 1902. Currently, green turtles are uncommon in offshore waters of the northern Gulf, but abundant in some inshore embayments. Shaver (1994) live-captured a number of green turtles in channels entering into Laguna Madre, in South Texas. She noted the abundance of green turtle strandings in Laguna Madre inshore waters and opined that the turtles may establish residency in the inshore foraging habitats as juveniles. Algae along the jetties at entrances to the inshore waters of South Texas was thought to be important to green turtles associated with a radio-telemetry project (Renaud *et al.*, 1995). Transmitter-equipped turtles remained near jetties for most of the tracking period. This project was restricted to late summer months, and therefore may reflect seasonal influences. Coyne (1994) observed increased movements of green turtles during warm water months.

Hawksbill turtle (*Eretmochelys imbricata*)

The hawksbill turtle is relatively uncommon in the waters of the continental United States, preferring 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. Nesting areas in the western North Atlantic include Puerto Rico and the Virgin Islands. There are accounts of hawksbills on the reefs of south Florida, and a surprising number of small hawksbills are encountered in Texas. Most of the Texas records are probably in the 1-2 year class range. Many of the individuals captured or stranded are unhealthy or injured (Hildebrand, 1983). The lack of sponge-covered reefs and the cold winters in the northern Gulf of Mexico probably prevent hawksbills from establishing a strong presence in this area.

Leatherback turtle (*Dermochelys coriacea*)

The Recovery Plan for Leatherback Turtles (*Dermochelys coriacea*) contains a description of the natural history and taxonomy of this species (USFWS and NMFS, 1992). Leatherbacks are widely distributed throughout the oceans of the world, and are found throughout waters of the Atlantic, Pacific, Caribbean, and the Gulf of Mexico (Ernst and Barbour, 1972). Leatherbacks are predominantly distributed pelagically, feeding primarily on jellyfish such as *Stomolophus*, *Chryaora*, and *Aurelia* (Rebel, 1974). They may come into shallow waters if there is an abundance of jellyfish nearshore. Leary (1957) reported a large group of up to 100 leatherbacks just offshore of Port Aransas, Texas associated with a dense aggregation of *Stomolophus*.

The status of the leatherback population is the most difficult to assess since major nesting beaches occur over broad areas within tropical waters outside the United States. The primary leatherback nesting beaches occur in French Guiana and Suriname in the western Atlantic and in Mexico in the eastern Pacific. Although increased observer effort on some nesting beaches has resulted in increased reports of leatherback nesting, declines in nest abundance have been reported from the beaches of greatest nesting densities. At Mexiquillo, Michoacan, Mexi o, Sarti *et al.* (1996) reported an average annual decline in leatherback nesting of about 23% between 1984 and 1996. The total number of females nesting on the Pacific coast of Mexico during the 1995-1996 season was estimated at fewer than 1000. The major western Atlantic nesting area for leatherbacks is located in the Suriname-French Guiana trans-boundary region. Chevalier and Girondot (1998) report that combined nesting in the two countries has been declining since 1992. Some nesting occurs on Florida's east coast, although nests are likely under-reported because surveys are not conducted during the entire period that leatherbacks may nest. In the eastern Caribbean, nesting occurs primarily in the Dominican Republic, the Virgin Islands, and on islands near Puerto Rico. Sandy Point, on the western edge of St. Croix, Virgin Islands, has been designated by the U.S. Fish and Wildlife Service (USFWS) as critical habitat for nesting leatherback turtles. Anecdotal information suggests nesting has declined at Caribbean beaches over the last several decades (NMFS and USFWS, 1995).

Kemp's Ridley (*Lepidochelys kempii*)

Of the seven extant species of sea turtles of the world, the Kemp's ridley has declined to the lowest population level. The Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*) (FWS and NMFS, 1992b) contains a description of the natural history, taxonomy, and distribution of the Kemp's or Atlantic ridley turtle. Kemp's ridleys nest in daytime aggregations known as arribadas, primarily at Rancho Nuevo, a stretch of beach in Mexico. Most of the population of adult females nest in this single locality (Pritchard, 1969). 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). By the early 1970s, the world population estimate of mature female Kemp's ridleys had been reduced to 2,500-5,000 individuals. The population declined further through the mid-1980s. Recent observations of increased nesting, discussed below, suggest that the decline in the ridley population has stopped, and there is cautious optimism that the population is now increasing.

The nearshore waters of the Gulf of Mexico are believed to provide important developmental habitat for juvenile Kemp's ridley and loggerhead sea turtles. 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. Stomach contents of Kemp's ridleys along the lower Texas coast had a predominance of nearshore crabs and mollusks, as well as fish, shrimp and other foods considered to be shrimp fishery discards (Shaver, 1991). Analyses of stomach contents from sea turtles stranded on upper Texas beaches apparently suggest similar nearshore foraging behavior (Plotkin, pers. comm.).

Research being conducted by Texas A&M University has resulted in the intentional live-captured of 100s 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 by biologists with the NMFS Galveston Laboratory using satellite and radio telemetry. 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.).

In recent years, unprecedented numbers of Kemp's ridley carcasses have been reported from Texas and Louisiana beaches during periods of high levels of shrimping effort. NMFS established a team of population biologists, sea turtle scientists, and managers, known as the Expert Working Group (EWG) to conduct a status assessment of sea turtle populations. Analyses conducted by the group have indicated that the Kemp's ridley population is in the early stages of recovery; however, strandings in some years have increased at rates higher than the rate of increase in the Kemp's population (TEWG, 1998). While many of the stranded turtles observed in recent years in Texas and Louisiana are believed to have been incidentally taken in the shrimp fishery, other sources of mortality exist in these waters. These stranding events illustrate the vulnerability of Kemp's ridley and loggerhead turtles to the impacts of human activities in nearshore Gulf of Mexico waters.

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 EWG. 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 U.S. Fish and Wildlife Service (FWS) 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. Adult ridley numbers have now grown from a low of approximately 1,050 adults producing 702 nests in 1985, to greater than 3,000 adults producing 1940 nests in 1995 and about 3,800 nests in 1998.

TEWG 1998 was unable to estimate the total population size and current mortality rates for the Kemp's ridley population. However, TEWG 1998 listed a number of preliminary conclusions. The TEWG 1998 report indicated that the Kemp's ridley population appears to be in the early stage of exponential expansion. Over the period 1987 to 1995, the rate of increase in the annual number of nests accelerated in a trend that would continue with enhanced hatchling production and the use of TEDs. Nesting data 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 a low of 702 nests in 1985. This the trajectory of adult abundance tracks trends in nest abundance from an estimate of 9,600 in 1966 to 1,050 in 1985. TEWG 1998 estimated that in 1995 there were 3,000 adult ridleys. The increased recruitment of new adults is illustrated in the proportion of neophyte, or first time nesters, which has increased from 6% to 28% from 1981 to 1989 and from 23% to 41% from 1990 to 1994. The population model, in TEWG 1998 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. It determined that the data reviewed suggested that adult Kemp's ridley turtles were restricted somewhat to the Gulf of Mexico in shallow near shore waters, and benthic immature turtles of 20-60 cm straight line carapace length are found in nearshore coastal waters including estuaries of the Gulf of Mexico and the Atlantic.

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. The population growth rate does not appear as steady as originally forecasted by the EWG, but annual fluctuations, due in part to irregular internesting periods, are normal for other sea turtle populations.

The area surveyed for ridley nests in Mexico was expanded in 1990 due to destruction of the primary nesting beach by Hurricane Gilbert. TEWG 1998 assumed that the increased nesting observed particularly since 1990 was a true increase, rather than the result of expanded beach coverage. 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. As noted by TEWG 1998, 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.

Loggerhead Sea Turtles (*Caretta caretta*)

The loggerhead is a highly migratory species and is found in waters around the globe. The threatened loggerhead is the most abundant species of sea turtle occurring in U.S. waters. The nearshore waters of the Gulf of Mexico are believed to provide important developmental habitat for juvenile loggerheads. Studies conducted on loggerheads stranded on the lower Texas coast (south of Matagorda Island) have indicated that stranded individuals were feeding in nearshore waters shortly before their death (Plotkin *et al.*, 1993).

TEWG 1998 identified four nesting subpopulations of loggerheads in the western North Atlantic based on mitochondrial DNA evidence. These include: (1) the northern subpopulation producing approximately 6,200 nests/year from North Carolina to northeast Florida; (2) the south Florida subpopulation occurring from just north of Cape Canaveral on the east coast of Florida and extending up to Naples on the west coast and producing approximately 64,000 nests/year; (3) the Florida Panhandle subpopulation, producing approximately 450 nests/year; and (4) the Yucatan subpopulation occurring on the northern and eastern Yucatan Peninsula in Mexico and producing approximately 1,500-2,000 nests/year.

Genetic analyses of benthic immature loggerheads collected from Atlantic foraging grounds identify a mix of the east coast subpopulations that is disproportionate to the number of hatchlings produced in these nesting assemblages. Although the northern nesting subpopulation produces only approximately 9% of the loggerhead nests, loggerheads on foraging grounds from the Chesapeake Bay to Georgia are nearly equally divided in origin between the two subpopulations (Sears, 1994; Sears *et al.*, 1995; Norrgard, 1995). Of equal interest, 57% of the immature loggerheads sampled in the Mediterranean were from the south Florida subpopulation, while only 43% were from the local Mediterranean nesting beaches (Laurent *et al.*, 1993; Bowen, 1995). Genetic work has not yet been done on nesting or foraging loggerheads in the Gulf of Mexico.

TEWG 1998 considered nesting data collected from index nesting beaches to index the population size of loggerheads and to consider trends in the size of the population. TEWG 1998 constructed total estimates by considering a ratio between nesting data (and associated estimated number of adult females and therefore adults in nearshore waters), proportion of adults represented in the strandings, and in one method, aerial survey estimates. These two methods indicated that for the 1989-1995 period, there were averages of 224,321 or 234,355 benthic loggerheads, respectively. TEWG 1998 listed the methods and assumptions in their report, and suggested that these numbers are likely underestimates. Aerial survey results suggest that loggerheads 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 considered long-term index nesting beach datasets when available to identify trends in the loggerhead population. Overall, TEWG 1998 determined that trends could be identified for two loggerhead subpopulations. The northern subpopulation appears to be stabilizing after a period of decline; the south Florida subpopulation appears to have shown significant increases over the last 25 years suggesting the population is recovering, although the trend could not be detected over the most recent seven years of nesting. An increase in the numbers of adult loggerheads has been reported in recent years in Florida waters without a concomitant increase in benthic immatures. These data may forecast limited recruitment to south Florida nesting beaches in the future. Since loggerheads take approximately 20-30 years to mature, the effects of decline in immature loggerheads might not be apparent on nesting beaches for decades. Therefore, TEWG 1998 cautions against considering trends in nesting too optimistically.

Briefly, TEWG 1998 made a number of conclusions regarding the loggerhead population. The report concluded that four distinct nesting populations exist based on genetic evidence, although separate management is not possible because of insufficient information on the in-water distribution of each subpopulation. The report concluded that the recovery goal of more than 12,800 nests for the northern subpopulation was not likely to be met. Currently, nests number about 6,200 and no perceptible increase has been documented. The recovery goal or "measurable increases" for the south Florida (south of Canaveral and including southwest Florida) appears to have been met, and this population appears to be stable or increasing. However, index nesting surveys have been done for too short a time; therefore, it is difficult to evaluate trends throughout the region. Recovery rates for the entire subpopulation cannot be determined with certainty at this time. However, caution is warranted because, although nesting activity has been increasing, catches of benthic immature turtles at the St. Lucie Nuclear Power Plant intake canal, which acts as a passive turtle collector on Florida's east coast, have not been increasing. TEWG 1998 recommended establishing index nest surveys areas in the Gulf of Mexico to monitor those populations, which do not currently have recovery goals assigned to them.

Fish

Gulf Sturgeon (*Acipenser oxyrinchus desotoi*)

Detailed information regarding the life history, abundance and distribution of Gulf sturgeon can be found in the Gulf Sturgeon Recovery/Management Plan (FWS and GSMFC, 1995). Gulf sturgeon were listed as threatened in 1991, and are under the joint jurisdiction of the Fish and Wildlife Service and NMFS. Historically, Gulf sturgeon occurred in most major rivers between the Mississippi and the Suwannee, and in marine waters from the Mississippi to Florida Bay. While little is known about the abundance of Gulf sturgeon through most of its range, estimates exist for the Suwannee and Apalachicola rivers. The FWS (1990, 1991, 1992 in FWS & GSMFC, 1995) reported an average of 115 individuals larger than 45 cm total length over-summering in the Apalachicola River below Jim Woodruff Lock and Dam. For the Suwannee River, population size estimates ranging from 2,250 to 3,300 individuals have been made (Carr and Rago, unpublished data in FWS & GSMFC, 1995).

There is sparse information available regarding the distribution of Gulf sturgeon in the marine environment. A few takes incidental to commercial and recreational fishing have been documented offshore of Louisiana, in the Mississippi Sound and Biloxi Bay, Pensacola Bay, Apalachicola Bay, Tampa Bay and Charlotte Harbor. Although biotelemetry studies geared toward identifying the movements of sturgeon once they have entered marine waters have been conducted, little information has been developed yet. Gulf sturgeon likely leave riverine waters in the late fall to early winter to forage in the marine or estuarine environment for benthic invertebrates over mud and sand bottoms and seagrass communities, and return to the rivers in the spring.

Directed and incidental take in fisheries and habitat loss have been identified as the major threats to the recovery of Gulf sturgeon.

Analysis of the Species Likely to be Affected

Of the above listed species occurring in the eastern Gulf of Mexico, NMFS believes that the five species of sea turtle are likely to be adversely affected by the proposed action. NMFS believes that the Gulf sturgeon and listed species of large whales are not likely to be adversely affected by the proposed action. Although the Gulf sturgeon's migratory habits are not well known, NMFS believes it is unlikely that Gulf sturgeon will stray from mud and sand bottom marine foraging areas in the Gulf to enter the rocky bottomed intake canal of the CREC and be affected by the cooling water intake system. Studies conducted by CREC from 1980 to 1983, to determine the species of fish and invertebrates affected by the cooling water system, showed no evidence of Gulf sturgeon. Species of large whales are not likely to occur in the inshore shallow waters by the intake canal. The remainder of the analysis in this biological opinion will focus on the five species of sea turtles.

IV. Environmental Baseline

Status of the Species Within the Action Area

The five species of sea turtles that occur in the action area are all highly migratory. The offshore waters of the eastern Gulf may be used by these species as post-hatchling developmental habitat, foraging habitat, or migratory pathways. NMFS believes that no individual members of any of the species are likely to be year-round residents of the action area. Individual animals will make migrations into nearshore waters as well as other areas of the Gulf of Mexico, Caribbean Sea, and North Atlantic Ocean. Therefore, the range-wide status of the species, given in Section II above, most appropriately reflects the species status within the action area.

Factors Affecting the Species Within the Action Area

The offshore waters of the eastern Gulf of Mexico remain relatively free of human activities that impact listed species of sea turtles. The only Federal action in the action area impacting these species, whose effects have been previously considered in a biological opinion, is the pelagic fishery for swordfish, tuna, and shark. As discussed above, however, sea turtles are not strict residents of the action area and may be affected by human activities throughout their migratory range. Therefore, this section will discuss the impacts of Federal actions on sea turtles throughout the Gulf of Mexico and western North Atlantic.

Federally-regulated commercial fishing operations represent the major human source of sea turtle injury and mortality in U.S. waters. Shrimp trawlers in the southeastern U.S. are required to use TEDs, which reduce a trawler's capture rate of sea turtles by 97%. Even so, NMFS estimated that 4,100 turtles may be captured annually by shrimp trawling, including 650 leatherbacks that cannot be released through TEDs, 1,700 turtles taken in try nets, and 1,750 turtles that fail to escape through the TED (NMFS, 1998). Henwood and Stuntz (1987) reported that the mortality rate for trawl-caught turtles ranged between 21% and 38%, although Magnuson *et al.* (1990) suggested Henwood and Stuntz's estimates were very conservative and likely an underestimate of the true mortality rate. The mid-Atlantic and Northeast fishery for summer flounder, scup, and black sea bass uses otter trawl gear that also captures turtles. Summer flounder trawlers fishing south of Cape Henry, Virginia (south of Oregon Inlet, North Carolina from January 15 to March 15) are required to use TEDs. Participants in this fishery who use a type of trawl known as a flynet, however, are not required to use TEDs, as TEDs for flynets have not been researched and NMFS is collecting further observer information on turtle bycatch by flynet vessels. The estimated, observed annual take rates for turtles in this multispecies fishery is 15 loggerheads and 3 leatherbacks, hawksbills, greens, or Kemp's ridley, in combination (NMFS, 1996a). The pelagic fishery for swordfish, tuna, and shark, which is prosecuted over large areas of the northwestern Atlantic and the Gulf of Mexico, including the action area, also has a fairly large bycatch of sea turtles. NMFS (1997b) estimated that the longline component of this fishery would annually take, through hooking or entanglement, 690 leatherbacks, 1,541 loggerheads, 46 green, and 23 Kemp's ridley turtles, with a projected mortality rate of 30%. In the driftnet component of the fishery, estimated annual levels of injury or mortality are 40 leatherbacks, 58 loggerheads, 4 Kemp's ridleys, 4 greens, and 2 hawksbills.

Military activities, including vessel operations and ordnance detonation, also affect listed species of sea turtles. U.S. Navy aerial bombing training in the ocean off the southeast U.S. coast, involving drops of live ordnance (500 and 1,000-lb bombs) is estimated to injure or kill, annually, 84 loggerheads, 12 leatherbacks, and 12 greens or Kemp's ridley, in combination (NMFS, 1997a). The U.S. Navy will also conduct ship-shock testing for the new SEAWOLF submarine off the Atlantic coast of Florida, using 5 submerged detonations of 10,000 lb explosive charges. This testing is estimated to injure or kill 50 loggerheads, 6 leatherbacks, and 4 hawksbills, greens, or Kemp's ridleys, in combination (NMFS, 1996b). The U.S. Coast Guard's operation of their boats and cutters, meanwhile, is estimated to take no more than one individual turtle – of any species – per year (NMFS, 1995). Formal consultation on Coast Guard or Navy activities in the Gulf of Mexico has not been conducted.

The construction and maintenance of Federal navigation channels has also been identified as a source of turtle mortality. Hopper dredges, which are frequently used in ocean bar channels and sometimes in harbor channels and offshore borrow areas, move relatively rapidly and can entrain and kill sea turtles, presumably as the drag arm of the moving dredge overtakes the slower moving turtle. Along the Atlantic Coast of the southeastern United States, NMFS estimates that annual, observed injury or mortality of sea turtles from hopper dredging may reach 35 loggerheads, 7 greens, 7 Kemp's ridleys, and 2 hawksbills (NMFS, 1997c). Along the north and west coasts of the Gulf of Mexico, channel maintenance dredging using a hopper dredge may injure or kill 30 loggerhead, 8 green, 14 Kemp's ridley, and 2 hawksbill sea turtles annually (NMFS, 1997d).

Sea turtles entering coastal or inshore areas have been affected by entrainment in the cooling-water systems of electrical generating plants. At the St. Lucie nuclear power plant at Hutchinson Island, Florida, large numbers of green and loggerhead turtles have been captured in the seawater intake canal in the past several years. Annual capture levels from 1994-1997 have ranged from almost 200 to almost 700 green turtles and from about 150 to over 350 loggerheads. Almost all of the turtles are caught and released alive; NMFS estimates the survival rate at 98.5% or greater (1997e). Other power plants in south Florida, west Florida, and North Carolina have also reported low levels of sea turtle entrainment, but formal consultation on these plants' operations has not been completed.

Sea turtles are vulnerable to blast injury and death from the use of underwater explosives. Klima *et al.* (1988) reported a dramatic elevation in the number of sea turtle strandings along the north Texas coast, coinciding with a large number of explosive removals of offshore oil platforms in the area. Since then, protective measures implemented by NMFS, the Corps of Engineers, and the Minerals Management Service, including required observers at explosive rig-removals, have been effective in minimizing the impacts of explosive rig-removals on sea turtles. From 1987 to 1997, a total of 1,013 platform removals took place with NMFS observers present. Sea turtles were observed at 112 of those sites, and two loggerhead turtles were recovered injured after blasting. Those animals were rehabilitated and released. In 1998, one loggerhead was killed as a result of rig-removal blasting. Although some mortality may occur and go undetected, the overall number of turtles impacted by rig-removal actions has been very low since the adoption of protective measures.

Throughout the coastal Gulf of Mexico, but particularly in Louisiana, the loss of thousands of acres of wetlands is occurring due to natural subsidence and erosion, as well as reduced sediment input from the Mississippi River. Impacts caused by residential, commercial, and agricultural developments appear to be the primary causes of wetland loss in Texas.

Oil spills from tankers transporting foreign oil, as well as the illegal discharge of oil and tar from vessels discharging bilge water will continue to affect water quality in the Gulf of Mexico. Cumulatively, these sources and natural oil seepage contribute most of the oil discharged into the Gulf of Mexico. Floating tar sampled during the 1970s, when bilge discharge was still legal, concluded that up to 60% of the pelagic tars sampled did not originate from the northern Gulf of Mexico coast.

Marine debris will likely persist in the action area in spite of MARPOL prohibitions. In Texas and Florida, approximately half of the stranded turtles examined have ingested marine debris (Plotkin and Amos, 1990 and Bolten and Bjorndal, 1991). Although fewer individuals are affected, entanglement in marine debris may contribute more frequently to the death of sea turtles.

Coastal runoff and river discharges carry large volumes of petrochemical and other contaminants from agricultural activities, cities and industries into the Gulf of Mexico. The coastal waters of the Gulf of Mexico have more sites with high contaminant concentrations than other areas of the coastal United States, due to the large number of waste discharge point sources. Although these contaminant concentrations do not likely affect the more pelagic waters of the action area, the species of turtles analyzed in this biological opinion travel between nearshore and offshore habitats and may be exposed to and accumulate these contaminants during their life cycles.

In a study conducted by the NMFS Galveston Laboratory between 1993 through 1995, 170 ridleys were reported associated with recreational hook-and-line gear; including 18 dead stranded turtles, 51 rehabilitated turtles, 5 that died during rehabilitation, and 96 that were released by fishermen (Cannon and Flanagan, 1996). The Sea Turtle Stranding and Salvage Network

(STSSN) also receives stranding reports that identify carcass anomalies that may be associated with the recreational fishery (entangled in line or net, fish line protruding, fish hook in mouth or digestive tract, fish line in digestive tract). The reports do not distinguish between commercial or recreational sources of gear, such as hook, net, and line, which may be used in both sectors. Cumulatively, fishery entanglement anomalies are noted in fewer than 4% of the stranded sea turtle carcasses reported between 1990 and 1996, and some carcasses carry more than one anomaly (e.g., fishing line in digestive tract/fishing line protruding from mouth or cloaca), therefore summing these reports may result in some double counting.

In summary, several factors are currently affecting species of sea turtles within the action area:

- federally regulated commercial fishing operations continue to cause significant injury and mortality of sea turtles in US waters;
- military activities which involve vessel operations and ordnance detonation continue to injure or kill sea turtles;
- construction and maintenance of Federal navigation channels has, and will likely continue to be a significant source of sea turtle mortality;
- sea turtles continue to be entrained by cooling-water systems of electrical generating plants; and
- activities controlled by state or local government or private entities that cause or control the reduction [illegible] wetlands, increased marine debris, recreational activities on the water, polluted runoff, and oil spills.

These activities have combine to slow the recovery of species of sea turtles protected by the ESA, throughout their range

V. Effects of the Action

Since units 1, 2, and 3 began commercial operation, marine turtles have occasionally been found in the intake canal. CREC records indicate that from 1994 to 1997, eight sea turtles were stranded on the unit 3 intake bar racks. CREC records for these years were opportunistic, and do not indicate species, time of year, size or disposition of the stranded turtles (dead or alive). Sea turtle monitoring activities at CREC have increased substantially since 1997 with the monitoring program implemented in March of 1998 and the implementation of the Sea Turtle Rescue Guidelines dated Sept 1998. The increased monitoring should provide a more realistic estimate of the number of sea turtles stranded or killed each year at the plants.

The number of sea turtle sightings in the intake canal and strandings on the bar racks increased dramatically in 1998. The majority of these were Kemp's ridley sea turtles. In February 1998, 2 sea turtles were found stranded on the bar racks. These turtles were released alive. During March 1998 an additional 19 turtles were stranded on the unit 3 bar rack and released alive. Four mortalities were discovered floating in the intake canal. CREC considers these four mortalities not causally related to plant operations since they were found upstream of the power plant intake structures. CREC considers it highly unlikely that a turtle mortality related to power plant operations could float against the incoming water current and by pass the surface trash boom structures.

In April, 1998 an additional 14 stranded sea turtles were released alive and 7 mortalities found. Four of these mortalities were found on the bar racks while the other 3 were found floating upstream of the intake structure. For the reasons described above CREC does not consider these three mortalities to be caused by plant operations. In May, 1998 a total of 4 sea turtles were stranded on the bar racks at unit 3 and released, 2 mortalities were recovered, one at unit 3 and the other was seen floating in the canal and finally recovered near the intakes for units 1 and 2. This mortality had evidence of a boat collision. During June and July no sea turtles were stranded at CREC. During August 1998, one live sub-adult green turtle was removed from the bar racks of units 1 and 2. This turtle was considered severely debilitated by fibropapillomatosis and was transferred, under the direction of the Florida Department of Environmental Protection (FDEP), to the Clearwater Marine Science Center for rehabilitation.

NMFS agrees with the BA that dead turtles floating in the canal are not causally related to plant operations for the reasons stated above. NMFS also believes that severely decomposed turtles found on the bar racks are also not causally related to plant operations as the bar racks are continually monitored on a daily basis for turtle strandings. Therefore dead sea turtles not considered causally related to plant operations and verified by the FDEP are not considered as lethally taken by CREC.

The records indicate that this activity has not taken many sea turtles for years up to 1998. For the four years from 1994 to 1997 the activities at CREC have taken an average of two sea turtles per year. Records for 1998 show a dramatic increase in the numbers of sea turtle strandings at CREC, especially for the months of February to May. In 1998 a total of 40 takes were stranded at the power plants, 5 being lethal. Of these, 37 of the turtles released alive were Kemp's ridley and all 5 lethal takes were also Kemp's ridley. All sea turtles stranded at CREC were sub-adults with carapace lengths ranging from 21 cm to 55 cm. There are no proven environmental factors that have caused this increase and population numbers are not monitored for this area so the increase could be from an increase in population or an increase in sub-adult turtles moving into this area from some other area (personal communication with Allen Foley, FDEP). According to CREC personnel there has been 4 Kemp's ridley sub-adult turtles released alive from the bar racks at unit 3, from January to March of 1999 (personal communication with David Bruzek, CREC). Thus far this rate of take is less than this time in 1998, and is considered comparable to other years excluding 1998.

Based on this information, and the fact that another anomalous year such as 1998 is possible, NMFS believes that the level of live take of sea turtles in BSEP's intake canal may reach 50 sea turtles rescued alive from the bar racks biannually and 5 lethal takes, biennially that are causally related to plant operations. NMFS does not believe that this level of lethal take is likely to appreciably reduce the likelihood of survival and recovery of the species.

VI. Cumulative Effects

Cumulative effects are the effects of future state, local, or private activities 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. Within the action area, major future developments in human activities, that are not part of a Federal action, are not anticipated. Because the action area is entirely within the Exclusive Economic Zone, new activities such as natural resource extraction/harvest would be subject to Federal review and/or regulation. As discussed in Section III, however, listed species of turtles migrate throughout the Gulf of Mexico and may be affected during their life cycles by non-Federal activities outside the action area. The state, local, and other non-federally regulated activities listed in the Environmental Baseline section of this BO, such as wetland loss, contaminated runoff, marine debris, and oil spills are expected to persist into the future and will continue to slow the recovery of sea turtles.

State-regulated commercial and recreational fishing activities in the Gulf of Mexico waters take endangered species. These takes are not reported and are unauthorized. It is expected that states will continue to license/permit large vessel and thrill-craft operations which do not fall under the purview of a Federal agency and will issue regulations that will affect fishery activities. NMFS will continue to work with states to develop ESA Section 6 agreements and Section 10 permits to enhance programs to quantify and mitigate these takes. Increased recreational vessel activity in inshore waters of the Gulf of Mexico will likely increase the number of turtles taken by injury or mortality in vessel collisions. Recreational hook-and-line fisheries have been known to lethally take sea turtles, including Kemp's ridleys. Continued cooperation between NMFS and the states on these issues should help decrease take of sea turtles caused by recreational activities.

VII. Conclusion

After reviewing the current status of the affected species of sea turtles, the environmental baseline for the action area, and the effects of the action, it is NMFS's biological opinion that the operation of the cooling water intake system of the Crystal River Energy Complex as outlined in the Nuclear Regulatory Commission's Biological Assessment, dated October 14, 1998, is not likely to jeopardize the continued existence of the loggerhead, leatherback, green, hawksbill, or Kemp's ridley sea turtles. No critical habitat has been designated for these species in the action area, therefore none will be affected.

VIII. Incidental Take Statement

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act 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 attempt to engage in any such conduct. 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 taking under the Act provided that such taking is in compliance with the reasonable and prudent measures and terms and conditions of the Incidental Take Statement.

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

Amount of Take

NMFS has estimated the impact of CREC's operation of its cooling water intake system on listed species of sea turtles (see Assessment of Impacts above). Based on this analysis, NMFS anticipates 50 live takes due to the rescue of sea turtles from the bar racks (of the five species analyzed in this BO), 5 lethal takes (lethal take being turtle mortalities considered causally related to plant operations and verified by the FDEP) and 8 dead turtles not causally related to plant operations could be incidentally taken every two years (annual records are from January 1-December 31 each year), as a result of this action.

Effect of the Take

In the accompanying BO, NMFS determined that this level of anticipated take is not likely to result in jeopardy to the Kemp's ridley, green, loggerhead, leatherback, and hawksbill sea turtles.

Reasonable and Prudent Measures

NMFS believes the following reasonable a prudent measures are necessary and appropriate to minimize impacts of incidental take of the Kemp's ridley, green, loggerhead, leatherback, and hawksbill sea turtles:

1. CREC will monitor sea turtle activities around the bar racks and rescue sea turtles stranded on the bar racks.

2. CREC will keep records of sea turtle strandings at the plants.

These measures are required to decrease the number of lethal takes caused by plant operations. The implementation of a plan to monitor the cooling water intake structures and to rescue sea turtles stranded on them before they are killed will reduce the number of lethal takes.

Terms and Conditions

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

1. Continue implementation of the procedures outlined in the Sea Turtle Rescue and Handling Guidelines for CREC dated September 9, 1998. All updates of the rescue plan will be reviewed by the FDEP and NMFS.

2. If any listed species are apparently injured or killed in the intake canal or the bar racks, a report, summarizing the incident, must be provided to the NMFS Southeast Regional Office's (SERO) Assistant Regional Administrator, Protected Resources Division, within 30 days of the incident.

3. All sea turtle takings at the plant will be recorded by species, size and time of year taken. These records will be made available to the SERO Assistant Regional Administrator, Protected Resources Division, 30 days after the start of each year or upon written request during other parts of the year. If non lethal take reaches 40 individuals, causally related lethal take reaches 3 individuals or if take of non causally related dead turtles reaches 6 individuals, CREC will notify the SERO Assistant Regional Administrator, Protected Resources Division within 5 days. After these levels of take are reached any subsequent take must be reported to the SERO Assistant Regional Administrator, Protected Resources Division within 24 hours of the take. Final disposition of all sea turtles taken at the plant (live, lethal, or non causally related lethal) shall be in accordance with the Sea Turtle Rescue and Handling Guidelines for CREC dated September 9, 1998.

NMFS believes that no more than 63 sea turtles will be incidentally taken every two years as a result of the proposed action. Thirteen of these takes will be lethal including 8 that are non-causally related to plant operations. The reasonable and prudent measures and their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of this action, this 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. The NRC must immediately provide an explanation of the causes of the taking and review with NMFS the need for possible modification of the reasonable and prudent measures.

IX. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorizations 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.

1. CREC should set up a tagging program for released sea turtles in conjunction with FDEP.

2. CREC should continue the evaluation and experimentation on methods to be employed that could be used to keep sea turtles away from the bar racks.

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

X. Reinitiation of Consultation

This concludes formal consultation on the actions outlined in the NRC's BA dated October 14, 1998. 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) an 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 (when designated) 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 the 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 and CREC must immediately request reinitiation of formal consultation.

References

Babcock, H.L. 1937. The sea turtles of the Bermuda Islands, with a survey of the present state of the turtle fishing industry. Proc. Zool. Soc. Lond. 107: 595-601.

Best, P.B. 1979. Social organization in sperm whales, Physeter macrocephalus. In: H.E. Winn and B.L. Olla (Eds.) Behavior of marine animals, volume 3: cetaceans, p.227-289. Plenum Press, N.Y.

Blaylock, R.A., J.W. Hain, L.J. Hansen, D.L. Palka, and G.T. Waring. 1995. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments. NOAA Tech. Mem. NMFS-SEFSC-363. 211 pp.

Bolten, A.B. and K.A. Bjorndal. 1991. Effects of marine debris on juvenile, pelagic sea turtles. Interim Project Report to the National Marine Fisheries Service Marine Entanglement Research Program. 41 pp.

Bowen, B.W. 1995. Tracking marine turtles with genetic markers. BioSci. 45:528-534.

Carr, A.F., M.H. Carr and A.B. Meylan. 1978. The ecology and migrations of sea turtles. 7. The western Caribbean green turtle colony. Bull. Amer. Mus. Nat. Hist. 162(1):1-46.

Carr, A.F. and L. Ogren. 1960. The ecology and migrations of sea turtles. 4. The green turtle in the Caribbean Sea. Bull. Amer. Mus. Nat. Hist. 131(1):1-48.

Carr, A.F. 1954. The passing of the fleet. A.I.B.S. Bull. 4(5):17-19.

Carr, A.F. 1952. Handbook of Turtles. Ithaca, New York: Cornell University Press.

Chevalier, J. and Girondot, M. 1998. Nesting dynamics of marine turtles in French Guiana during the 1997 nesting season. Bull. Soc. Herp. Fr., 85-86: 5-19.

Clarke, M.R. 1980. Cephalapoda in the diet of sperm whales of the Southern Hemisphere and their bearing on sperm whale biology. Discovery Rep. 37:1-324.

Clarke, M.R. 1962. Stomach contents of a sperm whale caught off Madeira in 1959. Norsk Hvalfangst-tidende 51(5):173-191.

Cox, B. A. and Mauermann, R. G. Incidental Catch and Disposition of Sea Turtles by the Brownsville-Port Isabel Gulf Shrimp Fleet. 5 pp.

Coyne, M. S. 1994. Feeding Ecology of Subadault Green Sea Turtles in South Texas Waters. Master's Degree Thesis, Texas A&M University. 76 pp.

Davis, R.W. and G.S. Fargion (eds). 1996. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. Volume II Technical Report. OCS Study MMS 96-0027. U.S. Dept of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, LA 357 pp.

Doughty, R. W. Sea turtles in Texas: A forgotten commerce. Southwestern Historical *Quarterly:43-70.*

Eckert, K.L. 1993. Draft Status Review of Sea Turtles Listed Under the Endangered Species Act of 1973. Leatherback Sea Turtle *Dermochelys coriacea*: Prepared for NMFS, Silver Spring, MD

Ehrhart, L.M. 1979. A survey of marine turtle nesting at Kennedy Space Center, Cape Canaveral Air Force Station, North Brevard County, Florida, 1-122. Unpublished report to Division of Marine Resources, St. Petersburg, Florida, Fla. Dept. Nat. Res.

Epperly, S.A. 1996 Personal Communication. NMFS Beaufort Laboratory, North Carolina.

Ernst, L.H. and R.W. Barbour. 1972. Turtles of the United States. Univ. Kentucky Press, Lexington, Kentucky.

Expert Working Group (Byles, Richard, C. Caillouet, D. Crouse, L. Crowder, S. Epperly, W. Gabriel, B. Gallaway, M.Harris, T. Henwood, S. Heppell, R.Marquez-M, S. Murphy, W. Teas, N. Thompson, and B. Witherington) 1996. Kemp's ridley sea turtle (*Lepidochelys kempii*) status report. Submitted to NMFS June 28, 1996.

Fuller, D. A. The Habitats, Distribution, and Incidental Capture of Sea Turtles in the Gulf of Mexico. Prepared As a Working Paper on Sea Turtles for the Task Force Developing the Draft Shrimp Management Plan for the US Gulf of Mexico. 1978:58 pages.

Fuller, D. A. and Tappan, A. M. The Occurrence of Sea Turtles in Louisiana Coastal Waters. Coastal Fisheries Institute, Center for Wetland Resources, Louisiana State University. 1986 Sep:46 pages.

Hansen, L.J., D.D. Mullin, T.A. Jefferson, and G.P. Scott. 1996. Visual surveys aboard ships and aircraft. Pages 55-132 in R.W. Davis and G.S. Fargion (eds). Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. Volume II Technical Report. OCS Study MMS 96-0027. U.S. Dept. Of the Interior, Minerals Management Service. Gulf of Mexico OCS Region. New Orleans, LA. 357pp.

Henwood, T.A. and W. Stuntz. 1987. Analysis of sea turtle captures and mortalities during commercial shrimp trawling. Fishery Bulletin 85(4): 813-817.

Henwood, T.A., W. Stuntz, and N. Thompson. 1992. Evaluation of U.S. Turtle Protective Measures under existing TED regulations, including estimates of shrimp trawler related mortality in the Wider Caribbean. NOAA Tech Memo NMFS-SEFSC-303.

Hildebrand, H.H. 1963. Hallazgo del area de anidacion de la tortuga marina "lora," *Lepidochelys kempii* (Garman), en la costa occidental del Gulfo de Mexico. Ciencia, Mex. 22(4):105-112.

Hildebrand, H. H. 1983. Random Notes on Sea Turtles in the Western Gulf of Mexico. Western Gulf of Mexico Sea Turtle Workshop Proceedings, January 13-14, 1983. pages 34-41.

Hirth, H.F. 1971. Synopsis of biological data on the green turtle *Chelonia mydas* (Linnaeus) 1758. FAO Fisheries Synopsis. 85:1-77.

Iverson, S., D.M.Allen, and J.B. Higman. 1993. Shrimp capture and culture fisheries of the United States. Imprint of John Wiley & Sons, Inc. New York.

IWC. Committee for Whaling Statistics. 1959-1983. International whaling statistics, volumes 41-91. Comm. Whaling Stat., Oslo, Norway, var. pages.

Keinath, J.A. and J.A. Musick. 1993. Movements and Diving Behavior of a Leatherback Turtle, *Dermochelys coriacea*. Copeia 1993(1):1010-1017.

Klima, E.F., G.R. Gitschlag, and M.L. Renaud. 1988. Impacts of the explosive removal of offshore petroleum platforms on sea turtles and dolphins. Marine Fisheries Review, 50(3)pp 33-42.

Leary, T. R. 1957. A schooling of leatherback turtles, Dermochelys coriacea coriacea, on the Texas coast. Copeia 1957(3):232.

Leatherwood, S. and R.R Reeves. 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco. 302 pp.

Magnuson, J.J., K.A. Bjorndal, W.D. DuPaul, GIL Graham, D.W. Owens, C.H. Peterson, P.C.H. Pritchard, J.I. Richardson, G.E. Saul, and C.W.West. 1990. Decline of the sea Turtles: Causes and Prevention. National Research Council, National Academy Press, Wash. D.C.

Marquez, R. 1996 Personal Communication. Instituto Nacional de la Pesca. Manzanillo, Colima, Mexico.

Marquez, R., R. Byles, P. Burchfield, N. Thompson, M. Sanchez, J. Diaz, M.A. Carrasco, A.S. Leo, and C. Jimenez. 1995. The Recovery of the Kemp's ridley sea turtle population in the Mexican Beach of Rancho Nuevo, Tamaulipas. Draft submitted to the Marine Turtle Newsletter

Meylan, A., B. Schroeder, and A. Mosier. 1995. Sea Turtle Nesting Activity in the State of Florida. Florida Marine Research Publications, No. 52.

Mullin, K.D., 1997 personal communication. NMFS Southeast Fisheries Science Center; Pascagoula Laboratory.

Mullin, K.D., W. Hoggard. C.L. Roden. R.R. Lohoefener, C.M. Rogers, and B. Taggart. 1994. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. Fishery Bulletin 92: 773-786.

National Marine Fisheries Service. 1998. Endangered Species Act section 7 consultation on shrimp trawling in the southeastern U.S. under the sea turtle conservation regulations. Biological Opinion, March 24. 32pp.

National Marine Fisheries Service. 1997a. Endangered Species Act section 7 consultation on Navy Activities off the Southeastern United States along the Atlantic Coast, May 15. 73pp.

National Marine Fisheries Service. 1997b. Endangered Species Act section 7 consultation on the Atlantic Pelagic Fishery for Swordfish, Tuna, and Shark, in the Exclusive Economic Zone. Biological Opinion, May 29. 95pp.

National Marine Fisheries Service. 1997c. Endangered Species Act section 7 consultation on the continued hopper dredging of channels and borrow areas in the southeastern United States. Biological Opinion, September 25. 15pp.

National Marine Fisheries Service. 1997d. Endangered Species Act section 7 consultation on channel maintenance dredging using a hopper dredge in the Galveston and New Orleans Districts of the Army Corps of Engineers. Biological Opinion, September 22. 15pp.

National Marine Fisheries Service. 1997e. Endangered Species Act section 7 consultation on the continued operation of the circulating water system of the St. Lucie nuclear generating plant. Biological Opinion, February 7. 39pp.

National Marine Fisheries Service. 1996a. Endangered Species Act section 7 consultation on the Fishery Management Plan (FMP) for Summer Flounder to include the management and fishing activities under the Draft FMPs for Scup and Black Sea Bass. Biological Opinion, February 29. 50pp.

National Marine Fisheries Service. 1996b. Endangered Species Act section 7 consultation on the proposed shock testing of the SEAWOLF submarine off the Atlantic Coast of Florida during the summer of 1997. Biological Opinion, December 12. 50pp.

National Marine Fisheries Service. 1995. Endangered Species Act section 7 consultation on United States Coast Guard vessel and aircraft activities along the Atlantic coast. Biological Opinion, September 15. 56pp.

Norrgard, J. 1995. Determination of stock composition and natal origin of a juvenile loggerhead turtle population (Caretta caretta) in Chesapeake Bay using mitochondrial DNA analysis. M.S. Thesis, College of William and Mary, Gloucester Point, Virginia. 47 pp.

Ogren, L. H. Biology and Ecology of Sea Turtles. 1988. Prepared for National Marine Fisheries, Panama City Laboratory. Sept. 7.

Parsons, J.J. 1962. The green turtle and man. Gainesville, University of Florida Press.

Peters, J.A. 1954. The amphibians and reptiles of the coast and coastal sierra of Michoacan, Mexico. Occ. Pap. Mus. Zool. 554:1-37.

Plotkin, P.T. 1995. Personal Communication. Drexel University, Philadelphia, Pennsylvania.

Plotkin, P. and A.F. Amos. 1990. Effects of anthropogenic debris on sea turtles in the northwestern Gulf of Mexico. *in* R.S. Shomura and M.L. Godfrey (eds.). Proceedings of the Second International Conference on Marine Debris. NOAA Tech. Memo NMFS-SWFSC-154: 736-743.

Plotkin, P. T., M.K. Wicksten, and A.F. Amos. 1993. Feeding ecology of the loggerhead sea turtle *Caretta caretta* in the Northwestern Gulf of Mexico. Marine Biology 115: 1-15.

Pritchard, P.C.H. 1969. Sea turtles of the Guianas. Bull. Fla. State Mus. 13(2):1-139.

Rebel, T.P. 1974. Sea turtles and the turtle industry of the West Indies, Florida and the Gulf of Mexico. Univ. Miami Press, Coral Gables, Florida.

Renaud, M.L. and J.A. Carpenter. 1994. Movements and submergence patterns of loggerhead turtles (*Caretta caretta*) in the Gulf of Mexico determined through satellite telemetry. Bulletin of Marine Science, 55(1):1-15.

Sarti M., L., S.A. Eckert, N. Garcia T., A.R. Barragan. 1996. Decline of the world's largest nesting assemblage of leatherback turtles. Marine Turtle Newsletter 74: 2-5.

Schmidley, D.J. 1981. Marine mammals of the southeastern United States and the Gulf of Mexico. U.S. Fish and Wildlife Service. Office of Biological Services, Washington, DC, FWS/OBS-80/41, 165 pp.

Sears, C.J. 1995. Preliminary genetic analysis of the population structure of Georgia loggerhead sea turtles. Presented at the Fifteenth Annual Symposium of Sea Turtle Biology and Conservation, February 1995, Hilton Head, SC.

Sears, C.J., B.W. Bowen, R.W. Chapman, S.B. Galloway, S.R. Hopkins-Murphy, and C.M. Woodley. 1995. Demographic composition of the juvenile loggerhead sea turtle (*Caretta caretta*) feeding population off Charleston, South Carolina: evidence from mitochondrial DNA markers. Mar. Biol. 123:869-874.

Shaver, D.J. 1991. Feeding ecology of wild and head-started Kemp's ridley sea turtles in south Texas waters. Journal of Herpetology. Vol. 23. 1991

Shaver, D.J. 1994. Sea turtle abundance, seasonality and growth data at the Mansfield Channel, Texas. In B.A. Schroeder and B.E. Witherington (compilers), Proceedings of the thirteenth annual symposium on sea turtle biology and conservation, NOAA Tech. Memo NMFS-SEFC-341: 166-169.

Townsend, C.H. 1935. The distribution of certain whales as shown by logbook records of American whale ships. Zoologica 19: 1-50.

Turtle Expert Working Group. 1998. An Assessment of the Kemp's Ridley (Lepidochelys kempii) and Loggerhead (Caretta caretta) Sea Turtle Populations in the Western North Atlantic. NOAA Technical Memorandum NMFS-SEFSC-409. 96 pp.

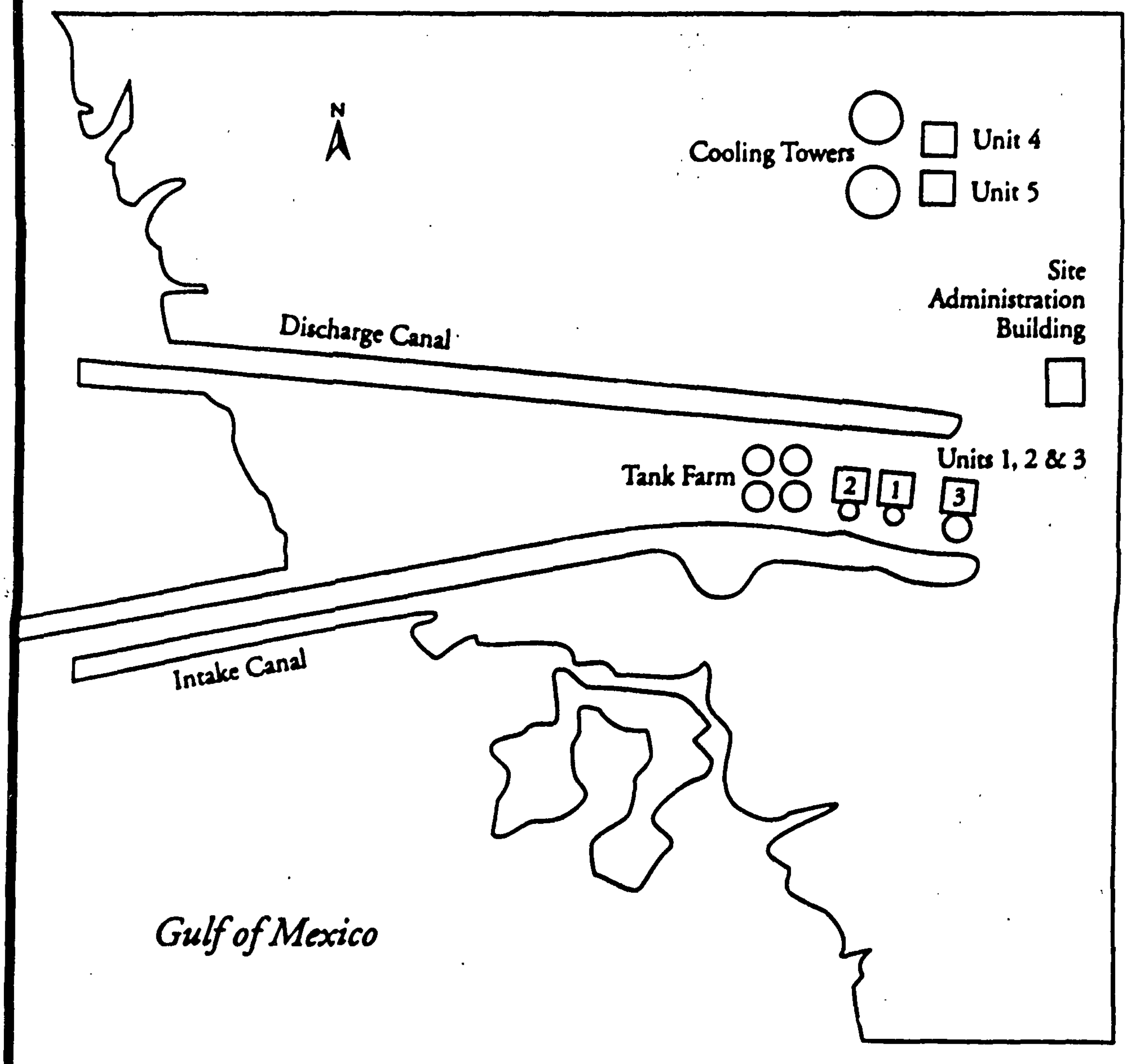
U.S. Fish and Wildlife Service and Gulf States Marine Fisheries Commission. 1995. Gulf Sturgeon Recovery Plan. Atlanta, GA. 170 pp.

Vargo, S., P. Lutz, D. Odell, E. Van Vleet and G. Bossart. 1986. Final report: Study of effects of oil on marine turtles. Tech. Rep. O.C.S. study MMS 86-0070. Vol. 2, 181 pp.

Waring, G.T., D.L. Palka, K. Mullin, J.W. Hain, L. J. Hansen, K.D. Bisack. 1997. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 1996. NOAA Technical Memo, Sept. 1997 Draft.

Young, G.A. 1991. Concise Methods for Predicting the Effects of Underwater Explosions on Marine Life. Naval Surface Warfare Center, Research and Technology Department, Dahlgren, Virginia.

ATTACHMENT 1



NOT TO SCALE

Site layout of the Crystal River Energy Complex.