

GENERIC DRAFT
HOPPER DREDGING



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1325 East-West Highway
Silver Spring, MD 20910
THE DIRECTOR

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NOV 25, 1991

John P. Elmore, P.E.
Chief, Operations, Construction
and Readiness Division
Directorate of Civil Works
U.S. Army Corps of Engineers
Department of the Army
Washington, D.C. 20314-1000

Dear Mr. Elmore:

Thank you for your November 20, 1991, letter responding to the National Marine Fisheries Service (NMFS) draft biological opinion on hopper dredging in the southeastern United States. We appreciate the opportunity to review your draft comments on the opinion, and I can assure you that all issues of concern to the U.S. Army Corps of Engineers (Corps) have been considered in preparation of a final biological opinion. Unfortunately, as you correctly noted in your letter, it will not be possible to resolve all matters concerning statements in the biological opinion by December 1, 1991. Therefore, we are issuing the enclosed opinion to allow dredging to begin as scheduled. Questions concerning this biological opinion should be directed to Robert Ziobro, Office of Protected Resources, Protected Species Management Division (301-427-2323).

Also enclosed are responses to your draft comments on the draft biological opinion. Many of these comments were helpful to us in improving the document, and have been incorporated in the opinion. For your information a "redlined" version of the draft opinion is enclosed so that changes can be identified readily (additions are highlighted and deletions are surrounded by highlighted brackets). We appreciate your cooperation in working towards a resolution on the sea turtle/hopper dredging issue and look forward to continued cooperation in solving this problem.

Sincerely,

William W. Fox, Jr.

Enclosures

THE ASSISTANT ADMINISTRATOR
FOR FISHERIES



Mark Doan

Endangered Species Act - Section 7 Consultation

Biological Opinion

Agency: U.S. Army Corps of Engineers

Activity: Dredging of channels in the Southeastern United States from North Carolina through Cape Canaveral, Florida

Consultation Conducted By: National Marine Fisheries Service, Southeast Regional Office

Date Issued: NOV 25 1991

A. Background:

The U.S. Army Corps of Engineers has primary responsibility for maintaining navigational channels in United States waters. To accomplish this task, dredging is periodically required. A variety of dredge types and techniques are employed on a channel specific basis, dependent upon the characteristics of channels, availability of disposal sites, local environmental regulations, types of material to be removed, proposed timing of the dredging, etc. In the southeastern United States, at least three types of dredges (hopper, clamshell, and pipeline) are commonly used.

NMFS has investigated the potential for sea turtle mortalities associated with each of these dredge types. Clamshell dredges are the least likely to adversely affect sea turtles because they are stationary and impact very small areas at a given time. Any sea turtle injured or killed by a clamshell dredge would have to be directly beneath the bucket. The chances of such an occurrence are extremely low, although a take of a live turtle by a clamshell dredge has been documented at Canaveral. On the basis of the best available information, NMFS has determined that dredging with a clamshell dredge is unlikely to result in the take of sea turtles.

Sea turtle take by pipeline dredges has also been investigated. NMFS has required observer coverage at pipeline outflows during several dredging projects in the southeast. No turtles or turtle parts were observed during these projects. Additionally, the Corps provided documentation of hundreds of man hours of informal observation by Corps inspectors, and no listed species were observed. Finally, pipeline dredge outflows are commonly monitored by other agency personnel, conservation organizations, and the general public. NMFS has never received a report of a turtle take by pipeline dredges.

Pipeline dredges are relatively stationary and only influence small areas at any given time. For a turtle to be taken with a pipeline dredge, it would have to approach the cutterhead and be caught in the suction. This type of behavior would appear

unlikely, but may be possible. Presently, NMFS has determined that pipeline dredges are unlikely to adversely affect sea turtles. This position, of course, could change if new information suggests that sea turtle/pipeline dredge interactions occur.

In addition to the three types of dredges identified, the special purpose split-hull hopper dredge CURRITUCK and sidecast dredges are used on a limited basis in the southeast. These dredges are not believed harmful to sea turtles because of the small size of dragheads (roughly 2' by 2'), slow speed of the vessels, and the low suction levels. For the present consultation, NMFS has determined that these dredges are unlikely to adversely affect sea turtles.

Of the three major dredge types, only the hopper dredge has been implicated in the mortality of endangered and threatened species. Thus, this biological opinion concentrates on the adverse impacts of hopper dredging in the southeastern United States.

The primary Endangered Species Act (ESA) concern with hopper dredging is the documented take of a significant number of sea turtles. A secondary concern is the potential for hopper dredge/right whale collisions. Past ESA section 7 consultations have addressed the adverse effects of hopper dredging to both endangered right whales and endangered/threatened sea turtles.

1. Sea turtles

The take of sea turtles by hopper dredges was first identified as a potential problem in the late 1970's. In early 1978, NMFS received reports of unprecedented numbers of sea turtles taken by shrimp trawlers in the Canaveral ship channel, Florida. Trawl surveys were conducted by NMFS during February and March of 1978, and the reports of high turtle abundance were corroborated. In August of 1978, NMFS requested that the Corps initiate ESA Section 7 consultation on the probable impacts of maintenance and construction dredging to sea turtles residing in the Canaveral channel.

On March 30, 1979, NMFS issued a biological opinion based on a threshold examination of the situation. This opinion concluded that insufficient information existed to determine whether or not dredging was likely to jeopardize the continued existence of sea turtles. Through agreement with the Corps and the U.S. Navy, trawl surveys were implemented to further assess turtle abundance and distribution in the channel.

On January 22, 1980, NMFS issued a biological opinion concluding that "dredging may result in the loss of large numbers of loggerhead sea turtles but is not likely to result in jeopardizing either the loggerhead or Atlantic ridley sea turtle

stocks." This opinion recommended that NMFS approved observers be placed aboard hopper dredges to monitor turtle take, and that dredging be restricted to the period of August 1 through November 1. No evidence of turtle take by hopper dredges existed at this point, but the potential for take was recognized.

A total of 71 turtle takes by hopper dredges was documented in the Canaveral channel over the period of July 11 through November 13, 1980. These takes were considered minimum estimates of mortality because it was believed that a significant percentage of the total take went undetected. The exact number of turtle takes cannot be documented because of the method used to collect specimens overflow screening. NMFS believes that a high percentage of takes are undetected in the spoil material. From this point on, the Corps acknowledged that hopper dredging in Canaveral posed a problem to sea turtles.

During the period of 1980 through 1986, NMFS, the Corps, and the U.S. Navy concentrated on reducing/eliminating turtle take by hopper dredges in the Canaveral entrance channel. Attempts were made to scare turtles out of the channel, devices were tested to detect and capture turtles, trawlers were used to remove turtles from the dredge path, dredges were equipped with deflector devices, and a variety of other ideas were tested. Unfortunately, no acceptable means of protecting sea turtles from hopper dredges was identified, and take of sea turtles continued.

While the Canaveral channel was being extensively surveyed and turtle take by hopper dredges documented, there was some speculation that similar problems existed in other Corps channel dredging projects. When asked to evaluate turtle take by hopper dredges in other channels, the Corps assured NMFS that no evidence of problems existed. In fact, trawl surveys of five east coast channels were conducted during 1981 and 1982 (Butler et al. 1987), and no channels with turtle concentrations similar to Canaveral were found. While one or two turtles were caught in each of the surveyed channels, hundreds were caught in the Canaveral channel. Because NMFS had no information that turtle take in other channels was significant, additional channel surveys were not required by NMFS.

Given the lack of information on turtle distributions in channels other than Canaveral, it is not surprising that Canaveral was treated as a unique problem. During this time period, NMFS was heavily involved in technology transfer of turtle excluder devices (TEDs) to the shrimping industry. Mortality of sea turtles by shrimp trawlers was known to be a significant problem, and the magnitude of this problem dictated that it be given the highest priority for resolution. The majority of NMFS resources were devoted to implementing TEDs, and little effort was devoted to assessing turtle abundance and distribution in southeastern United States channels.

In 1986, the U.S. Navy reinitiated ESA Section 7 consultation on Kings Bay, Georgia, channel dredging. The scope of the project involved widening and deepening of existing channels and extension of the channel approximately 14 miles. The Navy proposed to implement sea turtle conservation measures including observer coverage, screening of dredge overflow, and a stand-by trawler to catch and remove turtles, if necessary. NMFS concurred with these measures and issued a "no affect" determination through an informal consultation. This determination was later changed through reinitiation of consultation to a "may affect" opinion when turtle takes occurred. From July 1987 through December 1989, a total of 21 turtles were taken during hopper dredging operations in the Kings Bay project.

Turtle take by hopper dredges in Kings Bay resulted in major changes in NMFS policy on channel dredging. This was the first documented take of turtles by hopper dredges anywhere other than in the Canaveral channel. Additionally, the take included 3 endangered Kemp's ridley turtles and 3 endangered/threatened green turtles; only loggerhead turtle takes had been previously documented in Canaveral. NMFS began to consider the additive consequences of hopper dredging in the southeast as a whole, assuming that Kings Bay and Canaveral were not exceptional and that take levels observed in these channels might reflect take levels in other channels.

At NMFS' urging, the Corps' Jacksonville District and the Corps' Waterways Experiment Station (WES) jointly sponsored a May 11-12, 1988, "National Workshop on Methods to Minimize Dredging Impacts on Sea Turtles," held in Jacksonville, Florida. This workshop brought together representatives of the Corps, NMFS, the U.S. Navy, the dredging industry and the environmental community to discuss the dredging/sea turtle conflict. While the workshop was valuable in terms of heightening awareness of this problem and bringing together a diverse group of interested parties, limited action was taken to implement the recommendations of the participants. The Jacksonville District and WES did work together to design and test new draghead deflector designs on the Corp's dredge MCFARLAND as well as several contractor-owned hopper dredges, and developed and tested inflow screening on the MCFARLAND. Unfortunately, few of the other recommended actions were implemented.

In a July 8, 1988, letter from the Assistant Administrator for Fisheries to the Acting Commander of the Corps, NMFS applauded the Corps efforts in sponsoring the workshop. NMFS advised the Corps of agency plans to assess the cumulative impacts to sea turtles of dredging in channels other than Canaveral, and to "request formal consultation under Section 7 of the ESA wherever turtles are known to occur and hopper dredging is proposed." For the first time, NMFS clearly stated that "this conflict can no

longer be isolated to the Canaveral channel and the Corps Jacksonville District, but should be addressed on a National scale." In a letter of August 26, 1988, Corps General Withers responded stating that, "we will ensure that the coastal Corps districts continue to remain active players in this arena."

Since these letter were exchanged, observer coverage was required during 25-100 percent of all hopper dredging activities in Brunswick, Savannah, and Wilmington Harbor dredging projects. From 1988 through 1990, one turtle take was documented in the Brunswick channel, and another was documented in the Savannah channel with 25 percent observer coverage. No turtle takes were documented in the Wilmington channel with 100 percent observer coverage. As a requirement of a Section 7 consultation for the Charleston widening and deepening project, a one-year trawl survey of the channel was implemented by the Charleston Corps. This survey was not expected to yield high turtle abundance estimates, but was designed to provide information on when and where turtle takes might be avoided by prudent scheduling of dredging.

Another event that occurred in 1990 which has some bearing on this consultation was the publication of the National Academy of Sciences' study, "Decline of the Sea Turtle, Causes and Prevention." This study focused on sea turtle mortalities in the shrimp fishery where an estimated 5,000 to 50,000 loggerhead and 500 to 5,000 Kemp's ridley turtles were killed annually prior to implementation of turtle conservation regulations, but also examined other known sources of mortality. Hopper dredging in the southeast was estimated to result in the deaths of 50-500 loggerhead and 5-50 Kemp's ridley turtles annually. It is of importance to note that hopper dredging and collisions with vessels were identified as the greatest sources of sea turtle mortality other than fisheries.

During 1991 hopper dredging operations in the Brunswick channel, significant levels of turtle mortality were documented. From March 21 through June 19, a total of 21 turtle deaths were reported. These mortalities were documented at observer coverage levels of 25-50 percent, although Corps personnel and dredge operators reported turtle mortalities when observers were not present. During this dredging episode, 10-20 stranded turtles were observed with crushed carapaces similar to what might be expected in dredge related mortalities. Because of problems associated with documentation of turtle mortalities aboard hopper dredges, NMFS considers 21 mortalities to be a minimal estimate of actual turtle deaths during this project.

Immediately following the Brunswick dredging project, the dredge moved to Savannah Harbor and operated from June 20 through July 18. During this project, 17 loggerhead turtle mortalities were documented with 50 percent observer coverage. As with Brunswick,

NMFS considers this to be a minimal estimate of actual mortalities.

After completion of the Savannah work, the dredge moved to Charleston where trawl surveys for turtles were ongoing. The surveys suggested that turtles were present in the channel and that take was likely if dredging occurred during summer and fall months. To minimize take, the Corps began dredging in the outer reaches of the channel and slowly moved inshore as sections of the channel were completed. During the first few weeks of the project, no turtles were taken. Hopper dredging occurred in the outer channel from August to October 1, 1991. A total of three loggerheads were taken by the hopper dredge. Intensive trawling to relocate sea turtles from the ship channel encountered only 15 sea turtles which is relatively low compared to previous trawling efforts at Savannah and Brunswick ship channels.

The high levels of take in Brunswick and Savannah were not ignored by the Corps, and every effort to minimize take was employed. Trawlers were chartered to capture and relocate turtles in these channels, and it is believed that these actions helped to reduce the level of take. Unfortunately, it is not possible to quantify the effectiveness of turtle relocation techniques at this point because all such actions were taken after high levels of mortality were observed aboard dredges. The possibility remains that reductions in take aboard dredges following implementation of relocation procedures may simply reflect decreased population levels in the channels resulting from habitat disruption by dredges and/or prior high levels of take. Despite uncertainties about the effectiveness of relocation techniques, it appears that these techniques reduce turtle mortalities and warrant further investigation.

What has been learned from past dredging episodes is that turtle take cannot be avoided if hopper dredging occurs when turtles are present. To significantly reduce/eliminate turtle mortalities from hopper dredges given our present abilities to protect turtles, dredging should be scheduled in areas and at times when turtles are not present or occur at low abundance levels.

2. Right whales

In 1983 it was confirmed, through photo-identification, that right whales migrate from their summer feeding grounds to winter calving grounds off the coasts of Georgia and northern Florida. Portions of the North Atlantic right whale population are now known to migrate along the United States east coast each year from October through April.

On July 25, 1986, NMFS concurred with the Navy's determination of "no affect" for construction dredging in Kings Bay, Georgia.

NMFS concurrence was based upon the measures the Navy had agreed to implement to protect sea turtles and right whales. The protective measures included having a NMFS approved observer aboard the dredge during the peak right whale calving season of January through April.

The July 11, 1988, biological opinion for hopper dredging of the Canaveral Channel, Florida, recommended that observers aboard the dredge maintain a watch for right whales while the dredge was in transit to and from the disposal sites during the month of December. Subsequent opinions did not recommend dredging during the months of January through March and retained the recommendation that observers watch for right whales during December.

On March 3, 1989, NMFS issued a biological opinion for Kings Bay, Georgia, dredging which recommended that if hopper dredging occurred from November through April, aerial surveys should be conducted to determine if right whales were in the vicinity of the dredging operations. This opinion included requirements for observers to maintain a lookout during dredge transit to and from the disposal site. It was also recommended that night dredging cease or the dredge's transit speed to and from the disposal area be reduced to three knots or less if right whales were sighted within 10 nautical miles of the dredging activities.

On January 10, 1990, NMFS issued biological opinions on proposed dredging in Charleston Harbor, South Carolina, and Morehead City Harbor, North Carolina, which were based on an agreement with the Corps that a NMFS approved dedicated lookout or a member of the dredge crew would be aboard the hopper dredge to spot right whales during dredging and spoil disposal activities. Under the agreement, dredges were required to stop, alter course, or maneuver to avoid approaching right whales, and that maximum dredge transit speed would be five knots or less if right whales were in the vicinity. The Corps also agreed to provide educational information to aid the dredge crews in recognizing and avoiding right whales. The 1990 biological opinion on Port Royal, South Carolina contained the same agreement.

On May 8, 1991, NMFS issued biological opinions for proposed dredging in Savannah and Brunswick Harbors, Georgia. These opinions urged the Corps to take all possible precautions to assure that right whales were not adversely affected during hopper dredge transit to and from the disposal area.

Through aerial surveys and the use of lookouts the Corps has avoided collisions between right whales and hopper dredges. Continuation of these protective measures are believed necessary, and development of new methods to detect and avoid right whales is highly recommended.

This Biological Opinion is based on the best scientific and commercial data available. It incorporates information from:

- (1) previous Biological Opinions on dredging of channels in the southeastern United States,
- (2) Corps Biological Assessments,
- (3) discussions at Sea Turtle/Dredging Task Force meetings,
- (4) discussions at the May 11-12, 1988, dredging workshop,
- (5) the August 22, 1991, meeting in St. Petersburg, Florida, and
- (6) the scientific literature and other available information.

B. Proposed Activity

This consultation addresses Corps channel dredging activities along the southeastern Atlantic seaboard from North Carolina to Cape Canaveral, Florida. This includes both maintenance dredging and new construction dredging. Major channel dredging projects in which hopper dredges are normally used include:

- (1) Oregon Inlet, North Carolina
- (2) Morehead City, North Carolina
- (3) Wilmington Harbor, North Carolina
- (4) Georgetown, South Carolina
- (5) Charleston, South Carolina
- (6) Port Royal, South Carolina
- (7) Savannah, Georgia
- (8) Brunswick, Georgia
- (9) Kings Bay/St. Marys, Georgia
- (10) Jacksonville, Florida
- (11) St. Augustine, Florida
- (12) Ponce Inlet, Florida
- (13) Canaveral, Florida

Information on the timing and amount of materials removed during past hopper dredging projects in these channels was provided by Corps district offices and is attached.

C. Listed Species and Critical Habitat

Listed species under the jurisdiction of NMFS that may occur in channels along the southeastern United States and which may be affected by dredging include:

- (1) the endangered right whale - Eubalaena glacialis
- (2) the threatened loggerhead turtle - Caretta caretta
- (3) the endangered/threatened green turtle - Chelonia mydas
- (4) the endangered Kemp's ridley turtle - Lepidochelys kempi

Green turtles in United States waters are listed as threatened, except for the Florida breeding population which is listed as endangered.

Additional species which are known to occur along the Atlantic coast include:

- (1) the finback whale - Balaenoptera physalus
- (2) the humpback whale - Megaptera novaeangliae
- (3) the sei whale - Balaenoptera borealis
- (4) the sperm whale - Physeter macrocephalus
- (5) the hawksbill turtle - Eretmochelys imbricata
- (6) the leatherback turtle - Dermodochelys coriacea
- (7) the shortnose sturgeon - Acipenser brevirostrum

NMFS has determined that these species are unlikely to be adversely affected by hopper dredging activities.

D. Assessment of Impacts

1. Right whale (Eubalaena glacialis) - Endangered status

Right whale populations in the North Atlantic are estimated at a few hundred individuals (NMFS 1984). Aerial surveys in February 1984, between Ossabaw Island, Georgia, and Jupiter Inlet, Florida, revealed the presence of 13 right whales including four cow/calf pairs (Kraus, pers. comm.). During 1985 winter surveys which began in early February, an additional 10 right whales were sighted (Anon 1985). These data, observations by the right whale sighting network, and aerial surveys conducted by the University of Rhode Island indicate the presence of a right whale calving area off the southeastern coast of the United States. The majority of these sightings have occurred off the coast of Georgia, but three cow/calf pairs were observed within five miles of the Florida shoreline.

During 1988, additional data collected aboard dredges in the vicinity of Kings Bay, Georgia, suggests that right whales may be particularly vulnerable to vessel/whale collisions. On two separate occasions (February 6, 1988, and April 11, 1988), right whales were observed by hopper dredges while in transit to the offshore disposal site. During the February 6, 1988, encounter, the whale exhibited unexpected behavior when the vessel approached to within 100 yards. The animal oriented itself facing the vessel in a defensive profile, apparently planning to "bump heads" with the approaching vessel. If this behavior is the normal defense mechanism of this species, the possibilities of night collisions between vessels and right whales are greatly increased.

Another noteworthy whale encounter occurred on February 28, 1988, during clamshell dredging of Canaveral channel. A right whale approached to within 60 feet of the mouth of the harbor, confronted the north jetty, and turned eastward toward the sea. This whale was in the channel for a period of about 10 minutes;

fortunately, this occurred during daylight hours, and when no vessels were transiting the channel. The breeding/calving season off the southeastern United States coastline is primarily from January through March, but may extend from December through April.

NMFS does not anticipate any effects of the proposed dredging activity on populations of right whales, but believes that additional precautions to avoid vessel/right whale collisions may be necessary during winter dredging, particularly off Georgia and northern Florida.

2. Sea Turtles

NMFS believes that hopper dredging activities in the southeastern United States may adversely affect the endangered Kemp's ridley and Florida green turtles, and the threatened loggerhead turtle. Because of their low population numbers, the Kemp's ridley and green turtles are particularly vulnerable to the impacts of this activity.

Past maintenance dredging in the southeastern United States has been demonstrated to affect sea turtles adversely. The first documented instance of dredge related sea turtle mortality occurred in Cape Canaveral during the July-November 1980 dredging period. Subsequently, turtle/dredge encounters have been documented in most channels in the southeast. Ninety-five percent of these encounters resulted in mortality, although mortality rates varied by species and size of animals. Turtles are drawn into the dragheads, forced through the pumps and subsequently crushed. The remains, which usually consist of small sections of viscera, bones, shell, etc., are deposited in the hopper along with the dredged materials.

Sea turtle surveys of the Cape Canaveral ship channel have been conducted by NMFS since 1978. These surveys were initiated when unprecedented numbers of sea turtles in an apparent state of hibernation were discovered (Carr et al. 1980). Subsequent surveys have provided evidence that the Canaveral ship channel supports aggregations of sea turtles during all months of the year and particularly during cooler winter months (Henwood 1987; Butler et al. 1987; Henwood and Ogren 1987). More recent survey reports (Bolten and Bjorndal 1988; Christian and Harrington 1987; Henwood 1987) suggest that aggregations of sea turtles inhabiting the channel have not changed since the earlier studies.

There is a growing body of evidence that sea turtles are abundant in specific channels during certain months of the year. Trawl surveys and sea turtle removal activities using trawlers have been conducted in Kings Bay, Brunswick, Savannah, and Charleston. In each of these channels, significant catch rates of sea turtles have been documented at certain times of the year.

In addition to trawl surveys of discrete channels, a great deal of information is available on sea turtle distribution, abundance, and movements along the southeastern Atlantic seaboard. Turtle take data from shrimp trawlers, aerial surveys, stranding data, and nesting surveys provide information on seasonality of sea turtle abundance. While these data cannot be used to predict absolute number of turtles in any given channel, the fact that turtles are relatively abundant in adjacent sounds and nearshore waters is certainly an indicator of likely occurrence in channels. A cursory examination of the existing turtle distribution data indicates that turtles are known to be present in waters of Georgia, South Carolina and North Carolina from April through November of each year.

Three species of turtles, the loggerhead, Kemp's ridley and green, have been taken by hopper dredges in the southeast. Impacts on each species will be individually assessed because of differences in their abundance, distribution and habits.

a. Loggerhead turtle (Caretta caretta) - Threatened status

In the western Atlantic Ocean, loggerhead turtles occur from Argentina northward to Nova Scotia including the Gulf of Mexico and the Caribbean Sea (Carr 1952). Sporadic nesting is reported throughout the tropical and warmer temperate range of distribution, but the most important nesting areas are the Atlantic coast of Florida, Georgia and South Carolina (Carr and Carr 1978). The Florida nesting population of loggerheads has been estimated to be the second largest in the world (Ross 1982).

The foraging range of the loggerhead sea turtle extends throughout the warm waters of the United States continental shelf (Rebel 1974). On a seasonal basis, loggerhead turtles are common as far north as the Canadian portions of the Gulf of Maine (Lazell 1980), but during cooler months of the year, distributions shift to the south (Shoop et al. 1981). Loggerheads frequently forage around coral reefs, rocky places and old boat wrecks; they commonly enter bays, lagoons and estuaries (Ernst and Barbour 1972). Aerial surveys of loggerhead turtles at sea indicate that they are most common in waters less than 50 m in depth (Shoop et al. 1981; Fritts et al. 1983), but they occur pelagically as well. Shoop et al. (1981) speculated that loggerhead turtles sighted in deep oceanic water were probably in transit to other areas.

The primary food sources of the loggerhead turtle are benthic invertebrates including molluscs, crustaceans and sponges (Mortimer 1982). Crabs and conchs were identified (Carr 1952) as the most frequently found items in stomachs, although loggerheads often eat fish, clams, oysters, sponges and jellyfish. Ernst and Barbour (1972) included marine grasses and seaweeds, mussels, borers, squid, shrimp, amphipods, crabs, barnacles and sea

urchins among the foods of loggerhead turtles. The horseshoe crab (Limulus polyphemus) has been identified as a major food source of loggerheads in Mosquito Lagoon, Florida (Mortimer 1982).

Nesting aggregations of loggerhead sea turtles along the United States Atlantic coast have received considerable attention in recent years, but most studies have been limited to nesting migrations of adult females, development of eggs and behavior of hatchlings (Ernst and Barbour 1972). Little information on the life history of subadults and adult males is available. The work of Mendonca and Ehrhart (1982) suggests that subadult loggerhead turtles may use lagoonal systems as preferred habitats during stages of their life cycles.

Since 1978, loggerhead turtles occurring in the Cape Canaveral area have been studied extensively. Spatial and temporal changes in size and sex composition of loggerhead aggregations, monthly catch rates by trawlers, abundance estimates and movements into and out of the channel have been examined (Henwood 1987; Butler et al. 1987; Henwood and Stuntz 1987). Results of NMFS surveys are summarized in previous NMFS Biological Opinions.

The most recent information suggests that loggerheads occur in ship channels in the southeastern United States throughout much of the year, and that mortalities associated with hopper dredging are likely. Therefore, the direct effects of unrestricted hopper dredging will be mortalities of an unknown number of loggerhead turtles. Over eighty percent of these mortalities will be of subadult turtles.

Several sea turtle researchers (Ehrhart 1987; Frazer 1986; Murphy pers. comm.) have suggested that loggerhead turtle nesting populations in the United States are continuing to decline at rates of up to five percent annually. A theoretical explanation for these declines was provided by Crouse et al. (1987). Applying a Leftovitch stage-class matrix model of loggerhead populations on Little Cumberland Island, Georgia, these authors showed that loggerhead population stability is more sensitive to changes in the subadult stage of development than in other developmental stages. The significance of these findings with respect to dredging activities should be readily evident; by impacting the most sensitive developmental stages of loggerhead turtles, dredging may exert a major impact on the recovery of these populations.

To further examine the additive impacts of all channel dredging activities in areas where turtles are known to occur, we must first consider the magnitude of potential turtle mortalities from hopper dredging. In Canaveral channel alone, we have documented a minimum of 98 sea turtles taken by dredges that were monitored. Presently, we have no estimates of the actual percent of

mortalities which are documented by observers aboard hopper dredges, but suspect that our monitoring techniques (screening the overflows) allows the documentation of only a small number of the total mortalities.

During dredging of the Kings Bay channel, a minimum of 25 turtles have been taken by hopper dredges with observers aboard. As in Canaveral, the majority of these turtles were subadult loggerheads. During 1991 dredging of the Brunswick channel, 23 turtle incidents were reported. With the exception of one Kemp's ridley, all were believed to be loggerhead turtles. In the Savannah channel, a total of 17 loggerhead turtle mortalities were documented during 1991 hopper dredging. Two loggerhead turtles have been taken thus far in 1991 dredging of the Charleston, South Carolina, ship channel. In 1991 alone, we have already documented 42 turtle mortalities which we believe is a gross underestimate of the true levels of mortality.

Another major consideration in determining the additive impacts of hopper dredging to loggerhead stocks is the fact that most channels require annual maintenance dredging; a given number of turtles will be killed each year. This source of mortalities has been continuing since hopper dredges came into use, and will continue until an alternative to hopper dredging or an engineering solution to the problem is found. The continuous loss of an unknown number of subadult loggerheads from the populations could adversely affect the reproductive potential of the species and significantly prolong recovery.

b. Green turtle (Chelonia mydas) - Threatened/endangered status

Green turtles are circumglobally distributed mainly in waters between the northern and southern 20 degree C isotherms (Hirth 1971). In the western Atlantic, several major nesting assemblages have been identified and studied (Peters 1954; Carr and Ogren 1960; Duellman 1961; Parsons 1962; Pritchard 1969a; Schulz 1975; Carr et al. 1978). In the continental United States, however, the only known green turtle nesting occurs on the Atlantic coast of Florida (Ehrhart 1979).

While nesting activity is obviously important in determining population distributions, the remaining portion of the green turtle's life is spent on the foraging grounds. Some of the principal feeding pastures in the western Atlantic Ocean include: upper west coast of Florida, northwestern coast of Yucatan peninsula, south coast of Cuba, Mosquito Coast of Nicaragua, Caribbean coast of Panama, scattered areas along Colombia, and scattered areas off the Brazilian coast (Hirth 1971). The preferred food sources in these areas are: Cymodocea, Thalassia, Zostera, Sagittaria and Vallisneria (Babcock 1937; Underwood 1951; Carr 1954; Carr 1952; Neill 1958; Mexico 1966). Although no green turtle feeding pastures or major nesting beaches have

been identified on the southeast Atlantic coast, evidence provided by Mendonca and Ehrhart (1982) indicates that immature green turtles may utilize lagoonal systems during periods of their lives. These authors identified a population of young green turtles (carapace length 29.5 - 75.4 cm) believed to be resident in the Mosquito Lagoon, Florida. The Indian River system, of which Mosquito Lagoon is a part, supported a green turtle fishery during the late 1800's (Ehrhart 1983), and these turtles may be remnants of this historical colony.

Information on green turtle distribution and abundance in southeastern Atlantic channels is sparse. However, juvenile green turtles are known to occur seasonally throughout the southeastern United States, and take by hopper dredges in any channel would not be unexpected. During NMFS surveys in the Cape Canaveral area between 1978 and 1984, a total of 21 green turtles were captured; ten of these turtles were dead and the remaining 11 survived. All of these turtles were subadults ranging in size from 23.6 to 68.1 cm total straight-line carapace length. With the exceptions of August and November, green turtles were captured during all months of the year (Henwood and Ogren 1987).

The most immediate and damaging "dredge effect" on green turtles is injury or death which results from being drawn into the suction of the draghead. Dredge observers at Canaveral have documented the take by hopper dredges of three green turtles during 1980, one during 1981, three during 1988, nine during 1989, and five during 1991. Three green turtles have also been taken by hopper dredges in Kings Bay. Some of these turtles survived, but were injured and required rehabilitation before release.

The presence of green turtles in association with channel jetties has been observed in both Canaveral and in Texas. The Corps is presently cooperating with NMFS in tracking studies to determine the behavior of green turtles in and around channels. Preliminary findings indicate that green turtles may occupy relatively small foraging ranges (300-400 yards) in which they reside for weeks at a time. Given this behavior, it may be possible to capture and remove resident green turtles prior to hopper dredging of channels where green turtles are known to be present. Another option would be to schedule dredging projects when green turtles have left the area.

c. Kemp's ridley turtle (Lepidochelys kempii) - Endangered status

Of the seven extant species of sea turtles of the world, the Kemp's ridley is probably in the greatest danger of extinction. The only major nesting area for this species is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; Hildebrand 1963). Virtually the entire world population of adult females nest annually in this single locality (Pritchard 1969b).

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 1970's, the world population estimate of mature female Kemp's ridleys had been reduced to 2500-5000 individuals. Most recent estimates of the total population of sexually mature female Kemp's ridleys are less than 260 turtles (Byles pers. comm. 1987).

The foraging range of mature Kemp's ridley turtles is restricted to the Gulf of Mexico. Evidence provided by tagging programs (Chavez 1968), suggests that post-nesting females move in comparable numbers to the north (mostly to Louisiana) and to the south (mostly to Campeche) (Pritchard and Marquez 1973). It is assumed that adult male turtles follow similar migratory patterns.

Movements of hatchling Kemp's ridley turtles may be determined by current patterns: either the loop current for northward transport or an eddy for southward transport with occasional transportation through the Florida Straits via the Gulf Stream (Hildebrand 1982). Young Kemp's ridley turtles are known to occur in eastern United States coastal waters from Florida to Canadian portions of the Gulf of Maine (Lazell 1980). Pritchard and Marquez (1973) suggest that passive transportation via the Gulf Stream up the eastern coast of the United States may be the usual dispersal pattern of young Kemp's ridley turtles. They speculate that turtles feed and grow rapidly during passive transport, and by the time they reach offshore waters of New England they are large enough for active swimming. At this stage they reverse the direction of travel toward the Gulf of Mexico.

Kemp's ridley turtles feed primarily in shallow coastal waters on bottom-living crustaceans (Hildebrand 1982). Organisms identified from stomachs include crabs (Polydora, Hepatus, Callinectes, Panopeus, Minepepe, Ovalipes, Calappa, Portunus, Arenaeus), fish (Lutjanus, Leiostomus) and molluscs (Noculana, Corbula, Mulinia, Nassarius) (Dobie et al. 1961; Pritchard and Marquez 1973). All of these genera are forms common in the Gulf of Mexico and the eastern coast of the United States.

During trawl surveys in the vicinity of Cape Canaveral from 1978 through 1984, a total of 40 Kemp's ridley turtles were captured. An additional 21 ridley captures occurred in Georgia and South Carolina waters (Henwood and Ogren 1987). Interestingly, 93 percent of the Kemp's ridley captures in Canaveral occurred during the months of December through March, while all ridley captures north of Canaveral occurred during the months of June through November. These seasonal distribution patterns suggest that hopper dredge related mortality of Kemp's ridley turtles could be eliminated by prudent scheduling of dredging during times when the species is not present.

Four Kemp's ridley mortalities have been documented aboard hopper dredges in the southeastern United States. Three of these mortalities occurred at Kings Bay during 1988 (October 31-December 9 dredging period), and one occurred at Brunswick during 1991 (March 23-June 19 dredging period). Surprisingly, no Kemp's ridley mortalities have been documented at Cape Canaveral despite their relatively high abundance during winter months.

E. Conclusions

1. Right whale:

NMFS concludes that continued unrestricted hopper dredging in the southeastern United States is not likely to jeopardize the continued existence of the right whale (Eubalaena glacialis). This decision is contingent upon implementation of appropriate precautionary measures in areas and at times when right whales may be present. A right whale "watch" should be instituted aboard hopper dredges during the months of December through March in Georgia and northern Florida channels to assure that dredge/whale collisions during transit to and from the offshore disposal site are avoided. Similar right whale watches should be implemented in other channels during periods of known right whale migratory activity. Aerial surveys in the vicinity of Kings Bay should be continued, and similar measures may be appropriate in channels north and south of Kings Bay.

2. Sea Turtles:

NMFS concludes that unrestricted hopper dredging in the southeastern United States is likely to jeopardize the continued existence of the Florida green turtle (Chelonia mydas), and the Kemp's ridley turtle (Lepidochelys kempii). This opinion is based on the critically small population sizes of these two species, the occurrence of greens and Kemp's ridleys in shipping channels, the known adverse impacts of hopper dredging, and the additive impacts of past and future dredging on these species. NMFS also concludes that the additive effects of hopper dredging in all channels will adversely affect the loggerhead turtle (Caretta caretta) but is probably not likely to jeopardize its continued existence. This determination is based on the annual magnitude of hopper dredging in the southeastern United States, and the fact that subadult loggerheads are the predominant turtles taken during these activities.

NMFS believes that dredging can be conducted in the southeastern United States if reasonable and prudent alternatives are implemented to avoid the likelihood of jeopardizing the Kemp's ridley, green and loggerhead turtles. These alternatives have been discussed with the Corps.

F. Reasonable and prudent alternatives to the proposed action

There is ample evidence that the use of hopper dredges in the southeastern United States results in the take of sea turtles. The magnitude of this take is subject to debate, but NMFS believes that it could exceed documented take by a considerable amount. In view of the low incidence of nesting in Kemp's ridley and Florida green turtles and the lack of information on juvenile populations of these two species, NMFS has concluded that these species could be jeopardized by the continued unrestricted use of hopper dredges. Despite recent information suggesting that the subadult segment of the loggerhead population may be critical for recovery of the species, NMFS concludes that the recovery of loggerhead populations is not presently jeopardized by this activity. Accordingly, pursuant to Section 7 (b) of the ESA, the following alternatives are provided which would allow the channel dredging to continue without jeopardizing the existence of these sea turtle species.

1. Use of hopper dredges for channel dredging operations in the North Carolina, South Carolina, Georgia, and Florida to Cape Canaveral shall be restricted to the months of December through March.
2. Trawling should be conducted prior to the start of hopper dredge operations during this time period to ensure a low abundance of sea turtles. NOTE: This requirement is viewed by NMFS as a precautionary measure to ensure that dredging does not commence when turtles are present in very high concentrations or when endangered species such as Kemp's ridleys and green turtles are particularly abundant. Based on past stranding events concentrations of Kemp's ridley may occur at specific areas at specific times, but these aggregations are not predictable. The pre-dredging trawling efforts are designed to identify such situations and allow Corps and NMFS managers to implement additional precautionary measures or delay dredging as deemed appropriate. Some level of turtle capture during these surveys would not be unexpected, and low levels of turtle capture would not preclude commencement of dredging operations.
3. Hopper dredges shall not be used in the Canaveral channel at any time.
4. As new information on turtle distribution and abundance becomes available, this dredging window will be adjusted on a channel specific basis.
5. Pipeline and bucket dredges may be used during all months of the year in all southeastern United States channels.

6. If other types of dredging equipment are, or become, available the Corps should notify NMFS and describe its method of operation before using the dredge.

G. Conservation Recommendations

Pursuant to Section 7(a)(1) of the ESA the following conservation recommendations are made to assist the Corps in reducing/eliminating adverse impacts to loggerhead, green, and Kemp's ridley turtles that result from hopper dredging in the southeastern United States. Many of these recommendations have been discussed at the recent Corps/NMFS meeting in St. Petersburg, Florida, and the Corps has already implemented many of these suggestions.

1. The Corps should establish a program to address turtle/dredging conflicts on a regional or national scale. Recently documented high levels of turtle mortality in Brunswick and Savannah channels indicate that turtle take by hopper dredges can no longer be considered a problem unique to Canaveral and Kings Bay. NMFS suggests that such a program address the following:
 - a. Investigate possible modifications to existing dredges which might reduce or eliminate the take of sea turtles. Develop new dragheads or external screening techniques to exclude turtles from dangerous areas of high suction. Design an effective turtle deflector device to push turtles out of the dredge path. Basically, investigate any and all possible engineering solutions to the problem.
 - b. Explore potential biological approaches to temporarily moving turtles out of areas to be dredged. Additional studies using sound or other possible deterrents should be considered.
 - c. Determine through scientific studies where turtles may be found in the water column, whether they bury themselves in the soft sediments of channels, whether they are feeding in the channels, what factors attract turtles to channels, what is their behavior while in channels, where do they sleep, etc. An understanding of basic sea turtle biology might allow modification of dredging techniques to minimize impacts to turtles.
 - d. Survey all channels in which hopper dredges are used. Given adequate information on turtle distribution and abundance on a channel specific basis, it may be possible to expand or contract hopper dredging windows. Surveys may indicate that some channels do not support

significant turtle populations, and hopper dredging in these channels may be permitted on a year-round basis.

2. A more precise method of determining the amount and extent of sea turtle take is necessary. Present screening techniques are ineffective, and provide minimal estimates, at best, of the total sea turtle mortalities. The only sea turtle mortalities which can be documented are those in which body parts float, are large enough to be caught in the screens, and can be identified as sea turtles. NMFS believes that the vast majority of turtle takes by hopper dredges go undetected because body parts are buried in the dredged material. NMFS also believes that the grid on the dragheads precludes the passage of many turtle parts, ie. the turtles are impinged on the draghead and fall to the bottom unobserved when the suction is turned off and the dragheads brought aboard.

Scientific research permits and/or incidental take permits issued under section 10 (a) of the ESA may be necessary to conduct research on sea turtles or dragheads.

Incidental Take Statement

Section 7(b)(4) of the Endangered Species Act requires that when an agency action is found to be consistent with section 7(a)(2) of the Act and the proposed action may incidentally take individuals of listed species, NMFS will issue a statement that specifies the impact (amount or extent) of such incidental taking. It also states that reasonable and prudent measures be provided that are necessary to minimize such impacts. Incidental taking by the Federal agency or applicant that complies with the specified terms and conditions of this statement, is authorized and exempt from the taking prohibition of the ESA.

Based on results of previous dredging of southeastern United States channels, NMFS anticipates that future hopper dredging activities may result in the injury or mortality of loggerhead, Kemp's ridley and green turtles. Therefore, we have established a low level of incidental take and terms and conditions necessary to minimize and monitor this impact. A documented incidental take level of two (2) Kemp's ridley, or five (5) green, hawksbill or leatherback turtle mortalities, or fifty (50) loggerhead turtle mortalities is set pursuant to Section 7(b)(4) of the ESA. This take level represents a total allowable take through 1992 for all channel dredging in the southeastern United States combined. If the incidental take meets or exceeds this level, the Corps must reinitiate consultation.

To ensure that the specified levels of take are not misinterpreted as an allowable take that can be saved and used for particularly high risk dredging projects, the Corps should reinitiate consultation for any project in which five (5) turtles are taken. The Southeast Region, NMFS, will cooperate with the Corps in the review of such incidents to determine the need for developing further mitigation measures or to terminate the remaining dredging activity.

The above levels of take for dredging in the southeastern United States substantially exceed expected take upon implementation of the specified reasonable and prudent alternatives. However, uncertainty remains regarding when turtles may be present in specific channels, and whether seasonal restrictions on hopper dredging will be adequate in the southernmost channels. Annual differences in water temperatures during December and March will certainly influence whether turtles are present during a given year. For this reason, some level of turtle take in southerly channels is expected during the months of December and March. Seasonal restrictions on hopper dredging will be adjusted on a channel-by-channel basis as better information on turtle occurrence is collected.

The reasonable and prudent measures that NMFS believes are necessary to minimize the impact of hopper dredging in the southeastern United States have been discussed with the Corps. The following terms and conditions are established to implement these measures and to document the incidental take should such take occur:

1. All hopper dredging activities shall be completed during the months of December through March when sea turtle abundance is believed to be at its lowest. This dredging window can be adjusted on a channel specific basis if: (1) the Corps can provide sufficient scientific evidence that turtles are not present or that levels of abundance are extremely low during other months of the year, or (2) the Corps can provide evidence that an engineering or operational solution to the problem has been achieved and that turtle mortalities will not result from hopper dredging.
2. The Corps shall arrange for NMFS approved observers aboard hopper dredges to monitor the hopper spoil, overflow, screening, and dragheads for sea turtles and their remains. Observers shall be aboard the dredges during the months of December and March, and 100 percent coverage is recommended. If no turtle take is observed during December, observer coverage can be terminated during January and February or until there is evidence that turtles have returned to the project area. Weekly summary reports will be submitted to NMFS, Southeast Regional Office, by the observers to assess the monitoring effectiveness and sea turtle takes. During all hopper dredging operations, observers should maintain a watch for right whales during dredge transit to and from the disposal site.
3. The hopper dredge shall be equipped with screening or baskets to better monitor the intake and overflow of the dredged materials for sea turtles and their remains. These screens should sample at least 70 percent of the overflow area and should be installed at the applicable area (i.e., the "skimmer funnels," the starboard and port sides of the vessels, etc.). Every effort possible should be made to effectively sample the turtle parts which travel through the hopper and exit in the overflow material. Inflow screening is recommended whenever possible. New approaches to sampling for turtle parts should be investigated, if possible.
4. The Corps and NMFS shall develop a protocol for testing and evaluation of new draghead designs and/or deflector devices. At some point in the evaluation process, it will be necessary to test the effectiveness of such devices in channels where sea turtles are present. Thus, testing of promising draghead designs or deflector devices will be

permitted outside of the December-March dredging window under carefully monitored conditions. The Corps is responsible for ensuring that applicable permits for scientific research and/or incidental taking are obtained.

5. A report summarizing the results of the dredging and the sea turtle take must be submitted to the Corps and NMFS within 15 working days of completion of any given dredging project.

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