Biological Assessment for Hopper Dredging Affects on Sea Turtles

U.S. Army Corps of Engineers, Mobile District

(For Federally Authorized Navigation Projects)

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This Biological Assessment addresses threatened and endangered sea turtle species that 'may be affected, but not likely to be adversely affected' by hopper dredging of Federally authorized navigation projects located in U.S. Army Corps of Engineers (USACE), Mobile District, which includes coastal areas from Rigolets in Louisiana continuing east to the St. Marks River in Florida. The National Marine Fisheries Service (NMFS) has listed the following five species of sea turtles as either endangered or threatened that may occur in the northern Gulf near the study area. There is no proposed or designated critical habitat listed for these species in the Mobile District.

Green Sea Turtle (*Chelonia mydas*) – Threatened
Kemp's Ridley Sea Turtle (*Lepidochelys kempi*) – Endangered
Hawksbill Sea Turtle (*Eretmochelys imbricata*) – Endangered
Leatherback Sea Turtle (*Dermochelys coriacea*) – Endangered
Loggerhead Sea Turtle (*Caretta caretta*) – Threatened

Only threatened and endangered sea turtles will be discussed in this Biological Assessment. The assessment on sea turtles relies heavily on information from the 2002 Draft Biological Opinion concerning impacts of hopper dredging of navigation channels on threatened and endangered species conducted by the NMFS, and recent surveys and research of the Mobile District's area. Information on sea turtles along the Louisiana, Mississippi, and Alabama is generally sparse. Historical and recent occurrences of the Kemp's ridley, loggerhead, green, leatherback, and hawksbill sea turtles in the vicinity of navigation channels maintained by the Mobile District is summarized, and the potential impacts are discussed.

PROJECT DESCRIPTIONS

The USACE, Mobile District has responsibility for civil works activities from the St. Marks River westward to the Rigolets in Louisiana. Hopper dredges are routinely used to maintain ocean bar and entrance pass channels leading from the Gulf of Mexico through passes between offshore barrier islands into Mobile Bay, Mississippi Sound and Pensacola Bay.

The USACE, Mobile District has identified the following channels in which regular maintenance dredging is required and use of hopper dredges is anticipated.

1. Gulfport Harbor, Mississippi: The Mississippi Sound portion of the project is maintained on a roughly 18-24 month basis. The Mississippi Sound portion of the channel (includes the Sound Channel, Gulfport Ship Channel, Commercial Small Craft Harbor Entrance Channel, and Anchorage Basin) is maintained by pipeline dredge, though the Anchorage Basin may be rarely dredged by hopper dredge. Average yearly dredged material removed from the Anchorage Basin has been about 376,000 cubic yards. The Pass (Ship Island Pass bar channel) and the Gulf entrance channel are maintained on a 12-month basis. Prior to 1992, the majority of this material was removed by hopper dredge and placed in the ocean disposal sites; since 1992 the material from the bar channel has been removed by pipeline dredge and placed downdrift. About 400,000 - 450,000 cubic yards are removed yearly from each of the Pass and Gulf entrance channels. The Gulf entrance channel is maintained by hopper dredge with the material placed in ocean sites located on either side of the entrance channel. Currently the Gulf channel, Bar channel, Sound Channel, and Gulfport Ship Channel are maintained at their authorized depths of 38, 38, 36, and 36 feet, respectively (Figure 1). There are no jetty structures associated with this project. The Mobile District is initiating an investigation of a major improvement to the Gulfport project, including widening and deepening.

2. Pascagoula Harbor, Mississippi: The Mississippi Sound portion of this project is maintained on an 18-24 month basis, typically by pipeline dredge. The bar channel (includes the Gulf entrance channel and Horn Island Pass) is maintained approximately annually. The Pass portion of the project is maintained with a pipeline dredge; the Gulf entrance channel leading to the Pass, and the Horn Island impoundment basin, are usually maintained by hopper dredge with about 538,000 cubic yards being placed in the Pascagoula ocean disposal site each annual dredging cycle (Figure 2). There are no jetty structures associated with this project.

3. Mobile Harbor, Alabama: Prior to 1986, all material from the Mobile Bay portion of the project (Mobile Harbor Channel) was dredged by pipeline and sidecast adjacent to the channel. Since 1986 this area (Mobile Bay Ship Channel) has been typically dredged annually by hopper dredge on a continuous basis. Theodore Ship Channel, located about mid-way down the Mobile Harbor Channel, is typically maintained by pipeline dredge but occasionally, when the required dredging is in the vicinity of the juncture with the Mobile Ship Channel, this area will be dredged by hopper dredge. Dredging of the entrance channel leading from the Gulf to Mobile Pass is typically on a 24-month basis. Due to the hydrodynamics of the Mobile Pass, very little dredging is required between Miles 30 and 34, which encompasses the Pass (bar channel) into Mobile Bay between Fort Morgan and Fort Gaines. However, what dredging is required in the southern extent of the project (Pass and Gulf entrance channel) is typically done by deep-draft hopper dredge. On average, annually, approximately 6,125,000 cubic yards of material are dredged annually from Mobile Bay channel and about 1,284,000 cubic yards are dredged (by pipeline dredge) from Mobile River

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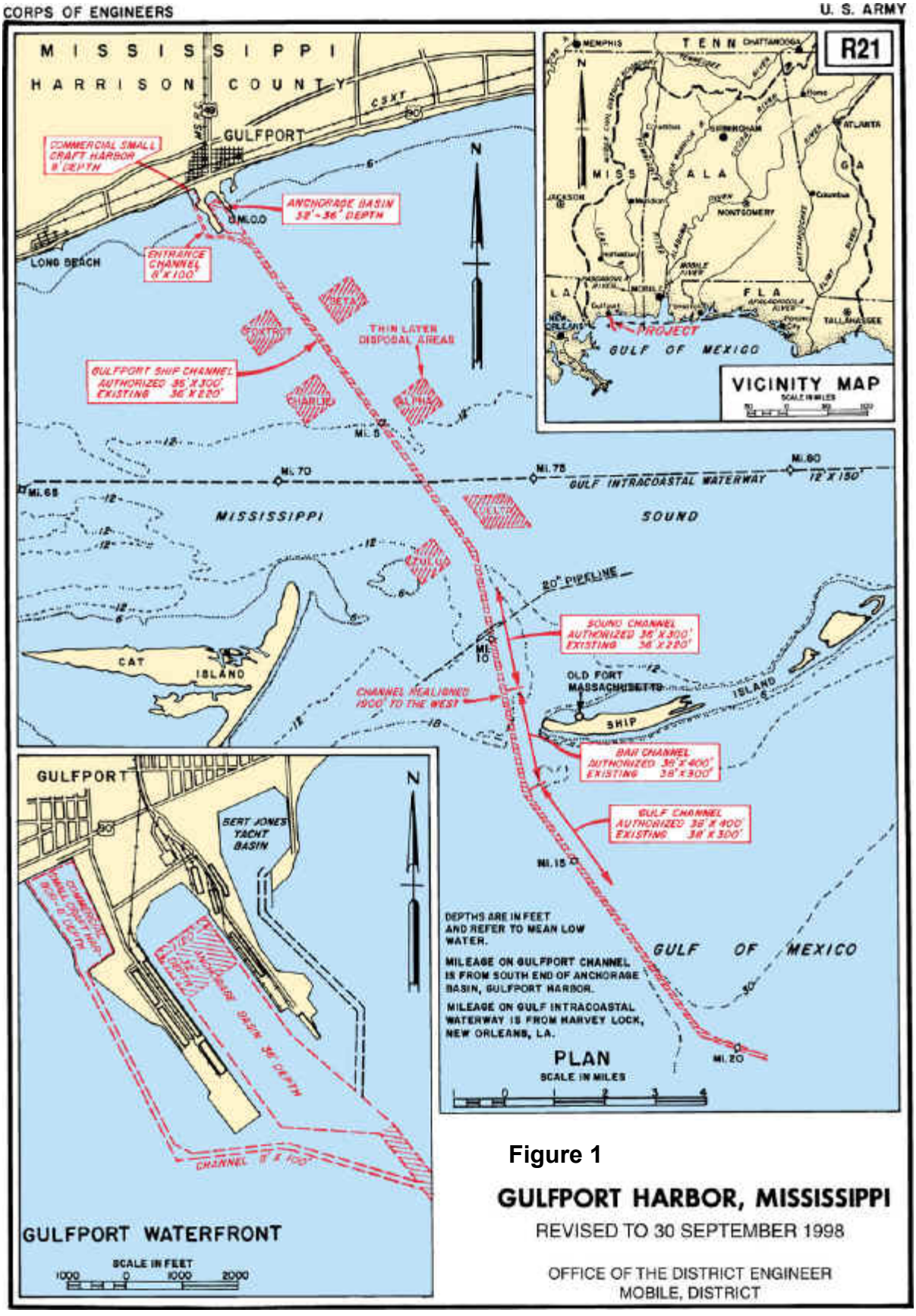

Figure 1

GULFPORT HARBOR, MISSISSIPPI

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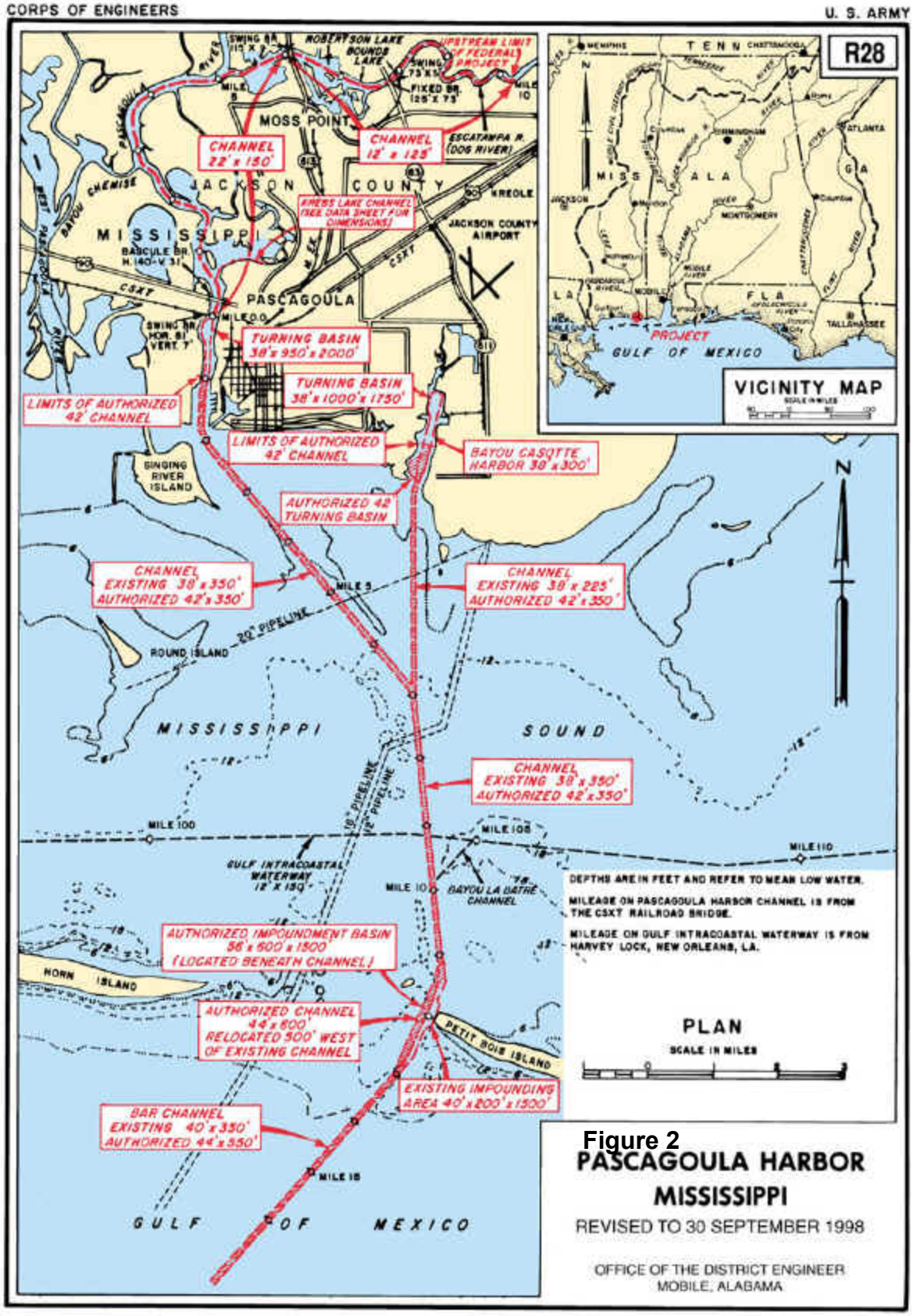

Figure 2

PASCAGOULA HARBOR
MISSISSIPPI

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channel (Figure 3). During routine maintenance approximately 540,000 cubic yards are dredged from the bar channel each dredging cycle (two years). Following tropical disturbances there is typically a need for maintenance of the bar channel which over the last two events ranged between 600,000 and 800,000 cubic yards. There are no jetty structures associated with this project.

4. Pensacola Harbor, Florida: The USACE, Mobile District is currently developing a long-term maintenance plan for civil works projects in Pensacola Bay, though in the past it has not routinely maintained this channel. In addition, the District typically acts as an agent for the U.S. Navy whose channel overlaps at greater depth and width and therefore subsumes the Federal channel at Pensacola. The Perdido Pass channel is routinely dredged by pipeline dredge with material placement directly on Perdido Key. The entrance channel from the Gulf of Mexico to approximately 1 mile south of Perdido Key would likely be maintained by hopper dredge with material placement in the littoral zone of Perdido Key. Past widening and deepening of the channel leading into Naval Air Station Pensacola was done by mechanical dredge and it is assumed that this will continue. It is expected that occasional emergencies will arise necessitating limited hopper dredge use in Perdido Key Pass or Pensacola Harbor, including the Navy Channel, Inner Harbor Channel, and Approach Channels to accommodate national defense needs or to deal with unexpected, hazardous shoaling caused by unusual storms or floods, hurricanes, etc. There are no jetty structures associated with this project.

SPECIES AND SUITABLE HABITAT

KEMP'S RIDLEY SEA TURTLE (*Lepidochelys kempi*)

The Kemp's ridley sea turtle is the smallest and most endangered of all sea turtles. Adults do not exceed 30 inches in shell length and range in weight from about 80 to 100 pounds. The broadly oval-shaped shell is usually olive grey, but the young are black. Primarily all Kemp's ridley nesting occurs on a single beach at Rancho Nuevo, Mexico about 30 kilometers south of the Rio Grande. In recent years Kemp's ridley nests have been documented on Padre Island, Texas, as well as in Florida and South Carolina. This nesting occurs from mid-April through August (Rabalais and Rabalais 1980). On one day in 1947 approximately 40,000 female Kemp's ridleys nested at Rancho Nuevo. A large scale nesting event such as this is called an arribada. Anthropogenic activities, such as the collection of eggs, fishing for juveniles and adults, killing adults for meat and other products, and direct take for indigenous use, are thought to be the primarily reason for the decline of this species. In addition to those sources of mortality, Kemp's ridleys have been subject to high levels of incidental take by shrimp trawling which is believed to have hurt their recovery.

Major foraging grounds include the Campeche-Tabasco region while some feed in coastal waters and bays of the Atlantic Ocean and the northern Gulf of Mexico

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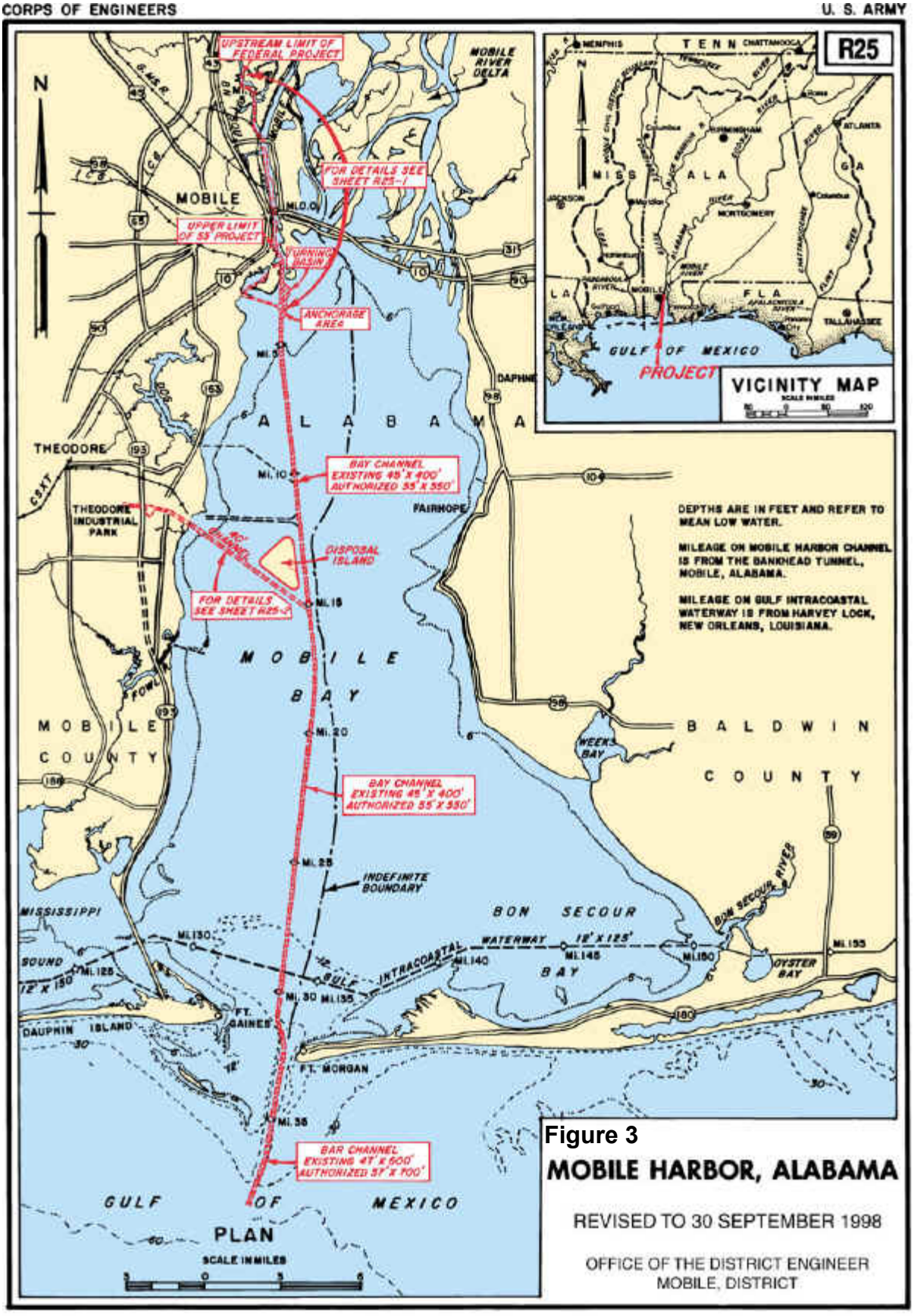

Figure 3

MOBILE HARBOR, ALABAMA

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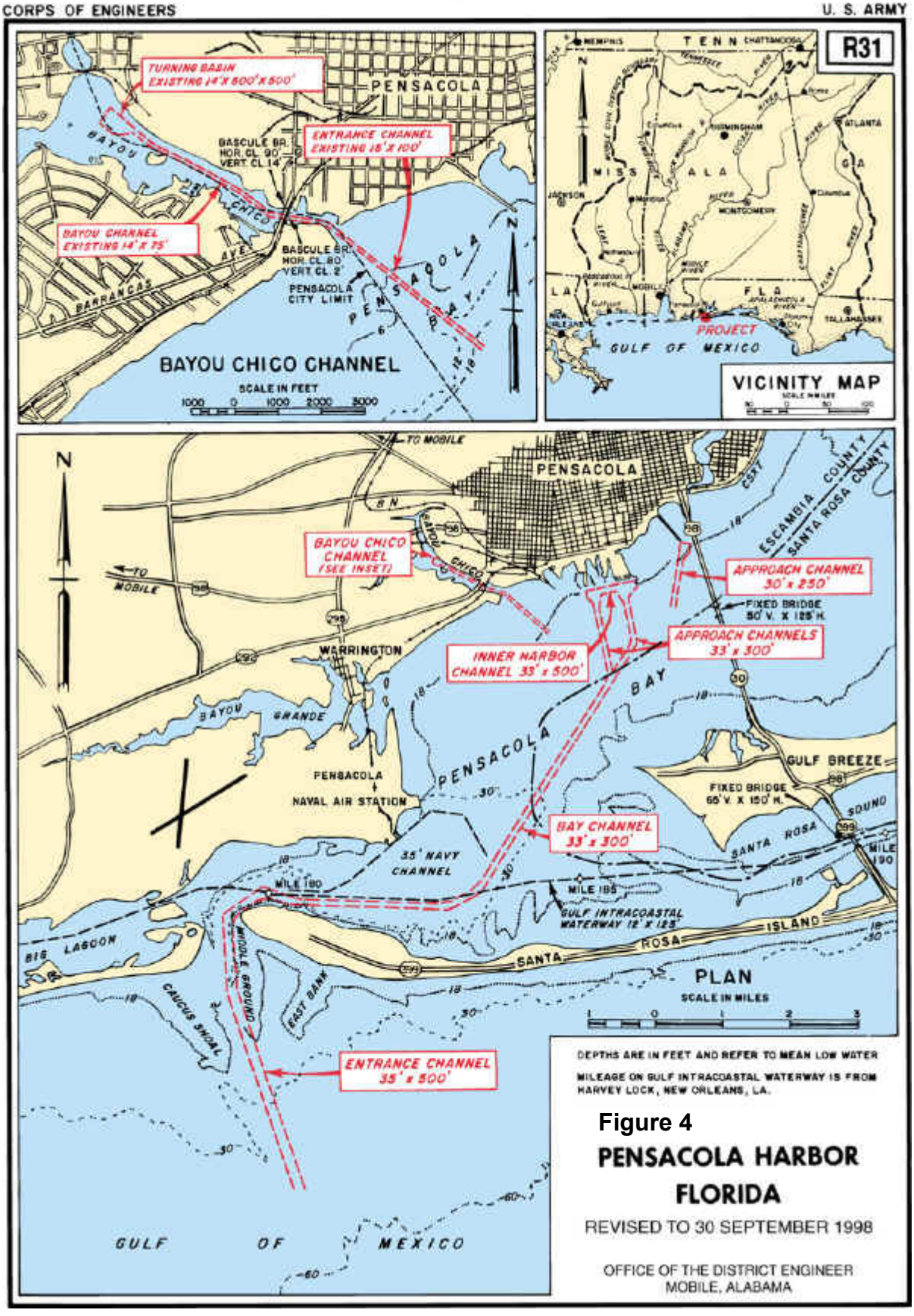

Figure 4

PENSACOLA HARBOR
FLORIDA

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(Chavez 1969). These sea turtles are usually found in water with low salinity, high turbidity, high organic content, and where shrimp are abundant. The continual influx of freshwater and high organic content associated with the northern Gulf of Mexico provides ideal foraging habitat for this species. Stomach content from Kemp's ridleys collected in shrimp trawls had crabs (*Callinectes*), gastropods (*Nassarius*), and clams (*Nuculana*, *Corbula*, and probably *Mulinia*), as well as mud balls, indicating feeding near a mud bottom in an estuarine or bay area. These benthic feeders are known to also feed upon jellyfish (Fritts et al. 1983). Presence of fish such as croaker and spotted seatrout in the gut of stranded individuals in Texas may suggest that turtles feed on the bycatch of shrimp trawlers (Landry 1986).

The total number of Kemp's ridleys occurring in the Gulf of Mexico is unknown. Collecting data to assess population trends for the Kemp's ridley presents scientists with many challenges. Scientists monitor trends of their most accessible life stages on the nesting beaches. Population trends are identified through directly monitoring their hatchling production and the status of adult females. Population declines of the Kemp's ridley sea turtles have been attributed to egg stealing on the localized nesting beach, capture of diurnal nesting females, and fishing and accidental capture in shrimp trawls (Fuller 1978; Pritchard and Marquez 1973).

Bi-national protection and monitoring by Mexico and the United States has occurred on the nesting beaches at Rancho Nuevo since 1978. In 1992, the USFWS and NMFS reported arribadas of up to 200 females as rare. Nest production plummeted to only 702 nests in 1985, but has been steadily increasing since that time. Over 1,500 nests were observed during the 1994-nesting season. In 2001, a record 1,000 Kemp's ridley sea turtle nests were recorded at Rancho Nuevo in just one day. This contrasts with only 3,640 reported in all of 1999 and 6,277 in all of 2000. While these data need to be interpreted cautiously due to expanded monitoring efforts since 1990, an estimated 107,687 hatchlings were released from Rancho Nuevo in 1994, compared to 45,000 to 80,000 from 1987 through 1991 (Byles, personal communication). In 1998, there were over 3,700 nests and 183,000 hatchlings; the number of nest declined slightly in 1999 with only 3,640, but hatchlings set a new record with over 225,000 (LSUCES 1999; LSUCES 2000).

Documented evidence and anecdotal accounts suggest a recent upward trend in the Kemp's ridley population. However, the Recovery Plan for the Kemp's ridley sea turtle has identified a recovery criteria of 10,000 nesting females in one season as a prerequisite for a determination that Kemp's ridleys can be downlisted to a threatened status (USFWS and NMFS, 1992).

LOGGERHEAD SEA TURTLE (*Caretta caretta*)

The loggerhead sea turtle is a medium to large turtle. Adults are reddish-brown in color and generally 31 to 45 inches in shell length with the record set at more than 48 inches. Loggerheads weigh between 170 and 350 pounds with the record set at greater than 500 pounds. Young loggerhead sea turtles are brown above and whitish, yellowish, or tan beneath, with three keels on their back and two on their underside.

Loggerhead sea turtles occur throughout the temperate and tropical regions of the Atlantic, Gulf of Mexico, Pacific, and Indian Oceans. This species may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, and the mouths of large rivers. In shallow Florida lagoons, loggerheads were found during the morning and evening, leaving the area during mid-day when temperatures reached 87° F. At dusk, turtles moved to a sleeping site and remained there until morning, possibly in response to changes in light or water temperature (Nelson 1986).

Loggerhead turtles are essentially carnivores, feeding primarily on sea urchins, sponges, squid, basket stars, crabs, horseshoe crabs, shrimp, and a variety of mollusks. Their strong beak-like jaws are adapted for crushing thick-shelled mollusks. Although loggerhead sea turtles are primarily bottom feeders, they also eat jellyfish and mangrove leaves obtained while swimming and resting near the sea surface. Presence of fish species such as croaker in stomachs of stranded individuals may indicate feeding on the by-catch of shrimp trawling (Landry 1986). Caldwell et al. (1955) suggest that the willingness of the loggerhead to consume any type of invertebrate food permits its range to be limited only by the presence of cold water.

As loggerheads mature, they travel and forage through near shore waters until their breeding season, when they return to the nesting beach areas. The majority of mature loggerheads appear to nest on a two or three year cycle. Major nesting beaches for loggerheads include the Sultanate of Oman, southeastern United States, and eastern Australia. From a global perspective, the southeastern U.S. nesting aggregation is of paramount importance to the survival of the species and is second in size only to the nesting aggregation on Masirah Island, Oman. This species nests within the U.S. from Texas to Virginia, although the major nesting concentrations are found along the Atlantic cost of Florida, Georgia, South Carolina, and North Carolina. About 80 percent of all loggerhead nesting in the southeastern U.S. occurs in six Florida counties (Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties). Total estimated nesting in the U.S. is approximately 50,000 to 70,000 nests per year. Nesting in the northern Gulf outside of Florida occurs primarily on the Chandeleur Islands in Louisiana and to a lesser extent on adjacent Ship, Horn, and Petit Bois Islands in Mississippi (Ogren 1977). Ogren (1977) reported a

historical reproductive assemblage of sea turtles, which nested seasonally on remote barrier beaches of eastern Louisiana, Mississippi, and Alabama.

Loss or degradation of suitable nesting habitat may be the most important factor affecting the nesting population in northern Gulf of Mexico (Ogren 1977). Overall the loss of nesting beaches, hatchling disorientation from artificial light, drowning in fishing and shrimping trawls, marine pollution, and plastics and Styrofoam have led to the decline of loggerheads.

Loggerhead sea turtles are considered turtles of shallow water. Juvenile loggerheads are thought to utilize bays and estuaries for feeding, while adults prefer waters less than 165 feet deep (Nelson 1986). Aerial surveys suggests that loggerheads (benthic immatures and adults) in U.S. waters are distributed in the following proportions: 54% in the southeast U.S. Atlantic, 29% in the northeast U.S. Atlantic, 12% in the eastern Gulf of Mexico, and 5% in the western Gulf of Mexico. During aerial surveys of the Gulf of Mexico, the majority (97 percent) of loggerheads were seen off the east and west coasts of Florida (Fritts 1983). Most were observed around mid-day near the surface, possibly related to surface basking behavior (Nelson 1986). Although loggerheads were seen off the coast of Alabama, Mississippi, and Louisiana, they were 50 times more abundant in Florida than in the western Gulf. The majority of the sightings were in the summer (Fritts et al. 1983). An individual tagged in Perdido Bay, Alabama was recaptured one year later only about a mile from the original capture site. In another case, a loggerhead had moved from Perdido Bay, Alabama into Pensacola Bay, Florida over a several month period (Nelson 2002).

Loggerheads are frequently observed near offshore oil platforms, natural rock reefs, and rock jetties along the Gulf Coast. Large numbers of stranded turtles were observed inshore of such areas (Rabalais and Rabalais 1980). Fishermen reported sightings of large turtles near the Gulf Coast. In a recent tracking study, loggerheads spent more than 90 percent of the time underwater, tended to avoid colder water, and spent much of the time in the vicinity of oil and gas structures, such as those found offshore of Mississippi and Alabama.

GREEN SEA TURTLE (*Chelonia mydas*)

The green sea turtle is mottled brown in color. The name is derived from the greenish fat of the body. The carapace is light or dark brown. It is sometimes shaded with olive, often with radiating mottled or wavy dark markings or large dark brown blotches. This species is considered medium to large in size for sea turtles with an average length of 36 to 48 inches. The record was set at about 60 inches in length. Its weight ranges from about 250 to 450 pounds with the record at more than 650 pounds. The upper surfaces of young green turtles are dark brown, while the undersides are white.

Although green sea turtles are found worldwide, this species is concentrated primarily between the 35° North and 35° South latitudes. Green sea turtles tend to occur in waters that remain warmer than 68° F; however, there is evidence that they may be buried under mud in a torpid state in waters to 50° F (Ehrhart 1977; Carr et al. 1979).

This species migrates often over long distances between feeding and nesting areas (Carr and Hirth 1962). During their first year of life, green sea turtles are thought to feed mainly on jellyfish and other invertebrates. Adult green sea turtles prefer an herbivorous diet frequenting shallow water flats for feeding (Fritts et al. 1983). Adult turtles feed primarily on seagrasses, such as *Thalassia testudinum*. This vegetation provides the turtles with a high fiber content and low forage quality (Bjorndal 1981a) and algae (Bjorndal 1985). Caribbean green sea turtles are considered by Bjorndal (l981b) to be nutrient-limited, resulting in low growth rate, delayed sexual maturity, and low annual reproductive effort. This low reproductive effort makes recovery of the species slow once the adult population numbers have been severely reduced (Bjorndal 1981). In the Gulf of Mexico, principal foraging areas are located in the upper west coast of Florida (Hirth 1971). Nocturnal resting sites may be a considerable distance from feeding areas, and distribution of the species is generally correlated with grassbed distribution, location of resting beaches, and possibly ocean currents (Hirth 1971).

Major nesting areas for green sea turtles in the Atlantic include Surinam, Guyana, French Guyana, Costa Rica, the Leeward Islands, and Ascension Island in the mid-Atlantic. Historically in the U. S., green turtles have been known to nest in the Florida Keys and Dry Tortugas. Yet, these turtles primarily nest on selected beaches along the coast of eastern Florida, predominantly Brevard through Broward Counties. However, they probably nested along the Gulf Coast before their decline. In the southeastern U.S., nesting season is roughly June through September. Nesting occurs nocturnally at 2, 3, or 4-year intervals. Only occasionally do females produce clutches in successive years. Estimates of age at sexual maturity range from 20 to 50 years (Balazs 1982; Frazer and Ehrhart 1985) and they may live over 100 years Zug et al. (1986). Immediately after hatching, green turtles swim past the surf and other shoreline obstructions, primarily at depths of about 8 inches or less below the water surface, and are dispersed both by vigorous swimming and surface currents (Frick 1976; Balzas 1980). The whereabouts of hatchlings to juvenile size is uncertain. Green turtles tracked in Texas waters spent more time on the surface, with fewer submergences at night than during the day, and a very small percentage of the time was spent in the Federally maintained navigation channels. The tracked turtles tended to utilize jetties, particularly outside of them, for foraging habitat (Renaud et. al. 1993).

Most green turtle populations have been depleted or endangered because of direct exploitation or incidental drowning in trawl nets (King 1981). A major factor

contributing to the green turtle's decline worldwide is commercial harvest for eggs and meat. In Florida, the nesting population was nearly extirpated within 100 years of the initiation of commercial exploitation (King 1981).
Fibropapillomatosis, a disease of sea turtles characterized by the development of multiple tumors on the skin and internal organs, is also a mortality factor and has seriously impacted green turtle populations in Florida, Hawaii, and other parts of the world. These tumors interfere with swimming, eating, breathing, vision, and reproduction, and turtles with heavy tumor burdens become severely debilitated and die. Other threats include loss or degradation of nesting habitat from coastal development and beach armoring; disorientation of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; and incidental take from commercial fishing operations.

LEATHERBACK SEA TURTLE (*Dermochelys coriacea*)

The leatherback sea turtle is the largest of all sea turtles. It may reach a length of about 7 feet and weigh as much as 1600 pounds. The carapace is smooth and is colored gray, green, brown and black. The plastron is yellowish white. Juveniles are black on top and white on the bottom.

This species is highly migratory and is the most pelagic of all sea turtles (NMFS and USFWS 1992). They are commonly found along continental shelf waters (Pritchard 1971; Hirth 1980; Fritts et al. 1983). Leatherback turtles' range extends from Cape Sable, Nova Scotia, south to Puerto Rico and the U.S. Virgin Islands. Leatherbacks are found in temperate waters while migrating to tropical waters to nest (Ross 1981). Distribution of this species has been linked to thermal preference and seasonal fluctuations in the Gulf Stream and other warm water features (Fritts et al. 1983). General decline of this species is attributed to exploitation of eggs (Ross 1981).

Leatherback sea turtles are omnivorous. Leatherbacks feed mainly on pelagic soft-bodied invertebrates such as jellyfish and tunicates. Their diet may also include squid, fish, crustaceans, algae, and floating seaweed. Highest concentrations of these prey animals are often found in upwelling areas or where ocean currents converge. They will also ingest plastic bags and other plastic debris, which are commonly generated by oil drilling rigs and production platforms in coastal Florida, Alabama, Mississippi, and Louisiana (Fritts et al. 1983).

Nesting of leatherback sea turtles is nocturnal with only a small number of nests occurring in the United States in the Gulf of Mexico (Florida) from April to late July (Pritchard 1971; Fuller 1978; Fritts et al. 1983). Leatherbacks prefer open access beaches possibly to avoid damage to their soft plastron and flippers. Unfortunately, such open beaches with little shoreline protection are vulnerable to beach erosion triggered by seasonal changes in wind and wave direction.

Thus, eggs may be lost when open beaches undergo severe and dramatic erosion. The Pacific coast of Mexico supports the world's largest known concentration of nesting leatherbacks. There is very little nesting in the United States (Gunter 1981).

Disturbance of the nesting grounds is the most serious threat to leatherback sea turtles. Although the flesh of this sea turtle is not eaten, the population has been threatened by egg-harvesting in countries such as Malaysia, Surinam, the Guianas, the west coast of Mexico, Costa Rica, and in several Caribbean islands. Leatherbacks were killed in the past for the abundant oil they yield, which was used for oil lamps and for caulking wooden boats. Ingesting plastic bags and other plastic wastes are another cause of death for leatherbacks turtles. The sea turtles confuse plastic wastes with one of their favorite foods jellyfish. When swallowed, plastics can clog a turtle's throat, esophagus, and intestines.

HAWKSBILL SEA TURTLE (*Eretmochelys imbricata*)

The hawksbill sea turtle is the second smallest sea turtle being somewhat larger than the Kemp's ridley. The hawksbill sea turtle is small to medium size with a very attractively colored shell of thick overlapping scales. The overlapping carapace scales are often streaked and marbled with amber, yellow, or brown. Hawksbill turtles have a distinct, hawks-like beak. The name of the turtle is derived from the tapered beak and narrow head.

Hawksbill sea turtles are highly migratory species. These turtles generally live most of their life in tropical waters such as the warmer parts of the Atlantic Ocean, Gulf of Mexico, and the Caribbean Sea (Carr 1952 and Witzell 1983). Florida and Texas are the only states where hawksbills are sighted with any regularity (NMFS and USFWS 1993). Juvenile hawksbills are normally found in waters less than 45 feet in depth. They are primarily found in areas around coral reefs, shoals, lagoons, lagoon channels and bays with marine vegetation that provides both protection and plant and animal food. Hawksbills can tolerate muddy bottoms with sparse vegetation unlike the green turtles. They are rarely seen in Louisiana, Alabama, and Mississippi waters.

Hawksbill sea turtles are probably diurnal species and only feed in daylight in captivity. Hawksbills were once thought to be generalist or opportunistic feeders but studies now indicate that the primary food source is comprised of sponges and other encrusting organisms. Other organisms found in the diet are now believed to be incidental organisms living in association with the sponges, which are being used for food (Meylan 1988). These turtles go through a pelagic feeding phase as hatchlings and are normally associated with seaweed mats. Juveniles forage in shallow waters near the shallowest coral reefs until they reach lengths of about 6 to 11 inches. As the turtles mature, they move from pelagic feeders to benthic feeders. With this change in feeding habits the

foraging territory is moved further and further from shore to the deeper waters as the turtles improve its capability for deep dives. Adults forage around reefs up to 300 feet in depth and are not usually in shallow waters less than 60 feet in depth. Offshore behavior of the turtles is not well understood. Both single and mated pairs of adult turtles and juveniles as well have been observed in all seasons in the Caribbean. It is thought they are foraging on the live bottom sponges in the area.

Hawksbills nest throughout their range, but most of the nesting occurs on restricted beaches, to which they return each time they nest. These turtles breed and nest in a diffuse rather than colonial nesting pattern in warm waters between the 25º North and 25º South latitudes (Rebel 1974). These turtles are some of the most solitary nesters of all the sea turtles. Depending on location, nesting may occur from April through November (Fuller et al. 1987). Hawksbills prefer to nest on clean beaches with greater oceanic exposure than those preferred by green sea turtles, although they are often found together on the same beach. The nesting sites are usually on beaches with a fine gravel texture. Hawksbills have been found in a variety of beach habitats ranging from pocket beaches only several yards wide formed between rock crevices to a low-energy sand beach with woody vegetation near the waterline. These turtles tend to use nesting sites where vegetation is close to the waters edge.

Hawksbills face most of the same threats that endanger all marine turtles. In addition, they are also singled out for their own special threat: humans find their shells highly attractive. Although the full extent of the threat is not known, experts believe that the killing of hawksbills for bekko is a major problem.

SEA TURTLES IN THE GULF OF MEXICO

Estuarine ecosystems in the northern Gulf of Mexico are considered vital for sea turtles, since they serve as developmental habitat for juveniles. Stranding data for sea turtles is often anecdotal and does not identify specific foraging areas within these waters. Only in recent years have we begun to systematically survey these waters for juvenile sea turtles. During a 1999-2001 survey in Alabama the abundance, location, and movements of juvenile sea turtles were evaluated. To a large extent, the results have been negative, thus documenting that many areas have a low abundance of sea turtles. For example, during the initial year of this survey (1999), no turtles were captured, although 20 different netting locations were examined. In an effort to increase the number of captures during the 2nd and 3rd year of the project, netting surveys continued while visual survey methods from boats were also conducted to increase the amount of area surveyed. In addition, sea turtle standings and salvage networks in the study area were assessed to better obtain turtles for tracking. However to date only 4 to 5 juvenile sea turtles per year were captured during 2000 and 2001, including both loggerhead and Kemp's ridley sea turtles. These low numbers are due to the low abundance of sea turtles in these waters.

KEMP'S RIDLEY SEA TURTLE (*Lepidochelys kempi*)

The nearshore areas of the Gulf of Mexico appear to be important habitats for the Kemp's ridley. Primary habitat for subadult ridleys includes Port Aransas, Texas continuing east to Cedar Key, Florida. These turtles are characteristically found in waters of low salinity, high turbidity, high organic content, and where shrimp are abundant (Zwinenberg 1977, Hughes 1972). Preliminary analysis of data collected by Texas A&M University 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. One hundred and thirty sea turtles have been tracked by NMFS Galveston Lab staff since 1980, including 91 ridleys tracked since September 1988 with USACE support. Preliminary analysis of data collected further supports data published by Texas A&M University of the Kemp's ridley's movement along the Gulf Coast. Juvenile ridleys are usually found in waters of 24 feet or less, and all ridleys are generally found in water depths less than 54 feet (Renaud, draft in-house report transmitted December 8, 1994).

In addition to the NMFS studies, satellite transmitters have been applied to approximately 50 adult female Kemp's ridleys over the last decade to identify the movements of the females after leaving the nesting beach in Rancho Nuevo, Mexico. While most female ridleys head south towards the Bay of Campeche after leaving the beach, two out of eight turtles headed into nearshore Texas waters during one year's study. In 1994, of four turtles that were tagged, three went south and one went as far north as the vicinity of the mouth of the Mississippi River. Clearly, reproductively active Kemp's ridleys, which are directly required for the recovery of the population, are found within the U.S. Gulf of Mexico, and are as vulnerable to human impacts as sub-adults.

Kemp's ridley sea turtles are thought to be the most abundant sea turtles noted on the Mississippi coast. The highly productive shrimping areas offshore of Mississippi are thought to be the major feeding grounds for subadult and adult ridleys. The current patterns in the Gulf of Mexico could aid in transporting individuals, where small turtles would enter the major clockwise loop current of the western Gulf of Mexico, carrying individuals north and east along Texas, Louisiana, and other northern Gulf areas (Pritchard and Marquez 1973; Hildebrand 1981).

Ridleys are commonly captured by shrimpers off the Texas coast and in heavily trawled areas of the Louisiana coast (Pritchard and Marquez 1973; Carr 1980). In recent years, an unprecedented number of Kemp's ridley carcasses have been reported from Texas and Louisiana beaches during periods of high levels of shrimping efforts. The cause of most of the strandings may have been the simultaneous occurrence of an intensive pulse of shrimping in an area of high Kemp's ridley abundance. Information regarding whether the abundance of sea

turtles in the northern Gulf was a seasonal anomaly, or represents the current status of sea turtles in nearshore waters, is not available.

Stomach content analyses on sea turtles stranded in Texas suggest that, in all years, most mortalities occur in nearshore waters. Stomach contents of Kemp's ridleys along the lower Texas coast also showed a predominance of nearshore crabs and mollusks, as well as fish, shrimp and other foods considered to be shrimp fishery discards (Shaver 1991). Over 150 Kemp's ridleys have been intentionally live-captured by research gillnets in 1993 and 1994 at Sabine Pass by Texas A&M University scientists conducting research for the USACE. This captures illustrate the availability of ridleys to human interactions in Gulf waters near the Texas coast.

LOGGERHEAD SEA TURTLE (*Caretta caretta*)

Subpopulations of loggerhead sea turtles are divided geographically into five groups. One subpopulation includes a Florida panhandle nesting subpopulation occurring at Eglin Air Force Base and the beaches near Panama City, Florida (approximately 1,200 nest in 1998). The continental shelf areas of the Gulf of Mexico provide foraging habitat to these turtles. Aerial surveys suggests that loggerheads (benthic immatures and adults) in U.S. waters are distributed primarily in the southeast U.S. Atlantic. During aerial surveys of the Gulf of Mexico, the majority (97 percent) of loggerheads were seen off the east and west coasts of Florida (Fritts 1983).

Strandings of loggerhead turtles are second only to the Kemp's ridleys along the Gulf Coast. 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). Recent capture and telemetry studies of sea turtle movements along the northern Gulf of Mexico showed usage of the nearshore areas near jetties and channels. An individual tagged in Perdido Bay, Alabama was recaptured one year later only about a mile from the original capture site. In another case, a loggerhead had moved from Perdido Bay, Alabama into Pensacola Bay, Florida over a several month period (Nelson 2002 unpublished data). Based on the limited data available it is difficult to estimate the size of the loggerhead sea turtle population in the U.S. and its territorial waters. However, there is a general agreement that the number of nesting females provides a useful index of the species' population size. There is limited nesting throughout the Gulf of Mexico west of Florida. Furthermore, netting locations along the Alabama's coast have been rather unsuccessful in capturing loggerheads or any other marine turtles. These low numbers are due to the low abundance of sea turtles in these waters.

GREEN SEA TURTLE (*Chelonia mydas*)

Green sea turtles are found in the Gulf of Mexico between Texas and Florida. Principal nesting areas for green sea turtles are in eastern Florida, predominantly Brevard through Broward Counties. Green sea turtles may be found foraging in areas with submerged aquatic vegetation near mainlands. Principal benthic foraging areas in the Gulf of Mexico include inlets in Texas and areas off the coast of Florida from Yankeetown to Tarpon Spring. Principle foraging and nesting areas for the green turtle does not include any areas in the Mobile District. Sightings of green sea turtles are rare in the Mobile District. The low number of nesting is due to the low abundance of green turtles found within the Mobile District's boundaries.

LEATHERBACK SEA TURTLE (*Dermochelys coriacea*)

Leatherback sea turtles are generally not found in the northern Gulf of Mexico because they prefer deep, pelagic, offshore waters. They occasionally may come into shallow waters to feed on aggregations of jellyfish but this is very rare. Sightings of leatherbacks within the boundaries of the Mobile District are very uncommon. Low numbers of leatherback turtles reported by fishermen in the Gulf Coast may reflect low numbers in the area, or lack of fishing in areas where the species would occur (Fuller 1986).

HAWKSBILL SEA TURTLE (*Eretmochelys imbricata*)

There are only rare sightings of hawksbill sea turtles in the proposed work areas of Louisiana, Mississippi, Alabama, and along the Gulf coast of Florida. Nesting within the southeastern U.S. and U.S. Caribbean is restricted to Puerto Rico, the U.S. Virgin Islands, and rarely, Florida (0-4 nest per year). Hawksbills are closely associated with coral reefs and other hard-bottom habitats that are not typically found within the Mobile District's boundaries. Hawksbills are sometimes seen along jetties. Texas is the only state in the continental U.S. other than Florida where hawksbills occur on any regular basis. Elsewhere along the northern Gulf of Mexico, live hawksbills are rarely recorded. This supports the general belief that hawksbills are scarce in these waters.

EFFECTS OF PROPOSED ACTION ON THREATENED AND ENDANDERED SPECIES

The USACE, Mobile District has historically conducted hopper dredging of its Federally authorized navigation projects along the Gulf Coast. The proposed operations 'may affect, but are not likely to adversely affect' any threatened and endangered sea turtles listed by NMFS. No direct impacts have been associated with the utilization of hopper dredges within Mobile District. It is conceivable that if a sea turtle were to come in contact with a draghead or be entrained by a draghead an impact could occur. This has not been documented within the

Mobile District. There have been no recorded strandings that would indicate turtle encounter with the dredges. Entrainment of food sources utilized by sea turtles could result in a very localized reduction in available food supply for the sea turtles. However, the availability of food sources would not be significantly affected as a result of the removal of a few individuals. The turbidity in the immediate vicinity of the dredge or disposal area could pose problems to the sea turtles. However, it is likely the turtles would immediately exit an area with increased turbidity thereby avoiding significant effects. Sufficient amount of passage room is left during the dredging operation so that the presence of hopper dredges should not hinder movement of these species. Furthermore, placement of dredged material at the nearshore disposal areas via routine hopper dredging is anticipated to benefit these endangered and threatened species by creating additional beach habitat along the barrier islands for nesting.

Channels under Mobile District's purview do not include any rock jetty structures that are utilized as habitat by hawksbill and loggerhead sea turtles. The majority of submerged aquatic vegetation (SAV) utilized by green sea turtles is located in remote areas outside of the dredging operations. Thus, a direct or indirect impact from hopper dredging is highly unlikely due to the low abundance of green turtles in the Mobile District and the proximity of these SAVs in relation to dredging operations. Channels maintained by the District consist primarily of firmly compacted, fine silty clay to sands. These characteristics are not suitable sea turtle habitat for hawksbill, green, and leatherback sea turtles, which are rarely sighted in the Mobile District's boundaries. If sea turtles, such as Kemp's ridleys or loggerheads, were to be in the vicinity of the dredging operations, a direct or indirect impact is not likely because the District dredges only the area in which shoaling has occurred. Furthermore, these sea turtles foraging in the pelagic water column or the benthic marine bottom would be able to avoid the operations.

The Galveston, New Orleans, and Jacksonville Districts attempt to schedule hopper dredging operations during the December 1st through March 31st window, wherever feasible. Hopper dredging priorities are developed in concert with other USACE Districts that conduct operations along the Atlantic and Gulf Coasts. Due to the low abundance of sea turtles present within Mobile District's boundaries compared to other Districts, priorities should be given to those Districts with greater abundances of sea turtles. The District recommends no window constraint be placed on Mobile District due to the lows number of sea turtles present, no recorded take of sea turtles, and no recorded strandings resulting from a dredge within its boundaries.

No listed threatened or endangered sea turtle is anticipated to be taken as a result of the proposed hopper dredging activities at Federally maintained navigation projects.

CONSERVATION MEASURES

Impacts to marine turtles from hopper dredges have been documented throughout the Gulf of Mexico in the Jacksonville, New Orleans and Galveston Districts. However, no impacts have been noted within the Mobile District's boundaries. We suspect this is due to a lower turtle population density in the north-central Gulf of Mexico and possible a lack of screening on Mobile District vessels. In an effort to expand the base of knowledge within the north-central Gulf area, our primary conservation measure will consist of the installation and monitoring of intake screens whenever possible on hopper dredges operating within Mobile District marine waters between April 1 and November 30. When sea turtle observers are on hopper dredges, in the areas and seasons that turtles may be present, 100% inflow screening will be performed whenever possible, and overflow screening will be considered when inflow screening is impractical. The draghead inflow screens should have 4-inch to 12-inch screening openings depending upon the material to be dredged. The smallest practical screen size will be chosen. Clogging should be greatly reduced with these flexible options; however, further clogging may compel removal of the screening altogether. Since the need to constantly clear the screens will increase the time it takes to complete the project and therefore increase the exposure of sea turtles to the risk of impingement or entrainment. Additionally, there are increased risks to sea turtles in the water column when the inflow is halted to clear screens, since this results in clogged intake pipes that may have to be removed from the bottom to discharge the clay.

The District has not traditionally utilized screens and observers as marine turtles are rarely sited within the District's project areas, and no turtle parts have historically been identified in the dredged material. Due to increased awareness of the potential impacts to the species and the limited amount of scientific data available, the District recognizes the need for the screened intakes with observers.

The District does not recognize the need for any further conservation measures at this time. After more data is available for the Mobile District geographical area, we will reevaluate the need for additional conservation measures. Should the data indicate the need for further protection, the District will evaluate all available measures including possible relocation trawling, turtle draghead deflectors, and other equipment improvements and dredging methodologies. At that time we would reinitiate consultation with the Service.

CONCLUSIONS

Based on the information available, the USACE, Mobile District recommends a 'may effect, but is likely not to adversely affect' decision be made for the District. Conservation measures of the Mobile District consist of installing and monitoring intake screens whenever possible on hopper dredges operating within Mobile

District marine waters between April 1 and November 30. After more data is available for the Mobile District geographical area, we will reevaluate the need for additional conservation measures.

REFERENCES

Baird, B. 1995. Biological Assessment: Impacts of Navigation Channel Hopper Dredging on Threatened and Endangered Species in Louisiana. Corps of Engineers, New Orleans, LA.

Baird, B. 1995. Biological Assessment: Impacts of Navigation Channel Hopper Dredging on Threatened and Endangered Species in Louisiana. Corps of Engineers, New Orleans, LA.

Balazs, G.H. 1982. Growth rates of immature green turtles in the Hawaiian Archipelago, pp. 117-125. In: K.A.

Banks, G.E., M.P. Alexander. 1994. Development and Evaluation of a Sea Turtle-Deflecting Hopper Dredge Draghead. Miscellaneous Paper HL-94-5, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Bjorndal (ed.), Biology and Conservation of Sea Turtles. Smithsonian Institution Press, Washington, DC.

Bjorndal, K.A. 1980. Demography of the breeding population of the green turtle, *Chelonia mydas*, at Tortuguero, Costa Rica. Copeia. 3:525:530.

Bjorndal, K.A. (ed.). 1981. Biology and Conservation of Sea Turtles. Proceedings of the World Conference on Sea Turtle Conservation, Washington, D.C., 26-30 November, 1976. Smithsonian Institution Press, Washington, D.C.

Bjorndal, K.A. (ed.). 1981a. Biology and conservation of sea turtles. Proceedings of the world conference on sea turtle conservation. 26-30 November 1979, Washington, D.C., Smithsonian Institution Press, Washington, D.C.

Bjorndal, K.A. 1981b. The consequences of herbivory for the life history pattern in the Caribbean green turtle, *Chelonia mydas*, pp. 111-116, In Bjorndal, K.A. 1981a.

Caldwell, D.K., A. Carr, T.R. Heller, Jr. 1955. Natural history notes on the Atlantic loggerhead turtle, *Caretta caretta*. Quart. J. Fla. Acad. Sci. 18(4): 292-302.

Carr, A. and H. Hirth. 1962. The ecology and migrations of sea turtles, five

comparative features of isolated green turtle colonies. Am. Mus. Nov. 2091: 1-42.

Carr, A. 1980. Some problems of sea turtle ecology. Amer. Zool. 20:489-498.

Carr, A.F., and D.K. Caldwell. 1956. The ecology and migrations of sea turtles, 1. Results of field work in Florida, 1955. Am. Mus. Noviates 1793.

Carr, A.F., D.R. Jackson, and J.B. Iverson. 1979. Marine turtles. Chapter XIV In A summary and analysis of environmental information on the Continental Shelf and Blake Plateau from Cape Hatteras to Cape Canaveral (1977). Vol. I, Book 3. Center for Natural Areas, South Gardiner, Maine.

Chavez, H. 1969. Tagging and recapture of the lora turtle (*Lepidochelys kempi*). Int. Turtle Tortoise Soc. J. 3(4): 14-19; 32-36.

Coastal Zone 80: Proceedings of the second symposium on coastal and ocean management. Vol. III. American Society of Civil Engineers, N.Y.

Department of the Interior. 1994. Gulf of Mexico Sales 152 and 155: Central and Western Planning Areas Final Environmental Impact Statement. OCS EIS/EA MMS 94-0058. Mineral Management Service, New Orleans, LA.

Ehrhart, L.M. 1977. Cold water stunning of marine turtles in Florida east coast lagoons: rescue measures, population characteristics and evidence of winter dormancy.

Fish and Wildlife Service and National Marine Fisheries Service. 1992. Recovery Plan for the Kemp's ridley sea turtle (*Lepidochelys kempi*). National Marine Fisheries Service, St. Petersburg, Fl.

Frazier, J.G. 1980. Marine turtles and problems in coastal management, pp. 2395-2411, In. B.L. Edge (ed.).

Frazer, N.B. and L.M. Ehrhart. 1985. Preliminary growth models for green, *Chelonia mydas*, and loggerhead, *Caretta caretta*, turtles in the wild. Copeia 1985:73-79.

Frick, J. 1976. Orientation and behavior of hatchling green turtles (*Chelonia mydas*) in the sea. Anim. Behav. 24: 849-857.

Fritts, T. 1983. Distribution of cetaceans and sea turtles in the Gulf of Mexico and nearby Atlantic Waters, p. 3-5, In C.E. Keller and J.K.Adams (eds).

Fritts, T.H., in. Hoffman, and M.A. McGehee. 1983. The distribution and abundance of marine turtles in the Gulf of Mexico and nearby Atlantic

waters. J. Herpetology 17(4): 327-344.

Fritts, T.H., A.B. Irvine, R.D. Jennings, L.A. Collum, W. Hoffman, and M.A. McGhee. 1983a. Turtles, birds, and mammals in the northern Gulf of Mexico and nearby Atlantic waters. FWS/OBS-82/64, U.S. Fish and Wildlife Service, Washington D.C.

Fuller, D.A. 1978. The habitats, distribution, and incidental capture of sea turtles in the Gulf of Mexico. Appendix A. Shrimp Fishery Management Plan of the U.S. Gulf of Mexico. Center for Wetland Resources, Louisiana State University, Baton Rouge.

Fuller, D.A., A.M. Tappan and M.C. Hester 1987. Sea turtles in Louisiana's coastal waters. LSU-CFI. Baton Rouge, La. Louisiana State University, Center for Wetland Resources.

FWS/OBS-80/41, .U.S. Fish and Wildlife Service, Washington, D.C.

Gunter, G. 1981. Status of turtles on Mississippi coast. Gulf Research Report 7(1):89-92.

Hendrickson, J.R. 1980. The ecological strategies of sea turtles. Amer. Zool. 20:597-608.

Hildebrand, H.H. 1981. A historical review of the status of sea turtle populations in the western Gulf of Mexico, pp. 447-453, In Bjorndal, K.A.

Hopkins, Gary. 2002. Personal Communication with Howard Ladner of the U.S. Army Corps of Engineers, Mobile District, Alabam.

http://www.mvn.usace.army.mil/ED/MRT/Usace_no/Content/threatened_and_endangered_specie.htm

http://www.nmfs.noaa.gov/prot_res/PR3/Turtles/turtles.html

http://northflorida.fws.gov/SeaTurtles/Turtle%20Factsheets/green-sea-turtle.htm

http://northflorida.fws.gov/SeaTurtles/Turtle%20Factsheets/loggerhead-sea-turtle.htm

http://serendip.brynmawr.edu/biology/projects97/DuComb.html

http://state-of-coast.noaa.gov/bulletins/html/ief_03/case.html

Joyce, J.C. 1982. Protecting sea turtles while dredging. Military Engineer 74:282-285

Landry, A. 1986. Stranding and natural history of sea turtles in the northern Gulf of Mexico. Presented at Seventh Annual Minerals Management Service, Gulf of Mexico OCS Region, Information Transfer Meeting. Session IV. D. Sea turtle problems in the Gulf of Mexico, 5 November, 1986.

Layne, J.N. 1965. Observations on marine mammals in Florida waters. Bulletin of the Florida State Museum of Biological Science. 9:131-181.

Lund, F. 1974. Marine turtle nesting in the United States. Unpublished MS.

Mann, Tom. 2001. Presentation from the Proceedings of the Singing River Symposium. Mississippi Natural Heritage Program, Mississippi Museum of Natural Science, Mississippi Department of Wildlife, Fisheries, & Parks.

Meylan, A. B. 1988. Spongivory in hawksbill turtles. A diet of glass. Science 239:393-395.

Moulding, J.D. 1988. Implementation of the Endangered Species Act, Canaveral Navigation Channel Dredging, a Case History. pp. 26-29. In Proceedings of the National Workshop on Methods to Minimize Dredging Impacts on Sea Turtles, 11 and 12 May, 1988.

Nelson, D.A. 1986. Life History and Environmental Requirements of Loggerhead Turtles. Technical Report EL-86-2, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Ms.

Ogren, L. 1977. Survey and reconnaissance of sea turtles in the northern Gulf of Mexico. Unpublished report NMFS.

Ogren, L. 1988. The biology and ecology of juvenile sea turtle: Kemp's ridley (*Lepidochelys kempi*) in the Gulf of Mexico and western North Atlantic. Draft report.

Paper presented at 1977 American Society of Ichthyologists and Herpetologists meeting, Gainesville, Fla.

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 (1993)

Pritchard, P.C.H. 1971. The leatherback or leathery turtle. *Dermochelys coriacea*. IUCN Monog. No. 1.

Pritchard, P.C.H. and R. Marquez. 1973. Kemp's Ridley Turtle or Atlantic Ridley. IUCN Monograph No. 2. Marine Turtle Series.

Proceedings of a workshop on cetaceans and sea turtles in the Gulf of Mexico: study planning for effects of Outer Continental Shelf development, 6-8 April, 1982. FWS/OBS-83/03.

Rabalais, S.C. and N.H. Rabalais. 1980. The occurrence of sea turtles on the South Texas Coast. Contrib. Mar. Sci. 23:123-129.

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, FL.

Renaud, M.L. and J.A. Carpenter, in press. Movements and submergence patterns of Loggerhead turtles (*Caretta caretta*) in the Gulf of Mexico determined through Satellite Telemetry. Bulletin of Marine Science.

Richardson, J.I., 1988. The Sea Turtles of the King's Bay Area and the Endangered Species Observer Program Associated with Construction Dredging of the St. Mary's Entrance Ship Channel. pp 32-46. In Proceedings of the National Workshop on Methods to Minimize Dredging Impacts on Sea Turtles, 11 and 12 May, 1988.

Ross, J.P. 1981. Historical decline of Loggerhead, Ridley, and Leatherback sea turtles, p. 189-195, In K.A. Bjorndal, 1981.

Schmidly, D.J. 1981. Marine mammals of the southeastern United States coast and the Gulf of Mexico.

SEAN Bulletin. 1980. Natural history specimens. Marine turtles. Smithsonian Institution, SEAN (Scientific Event Alert Network). Vol. 5(9): 13-14.

Solt, V. 1981. Denver scientist makes first sea turtle transmitter. In Fish and Wildlife News, Special Edition: Research. pp. 88-89. U.S. Fish and Wildlife Service, Washington, D.C. In Rabalais and Rabalais. 1980.

Viosca, Jr. 1961. Turtles, tame and truculent. La. Conserv. 13:5-8.

Witzell, W.N. 1983. Synopsis of biological data on the hawksbill turtle, *Eretmochelys imbricata* (Linnaeus, 1776). FAO Fisheries Synopsis 137:78.

Zug, G.R., A.H. Wynn, and C. Ruckdeschel. 1986. Age determination of loggerhead sea turtles, *Caretta caretta*, by incremental growth marks in the skeleton. Smithson. Contrib. Zool. 427.

Zwinenberg, A.J. 1977. Kemp's Ridley, *Lepidochelys kempi* (Garman 1980), undoubtedly the most endangered marine turtle today (with notes on the

current status of *Lepidochelys olivacea*). Bull. Maryland Herp. Soc. 13:170-192.

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