



United States Department of the Interior

PD

FISH AND WILDLIFE SERVICE

South Florida Ecosystem Office
P.O. Box 2676
Vero Beach, Florida 32961-2676

October 3, 1997

Colonel Terry Rice
District Engineer
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Attn: Planning Division

FWS Log No.: 4-1-97-I-682

Project: Dredging of the Gulf Intracoastal
Waterway

County: Sarasota

Dear Colonel Rice:

The U.S. Fish and Wildlife Service (FWS) has reviewed your letter dated September 8, 1997, and Environmental Assessment regarding the Gulf Intracoastal Waterway (GIW) Dredging Project of Venice Inlet in Sarasota County, Florida. Our comments are submitted in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (ESA). We have assigned FWS log number 4-1-97-I-682 to this consultation.

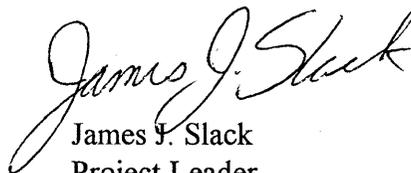
The proposed project is located within the nesting ranges of the threatened loggerhead sea turtle (*Caretta caretta*) and the endangered green sea turtle (*Chelonia mydas*). In your letter, the U.S. Army Corps of Engineers determined that this proposed action may affect these species. Currently, there is no critical habitat designated for the sea turtles listed above; therefore, none will be affected.

If the material dredged from the GIW is beach quality sand, it could be used to renourish the beach at Venice. Venice Beach has been renourished previously, and effects of that renourishment on threatened and endangered sea turtles were considered by the FWS in an October 1991 Biological Opinion. The FWS believes that the proposed action is likely to adversely affect threatened and endangered sea turtles. However, we also believe the October 1991 Biological Opinion applies to the proposed renourishment area. If all of the Terms and Conditions provided therein are followed for this project, adverse effects to sea turtles should be minimized. If the recommended measures for protection of sea turtles cannot be implemented for any reason, your agency would be required to reinitiate consultation with the FWS pursuant to 50 CFR 402.16.

Also in your letter, you determined that the proposed action may affect the West Indian manatee (*Trichechus manatus*); the FWS concurs with your determination. However, since you are willing to incorporate the standard manatee construction conditions into the project plans, we conclude that the proposed action is not likely to adversely affect the manatee.

Although this does not constitute a Biological Opinion as described under section 7 of the ESA, it does fulfill the requirements of the ESA, and no further action is required. If modifications are made in the project or if additional information involving potential effects on listed species becomes available, please notify Chuck Sultzman of our office at (561) 562-3909.

Sincerely yours,

A handwritten signature in cursive script that reads "James J. Slack". The signature is written in black ink and is positioned above the printed name and title.

James J. Slack
Project Leader
South Florida Field Office

cc:

FWS, Jacksonville, FL (Attn: Sandy MacPherson)

FDEP (OPSM), Tallahassee, FL

GFC, Punta Gorda, FL

Copy furnished:

Mr. David Arnold, Florida Department of Environmental
Protection, Office of Protected Species, 3900 Commonwealth
Boulevard, Mail Station 245, Tallahassee Florida 32399

bcc:

CESAJ-CO (Hanson)
CESAJ-DP-I (Scarborough)

J
Fonferek/CESAJ-PD-ER/2803/ljd *ljd*
Z/GR
~~Logger/CESAJ-PD-ER~~
~~McAdams/CESAJ-PD-EE~~
~~Smith/CESAJ-PD-E~~
AKS
~~Duke/CESAJ-PD~~

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September 8, 1997

Planning Division
Environmental Branch

Mr. Tom Grahl
Acting Field Supervisor
U.S. Fish and Wildlife Service
P.O. Box 2676
Vero Beach, Florida 32961-2676

Dear Mr. Grahl:

This is concerning our maintenance dredging of the Gulf Intracoastal Waterway at Venice Inlet, Sarasota County, Florida and the placement of material either on Venice Beach or on Snake Island to beneficially use dredged material to create wetlands and prevent further erosion of cultural resources.

We would like to incorporate by reference the Biological Opinion issued by your office as part of the U.S. Fish and Wildlife Coordination Act Report for the Sarasota County Shoreline Protection Project, October 1991, for impacts on sea turtles associated with beach placement. The dredged material from the maintenance work would also be placed within the footprint established by the shoreline protection project.

In addition to these impacts, we have determined that the maintenance dredging "May Effect" the Florida manatee. To mitigate this impact, we plan to incorporate the standard manatee protection conditions as recommended by your agency and the Florida Department of Environmental Protection into our project plans and specifications.

Therefore, we are requesting a Biological Opinion from your office concerning the impacts on sea turtles and manatees. Since these impacts are well known, we plan to submit an Environmental Assessment for the project in lieu of the standard Biological Assessment.

If you have any questions concerning this request contact Mr. Bill Fonferok of my staff at 904-232-2803.

Sincerely,

Dennis R. Duke
Acting Chief, Planning Division

SARASOTA COUNTY SHORELINE PROTECTION PROJECT
SARASOTA COUNTY, FLORIDA

DRAFT
FISH AND WILDLIFE
COORDINATION ACT REPORT

Submitted to:
Department of the Army
Jacksonville District
Corps of Engineers
Jacksonville, Florida



U.S. Fish and Wildlife Service
Fish and Wildlife Enhancement
Vero Beach, Florida

October 1991



United States Department of the Interior

FISH AND WILDLIFE SERVICE

P.O. BOX 2676

VERO BEACH, FLORIDA 32961-2676

October 30, 1991

Colonel Terrence C. Salt
District Engineer
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

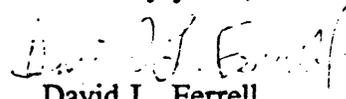
Attn: Planning Division

Dear Colonel Salt:

In accordance with the Fiscal Year 1991 Transfer Fund Agreement between The U.S. Fish and Wildlife Service (Service) and the Jacksonville District Corps of Engineers (Corps), this represents the Draft Fish and Wildlife Coordination Act Report on the Sarasota County Shoreline Protection Project, Sarasota County, Florida. The Corps has requested an evaluation of the environmental effects of nourishing 3.2 miles of beaches along the coastline of the City of Venice with material dredged from two borrow areas located offshore. This information is needed to enable the Corps to reformulate and evaluate the authorized project to assure that it conforms to current environmental needs and criteria.

In accordance with the Fish and Wildlife Coordination Act(48 Stat. 401, as amended; 16 U.S.C., 661 et seq.) the draft report is being coordinated with the National Marine Fisheries Service and the Florida Game and Fresh Water Fish Commission, and will be considered final when concurred with by those agencies and will represent the views of the Department of the Interior.

Sincerely yours,


David L. Ferrell
Field Supervisor

cc:
NMFS, Panama City, FL
FG&FWFC, Vero Beach, FL

Sarasota County Shoreline Protection Project
Sarasota County

Draft
Fish and Wildlife
Coordination Act Report

Submitted to Jacksonville District
U.S. Army Corps of Engineers
Jacksonville, Florida

Prepared by: Bruce Birnhak, Project Biologist
Approved by: David L. Ferrell, Field Supervisor

Vero Beach, Florida, Field Office
U.S. Fish and Wildlife Service
Vero Beach, Florida

October 1991

	<u>Page</u>
Index, and, List of Tables and Figures	iii
Executive Summary	iii
I. Introduction	1
II. Project Description	1
III. Description of Study Area	1
IV. Fish and Wildlife Resources	1
A. Community Descriptions	1
B. Taxa and Important Species	3
V. Fish and Wildlife Service Underwater Observations	5
Methods	5
Results	5
VI. Discussion and Impacts	6
VII. Biological Opinion-Loggerhead Sea Turtle	6
VIII. Mitigation	9
IX. Fish and Wildlife Service Recommendations	11
A. Project Design	11
B. Hardbottom Mitigation	11
X. Summary	12
XI. Literature Cited	13

List of Tables and Figures

<u>Tables</u>	<u>Page</u>
Table 1. Fish Species Observed at Reef Waterward of R-120	15
 <u>Figures</u>	
Figure 1. Vicinity Map	2
Figure 2. Areas of Hardbottom Impacted by Beach Fill	4

EXECUTIVE SUMMARY

The Corps of Engineers (Corps) has requested a Fish and Wildlife Coordination Act Report from the U.S. Fish and Wildlife Service (Service) regarding the environmental impacts of a proposed beach nourishment project at Sarasota County, Florida. Sand fill for the project would be obtained from the ebb tide shoal at Big Sarasota Pass and offshore of Manasota Key. The fill is of high quality and no rock outcrops were reported in the borrow area. Biological surveys of the area by the Service and the sponsor's contractors have shown that there are hardbottom areas immediately offshore of the beaches proposed for renourishment. Service SCUBA investigations indicate that there are currently approximately 2.4 acres of hardbottom within the project area. Our observations also show that these hardbottom areas currently provide habitat for a diverse community of fishes and invertebrates. One particular area of hardbottom is a productive 0.4 acre reef that the Service recommends be avoided and conserved.

The Service also recommends other hardbottom impacts be avoided if possible; however, based on a mitigation ratio of 1 to 1, 1.9 acres of artificial reef would adequately mitigate for 1.9 acres of hardbottom. Due to moderate energy and scouring, few large sponges or gorgonians, which take many years to grow, are able to become established in the nearshore environment. Some of the epibenthos, therefore, may be replaceable if an artificial structure of equal surface area and of similar substrate were to be placed outside the project area. The biological rationale supporting this mitigation recommendation is provided in the report.

The Service also recommends, as part of the mitigation plan, that a minimum of 0.5 acres of designed reef be deployed before sandpumping begins to provide alternative habitat for fish displaced by the project.

I. INTRODUCTION

Nourishment of the 3.2 miles of shoreline in the vicinity of the City of Venice in Sarasota County, Florida, was authorized by the Water Resource Development Act of 1986 (Public Law 99-662). The General Design Memorandum (GDM) for beach erosion control projects within Sarasota County was published in January, 1991.

II. PROJECT DESCRIPTION

The presently considered project calls for the construction of a protective beach along the 3.2 mile reach of shore from DNR monument number R-116 to DNR monument R-133. A total of 2.05 million cubic yards of sand would be placed during the initial construction. The authorized project berm elevation is 9.0 feet mean sea level. After construction, the equilibrium toe of fill would extend approximately 800 ft. offshore of the DNR survey monuments. The primary borrow area consists of two shoals located between 1.21 to 3.14 miles offshore of Manasota Key and about 9.8 miles south of Venice Inlet. Silt content of the sand at the shoal is reported to be 7 percent. The secondary borrow site is the ebb shoal of Big Sarasota Pass, the silt content at this site is 4 percent.

III. DESCRIPTION OF STUDY AREA

Sarasota County is situated on the Gulf of Mexico in southern Florida. The coastal City of Venice is located in the central part of the county. The project site is located on the beaches of the City of Venice, south of Venice Inlet (Fig. 1). Photographs of the existing beaches are attached in appendix A.

IV. FISH AND WILDLIFE RESOURCES

Fish and wildlife habitats in the project area which could be affected by this beach erosion control project include the intertidal beach zone, borrow area, nearshore reefs and hardbottom and the supralittoral beach which serves as nesting habitat for the threatened loggerhead sea turtle.

A. Community Descriptions

Intertidal Beach Zone. The beaches of Sarasota County are typical of other west-southern Florida beaches which are subject to the force of Gulf of Mexico waves. These beaches usually have low species diversity, but populations of individual species are often very large. Species such as coquina clams, ghost crabs, annelid worms, mole crabs and sand drum are highly specialized to survive in this moderately high energy environment.

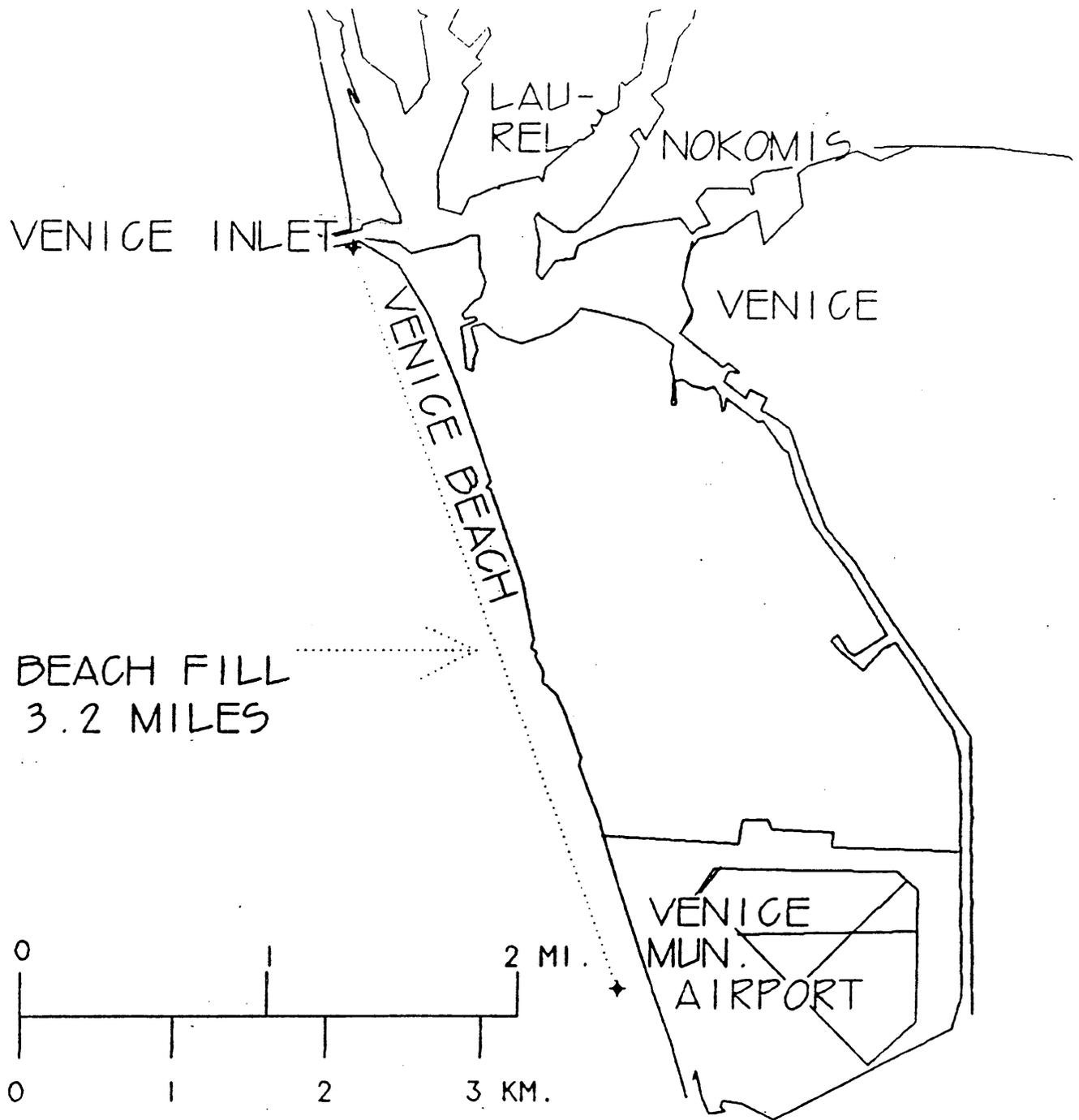


FIGURE 1. PROJECT VICINITY AND LIMITS

Borrow Area. Numerous species of macro-invertebrates inhabit the proposed borrow area. These include, hydrozoan, bivalves, gastropods, annelids, crustaceans, sea cucumbers, brittlestars, etc. These will be unavoidably lost during dredging. However, this habitat is not unique and the area will likely recover within one year (Courtenay, et. al. 1974). Motile fauna expected to inhabit this area would include penaeid shrimp, callinectid crabs, flounder and sole. These species should easily avoid the dredge and no adverse effects to them are anticipated, provided displacement habitat is available.

Nearshore Reefs and man-made and natural hardbottom. Rocky reefs occur adjacent to and seaward of the project area. These features were mapped by Coastal Planning & Engineering, Inc. a consultant firm hired by the local sponsor. These rock outcrops provide habitat for a wide variety of fishes and invertebrates. In addition to the natural reefs, a man-made groin and a derelict groin are also providing productive fishery habitat. Three other hardbottom areas are found in proximity to the beach.

B. Taxa and Important Species

Epibiota

The most abundant and evident producers on the Venice reefs are the algae. The exposed rock provides stable substrate for these organisms which, through photosynthesis, produce basic organic material on which much of the reef's food web is based. Carbon fixed far offshore is also concentrated on the reefs. Attached filter feeding organisms contribute to this organic base by trapping nutrient rich phytoplankton as it is swept past the reef by wave and wind generated currents. Sessile cnidaria such as anemones and stinging hydroids capture zooplankton and other larger organisms which drift to them.

Fishes and Motile Invertebrates

In addition to the algal food which grows on the reefs, fish and motile invertebrates are attracted to the basic structure of the reef. The numerous crevices, holes, and undercut ledges provide refuge from larger predatory fish. These reefs also provide a barrier to currents and substrate for attachment of demersile adhesive eggs.

Sea Turtles

The loggerhead turtle (Caretta caretta) nests primarily on beaches from North Carolina to Florida. Approximately ninety percent of loggerhead nesting within the U.S. occurs in Florida (Murphy and Hopkins, 1984). The highest density nesting beaches in Florida occur from Canaveral National Seashore, Volusia County, south to John U. Lloyd State Recreation Area in Broward county (Conley and Hoffman, 1986). Nesting densities vary from less than one nest per km on the average for some beaches in the northeast, southeast, and panhandle of Florida to over 600 nests per km on some stretches of beach in south Brevard County (Ehrhart and Witherington, 1986). The most recent estimate for

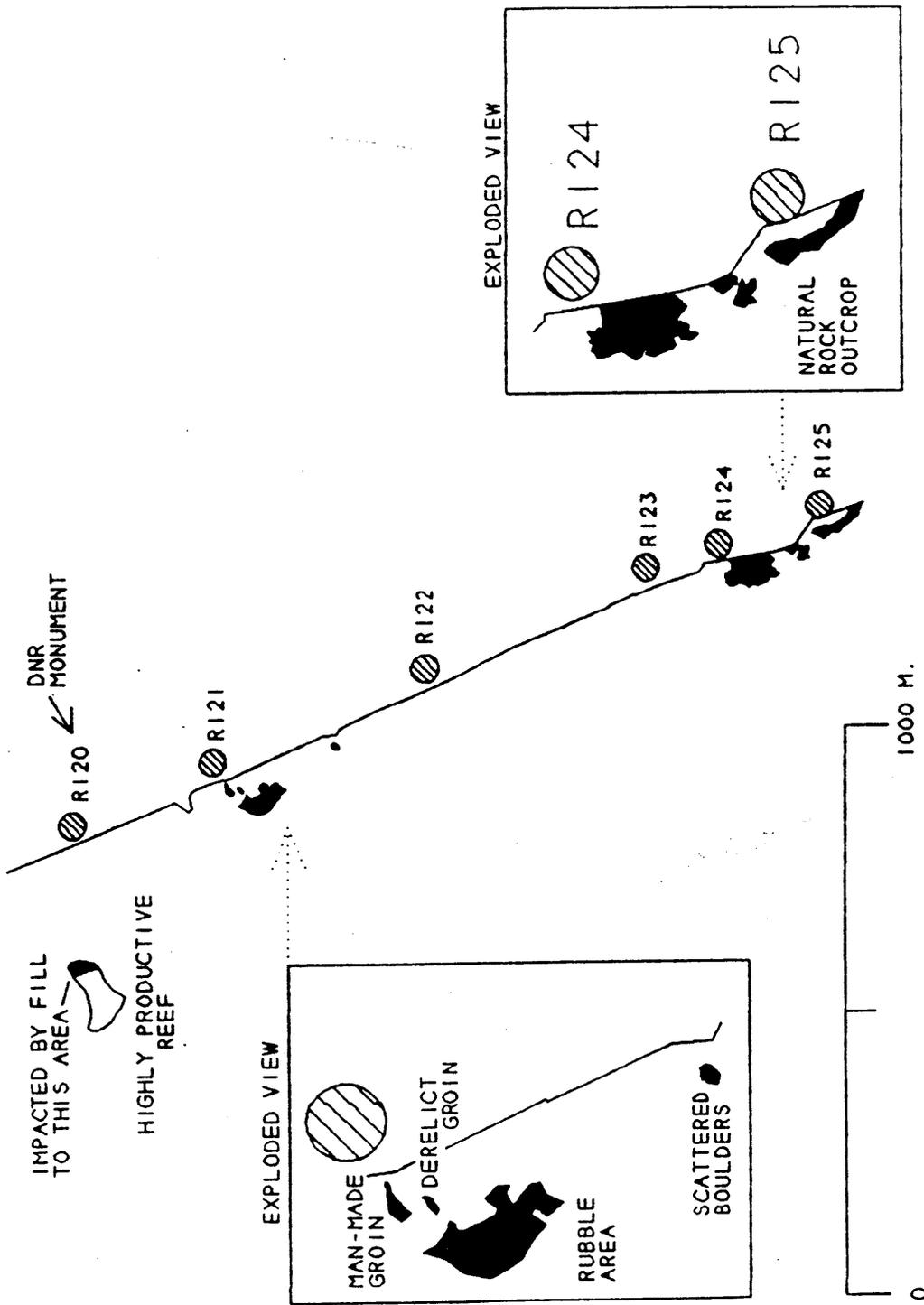


FIGURE 2. AREAS OF HARDBOTTOM

total annual nesting effort in the southeastern U.S. is 58,000 nests based on aerial surveys conducted in 1983 (Murphy and Hopkins, 1984). The U.S. loggerhead nesting population, one of the two most significant nesting populations in the world, may represent up to 30 percent of the worldwide loggerhead nesting population (Ross, 1982). This is in contrast to other sea turtle species where nesting occurs largely outside the U.S. The loggerhead nesting season is from May 1- September 15, with most nesting occurring in June and July.

V. FISH AND WILDLIFE SERVICE UNDERWATER OBSERVATIONS

Methods

On September 17, 1991, Fish and Wildlife Service biologists inspected hardbottom locations nearshore areas in the project area. The most productive reef that would be impacted by the beach fill is located approximately 750 feet west of DNR monument R-120. Underwater photographs of the reef (Appendix 2) were taken, and the variety of fish species recorded.

The sponsor of the project, the City of Venice hired the aforementioned consultant firm, Coastal Planning & Engineering, Inc. to obtain benthic information. Reefs offshore were located by side-scan sonar while inshore hardbottom areas were located on aerial photographs. Relying on the consultants information that no hardbottom communities occurred at the proposed location of the borrow areas, we concentrated on locating natural and man-made hardbottom in the area proposed to be filled by beach nourishment. Our survey revealed that in addition to the previously productive reef, a rock groin, a derelict groin, a scattered rock site, and a natural rock outcrop that originated on the land and ran west into the Gulf occurred within the project area.

The man-made groin occurs immediately south of Venice public beach is composed of large boulders and is .03 acres in area. This site is found near DNR monument R-121. A .03 acre derelict groin composed of large boulders also occurs near monument R-121. A .5 acre scattered rock area is also found near monument R-121. A .03 acre area of boulders occurs near DNR monument R-122. A natural rock outcrop encompassing an area of 1.3 acres is found between monuments R-124 and R-125 (See Figure 2).

Results

The most productive hardbottom community was found associated with the reef located west of DNR monument R-120. A list of the fishes observed at this reef is found on Table 1.

The next most important hardbottom area is the natural rock outcrop between R-124 and R-125. This area has 3-foot high relief and supports diverse fishery resources.

VI. DISCUSSION AND IMPACTS

Beach zone. Since sandy beaches are populated by small, short-lived organisms with great reproductive potential, in most instances these communities recover quickly from environmental disturbances. The impacts of this beach erosion project on the beach zone fauna will depend primarily on the quality of the nourishment material. Since the sand proposed to be used for this project is of similar composition to the natural beach, recovery of the beach fauna should occur in a few months or less.

Nearshore Reef Zone and hardbottom areas. We estimate that approximately 2.3 acres of nearshore reef and hardbottom areas will be buried by beach fill if this project is implemented as proposed. A portion of the most productive reef will be covered by beach fill. This is the reef located offshore DNR monument R-120. According to Corps GDM, the cross-section shows that the equilibrium toe of fill will extend offshore 820 feet at DNR monument R-120 which will cover .4 acres of reef. Because of the productivity of this reef, the Service considers this reef irreplaceable. In addition to the value of the reef to the productivity of the ecosystem, is the recreational value the reef provides. Beach access to the reef is afforded by Venice City Beach which allows SCUBA divers easy access to the reef. Consequently, the reef is heavily used.

VII. BIOLOGICAL OPINION - LOGGERHEAD SEA TURTLE

The loggerhead is the only species of marine turtle that nests on the projects beaches. These beaches are considered as low density nesting beaches. The Florida Department of Natural Resources report that 72 nests were constructed in 1989 on these beaches while in 1990 71 nests were counted. In a letter dated August 7, 1991, the Corps stated that the project may affect the nesting Loggerhead sea turtle. We concur with that determination.

If a nest relocation program is implemented, some nests will likely remain undetected and subsequently be buried by nourishment material or crushed by heavy equipment. In spite of the best intentions or efforts by persons relocating nests; wind, rain and tides can quickly obscure tracks and prevent workers from finding nests. If not properly conducted, relocation of nests to hatcheries can result in reduced hatching rate. In summary, although relocation of nests during beach nourishment is preferable to allowing destruction of the nests, the avoidance of adverse impacts is not absolute.

The Reasonable and Prudent Measures and the Terms and Conditions provided below with the Incidental Take statement, will reduce the degree of adverse impacts on sea

turtles. In view of this, it is the Service's Biological Opinion that the project as proposed is not likely to jeopardize the continued existence of listed sea turtles.

Incidental Take

Section 9 of the Endangered Species Act prohibits the taking of listed species without a special exemption. Taking is defined to mean harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Taking can only be authorized through special provisions.

Section 7(b)(4) of the Act requires that when a proposed agency action is found to be consistent with Section 7(a)(2) of the Act and the proposed action is likely to result in the take of some individuals of the listed species incidental to the action, the Service will issue a statement that specifies the impact (amount or extent) of such incidental taking. It also states that reasonable and prudent measures, coupled with terms and conditions to implement these measures, be provided to minimize such impacts. The Service must also specify procedures to be used to handle or dispose of any individual specimens taken. Reasonable and prudent measures are requirements of the action agency.

We have reviewed the biological information and other information relevant to this action, and based on our review, incidental take is authorized for all nests missed by a nest relocation program within the project boundary. This is inclusive of the direct impacts of nest burial and crushing and the indirect impacts of aberrant nests and broken eggs which may result from sand compaction in nesting seasons subsequent to nourishment activities.

Reasonable and Prudent Measures

The Service considers the following reasonable and prudent measures necessary and appropriate to minimize the take:

1. During periods of nesting activity, relocation of nests will be required.
2. Nourished beaches will be tilled if compaction or escarpments occur.

Terms and Conditions

Section 9 of the Endangered Species Act prohibits the taking of listed species without a special exemption. In order to be exempt from the prohibitions of Section 9 of the Act, the following terms and conditions, which implement the reasonable and prudent measures described above, must be complied with.

1. Nest survey and relocation activities must begin 65 days prior to nourishment activities as follows:

For Venice Beach, nest surveys and relocation do not have to begin earlier than May 1 or continue after September 15.
2. Nest surveys and relocations will be conducted by personnel with prior experience and training in nest survey and relocation procedures, and with a valid Florida Department of Natural Resources permit. This is essential to reduce the number of undetected nests.
3. Nests shall be relocated between sunrise and 10 a.m. each day and the relocation will be to a nearby self-release beach hatchery in a secure setting where artificial lighting will not conflict with hatchling orientation.
4. Nourished beaches will be plowed to a depth of at least 36 inches immediately following completion of beach nourishment if sand compaction measures greater than 500 cone penetrometer index units (cpu). Sand compaction measurements will be taken in February for at least two consecutive years, and tilling will be repeated if compaction exceeds 500 cpu.
5. Escarpments in excess of 18 inches extending more than 100 feet in length and exceeding 500 cpu will be mechanically leveled to the natural beach contour prior to May 1. If leveling is needed, nest relocation procedures will be followed as stated in #1-3. If escarpments in excess of these criteria reform in the two subsequent nesting seasons, they will be leveled to the natural beach contour as described above.
6. A report describing the actions taken to implement the terms and conditions will be submitted to this office within 60 days of completion of the proposed work for each year when activity has occurred. This report will include dates of actual construction activities names and qualifications of personnel involved in nest surveys and relocation activities, description and location of hatcheries, nest survey and relocation results and hatching success of nests.
7. The contractor will notify the Service office issuing this biological opinion 30 days prior to commencing the project.

CONSERVATION RECOMMENDATIONS

The following Conservation Recommendations are provided to further reduce the potential for adverse impact to nesting sea turtles.

1. Beach renourishment be planned for and conducted outside the period May 1 - September 15 whenever possible.
2. When the dredge is located off the nesting beach, nighttime lighting should be minimized by eliminating lights, screening, or shielding lights when possible. Low pressure sodium lights (shielded) are recommended for those lights which cannot be eliminated.
3. Sea oats or other appropriate dune vegetation should be planted on nourished beaches to enhance dune restoration. The Florida Department of Natural Resources, Division of Beaches and Shores, can provide technical assistance in the design and implementation.

In the event a turtle nest is dug up by beach construction activities, the following procedure should be followed:

1. Immediately notify the Florida Department of Natural Resources permitted individual responsible for nest relocation on the project for removal of the nest to the beach hatchery. Before eggs are relocated, the top of each egg will be marked with a non-toxic felt-tipped pen and individually and gently placed on 2-3 inches of moist sand in a rigid-walled container, being careful not to change the axis of the eggs. Eggs will be covered with a fine nylon mesh and then 2-3 inches of moist sand, shaded from the sun, and immediately transported to the artificial nest chamber, while ensuring that the orientation of each egg remains as in the natural nest.

This concludes consultation under Section 7 of the Act, as amended. If there are modifications made in the project, or if additional information becomes available relating to threatened and endangered species, reinitiation of consultation may be necessary.

VIII. MITIGATION

We estimate that most of the existing 2.3 acres of the nearshore rock will be either buried or severely degraded by beach fill as a result of this project. As stated previously, we consider the reef offshore DNR monument R-120 irreplaceable and thus cannot be mitigated. The other 1.9 acres of hardbottom are not as productive and can thus be mitigated. This could be accomplished by providing new limestone substrate in the form of an artificial reef of equivalent unscoured surface area.

Too often, artificial reefs are created without a clearly defined purpose and without sufficient planning. The United States, in particular, has pursued an unsophisticated and frugal approach to artificial reef planning and construction. The use of scrap and discarded rubble, because of its low cost, is most commonly used (McGurrin, et. al.,

1989) despite its inadequacy in providing suitable habitat for targeted species. In contrast, the Japanese have invested billions of dollars in developing techniques to create new habitat and increase seafood production (Grove, et. al., 1989; Sonu et. al., 1985). These efforts have been reported by Sheehy (1983), and Brock and Norris (1989) to have resulted in much more efficient reef technology. While costs per area of reef are higher, the increase in reef fish and epibenthic organism abundance per area over traditional U.S. reef technology (Sheehy, 1983; Brock and Norris, 1989) may more than offset this cost (Sato, 1985).

To correct the deficiencies in and fragmentation of the U.S. artificial reef program, the Secretary of Commerce was directed, under the provisions of the National Fishing Enhancement Act of 1984 to develop and publish a long-term National Artificial Reef Plan to promote and facilitate responsible and effective artificial reef use based on the best scientific information available. A working plan was published by the National Marine Fisheries Service in 1985 under the authorship of Richard B. Stone. To conform to the Plan each project should have a clearly defined list of species targeted for habitat enhancement and user group intended to be benefitted.

Some fundamental features which should be incorporated into the design are: 1) extensive unshaded horizontal surface area for the attachment and growth of gorgonians and macroalgae; 2) openings near the bottom, for Stone crabs, depth of at least 2 ft. and height of no more than 1 ft.; 3) interstitial spaces of approximately 10 cubic ft.; 4) large overhanging ledges to provide shaded resting space for large fish, particularly common snook; 5) numerous projections, crevices, and holes ranging in size from one to three inches in width and up to 1 foot in length (projections) and up to one foot in depth (holes and crevices). These smaller features are intended to provide refugia for small fish and for juvenile fishes, as well as to provide additional surface area for epibiotic growth.

We have seen designs for concrete modules, similar in design to Japanese modules, which could be used for artificial reef construction. These structures incorporate many of the features mentioned above but would be built of concrete rather than limestone. A possible solution to the potential problems associated with substrate selectivity in fouling organisms, would be to embed limestone rock in the surface of the concrete. Alternatively, the Corps of Engineers, by letter dated February 27, 1990, to the City of Vero Beach, proposed as mitigation for reef loss due to the Indian River County Erosion Control project, the construction of 8 rock rubble reef structures 100 feet long by 50 feet wide by 5 feet high. If the rocks used to construct such a reef are of a variety of sizes and of sufficient diameter (2 feet minimum) to provide large interstitial spaces and if the majority of the surface area of the structure were limestone, we would consider the construction of 16 of these modules to constitute adequate habitat replacement for the losses expected to occur as a result of the Sarasota County project. These structures would cover approximately 1.9 acres of the sea floor and would be of high relief with a significant proportion of the reef surface above the scour zone similar to the existing Venice Beach reefs.