BIENVILLE OFFSHORE ENERGY TERMINAL

TOPIC REPORT 3

BIOLOGICAL RESOURCES

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List of Acronyms

ac	acre(s)
ADCNR	Alabama Department of Conservation and Natural Resources
BOET	Bienville Offshore Energy Terminal
Bscfd	billion standard cubic feet per day
CPA	Central Planning Area
DWPA	Deepwater Port Act
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
FMC	Fisheries Management Council
FMP	fisheries management plan
ft	foot or feet
GMFMC	Gulf of Mexico Fisheries Management Council
GOM	Gulf of Mexico
ha	hectare(s)
HAPC	habitat area of particular concern
HiLoad	HiLoad LNG regasification unit
HMS	highly migratory species
IWC	International Whaling Commission
km	kilometer(s)
km^2	square kilometer(s)
LNG	liquefied natural gas
LNGC	liquefied natural gas carrier
m	meter(s)
m^3	cubic meter(s)
mgd	million gallons per day
mi	statute mile(s)
mi^2	square mile(s)
MMA	Marine Managed Area
MMPA	Marine Mammal Protection Act of 1972
MP	Main Pass
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NARP	National Artificial Reef Plan
NECG	Noise Exposure Criteria Group
NEPA	National Environmental Policy Act
NERR	Natural Estuarine Research Reserve
NMFS	National Oceanic and Atmospheric Administration's National Marine Fisheries Service
NMS	National Marine Sanctuary
NPS	National Park Service
NOAA	National Oceanic and Atmospheric Administration
NTL	Minerals Management Service Notice to Lessees
NWR	National Wildlife Refuge
OCS	Outer Continental Shelf

List of Acronyms (continued)

PLEM	pipeline end manifold
ROV	remotely operated vehicle
RPT	rapid-phase transition
SARS	Stock Assessment Reports
SEAMAP	South East Area Monitoring and Assessment Program
sp.	species
spp.	multiple species
Terminal	Bienville Offshore Energy Terminal
USFWS	U.S. Fish and Wildlife Service

3.0 BIOLOGICAL RESOURCES

TORP Terminal LP proposes to construct, own, and operate the Bienville Offshore Energy Terminal (BOET or Terminal) in the northeastern Gulf of Mexico (GOM), in Main Pass Lease Block 258 (MP 258). BOET will be located approximately 62.6 statute miles (mi) (100.7 kilometers [km]) south of Fort Morgan, Alabama, located on Mobile Point. The proposed Project will receive and vaporize liquefied natural gas (LNG) and deliver a peak 1.4 billion standard cubic feet per day (Bscfd) (39.6 million cubic meters [m3]) of pipeline-quality natural gas to existing offshore natural gas transmission infrastructure in south Alabama, Louisiana, and Mississippi.

Project components include two HiLoad LNG regasification units (HiLoads) connected to a new support platform via two Terminal pipelines that are each 30 inches (76.2 centimeters [cm]) in diameter and 1 mile (1.6 km) long, with associated pipeline end manifolds (PLEMs). Four new interconnecting pipelines (ranging from 16 to 30 inches [40.6 to 76.2 centimeters] in diameter and from 0.8 to 8.9 mi [1.3 to 14.2 km] in length) will be constructed to connect the support platform to four existing natural gas pipelines.

This Biological Resources Topic Report describes the biotic environment for the proposed BOET vicinity in the GOM. The report addresses potential Project impacts on biological resources, including habitats, threatened and endangered species, non-threatened and non-endangered species, and fisheries.

3.1 Existing Conditions – Proposed Action

3.1.1 Habitats

Offshore habitats in the GOM include soft bottom communities, hard/live bottom habitats, artificial reefs, *Sargassum* mats, and the water column itself. The following paragraphs summarize each of these different habitats that may be expected in the vicinity of the proposed Terminal.

3.1.1.1 Water Column

The biota found in the pelagic water column include phytoplankton, bacteria, zooplankton, ichthyoplankton, and larger animals—such as fish, sea turtles, cephalopods, crustaceans, and marine mammals. The zooplankton consist of holoplankton, organisms that spend their entire life (all life stages) in the water column, and meroplankton, organisms for which larval stages are spent in the water column. Examples of holoplankton are protozoans, copepods, chaetognaths, polychaetes, and euphasids. Polychaetes, echinoderms, gastropods, bivalves, and fish larvae and eggs are examples of meroplankton. Phytoplankton are typically at the mercy of the currents whereas zooplankton are able to swim to some extent. In general, the diversity of planktonic species decreases with decreased salinity, and biomass decreases with distance from shore. Temperature, salinity, and nutrients limit the geographical and vertical ranges of plankton. Typically, planktonic volume is greatest during summer due to the large abundance of meroplankton.

3.1.1.2 Aquatic Vegetative Communities

Sargassum is an essential component of the water column habitat in the GOM. *Sargassum* is a brown alga that forms dense floating mats in tropical Atlantic waters and the GOM. The floating mat provides habitat to a wide range of species in the pelagic water column. The *Sargassum* community is a worldwide circumtropical phenomenon comprised of a unique and diverse association of organisms (Dooley 1972). It is an essential component of the water column habitat in the GOM. *Sargassum* provides a habitat to a wide range of species in the pelagic water column. Animals associated with *Sargassum* include hydroids, copepods, fish (54 species), crab, gastropods, polychaetes, bryozoans, anemones, sea spiders, and stages of sea turtles. The majority of these organisms depend on the presence of the *Sargassum* algae. Shrimp and crab come into contact with *Sargassum* as it drifts with the current through the GOM. They comprise the bulk of the invertebrates that utilize *Sargassum* and are a major source of food for associated fish. *Sargassum* acts as a vehicle for dispersal of some of its inhabitants and might be important in the life histories of many species of fish. It provides them with a substrate, protection against predation, and concentration of food in the open GOM (GMFMC 2003). *Sargassum* alga rafts potentially constitute long-term havens for young sea turtles that drift with these floating ecosystems as they feed off their living organisms, possibly for several years. Large predators associated with the *Sargassum* complex include amberjacks (*Seriola dumerili*), dolphin (*Coryphaena hippurus*), and almaco jacks (*S. rivoliana*).

3.1.1.3 Soft-Bottom Communities

The major benthic habitat of the northern GOM consists of a soft muddy bottom. The benthic faunal component consists of two groups: infauna (animals that live in the substrate) and epifauna (animals that live on or are attached to the substrate). Infaunal communities on the continental shelf are generally dominated by polychaete worms (bristleworms), followed by crustaceans and mollusks. Epifaunal communities include crustaceans, echinoderms, mollusks, hydroids, sponges, and soft and hard corals. Shrimp and demersal fish are also closely associated with benthic communities (MMS 2002a). The distributions of these animals are typically influenced by sediment composition or grain size but also by temperature, salinity, and distance from shore (MMS 2002a). Illumination, food availability, currents, tides, and wave shock also play a role in the distribution of benthic fauna.

Benthic organisms are valuable indicators of water/sediment pollution and construction-related perturbations. They also transfer large amounts of food energy to the higher trophic levels. These relatively immotile infauna can provide evidence of habitat changes related to construction operations through changes in their presence and abundance. Species diversity varies significantly between habitat types. Species and individual abundances are generally higher in medium sand substrates in water less than 197 feet (ft) (60 meters [m]) and lower in finer sediments and deeper water. Species diversity is highest in habitats with medium to coarse sands and lower in habitats with finer sands that are in water depths over 197 ft (60 m) (BAV 2000).

Although many studies have been done on the benthic communities of the GOM, few included the BOET vicinity. Benthos studied most often in the GOM were in shallow water, closer to the coastlines; or in deepwater, starting at approximately 656 or 984 ft (200 or 300 m), depending on the study.

Studies of sediment in the GOM have described areas near the BOET vicinity. Data collected for the National Oceanographic Data Center referred to the sediment at 390 ft (119 m) as "extremely soft gray clay" (88°54 W, 29°1 N) (Shell 1967). Another data set gives percentages of gravel, sand, silt, clay, and mud comprising the sediment just slightly outside the BOET vicinity. According to that data, the sediment in that area is primarily sand, with much smaller amounts of the other sediment types. One sample was 83.03 percent sand, 7.07 percent clay, 5.58 percent gravel, and 4.32 percent silt (NOAA 1978). The term used for this sediment is clayey sand. A geohazard survey completed by Fugro in August 2005 has shown that the proposed block consists completely of soft bottom habitat. For a more complete review of the seafloor make-up, see Topic Report 6, "Geological Resources."

INVERTEBRATES

Macroinfaunal assemblages in the northeastern GOM have been classified variously on the basis of depth, sediment texture, or a combination of both. Sediment texture is more important in determining macroinfaunal assemblage composition than water depth, location, or season. However, there clearly are linkages between sediment texture and those other variables, through patterns of sediment deposition, transport, or resuspension. (BAV 2000.)

Benthic assemblages in the OCS of the northeastern GOM near the De Soto Canyon, located approximately 55.2 mi (88.8 km) northeast of BOET, have been summarized from several benthic studies since 1973. The conclusion is that the area is dominated numerically by polychaetous annelids. Typically, polychaetes comprise 30–40 percent of taxa and 50–60 percent of individuals. Crustaceans are generally the second most abundant with respect to both taxa (20–40 percent) and individuals (15–25 percent), while mollusks represent 15–25 percent of taxa and 15–25 percent of individuals. Other major taxonomic groups found in the northeastern GOM include echinoderms (especially ophiuroids), sipunculids, cephalochordates, and rhynchocoels. Both crustaceans and mollusks exhibit high variability in distribution, and are more abundant and diverse in sandier substrates than in finer substrates. (BAV 2000.)

Barry A. Vittor & Associates have identified various assemblages across the northeastern OCS. These assemblages are: I. Sand Assemblage (shelf wide), II. Silty Sand Assemblage (inner shelf < 100 m), III. Coarse Sand/Gravel Assemblage, and IV. Silty Sand Assemblage (outer shelf > 100 m). The species corresponding to each assemblage are listed in Table 3-1. (BAV 2000.)

Table 3-1. Species Associated with Northeastern Outer Continental Shelf Assemblages

Assemblage I	Polychaetes	
	Aricidea wassi	*Diopatra tridentata*
	Isolda pulchella	*Exogene lourei*
	Laonice cirrata	*Sigambra tentaculata*
	Mooreonuphis pallidula	*Synelmis albini*
	Nephtys picta	*Sphaerosyllis piriferopsis*
	Notomastus americanus	*Typosyllis amica*
	Mollusks	
	Abra lioica	*Caecum imbricatum*
	Astarte nana	*Chione intapurpurea*
	Cadulus tetrodon	*Ervilia concentrica*
	Nassarius albus	*Rictaxis punctostriatus*
	Nucula ageensis	*Tectonatica pusilla*
	Caecum cooperi	*Tellina aequistriata*
	Crustaceans	
	Alpheopsis harperi	*Eudevenopus honduranus*
	Alpheus floridana	*Eusarsiella disparalis*
	Ampelisca agassizi	*Rutiderma darbyi*
	Cyclaspis pustulata	*Rutiderma mollitum*
Assemblage II	Polychaetes	
	Aglaophamus verrilli	*Montecellina dorsobranchialis*
	Ampharete americana	*Nereis micromma*
	Aricidea wassi	*Owenia fusiformis*
	Armandia maculata	*Paraprionospio pinnata*
	Diopatra cuprea	*Prionospio cristata*
	Dispio uncinata	*Scoletoma verrilli*
	Galathowenia oculata	*Sigambra tentaculata*
	Goniada littorea	*Spiophanes bombyx*
	Goniadides carolinae	*Syllis hyalina*
	Lumbrineris verrilli	*Synelmis albini*
	Magelona pettiboneae	*Tharyx annulosus*
	Mediomastus sp.	
	Mollusks	
	Abra aequalis	*Tellina versicolor*
	Caecum pulchellum	*Turbonilla conradi*
	Crustaceans	
	Xenanthura brevitelson	*Ampelisca agassizi*
	Sipunculids	
	Aspidosiphon albus	*Golfingia trichocephala*
	Cephalochordates	
	Branchiostoma sp.	
	Phoronids	
	Phoronis sp.	

Table 3-1. Species Associated with Northeastern Outer Continental Shelf Assemblages (continued)

Assemblage III	Polychaetes	
	Ampharete acutifrons	*Filograna implexa*
	Aonides paucibranchiata	*Nephytys picta*
	Aricidea taylori	*Parapionosyllis longicirrata*
	Armandia maculata	*Polygordius* sp.
	Bhawania heteroseta	*Pronospio cristata*
	Ceratonereis mirabilis	*Protodorvillea kefersteini*
	Chloeia viridis	*Scoletoma verrilli*
	Chone duneri	*Sphaerosyllis piriferopsis*
	Eunice vittata	*Synelmis albini*
	Exogene dispar	
	Mollusks	
	Abra lioica	*Chione* sp.
	Caecum cooperi	*Ervilia concentrica*
	Crustaceans	
	Ampelisca agassizi	*Metharpinia floridana*
	Apseudes sp.	
	Cephalochordates	
	Branchiostoma sp.	
	Echinoderms	
	Amphiodia pulchella	
Assemblage IV	Polychaetes	
	Aglaophamus verrilli	*Nephtys incisa*
	Ampharete acutifrons	*Paralacydonia paradoxa*
	Aricidea neosuecica	*Paraprionospio pinnata*
	Armandia maculata	*Poecilochaetous johnsoni*
	Goniada maculata	*Prionospio steenstrupi*
	Laonice cirrata	*Synelmis albini*
	Mollusks	
	Nuculana acuta	*Yoldia liorhina*
	Crustaceans	
	Ampelisca verrilli	*Micropanope nuttingi*

Source: BAV 2000.

Assemblage I is broadly distributed throughout the OCS, typically in sand sediments that contain negligible amounts of silt/clay or gravel. Although there are some changes in species composition with depth, the numerically dominant taxa in Assemblage I are found from nearshore shallow waters to the edge of the shelf. Most species in these habitats are filter feeders, epibenthic deposit feeders, or carnivores. (BAV 2000.)

Assemblage II comprises taxa associated with silty sand and sandy silt sediments in shallower areas of the shelf. Sediments in these habitats generally contain more than 5–10 percent silt and occur in areas affected by sediment transport from estuarine systems such as Mobile Bay and Escambia Bay or by disposal of dredged material from navigation channels in the embayments in the area. Assemblage II species are primarily detritivores, including burrowing and surface deposit feeders. Suspension- and filter-feeding taxa are abundant in these habitats, but polychaetes predominate. This assemblage contains few species associated with organic fine sediments. (BAV 2000.)

Assemblage III has limited distribution based on patchy occurrences of coarse sand with gravel or rubble. These habitats are found in shallow to deep water and contain surface-dwelling, motile species, as well as filter feeders and burrowers. Assemblage III species include epibenthic deposit feeders, suspension feeders, and carnivores. (BAV 2000.)

Assemblage IV is associated with fine-sand and silty-sand habitats in waters over 328 ft (100 m) deep. These sediments occur on both sides of De Soto Canyon and inside channels that lead into the canyon. The organic content of these sediments is similar to that of the shallower silty-sand habitat, and the assemblages show similar feeding habitats. Burrowing and surface-deposit feeders predominate. (BAV 2000.) Generally, infaunal assemblages offshore Alabama tend to be dominated (numerically) by polychaetes (Shaw et al. 1982, Harper 1991). Other conspicuous members of the infaunal community include amphipod crustaceans and bivalves. Seasonality is apparent in the overall abundance of infauna, with winter densities generally lower than other seasons (Shaw et al. 1982, BAV 1985, Harper 1991).

The benthic foraminiferal assemblage of the GOM is very diverse. In a study of the northwestern GOM, 138 species occurred in three or more samples (Osterman 2003). Although the study area was to the west, some of the water depths sampled were similar to those in the BOET vicinity. In depths of approximately 345 to 473 ft (105 to 144 m), the most prevalent species of foraminiferans was *Uvigerina peregrina*. Other relatively common species were *Brizalina subaeariensis* v. *mexicana*, *Bulimina marginata*, *Lenticulina iota*, *Planulina foveolata*, and *Siphonina pulchra* (Osterman 2003).

BOET is located in an area consisting of a substrate that is primarily sand. The water depth of the support platform is approximately 418 ft (127 m), but the pipelines will be placed in water as shallow as 255 ft (77.7 m). Therefore, aspects of BOET are expected to occur in, or pass through, areas of both Assemblage I and Assemblage IV. Installation of the Terminal and pipelines will cause the loss of organisms located under the footprint; however, no impact is expected on the benthic community during operation.

3.1.1.4 Hard Bottom Communities

"Hard bottom" refers to areas with consolidated sediments consisting of limestone, siltstone, sandstone, coral, or shell and shell fragments. Live bottoms are hard bottoms with an associated epifauna of sponges, hydroids, corals, and sea whips, as well as a dense fish population (Cummins et al. 1962). Hard bottom features and areas are considered biologically sensitive. These include pinnacle trends, topographic features, and live bottom areas of low relief.

PINNACLE TRENDS

The primary hard/live-bottom features on the Mississippi-Alabama shelf between the Mississippi River and De Soto Canyon are known as the "Pinnacle Trend." The pinnacles appear to be carbonate reef structures in an intermediate stage between growth and fossilization (Ludwick and Walton 1957) and occur from 243 to 394 ft (74 to 120 m).

Pinnacle trends are carbonate (consisting of the salt of carbonic acid) mounds, ranging from less than a few feet to nearly 3,000 ft (less than a meter to nearly a kilometer) in diameter, that appear to be biogenic features formed during the last de-glaciation (MMS 2002b). Pinnacle trends in the northern GOM primarily occur in water depth of approximately 200 to 360 ft (60 to 110 m). MMS requires exclusion zones, or "no activity zones," around topographic highs, such as pinnacle trends on the OCS, because rises of 6 to 8 ft (1.8 to 2.4 m) stimulate increased biological productivity (MMS 2004).

The BOET vicinity coincides with a large area containing pinnacle reef tracts. However, no pinnacle reefs are within the proposed lease block (Main Pass [MP] 258). Figure 3-1 shows MP 258 and its coincidence with an area of Pinnacle Reef Tract. Each highlighted block is a lease block with a Live Bottom (Pinnacle Trend) Stipulation, which is designed to prevent drilling activities and anchoring from damaging the pinnacles. Figure 3-2 shows BOET and its associated features in relation to individual reefs nearby. The majority of the pinnacles reefs are more than 11 mi (17.7 km) from the closest point of the Proposed Project. The exceptions are a cluster of five small pinnacles reefs that correspond to what one study calls Megasite 3 (CSA and TAMU 2001). These five pinnacles reefs are Double Top Reef, NEGOM-CMEP Site 5, Shark Reef, Triple Top Reef, and Pancake Reef. Of these, Shark Reef is the closest to any Project aspect, at a distance of 0.8 mi (1.3 km) from the nearest proposed pipeline. Table 3-2 shows the distances from nearby pinnacles reefs to BOET and its associated features.

Double Top Reef — Double Top Reef is located in the MP 223 Lease Block, approximately 4.6 mi (7.4 km) north of BOET. It is a high-profile, horseshoe-shaped reef with a 328-ft (100-m) base diameter, consisting of multiple flat top mounds with steep vertical sides. The area of the reef is approximately 8 acres (ac) (3.0 hectares [ha]), with a base depth of 262 ft (80 m) and a maximum relief of 39 ft (12 m). During a 106.2-minute survey from a remotely operated vehicle (ROV), 354 fish were seen at Double Top Reef from 16 different taxa (Weaver et al. 2001).

NEGOM-CMEP Site 5 — Northeast of Double Top Reef is NEGOM-CMEP Site 5, a single high-relief mound with an area of 1.7 ac (0.7 ha). As with Double Top Reef, the base depth of

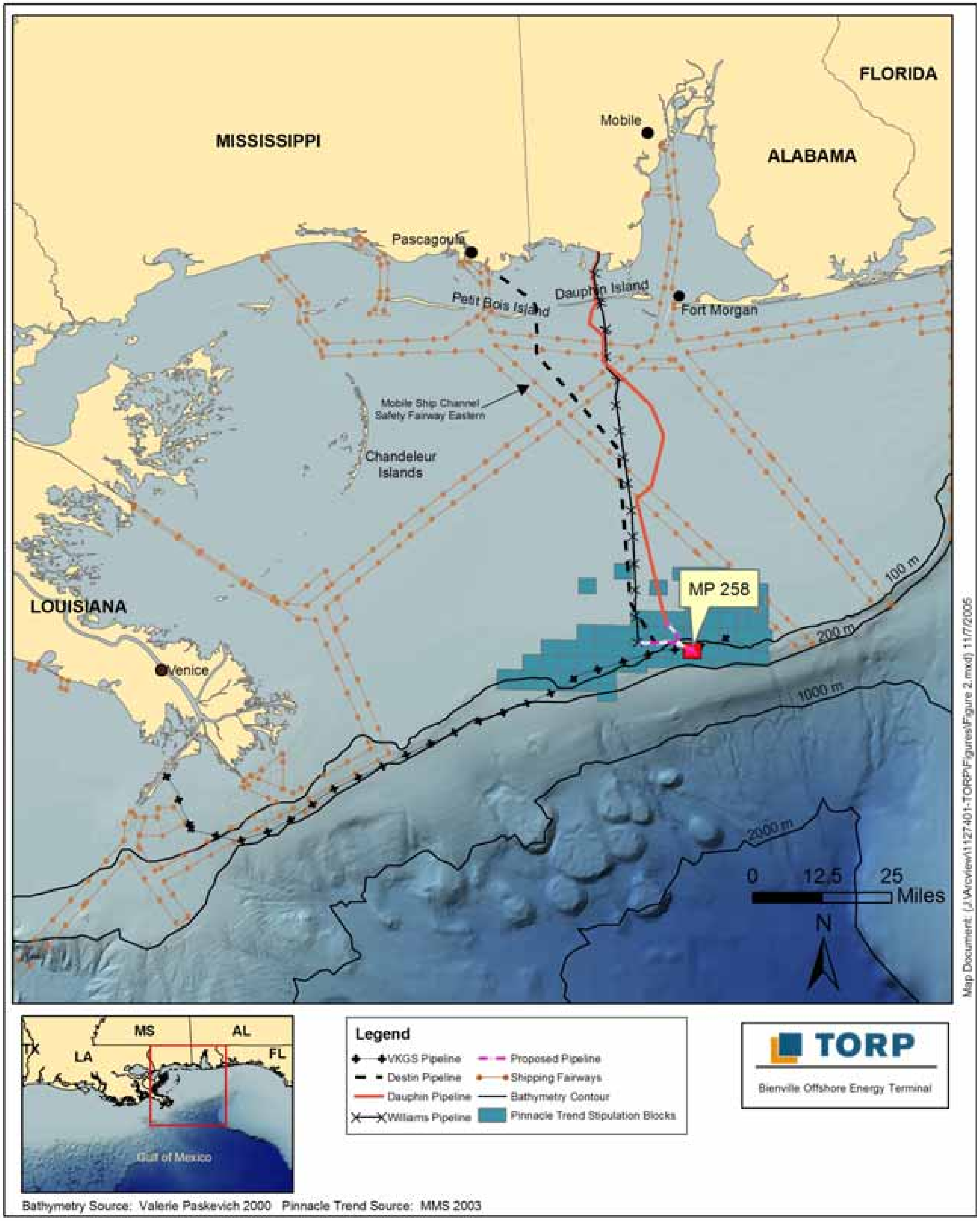

Figure 3-1. Lease Blocks under the Pinnacle Reef Tract Stipulation

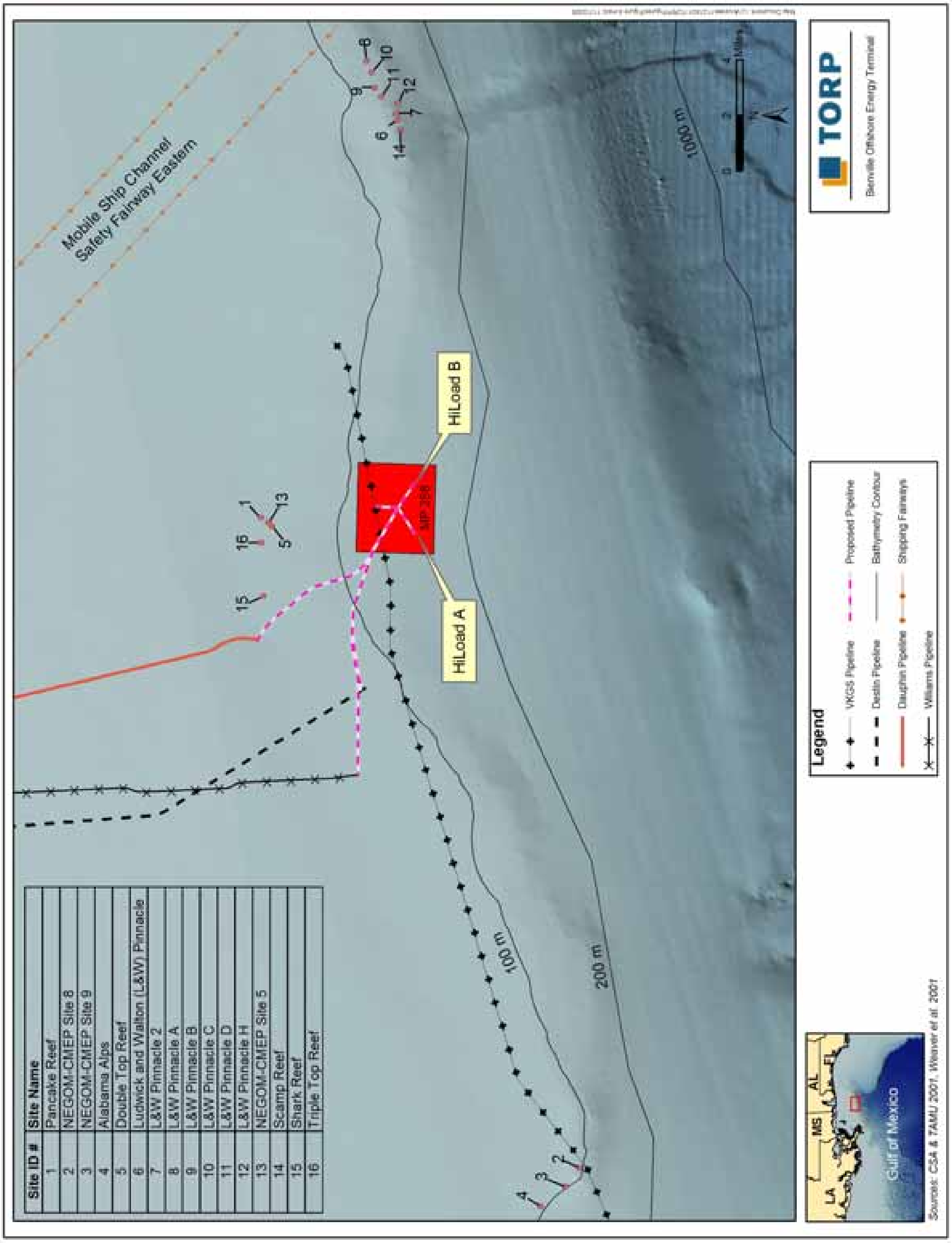

Figure 3-2. Individual Pinnacle Reefs Immediately Surrounding BOET

NEGOM-CMEP Site 5 is 262 ft (80 m), with a maximum relief of 39 ft (12 m). The ROV survey of this pinnacle reef showed the highest number of fish in the BOET vicinity: 580 fish from 21 different taxa (Weaver et al. 2001).

Table 3-2. Distances of Pinnacles to BOET Facilities and Pipelines

Reef	Distance to Closest Pipeline (miles)	Distance to HiLoad A (miles)	Distance to HiLoad B (miles)	Distance to Support Platform (miles)
Double Top Reef	2.3	5.2	5.3	4.6
NEGOM-CMEP Site 5	2.5	5.3	5.4	4.7
Shark Reef	0.8	5.7	6.5	5.5
Triple Top Reef	2.4	5.5	5.8	5.0
Pancake Reef	2.9	5.6	5.7	5.0
NEGOM-CMEP Site 8	14.6	20.7	22.4	21.8
NEGOM-CMEP Site 9	14.9	21.2	22.9	22.2
Alabama Alps	15.0	21.6	23.2	22.5
Ludwick and Walton (L&W) Pinnacle	1.6	13.3	11.6	12.6
L&W Pinnacle 2	13.3	15.0	13.3	14.1
L&W Pinnacle A	12.4	14.1	12.4	13.3
L&W Pinnacle B	12.9	14.6	12.9	13.7
L&W Pinnacle C	12.1	13.7	12.1	12.9
L&W Pinnacle D	11.9	13.5	11.9	12.8
L&W Pinnacle H	11.3	12.9	11.3	12.2
Scamp Reef	11.1	12.7	11.1	11.8

In another study, NEGOM-CMEP Site 5 and Double Top Reef were grouped together and referred to as Site 5. Site 5 showed distinct assemblages of organisms in different locations on its features. Organisms found on top of the largest feature were family Stenogorgiinae, *Swiftia exserta*, *Stichopathes lutken*, *Antipathes* multiple species (spp.), *Bebryce cinera/grandis*, *Ctenocella* (*Ellisella*) spp., *Hypnogorgia pendula*, and other unidentified gorgonian corals. Hermatypic as well as ahermatypic corals were sparsely distributed on the top interior, probably due to heavy accumulations of fine sediments. *Rhizopsammia manuelensis* was the dominant species on almost all surfaces of the smaller mounds associated with the feature. Other species found on the vertical face of the main feature and adjacent mounds included *Madracis/Oculina* species (sp.), *Madrepora carolina*, *Antipathes* spp., and *Stichopathes lutkeni*. Also present were the sea urchins *Stylocidaris affinis* and *Diadema antillarum*, a few unidentified sponge species, and small colonies of bryozoans. (MMS 2003a.)

Shark Reef — Shark reef is the westernmost reef of Megasite 3. It is a low-profile reef with a maximum relief of almost 10 ft (3 m) and a base depth of 253 ft (77 m). The reef is approximately 820 ft (250 m) long and covers an area of almost 3 ac (1.2 ha) (Weaver et al.

2001). Shark Reef has a well developed invertebrate community on its vertical walls and overhangs although many of the sessile invertebrates on the horizontal walls appeared to be dead at the time of the survey (Weaver et al. 2001). In regard to the fish community, the ROV showed 103 fish from 17 taxa in a 78.6-minute survey (Weaver et al. 2001). Shark Reef is the closest reef to the Terminal (5.5mi [8.8 km] away). It is also the closest reef to any aspect of the Terminal, 0.8 mi (1.3 km) east of the Dauphin pipeline tie-in.

Triple Top Reef — This is the largest reef within Megasite 3, covering almost 9 ac (3.6 ha). It is a series of high-relief mounds with a base depth of 249 ft (76 m) and a maximum relief of 26 ft (8 m). An ROV survey was not conducted for this reef (Weaver et al. 2001). Triple Top is 5.0 mi (8 km) north of the Terminal.

Pancake Reef — Pancake Reef is a low-profile mound that corresponds to NEGOM-CMEP Site 6 (Weaver et al. 2001). During studies on this reef, the most noticeable taxa included *Bebryce cinerea/grandis*, *Thesea* spp., *Ctenocella* (*Ellisella*) spp., *Antipathes*, and *Stichopates lutkeni* (GMFMC 2003). *Rhizopsammia manuelensis* was relatively common on the few features with more than 3.3 ft (1 m) of relief, and *Madracis/Oculina* sp. and *Madrepora carolina* also were observed occasionally (GMFMC 2003). Pancake Reef is also 5.0 mi (8 km) north of the Terminal.

Double Top, Triple Top, and Pancake Reefs all belong to the same shallow pinnacle trend. They have flat-top communities characterized by high sediment cover and dense invertebrate assemblages. These assemblages are dominated by octocorals and antipatharians with a few solitary corals. (Weaver et al. 2001.)

LOW-RELIEF LIVE BOTTOM

Much of the area of the eastern GOM consists of low-relief live bottom. These areas are seagrass communities, areas consisting of sessile invertebrates living on or attached to hard or rocky formations. Low-relief live-bottom areas also may promote use by sea turtles, fishes, and other fauna (MMS 2004). All areas of low-relief live bottom are at least 12.8 mi (20.6 km) east of BOET and are unlikely to be affected by the Terminal.

TOPOGRAPHIC FEATURES

Topographic features are isolated areas of high relief. These features support many commercially and recreationally important fishes, providing them shelter and food by way of the high biomass for which they provide habitat (MMS 2004). There are no topographic features east of the Mississippi Delta.

ARTIFICIAL REEFS

Anthropogenic structures used for oil and gas production inadvertently serve as artificial reefs, where fish communities can concentrate and flourish. These structures and reefs are being given serious attention as contributing to fishery habitat enhancement in the National Fishing

Enhancement Act of 1984. In response to that act, the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS, also known as NOAA Fisheries) developed the National Artificial Reef Plan (NARP). NARP recommended state-specific artificial reef plans, and most Gulf coast states now have such a plan. Artificial Reef Working Committees comprised of both state-level and federal-level members have worked toward developing artificial reef policies. The use of obsolete oil and gas platforms for artificial reefs has proved to be highly successful. In Rigs-to-Reefs programs, a platform is not dismantled but is left in place and donated to the state. A portion of the money saved by not dismantling the structure is donated to the state to support the artificial reef program. (MMS 2001.)

Approximately 1,200 square miles (mi^2) (3,108 square kilometers [km^2]) of offshore waters are included in the artificial reef general permit areas of Alabama, making this the largest artificial reef program in the United States. The five permit areas are the Hugh Swingle, Don Kelley North, Don Kelley South, Tatum-Winn North, and Tatum-Winn South general permit areas. Within these general permit areas, artificial reefs can be constructed by individuals after acquiring a permit from the Marine Resources Division. Reefs may be constructed outside of these areas if a permit is obtained from the U.S. Army Corps of Engineers pursuant to Section 10 of the River and Harbor Act of 1899; Section 404 of the Clean Water Act; and Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended. (ALDCNR 2004.)

Small cryptic fish such as blennies (*Blennidae*), as well as large grazers (e.g., sheepshead (*Archosargus probatocephalus*) and small grazers (e.g., butterflyfishes [*Chaetodontidae*]), appear trophically dependent on the biofouling community for food or cover. Atlantic spadefish (*Chaetodipterus faber*), lookdown (*Selene vomer*), Atlantic moonfish (*Selene setapinnis*), red snapper (*Lutjantus campechanus*), large tomtate (*Haemulon aurolineatum*), large groupers, and the creole-fish (*Paranthias furcifer*) all are trophically independent of platforms and often are responsible for most of the fish biomass around production platforms. (GMFMC 2003.)

Most of the large predators around petroleum platforms are believed to be highly transient. Both the pelagic prey and predator species are attracted to structures, but different schools are constantly moving into and away from the structures (GMFMC 2003).

Dominant species at shallower coastal platforms include sheepshead and schools of Atlantic spadefish. Also in schools are bluefish (*Pomatomus saltatrix)* and blue runner (*Caranx crysos*). On offshore platforms, the dominant fishes include bluefish, spadefish, and mixed schools of moonfish and lookdowns. Blue runner and other jacks (crevalle jack [*Caranx hippos*], greater amberjack [*Seriola dumerili*], and almaco jack) also are common. The snapper/grouper assemblage is a major component of the ichthyofauna, represented by large schools of gray snapper (*Lutjanus griseus*) and medium to large schools of red snapper and lane snapper (*Lutjanus synagris*). Scamp (*Mycteroperca phenax*) also are abundant. (GMFMC 2003.)

Of the general permit areas, BOET is closest to the Tatum-Winn South general permit area for artificial reefs, which is 2.2 mi (3.5 km) away. However, there are no artificial reefs within this permit area. The closest artificial reef is approximately 10.8 mi (17.4 km) west of BOET and is not likely to be affected by the Terminal.

3.1.1.5 Protected Areas

Marine Managed Areas — Marine Managed Areas (MMAs) is a term used by NOAA to refer to a number of biologically sensitive marine habitats that are managed by federal, state, or local agencies. MMAs in the GOM include national marine sanctuaries (NMSs), federal fishery management zones, national wildlife refuges (NWRs), and national estuarine research reserves (NERRs). All MMAs are offered varying degrees of protection from federal agencies such as NOAA Ocean Services, NMFS, the Department of Interior, U.S. Fish and Wildlife Service (USFWS), the National Park Service (NPS), and USCG—as well as state agencies. Breton NWR is the closest MMA to BOET, at a distance of almost 61.4 miles (98.8 km) to the northwest.

National Marine Sanctuaries — The National Marine Sanctuary Program was created by Title III of the Marine Protection, Research and Sanctuaries Act of 1972, which was renamed The National Marine Sanctuaries Act in 1992 (16 U.S.C. 1431 et seq.). Most NMSs prohibit drilling, dredging, discharging pollutants, and other activities considered to adversely affect wildlife. The only NMSs in the GOM region are Flower Garden Banks NMS and the Florida Keys NMS, neither of which is located in or near the BOET vicinity.

National Wildlife Refuges — NWRs near the BOET vicinity include the Delta NWR, Bon Secour NWR, Breton NWR, Grand Bay NWR, and Mississippi Sandhill Crane NWR. The USFWS administers more than 500 NWRs, each of which provides protection for the species that live there and the habitats that occur there. BOET is approximately 61.4 mi (98.8 km) from the nearest NWR, which is Breton NWR, and is expected to have no adverse affect on any NWR. NWRs near the BOET vicinity are identified in Figure 3-3.

Critical Habitats — Critical habitat is designated under the Endangered Species Act (ESA) as "a specific geographic area that is essential for the conservation of a threatened or endangered species and that may require special management for protection." Critical habitat can include an area that is not currently occupied by a species but is needed for the recovery of that species. Critical habitat has been designated for the wintering piping plover (*Charadrius melodus*) at various locations along the Louisiana and Alabama Gulf coast. The distance from BOET to an area of piping plover critical habitat is 61.3 mi (98.6 km). The Gulf sturgeon (*Acipenser oxyrinchus desotoi*) also has critical habitat in the northeastern GOM, but that habitat is located at least 58.3 mi (93.8 km) from any aspect of the proposed Project. Figure 3-4 shows the critical habitats of these two species.

Coral Reefs — Coral reefs are offered additional protection under Executive Order (EO) 13089, Coral Reef Protection. EO 13089 directs federal agencies to determine whether their proposed actions could affect coral reefs; to use their programs and authorities to protect and enhance the conditions of such ecosystems; and, to the extent permitted by law, to ensure that any actions they authorize, fund, or carry out will not degrade the conditions of such ecosystems. There are no natural coral reefs within the BOET vicinity; the closest (the Flower Gardens NMS) is 350 mi (560 km) away.

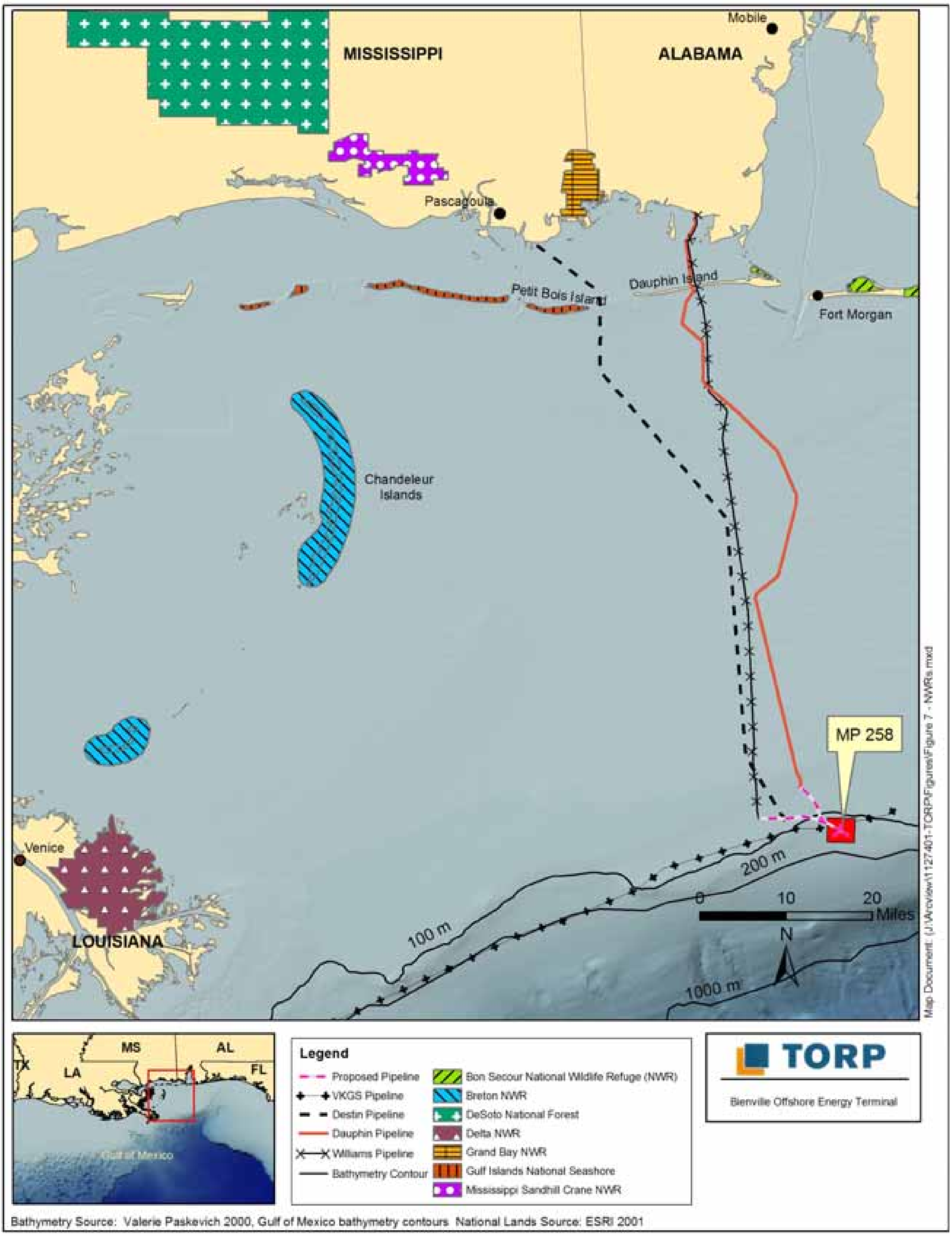

Figure 3-3. Protected Areas near the BOET Vicinity

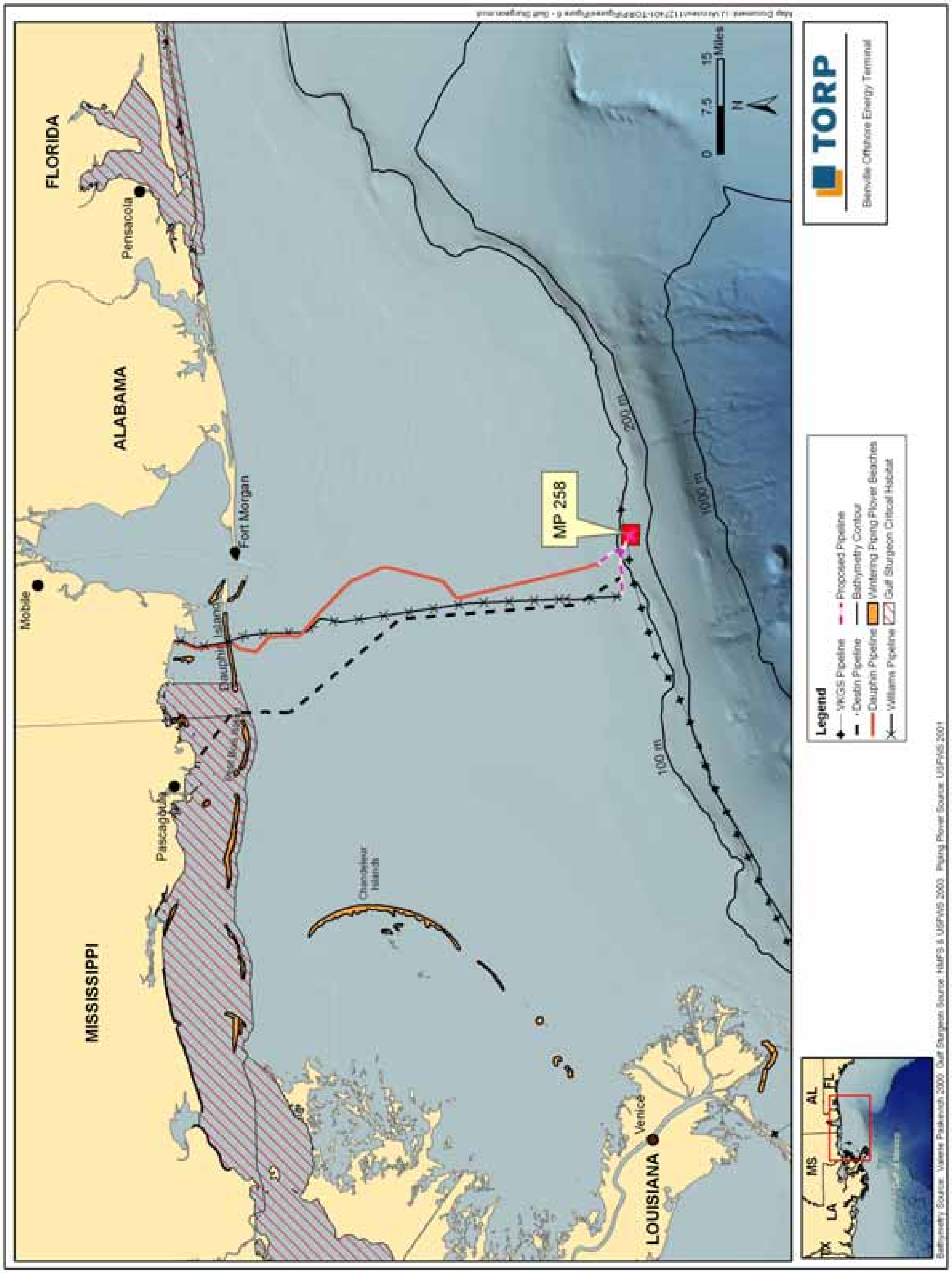

Figure 3-4. Critical Habitat for Wintering Piping Plover and Gulf Sturgeon

Essential Fish Habitat (EFH) — The Magnuson-Stevens Fishery Conservation and Management Act (MSA), reauthorized and amended by the Sustainable Fisheries Act (1996), authorized the establishment of essential fish habitat (EFH) to regulate marine fisheries. EFHs are "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity" (16 U.S.C. 1802[10]). NMFS, in association with regional fishery habitat councils administers this program. Fishermen and other entities must cooperate with NMFS and regional fishery habitat councils to achieve habitat goals (NOAA 2003a). Species with identified EFH are discussed in Section 3.1.4.5, "Essential Fish Habitat."

3.1.2 Threatened and Endangered Species

Certain species are federally protected under various acts. The Endangered Species Act (ESA) establishes a national policy designed to protect and conserve threatened and endangered species and the ecosystems upon which they depend. The ESA is administered by the USFWS and NMFS. The Marine Mammal Protection Act of 1972 (MMPA) established a moratorium on the taking of marine mammals in waters under U.S. jurisdiction. The MMPA defines "take" to mean "to harass, harm, shoot, wound, trap, hunt, capture, or kill, or attempt to engage in any such conduct (including actions that induce stress, adversely impact critical habitat, or result in adverse secondary or cumulative impacts**."**

The location and temporary distribution and abundance of protected species often are determined by a combination of environmental, biotic, and human-generated factors. Environmental factors include those that are chemical, climatological, or physical (i.e., related to characteristics of a location). Biotic factors include the distribution and abundance of prey, inter- and intra-specific competition, reproduction, natural mortality, catastrophic events (e.g., die-offs), and predation. Human-generated factors include noise, hunting pressure, pollution and oil spills, habitat loss and degradation, shipping traffic, recreational and commercial fishing, oil and gas development and production, and seismic exploration. The interplay of these various factors and the effects of various oceanographic characteristics (e.g., bottom depth and topographic relief) ultimately affect the location and temporary distribution of prey species, which is the major influence on the diversity, abundance, and distribution of protected species—including marine mammals, sea turtles, and migratory birds.

To comply with the requirements of Section 7 of the ESA, BOET has sought technical assistance from the USFWS and NMFS regarding the presence of federally listed or proposed endangered and threatened species in the project area. BOET has reviewed the rare and endangered species databases maintained by USFWS, NMFS, and the Alabama Department of Conservation and Natural Resources (ADCNR). The potential for listed endangered and threatened species to occur in the project area is based on an assessment of habitat availability, site observation, and agency data.

3.1.2.1 Protected Marine Mammals

Six of the whale species that occur in the GOM, along with the West Indian manatee, are listed as endangered. The endangered whale species are the sperm whale (*Physeter macrocephalus*), sei whale (*Balaenoptera borealis*), blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), northern right whale (*Eubalaena glacialis*), and humpback whale (*Megaptera novaeangliae*).

Sperm Whale — Sperm whales are the largest member of the suborder Odontoceti, or toothed whales. The species is the most abundant large cetacean in the GOM and represents the most important GOM cetacean in terms of collective biomass (NMFS 2002a). The International Whaling Commission (IWC) recognizes four populations of sperm whales worldwide: North Pacific, North Atlantic, northern Indian Ocean, and Southern Hemisphere (NMFS 2002a). GOM sperm whales are assessed as a unit stock by NMFS. The sperm whale is the only large cetacean common to the GOM (NMFS 2002a, MMS 2001). Sperm whales are found in the waters of the GOM throughout the year but are most common during summer. Consistent sightings, strandings, and catches indicate that there may be a distinct stock of sperm whales in the GOM (Schmidly 1981). The best estimate for the sperm whale population in the northern GOM is 1,114 individuals (NMFS 2005).

A study entitled “Cetaceans, Sea Turtles, and Seabirds in the Northern Gulf of Mexico: Distribution, Abundance, and Habitat Associations,” (more commonly known as the GulfCet II study) was a program conducted in 1996 and 1997 that used aerial surveys and shipboard visual and acoustic surveys to document cetacean, sea turtle, and seabird populations. This program was an extension of GulfCet I, a 3-year extensive survey of cetaceans in offshore waters (328 to 6,560 ft [100 to 2,000 m] deep) of the north-central and western GOM. An annual abundance of 530 sperm whales was estimated from GulfCet II survey data. The GulfCet II survey indicated that sperm whales were sighted throughout the GOM; however, sightings were most commonly aggregated along the 3,280-ft (1,000-m) isobath The presence of female and juvenile sperm whales south of the Mississippi River Delta was associated with cyclonic eddies. This association suggests that the whales are trying to stay near variable areas of low salinity, and nutrient-rich water with enhanced primary and secondary productivity. As such, distribution is related to the distribution of prey. (Davis et al. 2000b.) Currently, no critical habitat is designated for sperm whales in the GOM, but the area south of the Mississippi Delta may be essential habitat for sperm whales.

Although sperm whales are unlikely to enter into the BOET vicinity, they are found in the deeper waters just south of the proposed location, generally occurring in waters greater than 590 ft (180 m) deep (NMFS 2002a). Figure 3-5 shows the distribution of sperm whales in the northern GOM. While they can be encountered almost anywhere on the high seas, sperm whales show a preference for continental margins, sea mounts, and areas of upwelling where food is abundant (NMFS 2002a).

Sei Whale — The IWC recognizes two stocks of sei whales in the northwestern Atlantic Ocean, a Nova Scotia stock and a Labrador Sea stock (Waring et al. 2003). The Nova Scotia stock occurs in the waters of the U.S. Exclusive Economic Zone (EEZ). This stock is concentrated in the northern waters during feeding season (Waring et al. 2003). In spring and summer, the stock extends south to the Gulf of Maine and Georges Bank. The sei whale is generally distributed offshore, occasionally following prey species inshore (Waring et al. 2003). Sightings of the sei whale in the GOM are rare (NMFS 2002a).

In the Biological Opinion for the GOM OCS Multi-Lease Sale (MMS 2002b), NMFS concluded that there is no resident stock of this species in the GOM (NMFS 2002a). The potential for interaction between any of the proposed activities and this species is extremely low.

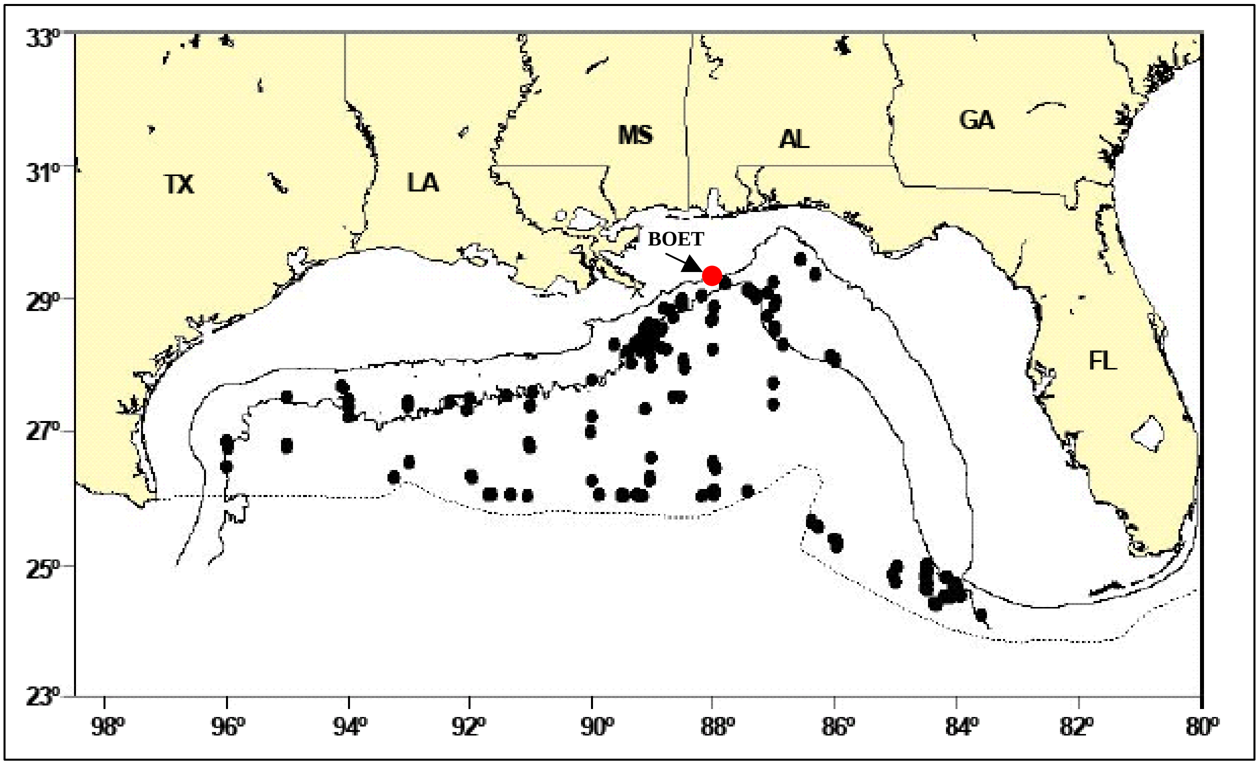

Figure 3-5. Distribution of Sperm Whale Sightings from SEFSC Spring Vessel Surveys during 1996–2001

Notes: Solid lines indicate the 100-meter and the 1,000-meter isobath. The dotted line indicates the offshore extent of the U.S. Exclusive Economic Zone.

SEFSC = Southeast Fisheries Science Center.

Source: NMFS 2005.

Blue Whale — The western North Atlantic stock of the blue whale is distributed from Arctic to temperate waters (Waring et al. 2003). Blue whales are most commonly sighted off eastern Canada and the Gulf of St. Lawrence (Waring et al. 2003). They are found in the Gulf of St. Lawrence in spring, summer, and fall, and off southern Newfoundland in winter. Based on four sightings, all in August (Waring et al. 2003), the U.S. EEZ might represent the southern part of the blue whale's feeding range. The southern limit of the species is unknown. However, the Navy tracked one blue whale acoustically for 1,400 nautical mi (2,592.8 km) from waters northeast of Bermuda to the southwest and west of Bermuda (NMFS 2002a). The presence of blue whale in the GOM is limited to two strandings on the Texas coast and two unconfirmed sightings (MMS 2001).

In the Biological Opinion for the GOM OCS Multi-Lease Sale (MMS 2002b), NMFS concluded that there is no resident stock of this species in the GOM (NMFS 2002a). The potential for interaction between any of the proposed activities and this species is extremely low.

Fin Whale — The IWC indicates that there is one stock of fin whales along the eastern United States (Waring et al. 2003). Fin whales are common in the waters of the U.S. EEZ, from the U.S./Canadian border south to Cape Hatteras, North Carolina (Waring et al. 2003). New England waters represent a major feeding ground for the fin whale (Waring et al. 2003). Fin whales migrate south in fall from the Labrador and Newfoundland region, past Bermuda, to the West Indies (NMFS 2002b). It is likely that fin whales in the U.S. EEZ undergo migrations to Canadian waters, open ocean areas, and even subtropical or tropical regions (Waring et al. 2003). However, these may not be the distinct annual migrations made by other mysticete species.

In the Biological Opinion for the GOM OCS Multi-Lease Sale (MMS 2002b), NMFS concluded that there is not a resident stock of this species in the GOM (NMFS 2002a). The potential for interaction between any of the proposed activities and this species is extremely low. As such, in past Deepwater Port Act (DWPA) applications, the USCG and MARAD have eliminated further evaluation of the fin whale.

Northern Right Whale — The distribution of the western northern right whale population ranges from wintering and calving grounds in coastal waters of the southeastern United States to summer feeding and nursery grounds in New England waters, northward to the Bay of Fundy and the Scotian Shelf (Waring et al. 2003). Early records of the northern right whale in the GOM represent either geographic anomalies or a more extensive historical range beyond the sole known calving and wintering ground in the waters of the southeastern United States (Waring et al. 2003). As such, the northern right whale is not expected to occur in the BOET vicinity.

In the Biological Opinion for the GOM OCS Multi-Lease Sale (MMS 2002b), NMFS concluded that there is not a resident stock of this species in the GOM (NMFS 2002a). The potential for interaction between any of the proposed activities and this species is extremely low.

Humpback Whale — Humpback whales in the western North Atlantic are distributed along the East Coast of the United States (including the Gulf of Maine), the Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, Iceland, and northern Norway. These areas constitute feeding areas in spring, summer, and fall for six discrete subpopulations of humpback whales. In 1995, the IWC acknowledged that whales from the Gulf of Maine could be treated as a separate stock for the purposes of management. This designation is based on the strong fidelity of whales to the region, and the attendant assumption that if subpopulations were wiped out, repopulation by immigration from adjacent areas will not occur on any reasonable management timescale. Whales from all six feeding areas calve and mate primarily in the West Indies in winter. Other documented mating and calving areas include the Cape Verde Islands, Puerto Rico, and the coast of Venezuela.

Humpback whale sightings and strandings have increased in recent years in the mid-Atlantic and southeastern United States, including the Delaware and Chesapeake Bays, Virginia, and North Carolina. Evidence suggests that mid-Atlantic areas represent both migratory pathways and winter feeding grounds for juveniles (Waring et al. 2003, NMFS 2002b).

In the Biological Opinion for the GOM OCS Multi-Lease Sale (MMS 2002b), NMFS concluded that there is not a resident stock of this species in the GOM (NMFS 2002a). The potential for interaction between any of the proposed activities and this species is extremely low.

West Indian Manatee — The West Indian manatee (*Trichechus manatus*) is considered rare in the northern GOM (Wursig et al. 2000). The species is divided into two subspecies: the Antillean manatee (*T. manatus manatus*), which is not known from the northern GOM, and the Florida manatee (*T. manatus latirostris*), which occurs mainly in Florida waters but will travel to the west coast of Louisiana in extreme cases (USFWS no date). The Florida manatee occasionally enters Lakes Pontchartrain and Maurepas (Louisiana), as well as associated coastal waters and streams, during summer months (Firmin 2003). Florida manatees have been reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, as well as in canals within the adjacent coastal marshes of Louisiana. They also have been occasionally observed elsewhere along the Louisiana and Alabama Gulf coast. The West Indian manatee has declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide might also adversely affect these animals (Firmin 2003).

NOISE

Marine mammals are very sensitive to sounds in the ocean, both natural and human-made. Marine mammals produce and hear a broad range of sounds to navigate and communicate because the oceans are much more transparent to sound than to light (NRC 2003). Although hearing ranges need to be determined for each of the species of marine mammals, the Noise Exposure Criteria Group (NECG) has proposed interim values for frequency-weighting in five groups of marine mammals: low-, mid-, and high-frequency cetaceans; pinnipeds in air; and pinnipeds in water (NECG 2005, unpublished). Except for the sperm whale, which falls into the category of mid-frequency cetacean, all of the threatened or endangered whale species listed above fall into the low-frequency cetacean group (NECG 2005, unpublished). Table 3-3 shows the groups of cetaceans evaluated by the NECG and the frequency ranges that they hear. The sirenians (manatees) were not included in this evaluation.

Sounds that occur within the auditory bandwidth of a species have the ability to “mask” other sounds occuring in the environment. Masking occurs when the noise created decreases the ability of an individual to hear other sounds. Masking becomes a problem when it covers biologically significant sounds, such as the call of a calf or conspecific (individual belonging to the same species), or the sound of a predator or hazard (NOAA 2003b).

The MMPA prohibits the “take” of marine mammals, which is defined as the harrassment, hunting, or capturing of marine mammals, or the attempt thereof. “Harassment” is further defined as any act of pursuit, annoyance, or torment. Currently, Level A harassment (potentially injurious to a marine mammal or marine mammal stock in the wild) for a marine mammal is defined as 180 dB_{rms} re: 1 µPa. Level B harassment (potentially disturbing a marine mammal or marine mammal stock in the wild by causing disruption to behavioral patterns) is 160 dB_{rms} re: 1 µPa for an impulse sound and 120 dB_{rms} re: 1 µPa for a continuous sound. (NOAA 2005a, GPO 2005.) For more information on noise effects on marine mammals, see Appendix D.

Table 3-3. Interim Frequency Weighting in Cetaceans Proposed by the Noise Exposure Criteria Group

Functional Hearing Group	Estimated Auditory Bandwidth	Genera Represented
Low-frequency cetaceans	7 Hz to 22 kHz	*Balaena, Caperea, Eschrichtius, Megaptera, Balaenoptera* (13 species/sub-species)
Mid-frequency cetaceans	150 Hz to 160 kHz	*Steno, Sousa, Sotalia, Tursiops, Stenella, Delphinus, Lagenodelphis, Lagenorhynchus, Lissodelphis, Grampus, Peponocephala, Feresa, Pseudorca, Orcinus, Globicephala, Orcacella, Physeter, Kogia, Delphinapterus, Monodon, Ziphius, Berardius, Tasmacetus, Hyperoodon, Mesoplodon* (56 species/sub-species)
High-frequency cetaceans	200 Hz to 180 kHz	*Phocoena, Neophocaena, Phocoenoides, Platanista, Inia, Lipotes, Pontoporia, Cephalorhynchus* (18 species/sub-species)

Note: The frequency cutoffs can be obtained from anatomical studies. The estimated auditory bandwidths are conservative estimates of the upper and lower boundaries for the most sensitive members of each group.

Source: Adapted from NECG 2005, unpublished.

3.1.2.2 Protected Sea Turtles

All five species of sea turtles that inhabit the GOM are threatened or endangered (MMS 2001). These species include the loggerhead sea turtle (*Caretta caretta*), Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), hawksbill sea turtle (*Eretmochelys imbricata*), and green sea turtle (*Chelonia mydas*). The loggerhead sea turtle is the most common sea turtle in the GOM, while the hawksbill sea turtle is the least common. USFWS and NMFS share the responsibility for sea turtle recovery under the authority of the ESA. Table 3-4 lists the sea turtles that occur in the northeastern GOM.

Sea turtle life history stages include eggs, hatchling, juvenile, and adult. In general, sea turtles nest along the entire northern GOM coastline; specific nesting distributions by species are described below. Hatchling sea turtles move offshore in a swimming frenzy immediately after hatching. Post frenzy, hatchling sea turtles move to areas of convergence or to *Sargassum* mats and undergo passive oceanic migrations (Wyneken 2001). Juvenile sea turtles actively recruit to nearshore nursery habitat and move into adult foraging habitat when approaching sexual maturity. At the onset of nesting, adults move between foraging habitats and nesting beaches. Mating habitat depends on species and might occur off nesting beaches or remotely. Females reside near nesting beaches during the nesting season (MMS 2002b).

There are no designated critical habitats or migratory routes for sea turtles in the northern GOM. However, NMFS recognizes many coastal areas as preferred habitat (i.e., important habitats for the species within a specific geographic area) for sea turtles. There are no nearshore or inshore areas associated with this project. *Sargassum* mats are also recognized as preferred habitat for hatchlings (MMS 2001). Highest sea turtle abundance in the western GOM occurs in depths from 0 to 60 ft (0 to 18 m). However, sea turtles are more abundant in the eastern GOM than in the western GOM (McDaniel et al. 2000).

Table 3-4. Sea Turtles Found in the Northeastern Gulf of Mexico

Species	Common Name	Endangered Species Act Classification
Caretta caretta	Loggerhead sea turtle	Threatened
Lepidochelys kempii	Kemp's ridley sea turtle	Endangered
Dermocheyls coriacea	Leatherback sea turtle	Endangered
Eretmochelys imbricata	Hawksbill sea turtle	Endangered
Chelonia mydas	Green sea turtle	Threatened[a]

[a] The breeding colony populations of the green sea turtle in Florida and on the Pacific Coast of Mexico are listed as endangered.

Green Sea Turtle — The green sea turtle breeding colony populations in Florida and on the Pacific Coast of Mexico have been federally listed as endangered; all other populations have been listed as threatened. The species was listed in 1978. The green sea turtle nests in tropical and subtropical waters worldwide and inhabits shallow waters (except when migrating) inside reefs, bays, and inlets. It is associated with marine grass and algae (USFWS 2002a). It is found in western Atlantic waters of the United States from Massachusetts to Texas, as well as in waters off Puerto Rico and the U.S. Virgin Islands (MMS 1999).

Individual females, on average, nest every 2–4 years; they lay 3.3 nests per season, with a clutch size of 140 eggs, at 13-day intervals (USFWS 2002a). The principal nesting area for green sea turtles is on the East Coast of Florida, although they also nest in North and South Carolina, Georgia, the U.S. Virgin Islands, and Puerto Rico. Conservative estimates from 1990 through 1999 range from 470 to 1,509 nesting females per year in Florida (NMFS 2002a). Since historical data on green sea turtles are sparse, it is unclear how reduced the nesting population is. Estimates indicate that the species might be recovering. Nesting in the GOM is rare but has been recorded at Eglin Air Force Base on the Florida Panhandle (MMS 1999).

Hatchlings eat a variety of plants and animals (USWS 2002a) and forage in areas such as coral reefs, emergent rocky bottom, *Sargassum* mats, lagoons, and bays (MMS 2001). The adults feed on seagrass and marine algae, including species of *Cymodocea*, *Thalassia*, and *Zostera* (USFWS 2002a, NMFS 2002b). Feeding grounds in the GOM include inshore south Texas waters, the upper West Coast of Florida, and the northwestern coast of the Yucatan Peninsula in Mexico.

The critical habitat designated by NMFS for the green sea turtle includes the coastal waters of Culebra Island, Puerto Rico, and its outlying keys (USFWS 2002a). It is unlikely that Terminal activities will adversely affect the green sea turtle population.

Kemp's Ridley Sea Turtle — Kemp's ridley sea turtle primarily inhabits coastal waters in the GOM and the northwestern Atlantic Ocean (NMFS and USFWS 1992a, NMFS 2002a). It is the smallest of the sea turtles, generally weighing less than 100 lb (45 kg). Kemp's ridley sea turtles have been federally listed as endangered since 1978 and are considered the most endangered sea turtle in the world (NMFS and USFWS 1992a, NMFS 2002a).

Nesting is limited to beaches at Rancho Nuevo in southern Tamaulipas, Mexico, and occurs from April to July (NMFS 2002a). Individual females nest, on average, every other year (ranging from every year to every 4 years), with an average of 2.5 nests per female per season. The average clutch size is 100 eggs (NMFS 2002a). Nesting data indicate a severe decline of Kemp's ridley sea turtles from more than 40,000 females when the Rancho Nuevo nesting aggregation was first discovered. In the 1970s, the number of females ranged from 2,000 to 5,000. The number of nests decreased to a low of 702 nests in 1985 but, by 2000, had increased again to 6,277 nests (NMFS 2002a).

Pelagic Kemp's ridley hatchlings feed on *Sargassum* and other epipelagic GOM species. Prey species for the adult Kemp's ridley sea turtle include nearshore crab, mollusks, fish, shrimp, and shrimp fishery discard (NMFS 2002a). Kemp's ridley sea turtles were sighted in both the GulfCet I and the GulfCet II surveys (MMS 1996, Davis et al. 2000b). Three Kemp's ridley sea turtles were sighted in shelf waters of the eastern GOM during the GulfCet II survey (Davis et al. 2000b). The abundance estimate resulting from these three sightings was 12 individuals. Nearshore waters of the GOM are believed to provide important developmental habitat for juveniles (NMFS 2002a). The primary subadult habitat is along the northern GOM coast from Cedar Key, Florida to Port Aransas, Texas (NMFS 2002a). Kemp's ridley turtles are also known to inhabit coastal waters of Mississippi and Alabama during migration and the non-breeding season (Van Hoose 1999). Although the Kemp's ridley may occur in the BOET vicinity, the rarity of the species, distance of nesting beaches, and location of prey species indicate that Terminal activites are unlikely to adversely affect the population.

Loggerhead Sea Turtle — The loggerhead sea turtle is the most abundant sea turtle in the GOM. They have been federally listed as a threatened species since 1978 (NMFS and USFWS 1991, NMFS 2002a). Loggerhead turtles are a cosmopolitan species, inhabiting temperate and tropical waters in the estuaries and on the continental shelves of both hemispheres (NMFS 2002c). The turtles typically reach 250 lbs (110 kg) or more; however, there are reports of some loggerheads that weighed more than 1,000 lbs (455 kg) (Behler and King 1979). Loggerhead turtles in the eastern GOM are usually found in water depths of less than 65 ft (20 m) (Fritts et al. 1983, Lohoefener et al. 1990, Hildebrand 1982); however, GulfCet II recorded sightings in water as deep as 3,280 ft (1,000 m). GulfCet II also indicated that loggerhead sea turtles were 20 times more likely to be seen on the continental shelf than on the continental slope. The turtles may use oceanic waters to travel between foraging sights (Davis et al. 2000b).

Loggerhead nests in the vicinity of the proposed Project have been seen at Bon Secour NWR, Dauphin Island, Gulf Islands National Seashore, and Breton NWR (TEWG 2000). In the southeastern United States, females mate from late April through early September (NMFS and USFWS 1991). Individual females may nest several times within one season, but they usually nest only every 2–3 years.

After leaving the beach, hatchlings apparently swim directly offshore and eventually become associated with *Sargassum* or debris in pelagic drift lines that result from current convergences. The evidence suggests that, when post-hatchlings become part of the *Sargassum* raft community, they remain there as pelagic immatures, riding circulating currents for several years and growing to approximately 17.7 in (45 cm) (carapace length). After that point, they abandon the pelagic habitat, migrate to the nearshore and estuarine waters along continental margins, and use those areas as the developmental habitat for the sub-adult stage (USFWS 1999). The loggerhead turtle matures at 20–38 years (NMFS 2002a).

The most significant threats to the loggerhead populations are coastal development, commercial fisheries (especially shrimping), and pollution. The effects of offshore lights are not known. They may attract hatchlings and interfere with proper offshore orientation, increasing the risk from predators.

The loggerhead turtle is the only species of sea turtle known to nest in Alabama. The nesting and hatching season for loggerhead sea turtles in Alabama extends from mid-March through November. Loggerhead turtles are nocturnal nesters but may infrequently nest during the day. Nesting trends for the loggerhead are generally declining.

Although the loggerhead sea turtle is the most abundant sea turtle in the GOM, it is unlikely to be affected by the proposed Terminal due to the species' preferred depths of less than 65 feet (20 m).

Hawksbill Sea Turtle — The hawksbill sea turtle is primarily coastal and is seldom seen in waters deeper than 65 ft (20 m) (USFWS 2002b). They inhabit rocky areas, coral reefs, lagoons, oceanic islands, shallow coastal areas, and narrow creeks and passes (USFWS 2002b). Hawksbill sea turtles are found in tropical and subtropical waters in the Atlantic, Pacific, and Indian Oceans (USFWS 2002b); they have been federally listed as endangered throughout their range since 1970 (USFWS 2002b).

Nesting females average approximately 34.3 in (87 cm) in curved carapace length and weigh approximately 176 lbs (80 kg). The species is distributed widely in the Caribbean and western Atlantic Ocean (NMFS 2002d). Nesting on the U.S. GOM beaches is extremely rare, with only one nest on Padre Island, Texas documented in 1998 (NMFS 2002a). The 6- to 8-month nesting season (April through November) for the hawksbill is longer than for any other sea turtle.

Hawksbill turtles are the least common sea turtle in the GOM (MMS 2002b), although they have been recorded in waters of all the states of the GOM (NMFS and USFWS 1993). Adults usually forage around coral reefs and other hard bottom habitats at depths of 328 ft (100 m) or more (NMFS 2002a), and primarily eat sponges (USFWS 2002b). This diet and their dependence on hard bottom communities make the species vulnerable to deteriorating conditions on coral reefs.

Hawksbill turtles are unlikely to be found in the BOET vicinity due to their preference of shallower water; therefore, they are unlikely to be adversely affected by the Terminal.

Leatherback Sea Turtle — The leatherback sea turtle is a primarily pelagic species and is distributed in temperate and tropical waters worldwide (NMFS and USWFS 1992b, USFWS 2002a). The GulfCet I survey indicated that leatherbacks are found primarily in waters deeper than 656 ft (200 m) (MMS 1996). It is the largest, deepest-diving, most migratory, and widestranging sea turtle (USFWS 2002c); the species has been federally listed as endangered since 1970 (USFWS 2002c).

Nesting occurs around the world from March through July (USFWS 2002c). On average, individual females nest every 2–3 years; they lay an average of five to seven nests per season, with a clutch size of 70–80 yolked eggs (USFWS 2002c). Nesting females have shown a severe decline from more than 115,000 females estimated in 1980 to recent estimates of 26,000–43,000 nesting females (USFWS 2002c).

Leatherbacks undergo extensive migrations from feeding grounds to nesting beaches (NMFS 2002a). Once they nest, they move offshore and use both coastal and pelagic waters (NMFS 2002c). Leatherbacks feed in the water column of temperate and subpolar regions of all oceans (NMFS 2002c). They feed primarily on jellyfish but also on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed (USFWS 2002c).

Leatherback turtles prefer deeper water than that of BOET and therefore are unlikely to be adversely affected by the Terminal.

3.1.2.3 Protected Birds

Only two protected birds may occur in the BOET vicinity, the brown pelican (*Pelicanus occidentalis)*, and the piping plover (*Charadrius melodus).*

Brown Pelican — The brown pelican is federally listed as endangered, except on the Atlantic coast of the United States, Florida, and Alabama—where it has been de-listed due to recovery. The brown pelican typically forages within 12 mi (20 km) of shore but on rare occasions has been seen at distances up to 118 mi (190 km) from shore (USFWS 2005a). BOET is located more than 60 mi (96.6 km) from shore, which is well outside the typical range of the brown pelican. Therefore, it is considered unlikely that a brown pelican will be found in the BOET vicinity or affected by the Project.

Piping Plover — There are three breeding populations of the piping plover, each of which was federally listed as threatened or endangered in 1986. All three populations of piping plovers winter along the South Atlantic, GOM, and Caribbean beaches—where they spend 70 percent of their time and where they are considered threatened (USFWS 2005b). The piping plover is a terrestrial species; the closest area of critical habitat is 61.3 mi (98.6 km) north of BOET. The piping plover therefore is unlikely to be affected by BOET.

3.1.2.4 Protected Fish

The only federally listed fish that occur in the GOM are the Gulf sturgeon (threatened) and smalltooth sawfish (*Pristis pectinata*) (endangered) (MMS 2002a). Both species are known to range in the coastal waters and estuaries within the GOM. The ranges of these two species are well outside of the BOET's proposed location.

Gulf Sturgeon — The Gulf sturgeon is anadromous; the immature and mature fish migrate into freshwater. Subadults and adults spend most of their time (8–9 months per year) in rivers, migrating out to the Gulf waters or estuaries in the cooler months. The immatures (less than 2 years old) remain in riverine habitats year-round. The current range of the sturgeon is believed to be from eastern Louisiana to west-central Florida, although individuals have been seen as far west as Galveston, Texas and as far east as southwestern Florida (MMS 2002b). Critical habitat for the Gulf sturgeon is at least 58.3 mi (93.8 km) from any aspect of the proposed Project. The Gulf sturgeon is not expected to be affected by BOET due to its distance from all aspects of the Project.

Smalltooth Sawfish — Once common in the shallow coastal waters and estuaries from Texas to Florida, the smalltooth sawfish is currently found only in peninsular Florida. Although little is known about the life history of this species, it is thought that maturation does not occur until age 10. This long maturation period, the propensity of the species to become tangled in nets, and habitat degradation likely account for the rapid population decline of the species in the United States over the last century (NOAA 2005b). It is unlikely that BOET activities will adversely affect the smalltooth sawfish.

3.1.3 Non-Threatened and Non-Endangered Species

3.1.3.1 Marine Mammals

Twenty-nine species of marine mammals (Table 3-5) are known to occur in waters of the GOM (MMS 2002a, Davis et al. 2000a). With one species exception, all of these mammals belong to the order Cetacea. Of the 28 species of cetaceans occurring in the GOM, seven belong to the suborder Mysticeti (baleen whales), and 21 belong to the suborder Odontoceti (toothed whales).

The exception, the West Indian manatee (*Trichecus manatus*) and its subspecies, the Florida manatee (*Trichehus manatus latirostris*), belong to the order Sirenia. All of these species are protected by the Marine Mammal Protection Act of 1972, and seven are protected by the ESA of 1973.

The range of seven species of non-endangered marine mammals may include the Terminal location—six dolphins and one small whale (Table 3-6). This was determined by the species distribution maps from the Draft Stock Assessment Reports (SARS) (NMFS 2005). BOET activities such as increased vessel traffic from service vessels and LNG carriers pose potential risks to marine mammals, although strike avoidance practices are expected to minimize contact between vessels and mammals.

Atlantic Spotted Dolphin (*Stenella frontalis*) — The Atlantic spotted dolphin is very common in the GOM (Jefferson et al. 1993). Along the Gulf coast, the Atlantic spotted dolphin inhabits the continental shelf, usually inside or near the 100-fathom curve but sometimes inhabiting very shallow water adjacent to the beach, perhaps in pursuit of migratory forage fish (Würsig et al. 2000). The diet of this species includes small fish, such as herring, anchovies, and flounder, and squid (Würsig et al. 2000).

Table 3-5. Marine Mammals Known to Occur in the Northern Gulf of Mexico

Taxa	Common Name	Relative Occurrence	Endangered Species Act Status
ORDER CETACEA	**WHALES, DOLPHINS, AND PORPOISES**		
Suborder Mysticeti	Baleen whales		
Family Balaenidae	Right whales		
Eubalaena glacialis	Northern right whale	X	E
Family Balaenopteridae	Rorquals		
Balaenoptera acutorostrata	Minke whale	R	
Balaenoptera borealis	Sei whale	R	E
Balaenoptera edeni	Bryde's whale	U	
Balaenoptera musculus	Blue whale	X	E
Balaenoptera physalus	Fin whale	R	E
Megaptera novaeangliae	Humpback whale	R	E
Suborder Odontoceti	Toothed Whales and Dolphins		
Family Physeteridae	Sperm whale		
Physeter macrocephalus	Sperm whale	C	E
Family Kogiidae	Pygmy and dwarf sperm whales		
Kogia breviceps	Pygmy sperm whale	U	
Kogia sima	Dwarf sperm whale	U	
Family Ziphiidae	Beaked whales		
Mesoplodon bidens	Sowerby's beaked whale	X	
Mesoplodon densirostris	Blainville's beaked whale	R	
Mesoplodon europaeus	Gervais' beaked whale	U	
Ziphius cavirostris	Cuvier's beaked whale	R	
Family Delphinidae	Dolphins		
Feresa attenuata	Pygmy killer whale	U	
Globicephala macrorhynchus	Short-finned pilot whale	C	
Grampus griseus	Risso's dolphin	C	
Lagenodelphis hosei	Fraser's dolphin	C	
Orcinus orca	Killer whale	U	
Peponocephala electra	Melon-headed whale	C	
Pseudorca crassidens	False killer whale	U	
Stenella attenuata	Pantropical spotted dolphin	C	
Stenella clymene	Clymene dolphin	C	

Table 3-5. Marine Mammals Known to Occur in the Northern Gulf of Mexico (continued)

Taxa	Common Name	Relative Occurrence	Endangered Species Act Status
Stenella coeruleoalba	Striped dolphin	C	
Family Delphinidae (continued)	Dolphins		
Stenella frontalis	Atlantic spotted dolphin	C	
Stenella longirostris	Spinner dolphin	C	
Steno bredanensis	Rough-toothed dolphin	C	
Tursiops truncatus	Bottlenose dolphin	C	
ORDER SIRENIA	**DUGONG AND MANATEES**		
Family Trichechidae	Manatees		
Trichechus manatus	West Indian manatee	C	E

Population status in the northern Gulf of Mexico is summarized according to the following categories:

C = Common: A species abundant in the region of occurrence. Most common species are widely distributed over the region.

U = Uncommon: A species that may or may not be widely distributed but does not occur in large numbers.

R = Rare: A species that is present in such small numbers throughout the region that it is seldom seen. Although not necessarily endangered, a rare species may become endangered if conditions in its environment change.

X = Extralimital: A species that occurs, but probably resulting from the unusual wandering of the animal into the region.

E = Endangered: A species determined to be in imminent danger of extinction throughout all of a significant portion of its range.

T = Threatened: A species determined likely to become endangered in the foreseeable future.

Source: Adapted from MMS 2002b.

Table 3-6. Common Non-Endangered Cetacean Species in the Gulf of Mexico Potentially Occurring in the Vicinity of the Proposed BOET

Species	Common Name	Estimated Population in the Northern GOM
Stenella frontalis	Atlantic spotted dolphin	6,505 [a]
Tursiops truncatus	Bottlenose dolphin	25,320 [b]
Stenella attenuata	Pantropical spotted dolphin	91,321[a]
Grampus griseus	Risso's dolphin	2,169 [a]
Stenella longirostris	Spinner dolphin	11,971 [a]
Stenella coeruleoalba	Stripped dolphin	30,947
Balaenoptera edeni[c]	Bryde's whale	40

Note: The potential occurrence of these species within the BOET vicinity was determined by the occurrence near the 100-meter isobath from distribution maps within the NOAA 2005 Draft Stock Assessment Reports (NMFS 2005).

[a] This species is generally located in oceanic waters.

[b] Estimate of the continental shelf stock only.

[c] Although not common within the northern Gulf of Mexico (GOM), Bryde's whales were seen near the 100-meter isobath east of the BOET vicinity and may represent a resident stock in the GOM.

Source: NMFS 2005.

Bottlenose Dolphin (*Tursiops truncatus*) — The bottlenose dolphin is one of the most common species of dolphin in the GOM (Davis and Fargion 1996). Although there are pelagic populations, population densities seem to be higher nearshore (Jefferson et al. 1993). Bottle-nosed dolphins are the only cetaceans known to regularly inhabit all marine environments, including bays, marshes, river inlets, and pelagic waters less than 3,281 ft (1,000 m) deep (Davis and Fargion 1996). Greatest numbers occur in passes connecting bays to open ocean (Schmidly 1981). This species feeds on a wide variety of fish and invertebrates, including squid; they sometimes feed cooperatively, herding their prey until it is concentrated near the water surface (The Mammal Society 2003). These dolphins also take advantage of human fisheries, usually by following shrimp boats for the prey that they stir up and for the catch that is tossed overboard (Würsig 2003).

Pantropical Spotted Dolphin *(Stenella attenuata)* – Found throughout the world in tropical and subtropical waters, the pantropical spotted dolphin is the most common cetacean in the deep waters of the GOM. Most sightings between 1989 and 1997 occurred in the northcentral GOM from south of the Mississippi Delta to the 656-foot (200-m) drop-off zone west of Florida. The pantropical spotted dolphin feeds near the surface on squid, shrimp, and fish. (Würsig et al. 2000.)

Risso's Dolphin (*Grampus griseus*) — Risso's dolphin inhabits tropical and temperate waters worldwide. Historically, this species was thought to be an uncommon resident of the GOM, but recent studies indicate otherwise (Mullin et al. 1991). Davis and Fargion (1996) found that Risso's dolphin is most common on the upper to middle continental slope near the Mississippi River, in waters less than 2,820 ft (860 m) deep. Risso's dolphin feeds primarily on squid, and its habitat preference might be a result of prey availability in these areas.

Spinner Dolphin *(Stenella longirostris)* — In most tropical waters, nearly all records of spinner dolphins are associated with inshore waters, islands, or banks (Culik 2003). Most sightings of spinner dolphins in the GOM have been east of the Mississippi River (MMS 2002c). This species shows a preference for waters between 3,116 and 3,608 ft (950 and 1,100 m) deep (Mullin et al. 1991) and feeds primarily on fish and squid.

Striped Dolphin *(Stenella coeruleoalba)* -– The striped dolphin is found in tropical and warm temperate waters between 50° N latitude and 40° N latitude. This species was seen regularly during the Fritts aerial surveys in the 1980s and in the eastern GulfCet survey, concentrated over the De Soto Canyon region east of the Mississippi Delta. Elsewhere in the world, they show an affinity to waters deeper than 656 ft (200 m), where they feed on mesopelagic fish and squid. (Würsig et al. 2000.)

Bryde's Whale (*Balaenoptera edeni*) — Bryde's whale is the second smallest of the baleen whales. It inhabits tropical to warm temperate waters of the Atlantic, Indian, and Pacific Oceans (Schmidly 1981). Davis and Fargion (1996) report that this species is the most common baleen whale in the GOM, occurring most frequently in the northeastern portion from the shelf edge to De Soto Canyon. The Bryde's whale feeds primarily on small pelagic fishes, such as sardines, anchovy, and mackerel, and cephalopods (Schmidly 1981).

NOISE

The earlier discussion of noise in relation to threatened and endangered marine mammals is relevant for non-threatened marine mammals. Except for the Bryde's whale, which falls into the category of low-frequency cetacean, all of the species listed above fall into the mid-frequency cetacean group (NECG 2005, unpublished). Table 3-3 shows the groups of cetaceans evaluated by the NECG and the frequency ranges that they hear. For more information on noise effects on marine mammals, see Appendix D.

3.1.3.2 Sea Turtles

Five species of sea turtles inhabit the GOM and Atlantic Ocean (Table 3-4). These are the Kemp's ridley, green, hawksbill, leatherback, and loggerhead turtles. These species are listed as endangered or threatened, and they are discussed in Section 3.1.2.2.

3.1.3.3 Seabirds

The waters of the northern GOM are inhabited by a diverse assemblage of resident and migratory birds (Clapp et al. 1982). Seabirds are those species that spend extended periods away from land and obtain all or most of their food from the sea while flying, swimming, or diving. Five taxonomic orders of seabirds are found in both offshore and coastal waters of the northern GOM: *Gaviiformes* (loons), *Podicipediformes* (grebes), *Procellariiformes* (albatrosses, fulmars, petrels, shearwaters, and storm-petrels), *Pelicaniformes* (pelicans, tropicbirds, boobies, gannets, cormorants, and frigatebirds), and *Charadriiformes* (phalaropes, gulls, terns, noddies, and skimmers). Some species of seabirds inhabit only pelagic habitats in the GOM (OCS and beyond [e.g., boobies, petrels, and shearwaters]) (Fritts and Reynolds 1981). Most GOM seabird species inhabit waters of the continental shelf and adjacent coastal and inshore habitats (Clapp et al. 1982, MMS 2002b).

GOM seabirds can be categorized as summer migrant pelagics, summer residents, wintering marine species, or permanent residents (Fritts and Reynolds 1981). Summer migrant pelagic species are those that are present in the GOM during summer but breed primarily elsewhere (e.g., black tern [*Chlidonias niger*], boobies, shearwaters, storm-petrels, and tropicbirds). Summer residents are those that are present during summer but also breed in the GOM (e.g., sandwich tern [*Sterna sandvicensis*] and sooty tern [*Sterna fuscata*]). Wintering marine bird species are those that may be found in the GOM only during winter (e.g., herring gull [*Larus argentatus*] and jaeger). Permanent resident species are found in the GOM throughout the year (e.g., laughing gull [*Larus atricilla*], royal tern [*Sterna maxima*], bridled tern [*Sterna anaethetus*], and magnificent frigatebird [*Fregata magnificens*]. (MMS 2002b.)

Two large-scale surveys have been conducted to determine the abundance and distribution of seabirds in the GOM: GulfCet I and GulfCet II. GulfCet I covered the northern and western GOM from the 328-ft to the 6,561-ft (100-m to the 2,000-m) isobaths. GulfCet II covered the same depths in the east but also covered more shallow depths of the northeastern GOM. (Davis et al. 2000b.)

During the GulfCet program, many factors influencing seabird distribution were found. GulfCet I showed that water depth influenced the distribution of species groups and individual species of seabirds, which varied both spatially and seasonally (MMS 1996). Environmental parameters, such as sea surface productivity, that affected seabird distribution were identified in GulfCet II (Davis et al. 2000a). The highest species diversity of seabirds was associated within cyclonic eddies, while the lowest species diversity occurred on the continental shelf (Davis et al. 2000a). Species diversity was greatest in spring and lowest in winter and fall; sighting rate, or numbers of bird sightings per day, was highest in summer and lowest in fall (MMS 1996, Davis et al. 2000a). Other evidence indicates that seabird groups tend to concentrate at fronts defined by steep temperature gradients (Ribic et al. 1997).

Results of two cruise surveys that covered the northeastern GOM were used to determine the distribution and abundance of seabirds in the BOET vicinity, one in late summer (October 1996) and one in mid-summer (August 1997). The late-summer survey was the first large-scale shipboard seabird study to be conducted in October, a time of seabird migration in the GOM (Davis et al. 2000b). Although the majority of the effort on these cruises was made in deeper water (>656 ft [200 m]), the observations accounted for depth as greater or less than 656 ft (200 m). Table 3-7 shows the species of seabirds that were seen while cruising in depths of less than 656 ft (200 m) of water.

Table 3-7. Seabird Species Observed during Two Cruises at <200 m Depth

Scientific Name	Common Name	Late Summer 1996	Mid-Summer 1997	GOM Status
Puffinus lherminieri	Audubon's shearwater	2	0	SMP
Calonectris diomedea	Cory's shearwater	1	2	SMP
Puffinus gravis	Greater shearwater	0	2	SMP
Family Procellariidae	Unidentified shearwaters	2	1	
Oceanodroma castro	Band-rumped storm-petrel	0	1	SMP
Oceanodroma leucorhoa	Leach's storm-petrel	0	1	SMP
Family Hydrobatidae	Unidentified storm-petrels	0	2	
Fregata magnificens	Magnificent frigatebird	6	4	PR
Family Fregatidae	Unidentified frigatebird	0	170	PR
Stercorarius longicaudus	Long-tailed jaeger	0	1	WS
Stercorarius pomarinus	Pomarine jaeger	1	1	WS
Family Laridae	Unidentified jaegers	2	0	
Larus atricilla	Laughing gull	44	21	PR
Larus argentatus	Herring gull	5	0	WS
Family Laridae	Unidentified gulls	3	0	
Sterna paradisaea/S. hirundo[a]	Arctic/common tern	0	2	
Chlidonias niger	Black tern	8	852	SMP
Sterna anaethetus	Bridled tern	1	0	PR
Sterna anaethetus/S. fuscata[a]	Bridled/sooty tern	0	6	PR/SR
Sterna hirundo	Common tern	7	1	
Sterna maxima	Royal tern	17	14	PR
Sterna sandvicensis	Sandwich tern	0	21	SR
Family Laridae	Unidentified terns	44	77	

Notes:

Results of two cruise surveys that covered the northeastern Gulf of Mexico (GOM) were used to determine the distribution and abundance of seabirds in the BOET vicinity, one in late summer (October 1996) and one in mid-summer (August 1997).

Summer migrant pelagic (SMP): Species present in the summer that breed primarily elsewhere.

Permanent resident (PR): Species permanently present in the GOM.

Wintering species (WS): Species found in the GOM during winter.

Summer resident (SR): Species present during summer that also breed in the GOM.

[a] The species noted are similar in appearance and therefore not always distinguishable.

Sources: Adapted from Davis et al. 2000b; GOM status from USCG and MARAD 2004a.

MIGRATORY BIRDS

The GOM is an important pathway for migratory birds, including many coastal and marine species. Most of the migrant birds overwinter in the neotropics (tropical Central America and South America), breed in eastern North America, and either directly cross the GOM (trans-Gulf migration) or move north or south by traversing the GOM coast or the Florida Peninsula (MMS 2002b). Recent studies indicate that the flight pathways of the majority of the trans-Gulf migrant birds during spring are directed toward the coastlines of Louisiana and eastern Texas, and are therefore outside the BOET vicinity.

Seabirds, especially migrating birds, are affected by offshore platforms in many positive ways. For most species, platforms provide a suitable stopover habitat. Birds that are fatigued from long migrations or overshot the coastlines during nocturnal migrations may use BOET to rest and feed. Many migrants seen to rest quietly on platforms for hours to days were probably recovering from such sources of fatigue as depletion of fat storage, accumulation of lactic acid, or upset central nervous coordination (Yapp 1956, Russell 2005). Most migrants that stop on platforms probably benefit from their stay (Russell 2005). Many shorter-distance migrants that spend the winter along the Gulf coast (such as wrens and sparrows) inadvertently overshoot the coastline during nocturnal migratory flights and end up over Gulf waters. These birds, which are evolutionarily ill-equipped to deal with the rigors of overwater migration, were among the heaviest users of platforms during fall; and the availability of platform rest stops probably enabled many individuals to return to land successfully (Russell 2005).

Migrating birds in the GOM include summer migrant pelagics and wintering marine species. As noted earlier, summer migrant pelagics are present in the GOM during summer but breed primarily elsewhere; wintering species are found in the GOM only during winter (USCG and MARAD 2004a).

OFFSHORE BIRDS

Offshore pelagic seabirds spend much of their life on or over saltwater, living and eating far from land most of the year. During breeding time, offshore pelagics return to colonial nesting areas along remote coastlines or islands. Most seabirds in the GOM, however, inhabit waters of the continental shelf and adjacent coastal and inshore habitats. There is generally a paucity of information on the distribution and status of pelagic birds, particularly in the case of OCS waters of the GOM (Davis et al. 2000b). As noted earlier, offshore birds of the GOM include permanent and summer residents.

3.1.3.4 Fish

The GOM marine habitats, ranging from coastal marshes to the deep-sea abyssal plain, support a varied and abundant fish fauna. Species found in a given area are related to variable ecological factors at the site, including salinity, primary productivity, and bottom substrate. These factors differ widely across the Gulf and between the inshore and offshore waters.

Fish species likely to be found in the offshore waters near the BOET are characterized as coastal pelagic, reef, demersal, and oceanic pelagic. Coastal pelagic species can be found from the shoreline to the shelf edge. Reef species are associated most commonly with natural or artificial topographic relief, such as live or hard bottoms, or oil platforms that tend to support a great diversity of species. Oceanic pelagic species occur mainly in the deep, open oceanic waters offshore from the shelf break. Demersal and coastal pelagic fish assemblages are recognized within broad habitat classes for the continental shelf and oceanic waters of the GOM. They are associated most closely with water depth and bottom substrate. The fish assemblages associated with the BOET vicinity are referred to as the inner shelf assemblage (Gallaway 1981).

ESTUARY FISH

Although estuaries are not an area of concern in the vicinity of the BOET, life stages of estuary fish may take them into the vicinity. Most fish reside in estuaries during the late larval/early juvenile stage of development. They tend to leave the estuaries as juveniles or subadults (once they are reproductive) and spawn at sea. The eggs hatch in the waters of the open GOM, and the developing larvae become part of the offshore planktonic community. Under the influence of tides, currents, and winds, the young eventually arrive at the estuarine nursery grounds—where they feed, grow, and mature prior to migrating out to sea to repeat the spawning process. The young remain in the estuaries for approximately a year, taking advantage of the greater availability of food and protection that the estuarine habitats afford. Most estuarine-dependent species grow rapidly and reach maturity in 1 year. They may remain in the estuary, migrate to sea to spawn (returning to the estuary between spawnings), or migrate from the shallow estuaries to spend the rest of their lives in the deeper waters of the GOM. Spawning activities typically are more concentrated in spring through summer, in shallower waters—in response to warmer temperatures and variable salinity conditions.

REEF FISH

Reef fishes are distributed widely in the GOM and occupy both pelagic and benthic habitats during their life cycles. Reef fish species occur in close association with natural or artificial materials on the seafloor. Live bottom areas of low or high vertical relief partition reef areas from surrounding sand/shell hash/mud bottom. A number of important reef fish species share the common life history characteristics of offshore spawning and transport of larvae inshore to settle in estuaries and seagrass meadows, where they spend an obligatory nursery phase before recruiting to adult stocks offshore. Examples of estuarine-dependent reef fish are the gag (*Mycteroperca micolepsis*) and the gray snapper. Other reef fish species are considered non-estuary dependent, such as the red snapper; these species remain close to underwater structures.

DEMERSAL FISH

The bottom-oriented, or demersal, fish fauna of the GOM are characterized by substrate composition and water depth (Gallaway 1981). Demersal fish assemblages are named by the dominant shrimp species found in the same sediment/depth regime. The dominant assemblage in the BOET vicinity is the brown shrimp assemblage found at depths of 72–299 ft (22–91 m) (MMS 2002a). The brown shrimp assemblage consists of species such as the longspine porgy (*Stenotomus caprinus*), sea robins (Triglidae), and dwarf goatfish (*Upeneus parvus*) (MMS 2002b). Darnell and Kleypas (1987) provided a comprehensive survey of demersal ichthyofauna of the eastern GOM shelf, from the Mississippi Delta to southwest Florida. Regional shelf waters supported approximately 347 species plus another 85 unresolved taxa from 80 families. Pinfish (*Lagodon rhomboides*) and longspine porgy were the most abundant species, together comprising approximately 19 percent of the catch. Total abundance was dominated by relatively few species; the top 13 species contributed over 50 percent of the entire catch.

Darnell and Kleypas (1987) described several distinctive fish assemblages based on the co-occurrence of species in trawl samples. Within the study region, they identified the Mississippi Bight assemblage extending from the Mississippi Delta eastward to about Perdido Bay, Florida and out to the shelf break. Of six assemblages discussed by Darnell and Kleypas (1987), the Mississippi Bight fauna was by far the most diverse assemblage in the eastern GOM. Abundant species included striped anchovy (*Anchoa hepsetus*), rock seabass (*Centropristis philadelphica*), silver seatrout (*Cynoscion arenarius*), pinfish, spot (*Leiostomus xanthurus*), Atlantic croaker (*Micropognias undulatus*), and longspine porgy.

COASTAL PELAGIC FISH

Coastal pelagic fish inhabit the shelf waters of the GOM throughout the year. The lowest abundance of all species occurs in winter, with peak numbers found during summer and fall. The distribution of most species depends on water column structure, which varies seasonally and spatially. These species can be divided into two groups: the large predatory species and the smaller planktivorous species. Both groups form schools, undergo migrations, grow rapidly, mature early, and exhibit high fecundity. Some species, such as Spanish mackerel (*Scomberomorus maculatus*), Gulf menhaden (*Brevoortia patronus*), anchovies (Engraulidae), and herrings (Clupeidae), form large schools; others, such as cobia (*Rachycentron canadum*), form small schools or travel singularly. The smaller coastal pelagic species often are preyed upon by the larger species, as well as by piscivorous (fish-eating) birds (MMS 2002b).

Some coastal pelagic species (especially Spanish sardine [*Sardinella aurita*], round scad [*Decapterus punctatus*], blue runner, king mackerel [*Scomberomorus cavalla*], and cobia) show an affinity for vertical structure and often are observed around natural or artificial structures, where they are classified best as transients rather than true residents (Klima and Wickham 1971, Chandler et al. 1985). Most of the large-bodied, predatory coastal pelagic species are important to commercial or recreational fisheries. King and Spanish mackerel, cobia, and jacks are sought by the charter and headboat fisheries in the region.

OCEANIC PELAGIC FISH

Oceanic pelagics occur throughout the GOM, especially at or beyond the shelf edge. They are reportedly associated with mesoscale hydrographic features, such as fronts, eddies, and discontinuities. Common oceanic pelagic species include tunas and wahoo (Scombridae), marlins and sailfish (Istiophoridae), swordfish (*Xiphias gladius*), dolphins, and mako sharks (*Isurus* sp.). In addition to these large predatory species, there are halfbeaks and flyingfishes (Exocoetidae) and driftfishes (Ariommatidae). Lesser known oceanic pelagics include opah, snake mackerels (Gempylidae), ribbonfishes (Trachipteridae), and escolar (*Lepidocybium flavobrunneum*). Many of the oceanic fishes associate with drifting *Sargassum*, which provides forage and nursery areas (MMS 2003a).

3.1.3.5 Ichthyoplankton

Most fish inhabiting the GOM have pelagic larval stages. Ditty et al. (1988) summarized information from over 80 studies on ichthyoplankton in the northern GOM and reported 200 fish species from 61 families. The larval stage can range in duration from 10 to 100 days. Year-class strength in adult populations of fish and invertebrates largely depends on variability in survival and transport of pelagic larvae. The distribution of fish larvae depends on spawning behavior of adults, hydrographic structure and transport at a variety of scales, duration of the pelagic period, behavior of larvae, and larval mortality and growth (MMS 2002a).

For most of the year in the northcentral GOM, densities of ichthyoplankton are greater at the surface and decrease with depth (Shaw et al. 2002); however, movement of larvae throughout the water column within a 24-hour period is common. Water temperature is a major influence on the structure of larval fish assemblages (MMS 2002b). Larval densities are lowest during winter, increase during spring, peak during summer, and decline during fall. Table 3-8 presents the seasonality and peak seasonal occurrence of larval fishes in the northern GOM. Most fish species will be in the BOET vicinity from spring through early fall.

Many ichthyoplankton taxa are collected within specific depth ranges. As shown in Table 3-9, larvae of several inshore demersal species are found in water depths shallower than 82 ft (25 m). This includes an important forage species (Atlantic bumper [*Chloroscombrus chrysurus*]).

Several clupeids (herrings) and serranids (sea basses) are found at depths shallower than 164 ft (50 m). Some species are collected exclusively at depths of 164 to 656 ft (50 to 200 m). Wide-ranging epipelagic species were collected in water depths exceeding 492 ft (150 m). Species utilizing water depths greater than 328 feet (100 m) are likely to occur in the Project area.

Plankton surveys have been conducted in the GOM since 1982 as part of the South East Area Monitoring and Assessment Program (SEAMAP). The SEAMAP data are split into two periods: summer (June through November), and winter (December through May). Although sampling is conducted during both periods, data are gathered more frequently in summer period than in winter. Plankton are collected using both a neuston net and a bongo net. The neuston net has a 3.28- x 6.56-ft (1- x 2-m) mouth opening and a mesh size of 0.04 inch (0.950 millimeter [mm]). This net is fished at a depth of 1.64 ft (0.5 m) along the surface of the water. The bongo net has a 23.6-inch (60-cm) mouth opening and carries 0.01-inch (0.33-mm) mesh netting. The bongo net is fitted with a flowmeter that allows the volume of water filtered during the tow to be measured. This net is fished from approximately 3.28 to 16.4 ft (1 to 5 m) off the bottom to the water's surface and yields a sample from the water column that is integrated over depth.

Table 3-8. Seasonality and Peak Seasonal Occurrence of Larval Fishes

Genus/Species	Common Name	Seasonal Occurrence											
		J	F	M	A	M	J	J	A	S	O	N	D
Opisthonema oglinum	Atlantic thread herring			○	○	■	■	■	■	○	○	○	
Harengula jaguana	Scaled sardine			○	○	■	■	■	■	○	○	○	
Sardinella aurita	Spanish sardine			○	○	○	○	○	○	○	○	○	
Brevoortia sp.	Menhaden	○	○	○	○	○					○	○	○
Eutremeus teres	Round herring	■	■	■	○	○	○					○	○
Anchoa sp.	Anchovy	○	○	■	■	■	■	■	■	■	○	○	○
Bregmaceros sp.	Codlet	○	○	○	○	○	○	○	○	○	○	○	○
Urophycis sp.	Hake	○	○	○								○	○
Ophidion sp.	Cusk-eel	○	○	○	○	○	○	○	○	○	○	○	○
Serraniculus pumilio	Pygmy sea bass					○	■	■	■	■	○	○	
Serranus sp.	Bass	○	○		○	○	○	○	○	○	○	○	○
Centropristis sp.	Sea bass	○	○	○	○	○		○		○	○	○	○
Centropristis striata	Gulf black sea bass	○	○	○		○				○	○	○	
Diplectrum sp.	Sand perch	○	○	○	○	■	■	■	■	○	○	○	○
Apogon sp.	Cardinalfish							○					
Pomatomus saltatrix	Bluefish				○						○	○	○
Rachycentron canadum	Cobia				○	○	○	○	○	○			
Chloroscombrus chrysurus	Atlantic bumper				○	○	■	■	■	■	○		
Caranx sp.	Jack	○	○	○	○	○	○	○	○	○	○	○	○
Caranx crysos	Blue runner			○	○	○	■	■	■	○	○	○	
Decapterus punctatus	Round scad			○	■	■	■	■	■	■	○	○	
Oligoplites saurus	Leatherjacket				○	○	■	■	■	○	○	○	
Selar crumenophthalmus	Bigeye scad				○	○	○	○	○	○	○		
Selene sp.	Moonfish					○	○	■	■	■	○	○	
Seriola sp.	Amberjack	○	○	○	○	○	○	○	○	○	○	○	○
Coryphaena sp.	Dolphinfish					○	○	○	○	○	○	○	
Coryphaena hippurus	Dolphin		○	○	○	○	○	○	○	○	○	○	
Lutjanus sp.	Snappers				○	○	■	■	■	○	○	○	
Lutjanus campechanus	Red snapper					○	○	○	○	○	○	○	
Pristipomoides aquilonaris	Wenchman		○			○	○	○	○	○	○	○	○
Rhomboplites aurorubens	Vermilion snapper	○				○	○	○	○	○	○	○	○
Lagodon rhomboides	Pinfish	■	■	○	○						○	○	■

Table 3-8. Seasonality and Peak Seasonal Occurrence of Larval Fishes (continued)

Genus/Species	Common Name	Seasonal Occurrence											
		J	F	M	A	M	J	J	A	S	O	N	D
Bairdiella chrysoura	Silver perch			○	■	■	■	■	■	○	○		
Cynoscion arenarius	Sand seatrout		○	■	■	○	○	■	■	○	○		
Micropogonias undulatus	Atlantic croaker	■	○	○	○					○	■	■	■
Sciaenops ocellatus	Red drum								○	■	■	○	
Cynoscion nothus	Silver seatrout					○	○	○	○	■	■	○	
Larimus fasciatus	Banded drum				○	○	○	○	○	■	○	○	
Leiostomus xanthurus	Spot	■	○	○	○						○	○	■
Menticirrhus sp.	Kingfish		○	○	○	○	○	○	○	○	○	○	○
Stellifer lanceolatus	Star drum				○	○	○	○	○	○	○		
Kyphosus sp.	Chub	○	○		○	○	○	○				○	
Chaetodipterus faber	Atlantic spadefish				○	○	■	■	■	○			
Mugil sp.	Mullets	○	○	○	○	○	○	○	○	○	○	○	○
Mugil curema	White mullet				○	■	■	■	○				
Sphyraena sp.	Barracuda				○	○	■	■	■	○	○	○	
Callionymus sp.	Dragonet					○				○			
Trichiurus lepturus	Atlantic cutlassfish	○	○	○	○	○	○	○	○	○	○	○	○
Thunnus thynnus	Bluefin tuna				○	○	○						
Auxis sp.	Frigate/bullet mackerel	○	○	○	○	■	■	■	■	■	○	○	
Scomberomorus cavalla	King mackerel					○	○	○	■	■	○	○	
Euthynnus alletteratus	Bonito				○	■	■	■	■	■	○	○	
Scomberomorus maculatus	Spanish mackerel				○	○	○	○	■	■	○		
Scorpaena sp.	Scorpionfish	○	○	○	○	○	○	○	○	○	○	○	○
Prionotus sp.	Searobin	○	○	○	○	○	○	○	○	○	○	○	○
Bothus sp.	Flounder	○			○	○	○	○	○	○	○	○	○
Citharichthys sp.	Whiff	○	○	○	○	○	○	○	○	○	○	○	○
Citharichthys gymnorhinus	Anglefin whiff	○	○			○	○	○	○	○	○	○	○
Citharichthys spilopterus	Bay whiff	○	○	○	○	○		○	○	○	○	○	○
Cyclopsetta sp.	Flounder	○	○	○		○	○	■	■	■	○	○	○
Engyophrys senta	Spiny flounder					○	○	○	○	○	○		
Etropus crossotus	Fringed flounder				○	○	○	○	○	○	○	○	
Paralichthys sp.	Flounder	■	■	○	○					○	○	○	■
Syacium sp.	Flounder				○	○	■	■	■	○	○	○	○
Syacium papillosum	Dusky flounder					○	■	■	■	■	○	○	

Table 3-8. Seasonality and Peak Seasonal Occurrence of Larval Fishes (continued)

Genus/Species	Common Name	Seasonal Occurrence											
		J	F	M	A	M	J	J	A	S	O	N	D
Symphurus sp.	Tonguefish	○	○	○	○	○	○	○	○	○	○	○	○
Balistes sp.	Triggerfish							○	○				
Monocanthus sp.	Filefish					○				○	○		
Sphoeroides sp.	Puffer	○	○	○	○	○	○	○	○	○	○	○	○
Cubiceps pauciradiatus	Bigeye cigarfish	○	○	○	○	○	○	○	○	○	○	○	○
Psenes sp.	Driftfish		○						○			○	
Peprilus paru	Atlantic harvestfish				○	○	■	■	■	○	○	○	
Peprilus burti	Gulf butterfish	■	■	■	○	○	○	○	○	○	○	■	■

O = Occurrence.

■ = Peak seasonal occurrence.

Source: Adapted from Ditty et al. 1988.

Table 3-9. Primary Depth Distribution of Larval Fishes

Genus/Species	Common Name	Depth				
		<25 m	<50 m	<100 m	50–200 m	>150 m
Archosargus probatocephalus[a]	Sheepshead	●				
Chaetodipterus faber	Atlantic spadefish	●				
Chloroscombrus chrysurus	Atlantic bumper	●				
Cynoscion arenarius	Sand seatrout	●				
C. nebulosus[a]	Spotted seatrout	●				
Orthopristis chrysoptera	Pigfish	●				
Peprilus paru	Atlantic harvestfish	●				
Pogonias cromis[a]	Black drum	●				
Anchoa spp.	Anchovies		●			
Brevoortia patronus[a]	Gulf menhaden		●			
Centropristis striata	Gulf black sea bass		●			
Diplectrum formosum	Sand perch		●			
Harengula jaguana	Scaled sardine		●			
Lagodon rhomboides[a]	Pinfish		●			
Leiostomus xanthurus[a]	Spot		●			
Micropogonias undulatus[a]	Atlantic croaker		●			
Opisthonema oglinum	Atlantic thread herring		●			
Sardinella aurita	Spanish sardine		●			
Scomberomorus maculatus	Spanish mackerel		●			
Serraniculus pumilio	Pygmy sea bass		●			
Decapterus punctatus	Round scad			●		
Peprilus burti	Gulf butterfish			●		
Auxis sp.	Frigate/bullet mackerel				●	
Caranx crysos	Blue runner				●	
Etrumeus teres	Round herring				●	
Euthynnus alletteratus	Bonito				●	
Hemanthias vivanus	Red barbier				●	
Lutjanus campechanus	Red snapper				●	
Scomberomorus cavalla	King mackerel				●	
Trachurus lathami	Rough scad				●	
Euthynnus pelamis	Skipjack tuna					●
Istiophorus spp.	Sailfishes					●
Xiphias gladius	Swordfish					●

Note: Depth ranges are those at which >75 percent of larvae were collected.

[a] Species with estuarine-dependent larvae.

Source: Adapted from Ditty et al. 1988, MMS 2002b.

The methodology used for the determination of ichthyoplankton abundance is described in Appendices A-1 and A-2. Ichthyoplankton abundance at BOET was determined from the raw SEAMAP data (Attachment 1 of Appendix A-2) from samples taken in the BOET vicinity and the area surrounding it. From these data, the annual average densities for fish eggs and larvae were determined to be 1.210 eggs/m^3 and 2.410 larvae/m^3. Because BOET is in the center of the SEAMAP sampling area, the data are considered to be representative of what is likely to occur there. The densities of fish eggs and larvae are expected to be slightly higher during the warmer months, when spawning occurs in many species. However, a few species will migrate out to the outer shelf to spawn during winter, including Atlantic croaker, spot, and Gulf menhaden (MMS 2002b).

The larvae in these samples were identified to the lowest possible taxonomic level (order, family, genus, or species). If identification was not possible, the specimen was grouped as an unidentified fish. Throughout the summer sampling period, 280 groups of identified fish were collected. The 10 most abundant taxa identified during this period within the BOET vicinity are shown in order of their abundance as follows:

Summer

- *Brevoortia* spp. (Menhaden genus)
- Engraulidae (Anchovy family)
- *Bregmaceros* spp. (Codlet genus)
- Synodontidae (Lizardfish family)
- Gobiidae (Goby family)
- *Diaphus* spp. (Laternfish genus)
- Ophidiidae (Cusk-eel family)
- *Symphurus* spp. (Sole genus)
- *Leiostomus xanthurus* (Spot)
- Labridae (Wrasse family)

A complete list of the taxa found during SEAMAP sampling and their larval abundance can be found in Attachment 1 of Appendix A-2.

Also using SEAMAP data, Rooker et al. (2005) determined the densities of seven commercially important taxa collected according to gear type (bongo or neuston net), season, and region. Regional samples included various areas in the northern GOM to determine whether densities of certain fishes in the BOET vicinity were similar to densities in other areas. Figure 3-6 shows the various areas of interest. Higher than average densities of certain species within the BOET vicinity indicates a "hot spot" for that species; an impact associated with the Terminal would be greater for that species than one with lower densities. (Rooker et al. 2005) (Appendix B.)

The seven taxa that were involved in this study were the Balistids, groupers, billfishes, snappers, mackerels, tunas, and *Seriola*. Because SEAMAP data identifies an individual larva to the lowest possible classification and because species identification is not always possible, the densities of these taxa were calculated using values of their respective family and/or genus along with the specific species density when possible. Therefore, along with the commercially important species, other species that are not fished also are included. (Rooker et al. 2005) (Appendix B.)

The area in which BOET falls, Area A, has a higher density of balistids in the surface waters than any other area, with highest density during summer and early fall. Grouper had the highest mean densities from both gear types. Area A is one of the most significant areas for grouper with respect to early stage larvae. Billfishes are essentially absent from Area A. High densities of snapper were encountered, with a peak in September for both gears. Mackerel and tuna densities were relatively low in Area A. No *Seriola* were reported from bongo net tows in Area A, and neuston net catch rates were typically higher in environments further offshore. Appendix B contains the complete details of the study, along with graphs showing the densities of each taxon with regard to season, gear type, and area. (Rooker et al. 2005.) (Appendix B.) Biological monitoring at BOET, beginning prior to installation, will determine species composition and relative abundance of ichthyoplankton in the immediate vicinity of BOET. The biological monitoring plan is described in Section 5 of Appendix B.

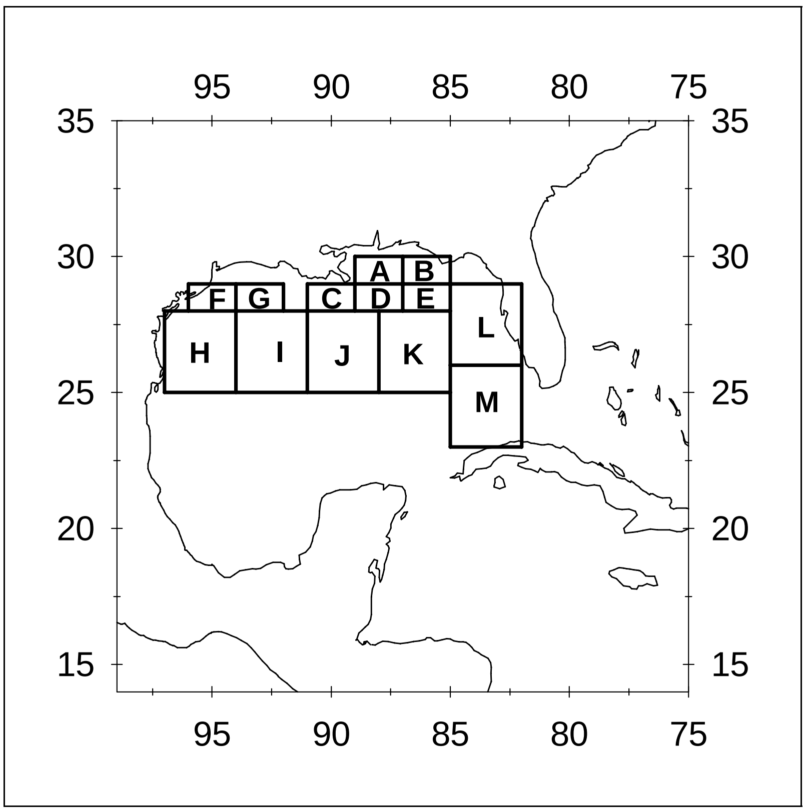

Figure 3-6. Areas Defined for Spatial Comparison of Bongo and Neuston Net SEAMAP Ichthyoplankton Analyses

Note: Area “A” represents the BOET site.

SEAMAP = South East Area Monitoring and Assessment Program.

3.1.3.6 Phytoplankton

Phytoplankton have a major impact on the near-surface nutrient concentration within the photic zone, being largely responsible for the primary production in the ocean (Qian et al. 2003). Alterations in the phytoplankton community composition, therefore, can lead to negative ecological impacts on entire ecosystems. Harmful blooms, areas of hypoxia, eutrophication, and decreases in nutrient availability are all consequences of changes in phytoplankton communities (See et al. 2005).

Shelf phytoplankton are more abundant, more productive, and seasonally more variable than the deep GOM plankton (MMS 2002c). This is related to salinity changes, greater nutrient availability, increased vertical mixing, and different zooplankton predation in the shelf environment (MMS 2002c). The highest values of surface primary production are found in the upwelling area north of the Yucatan Channel and in the De Soto Canyon region (GMFMC 2004). In general, the western GOM is more productive in the oceanic region than the eastern GOM. It is generally assumed that all the phytoplankton is consumed by the zooplankton, except for brief periods during major plankton blooms (GMFMC 2004).

In the northeastern GOM, over the continental margin, phytoplankton communities have been shown to consist mostly of prymnesiophytes, prokaryotes, cyanobacteria, diatoms, and pelagophytes. Prymnesiophytes were the most abundant taxa, reaching highest abundance in the outer shelf and slope waters. (Qian et al. 2003.)

Phytoplankton are marine plants, and like all plants, contain chlorophyll. Because of this, chlorophyll in the ocean often is used to measure the abundance and distribution of phytoplankton. Rooker et al. (2005) used 2 years (2003–2004) of monthly historical chlorophyll values in the general vicinity of BOET to determine whether there was a pattern of phytoplankton bloom in the area. The study showed that chlorophyll concentrations were typically low during fall, and higher during winter and spring, but otherwise showed no discernible pattern. See Appendix B for the methods used to measure chlorophyll during this study.

3.1.3.7 Zooplankton

Zooplankton are the key mediators of particle flux, fisheries recruitment, and biomass production within the world oceans (Lenz 2000, Remsen et al. 2004). Abundance and diversity of zooplankton in the GOM changes temporally and spatially. According to a 1979 study, biomass ranges from 60 to 630 mg/m³ (Marum 1979), with a peak in spring and a low in late summer or fall. In the eastern GOM, abundance decreases exponentially with depth; over half the biomass occurs in the upper 656 ft (200 m) (Hopkins 1982). However, low-latitude oligotrophic systems like the GOM tend to have low zooplankton abundances (Remsen et al. 2004). Species diversity is the reverse of abundance, with a peak in fall and lowest diversity in spring.

A study conducted in 1982 throughout the eastern GOM showed a diverse zooplankton community, with 21 genera individually exceeding 1 percent of the biomass from 0 to 3,281 ft (0 to 1,000 m). This study also showed that abundance decreased by two orders of magnitude between the surface and 3,281 ft (1,000 m). Seventy-five percent of the individuals occurred in the upper 656 ft (200 m). Peak abundance was at 164 ft (50 m) during the day and 98 ft (30 m) at night. Copepods were dominant both numerically and in relation to biomass. (Hopkins 1982.)

3.1.4 Fisheries

The GOM supports many economically important fisheries. The following discussion addresses the fisheries associated with shrimp, crab, and mollusks, as well as commercial and recreational finfish fisheries within the GOM. The specific economic values associated with these fisheries are discussed in detail in Topic Report 5, "Socioeconomics."

3.1.4.1 Crustaceans

Important shellfish groups landed at ports in Alabama and along Florida's northwest coast include shrimp, oysters, and crab. These three species groups are almost exclusively fished in inland (estuarine) waters. (MMS 2002c.)

Shrimping in the GOM occurs mainly in De Soto Canyon and in Louisiana, Mississippi, Alabama (primarily brown shrimp [*Penaeus aztecus*] with some white shrimp [*P. setiferus*] catches), and Florida state waters (primarily pink shrimp [*P. duorarum*]). Relatively little shrimping occurs in the shelf waters of offshore Alabama. (MMS 2002c.)

Although many kinds of shrimp are found in the GOM, only those of the family *Penaeidae* are large enough to be considered seafood (TPWD 2004). Brown shrimp, white shrimp, and pink shrimp make up the bulk of shrimp landings. Other shrimp of minor commercial value in the Gulf are the seabob, (*Xiphopenaeus kroyeri*), the rock shrimp, (*Sicyonia brevirostris*), and a deep-water type called the royal red shrimp, *(Pleoticus robustus*) (TPWD 2004). Of these shrimp, the only two species that may appear in the BOET vicinity are the brown shrimp and the royal red shrimp.

Brown shrimp are found in the estuaries, and in offshore waters to depths of 360 ft (110 m) in the central and western GOM, but are most abundant in water depths of 98 to 118 feet (30 to 55 m) (NOAA 1985). Post larvae and juveniles typically occur within estuaries, while adults occur outside of bay areas. Due to the greater abundance of brown shrimp in relatively shallow water, it is expected to be an uncommon visitor to BOET, and fishing of the species is not expected to occur in the area.

Royal red shrimp occur in the deeper waters of the GOM. Although they will range from depths from 230 to over 3,000 ft (70 to over 915 m), their preferred depth range is from 820 to 1,804 ft (from 250 to 550 m) on level bottoms of sand, clay, or mud (CSA 2002). Because the Terminal will be located in water much shallower than the preferred depth of this species, the royal red shrimp is expected to be an uncommon visitor to BOET, and fishing of the species is not expected to occur in the area.

The crab fisheries in the GOM include three species of crab (Gulf stone crab [*Menippe adina*], golden crab [*Chaceon fenneri*], and blue crab [*Callinectes sapidus*]) and one species of lobster (spiny lobster [*Panulirus argus*]). Blue crab are economically important, and the only species of crab in the Gulf that comprises a substantial fishery (MMS 2002c). Blue crab range from shore to depths of 298 feet (90 m) but are most common inside 115 feet (35 m) (NOAA 1985). Stone crab and spiny lobster have only moderate value on a national basis and are more important regionally or locally (NMFS 1999a). Golden crab are subject to only limited commercial fishing in offshore Florida due to their inability to sustain a large fishery (NOAA 1998). Spiny lobster utilize the BOET vicinity only as pelagic larvae, and adults are fished mainly off of South Florida (GMFMC 2004). Although occurrence of these species in the BOET vicinity is possible, presence of the species is not expected due to its preferred depth and habitat range.

3.1.4.2 Mollusks

Shellfish resources in the GOM range from species located only in brackish wetlands to species found mainly in saline marsh and inshore coastal areas. Life history strategies are influenced by tides, lunar cycles, maturation state, and estuarine temperature changes. Very few individuals live more than a year, and most are less than 6 months old when they enter the extensive inshore and nearshore fishery. Yearly variations in shellfish populations are frequently as high as 100 percent and are most often a result of extremes in salinity and temperature during the period of larval development.

The eastern oyster (*Crassostrea virginica*), an important commercial species, is found throughout the GOM in intertidal and subtidal areas with high salinities and moderate temperatures. Estuarine areas containing suitable substrate that are relatively calm, but with continuous water flow and low sedimentation, are ideal habitats for oysters. Oyster reefs in the northern GOM are most extensive in Louisiana and Florida. No oyster reefs occur near the BOET vicinity.

As measured in a 1995 survey, there were 3,476 ac (1,407 ha) of productive public oyster reefs area in the Cedar Point Buoy – Kings Buoy vicinity of Alabama. Adding an additional 1,208 ac (489 ha) of Baldwin County – Upper Bay – Portersville Bay Reefs gives the state a total of 4,685 ac (1,896 ha) of mapped oyster reef. There are other small, scattered patches of oysters especially along the western shore of Mobile Bay, in addition to the riparian beds located in Heron Bay and the Mississippi Sound (May 1971). The average annual harvest over the past 10 years has been 650,810 pounds (lbs) (295,207 kg) of meat. To increase overall production, the Alabama Marine Resources Division has planted culture material on state reefs.

3.1.4.3 Finfish

The northern GOM traditionally has been one of the most productive fishery areas in North America (Gunter 1967). The Gulf coast region has the highest domestic landings for commercial fish and shellfish with the exception of Alaska (EPA 2004).

Approximately 46 percent of the southeastern United States wetlands and estuaries important to fish resources are located in the GOM (Mager and Ruebsamen 1988**).** Consequently, estuary-dependent species of finfish and shellfish dominate the fisheries of the central and northcentral

Gulf. Many finfish resources are linked directly and indirectly to the estuaries located in the GOM. Finfish are directly estuary dependent when the population relies on low-salinity brackish wetlands for most of their life history, such as during the maturation and development of larvae and juveniles. Offshore demersal species are related indirectly to the estuaries because they influence the productivity and food availability on the continental shelf (Darnell and Soniat 1979, Darnell 1988**).**

COMMERCIAL SPECIES

Reef fish, along with coastal pelagic fishes, are the groups most sought after by fisherman from Alabama, Florida, and Mississippi who fish the oil and gas platforms off the adjacent states. Important finfish groups landed at ports in Alabama and along Florida's northwest coast include snapper, porgies, mullet (Mugilidae), baitfish, jacks, triggerfish (Balistidae), grouper, tuna, and other pelagics. Commercially important estuary-related species include menhaden, shrimps, oyster, crabs, and Sciaenids (croaker, red and black drum, and spotted sea trout).

The GOM provides nearly 21 percent of the commercial fish landings in the continental United States on an annual basis. Gulf menhaden comprised the bulk of the commercial landings in the GOM over the period from 1997 to 2001. The average annual landings of Gulf menhaden for this period were 1.29 billion lbs (585 million kg) (74 percent of the landings). Other species that dominated commercial landings for this period were brown shrimp (8 percent), white shrimp (4 percent), blue crab (4 percent), and eastern oyster (4 percent). Alabama's total commercial fishery landings for 2001 were over 25 million lbs (11.3 million kg), valued at $44.9 million. Shrimp was the most important fishery, with approximately 14.3 million lbs (6.5 million kg) landed, valued at approximately $34 million. (NMFS 2003.) For more information regarding commercial fishing in the proposed Project area, please refer to Topic Report 5, "Socioeconomics."

RECREATIONAL SPECIES

Marine recreational fishing in the GOM is a major industry, accounting for nearly a billion dollars in sales and thousands of jobs. The Gulf coast states from Louisiana to Florida account for about 1.6 million registered motorboats, with almost 4 million anglers making more than 16 million saltwater fishing trips in 1998 (NMFS 1999b; MMS 2003a); few of these trips extend into offshore federal jurisdiction (MMS 2003a).

The largest harvests of recreational fish species by weight were of red drum (Sciaenops ocellatus), spotted seatrout (*Cynoscion nebulosus*), dolphin, red snapper, groupers, sheepshead, king mackerel, Spanish mackerel, and sand trout (*Cynoscion arenarius*) (NMFS 2003). For information regarding recreational fishing in the proposed Project area, please refer to Topic Report 5, "Socioeconomics."

3.1.4.4 Essential Fish Habitat

As noted in Section 3.2, the MSA calls for direct action to stop or reverse the continued loss of fish habitats. Toward this end, Congress mandated the identification of habitats essential to managed species and measures to conserve and enhance this habitat. Under the MSA, Congress directs NMFS and the eight regional Fishery Management Councils (FMCs)—under the authority of the Secretary of Commerce, to describe and identify EFH in fishery management plans; minimize, to the extent practicable, the adverse effects of fishing on EFH; and identify other actions to encourage the conservation and enhancement of EFH. The MSA requires cooperation among NMFS, the FMCs, fishing participants, and federal and state agencies to protect, conserve, and enhance EFH. The statute includes a mandate that federal agencies must consult with the Secretary of Commerce on all activities or proposed activities that are authorized, funded, or undertaken by the agency and that might adversely affect EFH. NMFS recommends consolidated EFH consultations with interagency coordination procedures required by other statutes such as the National Environmental Policy Act (NEPA) or the ESA (50 CFR 600.920[e][I]) to reduce duplication and improve efficiency. The mandatory contents of an EFH Assessment are detailed in 50 CFR 600.920(e)(3).

Commercial and recreational fisheries resources in the federal waters of the GOM are managed by the Gulf of Mexico Fishery Management Council (GMFMC) and NMFS. The GMFMC is one of the eight regional FMCs established by the MSA. Fishery management plans (FMPs) developed by the GMFMC include:

- Red Drum Fishery Management Plan,
- Reef Fish Fishery Management Plan,
- Coastal Migratory Pelagic Fishery Management Plan,
- Shrimp Fishery Management Plan,
- Stone Crab Fishery Management Plan,
- Spiny Lobster Fishery Management Plan, and
- Coral and Coral Reefs Fishery Management Plan.

As stated earlier, the MSA defines essential fish habitat as “those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity: (MSA § 3[10]). EFH must be designated for the fishery as a whole (16 U.S.C§1853 [a][7]). The final rule clarifies that every FMP must describe and identify EFH for each life stage of each managed species. A more detailed discussion of EFH is located in Appendix C. Table 3-10 identifies all species in the GOM that are listed in the GMFMC FMPs.

EFH for highly migratory species (HMSs) is described in separate FMPs, including the Final Fishery Management Plan for Atlantic Tuna, Swordfish, and Sharks (NMFS 1999c), and Amendment I to the Atlantic Billfish Fishery Management Plan (NMFS 1999d). NMFS directly manages HMSs in the GOM. HMSs are a concern due to their place as apex predators. When apex predators are over-fished, their removal may induce changes in the ecosystem—including increases in the abundance of the lower trophic levels and of other high-level predators (GMFMC 2004).

Table 3-10. Species Listed in Gulf of Mexico Fishery Management Plans

Scientific Name	Common Name
Red Drum FMP	
Sciaenops ocellatus	Red drum
Coastal Migratory Pelagic FMP	
Scomberomorus cavalla	King mackerel
Scomberomorus maculatus	Spanish mackerel
Rachycentron canadum	Cobia
Scomberomorus regalis[a]	Cero
Euthynnus alleteratus[a]	Little tunny
Coryphaena hippurus[a]	Dolphin
Pomatomus saltatrix[a]	Bluefish
Stone Crab FMP	
Menippe mercenaria	Stone crab
Menippe adina	Stone crab (Cedar Key N)
Spiny Lobster FMP	
Panulirus argus	Spiny lobster
Scyllarides nodife	Slipper lobster
Panulirus guttatus[a]	Spotted spiny lobster
Panulirus laevicauda[a]	Smooth tail lobster
Scyllarides aequinoctialis[a]	Spanish slipper lobster
Coral and Coral Reefs FMP[b]	
Class Hydrozoa	Stinging and hyrdrocoral
Class Anthozoa	Sea fans, whips, precious coral, sea pen, and stoney corals
Reef Fish FMP	
Balistes capriscus	Gray triggerfish
Seriola dumerili	Greater amberjack
Seriola fasciata	Lesser amberjack
Seriola rivoliana	Almaco jack
Seriola zonata	Banded rudderfish
Lachnolaimus maximus	Hogfish
Etelis oculatus	Queen snapper
Lutjanus analis	Mutton snapper
Lutjanus campechanus	Red snapper
Lutjanus apodus	Schoolmaster
Reef Fish FMP (continued)	
Lutjanus buccanella	Blackfin snapper
Lutjanus cyanopterus	Cubera snapper
Lutjanus griseus	Gray (mangrove) snapper
Lutjanus jocu	Dog snapper
Lutjanus mahogoni	Mahogany snapper
Lutjanus synagris	Lane snapper
Lutjanus vivanus	Silk snapper
Ocyurus chrysurus	Yellowtail snapper
Pristipomoides aquilonaris	Wenchman
Rhomboplites aurorubens	Vermilion snapper
Caulolatilus chrysops	Goldface tilefish
Caulolatilus cyanops	Blackline tilefish
Caulolatilus intermedius	Anchor rilefish
Caulolatilus microps	Blueline tilefish
Lopholatilus chamaeleonticeps	Golden tilefish
Diplectrum bivittatum	Dwarf sand perch
Epinephelus adscensionis	Rock hind
Epinephelus drummondhayi drummondhayi[a]	Speckled hind
Epinephelus flavolimbatus[c]	Yellowedge grouper
Epinephelus guttatus	Red hind
Epinephelus itajara[d]	Goliath grouper
Epinephelus morio	Red grouper
Epinephelus mystacinus[c]	Misty grouper
Epinephelus nigritus[c]	Warsaw grouper
Epinephelus niveatus[c]	Snowy grouper
Epinephelus striatus[d]	Nassau grouper
Epinephelus inermis	Marbled grouper
Mycteroperca bonaci	Black grouper
Mycteroperca interstitialis	Yellowmouth grouper
Mycteroperca microlepis	Gag
Mycteroperca phenax	Scamp
Mycteroperca venenosa	Yellowfin grouper

[a] Species in the fishery but not in the management group of the Fishery Management Plan (FMP).

[b] Although the FMP does not list individual species comprising the management unit, the listed classes are referred to in the FMP as occurring in the Gulf of Mexico or South Atlantic waters.

[c] Deepwater groupers.

[d] Protected groupers.

Sources: For FMP species: GMFMC 2003; for coral and coral reefs classes: GMFMC 2005.

Table 3-11. Impacts on Species Included in Gulf of Mexico Fishery Management Plans – According to Life Stage, Depth, Habitat Use, and Occurrence within the BOET Vicinity

Common name	Habitat	Eggs	Larvae	Post Larvae	Early Juveniles	Late Juveniles	Adults	Spawning Adults
Golden tilefish[a]	Depth range	80-450 m[b]	80-450 m[b]	80-450 m[b]	80-450 m	80-450 m	80-450 m	80-450 m[c]
	Occurrence	Common	Common	Common	Nursery area	Nursery area	Adult area	Adult area
	Pelagic	HD(C,O)	HD(C,O)					
	Hard bottom				HD(C)	HD(C)	FD(C)	
	Soft bottom				HD(C,O)	HD(C,O)	FD(C,O)	
	Shelf edge/slope	HD(C)			HD(C)	HD(C)	FD(C)	
Almaco jack[d]	Depth range	15-160 m[b]	15-160 m[b]	15-160 m[b]	15-160 m[e]	15-160 m[e]	15-160 m[f]	15-160 m[c]
	Occurrence	Occurrence	Occurrence	Occurrence	Nursery area	Nursery area	Adult area	Occurrence
	Drift algae				*HD(C,O)*	*HD(C,O)*		
	Pelagic	**E(O)**					Unknown	**SD(C,O)**
Anchor tilefish[g]	Depth range	60-256 m	60-256 m	60-256 m	60-256 m	60-256 m	60-256 m	60-256 m
	Occurrence	Common	Common	Common	Nursery area	Nursery area	Adult area	Adult area
	Pelagic	HD(C,O)	HD(C,O)					
	Hard bottom						FD(C)	
	Shelf edge/slope						FD(C)	
	Sand/shell						FD(C,O)	
	Soft bottom						FD(C,O)	

Table 3-11. Impacts on Species Included in Gulf of Mexico Fishery Management Plans – According to Life Stage, Depth, Habitat Use, and Occurrence within the BOET Vicinity (continued)

Common name	Habitat	Eggs	Larvae	Post Larvae	Early Juveniles	Late Juveniles	Adults	Spawning Adults
Goldface tilefish[g]	Depth range	60-256 m	60-256 m	60-256 m	60-256 m	60-256 m	60-256 m	60-256 m
	Occurrence	Common	Common	Common	Nursery area	Nursery area	Adult area	Adult area
	Pelagic	HD(C,O)	HD(C,O)					
	Hard bottom						FD(C)	
	Shelf edge/slope						FD(C)	
	Sand/shell						FD(C,O)	
	Soft bottom						FD(C,O)	
Gray triggerfish	Depth range	10-100 m[b]				10-100 m	10-100 m	10-100 m[c]
	Occurrence	Common	Common	Common	Nursery area	Nursery area	Adult area	Adult area
	Reefs	HD(C)					BD,FD(C)	SD, FD(C)
	Sand/shell						FD(C)	FD(C)
Greater amberjack	Depth range	1-360 m	1-360 m	1-360 m	1-360 m	1-360 m	1-360 m	1-360 m
	Occurrence	Common	Common	Common	Nursery area	Nursery area	Adult area	Adult area
	Drift algae				*HD(C,O)*	*HD(C,O)*		
	Pelagic	**E(O)**	**E/I(O)**	**I(O)**			Unknown	**SD(C,O)**
	Reefs						FD(C)	
Lane snapper[h]	Depth range	4-132 m[b]	4-132 m[b]		0-20 m	0-20 m	4-132 m	4-132 m[c]
	Occurrence	Common	Common	Common	Nursery area	Nursery area	Adult area	Adult area
	Pelagic	**E(O)**						
	Reefs						FD(C)	
	Banks						FD(C)	
	Sand/shell						FD(C,O)	
	Shelf edge/slope							SD(C)

Table 3-11. Impacts on Species Included in Gulf of Mexico Fishery Management Plans – According to Life Stage, Depth, Habitat Use, and Occurrence within the BOET Vicinity (continued)

Common name	Habitat	Eggs	Larvae	Post Larvae	Early Juveniles	Late Juveniles	Adults	Spawning Adults
Lesser amberjack	Depth range				55-130 m[b]	55-130 m[b]	55-130 m[c]	55-130 m
	Occurrence	Common	Common	Common	Nursery area	Nursery area	Adult area	Adult area
	Drift algae				*HD(C,O)*	*HD(C,O)*		
	Shelf edge/slope						Unknown	SD(C)
Red snapper	Depth range	18-37 m[b]	18-37 m[b]	18-37 m[b]	17-183 m	20-46 m	7-146 m	18-37 m[c]
	Occurrence	Common	Common	Common	Nursery area	Nursery area	Adult area[i]	Adult area[i]
	Pelagic	**E(O)**	**E/I(O)**					
	Hardbottom				HD,FD(C)		FD(C,O)	
	Sand/shell				HD,FD(C,O)			
	Soft bottom				HD,FD(C,O)			
	Reefs						FD(C)	
Warsaw grouper[j]	Depth range	40-525 m[b]	40-525 m[b]	40-525 m[b]	20-30 m[e]	20-30 m[f]	40-525 m	40-525 m[c]
	Occurrence	Common	Common	Common	Nursery area	Nursery area	Adult area	Adult area
	Pelagic	HD(C,O)	HD(C,O)					
	Hardbottom						FD(C)	
	Shelf edge/slope						FD(C)	
Wenchman[k]	Depth range	80-200 m[b]	80-200 m[b]	80-200 m[b]	19-378 m[e]	19-378 m[e]	19-378 m[f]	80-200 m[c]
	Occurrence	Common	Common	Common	Nursery area	Nursery area	Adult area	Adult area
	Pelagic	HD(C,O)	HD(C,O)					
	Hardbottom						FD(C)	
	Shelf edge/slope						FD(C)	SD(C)
King mackerel[l]	Depth range	35-180 m	35-180 m		< 9 m		35 m to shelf edge[m]	35-180 m
	Occurrence	Common	Common	Common	Nursery area	Nursery area	Adult area[i]	Adult area
	Pelagic	**E(O)**	**E/I(O)**		HD,FD(C,O)		FD(C,O)	**SD(C,O)**

Table 3-11. Impacts on Species Included in Gulf of Mexico Fishery Management Plans – According to Life Stage, Depth, Habitat Use, and Occurrence within the BOET Vicinity (continued)

Common name	Habitat	Eggs	Larvae	Post Larvae	Early Juveniles	Late Juveniles	Adults	Spawning Adults
Cobia	Depth range	< 1 m	11-53 m	11-53 m	5-300 m	6-9 m	1-70 m	1-70 m
	Occurrence	Common	Common	Common	Nursery	Nursery	Adult area	Adult area
	Pelagic	X	**E/I(O)**	**E/I(O)**	HD(C,O)	HD,FD(C,O)	FD(C,O)	**SD(C,O)**
Brown shrimp	Depth range	18-110 m	0-82 m	n	0-18 m	0-18 m	14-110	18-110
	Occurrence	Common	Common	Common	Nursery area	Nursery area	Adult area[c]	Adult area
	Pelagic		**E/I(O)**					
	Sand/shell	HD(C,O)					FD(C,O)	SD(C,O)
	Soft bottom	HD(C,O)					FD(C,O)	SD(C,O)
Slipper Lobster	Depth range		0-75 m		0-71 m	0-71 m	2-100 m	2-100 m
	Occurrence		Common	Occurrence	Occurrence	Occurrence	Occurrence	Occurrence
	Pelagic		**E/I(O)**					
	Reefs						FD(C)	SD(C)
	Sand/shell						FD(C)	SD(C)
	Soft bottom						FD(C)	SD(C)

C = Construction; these species may be temporarily disturbed in the noted habitat due to Project construction.
E/I = Entrainment/Impingement; these species may be entrained or impinged by the Project.
FD = Feeding Disruption; the area specified is used for feeding; therefore, feeding may be disrupted by Project activities.
HD = Habitat Disruption; the area specified is used as habitat; therefore, a habitat disruption may occur due to Project activities.
O = Operation; these species may be disturbed in the noted habitat due to Project operation.
Red/Bold = Major impact.
Blue/Italic = Moderate impact.
Purple/Regular = Negligible impact.

[a] Most common between 820.2 and 1,148.3 feet (ft) (250 and 350 meters [m]). Late juveniles and adults construct and inhabit burrows.

[b, c] For this species, depths [c] served as proxy values for depths [b].

[d] The northern Gulf of Mexico is probably not an important spawning area.

[e, f] For this species, depths [f] served as proxy values for depths [c].

[g] The habitat usage and depth range of this species was inferred from the blueline tilefish due to placement in the same guild.

Table 3-11. Impacts on Species Included in Gulf of Mexico Fishery Management Plans – According to Life Stage, Depth, Habitat Use, and Occurrence within the BOET Vicinity (continued)

[h] Adults most common in coral reef areas and sand/shell bottoms. Spawning detected on shelf waters in Cuba and on inner shelf off Campeche.

[i] Major adult area and commercial fishing ground.

[j] Adults commonly found between 131.2 and 820.2 ft (40 and250 m).

[k] Most abundant between 262.5 and 656.2 ft (80 and 200 m) depth.

[l] Areas of abundance for larvae and juveniles in northcentral and northwestern GOM linked to Mississippi River plume. Adult areas of abundance are in waters of Florida and Mexico. Spawning over outer continental shelf, northwestern and northeastern GOM are considered important areas.

[m] Adults most commonly found in less than 262.5 ft (80 m) of water.

[n] Pre-settlement post larvae are grouped with larvae. Late post larvae are grouped with juveniles.

Source: Adapted from GMFMC 2003 (Tables 3.2.13, 3.2.15, 3.2.16, 3.2.17, 3.2.19, 3.2.20, 3.2.6, 3.2.8, and 3.2.9).

NMFS also recommends that FMPs identify habitat areas of particular concern (HAPCs). The general types of HAPC include nearshore areas of intertidal and estuarine habitats that may provide food and rearing for juvenile fish and shell fish managed by the FMC; offshore areas with substrates of high habitat value or vertical relief that serve as cover for fish and shell fish; and marine and estuary habitat used for migration, spawning, and rearing of fish and shellfish. Marine sanctuaries and national estuary reserves managed by the GMFMC have been designated in the Project area and are considered to be HAPCs that meet the above general guidelines. These HAPCs include Weeks Bay NERR and Grand Bay, Mississippi, (NMFS 2001.) (See Topic Report 7, "Marine and Land Use, Recreation, and Aesthetics" for additional information.)

Many species included in FMPs occur in the BOET vicinity. All species with EFH that may commonly occur in the BOET vicinity are described below. These species were determined based on tables supplied by the Draft Environmental Impact Statement for the Generic Essential Fish Habitat Amendment (GMFMC 2003) or, in the case of the highly migratory species, through assessment of the Draft Consolidated Atlantic Highly Migratory Species Fishery Management Plan (HMSMD 2005). Table 3-11 lists the species governed by the GMFMC that may commonly occur at BOET according to their life stage, depth, and habitat utilization. Table 3-12 lists the HMS species governed by NOAA that may commonly occur in the BOET vicinity according to their life stage. Both tables also indicate possible impacts, through construction or operation of the Project, to each life stage according to habitat utilization. Table 3-13 lists potential impacts on regional habitats included in the EFH of FMP species.

Table 3-12. Impacts on Species Included in the Highly Migratory Species Fishery Management Plan – According to Life Stage and Occurrence within the BOET Vicinity

Common Name	Life Stage in Which Essential Fish Habitat Would Be Crossed	Impact
Atlantic bluefin tuna	Spawning, eggs, and larvae	**E/I(O)**
Scalloped hammerhead shark	Juvenile	HD(C,O)
Tiger shark	Juvenile	HD(C,O)
	Adult	HD(C,O)
Atlantic sharpnose shark	Adult	HD(C,O)
Blacktip shark	Neonate	HD(C,O)
	Juvenile	HD(C,O)
White marlin	Adult	HD(C,O)

C = Construction; species may be temporarily disturbed in the pelagic habitat due to Project construction.
E/I = Entrainment/Impingement; species may be entrained or impinged by the Project.
HD = Habitat Disruption; disruption of the pelagic habitat may occur due to Project activities.
O = Operation; these species may be disturbed in the pelagic habitat due to Project operation.
Red/Bold = Major impact.
Purple/Regular = Negligible impact.

Source: HMSMD 2005.

Table 3-13. Impacts on Habitats Used by Species Included in Gulf of Mexico and Highly Migratory Species Fishery Management Plans

Fishery Management Plan	Highly Used Habitat	Potential Project Impacts on Habitat
Red drum	Nearshore hard bottoms	No impact expected.
	Nearshore sand/shell	No impact expected.
	Estuarine submerged aquatic vegetation	No impact expected.
	Estuarine soft bottom	No impact expected.
Reef fish	Nearshore reefs	No impact expected.
	Offshore hard bottoms	Negligible sediment transfer and increased turbidity to areas near pipeline placement.
	Offshore reefs	Negligible sediment transfer and increased turbidity to areas near pipeline placement.
	Offshore sand	Loss of approximately 9.06 acres of sandy bottom area due to the Terminal footprint. Sediment resuspension during construction.
	Offshore shelf edge/slope	Sediment resuspension during construction.
Coastal migratory pelagic	Nearshore pelagic	No impact expected.
	Offshore pelagic	Negligible impact on water quality through vessel discharge and cold-water discharge.
	Estuarine pelagic	No impact expected.
	Offshore drift algae	Negligible impact on water quality through vessel discharge and coldwater discharge. Possible disruption of habitat by vessel collision.
	Offshore shelf edge/slope	Sediment resuspension during construction.
Shrimp	Offshore sand/shell	Loss of approximately 9.06 acres of sandy bottom area due to the Terminal footprint. Sediment resuspension during construction.
	Offshore soft bottom	Loss of approximately 9.06 acres of sandy bottom area due to the Terminal footprint. Sediment resuspension during construction.
	Nearshore sand/shell	No impact expected.
	Nearshore soft bottom	No impact expected.
	Estuarine soft bottoms	No impact expected.

Table 3-13. Impacts on Habitats Used by Species Included in the Gulf of Mexico and Highly Migratory Species Fishery Management Plans (continued)

Fishery Management Plan	Highly Used Habitat	Potential Project Impacts on Habitat
Stone crab	Estuarine hard bottoms	No impact expected.
	Estuarine sand/shell	No impact expected.
	Estuarine submerged aquatic vegetation	No impact expected.
Spiny lobster	Offshore pelagic[a]	Negligible impact on water quality through vessel discharge and coldwater discharge.
Corals and Coral Reefs	Coral reefs	No impact is expected on any coral reef in the Gulf of Mexico.
	Hard bottoms	Negligible impact on water quality through vessel discharge.
Highly migratory species	Offshore pelagic	Negligible impact on water quality through vessel discharge and coldwater discharge.

Note: No impact is expected on any nearshore or estuarine areas due to the distance of any aspect of the Project from those areas.

[a] Only larvae are present.

Source: GMFMC 2004.

Each of the following species occurs during at least one life stage within the BOET vicinity. Those species with life stages that utilize the pelagic environment are more likely to be affected by the Terminal than species that are demersal or utilize hard substrate. Although the effects are localized, the pelagic environment will be affected by discharges from the increased vessel traffic and the cold water produced by LNG regasification.

Golden Tilefish (*Lopholatilus chamaeleonticeps*) — The golden tilefish occurs throughout the deeper waters of the GOM. It is demersal, occurring from depths of 262 to 1,476 ft (80 to 450 m) but is most commonly found between depths of 820 and 1,476 ft (250 and 450 m). Preferred habitat is rough bottom and steep slopes. Eggs and larvae are pelagic, while early juveniles are pelagic to benthic. Late juveniles burrow and occupy shafts in the substrate. Adults also dig and occupy burrows along the OCS and on the flanks of submarine canyons (GMFMC 2004).

Anchor and Goldface Tilefish (*Caulolatilus intermedius and Caulolatilus chrysops*) — The life history and distribution of these two species are inferred from the blueline tilefish (*Caulolatilus microps*) due to placement in the same guild. These tilefish are common in the GOM and occur in depths from 197 to 840 ft (60 to 256 m). In the offshore environment, eggs and larvae are pelagic; the adults use a variety of bottom habitats (GMFMC 2004).

Almaco Jack (*Seriola rivoliana*) — The almaco jack is believed to occur throughout the GOM, although little is known about its habitat use. Juveniles are known to use *Sargassum* as a refuge in open waters and off barrier islands. Adults are found far offshore, often associated with offshore platforms (GMFMC 2004).

Warsaw Grouper (*Epinephelus nigritus*) — The warsaw grouper is a deepwater species distributed throughout the GOM in association with hard bottoms. They occur from 131 to 1,722 ft (40 to 525 m), although more commonly down only to 820 ft (250 m). They prefer rough, rocky bottoms with high profiles such as steep cliffs and rocky ledges. Early juveniles are found in shallow nearshore habitats and may enter bays, moving into deeper water as they grow (GMFMC 2004).

Wenchman (*Pristipomoides aquilonaris*) — Found throughout the GOM, wenchman occupy hard bottom habitats of the mid to outer shelf, where they primarily feed on small fish. They are found at depths ranging from 62 to 1,240 ft (19 to 378 m) but are most abundant between 262 and 656 ft (80 and 200 m) (GMFMC 2004).

Brown Shrimp (*Penaeus aztecus*) — Brown shrimp have their greatest abundance in the central and western GOM. The brown shrimp is found in estuaries and offshore waters to depths of 361 ft (110 m), although they are most common in water depths of 98 to 118 feet (30 to 55 m) (NOAA 1985). Species abundance and habitat requirements for the brown shrimp are separated by life stage. Post larvae and juveniles typically occur within estuaries, while adults occur outside of bay areas. In estuaries, brown shrimp post larvae and juveniles are associated with shallow vegetated habitats, but they also are found over silty sand and non-vegetated mud bottoms. The density of post larvae and juveniles is highest in marsh edge habitat and submerged vegetation, followed by tidal creeks, inner marsh, shallow open water, and oyster reefs.

Red Snapper (*Lutjanus campechanus*) — Red snapper are demersal and are found over sandy and rocky bottoms, around reefs, and around underwater objects in depths to 656 ft (200 m) and possibly deeper. Adults favor deeper water in the northern GOM and are concentrated off Yucatan, Texas, and Louisiana at depths of 23 to 479 ft (7 to 146 m); they are most abundant at depths of 131 to 361 ft (40 to 110 m). They commonly occur in submarine gullies and depressions, and over coral reefs, rock outcroppings, and gravel bottoms. Spawning occurs in offshore waters from May to October, at depths of 59 to 121 ft (18 to 37 m) and over fine sand bottom away from reefs. Eggs are found offshore in summer and fall. Larvae, post larvae, and early juvenile are found July through November in shelf waters, in depths ranging from 56 to 600 ft (17 to 183 m). Early and late juveniles often are associated with structures, objects, or small burrows; but they also are abundant over barren sand and mud bottom (GMFMC 2004).

Lane Snapper (*Lutjanus synagris*) — The lane snapper occurs throughout the shelf area of the GOM in depths to 426 ft (130 m). This species is demersal, occurring over all bottom types, but it is most common in coral reef areas and sandy bottoms. Spawning occurs in offshore waters from March through September (peak July and August). Adults occur offshore at depths of 13 to 433 ft (4 to 132 m), on sand bottom, in natural channels, on banks, and on artificial reefs. Early and late juveniles appear to favor grass flats, reefs, and soft bottom areas to offshore depths of 66 ft (20 m). Information on habitat preferences of larvae and post larvae is non-existent and is in need of research (GMFMC 2004).

Greater Amberjack (*Seriola dumerili*) — The greater amberjack occurs throughout the Gulf Coast to depths of 1,200 ft (365.8 m). Information is sparse on habitat associations for all life stages. Adults are pelagic and epibenthic, occurring over reefs and wrecks and around buoys. Very little information exists on spawning adults. In the northern GOM, spawning occurs from May to July and, based on histology, may be as early as April. Juveniles also are pelagic and often are attracted to floating plants and debris in offshore nursery areas (NOAA 1985, GMFMC 2004).

Lesser Amberjack (*Seriola faciata*) — Information on this species is sparse, particularly for the early life stages. Juveniles occur offshore in late summer and fall in the northern GOM. Small juveniles are associated with floating *Sargassum*. Adults are found offshore year-round in the northern GOM, where they are associated with oil and gas rigs and irregular bottom. Spawning occurs offshore September–December and February–March, probably in association with oil and gas structures and irregular bottom (GMFMC 2004).

Gray Triggerfish (*Balistes capriscus*) — Information about this species is sparse, particularly for the early life stages (eggs and larvae). Eggs occur in late spring and summer, in nests prepared in sand near natural and artificial reefs. Eggs are guarded by the female and/or male. Larvae and post larvae are pelagic, occurring in the upper water column and usually associated with *Sargassum* and other flotsam. Early and late juveniles also are associated with *Sargassum* and may be found in mangrove estuaries. Adults are found offshore in waters greater than 30 ft (9.1 m), where they are associated with natural and artificial reefs. However, they may move away from structures to feed and have been observed hunting over soft bottoms (GMFMC 2004).

King Mackerel (*Scomberomorus cavalla*) — Within the GOM, king mackerel have centers of distribution in south Florida and Louisiana. Adults are found over reefs, in coastal waters, and over the shelf edge in depths of up to 656.2 ft (200 m)—although they generally occur in less than 262.5 ft (80 m) of water. Eggs are pelagic and found offshore between 114.8 and 590.6 ft (35 and 180 m) in spring and summer. Larvae occur over the middle and outer continental shelves, principally in the northcentral and northwestern GOM; juveniles are found closer inshore and out to the mid shelf (GMFMC 2004).

Cobia (*Rachycentron canadum*) — Cobia are found throughout the coastal and offshore waters of the GOM. The species is large, pelagic, and epibenthic; it often inhabits areas near wrecks, reefs, pilings, buoys, and floating objects. The proposed facilities could attract this species. Although adults occur year-round throughout the GOM, they display seasonal migrations and occur more abundantly in March–October in the northern GOM and in November–March in the southern GOM. Spawning occurs in spring and summer in the northern GOM throughout all adult areas, except in estuaries (NOAA 1985). Eggs are pelagic, usually found in the top meter of the water column in the summer. Larvae are found in offshore shelf waters of the northern GOM, where they feed on zooplankton (GMFMC 2004).

Slipper Lobster (*Scyllarides nodife*) — Very little is known on the life history of slipper lobsters. Adults occur out to depths of 328 ft (100 m) over reefs, sand/shell, and soft bottom areas, where they feed and spawn. Larvae are mainly pelagic to depths of 246 ft (75 m) (GMFMC 2003).

Atlantic Bluefin Tuna (*Thunnus thynnus*) — Bluefin tuna are epipelagic and usually oceanic, although they do come close to shore seasonally (Collette and Nauen). In the west Atlantic, bluefin mature at 8 years; spawning occurs from April to June in the GOM and Florida Straits (Block et al. 2005, McGowan and Richards 1989). Larvae generally are retained in the GOM and are found around the 1,000-fathom curve in the northern GOM, within a narrow temperature and salinity range (approximately 78.8 °F [26 °C] and 36 ppt). They initially feed on zooplankton but quickly switch to a piscivorous diet. In June, the young-of-the-year begin moving in schools to juvenile habitats (McGowan and Richards 1989) thought to be located over the continental shelf. The U.S. fishery status of bluefin tuna is considered over-fished, with continuous over-fishing occurring (HMSMD 2005).

Scalloped Hammerhead (*Sphyrna lewini*) — This is a very common, large, schooling hammerhead occurring in warm waters. It migrates seasonally north to south along the eastern United States. The scalloped hammerhead is considered vulnerable to over-fishing because its schooling habits make it extremely vulnerable to gillnet fisheries (HSMSD 2005).

Tiger Shark (*Galeocerdo cuvieri*) — The tiger shark inhabits warm waters in both deep oceanic and shallow coastal regions (Castro 1983). It is one of the larger shark species, reaching over 18 ft (5.5 m) and almost 2,000 pounds (907 kg). Maturation occurs at age 7 for males and at age 10 for females, with the species living up to 16 years (unverified). Females do not produce a litter each year (Simpfendorfer 1992), and nursery areas appear to be offshore.

Atlantic Sharpnose (*Rhizoprionodon terraenovae*) — This is a small coastal species, common year-round in the GOM. Although large numbers of Atlantic sharpnose are taken as catch during trawling, the species is fast-growing and reproduces yearly, allowing the population to maintain itself (HMSMD 2005).

Blacktip Shark (*Carcharhinus limbatus*) — The blacktip shark is circumtropical in shallow coastal waters and offshore surface waters of the continental shelves. It is a fast-moving shark that is often seen at the surface, frequently leaping and spinning out of the water. It often forms large schools that migrate seasonally along the coast. The blacktip, along with the sandbar, shark are the two primary species in the U.S. commercial shark fishery. (HMSMD 2005.)

White Marlin (*Tetrapturus albidus*) — This species is oceanic and epipelagic. It usually occurs in the upper 66 to 98 feet (20 to 30 m), although it may go to depths of 656 to 820 feet (200 to 250 m). The white marlin is generally solitary but is sometimes found in small groups of same-aged individuals. White marlin are targeted by the recreational fishery and are presently over-fished, with over-fishing still occurring. (HMSMD 2005.)

3.2 Existing Conditions – Alternatives

All alternative locations for BOET are within 5 mi (8 km) of the proposed location and occur in the same environmental conditions.

3.3 Biological Impacts – Proposed Action

BOET has been sited to avoid or minimize adverse impacts on biological resources. The proposed Terminal is located in the deep offshore conditions away from biologically sensitive areas and is connected to existing infrastructure. These features significantly reduce environmental impacts and ship congestion from construction, operation, and decommissioning activities that typically may be associated with land-based liquefied natural gas (LNG) facilities and associated pipeline expansion. A complete description of the construction, operation, and decommissioning activities that will be completed for BOET is included in Topic Report 1, "Project Description." Noise created during the construction, operation, and decommissioning of BOET is discussed in detail in Topic Report 8, "Air and Noise Quality."

3.3.1 Construction Impacts

Terminal construction includes shoreline fabrication and offshore installation of several components, including the support platform, pipeline end manifolds (PLEMs), the interconnect and Terminal pipelines, and the mooring points. The dimensions of each of these Terminal aspects with respect to the seafloor, and the disruptions they will cause, are displayed in Table 3-14. Fabrication will take place at an existing onshore location and will not cause an additional impact on the local environments. During construction and installation, 29 vessel trips and 40 helicopter trips are expected to occur, traveling from shore to the BOET vicinity.

Construction and installation of the facilities may affect areas within MP 258 and the pipeline corridors, such as a temporary increase in turbidity and compaction or displacement of sediment under the facility footprint, and increased noise levels from pile driving. The increased noise and turbidity associated with pipeline placement may create a minor, temporary adverse impact on local species by disrupting feeding behavior, breeding behavior, and habitat utilization.

Hydrostatic testing will affect small marine life by pulling in a total of 9.4 million gallons (36,000 m^3) of surface water through a 0.25-inch (6-mm) mesh screen. The size of the screen will exclude larger individuals, but smaller individuals located in the vicinity of the intake point will be impinged or entrained.

The construction and support vessels also will affect the water in ways typically associated with marine vessel operation, such as disposal of treated black and gray water and release of bilge water. Impacts on water quality are expected to be minor and temporary due to the large dilution capability of the GOM. For additional information on water quality and Project-related impacts see Topic Report 2, "Water Use and Quality." Pipeline construction impacts also are expected to be minimal due to laying the pipelines on the seafloor.

Table 3-14. Area and Amount of Seafloor Disruption due to Construction and Installation of BOET

Terminal Aspect	Footprint (acres)	Sediment Displaced (cubic yards)	Installation Work Area (acres)	Length (miles)	Bury Depth (feet)
Support Platform (four pilings total)	0.81	1,675	0.81	NA	400
Terminal pipeline #1 (30")	0.31	1,000	24	1	0
Terminal pipeline #2 (30")	0.31	1,000	24	1	0
HiLoad pipeline end manifold (PLEM) #1 (three pilings total)	0.02	172	0.02	NA	164
HiLoad PLEM #2 (three pilings total)	0.02	172	0.02	NA	164
Mooring Points (six pilings total)	0.0039	722	0.0039	NA	115
16" Viosca Knoll interconnect	0.20	330	30	0.83	0
24" Dauphin interconnect	1.90	4,900	200	6.80	0
24" Williams interconnect	2.80	7,100	280	8.90	0
30" Destin interconnect	2.70	8,700	230	6.20	0
Total	**9.06**	**25,771**	**788.85**	**24.73**	**NA**

3.3.1.1 Habitats

WATER COLUMN

Construction of BOET will cause increased turbidity in the water column due to the increased vessel traffic, and placement of Terminal facilities and pipelines. Although the effect is expected to be localized and limited to the time of facility placement, the turbidity may cause a decrease in an organism's ability to detect prey and predators. Therefore, the increased turbidity is considered a minor, temporary adverse impact on individuals in the area.

AQUATIC VEGETATIVE COMMUNITIES

Sargassum, as a floating algal mat, possibly will be in the pathway of support vessels during project construction. *Sargassum* directly in the path of oncoming support and transport vessels may be submerged to depths under the vessel, and portions of the mat may be destroyed by passage under the propeller. Although certain species living within the mat breathe air (e.g. sea turtles), they are able to sustain long periods under water and would not be affected by slightly prolonged submergence. It is likely that *Sargassum* mats in the path of vessels will be gently pushed away from the oncoming vessel due to the pressure of the bow waves and the buoyant nature of the mats. In the unlikely event of destruction of *Sargassum* by the propeller of a vessel, there is the potential to cause a moderate, temporary adverse impact on organisms due to loss of habitat.

SOFT BOTTOM COMMUNITIES

Construction of BOET will require some disturbance to soft bottom communities. Because the lease block consists entirely of soft bottom habitat, all facilities will affect soft bottom habitat. This is due mainly to placement of the BOET facilities. Unvegetated soft bottom is not an ecologically sensitive habitat, providing a home mainly for infauna, epifauna, and demersal fishes. Demersal fishes most likely will leave the area when faced with the disturbance of their habitat. The more immotile infauna and epifauna may suffer mortality if located under the footprint of the facilities. However, due to the design of BOET and its relatively small footprint, little soft bottom area will be covered. In addition, the pipelines will be placed on the seafloor, not buried, greatly decreasing the amount of sediment that will become suspended and thereby reducing the number of benthic organisms likely to become smothered when that sediment settles. The adverse impact on soft bottom communities therefore is considered minor but long term and would be localized to the footprint of the facilities.

HARD BOTTOM COMMUNITIES

The Live Bottom (Pinnacle Trend) Stipulation (NTL No. 2004-G05) states that a live bottom survey must be conducted prior to any construction activities or placement of any structure for exploration or development on lease blocks included in the stipulation—including, but not limited to, anchoring and pipeline and platform placement. The geohazard and archaeological survey determined the presence of live bottom areas in MP 258 and along the proposed pipeline routes. According to the live bottom survey, there are no hard bottom communities within MP 258 to be affected directly by facility placement and only small, low-relief areas along the proposed pipeline routes.

In accordance with the Live Bottom Stipulation, no bottom-disturbing activities—including those caused by anchors, chains, and cables—will be conducted within 110 ft (30 m) from any hard bottom communities/pinnacles with a vertical relief of 8 ft (2.4 m) or more. The closest area of live bottom that is affected by this stipulation is Shark Reef (maximum relief of 9.8 ft [3 m]), which is approximately 0.8 mi or 4,224 ft (1.3 km) from the Dauphin Interconnect Pipeline. Sediment resuspended by installation is expected to settle before reaching Shark Reef; therefore, no impact on the reef is expected due to installation of BOET.

Local sediment consists mainly of sand, which will settle a short distance after being suspended by the construction, depending on current speed. Increased turbidity and sediment transport to hard bottom communities is expected to cause a minor, temporary adverse impact during pipeline placement.

PROTECTED AREAS

No impact is foreseen on protected areas in the northeast GOM because of their distance from any aspect of BOET construction.

3.3.1.2 Threatened and Endangered Species

MARINE MAMMALS

Increased vessel traffic increases the likelihood of collision between ships and marine mammals, resulting in possible injury or death to some animals, vessel impact will be highly unlikely. Cetaceans typically are able to avoid vessels and all BOET construction and support vessels will be required to follow Notice to Lessees (NTL) No. 2003-G10 regarding vessel strike avoidance and injured/dead protected species reporting, which will further minimize vessel impact. Regarding vessel strike avoidance, the NTL states that a distance of 295 feet (90 m) or greater should be maintained between a vessel and a large whale, and 148 feet (45 m) or greater between vessels and smaller cetaceans. Additionally, the NTL specifies reduced speeds of 10 knots when traveling near groups of cetaceans and a travel path parallel to that of the animals. Regarding dead/injured protected species reporting, the NTL states that any protected species found in this state must be reported to either the Marine Mammal and Sea Turtle Stranding Hotline or the Marine Mammal Stranding Network. If the reporting vessel was causative of the injury/death, it also must report the incident to MMS within 24 hours.

The slowest-moving mammal species that would most likely be affected by vessel collision are manatees. Manatees are not expected to occur in the BOET vicinity, since they utilize a much shallower and nearshore environment. Of the six species of threatened or endangered whales that occur in the GOM, only the sperm whale is common. Although all of the whales utilize deeper waters, they have the ability to avoid inhospitable environments by diving or leaving the area. However, they may occasionally occur within the BOET vicinity.

Noise created by installation activities such as pile driving can adversely affect marine mammals if the sound is very loud, or occurs close to them. Noise created by pile driving at BOET is expected to be approximately 126 dB re 1 μPa, which is below the level of harassment (as described in Section 3.1.2.1). A more detailed discussion of noise created by installation of BOET is described in Topic Report 8, "Air and Noise Quality".

Ingestion of human-made debris, which could cause internal damage or introduce toxins to the system, will be minimized by following NTL No. 2003-G11 regarding OCS trash and debris. This NTL states, among other things, that marine discharge of trash and debris is prohibited under 30 CFR 250.300, that prominent placards regarding marine debris and trash disposal be placed in relevant areas, and that offshore employees and contractors must complete marine trash and debris awareness training at the start of employment and annually thereafter.

The overall adverse impact of construction activities, such as increased noise, turbidity, and vessel traffic, on threatened and endangered marine mammals is expected to be minor and temporary due to the stated mitigation measures and to the preferred habitat of these species outside the BOET vicinity.

SEA TURTLES

The five species of threatened or endangered reptiles that occur in the GOM are susceptible to vessel impact and ingestion of human-made debris. Like marine mammals, marine reptiles have the ability to dive to deeper depths to avoid an oncoming vessel or to leave an inhospitable environment. All BOET construction and support vessels will be required to follow NTL No. 2003-G10 regarding vessel strike avoidance and injured/dead protected species reporting, which will further minimize vessel impact. Regarding vessel strike avoidance, the NTL states that a distance of 148 feet (45 m) or greater should be maintained between vessels and sea turtles. Regarding dead/injured protected species reporting, the NTL states that any protected species found in this state must be reported to either the Marine Mammal and Sea Turtle Stranding Hotline or the Marine Mammal Stranding Network. If the reporting vessel was causative of the injury/death, it also must report the incident to MMS within 24 hours.

Ingestion of human-made debris, which could cause internal damage or introduce toxins to the system, will be minimized by following NTL No. 2003-G11 regarding OCS trash and debris. This NTL states, among other things, that marine discharge of trash and debris is prohibited under 30 CFR 250.300, that prominent placards regarding marine debris and trash disposal be placed in relevant areas, and that offshore employees and contractors must complete marine trash and debris awareness training at the start of employment and annually thereafter.

The overall adverse impact of construction activities, such as increased noise, turbidity, and vessel traffic, on sea turtles is expected to be minor and temporary due to the stated mitigation measures and the ability of these species to avoid an inhospitable environment.

PROTECTED BIRDS

The brown pelican is listed as endangered in certain areas of the United States, but it has been de-listed in Alabama. The occurrence of this species generally is limited to coastal waters out to

12 mi (20 km) from shore and is therefore outside the BOET vicinity. No impact on the brown pelican is expected from construction of BOET.

PROTECTED FISH

The ranges of both species of protected fish in the GOM, the Gulf sturgeon and the smalltooth sawfish, are much closer to shore and do not occur within the BOET vicinity. Therefore, no impact on these two species is expected from construction of BOET.

3.3.1.3 Non-Threatened and Non-Endangered Species

MARINE MAMMALS

Non-threatened and non-endangered marine mammals species may be affected in ways identical to those described for threatened and endangered marine mammals, via vessel impact and debris ingestion. Bow-riding is a common practice of the smaller GOM species such as the bottlenose dolphin, and they are unlikely to be involved in a vessel collision. Additionally, NTL No. 2003-G10, regarding vessel strike avoidance and injured/dead protected species reporting, will be followed by BOET vessels, further minimizing vessel impact. The NTL states that a distance of 148 feet (45 m) or greater should be maintained between vessels and the smaller cetaceans. The NTL also specifies reduced speeds of 10 knots when traveling near groups of cetaceans and a travel path parallel to that of the animals. Regarding dead/injured protected species reporting, the NTL states that any protected species found in this state must be reported to either the Marine Mammal and Sea Turtle Stranding Hotline or the Marine Mammal Stranding Network. If the reporting vessel was causative of the injury/death, it also must report the incident to MMS within 24 hours.

Noise created by installation activities such as pile driving can adversely affect marine mammals if the sound is very loud or occurs close to them. Noise created by pile driving at BOET is expected to be approximately 126 dB re 1 μPa, which is below the level of harassment (as described in Section 3.1.2.1). A more detailed discussion of noise created by the installation of BOET is described in Topic Report 8, "Air and Noise Quality."

NTL No. 2003-G11 regarding OCS trash and debris will be followed to minimize the impact of construction on marine mammals. This NTL states, among other things, that marine discharge of trash and debris is prohibited under 30 CFR 250.300, that prominent placards regarding marine debris and trash disposal be placed in relevant areas, and that offshore employees and contractors must complete marine trash and debris awareness training at the start of employment and annually thereafter.

The adverse impact of construction, such as increased noise, turbidity, and vessel traffic, on these marine mammals is expected to be minor and temporary due to the stated mitigation measures and the ability of these species to avoid an inhospitable environment.

SEA TURTLES

All sea turtles within the GOM are listed as threatened or endangered; potential impacts are therefore discussed in Section 3.3.1.2.

SEABIRDS

Seabirds are unlikely to be affected by construction of BOET. Species found at that distance from shore generally spend much of their time in flight but may rest on passing vessels. Human-made debris lost from vessels may affect species if ingested; however, guidelines for trash disposal will be followed to minimize the amount of debris lost. Adverse construction impacts on seabirds are expected to be minor and temporary.

FISH

Construction of BOET may cause increased turbidity in the water column, thereby decreasing the ability of fish to detect both prey and predators. Because the increased turbidity will also decrease the visual abilities of predators, the adverse impact on fish due to construction in the BOET vicinity is expected to be minor and temporary.

ICHTHYOPLANKTON

Ichthyoplankton are confined to the water column and will not be affected by the sediment resuspended by installation of BOET and its pipelines. Any effect on water quality from construction activities or vessel discharge of waste and water at the surface will quickly become negligible due to the vast dilution capacity of the ocean. Hydrostatic testing will affect ichthyoplankton through entrainment into the pipeline or impingement onto the intake screen. Adverse impacts on ichthyoplankton from construction in the BOET vicinity are expected to be minor and temporary.

PHYTOPLANKTON

Phytoplankton are confined to the water column and will not be affected by the sediment resuspended by installation of BOET and its pipelines. Any effect on water quality from construction activities or vessel discharge of waste and water at the surface will quickly become negligible due to the vast dilution capacity of the ocean. Hydrostatic testing will affect phytoplankton through entrainment into the pipeline or impingement onto the intake screen. Adverse impacts on phytoplankton from construction in the BOET vicinity are expected to be minor and temporary.

ZOOPLANKTON

Zooplankton are confined to the water column and will not be affected by the sediment resuspended by installation of BOET and its pipelines. Any effect on water quality from construction activities or vessel discharge of waste and water at the surface will quickly become negligible due to the vast dilution capacity of the ocean. Hydrostatic testing will affect zooplankton through entrainment into the pipeline or impingement onto the intake screen. Adverse impacts on zooplankton from construction in the BOET vicinity are expected to be minor and temporary.

3.3.1.4 Fisheries

CRUSTACEANS

In general, white and pink shrimp utilize water depths other than those in the BOET vicinity. Brown and royal red shrimp may occur in the area but are not expected often due to the location of the Terminal at the extreme edge of their ranges. Shrimp fisheries may be deterred from the BOET vicinity during construction due to the spatial needs of facility construction. Because BOET is not in an area of high shrimp abundance, the adverse construction impacts of BOET on the shrimp fishery are expected to be negligible and temporary. For socioeconomic impacts on the shrimp fishery, see Topic Report 5, "Socioeconomics."

MOLLUSKS

Shellfish fisheries of the GOM are limited to more coastal areas and are not expected to be affected by construction of BOET. For socioeconomic impacts on the mollusk fishery, see Topic Report 5, "Socioeconomics."

FINFISH

Fishery activities may decrease in the area of BOET temporarily during construction activities. This is due in part to the spatial needs of construction and to the likely event of species moving away from an inhospitable environment. Adverse impacts on the finfish fisheries during BOET construction are expected to be minor and temporary. For socioeconomic impacts on the finfish fisheries, see Topic Report 5, "Socioeconomics."

ESSENTIAL FISH HABITAT

Construction of BOET will affect small areas of EFH in the northern GOM due to the footprint of the proposed facilities. The soft bottom areas that will be affected by terminal placement and anchoring are generally not ecologically sensitive, although they are included in the EFH. Anchoring will occur only during installation and within MP 258. Vessels involved in pipeline placement will use dynamic positioning, avoiding the need to anchor. The high availability of the soft bottom substrate throughout the GOM indicates that impact to the species that use that habitat will be adverse, but minor and temporary.

3.3.2 Operation Impacts

Operation impacts are limited to increased vessel traffic and associated discharges, increased helicopter traffic, support platform operations, and the intake and outflow of water for LNG regasification, along with the noise created by cleaning intake screens. LNG carriers attach to mooring points and do not need to anchor, avoiding increased turbidity and disturbance of the seafloor.

During operation, a maximum of 159 LNG carriers are expected to visit BOET each year. Each time an LNG carrier visits, two vessels will be deployed from the Terminal—one traveling approximately 20 miles (32 km) to meet the LNG carrier, and one traveling 1 mile (1.6 km) to reach the HiLoad. In addition, each year 64 vessels and 52 helicopters are expected to travel from BOET to shore. These activities will cause a temporary decrease in water quality in the area that will quickly become diluted, an increase in the amount of debris lost at sea, and an increase in noise levels.

For LNG regasification, the HiLoad will use a maximum of 126.7 million gallons per day (mgd) (479,612 m^3 per day) of seawater to heat the LNG. The water will be taken in through eight seawater intake filters at a depth of 75 to 90 ft (23 to 27 m) below the surface, depending on the draft of the LNG carrier. The screen slot opening of the intake filter will be 5/64 inch (2 mm), with pumps selected to maintain an intake velocity of less than 0.5 ft/s (0.15 m/s). The seawater will be cooled by 20 °F (11 °C) during passage through the vaporizers before being discharged at a depth of 90–105 ft (27–32 m). Design of the discharge system will ensure that the temperature differential of the discharge plume will not exceed 3 °F (1.7 °C) within 328 ft (100 m) of the discharge point. The intake velocity of the seawater is similar to the natural current speed in the BOET vicinity so that the flow of water will not create excess turbidity in the water column.

No chemicals will be added to the intake water to prevent biofouling of the piping during regasification. Instead, any organisms that have settled during regasification will be removed (via sodium hypochlorite injection and water circulation within the pipes) during the idle period of the HiLoad. The treated water will be reused as needed and then transported to shore. This process eliminates the need to release sodium hypochlorite into the environment. The treated water will be stored for a maximum of 60 days, at which time, the by-products of sodium hypochlorite (trihalomethanes [THMs], primarily bromoform) are expected to have reached levels of approximately 0.28 mg/L. Although a tank breach is unlikely, research has shown that many marine organisms, with the exception of the American oyster, would not be harmed by a concentration this low (UKMSAC undated).

During operation, the intake of water for regasification may cause small organisms and debris to become impinged on the intake screens. Material that is not removed by the sweeping flow will be removed from the screen by a burst of air, or airburst, that will force all remaining material from the screen. Preliminary information on the characterization of the sound created by the airburst was determined by testing a similar airburst system. Those characteristics are shown in

Table 3-15. Although the airburst of the proposed system is expected to be louder (a higher decibel sound), the frequency of the sound and the rate of attenuation are expected to be the same. At startup of operations, each of the 16 screens (8 screens per HiLoad) will be cleaned once per day by use of the airburst. One screen will be cleaned at a time, followed by a 20-minute interval before the next screen is cleaned. Each burst will last approximately 10 seconds, with the highest intensity sound occurring for approximately 2 seconds. After an initial start-up period, differential pressure sensors on the screens will determine the frequency of airbursts needed. Based on the hydrodynamic design of the screens and their position within the water column, plugging is not expected to occur frequently. Therefore, the frequency of the necessary airbursts is expected to be less than once per day.

Table 3-15. Sound Characterization of the Airburst System

Test #	Distance from Source (ft)	Sound Duration (sec)	Estimated Maximum Intensity (dB re 1 µPa)	dB Change	Sound Intensity (Hz)
Source	0	---	108.77	---	---
1	35	10.10	108.50	0.0076/ft	10.60
2	100	6.30	108.01	0.0075/ft	7.00
3	400	1.65	105.34	0.0089/ft	15.00
4	500	2.00	104.69	0.0065/ft	18.00
5	1,000	---	100.88	3.81/500 ft	---
6	1,500	---	97.07	3.81/500 ft	---
7	2,000	---	93.26	3.81/500 ft	---
8	3,000	---	85.64	3.81/500 ft	---
9	4,000	---	78.02	3.81/500 ft	---
10	5,000	---	70.40	3.81/500 ft	---
11	10,000	---	51.35	3.81/500 ft	---

Note: The value of the source was estimated; the values of tests 1–4 were measured during the study; the values of tests 5–11 were calculated values per regression.

--- = Information not calculated.

Source: Cook Legacy 2005.

Although unlikely, due to safety precautions taken at BOET, LNG spills are anticipated to cause an adverse impact on marine life that utilizes surface waters, such as marine mammals, sea turtles, and marine birds. A spill can affect these species through cryogenic burning, asphyxiation, or other injuries related to LNG fires or rapid phase transition (RPT). Because LNG is stored at such a low temperature (-262 ºF [-163 ºF]), a pool of spilled LNG likely would cause a cryogenic burn to any animal that came into contact with it for an extended period of time (SNL 2004). However, once the liquid is released, it begins to evaporate to the air, limiting the amount of time that the pool is available for contact (SNL 2004). The concentration of LNG would be highest in the center of the cloud, dispersing as the cloud expands. As the cloud expands, the volume of the LNG vapor in air will attain a flammable volume (between 5.5 and 15 percent in air) (CEC 2003). During this flammable period, a nearby ignition source could cause the vapor to ignite, burning the evaporating gas and causing a "pool fire" over the spilled LNG (CEC 2003). RPT can occur when contact between a cold and a hot liquid causes the cold liquid to reach its superheat limit, resulting in a spontaneous and explosive burning off of the cold liquid (SNL 2004). LNG spills would cause a moderate, temporary adverse impact to any species that comes into contact with either the spilled LNG or a vapor cloud capable of displacing oxygen. An LNG spill would cause a major, long-term adverse impact to species that are in the immediate vicinity of a pool fire or RPT. Most of the marine life that utilizes surface water is able to avoid an inhospitable environment. LNG does not dissolve in water and will boil off completely; therefore, no residual impacts on water quality, pelagic EFH, or local species are expected after the LNG has boiled off and the vapors have dispersed.

The presence of the support platform will result in a long-term, moderate beneficial impact on local species due to the habitat it will provide. Discharges from the support platform (Approximately 309,802 gpd, representing cooling water, treated sanitary wastes, potable water treatment, hypochlorite generator cleaning water, and washdown waters) would be similar to currently accepted discharges from manned platforms in the area, and would quickly dilute in the open GOM. Because existing platforms in the area are able to sustain a hospitable environment with similar discharges, the discharges from BOET are expected to result in a long-term, minor adverse impact on local species.

3.3.2.1 Habitats

WATER COLUMN

The HiLoad discharge plume will affect the water column by cooling the local water. The temperature of the water will return to within 3 °F (1.7 °C) within 328 ft (100 m) of the discharge point. No chemicals will be added to the discharge water. This constitutes a long-term moderate, but local, adverse impact on the water column.

AQUATIC VEGETATIVE COMMUNITIES

Sargassum, as a floating algal mat, will possibly be in the pathway of support vessels and LNG carriers during operation. *Sargassum* directly in the path of oncoming support and transport vessels may be submerged to depths under the vessel, and portions of the mat may be destroyed by passage under the propeller. Although certain species living within the mat breathe air (e.g. sea turtles), they are able to sustain long periods under water and will not be affected by slightly prolonged submergence. However, it is likely that *Sargassum* mats in the path of vessels will be gently pushed away from the oncoming vessel due to the pressure of the bow waves and the buoyant nature of the mats. In the unlikely event of destruction of *Sargassum* by the propeller of a vessel, there is the potential to cause a moderate, temporary adverse impact on organisms due to loss of habitat.

SOFT BOTTOM COMMUNITIES

Soft bottom habitat located adjacent to the footprint of the Terminal or pipelines, and their associated benthic assemblages, will not be altered by operations as no anchoring or other bottom-disturbing activities will occur. Aside from the non-motile organisms that were lost beneath the footprint, the vast expanse of soft bottom in the BOET vicinity guarantees that ample habitat will remain.

HARD BOTTOM COMMUNITIES

All hard bottom communities are at least 4.6 mi (7.4 km) away from the support platform. Therefore, no impacts on hard bottom communities are expected due to BOET operation. Once constructed, the Terminal will function as an artificial reef, providing a hard substrate to which organisms can recruit. That colonization of organisms, and the presence of the Terminal itself, will attract fish species—making the Terminal a stand-alone community. In addition, because fishing is prohibited in the 1,640-ft (500-m) safety zone, fish species are provided a refuge and the community will likely become large and diverse. The addition of hard substrate for habitat utilization is considered a moderate, positive, and long-term impact.

PROTECTED AREAS

All protected areas are at least 4.6 mi (7.4 km) away from the support platform. Therefore, no impacts are expected on protected areas due to BOET operation.

3.3.2.2 Threatened and Endangered Species

MARINE MAMMALS

While increased vessel traffic increases the likelihood of collision between ships and marine mammals, resulting in possible injury or death to some animals, vessel impact will be highly unlikely. The majority of collisions appear to occur over or near the continental shelf, with most lethal or severe injuries caused by ships 262 ft (80 m) or longer and ships traveling 14 knots or faster (MMS 2002c). Vessels operated by BOET will be approximately 100 feet (30 m) long, will generally travel at speeds of 12 to 16 knots, and will follow guidelines in NTL No. 2003-G10 regarding marine mammal avoidance by marine vessels and dead/injured protected species reporting (see Section 3.3.1.2), decreasing the chance of collision. A BOET mooring master will board LNG carriers approximately 20 miles (32 km) south of the facilities, at which point, the LNG carriers also will be required to follow NTL No. 2003-G10. Before boarding of the mooring master, BOET has no control over the LNG carriers entering the GOM, of which from 110 to 159 are expected each year (depending on their size). However, vessels en route to BOET will be advised to follow NTL No. 2003-G10, thereby minimizing possible strikes. Ingestion of man-made debris could cause internal damage or introduce toxins to the system. These impacts will be minimized by following NTL No. 2003-G11 regarding marine trash and debris (see Section 3.3.1.2).

All of the threatened and endangered cetaceans that occur in northern GOM, with the exception of the sperm whale, are low-frequency cetaceans. Their estimated auditory bandwidth is from 7 Hz to 22 kHz (NECG 2005, unpublished). The low frequencies of the airbursts have the potential to mask sound from these species. However, operation of the airburst system is expected to be minimal after the initial start-up of operations, and all of the low-frequency threatened and endangered cetaceans that occur in the northern GOM are rare or extralimital to the area. Therefore, no masking affects are expected to occur to this group. The sperm whale is the only common threatened or endangered cetacean that occurs in the northern GOM and has an estimated auditory bandwidth of 150 Hz to 160 kHz. Because the frequency range of the sperm whale is outside that of the airburst, no masking is expected. Although the decibel level of the sound for the proposed system will be higher than what is reported in Table 3-15, the reported sound level is low enough to imply that the airburst at BOET will not create a sound loud enough to approach harassment levels.

During operation, approximately 52 helicopters are expected to visit BOET per year. This will increase the ambient noise levels within the BOET vicinity and become a potential source of stress to the threatened and endangered species that occur in the area.

The overall adverse impact of operation activities on threatened and endangered marine mammals is expected to be minor and long term.

SEA TURTLES

The five species of threatened or endangered reptiles that occur in the GOM are susceptible to vessel impact and ingestion of human-made debris. Like marine mammals, marine reptiles have the ability to dive to deeper depths to avoid an oncoming vessel or to leave an inhospitable environment. All BOET vessels will be required to follow NTL No. 2003-G10 for sea turtle avoidance by marine vessels (see Section 3.3.1.2), which will further minimize vessel impact. Ingestion of man-made debris, which could cause internal damage or introduce toxins to the system, will be minimized by following NTL No. 2003-G11 regarding marine trash and debris (see Section 3.3.1.2).

The presence of the support platform likely will result in a long-term, minor beneficial impact on adult sea turtles due to the increase in substrate and therefore prey items. Hatchling and juvenile sea turtles are not expected to often utilize the support platform due to their preference for traveling in *Sargassum* mats or utilizing more shallow water habitats. If a hatchling or juvenile does utilize the support platform, it would be subject to increased predation, resulting in a long-term, major adverse impact on individuals. The lighting of terminals closer to shore may disorient the offshore migration of neonates; however, BOET is of a sufficient distance from shore so that impact from lighting is not expected. The overall adverse impact of operation activities on sea turtles is expected to be minor and long term.

PROTECTED BIRDS

The brown pelican is listed as endangered in certain areas of the United States, but it has been de-listed in Alabama. The occurrence of this species generally is limited to coastal waters out to 12 mi (20 km) from shore and is therefore outside the BOET vicinity. No impact on the brown pelican is expected during operation of BOET.

PROTECTED FISH

The ranges of both species of protected fish in the GOM, the Gulf sturgeon and the smalltooth sawfish, are much closer to shore and do not occur within the BOET vicinity. Therefore, no impact on either of these two species is expected from operation of BOET.

3.3.2.3 Non-Threatened and Non-Endangered Species

MARINE MAMMALS

Increased vessel traffic increases the likelihood of collision between ships and marine mammals, resulting in possible injury or death to some animals. Most species of non-threatened and non-endangered marine mammals in the GOM are the smaller delphinids that often choose to ride the bow waves of nearby vessels and seem adept at avoiding injury. As noted earlier, the majority of collisions involving marine mammals appear to occur over or near the continental shelf, with most lethal or severe injuries caused by ships 262 ft (80 m) or longer and ships traveling 14 knots or faster (MMS 2002c). Vessels operated by BOET will be approximately 100 ft (30 m) long, will generally travel at 12 to 16 knots, and will follow NTL No. 2003-G10 regarding marine mammal avoidance by marine vessels and dead/injured protected species reporting (see Section 3.3.1.2), decreasing the chance of collision. A BOET mooring master will board LNG carriers approximately 20 miles (32 km) south of the facilities, at which point, the LNG carriers also will be required to follow NTL No. 2003-G10. Before boarding of the mooring master, BOET has no control over the LNG carriers entering the GOM, of which from 110 to 159 are expected each year (depending on their size). However, vessels en route to BOET will be advised to follow NTL No. 2003-G10, thereby minimizing possible strikes. Ingestion of man-made debris could cause internal damage or introduce toxins to the system. These impacts will be minimized by following NTL No. 2003-G11 regarding marine trash and debris (see Section 3.3.1.2).

All of the non-threatened and non-endangered cetaceans that occur in northern GOM, with the exception of the Bryde's whale, are mid-frequency cetaceans. Their estimated auditory bandwidth is from 150 Hz to 160 kHz (NECG 2005, unpublished). The low frequencies of the airbursts do not have the potential to mask sound from these species. The Bryde's whale is a low-frequency cetacean (estimated auditory bandwidth of 7 Hz to 22 kHz) and operation of the airburst system has the potential to mask biologically important sounds. However, because the Bryde's whale is considered uncommon in the northern GOM, and the use of the airburst system is expected to be minimal after the initial start-up of operations, impact to the Bryde's whale from masking is expected to be long-term and adverse, but negligible. Although the decibel level of the sound for the proposed system will be higher than what is reported in Table 3-15, the reported sound level is low enough to imply that the airburst at BOET will not create a sound loud enough to approach harassment levels.

During operation, approximately 52 helicopters are expected to visit BOET per year. This will increase the ambient noise levels within the BOET vicinity and become a potential source of stress to the species that occur in the area. The overall adverse impact of operation activities on marine mammals is expected to be minor and long term.

SEA TURTLES

All marine reptiles within the GOM are listed as threatened or endangered; operation impacts for these species are discussed in Section 3.3.2.2.

SEABIRDS

Platforms have three primary proximate impacts on migrant birds: (1) they provide habitat for resting and refueling; (2) they induce nocturnal circulations (circling the platform, evidently to remain near the light); and (3) they result in some mortality through collisions (Russell 2005). Mortality caused by in-flight impact is considered a minor, long-term adverse impact on bird populations; however, the beneficial effects of the presence of the platform for seabird populations most likely would outweigh the detrimental effects of potential collisions, by increasing the percentage that is able to return to land.

FISH

Construction of BOET may cause increased turbidity in the water column, thereby decreasing the ability of fish to detect both prey and predators. Because the increased turbidity will also decrease the visual abilities of predators, the adverse impact on fish due to construction in the BOET vicinity is expected to be minor and temporary.

ICHTHYOPLANKTON

Water taken into the HiLoad for regasification will be taken in through a screen of mesh size 5/64 inches (2 mm) and an intake velocity of less than 0.5 ft/s (0.15 m/s). Natural current cross-sweeping will reduce the number of ichthyoplankton caught in the inflow of water. In the event that ichthyoplankton are pulled toward the HiLoad, those small enough to flow through the mesh will become entrained; the larger ichthyoplankton, if unable to swim out of the current, will become impinged on the screen surface and swept off by the current.

The change in water temperature at the discharge point, in the range of 20 °F (11 °C), likely will affect local ichthyoplankton up to various distances, depending on how quickly the temperature returns to ambient and the range of temperature tolerance of the ichthyoplankton. The first impact will be associated with the start-up of regasification. After the start-up of the plume, the outward flow of the water should keep any new ichthyoplankton from entering into the coldest zone of water. There will be no chemicals in the discharge plume.

According to the SEAMAP data, average densities in the sampling area are 2.410 larvae and 1.210 eggs per 3.3 ft^3 (1 m^3). The potential entrainment of fish eggs and larvae was obtained by multiplying densities observed during the SEAMAP studies by three to account for net extrusion. That adjusted density was multiplied by the daily average intake volume of BOET times the days of exposure. According to these calculations, approximately 637 million fish eggs and 1.3 billion larval fish will be entrained through the system or impinged on the screen each year. Consistent with USCG and MARAD (2004b), as amended by USCG and MARAD (2005a), the key fish species of concern were red drum, red snapper, Gulf menhaden, and bay anchovy. Although all of these species occur in the region of BOET, red drum, bay anchovy, and Gulf menhaden are not expected to be common at the Terminal itself due to their preferred depth ranges. The SEAMAP block for BOET was determined using the Hanisko method. The block was then rotated 20 degrees, per NMFS guidance, to place it along depth contours similar to those found at BOET—in an attempt to exclude sampling of species that utilize much shallower or deeper waters.. From the SEAMAP data, the number of eggs and larvae of each of these species expected to be entrained/impinged was calculated, as well as the corresponding number of age-1 equivalents and biomass lost (Table 3-16) from the BOET vicinity. A more thorough description of the SEAMAP data analysis is included in Appendices A-1 and A-2.

Estimates of key species lost are considered high because, with the exception of the red snapper, the preferred depths of the larvae are much shallower than the depths of the proposed Terminal. The combined influences of the entrainment/impingement of the intake and the temperature change of the discharge plume impact a high number of ichthyoplankton, but with regard to the ichthyoplankton population, the operation impact of BOET is expected to be adverse and long-term, but minor.

Table 3-16. Entrainment/Impingement Values of Species of Concern Based on SEAMAP Regional Data

Species	Eggs	Larvae	Age-1 Representatives Lost	Age-1 Biomass Lost (lbs)
Bay anchovy	52,116,616	104,372,859	58,335	---
Gulf menhaden	637,560,173	1,276,828,458	1,196,407	94,851
Red drum	97,905	196,072	184	654
Red snapper	175,255	350,979	147	174

Note: Because anchovies are not fished, the biomass lost was not calculated.

Some larval fish undergo vertical diurnal migrations and are concentrated in deeper waters during the day and in shallower waters at night. These species are typically exposed to a wide range of water temperatures and show increased levels of thermal tolerance (Myers et al. 1986). Some larval species could be affected by sudden exposure to the cold temperatures. However, information on lethal temperature levels in ichthyoplankton is not readily available. The discharge plume will have a cold core that may affect larval fish that occur there, but as the plume moves out and away from the discharge point, the water will warm and there will be no further impact on the larvae.

PHYTOPLANKTON

Water taken into the HiLoad for regasification will be taken in through a screen of mesh size 5/64 inches (2 mm) and an intake velocity of less than 0.5 ft/s (0.15 m/s). Natural current cross-sweeping will reduce the number of phytoplankton caught in the inflow of water. Individual phytoplankton are very small and, if pulled toward the HiLoad, will become entrained through the mesh. Chain-forming phytoplankton pulled toward the HiLoad likely will become impinged on the screen surface and then swept off by the sweeping current.

The change in water temperature at the discharge point, in the range of 20.0 °F (11 °C), likely will affect local phytoplankton up to various distances—depending on how quickly the temperature returns to ambient and the range of temperature tolerance of the plankton. The first impact will be associated with the start-up of regasification. After the start-up of the plume, the outward flow of the water should keep any new phytoplankton from entering into the coldest zone of water. There will be no chemicals in the discharge plume.

Due to the high reproductive capacity of phytoplankton, adverse operation impacts are expected to be minor but long term.

Phytoplankton may be affected by sudden exposure to the cold discharge. However, as the plume moves out and away from the discharge point, the water will warm and there will be no further impact on phytoplankton.

ZOOPLANKTON

Water taken into the HiLoad for regasification will be taken in through a screen of mesh size 5/64 inches (2 mm) and an intake velocity of less than 0.5 ft/s (0.15 m/s). Natural current cross-sweeping will reduce the number of zooplankton caught in the inflow of water. In the event that zooplankton are pulled toward the HiLoad, those small enough to flow through the mesh will become entrained; the larger zooplankton, will become impinged on the screen surface and then swept off by the sweeping current.

The change in water temperature at the discharge point, in the range of 20 °F (11 °C), likely will affect local zooplankton up to various distances, depending on how quickly the temperature returns to ambient and the range of temperature tolerance of the zooplankton. The first impact will be associated with the start-up of regasification. After the start-up of the plume, the outward flow of the water should keep any new plankton from entering into the coldest zone of water. There will be no chemicals in the discharge plume.

Due to the highly reproductive capacity of zooplankton, adverse operation impacts are expected to be minor but long term.

Some zooplankton undergo vertical diurnal migrations, concentrated in deeper waters during the day and in shallower waters at night. These species are typically exposed to a wide range of water temperatures and show increased levels of thermal tolerance (Myers et al. 1986). Some zooplankton may be affected by sudden exposure to the cold temperatures. However, as the plume moves out and away from the discharge point, the water will warm and there will be no further impact on zooplankton.

3.3.2.4 Fisheries

CRUSTACEANS

In general, white and pink shrimp utilize water depths shallower than those in the BOET vicinity. Brown and royal red shrimp may occur in the area but are not expected often due to the location of the Terminal at the extreme edge of their ranges. Shrimp larvae that do occur in the area may be entrained or impinged by the intake on the HiLoads. This will cause a slight decrease in the number of shrimp that make it into the fishery. Shrimp fisheries will not be able to utilize areas within the safety zones of the Support Platform and HiLoads. Because BOET is not in an area of high shrimp abundance, the shrimp fishery is expected to experience a negligible, long-term adverse impact from operation of BOET. For socioeconomic impacts on the shrimp fishery, see Topic Report 5, “Socioeconomics.”

MOLLUSKS

Shellfish fisheries of the GOM are limited to more coastal areas and are not expected to be affected by normal operation of BOET. The American oyster has been shown to be sensitive to low levels of bromoform (0.05 mg/L), which is expected to be the main component of the treated water transported from the HiLoad to shore. Therefore, the offshore service vessel route to shore (during transport of the treated water) will avoid any oyster bed so that, in the unlikely event of a spill, ample time would be available for the solution to dilute before reaching any sensitive area. For socioeconomic impacts on the mollusk fishery, see Topic Report 5, “Socioeconomics.”

FINFISH

Larval fish (ichthyoplankton) that occur in the area of the proposed Terminal may be entrained or impinged by the intake on the HiLoads. This will cause a slight decrease in the number of each fish species that makes it into the fishery. In addition, finfish fisheries will not be able to utilize areas within the safety zones of the Terminal and the HiLoads. The finfish fishery is expected to experience a negligible, long-term adverse impact from operation of BOET. See Topic Report 5, “Socioeconomics,” concerning socioeconomic impacts on the finfish fisheries.

ESSENTIAL FISH HABITAT

Although the HiLoads float in water depths of 450–460 ft (137–140 m), operation of BOET is expected to disturb only the top 150 ft (46 m) of the water. Pelagic EFH will be disturbed via the intake of water and the cold-water discharge plume, along with the discharges associated with increased vessel traffic. Any impacts on EFH from the coldwater and vessel discharges will be localized, and many other pelagic areas can be utilized by species. This adverse impact is considered minor but long term. The soft bottom of the BOET vicinity also is included in the EFH of certain species. This environment is not expected to be affected by operation of the Terminal due to the depth of the water in which it will be located.

3.3.3 Decommissioning Impacts

BOET is designed for a 25-year life. Decommissioning plans for the Terminal are generally to follow conventional OCS abandonment practices for the facilities at the time of abandonment. The HiLoads and risers will be disconnected and returned to land for disposal. The support platform decks will be cleared of equipment, and materials will be returned to land for disposal or salvage as appropriate. The legs of the platform will be cut at the mudline and disposed of in accordance with the current MMS requirements. The HiLoads, PLEMs, and mooring points will be removed while leaving the buried pilings of the PLEMS and mooring points in place. The pipeline components will be abandoned in place, also in accordance with MMS requirements, thus avoiding disruption of the seafloor and of the biota that may have colonized the hard substrate that the pipeline provided.

The use of explosives during decommissioning could cause short- or long-term, minor to major adverse impacts on local species. Injuries from underwater explosions result from the rapid rise time of the shock wave and the negative pressure wave generated by the collapsing bubble (CSA 2004). Possible injuries from explosives include temporary or permanent threshold shift in hearing, visceral hemorrhage, tactile discomfort, or death (MMS 2005). The use of explosives is not proposed for BOET decommissioning; however, should it be considered in the future, a blast plan would be written, consultation under Section 7 of the ESA would be sought, and all applicable regulations (such as those given in NTL No. 2004-G06 regarding structure removal) would be followed.

Approximately 29 vessel trips and 40 helicopter trips are expected during decommissioning. These activities will cause a temporary decrease in water quality in the area that quickly will be diluted and increases in the potential amount of debris lost at sea, noise levels, and sediment disruption from anchoring vessels.

3.3.3.1 Habitats

WATER COLUMN

The cutting and removal of Terminal facilities, as well as the increased vessel traffic this necessitates, will increase the turbidity of the local waters. This adverse impact is considered minor and will be limited to the time required for facility removal, after which, conditions will quickly return to pre-decommissioning status.

AQUATIC VEGETATIVE COMMUNITIES

Sargassum, as a floating algal mat, will possibly be in the pathway of support vessels during project decommissioning. *Sargassum* directly in the path of oncoming support and transport vessels may be submerged to depths under the vessel, and portions of the mat may be destroyed by passage under the prop. Although certain species living within the mat breathe air (e.g. sea turtles), they are able to sustain long periods under water and will not be affected by slightly prolonged submergence. It is likely that *Sargassum* mats in the path of vessels will be gently pushed away from the oncoming vessel due to the pressure of the bow waves and the buoyant nature of the mats. In the unlikely event of destruction of *Sargassum* by the propeller of a vessel, the potential exists for a moderate, temporary adverse impact on organisms due to loss of habitat.

SOFT BOTTOM COMMUNITIES

Decommissioning of BOET will require some disturbance to soft bottom communities. Because the proposed lease block consists entirely of soft bottom habitat, all activities associated with the seafloor will affect soft bottom habitat. Turbidity will be increased during cutting and removal of the support platform, PLEMs, and mooring points—possibly decreasing the ability of local species to detect prey and predators. Most likely, the local fish will leave the area as a reaction to the removal activities and will not be affected by the increased turbidity. The adverse impact on soft bottom communities is expected to be minor and temporary—and will be limited to the duration of time that it takes for facility removal, after which, conditions will quickly return to preconstruction status.

HARD BOTTOM COMMUNITIES

All hard bottom areas are at least 4.6 miles (7.4 km) away from the Terminal. Therefore, no impacts on hard bottom areas are expected due to BOET decommissioning.

PROTECTED AREAS

No impact is foreseen on protected areas in the northeast GOM due to their distance from any aspect of BOET decommissioning.

3.3.3.2 Threatened and Endangered Species

MARINE MAMMALS

While increased vessel traffic during decommissioning increases the likelihood of collision between ships and marine mammals, resulting in possible injury or death to some animals, vessel impact is highly unlikely. Cetaceans typically are able to avoid vessels, and all BOET decommissioning vessels will be required to follow NTL No. 2003-G10 regarding marine mammal avoidance by marine vessels and dead/injured protected species reporting (see Section .3.1.2),which will further minimize vessel impact.

The slowest-moving mammal species that would most likely be affected by vessel collision are manatees. Manatees are not expected to occur in the BOET vicinity, they utilize a much shallower and nearshore environment. Of the six species of threatened or endangered whales that occur in the GOM, only the sperm whale is common. Although all of the whales utilize deeper waters, they have the ability to avoid inhospitable environments by diving or leaving the area.

Blasting is not currently proposed for Terminal removal and the noise created during decommissioning is expected to be minimal. Should blasting be required, it would be performed in accordance with applicable regulations at the time for protection of all marine species, including a consultation under Section 7 of the ESA.

Guidelines for avoidance and trash disposal (NTL No. 2003-G11) will be followed to minimize the impact of decommissioning on marine mammals. The overall adverse impact of proposed decommissioning activities on threatened and endangered marine mammals is expected to be minor and temporary.

SEA TURTLES

The five species of threatened or endangered reptiles that occur in the GOM are susceptible to vessel impact and ingestion of man-made debris. Like marine mammals, marine reptiles have the ability to dive to deeper depths to avoid an oncoming vessel or to leave an inhospitable environment. All BOET vessels will be required to follow NTL No. 2003-G10 regarding sea turtle avoidance by marine vessels and dead/injured protected species reporting (see Section 3.3.1.2), which will further minimize vessel impact. Ingestion of man-made debris, which could cause internal damage or introduce toxins to the system, will be minimized by following current trash disposal guidance (NTL No 2003-G11). Blasting is not currently proposed for Terminal removal and the noise created during decommissioning is expected to be minimal. Should blasting be required, it would be performed in accordance with applicable regulations at the time for protection of all marine species, including a consultation under Section 7 of the ESA. The overall adverse impact of decommissioning activities on sea turtles is expected to be minor and temporary.

PROTECTED BIRDS

The brown pelican is listed as endangered in certain areas of the United States, but it has been de-listed in Alabama. The occurrence of this species generally is limited to coastal waters out to 12 mi (20 km) from shore and is therefore outside the BOET vicinity. No impact on the brown pelican is expected during decommissioning of BOET.

PROTECTED FISH

The ranges of both species of protected fish in the GOM, the Gulf sturgeon and the smalltooth sawfish, are much closer to shore and do not occur within the BOET vicinity. Therefore, no impact on these two species is expected from decommissioning of BOET.

3.3.3.3 Non-Threatened and Non-Endangered Species

MARINE MAMMALS

Non-threatened and non-endangered marine mammals species may be affected in ways identical to those described for threatened and endangered marine mammals, via vessel impact and debris ingestion. Bow-riding is a common practice of the smaller GOM species such as the bottlenose dolphin, and they are unlikely to be involved in a vessel collision. Additionally, all BOET vessels will be required to follow NTL No. 2003-G10 regarding marine mammal avoidance by marine vessels and dead/injured protected species reporting (see Section 3.3.1.2).

Guidelines for avoidance and trash disposal (NTL No. 2003-G11) will be followed to minimize the impact of construction on marine mammals. Blasting is not proposed for Terminal removal and the noise created during decommissioning is expected to be minimal. Should blasting be required, it would be performed in accordance with applicable regulations at the time for protection of all marine species. The adverse impact of decommissioning on these marine mammals is expected to be minor and temporary.

SEA TURTLES

All marine reptiles within the GOM are listed as threatened or endangered; impacts on these species are discussed in Section 3.3.3.2.

SEABIRDS

Individual seabirds may be affected by removal of the support platform if they have learned to use it as a resting spot during overwater flights. However, BOET is not in the direct migratory pathway through the GOM, and most species that venture that far offshore stay in flight for the majority of their travel. The adverse effect of removal of the support platform is expected to be minor and temporary because affected birds could establish a new resting location.

FISH

Decommissioning of BOET may cause increased turbidity in the water column, thereby decreasing the ability of fish to detect both prey and predators. Because the increased turbidity also will decrease the visual abilities of predators, the adverse impact on fish due to decommissioning of BOET is expected to be minor and temporary.

ICHTHYOPLANKTON

Decommissioning of BOET may cause increased turbidity in the water column, thereby decreasing the ability of ichthyoplankton to detect both prey and predators. Because the increased turbidity also will decrease the visual ability of the predators, a minor, temporary adverse impact is expected during decommissioning.

PHYTOPLANKTON

Decommissioning of BOET may cause increased turbidity in the water column, thereby decreasing the ability of phytoplankton to detect both prey and predators. Because the increased turbidity also will decrease the visual ability of the predators, a minor, temporary adverse impact is expected during decommissioning.

ZOOPLANKTON

Decommissioning of BOET may cause increased turbidity in the water column, thereby decreasing the ability of zooplankton to detect both prey and predators. Because the increased turbidity also will decrease the visual ability of the predators, a minor temporary adverse impact is expected during decommissioning.

3.3.3.4 Fisheries

CRUSTACEANS

In general, white and pink shrimp utilize water depths shallower than those in the BOET vicinity. Brown and royal red shrimp may occur in the area but are not expected often due to the location of the Terminal at the extreme edge of their ranges. Blue crab also utilize more shallow waters, preferring depths inside 115 feet (35 m); therefore, blue crab are not expected often at BOET. Shrimp and crab fisheries will be deterred from the area during decommissioning activities. After the decommissioning is finished, fishery activities will return to preconstruction levels. Because BOET is not in an area of high shrimp or crab abundance, decommissioning will cause a minor, long-term beneficial impact on the shrimp fisheries due to the reopening of fishing grounds.

MOLLUSKS

Shellfish fisheries of the GOM are limited to more coastal areas and are not expected to be affected by decommissioning of BOET.

FINFISH

Finfish fisheries that have been restricted from the area during operations will be allowed to return following decommissioning. After the completion of decommissioning, activities of the fishery will return to preconstruction levels. Decommissioning will cause a minor, long-term, beneficial impact on the finfish fisheries.

ESSENTIAL FISH HABITAT

Decommissioning of BOET is expected to disturb both pelagic and soft bottom areas of local EFH. The removal of structure will cause a temporary increase in turbidity to both the water column and the seafloor. Adverse impacts on EFH from increased turbidity are expected to be minor and temporary.

3.3.4 Biological Impacts – Alternative Locations

All alternative locations for BOET are in the same 40-block vicinity as the proposed location and occur in the same environmental conditions. Therefore, identical impacts are expected.

3.3.5 Cumulative Impacts

There are currently over 4,000 oil and gas platforms in the continental shelf waters of the northern GOM. Each platform affects the environment and biological resources in similar ways, but typically in a localized manner. This section describes the cumulative impacts on the environment and resources when taking into account all of the activity that is occurring in the GOM. The contribution of BOET is considered negligible relative to the total number of platforms; its impacts and potential for damage to the environment are small when compared to other OCS activities.

3.3.5.1 Habitats

WATER COLUMN

Cumulative discharge of domestic and industrial waste water, and increased turbidity from placement of structures and anchoring can change the chemical composition of the water in localized areas. However, due to the vast dilution capability of the GOM, no significant impact is expected on the water column from the combined activities within the area.

AQUATIC VEGETATIVE COMMUNITIES

Seagrasses will be adversely affected by degradation in water quality, pipeline placement, and anchoring. Pipelines crossing through areas of seagrass cause loss of habitat. Seagrass meadows may take many decades to form; once cut or damaged, it may take as long as 10 years to recover, depending on the species, extent of damage, water quality, and sediment characteristics (GMFMC 2004). Installation of new pipeline for future facilities will cause a major, long term adverse impact on seagrasses that are in its path. Aquatic vegetative communities are not reported in the BOET vicinity and will not be affected by the Project.

SOFT BOTTOM COMMUNITIES

Soft bottom habitat is disturbed by all of the facilities in the GOM. Fortunately, this habitat is not biologically sensitive and recovers quickly after being disturbed. Although the number of platforms in the GOM causes a loss of mostly soft bottom habitat, the affected amount is insignificant when compared to the amount of soft bottom habitat remaining in the GOM. The addition of one new facility will not be noticed outside of the immediate vicinity of the Terminal.

HARD BOTTOM COMMUNITIES

Damage caused by anchoring, infrastructure and pipeline placement, and infrastructure removal (from explosive or non-explosive operations), blowouts, drilling discharges, produced-water discharges, and disposal of domestic and sanitary wastes can cause the immediate mortality of live-bottom organisms or alteration of sediments to the point that recolonization of the affected areas may be delayed or impossible. Anchoring may damage these biological communities, decreasing the attraction of fish to the area. (MMS 2002c.) Seventy blocks within the northeast GOM are within the region defined as the pinnacle trend that may contain live bottoms that are sensitive to oil and gas activities. Prior to any construction activities or placement of any structure for exploration or development in these blocks—including, but not limited to, anchoring, well drilling, and pipeline and platform placement—a live bottom survey must be conducted as part of the Live Bottom (Pinnacle Trend) Stipulation (NTL No. 2004-G05). In accordance with the Stipulation, no bottom-disturbing activities, including those caused by anchors, chains, and cables, will be conducted within 110 ft (30 m) from any hard bottoms/pinnacles with a vertical relief of 8 ft (2.4 m) or more. All aspects of BOET are at least 0.8 mi (1.3 km) from any live bottom area that is included in the stipulation; the Terminal therefore is unlikely to affect these communities.

Impacts resulting from activities in the Central Planning Area (CPA) are not expected to adversely affect the pinnacle trend environment because of implementation of the Live Bottom Stipulation. Potential impacts from blowouts, pipeline emplacement, mud and cutting discharges, and structure removals will be minimized because of the Stipulation and the low levels of oil and gas activities anticipated in the area. The frequency of impacts on the pinnacles would be rare, and the severity is expected to be slight because of the widespread nature of the features. (MMS 2002c.)

Other topographic features, such as the Flower Gardens NMS, Weeks Bay NERR, and Grand Bay, are protected by the Topographic Features Stipulation, which could prevent most potential impacts on the communities from bottom-disturbing activities. Recovery from impact incidences and operation discharges would take place within 10 years (MMS 2002c).

PROTECTED AREAS

These areas are protected from the majority of offshore activity but could suffer indirect impacts such as degradation of water quality. Indirect impacts may cause a minor, long-term adverse impact.

3.3.5.2 Threatened and Endangered Species

MARINE MAMMALS

OCS activities affecting threatened and endangered species include degradation of water quality from operation discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, loss of debris from service vessels and OCS structures, commercial fishing, capture and removal, and pathogens. The cumulative impact of these activities can cause chronic and sporadic sublethal effects that may cause stress to local individuals and populations, making them more susceptible to infection from natural or anthropogenic sources. Few lethal effects are expected from oil spills, chance collisions with vessels, ingestion of plastic material, commercial fishing, and pathogens. Deaths as a result of structure removals are not expected due to implementation of NMFS observer mitigation measures.

The routine activities of oil and gas activities are not expected to result in long-term adverse effects on the size or productivity of any marine mammal species or population stock endemic to the northern GOM (MMS 2002c).

MARINE REPTILES

The major impact-producing factors on marine reptiles resulting from the routine activities associated with oil and gas activities in the GOM include water quality degradation from operation discharges, noise from helicopter and vessel traffic, operating of platforms and drillships, vessel collisions, brightly-lit platforms, explosive platform removals, and OCS-related trash and debris. Lethal effects are most likely to be from chance collisions with OCS service vessels and ingestion of plastic materials. “Takes” due to explosive removals are expected to be rare due to the NMFS observer program. Most OCS activities are expected to cause sublethal effects. Contaminants in waste discharges and drilling muds might indirectly affect sea turtles through food-chain biomagnification. Chronic sublethal effects, such as stress, that result in persistent physiological or behavioral changes or avoidance of affected areas could cause declines in survival or fecundity. (MMS 2002c.) Any impact adversely affecting survival or fecundity would be considered a substantial, long-term adverse impact. However, the routine activities of offshore activities are unlikely to result in significant adverse effects on the size or recovery of any sea turtle species or population within the GOM (MMS 2002c).

PROTECTED BIRDS

Protected birds, such as the brown pelican and piping plover, may be affected by both onshore and offshore aspects of oil and gas facilities. Because nesting occurs on coastal areas, any land-based activity crossing through may affect these species. BOET is not expected to affect these species.

PROTECTED FISH

Impacts on the Gulf sturgeon from routine activities of oil and gas industries in the GOM include degradation of estuarine and marine water quality, and pipeline installation through its habitat. Designation of critical habitat protects biologically important areas for this species. Routine activities in offshore areas are not expected to significantly affect the Gulf sturgeon.

3.3.5.3 Non-Threatened and Non-Endangered Species

MARINE MAMMALS

OCS activities affecting non-threatened and non-endangered species include degradation of water quality from operation discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, loss of debris from service vessels and OCS structures, commercial fishing, capture and removal, and pathogens. The cumulative impact of these activities can cause chronic and sporadic sublethal effects that may cause stress to local individuals and populations, making them more susceptible to infection from natural or anthropogenic sources. Few lethal effects are expected from oil spills, chance collisions with vessels, ingestion of plastic material, commercial fishing, and pathogens. Deaths as a result of structure removals are not expected due to implementation of NMFS observer mitigation measures.

The routine activities of oil and gas activities are not expected to result in long-term adverse effects on the size or productivity of any marine mammal species or population stock endemic to the northern GOM (MMS 2002c).

MARINE REPTILES

All marine reptiles in the GOM are listed as threatened or endangered; cumulative impacts are the same as those discussed in Section 3.3.2.2.

SEABIRDS

Cumulative effects of oil and gas facilities in the GOM may affect seabirds in positive ways. During migration, the platforms may serve as rest spots for weary seabirds, allowing a higher percentage of birds to return to shore. However, removal of platforms may adversely affect birds that have learned to use the platforms as stopovers during migration. These individuals may suffer a major adverse impact if they do not have sufficient energy to reach the shore. Other potential adverse impacts include collision with the Terminals, helicopters, and vessels, and the noise produced by them, as well as habitat degradation.

Most effects are expected to be sublethal, including behavioral effects, and displacement of localized groups from affected habitats. Chronic sublethal stress, however, is often undetectable in birds. As a result of stress, individuals may weaken, facilitating infection and disease. Cumulative adverse impacts on the bird populations in the GOM are expected to be long term and minor.

FISH

Fish will be affected by degradation in water quality, habitat loss, structure installation and removal, dredging, and operation discharges. Cumulative impacts on fish populations from offshore activities are expected to be minimal.

ICHTHYOPLANKTON

With regard to larval and egg entrainment, two characteristics distinguish BOET from the other proposed or existing LNG deepwater ports in the GOM, and the common exploration/production of oil and gas on the OCS: the distance of the Terminal from land (62.6 mi [100.7 km]) and the standing depth of the water (about 425 feet [130 m]). The more productive areas within the ocean are closer to land due to nutrient run-off and freshwater input, among other factors. BOET benefits from its placement with a relatively low density of fish eggs and larvae (see Table 3-17).

Of the seven proposed or existing deepwater LNG ports in the GOM, BOET has the lowest annual entrainment of fish eggs and larvae with the exception of Gulf Gateway, which is also in deeper water (91 m or 298 ft) and even further from shore (187 km or 116 mi). Individual species loss of age-1 equivalents due to entrainment varies between the deepwater ports; however, the Terminal remains at the low end of the scale. With regard to the key species, BOET accounts for only 0.8 percent of the red snapper and 0.5 percent of the red drum equivalent yield lost in the GOM annually to proposed or existing LNG terminals. BOET does, however, account for 21.3 percent of the Gulf menhaden equivalent yield lost to the terminals annually. This is due in part to the way entrainment for this species was calculated (see Appendix A-2).

PHYTOPLANKTON

All seven of the proposed or existing LNG terminals would be, or are, in the northern GOM and would cause a slight decrease in the phytoplankton populations immediately surrounding each terminal. However, the high rate of reproduction of phytoplankton ensures that the overall GOM population would not suffer a significant impact.

Table 3-17. Comparison of Fish Egg and Larval Densities, and Entrainment and Equivalent Yield Loss with Respect to Proposed or Existing Deepwater Ports in the Gulf of Mexico

Deepwater Port	Egg Density per Million Gallons of Seawater (3,785 m³) [a]	Larval Density per Million Gallons of Seawater (3,785 m³) [a]	Annual Egg Entrainment (millions) [b]	Annual Larval Entrainment (millions) [b]	Gulf Menhaden Equivalent Yield Lost Annually (lbs)	Red Snapper Equivalent Yield Lost Annually (lbs)	Red Drum Equivalent Yield Lost Annually (lbs)
Deepwater Ports of the Northeastern Gulf of Mexico (GOM)							
TORP[c]	4,580	9,122	637	1,269	94,851	174	654
Compass Port [d]	17,471	25,457	2,602	3,792	224,164	673	25,657
MPEH [e]	8,235	11,005	1,623	2,169	14,010	370	4008
Deepwater Ports of the Northwestern GOM							
Beacon Port [f]	13,806[g]	17,730	2,532	3,252	2,581	16,016	NA
Gulf Landing [h]	15,658	35,389	2,332	5,270	8,327	723	100,985
Port Pelican [i]	11,587	22,067	2,238	4,262	65,833	1,946	1,183
Gulf Gateway [j]	5,027	10,523	284	595	35,485	1,049	638
Regional Estimated Cumulative Entrainment Summary							
Northeastern GOM	10,095	15,195	4,862	7,230	333,025	1,217	30,319
Northwestern GOM	10,757	21,427	7,386	13,379	112,226	19,734	102,806
Total GOM	10,426	18,311	12,248	20,609	445,251	20,951	133,125

a Egg and larval densities are based on SEAMAP data (except where noted) and do not reflect the x3 mulitiplier that the model applies to these data to compensate for sampling gear inefficiency.

b Annual entrainment estimates do include the x3 multiplier to correct for sampling gear inefficiency.

c Numbers were calculated using proposed throughput.

d Source: USCG and MARAD 2005b.

e Source: USCG and MARAD 2005c.

f Source: ConocoPhillips 2005.

g Source: USCG and MARAD 2005d.

h Source: USCG and MARAD 2004b.

i Source: USCG and MARAD 2003a. Development of this project has been deferred by the Applicant.

j Source: USCG and MARAD 2003b.

ZOOPLANKTON

The combined effect of all seven proposed or existing LNG terminals in the GOM would cause a slight decrease in the populations immediately surrounding each terminal. However, the high rate of reproduction of zooplankton ensures that the GOM population would not suffer a significant impact.

3.3.5.4 Fisheries

CRUSTACEANS

Activities such as seismic surveys and pipeline trenching will cause negligible impacts and will not deleteriously affect commercial fishing activities. Operations such as production platform placement, underwater OCS impediments, and explosive platform removal, will cause slightly greater impacts on commercial fishing. However, the fisheries will recover from any impacts within 6 months (MMS 2002c).

MOLLUSKS

Activities such as seismic surveys and pipeline trenching will cause negligible impacts and will not deleteriously affect commercial fishing activities. Operations such as production platform placement, underwater OCS impediments, and explosive platform removal, will cause slightly greater impacts on commercial fishing. However, the fisheries will recover from any impacts within 6 months (MMS 2002c).

FINFISH

Activities such as seismic surveys and pipeline trenching will cause negligible impacts and will not deleteriously affect commercial fishing activities. Operations such as production platform placement, underwater OCS impediments, and explosive platform removal, will cause slightly greater impacts on commercial fishing. However, the fisheries will recover from any impacts within 6 months (MMS 2002c).

ESSENTIAL FISH HABITAT

Because cumulative impacts on EFH include impacts on many different environments, effects on EFH vary widely. Inshore EFH, such as wetlands and estuaries, may be disturbed and lost through dredging, water degradation, pipe lay, and spills. Inland areas are important as nursery habitat, and loss of that habitat is considered a significant, long-term adverse impact. Offshore EFH is less susceptible to habitat degradation, due in part to the vast amount of soft bottom habitat, which is not biologically sensitive. Reefs and other topographic features that are biologically sensitive are protected by various stipulations that shelter them from oil and gas activities.

3.4 References

ALDCNR 2004 — Alabama Department of Conservation and Natural Resources. 2004. Alabama Artificial Reefs: General Permit Areas. Available online: <http://www.dcnr.state.al.us/Fishing/ saltwater/where/artificial-reefs/>. Accessed June 2005.

BAV 2000 — Barry A. Vittor & Associates, Inc. 2000. Benthic Macroinfauna of the Northeastern Gulf of Mexico OCS, near De Soto Canyon. October 19–21, 1999. In Physical/Biological Oceanographic Integration Workshop for the DeSoto Canyon and Adjacent Shelf. (OCS Study MMS 2000-074.) Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA.

BAV 1985 — Barry A. Vittor & Associates, Inc. 1985. Tuscaloosa Trend Regional Data Search and Synthesis Study. Volume 1: Synthesis Report. Final report prepared for the Minerals Management Service. (Contract No. 14-12-0001-30048.) Metairie, LA. 477 pages.

Behler and King 1979 — Behler, J. L. and F. W. King. 1979. Tuscaloosa Trend Regional Data Search and Synthesis Study. Volume 1: Final Report. (OCS Study MMS 85-0056.) Minerals Management Service. New Orleans, LA.

Block et al. 2005 — Block, B. A., S. L. H. Teo, A. Walli, A. Boustany, M. J. W. Stokesbury, C. J. Farwell, K. C. Weng, H. Dewar, and T. D. Williams. Electronic Tagging and Population Structure of Atlantic Bluefin Tuna. Nature 434:1121–27.

Castro 1983 — Castro, J. I. 1983. The Sharks of North American Waters. Texas A&M University Press. College Station, TX.

CEC 2003 — California Energy Commission. 2003. Liquified Natural Gas in California: History, Risks, and Siting. Staff White Paper. (700-03-005.) Available online: http://www.energy.ca.gov/lng/documents/index.html. Accessed April 2006.

Chandler et al. 1985 — Chandler, C. R., R. M. Sanders, Jr., and A. M. Landry, Jr. 1985. Effects of Three Substrate Variables on Two Artificial Reef Fish Communities. Bull. Mar. Sci. 37(1):129–142.

Clapp et al. 1982 — Clapp, R. B., R. C. Banks, D. Morgan-Jacobs, and W. A. Hoffman. 1982. Marine Birds of the Southeastern United States and Gulf of Mexico.

Part I, Gaviiformes and Pelicaniformes. (FWS/OBS-82/01.) U.S. Fish and Wildlife Service, Office of Biological Services. Washington, DC.

Collette and Nauen 1983 — Collette, B. B. and C. E. Nauen. 1983. FAO Species Catalogue Volume 2. Scombrids of the World. An Annotated and Illustrated Catalogue of Tunas, Mackerels, Bonitos and Related Species Known to Date. FAO Fish. Synop. 125:2, 137.

ConocoPhillips 2005 — ConocoPhillips. 2005. Beacon Port LLC Deepwater Port Act license application. ConocoPhillips. (Docket No. USCG-2005-21232.) January. Submitted to the U.S. Coast Guard. Houston, TX.

Cook Legacy 2005 — Cook Legacy Coating Company. 2005. Cook Legacy Coating Company TORP LNG Wedgewire Screen Report, TORP LNG Environmental Summary. Canal Winchester, OH. Prepared for Entrix, Inc.

CSA 2004 — Continental Shelf Associates, Inc. 2004. Explosive Removal of Offshore Structures: Information Synthesis Report. (OCS Study MMS 2003-070.) Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA.

CSA 2002 — Continental Shelf Associates, Inc. 2002. Deepwater Program: Bluewater Fishing nd OCS Activity, Interactions between the Fishing and Petroleum Industries in Deepwaters of the Gulf of Mexico. (OCS Study MMS 2002-078.) Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. 193 pages and appendices.

CSA and TAMU 2001 — Continental Shelf Associates, Inc., and Texas A&M University. 2001. Mississippi/Alabama Pinnacle Trend Ecosystem Monitoring. Final Synthesis Report. (USGS BSR 2001-0007/OCS Study MMS 2001-080.) U.S. Geological Survey, Biological Resources Division, and Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. 415 pages and appendices.

Culik 2003 — Culik, Boris. 2003. *Stenella longirostris* (Gray, 1828). Available online: <http://www.cms.int/reports/small_cetaceans/data/S_longirostris/s_longirostris.htm>. Accessed November 2005.

Cummins et al. 1962 — Cummins, R., Jr., J. B. Rivers, and P. Struhsaker. 1962. Snapper Trawling Explorations along the Southeastern Coast of the United States. Comm. Fish. Rev. 24:1–7.

Darnell 1988 — Darnell, R. M. 1988. Marine Biology. In N. W. Phillips and B. M. James (eds.), Offshore Texas and Louisiana Marine Ecosystems Data Synthesis.

Volume II: Synthesis Report. (OCS Study MMS 88-0067.) Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA.

Darnell and Kleypas 1987	Darnell, R. M. and J. A. Kleypas. 1987. Eastern Gulf Shelf Bio-Atlas, a Study of the Distribution of Demersal Fishes and Penaeid Shrimp of Soft Bottom of the Continental Shelf from the Mississippi River Delta to the Florida Keys. (OCS Study MMS 86-0041.) Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA.
Darnell and Soniatt 1979	Darnell, R. M., and T. M. Soniatt. 1979. The Estuary/Continental Shelf as an Interactive System. In R. J. Livingston (ed.), Ecological Processes in Coastal and Marine Systems. Plenum Press. New York, NY. Pages 489–525.
Davis and Fargion 1996	Davis, R. W. and G. S. Fargion (eds.). 1996. Distribution and Abundance of Cetaceans in the North-Central and Western Gulf of Mexico. Final Report. Volume II: Technical Report. (OCS Study MMS 96-0027.) Prepared by the Texas Institute of Oceanography and the National Marine Fisheries Service for the Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. 357 pages.
Davis et al. 2000a	Minerals Management Service and U.S. Coast Guard. 2000a. Executive Summary. In Davis, R. W., W. E. Evans, and B. Würsig (eds.), 2000, Cetaceans, Sea Turtles and Seabirds in the Northern Gulf of Mexico: Distribution, Abundance and Habitat Associations. Volume I. (USGS/BRD/CR-1999-0006 and OCS Study MMS 2000-002.) Prepared by Texas A&M University at Galveston and the National Marine Fisheries Service. U.S. Geological Survey, Biological Resources Division, and Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. 27 pages.
Davis et al. 2000b	Minerals Management Service and U.S. Coast Guard. 2000b. Technical Report. In Davis, R. W., W. E. Evans, and B. Würsig (eds.), 2000, Cetaceans, Sea Turtles and Seabirds in the Northern Gulf of Mexico: Distribution, abundance and Habitat Associations. Volume II. Prepared by Texas A&M University at Galveston and the National Marine Fisheries Service. (USGS/BRD/CR-1999-0006 and OCS Study MMS 2000-003.) U.S. Geological Survey, Biological Resources Division, and Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. 346 pages.
Ditty et al. 1988	Ditty, J. G., G. G. Zieke, and R. F. Shaw. 1988. Seasonality and Depth Distribution of Larval Fishes in the Northern Gulf of Mexico above 26"00'N. Fishery Bulletin 86:811–23.

Dooley 1972 Dooley, J. K. 1972. Fishes Associated with the Pelagic Sargassum Complex with a Discussion of the Sargassum Community. Contributions in Marine Science. Volume 16. The University of Texas Marine Science Institute. Port Aransas, TX. Pages 1–32.

EPA 2004 U.S. Environmental Protection Agency. 2004. National Coastal Condition Report II. (EPA-620/R-03/002.) Office of Research and Development/Office of Water. Washington, DC.

ESRI 2001 ESRI. 2001. ESRI data and maps: Canada, Mexico, and the United States. ARCGIS Shapefiles. Redlands, CA.

Firmin 2003 Firmin, B. 2003. Personal Communication between Ms. Bridgette Firmin (U.S. Fish and Wildlife Service) and Mr. Brian Hoppy (e^2M) regarding information on threatened and endangered species. May 15, 2003.

Fritts and Reynolds 1981 Fritts, T. H. and R. P. Reynolds. 1981. Pilot Study of the Marine Mammals, Birds, and Turtles in OCS Areas of the Gulf of Mexico. (FWSIOBS-81/36.) U.S. Fish and Wildlife Service, Office of Biological Services. Washington, DC.

Fritts et al. 1983 Fritts, T. H., A. B. Irvine, R. D. Jennings, L. A. Collum, W. Hoffman, and M. A. McGehee. 1983. Turtles, Birds, and Mammals in the Northern Gulf of Mexico and Nearby Atlantic Waters. (FWS/OBS-82/65.) U.S. Fish and Wildlife Service, Office of Biological Services. Washington, DC. 455 pages.

Gallaway 1981 Gallaway, B. J. 1981. An Ecosystem Analysis of Oil and Gas Development on the Texas-Louisiana Continental Shelf. (FWS/OBS-81/27.) U.S. Fish and Wildlife Service, Office of Biological Services. Washington, DC.

GMFMC 2005 Gulf of Mexico Fishery Management Council. 2005. Final Generic Amendment for Addressing Essential Fish Habitat Requirements, Habitat Areas of Particular Concern, and Adverse Effects of Fishing in the Following Fishery Management Plans of the Gulf of Mexico: Shrimp Fishery of the Gulf of Mexico, Red Drum Fishery of the Gulf of Mexico, Reef Fish Fishery of the Gulf of Mexico, Stone Crab Fishery in the Gulf of Mexico, Coral and Coral Reef Fishery of the Gulf of Mexico, Spiny Lobster Fishery of the Gulf of Mexico and South Atlantic, and Coastal Migratory Pelagic Resources of the Gulf of Mexico and South Atlantic. Tampa, FL.

GMFMC 2004 Gulf of Mexico Fishery Management Council. 2004. Final Environmental Impact Statement of Generic Amendment for Addressing Essential Fish Habitat Requirements in the Following Fishery

Management Plans of the Gulf of Mexico: Shrimp Fishery of the Gulf of Mexico, Red Drum Fishery of the Gulf of Mexico, Reef Fish Fishery of the Gulf of Mexico, Stone Crab Fishery in the Gulf of Mexico, Coral and Coral Reef Fishery of the Gulf of Mexico, Spiny Lobster Fishery of the Gulf of Mexico and South Atlantic, and Coastal Migratory Pelagic Resources of the Gulf of Mexico and South Atlantic. Tampa, FL.

GMFMC 2003 Gulf of Mexico Fishery Management Council. 2003. Draft Environmental Impact Statement of Generic Amendment for Addressing Essential Fish Habitat Requirements in the Following Fishery Management Plans of the Gulf of Mexico: Shrimp Fishery of the Gulf of Mexico, United States Waters, Red Drum Fishery of the Gulf of Mexico, Reef Fishery of the Gulf of Mexico, Coastal Migratory Resources (Mackerels) in the Gulf of Mexico and South Atlantic, Stone Crab Fishery of the Gulf of Mexico, Spiny Lobster Fishery of the Gulf of Mexico and South Atlantic, and Coral and Coral Reefs of the Gulf of Mexico. Tampa, FL.

GPO 2005 U.S. Government Printing Office. 2005. Endangered Fish and Wildlife; Notice of Intent to Prepare an Environmental Impact Statement. National Oceanic and Atmospheric Administration. Federal Register Volume 70 (7):1871-75. January 2005.

Gunter 1967 Gunter, G. 1967. Some Relationships of Estuaries to the Fisheries of the Gulf of Mexico. In G. Lauff (ed.), 1964, Estuaries [papers]. Conference on Estuaries, Jekyll Island. American Association for the Advancement of Science. Washington, DC.

Harper 1991 Harper, D. E., Jr. 1991. Macroinfauna and Macroepifauna. In J. M. Brooks and C. P. Gaiamonna (eds.), Mississippi-Alabama Continental Shelf Ecosystem Study Data Summary and Synthesis. Volume II: Technical Narrative. (OCS Study 91-0063.) Minerals Management Service. New Orleans, LA.

Hildebrand 1982 Hildebrand, H. H. 1982. A Historical Review of the Status of Sea Turtles Populations in the Western Gulf of Mexico. In Bjorndal, K. A. (ed.), Biology and Conservation of Sea Turtles. November 26–30, 1979. Proceedings of the World Conference on Sea Turtle Conservation, Washington, DC. Smithsonian Institution Press. Washington, DC. Pages 447–53.

HMSMD 2005 Highly Migratory Species Management Division. 2005. Draft Consolidated Atlantic Highly Migratory Species Fishery Management Plan. Volume I. National Marine Fisheries Service, Office of Sustainable Fisheries. Silver Spring, MD.

Hopkins 1982 Hopkins, T. K. 1982. The Vertical Distribution of Zooplankton in the Eastern Gulf of Mexico. Deep-Sea Research 29(9A):1,069–83.

Jefferson et al. 1993 Jefferson, T. A., S. Leatherwood, and M. A. Webber. 1993. Food and Agricultural Organization Species Identification Guide. Marine Mammals of the World. United Nations Environment Programme, Food and Agricultural Organization. Rome, Italy. Available online: <http://www.fao.org/docrep/T0725E/t0725e00.htm>. Accessed November 2004. 320 pages.

Kaufman 1996 Kaufman, K. 1996. Lives of North American Birds. Houghton Mifflin Company. Boston, MA. 675 pages.

Klima and Wickham 1971 Klima, E. F. and D. A. Wickham. 1979. Attraction of Coastal Pelagic Fishes with Artificial Structures. Transactions of the American Fisheries Society 100:1, 86–99.

Lenz 2000 Lenz, J. 2000. Introduction. In R. P. Harris, P. H. Wiebe, J. Lenz, H. R. Skjoldal, and M. Huntley (eds), ICES Zooplankton Methodology Manual. Academic Press. San Diego, CA.

Lohoefener et al. 1990 Lohoefener, R. R., W. Hoggard, K. Mullin, C. Roden, and C. Rogers. 1990. Association of Sea Turtles with Petroleum Platforms in the North-Central Gulf of Mexico. Final Report. (MMS 90-0025.) Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. 90 pages.

Ludwick and Walton 1957 Ludwick, J. C. and W. R. Walton. 1957. Shelf-Edge Clacareous Prominences in the Northeastern Gulf of Mexico. AAPG Bull. 41:2, 054-2, 101.

Mager and Ruebsamen 1988 Mager, A. and R. Ruebsamen. 1988. National Marine Fisheries Service Habitat Conservation Efforts in the Coastal Southeastern United States. Marine Fisheries Review. 50:3,43–50.

May 1971 May, E. B. 1971. A Survey of the Oyster and Oyster Shell Resources of Alabama. Ala. Mar. Res. Bull. 4:1–53.

McDaniel et al. 2000 McDaniel, C. J., L. B. Crowder, and J. A. Priddy. 2000. Spatial Dynamics of Sea Turtle Abundance and Shrimping Intensity in the United States Gulf of Mexico. Conservation Ecology 4(1):15. Available online: <http://www.consecol.org/vol4/issl/artl5b>. Accessed April 2003.

McGowan and Richards 1989 — McGowan, M. F. and W. J. Richards. 1989. Bluefin Tuna, *Thunnus thynnus*, Larvae in the Gulf Stream off the Southeastern United States: Satellite and Shipboard Observations of Their Environment. Fish. Bull. 87:615–631.

MMS 2005 — Minerals Management Service. 2005. Structure-Removal Operations on the Outer Continental Shelf of the Gulf of Mexico – Programmatic Environmental Assessment. (OCS EIS/EA MMS 2005-013.) Gulf of Mexico OCS Region. New Orleans, LA.

MMS 2004 — Minerals Management Service. 2004. Notice to Lessees and Operators of Federal Oil, Gas, and Sulphur Leases and Pipeline Right-Of-Way Holders in the Outer Continental Shelf. (NTL No. 2004-G05.) Gulf of Mexico OCS Region. New Orleans, LA.

MMS 2003a — Minerals Management Service. 2003. Gulf of Mexico Outer Continental Shelf Oil and Gas Lease Sales 189 and 197. Eastern Planning Area. Final Environmental Impact Statement. Volume I: Chapters 1–8 and Appendices. (OCS EIS/EA MMS 2003-020.) Gulf of Mexico OCS Region. New Orleans, LA. 632 pages.

MMS 2002a — Minerals Management Service. 2002a. Gulf of Mexico Outer Continental Shelf Oil and Gas Lease Sales: 2003–2007. Central Planning Area. Draft Environmental Impact Statement. (OCS EIS/EA MMS 2002-015.) Gulf of Mexico OCS Region. New Orleans, LA.

MMS 2002b — Minerals Management Service. 2002b. Outer Continental Shelf Oil and Gas Leasing Program: 2002–2007. Central and Western Planning Areas. Final Environmental Impact Statement. Volume I. (OCS EIS/EA MMS 2002-006.) Gulf of Mexico OCS Region. New Orleans, LA.

MMS 2002c — Minerals Management Service. 2002c. Gulf of Mexico Outer Continental Shelf Oil and Gas Lease Sales: 2003–2007. Central Planning Area Sales 185,190,194,198, and 201; Western Planning Area Sales 187, 192, 196, and 200. Final Environmental Impact Statement. (OCS EIS/EA MMS 2002-052.) Gulf of Mexico OCS Region. New Orleans, LA.

MMS 2001 — Minerals Management Service. 2001. Proposed Use of Floating Production, Storage, and Offloading Systems on the Gulf of Mexico Outer Continental Shelf. Final Environmental Impact Statement. (OCS EIS/EA MKMS 2000-090.) Gulf of Mexico OCS Region. New Orleans, LA.

MMS 1999 — Minerals Management Service. 1999. Destin Dome 56-Unit Development and Production Plan and Right-of-Way Application. Draft Environmental Impact Statement. Volume I. (OCS EIS/EA MMS 99-040.) Gulf of Mexico OCS Region. New Orleans, LA.

MMS 1996 — Minerals Management Service. 1996. Distribution and Abundance of Cetaceans in the North-Central and Western Gulf of Mexico. Final Report. Volume 1. (OCS Study MMS 96-0026.) Gulf of Mexico OCS Region. New Orleans, LA.

Mullin et al. 1991 — Mullin, K. W., C. R. Hoggard, R. Lohoefener, C. Rogers, and B. Taggart. 1991. Cetaceans on the Upper Slope in the North-Central Gulf of Mexico. Minerals Management Service, Gulf of Mexico OCS Region. (OCS Study MMS 91-0027.) New Orleans, LA.

Myers et al. 1986 — Myers, E. P., D. E. Hoss, W. M. Matsumoto, D. S. Peters, M. P. Seki, R. N. Uchida, J. D. Ditmars, and R. A. Paddock. 1986. The Potential Impact of Ocean Thermal Energy Conversion (OTEC) on Fisheries. National Oceanic and Atmospheric Administration.

NECG 2005 Unpublished — Noise Exposure Criteria Group. 2005. Strategies for Weighting Exposure in the Development of Acoustic Criteria for Marine Mammals. Presented to the 150th Meeting of the Acoustical Society of America. October 17–21. Minneapolis, MN.

NMFS 2005 — National Marine Fisheries Service. 2005. Draft 2005 Stock Assessment Reports. Office of Protected Resources. Available online: <http://www.nmfs.noaa.gov/prot_res/PR2/Stock_Assessment_Program/sars_draft.html>. Accessed September 2005.

NMFS 2003 — National Marine Fisheries Service. 2003. Personal Communication from the National Marine Fisheries Service, Fisheries Statistics and Economics Division. September 2003.

NMFS 2002a — National Marine Fisheries Service. 2002a. Biological Opinion on Gulf of Mexico Outer Continental Shelf Multi-Lease Sale (185, 187, 190, 192, 194, 198, 200, 201). Endangered Species Act – Section 7 Consultation. (Consultation No. F/SER/2002/0718).

NMFS 2002b — National Marine Fisheries Service. 2002b. Biological Opinion on Proposed Employment of Surveillance Towed Array Sensor System Low Frequency Active Sonar. Endangered Species Act – Section 7 Consultation.

NMFS 2002c — National Marine Fisheries Service. 2002c. Loggerhead Sea Turtles (*Caretta caretta*). Office of Protected Resources. Available online: <http://www.nmfs.noaa.gov/pr/species/ turtles/ loggerhead.html>. Accessed November 2005.

NMFS 2002d — National Marine Fisheries Service. 2002d. Hawksbill Sea Turtle (*Eretmochelys imbricata*). Office of Protected Resources. Available online: <http://www.nmfs.noaa. gov/pr/species/turtles/hawksbill.html>. Accessed July 2005.

NMFS 2001 National Marine Fisheries Service. 2001. Regional Council Approaches to the Identification and Protection of Habitat Areas of Particular Concern. Office of Habitat Conservation. Silver Springs, MD.

NMFS 1999a National Marine Fisheries Service. 1999a. Our Living Oceans. Report on the Status of U.S. Living Marine Resources. National Oceanic and Atmospheric Administration Technical Memorandum. (NMFS-F/SPO-41.) Available online: <http://spo.nwr.noaa. gov/unit11.pdf>. Accessed August 2005.

NMFS 1999b National Marine Fisheries Service. 1999b. Marine Recreational Fisheries Statistics Survey, Gulf of Mexico. In_Minerals Management Service. 2003. Gulf of Mexico Outer Continental Shelf Oil and Gas Lease Sales 189 and 197. Eastern Planning Area. Final Environmental Impact Statement. Volume I: Chapters 1–8 and Appendices. (OCS EIS/EA MMS 2003-020.) Gulf of Mexico OCS Region. New Orleans, LA. 632 pages.

NMFS 1999c National Marine Fisheries Service. 1999c. Final Fishery Management Plan for Atlantic Tuna, Swordfish, and Sharks. Prepared by the Highly Migratory Species Management Division. Silver Springs, MD

NMFS 1999d National Marine Fisheries Service. 1999d. Amendment 1 to the Atlantic Billfish Fishery Management Plan. Available online: <http://noaa.gov/sfa/hms>. Accessed April 2003.

NMFS and USFWS 2003 U.S. Fish and Wildlife Service and the National Marine Fisheries Service. 2003. Designate Critical Habitat for the Gulf Sturgeon. Available online: <http://alabama.fws.gov/gs>. Accessed September 2004.

NMFS and USFWS 1993 NMFS and USFWS. 1993. Recovery Plan for Hawksbill Turtles (*Eretmochelys imbricata*) in the United States. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico. National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Washington, DC.

NMFS and USFWS 1992a NMFS and USFWS. 1992a. Recovery Plan for Kemp's Ridley Sea Turtle (*Lepidochelys kempii*). National Oceanic and Atmospheric Administration, National Marine Fisheries Service. St. Petersburg, FL. Available online: <http://www.nmfs.noaa.gov/prot_res/ readingrm/ Recoverplans/kempsrid.pdf>.

NMFS and USFWS 1992b	NMFS and USFWS. 1992b. Recovery Plan for Leatherback Turtles (*Dermochelys coriacea*) in the United States. Caribbean, Atlantic and Gulf of Mexico. National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Washington, DC.
NMFS and USFWS 1991	National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1991a. Recovery Plan for the United States. Population of Loggerhead Turtle (*Caretta caretta*). National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Washington, DC.
NOAA 2005a	National Oceanic and Atmospheric Administration. 2005a. Marine Mammal Protection Act (MMPA) of 1972. Office of Protected Resources. Available online: http://www.nmfs.noaa.gov/pr/laws/mmpa.htm. Accessed December 2005.
NOAA 2005b	National Oceanic and Atmospheric Administration. 2005b. Smalltooth Sawfish (*Pristis pectinata*). Available online: <http://www.nmfs.noaa.gov/prot_res/species/fish/ smalltooth_sawfish.html>. Accessed September 2005.
NOAA 2003a	National Oceanic and Atmospheric Administration. 2003a. Biological Opinion Based on Review of Gulf of Mexico Outer Continental Shelf Oil and Gas Lease Sales 189 and 197 (Consultation No. F/SER/2002/01264.) Washington, DC.
NOAA 2003b	National Oceanic and Atmospheric Administration. 2003b. Draft Environmental Assessment on the Effects of Scientific Research Activities Associated with Development of a Low-Power High-Frequency Sonar System to Detect Marine Mammals. Office of Protected Resources. Silver Springs, MD.
NOAA 1985	National Oceanic and Atmospheric Administration. 1985. Gulf of Mexico Coastal and Ocean Zones Strategic Assessment: Data Atlas. National Ocean Service. Washington, DC.
NOAA 1978	National Oceanic and Atmospheric Administration. 1978. The MAFLA – Mississippi, Alabama, and Florida Study. University of Southern Florida. National Geophysical Data Center. Available online: <http://oas.ngdc.noaa.gov/mgg/plsql/geolin.set_expand? v_mggid=03995010>. Accessed June 2005.
Osterman 2003	Osterman, L. E. 2003. Benthic Foraminifers from the Continental Shelf and Slope of the Gulf of Mexico: An Indicator of Shelf Hypoxia. Estuarine, Coastal and Shelf Science 58:17–35.

Perret et al. 1980	Perret, W. S., J. E. Weaver, R. O. Williams, P. L. Johansen, T. D. McIlwain, R. C. Raulenson, and W. M. Tatum. 1980. Fishery Profiles of Red Drum and Spotted Sea Trout. In R. E. Reagan, 1985, Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Gulf of Mexico) – Red Drum. (Biological Report 82[11.36] and TR EL-82-4.) U.S. Fish and Wildlife Service, Division of Biological Services, and U.S. Army Corps of Engineers. Gulf states Mar. Fish. Comm. No. 6. 60 pages.
Qian et al. 2003	Qian, Y., A. E. Jochens, M. C. Kennicutt II, and D. C. Biggs. 2003. Spatial and Temporal Variability of Phytoplankton Biomass and Community Structure over the Continental Margin of the Northeast Gulf of Mexico Based on Pigment Analysis. Continental Shelf Research 23:1-17.
Remsen et al. 2004	Remsen, A., T. L. Hopkins, and S. Samson. 2004. What You See Is Not What You Catch: A Comparison of Concurrently Collected Net, Optical Plankton Counter, and Shadowed Image Particle Profiling Evaluation Recorder Data from the Northeast Gulf of Mexico. Deep-Sea Research I 51:129–151.
Ribic et al. 1997	Ribic, C.A., R. Davis, N. Hess, and D. Peake. 1997. Distribution of Seabirds in the Northern Gulf of Mexico in Relation to Mesoscale Features: Initial Observations. ICES Journal of Marine Science 54:545–55.
Rooker et al. 2005	Rooker, J., R. Kraus, A. Quigg. 2005. Characterization of Physical, Chemical, and Biological Conditions in the Vicinity of the Bienville Offshore Energy Terminal. (Project No. 05A-004.) Prepared for Entrix, Inc.
Russell 2005	Russell, R. W. 2005. Interactions between Migrating Birds and Offshore Oil and Gas Platforms in the Northern Gulf of Mexico. Final Report. (OCS Study MMS 2005-009.) Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. 348 pages.
SNL 2004	Sandia National Laboratories. 2004. Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill over Water. (SAND2004-6258.) Albuquerque, NM and Livermore, CA.
Schmidly 1981	Schmidly, D. J. 1981. Marine Mammals of the Southeastern United States Coast and the Gulf of Mexico. (FWS/OBS-80/41.) U.S. Fish and Wildlife Service, Office of Biological Service. Washington, DC. 165 pages.
SEAMAP 2003	Southeast Area Monitoring and Assessment Program. 2003. Database for Southeast Area Monitoring and Assessment Program Ichthyoplankton

	Surveys. Provided by Mark McDuff and Joanne Shultz of the National Marine Fisheries Service, Gulf States Marine Fisheries Program. June.
See et al. 2005	See, J. H., L. Campbell, T. L. Richardson, J. L. Pinckney, R. Shen, and N. L. Guinasso, Jr. 2005. Combining New Technologies for Determination of Phytoplankton Community Structure in the Northern Gulf of Mexico. Journal of Phycology 41:305–10.
SEFSC 2002	Southeast Fisheries Science Center. 2002. Vermilion Snapper. Available online: <http://www.sefscpanamalab.noaa.gov/biopro/vermillion_snapper_identification.htm>. Accessed May 2005.
Shaw et al. 1982	Shaw, J. K., P. G. Johnson, R. M. Ewing, C. E. Comiskey, C. C. Brandt, and T. A. Farmer. 1982. Benthic Macroinfauna Community Characterizations in Mississippi Sound and Adjacent Waters. U.S. Army Corps of Engineers, Mobile District. Mobile, AL. 442 pages.
Shaw et al. 2002	Shaw, R. F., D. C. Lindquist, M. C. Benfield, T. Farooqi, and J. T. Plunket. 2002. Offshore Petroleum Platforms: Functional Significance for Larval Fish Across Longitudinal and Latitudinal Gradients. (OCS Study MMS 2002-077.) Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA.
Shell 1967	Shell Oil Company. 1967. Core Descriptions from Offshore Alaska and Gulf of Mexico. National Oceanic and Atmospheric Administration, National Geophysical Data Center. Available online: <http://map4.ngdc.noaa.gov/map_list.html>. Accessed June 2005.
Simpfendorfer 1992	Simpfendorfer, C. 1992. Biology of Tiger Sharks (*Galeocerdo cuvier*) Caught by the Queensland Shark Meshing Program off Townsville, Australia. Aust. J. Mar. Freshwater Res. 43:33–34.
TEWG 2000	Turtle Expert Working Group. 2000. Assessment Update for the Kemp's Ridley and Loggerhead Sea Turtle Populations in the Western North Atlantic. (National Oceanic and Atmospheric Administration Technical Memorandum NMFS-SEFSC-444.) 115 pages.
The Mammal Society 2003	The Mammal Society. 2003. The Bottle-Nosed Dolphin (*Tursiops Truncatus*). Available online: http://www.abdn.ac.uk/mammal/dolphin.shtml. Accessed November 2005.
TPWD 2004	Texas Parks and Wildlife Division. 2004. Shrimp. Available online: <http://www.tpwd.state.tx.us/fish/specinfo/shrimp/shrimbro.phtml?print=true>. Accessed June 2005.

USCG and MARAD 2005a — U.S. Coast Guard and U.S. Maritime Administration. 2005a. USCG Staff Internal Communication, January 21, 2005, Pending Errata to the Gulf Landing Final EIS (USCG and MARAD 2004) Presenting the Content Changes in Appendix G.

USCG and MARAD 2005b — U.S. Coast Guard and U.S. Maritime Administration. 2005b. Draft Environmental Impact Statement for the Compass Port Liquefied Natural Gas Project. (Docket No. USCG-2004-17659.)

USCG and MARAD 2005c — U.S. Coast Guard and U.S. Maritime Administration. 2005c. Errata for the Main Pass Energy Hub Project. (Docket No. USCG-2004-17696.) July 2005.

USCG and MARAD 2005d — U.S. Coast Guard and U.S. Maritime Administration. 2005d. Draft Environmental Impact Statement for the Pearl Crossing Liquefied Natural Gas Project. (Docket No. USCG-2004-18474.) April.

USCG and MARAD 2004a — U.S. Coast Guard and U.S. Maritime Administration. 2004. Draft Environmental Impact Statement for the Gulf Landing LLC Deepwater License Application. (Docket No. USCG-2004-16860.)

USCG and MARAD 2004b — U.S. Coast Guard and U.S. Maritime Administration. 2004b. Final Environmental Impact Statement for the Gulf Landing LLC Deepwater Port License Application. Appendix G: Ichthyoplankton Assessment Model Methodology and Results for the Gulf Landing LLC Deepwater Port License Application Environmental Impact Statement. (Docket No. USCG-2004-16860.) Prepared by e2m. November. Washington, DC.

USCG and MARAD 2003a — U.S. Coast Guard and U.S. Maritime Administration. 2003a. Port Pelican Final Environmental Impact Statement. (Docket No. USCG-2002-14134.)

USCG and MARAD 2003b — U.S. Coast Guard and U.S. Maritime Administration. 2003b. Final Environmental Assessment of the El Paso Energy Bridge Gulf of Mexico LLC Deepwater Port License Application. (Docket No. USCG-2002-14134.)

USFWS 2005a — U.S. Fish and Wildlife Service. 2005a. Regional Seabird Conservation Plan, Pacific Region. Migratory Birds and Habitat Programs, Pacific Region. Portland, OR.

USFWS 2005b — U.S. Fish and Wildlife Service. 2005b. All About Piping Plovers. Available online: http://www.fws.gov/plover/facts.html. Accessed December 2005.

USFWS 2002a — U.S. Fish and Wildlife Service. 2002a. Green Sea Turtle (*Chelonia mydas*) Fact Sheet. Available online: <http://northflorida.fws.gov/SeaTurtles/Turtle%20FactSheets/Green-Sea-Turtle.htm>. Accessed April 2003.

USFWS 2002b — U.S. Fish and Wildlife Service. 2002c. Hawksbill Sea Turtle (*Eretmochelys imbricata*) Fact Sheet. Available online: <http://northflorida.fws.gov/SeaTurtles/Turtle%20FactSheets/Hawksbill-Sea-Turtle.htm>. Accessed April 2003.

USFWS 2002c — U.S. Fish and Wildlife Service. 2002b. Leatherback Sea Turtle (*Dermochelys coriacea*) Fact Sheet. Available online: <http://northflorida.fws.gov/SeaTurtles/Turtle%20FactSheets/leatherback-sea-turtle.htm>. Accessed April 2003.

USFWS 2001 — U.S. Fish and Wildlife Service. 2001. Final Determination of Critical Habitat for Wintering Piping Plovers (*Charadrius melodus*) Geographic Information Systems File. Received via e-mail from Mark Jacobson, July 30, 2004.

USFWS 1999 — U.S. Fish and Wildlife Service. 1999. South Florida Multi-Species Recovery Plan. Available Online: <http://www.fws.gov/verobeach/Programs/Recovery/vbms4.html>. Accessed November 2005.

USFWS no date — U.S. Fish and Wildlife Service. No date. West Indian Manate (*Trichechus manatus latirostris*) Florida Stock. Available online: <http://www.nmfs.noaa.gov/pr/PR2/Stock_Assessment_Program/individual_sars.html>. Accessed December 2005.

Van Hoose 1999 — Van Hoose, M. 1999. Alabama Division of Marine Resources. Personal communication on July 14, 1999.

Waring et al. 2003 — Waring, G. T, J. M. Quintal and C. P.Fairfield (eds.). 2003. Draft United States Atlantic and Gulf of Mexico Marine Mammal Stock Assessment – 2002. (National Oceanic and Atmospheric Administration Technical Memorandum NMFS-NE-182.) Available online: <http://www.nefsc.noaa.gov/nefsc/publications/tm/tm169/>. Accessed July 2005.

Weaver et al. 2001 — Weaver, D. C., G. D. Dennis, and K. J. Sulak. 2001. Northeastern Gulf of Mexico Coastal and Marine Ecosystem Program: Community Structure and Trophic Ecology of Demersal Fishes on the Pinnacles Reef Tract. Final Synthesis Report. (USGS BSR-2001-0008 and OCS Study MMS 2002-034.) U.S. Geological Survey and Minerals Management Service

Gulf of Mexico OCS Region. New Orleans, LA. 92 pages and appendices.

Würsig 2003 — Würsig, B. G. 2003. Bottlenose Dolphin. Microsoft Encarta Online Encyclopedia 2003. 1997–2003 Microsoft Corporation. All rights reserved. Available online: <http://encarta.msn.com>. Accessed September 2003.

Würsig et al. 2000 — Würsig, B., T. A. Jefferson, and D. J. Schmidly. 2000. The Marine Mammals of the Gulf of Mexico. Texas A&M University Press. College Station, TX. 232 pages.

Wynekin 2001 — Wyneken, J. 2001. The Migratory Behaviour of Hatchling Sea Turtles beyond the Beach. Available online: <http://www.arbec.com.my/sea-turtles/art13julyseptO1.htm>. Accessed June 2003.

Yapp 1956 — Yapp, W. B. 1956. Two Physiological Considerations in Bird Migration. Wilson Bull. 68:312–19.