3 AFFECTED ENVIRONMENT

The Navy is meeting its EO 12114 responsibilities by preparing the OEIS, which includes a review of the affected environment and a description of any adverse environmental impacts that cannot be avoided if the proposed action is adopted. The Navy is meeting its NEPA requirements through the EIS. The CEQ’s regulations implementing NEPA (40 CFR Part 1500) require that an EIS succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration, and that impacts be discussed in proportion to their significance.

Consequently, this chapter presents a discussion of several affected environments that could be impacted by implementation of the proposed USWTR, as follows:

- Physical characteristics of the marine environment, including geology, bathymetry, substrate, water, and currents (Subchapter 3.1)
- Ecological systems, including marine animals and their habitats and threatened and endangered species (Subchapter 3.2)
- The underwater acoustical environment, including background information on acoustical terminology and the hearing characteristics of marine animals (Subchapter 3.3)
- Socioeconomic conditions, including data on commercial and recreational fishing (Subchapter 3.4)
- Cultural resources at sea including shipwrecks (Subchapter 3.5)
- Landside environment including the proposed location for the USWTR cabling (Subchapter 3.6)
- Coastal resources uses and the relationship of the CZMA to the Jacksonville, Charleston, Cherry Point, and VACAPES OPAREA sites (Subchapter 3.7)

The analysis of these affected environments will present a baseline against which the impacts of implementation of the USWTR can be measured.

As described in Chapter 2, the proposed USWTR Sites A, B, C, and D occupy a small portion of the Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs, respectively. The affected environment is described in this chapter with respect to these OPAREAs.

The majority of the information presented here was compiled from the Navy’s Marine Resource Assessments (MRA) program. The Navy MRA program is implemented by the U.S. Navy.
Commander, Fleet Forces Command, to collect data and information concerning the protected and commercial marine resources found in the Navy’s OPAREAs. Specifically, the goal of the MRA program is to describe and document the marine resources present in each of the Navy’s OPAREAs. Significant effort has been made to ensure that all applicable data sources have been considered and included in the assessment of protected species distributions.

The MRAs represent a compilation and synthesis of available survey data (primarily NMFS surveys), stranding, incidental fisheries bycatch, tagging, satellite tracking, and nesting data, as well as peer-reviewed literature and NMFS reports, including stock assessment reports, recovery plans, and survey reports.

The Internet and collaboration with other agencies and institutions were additional sources of information used to compile this final OEIS/EIS, as referenced within the text.

### 3.1 Physical Environment

Operational requirements for the USWTR require a depth of 37 to 274 m (120 to 900 ft), a depth that generally falls within the areas of the continental shelf and the continental slope. The continental shelf is a broad, shallow, sea-floor platform that, although submerged, is clearly part of the continental mass. Along the Atlantic Coast, the continental shelf extends from the shoreline to a depth of about 200 m (660 ft). At the shelf edge, the shelf gives way sharply to the continental slope, which descends about 3,500 m (12,000 ft) to the main ocean floor. The gradient of the continental shelf is generally flat, with a regional slope of 1 m per km (0.01%), while the continental slope is much steeper.

The proposed USWTR Sites A, B, C, and D under consideration are located on the outer continental shelf, offshore of the coastal plain in the eastern United States. The continental shelf ranges from a maximum width of more than 300 km (162 NM) off New Jersey to a minimum width of less than 50 km (27 NM) off Cape Hatteras, North Carolina, with an average width of 65 km (35 NM).

#### 3.1.1 Geology, Bathymetry, and Substrate

The surface of the continental shelf is uneven, with small hills and ridges alternating with basin-like depressions, broad valley-like troughs, and occasional narrow steep-walled valleys called submarine canyons. Most areas of the continental shelf were above sea level during the last glaciation (two million to ten thousand years ago), and were subject to the erosion and sedimentation. The majority of the material on the continental shelf and slope comes from the land, transported by rivers or wind. Waves and tidal currents acting on the shelves have modified the surface since the last glaciation. Coarse material such as sand tends to deposit in shallow waters while silt and mud particles are carried into deeper water for deposition.
Geological oceanographic considerations that may affect the final design, installation, and operation of the USWTR include bottom composition (as it affects the ability to bury a submarine cable); bottom hardness (as it affects the reflection of sound from the seabed); and sediment transport (as it may bury a hydrophone or expose a buried submarine cable) (DeAlteris, 1996).

### 3.1.1.1 Site A

The proposed Site A USWTR is located offshore of northeast Florida in the South Atlantic bight (SAB). The edge of the range would be approximately 94 km (51 NM) from shore. The depth of water at the proposed site ranges from 37 to 366 m (120 to 1,200 ft). Figure 3.1-1 depicts the bathymetry of the area which shows ocean floor depth and relief/terrain as contour lines (called depth contours or isobaths).

The physiography of the sea floor beneath the Jacksonville OPAREA is notably featureless. The wide, flat Florida-Hatteras Shelf, underlying about half of the OPAREA, is characterized by low relief and a relatively gentle gradient. The remainder of the sea floor beneath the OPAREA consists of the northern two-thirds of Blake Plateau, a massive physiographic feature that measures 228,000 km² (71,250 NM²) in size. The proposed USWTR site is situated on the slope between the continental shelf and the Blake Plateau.

This entire area has been eroded and shaped by the Gulf Stream, giving it a unique continental margin. The sea floor has relatively smooth topography and is composed primarily of fine sand and gravel with a high concentration of carbonate shells.

The Southeast Area Monitoring and Assessment Program (SEAMAP) (Atlantic States Marine Fisheries Commission [ASMFC], 2001) database contains data for 115 of the 597 grid cells in the proposed Site A USWTR. Of these cells, 46% (53) were classified as hard bottom\(^1\), 10% (11) were classified as possible hard bottom, and 44% (51) were classified as not hard bottom.

### 3.1.1.2 Site B

The proposed Site B USWTR would be located offshore of northeastern South Carolina in the SAB. The edge of the range would be approximately 83 km (45 NM) from shore. The depth of water at the proposed site ranges from 37 to 305 m (120 to 1,000 ft). Figure 3.1-2 depicts the bathymetry of the area which shows ocean floor depth and relief/terrain as contour lines (called depth contours or isobaths).

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\(^1\) Hard bottom is defined as an area of the sea floor, usually on the continental shelf, associated with hard substrate such as rocks, boulders, or outcroppings of hard rock that may serve as attachment surfaces for organisms such as corals, sponges, or other benthic invertebrates or algae (SAFMC, 1998a). See Subchapter 3.2.4 for details.
Bathymetry in the Site A Area

Figure 3.1-1

Note: Map data not projected.
Bathymetry in the Site B Area

Note: Map data not projected.

Figure 3.1-2
The Charleston Bump is a distinctive feature of the sea floor in the Charleston OPAREA, consisting of a rocky island of bottom relief located at approximately 31°30’N and 79°W in 400 to 700 m (1,312 to 2,297 ft) water depth (Bane et al, 2001). The bump includes an underwater ridge and trough complex that runs roughly perpendicular to shore and to the Gulf Stream flow. This “island” of relief in an otherwise flat seafloor bottom causes an offshore deflection of the Gulf Stream’s path and the occurrence of meanders, eddies, and upwelling over the continental shelf in this area. The Charleston Bump provides a unique habitat area for pelagic and demersal fishes.

The distribution of bottom sediments found on the continental shelf and slope of the SAB are more complex than those found in other areas (Amato, 1994). The layers of sand and gravel are much thinner than found north of Cape Hatteras, and rock outcrops are common. Most of the sediments found covering the continental shelf of the SAB are quartzose sand with a thin band of fine-grained sand and silt. The bottom sediments found south of Cape Hatteras contain from 5 to 50% calcium carbonate.

The SEAMAP (ASMFC, 2001) database contains data for 48 of the 562 grid cells in the proposed Site B USWTR. Of these cells, 54% (26) were classified as hard bottom, 10% (5) were classified as possible hard bottom, and 36% (17) were classified as not hard bottom.

3.1.1.3 Site C

The proposed Site C USWTR would be located offshore of northeastern North Carolina in Onslow Bay. The site is in the Cherry Point OPAREA in the South Atlantic bight (SAB). The edge of the range would be approximately 86 km (47 NM) from shore.

Onslow Bay lies between Cape Lookout and Cape Fear, North Carolina. It is located in the northern portion of the Florida-Hatteras shelf region. New River drains a small portion of the central North Carolina Coastal Plain Province and discharges into the center of Onslow Bay. Figure 3.1-3 depicts the bathymetry of the area around the proposed Site C USWTR.

The continental shelf off North Carolina is relatively narrow, but is morphologically complex as compared to other areas of the continental shelf (DeAlteris, 1996). A long, linear trough (Carolina trough) underlies most of the continental shelf and slope in this region. Sediments on the outer shelf and upper slope lie in a series of lenses caused by repeated erosion and deposition on the outer shelf by the Gulf Stream. The upper-slope morphology is further complicated by the occasional buildup of carbonate reefs just seaward of the shelf break. The most abundant rocks are sandstone and limestone with a high percentage of fossils.

The slope extends from 100 to 400 m (328 to 1,312 ft) within the limits of the study area. Side-scan sonar shows areas of rough hard bottom, areas of smooth sand bottom, and areas with alternating hard and soft bottom. The shallower portion of the slope is characterized by smooth sand, while the deeper portion is characterized by large-scale sand waves (DeAlteris, 1996). Sub-
Bathymetry in the Site C Area

Note: Map data not projected.

Figure 3.1-3
bottom echo sounder data show areas of hard and soft bottom. The sampling showed no large bottom obstructions in the area.

The SEAMAP (ASMFC, 2001) database contains data for 143 of the 687 grid cells in the proposed Site C USWTR. Of these cells, 31% (44) were classified as hard bottom, 12% (17) were classified as possible hard bottom, and 57% (82) were classified as not hard bottom. Moser et al. (1995) found evidence of hard bottom at 11% of the 5,796 stations evaluated, with 5% of the stations classified as possible hard bottom.

3.1.1.4 Site D

The proposed Site D USWTR would be located offshore of northeastern Virginia within the Mid-Atlantic bight (MAB). The edge of the range would be approximately 85 km (46 NM) from shore.

The depth of water in the continental shelf at the proposed Site D USWTR averages 75 m (246 ft) (DoN, 1995b). From the geographic center of the site, the 40-m (131-ft) contour extends 37 km (20 NM) landward, and the 400-m (1,312-ft) contour extends 18 km (10 NM) seaward. The shelf edge occurs at 200 m (656 ft). Figure 3.1-4 depicts the bathymetry of the area around the proposed Site D USWTR.

Sediment texture varies from gravel patches and a fine sand mixture inshore to medium sand offshore, extending to the shelf edge. Fine sand/silt characterizes the edge of the shelf from 200 to 400 m (656 to 1,312 ft). The sediments at the proposed Site D USWTR are typical of the offshore-to-shelf-edge area, consisting of fine quartz sand with a patchy veneer of shells (DoN, 1995b). No hard bottom data are available for the proposed Site D location, as it is outside the area covered by SEAMAP data.

3.1.2 Water Characteristics and Currents

This subchapter describes the general water characteristics and circulation patterns of the Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs. The Gulf Stream has a pronounced influence on the four OPAREAs. The western continental margin of any ocean basin is the location of intense boundary currents; the Gulf Stream is the western boundary current of the North Atlantic Ocean. The Gulf Stream is part of a larger current system called the Gulf Stream System that also includes the Loop Current in the Gulf of Mexico and the Florida Current in the Atlantic, between the Straits of Florida and Cape Hatteras.

The Gulf Stream is a powerful surface current, carrying warm water into the cooler North Atlantic, and it exerts a considerable influence on the oceanographic conditions in each OPAREA. In general, the Gulf Stream flows roughly parallel to the coastline from the Florida Straits to Cape Hatteras, where it is deflected from the North American continent and flows northeastward past the Grand Banks. Figure 3.1-5 shows the approximate location of the Gulf Stream.
Figure 3.1-4

Bathymetry in the Site D Area

Site D USWTR

Continental Shelf Break

60 60
60 Kilometers

30 30
30 Nautical Miles

North Carolina
Maryland
Delaware
New Jersey
Virginia
North Carolina

Chesapeake Bay
CG Air Station
Elizabeth City, NC
NAS Oceana
Amphibious Base
Little Creek
NS Norfolk
Langley AFB
NASA Wallops Island, VA
NWS Yorktown
CG Air Station
Elizabeth City, NC

Albemarle Sound
Atlantic Ocean
Baltimore Canyon
Norfolk Canyon
Washington Canyon
Wilmington Canyon
Bathymetry in the Site D Area

60 0 60 30 Kilometers
30 0 30 15 Nautical Miles

Figure 3.1-4
Path of Gulf Stream

Figure 3.1-5

Mean Gulf Stream Axis
Standard Deviation of Gulf Stream Axis
Extreme Gulf Stream Front Position
USWTR Site
OPAREA

100 0 100 Kilometers

N
Stream with respect to the proposed USWTR sites. The position of the Gulf Stream as it leaves the coast changes throughout the year. In the fall, it shifts north (landward), while in the winter and early spring it shifts south (seaward). The estimated meridional range of annual variation in stream path is about 100 km (54 NM). Changes in the Gulf Stream’s transport, meandering, and structure have been observed at various temporal scales as it flows northeast.

The Gulf Stream usually is sharply defined on its west and north margins as an abrupt boundary or wall, but is less well defined on its east or south margins where the character of the current gradually merges with that of the Sargasso Sea (Pickard and Emery, 1990; Thurman, 1994). Surface velocities range from 3.7 to 9.2 km/hr (2 to 5 kt), and the water temperature is 25 to 28 degrees Celsius (°C) (77 to 82 degrees Fahrenheit [°F]) (Mann and Lazier, 1991).

The warm, nutrient-poor Gulf Stream waters do not readily mix with the colder, productive polar waters they meet, so a distinct temperature edge is maintained between the Gulf Stream and adjacent waters. As a result, the Gulf Stream forms a tongue of tropical water that extends north and provides habitat for warm-water species in otherwise cold latitudes. Further, sea turtles are known to follow the Gulf Stream up the eastern seaboard on their way to the North Atlantic.

3.1.2.1 Site A

Temperature and Salinity

The waters of the Jacksonville OPAREA follow an annual temperature cycle that lags the seasonal atmospheric temperate changes (DoN, 2008n). Throughout the year, there is an eastern gradient of increasing temperature on the sea surface, with the highest temperature centered in the Gulf Stream. Water temperature and salinity are vertically stratified within the Gulf Stream, with salinity increasing and temperature decreasing with increasing depth. Near the shore, there is a temperature fluctuation greater than 10°C (18°F) throughout the year, whereas beyond the shelf break, the annual change in temperature is about half that of shelf waters. The Gulf Stream, which brings warm, tropical waters northward through the offshore region of OPAREA, is largely responsible for maintaining relatively consistent offshore temperatures.

Water temperatures in the Jacksonville OPAREA vary between 19 and 29°C (66 and 84°F). The Jacksonville OPAREA has the greatest difference in temperature in the winter, when temperatures vary between 19° and 24°C (66° and 75°F). The most stable temperatures occur during summer, when water temperature throughout the Jacksonville OPAREA is 27° to 28°C (81° to 82°F), with some intrusion of warmer water, about 29°C (84°F), around the Gulf Stream.

Salinity in the SAB and in the JAX/CHASN OPAREA ranges from 33 to 36.5 practical salinity units (psu), with lower salinities found near the coast and highest salinities found near the shelf break (Blanton et al., 2003). Variability in salinity is due to the intrusion of saltier (>36 psu) water from over the continental slope, freshwater input from rivers, and coastal run-off (Emery and Uchupi, 1972; Durako et al., 2005; Aretxabaleta et al., 2006). An increase in the salinity of shelf waters is often coincident with an onshore intrusion of the Gulf Stream and upwelling of
deep, higher salinity water, although higher salinities do occur farther north than the mean axis of the Gulf Stream (Aretxabaleta et al., 2006).

**Circulation**

The Gulf Stream is the dominant surface water mass in the SAB and the Jacksonville OPAREA. Southerly flowing currents, which typically occur north of Cape Hatteras, are transient events in the SAB and, when present, are limited to the area along the coast. Circulation over the continental shelf in the SAB is characterized by a broad, slow, northerly flow of water, with frequent intrusions of the Gulf Stream onto the shelf.

As the Gulf Stream enters the Jacksonville OPAREA at a water depth of less than 100 m (328 ft), it is fairly narrow and clearly defined. As the current travels northward and eastward through the OPAREA, it expands to approximately 50 km (27 NM) in width and more than 500 m (1,641 ft) in depth. Surface velocities range from 4.3 to 10.7 km/hr (2.3 to 5.8 knots [kt]), and the water temperature is 25 to 28ºC (77 to 82ºF) (Mann and Lazier, 1996). The west front of the Gulf Stream is variable; the position where it leaves the coast changes throughout the year, sometimes covering Site A (see Figure 3.1-5).

In deep waters within the SAB, currents flow in directions opposite to those of the Gulf Stream. The Deep Water Boundary Current is comprised of several cold, deep-water masses, each with a characteristic temperature and salinity. The Deep Water Boundary Current flows southward towards the equator at depths between 800 and 4,000 m (2,625 and 13,124 ft) along the eastern flank of the Blake Plateau (C. Adams et al., 1993).

**3.1.2.2 Site B**

**Temperature and Salinity**

The waters of the Charleston OPAREA, in which Site B is located, undergo an annual cycle of temperature change. Water temperature and salinity are vertically stratified within the Gulf Stream, with salinity increasing and temperature decreasing with increasing depth. During most of the year, there is a clear north-south temperature gradient (with Cape Hatteras being the pronounced dividing line), although this trend is less apparent in summer when surface water temperatures are homogeneous. The surface waters are nearly homogeneous in summer, with almost uniform surface temperatures of 26 to 28ºC (79 to 82ºF). Temperatures are cooler during winter months, about 10 to 16ºC (50 to 60ºF) (NOAA, 2007a). Salinity in the SAB and in the JAX/CHASN OPAREA ranges from 33 to 36.5 psu, with lower salinities found near the coast and highest salinities found near the shelf break (Blanton et al., 2003).

**Circulation**

As previously discussed, the Charleston Bump is a unique feature that exists off the coast of South Carolina and Georgia that influences the flow of the Gulf Stream in this area. The Charleston Bump rises off the surrounding Blake Plateau from 610 m (2,000 ft) deep to a depth
of about 366 m (1,200 ft). The offshore deflection of the Gulf Stream by the Charleston Bump causes large meanders and eddies in the region between the Charleston Bump and Cape Hatteras (Verity et al., 1993). Just downstream of the Charleston Bump is an area where a nearly-persistent eastward displacement of shelf water causes the formation of the cyclonic circulation known as the Charleston Gyre. The gyre maintains its circulation shoreward of the Gulf Stream off of Long Bay, South Carolina. This semi-persistent feature causes the macroalgae *Sargassum* and multiple species of ichthyoplankton to be retained on the Florida-Hatteras Shelf offshore of South Carolina.

The offshore deflection of the Gulf Stream by the Charleston Bump has been observed to vary in magnitude, such that the state of the deflection is typically described as either weak or strong (Bane et al., 2001). Whether the magnitude of the deflection is weak or strong also seems to affect the organization of the Charleston Gyre (Bane et al., 2001). When the Gulf Stream is strongly deflected offshore, the gyre is in its most persistent state and fewer meanders in the Gulf Stream occur between the Charleston Bump and Cape Hatteras. When the Gulf Stream is weakly deflected, meanders and eddies are spun off downstream of the bump, causing the gyre to oscillate in strength and organization (Bane et al., 2001). The transition in the Gulf Stream from a weakly deflected state to a strongly deflected state can occur in a matter of days (Bane et al., 2001).

### 3.1.2.3 Site C

#### Temperature and Salinity

The waters of the Cherry Point OPAREA in which Site C is located exhibit a clear north-south gradient of increasing sea surface temperature (SST) during most of the year, although this trend is less apparent in summer when the surface temperatures are nearly homogeneous (DoN, 2008l). The Gulf Stream’s intrusion into the Cherry Point OPAREA regulates surface and subsurface temperatures in all seasons, reducing the magnitude of seasonal temperature fluctuations. Over the course of the year, nearshore waters undergo more than a 20°C (68°F) temperature change (Newton et al., 1971).

Near-bottom shelf waters are about 5°C (41°F) off Cape Hatteras in winter and increase eastward to about 10°C (50°F) and southward to as high as 20°C (68°F) (Newton et al., 1971). In summer, bottom waters range from about 10 to 25°C (50 to 77°F), with temperature gradually increasing shoreward along the shelf. Bottom temperatures along the shelf break range from about 9 to 11°C (48 to 52°F) in winter with significantly colder (2 to 6°C [36 to 43°F]) bottom waters found inshore just north of Cape Hatteras (S. Cook, 1988).

Water temperatures are at the minimum in winter, with a well defined thermal convergence of cold, northern waters and warm Gulf Stream waters off Cape Hatteras (DoN, 2008l). In spring the water column begins warming, and the thermal convergence area moves north of Cape Hatteras and closer to the mouth of Chesapeake Bay. As late spring progresses into early summer, a seasonal thermocline is established in the waters of the Cherry Point OPAREA and...
throughout the region. Isotherms (lines of constant temperature) incline steeply seaward. In early summer, the surface temperature contrast in the Cherry Point OPAREA is no greater than anywhere else along the U.S. east coast. The surface waters are almost homogeneous in summer, with nearly uniform surface temperatures over the entire OPAREA. The thermocline reaches its maximum stability shortly before cooling begins in fall.

The salinity over the continental shelf ranges from 28 to 36 psu, with lower salinities nearest the coast and the highest salinities found near the continental shelf break or near Cape Hatteras (DoN, 2008l). The variability is due to the intrusion of saltier water (> 35 psu) from the continental slope waters and freshwater input from coastal sources with the most dominant source of fresh water being the Chesapeake Bay outflow (Garland and Zimmer, 2002; Lentz et al., 2003; Dzvonkowski and Yan, 2005). A salty wedge of water can be seen intruding onto the shelf in the Cape Hatteras area during every season and in particular during winter when the average salinity reaches 36 psu (S. Cook, 1988). This high salinity intrusion onto the shelf appears to be coincident with the average path of the Gulf Stream through the area, although higher salinities do occur farther north than the mean axis of the Gulf Stream. Continental slope waters in the Cherry Point OPAREA maintain a fairly uniform salinity range (32 to 36 psu) throughout the year, with pockets of higher salinity water (38 psu) found near the Gulf Stream’s north wall in the fall.

Circulation

The Gulf Stream is the dominant surface water mass or current in the Cherry Point OPAREA. In this OPAREA, the Gulf Stream is about 100 km (54 NM) wide and 1,000 m (3,280 ft) deep (Gyory et al., 2005). Surface velocity ranges from 3.7 to 9.3 km/hr (2 to 5 kt), with a temperature range of 25 to 28°C (77 to 82°F). The position of the Gulf Stream in the Cherry Point OPAREA and where it leaves the coast (see Figure 3.1-5) are variable throughout the year due to a number of oceanographic and atmospheric influences, but generally the Gulf Stream overlaps with Site C. Influences include water column stratification, the North Atlantic Oscillation (NAO), and instability in the mean flow past Cape Hatteras (Taylor and Stephens, 1998; Schmeits and Dijkstra, 2000; Pershing et al., 2001)

The continental shelf waters of Onslow Bay are typical of coastal SAB waters, and can be subdivided into three distinct flow regimes: the inner shelf, mid-shelf, and outer shelf (DoN, 1995b). Due to river runoff, a band of relatively low-salinity stratified water characterizes the inner shelf (0 to 20 m [0 to 66 ft]). Local wind action influences the flow and sea-level variability. Surface and bottom currents on the inner shelf are weak (less than 0.2 km [0.1 kt]) and variable in direction.

Winds also influence the currents in the mid-shelf zone (20 to 40 m [66 to 131 ft]). Stratification occurs seasonally, with well-mixed conditions characterizing fall and winter, and vertical stratification during spring and summer. Measurements taken in 40-m (131-ft) depths in the mid-shelf region indicate moderate tidal influence, with a maximum tidal current at the surface of 1.1 km/hr (0.6 kt) and at the bottom of 0.6 km (0.3 kt). During storms, currents of up to 2.8 km/hr
(1.5 kt) and 1.1 km/hr (0.6 kt) can occur at the surface and bottom, respectively (Pietrafesa et al., 1978).

The outer shelf at Onslow Bay is influenced by the Gulf Stream. The current constantly scour the seabed, and plants and animals are transported in the main axis of the current or concentrated along strong thermal gradients associated with boundaries of the current.

3.1.2.4 Site D

The continental shelf waters off Wallops Island, Virginia, are located in the MAB that extends from Nantucket Shoals, Massachusetts, to Cape Hatteras, North Carolina. Among the large rivers and estuaries that discharge fresh water into the MAB are the Hudson River, Delaware Bay, and Chesapeake Bay.

Temperature and Salinity

During most of the year, there is a clear gradient of increasing SST from north to south in the VACAPES OPAREA; this trend is less obvious in summer when the range in surface water temperatures is smallest (DoN, 2008m). Water temperatures in the OPAREA reach a minimum in winter with a well defined thermal convergence of cold, northern waters and warm Gulf Stream waters off of Cape Hatteras. The effects of the Gulf Stream are most noticeable in the southern portion of the VACAPES OPAREA where seasonal SST ranges from a low of approximately 21°C in winter to 31°C in summer (70° to 88°F). Just north of Cape Hatteras, the Gulf Stream separates from the coast, and waters on the continental shelf near the mouth of Chesapeake Bay undergo a much wider seasonal cycle, ranging in temperature between 8° and 26°C (46° to 79°F) (DoN, 2008m).

Salinity over the southern Hatteras-Cape Cod Shelf ranges between 30 and 35 psu throughout most of the year with variability dependent on several factors, including freshwater input, wind stress and whether winds are downwelling-favorable or upwelling-favorable, transient storm systems, and the position of the Gulf Stream (Kim et al., 2001; Emery and Uchupi, 1972). Increases in salinity over the shelf are often associated with persistent southerly upwelling-favorable winds (i.e., winds out of the south). Cross-shelf currents with speeds of 0.7 km/hr (0.4 kt) have been observed at the frontal boundary between saltwater intrusions and the fresher shelf water, resulting in the onset of instabilities along the front and mixing between the two water masses. Intrusions typically initiate rapidly and persist for only a short period of time (~hours), and in addition to upwelling-favorable winds, may also result from Gulf Stream meanders and warm-core eddies (Flagg et al., 1994; Kim et al., 2001).

Circulation

The Gulf Stream flows northward along the U.S. southeast coast, and is the dominant surface current in the western North Atlantic, SAB, and VACAPES OPAREA. In addition to the Gulf Stream, which flows through the southern half of the VACAPES OPAREA immediately after
diverging from the coast off of Cape Hatteras, currents originating from the outflow of both Chesapeake Bay and Delaware Bay influence the surface circulation in the OPAREA (DoN, 2008m). The Chesapeake Bay plume flows seaward from the mouth of the bay and then turns south to form a coastal jet that can extend as far as Cape Hatteras. Similarly, the Delaware Coastal Current initiates in Delaware Bay and flows southward along the DELMARVA Peninsula before being entrained into the Chesapeake Bay plume.

On average, surface currents over the Florida-Hatteras Shelf move slowly to the northeast, and surface currents over the Hatteras-Cape Cod Shelf move to the southwest until a confluence of the two water masses occurs just north of Cape Hatteras (Emery and Uchupi, 1972; Pickard and Emery, 1990). However, reversals in the direction of flow over the shelves have been observed and tend to coincide with changes in the direction of the prevailing winds and low river discharge (Emery and Uchupi, 1972). The Gulf Stream and its meanders strongly influence the general flow of currents over the Florida-Hatteras Shelf, whereas remnants of the southeasterly flowing Labrador Current, located upstream of the VACAPES OPAREA, direct the flow of the cold, temperate waters over the Hatteras-Cape Cod Shelf, as well as the slope water found just beyond the shelf break (Emery and Uchupi, 1972; GoMOOS, 2005).
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3.2 Ecology

This subchapter presents an overview of the biological communities present at the four alternative USWTR sites and the surrounding OPAREAs, which were used to provide a regional context for the discussions. Thus, the following sections refer in many cases to the entire OPAREAs. However, it should be noted that in every case, the USWTR sites encompass only a small portion of each of the OPAREAs (as described in Chapter 2 and depicted in Figure 2-11; Figure 2-15, Figure 2-19, and Figure 2-23).

3.2.1 Plankton

The information presented herein regarding plankton is general in nature and is applicable to all aquatic environments. Plankton refers to organisms that passively float or weakly swim in water. While planktonic organisms may have some locomotory ability, they generally do not have enough power to counteract major ocean currents or turbulence. The majority of planktonic organisms are, at most, a few centimeters in length (less than an inch).

There are two principal groups of plankton – phytoplankton and zooplankton. Phytoplankton includes planktonic plant life, typically microscopic algae such as diatoms, dinoflagellates, and blue-green algae. Zooplankton, or animal plankton, provides the intermediate link between primary producers, such as phytoplankton, and secondary consumers, such as macroinvertebrates and fish. Zooplankton can include organisms that spend their entire life as plankton, such as copepods, cladocerans, and rotifers, or those that spend only a portion of their life as plankton, such as larvae of benthic invertebrates, benthic chordates, and certain fish. Larval fish are discussed in Subchapter 3.2.3.

3.2.2 Macroinvertebrates

Macroinvertebrates along the continental shelf off the coasts of Florida, North and South Carolina, and Virginia, have been studied in detail, and are summarized below for the four alternative USWTR site locations.

3.2.2.1 Site A

The Jacksonville OPAREA has considerable live hard bottom (e.g., Gray’s Reef and the Charleston Bump), particularly off the coast of Georgia, well north of the proposed USWTR site. This area has warm water temperatures from the Gulf Stream current (~16°C [61°F] in January to ~29°C [84°F] in August), high salinities (34.3 to 36.6 practical salinity units [psu]), and consistent circulation patterns (northward flowing current) year to year (Wenner et al., 1984; NDBC, 2005; GRNMS, 2006).
Within the Jacksonville OPAREA, the Blake Plateau provides habitat for deep sea corals and sponges (Reed et al., 2006). The Blake Plateau consists of a flat portion of the continental slope that runs from the Bahamas Banks to North Carolina and supports non-reef forming corals and sponges, invertebrates including mollusks, echinoderms, and crustaceans, and fish (Milliman and Wright, 1987; Popenoe and Manheim, 2001). Most corals and sponges live on the inner region of the Blake Plateau north of 31°45’N latitude (Popenoe and Manheim, 2001). Temperate anthozoans found on the continental shelf include octocorals, such as gorgonians, soft corals, and telastaceans (DoN, 2008n). These octocorals may consume zooplankton in addition to using photosynthesis for nutrition (Huntsman and Macintyre, 1971; BLM, 1976; Reed, 1980; W. Miller, 1995).

Deep sea corals (ahermatypic corals that do not contain symbiotic algae) are also found along the continental slope (George, 2002; S. Ross, 2004; FFWCC, 2005b). Deep sea corals are fragile habitats that are now believed to contain more species than their shallow water counterparts but face serious danger from man-made threats, such as crushing by bottom fishing gear, ocean dumping, and mineral exploration (Freiwald et al., 2004). The two most abundant deep sea corals found in the Jacksonville/Charleston OPAREA are *Lophelia pertusa* and *Enallopsammia profunda* (Popenoe and Manheim, 2001; Reed and Ross, 2005).

*Lophelia pertusa* is an ahermatypic hard coral found in all oceans but polar. Its global depth range is 60 to 2,170 m (197 to 2,170 ft). It is found in the Jacksonville OPAREA at water depths between 200 and 1,000 m (656 and 3,280 ft) and temperatures around 10°C (50°F) (Stetson et al., 1962; S. Ross, 2004; NOAA 2005, 2006a). *Lophelia pertusa* can form colonies as tall as 10 m (33 ft), creating cauliflower-like frameworks and coral banks (J. Wilson, 1979; Reed, 1992, 2002). Other benthic fauna usually associated with *L. pertusa* reefs are massive plate-like sponges (e.g., *Pachastrella monilifera*, *Phakellia ventilabrum*) and gorgonians (e.g., *Plumarella pourtalessi*) (Reed, 2002).

*Enallopsammia profunda* is an ahermatypic hard coral found in the western Atlantic from as far north as Massachusetts and as far south as the Antilles at depths between 146 and 1,748 m (479 and 5,735 ft) (Cairns et al., 1981). *E. profunda* is usually associated with *Lophelia pertusa* in the Jacksonville OPAREA and forms colonies up to 1 m (3.3 ft) in diameter (Reed, 2002).

There are three areas that represent substantial deep sea coral habitat within the Jacksonville/Charleston OPAREA: Stetson Reef, Savannah lithoherms, and East Florida. These areas within the Jacksonville/Charleston OPAREA are all found at depths of about 550 m (1,804 ft) or greater (DoN, 2008n) and are therefore well outside of the range area. The Stetson *Lophelia* reefs are an extensive region of *Lophelia* along the eastern Blake Plateau off South Carolina at a depth of 822 m (2,697 ft), the Savannah *Lophelia* lithoherms are an extensive region of lithoherms along the western Blake Plateau off Georgia at a depth of 550 m (1,804 ft), and the east Florida *Lophelia* reefs occur along a 222-km (120 NM) stretch off eastern Florida at a depth 700 to 800 m (2,297 to 2,675 ft) (Reed et al., 2006).
Several commercially important invertebrates such as pink shrimp, rock shrimp (*Sicyonia brevirostris*), and royal red shrimp (*Pleoticus robustus* or *Hymenopenaeus robustus*) are seasonally abundant in the Jacksonville OPAREA (see Subchapter 3.4.2.1). Other species of decapod crustaceans, stomatopod crustaceans, and cephalopods are also found in the area. Additional principal benthic epifaunal groups include mollusks, echinoderms, and anemones. The distribution of epifauna in this area appears to be governed largely by hydrographic patterns and the intermittent influence of the Gulf Stream (Texas Instruments, 1979).

### 3.2.2.2 Site B

As discussed for Site A, the Jacksonville and Charleston areas contain hard bottom reefs, which represent an important biological resource in the South Atlantic Bight (SAB). Deep coral banks and areas of rocky outcrops occur all along the continental shelf edge from northern Florida to Cape Hatteras at depths of 100 to 500 m (328 to 1,640 ft) (NOAA, 2006b), and serve as popular fishing grounds for commercial fishermen.

There are also many sediment-dwelling infauna (e.g., worms, crustaceans, mollusks, echinoderms) present in this area. Van Dolah et al. (1987) reported a high diversity of macroinfauna, with mean numbers of species ranging from 34 to 70 species / 0.04m$^2$ (0.43 ft$^2$), in a study conducted in inner shelf sands off the coast of South Carolina.

The largest and most economically valuable fishery in South Carolina is that for white and brown shrimp (South Carolina Sea Grant, 2007) (see Subchapter 3.4.2.2). This fishery occurs primarily inshore of the proposed range area. A rock shrimp fishery, however, may occur sporadically off of South Carolina in waters from 27 to 55 m (90 to 180 ft), and therefore overlap the more shallow areas of the proposed range (South Atlantic Fishery Management Council [SAFMC], 2004a; South Carolina Department of Natural Resources, 2007a).

### 3.2.2.3 Site C

North Carolina is considered a warm temperate subtropical region (Cerame-Vivas and Gray, 1966; Moyle and Cech, 1988). The benthic fauna (~211 species) that live on the continental shelf off the coast of North Carolina, in particular around Cape Hatteras, experience dramatic seasonal changes and a narrowing continental shelf that creates challenging conditions (Cerame-Vivas and Gray, 1966). Water temperatures in the winter north of Cape Hatteras ($\geq 4.5^\circ$C [40$^\circ$F]) are about 6 to 11$^\circ$C (43 to 52$^\circ$F) colder than water temperatures south of Cape Hatteras (11$^\circ$C [52$^\circ$F]) in the winter on the inner- and mid-shelf creating biogeographic provinces (Cerame-Vivas and Gray, 1966).

Biogeographic provinces are large separations in biota due to environmental variables (i.e., temperature and currents) (Cerame-Vivas and Gray, 1966). Although biogeographic provinces exist, species diversity remains high throughout the year across the shelf in the Cherry Point OPAREA (Kirby-Smith, 1989). Within the Cherry Point OPAREA and vicinity, live hard bottom and biogenic reef communities are found at depths between 3 and 500+ m (10 and 1,640+ ft).
Thirty percent of the shelf area within a 200-m (656-ft) isobath from North Carolina to Cape Canaveral, Florida (South Atlantic Bight) is live hard bottom (biogenic reef) habitat, most of which is macroalgae (SAFMC, 1998a).

Common species found inhabiting (in and around) the reefs in the northern shelf regions of the Cherry Point OPAREA (i.e., north of Cape Hatteras) are sponges, arthropods, gastropods, and echinoderms (Cerame-Vivas and Gray, 1966). This region has more temperate fauna and lower species diversity due to a lack of warm water from the Gulf Stream current, which is farther out in the Atlantic and does not cross over the shelf as it does south of Cape Hatteras (Cerame-Vivas and Gray, 1966).

The benthic fauna of the shelf region south of Cape Hatteras consist of more subtropical species due to a wider continental shelf, increased hard bottom and biogenic reefs, and warmer water mixing from the Gulf Stream Current (Menzies et al., 1966). The benthic fauna here include sponges, hard and soft corals, bryozoans, annelids, mollusks, arthropods, and echinoids (Cerame-Vivas and Gray, 1966; Menzies et al., 1966). Higher abundances of benthic fauna tend to aggregate not only on hard bottom and biogenic reefs but also in the adjacent soft sediment near these areas (1 to 75 m [3 to 246 ft]) due to the availability of prey associated with them (Kirby-Smith, 1989; Posey and Ambrose, 1994).

There are no tropical coral reefs within the Cherry Point OPAREA or vicinity but there are isolated coral patches, sea fans, algae, and sponges associated with hard bottom (Huntsman and Macintyre, 1971). In particular, the Ben Franklin temperate reef, 20 m (60 ft) deep, is located within Onslow Bay, at 33°59′3″N, 77°21′18″W (George, 2002). The Ben Franklin temperate reef is well known for its abundance of compact ivory tree coral (*Oculina arbuscula*), macroalgae, and a reef isopod (*Eurydice bowmani*) (George, 2002). Other scleractinian corals found in Onslow Bay are *Solenastrea hyades*, *Siderastrea siderea*, ivory tree coral (*Oculina varicosa*), *Astrangia astreiformis*, *Phyllangia americana*, and *Ballanophyllia floridana* (Huntsman and Macintyre, 1971). In addition to hard corals, soft corals such as *Titanedeum frauenfeldii* and *Telesello fruticulosa* and four species of sponges (*Homaxinella waltonsmithi*, *Spheciospongia vesparium*, *Cliona caribbaea*, and *Halichondria bowerbanki*) are also abundant on the reefs throughout the shelf (NCDMF, 2005a).

Two deep sea coral banks (*Lophelia pertusa*), the northern and southern *Lophelia* banks, exist within the slope area of the Cherry Point OPAREA in water depths between 200 and 1,000 m (656 to 3,280 ft), (Stetson et al., 1962; S. Ross, 2004; NOAA, 2005, 2006a).

The northern *Lophelia* banks exist off Cape Lookout (500-m [1,640-ft] isobath). They appear to have abundant *L. pertusa* but size and area data are lacking. The northern *Lophelia* banks grow on top of a ridge system composed of dead coral rubble and trapped sediments. The *Lophelia* banks extend vertically 80 m (262 ft) over a distance of 1 km (0.5 NM). Abundant numbers of brittle stars (*Ophiacantha bidentata*), crabs (galatheid), and basket stars (*Novodinia antillensis*) forage the banks for food, suggesting a biologically rich environment. The southern *Lophelia* banks are very similar to the northern *Lophelia* banks. They occur off the coast of Cape Fear,
North Carolina, along a ridge system (0.4 km [0.2 NM]) (500 m [1,640 ft] isobath) and can grow as tall as 53 m (174 ft) (S. Ross, 2004; Reed and Ross, 2005).

In addition to the *Lophelia* banks there are also two canyons in the Cherry Point OPAREA located between Cape Hatteras and Cape Lookout: Hatteras Canyon and Pamlico Canyon. These canyons support various benthic fauna such as sea pens (*Kophobelemnon stelliferum* and *Distichoptilum gracile*); anemones (*Actinauge verrilli*); and sponges (*Hyalonema boreale*) (Rowe, 1971; Hecker, 1994).

Commercially important invertebrates such as penaeid shrimp (e.g., white shrimp [*Litopenaeus setiferus*], brown shrimp [*Farfantepenaeus aztecus*], pink shrimp [*F. duorarum*], and portunid crab [*Callinectes similes*]) are seasonally abundant in the SAB (see Subchapter 3.4.2.3). Other species of decapod crustaceans, stomatopod crustaceans, and cephalopods are also found in the SAB.

3.2.2.4 Site D

Hard bottom of the VACAPES OPAREA consists of a variety of naturally occurring and human-made substrates (Steimle and Zetlin, 2000) colonized by sessile and motile benthic organisms, and used by demersal organisms. Benthic communities include hard and soft corals, hydroids, anemones, crustaceans, encrusting algae, sponges, sea turtles, and commercial/recreational fishes (Wigley and Theroux, 1981; A. Jones et al., 1985; Steimle and Zetlin, 2000). Benthic habitats in this area include numerous sand and sand-shell shoals which do not support high biotic diversity. Between shoals, “valleys” carved by currents do support considerable benthic diversity such as annelids and bivalves (Cutter et al., 2000).

There are also four submarine canyons within or near the VACAPES OPAREA: Wilmington, Baltimore, Washington, and Norfolk. These canyons support numerous benthic species (i.e., invertebrates, fish, and coral) and provide habitat for deep sea corals and sponges (primarily at depths between 100 and 2,000 m [328 to 6,562 ft]) along with commercially important fish species (Watling and Auster, 2005). Corals and sponges are found in the canyons despite heavy sedimentation and limited suitable substrates for attachment (Hecker et al., 1980). The upper slope fauna of Baltimore Canyon are similar to the fauna found on the nearby shallow water shelf (Hecker et al., 1980). The most abundant coral in the Baltimore Canyon is the small, white, sea pen (soft coral) (*Pennatula aculeate*), which lives on soft sediment between 100 and 300 m (328 to 656 ft) (Hecker et al., 1980). The lower slope fauna of Baltimore Canyon (1,400 m+ [4,593 ft+]) have similar species to the upper slope fauna and are mainly composed of soft corals (Alcyonaceans) (Hecker et al., 1980, 1983). Hecker et al. (1980) found crabs (*Geryon quinquedens*) and fish (*Synaphobranchus kaupi*) to be the most abundant deep sea organisms in Baltimore Canyon.

There are no tropical coral reefs within the VACAPES OPAREA or vicinity, but temperate corals are found on the shelf that not only use photosynthesis as a mode of nutrition but also consume zooplankton (Wigley and Theroux, 1981; Steimle and Zetlin, 2000). In addition, deep
sea corals that form large coral communities are found along the continental slope between 200 and 1,000 m (656 to 3280 ft) in the VACAPES OPAREA and vicinity (Reed et al., 2006).

The VACAPES OPAREA has some isolated patches of soft and hard corals, hydroids, zoanthids, and sponges that colonize rock outcappings, artificial reefs, and shipwrecks (Steimle and Zetlin, 2000). The southern region (northern North Carolina) of the VACAPES OPAREA contains more sponge and coral coverage as natural hard bottom increases and warmer water temperatures prevail (Wigley and Theroux, 1981). Seventeen species of hard corals are found from Cape Hatteras to Maine, but only one species is found in shallow water (northern star coral [Astrangia poculata]); the remaining species are found in water depths of 100 m (328 ft) and deeper (Cairns and Chapman, 2001). The northern star coral is found in the shallow areas (1 to 35 m [3 to 115 ft]) of the VACAPES OPAREA and vicinity associated with hard bottom such as artificial reefs (Cairns and Chapman, 2001; Figley, 2003).

Whip coral (Leptogorgia virgulata) is a soft coral that grows in estuaries and coastal zones between 1 and 20 m (3 to 66 ft) (Kaplan, 1988). Whip coral is common in the Chesapeake Bay (Kaplan, 1988). The most common anthozoans in the VACAPES OPAREA are sea anemones (Metridium senile) and hydroids (Wigley and Theroux, 1981; Steimle and Zetlin, 2000). Sponges of the VACAPES OPAREA include Halichondria sp., Polmastia sp., and the loggerhead sponge, Spheciosponia vesparia (Wigley and Theroux, 1981; Steimle and Zetlin, 2000).

Within the VACAPES OPAREA sponges exist in moderate densities along the outer shelf and rise region (Wigley and Theroux, 1981). Finger sponge (Haliclona oculata) is found in this region on the inner shelf from 1 to 124 m (3 to 407 ft) and can grow to a height of 46 cm (1.5 ft). In addition to sponges, soft corals (Alcyonaria) are found in abundance along the shelf, slope, and part of the rise (Watling and Auster, 2005). Alcyonaceaens (in water depths greater than 500 m [1640 ft]), such as Anthomastus spp., Acanthogorgia spp., Acanella spp., and Anthothela spp., are found within the VACAPES OPAREA. Paragorgia arborea and Primnoa resedaeformis are also found in the VACAPES OPAREA on the outer continental shelf and upper slope (150 m [492 ft]) (Watling and Auster, 2005).

Besides sponges and soft coral species, several hard coral species also exist on the outer continental shelf within the VACAPES OPAREA, such as Dasmosmilia lymani (depth range 48 to 366 m [157 to 1201 ft]) and Dellocyathus italicus (403 to 2,634 m [1,322 to 8,642 ft]) (Cairns and Stanley, 1981).

Commercially important invertebrates such as the sea scallop (Plactopecten magellanicus) and blue crab (Callinectes sapidus) are seasonally abundant in the VACAPES OPAREA (see Subchapter 3.4.2.4). Other species of decapod crustaceans, stomatopod crustaceans, and cephalopods are also found in the VACAPES OPAREA.
3.2.3 Fish

The structure of fish communities depends on abiotic (physical) factors, such as salinity, temperature, and dissolved oxygen, and biotic (biological) factors such as food availability, competition, predation, and habitat requirements. Pelagic fish live in the water column, while demersal fish live near the bottom.

Habitats along the Atlantic continental shelf between the inshore high-tide mark and the edge of the shelf include the inner subtidal or open-water habitats, where the water depth is approximately 50 m (164 ft), and the outer subtidal zone, where water depths range from 50 to 150 m (164 to 492 ft).

The SAB and the Mid-Atlantic Bight (MAB) feature different fish assemblages, largely due to water temperature difference. The SAB features more warm-temperate and subtropical fish species, while the MAB features largely temperate fish species. Some subtropical fish are present in the MAB in the warmer late summer/early fall months. Cape Hatteras is the general transition point between the two regions; that is because the Gulf Stream, characterized previously as a powerful surface current that carries warm water into the cooler North Atlantic, flows roughly parallel to the coastline from Florida to Cape Hatteras. At Cape Hatteras, the Gulf Stream is deflected away from the North American continent.

In addition to water temperature differences, there are differences with respect to the reef fish that are represented in both areas. Although coral reefs do not exist in either of the regions, coral reef-associated fishes are well represented in the SAB due to a combination of the large number of artificial habitats, the warm water from the Gulf Stream, and the pelagic larvae of coral-associated fishes. Artificial habitats are present in the MAB, but these habitats tend to have a low diversity of reef fish compared to the more diverse reef fish communities in the SAB.

Specific information pertaining to the fish assemblages inhabiting the waters of the Atlantic continental shelf and the continental slope off the coasts of Florida, South Carolina, North Carolina, and Virginia relative to the four proposed USWTR sites is contained in the following text. Additional information specific to commercial and recreational fisheries is contained in Subchapters 3.4.2 and 3.4.3, respectively. Subchapter 3.2.8.1 discusses fish species designated as endangered or threatened under the Endangered Species Act (ESA), as well as those designated as species of concern by the National Marine Fisheries Service (NMFS).

3.2.3.1 Site A

The Jacksonville OPAREA is located in the SAB. The dynamic interplay of cold currents from the north and the warm Gulf Stream from the south has profound effects on the fish fauna of the SAB. Population structure, local movements, and regional migrations of many species are the result of seasonal variations in water temperature and current patterns. Fish species move in and out of the area throughout the year based on their thermal tolerances, prey availability, and other
environmental/ecological variables. Because of this, fish that are more typical of regions to the north or south of the area may well be represented within the SAB at certain times.

Although the states bordering the Jacksonville OPAREA do not include extensive estuarine areas, those that are present serve as important nursery and maturation areas for various fish species. Many of the fish common to the Jacksonville OPAREA (e.g., snappers, groupers, drums, and croakers) are developmentally and ecologically linked to estuaries. Other species spend their entire lives in the open, offshore waters. The Jacksonville OPAREA contains different habitats that support various fish assemblages, as follows:

- **Coastal:** The habitat encompassed by the coastal fisheries extends from the shore seaward across the continental shelf to the shelf break. Although hermatypic coral reefs do not exist in the SAB (within Site A), fish typically associated with coral reefs (e.g., black sea bass \([Centropristis striata]\), red snapper \([Lutjanus campechanus]\), triggerfishes) are still common in the Jacksonville OPAREA. While much of the continental shelf of the SAB is relatively featureless, occasional patches of complex structural habitat (e.g., live/hard bottom, shipwrecks, and constructed artificial reefs) exist that attract reef fish. The combination of habitat complexity, warm water from the Gulf Stream, and pelagic larvae of coral reef-associated fish results in significant assemblages of reef fish in the Jacksonville OPAREA.

- **Open Shelf:** Pelagic fish species (e.g., tuna, marlins, swordfish) spend their entire lives in the water column in offshore waters. Different species may be associated with particular portions of the water column (i.e., mid-water and near-surface habitats). Pelagic fish sometimes aggregate for feeding and breeding along oceanfronts, including those oceanfronts associated with the Gulf Stream.

- **Shelf Edge:** The shelf edge occurs between the coastal habitats of the shelf and the continental slope. Live/hard bottom is common along this region, primarily composed of jagged broken bottom where groupers, snappers, and porgies congregate. Examples of species associated with this habitat include the hogfish \((Lachnolaimous maximus)\), gag \((Mycteroperca microlepis)\), black grouper \((Mycteroperca bonaci)\), red snapper, vermilion snapper \((Rhomboplites aurorubens)\), gray triggerfish \((Balistes vetula)\), and bigeye \((Priacanthus arenatus)\), among others.

The Navy performed a literature search to compile information on the assemblages of finfish species that, based on previous surveys, may occur within the proposed USWTR sites or the trunk cable corridors. Table A-1 in Appendix A presents a list of the fish species that may occur in Site A or in the associated trunk cable corridor.
3.2.3.2 Site B

Like the Jacksonville OPAREA, the Charleston OPAREA is located in the SAB. The description in Subchapter 3.2.3.1 of the fish assemblages inhabiting the waters of the Jacksonville OPAREA and Site A also applies to the Charleston OPAREA and Site B.

The Navy performed a literature search to compile information on the assemblages of finfish species that, based on previous surveys, may occur within the proposed USWTR sites or the truck cable corridors. Table A-2 in Appendix A presents a list of the fish species that may occur in Site B or in the associated trunk cable corridor.

3.2.3.3 Site C

The fish in the Cherry Point OPAREA are diverse, with more than 686 fish representing 149 families (DoN, 2008l). However, none of the species within the OPAREA are listed as threatened or endangered under ESA. Most fish species in the Cherry Point OPAREA are associated with the subtropical/tropical (southern) fauna attributable to the Gulf Stream, although a large percentage of fish are migratory (as they follow temperature gradients).

North Carolina has an extensive network of estuaries that function as breeding grounds, feeding grounds, and havens from predation for many fish species. Many of the fish common to the Cherry Point OPAREA utilize estuaries at some phase of their life cycle. Other species spend their entire lives in the open, offshore waters. The Cherry Point OPAREA contains different habitats that support various fish assemblages, as follows:

- **Coastal**: Coastal fisheries habitat begins beyond the Outer Banks, extends north and south along the entire length of the North Carolina coast, and seaward along the gradually sloping bottom to a depth of 110 m (361 ft). Fish assemblages within this habitat vary greatly, depending on time of year and associated water temperatures and currents. For example, in the summer, numerous pelagic fish exist in the water column, but demersal fish, with the exception of sharks, move into deeper, cooler, offshore waters. In the fall (September and October), most fish migrate out of the sounds or estuaries to the south or from offshore waters into nearby shelf waters to spend the winter.

- **Open Shelf**: The open-shelf habitat to the south of Cape Hatteras abounds seasonally with oceanic pelagic fish, such as sharks, tunas, and marlins, among others. Many of the coastal fish can also be found at some point of the year (depending on the season) in the open shelf or slope habitat. Many flounders and porgies are prevalent in North Carolina shelf waters in the fall; many other species migrate north or south. Fish living in the rough seas over the shelf during the winter months (December to March) typically include dense schools of drums (Sciaenidae), puffers (Tetraodontidae), monkfish (*Lophius americanus*), and spiny dogfish (*Squalus acanthias*), among others.
• **Shelf Edge**: The shelf edge is a transition zone between the coastal habitats, the open shelf, and the continental slope. It has a jagged broken bottom where groupers, snappers, and porgies congregate; otherwise, little is known about the fish of this habitat because strong currents limit sampling. Live/hard bottom is found at or near the shelf edge. Primary reef species require structurally complex habitats. Examples of species associated with this habitat include black sea bass, tautog (*Tautoga onitis*), red snapper, silk snapper (*Lutjanus vivanus*), pinfish (*Lagodon rhomboides*), crested blenny (*Hypleurochilus geminatus*), gray triggerfish, and bigeye, among others.

South of Cape Lookout, the lower shelf has a gradual slope and bottom sediments are typically comprised of fine- and medium-grained sand and silty clay. Species in the Macrouridae (rattails and grenadiers) and Gadidae (cods) families have been found using the muddy bottom of the lower shelf edge.

The Navy performed a literature search to compile information on the assemblages of finfish species that, based on previous surveys, may occur within the proposed USWTR sites or the truck cable corridors. Table A-3 in Appendix A presents a list of the fish species that may occur in Site C or in the associated trunk cable corridor.

### 3.2.3.4 Site D

The VACAPES OPAREA is located in the southern portion of the MAB, in the region between Cape Cod and Cape Hatteras that forms the Virginian Transition Province. While there are distinct fish assemblages in the boreal (cold-temperate) waters north of Cape Cod and in the subtropical/tropical (warm-temperate) waters south of Cape Hatteras, there are few endemic fish species in the variable MAB waters. Fish species composition, however, is diverse since numerous species, including commercially and recreationally important species, migrate seasonally through this region. At least 250 fish species may occur in the MAB, including demersal and pelagic fish.

There is significant overlap of cold-temperate and warm-temperate species and dramatic seasonal shifts in their distribution. Warm-water species such as bluefish (*Pomatomus saltatrix*) and weakfish (*Cynoscion regalis*) enter the region as temperatures rise in the spring and summer, while cold-water species such as Atlantic cod (*Gadus morhua*), Atlantic herring (*Clupea harengus*), and American shad (*Alosa sapidissima*) migrate north. Similarly, as fall approaches, warm-water species may migrate offshore toward deep waters and then move southward, while cold-water species move south into the MAB areas.
The MAB contains different habitats that support various fish assemblages, as follows:

- **Coastal:** Coastal habitat includes that area from the continental shelf break inshore. Sharks are a well-represented group in the VACAPES OPAREA. Other coastal pelagic fish species include Atlantic mackerel (*Scomber scombrus*), Atlantic menhaden (*Brevoortia tyrannus*), bluefish, alewife, and butterfish (*Peprilis triacanthus*).

- **Open Shelf:** Pelagic fish of the open shelf are highly migratory and include tuna (*Thunnus* spp.), white marlin (*Tetrapterus albidus*), blue marlin (*Makaira nigricans*), sailfish (*Istiophorus platypterus*), swordfish (*Xiphias gladius*), wahoo (*Acanthocybium solandri*), and dolphinfish (*Coryphaena hippurus*). All life stages (i.e., eggs, larvae, juveniles, adults) of these species are closely associated with the Gulf Stream. Fish associated with the drifting mats of *Sargassum* are also considered to be in the ocean pelagic group; approximately 100 species of fish are associated with pelagic *Sargassum* (SAFMC, 1998). Demersal fish, such as summer flounder (*Paralichthys dentatus*) and windowpane flounder (*Scophthalmus aquosus*), are species that preferentially live on or near bottom habitats.

- **Shelf Edge:** The continental shelf edge habitat is a transition zone between the inshore habitats and the continental slope leading to the abyssal plain. The shelf edge habitat north of Cape Hatteras has a jagged, broken bottom, over which many groupers, snappers, and porgies abound.

The Navy performed a literature search to compile information on the assemblages of finfish species that, based on previous surveys, may occur within the proposed USWTR sites or the trunk cable corridors. Table A-4 in Appendix A presents a list of the fish species that may occur in Site D or in the associated trunk cable corridor.
3.2.4 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 USC 1801 et seq.), as amended, establishes management authority over all fishing within the U.S. Exclusive Economic Zone (EEZ); all anadromous fish (marine fish that spawn in freshwater) throughout their migratory range; and all fish on the continental shelf. The MSA mandated the formation of eight Fishery Management Councils (FMCs), which function to conserve and manage certain fisheries within their geographic jurisdiction. The councils are required to prepare and maintain a Fishery Management Plan (FMP) for each fishery that requires management. Amendments contained in the Sustainable Fisheries Act of 1996 (Public Law 104-267) require the councils to identify Essential Fish Habitat (EFH) for each fishery covered under a FMP. EFH is defined as the waters and substrate necessary for spawning, breeding, or growth to maturity (16 USC 1802[10]). The term “fish” is defined as “finfish, mollusks, crustaceans, and all other forms of marine animals and plant life other than marine mammals and birds.” NMFS further clarified EFH (50 CFR 600.05 through 600.930) by the following definitions:

- **Waters**: aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate

- **Substrate**: sediment, hard bottom, structures underlying the waters, and associated biological communities

- **Necessary**: the habitat required to support sustainable fisheries and managed species’ contribution to a healthy ecosystem

- **Spawning, breeding, feeding, or growth to maturity**: stages representing a species’ full life cycle

In addition to the regional FMCs, the Atlantic States Marine Fisheries Commission (ASMFC) and NMFS also have management responsibilities for certain fisheries. The ASMFC is a consortium of the 15 coastal states from Florida through Maine that manages fish in state waters. The ASMFC currently manages 22 Atlantic coastal fish species or species groups (ASMFC, 2009). NMFS has jurisdiction over highly migratory species (HMS) in federal waters off the U.S. Atlantic coast and Gulf of Mexico. Typically, both the ASMFC and NMFS work closely with regional FMCs in preparing and implementing fishery management strategies.

As required by the MSA, federal agencies must consult with NMFS, Habitat Conservation Division, on any proposed federal action that may adversely affect EFH. In addition to EFH designations, areas called Habitat Areas of Particular Concern (HAPC) are designated to provide additional focus for conservation efforts and represent subsets of designated EFH that are rare, especially important ecologically to a species/lifestage, particularly susceptible to human-induced degradation, or located in environmentally stressed areas (50 CFR 600.805-600.815(a)(8)). HAPCs typically include high-value intertidal and estuarine habitats, offshore...
areas of high habitat value or vertical relief, and habitats used for migration, spawning, and rearing of fish and shellfish. Categorization as HAPC does not confer additional protection or restriction to the designated area.

Recently, the SAFMC and New England Fishery Management Council (NEFMC) have proposed to protect and designate deep-sea canyon and deep-sea coral habitats as HAPC. Some of these areas lie within and/or adjacent to Sites A, B, C, and D (NEFMC, 2007). They provide habitat for deep-sea corals and EFH for many species (J.A. Moore et al., 2003; L.E. Morgan et al., 2005, 2006). In the MAB (Hudson Shelf Valley and Canyon, Norfolk, Baltimore, Washington, and Wilmington canyons) and southeast waters (Savannah, east Florida, Stetson Reef, Cape Fear Banks, and Cape Lookout Banks), deep-sea canyons provide habitat for cold-water (also called deep-sea) corals, including scleractinian corals (stony corals), cerianthid anemones (Cnidaria, Anthozoa, Hexacorallia, Ceriantharia), sponges (Porifera), antipatharians (black corals), hydrocorals, and octocorals (gorgonians, soft corals, and sea pens) (Lumsden et al., 2007). These organisms may occur as solitary individuals (e.g., solitary scleractinian corals) and also can form both reef-like structures and thickets that provide habitat for numerous marine species.

Managed fish species may be categorized as temperate, subtropical-tropical, or highly migratory species. The FMCs classify EFH for temperate and subtropical-tropical managed species in terms of five basic lifestages: (1) Eggs, (2) Larvae, (3) Juveniles, (4) Adults, and (5) Spawning Adults. Eggs are those individuals that have been spawned but not hatched and are completely dependent on the egg’s yolk for nutrition. Larvae are individuals that have hatched and can capture prey, while juveniles are those individuals that are not sexually mature but possess fully formed organ systems that are similar to adults. Adults are sexually mature individuals that are not necessarily in spawning condition. Finally, spawning adults are those individuals capable of spawning (MAFMC, 1998a, 2000; MAFMC and ASFMC, 1998a, b; MAFMC and NEFMC, 1999, NEFMC, 1998, 1999; SAFMC, 1998a).

NMFS categorizes the lifestages of managed tuna, swordfish, and billfish somewhat differently than the FMCs, resulting in three categories that are based on common habitat usage by all lifestages in each group: (1) Spawning Adults, Eggs, and Larvae; (2) Juveniles and Subadults; and (3) Adults. Subadults are those individuals just reaching sexual maturity. The category of Spawning Adults, Eggs, and Larvae is associated with spawning location and the circulation patterns that control the distribution of the eggs and larvae (NMFS, 1999b, d).
NMFS uses a different lifestage classification system for sharks; the system bases the lifestage combinations on the general habitat shifts that accompany each developmental stage. The three resulting categories are: (1) Neonate and Early Juvenile (including newborns and pups less than one year old), (2) Late Juvenile and Subadult (age one to adult), and (3) Adult (sexually mature sharks) (NMFS, 1999d). In Amendment 1 to the FMP for the Atlantic Tunas, Swordfish, and Sharks (NMFS, 2003b), the first two lifestages were modified as follows: the Neonate and Early Juvenile category was renamed “Neonate,” which primarily includes neonates and small young-of-the-year (born within the year) sharks; and the Late Juveniles and Subadults category was renamed “Juveniles,” which includes all immature sharks from young to late juveniles (NMFS, 2003b).

Of the eight FMCs, three have geographic areas of jurisdiction within the four sites evaluated in this report. In addition, NMFS has jurisdiction over HMS throughout these areas. The fisheries and management units (MUs; individual species or groups of species managed through a FMP) for which EFH has been established in the study areas are listed in Table 3.2-1. The EFH Assessment (DoN, 2009g) contains a complete list of EFH species and the life stages found at each of the four sites.

The NEFMC manages nine fishery resources within the EEZ off the coasts of Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut. Although none of the four sites evaluated here are within this geographic region, it has jurisdiction over some of the MUs present at the sites. The Northeast Multispecies Fishery consists of 15 species of groundfish (demersal fish) that occupy similar habitats and that are harvested with similar methods. A subset of three (i.e., silver hake [whiting], red hake [ling], and offshore hake [blackeye whiting]) of these species requiring additional management measures comprises the small mesh multispecies fishery, which are managed primarily through a combination of mesh size restrictions and possession limits. In addition to the small mesh multispecies fisheries, the remaining 12 species comprise the large mesh multispecies fisheries. The spiny dogfish fishery is managed jointly by the NEFMC, ASMFC, and Mid-Atlantic Fishery Management Council (MAFMC), which is considered the lead council. The Monkfish MU is jointly managed by the NEFMC and MAFMC, with NEFMC acting as the lead. The Atlantic Herring MU is jointly managed by the NEFMC and ASMFC.
Table 3.2-1

Fish Species and Management Units for Which EFH Has Been Identified in the Study Areas

<table>
<thead>
<tr>
<th>New England Fishery Management Council Jurisdiction</th>
</tr>
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<tbody>
<tr>
<td>Atlantic Herring Management Unit</td>
</tr>
<tr>
<td>Atlantic Sea Scallop Management Unit</td>
</tr>
<tr>
<td>Deep-Sea Red Crab Management Unit</td>
</tr>
<tr>
<td>Monkfish Management Unit</td>
</tr>
<tr>
<td>Northeast Multispecies Management Unit (15 species)</td>
</tr>
<tr>
<td>Large Mesh Multispecies (12 species)</td>
</tr>
<tr>
<td>Small Mesh Multispecies (3 species)</td>
</tr>
<tr>
<td>Northeast Skate Complex Management Unit (4 species)</td>
</tr>
<tr>
<td>Spiny Dogfish Management Unit</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Mid-Atlantic Fishery Management Council Jurisdiction</th>
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</thead>
<tbody>
<tr>
<td>Atlantic Mackerel, Squid, and Butterfish Management Unit (4 species)</td>
</tr>
<tr>
<td>Bluefish Management Unit</td>
</tr>
<tr>
<td>Spiny Dogfish Management Unit</td>
</tr>
<tr>
<td>Surfclam and Ocean Quahog Management Unit (2 species)</td>
</tr>
<tr>
<td>Summer Flounder, Scup, and Black Sea Bass Management Unit (3 species)</td>
</tr>
<tr>
<td>Tilefish Management Unit</td>
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<tr>
<td>Monkfish Management Unit</td>
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<tr>
<th>South Atlantic Fishery Management Council Jurisdiction</th>
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</thead>
<tbody>
<tr>
<td>Coastal Migratory Pelagics Management Unit (3 species)</td>
</tr>
<tr>
<td>Coral, Coral Reefs, and Live/Hard Bottom Management Unit (multiple species)</td>
</tr>
<tr>
<td>Dolphinfish/Wahoo Management Unit (3 species)</td>
</tr>
<tr>
<td>Golden Crab Management Unit</td>
</tr>
<tr>
<td>Sargassum Management Unit (2 species)</td>
</tr>
<tr>
<td>Shrimp Management Unit (6 species)</td>
</tr>
<tr>
<td>Snapper-Grouper Complex Management Unit (73 species)</td>
</tr>
<tr>
<td>Spiny Lobster Management Unit (2 species)</td>
</tr>
<tr>
<td>Calico Scallop Management Unit</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Highly Migratory Species - National Marine Fisheries Service Jurisdiction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Billfish Management Unit (3 species)</td>
</tr>
<tr>
<td>Tuna Management Unit (5 species)</td>
</tr>
<tr>
<td>Swordfish Management Unit (1 species)</td>
</tr>
<tr>
<td>Large Coastal Sharks Management Unit (10 species)</td>
</tr>
<tr>
<td>Small Coastal Sharks Management Unit (4 species)</td>
</tr>
<tr>
<td>Pelagic Sharks Management Unit (3 species)</td>
</tr>
<tr>
<td>Prohibited Species Management Unit (6 species)</td>
</tr>
</tbody>
</table>
The MAFMC manages seven fishery resources (including shellfish species: Atlantic surfclam and ocean quahog) in federal waters off the coasts of New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina. (North Carolina is represented on both the Mid-Atlantic and South Atlantic Fishery Management Councils.) This geographic area includes the VACAPES OPAREA and most of the Cherry Point OPAREA. The Atlantic Mackerel, Squid, and Butterfish MU includes two commercially important squid species (long-finned and short-finned). The MAFMC jointly manages both the bluefish fishery and the summer flounder, scup, and black sea bass fishery group with the ASMFC. The tilefish is managed as a single species MU by the MAFMC, but is also one of the species included in the Snapper-Grouper Complex MU, which is managed by the SAFMC. In addition to the tilefish, the black sea bass is also managed separately by the SAFMC as part of the snapper grouper MU.

The SAFMC manages nine fishery resources in federal waters off the coasts of North Carolina, South Carolina, Georgia, and the east coast of Florida to Key West (SAFMC, 2008). This geographic area includes part of the Cherry Point OPAREA, the Charleston OPAREA, and the Jacksonville OPAREA. Coastal Migratory Pelagic species are managed jointly with the Gulf of Mexico Fishery Management Council (GMFMC). These species are considered a single MU because their occurrence is influenced by similar temperature and salinity parameters. The snapper-grouper complex includes 73 species of tropical and subtropical fish that are generally demersal in nature, occupy the same habitat types, and are harvested with similar methods. This complex includes numerous species of snappers, groupers, sea basses, porgies, grunts, tilefishes, triggerfishes, wrasses, and jacks. The shrimp fishery includes pink shrimp, white shrimp, brown shrimp, royal red shrimp, brown rock shrimp, and seabob shrimp. The spiny lobster fishery is also managed jointly with the GMFMC. Other MUs managed by the SAFMC include the Atlantic calico scallop, golden crab, and the dolphinfish/wahoo complex. The management authority of the red drum, formerly managed jointly by the SAFMC and ASMFC, was transferred from the SAFMC, in cooperation with the MAFMC, under MSA to the ASMFC under the Atlantic Coastal Fisheries Cooperative Management Act on November 5, 2008 (NMFS, 2008a).

In addition to fish species, the SAFMC has prepared FMPs for important habitats including coral, coral reefs, and live/hard bottom and Sargassum seaweed. The SAFMC generally divides EFH into inshore/estuarine and offshore categories. Inshore/estuarine EFH includes estuarine and palustrine marshes, shrub/scrub mangroves, seagrass, oyster reefs, shell banks, intertidal flats, aquatic beds, and the estuarine water column. Offshore habitats include live/hard bottom, coral and coral reefs, artificial/manmade reefs, Sargassum, and the marine water column.

In keeping with Executive Order 13158 that directs federal agencies to protect the significant natural and cultural resources within the marine environment for the benefit of present and future generations by strengthening and expanding the Nation's system of marine protected areas (MPAs), the NMFS has recently designated eight deepwater MPAs along the southeastern coast of the U.S. as part of the South Atlantic snapper-grouper FMP which was implemented as Amendment 14, effective 12 February 2009 (NMFS, 2009a). The MPAs are designed to protect a portion of the long-lived, "deepwater" snapper-grouper complex species (e.g., snowy grouper,
speckled hind, and blueline tilefish) and their spawning grounds. Designated MPAs occur within the proposed boundaries of Sites A and B (see Figure 3.2-1 and Figure 3.2-2). The MPAs are geographically defined areas of the marine environment where fishing or retention of snapper-grouper complex species, and any deployment of shark-bottom longline fishing gear are prohibited (SAFMC, 2007c). The SAFMC’s proposed prohibition on the use of shark bottom longlines in the MPAs was implemented by NMFS HMS Division in a separate final rule on 24 June 2008 (NMFS, 2008b). The primary purpose of the MPAs is to protect the population of deepwater snapper-grouper species from fishing pressure to achieve a more natural sex ratio, age, size, and genetic structure (SAFMC, 2007c). Another stated purpose of the MPAs is the protection of habitat and spawning areas of snapper-grouper species since recent stock assessments have shown several snapper-grouper species to be overfished (SAFMC, 2005). These spawning grounds are considered to be HAPC by the SAFMC. Deepwater snapper-grouper stocks are vulnerable to overfishing since they are long-lived, do not survive the trauma of capture from deep water, and may form large aggregations when reproducing (SAFMC, 2007c).

HMS include several species of tunas, sharks, swordfish, and billfish. These species are generally associated with physiographic and hydrographic features such as ocean fronts, current boundaries, the continental shelf margin, or sea mounts. HMS may occur from the open ocean to nearshore waters. HMS in the Atlantic Ocean are managed by the HMS Division of the NMFS.

EFH for managed species and MUs listed in Table 3.2-1 may be characterized with the general habitat categories described below. A complete description of EFH for each species and lifestage may be obtained by contacting the appropriate fishery management council or by visiting the NMFS Office of Habitat Conservation, Habitat Protection Division website (NMFS, 2009i).

3.2.4.1 Site A

The SAFMC is responsible for the fisheries in federal waters off the coast of Florida. The SAFMC published its final EFH plan (SAFMC, 1998a) in the Federal Register on March 4, 1999. This plan describes the EFHs of the South Atlantic region (from Cape Hatteras to the Dry Tortugas) and their distribution. The SAFMC maintains FMPs for the following eight MUs: shrimp; snapper-grouper; coastal migratory pelagics; golden crab; dolphinfish and wahoo; spiny lobster; coral, coral reef, and live bottom; and Sargassum (SAFMC, 1998a, b, 2009). SAFMC also manages the calico scallop (SAFMC, 2008), for which a FMP is being prepared. Additionally, in the South Atlantic region, NMFS maintains a FMP for the following seven MUs: billfish, tunas, swordfish, small coastal sharks, large coastal sharks, pelagic sharks, and prohibited species (NMFS, 2006b).

As previously discussed, the designated North Florida MPA is located in Site A (Figure 3.2-2). Within the MPAs, fishing or retention of snapper-grouper species, and any deployment of shark-bottom longline fishing gear are prohibited (SAFMC, 2007c; NMFS 2008b, 2009a). The EFH Assessment (DoN, 2009g) contains site-specific details of the MUs and managed species, along with EFH maps.
Figure 3.2-2

Marine Protected Areas in and Near Site B


Note: Map data not projected.
There are eight marine EFHs within the Site A area, including the USWTR range itself (1,535 km² [448 NM²]) and the corridor that connects the range with the shore facility (corridor) (2,085 km² [608 NM²]) (NOAA, 1999; NMFS, 2002a, b; DoN, 2009g). These EFHs include benthic substrate, live/hard bottom, artificial/manmade reefs, pelagic *Sargassum*, the water column, currents, nearshore habitats, and HAPCs.

- **Benthic substrates (not including live/hard bottom)** – Benthic substrate habitats comprise seafloor substrate on the continental shelf and slope that consists of soft sediments such as gravel, cobbles, pebbles, sand, clay, mud, silt, and shell fragments, and the water-sediment interface directly above the bottom substrate that is used by many invertebrates (e.g., members of shrimp MU). These benthic substrate habitats are utilized by a variety of species for spawning, nesting, development, dispersal, and feeding (NOAA, 1999, NMFS 1999c, 2002a, b; SAFMC, 1998a).

The benthic substrates within the range that appear along the outer continental shelf and shelf break (~40 to 100 m [~ 131 to 329 ft]) are mostly carbonate sediments (medium to fine grain) that make up between 50 and 95 percent of sediments on the outer Florida-Hatteras Shelf and the adjacent Florida-Hatteras Slope (A. Jones et al., 1985; Emery and Uchupi, 1972). Further seaward, between 85 and 93 percent of sediments on Blake Plateau are composed of carbonate (A. Jones et al., 1985; Emery and Uchupi, 1972). Within the Site A range, benthic substrates (not including live/hard bottom) comprise 61 percent of the area (935 km² [273 NM²]), while in the corridor, 91 percent (1,888 km² [550 NM²]) is considered to contain benthic substrates. Within the range, 21 species in 11 MUs use benthic substrates (DoN, 2009g). In the corridor area, 18 species in eight MUs use benthic substrates (DoN, 2009g).

- **Live/hard bottom** – Live/hard bottom refers to areas of the seafloor associated with hard substrate such as rocks, boulders, outcroppings of hard rock, or hard, tightly compacted sediments that support communities of living organisms such as sponges, mussels, hydroids, amphipod tubes, red algae, bryozoans, and corals in oceanic waters or oysters and bivalves in inshore waters (SAFMC, 1998a). The SAFMC (1998a) defines live/hard bottom as constituting “a group of communities characterized by a thin veneer of live corals and other biota overlying assorted sediment types.” The range is located in the southern portion of the Georgia Bight where the shelf is wide and gently slopes seaward. Throughout the shelf within the range, hard bottom consists of rock scarps, rock ledges, and flat top rocks with undercut channels that support sessile and colonizing organisms (Moser et al., 1995a). The SAFMC does not consider shipwrecks to be EFH.

Live/hard bottom communities in the training range of Site A are found on a Holocene rock-ridge system that extends along the shelf break (Kirby-Smith,
The rock-ridge system is composed of consolidated sediments, limestone algae, and sandstone (Kirby-Smith, 1989; ASMFC, 2001). Although Site A contains isolated coral patches or mounds (DeVictor and Morton, 2007), there are no true coral reefs similar in size, structure, or composition to those found in the Bahamas or Antilles regions further south.

The live/hard bottom areas constitute essential habitat for various warm-temperate and tropical species of the snapper-grouper complex and associated fishes. Offshore live/hard bottom habitats are used by many adult members of the snapper-grouper MU for feeding, shelter, and spawning (NEFMC, 1998; SAFMC, 1998a).

Within the Site A range, live/hard bottom areas comprise about 39% of the range (600 km² [175 NM²]). In the corridor, nine percent (197 km² [57 NM²]) is considered to be live/hard bottom. Eighteen species in six MUs use the live/hard bottom habitat of the range (DoN, 2009g), while in the corridor, 17 species in five MUs use live/hard bottom habitat (DoN, 2009g).

- **Artificial/manmade reefs** – Artificial/manmade reefs are defined as sea floor areas where suitable structures or materials have intentionally been placed for the purpose of providing long-term habitat for various fish and invertebrates. These types of artificial reefs are designated EFH. While there are no artificial reefs in the range area, there are 106 artificial reef complexes in the corridor area (FFWCC, 2006, 2008). Five species from two MUs use the artificial/manmade reef EFH in the corridor area (SAFMC, 1998a; DoN, 2009g).

- **Pelagic Sargassum** – Pelagic *Sargassum* is defined as dynamic structural habitat that is created by free-floating mats (windrows) of brown algae: *Sargassum natans* and *S. fluitans* (Settle, 1993). Most pelagic *Sargassum* circulates between 20° and 40°N latitudes and 30°W longitude and the western edge of the Florida Current/Gulf Stream (SAFMC, 1998a). Large quantities of *Sargassum* can form on the continental shelf off the southeastern U.S., and depending on prevailing surface currents, these mats may remain on the shelf for extended periods. The windrows flow with the Gulf Stream current and act as a type of “food conveyor belt” for many species of fish and invertebrates, transiting from the south to the north (Dooley, 1972; Butler et al., 1983; SAFMC, 1998a). Pelagic *Sargassum* is considered EFH because it provides protection and feeding opportunity; the mats can also be used as a spawning substrate to a variety of fish species (SAFMC, 1998c). Casazza and Ross (2008) reported that *Sargassum* provides a substantial nursery habitat for many juvenile fishes off the U.S. southeastern coastline. Over 100 species of fish have been collected or observed in association with *Sargassum* habitats, including reef, coastal demersal, coastal pelagic, epipelagic, and mesopelagic species. The presence of this habitat within Site A is transient and is dependent on prevailing winds, currents, and seasons (Dooley, 1972). *Sargassum*
temperature requirements change seasonally, ranging from 15°C (59°F) in the
winter to 28°C (82°F) in the summer months (Garrison, 2004). *Sargassum* is most
abundant in the late fall after its summer growth (Butler et al., 1983).

Within Site A, pelagic *Sargassum* habitat has the potential to occur in all of the
surface waters in the range and the corridor at any given time. There are 20
species in 3 MUs that use both the range and corridor areas as pelagic *Sargassum*
EFH (DoN, 2009g).

- **Water column** – Water column is defined as specific “structural” components of
  the water column that provide habitat for a broad array of managed species. The
  structural components of the water column that help define EFH include
  environmental parameters such as salinity, water temperature, nutrients, and
density (SAFMC, 1998a). The water column can be categorized into three layers:
  the surface water layer (or upper layer), the thermocline/pycnocline, and the deep
  water layer (Pickard and Emery, 1982; Schmitz et al., 1987). Circulation in the
  water column is controlled by both wind and water density, with wind-driven
circulation dominating in the upper 100 m (328 ft) of the water column (Schmitz
et al., 1987) and density-driven (or thermohaline) circulation in water depths
generally greater than 100 m (328 ft) (Picakard and Emery, 1982; Schmitz et al.,
1987). Planktonic organisms support the oceanic food web and provide nutrition
for many commercially important fish species (Parsons et al., 1984). Planktonic
organisms drift with currents and are found throughout the water column within
the range.

The water column extends from the sea surface to a depth of 40 m (131 ft) in the
corridor and from the sea surface to a maximum depth of 400 m (1,312 ft) in the
range. Depending on the species, designated habitat may only refer to part of the
water column such as the surface or bottom waters. Within Site A, the water
column overlies the range and corridor to areas of 1,535 km² (448 NM²) and
2,085 km² (608 NM²), respectively. The water column as EFH supports 39
species in 13 MUs in the range area and 39 species in 11 MUs in the corridor area
(DoN, 2009g).

- **Currents** – Here currents refer to surface circulation features of the southeastern
  U.S. dominated by the Gulf Stream that provides a dispersal mechanism for the
  larvae of many fish and invertebrate species (SAFMC, 1998a). The Gulf Stream is
  preceded by the Florida Current and flows to the northeast over deep water from
  southern Florida to Cape Hatteras, North Carolina, and then east into the northern
  Atlantic Ocean (Bumpus, 1973; Pickard and Emery, 1982). The Gulf Stream is
  bordered to the west by cool nearshore and slope waters and to the east by the
  warm Sargasso Sea. Currents west of the Gulf Stream are those that influence the
  range and corridor areas. Circulation over the continental shelf in the Site A area
  is characterized by a slow and broad northerly flow. Further, currents over the
shelf fluctuate seasonally and are predominantly wind-driven, but are also influenced by tides, transient storm systems, changes in density caused by fresh water input, and intrusion by Gulf Stream waters (Shen et al., 2000; Marmorino et al., 2002; Lentz et al., 2003). Frontal eddies commonly form when the distance between the Gulf Stream and the coast is greatest, such as off the coast of northern Florida (Yoder et al., 1981). Within Site A, currents as EFH influence the entire water column of the range (1,535 km$^2$ [448 NM$^2$]) and 69 percent of the potential corridor (1,432 km$^2$ [418 NM$^2$]). Twenty-nine species in nine MUs use currents as EFH (DoN, 2009g).

- **Nearshore** – Nearshore is defined as state waters (i.e., waters from estuaries to 5.5 km [3 NM] from shore), which include tidal freshwater, estuarine emergent vegetated wetlands (i.e., flooded salt and brackish marshes, marsh, and tidal creeks), submerged rooted vascular plants (sea grasses), oyster reefs and shell banks, soft sediment bottom, hard bottom, ocean high salinity surf zones, artificial reefs, and estuarine water column (SAFMC, 1998a). There are no nearshore habitats in the range area. Only 0.3 percent (6.9 km$^2$ [3.7 NM$^2$]) of the 2,085-km$^2$ (608-NM$^2$) corridor within Site A is designated as nearshore EFH. Nearshore EFH includes the water column, submerged aquatic vegetation (SAV), and other hard and soft benthic substrates. The nearshore EFH of the corridor area is used by 45 species in 14 MUs (DoN, 2009g).

- **HAPC** – HAPC is defined as special designations of EFH. These designations encompass a variety of species and habitats, including pelagic *Sargassum*; SAV; mangroves; hermatypic coral habitats and reefs; coastal inlets; state-designated nursery areas; state-designated overwintering areas; live/hard bottom used as spawning habitat for members of the snapper-grouper complex; oyster/shell habitat; and nearshore (< 4 m [13 ft] deep) hard bottom habitat. Designation of HAPC may vary, depending on the particular FMC. Some councils specify individual or specific habitats while others designate broad geographic areas. Some councils designate HAPC for all managed species, while others designate HAPC for particular species or life stages. The most common HAPC is pelagic *Sargassum*, which can occur at any given time within the range and corridor areas. Pelagic *Sargassum* is spawning habitat for coastal migratory pelagic MU species. Within Site A, designated HAPC occurs in the surface waters in areas where *Sargassum* is present and on the bottom as areas of live/hard bottom identified as snapper-grouper spawning grounds. The SAFMC proposes designating deepwater coral areas off the coasts of North Carolina, South Carolina, Georgia, and Florida, as a coral-HAPC, which is similar to an EFH-HAPC designation. The HAPCs are used by 25 species in five MUs in the range area and by 26 species in six MUs in the corridor area (DoN, 2009g).
3.2.4.2 Site B

In federal waters, the SAFMC is responsible for managing the fisheries off the South Carolina coast. In addition, some of the species found off South Carolina are covered by the MAFMC, which co-manages the spiny dogfish with the NEFMC.

For Site B, the SAFMC and NMFS maintain FMPs for nine MUs and seven MUs, respectively, as described for Site A (SAFMC, 1998a, b; NMFS, 2006b). In the Charleston OPAREA, the MAFMC maintains FMPs for three MUs (summer flounder, scup, and black sea bass; bluefish; and spiny dogfish) (MAFMC, 1998a). As previously discussed, eight MPAs have recently been designated by the SAFMC’s as part of the South Atlantic snapper-grouper FMP. The designated Charleston Deep Artificial Reef MPA is located in Site B (Figure 3.2-3). Within the MPAs, fishing or retention of snapper grouper species, and any deployment of shark-bottom longline fishing gear are prohibited (SAFMC, 2007c; NMFS 2008b, 2009a).

There are eight marine EFHs found within the Site B area, including the USWTR range (1,471 km² [428 NM²]) and the corridor that connects the range with the shore facility (corridor) (1,217 km² [354 NM²]) (NOAA, 1999; NMFS, 2002a, b; DoN, 2009g): benthic substrate, live/hard bottom, artificial/manmade reefs, pelagic *Sargassum*, the water column, currents, nearshore habitats, and HAPCs.

- **Benthic substrates (not including live/hard bottom)** – The benthic substrate found in Site B is composed primarily of quartzite or calcium carbonate (25 to 75 percent) sand or thin layers of fine-grained sand and silt (Amato, 1994; USGS, 2000). Within Site B, benthic substrates (not including live/hard bottom) comprise 87 percent of the range (1,285 km² [375 NM²]) and 78 percent of the corridor (947 km² [276 NM²]). Within the range and corridor, 23 species in nine MUs and 18 species in five MUs, respectively use these types of benthic substrates (DoN, 2009g).

- **Live/hard bottom** – Nearshore and offshore live/hard bottom communities in the region of Site B (Figure 3.2-4) are typically developed by benthic organisms including sponges, bivalves, hydroids, amphipod tubes, red algae, bryozoans, anthozoans, and macroalgae. Areas of live/hard bottom comprise habitat for various warm-temperate and tropical species of the snapper-grouper complex and associated fishes. Many adult members of the snapper-grouper MU use these offshore live/hard bottom habitats (NEFMC, 1998; SAFMC, 1998a).

Live/hard bottom communities in Site B are found on a Holocene rock-ridge system that extends along the shelf break (Kirby-Smith, 1989; ASMFC, 2001). The rock-ridge system is composed of consolidated sediments, limestone algae, and sandstone (Kirby-Smith, 1989; ASMFC, 2001). Part of the seafloor of the Site B range is a relict rock ridge that extends along the shelf break from Cape Hatteras, North Carolina, south to Florida; this rock ridge is encrusted with fauna.
Biogenic Reef Community Data for Site A

Figure 3.2-3

- Hard Bottom - Shallow Water*
- Possible Hard Bottom*
- No Hard Bottom*
- Junction Box
- Trunk Cable
- Site A USWTR

Lophelia Reefs
- Range of Possible Trunk Cable Locations
- Coral Mound**
- Rock/Coral Rubble**

Exposed hard pavement w/ limestone base or thinly covered hard substrate - high relief**
- Thinly covered hard substrate - med to low relief**
- Exposed hard pavement w/ siltstone base**

* Bottom type data from SEAMAP CD-ROM version 1.2 and data compiled by Florida Marine Research Institute, 1998
** FWC-FWRI Final Habitat Plan for the South Atlantic Region, October 1998
Biogenic Reef Community Data for Site B

Figure 3.2-4

South Carolina

AFB Charleston

NWS Charleston

Range of Possible Trunk Cable Locations

Possible Hard Bottom*
No Hard Bottom*
Junction Box
Trunk Cable
Site B USWTR

Hard Bottom - Shallow Water*
Lophelia Reefs
Possible Hard Bottom*
Coral Mound**
Exposed hard pavement w/ limestone base or thinly covered hard substrate - high relief**
Exposed hard pavement w/ siltstone base**
Exposed hard pavement**

Lophelia Reefs
Range of Possible Trunk Cable Locations
Coral Mound**
Rock/Coral Rubble**
Unconsolidated Sand**

Thinly covered hard substrate - medium to low relief**

* Bottom type data from SEAMAP CD-ROM version 1.2 and data compiled by Florida Marine Research Institute, 1998
** FWC-FWRI Final Habitat Plan for the South Atlantic Region, October 1998.
and flora. Although Site B may contain isolated coral patches or mounds (DeVictor and Morton, 2007), there are no true coral reefs similar in size, structure, or composition to those found in the Caribbean.

Within Site B, areas of known live/hard bottom comprise about 13 percent (186 km$^2$ [54 NM$^2$]) of the range and 22 percent (270 km$^2$ [79 NM$^2$]) of the corridor (SAFMC 2001, 2007). Nineteen species in six MUs use the live/hard bottom habitat of the range, while 15 species in four MUs utilize the corridor’s live/hard bottom habitat (DoN, 2009g).

Within the range, outer shelf live/hard bottom supports hard and soft corals, sponges, bryozoans, and numerous snapper-grouper MU species (BLM, 1978; NOAA, 2005). The Savannah lithoherms, a type of deepwater reef, consist of dense mounds of the reef-building corals *Lophelia pertusa* and *Enallopsammia profunda* (Reed et al., 2006). They are located in the southeastern portion of Site B; 167 km (90 NM) off the coast of Savannah, Georgia, along the western edge of the Blake Plateau in water depths of 490 to 550 m (1,608 to 1,805 ft) (Reed and Ross, 2005; Reed et al., 2006). The *L. pertusa* mounds reach 30 to 60 m (98 to 197 ft) in height and occur along the Florida-Hatteras slope on the Charleston Bump (450 to 850 m [1,476 to 2,789 ft]) (Reed et al., 2006). The north faces of the lithoherms have exposed black phosphoritic pavements that support coral mounds. The mounds have a NNE-SSW orientation, are 10 m (33 ft) in height, average 1 km (3,281 ft) in length, and have 25° to 37° slopes (Reed et al., 2006). In addition to *L. pertusa* there are other coral and sponge species (10 percent of the total live coverage) found on the north faces of the high relief mounds such as black coral (*Antipathes* sp.), octocorals (gorgonians), and numerous species of sponges (fan sponges [*Phakellia* sp.], and glass sponges [*Hexactinellida*]) (Reed et al., 2006). The south slopes of the lithoherms have less of a slope (10°) and 90 percent of their substrate consists dead of *L. pertusa* and coarse sand (Reed et al., 2006).

The SAFMC has developed strategies and plans to protect deep sea coral and sponge habitat. For example, the proposed Charleston Deep Artificial Reef MPA located in Site B would prohibit bottom fishing gear and anchoring in this area (SAFMC, 2007c). Site B corals are also protected under the SAFMC FMP for coral. The FMP prohibits the harvest of stony corals, sea fans, coral reefs, and live rock except as authorized for scientific and educational purposes (SAFMC, 2006).

Within the corridor area, there are isolated coral patches or mound reefs that grow on the top of exposed live/hard bottom consisting of temperate hard corals (*Oculina arbuscula*), soft corals, invertebrates, amphipods, and many commercial and recreational fish species (DeVictor and Morton, 2007).
Artificial/manmade reefs – Artificial/manmade reefs identified as EFH are found throughout the Charleston OPAREA. While there are no artificial reefs in the range, there are three artificial reef complexes in the corridor (SCDNR, 2006). Four species from four MUs use the artificial/manmade reef EFH in the corridor area (SAFMC, 1998a; DoN, 2009g).

Pelagic Sargassum – The presence of pelagic Sargassum within Site B is transient and is dependent on prevailing surface currents (occasional mats of Sargassum may float through the area). Within Site B, pelagic Sargassum habitat has the potential to occur at any given time. The pelagic Sargassum EFH supports 20 fish and invertebrate species in two MUs in the range and 19 species in three MUs in the corridor (DoN, 2009g).

Water column – Within Site B, the EFH-designated water column habitat overlies 100 percent of the range (1,471 km² [428 NM²]) and 100 percent of the corridor (1,217 km² [354 NM²]). The water column EFH supports 38 species in 15 MUs in the range and 38 species in 11 MUs in the corridor (DoN, 2009g).

Currents – In the Site B range, the entire range (716 km² [208 NM²]) and 74 percent (898 km² [262 NM²]) of the corridor is designated as currents EFH due to the presence of the Gulf Stream. A total 31 species in ten MUs use currents as EFH (DoN, 2009g).

Nearshore – There are no nearshore habitats in the Site B range. In the Site B corridor, nearshore EFH consists of estuaries, coastal embayments, wetlands, water column, oyster reefs, SAV, and other hard and soft benthic substrates (SAFMC, 1998a) and comprises 8.4 km² (2.4 NM²) or about 0.69 percent of the total corridor area. Nearshore EFH supports 42 species in 13 MUs (DoN, 2009g).

HAPC – Within Site B, the HAPC consist of pelagic Sargassum (which has the potential to occur anywhere within the range and corridor but has a patchy distribution), coral and live/hard bottom (important to species of the snapper-grouper complex for spawning), oyster habitat, and nearshore habitats (SAV, coastal inlets, mangroves, etc.). The SAFMC proposes designating deepwater coral areas off the coasts of North Carolina, South Carolina, Georgia, and Florida, as a coral-HAPC, which is similar to an EFH-HAPC designation. Seventy-nine point source location (e.g., reefs) HAPC occur in the range and 23 occur in the corridor at Site B. The HAPC support 25 species in seven MUs in the range and 26 species in six MUs in the corridor (DoN, 2009g).
3.2.4.3 Site C

In federal waters, the SAFMC and the MAFMC are responsible for managing fisheries off the North Carolina coast. In addition, some of the species found off North Carolina are covered by the NEFMC, which co-manages the monkfish and the spiny dogfish with the MAFMC.

For Site C, the SAFMC and NMFS maintain FMPs for nine MUs and seven MUs, respectively, as cited for Site A (see Subchapter 3.2.4.1) (SAFMC, 1998a, b; NMFS, 2006b). In the Cherry Point OPAREA, the MAFMC maintains FMPs for six MUs (summer flounder, scup, and black sea bass; bluefish; tilefish; Atlantic surfclam and ocean quahog; Atlantic mackerel, squid, and butterfish; and spiny dogfish), and the NEFMC maintains FMPs for four MUs (deep-sea red crab; northeast multispecies; northeast skate complex; and monkfish) (MAFMC, 1998a; NEFMC, 1998).

Eight types of marine EFHs are found within the Site C area, including the USWTR range (1,639 km² [478 NM²]) and the corridor that connects the range with the shore facility (corridor) (1,835 km² [535 NM²]) (NOAA, 1999; NMFS, 2002a, b): benthic substrate, live/hard bottom, artificial/manmade reefs, pelagic Sargassum, the water column, currents, nearshore habitats, and HAPCs.

- **Benthic substrates (not including live/hard bottom)** – The benthic substrate (not including live/hard bottom) found in Site C is composed primarily of quartzite or calcium carbonate (25 to 75 percent) sand or thin layers of fine-grained sand and silt (Hollister, 1973; Amato, 1994; USGS, 2000; Street et al., 2005). Within Site C, EFH-designated benthic substrates comprise 94 percent of the range (1,534 km² [447 NM²]) and 89 percent of the corridor (1,637 km² [477 NM²]). The benthic substrates EFH supports 22 species in 10 MUs in the range area (DoN, 2009g) and 20 species in 9 MUs in the corridor area (DoN, 2009g).

- **Live/hard bottom** – Nearshore and offshore live/hard bottom communities in the Site C area are typically developed by benthic organisms, including sponges, bivalves, hydroids, amphipod tubes, red algae, bryozoans, anthozoans, and macroalgae. These communities in the training range of Site C are found on a Holocene rock-ridge system that extends along the shelf break (Kirby-Smith, 1989; ASMFC, 2001). The rock-ridge system is composed of consolidated sediments, limestone algae, and sandstone (Kirby-Smith, 1989; ASMFC, 2001). Part of the seafloor of the Site C range is a relict rock ridge that extends along the shelf break from Cape Hatteras, North Carolina, south to Florida; it is encrusted with fauna and flora.

Within Site C, live/hard bottom EFH comprises six percent of the range (105 km² [31 NM²]) and 11 percent of the corridor area (204 km² [59 NM²]) (Figure 3.2-5). Live/hard bottom in Site C supports 11 species in three MUs in the range area and nine species in three MUs in the corridor area (DoN, 2009g).
Biogenic Reef Community Data for Site C

Figure 3.2-5

* Bottom type data from SEAMAP CD-ROM version 1.2
Within the range area, outer shelf reefs support hard and soft corals, sponges, bryozoans, and numerous snapper-grouper MU species (BLM, 1978; NOAA, 2005). Two deepwater coral reefs known as the *Lophelia* banks are located on top of the ridge system extending along the shelf break at water depths between 200 and 1,000 m (656 and 3,280 ft) (Stetson et al., 1962; S. Ross, 2004; NOAA, 2005, 2006a). The northernmost area contains the most extensive coral mounds off North Carolina (SAFMC, 2007a). The main mound system rises vertically nearly 80 m (262 ft) over a distance of about one kilometer (0.5 NM). Sides and tops of these mounds are covered extensively with two types of deep water corals, *Lophelia pertusa* and *Madrepora oculata*. The second area contains mounds that rise at least 53 m (174 ft) over a distance of about 0.4 km (0.2 NM). The SAFMC has developed strategies and plans to protect deep sea coral and sponge habitat. For example, there is a proposed HAPC site for the Cape Lookout *Lophelia* banks located in Site C, which would prohibit bottom fishing gear and anchoring (SAFMC, 2007b). Site corals are also protected under the SAFMC FMP for coral that prohibits the harvest of stony corals, sea fans, coral reefs, and live rock except as authorized for scientific and educational purposes (SAFMC, 2006).

Within the corridor area, there are reefs that grow on the top of exposed live/hard bottom that consist of temperate hard corals (*Oculina arbuscula*), soft corals, invertebrates, amphipods, and many commercial and recreational fish species (Huntsman and Macintyre, 1971; NCDMF, 2005a).

- **Artificial/manmade reefs** – Artificial reefs identified as EFH are found throughout the Cherry Point OPAREA. There are ten artificial reefs located in the range area and 30 reef complexes that encompass more than 100 reef sites in the corridor area. Artificial reefs serve as an EFH to four species in two MUs in the range area and four species in one MU in the corridor area (DoN, 2009g).

- **Pelagic *Sargassum* habitat** – Occasional pelagic mats of *Sargassum* may float through Site C, yet their presence within the area is transient and dependent on prevailing surface currents. Casazza and Ross (2008) reported at least 80 species of fish under *Sargassum* weedlines off Cape Hatteras, North Carolina. Within Site C, pelagic *Sargassum* habitat has the potential to occur throughout the range area and corridor areas at any given time. The pelagic *Sargassum* EFH supports 17 species in three MUs in the range area and 18 species in two MUs in the corridor areas (DoN, 2009g).

- **Water column** – Within Site C, the EFH-designated water column habitat comprises 100 percent of the range area (1,639 km² [478 NM²]) and 100 percent of the corridor area (1,835 km² [535 NM²]). The water column EFH supports 40 species in 15 MUs in the range area and 38 species in 13 MUs in the corridor area (DoN, 2009g).
• **Currents** – The entire 1,639 km² (478 NM²) of the range is designated as current EFH. In addition, 92 percent (1,691 km² [262 NM²]) of the corridor closest to the range is also considered current EFH. A total of 29 species in 10 MUs in the range and corridor use currents as EFH (DoN, 2009g).

• **Nearshore** – There are no nearshore habitats in the Site C range. In the Site C corridor nearshore EFH consists of estuaries, coastal embayments, wetlands, water column, oyster reefs, and hard bottom (Street et al., 2005) and comprises 6.9 km² (3.7 NM²) or about 0.4 percent of the overall corridor. Nearshore EFH of the corridor supports 39 species in 14 MUs (DoN, 2009g).

• **HAPC** – Within Site C, HAPC consists primarily of pelagic *Sargassum*, which has the potential to occur anywhere within the range and corridor but has a patchy distribution, live/hard bottom identified as spawning grounds for species in the snapper-grouper complex, oyster habitat, and nearshore habitats (SAV, coastal inlets, mangroves, etc). The SAFMC proposes designating deepwater coral areas off the coasts of North Carolina, South Carolina, Georgia, and Florida, as a coral-HAPC, which is similar to an EFH-HAPC designation. Twelve point source location (e.g., spawning grounds) HAPC occur in the range and 15 occur in the corridor at Site C. The HAPC supports 25 species in four MUs in the range area and 30 species in seven MUs in the corridor area (DoN, 2009g).

### 3.2.4.4 Site D

The MAFMC is responsible for the management of fisheries in federal waters off the mid-Atlantic Coast, including Virginia. FMPs maintained by the MAFMC and NMFS for MUs relevant to Site D pertain to the same six and seven MUs, respectively, cited for Site C in Subchapter 3.2.4.3 (MAFMC, 1998a; NMFS, 2006a). The NEFMC maintains FMPs for six MUs in the VACAPES OPAREA: Atlantic herring, Atlantic sea scallop, deep-sea red crab, northeast multispecies, northeast skate complex, and monkfish (NEFMC, 1998).

The MAFMC and NMFS have identified eight marine/offshore EFHs for the Site D range (1,591 km² [464 NM²]) and corridor (1,480 km² [431 NM²]) (NOAA, 1999; NMFS, 2002a, b): benthic substrate, live/hard bottom, artificial/manmade reefs, pelagic *Sargassum*, the water column, nearshore habitat, and HAPCs. The range and corridor areas of Site D are west of the Gulf Stream; therefore current EFH is outside of the study area and no current EFH is located within Site D.

• **Benthic substrates (not including live/hard bottom)** – Most benthic substrates in the range originated from rivers, glaciers, terrigenous and submarine outcrops of older rocks, and biogenic productivity (Tucholke, 1987). Due to the high-energy current and tidal systems that pass over the shelf in the range, sediments are swept off the shelf into deeper water (Riggs et al., 1998). The sediments on the shelf within the range consist mostly of quartz and feldspar and increase in
grain size closer to the shelf break (Hollister, 1973; Tucholke, 1987; USGS, 2000). In addition, there is very little calcium carbonate (five percent) mixed in with the sand on the shelf, which distinguishes Site D from the other sites located farther south.

In the range and on the slope, there is an accumulation of silty clay (Tucholke, 1987). Soft benthic substrates within the corridor are composed of the same soft substrates that occur in the range but have greater amounts of finer grained silts and clays (e.g., shoals) deposited from tidal currents (Hollister, 1973; Tucholke, 1987; USGS, 2000). Overall, the benthic soft sediments of the corridor are finer closer to shore, primarily due to erosion and suspension induced by the Gulf Stream, as well as storms that distribute and resuspend bottom sediments (Tucholke, 1987). Within Site D, benthic substrates (not including live/hard bottom) comprise 100 percent of the seafloor in the range (1,591 km² or 464 NM²) and 100 percent of the seafloor in the corridor (1,480 km² or 431 NM²). The benthic substrates support 26 species in 12 MUs in the range area and 19 species in nine MUs in the corridor area (DoN, 2009g).

- **Live/Hard bottom** – Live/hard bottom EFH in the range and corridor areas exists only in the form of shipwrecks, which are considered by the MAFMC to be EFH. Details on the extent or locations of natural live/hard bottom are unavailable (Amato, 1994; USGS, 2000; NAVOCEANO, 2006b; MAFMC, 1998b; Hoff, 2006). The EFH-designated hard bottom is used by 12 species in 8 MUs in the range and 7 species in 6 MUs in the corridor (DoN, 2009g).

- **Artificial/Manmade Reefs** – Within Site D, there are no dedicated artificial or manmade reefs in the range, but there are five are found in the corridor. The Virginia Marine Resources Commission (VMRC) maintains the artificial reef program in Virginia waterways. The five artificial reefs in the corridor are composed of various materials such as railway cars and military vehicles. Artificial reefs in this region on the continental shelf attract numerous commercially important fish species because of the relatively featureless topography in this area (Steimle and Zetlin, 2000). The artificial reefs designated as EFH support one species in one MU (DoN, 2009g).

- **Pelagic Sargassum** – *Sargassum* may occur throughout the entire range but is not always present since its distribution is dependent on currents. Within Site D, pelagic *Sargassum* has the potential to occur in the range and the corridor (1,480 km² [431 NM²]) at any given time. The EFH-designated pelagic *Sargassum* may support three species in one MU in both the range and corridor area (DoN, 2009g).

- **Water Column** – Within Site D, the EFH-designated water column comprises 100 percent of the range (1,591 km² or 464 NM²) and 100 percent of the corridor.
The water column can support 38 species in 16 MUs in the range area and 28 species in 15 MUs in the corridor area (DoN, 2009g).

- **Nearshore Habitat EFH** – There is no nearshore habitat designated as EFH in the range area. The nearshore habitat in the corridor consists of coastal bays and wetlands that support abundant juvenile fish and shellfish (Wazniak et al., 2004; MDDNR, 2006). Chincoteague Bay is located along the eastern shore of Virginia and Maryland within the Assateague barrier island chain and supports numerous seagrass beds, salt marshes, and wetlands, which shelter various life stages of fish and shellfish species (Wazniak et al., 2004). Three percent of the corridor area (51 km² [27 NM²]) is designated as nearshore EFH and supports 26 species of fish and invertebrates in 14 MUs (DoN, 2009g).

- **HAPC** – Surface waters of the range and the corridor are designated as HAPC and can occur anywhere in the range because of the potential for the presence of pelagic *Sargassum*. Three species of fish and invertebrates in one MU utilize the range as HAPC (DoN, 2009g). In addition, five species of fish and invertebrates in three MUs utilize the corridor as HAPC (DoN, 2009g).

### 3.2.5 Sea Turtles

Five species of sea turtles occur in the Atlantic coastal waters off the eastern U.S., including the continental shelf and shelf-break regions. All five are listed as threatened or endangered (as shown in Table 3.2-2). Extralimital occurrences of the olive ridley turtle (*Lepidochelys olivacea*) are possible but not likely, as they occur south of Florida in the Southern Atlantic Ocean (Foley et al., 2003; Stokes and Epperly, 2006), and, thus, this species is not discussed further here.

NMFS and USFWS share jurisdictional responsibility for sea turtles under the ESA. USFWS has responsibility in the terrestrial environment while NMFS has responsibility in the marine environment. USFWS jurisdiction on terrestrial environments applies during the nesting stage of the sea turtles’ life cycle and on any beach habitat where regulatory and conservation measures apply, while NMFS jurisdiction applies when the sea turtles are in the water.

Along the U.S. Atlantic coast, four sea turtle species (leatherback, loggerhead, Kemp’s ridley and green) migrate seasonally from offshore and warmer southern waters far into northern latitudes each summer (Morreale, 2005). Nesting is also documented for beaches bordering the region.
### Table 3.2-2

<table>
<thead>
<tr>
<th>Species</th>
<th>Scientific Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hawksbill</td>
<td><em>Eretmochelys imbricata</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Leatherback</td>
<td><em>Dermochelys coriacea</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Green</td>
<td><em>Chelonia mydas</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Loggerhead</td>
<td><em>Caretta caretta</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Kemp’s ridley</td>
<td><em>Lepidochelys kempi</em></td>
<td>Endangered</td>
</tr>
</tbody>
</table>

Note: Green sea turtles are listed as threatened; however, the Florida and Mexican Pacific coast nesting populations are listed as endangered. There is the potential for green sea turtles from the endangered Florida population to be found in the JAX, CHASN, CHPT, and VACAPES OPAREAs.

Off the U.S. Atlantic Coast, sea turtle distribution in temperate waters generally shifts on a seasonal basis in response to changes in water temperature and prey availability (Lutcavage and Musick, 1985; Musick and Limpus, 1997; Coles and Musick, 2000). During winter months, sea turtle distribution shifts either south or offshore, where water temperatures are warmer and prey is more abundant (e.g., Epperly et al., 1995a, b, c). Throughout the rest of the year, sea turtles are common residents of inshore and nearshore waters along the U.S. Atlantic Coast as far north as Massachusetts.

3.2.5.1 Site A

Large numbers of juvenile sea turtles use the many lagoons, estuaries, bays, and offshore reefs of the southeast U.S. coast as both foraging and resting habitats. In addition, the waters of the Jacksonville OPAREA provide suitable habitat for mature females that travel long distances to nest on the region’s ocean-facing beaches. As a region, the southeast U.S. has the most diverse and abundant sea turtle populations in the entire U.S.

**Loggerhead Turtle – Site A**

- **General Description**—The loggerhead turtle is a large hard-shelled sea turtle that is named for its disproportionately large head. The average straight carapace length (SCL) of an adult female loggerhead is between 90 and 95 cm (3.0 and 3.1 ft) and the average weight is 100 to 150 kg (220 to 330 lbs) (C. Dodd, 1988). Adults are mainly reddish-brown in color on top and yellowish underneath.

The diet of loggerhead turtles changes with age and size (e.g., Godley et al., 1998). The gut contents of post-hatchlings found in masses of *Sargassum* contained parts of *Sargassum*, zooplankton, jellyfish, larval shrimp and crabs, and gastropods (Carr and Meylan, 1980; Richardson and McGillivary, 1991; Witherington, 1994). Juvenile and subadult loggerhead turtles are omnivorous,
foraging on pelagic crabs, mollusks, jellyfish, and vegetation captured at or near
the surface (C. Dodd, 1988; Frick et al., 1999). Adult loggerheads are
carnivorous, often foraging on fish in nearshore waters, as well as benthic
invertebrates (mollusks, crustaceans, and coelenterates) (C. Dodd, 1988).

On average, loggerheads spend over 90 percent of their time underwater (Byles,
1988; Renaud and Carpenter, 1994; Narazaki et al., 2006). Loggerheads tend to
remain at depths shallower than 100 m (328 ft) (e.g., Houghton et al., 2002;
Polovina et al., 2003; Hawkes et al., 2006; Narazaki et al., 2006; McClellan et al.,
2007). Routine dive depths are typically shallower than 30 m (98 ft) (Houghton et
al., 2002), although dives of up to 233 m (764 ft) have been recorded for a post-
nesting female loggerhead off Japan (Sakamoto et al., 1990). During routine
activities, dives typically can last from 4 to 120 minutes (min) (Byles, 1988;
Sakamoto et al., 1990; Renaud and Carpenter, 1994; Bentivegna et al., 2003; C.
Dodd and Byles, 2003).

- **Status**—Loggerhead turtles are listed as threatened under the ESA. The
  loggerhead is the most abundant sea turtle occurring in U.S. waters. In the
  continental U.S. there are four demographically independent loggerhead nesting
groups or subpopulations: (1) Northern: North Carolina, South Carolina, Georgia,
and northeast Florida; (2) South Florida: occurring from 29°N on the east coast to
Sarasota on the west coast; (3) Florida Panhandle: Eglin Air Force Base and the
beaches near Panama City, and (4) Dry Tortugas (Witherington et al., 2006).
Bowen et al. (1995) noted that under a conventional interpretation of the nuclear
deoxyribonucleic acid (DNA) data, all breeding populations in the entire
southeastern U.S. would be regarded as a single management unit, yet the
mitochondrial DNA data indicate multiple isolated populations, and further
suggest this complex population structure mandates a different management
strategy at each life stage. The South Florida nesting subpopulation is the largest
loggerhead rookery in the Atlantic Ocean (and the second largest in the world),
followed by the Northern, the Florida Panhandle, and the Dry Tortugas
subpopulations (Ehrhart et al., 2003; Witherington et al., 2006). The south Florida
nesting subpopulation produced between 43,500 and 83,400 nests annually over
the past decade (USFWS and NMFS, 2003). Nesting trends indicate that the
number of nesting females associated with the south Florida subpopulation is
increasing (Epperly et al., 2001). The south Florida subpopulation also contributes
significantly to loggerheads off the Carolinas (66 percent) and in North Carolina’s
Albemarle-Pamlico Estuarine Complex (Epperly et al., 2001).

- **Habitat**—The loggerhead turtle occurs worldwide in habitats ranging from
  coastal estuaries to waters far beyond the continental shelf (C. Dodd, 1988). The
  species may be found hundreds of miles out to sea, as well as in inshore areas
  such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large
  rivers. Results from tagging data of juvenile loggerheads in both the eastern and
western North Atlantic suggest that the location of currents and associated frontal eddies is important to the foraging ecology of the pelagic stage of this species (McClellan et al., 2007). The neritic juvenile stage and adult foraging stage both occur in the neritic zone (shallow water, or nearshore marine zone extending from the low-tide level to a depth of 200 m [656 ft]).

Coral reefs, rocky places, and shipwrecks are often used as feeding areas. The turtles in these areas feed primarily on the bottom (epibenthic/demersal), though prey is also captured throughout the water column (Bjorndal, 2003; Bolten, 2003). The neritic zone not only provides crucial foraging habitat but can also provide inter-nesting and overwintering habitat. Satellite telemetry data from tagged nesting females has revealed that post-nesting migratory routes can be highly variable from one individual to another; ranging from coastal to deep oceanic waters (Schroeder et al., 2003).

- **General Distribution**—Loggerhead turtles are widely distributed in subtropical and temperate waters (C. Dodd, 1988). Loggerhead turtles can be found along the U.S. Atlantic coast from Cape Cod to the Florida Keys during any season. Loggerheads seem generally restricted to waters of the North Atlantic Ocean south of 38°N, with mean SSTs around 22°C (72°F). In the MAB, loggerheads concentrate in continental shelf waters but are also commonly sighted in deeper, offshore waters (Shoop and Kenney, 1992). A pattern of a higher proportion of small and apparently young individuals has been noted along a northward gradient in loggerheads, green turtles, and particularly in Kemp’s ridleys (Morreale and Standora, 2005). In North Carolina and Virginia, the proportion of breeding adult loggerheads in bays and estuaries is smaller than in Georgia and Florida, with most individuals classified as medium-sized juveniles.

Low water temperatures affect loggerhead turtle activity and cold-stunned (severe hypothermia) loggerheads have been found in various locales, including off the northeastern U.S. (Morreale et al., 1992). Immature loggerheads inhabiting cool-temperate areas in the western North Atlantic usually migrate seasonally to avoid cold-stunning (Musick and Limpus, 1997). Some loggerheads are believed to escape cold conditions by burying themselves in the bottom sediment and hibernating (Carr et al., 1980; Ogren and McVea, 1995; Hochscheid et al., 2005). In early spring, juvenile loggerheads over-wintering in southeastern U.S. waters begin to migrate north to developmental feeding habitats (Morreale and Standora, 2005).

The generally accepted life-history model for the species has been summarized by Musick and Limpus (1997), Bolten (2003), and Hawkes et al. (2006). Hatchlings travel to oceanic habitats, often occurring in *Sargassum* drift lines (Carr, 1986, 1987b; Witherington and Hirama, 2006). When juveniles reach sizes between 40 and 60 cm (1.3 to 2.0 ft) in carapace length (about 14 years old) some individuals
begin to recruit to the neritic zone (benthic habitat in shallow coastal waters) close to their natal area, while others remain in the oceanic habitat or move back and forth between the two (e.g., Musick and Limpus, 1997; Laurent et al., 1998). Turtles either may utilize the same neritic developmental habitat all through maturation, or they may move among different areas and finally settle in an adult foraging habitat. At sexual maturity (about 30 yrs old), adults switch from subadult to adult neritic foraging habitats (Musick and Limpus, 1997; Godley et al., 2003).

In direct contrast with the accepted life-history model for this species, Hawkes et al. (2006) recently reported that tagging work at the Cape Verde Islands (Africa) revealed two distinct adult foraging strategies that appear to be linked to body size. The larger turtles foraged in coastal waters, whereas smaller individuals foraged oceanically. Likewise, off Japan, epipelagic foraging has been recorded for adult female loggerheads (Hatase et al., 2002). Hawkes et al. (2006) also found that movements of adult loggerheads off Cape Verde were in part driven by local surface currents, with active movement by individuals to remain in areas of high productivity.

Occurrence in the Proposed Site A USWTR—Loggerheads are expected to occur year-round within the Site A USWTR. They are the most common sea turtle species present in the Jacksonville OPAREA and occur year-round, using the waters for overwintering, foraging, migrating, and traveling to nesting beaches. Loggerheads are distributed over the continental shelf and slope, with the majority found between the shoreline and the shelf break. Significant populations are known to occur in the following areas: Cape Fear River, North Carolina; Charleston Harbor, South Carolina; Port of Savannah, Georgia; and the Cape Canaveral Ship Channel, Florida. Juveniles and subadults constitute more than 80 percent of loggerheads encountered in these areas from August through March (Henwood, 1987). Nesting begins in early May and lasts through early September. After an approximate two-month incubation period, eggs hatch between late June and mid-November (FFWCC, 2002). Nesting occurs along almost the entire coastline adjacent to the Jacksonville OPAREA; several of the locations are high-density nesting beaches (DoN, 2008n).

Surveys conducted in 2006 identified 103 loggerhead nests along Duval County beaches (FFWCC-FWRI, 2006a). Loggerheads have nested and continue to nest at NAVSTA Mayport beaches. Surveys began in 1998 with two nests recorded and have since indicated that the numbers have grown to 21 nests and 1,177 hatchlings in 2006, which is the largest number on record at the station (DoN, 2007g).

**Leatherback Turtle – Site A**

- **General Description**—The leatherback turtle is the largest living sea turtle. Mature males and females can be as long as 2 m (6.6 ft) curved carapace length (CCL) (NMFS and USFWS, 1992). Specimens less than 145 cm (4.8 ft) CCL are
considered to be juveniles (NMFS-SEFSC, 2001; S. Eckert, 2002). Adult leatherbacks typically weigh between 200 and 700 kg (440 and 1,540 lbs) (NMFS and USFWS, 1992), although larger individuals have been documented (K. Eckert and Luginbuhl, 1988).

This species is placed in a separate family from all other sea turtles, in part because of their unique carapace structure. The leatherback’s carapace lacks the outer layer of horny scutes possessed by all other sea turtles. It is instead composed of a flexible layer of dermal bones underlying tough, oily connective tissue and smooth skin. The body is barrel-shaped and tapered to the rear, with seven longitudinal dorsal ridges, and is almost completely black with variable spotting. All adults possess a unique pink spot on the dorsal surface of their heads, a marking used by scientists to identify specific individuals (D. McDonald and Dutton, 1996).

Leatherbacks feed throughout the epipelagic and into the mesopelagic zones of the water column (Davenport, 1988; S. Eckert et al., 1989; Grant and Ferrell, 1993; Salmon et al., 2004; James et al., 2005a). Prey is predominantly gelatinous zooplankton such as cnidarians (jellyfish and siphonophores) and tunicates (salps and pyrosomas) (NMFS and USFWS, 1992; Grant and Ferrell, 1993; Bjorndal, 1997; James and Herman, 2001; Salmon et al., 2004).

The leatherback is the deepest-diving sea turtle, with a recorded maximum dive depth of 1,230 m (4,035 ft) (Hays et al., 2004a), though most dives are much shallower than this (usually less than 200 m [656 ft]) (Hays et al., 2004a; Sale et al., 2006). Leatherbacks spend the majority of their time in the upper 65 m (213 ft) of the water column regardless of their behavior (Jonsen et al., 2007). The aerobic dive limit for the leatherback turtle is estimated to be between 33 and 67 min (e.g., Southwood et al., 1999; Hays et al., 2004b; Wallace et al., 2005). Tagging data has revealed that changes in individual turtle diving activity appear to be related to water temperature, suggesting an influence of seasonal prey availability on their diving behavior (e.g., Hays et al., 2004b). Leatherbacks dive deeper and longer in the lower latitudes versus the higher latitudes (south versus the north) (James et al., 2005a). In northern waters, they are also known to dive to waters with temperatures just above freezing (James et al., 2006; Jonsen et al., 2007). James et al. (2006) noted a considerable variability in surface time between the northern and southern latitudes. Dives in the north are punctuated by longer surface intervals (equating to much more time spent at the surface per 24-hour period), with individuals spending up to 50 percent of their time at or near the surface in northern foraging areas, perhaps in part to thermoregulate (i.e., bask).

- **Status**—Leatherback turtles are listed as endangered under the ESA. Critical habitat for leatherbacks is designated in the Caribbean at Sandy Point, St. Croix, U.S. Virgin Islands (USVI) (NMFS, 1979). All inshore and offshore waters
adjacent to the U.S. Atlantic Coast between Cape Canaveral, Florida and the North Carolina-Virginia border (within the U.S. EEZ) have been designated as a “leatherback conservation zone” year-round (NOAA Fisheries, 1995).

- **Habitat**—Throughout their lives, leatherbacks are essentially oceanic, yet they enter into coastal waters for foraging and reproduction. There is limited information available regarding the habitats utilized by post-hatchling and early juvenile leatherbacks since these age classes are entirely oceanic (NMFS and USFWS, 1992). These life stages are restricted to waters warmer than 26°C (79°F) and therefore the juveniles spend much time in tropical waters (S. Eckert, 2002).

Late juvenile and adult leatherback turtles range from the mid-ocean to the continental shelf and nearshore waters (Schroeder and Thompson, 1987; Shoop and Kenney, 1992; Grant and Ferrell, 1993; Epperly et al., 1995b). Juvenile and adult foraging habitats include both coastal areas in temperate waters and offshore areas in tropical waters (Frazier, 2001). Adults may also feed in cold waters at high latitudes (James et al., 2006). The movements of adult leatherbacks appear to be linked to the seasonal availability of their prey and reproductive cycle requirements, and may be strongly influenced by oceanic currents (Collard, 1990; Davenport and Balazs, 1991; Luschi et al., 2006).

- **General Distribution**—The leatherback turtle is distributed circumglobally in tropical, subtropical, and warm-temperate waters throughout the year and into cooler temperate waters during warmer months (NMFS and USFWS, 1992; James et al., 2005b) as far north as Nova Scotia, Newfoundland, Iceland, the British Isles, and Norway (Bleakney, 1965; Brongersma, 1972; Threlfall, 1978; Goff and Lien, 1988). The leatherback is the most oceanic and wide-ranging of sea turtles, undertaking extensive migrations along distinct depth contours for hundreds to thousands of kilometers (Morreale et al., 1996; Hughes et al., 1998). Adult leatherback turtles forage in temperate and subpolar regions in all oceans and migrate to tropical nesting beaches between 30°N and 20°S.

According to aerial survey data, there is a northward movement of individuals along the southeast coast of the U.S. in the late winter/early spring. In February and March, most leatherbacks along the U.S. Atlantic coast are found in the waters off northeast Florida. By April and May, leatherbacks begin to occur in larger numbers off the coasts of Georgia and the Carolinas (NMFS, 1995, 2000). In late spring/early summer, leatherbacks appear off the mid-Atlantic and New England coasts, while by late summer/early fall, many will have traveled as far north as the waters off eastern Canada, remaining in the northeast from approximately May through October (CETAP, 1982; Shoop and Kenney, 1992; Wyneken et al., 2005). The location of these foraging areas changes seasonally. From March through November, foraging areas occur on the North American
continental shelf and shift to off-shelf waters from December through February (S. Eckert et al., 2006).

Leatherback nesting occurs on isolated mainland beaches in tropical (mainly Atlantic and Pacific, few in Indian Ocean) and temperate oceans (southwest Indian Ocean) (NMFS and USFWS, 1992) and to a lesser degree on some islands (e.g., the Greater and Lesser Antilles). In the U.S., the densest nesting is in Florida along the Atlantic coast from Jensen Beach south to Palm Beach (Stewart and Johnson, 2006). Sporadic nesting occurs in Georgia, South Carolina, and as far north as North Carolina (Rabon et al., 2003).

Occurrence in the Proposed Site A USWTR—Leatherbacks are expected to occur year-round within the Site A USWTR. Leatherback foraging areas in the western Atlantic are located on the continental shelf (30 to 50°N) as well as offshore (42°N, 65°W) (S. Eckert et al., 2006). The location of these foraging areas changes seasonally. From March through November, foraging areas occur on the North American continental shelf yet shift to off-shelf waters from December through February (S. Eckert et al., 2006). Nesting occurs from March through July with an incubation period of 55 to 75 days (DoN, 2007g). Leatherbacks typically nest along the beaches from Brevard County south to Broward County and also nest in low numbers along the beaches of Duval County (FFWCC-FWRI, 2006b).

Green Turtle – Site A

- **General Description**—The green turtle is the largest hard-shelled sea turtle, with adults commonly reaching 1 m (3.3 ft) in carapace length and 150 kg (330 lbs) in weight (NMFS and USFWS, 1991). The adult carapace ranges in color from solid black to gray, yellow, green, and brown in muted to conspicuous patterns; the plastron is a much lighter yellow to white. The common name refers to the color of the green turtle’s fat (Hirth, 1997).

  Very young green turtles are omnivorous, leaning to carnivory (Bjorndal, 1985; Bjorndal, 1997). Salmon et al. (2004) reported that posthatchling green turtles were found to feed near the surface on floating *Thalassia* and *Sargassum* or at shallow depths on ctenophores and unidentified gelatinous eggs but ignored large jellyfish (*Aurelia*) off southeastern Florida. Adult green turtles feed primarily on seagrasses (e.g., turtle grass [*Thalassia testudinum*], manatee grass [*Syringodium filliforme*], shoal grass [*Halodule wrightii*], and eelgrass [*Zostera marina*]), macroalgae, and reef-associated organisms (Burke et al., 1992; Bjorndal, 1997). They also consume jellyfish, salps, and sponges (Mortimer, 1995; Bjorndal, 1997).

  Green turtle diving behavior is likely influenced by the age class of the individual and depth of prey assemblages (Salmon et al., 2004). Adults dive deeper and slightly longer than juveniles, whose dives are generally shallow in depth (< 6 m
[(20 ft)] and shorter in duration (Salmon et al., 2004). Adult green turtles typically dive shallower than 30 m (98 ft) (Hochscheid et al., 1999; Hays et al., 2000); however, a maximum dive depth of 110 m (360 ft) was recorded (Berkson, 1967; Hochscheid et al., 1999; Hays et al., 2000). Green turtles have been known to forage and also rest at depths of 20 to 50 m (65 to 164 ft) (Balazs, 1980; Brill et al., 1995). The maximum dive time recorded for a juvenile green turtle is 66 min, with routine dives ranging from 9 to 23 min (Brill et al., 1995). Individuals may remain at the surface for longer periods of time during the winter than summer, likely due to physiological needs such as thermoregulation (Southwood et al., 2003).

- **Status**—The green turtle is classified as threatened under the ESA, with the Florida and Mexican Pacific coast nesting populations listed as endangered (NMFS and USFWS 1991d). Recent population estimates for green turtles in the western Atlantic area are not available (NMFS, 2006i).

- **Habitat**—Post-hatchling and early-juvenile green turtles reside in convergence zones in the open ocean, where they spend an undetermined amount of time in the pelagic environment (Carr, 1987a; Witherington and Hirama, 2006). Once green turtles reach a carapace length of 20 to 25 cm (7.9 to 9.8 in), they migrate to shallow nearshore areas (<50 m [164 ft] in depth) where they spend the majority of their lives as late juveniles and adults. The optimal developmental habitats for late juveniles and foraging adults are warm, shallow waters (3 to 5 m [10 to 16 ft] in depth), with an abundance of submerged aquatic vegetation, and located proximal to nearshore reefs or rocky areas, used by green turtles for resting (e.g., Holloway-Adkins and Provancha, 2005; Witherington et al., 2006).

- **General Distribution**—The green turtle has a circumglobal distribution, occurring throughout tropical and, to a lesser extent, subtropical waters (Seminoff and MTSG Green Turtle Task Force, 2004). Green turtles found in U.S. waters come from nesting beaches widely scattered throughout the Atlantic (Witherington et al., 2006). In U.S. Atlantic and Gulf of Mexico waters, greens are found around the USVI, Puerto Rico, and along the continental U.S. from Texas to Massachusetts (NMFS and USFWS, 1991). Juvenile green turtles utilize estuarine waters along the U.S. Atlantic coast as summer developmental habitat, as far north as Long Island Sound, Chesapeake Bay, and North Carolina sounds (Epperly et al., 1995a, b; Musick and Limpus, 1997). Nearshore water temperatures play a major role in determining green turtle distribution along the Atlantic and Gulf coasts of the U.S. (e.g., Musick and Limpus, 1997; Witherington et al., 2006). Adults are predominantly tropical and are only occasionally found north of southern Florida. Most sightings of individuals north of Florida occur between late spring and early fall and are juveniles (Lazell, 1980; CETAP, 1982; Burke et al., 1992; Epperly et al., 1995b).
Optimal feeding habitats for green turtles in the continental U.S. include waters in Florida and southern Texas such as the Indian River Lagoon, Florida Keys, Florida Bay, Homosassa Springs, Crystal River, Cedar Keys, and Laguna Madre Complex (NMFS and USFWS, 1991; Hirth, 1997). The inshore waters of North Carolina are also an important feeding habitat for juveniles of this species (Epperly et al., 1995b).

Green turtles nest on both island and continental beaches between 30°N and 30°S latitudes (Witherington et al., 2006). Although Florida is near the northern extent of the green turtle’s Atlantic nesting range, it hosts a significant proportion of green turtle nesting (Witherington et al., 2006). Approximately 99 percent of the green turtle nesting in Florida occurs on the Atlantic coast, with Brevard through Broward counties hosting the greatest nesting activity (Meylan et al., 1995; Witherington et al., 2006). There are scattered nesting records in Georgia and the Carolinas (Peterson et al., 1985; Schwartz, 1989; NMFS and USFWS, 1991).

Occurrence in the Proposed Site A USWTR—Green turtles are expected to occur year-round within the Site A USWTR. Year-round resident juvenile green turtles along the Atlantic coast of Florida are found in the Indian River Lagoon as well as Florida Bay/Florida Keys south of Site A (NMFS and USFWS, 1991). During the summer months, juvenile green turtles use developmental habitats outside of the Jacksonville OPAREA and migrate through it to reach these habitats in the spring and fall. Throughout the year, green turtle occurrences in the northeastern Florida are concentrated over the continental shelf to the west of the Gulf Stream Current.

Nesting season takes place from April through September with an incubation period of approximately two months (FFWCC, 2002; DoN 2007g). Surveys conducted in 2006 identified four green turtle nests along Duval County beaches (FFWCC-FWRI, 2006a), but there are no records of them nesting at NAVSTA Mayport beaches.

**Kemp’s Ridley Turtle—Site A**

- **General Description**—Kemp’s ridleys are considered the smallest marine turtle in the world (NOAA, 2008a). This species has a straight carapace length of approximately 60 to 70 cm (2.0 to 2.3 ft) (with shell length and width being nearly equal) and weigh about 45 kg (100 lbs) (USFWS and NMFS, 1992; Gulko and Eckert, 2004). The carapace is round to somewhat heart-shaped and grayish green in color.

Kemp’s ridleys feed primarily on portunids and other types of crabs (Lutcavage and Musick, 1985; Keinath et al., 1987; Seney and Musick, 2005), but are also known to prey on mollusks, shrimp, fish, jellyfish, and plant material (Marquez-M., 1994; Frick et al., 1999). Kemp’s ridleys may also feed on shrimp fishery bycatch (Landry and Costa, 1999).
Few data are available on the maximum dive duration. Satellite-tagged juvenile Kemp’s ridley turtles demonstrate different mean surface intervals and dive depths depending on whether the individual is located in shallow coastal areas (short surface intervals) or in deeper, offshore areas (longer surface intervals). Dive times range from a few seconds to a maximum of 167 min, with routine dives lasting between 17 and 34 min (Mendonça and Pritchard, 1986; Renaud, 1995). In Cedar Keys, Florida, the average submergence duration was found to be approximately 8.4 min (Schmid et al., 2002). Renaud and Williams (2005) noted seasonal differences in dive durations, with longer dives (>30 min) during the winter and 15-min dives during the remainder of the year. Sasso and Witzell (2006) reported longer dives at night than during the day. Over a 12-hr period, Kemp’s ridleys spend up to 96 percent of their time submerged (Byles, 1989; Gitschlag, 1996; Renaud and Williams, 2005; Sasso and Witzell, 2006).

- **Status**—The Kemp’s ridley turtle is classified as endangered under the ESA; this is considered the world’s most endangered sea turtle species (USFWS and NMFS, 1992b). The worldwide population declined from tens of thousands of nesting females in the late 1940s to approximately 300 nesting females in 1985 (TEWG, 2000). From 1985 to 1999, the number of nests at Rancho Nuevo increased at a mean rate of 11.3 percent per year (TEWG, 2000). Positive trends in 2005 were recorded in Rancho Nuevo, Tamaulipas (6,947 nests) on the eastern coast of Mexico, Barra del Tordo (701 nests), and Barra de Tepehuajes (1,610 nests) (USFWS, 2005). Nesting levels at Padre Island National Seashore in Texas, the site of a Kemp’s ridley head-starting and imprinting program from 1978 to 1988, have shown a slow but steady rise throughout time (Shaver and Wibbels, 2007).

- **Habitat**—Kemp’s ridley turtles occur in open ocean and *Sargassum* habitats of the North Atlantic Ocean as post-hatchlings and small juveniles (e.g., Manzella et al., 1991; Witherington and Hira, 2006). They move as large juveniles and adults to benthic, nearshore feeding grounds along the U.S. Atlantic and Gulf coasts (Morreale and Standora, 2005). Habitats frequently utilized include warm-temperate to subtropical sounds, bays, estuaries, tidal passes, shipping channels, and beachfront waters where their preferred food, including the blue crab (*Callinectes sapidus*), occurs (Lutcavage and Musick, 1985; Landry and Costa 1999; Seney and Musick, 2005). Models indicate that the most suitable habitats are less than 10 m (33 ft) in bottom depth with sea surface temperatures between 22 and 32°C (72 to 90°F) (Coyne et al., 2000). Seagrass beds and mud bottom, as well as live bottom, are important developmental habitats (Schmid and Barichivich, 2006). Postnesting Kemp’s ridleys travel along coastal corridors generally shallower than 50 m (164 ft) in bottom depth (Morreale et al., 2007).

- **General Distribution**—Feeding grounds and developmental areas are found on the Atlantic and Gulf coasts of the U.S. Henwood (1987) and Gitschlag (1996)
documented sightings and movements of juveniles within and among preferred habitats along both the Atlantic and Gulf coasts. Next to loggerheads, Kemp’s ridleys are the second most abundant sea turtle in mid-Atlantic waters (Keinath et al., 1987; Musick and Limpus, 1997). Some Kemp’s ridley juveniles may migrate as far north as New York and New England, arriving in these areas around June (Morreale and Standora, 2005). Most individuals throughout the range are immature, but the latitudinal gradient still exists (Morreale and Standora, 2005). A few larger individuals are reported in southern and mid-Atlantic states (Florida, Georgia, South Carolina, Virginia), but the vast majority are small (Morreale and Standora, 2005). In the northeastern waters of New York and Massachusetts, only small-sized Kemp’s ridleys are documented.

During the winter, Kemp’s ridleys are prompted by cooler water temperatures to leave northern developmental habitats and migrate south to warmer waters in Florida (Marquez-M., 1994). Migrations tend to take place in nearshore waters along the mid-Atlantic coast (Morreale and Standora, 2005; Morreale et al., 2007); juveniles and adults typically travel inshore of the 18 m (59 ft) isobath (Renaud and Williams, 2005). This migratory corridor is a narrow band running within continental shelf waters, possibly spanning the entire length of the U.S. Atlantic Coast (Morreale and Standora, 2005; Morreale et al., 2007). Seasonal movements continue until turtles reach sexual maturity, at which time, they return to breeding grounds in the Gulf of Mexico (Henwood and Ogren, 1987).

Individuals are known to overwinter in areas south of Cape Hatteras, North Carolina, although the majority of Kemp’s ridleys stay in Florida near Cape Canaveral (Henwood and Ogren, 1987). Overwintering individuals may occasionally bury in the mud to hibernate (Schwartz, 1989; Marquez-M., 1994). Individuals that overwinter in southern North Carolina may subsequently moved into warmer waters (e.g., Gulf Stream or areas off South Carolina) during the mid-winter (Renaud, 1995; Morreale and Standora, 2005). For example, an individual tagged in Beaufort in 1989 was tracked to stay the winter in Onslow Bay, North Carolina, and subsequently move into the Gulf Stream when temperatures cooled close to shore in January 1990 (Renaud, 1995).

Nesting occurs primarily on a single nesting beach at Rancho Nuevo, Tamaulipas, on the eastern coast of Mexico (USFWS and NMFS, 1992), with a few additional nests in Texas, Florida, South Carolina, and North Carolina (Meylan et al., 1990; Weber, 1995; Caribbean Conservation Corporation, 1996; Foote and Mueller, 2002). The first successful nesting on the east coast of Florida occurred in 1996 just south of Daytona Beach in Volusia County (Godfrey, 1996). This individual nested twice in this area. Additional nesting attempts have been recorded in Palm Beach County and on the west coast of Florida (Meylan et al., 1990; Godfrey, 1996). In June 2003, the National Park Service (NPS) documented a female
Kemp’s ridley nesting at Cape Lookout National Seashore in North Carolina (NPS, 2003).

Occurrence in the Proposed Site A USWTR—Kemp’s ridleys are expected to occur within the vicinity of the Site A USWTR year-round. Water temperature is an influential factor in the occurrence and distribution of Kemp’s ridleys within the Jacksonville OPAREA. Kemp’s ridleys utilize developmental habitats in North Carolina, South Carolina, and Georgia from April through October (Morreale and Standora, 2005) and the majority of Kemp’s ridleys overwinter off the coasts of Florida and Georgia (Henwood, 1987).

Kemp’s ridleys nest infrequently in northern Florida with the highest density of nests occurring in the counties of Brevard to Palm Beach (FFWCC-FWRI, 2006a). There are no nests documented for Kemp’s ridley in Duval County for the last 25 years and the closest nesting sites have been along Volusia County beaches (FFWCC, 2007).

**Hawksbill Sea Turtle – Site A**

- **General Description**—The hawksbill turtle is a small to medium-sized sea turtle; adults range between 65 and 90 cm (2.1 to 3.0 ft) in carapace length and typically weigh around 80 kg (176 lbs) (Witzell, 1983; NMFS and USFWS, 1993). Hawksbills are distinguished by their hawk-like beaks, posteriorly overlapping carapace scutes, and two pairs of claws on their flippers (NMFS and USFWS, 1993). The carapace is often brown or amber with irregularly radiating streaks of yellow, orange, black, and reddish-brown.

Hawksbills are considered to be omnivorous during the later juvenile stage, feeding on encrusting organisms such as sponges, tunicates, bryozoans, algae, mollusks, and a variety of other items including crustaceans and jellyfish (Bjorndal, 1997). Older juveniles and adults are more specialized and feed primarily on sponges, which comprise as much as 95 percent of their diet in some locations (Witzell, 1983; Meylan, 1988).

Hawksbills may have one of the longest routine dive times of all the sea turtles. Starbird et al. (1999) reported that inter-nesting females at Buck Island, USVI averaged 56 min dives with a maximum dive time of 74 min. Average dives during the day ranged from 34 to 65 min, while those at night were between 42 and 74 min. Data from time-depth recorders have indicated that foraging dives of immature hawksbills in Puerto Rico range from 9 to 14 min in duration, with a mean depth of 4.7 m (15.4 ft) (Van Dam and Diez, 1996). These individuals were found to be most active during the day. Changes in water temperature have an effect on the behavioral ecology of hawksbill turtles, with an increase in nocturnal dive duration with decreasing water temperatures during the winter (Storch et al., 2005).
- **Status**— The hawksbill turtle is listed as endangered under the ESA. This species is second only to the Kemp’s ridley in terms of endangerment (NMFS and USFWS, 1993; Bass, 1994). There is designated critical habitat for the species in the Caribbean that includes the waters surrounding Mona and Monito islands, Puerto Rico (NMFS, 1998c).

- **Habitat**—Hawksbill turtles inhabit oceanic waters as post-hatchlings and small juveniles, where they are sometimes associated with driftlines and floating patches of *Sargassum* (Parker, 1995; Witherington and Hirama, 2006). The developmental habitats for juvenile benthic-stage hawksbills are the same as the primary feeding grounds for adults. They include tropical, nearshore waters associated with coral reefs, hard bottoms, or estuaries with mangroves (Musick and Limpus, 1997). Coral reefs are recognized as optimal hawksbill habitat for juveniles, sub-adults, and adults (NMFS and USFWS, 1993; Diez et al., 2003). In neritic habitats, resting areas for late juvenile and adult hawksbills are typically located in deeper waters, such as sandy bottoms at the base of a reef flat, than their foraging areas (Houghton et al., 2003). Late juveniles generally reside on shallow reefs less than 18 m (59 ft) deep. However, as they mature into adults, hawksbills move to deeper habitats and may forage to depths greater than 90 m (295 ft). Benthic-stage hawksbills are seldom found in waters beyond the continental or insular shelf, unless they are in transit between distant foraging or nesting grounds (NMFS and USFWS, 1993).

- **General Distribution**—Hawksbill turtles are circumtropical in distribution, generally occurring from 30°N to 30°S within the Atlantic, Pacific, and Indian oceans (Witzell, 1983). The hawksbill turtle has only rarely been recorded away from the tropics. In the Atlantic Ocean, this species is found throughout the Gulf of Mexico, the Greater and Lesser Antilles, and southern Florida, as well as along the mainland of Central America south to Brazil (NMFS and USFWS, 1993). The hawksbill is rare north of Florida (Lee and Palmer, 1981; Keinath et al., 1991; Parker, 1995; Plotkin, 1995; USFWS, 2001a), but small hawksbills have stranded as far north as Cape Cod, Massachusetts (NMFS, 2006i). Adult hawksbills are rarely documented in Florida waters, although nesting females occasionally visit beaches along the southeastern coast and the Florida Keys (Meylan and Redlow, 2006).

Major foraging populations in U.S. waters occur in the vicinity of the coral reefs surrounding Mona Island, Puerto Rico and Buck Island, St. Croix, USVI (Starbird et al., 1999). Smaller populations of hawksbills reside in the hard bottom habitats that surround the Florida Keys and other small islands in Puerto Rico and the USVI (Witzell, 1983; NMFS and USFWS, 1993). Virtually all nesting is restricted between latitudes 25°N and 35°S. Hawksbill nesting in Florida has been reported from Cape Canaveral National Seashore south to Boca Grande Key and
the Marquesas Islands and a single locality on the west coast (Longboat Key) (Meylan and Redlow, 2006).

Occurrence in the Proposed Site A USWTR—Although rare, hawksbills may occur within the Site A USWTR at any time during the year (DoN, 2008n). The majority of animals stranded or sighted in or near the action area are immature (Meylan, 1992; Parker, 1995). The hawksbill is a tropical species and is more likely to be found along the southern portion of Florida (NMFS, 2007e; Meylan and Redlow, 2006); however a recent hypothesis suggests that the Florida current and the Gulf Stream may represent a dispersal corridor for Caribbean and Gulf region post-hatchlings (Meylan and Redlow, 2006).

3.2.5.2 Site B

As discussed above, the southeast U.S. has the most diverse and abundant sea turtle populations in the U.S. All five species of sea turtles occurring in the Atlantic coastal waters off the eastern U.S. may be present in or around Site B.

**Loggerhead Turtle – Site B**

Loggerheads are resident off the coast of South Carolina year round. The major nesting area for the loggerhead in the western Atlantic is the southeastern United States. In South Carolina, the primary nesting beaches are between North Inlet and Prices’ Inlet, but other beaches in the southern part of the state also have moderate nesting densities. These are mainly undeveloped nesting beaches between Kiawah Island and Hilton Head. The nesting season runs from mid May to mid August. The average clutch size in South Carolina is 126 eggs. The average incubation duration is 58 days. The loggerhead is the most common sea turtle to strand in South Carolina and the nesting population has declined three percent per year since records began in 1980 (SCDNR, 2007b).

Available data on sightings, strandings, and bycatch strongly demonstrate that the loggerhead is the most common sea turtle in the Charleston OPAREA and are expected to occur within the vicinity of the Site B USWTR. In 2007, there were 31 reported loggerhead strandings in Charleston County (Seaturtle.org, 2008).

**Leatherback Turtle – Site B**

Leatherback sea turtles are expected to occur throughout the Charleston OPAREA during all seasons, as they inhabit both oceanic and coastal environments (DoN, 2008n). Leatherbacks concentrate in different areas depending upon the season, due to factors including their highly migratory nature and the seasonal availability of jellyfish in particular regions of the SAB.

Since the leatherback is commonly found in relatively shallow continental waters along the entire U.S. Atlantic Coast, occurrence for the spring, summer, and fall ranges from the shoreline to the 200-m (656-ft) isobath. Survey data indicate that, during the winter, leatherbacks are
concentrated mainly in the shelf waters south of Charleston, South Carolina. In 2007, there were no reported leatherback strandings in Charleston County (Seaturtle.org, 2008). In the summertime, expected occurrence is largely limited to coastal waters south of Jacksonville. Leatherbacks are expected to occur within the vicinity of the Site B USWTR during all seasons.

As a result of the leatherback’s wide-ranging occurrence in waters off the southeast U.S. coast and the fact that this species is often incidentally captured by commercial shrimp trawling fisheries, all inshore and offshore waters adjacent to the U.S. Atlantic Coast between Cape Canaveral, Florida and the North Carolina-Virginia border (within the U.S. EEZ) are designated as a “leatherback conservation zone” year-round (NOAA Fisheries, 1995), an area where there are restrictions on shrimp trawling.

**Green Turtle – Site B**

South of Cape Hatteras, North Carolina, green sea turtles may occur year-round in waters between the shoreline and the 50-m (164-ft) isobath. The preferred habitats of this species are seagrass beds and worm-rock reefs, which are located primarily in shallow-water environments along the east coast (DoN, 2008n). Juvenile green turtles are found in South Carolina (ranging in size from 28 to 38 cm [11 to 15 in] in CCL) in shallow creeks, bays, and salt marshes feeding on epiphytic green algae such as sea lettuce. Green turtles have the greatest likelihood of occurring within the vicinity of the Site B USWTR during winter. In 2007, there were five reported green turtle strandings in Charleston County (Seaturtle, 2008).

**Kemp’s Ridley Turtle – Site B**

Juvenile Kemp’s ridleys (18 to 65 cm [11 to 26 in]) occur along the South Carolina coast during the summer. In 1992, there was one Kemp’s ridley nest in South Carolina. In 2007, there were six reported Kemp’s ridley strandings in Charleston County (Seaturtle, 2008). This species represents the second most common turtle to strand on the South Carolina coast. They feed on fast swimming crabs (e.g., blue crabs) and are sometimes caught by hook and line fishermen. Kemp’s ridleys are expected to occur within the vicinity of the Site B USWTR year-round.

**Hawksbill Sea Turtle – Site B**

Sparse sighting, stranding, and bycatch data indicate that the occurrence of hawksbill sea turtles within the vicinity of the Charleston OPAREA is rare during all seasons (DoN, 2008n). In 2007, there were no hawksbill strandings in Charleston County or in South Carolina (Seaturtle, 2008). Although scientists believe hawksbills to be common inhabitants of the coastal waters off southeastern Florida, they are rare north of Florida (DoN, 2008n) and are not expected to occur in the vicinity of the USWTR Site B location.
3.2.5.3 Site C

The temperate inshore and nearshore waters of North Carolina host all five species of sea turtles throughout much of the year, most of which are immature individuals (Lee and Palmer, 1981; Lutcavage and Musick, 1985; Keinath et al., 1987, 1996; Byles, 1988; Barnard et al., 1989; Schwartz, 1989; Epperly et al., 1995a, b, c). Due to the narrowness of North Carolina’s continental shelf near Cape Hatteras (and its close association with the western wall of the Gulf Stream), sea turtles are often concentrated in the shallow, nearshore waters (Epperly et al., 1995b; Keinath et al., 1996). Inshore and estuarine waters serve as important developmental habitat for juvenile loggerhead, green, and Kemp’s ridley turtles (Epperly et al., 1995b).

Along the U.S. Atlantic coast, nesting has been known to occur as early as February and as late as October, although the official nesting season (the time of year when the vast majority of nesting activity occurs) begins in May and ends in August (Meylan et al., 1995; Webster and Cook, 2001). North Carolina and southern Virginia are recognized as the northern limit of nesting activity, (Schwartz, 1989; NCMFC, 2007). Adult sea turtles (primarily loggerheads, as well as a few greens and infrequent leatherbacks) most often visit ocean-facing beaches to nest in June and July. Although nesting is known to occur along the entire North Carolina coast, the highest levels of sea turtle nesting activity occur along Cape Lookout National Seashore and Onslow Beach (Hopkins and Richardson, 1984; Schwartz, 1989).

In 2006, 131 sea turtles nests (128 loggerhead and 3 green) were recorded along the 90-km (56-mi) stretch of beaches at Cape Lookout National Seashore including North Core, South Core, and Shackleford Banks (NPS, 2007a). Data from the Bogue Banks Sea Turtle Project (area including the ocean-facing beaches of Atlantic Beach, Pine Knoll Shores, Indian Beach/Salter Path, and Emerald Isle) report an average of 29 nests per year (primarily loggerhead) since 2002, with a high of 39 in 2003 (Holloman and Godfrey, 2007). Additionally, sea turtle nesting has been monitored on a stretch of military-controlled land (Camp LeJeune) at Onslow Beach since 1979. Approximately 18 km (11 mi) of beach are monitored annually from mid May through August. Sea turtle nesting (loggerhead and green turtles) is known to occur on Onslow Beach at an approximate density of 3.5 nests per km (5.6 nests per mi) (USFWS, 2002). With respect specifically to Riesley Pier (the landside USWTR location), nest density estimates are 5.1 nests per km (8.2 nests per mi) (with annual nesting of four nests per year) on a beach segment ranging from the pier to approximately 0.7 km (0.5 mi) north of the pier (USFWS, 2002).

**Loggerhead Turtle – Site C**

Loggerheads are the most commonly sighted species of sea turtle in the Cherry Point OPAREA, using North Carolina waters for overwintering, foraging, and traveling to nesting beaches (DoN, 2008l). Seasonal water temperatures influence loggerhead occurrence offshore North Carolina, although loggerheads are resident year-round south of Cape Hatteras. Occurrence trends to shelf waters throughout the year; during the winter, loggerhead presence may extend further offshore. A high concentration of loggerheads occurs in shelf waters offshore Maryland during the spring (DoN, 2008l). Spring and summer represent peak nesting times for loggerheads in North
Carolina; during these seasons, individuals may traverse the OPAREA en route to nesting beaches. Loggerheads are expected to occur within the vicinity of the USWTR Site C during all seasons.

Nesting activity along the entire North Carolina coast commences in the spring, peaking in the month of June (NCMFC, 2007). Loggerhead nesting is common on ocean facing beaches of North Carolina including Onslow Beach in the vicinity of the proposed USWTR shore landing site. In 2006, 33 loggerhead nests were reported on Bogue Banks (Holloman and Godfrey, 2007). Cordes and Rikard (2006) reported 136 loggerhead nests in Cape Lookout National Seashore for the 2005 season.

**Leatherback Turtle – Site C**

The leatherback is the second most-sighted species of sea turtle in the Cherry Point OPAREA. Compared to the other four sea turtles, the distribution of the leatherback is the most extensive within the OPAREA, with individuals inhabiting both oceanic and coastal waters as far north as the Gulf of Maine.

Although adult leatherbacks are common in the Atlantic Ocean off the coast of North Carolina at certain times of the year, nesting in the region is rare. In North America, the northeast coast of Florida was considered the northern limit for leatherback nesting until the early 1980s (Allen & Neill, 1957; Caldwell, 1959; Caldwell et al., 1956; Nichols & Du Toit, 1983; Seyle, 1985). Rabon et al. (2003) published a review and summary of leatherback nesting activities north of Florida. The first potential evidence of leatherback nesting in North Carolina was in 1966 in the form of an unconfirmed report of hatchlings found on South Core Banks, near Cape Lookout (Carteret County) (Schwartz, 1976, 1977). During the 1998 nesting season two confirmed nests were observed at Cape Hatteras National Seashore (Rabon et al., 2003). During the 2000 nesting season four leatherback nests were confirmed in North Carolina. Three nests were documented at Cape Hatteras National Seashore and one at Cape Lookout National Seashore. One leatherback nest was also confirmed in North Carolina (Cape Hatteras National Seashore) in 2002 (Rabon et al., 2003).

The North Carolina records constitute the northernmost, confirmed reports of leatherback nests along the east coast of the United States. Almost all *Dermochelys* nesting activity in North Carolina has been concentrated along beaches between Cape Lookout and Cape Hatteras. Leatherback sea turtles nest every two to three years and their average intraseasonal nesting interval is approximately nine to ten days (NMFS & USFWS, 1992b). Thus, Rabon et al. (2003) note that the nesting records reported for North Carolina could represent the activities of a single female. In addition to the summary provided by Rabon et al. (2003), more recent leatherback nesting activity in North Carolina has been reported. Cordes and Rikard (2006) reported seven nests in 2004 and five nests in 2005 from Cape Lookout National Seashore and Holloman and Godfrey (2006) reported two leatherback nests in 2005 on the island of Bogue Banks. The NPS also confirmed one leatherback nest in 2006 (NPS, 2007b).
Because leatherbacks on the east coast of the United States may nest as early as late February (Meylan et al., 1995), current data for North Carolina are likely an underestimate of actual leatherback nesting activity. Beach patrols usually commence in May or June to maximize observations of nesting loggerhead turtles; therefore, leatherback nests may have been missed (Rabon et al., 2003).

The majority of leatherback sightings within the Cherry Point OPAREA occur on the continental shelf, although several bycatch records exist for waters beyond the shelf break (DoN, 2008l). As evidenced by a combination of sighting and bycatch records, this species occurs in offshore waters, especially north of Cape Lookout (Lee and Palmer, 1981; Schwartz, 1989). The greatest concentrations of leatherbacks are expected to occur in North Carolina from mid-April through mid-October (Keinath et al., 1996); the greatest abundance of leatherbacks in the OPAREA is expected during the spring and summer. Seasonal movements of large subadult and adult leatherbacks have been documented by aerial surveys along the U.S. Atlantic coast; yet, leatherbacks are likely not constrained by seasonal temperature variations. Leatherback occurrence is seasonal along the U.S. Atlantic coast, with the number of sightings along the northern area of the coast increasing from winter to summer. Leatherbacks are expected to occur within the vicinity of the USWTR Site C during all seasons.

**Green Turtle – Site C**

Green turtles may occur within the vicinity of the USWTR Site C year-round (DoN, 2008l). Juvenile greens use developmental habitats adjacent to the OPAREA during the summer months as well as travel to and from these habitats during the spring and fall. During the winter, the highest concentration of greens occurs just north of Cape Canaveral, Florida, a known overwintering area for juveniles (DoN, 2008l). During spring, summer, and fall, high concentrations of greens occur offshore the more northern states, specifically North Carolina, Virginia, Delaware, and New Jersey. Year-round, green turtle occurrence records are clustered along the North Carolina coast and within shelf waters (DoN, 2008l).


**Kemp’s Ridley Turtle– Site C**

Kemp’s ridleys occur within the vicinity of the USWTR Site C year-round, although occurrence is most common during the winter and summer months (DoN, 2008l). Water temperature is likely the most influential factor in the seasonal occurrence of Kemp’s ridleys within the OPAREA. Kemp’s ridley hatchlings may occur offshore near the eastern edge of the OPAREA and Gulf Stream in *Sargassum*. Spring and fall appear to experience the greatest number of strandings.
Hawksbill Turtle– Site C

Although rare, hawksbills may occur within the vicinity of the USWTR Site C year-round (DoN, 2008). Based upon sighting and stranding records, occurrences are generally expected to be inshore and within shelf waters (DoN, 2008). As this species is typically tropical, any occurrences within the Site C area are likely to be accidental. Many hawksbill strandings in North Carolina have been small juveniles (Frick, 2001; Mazarella, 2001; Godfrey, 2003), suggesting individuals may enter the OPAREA from pelagic juvenile habitat. Yet as North Carolina waters do not offer optimal developmental habitat for juvenile or foraging habitat for adults (NMFS and USFWS, 1993; Diez et al., 2003), individuals would not be expected to remain in the OPAREA.

Sea Turtle Sanctuary

In 1980, the North Carolina state legislature established the first U.S. sea turtle sanctuary in the waters off Onslow Beach, Brown’s Island, and Bear Island. As described in the North Carolina Administrative Code (NCAC) 15A.031.0107, it is unlawful to use commercial fishing equipment in the turtle sanctuary from June 1 to August 31 (NCAC, 2007). The sanctuary extends approximately 1 km (0.5 NM) offshore and is approximately 82 km (44 NM) from the Cherry Point OPAREA (Figure 3.2-6). This sanctuary was established under North Carolina fishery laws after researchers discovered that intense shrimp trawling coincided with high nesting activity along Onslow and Hammocks beaches (Schwartz, 1989a). Under this law, shrimp trawling within the sanctuary was prohibited between June 1 and August 31 unless permitted by the North Carolina fisheries director, who was given the right to modify the sanctuary within the described area and vary implementation between specified dates depending upon the existing environmental conditions (Godfrey, 2003). The Site C USWTR trunk cable would cross this sanctuary.

3.2.5.4 Site D

The waters off the Virginia and North Carolina coasts are important transitional habitat for juvenile sea turtles. Juvenile sea turtles along the U.S. Atlantic coast exhibit seasonal foraging movements, migrating north along the coast in the early spring to coastal development habitats and south in the fall (Morreale and Standora, 2005). Coastal waters of Virginia, particularly the Chesapeake Bay, serve as developmental habitat for juvenile loggerhead and Kemp’s ridley sea turtles that take up residency during the summer months (Lutcavage, 1981; Lutcavage and Musick, 1985; Mansfield and Musick, 2006). The presence of juvenile sea turtles in the Chesapeake Bay area and Virginia coastal waters peaks from May through early November (Lutcavage, 1981). As waters cool in the fall, most sea turtles emigrate out of the Chesapeake Bay and Virginia coastal waters to travel southward at least as far as Cape Hatteras, North Carolina to avoid cold stunning. Many turtles that overwinter off North Carolina remain near the edge of the Gulf Stream during the winter months of January and February (Epperly et al., 1995b; Musick and Limpus, 1997). As waters warm again in the spring, sea turtles migrate back inshore and expand their range northward. The coastal area immediately adjacent to Cape
Onslow County
Cape Lookout
MCAS Cherry Point
US Army Reserve Center
81.97 km (44.23 NM)
Sea Turtle Sanctuary
Atlantic Ocean
MCAS New River
MCB Camp Lejeune
Onslow Bay Sea Turtle Sanctuary

Source: North Carolina Marine Fisheries - 2004

Figure 3.2-6
Hatteras has long been recognized as a migratory pathway for loggerheads and Kemp’s ridleys, as well as adult leatherbacks (Lee and Palmer, 1981).

Sea turtle occurrences in the VACAPES OPAREA peak during spring and fall, as turtles migrate to northern summer foraging grounds and again in the fall as they migrate to southern overwintering habitats. Sea turtle concentrations are widely distributed along the east coast and into the Chesapeake Bay during the summer resulting in lower concentrations within the OPAREA during this time. The lowest concentrations of sea turtles are expected to occur during the winter (DoN, 2008m).

**Loggerhead Turtle – Site D**

Loggerheads occur year-round in the VACAPES OPAREA using waters of the OPAREA for foraging and transit to nesting beaches. Seasonal water temperatures influence loggerhead occurrence within the OPAREA. A high concentration of loggerheads occurs in shelf waters offshore Maryland during the spring and northern North Carolina during the fall (DoN, 2008m). During spring and fall, loggerheads are likely transiting the OPAREA to access summer foraging or overwintering habitats. Loggerheads are expected to occur in the Site D USWTR year-round. Sea turtles are known to nest along Virginia’s eastern shore, the Virginia Beach oceanfront, and coastal North Carolina, including the Outer Banks (Mansfield, 2006). Back Bay National Wildlife Refuge (NWR) has monitored sea turtle nesting in Virginia Beach, Virginia since 1970 (Cross and James, 2001). During the 2005 nesting season, six loggerhead nests and one green turtle nest were documented at Back Bay NWR (USFWS, 2005).

**Leatherback Turtle – Site D**

Leatherbacks are found year-round in the VACAPES OPAREA with the greatest occurrence during the summer. Based on a combination of sighting and bycatch records, this species may occur in OPAREA shelf waters or offshore waters just beyond the shelf break (DoN, 2008m). The greatest concentrations of leatherbacks expected to occur in the OPAREA vary seasonally by location. For example, leatherback presence is expected to peak in Virginia in May and July and in North Carolina from mid-April through mid-October (Keinath et al., 1996). Seasonal movements of large subadult and adult leatherbacks have been documented by aerial surveys along the U.S. Atlantic coast; yet, leatherbacks are likely not constrained by seasonal temperature variations. Leatherback occurrence is seasonal along the U.S. Atlantic coast, with the number of sightings along the northern area of the coast increasing from winter to summer. Leatherback turtles are expected to occur in the Site D USWTR during the spring, summer, and fall months.

**Green Turtle – Site D**

Green turtles may occur throughout the Site D USWTR from spring through fall, and are least common within the OPAREA during the winter (DoN, 2008m). Summer represents the peak
time for green turtle occurrence in the OPAREA due to the presence of summer developmental foraging habitat along the coast (DoN, 2008m).

Kemp’s Ridley Turtle– Site D

Kemp’s ridleys occur within the Site D USWTR year-round although occurrence is most common during the summer. Water temperature is likely the most influential factor in the seasonal occurrence of Kemp’s ridleys within the OPAREA. Juvenile Kemp’s ridleys are the second most common, after loggerheads, to use Virginia developmental habitat (Mansfield, 2006). Kemp’s ridley hatchlings may occur offshore near the eastern edge of the OPAREA and Gulf Stream in Sargassum (DoN, 2008m). Spring and fall appear to experience the greatest number of strandings (DoN, 2008m).

Hawksbill Turtle– Site D

Hawksbills are rare within the Site D USWTR yet may occur throughout the year. Based upon limited data, occurrences are expected to be more common within shelf waters or along the shelf break. As this species is typically tropical, any occurrences within the OPAREA are likely accidental. Many hawksbill strandings adjacent to the OPAREA have been small juveniles (Frick, 2001; Mazarella, 2001; Godfrey, 2003) suggesting individuals may enter the OPAREA from pelagic juvenile habitat. Sightings and bycatch records along the shelf break may support this (DoN, 2008m). However, OPAREA waters do not offer optimal developmental habitat for juvenile or foraging habitat for adults (NMFS and USFWS, 1993; Diez et al., 2003), and individuals would not be expected to remain in the OPAREA.

3.2.6 Marine Mammals

There are 35 marine mammal species with possible or confirmed occurrence in the combined Jacksonville and Charleston OPAREAs, 38 species in the Cherry Point OPAREA, and 40 species in the VACAPES OPAREA (Table 3.2-3). Marine mammals include cetaceans (whales, dolphins, and porpoises), pinnipeds (seals), and a sirenian species (manatee).

As in the previous subchapter, the information provided here also relies on the data gathered in the Navy’s MRA program updates for the JAX/CHASN OPAREA (DoN, 2008n), the Cherry Point OPAREA (DoN, 2008l), and the VACAPES OPAREA (DoN, 2008m). The OPAREA data were used to provide a regional context for each marine mammal species. This section refers in many cases to the entire OPAREAs; however, animals may be found outside typical distribution ranges described within the MRA. As shown in Figures 2-13, 2-17, 2-21, and 2-25, each proposed USWTR encompasses a small portion of each OPAREA.
### Table 3.2-3

Marine Mammal Species of the
Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs
and their status under the Endangered Species Act (ESA)

<table>
<thead>
<tr>
<th>Order Cetacea</th>
<th>Scientific Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suborder Mysticeti (baleen whales)</td>
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<td></td>
</tr>
<tr>
<td>Family Balaenidae (right whales)</td>
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<tr>
<td>North Atlantic right whale</td>
<td><em>Eubalaena glacialis</em></td>
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<tr>
<td>Family Balaenopteridae (rorquals)</td>
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<tr>
<td>Humpback whale</td>
<td><em>Megaptera novaeangliae</em></td>
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</tr>
<tr>
<td>Minke whale</td>
<td><em>Balaenoptera acutorostrata</em></td>
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<tr>
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<td><em>Balaenoptera edeni</em></td>
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<tr>
<td>Sei whale</td>
<td><em>Balaenoptera borealis</em></td>
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</tr>
<tr>
<td>Fin whale</td>
<td><em>Balaenoptera physalus</em></td>
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<tr>
<td>Blue whale</td>
<td><em>Balaenoptera musculus</em></td>
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<tr>
<td>Suborder Odontoceti (toothed whales)</td>
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<tr>
<td>Family Physeteridae (sperm whale)</td>
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<tr>
<td>Sperm whale</td>
<td><em>Physeter macrocephalus</em></td>
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<tr>
<td>Family Kogiidae (pygmy sperm whales)</td>
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<tr>
<td>Pygmy sperm whale</td>
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<tr>
<td>Dwarf sperm whale</td>
<td><em>Kogia sima</em></td>
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<tr>
<td>Family Ziphiidae (beaked whales)</td>
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<tr>
<td>Cuvier's beaked whale</td>
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<td>True's beaked whale</td>
<td><em>Mesoplodon mirus</em></td>
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<td>Gervais’ beaked whale</td>
<td><em>Mesoplodon europaeus</em></td>
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<td>Sowerby's beaked whale</td>
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<td>Blainville's beaked whale</td>
<td><em>Mesoplodon densirostris</em></td>
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<tr>
<td>Northern bottlenose whale</td>
<td><em>Hyperoodon ampullatus</em></td>
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<tr>
<td>Family Delphinidae (dolphins)</td>
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<tr>
<td>Rough-toothed dolphin</td>
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<td>Bottlenose dolphin</td>
<td><em>Tursiops truncatus</em></td>
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<tr>
<td>Pantropical spotted dolphin</td>
<td><em>Stenella attenuata</em></td>
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<td>Atlantic spotted dolphin</td>
<td><em>Stenella frontalis</em></td>
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<tr>
<td>Spinner dolphin</td>
<td><em>Stenella longirostris</em></td>
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<tr>
<td>Clymene dolphin</td>
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<tr>
<td>Striped dolphin</td>
<td><em>Stenella coeruleoalba</em></td>
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<td>Common dolphin</td>
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<td>Fraser's dolphin</td>
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<td>White-beaked dolphin</td>
<td><em>Lagenorhynchus albirostris</em></td>
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<tr>
<td>Atlantic white-sided dolphin</td>
<td><em>Lagenorhynchus acutus</em></td>
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<tr>
<td>Risso's dolphin</td>
<td><em>Grampus griseus</em></td>
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<tr>
<td>Melon-headed whale</td>
<td><em>Peponocephala electra</em></td>
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<tr>
<td>Pygmy killer whale</td>
<td><em>Feresa attenuata</em></td>
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<tr>
<td>False killer whale</td>
<td><em>Pseudorca crassidens</em></td>
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<tr>
<td>Killer whale</td>
<td><em>Orcinus Orca</em></td>
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<td>Long-finned pilot whale</td>
<td><em>Globicephala melas</em></td>
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<tr>
<td>Short-finned pilot whale</td>
<td><em>Globicephala macrorhynchus</em></td>
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<tr>
<td>Family Phocoenidae (porpoises)</td>
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</tr>
<tr>
<td>Harbor porpoise</td>
<td><em>Phocoena phocoena</em></td>
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</tbody>
</table>

Affected Environment

| 3.2-51 | Ecology |
Once again, it is important to note that the occurrence designations are predictions based on the likelihood of encountering a species in a given area, and are not intended to provide a measure of density or abundance. These predictions are based on occurrence data and the species’ known distributions and habitat preferences. Each species description below concludes with a determination of that species’ anticipated occurrence in the proposed USWTR sites.

The assemblages of marine mammals at each of the USWTR sites differ even though the sites are relatively close to one another. Those marine mammal groups south of Cape Hatteras (in both the JAX/CHASN and Cherry Point OPAREA vicinities) tend to have a warm-temperate and tropical composition, while those in the VACAPES area have a warm- and cool-temperate overlapping distribution.

### 3.2.6.1 Site A

The Site A USWTR is located within the Jacksonville OPAREA (Figure 2-13). Thirty-five marine mammal species have confirmed or potential occurrence in the proposed Jacksonville OPAREA. These include 32 cetacean, two pinniped, and one sirenian species (DoN, 2008n) (See Table 3.2-3). Although these 35 marine mammal species may have recorded sightings or strandings in or near the study area, only 15 of those species are considered to occur regularly in the region. The remaining species are considered extralimital indicating that there are one or more records of an animal’s presence in the study area, but it is considered beyond the normal range of the species. Some cetacean species are resident in the area year-round (e.g., bottlenose dolphins), while others (e.g., North Atlantic right and humpback whales) occur seasonally as they migrate through the area. Following is a general description of the marine mammals that may occur in the Jacksonville OPAREA and, more specifically, in the vicinity of the Site A USWTR.

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**Table 3.2-3 (cont’d)**

Marine Mammal Species of the Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs and their status under the Endangered Species Act (ESA)

<table>
<thead>
<tr>
<th>Order Carnivora</th>
<th>Scientific Name</th>
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<tr>
<td>Suborder Pinnipedia (seals, sea lions, walruses)</td>
<td>Family Phocidae (true seals)</td>
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<tr>
<td>Harbor seal</td>
<td><em>Phoca vitulina</em></td>
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<td>Gray seal</td>
<td><em>Halichoerus grypus</em></td>
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<td>Harp seal</td>
<td><em>Pagophilus groenlandicus</em></td>
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<td>Hooded seal</td>
<td><em>Cystophora cristata</em></td>
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<tr>
<td>Order Sirenia</td>
<td>Family Trichechidae (manatees)</td>
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<tr>
<td>West Indian manatee</td>
<td><em>Trichechus manatus</em></td>
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Notes: Naming convention matches that used in NOAA stock assessment reports.
Source: DoN, 2008l, m, n
Any occurrences of the hooded (*Cystophora cristata*) and harbor seals (*Phoca vitulina*) would be considered extralimital, since the proposed range area is well south of these species’ typical ranges (DoN, 2007a, 2008n). These occurrences are discussed here, but based on this information, pinnipeds are not included in this report.

**Mysticetes**

Records for baleen whales in the Jacksonville OPAREA include the North Atlantic right whale (*Eubalaena glacialis*), humpback whale (*Megaptera novaeangliae*), minke whale (*Balaenoptera acutorostrata*), Bryde’s whale (*Balaenoptera edeni*), sei whale (*Balaenoptera borealis*), fin whale (*Balaenoptera physalus*), and blue whale (*Balaenoptera musculus*).

**North Atlantic Right Whale – Site A**

- **General Description**—Adults are robust and may reach 18 m (59 ft) in length (Jefferson et al., 1993). North Atlantic right whales feed on zooplankton, particularly large calanoid copepods such as *Calanus* (Kenney et al., 1985; Beardsley et al., 1996; Baumgartner et al., 2007).

- **Status**—The North Atlantic right whale is one of the world’s most endangered large whale species (Clapham et al., 1999; Perry et al., 1999; IWC, 2001). According to the North Atlantic right whale report card released annually by the North Atlantic Right Whale Consortium, approximately 393 individuals are thought to occur in the western North Atlantic (NARWC, 2007). The most recent NOAA stock assessment report (SAR) states that in a review of the photo-id recapture database for June 2006, 313 individually recognized whales were known to be alive during 2001 (Waring et al., 2008). This is considered the minimum population size. The North Atlantic right whale is under the jurisdiction of the NMFS. The recovery plan for the North Atlantic right whale was published in 2005 (NMFS, 2005a).

This species is presently declining in number (Caswell et al., 1999; Kraus et al., 2005). Kraus et al. (2005) noted that the recent increases in birth rate were insufficient to counter the observed spike in human-caused mortality that has recently occurred.

The coastal waters off the southeastern U.S. support the only known calving ground for the North Atlantic right whale. In the mid 1990s, the Navy, USCG, USACE, and NMFS entered into a Memorandum of Agreement pursuant to the ESA. The Early Warning System (EWS) (Right Whale Sighting Advisory System) is a result of that agreement. In an effort to reduce ship collisions with critically endangered North Atlantic right whales, the EWS was initiated in 1994 for the calving region along the southeastern U.S. coast. This system was extended in 1996 to the feeding areas off New England (MMC, 2003).
The EWS is a collaborative effort which involves comprehensive aerial surveys conducted during the North Atlantic right whale calving season. Surveys are flown daily, weather permitting, from December 1st through March 31st. East-west transects are flown from the shoreline to approximately 56 to 65 km (30 to 35 NM) offshore. The purpose of the surveys is to locate North Atlantic right whales, and provide whale detection and reporting information to mariners in the calving ground in an effort to avoid collisions with this endangered species. When a North Atlantic right whale is sighted, information from the aerial survey aircraft is passed to a ground contact. The ground contact e-mails the sighting information to a wide network distribution which includes FACSFAC JAX, the USCG, the USACE, and non-profit and commercial interests. Additionally, the ground contact follows up with a call to FACSFAC JAX to provide further information if necessary.

FACSFAC JAX records this information and disseminates it to all Navy vessels and aircraft operating in the consultation area via the Secret Internet Protocol Router Network (SIPRNET) system. General sighting information and reporting procedures are broadcasted over the following methods: NOAA weather radio, USCG NAVTEX system, and Broadcast Notice to Mariners over VHF mariner-band radio channel 16. The EWS is a wide communication effort to ensure that all vessels in the area are aware of the most recent right whale sightings and can avoid them.

In 1999, a Mandatory Ship Reporting System was implemented by the USCG (USCG, 1999; 2001). This reporting system requires specified vessels (Navy ships are exempt) to report their location while in the nursery and feeding areas of the right whale (Ward-Geiger et al., 2005). At the same time, ships receive information on locations of North Atlantic right whale sightings in order to avoid whale collisions. Reporting takes place in the southeastern U.S. from 15 November through 15 April. In the northeastern U.S., the reporting system is year-round and the geographical boundaries include the waters of Cape Cod Bay, Massachusetts Bay, and the Great South Channel east and southeast of Massachusetts.

- **Diving Behavior**—Dives of 5 to 15 min or longer have been reported (CETAP, 1982; Baumgartner and Mate, 2003), but can be much shorter when feeding (Winn et al., 1995). Foraging dives in the known feeding high-use areas are frequently near the bottom of the water column (Goodyear, 1993; Mate et al., 1997; Baumgartner et al., 2003). Baumgartner and Mate (2003) found that the average depth of a right whale dive was strongly correlated with both the average depth of peak copepod abundance and the average depth of the mixed layer’s upper surface. Right whale feeding dives are characterized by a rapid descent from the surface to a particular depth between 80 and 175 m (262 to 574 ft), remarkable fidelity to that depth for 5 to 14 min, and then rapid ascent back to the
surface (Baumgartner and Mate, 2003). Longer surface intervals have been observed for reproductively active females and their calves (Baumgartner and Mate, 2003). The longest tracking of a right whale is of an adult female which migrated 1,928 km (1,040 NM) in 23 days (mean was 3.5 km/hr [1.9 NM/hr) from 40 km (22 NM) west of Browns Bank (Bay of Fundy) to Georgia (Mate and Baumgartner, 2001).

**Acoustics and Hearing**—Northern right whales produce a variety of sounds, including moans, screams, gunshots, blows, upcalls, downcalls, and warbles that are often linked to specific behaviors (Matthews et al., 2001; Laurinolli et al., 2003; Vanderlaan et al., 2003; Parks et al., 2005; Parks and Tyack, 2005). Sounds can be divided into three main categories: (1) blow sounds; (2) broadband impulsive sounds; and (3) tonal call types (Parks and Clark, 2007). Blow sounds are those coinciding with an exhalation; it is not known whether these are intentional communication signals or just produced incidentally (Parks and Clark, 2007). Broadband sounds include non-vocal slaps (when the whale strikes the surface of the water with parts of its body) and the “gunshot” sound; data suggests that the latter serves a communicative purpose (Parks and Clark, 2007). Tonal calls can be divided into simple, low-frequency, stereo-typed calls and more complex, frequency-modulated (FM), higher-frequency calls (Parks and Clark, 2007). Most of these sounds range in frequency from 0.02 to 15 kHz (dominant frequency range from 0.02 to less than 2 kHz; durations typically range from 0.01 to multiple seconds) with some sounds having multiple harmonics (Parks and Tyack, 2005). Source levels for some of these sounds have been measured as ranging from 137 to 192 decibels at the reference level of one micropascal (dB re 1 μPa) root mean square (rms) (Parks et al., 2005; Parks and Tyack, 2005). In certain regions (i.e., northeast Atlantic), preliminary results indicate that right whales vocalize more from dusk to dawn than during the daytime (Leaper and Gillespie, 2006).

Recent morphometric analyses of northern right whale inner ears estimates a hearing range of approximately 0.01 to 22 kHz based on established marine mammal models (Parks et al., 2004; Parks and Tyack, 2005; Parks et al., 2007). In addition, Parks et al. (2007) estimated the functional hearing range for right whales to be 15 Hz to 18 kHz. Nowacek et al. (2004) observed that exposure to short tones and down sweeps, ranging in frequency from 0.5 to 4.5 kHz, induced an alteration in behavior (received levels of 133 to 148 dB re 1 μPa), but exposure to sounds produced by vessels (dominant frequency range of 0.05 to 0.5 kHz) did not produce any behavioral response (received levels of 132 to 142 dB re 1 μPa).

**Habitat**—North Atlantic right whales on the winter calving grounds are most often found in very shallow, nearshore regions within cooler SSTs inshore of a mid-shelf front (Kraus et al., 1993; Ward, 1999). High whale densities can extend more northerly than the current defined boundary of the calving critical habitat in
response to interannual variability in regional SST distribution (Garrison, 2007). Warm Gulf Stream waters appear to represent a thermal limit (both southward and eastward) for right whales (Keller et al., 2006).

The feeding areas are characterized by bottom topography, water column structure, currents, and tides that combine to physically concentrate zooplankton into extremely dense patches (Wishner et al., 1988; Murison and Gaskin, 1989; Macaulay et al., 1995; Beardsley et al., 1996; Baumgartner et al., 2003).

- General Distribution—Right whales occur in sub-polar to temperate waters. The North Atlantic right whale was historically widely distributed, ranging from latitudes of 60°N to 20°N prior to serious declines in abundance due to intensive whaling (e.g., NMFS, 2006q; Reeves et al., 2007). North Atlantic right whales are found primarily in continental shelf waters between Florida and Nova Scotia (Winn et al., 1986). Most sightings are concentrated within five high-use areas: coastal waters of the southeastern U.S. (Georgia and Florida), Cape Cod and Massachusetts Bays, the Great South Channel, the Bay of Fundy, and the Nova Scotian Shelf (Winn et al., 1986; NMFS, 2005a). Of these, one calving and two feeding areas in U.S. waters are designated as critical habitat for North Atlantic right whales under the ESA (NMFS, 1994; NMFS, 2005a) (Figure 3.2-7). The critical habitat designated waters off Georgia and northern Florida are the only known calving ground for western North Atlantic right whales, with use concentrated in the winter (as early as November and through March) (Winn et al., 1986). The feeding grounds of Cape Cod Bay which have concentrated use in February through April (Winn et al., 1986; Hamilton and Mayo, 1990) and the Great South Channel east of Cape Cod with concentrated use in April through June (Winn et al., 1986; Kenney et al., 1995) have also been designated as critical habitat for the North Atlantic right whale (Figure 3.2-7).

Most North Atlantic right whale sightings follow a well-defined seasonal migratory pattern through several consistently utilized habitats (Winn et al., 1986). It should be noted, however, that some individuals may be sighted in these habitats outside the typical time of year and that migration routes are poorly known (Winn et al., 1986). Right whales typically migrate within 65 km (35 NM) of shore, but individuals have been observed farther offshore (Knowlton, 1997). In fact, trans-Atlantic migrations of North Atlantic right whales between the eastern U.S. coast and Norway have been documented (Jacobsen et al., 2004) which suggests a possible offshore migration path.

During the spring through early summer, North Atlantic right whales are found on feeding grounds off the northeastern U.S. and Canada. During the winter (as early as November and through March), North Atlantic right whales may be found in coastal waters off North Carolina, Georgia, and northern Florida (Winn et al., 1986).
Designated Critical Habitats for North Atlantic Right Whales

Figure 3.2-7

North Atlantic Right Whale Critical Habitat
USWTR Candidate Sites
OPAREAs
Occurrence in the Site A USWTR—North Atlantic right whales migrate to the coastal waters of the southeastern U.S. to calve during the winter months (November through March). The coastal waters off Georgia and northern Florida are the only known calving ground for the North Atlantic right whale. During the summer, North Atlantic right whales should occur further north on their feeding grounds; however, North Atlantic right whales might be seen anywhere off the Atlantic U.S. throughout the year (Gaskin, 1982). As noted by Kraus et al. (1993), North Atlantic right whale sightings have been opportunistically reported off the southeastern U.S. as early as September and as late as June in some years. Recently, a mother and calf pair was sighted off of northeastern Florida in July (NOAA Fisheries, 2007). The North Atlantic right whale may occur year-round from the shore to the continental shelf break in the OPAREA, with a peak concentration during November through March. The North Atlantic right whale is expected to occur in the Site A USWTR.

**Designated North Atlantic Right Whale Critical Habitat**

One calving area and two feeding areas in U.S. waters are designated as critical habitat for North Atlantic right whales under the ESA (Figure 3.2-7) (NMFS, 1994; NMFS, 2005a). The critical habitat designated waters off Georgia and northern Florida are the only known calving ground for western North Atlantic right whales, with use concentrated in the winter (as early as November and through March) (Winn et al., 1986). The feeding grounds of Cape Cod Bay which have individuals in February through April (Winn et al., 1986; Hamilton and Mayo, 1990) and the Great South Channel east of Cape Cod with use in April through June (Winn et al., 1986; Kenney et al., 1995) have also been designated as critical habitat for the North Atlantic right whale. Critical habitat designations affect federal agency actions or federally-funded or permitted activities.

**Humpback Whale –Site A**

- **General Description**—Adult humpback whales are 11 to 16 m (36 to 52 ft) in length and are more robust than other rorquals. The body is black or dark gray, with very long (about one-third of the body length) flippers that are usually at least partially white (Jefferson et al., 1993; Clapham and Mead, 1999). Humpback whales feed on a wide variety of invertebrates and small schooling fishes, including euphausiids (krill); the most common fish prey are herring, mackerel, sand lance, sardines, anchovies, and capelin (Clapham and Mead, 1999).

- **Status**—An estimated 11,570 humpback whales occur in the entire North Atlantic (Stevick et al., 2003a). Humpback whales in the North Atlantic are thought to belong to five different stocks based on feeding locations (Katona and Beard, 1990; Waring et al., 2008): Gulf of Maine, Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, and Iceland. There appears to be very little exchange between these separate feeding stocks (Katona and Beard, 1990). The best estimate of abundance for the Gulf of Maine Stock is 847 individuals (Waring et al., 2008) based on a 2006 aerial survey. The humpback
whale is listed as endangered under the ESA and management of the species is under the jurisdiction of the NMFS. The recovery plan for the humpback whale was issued in 1991 (NMFS, 1991a).

- **Diving Behavior**—Humpback whale diving behavior depends on the time of year (Clapham and Mead, 1999). In summer, most dives last less than 5 min; those exceeding 10 min are atypical. In winter (December through March), dives average 10 to 15 min; dives of greater than 30 min have been recorded (Clapham and Mead, 1999). Although humpback whales have been recorded to dive as deep as 500 m (1,640 ft) (Dietz et al., 2002), on the feeding grounds they spend the majority of their time in the upper 120 m (394 ft) of the water column (Dolphin, 1987; Dietz et al., 2002). Recent D-tag work revealed that humpbacks are usually only a few meters below the water’s surface while foraging (Ware et al., 2006). On wintering grounds, Baird et al. (2000) recorded dives deeper than 100 m (328 ft).

- **Acoustics and Hearing**—Humpback whales are known to produce three classes of vocalizations: (1) “songs” in the late fall, winter, and spring by solitary males; (2) sounds made within groups on the wintering (calving) grounds; and (3) social sounds made on the feeding grounds (Thomson and Richardson, 1995).

The best-known types of sounds produced by humpback whales are songs, which are thought to be breeding displays used only by adult males (Helweg et al., 1992). Singing is most common on breeding grounds during the winter and spring months, but is occasionally heard outside breeding areas and out of season (Mattila et al., 1987; Gabriele et al., 2001; Gabriele and Frankel, 2002; Clark and Clapham, 2004). Humpback song is an incredibly elaborate series of patterned vocalizations, which are hierarchical in nature (Payne and McVay, 1971). There is geographical variation in humpback whale song, with different populations singing different songs, and all members of a population using the same basic song; however, the song evolves over the course of a breeding season, but remains nearly unchanged from the end of one season to the start of the next (Payne et al., 1983).

Social calls are from 50 hertz (Hz) to over 10 kHz, with dominant frequencies below 3 kHz (Silber, 1986). Female vocalizations appear to be simple; Simão and Moreira (2005) noted little complexity. The male song, however, is complex and changes between seasons. Components of the song range from under 20 Hz to 4 kHz and occasionally 8 kHz, with source levels measured between 151 and 189 dB re 1 μPa and high-frequency harmonics extending beyond 24 kHz (Au et al., 2001; Au et al., 2006). Songs have also been recorded on feeding grounds (Mattila et al., 1987; Clark and Clapham, 2004). The main energy lies between 0.2 and 3.0 kHz, with frequency peaks at 4.7 kHz. “Feeding” calls, unlike song and social sounds, are highly stereotyped series of narrow-band trumpeting calls.
They are 20 Hz to 2 kHz, less than 1 second (s) in duration, and have source levels of 162 to 192 dB re 1 μPa. The fundamental frequency of feeding calls is estimated to be approximately 500 Hz (D’Vincent et al., 1985; Thompson et al., 1986). Zoidis et al. (2008) recorded humpback whale calves in Hawaii and reported that they produced simple structured vocalizations that were mostly low frequency (140 to 4,000 Hz with a mean of 220 Hz).

More recently, the acoustics and dive profiles associated with humpback whale feeding behavior in the northwest Atlantic has been documented with D-tags (Stimpert et al., 2007). Underwater lunge behavior was associated with nocturnal feeding at depth and with multiple bouts of broadband click trains that were acoustically different from toothed whale echolocation: Stimpert et al. (2007) termed these sounds “mega-clicks” which showed relatively low received levels at the D-tags with the majority of acoustic energy below 2 kHz. More data are required to facilitate a more complete understanding of this newly-described acoustic, dive and feeding behavior of humpback whales. Humpback whale calves produce low frequency vocalizations (mean = 220 Hz) that are simple in structure, and are narrow in bandwidth (mean = 2 kHz) (Zoidis et al., 2008).

While no measured data on hearing ability are available for this species, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing. Houser et al. (2001) produced the first humpback whale audiogram (using a mathematical model). The predicted audiogram indicates sensitivity to frequencies from 700 Hz to 10 kHz, with maximum relative sensitivity between 2 and 6 kHz. Au et al. (2006) noted that if the popular notion that animals generally hear the totality of the sounds they produce is applied to humpback whales, this suggests that its upper frequency limit of hearing is as high as 24 kHz.

- **Habitat**—Although humpback whales typically travel over deep, oceanic waters during migration, their feeding and breeding habitats are mostly in shallow, coastal waters over continental shelves (Clapham and Mead, 1999). Shallow banks or ledges with high sea-floor relief characterize feeding grounds (Payne et al., 1990; Hamazaki, 2002). The habitat requirements of wintering humpbacks appear to be determined by the conditions necessary for calving. Optimal calving conditions are warm waters (24° to 28°C [75 to 82°F) and relatively shallow, low-relief ocean bottom in protected areas (i.e., behind reefs) (Sanders et al., 2005). Females with calves occur in significantly shallower waters than other groups of humpback whales, and breeding adults use deeper, more offshore waters (Smultea, 1994; Ersts and Rosenbaum, 2003).

- **General Distribution**—Humpback whales are globally distributed in all major oceans and most seas. They are generally found during the summer on high-latitude feeding grounds and during the winter in the tropics and subtropics around islands, over shallow banks, and along continental coasts, where calving
occurs. Most humpback whale sightings are in nearshore and continental shelf waters; however, humpback whales frequently travel through deep water during migration (Clapham and Mattila, 1990; Calambokidis et al., 2001).

In the North Atlantic Ocean, humpbacks are found from spring through fall on feeding grounds that are located from south of New England to northern Norway (NMFS, 1991). During the winter, most of the North Atlantic population of humpback whales is believed to migrate south to calving grounds in the West Indies region (Whitehead and Moore, 1982; Smith et al., 1999; Stevick et al., 2003b). There has been an increasing occurrence of humpbacks, which appear to be primarily juveniles, during the winter along the U.S. Atlantic coast from Florida north to Virginia (Clapham et al., 1993; Swingle et al., 1993; Wiley et al., 1995; Laerm et al., 1997). It has recently been proposed that the mid-Atlantic region primarily represents a supplemental winter feeding ground, which is also an area of mixing of humpback whales from different feeding stocks (Barco et al., 2002).

**Occurrence in the Site A USWTR**—Humpback whales may occur throughout the Jacksonville OPAREA (including the Site A USWTR) during fall, winter, and spring during migrations between calving grounds in the Caribbean and feeding grounds off the northeastern U.S. Humpback whales are not expected in the vicinity of the Site A area during summer, since they should occur further north on their feeding grounds; however, rare occurrences are possible, since there are documented sightings to the south in the Bahamas during this time of year (DoN, 2008n).

**Minke Whale – Site A**

- **General Description**—Minke whales are small rorquals; adults reach lengths of just over 9 m (Jefferson et al., 1993). In the western North Atlantic, minke whales feed primarily on schooling fish, such as sand lance, capelin, herring, and mackerel (Kenney et al., 1985), as well as copepods and krill (Horwood, 1990).

- **Status**—There are four recognized populations in the North Atlantic Ocean: Canadian East Coast, West Greenland, Central North Atlantic, and Northeastern North Atlantic (Donovan, 1991). Minke whales off the eastern U.S. are considered to be part of the Canadian East Coast stock which inhabits the area from the eastern half of the Davis Strait to 45° West (W) and south to the Gulf of Mexico (Waring et al., 2008). The best estimate of abundance for the Canadian East Coast stock is 3,312 individuals (Waring et al., 2008). The minke whale is under the jurisdiction of NMFS.

- **Diving Behavior**—Diel and seasonal variation in surfacing rates are documented for this species; this is probably due to changes in feeding patterns (Stockin et al., 2001). Dive durations of 7 to 380 s are recorded in the eastern North Pacific and
the eastern North Atlantic (Lydersen and Øritsland, 1990; Stern, 1992; Stockin et al., 2001). Mean time at the surface averages 3.4 s (standard deviation [SD] was ± 0.3 s) (Lydersen and Øritsland, 1990). Stern (1992) described a general surfacing pattern of minke whales consisting of about four surfacings interspersed by short-duration dives averaging 38 s. After the fourth surfacing, there was a longer duration dive ranging from approximately 2 to 6 min.

- **Acoustics and Hearing**—Recordings of minke whale sounds indicate the production of both high- and low-frequency sounds (range of 0.06 to 20 kHz) (Beamish and Mitchell, 1973; Winn and Perkins, 1976; Thomson and Richardson, 1995; Mellinger et al., 2000). Minke whale sounds have a dominant frequency range of 0.06 to greater than 12 kHz, depending on sound type (Thomson and Richardson, 1995; Edds-Walton, 2000). Mellinger et al. (2000) described two basic forms of pulse trains: a “speed-up” pulse train (dominant frequency range: 0.2 to 0.4 kHz) with individual pulses lasting 40 to 60 ms, and a less common “slow-down” pulse train (dominant frequency range: 50 to 0.35 kHz) lasting for 70 to 140 ms. Source levels for this species have been estimated to range from 151 to 175 dB re 1 μPa (Ketten, 1998). Gedamke et al. (2001) recorded a complex and stereotyped sound sequence (“star-wars vocalization”) in the southern hemisphere that spanned a frequency range of 50 Hz to 9.4 kHz. Broadband source levels between 150 and 165 dB re 1 μPa were calculated for this star-wars vocalization. “Boings” recorded in the North Pacific have many striking similarities to the star-wars vocalization in both structure and acoustic behavior. “Boings” are produced by minke whales and are suggested to be a breeding display, consisting of a brief pulse at 1.3 kHz followed by an amplitude-modulated call with greatest energy at 1.4 kHz, with slight frequency modulation over a duration of 2.5 s (Rankin and Barlow, 2005).

While no empirical data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes are most adapted to hear low to infrasonic frequencies.

- **Habitat**—Off eastern North America, minke whales generally remain in waters over the continental shelf, including inshore bays and estuaries (Mitchell and Kozicki, 1975; Murphy, 1995; Mignucci-Giannoni, 1998). However, based on whaling catches and global surveys, there is an offshore component to minke whale distribution (Slijper et al., 1964; Horwood, 1990; Mitchell, 1991).

- **General Distribution**—Minke whales are distributed in polar, temperate, and tropical waters (Jefferson et al., 1993); they are less common in the tropics than in cooler waters. This species is more abundant in New England waters than in the mid-Atlantic (Hamazaki, 2002; Waring et al., 2006). The southernmost sighting in recent NMFS shipboard surveys was of one individual offshore of the mouth of Chesapeake Bay, in waters with a bottom depth of 3,475 m (11,400 ft) (Mullin
and Fulling, 2003). Minke whales off the U.S. Atlantic coast apparently migrate offshore and southward in winter (Mitchell, 1991). Minke whales are known to occur during the winter months (November through March) in the western North Atlantic from Bermuda to the West Indies (Winn and Perkins, 1976; Mitchell, 1991; Mellinger et al., 2000).

Mating is thought to occur in October to March but has never been observed (Stewart and Leatherwood, 1985). However, location of specific breeding grounds is unknown though it is thought to be in areas of low latitude (Jefferson et al., 2008).

Occurrence in the Site A USWTR—Minke whales generally occupy the continental shelf and are widely scattered in the mid-Atlantic region (CETAP, 1982). Minke whale sightings have been recorded in the vicinity of the Action Area during the winter (DoN, 2008n). The winter range of some rorquals (and often extrapolated to the minke whale) is thought to be in deep, offshore waters particularly at lower latitudes (Kellogg, 1928; Gaskin, 1982), and minke whale sightings have been reported in deep waters during this time of year (Slijper et al., 1964; Mitchell, 1991). In the Jacksonville OPAREA, minke whales may occur just inshore of the shelf break and seaward throughout most of the year (DoN, 2008n). The minke whale is expected to occur in the Site A USWTR, except during the summer, when minke whales are expected to occur at higher latitudes on their feeding grounds.

**Bryde’s Whale – Site A**

- **General Description**—Bryde’s whales usually have three prominent ridges on the rostrum (other rorquals generally have only one) (Jefferson et al., 1993). Adults can be up to 15.5 m (51 ft) in length (Jefferson et al., 1993). Bryde’s whales can be easily confused with sei whales. Bryde’s whales are lunge-feeders, feeding on schooling fish and krill (Nemoto and Kawamura, 1977; Siciliano et al., 2004; Anderson, 2005).

- **Status**—No abundance information is currently available for Bryde’s whales in the western North Atlantic (Waring et al., 2008). Bryde’s whales are under the jurisdiction of NMFS.

- **Diving Behavior**—Bryde’s whales are lunge-feeders, feeding on schooling fish and krill (Nemoto and Kawamura, 1977; Siciliano et al., 2004; Anderson, 2005). Cummings (1985) reported that Bryde’s whales may dive as long as 20 min.

- **Acoustics and Hearing**—Bryde’s whales produce low frequency tonal and swept calls similar to those of other rorquals (Oleson et al., 2003). Calls vary regionally, yet all but one of the call types have a fundamental frequency below 60 Hz. They last from one-quarter of a second to several seconds and are produced in extended sequences (Oleson et al., 2003). Heimlich et al. (2005) recently described five
tone types. While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

- **Habitat**—Bryde’s whales are found both offshore and near the coasts in many regions. The Bryde’s whale appears to have a preference for water temperatures between approximately 15° and 20°C (58 to 69°F) (Yoshida and Kato, 1999). Bryde’s whales are more restricted to tropical and subtropical waters than other rorquals.

  General Distribution—Bryde’s whales are found in subtropical and tropical waters and generally do not range north of 40° in the northern hemisphere or south of 40° in the southern hemisphere (Jefferson et al., 1993). The Bryde’s whale does not have a well-defined breeding season in most areas and locations of specific breeding areas are unknown.

  Occurrence in the Site A USWTR—There is a general lack of knowledge of this species, particularly in the North Atlantic, although records support a tropical occurrence for the species here (Mead, 1977). This species has been known to strand on the coasts of Georgia and eastern Florida (Schmidly, 1981). It is possible some of the sightings of unidentified rorquals recorded in the region may be of Bryde’s whales. Bryde’s whales may occur seaward of the shoreline year-round (DoN, 2008n). It is expected that Bryde’s whales may occur in the Site A USWTR.

  **Sei Whale – Site A**

  - **General Description**—Adult sei whales are up to 18 m (59 ft) in length and are mostly dark gray in color with a lighter belly, often with mottling on the back (Jefferson et al., 1993). In the North Atlantic Ocean, the major prey species are copepods and krill (Kenney et al., 1985).

  - **Status**—The IWC recognizes three sei whale stocks in the North Atlantic: Nova Scotia, Iceland-Denmark Strait, and Northeast Atlantic (Perry et al., 1999). The Nova Scotia Stock occurs in U.S. Atlantic waters (Waring et al., 2008). The best abundance estimate for sei whales in the western North Atlantic is 207; however this is considered conservative due to uncertainties in population movements and structure (Waring et al., 2008). The sei whale is under the jurisdiction of the NMFS. A draft recovery plan for fin and sei whales was released in 1998 (NMFS, 1998a). It has since been determined that the two species should have separate recovery plans. The independent recovery plan for the sei whale has not yet been issued; however, the species is listed as endangered under the ESA.

  - **Diving Behavior**—There are no reported diving depths or durations for sei whales.
• **Acoustics and Hearing**—Sei whales produce low frequency downswept vocalizations, averaging from 82 to 34 Hz over 1.4 seconds (Baumgartner et al., 2008). Sei whale vocalizations have been recorded only on a few occasions. Recordings from the North Atlantic consisted of paired sequences (0.5 to 0.8 s, separated by 0.4 to 1.0 s) of 10 to 20 short (4 milliseconds [ms]) FM sweeps between 1.5 and 3.5 kHz; source level was not known (Thomson and Richardson, 1995). These mid-frequency calls are distinctly different from low-frequency tonal and frequency swept calls recently recorded in the Antarctic; the average duration of the tonal calls was 0.45 ± 0.3 s, with an average frequency of 433 ± 192 Hz and a maximum source level of 156 ± 3.6 dB re 1 μPa (McDonald et al., 2005). While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

• **Habitat**—Sei whales are most often found in deep, oceanic waters of the cool temperate zone. Sei whales appear to prefer regions of steep bathymetric relief, such as the continental shelf break, canyons, or basins situated between banks and ledges (Kenney and Winn, 1987; Schilling et al., 1992; Gregr and Trites, 2001; Best and Lockyer, 2002). These areas are often the location of persistent hydrographic features, which may be important factors in concentrating prey, especially copepods. On the feeding grounds, the distribution is largely associated with oceanic frontal systems (Horwood, 1987). Characteristics of preferred breeding grounds are unknown. Horwood (1987) noted that sei whales prefer oceanic waters and are rarely found in marginal seas; historical whaling catches were usually from deepwater, and land station catches were usually taken from along or just off the edges of the continental shelf.

• **General Distribution**—Sei whales have a worldwide distribution but are found primarily in cold temperate to subpolar latitudes rather than in the tropics or near the poles (Horwood, 1987). Sei whales spend the summer months feeding in the subpolar higher latitudes and return to the lower latitudes to calve in the winter. For the most part, the location of winter breeding areas remains a mystery (Rice, 1998; Perry et al., 1999).

In the western North Atlantic Ocean, the Nova Scotia Stock of the sei whale occurs primarily from Georges Bank north to Davis Strait (northeast Canada, between Greenland and Baffin Island; Perry et al., 1999). Peak abundance in U.S. waters occurs from winter through spring (mid-March through mid-June), primarily around the edges of Georges Bank (CETAP, 1982; Stimpert et al., 2003). The distribution of the Nova Scotia stock might extend along the U.S. coast at least to North Carolina (NMFS, 1998a).

The hypothesis is that the Nova Scotia stock moves from spring feeding grounds on or near Georges Bank, to the Scotian Shelf in June and July, eastward to perhaps Newfoundland and the Grand Banks in late summer, then back to the
Scotian Shelf in fall, and offshore and south in winter (Mitchell and Chapman, 1977).

Occurrence in the Site A USWTR—The sei whale may occur rarely in Jacksonville OPAREA (including the Site A USWTR) during fall, winter, and spring due to the species’ preference for deep, oceanic waters (waters with a bottom depth >2,000 m [6,500 ft]). Sei whales are not expected to occur in the OPAREA during the summer when they are on feeding grounds around the eastern Scotian Shelf or Grand Banks (Mitchell, 1975; Mitchell and Chapman, 1977). The sei whale is expected to occur only rarely in the deep water portions of Site A USWTR.

**Fin Whale — Site A**

- **General Description**—The fin whale is the second-largest whale species, with adults reaching 24 m (79 ft) in length (Jefferson et al., 1993). Fin whales feed by “gulping” upon a wide variety of small, schooling prey (especially herring, capelin, and sand lance) including squid and crustaceans (krill and copepods) (Kenney et al., 1985; NMFS, 2006).

- **Status**—The NOAA SAR estimates that there are 2,269 individual fin whales in the U.S. Atlantic waters (Waring et al., 2008); this is probably an underestimate, however, as survey coverage of known and potential fin whale habitat was incomplete. The fin whale is listed as endangered under the ESA and is managed under jurisdiction of the NMFS. The draft recovery plan for the fin whale was released in June 2006 (NMFS, 2006). NMFS recently initiated a five-year review for the fin whale under the ESA (NMFS, 2007).

- **Diving Behavior**—Fin whale dives are typically 5 to 15 min long and separated by sequences of four to five blows at 10- to 20-s intervals (CETAP, 1982; Stone et al., 1992; Lafortuna et al., 2003). Kopelman and Sadove (1995) found significant differences in blow intervals, dive times, and blows per hour between surface-feeding and non-surface-feeding fin whales. Croll et al. (2001b) determined that fin whales off the Pacific coast dived to a mean of 98 m (321 ft) (SD of ± 33 m [107 ft]) with a duration of 6.3 min (SD of ± 1.5 min) when foraging and to 59 m (195 ft) (SD of ± 30 m [97 ft]) with a duration of 4.2 min (SD of ± 1.7 min) when not foraging. Panigada et al. (1999) reported fin whale dives exceeding 150 m (492 ft) and coinciding with the diel migration of krill.

- **Acoustics and Hearing**—Fin and blue whales produce calls with the lowest frequency and highest source levels of all cetaceans. Infrasonic, pattern sounds have been documented for fin whales (Watkins et al., 1987; Clark and Fristrup, 1997; McDonald and Fox, 1999). Fin whales produce a variety of sounds with a frequency range up to 750 Hz. The long, patterned 15 to 30 Hz vocal sequence is most typically recorded; only males are known to produce these (Croll et al., 2002). The most typical fin whale sound is a 20 Hz infrasonic pulse (actually an
FM sweep from about 23 to 18 Hz) with durations of about 1 s and can reach source levels of 184 to 186 dB re 1 μPa (maximum up to 200; Watkins et al., 1987; Thomson and Richardson, 1995; Charif et al., 2002). Croll et al. (2002) recently suggested that these long, patterned vocalizations might function as male breeding displays, much like those that male humpback whales sing. The source depth, or depth of calling fin whales, has been reported to be about 50 m (164 ft) (Watkins et al., 1987). While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

- **Habitat**—The fin whale is found in continental shelf, slope, and oceanic waters. Off the U.S. east coast, the fin whale appears to be scarce in slope and Gulf Stream waters (CETAP, 1982; Waring et al., 1992). Waring et al. (1992) reported sighting fin whales along the edge of a warm core eddy and a remnant near Wilmington Canyon, along the northern wall of the Gulf Stream. Globally, this species tends to be aggregated in locations where populations of prey are most plentiful, irrespective of water depth, although those locations may shift seasonally or annually (Payne et al., 1986; 1990; Kenney et al., 1997; Notarbartolo-di-Sciara et al., 2003). Clark and Gagnon (2004) determined that vocalizing fin whales show strong preferences for shelf breaks, seamounts, or other areas where food resources are known to occur, even during summer months.

- **General Distribution**—Fin whales are broadly distributed throughout the world’s oceans, including temperate, tropical, and polar regions (Jefferson et al., 2008). The overall range of fin whales in the North Atlantic extends from the Gulf of Mexico/Caribbean Sea and Mediterranean Sea north to Greenland, Iceland, and Norway (Gambell, 1985; NMFS, 1998a). In the western North Atlantic, the fin whale is the most commonly sighted large whale in continental shelf waters from the mid-Atlantic coast of the U.S. to eastern Canada (CETAP, 1982; Hain et al., 1992).

Relatively consistent sighting locations for fin whales off the U.S. Atlantic coast include the banks on the Nova Scotian Shelf, Georges Bank, Jeffreys Ledge, Cashes Ledge, Stellwagen Bank, Grand Manan Bank, Newfoundland Grand Banks, the Great South Channel, the Gulf of St. Lawrence, off Long Island and Block Island, Rhode Island, and along the shelf break of the northeastern U.S. (CETAP, 1982; Hain et al., 1992; Waring et al., 2004). Hain et al. (1992) reported that the single most important habitat in their study was a region of the western Gulf of Maine, to Jeffreys Ledge, Cape Ann, Stellwagen Bank, and to the Great South Channel, in approximately 50 m (164 ft) of water. This was an area of high prey (sand lance) density during the 1970s and early 1980s (Kenney and Winn, 1986). Secondary areas of important fin whale habitat included the mid- to outer shelf from the northeast area of Georges Bank through the MAB.
Based on passive acoustic detection using Navy Sound Surveillance System (SOSUS) hydrophones in the western North Atlantic (Clark, 1995), fin whales are believed to move southward in the fall and northward in spring. The location and extent of the wintering grounds are poorly known (Aguilar, 2002). Fin whales have been seen feeding as far south as the coast of Virginia (Hain et al., 1992).

Fin whales are not completely absent from northeastern U.S. continental shelf waters in winter, indicating that not all members of the population conduct a full seasonal migration. Perhaps a fifth to a quarter of the spring/summer peak population remains in this area year-round (CETAP, 1982; Hain et al., 1992).

Peak calving is in October through January (Hain et al., 1992). However, location of breeding grounds is unknown.

Occurrence in the Site A USWTR—Fin whales are more commonly found north of Cape Hatteras (CETAP, 1982; Hain et al., 1992; Waring et al., 2007) than in the Jacksonville OPAREA. Fin whales may occur seaward of the shore in the Site A USWTR during the winter, spring, and fall (DoN, 2008n). During the summer, fin whales should be on their feeding grounds at higher latitudes off the northeastern U.S. and are not expected to occur offshore of Florida.

**Blue Whale – Site A**

- **General Description**—Blue whales are the largest-living animals. Adult blue whales in the Northern Hemisphere reach 23 to 28 m (75 to 92 ft) in length (Jefferson et al., 1993). Blue whales, like other rorquals, feed by “gulping” (Pivorunas, 1979) almost exclusively on krill (Nemoto and Kawamura, 1977).

- **Status**—The endangered blue whale was severely depleted by commercial whaling in the twentieth century (NMFS, 1998b). At least two discrete populations are found in the North Atlantic. One ranges from West Greenland to New England and is centered in eastern Canadian waters; the other is centered in Icelandic waters and extends south to northwest Africa (Sears et al., 2005). There are no current estimates of abundance for the North Atlantic blue whale (Waring et al., 2008); however, the 308 photo-identified individuals from the Gulf of St. Lawrence area are considered to be a minimum population estimate for the western North Atlantic stock (Sears et al., 1987; Waring et al., 2008). The blue whale is under the jurisdiction of the NMFS. The recovery plan for the blue whale was issued in 1998 (NMFS, 1998b).

- **Diving Behavior**—Blue whales spend greater than 94 percent of their time below the water’s surface (Lagerquist et al., 2000). Croll et al. (2001a) determined that blue whales dived to an average of 140 m (459 ft) (S.D. of ± 46 m [152 ft]) and for 7.8 min (S.D. of ± 1.9 min) when foraging and to 68 m (222 ft) (S.D. of ± 51 m [169 ft]) and for 4.9 min (S.D. of ± 2.5 min) when not foraging. However,
dives deeper than 300 m (984 ft) have been recorded from tagged individuals (Calambokidis et al., 2003).

- **Acoustics and Hearing**— Blue and fin whales produce calls with the lowest frequency and highest source levels of all cetaceans. Sounds are divided into two categories: short-duration or long duration. Blue whale vocalizations are typically long, patterned low-frequency sounds with durations up to 36 seconds (Thomson and Richardson, 1995) repeated every 1 to 2 min (Mellinger and Clark, 2003). Their frequency range is 12 to 400 Hz, with dominant energy in the infrasonic range at 12 to 25 Hz (Ketten, 1998; Mellinger and Clark, 2003). These long, patterned, infrasonic call series are sometimes referred to as “songs.” The short-duration sounds are transient, frequency-modulated calls having a higher frequency range and shorter duration than song notes and often sweeping down in frequency (Di Iorio et al., 2005; Rankin et al., 2005). Short-duration sounds appear to be common; however, they are underrepresented in the literature (Rankin et al., 2005). These short-duration sounds are less than 5 seconds in duration (Di Iorio et al., 2005; Rankin et al., 2005) and are high-intensity, broadband (858±148 Hz) pulses (Di Iorio et al., 2005). Source levels of blue whale vocalizations are up to 188 dB re 1 μPa-m (Ketten, 1998; Moore, 1999; McDonald et al., 2001). During the Magellan II Sea Test (at-sea exercises designed to test systems for antisubmarine warfare) off the coast of California in 1994, blue whale vocalization source levels at 17 Hz were estimated in the range of 195 dB re 1 μPa-m (Aburto et al., 1997). Vocalizations of blue whales appear to vary among geographic areas (Rivers, 1997), with clear differences in call structure suggestive of separate populations for the western and eastern regions of the North Pacific (Stafford et al., 2001). Blue whale sounds in the North Atlantic have been confirmed to have different characteristics (i.e., frequency, duration, and repetition) than those recorded in other parts of the world (Mellinger and Clark, 2003; Berchok et al., 2006). Stafford et al. (2005) recorded the highest calling rates when blue whale prey was closest to the surface during its vertical migration. While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

- **Habitat**—Blue whales inhabit both coastal and oceanic waters in temperate and tropical areas (Yochem and Leatherwood, 1985). Blue whales in the Atlantic are primarily found in deeper, offshore waters and are rare in shallow, shelf waters (Wenzel et al., 1988). Important foraging areas for this species include the edges of continental shelves and upwelling regions (Reilly and Thayer, 1990; Schoenherr, 1991). Based on acoustic and tagging data from the North Pacific, relatively cold, productive waters and fronts attract feeding blue whales (e.g., Moore et al., 2002). In the Gulf of St. Lawrence, blue whales show strong preferences for the nearshore regions where strong tidal and current mixing leads to high productivity and rich prey resources (Sears et al., 1990). Clark and Gagnon (2004) determined that vocalizing blue whales show strong preferences
for shelf breaks, sea mounts, or other areas where food resources are known to occur, even during summer months.

- **General Distribution**—Blue whales are distributed from the ice edge to the tropics and subtropics in both hemispheres (Jefferson et al., 1993). Stranding and sighting data suggest that the blue whale’s original range in the Atlantic extended south to Florida, the Gulf of Mexico, however the southern limit of this species’ range is unknown (Yochem and Leatherwood, 1985). Blue whales rarely occur in the U.S. Atlantic EEZ and the Gulf of Maine from August to October, which may represent the limits of their feeding range (CETAP, 1982; Wenzel et al., 1988). Researchers using Navy Integrated Undersea Surveillance System (IUSS) resources have more recently been able to detect blue whales throughout the open Atlantic south to at least The Bahamas (Clark, 1995; Clark and Gagnon, 2004) suggesting that all North Atlantic blue whales may comprise a single stock (NMFS, 1998a).

Calving occurs primarily during the winter (Yochem and Leatherwood, 1985; Jefferson et al., 2008). Breeding grounds are thought to be located in tropical/subtropical waters; however exact locations are unknown (Jefferson et al., 2008).

Occurrence in the Site A USWTR—Blue whales may occur rarely in the Jacksonville OPAREA (including the Site A USWTR) during fall, winter, and spring due to their preference for deep oceanic waters (waters with a bottom depth >2,000 m [6,560 ft]). Winter range of most rorquals (blue, fin, sei, and minke whales) is hypothesized to be in offshore waters (Kellogg, 1928; Gaskin, 1982). Blue whales are not expected to occur in the Site A area during summer when they are likely farther north in their feeding ranges.

**Odontocetes**

Following is a general discussion of the distribution of odontocete species that may occur in the Jacksonville OPAREA in the vicinity of Site A.

**Sperm Whale – Site A**

- **General Description**—The sperm whale is the largest toothed whale species. Adult females can reach 12 m (39 ft) in length, while adult males measure as much as 18 m (59 ft) in length (Jefferson et al., 1993). Sperm whales prey on mesopelagic squids and other cephalopods, as well as demersal fishes and benthic invertebrates (Rice, 1989; Clarke, 1996).

- **Status**—Sperm whales are classified as endangered under the ESA (NMFS, 2006d), although they are globally not in any immediate danger of extinction. The current combined best estimate of sperm whale abundance from Florida to the
Bay of Fundy in the western North Atlantic Ocean is 4,804 individuals (Waring et al., 2008). Stock structure for sperm whales in the North Atlantic is unknown (Dufault et al., 1999). The sperm whale is under the jurisdiction of the NMFS. The draft recovery plan for the sperm whale was released in June 2006 for public comment (NMFS, 2006m). In January 2007, NMFS initiated a five-year review for the sperm whale under the ESA (NMFS, 2007d).

- **Diving Behavior**—Sperm whales forage during deep dives that routinely exceed a depth of 400 m (1,312 ft) and a duration of 30 minutes (Watkins et al., 2002). They are capable of diving to depths of over 2,000 m (6,562 ft) with durations of over 60 minutes (Watkins et al., 1993). Sperm whales spend up to 83 percent of daylight hours underwater (Jaquet et al., 2000; Amano and Yoshioka, 2003). Males do not spend extensive periods of time at the surface (Jaquet et al., 2000). In contrast, females spend prolonged periods of time at the surface (1 to 5 hr daily) without foraging (Whitehead and Weilgart, 1991; Amano and Yoshioka, 2003). An average dive cycle consists of about a 45-min dive with a 9-min surface interval (Watwood et al., 2006). The average swimming speed is estimated to be 2.5 km/hr (1.3 NM/hr) (Watkins et al., 2002). Dive descents for tagged individuals average 11 min at a rate of 1.52 m/s (2.95 kt), and ascents average 11.8 min at a rate of 5.5 km/hr (3 NM/hr) (Watkins et al., 2002).

- **Acoustics and Hearing**—Sperm whales typically produce short-duration (less than 30 ms), repetitive broadband clicks used for communication and echolocation. These clicks range in frequency from 0.1 to 30 kHz, with dominant frequencies between the 2 to 4 kHz and 10 to 16 kHz ranges (Thomson and Richardson, 1995). When sperm whales are socializing, they tend to repeat series of group-distinctive clicks (codas), which follow a precise rhythm and may last for hours (Watkins and Schevill, 1977). The different types of codas have been associated with specific behavioral contexts (Frantzis and Alexadou, 2008). Codas are shared between individuals of a social unit and are considered to be primarily for intragroup communication (Weilgart and Whitehead, 1997; Rendell and Whitehead, 2004). Recent research in the South Pacific suggests that in breeding areas the majority of codas are produced by mature females (Marcoux et al., 2006). Coda repertoires have also been found to vary geographically and are categorized as dialects, similar to those of killer whales (Weilgart and Whitehead, 1997; Pavan et al., 2000). For example, significant differences in coda repertoire have been observed between sperm whales in the Caribbean and those in the Pacific (Weilgart and Whitehead, 1997). Furthermore, the clicks of neonatal sperm whales are very different from those of adults. Neonatal clicks are of low-directionality, long-duration (2 to 12 ms), low-frequency (dominant frequencies around 0.5 kHz) with estimated source levels between 140 and 162 dB re 1 μPa rms, and are hypothesized to function in communication with adults (Madsen et al., 2003a). Source levels from adult sperm whales’ highly directional (possible echolocation), short (100 microseconds [μs]) clicks have been estimated
up to 236 dB re 1 μPa rms (Møhl et al., 2003). Creaks (rapid sets of clicks) are heard most-frequently when sperm whales are engaged in foraging behavior in the deepest portion of their dives with intervals between clicks and source levels being altered during these behaviors (Miller et al., 2004; Laplanche et al., 2005). It has been shown that sperm whales may produce clicks during 81 percent of their dive period, specifically 64 percent of the time during their descent phases (Watwood et al., 2006). In addition to producing clicks, sperm whales in some regions like Sri Lanka and the Mediterranean Sea have been recorded making what are called trumpets at the beginning of dives just before commencing click production (Teloni, 2005). The estimated source level of one of these low intensity sounds (trumpets) was estimated to be 172 dB re 1 μPa (Teloni et al., 2005).

The anatomy of the sperm whale’s inner and middle ear indicates an ability to best hear high-frequency to ultrasonic frequency sounds. They may also possess better low-frequency hearing than other odontocetes, although not as low as many baleen whales (Ketten, 1992). The auditory brainstem response (ABR) technique used on a stranded neonatal sperm whale indicated it could hear sounds from 2.5 to 60 kHz with best sensitivity to frequencies between 5 and 20 kHz (Ridgway and Carder, 2001).

- **Habitat**—Sperm whale distribution can be variable, but is generally associated with waters over the continental shelf edge, continental slope, and offshore (CETAP, 1982; Hain et al., 1985; Smith et al., 1996; Waring et al., 2001; Davis et al., 2002). Rice (1989) noted a strong offshore preference by sperm whales.

In some areas, sperm whale densities have been correlated with high secondary productivity and steep underwater topography (Jaquet and Whitehead, 1996). Data from the Gulf of Mexico suggest that sperm whales adjust their movements to stay in or near cold-core rings (Davis et al., 2000, 2002), which demonstrate that sperm whales can shift their movements in response to prey density.

Off the eastern U.S., sperm whales are found in regions of pronounced horizontal temperature gradients, such as along the edges of the Gulf Stream and within warm-core rings (Waring et al., 1993; Jaquet et al., 1996; Griffin, 1999). Fritts et al. (1983) reported sighting sperm whales associated with the Gulf Stream. Waring et al. (2003) conducted a deepwater survey south of Georges Bank in 2002 and examined fine-scale habitat use by sperm whales. Sperm whales were located in waters characterized by sea-surface temperatures of 23° to 25°C (73° to 77°F) and bottom depths of 325 to 2,300 m (1,066 to 7,546 ft) (Waring et al., 2003).

- **General Distribution**—Sperm whales are found from tropical to polar waters in all oceans of the world between approximately 70°N and 70°S (Rice, 1998).
Females are normally restricted to areas with SST greater than approximately 15°C (59°F), whereas males, and especially the largest males, can be found in waters as far poleward as the pack ice with temperatures close to 0°C (32°F) (Rice, 1989). The thermal limits of female distribution correspond approximately to the 40° parallel (50° in the North Pacific) (Whitehead, 2003).

Sperm whales are the most-frequently sighted whales seaward of the continental shelf off the eastern U.S. (CETAP, 1982; Kenney and Winn, 1987; Waring et al., 1993; Waring et al., 2007). In Atlantic EEZ waters, sperm whales appear to have a distinctly seasonal distribution (CETAP, 1982; Scott and Sadove, 1997; Waring et al., 2007). Although concentrations shift depending on the season, sperm whales are generally distributed in Atlantic EEZ waters year-round.

Mating may occur December through August, with the peak breeding season falling in the spring (NMFS, 2006m); however location of specific breeding grounds is unknown.

Occurrence in the Site A USWTR—Sperm whales may occur year-round seaward of the shelf break throughout the Jacksonville OPAREA. The sperm whale is expected in the vicinity of Site A USWTR, particularly in areas around the shelf break and seaward.

**Pygmy and Dwarf Sperm Whales – Site A**

- **General Description**—Dwarf and pygmy sperm whales are difficult for the inexperienced observer to distinguish from one another at sea, and sightings of either species are often categorized as *Kogia* spp. The difficulty in identifying pygmy and dwarf sperm whales is exacerbated by their avoidance reaction towards ships and change in behavior towards approaching survey aircraft (Würsig et al., 1998). Pygmy and dwarf sperm whales reach body lengths of around 3 and 2.5 m (8 and 10 ft), respectively (Plön and Bernard, 1999). *Kogia* spp. feed on cephalopods and, less often, on deep-sea fish and shrimp (Caldwell and Caldwell, 1989; McAlpine et al., 1997; Willis and Baird, 1998; Santos et al., 2006).

- **Status**—There is currently no information to differentiate Atlantic stock(s) (Waring et al., 2008). The best estimate of abundance for both species combined in the western North Atlantic is 395 individuals (Waring et al., 2008). Species-level abundance estimates cannot be calculated due to uncertainty of species identification at sea (Waring et al., 2008). Pygmy and dwarf sperm whales are under the jurisdiction of NMFS.

- **Diving Behavior**—Willis and Baird (1998) reported that whales of the genus *Kogia* make dives of up to 25 min. Dive times ranging from 15 to 30 min (with 2 min surface intervals) have been recorded for a dwarf sperm whale in the Gulf of
California (Breese and Tershy, 1993). Median dive times of around 11 min are documented for *Kogia* (Barlow, 1999). A satellite-tagged pygmy sperm whale released off Florida was found to make long nighttime dives, presumably indicating foraging on squid in the deep scattering layer (DSL) (Scott et al., 2001). Most sightings of *Kogia* are brief; these whales are often difficult to approach and they sometimes actively avoid aircraft and vessels (Würsig et al., 1998).

- **Acoustics and Hearing**—There is little published information on sounds produced by *Kogia* spp., although they are categorized as non-whistling smaller toothed whales. Recently, free-ranging dwarf sperm whales off La Martinique (Lesser Antilles) were recorded producing clicks at 13 to 33 kHz with durations of 0.3 to 0.5 s (Jérémie et al., 2006). The only sound recordings for the pygmy sperm whale are from two stranded individuals. A stranded individual being prepared for release in the western North Atlantic emitted clicks of narrowband pulses with a mean duration of 119 μs, interclick intervals between 40 and 70 ms, centroid frequency of 129 kHz, peak frequency of 130 kHz, and apparent source level of up to 175 dB re 1 μPa peak-to-peak (Madsen et al., 2005). Another individual found stranded in Monterey Bay produced echolocation clicks ranging from 60 to 200 kHz, with a dominant frequency of 120 to 130 kHz (Ridgway and Carder, 2001).

No information on sound production or hearing is available for the dwarf sperm whale. An ABR study completed on a stranded pygmy sperm whale indicated a hearing range of 90 to 150 kHz (Ridgway and Carder, 2001).

- **Habitat**—*Kogia* spp. occur in waters along the continental shelf break and over the continental slope (e.g., Baumgartner et al., 2001; McAlpine, 2002). Data from the Gulf of Mexico suggest that *Kogia* spp. may associate with frontal regions along the continental shelf break and upper continental slope, where higher epipelagic zooplankton biomass may enhance the densities of squids, their primary prey (Baumgartner et al., 2001).

- **General Distribution**—Both *Kogia* species apparently have a worldwide distribution in tropical and temperate waters (Jefferson et al., 1993). In the western Atlantic Ocean, stranding records have documented the pygmy sperm whale as far north as the northern Gulf of St. Lawrence, New Brunswick and parts of eastern Canada (Piers, 1923, Measures et al., 2004; McAlpine et al., 1997; Baird et al., 1996) and as far south as Colombia and around to Brazil (in the southern Atlantic) (de Carvalho, 1967; Geise and Borobia, 1987; Muñoz-Hincapié et al., 1998). Pygmy sperm whales are also found in the Gulf of Mexico (Hysmith, 1976; Gunter et al., 1955; Baumgartner et al., 2001) and in the Caribbean (MacLeod and Hauser, 2002).
The northern range of the dwarf sperm whale is largely unknown; however, multiple stranding records exist on the eastern coast of the U.S. as far north as North Carolina (Hohn et al., 2006) and Virginia (Morgan et al., 2002; Potter, 1979). Records of strandings and incidental captures indicate the dwarf sperm whale may range as far south as the Northern Antilles in the northern Atlantic (Muñoz-Hincapié et al., 1998); although records continue south along Brazil in the southern Atlantic (Muñoz-Hincapié et al., 1998). Dwarf sperm whales occur in the Caribbean (Caldwell et al., 1973; Cardona-Maldonado and Mignucci-Giannoni, 1999) and the Gulf of Mexico (Davis et al., 2002; Jefferson and Schiro, 1997).

Births have been recorded between December and March for dwarf sperm whales in South Africa (Plön, 2004), however, the breeding season and specific locations in the northwest Atlantic are unknown. Seasonality and location of pygmy sperm whale breeding is unknown.

Occurrence in the Site A USWTR—*Kogia* spp. generally occur along the continental shelf break and over the continental slope (e.g., Baumgartner et al., 2001; McAlpine, 2002). *Kogia* spp. are expected to occur seaward of the shelf break throughout Site A year-round. Few sightings are recorded in the Jacksonville OPAREA, which is likely due to incomplete survey coverage throughout most of the deep waters of this region (especially during winter and fall), as well as their avoidance reactions towards ships. Strandings are recorded near the Jacksonville OPAREA during all seasons and support the likelihood of *Kogia* occurrence in the region year-round (DoN, 2008n). *Kogia* spp. may occur seaward of the shelf break throughout the Jacksonville OPAREA vicinity year-round and are expected in this region in the Site A USWTR.

**Beaked Whales – Site A**

Based upon available data, the following five beaked whale species may be affected by the proposed activities in the Site A area: Cuvier's beaked whales and four members of the genus *Mesoplodon* (True’s, Gervais', Blainville's, and Sowerby's beaked whales).

- **General Description**—Cuvier's beaked whales are relatively robust compared to other beaked whale species. Male and female Cuvier's beaked whales may reach 7.5 and 7.0 m (25 and 23 ft) in length, respectively (Jefferson et al., 1993). *Mesoplodon* species have maximum reported adult lengths of 6.2 m (20 ft) (Mead, 1989). Stomach content analyses of captured and stranded individuals suggest beaked whales are deep divers that feed by suction on mesopelagic fishes, squids, and deepwater benthic invertebrates (Heyning, 1989; Heyning and Mead, 1996; Santos et al., 2001; MacLeod et al., 2003). Stomach contents of Cuvier’s beaked whales rarely contain fishes, while stomach contents of *Mesoplodon* species frequently do (MacLeod et al., 2003).
Status—The best estimate of *Mesoplodon* spp. and Cuvier’s beaked whale abundance combined in the western North Atlantic is 3,513 individuals (Waring et al., 2008). A recent study of global phylogeographic structure of Cuvier’s beaked whales suggested that some regions show a high level of differentiation (Dalebout et al., 2005); however, Dalebout et al., (2005) could not discern finer-scale population differences within the North Atlantic. Beaked whales are under the jurisdiction of NMFS.

Diving Behavior—Dives range from those near the surface where the animals are still visible to long, deep dives. Dive durations for *Mesoplodon* spp. are typically over 20 min (Barlow, 1999; Baird et al., 2005). Tagged northern bottlenose whales off Nova Scotia were found to dive approximately every 80 min to over 800 m (2,625 ft), with a maximum dive depth of 1,453 m (4,764 ft) for as long as 70 min (Hooker and Baird, 1999). Northern bottlenose whale dives fall into two discrete categories: short-duration (mean of 12 min), shallow dives and long-duration (mean of 37 min), deep dives (Hooker and Baird, 1999). Tagged Cuvier’s beaked whale dive durations as long as 87 min and dive depths of up to 1,990 m (6,529 ft) have been recorded (Baird et al., 2004; Baird et al., 2005). Tagged Blainville’s beaked whale dives have been recorded to 1,408 m (4,619 ft) and lasting as long as 54 min (Baird et al., 2005). Baird et al. (2005) reported that several aspects of diving were similar between Cuvier’s and Blainville’s beaked whales: (1) both dove for 48 to 68 min to depths greater than 800 m (2,625 ft), with one long dive occurring on average every 2 hr; (2) ascent rates for long/deep dives were substantially slower than descent rates, while during shorter dives there were no consistent differences; and (3) both spent prolonged periods of time (66 to 155 min) in the upper 50 m (164 ft) of the water column. Both species make a series of shallow dives after a deep foraging dive to recover from oxygen debt; average intervals between foraging dives have been recorded as 63 min for Cuvier’s beaked whales and 92 min for Blainville’s beaked whales (Tyack et al., 2006).

Acoustics and Hearing—Sounds recorded from beaked whales are divided into two categories: whistles and pulsed sounds (clicks); whistles likely serve a communicative function and pulsed sounds are important in foraging and/or navigation (Johnson et al., 2004; Madsen et al., 2005) (MacLeod and D’Amico, 2006; Tyack et al., 2006). Whistle frequencies are about 2 to 12 kHz, while pulsed sounds range in frequency from 300 Hz to 135 kHz; however, as noted by MacLeod and D’Amico (2006), higher frequencies may not be recorded due to equipment limitations. Whistles recorded from free-ranging Cuvier’s beaked whales off Greece ranged in frequency from 8 to 12 kHz, with an upsweep of about 1 s (Manghi et al., 1999), while pulsed sounds had a narrow peak frequency of 13 to 17 kHz, lasting 15 to 44 s in duration (Frantzis et al., 2002). Short whistles and chirps from a stranded subadult Blainville's beaked whale ranged in
frequency from slightly less than 1 to almost 6 kHz (Caldwell and Caldwell, 1971a).

Recent studies incorporating D-tags (miniature sound and orientation recording tag) attached to Blainville’s beaked whales in the Canary Islands and Cuvier’s beaked whales in the Ligurian Sea recorded high-frequency echolocation clicks (duration: 175 μs for Blainville’s and 200 to 250 μs for Cuvier’s) with dominant frequency ranges from about 20 to over 40 kHz (limit of recording system was 48 kHz) and only at depths greater than 200 m (656 ft) (Johnson et al., 2004; Madsen et al., 2005; Zimmer et al., 2005; Tyack et al., 2006). The source level of the Blainville’s beaked whales’ clicks were estimated to range from 200 to 220 dB re 1 μPa peak-to-peak (Johnson et al., 2004), while they were 214 dB re 1 μPa peak-to-peak for the Cuvier’s beaked whale (Zimmer et al., 2005).

From anatomical examination of their ears, it is presumed that beaked whales are predominantly adapted to best hear ultrasonic frequencies (MacLeod, 1999; Ketten, 2000). Beaked whales have well-developed semi-circular canals (typically for vestibular function but may function differently in beaked whales) compared to other cetacean species, and they may be more sensitive than other cetaceans to low-frequency sounds (MacLeod, 1999; Ketten, 2000). Ketten (2000) remarked on how beaked whale ears (computerized tomography [CT] scans of Cuvier’s, Blainville’s, Sowerby’s, and Gervais’ beaked whale heads) have anomalously well-developed vestibular elements and heavily reinforced (large bore, strutting) Eustachian tubes and noted that they may impart special resonances and acoustic sensitivities. The only direct measure of beaked whale hearing is from a stranded juvenile Gervais’ beaked whale using auditory evoked potential techniques (Cook et al., 2006). The hearing range was 5 to 80 kHz, with greatest sensitivity at 40 and 80 kHz (Cook et al., 2006).

- **Habitat**—World-wide, beaked whales normally inhabit continental slope and deep oceanic waters (>200 m [656 ft]) (Waring et al., 2001; Cañadas et al., 2002; Pitman, 2002; MacLeod et al., 2004; Ferguson et al., 2006; MacLeod and Mitchell, 2006). Beaked whales are only occasionally reported in waters over the continental shelf (Pitman, 2002). Distribution of *Mesoplodon* spp. in the North Atlantic may relate to water temperature (MacLeod, 2000b). The Blainville’s and Gervais' beaked whales occur in warmer southern waters, in contrast to Sowerby’s and True’s beaked whales that are more northern (MacLeod, 2000a). Beaked whale abundance off the eastern U.S. may be highest in association with the Gulf Stream and the warm-core rings it develops (Waring et al., 1992). In summer, the continental shelf break off the northeastern U.S. is primary habitat (Waring et al., 2001).

- **General Distribution**—Cuvier's beaked whales are the most widely-distributed of the beaked whales and are present in most regions of all major oceans
(Heyning, 1989; MacLeod et al., 2006). This species occupies almost all temperate, subtropical, and tropical waters, as well as subpolar and even polar waters in some areas (MacLeod et al., 2006). Blainville's beaked whales are thought to have a continuous distribution throughout tropical, subtropical, and warm-temperate waters of the world’s oceans; they occasionally occur in cold-temperate areas (MacLeod et al., 2006). The Gervais’ beaked whale is restricted to warm-temperate and tropical Atlantic waters with records throughout the Caribbean Sea (MacLeod et al., 2006). The Sowerby’s beaked whale is endemic to the North Atlantic; this is considered to be more of a temperate species (MacLeod et al., 2006). In the western North Atlantic, confirmed strandings of True’s beaked whales are recorded from Nova Scotia to Florida and also in Bermuda (MacLeod et al., 2006). There is also a sighting made southeast of Hatteras Inlet, North Carolina (note that the latitude provided by Tove is incorrect) (Tove, 1995).

The continental shelf margins from Cape Hatteras to southern Nova Scotia were recently identified as known “key areas” for beaked whales in a global review by MacLeod and Mitchell (2006). Beaked whale life histories are poorly known, reproductive biology is generally not described, and the locations of specific breeding grounds are unknown.

Occurrence in the Site A USWTR—Cuvier’s, True’s, Gervais’, and Blainville’s beaked whales are the only beaked whale species that may occur in the Jacksonville OPAREA, with possible extralimital occurrences of the Sowerby’s beaked whale. Beaked whale abundance off the U.S. Atlantic Coast may be highest in association with the Gulf Stream and the warm-core rings it develops (Waring et al., 1992). Beaked whales may occur seaward of the shelf break throughout the Jacksonville OPAREA (DoN, 2008n). Expected beaked whale occurrence is seaward of the shelf break year-round in the Site A USWTR. Beaked whale sightings in the western North Atlantic Ocean appear to be concentrated in waters between the 200-m (656-ft) isobath and those just beyond the 2,000-m isobath (6,560 ft) (DoN, 2008l, m).

### Rough-toothed Dolphin – Site A

- **General Description**—The rough-toothed dolphin is relatively robust with a cone-shaped head with no demarcation between the melon and beak (Jefferson et al., 1993). Rough-toothed dolphins reach 2.8 m (9.2 ft) in length (Jefferson et al., 1993). They feed on cephalopods and fish, including large fish such as dorado (Miyazaki and Perrin, 1994; Reeves et al., 1999; Pitman and Stinchcomb, 2002).

- **Status**—No abundance estimate is available for rough-toothed dolphins in the western North Atlantic (Waring et al., 2008). The rough-toothed dolphin is under the jurisdiction of NMFS.
• **Diving Behavior**—Rough-toothed dolphins may stay submerged for up to 15 min (Miyazaki and Perrin, 1994) and are known to dive as deep as 150 m (492 ft) (Manire and Wells, 2005).

• **Acoustics and Hearing**—The rough-toothed dolphin produces a variety of sounds, including broadband echolocation clicks and whistles. Echolocation clicks (duration less than 250 µs) typically have a frequency range of 0.1 to 200 kHz, with a dominant frequency of 25 kHz (Miyazaki and Perrin, 1994; Yu et al., 2003; Chou, 2005). Whistles (duration less than 1 s) have a wide frequency range of 0.3 to greater than 24 kHz but dominate in the 2 to 14 kHz range (Miyazaki and Perrin, 1994; Yu et al., 2003).

Auditory evoked potential (AEP) measurements were performed on six individuals involved in a mass stranding event on Hutchinson Island, Florida in August 2004 (Cook et al., 2005). The rough-toothed dolphin can detect sounds between 5 and 80 kHz and is most likely capable of detecting frequencies much higher than 80 kHz (Cook et al., 2005).

• **Habitat**—The rough-toothed dolphin is regarded as an offshore species that prefers deep waters; however, it can occur in shallower waters as well (e.g., Gannier and West, 2005). Tagging data for this species from the Gulf of Mexico and western North Atlantic provide important information on habitat preferences. Three dolphins with satellite-linked transmitters released in 1998 off the Gulf Coast of Florida were tracked off the Florida panhandle in average water depths of 195 m (640 ft) (Wells et al., 1999). Dolphins released in March of 2005 after a mass stranding were tagged with satellite-linked transmitters and released southeast of Fort Pierce moved within the Gulf Stream and parallel to the continental shelf off Florida, Georgia, and South Carolina, in waters with a depth of 400 to 800 m (1,312 to 2,625 ft) (Manire and Wells, 2005). They later moved northeast into waters with a depth greater than 4,000 m (13,120 ft) (Manire and Wells, 2005). Another tagged dolphin released after the 2005 mass stranding moved north as far as Charleston, South Carolina, before returning to the Miami area, remaining in relatively shallow waters (Wells, 2007). During May 2005, seven more rough-toothed dolphins (stranded in the Florida Keys in March 2005 and rehabilitated) were tagged and released by the Marine Mammal Conservancy in the Florida Keys (Wells, 2007). During an initial period of apparent disorientation in the shallow waters west of Andros Island, they continued to the east, then moved north through Crooked Island Passage, and paralleled the West Indies (Wells, 2007). The last signal placed them northeast of the Lesser Antilles (Wells, 2007). During September 2005, two more individuals (from the same mass stranding) were satellite-tagged and released east of the Florida Keys and proceeded south to a deep trench close to the north coast of Cuba (Wells, 2007).
- **General Distribution**—Rough-toothed dolphins are found in tropical to warm-temperate waters globally, rarely ranging north of 40°N or south of 35°S (Miyazaki and Perrin, 1994). This species is not a commonly encountered species in the areas where it is known to occur (Jefferson, 2002). Not many records for this species exist from the western North Atlantic, but they indicate that this species occurs from Virginia south to Florida, the Gulf of Mexico, the West Indies, and along the northeastern coast of South America (Leatherwood et al., 1976; Jefferson et al., 2008). Seasonality and location of rough-toothed dolphin breeding is unknown.

Occurrence in the Site A USWTR— Occurrence is expected seaward of the shelf break throughout the Jacksonville OPAREA based on this species’ preference for deep waters (DoN, 2008n). Rough-toothed dolphins are expected seaward of the shelf break in the Site A USWTR.

**Bottlenose Dolphin – Site A**

- **General Description**—Bottlenose dolphins are large and robust with striking regional variations in body size; adult body lengths range from 1.9 to 3.8 m (6.2 to 12.5 ft) (Jefferson et al., 1993). Bottlenose dolphins are opportunistic feeders that utilize numerous feeding strategies to prey upon a variety of fish, cephalopods, and shrimp (Shane, 1990; Wells and Scott, 1999).

- **Status**—Two forms of bottlenose dolphins are recognized in the western North Atlantic Ocean: nearshore (coastal) and offshore (Waring et al., 2008). The best estimate for the western North Atlantic coastal stock of bottlenose dolphins is 15,620 (Waring et al., 2008). Currently, a single western North Atlantic offshore stock is recognized seaward of 34 km (18NM) from the U.S. coastline (Waring et al., 2008). The best population estimate for this stock is 81,588 individuals (Waring et al., 2008).

- **Diving Behavior**—Dive durations as long as 15 min are recorded for trained individuals (Ridgway et al., 1969). Typical dives, however, are more shallow and of a much shorter duration. Mean dive durations of Atlantic bottlenose dolphins typically range from 20 to 40 s at shallow depths (Mate et al., 1995) and can last longer than 5 min during deep offshore dives (Klatsky et al., 2005). Offshore bottlenose dolphins regularly dive to 450 m (1,476 ft) and possibly as deep as 700 m (2,297 ft) (Klatsky et al., 2005). Bottlenose dolphin dive behavior may correlate with diel cycles (Mate et al., 1995; Klatsky et al., 2005); this may be especially true for offshore stocks, which have dive deeper and more frequently at night to feed upon the deep scattering layer (Klatsky et al., 2005).

- **Acoustics and Hearing**—Sounds emitted by bottlenose dolphins have been classified into two broad categories: pulsed sounds (including clicks and burst-pulses) and narrow-band continuous sounds (whistles), which usually are
frequency modulated. Clicks and whistles have a dominant frequency range of 110 to 130 kHz and a source level of 218 to 228 dB re 1 μPa (Au, 1993) and 3.4 to 14.5 kHz and 125 to 173 dB re 1 μPa, respectively (Ketten, 1998). Whistles are primarily associated with communication and can serve to identify specific individuals (i.e., signature whistles) (Caldwell and Caldwell, 1965; Janik et al., 2006). Up to 52 percent of whistles produced by bottlenose dolphin groups with mother-calf pairs can be classified as signature whistles (Cook et al., 2004). Sound production is also influenced by group type (single or multiple individuals), habitat, and behavior (Nowacek, 2005). Bray calls (low-frequency vocalizations; majority of energy below 4 kHz), for example, are used when capturing fishes, specifically sea trout (Salmo trutta) and Atlantic salmon (Salmo salar), in some regions (i.e., Moray Firth, Scotland) (Janik, 2000). Additionally, whistle production has been observed to increase while feeding (Acevedo-Gutiérrez and Stienessen, 2004; Cook et al., 2004). Furthermore, both whistles and clicks have been demonstrated to vary geographically in terms of overall vocal activity, group size, and specific context (e.g., feeding, milling, traveling, and socializing) (Jones and Sayigh, 2002; Zaretsky et al., 2005; Baron, 2006). For example, preliminary research indicates that characteristics of whistles from populations in the northern Gulf of Mexico significantly differ (i.e., in frequency and duration) from those in the western north Atlantic (Zaretsky et al., 2005; Baron, 2006).

Bottlenose dolphins can typically hear within a broad frequency range of 0.04 to 160 kHz (Au, 1993; Turl, 1993). Electrophysiological experiments suggest that the bottlenose dolphin brain has a dual analysis system: one specialized for ultrasonic clicks and another for lower-frequency sounds, such as whistles (Ridgway, 2000). Scientists have reported a range of highest sensitivity between 25 and 70 kHz, with peaks in sensitivity at 25 and 50 kHz (Nachtigall et al., 2000). Recent research on the same individuals indicates that auditory thresholds obtained by electrophysiological methods correlate well with those obtained in behavior studies, except at the some lower (10 kHz) and higher (80 and 100 kHz) frequencies (Finneran and Houser, 2006).

Threshold shifts refer to shifts in the ability to detect sound within certain acoustic ranges due to a marine mammal’s exposure to sound. Temporary threshold shifts (TTS) in hearing have been experimentally induced in captive bottlenose dolphins using a variety of noises (i.e., broad-band, pulses) (DoN, 1997b; Schlundt et al., 2000; Nachtigall et al., 2003; Finneran et al., 2005; Mooney et al., 2005; Mooney, 2006). For example, TTS has been induced with exposure to a 3 kHz, 1-s pulse with sound exposure level (SEL) of 195 dB referenced to 1 micropascal squared second (dB re 1 μPa²·s) (Finneran et al., 2005), one-second pulses from 3 to 20 kHz at 192 to 201 dB re 1μPa (Schlundt et al., 2000), and octave band noise (4 to 11 kHz) for 50 min at 179 dB re 1 μPa (Nachtigall et al., 2003). Preliminary research indicates that TTS and recovery after noise exposure are frequency
dependent and that an inverse relationship exists between exposure time and sound pressure level associated with exposure (Mooney et al., 2005; Mooney, 2006). Observed changes in behavior were induced with an exposure to a 75 kHz one-second pulse at 178 dB re 1 μPa (DoN, 1997b; Schlundt et al., 2000). Finneran et al. (2005) concluded that a SEL of 195 dB re 1 μPa²-s is a reasonable threshold for the onset of TTS in bottlenose dolphins exposed to mid-frequency tones.

- **Habitat**—Coastal bottlenose dolphins occur in coastal embayments and estuaries as well as in waters over the continental shelf; individuals may exhibit either resident or migratory patterns in coastal areas (Kenney, 1990). Bays, sounds, and estuaries are high-use habitats for bottlenose dolphins due to their importance as nursery and feeding areas (Read et al., 2003).

Coastal bottlenose dolphins show a temperature-limited distribution, occurring in significantly warmer waters than the offshore stock, and having a distinct northern boundary (Kenney, 1990). A study of the Chesapeake Bay/Virginia coast area showed a much greater probability of sightings with SSTs of 16° to 28°C (61° to 82°F) (Armstrong et al., 2005). SST may significantly influence seasonal movements of migrating coastal dolphins along the western Atlantic coast (Barco et al., 1999); these seasonal movements are likely also influenced by movements of prey resources.

In the western North Atlantic, the greatest concentrations of the offshore stock are along the continental shelf break (Kenney, 1990). Evidence suggests that there is a distinct spatial separation of the coastal and offshore stocks during the summer; however the morphotypes overlap in the winter (Garrison et al., 2003; Torres et al., 2003). During CETAP surveys, offshore bottlenose dolphins generally were distributed between the 200 and 2,000-m (656 and 6,560-ft) isobaths in waters with a mean bottom depth of 846 m (2,776 ft) from Cape Hatteras to the eastern end of Georges Bank. Geography and temperature also influence the distribution of offshore bottlenose dolphins (Kenney, 1990).

- **General Distribution**—In the western North Atlantic, bottlenose dolphins occur as far north as Nova Scotia but are most common in coastal waters from New England to Florida, the Gulf of Mexico, the Caribbean, and southward to Venezuela and Brazil (Würsig et al., 2000). Bottlenose dolphins occur seasonally in estuaries and coastal embayments as far north as Delaware Bay (Kenney, 1990) and in waters over the outer continental shelf and inner slope, as far north as Georges Bank (CETAP, 1982; Kenney, 1990).

Populations exhibit seasonal migrations regulated by temperature and prey availability (Torres et al., 2005), traveling as far north as New Jersey in summer and as far south as central Florida in winter (Urian et al., 1999).
Coastal bottlenose dolphins along the western Atlantic coast may exhibit either resident or migratory patterns (Waring et al., 2008). Photo-identification studies support evidence of year-round resident bottlenose dolphin populations in Beaufort and Wilmington, North Carolina (Koster et al., 2000); these are the northernmost documented sites of year-round residency for bottlenose dolphins in the western North Atlantic (Koster et al., 2000). Migratory dolphins may enter these areas seasonally as well, as evidenced by a bottlenose dolphin tagged in 2001 in Virginia Beach who overwintered in waters between Cape Hatteras and Cape Lookout (NMFS-SEFSC, 2001a).

Bottlenose dolphins are flexible in their timing of reproduction. Seasons of birth for bottlenose dolphin populations are likely responses to seasonal patterns of availability of local resources (Urian et al., 1996). There are no specific breeding locations for this species.

Occurrence in the Site A USWTR — Bottlenose dolphins are abundant in continental shelf and inner slope waters throughout the western North Atlantic (CETAP, 1982; Kenney, 1990; Waring et al., 2008). The greatest concentrations of offshore animals are along the continental shelf break and between the 200- and 2,000-m (656 and 6,560-ft) isobaths (Kenney, 1990; Waring et al, 2008); however, tagging data suggest that the range of offshore bottlenose dolphins may actually extend further offshore into much deeper waters (Wells et al., 1999). Bottlenose dolphins occur throughout the Jacksonville OPAREA vicinity year-round, in both coastal and deep offshore waters. During a NMFS-SEFSC survey of the area south of Maryland to central Florida, Mullin and Fulling (2003) reported sighting bottlenose dolphins throughout the study area, but primarily in or near continental shelf waters. Bottlenose dolphins are expected throughout Site A USWTR.

**Atlantic Spotted Dolphin – Site A**

- **General Description**—Atlantic spotted dolphin adults are up to 2.3 m (7.5 ft) long and can weigh as much as 143 kg (315 lbs) (Jefferson et al., 1993). Atlantic spotted dolphins are born spotless and develop spots as they age (Perrin et al., 1994a; Herzing, 1997). There is marked regional variation in the adult body size of the Atlantic spotted dolphin (Perrin et al., 1987). There are two forms: a robust, heavily spotted form that inhabits the continental shelf, usually found within 250 to 350 km (135 to 189 NM) of the coast and a smaller, less-spotted form that inhabits offshore waters (Perrin et al., 1994a). Atlantic spotted dolphins feed on small cephalopods, fish, and benthic invertebrates (Perrin et al., 1994a).

- **Status**—The best estimate of Atlantic spotted dolphin abundance in the western North Atlantic is 50,978 individuals (Waring et al., 2008). Recent genetic evidence suggests that there are at least two populations in the western North Atlantic (Adams and Rosel, 2006), as well as possible continental shelf and offshore segregations. Atlantic populations are divided along a latitudinal
boundary corresponding roughly to Cape Hatteras (Adams and Rosel, 2006). The Atlantic spotted dolphin is under the jurisdiction of NMFS.

- **Diving Behavior**—The only information on diving depth for this species is from a satellite-tagged individual in the Gulf of Mexico (Davis et al., 1996). This individual made short, shallow dives to less than 10 m (33 ft) and as deep as 60 m (197 ft), while in waters over the continental shelf on 76 percent of dives.

- **Acoustics and Hearing**—A variety of sounds including whistles, echolocation clicks, squawks, barks, growls, and chirps have been recorded for the Atlantic spotted dolphin (Thomson and Richardson, 1995). Whistles have dominant frequencies below 20 kHz (range: 7.1 to 14.5 kHz) but multiple harmonics extend above 100 kHz, while burst pulses consist of frequencies above 20 kHz (dominant frequency of approximately 40 kHz) (Lammers et al., 2003). Other sounds, such as squawks, barks, growls, and chirps, typically range in frequency from 0.1 to 8 kHz (Thomson and Richardson, 1995). Recently recorded echolocation clicks have two dominant frequency ranges at 40 to 50 kHz and 110 to 130 kHz, depending on source level (i.e., lower source levels typically correspond to lower frequencies and higher frequencies to higher source levels (Au and Herzing, 2003). Echolocation click source levels as high as 210 dB re 1 μPa peak-to-peak have been recorded (Au and Herzing, 2003). Spotted dolphins in The Bahamas were frequently recorded during agonistic/aggressive interactions with bottlenose dolphins (and their own species) to produce squawks (0.2 to 12 kHz broad band burst pulses; males and females), screams (5.8 to 9.4 kHz whistles; males only), barks (0.2 to 20 kHz burst pulses; males only), and synchronized squawks (0.1-15 kHz burst pulses; males only in a coordinated group) (Herzing, 1996).

There has been no data collected on Atlantic spotted dolphin hearing ability. However, odontocetes are generally adapted to hear high-frequencies (Ketten, 1997).

- **Habitat**—Atlantic spotted dolphins occupy both continental shelf and offshore habitats. The large, heavily-spotted coastal form typically occurs over the continental shelf within or near the 185 m (607 ft) isobath, 8 to 20 km (4 to 11 NM) from shore (Perrin et al., 1994a; Davis et al., 1998; Perrin, 2002b). There are also frequent sightings beyond the continental shelf break in the Caribbean Sea, Gulf of Mexico, and off the U.S. Atlantic Coast (Mills and Rademacher, 1996; Roden and Mullin, 2000; Fulling et al., 2003; Mullin and Fulling, 2003; Mullin et al., 2004). Atlantic spotted dolphins are found commonly in inshore waters south of Chesapeake Bay as well as over continental shelf break and slope waters north of this region (Payne et al., 1984; Mullin and Fulling, 2003). Sightings have also been made along the northern wall of the Gulf Stream and its associated warm-core ring features (Waring et al., 1992).
General Distribution—Atlantic spotted dolphins are distributed in warm-temperate and tropical Atlantic waters from approximately 45°N to 35°S; in the western North Atlantic, this translates to waters from northern New England to Venezuela, including the Gulf of Mexico and the Caribbean Sea (Perrin et al., 1987).

Peak calving periods in the Bahamas are early spring and late fall (Herzing, 1997). However, in the western Atlantic breeding times and locations are largely unknown.

Occurrence in the Site A USWTR—Atlantic spotted dolphins may occur in both continental shelf and offshore waters of the Jacksonville OPAREA year-round. Atlantic spotted dolphins regularly occur in waters over the continental shelf and slope (Payne et al., 1984; Mullin and Fulling, 2003). The Gulf Stream and its associated warm-core ring features likely influence occurrence of this species in this region. Atlantic spotted dolphins are expected throughout Site A USWTR.

Pantropical Spotted Dolphin – Site A

General Description—The pantropical spotted dolphin is a rather slender dolphin. Adults may reach 2.6 m (8.5 ft) in length (Jefferson et al., 1993). Pantropical spotted dolphins are born spotless and develop spots as they age although the degree of spotting varies geographically (Perrin and Hohn, 1994). North and offshore of Cape Hatteras, adults may bear only a few small, dark, ventral spots whereas individuals over the continental shelf become so heavily spotted that they appear nearly white (Perrin and Hohn, 1994). Pantropical spotted dolphins prey on epipelagic fish, squid, and crustaceans (Perrin and Hohn, 1994; Robertson and Chivers, 1997; Wang et al., 2003).

Status—The best estimate of abundance of the western North Atlantic stock of pantropical spotted dolphins is 4,439 individuals (Waring et al., 2008). There is no information on stock differentiation for pantropical spotted dolphins in the U.S. Atlantic (Waring et al., 2008). The pantropical spotted dolphin is under the jurisdiction of NMFS.

Diving Behavior—Dives during the day generally are shorter and shallower than dives at night; rates of descent and ascent are higher at night than during the day (Baird et al., 2001). Similar mean dive durations and depths have been obtained for tagged pantropical spotted dolphins in the eastern tropical Pacific and off Hawaii (Baird et al., 2001).

Acoustics and Hearing—Pantropical spotted dolphin whistles have a frequency range of 3.1 to 21.4 kHz (Thomson and Richardson, 1995). Clicks typically have two frequency peaks (bimodal) at 40 to 60 kHz and 120 to 140 kHz with
estimated source levels up to 220 dB re 1 μPa peak-to-peak (Schotten et al., 2004). No direct measures of hearing ability are available for pantropical spotted dolphins, but ear anatomy has been studied and indicates that this species should be adapted to hear the lower range of ultrasonic frequencies (less than 100 kHz) (Ketten, 1992; 1997).

- **Habitat**—Pantropical spotted dolphins tend to associate with bathymetric relief and oceanographic interfaces. Pantropical spotted dolphins may rarely be sighted in shallower waters (e.g., Peddemors, 1999; Gannier, 2002; Mignucci-Giannoni et al., 2003; Waring et al., 2007). Along the northeastern U.S., Waring et al. (1992) found that *Stenella* spp. were distributed along the Gulf Stream’s northern wall. *Stenella* sightings also occurred within the Gulf Stream, which is consistent with the oceanic distribution of this genus and its preference for warm water (Waring et al., 1992; Mullin and Fulling, 2003).

- **General Distribution**—Pantropical spotted dolphins occur in subtropical and tropical waters worldwide (Perrin and Hohn, 1994).

In the eastern tropical Pacific, where this species has been best studied, there are two (possibly three) calving peaks: one in spring, (one possibly in summer), and one in fall (Perrin and Hohn, 1994). However, in the western Atlantic breeding times and locations are largely unknown.

**Occurrence in the Site A USWTR**— Pantropical spotted dolphins have been sighted along the Florida shelf and slope waters and offshore in Gulf Stream waters southeast of Cape Hatteras (Waring et al., 2008). In the Atlantic, this species is considered broadly sympatric with Atlantic spotted dolphins (Perrin and Hohn, 1994). The offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea. Based on sighting data and known habitat preferences, pantropical spotted dolphins may occur seaward of the shelf break throughout the Jacksonville OPAREA year-round. Pantropical spotted dolphins are expected to occur in waters seaward of the shelf break in the Site A USWTR.

**Spinner Dolphin – Site A**

- **General Description**—The spinner dolphin generally has a dark eye-to-flipper stripe and dark lips and beak tip (Jefferson et al., 1993). This species typically has a three-part color pattern (dark gray cape, light gray sides, and white belly). Adults can reach 2.4 m (7.8 ft) in length (Jefferson et al., 1993). Spinner dolphins feed primarily on small mesopelagic fish, squid, and sergestid shrimp (Perrin and Gilpatrick, 1994).

- **Status**—No abundance estimates are currently available for the western North Atlantic stock of spinner dolphins (Waring et al., 2008). Stock structure in the
western North Atlantic is unknown (Waring et al., 2008). The spinner dolphin is under the jurisdiction of NMFS.

- **Diving Behavior**—Spinner dolphins feed primarily on small mesopelagic fish, squid, and sergestid shrimp, and they dive to at least 200 to 300 m (656 to 984 ft) (Perrin and Gilpatrick, 1994). Foraging takes place primarily at night when the mesopelagic community migrates vertically towards the surface and also horizontally towards the shore at night (Benoit-Bird et al., 2001; Benoit-Bird and Au, 2004). Rather than foraging offshore for the entire night, spinner dolphins track the horizontal migration of their prey (Benoit-Bird and Au, 2003). This tracking of the prey allows spinner dolphins to maximize their foraging time while foraging on the prey at its highest densities (Benoit-Bird and Au, 2003; Benoit-Bird, 2004).

Spinner dolphins are well known for their propensity to leap high into the air and spin before landing in the water; the purpose of this behavior is unknown. Norris and Dohl (1980) also described several other types of aerial behavior, including several other leap types, backslaps, headsots, noseouts, tailslaps, and a behavior called “motorboating.” Undoubtedly, spinner dolphins are one of the most aerially active of all dolphin species.

- **Acoustics and Hearing**— Pulses, whistles, and clicks have been recorded from spinner dolphins. Pulses have a frequency range of 1 to 160 kHz, while whistles have been recorded between 1 to 25 kHz (Ketten, 1998; Lammers et al., 2003). Spinner dolphins consistently produce whistles with frequencies as high as 16.9 to 17.9 kHz with a maximum frequency for the fundamental component at 24.9 kHz (Bazúa-Durán and Au, 2002; Lammers et al., 2003). Clicks have a dominant frequency of 60 kHz (Ketten, 1998). The burst pulses are predominantly ultrasonic, often with little or no energy below 20 kHz (Lammers et al., 2003). Source levels between 195 and 222 dB re 1 μPa peak-to-peak have been recorded for spinner dolphin clicks (Schotten et al., 2004). There are no data available on the hearing of spinner dolphins.

- **Habitat**—Spinner dolphins occur in both oceanic and coastal environments. Most sightings of this species have been associated with inshore waters, islands, or banks (Perrin and Gilpatrick, 1994). Spinner dolphin distribution in the Gulf of Mexico and off the northeastern U.S. coast is primarily in offshore waters. Along the northeastern U.S. and Gulf of Mexico, they are distributed in waters with a bottom depth greater than 2,000 m (6,562 ft) (CETAP, 1982; Davis et al., 1998). Off the eastern U.S. coast, spinner dolphins were sighted within the Gulf Stream, which is consistent with the oceanic distribution and warm-water preference of this genus (Waring et al., 1992).
• **General Distribution**—Spinner dolphins are found in subtropical and tropical waters worldwide, with different geographical forms in various ocean basins. The range of this species extends to near 40° latitude (Jefferson et al., 1993). Distribution in the western North Atlantic is thought to extend from North Carolina south to Venezuela (Schmidly, 1981), including the Gulf of Mexico (Davis et al., 2002).

Breeding occurs across all season with calving peaks that may range from late spring to fall for different populations (Jefferson et al., 2008); however location of breeding areas is unknown.

**Occurrence in the Site A USWTR**—Spinner dolphins may occur seaward of the vicinity of the continental shelf break in the Jacksonville OPAREA based on known preference for deep, warm waters, and the distribution of the few confirmed records for this species in the area (DoN, 2008n). In the Site A USWTR, spinner dolphins are expected to occur near the shelf break and in deep waters seaward of the shelf break year-round.

**Clymene Dolphin – Site A**

• **General Description**—Due to similarity in appearance, Clymene dolphins are easily confused with spinner and short-beaked common dolphins (Fertl et al., 2003). The Clymene dolphin, however, is smaller and more robust, with a much shorter and stockier beak. The Clymene dolphin can reach 2 m (6.6 ft) in length and weights of 85 kg (187 lbs) (Jefferson et al., 1993). Clymene dolphins feed on small pelagic fish and squid (Perrin et al., 1981; Perrin and Mead, 1994; Fertl et al., 1997).

• **Status**—The population in the western North Atlantic is currently considered a separate stock for management purposes although there is not enough information to distinguish this stock from the Gulf of Mexico stock(s) (Waring et al., 2008). The best estimate of abundance for the western North Atlantic stock of Clymene dolphins is 6,086 individuals (Waring et al., 2008). The Clymene dolphin is under NMFS jurisdiction.

• **Diving Behavior**—There is no diving information available for this species.

• **Acoustics and Hearing**—The only data available for this species is a description of their whistles. Clymene dolphin whistle structure is similar to that of other stenellids, but it is generally higher in frequency (range of 6.3 to 19.2 kHz) (Mullin et al., 1994a).

There is no empirical data on the hearing ability of Clymene dolphins; however, the most sensitive hearing range for odontocetes generally includes high frequencies (Ketten, 1997).
Habitat—Clymene dolphins are a tropical to subtropical species, primarily sighted in deep waters well beyond the edge of the continental shelf (Fertl et al., 2003). Biogeographically, the Clymene dolphin is found in the warmer waters of the North Atlantic from the North Equatorial Current, the Gulf Stream, and the Canary Current (Fertl et al., 2003). In the western North Atlantic, Clymene dolphins were identified primarily in offshore waters east of Cape Hatteras over the continental slope and are likely to be strongly influenced by oceanographic features of the Gulf Stream (Mullin and Fulling, 2003).

General Distribution—In the western Atlantic Ocean, Clymene dolphins are distributed from New Jersey to Brazil, including the Gulf of Mexico and Caribbean Sea (Fertl et al., 2003; Moreno et al., 2005). Seasonality and location of Clymene dolphin breeding is unknown.

Occurrence in the Site A USWTR—Clymene dolphins have been found stranded along the Atlantic coast of Florida adjacent to the OPAREA and further south throughout the year (Caldwell and Caldwell, 1975; Perrin et al., 1981; Fertl et al., 2003). Based on confirmed sightings and the preference of this species for deep waters, Clymene dolphins are expected in waters seaward of the shelf break in the Jacksonville OPAREA throughout the year. Clymene dolphins are expected in waters seaward of the shelf break in the Site A USWTR.

Striped Dolphin – Site A

General Description—The striped dolphin is uniquely marked with black lateral stripes from eye to flipper and eye to anus. There is also a light gray spinal blaze originating above and behind the eye and narrowing below and behind the dorsal fin (Jefferson et al., 2008). This species reaches 2.6 m (8.5 ft) in length. Small, mid-water fishes (in particular, myctophids or lanternfish) and squids are the dominant prey (Perrin et al., 1994b; Ringelstein et al., 2006).

Status—The best estimate of striped dolphin abundance in the western North Atlantic is 94,462 individuals (Waring et al., 2008). The striped dolphin is under the jurisdiction of NMFS.

Diving Behavior—Striped dolphins often feed in pelagic or benthopelagic zones along the continental slope or just beyond it in oceanic waters. A majority of their prey possesses luminescent organs, suggesting that striped dolphins may be feeding at great depths, possibly diving to 200 to 700 m (656 to 2,297 ft) to reach potential prey (Archer II and Perrin, 1999). Striped dolphins may feed at night in order to take advantage of the deep scattering layer’s diurnal vertical movements.

Acoustics and Hearing—Striped dolphin whistles range from 6 to greater than 24 kHz, with dominant frequencies ranging from 8 to 12.5 kHz (Thomson and Richardson, 1995). A single striped dolphin’s hearing range, determined by using
standard psycho-acoustic techniques, was from 0.5 to 160 kHz with best sensitivity at 64 kHz (Kastelein et al., 2003).

- **Habitat**—Striped dolphins are usually found beyond the continental shelf, typically over the continental slope out to oceanic waters and are often associated with convergence zones and waters influenced by upwelling (Au and Perryman, 1985). This species also occurs in conjunction with the shelf edge in the northeastern U.S. (between Cape Hatteras and Georges Bank; Hain et al., 1985). Striped dolphins are known to associate with the Gulf Stream’s northern wall and warm-core ring features (Waring et al., 1992).

- **General Distribution**—Striped dolphins are distributed worldwide in cool-temperate to tropical zones. In the western North Atlantic, this species occurs from Nova Scotia southward to the Caribbean Sea, Gulf of Mexico, and Brazil (Baird et al., 1993; Jefferson et al., 2008). Off the northeastern U.S., striped dolphins are distributed along the continental shelf break from Cape Hatteras to the southern margin of Georges Bank, as well as offshore over the continental slope and continental rise in the mid-Atlantic region (CETAP, 1982).

Off Japan, where their biology has been best studied, there are two calving peaks: one in summer and one in winter (Perrin et al., 1994b). However, in the western Atlantic breeding times and locations are largely unknown.

**Occurrence in the Site A USWTR**—Based on sparse available data, striped dolphins may sporadically occur near and seaward of the shelf break throughout the Jacksonville OPAREA year-round. Striped dolphins may occur rarely in the vicinity of the shelf break within the Site A USWTR.

**Common Dolphin – Site A**

- **General Description**—Only the short-beaked common dolphin is expected to occur in the Action Area. The short-beaked common dolphin is a moderately-robust dolphin, with a moderate-length beak, and a tall, slightly falcate dorsal fin. Length ranges up to about 2.3 m (7.5 ft) (females) and 2.6 m (8.5 ft) (males); however, there is substantial geographic variation (Jefferson et al., 1993). Common dolphins feed on a wide variety of epipelagic and mesopelagic schooling fish and squid, such as the long-finned squid, Atlantic mackerel, herring, whiting, pilchard, and anchovy (Waring et al., 1990; Overholtz and Waring, 1991).

- **Status**—The best estimate of abundance for the Western North Atlantic *Delphinus* spp. stock is 120,743 individuals (Waring et al., 2008). There is no information available for western North Atlantic common dolphin stock structure (Waring et al., 2008). The common dolphin is under the jurisdiction of NMFS.
- **Diving Behavior**—Diel fluctuations in vocal activity of this species (more vocal activity during late evening and early morning) appear to be linked to feeding on the deep scattering layer as it rises (Goold, 2000). Foraging dives up to 200 m (656 ft) in depth have been recorded off southern California (Evans, 1994).

- **Acoustics and Hearing**—Recorded *Delphinus* spp. vocalizations include whistles, chirps, barks, and clicks (Ketten, 1998). Clicks range from 0.2 to 150 kHz with dominant frequencies between 23 and 67 kHz and estimated source levels of 170 dB re 1 µPa. Chirps and barks typically have a frequency range from less than 0.5 to 14 kHz, and whistles range in frequency from 2 to 18 kHz (DoN, 1976; Thomson and Richardson, 1995; Ketten, 1998; Oswald et al., 2003). Maximum source levels are approximately 180 dB re 1 µPa (DoN, 1976). This species’ hearing range extends from 10 to 150 kHz; sensitivity is greatest from 60 to 70 kHz (Popov and Klishin, 1998).

- **Habitat**—Common dolphins occupy a variety of habitats, including shallow continental shelf waters, waters along the continental shelf break, and continental slope and oceanic areas. Along the U.S. Atlantic coast, common dolphins typically occur in temperate waters on the continental shelf between the 100 and 200 m (328 and 656 ft) isobaths, but can occur in association with the Gulf Stream (CETAP, 1982; Selzer and Payne, 1988; Waring and Palka, 2002).

- **General Distribution**—Common dolphins occur from southern Norway to West Africa in the eastern Atlantic and from Newfoundland to Florida in the western Atlantic (Perrin, 2002a), although this species more commonly occurs in temperate, cooler waters in the northwestern Atlantic (Waring and Palka, 2002). This species is abundant within a broad band paralleling the continental slope from 35°N to the northeast peak of Georges Bank (Selzer and Payne, 1988). Short-beaked common dolphin sightings are known to occur primarily along the continental shelf break south of 40°N in spring and north of this latitude in fall. During fall, this species is particularly abundant along the northern edge of Georges Bank (CETAP, 1982) but less common south of Cape Hatteras (Waring et al., 2008).

Calving peaks differ between stocks, and have been reported in spring and autumn as well as in spring and summer (Jefferson et al., 1993). However, locations of breeding areas are unknown.

**Occurrence in the Site A USWTR**—Although the common dolphin is often found along the shelf-edge, there are sighting and bycatch records in shallower waters to the north, as well as sightings on the continental shelf in the JAX/CHASN OPAREA (DoN, 2008n). Based on the cool water temperature preferences of this species and available sighting data, there is likely a very low possibility of encountering common dolphins only during the winter, spring, and fall throughout the Jacksonville OPAREA (DoN, 2008n). Common dolphins may occur in the Site A...
USWTR during this time of year. While there are a number of historical stranding records for common dolphins during the summer, there have been no recent confirmed records for this species. Therefore, common dolphins are not expected to occur in the Site A USWTR during the summer.

**Fraser's Dolphin – Site A**

- **General Description**—The Fraser's dolphin reaches a maximum length of 2.7 m (8.9 ft) and is generally more robust than other small delphinids (Jefferson et al., 1993). They feed on mesopelagic fish, squid, and shrimp (Jefferson and Leatherwood, 1994; Perrin et al., 1994a).

- **Status**—No abundance estimate of Fraser’s dolphins in the western North Atlantic is available (Waring et al., 2008). Fraser’s dolphins are under the jurisdiction of NMFS.

- **Diving Behavior**—There is no information available on depths to which Fraser's dolphins may dive, but they are thought to be capable of deep diving.

**Acoustics and Hearing**—Fraser's dolphin whistles have been recorded having a frequency range of 7.6 to 13.4 kHz in the Gulf of Mexico (duration less than 0.5 s) (Leatherwood et al., 1993). There are no empirical hearing data available for this species.

- **Habitat**—The Fraser’s dolphin is an oceanic species, except in places where deepwater approaches a coastline (Dolar, 2002).

- **General Distribution**—Fraser's dolphins are found in subtropical and tropical waters around the world, typically between 30°N and 30°S (Jefferson et al., 1993). Few records are available from the Atlantic Ocean (Leatherwood et al., 1993; Watkins et al., 1994; Bolaños and Villarroel-Marín, 2003). Location of Fraser’s dolphin breeding is unknown, and available data do not support calving seasonality.

Occurrence in the Site A USWTR—Although there are no confirmed records of Fraser’s dolphins in the Jacksonville OPAREA, the most likely area of occurrence in the study area is in waters beyond the shelf break; distribution is assumed to be similar year-round. Fraser’s dolphins may occur seaward of the shelf break in the Site A USWTR.

**Risso’s Dolphin – Site A**

- **General Description**—Risso’s dolphins are moderately large, robust animals reaching at least 3.8 m (12.5 ft) in length (Jefferson et al., 1993). Cephalopods are their primary prey (Clarke, 1996).
**Status**—The best estimate of Risso’s dolphin abundance in the western North Atlantic is 20,479 individuals (Waring et al., 2008). Risso’s dolphins are under the jurisdiction of NMFS.

**Diving Behavior**—Individuals may remain submerged on dives for up to 30 min and dive as deep as 600 m (1,967 ft) (DiGiovanni et al., 2005).

**Acoustics and Hearing**—Risso’s dolphin vocalizations include broadband clicks, barks, buzzes, grunts, chirps, whistles, and combined whistle and burst-pulse sounds that range in frequency from 0.4 to 22 kHz and in duration from less than a second to several seconds (Corkeron and Van Parijs, 2001). The combined whistle and burst pulse sound (2 to 22 kHz, mean duration of 8 s) appears to be unique to Risso’s dolphin (Corkeron and Van Parijs, 2001). Risso’s dolphins also produce echolocation clicks (40 to 70 µs duration) with a dominant frequency range of 50 to 65 kHz and estimated source levels up to 222 dB re 1 µPa peak-to-peak (Thomson and Richardson, 1995; Philips et al., 2003; Madsen et al., 2004b).

Baseline research on the hearing ability of this species was conducted by Nachtigall et al. (1995) in a natural setting (included natural background noise) using behavioral methods on one older individual. This individual could hear frequencies ranging from 1.6 to 100 kHz and was most sensitive between 8 and 64 kHz. Recently, the auditory brainstem response technique has been used to measure hearing in a stranded infant (Nachtigall et al., 2005). This individual could hear frequencies ranging from 4 to 150 kHz, with best sensitivity at 90 kHz. This study demonstrated that this species can hear higher frequencies than previously reported.

**Habitat**—Several studies have noted that Risso’s dolphins are found offshore, along the continental slope, and over the continental shelf (CETAP, 1982; Green et al., 1992; Baumgartner, 1997; Davis et al., 1998; Mignucci-Giannoni, 1998; Kruse et al., 1999). Baumgartner (1997) hypothesized that the fidelity of Risso’s dolphins on the steeper portions of the upper continental slope in the Gulf of Mexico is most likely the result of cephalopod prey distribution in the same area.

**General Distribution**—Risso’s dolphins are distributed worldwide in cool-temperate to tropical waters from roughly 60°N to 60°S, where SSTs are generally greater than 10°C (50°F) (Kruse et al., 1999). In the western North Atlantic, this species is found from Newfoundland (Jefferson et al., 2008) southward to the Gulf of Mexico (Baumgartner, 1997; Jefferson and Schiro, 1997), throughout the Caribbean, and around the equator (van Bree, 1975; Ward et al., 2001).

Risso’s dolphins are distributed along the continental shelf break and slope waters from Cape Hatteras north to Georges Bank in spring, summer, and fall (CETAP,
1982; Payne et al., 1984). In the winter the range shifts to MAB and offshore waters (Payne et al., 1984). Risso’s dolphins may also occur in the waters from the mid-shelf to over the slope from Georges Bank south to, and including, the MAB, primarily in the summer and fall (Payne et al., 1984). Only rare occurrences are noted in the Gulf of Maine (Payne et al., 1984). In the North Atlantic, there appears to be a summer calving peak (Jefferson et al., 1993); however locations of breeding areas are unknown.

Occurrence in the Site A USWTR—Risso’s dolphins may occur seaward of just inshore of the shelf break in the Jacksonville OPAREA based on sighting data and the preference of this species for deep waters. Risso’s dolphins are expected in the vicinity of the shelf break and seaward year-round in the Site A USWTR.

**Melon-headed Whale – Site A**

- **General Description**—Melon-headed whales at sea closely resemble pygmy killer whales; both species have blunt heads with little or no beak. Melon-headed whales have pointed (versus rounded) flippers and a more triangular head shape than pygmy killer whales (Jefferson et al., 1993). Melon-headed whales reach a maximum length of 2.8 m (9.0 ft) (Jefferson et al., 1993). Melon-headed whales prey on squid, pelagic fish, and occasionally crustaceans. Most fish and squid prey are mesopelagic in waters up to 1,500 m (4,921 ft) deep, suggesting that feeding takes place deep in the water column (Jefferson and Barros, 1997).

- **Status**—There are no abundance estimates for melon-headed whales in the western North Atlantic (Waring et al., 2008). The melon-headed whale is under the jurisdiction of NMFS.

- **Diving Behavior**—Melon-headed whales prey on squids, pelagic fishes, and occasionally crustaceans. Most fish and squid prey are mesopelagic in waters up to 1,500 m (4,921 ft) deep, suggesting that feeding takes place deep in the water column (Jefferson and Barros, 1997). There is no information on specific diving depths for melon-headed whales.

- **Acoustics and Hearing**—The only published acoustic information for melon-headed whales is from the southeastern Caribbean (Watkins et al., 1997). Sounds recorded included whistles and click sequences. Recorded whistles have dominant frequencies between 8 and 12 kHz; higher-level whistles were estimated at no more than 155 dB re 1 μPa (Watkins et al., 1997). Clicks had dominant frequencies of 20 to 40 kHz; higher-level click bursts were judged to be about 165 dB re 1 μPa (Watkins et al., 1997). No empirical data on hearing ability for this species are available.
Habitat—Melon-headed whales are most often found in offshore waters. Sightings off Cape Hatteras, North Carolina are reported in waters greater than 2,500 m (8,200 ft) (Waring et al., 2008), and most in the Gulf of Mexico have been well beyond the edge of the continental shelf break (Mullin et al., 1994; Davis and Fargion, 1996a; Davis et al., 2000) and out over the abyssal plain (Waring et al., 2004). Nearshore sightings are generally from areas where deep, oceanic waters approach the coast (Perryman, 2002).

General Distribution—Melon-headed whales occur worldwide in subtropical and tropical waters. There are very few records for melon-headed whales in the North Atlantic (Ross and Leatherwood, 1994; Jefferson and Barros, 1997). Maryland is thought to represent the extreme of the northern distribution for this species in the northwest Atlantic (Perryman et al., 1994; Jefferson and Barros, 1997). Seasonality and location of melon-headed whale breeding are unknown.

Occurrence in the Site A USWTR—The melon-headed whale is an oceanic species. Strandings have been recorded along the Florida coastline (DoN, 2008n). Based on the low number of confirmed sightings of this species along the Atlantic U.S. coast and the melon-headed whale’s propensity for warmer and deeper waters, melon-headed whales may occur seaward of the shelf break in the Jacksonville OPAREA. Therefore, the melon-headed whale may occur rarely in the deep water portion of Site A USWTR.

Pygmy Killer Whale – Site A

General Description—The pygmy killer whale is often confused with the melon-headed whale and less often with the false killer whale. Flipper shape is the best distinguishing characteristic; pygmy killer whales have rounded flipper tips (Jefferson et al., 1993). Pygmy killer whales reach lengths of up to 2.6 m (8.5 ft) (Jefferson et al., 1993). Pygmy killer whales eat predominantly fishes and squids, and sometimes take large fish. They are known to occasionally attack other dolphins (Perryman and Foster, 1980; Ross and Leatherwood, 1994).

Status—There are no abundance estimates for pygmy killer whales in the western North Atlantic (Waring et al., 2008). Pygmy killer whales are under the jurisdiction of NMFS.

Diving Behavior—There is no diving information available for this species.

Acoustics and Hearing—The pygmy killer whale emits short duration, broadband signals similar to a large number of other delphinid species (Madsen et al., 2004b). Clicks produced by pygmy killer whales have centroid frequencies (i.e., the frequency at which the energy in the click is divided into two equal portions) between 70 and 85 kHz; there are bimodal peak frequencies between 45 and 117 kHz. The estimated source levels are between 197 and 223 dB re 1 μPa
peak-to-peak (Madsen et al., 2004b). These clicks possess characteristics of echolocation clicks (Madsen et al., 2004b). There are no empirical hearing data available for this species.

- **Habitat**—Pygmy killer whales generally occupy offshore habitats. In the northern Gulf of Mexico, this species is found primarily in deeper waters off the continental shelf (Davis and Fargion, 1996b; Davis et al., 2000) out to waters over the abyssal plain (Jefferson, 2006). Pygmy killer whales were sighted in waters deeper than 1,500 m (4,921 ft) off Cape Hatteras (Hansen et al., 1994).

**General Distribution**—Pygmy killer whales have a worldwide distribution in tropical and subtropical waters, generally not ranging north of 40°N or south of 35°S (Jefferson et al., 1993). There are few records of this species in the western North Atlantic (e.g., Caldwell and Caldwell, 1971; Ross and Leatherwood, 1994). Most records from outside the tropics are associated with unseasonable intrusions of warm water into higher latitudes (Ross and Leatherwood, 1994). Seasonality and location of pygmy killer whale breeding are unknown.

**Occurrence in the Site A USWTR**—A sighting of six individuals is confirmed in the vicinity of the Jacksonville OPAREA (Hansen et al., 1994). There are also a few strandings to the south (Caldwell and Caldwell, 1975; Schmidly, 1981). The pygmy killer whale is an oceanic species; occurrence is expected seaward of the shelf break year-round throughout the Jacksonville OPAREA. Pygmy killer whales may occur in the deep water portions of Site A USWTR.

### False Killer Whale – Site A

- **General Description**—The false killer whale has a long slender body, a rounded overhanging forehead, and little or no beak (Jefferson et al., 1993). Individuals reach maximum lengths of 6.1 m (20 ft) (Jefferson et al., 1993). The flippers have a characteristic hump on the S-shaped leading edge—this is perhaps the best characteristic for distinguishing this species from the other “blackfish” (an informal grouping that is often taken to include pygmy killer, melon-headed, and pilot whales; Jefferson et al., 1993). Deepwater cephalopods and fishes are their primary prey (Odell and McClune, 1999), but large pelagic species, such as dorado, have been taken. False killer whales are known to attack marine mammals such as other delphinids, (Perryman and Foster, 1980; Stacey and Baird, 1991), sperm whales (Palacios and Mate, 1996), and baleen whales (Hoyt, 1983; Jefferson, 2006).

- **Status**—There are no abundance estimates available for this species in the western North Atlantic (Waring et al., 2008). The false killer whale is under the jurisdiction of NMFS.
**Diving Behavior**—Few diving data are available, although individuals are documented to dive as deep as 500 m (1,640 ft) (Odell and McClune, 1999). Shallower dive depths (maximum of 53 m [174 ft]; averaging from 8 to 12 m [26 to 39 ft]) have been recorded for false killer whales in Hawaiian waters.

**Acoustics and Hearing**—Dominant frequencies of false killer whale whistles are from 4 to 9.5 kHz, and those of their echolocation clicks are from either 20 to 60 kHz or 100 to 130 kHz depending on ambient noise and target distance (Thomson and Richardson, 1995). Click source levels typically range from 200 to 228 dB re 1 μPa-m (Ketten, 1998). Recently, false killer whales recorded in the Indian Ocean produced echolocation clicks with dominant frequencies of about 40 kHz and estimated source levels of 201-225 dB re 1 μPa-m peak-to-peak (Madsen et al., 2004b).

False killer whales can hear frequencies ranging from approximately 2 to 115 kHz, with their best hearing sensitivity ranging from 16 to 64 kHz (Thomas et al., 1988). Additional behavioral audiograms of false killer whales support a narrower range of best hearing sensitivity between 16 and 24 kHz, with peak sensitivity at 20 kHz (Yuen et al., 2005). The same study also measured audiograms using the ABR technique, which came to similar results, with a range of best hearing sensitivity between 16 and 22.5 kHz, peaking at 22.5 kHz (Yuen et al., 2005). Behavioral audiograms in this study consistently resulted in lower thresholds than those obtained by ABR.

**Habitat**—False killer whales are primarily offshore animals, although they do come close to shore, particularly around oceanic islands (Baird, 2002). Inshore movements are occasionally associated with movements of prey and shoreward flooding of warm ocean currents (Stacey et al., 1994).

**General Distribution**—False killer whales are found in tropical and temperate waters, generally between 50°S and 50°N latitude with a few records north of 50°N in the Pacific and the Atlantic (Baird et al., 1989; Odell and McClune, 1999). Seasonality and location of false killer whale breeding are unknown.

Occurrence in the Site A USWTR—False killer whales occur in offshore, warm waters worldwide (Baird, 2002). The warm waters of the Gulf Stream are likely to influence their occurrence in the Action Area. Occurrence is expected seaward of the shelf break throughout the Jacksonville OPAREA year-round. The false killer whale is expected in waters of the Site A USWTR location that are seaward of the shelf break.

**Killer Whale — Site A**

**General Description**—Killer whales are probably the most instantly recognizable of all the cetaceans. The black-and-white color pattern of the killer whale is
striking, as is the tall, erect dorsal fin of the adult male (1.0 to 1.8 m [3.3 to 5.9 ft] in height). This is the largest member of the dolphin family. Females may reach 7.7 m (25 ft) in length and males 9.0 m (30 ft) (Dahlheim and Heyning, 1999). Killer whales feed on fish, cephalopods, seabirds, sea turtles, and other marine mammals (Katona et al., 1988; Jefferson et al., 1991; Jefferson et al., 2008).

- **Status**—There are no estimates of abundance for killer whales in the western North Atlantic (Waring et al., 2008). Most cetacean taxonomists agree that multiple killer whale species or subspecies occur worldwide (Krahn et al., 2004; Waples and Clapham, 2004). However, at this time, further information is not available, particularly for the western North Atlantic. The killer whale is under the jurisdiction of NMFS.

- **Diving Behavior**—The maximum recorded depth for a free-ranging killer whale dive was 264 m (866 ft) off British Columbia (Baird et al., 2005). A trained killer whale dove to 260 m (853 ft) (Dahlheim and Heyning, 1999). The longest duration of a recorded dive was 17 min (Dahlheim and Heyning, 1999); however, shallower dives were much more common for eight tagged individuals, where less than three percent of all dives examined were greater than 30 m (98 ft) in depth (Baird et al., 2003).

- **Acoustics and Hearing**—Killer whales produce a wide variety of clicks and whistles, but most of this species’ social sounds are pulsed, with frequencies ranging from 0.5 to 25 kHz (dominant frequency range: 1 to 6 kHz) (Thomson and Richardson, 1995). Echolocation clicks recorded for Canadian killer whales foraging on salmon have source levels ranging from 195 to 224 dB re 1 µPa peak-to-peak, a center frequency ranging from 45 to 80 kHz, and durations of 80 to 120 µs (Au et al., 2004). Echolocation clicks from Norwegian killer whales were considerably lower than the previously mentioned study and ranged from 173 to 202 dB re 1 µPa peak-to-peak. The clicks had a center frequency ranging from 22 to 49 kHz and durations of 31 to 203 µs (Simon et al., 2007). Source levels associated with social sounds have been calculated to range from 131 to 168 dB re 1 µPa and have been demonstrated to vary with vocalization type (e.g., whistles: average source level of 140.2 dB re 1 µPa, variable calls: average source level of 146.6 dB re 1 µPa, and stereotyped calls: average source level 152.6 dB re 1 µPa) (Veirs, 2004). Additionally, killer whales modify their vocalizations depending on social context or ecological function (i.e., short-range vocalizations [less than 10 km {5 NM} range] are typically associated with social and resting behaviors and long-range vocalizations [10 to 16 km {5 to 9 NM} range] are associated with travel and foraging) (Miller, 2006). Likewise, echolocation clicks are adapted to the type of fish prey (Simon et al., 2007).

Acoustic studies of resident killer whales in British Columbia have found that they possess dialects, which are highly stereotyped, repetitive discrete calls that
are group-specific and are shared by all group members (Ford, 2002). These dialects likely are used to maintain group identity and cohesion and may serve as indicators of relatedness that help in the avoidance of inbreeding between closely related whales (Ford, 1991; 2002). Dialects have been documented in northern Norway (Ford, 2002) and southern Alaskan killer whales populations (Yurk et al., 2002) and are likely occur in other regions as well. Both behavioral and ABR techniques indicate killer whales can hear a frequency range of 1 to 100 kHz and are most sensitive at 20 kHz, which is one of the lowest maximum-sensitivity frequency known among toothed whales (Szymanski et al., 1999).

- **Habitat**—Killer whales have the most ubiquitous distribution of any species of marine mammal, and they have been observed in virtually every marine habitat from the tropics to the poles and from shallow, inshore waters (and even rivers) to deep, oceanic regions (Dahlheim and Heyning, 1999). In coastal areas, killer whales often enter shallow bays, estuaries, and river mouths (Leatherwood et al., 1976). Based on a review of historical sighting and whaling records, killer whales in the northwestern Atlantic are found most often along the shelf break and further offshore (Katona et al., 1988; Mitchell and Reeves, 1988). Killer whales in the Hatteras-Fundy region probably respond to the migration and seasonal distribution patterns of prey species, such as bluefin tuna, herring, and squids (Katona et al., 1988; Gormley, 1990).

- **General Distribution**—Killer whales are found throughout all oceans and contiguous seas, from equatorial regions to polar pack ice zones of both hemispheres. In the western North Atlantic, killer whales are known from the polar pack ice, off of Baffin Island, and in Labrador Sound southward to Florida, the Bahamas, and the Gulf of Mexico (Dahlheim and Heyning, 1999), where they have been sighted year-round (Jefferson and Schiro, 1997; O’Sullivan and Mullin, 1997). A year-round killer whale population in the western North Atlantic may exist south of around 35°N (Katona et al., 1988).

In the Atlantic, calving takes place in late fall to mid-winter (Jefferson et al., 2008). However, the location of killer whale breeding in the North Atlantic is unknown.

**Occurrence in the Site A USWTR**—Killer whale sightings in the Jacksonville OPAREA and its vicinity have been recorded close to shore (DoN, 2008n). However, just to the north of the OPAREA, there are sightings in deep waters seaward of the continental shelf break. Occurrence in the Site A USWTR is expected seaward of the shoreline year-round based on available sighting data and the diverse habitat preferences of this species.
Long-finned and Short-finned Pilot Whales – Site A

- **General Description**—Pilot whales are among the largest dolphins, with long-finned pilot whales potentially reaching 5.7 m (19 ft) (females) and 6.7 m (22 ft) (males) in length. Short-finned pilot whales may reach 5.5 m (18 ft) (females) and 6.1 m (20 ft) (males) in length (Jefferson et al., 1993). The flippers of long-finned pilot whales are extremely long, sickle shaped, and slender, with pointed tips, and an angled leading edge that forms an “elbow”. Long-finned pilot whale flippers range from 18 to 27 percent of length. Short-finned pilot whales have flippers that are somewhat shorter than long-finned pilot whale at 16 to 22 percent of the total body length (Jefferson et al., 1993). Both pilot whale species feed primarily on squid but also take fish (Bernard and Reilly, 1999).

- **Status**—The best estimate of pilot whale abundance (combined short-finned and long-finned) in the western North Atlantic is 31,139 individuals (Waring et al., 2008). Pilot whales are under the jurisdiction of NMFS.

- **Diving Behavior**—Pilot whales are deep divers, staying submerged for up to 27 min and routinely diving to 600 to 800 m (1,967 to 2,625 ft) (Baird et al., 2003; Aguilar de Soto et al., 2005). Mate (1989) described movements of a satellite-tagged, rehabilitated long-finned pilot whale released off Cape Cod that traveled roughly 7,600 km (4,101 NM) during the three months of the tag’s operation. Daily movements of up to 234 km (126 NM) are documented. Deep diving occurred mainly at night, when prey within the deep scattering layer approached the surface. Tagged long-finned pilot whales in the Ligurian Sea were also found to make their deepest dives (up to 648 m [2,126 ft]) after dark (Baird et al., 2002). Two rehabilitated juvenile long-finned pilot whales released south of Montauk Point, New York made dives in excess of 26 min (Nawojchik et al., 2003). However, mean dive duration for a satellite tagged long-finned pilot whale in the Gulf of Maine ranged from 33 to 40 s, depending upon the month (July through September) (Mate et al., 2005).

- **Acoustics and Hearing**—Pilot whale sound production includes whistles and echolocation clicks. Short-finned pilot whale whistles and clicks have a dominant frequency range of 2 to 14 kHz and 30 to 60 kHz (Ketten, 1998; Richardson et al., 1995), respectively, at an estimated source level of 180 dB re 1 µPa-m peak (DoN, 1976; Ketten, 1998). Rendell and Gordan (1999) recorded vocalizations from a group of approximately 50 long-finned pilot whales in the Ligurian Sea in conjunction with the presence of military sonar signals, which facilitated an examination of this species short-term response to external sound sources. Whistle production was examined in relation to sonar pulses: frequency ranged from 4.1 to 8.7 kHz with a mean duration of .93 s, and showed varying contour patterns spectrographically (Rendell and Gordon, 1999). Preliminary results from these data suggest that certain whistles were associated with sonar signals;
however, the functional meaning of how these signals might be correlated to external sonar is unclear. Long-finned pilot whales have been shown to modify their whistle characteristics in the presence of sonar transmissions in the Ligurian sea (Rendell and Gorden, 1999).

There are no hearing data available for either pilot whale species. However, the most sensitive hearing range for odontocetes generally includes high frequencies (Ketten, 1997).

- **Habitat**—Pilot whales occur along the continental shelf break, in continental slope waters, and in areas of high-topographic relief (Olson and Reilly, 2002). They also occur close to shore at oceanic islands where the shelf is narrow and deeper waters are nearby (Mignucci-Giannoni, 1998; Gannier, 2000; Anderson, 2005). While pilot whales are typically distributed along the continental shelf break, they are also commonly sighted on the continental shelf and inshore of the 100 m (328 ft) isobath, as well as seaward of the 2,000 m (6,560 ft) isobath north of Cape Hatteras (CETAP, 1982; Payne and Heinemann, 1993). Long-finned pilot whale sightings extend south to near Cape Hatteras (Abend and Smith, 1999) along the continental slope. Waring et al. (1992) sighted pilot whales principally along the northern wall of the Gulf Stream and along the shelf break at thermal fronts. A few of these sightings were also made in the mid-portion of the Gulf Stream near Cape Hatteras (Abend and Smith, 1999).

- **General Distribution**—Long-finned pilot whales are distributed in subpolar to temperate North Atlantic waters offshore and in some coastal waters. The short-finned pilot whale usually does not range north of 50°N or south of 40°S (Jefferson et al., 1993); however, short-finned pilot whales have stranded as far north as Rhode Island. Strandings of long-finned pilot whales have been recorded as far south as South Carolina (Waring et al., 2008). Short-finned pilot whales are common south of Cape Hatteras (Caldwell and Golley, 1965; Irvine et al., 1979). Long-finned pilot whales appear to concentrate during winter along the continental shelf break primarily between Cape Hatteras and Georges Bank (Waring et al., 1990). The apparent ranges of the two pilot whale species overlap in shelf/shelf-edge and slope waters of the northeastern U.S. between 35°N and 38° to 39°N (New Jersey to Cape Hatteras, North Carolina) (Payne and Heinemann, 1993); however, incidents of strandings of short-finned pilot whales as far north as Block Island, RI and Nova Scotia indicate that area of overlap may be larger than previously thought (Waring et al., 2008).

Pilot whales concentrate along the continental shelf break from during late winter and early spring north of Cape Hatteras (CETAP, 1982; Payne and Heinemann, 1993). This corresponds to a general movement northward and onto the continental shelf from continental slope waters (Payne and Heinemann, 1993). Short-finned pilot whales seem to move from offshore to continental shelf break
waters and then northward to approximately 39°N, east of Delaware Bay during summer (Payne and Heinemann, 1993). Sightings coalesce into a patchy continuum and, by December, most short-finned pilot whales occur in the mid-Atlantic slope waters east of Cape Hatteras (Payne and Heinemann, 1993). Although pilot whales appear to be seasonally migratory, sightings indicate common year-round residents in some continental shelf areas, such as the southern margin of Georges Bank (CETAP, 1982; Abend and Smith, 1999).

The calving peak for long-finned pilot whales is from July to September in the northern hemisphere (Bernard and Reilly, 1999). Short-finned pilot whale calving peaks in the northern hemisphere are in the fall and winter for the majority of populations (Jefferson et al., 2008). Locations of breeding areas are unknown.

Occurrence in the Site A USWTR—The Jacksonville OPAREA is located well south of the suggested overlap area for the two pilot whale species (Payne and Heinemann, 1993). Thus, the sightings of unidentified pilot whales in the Jacksonville OPAREA are most likely of the short-finned pilot whale (DoN, 2008n). The majority of pilot whale strandings on beaches adjacent to the Jacksonville OPAREA are of the short-finned pilot whale (Moore, 1953; Layne, 1965; Irvine et al., 1979; Winn et al., 1979; Schmidly, 1981). Schmidly (1981) reported on two possible long-finned pilot whale skulls from localities south of latitude 34°N (St. Catherine’s Island, Georgia, was the southernmost record), but noted that their identification had not been verified. If those two records were proven to be of long-finned pilot whales, they would be the southernmost records for this species in the western North Atlantic. As deepwater species, pilot whales are expected seaward of the shelf break throughout the OPAREA year-round. They may also occur between the shore and shelf break which is supported by opportunistic sightings and bycatch records inshore of the shelf break to the north of the OPAREA (DoN, 2008n). Short-finned pilot whales are expected to occur throughout the Site A USWTR.

**Harbor Porpoise – Site A**

- **General Description**—Harbor porpoises are the smallest cetaceans in the North Atlantic with a maximum length of 2 m (7 ft) (Jefferson et al., 1993). The body is stocky, dark gray to black dorsally and white ventrally. There may be a dark stripe from the mouth to the flipper. The head is blunt, with no distinct beak. The flippers are small and pointed and the dorsal fin is short and triangular, located slightly behind the middle of the back.

- **Status**—There are four proposed harbor porpoise populations in the western North Atlantic: Gulf of Maine and Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland stocks (Gaskin, 1992). The best estimate of abundance for the Gulf of Maine and Bay of Fundy stock is 89,700 individuals (Waring et al., 2007).
Diving Behavior – Harbor porpoises make brief dives, generally lasting less than 5 min (Westgate et al., 1995). Tagged harbor porpoise individuals spend 3 to 7 percent of their time at the surface and 33 to 60 percent in the upper 2 m (7 ft) (Westgate et al., 1995; Read and Westgate, 1997). Average dive depths range from 14 to 41 m (46 to 135 ft) with a maximum known dive of 226 m (741 ft) and average dive durations ranging from 44 to 103 seconds (Westgate et al., 1995). Westgate and Read (1998) noted that dive records of tagged porpoises did not reflect the vertical migration of their prey; porpoises made deep dives during both day and night.

Acoustics and Hearing – Harbor porpoise vocalizations include clicks and pulses (Ketten, 1998), as well as whistle-like signals (Verboom and Kastelein, 1995). The dominant frequency range is 110 to 150 kHz, with source levels between 135 and 205 dB re 1 µPa (Ketten, 1998) (Villadsgaard, 2007). Echolocation signals include one or two low-frequency components in the 1.4 to 2.5 kHz range (Verboom and Kastelein, 1995).

The auditory-evoked potential method suggests that the harbor porpoise actually has two frequency ranges of best sensitivity. More recent psycho-acoustic studies found the range of best hearing to be 16 to 140 kHz, with a reduced sensitivity around 64 kHz (Kastelein et al., 2002). Maximum sensitivity occurs between 100 and 140 kHz (Kastelein et al., 2002).

Habitat – Most harbor porpoises are found on the continental shelf, with some sightings in continental slope and offshore waters (Westgate et al., 1998; Waring et al., 2007). However, pelagic drift net bycatches and movements of a satellite-tracked individual, which swam offshore into water over 1,800 m (5,900 ft) deep, indicate a potential offshore distribution (Read et al., 1996; Westgate et al., 1998).

General Distribution – Harbor porpoises occur in subpolar to cool-temperate waters in the North Atlantic and Pacific (Read, 1999). Off the northeastern United States, harbor porpoise distribution is strongly concentrated in the Gulf of Maine/Georges Bank region, with more scattered occurrences to the mid-Atlantic (CETAP, 1982; Northridge, 1996). From July through September, harbor porpoises are concentrated in the northern Gulf of Maine and southern Bay of Fundy, generally in waters less than 150 m (492 ft) deep (Palka, 1995), with a few sightings in the upper Bay of Fundy and on the northern edge of Georges Bank (Palka, 2000). From October through December, harbor porpoise densities are widely dispersed from New Jersey to Maine, with lower densities to the north and south of this region (NMFS, 2001). From January through March, intermediate densities of harbor porpoises can be found in waters off New Jersey to North Carolina, and lower densities are found in waters off New York to New Brunswick, Canada (NMFS, 2001). Stranding data indicate that the southern limit is northern Florida (Polacheck, 1995; Read, 1999).
Occurrence in the Site A USWTR—The harbor porpoise primarily occurs on the continental shelf in cool temperate to subpolar waters (Read, 1999) that are at higher latitudes than the Jacksonville OPAREA. Northern Florida appears to be the southern limit for this species. Harbor porpoises may occur rarely in the portion of Site A USWTR over the continental shelf.

Pinnipeds (Seals) – Site A

Blaylock et al. (1995) reported that four seal species are known to occur in the western North Atlantic ocean: harbor seal, gray seal, harp seal, and hooded seal. Although there are many species of seals found in the western North Atlantic, none normally range as far south as the Jacksonville OPAREA. However, both harbor seals and hooded seals have been infrequently sighted in the OPAREA (DoN, 2008n). The probability of encountering a seal at the Site A USWTR is very low and all seal species are considered extralimital in the Jacksonville OPAREA.

Sirenians (Manatees) – Site A

- **General Description**—The West Indian manatee is a rotund, slow-moving animal, which reaches a maximum length of 3.9 m (13 ft) (Jefferson et al., 1993). Two important aspects of the West Indian manatee’s physiology influence behavior: nutrition and metabolism. West Indian manatees have an unusually low metabolic rate and a high thermal conductance that lead to energetic stress in winter (Bossart et al., 2002). West Indian manatees are herbivores that feed opportunistically on a wide variety of submerged, floating, and emergent vegetation, but they also ingest invertebrates (USFWS, 2001; Courbis and Worthy, 2003; Reich and Worthy, 2006).

- **Status and Management**—West Indian manatee numbers are assessed by aerial surveys during the winter months when manatees are concentrated in warm-water refuges. Aerial surveys conducted in 2007 produced a preliminary abundance estimate 2,812 manatees in Florida (FMRI, 2007). Along Florida’s Gulf Coast, observers counted 1,400 West Indian manatees, while observers on the Atlantic coast counted 1,412 (FMRI, 2007).

The manatee is under the jurisdiction of the USFWS. In the most recent revision of the West Indian manatee recovery plan, it was concluded that, based upon movement patterns, West Indian manatees around Florida should be divided into four relatively discrete management units or subpopulations, each representing a significant portion of the species’ range (USFWS, 2001b). Manatees found along the Atlantic U.S. coast make up two subpopulations: the Atlantic Region and the Upper St. Johns River Region (USFWS, 2001). Manatees from the western coast of Florida make up the other two subpopulations: the Northwest Region and the Southwest Region (USFWS, 2001b).
In 1976, critical habitat was designated for the West Indian manatee in Florida (USFWS, 1976). There are two types of manatee protection areas in the state of Florida: manatee sanctuaries and manatee refuges (USFWS, 2001b, 2002a,b). Manatee sanctuaries are areas where all waterborne activities are prohibited while manatee refuges are areas where activities are permitted but certain waterborne activities may be regulated (USFWS, 2001b, 2002a,b).

- **Diving Behavior**—Manatees are shallow divers. The distribution of preferred seagrasses is mostly limited to areas of high light; therefore, manatees are fairly restricted to shallower nearshore waters (Wells et al., 1999). It is unlikely that manatees descend much deeper than 20 m (66 ft), and don’t usually remain submerged for longer than 2 to 3 min; however, when bottom resting, manatees have been known to stay submerged for up to 24 min (Wells et al., 1999).

- **Acoustics and Hearing**—West Indian manatees produce a variety of squeak-like sounds that have a typical frequency range of 0.6 to 12 kHz (dominant frequency range from 2 to 5 kHz), and last 0.25 to 0.5 s (Steel and Morris, 1982; Thomson and Richardson, 1995; Niezrecki et al., 2003). Recently, vocalizations below 0.1 kHz have also been recorded (Frisch and Frisch, 2003; Frisch, 2006). Overall, West Indian manatee vocalizations are considered relatively stereotypic, with little variation between isolated populations examined (i.e., between Florida and Belize populations; Nowacek et al., 2003). However, vocalizations have been newly shown to possess nonlinear dynamic characteristics (e.g., subharmonics or abrupt, unpredictable transitions between frequencies), which could aid in individual recognition and mother-calf communication (Mann et al., 2006). Average source levels for vocalizations have been calculated to range from 90 to 138 decibels referenced to 1 micropascal (dB re 1 μPa) (average: 100 to 112 dB re 1 μPa) (Nowacek et al., 2003; Phillips et al., 2004). Behavioral data on two animals indicate an underwater hearing range of approximately 0.4 to 46 kHz, with best sensitivity between 16 and 18 kHz (Gerstein et al., 1999), while earlier electrophysiological studies indicated best sensitivity from 1 to 1.5 kHz (Bullock et al., 1982).

- **Habitat**—Sightings of manatees are restricted to warm freshwater, estuarine, and extremely nearshore coastal waters. Manatees occur in very shallow waters of 2 to 4 m (7 to 13 ft) in depth generally close to shore (approximately less than 1 km [0.5 NM]) (Beck et al., 2004). Shallow seagrass beds close to deep channels are preferred feeding areas in coastal and riverine habitats (Lefebvre et al., 2000; USFWS, 2001b). West Indian manatees are frequently located in secluded canals, creeks, embayments, and lagoons near the mouths of coastal rivers and sloughs. These areas serve as locations of feeding, resting, mating, and calving (USFWS, 2001b). Estuarine and brackish waters with access to natural and artificial freshwater sources are typical West Indian manatee habitat (USFWS, 2001). When ambient water temperatures drop below about 20°C (69°F) in fall and
winter, migration to natural or anthropogenic warm-water sources takes place (Irvine, 1983). Effluents from sewage treatment plants are important sources of freshwater for West Indian manatees in the Caribbean Sea (Rathbun et al., 1985). Manatees are also observed drinking fresh water that flows out of the mouths of rivers (Lefebvre et al., 2001) and out of offered hoses at harbors (Fertl et al., 2005).

- **General Distribution**—The West Indian manatee occurs in warm, subtropical, and tropical waters of the western North Atlantic Ocean, from the southeastern U.S. to Central America, northern South America, and the West Indies (Lefebvre et al., 2001). West Indian manatees occur along both the Atlantic and Gulf coasts of Florida. West Indian manatees are sometimes reported in the Florida Keys; these sightings are typically in the upper Florida Keys, with some reports as far south as Key West (Moore, 1951b, 1951a; Beck, 2006). During winter months, the West Indian manatee population confines itself to inshore and inner shelf waters of the southern half of peninsular Florida and to springs and warm water outfalls (e.g., power plant cooling water outfalls) just beyond northeastern Florida. As water temperatures rise in spring, West Indian manatees disperse from winter aggregation areas.

Several patterns of seasonal movement are known along the Atlantic coast ranging from year-round residence to long-distance migration (Deutsch et al., 2003). Individuals may be highly consistent in seasonal movement patterns and show strong fidelity to warm and winter ranges, both within and across years (Deutsch et al., 2003).

**Occurrence in the Site A USWTR**—Manatees are expected in the freshwater, estuarine, and nearshore coastal waters in or near the cable range portion of Site A throughout the year. They are not expected in the offshore portions of the Jacksonville OPAREA.

**Designated Critical Habitat for the West Indian Manatee**

Critical habitat for the West Indian manatee was designated under 41 Federal Register (FR) 41914 in 1976 with an augmentation and correction in 1977 (USFWS, 1976). The habitat extends throughout the state of Florida and encompasses the St Johns River and Lake George in and near the vicinity of the Jacksonville OPAREA. The designated area includes all of the West Indian manatee’s known range at the time of designation (including waterways throughout about one-third to one-half of Florida) (Laist, 2002). This critical habitat designation has been infrequently used or referenced since it is broad in description, treats all waterways the same, and does not highlight any particular areas (Laist, 2002).
3.2.6.2 Site B

The Site B USWTR is located within the Charleston OPAREA (Figure 2-17). Following is a general description of the marine mammals that may occur in the Charleston OPAREA, if not already described in the previous section, and more specifically, in the vicinity of the Site B USWTR.

**Mysticetes**

Records for baleen whales in the Charleston OPAREA include the North Atlantic right whale, humpback whale, minke whale, Bryde’s whale, sei whale, fin whale, and blue whale.

**North Atlantic Right Whale – Site B**

The coastal waters of the Carolinas are suggested to be a migratory corridor for the Northern Atlantic right whale between their calving grounds off Georgia and Florida and their feeding grounds in the Gulf of Maine (Winn et al., 1986). Right whales may travel through the USWTR Site B during their migrations to and from calving grounds (DoN, 2008n). An examination of sighting records from all sources between 1950 and 1992 found that wintering Northern Atlantic right whales were observed widely along the coast from Cape Hatteras to Miami (Kraus et al., 1993). Sightings off the Carolinas were comprised of single individuals that appeared to be transients (Kraus et al., 1993). These observations are consistent with the hypothesis that the coastal waters of the Carolinas are part of a migratory corridor for the Northern Atlantic right whale (Winn et al., 1986). Knowlton et al. (2002) analyzed sightings data collected in the mid-Atlantic from northern Georgia to southern New England and found that the majority of Northern Atlantic right whale sightings occurred within approximately 56 km (30 NM) from shore. Until better information is available on the width of the Northern Atlantic right whale’s migratory corridor, it has been recommended that management considerations are needed for the coastal areas along the mid-Atlantic migratory corridor within 65 km from shore (35 NM) (Knowlton, 1997). North Atlantic right whales are expected in the Site B USWTR.

**Humpback Whale – Site B**

Humpback whales may occur throughout the Charleston OPAREA in fall, winter, and spring during migrations between calving grounds in the Caribbean and feeding grounds off the northeastern U.S. There is an increasing occurrence of humpback whale sightings and strandings during the winter (particularly January through April) along the U.S. Atlantic coast from Florida north to Virginia (Clapham et al., 1993; Swingle et al., 1993; Wiley et al., 1995; Laerm et al., 1997). Humpback whales are not expected in the Charleston OPAREA during summer since they should occur further north on their feeding grounds. Humpback whales may occur in the Site B USWTR during fall, winter, and spring while migrating to and from the Caribbean winter calving grounds, but are not expected to occur in the Site B USWTR during summer.
Minke Whale – Site B

Minke whales are more abundant in New England waters than the mid-Atlantic (Hamazaki, 2002; Waring et al., 2006). The southernmost sighting in recent NMFS shipboard surveys was of one individual offshore of the mouth of Chesapeake Bay, in waters with a bottom depth of 3,475 m (11,400 ft) (Mullin and Fulling, 2003). There appears to be a strong seasonal component to minke whale distribution (Horwood, 1990). Spring and summer are periods of relatively widespread minke whale occurrence off the northeastern U.S. and winter is the only season that the minke whale may occur in the Charleston OPAREA, primarily in shelf and deep waters (DoN, 2008n). Minke whales are expected in the Site B USWTR.

Bryde’s Whale – Site B

There is a general lack of knowledge of this species, particularly in the North Atlantic, although records support a tropical occurrence for the species (Mead, 1977). Although no confirmed sightings of Bryde’s whales have been recorded in the Charleston OPAREA, strandings have been recorded in this region throughout the year (DoN, 2008n). Bryde’s whales may occur throughout the OPAREA year-round (DoN, 2008n). Bryde’s whales may occur in the Site B USWTR.

Sei Whale – Site B

In the western North Atlantic Ocean, sei whales occur primarily from Georges Bank north to Davis Strait (northeast Canada, between Greenland and Baffin Island) (Perry et al., 1999). One sei whale stranding is recorded near Cape Island, South Carolina (Mead, 1977). Winter range of most rorquals (blue, fin, sei, and minke whales) is hypothesized to be in offshore waters (Kellogg, 1928; Gaskin, 1982). Based on their preference for deep, oceanic waters, sei whales may occur in waters seaward of the 2,000 m (6,562 ft) isobath throughout the Charleston OPAREA during fall, winter, and spring. Sei whale occurrence is probably the same during these seasons due to early or late migrating individuals. Sei whales are not expected to occur in the OPAREA during summer since they should be on feeding grounds around the eastern Scotian Shelf or Grand Banks. Sei whales may occur in the deep water portions of Site B USWTR during fall, winter, and spring.

Fin Whale – Site B

Fin whales are more commonly encountered north of Cape Hatteras (CETAP, 1982; Hain et al., 1992; Waring et al., 2007). Fin whales may occur in both continental shelf and offshore waters. Preliminary results from the Navy's deep water hydrophone arrays indicate a substantial deep-ocean component to fin whale distribution (Clark, 1995; Waring et al., 2007). There are only a few sighting records of this species here, likely due to incomplete survey coverage throughout the deep waters of the Charleston OPAREA as well as the fact that fin whales may be difficult to distinguish from some other rorqual species during survey efforts. Fin whales have only been sighted in the Charleston OPAREA in winter (DoN, 2008n); however, fin whales may occur in
the OPAREA in the fall, winter, and spring. In the summer fin whales are likely to be found on feeding grounds to the north and not in the Charleston OPAREA. Fin whales may occur in the Site B USWTR during fall, winter, and spring.

**Blue Whale – Site B**

Blue whales have never been sighted or reported to strand in the OPAREA. The absence of records of blue whales in the Charleston OPAREA does not necessarily indicate the absence of this species, but may reflect the fact blue whales are often difficult to distinguish from other large rorquals (DoN, 2008n). This whale is primarily a deep-water species. Winter range of most rorquals (blue, fin, sei, and minke whales) is hypothesized to be in offshore waters (Kellogg, 1928; Gaskin, 1982). Blue whales may occur in waters seaward of the 2,000 m (6,562 ft) isobath throughout the Charleston OPAREA during fall, winter, and spring. Blue whales are not expected to occur in the Charleston OPAREA during summer when they should occur farther north in their feeding ranges. Blue whales may occur in deep water portions of Site B USWTR during fall, winter, and spring.

**Odontocetes**

Following is a general discussion of the distribution of odontocete species that may be found in the Charleston OPAREA in the vicinity of Site B.

**Sperm Whale – Site B**

There are a number of historical stranding and whaling records of sperm whales within and adjacent to the Charleston OPAREA (Moore, 1953; Caldwell et al., 1971; Winn et al., 1979). In fact, sperm whales in the 1800s were frequently taken by whaling boats on the Charleston Grounds off Charleston, South Carolina during January (Townsend, 1935). Whaling records suggest an offshore distribution of sperm whales off the southeastern U.S., over the Blake Plateau, and into deep waters (Schmidly, 1981). Occurrence of sperm whales in the Charleston OPAREA may be underestimated due to the sparse survey effort in offshore waters of this region, particularly during the winter when Northern Atlantic right whale survey effort is concentrated in nearshore waters where sperm whales are not generally found (DoN, 2008n). Sperm whales may occur in the Charleston OPAREA from the vicinity of the continental shelf break continuing beyond the eastern boundary of the OPAREA throughout the year (DoN, 2008n). Sperm whales are expected seaward of the shelf break in the Site B USWTR.
Pygmy and Dwarf Sperm Whales – Site B

In the North Atlantic, pygmy and dwarf sperm whales (*Kogia breviceps* and *K. sima*, respectively) are shelf-edge species occurring in warm-temperate to tropical waters (DoN, 2002d). *Kogia* generally occur along the continental shelf break and over the continental slope (e.g., Baumgartner et al., 2001; McAlpine, 2002). There are very few sighting records of *Kogia* in the Charleston OPAREA which is likely due to incomplete survey coverage throughout most of the deep waters of this region (especially during winter and fall), as well as their avoidance reactions towards ships (DoN, 2008n). Occurrence of *Kogia* in the vicinity of the Site B USWTR is recognized based on the large number of strandings recorded throughout the year (DoN, 2008n). *Kogia* may occur seaward of the shelf break throughout the Charleston OPAREA and the Site B USWTR year-round.

Beaked Whales – Site B

Beaked whales are deep water species. Based on the cryptic behavior and similarity in appearance of these species, it is often difficult to identify beaked whales to the species level. Cuvier’s, Gervais’, and Blainville’s beaked whales are the only beaked whale species expected to occur regularly in the Charleston OPAREA, with possible sightings of True’s and Sowerby’s beaked whales (DoN, 2008n). Of note is a mass stranding of four Blainville’s beaked whales in North Carolina (unspecified exact location) that occurred subsequent to Hurricane Bonnie in 1998 (Norman and Mead, 2001). There are few sighting records of beaked whales in the OPAREA, which is likely due to incomplete survey coverage throughout most of the deep waters of the OPAREA. Beaked whales may occur in the area from the vicinity of the continental shelf break to seaward of the eastern boundary of the Charleston OPAREA. Beaked whales are expected in the vicinity of the shelf break and seaward in the Site B USWTR.

Rough-toothed Dolphin – Site B

Four sightings in the JAX/CHASN OPAREA and a few strandings inshore of the OPAREA boundary confirm the presence of this species here throughout the year (DoN, 2008n). Based on the sighting records and the known preference of this species for deep waters, rough-toothed dolphin may occur seaward of the shelf break year-round on only a sporadic basis. The rough-toothed dolphin is expected seaward of the shelf break in Site B USWTR.

Bottlenose Dolphin – Site B

Bottlenose dolphins are abundant in continental shelf and inner slope waters throughout the western North Atlantic (CETAP, 1982; Kenney, 1990; Waring et al., 2007). The greatest concentrations of offshore animals are along the continental shelf break and between the 200 and 2,000 m isobaths (656 to 6,562 ft) (Kenney, 1990; Waring et al., 2007). However, the range of offshore bottlenose dolphins may actually extend into deeper waters (Wells et al., 1999). The bottlenose dolphin may occur in Site B USWTR as well as throughout the Charleston OPAREA year-round.
Atlantic Spotted Dolphin – Site B

Spotted dolphins may occur from the coastline to seaward of the eastern boundary of the Charleston OPAREA throughout the year. Atlantic spotted dolphins may occur in both continental shelf and offshore waters (Perrin et al., 1994a). The offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea. Therefore, the low number of sightings of pantropical spotted dolphins in offshore waters of the OPAREA may be more of a reflection of survey observers not distinguishing between the two species (DoN, 2008n). Atlantic spotted dolphins may occur in continental shelf and offshore waters throughout the Charleston OPAREA (DoN, 2008n). The Atlantic spotted dolphin is expected throughout Site B USWTR.

Pantropical Spotted Dolphin – Site B

The pantropical spotted dolphin is a deep water species (Jefferson et al., 1993). Pantropical spotted dolphins have been sighted along the Florida shelf and slope waters and offshore in Gulf Stream waters southeast of Cape Hatteras (Waring et al., 2007). In the Atlantic, this species is considered broadly sympatric with Atlantic spotted dolphins (Perrin and Hohn, 1994). The offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea. Therefore, the low number of sightings of pantropical spotted dolphins in offshore waters of the Charleston OPAREA may be more of a reflection of survey observers not distinguishing between the two species (DoN, 2008n). Pantropical spotted dolphins may occur seaward of the shelf break throughout the Charleston OPAREA (DoN, 2008n). Pantropical spotted dolphins are expected in the areas seaward of the shelf break within the Site B USWTR.

Spinner Dolphin – Site B

Spinner dolphin sighting, stranding, and bycatch records are documented in or near the OPAREA throughout much of the year (DoN, 2008n). Spinner dolphins may occur from the shelf break to eastward of the OPAREA boundary based on the spinner dolphin’s preference for deep, warm waters (DoN, 2008n). No seasonal differences in occurrence are anticipated. Spinner dolphins are expected seaward of the shelf break in Site B USWTR.

Clymene Dolphin – Site B

Clymene dolphins have been found stranded along the Atlantic coast of Florida adjacent to the Charleston OPAREA and further south throughout the year (Caldwell and Caldwell, 1975; Perrin et al., 1981; Fertl et al., 2003). The summer sighting in continental shelf waters was recorded during aerial surveys and may be a misidentification since Clymene dolphins are not typically sighted in such shallow waters. Based on confirmed sightings and the preference of this species for deep waters, Clymene dolphins may occur in waters seaward of the shelf break throughout the Charleston OPAREA (DoN, 2008n). The Clymene dolphin is expected seaward of the shelf break in the Site B USWTR.
**Stripped Dolphin – Site B**

The striped dolphin is a deep water species that is generally distributed north of Cape Hatteras (CETAP, 1982). In the JAX/CHASN OPAREA, there are only two sightings of the striped dolphin (DoN, 2008n). The paucity of sighting data for striped dolphins in this area is likely due to incomplete survey coverage throughout most of the deep waters of the OPAREA, as well as this species’ preference for more temperate waters further north (Waring and Palka, 2002). Several strandings are recorded inshore of the OPAREA boundaries during all seasons and striped dolphins may occur in the Charleston OPAREA year-round (DoN, 2008n). The striped dolphin is expected near and seaward of the shelf break in Site B USWTR.

**Common Dolphin – Site B**

Common dolphins occur along the shelf break from Cape Hatteras to Nova Scotia year-round (CETAP, 1982). This species is less common south of Cape Hatteras (Waring et al., 2007); occurrence south of Cape Hatteras is considered questionable (Kenney, 2007). Although the common dolphin is often found along the shelf-edge, there are sighting and bycatch records in shallower waters to the north, as well as sightings on the continental shelf in the JAX/CHASN OPAREA (DoN, 2008n). Based on the cool water temperature preferences of this species and available sighting data, there is likely a very low possibility of encountering common dolphins only during the winter, spring, and fall throughout the Charleston OPAREA (DoN, 2008n). Common dolphins may occur in the Site B USWTR during this time of year. While there are a number of historical stranding records for common dolphins during the summer, there have been no recent confirmed records for this species. Therefore, common dolphins are not expected to occur in the Site B USWTR during the summer.

**Fraser’s Dolphin – Site B**

Fraser’s dolphin is a deep-water species that prefers warm waters. While there are no confirmed records of Fraser’s dolphin in the Charleston OPAREA, there is one confirmed sighting farther north in deep waters (>3,000 m [9,843 ft] in depth) offshore of Cape Hatteras (NMFS-SEFSC, 1999). Fraser’s dolphins may occur seaward of the shelf break throughout the Charleston OPAREA year-round. Fraser’s dolphin may occur seaward of the shelf break in Site B USWTR.

**Risso’s Dolphin – Site B**

Globally, Risso’s dolphin is most commonly found in areas with steep bottom topography, such as the area seaward of the continental shelf break, and is often sighted in association with Gulf Stream warm-core rings which are areas of enhanced productivity. Risso’s dolphin may occur year-round along the path of the Gulf Stream and including steep portions of the continental slope in the in the Charleston OPAREA and along the shelf break and extending seaward over the continental slope throughout the area, with seasonal variations (DoN, 2008n). Risso’s dolphins are expected in the vicinity of the shelf break and seaward within the Site B USWTR.
Melon-headed Whale – Site B

Melon-headed and pygmy killer whales can be difficult to distinguish from one another, and on many occasions, only a determination of “pygmy killer whale/melon-headed whale” can be made. The melon-headed whale is an oceanic species; which may occur seaward of the shelf break year-round (DoN, 2008n). Melon-headed whales may occur in the deep water portions of Site B USWTR.

Pygmy Killer Whale – Site B

Records of pygmy killer whales in this region include several strandings inshore of the JAX/CHASN OPAREA and two sightings in offshore waters of the OPAREA (DoN, 2008n). The pygmy killer whale is an oceanic species; which may occur seaward of the shelf break year-round. Pygmy killer whales may occur seaward of the shelf break in Site B USWTR.

False Killer Whale – Site B

False killer whales occur in offshore, warm waters worldwide (Baird, 2002). A small number of sightings are recorded in offshore waters of the OPAREA (DoN, 2008n). Strandings are also recorded in this region. False killer whales may occur in the Charleston OPAREA and are expected seaward of the shelf break throughout the year. False killer whales may occur in the deep water portions of Site B USWTR.

Killer Whale – Site B

A small number of killer whale sightings are recorded in both shallow and deep waters of the JAX/CHASN OPAREA and vicinity (DoN, 2008n). Killer whales may occur throughout the OPAREA year-round based on sighting data and the diverse habitat preferences of this species. Killer whales are expected throughout Site B USWTR.

Long-finned and Short-finned Pilot Whales – Site B

Identification of pilot whales to species is difficult at sea, and identification is often made to the generic level only. The Charleston OPAREA is located south of the suggested region of overlap between both pilot whale species (Payne and Heinemann, 1993). Thus, sightings of unidentified pilot whales in the OPAREA are most likely of short-finned pilot whales which are more common south of Cape Hatteras. The majority of pilot whale strandings on beaches inshore of the OPAREA are of the short-finned pilot whale (Moore, 1953; Layne, 1965; Irvine et al., 1979; Winn et al., 1979; Schmidly, 1981). Short-finned pilot whales may occur throughout the Charleston OPAREA during most of the year (DoN, 2008n). Short-finned pilot whales are expected in the Site B USWTR.
Harbor Porpoise – Site B

The harbor porpoise primarily occurs on the continental shelf, in cool temperate to subpolar waters (Read, 1999), that are at higher latitudes than the Charleston OPAREA. Occurrences of harbor porpoises in the mid-Atlantic are scattered (CETAP, 1982; Northridge, 1996). Stranding data indicate that the southern limit is northern Florida (Polacheck, 1995; Read, 1999) and are unlikely to occur in the Charleston OPAREA in spring, summer, or fall (DoN, 2008n). Harbor porpoises may occur rarely in the Site B USWTR.

Pinnipeds (Seals) – Site B

Vagrant harbor seals are occasionally found as far south as the Carolinas and as far south as Daytona Beach, Florida (Caldwell and Caldwell, 1969). Winn et al. (1979) suggested that harbor seals found in this area are likely young individuals that disperse from the north during the winter months. Sightings and strandings of harbor seals have been documented throughout the year in South Carolina (Caldwell, 1961; Caldwell and Golley, 1965; McFee, 2006).

Several records of hooded seals have been reported in North Carolina, Georgia, and Florida (Goodwin, 1954; Mignucci-Giannoni and Odell, 2001; Harry et al., 2005). It is possible for vagrant hooded seals to be found near the Charleston OPAREA throughout the year.

Despite records of seal species in and near the OPAREA, all pinniped species are considered extralimital in the Charleston OPAREA and the Site B USWTR.

Sirenians (Manatees) – Site B

West Indian manatees occur in warm, subtropical, and tropical waters of the western North Atlantic from the southeastern U.S. to Central America, northern South America, and the West Indies, primarily in freshwater systems, estuaries, and shallow, nearshore, coastal waters (Lefebvre et al., 2001). Manatees are frequently reported in the coastal rivers of Georgia and South Carolina during warmer months (Zoodsma, 1991; Lefebvre et al., 2001). Sightings on the Atlantic coast drop off markedly north of South Carolina (Lefebvre et al., 2001). Manatees may occur in Site B USWTR.

3.2.6.3 Site C

As stated previously, the Site C is located within the Cherry Point OPAREA (Figure 2-21). Following is a general description of the distribution of the marine mammals that may occur in the Cherry Point OPAREA and more specifically in the vicinity of the Site C USWTR.
Mysticetes

There are records for baleen whale species in North Carolina waters as follows: North Atlantic right whale, humpback whale, minke whale, Bryde’s whale, sei whale, and fin whale. There are no records of blue whales in North Carolina waters, although their distribution and range may include North Carolina (NMFS, 1998b; Waring et al., 1997, 1999).

North Atlantic Right Whale – Site C

The coastal waters of the Carolinas are part of a migratory corridor for the right whale (Winn et al., 1986; Knowlton et al., 2002). There have been opportunistic sightings of right whales in deep waters of the Cherry Point OPAREA (DoN, 2008l). There is a lack of survey effort for right whales in offshore waters (and the Cherry Point OPAREA specifically).

Knowlton et al. (2002) reviewed right whale sightings and survey efforts for the mid-Atlantic and reported that 94 percent of the right whale sightings were within 55 km (30 NM) of the coast, that well over half the sightings (64 percent) were within 18.5 km (10 NM) of the coast, and that 80 percent of all tagged animal sightings occurred within 55 km (30 NM) of land.

North Atlantic right whale occurrence in the Cherry Point OPAREA is between October through April, with peak sightings in February and March (Knowlton et al., 2002). During the summer months, right whales should occur farther north on their feeding grounds; however, there is one reported sighting in the summer in the Cherry Point OPAREA (DoN, 2008l). The North Atlantic right whale is expected to occur in the vicinity of the Site C USWTR.

Humpback Whale – Site C

Humpback whales may occur on the continental shelf and in deep waters of the Cherry Point OPAREA in fall, winter, and spring during migrations between calving grounds in the Caribbean and feeding grounds off the northeastern U.S. (DoN, 2008l). There is an increasing occurrence of humpback whale sightings and strandings during the winter (particularly January through April) along the U.S. Atlantic coast from Florida north to Virginia (Clapham et al., 1993; Swingle et al., 1993; Wiley et al., 1995; Laerm et al., 1997). Sightings of humpback whales migrating through this area are likely not well-represented here due to the lack of survey effort in offshore waters of the Cherry Point OPAREA. Humpback whales are not expected to occur in the Cherry Point OPAREA during summer when they should occur farther north on their feeding grounds (DoN, 2008l). Humpback whales may occur in the Site C USWTR during fall, winter, and spring.

Minke Whale – Site C

Minke whales are only occasionally found, and on a widely-scattered basis, in the mid-Atlantic area (CETAP, 1982). There is a more common occurrence further north of the Cherry Point OPAREA (Hamazaki, 2002; Waring et al., 2006). The dynamics of the Gulf Stream in the Cape Hatteras region probably play a role in the zoogeography of minke whales throughout much of
the year. There are no records of minke whales within the OPAREA; however, scattered sighting and stranding records just outside of the OPAREA boundaries indicate the presence of this species (DoN, 2008). The lack of sighting data is likely due to incomplete survey coverage in the OPAREA, especially during spring and fall. Minke whales may occur in the Cherry Point OPAREA in the spring, winter, and fall. During the summer, minke whales are expected to occur at higher latitudes on their feeding grounds; however they may occur in the OPAREA, particularly the northern portion. Minke whales are expected to occur in the Site C USWTR.

**Bryde’s Whale – Site C**

There is a general lack of knowledge of Bryde’s whale, particularly in the North Atlantic, although records support a tropical occurrence for the species (Mead, 1977). An extralimital Bryde’s whale stranding is recorded from the winter of 1927 well within Chesapeake Bay (Mead, 1977). Bryde’s whale has been known to strand farther south on the coasts of Georgia and eastern Florida (Schmidly, 1981). Although a tropical species, Bryde’s whales may occur within the Cherry Point OPAREA and the Site C USWTR.

**Sei Whale – Site C**

No sei whale records are documented for the Cherry Point OPAREA, but sightings are recorded further north (DoN, 2008). The winter range of most rorquals (blue, fin, sei, and minke whales) is hypothesized to be in offshore waters (Kellogg, 1928; Gaskin, 1982). Acoustic data support the hypothesis of an offshore wintering habitat (Clark, 1995). Based on their preference for deep, oceanic waters, sei whales may occur in waters seaward of the 2,000 m (6,562 ft) isobath throughout the Cherry Point OPAREA during fall, winter, and spring. Sei whale occurrence is probably the same during these seasons due to individual whales migrating earlier or later in the year (and appearing in a different season). Sei whales are not expected to occur in the Cherry Point OPAREA during summer, since they should be on feeding grounds around the eastern Scotian Shelf or Grand Banks. Sei whales are expected in the deep water portions of Site C USWTR during fall, winter, and spring.

**Fin Whale – Site C**

Fin whales are more commonly encountered north of Cape Hatteras (CETAP, 1982; Hain et al., 1992; Waring et al., 2007). The dynamics of the Gulf Stream in the Cape Hatteras region probably play a role in the zoogeography of fin whales throughout much of the year. Fin whales may occur in both continental shelf and offshore waters. Preliminary results from the Navy's deepwater hydrophone arrays indicate a substantial deep-ocean component to fin whale distribution (Clark, 1995; Waring et al., 2007). There is only one sighting record of this species in the Cherry Point OPAREA. This is likely due to incomplete survey coverage throughout the deep waters of the OPAREA, as well as the fact that fin whales may be difficult to distinguish from some other rorqual species during survey efforts. During winter, fin whales may occur in the Cherry Point OPAREA. During spring and fall, fin whales may occur just north of the OPAREA, and could overlap the northern portion of the Cherry Point OPAREA (DoN, 2008).
In the summer months, fin whales are expected to be farther north on feeding grounds and not likely to occur in the Cherry Point OPAREA (DoN, 2008l). Fin whales may occur in the Site C USWTR during fall, winter, and spring.

**Blue Whale – Site C**

The lack of blue whale records in the OPAREA may result from the fact that blue whales are often difficult to distinguish from other rorquals. The blue whale is primarily a deepwater species. Winter range of most rorquals (blue, fin, sei, and minke whales) is hypothesized to be in offshore waters (Kellogg, 1928; Gaskin, 1982). Acoustic data support the hypothesis of an offshore wintering habitat (Clark, 1995). Blue whales may occur in waters seaward of the 2,000 m (6,562 ft) isobath throughout the Cherry Point OPAREA during fall, winter, and spring (DoN, 2008l). Blue whales are not expected to occur in the Cherry Point OPAREA during summer when they should occur farther north in their feeding ranges (DoN, 2008l). Blue whales may occur in the deep water portions of Site C USWTR during fall, winter, and spring.

**Odontocetes**

Following is a general discussion of the distribution of odontocete species that may occur in the Cherry Point OPAREA.

**Sperm Whale – Site C**

Worldwide, sperm whales exhibit a strong affinity for deep waters beyond the continental shelf break (Rice, 1989). The recorded observations of sperm whales in the Cherry Point OPAREA and vicinity support this trend, with sightings consistently recorded in waters beyond the shelf break (DoN, 2008l). In winter, sightings are clustered in slope and deep waters in the northern end of the Cherry Point OPAREA (DoN, 2008l). The paucity of sighting data for the rest of the OPAREA is most likely due to incomplete survey effort in offshore waters. Sperm whales were never sighted during baseline surveys at the Site C USWTR location (13 aerial surveys totaling over 7,000 km [4,350 mi] of trackline) conducted from 1998 to 1999 by the University of North Carolina – Wilmington (UNCW) (DoN, 1999a). During the summer 1998 Southeast Fisheries Science Center (SEFSC)/NMFS surveys (Mullin, 1999), most sightings were north of Cape Hatteras, with only two far offshore in slope waters east of Cape Hatteras. During the summer 1999 SEFSC/NMFS surveys (Roden, 2000), two sightings were reported along the shelf edge east of Cape Lookout. Sperm whales may occur in the Site C USWTR year-round.

**Pygmy and Dwarf Sperm Whales – Site C**

Pygmy and dwarf sperm whales (*Kogia*) generally occur along the continental shelf break and over the continental slope (e.g., Baumgartner et al., 2001; McAlpine, 2002). There are very few sighting records of *Kogia* in the Cherry Point OPAREA which is likely due to incomplete survey coverage throughout most of the deep waters of this region (especially during spring and fall) as well as their avoidance reactions towards ships (DoN, 2008l). However, several strandings are
recorded inshore of the OPAREA boundaries during all seasons and support the likelihood of *Kogia* occurrence in waters off North Carolina (Hohn et al., 2006; MMC, 2006).

*Kogia* may occur over the shelf break and seaward throughout the year. Pygmy and dwarf sperm whales are expected to occur in Site C USWTR.

### Beaked Whales – Site C

Based upon available data, six beaked whales are known to occur in the Cherry Point OPAREA: Cuvier's beaked whales, northern bottlenose whales, and four members of the genus *Mesoplodon* (True’s, Gervais’, Blainville's, and Sowerby's beaked whales). Cuvier’s, True’s, Gervais’, and Blainville’s beaked whales are the only beaked whale species expected to occur regularly in the OPAREA, with possible sightings of Sowerby’s beaked whales and one extralimital record of a northern bottlenose whale inshore of the Cherry Point OPAREA (DoN, 2008l).

With respect to the Cherry Point OPAREA, the continental slope is relatively wide south of Hatteras, and at-sea sightings of beaked whales are few, although sighting effort has been limited in this area. Sightings of all beaked whale species recorded in waters along the U.S. Atlantic coast indicate a pattern of distribution similar to that described by Pitman (2002). Nearly all sightings were made in very deep waters (>200m [660 ft]) near the continental shelf edge, within the Gulf Stream or Gulf Stream features such as warm core eddies and the north wall (CETAP, 1982; Waring et al., 1992; Tove, 1995; Waring et al., 2001a; Waring et al, 2002). There is one extralimital stranding record of a northern bottlenose whale (also in the beaked whale family) inshore of the Cherry Point OPAREA. Of note is a mass stranding of four Blainville’s beaked whales in North Carolina (unspecified exact location) that occurred subsequent to Hurricane Bonnie in 1998 (Norman and Mead, 2001). There are very few sighting records of beaked whales in the Cherry Point OPAREA which is likely due to incomplete survey coverage throughout most of the deep waters of the OPAREA (DoN, 2008l), where beaked whales are expected to occur. Beaked whales have been observed in the area around Cape Hatteras by a charter boat fisherman (Patterson, 2008). The location where these observations have been made averages 200 km (107 NM) to the north of Site C; the oceanography and ecology of this area is different than Site C due to the influence of the Hatteras Front. This area has been identified as an area with relatively high diversity and abundance of marine species. Beaked whales may occur seaward of the shelf break throughout the year. Beaked whales are expected to occur seaward of the shelf break in Site C USWTR.

### Rough-toothed Dolphin – Site C

Rough-toothed dolphins may occur seaward of the shelf break. During the winter, the rough-toothed dolphin’s occurrence is expected in warmer waters, so the occurrence in the Cherry Point OPAREA follows the western edge of the standard deviation of the Gulf Stream (DoN, 2008l). A few strandings and one sighting of the rough-toothed dolphin have been recorded near the Cherry Point OPAREA (DoN, 2008l). The rough-toothed dolphin is expected to occur seaward of the shelf break in Site C USWTR.
Bottlenose Dolphin – Site C

Bottlenose dolphins are abundant in continental shelf and inner slope waters throughout the western North Atlantic (CETAP, 1982; Kenney, 1990; Waring et al., 2007). The greatest concentrations of offshore animals are along the continental shelf break and between the 200 and 2,000 m isobaths (656 to 6,562 ft) (Kenney, 1990; Waring et al., 2007). However, the range of offshore bottlenose dolphins may actually extend into deeper waters (Wells et al., 1999), possibly even over the Hatteras Abyssal Plain just southeast of the Cherry Point OPAREA. The nearshore waters of the Outer Banks serve as winter habitat for coastal bottlenose dolphins (Read et al., 2003). Cape Hatteras represents important habitat for bottlenose dolphins, particularly in winter, as evidenced from concentrations of bottlenose dolphins during recent aerial surveys (Torres et al., 2005).

In North Carolina, there is significant overlap between distributions of coastal and offshore dolphins during the summer. North of Cape Lookout, there is a separation of the two stocks by bottom depth; the coastal form occurs in nearshore waters (<20 m [<66 ft] deep) while the offshore form is in deeper waters (>40 m [>131 ft] deep) (Garrison and Hoggard, 2003); however, south of Cape Lookout to northern Florida, there is significant spatial overlap between the two stocks. In this region, coastal dolphins may be found in waters as deep as 31 m (102 ft) and 75 km (40 NM) from shore while offshore dolphins may occur in waters as shallow as 13 m (43 ft) (Garrison et al., 2003). Additional aerial surveys and genetic sampling are required to better understand the distribution of the two stocks throughout the year. The bottlenose dolphin is expected to occur in Site C USWTR.

Atlantic Spotted Dolphin – Site C

Atlantic spotted dolphins may occur in both continental shelf and offshore waters (Perrin et al., 1994a); resulting in broad range of distribution in the Cherry Point OPAREA (DoN, 2008l). Sightings are scattered throughout the OPAREA (DoN 2008l). In the Atlantic, this species is considered broadly sympatric with pantropical spotted dolphins (Perrin and Hohn, 1994) and the offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea. Therefore, the low number of sightings of Atlantic spotted dolphins in offshore waters of the OPAREA may be more of a reflection of survey observers not distinguishing between the two species. Atlantic spotted dolphins may occur throughout the Cherry Point OPAREA year-round and are expected to occur in Site C USWTR.

Pantropical Spotted Dolphin – Site C

The pantropical spotted dolphin is a deepwater species (Jefferson et al., 1993). Pantropical spotted dolphins have been sighted along the Florida shelf and slope waters and offshore in Gulf Stream waters southeast of Cape Hatteras (Waring et al., 2007). In the Atlantic, this species is considered broadly sympatric with Atlantic spotted dolphins (Perrin and Hohn, 1994). The offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea. Therefore, the low number of sightings of pantropical spotted dolphins in
offshore waters of the Cherry Point OPAREA may be more of a reflection of survey observers not distinguishing between the two species. Pantropical spotted dolphins may occur in the deepwater portions of the Cherry Point OPAREA. They are expected to occur seaward of the shelf break in Site C USWTR.

**Spinner Dolphin – Site C**

There is only one sighting record for the spinner dolphin in the Cherry Point OPAREA; several sighting and bycatch records are north of this area (DoN, 2008l). Spinner dolphins prefer offshore, warm water habitats. Spinner dolphins may occur from the vicinity of the continental shelf break to eastward of the OPAREA boundary based on the known habitat preferences of this species. No seasonal differences in occurrence are anticipated. The spinner may occur near and seaward of the shelf break in Site C USWTR.

**Clymene Dolphin – Site C**

Clymene dolphin sightings have been recorded in offshore waters in or near the OPAREA (DoN, 2008l). The oceanographic features of the Gulf Stream likely influence the distribution of Clymene dolphins in this area. Based on confirmed sightings and the preference of this species for deep waters, Clymene dolphins may occur in waters seaward of the shelf break throughout the Cherry Point OPAREA (DoN, 2008l). The Clymene dolphin may occur seaward of the shelf break in Site C USWTR.

**Striped Dolphin – Site C**

The striped dolphin is a deepwater species that is generally distributed north of Cape Hatteras (CETAP, 1982). In the Cherry Point OPAREA, there is only one record of this species, which is a sighting near the northern perimeter of the OPAREA (DoN, 2008l). The paucity of sighting data for striped dolphins in this area is likely due to incomplete survey coverage throughout most of the deep waters of the OPAREA, as well as this species’ preference for more temperate waters further north (Waring and Palka, 2002). Sightings have been recorded just north of the OPAREA boundary (DoN, 2008l). Several strandings are recorded inshore of the Cherry Point OPAREA boundaries during all seasons and support the likelihood of striped dolphin occurrence in Site C USWTR. Striped dolphins may occur near and seaward of the shelf break in the Site C USWTR.

**Common Dolphin – Site C**

Common dolphins occur along the shelf break from Cape Hatteras to Nova Scotia year-round (CETAP, 1982). This species is less common south of Cape Hatteras (Waring et al., 2007); common dolphin occurrence south of Cape Hatteras is questionable (Kenney, 2007). In winter, the common dolphin may occur north of the OPAREA near the northern wall of the Gulf Stream (DoN, 2008l). This is a region of enhanced primary productivity resulting in localized prey concentrations. Common dolphins may occur in the northern portion of the OPAREA near Cape
Hatteras and includes waters over the continental shelf and slope as well as nearshore waters (DoN, 2008l). Common dolphins are expected to occur in the Site C USWTR.

**Fraser’s Dolphin – Site C**

One confirmed sighting of Fraser’s dolphin was recorded in deep waters (>3,000 m [9,843 ft] in depth) offshore of Cape Hatteras (NMFS-SEFSC, 1999). Based on known preferences for deep-water, Fraser’s dolphins may occur seaward of the shelf break throughout the Cherry Point OPAREA year-round. The Fraser’s dolphin may occur seaward of the shelf break in Site C USWTR.

**Risso’s Dolphin – Site C**

Risso’s dolphins are most commonly found in areas with steep bottom topography and are often sighted along the northern wall of the Gulf Stream which is a region of enhanced productivity. Sightings within the Cherry Point OPAREA generally follow this pattern of distribution along the path of the Gulf Stream and including steep portions of the continental slope (DoN, 2008l). Risso’s dolphins may occur near and seaward of the shelf break seaward in the Cherry Point OPAREA. Risso’s dolphins are expected to occur in the vicinity of the shelf break and seaward of the shelf break in Site C USWTR.

**Melon-headed Whale – Site C**

Melon-headed and pygmy killer whales can be difficult to distinguish from one another, and on many occasions, only a determination of “pygmy killer whale/melon-headed whale” can be made. One sighting of around 80 melon-headed whales is recorded in offshore waters north of the Cherry Point OPAREA (DoN, 2008l). The melon-headed whale is an oceanic species; which may occur seaward of the shelf break year-round. The melon-headed whale is expected to occur in the seaward of the shelf break in Site C USWTR.

**Pygmy Killer Whale – Site C**

Few strandings and an offshore sighting of the pygmy killer whale are recorded near the Cherry Point OPAREA (DoN, 2008l). The pygmy killer whale is an oceanic species; which may occur seaward of the shelf break year-round. The pygmy killer whale is expected to seaward of the shelf break in Site C USWTR.

**False Killer Whale – Site C**

False killer whales occur in offshore, warm waters worldwide (Baird, 2002). The warm waters of the Gulf Stream likely influence their occurrence to the north of the Cherry Point OPAREA. A small number of sightings are recorded in the OPAREA (DoN, 2008l). False killer whales may occur seaward of the shelf break throughout the year. The false killer whale is expected to occur in the seaward of the shelf break in Site C USWTR.
Killer Whale – Site C

A small number of killer whale sightings are recorded in both shallow and deep waters of the OPAREA and vicinity. Strandings are also reported along the coast of North Carolina (DoN, 2008l). Killer whales may occur seaward of the shoreline year-round based on sighting data and the diverse habitat preferences of this species. They are expected to occur in Site C USWTR.

Long-finned and Short-finned Pilot Whales – Site C

Identification of pilot whales to the species level is difficult at sea, and the Cherry Point OPAREA is located in the overlap area for the ranges of both pilot whale species (Payne and Heinemann, 1993). Throughout the year, pilot whales are predicted to occur in waters with steep bottom topography, such as Hatteras Canyon, and steep slope areas (DoN, 2008l). Pilot whales are often sighted along the northern wall of the Gulf Stream which is a region of enhanced productivity. Throughout most of the deep waters of the Cherry Point OPAREA there is a lack of sufficient survey effort to accurately predict the occurrence patterns of these species. Pilot whales may occur from around the shelf break to deep, offshore waters. Pilot whales are expected to occur in Site C USWTR.

Harbor Porpoise – Site C

The harbor porpoise primarily occurs on the continental shelf, in cool temperate to subpolar waters (Read, 1999) that are at higher latitudes than the Cherry Point OPAREA. Occurrences of harbor porpoises in the mid-Atlantic are scattered (CETAP, 1982; Northridge, 1996). Intermediate densities of harbor porpoises are found in waters off North Carolina during winter (January through March) (Waring et al., 2007). Harbor porpoises may occur along the continental shelf in the northern part of the Cherry Point OPAREA in winter, based on sighting and bycatch records north of Cape Hatteras and the large number of strandings recorded inshore of the OPAREA (DoN, 2008l). The harbor porpoise is expected to occur in Site C USWTR.

Pinnipeds (Seals) – Site C

Several strandings of harbor seals near the OPAREA have been recorded during the winter, spring, and fall (DoN, 2008l). Winn et al. (1979) suggested that harbor seals found in this area are likely young individuals that disperse from the north during the winter months. Stranding data support a consistent seasonal occurrence of harbor seals in this region (Harry et al., 2005). Between 2000 and 2005, at least 71 records of harbor seal strandings were reported for North Carolina and Virginia (Harry et al., 2005). Most of these strandings occurred between November and April and were of young individuals. In February 2003, a harbor seal was rescued from Cape Lookout, North Carolina (WhaleNet, 2003). Sightings and strandings of harbor seals have been documented throughout the year in South Carolina (McFee, 2006). Therefore, harbor seals may make their way south along the coast of North Carolina and occur near the OPAREA any time of the year. Harbor seals may occur near the Site C USWTR.
Any occurrences of the gray seal, harp seal, and hooded seal in the Cherry Point OPAREA are considered to be extralimital (DoN, 2008). These species are not expected to occur in the vicinity of Site C USWTR.

**Sirenians (Manatees) – Site C**

One manatee stranding is recorded in the New River inshore of the OPAREA (DoN, 2008). The vast majority of sightings in North Carolina waters are of subadults (Schwartz, 1995). It is possible that West Indian manatees may be expanding their range into North Carolina waters (Schwartz, 1995). West Indian manatees have been sighted in estuarine and coastal waters of North Carolina during all seasons, with summer and fall having the most reports (Schwartz, 1995). Based on their known habitat preferences, manatees may occur throughout the freshwater, estuarine, and nearshore coastal waters in or near the OPAREA and the Site C USWTR year-round.

### 3.2.6.4 Site D

The Site D USWTR is located within the VACAPES OPAREA (Figure 2-25). The majority of the species found in the VACAPES OPAREA belong to the order Cetacea (whales, dolphins, and porpoises). Following is a general description of the marine mammals that may occur in the VACAPES OPAREA if not already described in the previous sections, and more specifically, in the vicinity of the Site D USWTR.

While there is overlap between the marine mammal species occurring in the VACAPES and Cherry Point OPAREAs, the density of marine mammals is higher in the VACAPES area. The Gulf Stream, in concert with the canyons, banks, and cooler northern waters of Virginia, sets up conditions that are conducive to high productivity. Large standing stocks of marine mammals can be supported in areas where upwelling occurs and results in a very complex food chain in which marine mammals play a role as consumer of plankton, fish, and squid.

**Mysticetes**

Mysticetes utilize the VACAPES area regularly as feeding grounds, as well as during migration between northern and southern waters. Records for baleen whales in the VACAPES OPAREA include the North Atlantic right whale, humpback whale, minke whale, Bryde’s whale, sei whale, fin whale, and blue whale.

**North Atlantic Right Whale – Site D**

Although North Atlantic right whales are likely to be found on feeding grounds north of the VACAPES OPAREA during the summer, there have been sightings and strandings near the OPAREA (DoN 2008m). There have also been opportunistic sightings of right whales in deep waters of the VACAPES OPAREA (DoN, 2008m). There is a lack of survey effort for North Atlantic right whales in offshore waters (specifically in the VACAPES OPAREA). North
Atlantic right whales may occur in the VACAPES OPAREA during all seasons (DoN, 2008m). The North Atlantic right whale may occur in Site D USWTR.

**Humpback Whale – Site D**

Humpback whales occur on the continental shelf and in deep waters of the VACAPES OPAREA in fall, winter, and spring during migrations between calving grounds in the Caribbean and feeding grounds off the northeastern U.S. (DoN, 2008m). During the summer, humpback whales are found farther north at the feeding grounds; however one recorded sighting indicates that presence of individual animals is possible (DoN, 2008m). There is an increasing occurrence of humpback whale sightings and strandings during the winter (particularly January through April) along the U.S. Atlantic coast from Florida north to Virginia (Clapham et al. 1993; Swingle et al. 1993; Wiley et al. 1995; Laerm et al. 1997). Sightings of humpback whales migrating through this area are likely not well-represented here due to the lack of complete survey effort in offshore waters of the VACAPES OPAREA. The humpback whale is expected to occur in Site D USWTR.

**Minke Whale – Site D**

Minke whales generally occur north of the VACAPES OPAREA (DoN, 2008m). Most sightings in the OPAREA and vicinity are recorded in spring over the continental shelf; few are scattered in slope waters just beyond the shelf break (DoN, 2008m). The paucity of sighting data in deep water is likely due to incomplete survey coverage in the OPAREA, especially during winter and fall. Minke whales may occur throughout the OPAREA and the Site D USWTR year-round.

**Bryde’s Whale – Site D**

There is one Bryde’s whale stranding recorded from the winter of 1927 within Chesapeake Bay (Mead, 1977). A few unidentified Bryde’s/sei whale records are also documented near the shelf break off the coast of Virginia (DoN, 1995b). Bryde’s whales may occur throughout the VACAPES OPAREA and the Site D USWTR year-round.

**Sei Whale – Site D**

Sightings of sei whales in continental shelf and slope waters as well as farther offshore and strandings are documented in or near the OPAREA throughout the year (DoN, 2008m). The winter range of most rorquals (blue, fin, sei, and minke whales) is hypothesized to be in offshore waters (Kellogg, 1928; Gaskin, 1982); acoustic data support this hypothesis of an offshore wintering habitat (Clark, 1995). Sei whales may occur throughout the VACAPES OPAREA year-round. During the summer, sei whales are generally farther north on feeding grounds around the eastern Scotian Shelf or Grand Banks; however, sightings within the OPAREA during this time of year may represent individuals making early or late migrations to the feeding grounds (DoN, 2008m). The sei whale may occur in the Site D USWTR.
Fin Whale – Site D

Fin whales are more commonly encountered north of Cape Hatteras than in more southern waters (CETAP, 1982; Hain et al., 1992; Waring et al., 2007). Fin whales may occur in both continental shelf and offshore waters of the VACAPES OPAREA year-round. Preliminary results from the Navy’s deepwater hydrophone arrays indicate a substantial deep-ocean component to fin whale distribution (Clark, 1995; Waring et al., 2007). Sightings in the VACAPES OPAREA span shelf waters, the shelf break and deep water (DoN, 2008m). Fin whales may occur in both shelf and offshore waters of the OPAREA year-round (DoN, 2008m). The fin whale may occur in the vicinity of the Site D USWTR.

Blue Whale – Site D

In the VACAPES OPAREA there is only one blue whale record, a sighting made between the 3,000 and 4,000 m (9,842 and 13,123 ft) isobaths during a CETAP survey in 1969 (DoN, 2008m). The paucity of blue whale records in the VACAPES OPAREA may indicate that blue whales are often difficult to distinguish from other rorquals. The blue whale is primarily a deepwater species but is occasionally found in shallow, shelf waters. The winter range of most rorquals (blue, fin, sei, and minke whales) is hypothesized to be in offshore waters (Kellogg, 1928; Gaskin, 1982). Acoustic data support the hypothesis of an offshore wintering habitat (Clark, 1995). Blue whales may occur in waters seaward of the 50 m (164 ft) isobath throughout the VACAPES OPAREA during fall, winter, and spring (DoN, 2008m). Blue whales are not expected to occur in the OPAREA during summer when they should occur farther north in their feeding ranges. The blue whale may occur in the vicinity of the Site D USWTR during fall, winter, and spring.

Odontocetes

Following is a general discussion of the distribution of odontocete species that may be found in the Site D area.

Sperm Whale – Site D

Worldwide, sperm whales exhibit a strong affinity for deep waters beyond the continental shelf break (Rice, 1989). The recorded observations of sperm whales in the VACAPES OPAREA and vicinity support this trend, with sightings consistently recorded in waters beyond the shelf break (DoN, 2008m). While sperm whales are expected to be present year-round, there have been more sightings in spring and summer than in the other months (DoN, 2008m). Sperm whales may occur throughout the slope and deep waters of the OPAREA (DoN, 2008m). The sperm whale is expected to occur in the Site D USWTR.
Pygmy and Dwarf Sperm Whales – Site D

Few *Kogia* sightings are recorded in the VACAPES OPAREA which is likely due to incomplete survey coverage throughout most of the deep waters of this region (especially during winter and fall) as well as their avoidance reactions towards ships (DoN, 2008m). However, strandings are recorded inshore of the OPAREA boundaries during all seasons and support the likelihood of *Kogia* occurrence in the VACAPES OPAREA year-round. Pygmy and dwarf sperm whales are expected to occur in the Site D USWTR.

Beaked Whales – Site D

Beaked whales are deepwater species. Based on the cryptic behavior and similarity in appearance of these species, it is difficult to identify beaked whales to species. Cuvier’s, True’s, Gervais’, and Blainville’s beaked whales are the only beaked whale species expected to occur regularly in the VACAPES OPAREA, with possible sightings of Sowerby’s beaked whales (DoN, 2008m). There is one extralimital stranding record of a northern bottlenose whale (in the beaked whale family) inshore of the VACAPES OPAREA. Beaked whales may occur over the shelf break and seaward throughout the year in the VACAPES OPAREA. Beaked whales are expected to occur seaward of the shelf break in the Site D USWTR.

The proposed USWTR Site D location is situated in such a way that portions of the shelf, shelf edge, and slope are overlapped by the boundaries of the proposed training range (DoN, 1999b). During an examination of physical habitat characteristics of cetaceans in the Gulf of Mexico, beaked whales and other deep-diving species most often occurred in waters with the steepest sea surface temperature gradients. Such areas are likely associated with thermal fronts and eddy systems. Sightings of beaked whales have also been associated with canyon features between the 200- and 2,000-m (660- and 6,600-ft) isobaths that were not associated with noticeable thermal gradients. In the summer months, beaked whales use the shelf-edge region of the northeast coast as a primary habitat (Waring et al., 2001b).

Preliminary results of predictive habitat modeling performed by DoN (2004d) indicated that, in the vicinity of the Site D USWTR, areas classified as potential beaked whale habitat were primarily in waters deeper than approximately 500 m. This suggests that beaked whale habitat may largely be located to the east of the proposed range site, which encompasses depths of 55 to 366 m (188 to 1,200 ft).

Rough-toothed Dolphin – Site D

A few strandings and two sightings of rough-toothed dolphin have been recorded in or near the VACAPES OPAREA (DoN, 2008m). Rough-toothed dolphins may occur seaward of the shelf break based on this species’ preference for deep waters. During the winter, the rough-toothed dolphin’s occurrence is expected in warmer waters, so occurrence in the OPAREA may follow the western edge of the Gulf Stream. The rough-toothed dolphin may occur in the OPAREA.
year-round. The rough-toothed dolphin is expected to occur seaward of the shelf break in the Site D USWTR site.

**Bottlenose Dolphin – Site D**

The range of offshore bottlenose dolphins may extend into deeper waters (Wells et al., 1999), including the Hatteras Abyssal Plain just southeast of the VACAPES OPAREA. Due to the lack of complete survey effort in offshore waters of the VACAPES OPAREA, occurrence of the offshore stock is likely not well represented here (DoN, 2008m). The bottlenose dolphin may occur in the OPAREA year-round. The bottlenose dolphin is expected to occur in the Site D USWTR.

**Atlantic Spotted Dolphin – Site D**

In the Atlantic, Atlantic spotted dolphin is considered broadly sympatric with pantropical spotted dolphins (Perrin and Hohn, 1994). The offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea. Therefore, the low number of sightings of Atlantic spotted dolphins in offshore waters of the VACAPES OPAREA may be more of a reflection of survey observers not distinguishing between the two species (DoN, 2008m). Atlantic spotted dolphins may occur in continental shelf and offshore waters throughout the VACAPES OPAREA. The Atlantic spotted dolphin is expected to occur in the Site D USWTR.

**Pantropical Spotted Dolphin – Site D**

The low number of sightings of pantropical spotted dolphins in offshore waters of the VACAPES OPAREA may be more of a reflection of survey observers not distinguishing between the Atlantic spotted and pantropical spotted dolphins (DoN, 2008m). Based on sighting data and known habitat preferences, pantropical spotted dolphins may occur seaward of the shelf break throughout the VACAPES OPAREA and the Site D USWTR.

**Spinner Dolphin – Site D**

Several stranding, sighting, and bycatch records of the spinner dolphin are documented in or near the OPAREA (DoN, 2008m). Spinner dolphins prefer warm, offshore waters as evidenced by the sighting and bycatch records associated with the Gulf Stream in the winter and spring months. Spinner dolphin may occur from the vicinity of the continental shelf break to eastward of the VACAPES OPAREA boundary in association with the Gulf Stream’s northern boundary. No seasonal differences in occurrence are anticipated. The spinner dolphin is expected to occur in the Site D USWTR.
Clymene Dolphin – Site D

Most Clymene dolphin sightings in or near the VACAPES OPAREA are recorded in offshore waters over the continental slope and follow the path of the Gulf Stream (DoN, 2008m). The oceanographic features of the Gulf Stream likely influence the distribution of Clymene dolphins in this region. Based on confirmed sightings and the preference of this species for warm, deep waters, Clymene dolphins are expected in waters seaward of the shelf break south of the northern wall of the Gulf Stream. Only two sightings (both during summer) are documented north of the Gulf Stream in the OPAREA (DoN, 2008m). Clymene dolphins may occur north of the Gulf Stream’s warm water influence, particularly during summer when water temperatures are generally warmer. The Clymene dolphin may occur seaward of the shelf break in the Site D USWTR.

Striped Dolphin – Site D

As noted earlier, the striped dolphin is a deep water species that is generally distributed north of Cape Hatteras (CETAP, 1982), which is supported by the distribution of sightings in the VACAPES OPAREA. The southern edge of this species’ predicted occurrence in the VACAPES OPAREA appears to be influenced by meanderings of the Gulf Stream (DoN, 2008m). Sightings predominately occur along the Gulf Stream’s northern wall, where it travels through the southern part of the VACAPES OPAREA. Occurrence is expected near and seaward of the shelf break throughout the OPAREA year-round. The striped dolphin may occur near and seaward of the shelf break in the Site D USWTR.

Common Dolphin – Site D

Common dolphins primarily occur in a broad band along the shelf break from Cape Hatteras to Nova Scotia year-round (CETAP, 1982). The common dolphin occurs year-round in the VACAPES OPAREA, with the most sightings and strandings recorded in winter and spring (DoN, 2008m). Common dolphins may occur throughout the OPAREA year-round. The common dolphin is expected to occur in the Site D USWTR.

Fraser’s Dolphin – Site D

Fraser’s dolphin, a deepwater species, is found in the tropical waters of the world. Only one sighting is documented in the VACAPES OPAREA; this sighting was recorded in deep waters (>3,000 m in depth) offshore of Cape Hatteras (NMFS-SEFSC, 1999). Fraser’s dolphins may occur seaward of the shelf break throughout the OPAREA year-round. The Fraser’s may occur near and seaward of the shelf break in the Site D USWTR.

White-beaked Dolphin – Site D

The white-beaked dolphin is found in the North Atlantic, in cold-temperate and subarctic waters. Any occurrences of the white-beaked dolphin in the VACAPES OPAREA are considered to be...
extralimital (DoN, 2008m). One sighting record is documented in the OPAREA along the shelf break during spring (DoN, 2008m). Based on the habitat preferences of this species, the white-beaked dolphin may occur very rarely in waters between the shoreline and the 2,000 m (6,562 ft) isobath throughout the OPAREA. The white-beaked dolphin is not expected to occur in the vicinity of the Site D USWTR.

**Atlantic White-sided Dolphin – Site D**

White-sided dolphin sightings are recorded mostly in the northern VACAPES OPAREA and vicinity. Strandings and bycatch records are also documented near the OPAREA (DoN, 2008m). Due to this species’ preference for colder waters, the Gulf Stream may be a southern boundary for Atlantic white-sided dolphin distribution. This species may occur primarily in waters over the continental shelf throughout the OPAREA year-round. However, distribution may also range farther offshore which is evidenced by the sighting records offshore in waters over the continental slope in and near the OPAREA (DoN, 2008m). The Atlantic white-sided dolphin may occur in the Site D USWTR.

**Risso’s Dolphin – Site D**

Risso’s dolphins are most commonly found in areas with steep bottom topography and are often sighted along the northern wall of the Gulf Stream which is a region of enhanced productivity. Sightings in the VACAPES OPAREA generally follow this pattern of distribution with patches of occurrence predicted along the path of the Gulf Stream and including steep portions of the continental slope (DoN, 2008m). The Risso’s dolphin is expected to occur in the VACAPES OPAREA and the Site D USWTR year-round.

**Melon-headed Whale – Site D**

Melon-headed and pygmy killer whales can be difficult to distinguish from one another, and on many occasions only a determination of “pygmy killer whale/melon-headed whale” can be made. Two sightings of melon-headed whales are recorded in deep (>2,500 m [>8,200 ft]) offshore waters along the path of the Gulf Stream in the southern VACAPES OPAREA (DoN, 2008m). Based on warm water preferences, melon-headed whale occurrence in the OPAREA during winter is likely influenced by the Gulf Stream. The melon-headed whale is an oceanic species, which may occur seaward of the shelf break year-round throughout the VACAPES OPAREA. The melon-headed whale may occur near and seaward of the shelf break in the Site D USWTR.
**Pygmy Killer Whale – Site D**

Only one confirmed record, a fall stranding north of Cape Hatteras, is documented for pygmy killer whales in the VACAPES OPAREA and vicinity (DoN, 2008m). The pygmy killer whale is an oceanic species; which may occur seaward of the shelf break year-round throughout the VACAPES OPAREA. Based on warm water preferences, pygmy killer whale occurrence in the OPAREA during winter is likely influenced by the Gulf Stream. The pygmy killer whale may occur near and seaward of the shelf break in the Site D USWTR.

**False Killer Whale – Site D**

False killer whales occur in offshore, warm waters worldwide (Baird, 2002). The warm waters of the Gulf Stream likely influence their occurrence in the southern VACAPES OPAREA. A small number of sightings and strandings are recorded near the OPAREA; the sightings reflect the preference of this species for offshore waters (DoN, 2008m). False killer whales may occur seaward of the shelf break throughout the OPAREA year-round. The false killer whale may occur near and seaward of the shelf break in the Site D USWTR.

**Killer Whale – Site D**

Several killer whale sightings are recorded in both shallow and deep waters of the VACAPES OPAREA and vicinity (DoN, 2008m). Strandings are also reported along the Outer Banks (DoN, 2008m). Killer whales may occur throughout the OPAREA and vicinity year-round based on sighting data and the diverse habitat preferences of this species. They may occur throughout the Site D USWTR.

**Long-finned and Short-finned Pilot Whales – Site D**

The VACAPES OPAREA is located in a region of range overlap between both pilot whale species (Payne and Heinemann, 1993). Identification of pilot whales to species is difficult at sea, and identification is often made to the genus level only. All seasons support sighting and bycatch records of unidentified pilot whales (likely short-finned pilot whales) in Gulf Stream waters of the VACAPES OPAREA due to the tropical nature of this species (DoN, 2008m).

Throughout the year, pilot whales may occur in waters with steep bottom topography (i.e., canyons and steep slope areas) which are likely feeding areas. These areas also follow the path of the Gulf Stream. Pilot whales are often sighted along the northern wall of the Gulf Stream which is a region of enhanced productivity. Both species of pilot whale may occur in the VACAPES OPAREA and the Site D USWTR year-round.
Harbor Porpoise – Site D

The harbor porpoise primarily occurs on the continental shelf in cool temperate to subpolar waters (Read, 1999) that are at higher latitudes than the VACAPES OPAREA (DoN, 2008m). Occurrences of harbor porpoises in the mid-Atlantic are scattered (CETAP, 1982; Northridge 1996). Intermediate densities of harbor porpoises are found in waters off North Carolina during winter (January through March) (Waring et al., 2007). The harbor porpoise may occur in the VACAPES OPAREA, particularly during winter months, and is expected to occur in the Site D USWTR.

Pinnipeds (Seals) – Site D

Blaylock et al. (1995) report that four seal species are known to occur in the western North Atlantic Ocean: harbor seal, gray seal, harp seal, and hooded seal. Stranding records show a considerable dropoff in the sighting of seals south of the New Jersey/Delaware area. Winn et al. (1979) suggested that harbor seals found in this area are likely young individuals that disperse from the north during the winter months. Stranding data support a consistent seasonal occurrence of harbor seals in this region (Harry et al., 2005). Most harbor seal strandings near the OPAREA are documented during winter. Between 2000 and 2005, at least 71 records of harbor seal strandings were reported for North Carolina and Virginia (Harry et al., 2005). Most of these strandings occurred between November and April and were of young individuals. Sightings and strandings of harbor seals have been documented throughout the year in South Carolina (McFee, 2006). Therefore, harbor seals may move south and occur along the coast near the VACAPES OPAREA and the Site D USWTR any time of the year (DoN, 2008m). Any occurrences of the gray seal, harp seal, and hooded seal in the VACAPES OPAREA and Site D USWTR are considered to be extralimital (DoN, 2008m).

Sirenians (Manatees) – Site D

There are several unpublished records and personal observations of manatees throughout this region. Manatees have been reported near the OPAREA as far north as the Potomac River (sighting in August 1980) and Buckroe Beach, Hampton City, Chesapeake Bay (a stranding reported in October 1980) (Rathbun et al., 1982). Based on their known habitat preferences, manatees could occur throughout the freshwater, estuarine, and nearshore coastal waters in or near the VACAPES OPAREA year-round; however, any occurrences in the OPAREA or Site D USWTR would be considered extralimital (DoN, 2008m).

3.2.6.5 Cetacean Stranding Events

When a live or dead marine mammal swims or floats onto shore and becomes “beached” or incapable of returning to sea, the event is termed a “stranding” (Perrin and Geraci, 2002; Geraci and Lounsbury, 2005; NMFS, 2007e). The legal definition for a stranding within the United States is that “a marine mammal is dead and is (i) on a beach or shore of the United States; or (ii) in waters under the jurisdiction of the United States (including any navigable waters); or (B) a
marine mammal is alive and is (i) on a beach or shore of the United States and is unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is in need of apparent medical attention; or (iii) in the waters under the jurisdiction of the United States (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance” (16 USC 421h).

The majority of animals that strand are dead or moribund (i.e., dying) (NMFS, 2007e). For animals that strand alive, human intervention through medical aid and/or guidance seaward may be required for the animal to return to the sea. If unable to return to sea, rehabilitation at an appropriate facility may be determined as the best opportunity for animal survival. An event where animals are found out of their normal habitat is may be considered a stranding depending on circumstances even though animals do not necessarily end up beaching (Southall, 2006).

Three general categories can be used to describe strandings: single, mass, and unusual mortality events. The most frequent type of stranding is a single stranding, which involves only one animal (or a mother/calf pair) (NMFS, 2007e).

A mass stranding involves two or more marine mammals of the same species other than a mother/calf pair (Wilkinson, 1991), and may span one or more days and range over several miles (Simmonds and Lopez-Jurado, 1991; Frantzis, 1998; Walsh et al., 2001; Freitas, 2004). In North America, only a few species typically strand in large groups of 15 or more and include sperm whales, pilot whales, false killer whales, Atlantic white-sided dolphins, white-beaked dolphins, and rough-toothed dolphins (Odell, 1987; Walsh et al., 2001). Some species, such as pilot whales, false-killer whales, and melon-headed whales, occasionally strand in groups of 50 to 150 or more (Geraci et al., 1999). All of these normally pelagic off-shore species are highly sociable and are usually infrequently encountered in coastal waters. Species that commonly strand in smaller numbers include pygmy killer whales, common dolphins, bottlenose dolphins, Pacific white-sided dolphins, Frasier’s dolphins, gray whales and humpback whales (west coast only), harbor porpoise, Cuvier’s beaked whales, California sea lions, and harbor seals (Mazzuca et al., 1999, Norman et al., 2004, Geraci and Lounsbury, 2005).

Unusual mortality events (UMEs) can be a series of single strandings or mass strandings, or unexpected mortalities (i.e., die-offs) that occur under unusual circumstances (Dierauf and Gulland, 2001; Harwood, 2001; Gulland, 2006; NMFS, 2007e). These events may be interrelated: for instance, at-sea die-offs lead to increased stranding frequency over a short period of time, generally within one to two months. As published by the NMFS, revised criteria for defining a UME include the following (Hohn et al., 2006):

- A marked increase in the magnitude or a marked change in the nature of morbidity, mortality, or strandings when compared with prior records
- A temporal change in morbidity, mortality, or strandings is occurring
- A spatial change in morbidity, mortality, or strandings is occurring
• Difference in species, age, or sex composition of the affected animals from that of animals that are normally affected

• Similar or unusual pathologic findings, behavior patterns, clinical signs, or general physical condition (e.g., blubber thickness) in affected animals

• Potentially significant morbidity, mortality, or stranding observed in species, stocks, or populations that are particularly vulnerable (e.g., listed as depleted, threatened or endangered or declining). For example, stranding of three or four right whales may be cause for great concern whereas stranding of a similar number of fin whales may not.

• Morbidity observed concurrent with or as part of an unexplained continual decline of a marine mammal population, stock, or species

UMEs are usually unexpected, infrequent, and may involve a significant number of marine mammal mortalities. As discussed below, unusual environmental conditions are probably responsible for most UMEs and marine mammal die-offs (Vidal and Gallo-Reynoso, 1996; Geraci et al., 1999; Walsh et al., 2001; Gulland and Hall, 2005).

Reports of marine mammal strandings can be traced back to ancient Greece (Walsh et al., 2001). Like any wildlife population, there are normal background mortality rates that influence marine mammal population dynamics, including starvation, predation, aging, reproductive success, and disease (Geraci et al., 1999; Carretta et al., 2007). Strandings in and of themselves may be reflective of this natural cycle or, more recently, may be the result of anthropogenic sources (i.e., human impacts). Current science suggests that multiple factors, both natural and man-made, may be acting alone or in combination to cause a marine mammal to strand (Geraci et al., 1999; Culik, 2002; Perrin and Geraci, 2002; Geraci and Lounsbury, 2005; NRC, 2006). Appendix E of this final OEIS/EIS contains a detailed discussion of potential causes of stranding.

While post-stranding data collection and necropsies of dead animals are attempted in an effort to find a possible cause for the stranding, it is often difficult to pinpoint exactly one factor that can be blamed for any given stranding. An animal suffering from one ailment becomes susceptible to various other influences because of its weakened condition, making it difficult to determine a primary cause. In many stranding cases, scientists never learn the exact reason for the stranding. Specific potential stranding causes can include both natural and human influenced (anthropogenic) causes as listed below:

• Natural stranding causes
  – disease
  – natural toxins
  – weather and climatic influences
  – navigation errors
  – social cohesion
Specific beaked whale stranding events that may be associated with naval operations are as follows:

- May 1996: Greece (NATO/U.S.)
- March 2000: Bahamas (U.S.)
- May 2000: Portugal, Madeira Islands (NATO/U.S.)
- September 2002: Spain, Canary Islands (NATO/U.S.)
- January 2006: Spain, Mediterranean Sea coast (NATO/U.S.)

As discussed in Appendix E, Cetacean Stranding Report, these stranding events represent a small overall number of animals (40 animals) over an 11 year period. While beaked whale strandings have been documented since the 1800s (Geraci and Lounsbury, 1993; Cox et al., 2006; Podesta et al., 2006), the state of science can not yet determine if a sound source such as mid-frequency sonar alone causes beaked whale strandings, or if other factors (acoustic, biological, or environmental) must co-occur in conjunction with a sound source (Cox et al., 2006). Four (Greece, Portugal, Spain [twice]) of the five events listed above occurred during NATO exercises or events where DON presence was limited. One (Bahamas) of the five events involved only DoN ships. These five events are described briefly below.

- May 1996 Greece - Twelve Cuvier’s beaked whales (Ziphius cavirostris) stranded along the coast of the Kyparissiakos Gulf on May 12 and 13, 1996 (Frantzis, 1998). From May 11 through May 15, the NATO research vessel Alliance was conducting sonar tests with signals of 600 Hz and 3 kHz and root-mean-squared (rms) sound pressure levels (SPL) of 228 and 226 dB re: 1μPa, respectively (D'Amico and Verboom, 1998; D'Spain et al., 2006). The timing and the location of the testing encompassed the time and location of the whale strandings (Frantzis, 1998). However, because information for the necropsies was incomplete and inconclusive, the cause of the stranding cannot be precisely determined (Frantzis, 1998).

- March 2000, Bahamas – Seventeen marine mammals comprised of Cuvier’s beaked whales, Blainville’s beaked whales (Mesoplodon densirostris), minke whales (Balaenoptera acutorostrata), and one spotted dolphin (Stenella frontalis), stranded along the Northeast and Northwest Providence Channels of the Bahamas Islands on March 15-16, 2000 (Evans and England, 2001). The strandings
occurred over a 36-hour period and coincided with DON use of mid-frequency active sonar within the channel. Navy ships were involved in tactical sonar exercises for approximately 16 hours on March 15. The ships, which operated the AN/SQS-53C and AN/SQS-56, moved through the channel while emitting sonar pings approximately every 24 seconds. The timing of pings was staggered between ships and average source levels of pings varied from a nominal 235 dB SPL (AN/SQS-53C) to 223 dB SPL (AN/SQS-56). The center frequency of pings was 3.3 kHz. Passive acoustic monitoring records demonstrated that no large scale acoustic activity besides the Navy sonar exercise occurred in the times surrounding the stranding event. The mechanism by which sonar could have caused the observed traumas or caused the animals to strand was undetermined (Evans and England, 2001).

- May 2000, Madeira Island, Portugal – Three Cuvier’s beaked whales stranded on two islands in the Madeira Archipelago, Portugal, from May 10 – 14, 2000 (Cox et al., 2006). A joint NATO amphibious training exercise, named “Linked Seas 2000,” which involved participants from 17 countries, took place in Portugal during May 2 – 15, 2000. The timing and location of the exercises overlapped with that of the stranding incident. Although the details about whether or how sonar was used during “Linked Seas 2000” is unknown, the presence of naval activity within the region at the time of the strandings suggested a possible relationship to Navy activity.

- September 2002, Canary Islands, Spain – On September 24, 2002, 14 beaked whales stranded on Fuerteventura and Lanzaote Islands in the Canary Islands (Jepson et al., 2003). At the time of the strandings, an international naval exercise, NATO exercise Neo-Tapon 2002 (Fernández et al., 2005), which involved numerous surface warships and several submarines was being conducted off the coast of the Canary Islands. Tactical mid-frequency active sonar was utilized during the exercises, and strandings began within hours of the onset of the use of mid-frequency sonar (Fernández et al., 2005). The association of NATO mid-frequency sonar use close in space and time to the beaked whale strandings, and the similarity between this stranding event and previous beaked whale mass strandings coincident with sonar use suggests that a similar scenario and causative mechanism of stranding may be shared between the events.

- January 2006, Spain – The Spanish Cetacean Society reported an atypical mass stranding of four beaked whales that occurred January 26 to 28, 2006, on the southeast coast of Spain near Mojacar (Gulf of Vera) in the Western Mediterranean Sea. From January 25-26, 2006, a NATO surface ship group (seven ships including one U.S. ship under NATO operational command) conducted active sonar training against a Spanish submarine within 50 nm of the stranding site. According to the pathologists, a likely cause of this type of beaked whale mass stranding event may have been anthropogenic acoustic activities.
However, no detailed pathological results confirming this supposition have been published to date, and no positive acoustic link was established as a direct cause of the stranding when evaluated in conjunction with NATO activities.

Potential impacts to all species of cetaceans worldwide from fishery related mortality can be orders of magnitude more significant than those believed to be related to sonar activity (100,000s of animals versus 10s of animals) (Culik, 2002; ICES, 2005b; Read et al., 2006). This does not negate the influence of any mortality or additional stressor to small, regionalized sub-populations which may be at greater risk from human related mortalities (fishing, vessel strike, sound) than populations with larger oceanic level distribution or migrations. ICES (2005a) noted, however, that taken in context of marine mammal populations in general, sonar is not a major threat, or significant portion of the overall ocean noise budget. A constructive framework and continued research based on sound scientific principles is needed in order to avoid speculation as to stranding causes, and to further our understanding of potential effects or lack of effects from military mid-frequency sonar (Bradshaw et al., 2006; ICES, 2005b; Barlow and Gisiner, 2006; Cox et al., 2006).

### 3.2.7 Seabirds and Migratory Birds

Seabirds are birds whose normal habitat and food source is the sea, whether they utilize coastal waters (nearshore), offshore waters (continental shelf), or pelagic waters (open sea) (Harrison, 1983). Pelagic birds can be divided into three groups based on breeding and foraging habitat:

- Species such as albatrosses, petrels, frigatebirds, tropicbirds, boobies, and some terns that forage over the ocean and nest on oceanic islands.

- Species such as pelicans, cormorants, gulls, and some terns that nest along the coast and forage in nearshore areas.

- Those few species such as skuas, jaegers, Franklin’s gull, Bonaparte’s gull, ring-billed gull, and black tern that nest and forage in inland habitats and come to the coastal areas during non-breeding seasons (Schreiber and Burger, 2002).
Seabirds can forage considerable distances; some albatross and petrel species are known to travel hundreds of kilometers on single foraging trips. Several species exhibit dominant or secondary feeding behavior that would place them in the vicinities of the Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs. Table 3.2-4 lists the seabirds that are known to utilize the coastal and offshore waters in the four OPAREAs at various times of the year.

While some seabirds are permanent residents to an area, other seabirds migrate to the area annually. Specifically, a migratory bird is any species or family of birds that live, reproduce, or migrate within or across international borders at some point during its annual life cycle. As discussed in Subchapter 1.6, migratory birds are protected under the MBTA. Virginia, North Carolina, South Carolina, and Florida lie within the Atlantic Flyway, a major migration route along the east coast of the U.S. During the fall and spring migratory seasons, large numbers of birds utilize the flyway. The coastal route of the Atlantic Flyway generally follows the shoreline, and migratory birds are typically associated with the coast. The four USWTR sites, A, B, C, and D, are located offshore from the principal routes of migratory birds.

Foraging Habits

Overall, the majority of birds likely to occur in the USTWR Site areas feed in shallow waters and typically do not fully submerge themselves in the water. Rather, these seabirds plunge-dive from the air into the water and feed by aerial dipping (taking food from the water surface in flight) (Slotterback, 2002). Other common feeding methods include surface-seizing (sitting on water and taking food from surface), surface-dipping (swimming and then dipping to pick up items below the surface), jump-plunging (swimming, then jumping upward and diving under water), or picking up food while walking (Burger and Gochfeld, 2002). For example, shearwaters and petrels tend to skim waves in search of food, while the majority of gull and tern species eat only small fish and feed by plunge-diving head-first from flight, often from a hovering position (National Geographic, 2002; MMS, 2007h). The gull-billed tern and sooty tern, however, pluck food from the water’s surface (MMS, 2007h). Diving birds such as cormorants, loons, and grebes generally feed by pushing themselves underwater with their wings and/or feet.

For seabirds that dive for food that are found in the OPAREAs, research indicates that the longest recorded dive time was 28 seconds for the double-crested cormorant, which also had a minimum dive time of 19 seconds (Hatch and Weseloh, 1999). Maximum dive depths for species in the areas were 12 m (39 ft) for the pied-billed grebe (Muller and Storer, 1999), and 8 m (26 ft) for the double-crested cormorant (Hatch and Weseloh, 1999). The average dive length for the double-crested cormorant was approximately 5 m (16 ft) (Hatch and Weseloh, 1999). A representative overview of foraging habits for birds likely to occur in the USWTR OPAREAs is presented in Table 3-2.5.
Table 3.2-4

Seabirds Occurring in the OPAREAs

<table>
<thead>
<tr>
<th>Family</th>
<th>Common Name</th>
<th>Scientific Name</th>
<th>OPAREAs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>JAX</td>
</tr>
<tr>
<td><strong>Diomedeidae</strong></td>
<td>Yellow-nosed albatross</td>
<td>Thalassarche chlororhynchos</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Herald petrel</td>
<td>Pterodroma arminjoniana</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Fea’s petrel</td>
<td>Pterodroma feae</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Bermuda petrel</td>
<td>Pterodroma cahow</td>
<td>0</td>
</tr>
<tr>
<td><strong>Procellariidae</strong></td>
<td>Black-capped petrel</td>
<td>Pterodroma hasitata</td>
<td>May-Oct</td>
</tr>
<tr>
<td></td>
<td>Cory’s shearwater</td>
<td>Calonectris diomedea</td>
<td>May-Nov</td>
</tr>
<tr>
<td></td>
<td>Greater shearwater</td>
<td>Puffinus gravis</td>
<td>Mar-Jun</td>
</tr>
<tr>
<td></td>
<td>Sooty shearwater</td>
<td>Puffinus griseus</td>
<td>Spring</td>
</tr>
<tr>
<td></td>
<td>Manx shearwater</td>
<td>Puffinus puffinus</td>
<td>R (winter)</td>
</tr>
<tr>
<td><strong>Hydrobatidae</strong></td>
<td>Wilson’s storm-petrel</td>
<td>Oceanites oceanicus</td>
<td>May-Sep</td>
</tr>
<tr>
<td></td>
<td>White-faced storm-petrel</td>
<td>Pelagodroma marina</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Leach’s storm-petrel</td>
<td>Oceanodroma leucorhoa</td>
<td>S</td>
</tr>
<tr>
<td></td>
<td>Band-rumped storm-petrel</td>
<td>Oceanodroma castro</td>
<td>May-Aug</td>
</tr>
<tr>
<td><strong>Phaethontidae</strong></td>
<td>White-tailed tropicbird</td>
<td>Phaethon lepturus</td>
<td>May-Aug</td>
</tr>
<tr>
<td><strong>Sulidae</strong></td>
<td>Masked booby</td>
<td>Sula dactylatra</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Brown booby</td>
<td>Sula leucogaster</td>
<td>R</td>
</tr>
</tbody>
</table>
Table 3.2-4 (cont'd)

Seabirds Occurring in the OPAREAs

| Family          | Common Name          | Scientific Name                | OPAREAs       |
|-----------------|----------------------|--------------------------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                 |                      |                                | JAX | CHASN | CHPT | VACAPES         |
| Pelecanidae     | Brown pelican        | *Pelecanus occidentalis*       | A   | A     | A    | A               |
|                 | American white pelican | *Pelecanus erythrorhynchos*     | A   | A     | R    | R               |
| Phalacrocoracidae | Double-crested cormorant | *Phalacrocorax auritus*        | A   | A     | A    | A               |
|                 | Great cormorant       | *Phalacrocorax carbo*          | Jun-Jan | Jun-Jan | Jun-Jan | Jun-Jan         |
|                  |                      |                                |                |        |      |                 |
| Fregatidae      | Magnificent frigatebird | *Fregata magnificens*         | A   | A     | R(Apr-Sep) | R(Apr-Sep)     |
|                  |                      |                                |                |        |      |                 |
| Alcidae         | Dovekie               | *Alle alle*                    | R (winter) | R (winter) | R (winter) | Oct-Mar         |
|                 | Razorbill            | *Alca torda*                   | R (winter) | R (winter) | R (winter) | Sep-Feb         |
|                 | Common murre          | *Uria aalge*                   | 0   | 0     | 0    | R (Sep – Mar)   |
|                 | Thick-billed murre    | *Uria lomvia*                  | R (winter) | R (winter) | R (winter) | Oct-Mar         |
|                 | Black guillemot       | *Cepphus grille*               | 0   | 0     | 0    | R (winter)      |
|                 | Atlantic puffin       | *Fratercula artica*            | 0   | 0     | 0    | Sep-Feb         |
|                 | Long-tailed jaeger    | *Stercorarius longicaudus*      | R   | R     | Nov-Mar | Nov-Mar         |
|                 | Parasitic jaeger      | *Stercorarius parasiticus*     | Sep-May | Sep-May | Sep-May | Spring/Fall     |
|                 | Pomarine jaeger       | *Stercorarius pomarinus*       | Sep-May | Sep-May | Sep-May | Spring/Fall     |
|                 | Great skua            | *Stercorarius skua*            | 0   | 0     | Nov-Apr | Nov-Apr         |
|                 | Laughing gull         | *Larus atricilla*              | A   | A     | A    | A               |
|                 | Herring gull          | *Larus argentatus*             | A   | A     | A    | A               |
|                 | Great black-backed gull | *Larus marinus*              | A   | A     | A    | A               |
Table 3.2-4 (cont’d)
Seabirds Occurring in the OPAREAs

<table>
<thead>
<tr>
<th>Family</th>
<th>Common Name</th>
<th>Scientific Name</th>
<th>OPAREAs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>JAX</td>
<td>CHASN</td>
</tr>
<tr>
<td>Laridae</td>
<td>Black-headed gull</td>
<td>Larus ridibundus</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Bonaparte’s gull</td>
<td>Larus philadelphia</td>
<td>Jan-Jun</td>
</tr>
<tr>
<td></td>
<td>Lesser black-backed gull</td>
<td>Larus fuscus</td>
<td>Sep-Mar</td>
</tr>
<tr>
<td></td>
<td>Little gull</td>
<td>Larus minutus</td>
<td>Sep-Mar</td>
</tr>
<tr>
<td></td>
<td>Glaucous gull</td>
<td>Larus hyperboreus</td>
<td>Sep-May</td>
</tr>
<tr>
<td></td>
<td>Iceland gull</td>
<td>Larus glaucoides</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Roseate tern</td>
<td>Sterna dougallii</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Gull-billed tern</td>
<td>Sterna nilotica</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Caspian tern</td>
<td>Sterna caspia</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Royal tern</td>
<td>Sterna maxima</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Sandwich tern</td>
<td>Sterna sandvicensis</td>
<td>May-Jul</td>
</tr>
<tr>
<td></td>
<td>Common tern</td>
<td>Sterna hirundo</td>
<td>May-Jul</td>
</tr>
<tr>
<td></td>
<td>Forster’s tern</td>
<td>Sterna forsteri</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Least tern</td>
<td>Sterna antillarum</td>
<td>May-Jun</td>
</tr>
<tr>
<td></td>
<td>Bridled tern</td>
<td>Sterna anaethetus</td>
<td>R (Jun-Sep)</td>
</tr>
<tr>
<td></td>
<td>Sooty tern</td>
<td>Sterna fuscata</td>
<td>R (Jun-Sep)</td>
</tr>
<tr>
<td></td>
<td>Brown Noddy</td>
<td>Anous stolidus</td>
<td>R</td>
</tr>
</tbody>
</table>

Notes: A = all year; S = summer; R = rare occurrence; 0 = does not occur.
Source: DoN, 2007d.
<table>
<thead>
<tr>
<th>Bird</th>
<th>Food Selection</th>
<th>Food Location of Feeding</th>
<th>Feeding Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Band-Rumped Storm Petrels</td>
<td>Squid and small fish from ocean surface; few crustaceans</td>
<td>Internal wave crests at or just below surface</td>
<td>Aerial dipping</td>
</tr>
<tr>
<td>(Oceanodroma castro)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bonaparte’s Gulls</td>
<td>Small fish, krill, amphipods, and insects such as snails, marine worms, grasshoppers, beetles, locusts, ants, and bees</td>
<td>Shallow (&lt; 0.9 m [3 ft]) habitats including lakes, ponds, muskegs, rivers, large bays, coastal estuaries, tidal rips, surf, and open ocean</td>
<td>Plunge-diving, aerial dipping, surface-seizing, surface-dipping, jump-plunging, and walking</td>
</tr>
<tr>
<td>(Larus philadelphia)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridled Terns</td>
<td>Primarily small schools of fish near the ocean’s surface, crustaceans, and</td>
<td>Air-sea boundary layer, typically 0.9 to 2.1 m (3 to 7 ft) above and on sea surface</td>
<td>Aerial dipping (pecking)</td>
</tr>
<tr>
<td>(Sterna anaethetus)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown Pelicans</td>
<td>Primarily small schools of fish near the ocean’s surface such as menhaden and mullet along Atlantic and Gulf Coasts</td>
<td>Shallow habitats within 20 km (11 NM) of shore</td>
<td>Plunge-dives and aerial diving</td>
</tr>
<tr>
<td>(Pelecanus occidentalis)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Double-Crested Cormorants</td>
<td>Mostly slow-moving schooling species; occasionally insects, amphibians, and crustaceans</td>
<td>Shallow open water (&lt; 7.9 m [26 ft] deep) and close to shore (&lt; 5.6 km [3 NM])</td>
<td>Plunge-diving</td>
</tr>
<tr>
<td>(Phalacrocorax auritus)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forster’s Tern</td>
<td>Primarily small fish; some arthropods</td>
<td>Shallow saltwater estuaries and coastal areas (&lt; 3 ft), over flood-tide mudflats, marshes, lakes, and water channels</td>
<td>Aerial diving</td>
</tr>
<tr>
<td>(Sterna forsteri)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gull Billed Terns</td>
<td>Terrestrial and aquatic animals such as insects, lizards, fish, and chicks of other birds</td>
<td>Beaches and salt marshes, inland over plowed fields, and shrubby habitats</td>
<td>Does not generally plunge-dive; Instead plucks food from the water</td>
</tr>
<tr>
<td>(Sterna nilotica)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horned Grebes</td>
<td>Fish and crustaceans, including amphipods and crayfish</td>
<td>Shallow- to moderately deep (&lt;6.1 m [20 ft]) habitats</td>
<td>Surface-swimming and plunge-diving</td>
</tr>
<tr>
<td>(Podiceps auritus)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laughing Gulls</td>
<td>Aquatic and terrestrial invertebrates such as earthworms, flying insects, beetles, snails, crabs, fish, and squid; garbage; and berries</td>
<td>Coastal edge and inland</td>
<td>Surface-dipping, walking, plunge-diving, and pirating food from other species</td>
</tr>
<tr>
<td>(Larus atricilla)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 3.2-5 (cont’d)

**Foraging Habits of Seabirds Occurring in OPAREAs**

<table>
<thead>
<tr>
<th>Bird</th>
<th>Food Selection</th>
<th>Food Location of Feeding</th>
<th>Feeding Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least Terns (Sterna antillarum)</td>
<td>Small fish, shrimp, and other invertebrates</td>
<td>Shallow water habitats such as marine coasts, bays, lagoons, estuaries, river and creek mouths, tidal marshes, and lakes</td>
<td>Plunge-diving</td>
</tr>
<tr>
<td>Parasitic Jaegers (Stercorarius parasiticus)</td>
<td>Depends on breeding populations, but can include birds, eggs, and rodents</td>
<td>Near colonies of nesting seabirds</td>
<td>Plunge-diving and pirating food from other species</td>
</tr>
<tr>
<td>Sandwich Terns (Sterna sandvicensis)</td>
<td>Small marine fish, squid, and crustaceans</td>
<td>Coastal marine areas such as open ocean and bays, inlets, and outflows; usually &lt; 1.9 km [1 NM] off shore</td>
<td>Plunge-diving</td>
</tr>
<tr>
<td>Sooty Terns (Sterna fuscata)</td>
<td>Small pelagic fish and squid; feeds over large predatory fish including tuna</td>
<td>Within 10 cm (4 in) of the ocean surface, far at sea in tropical, and subtropical oceanic waters</td>
<td>Plunge-diving</td>
</tr>
</tbody>
</table>

Sources: Braune, 1987, Slotterback, 2002; Burger and Gochfeld, 2002; Burger and Gochfeld, 1996; Haney et al., 1999; Shields, 2002; Hatch and Weseloh, 1999; McNicholl et al., 2001; Parnell et al., 1995; Palmer, 1962; Stedman, 2000; Burger, 1996; Thompson et al., 1997; Wiley and Lee, 1999; Muller and Storer, 1999; Shealer, 1999; Schreiber et al., 2002.
3.2.8 Endangered and Threatened Species

Section 7(a)(2) of the ESA of 1973 (as amended in 1978 and 1982) requires federal agencies to ensure that their actions do not jeopardize the continued existence of any listed endangered or threatened species or result in the destruction or adverse modification of designated critical habitat. A species is considered “endangered” if it is in danger of extinction throughout all or a significant portion of its range, and “threatened” if it is likely to become endangered in the foreseeable future due to any of the following factors (Section 4(a)(1)(A – E), 1982 amendment):

- Present or threatened destruction, modification, or curtailment of its habitat or range
- Overutilization for commercial, recreational, scientific, or educational purposes
- Disease or predation
- Inadequacy of existing regulatory mechanisms
- Other natural or manmade factors affecting its continued existence.

3.2.8.1 Fish

This section discusses ESA-listed fish species, candidate species for ESA-listing, and species of concern whose distribution overlaps at least one of the four proposed USWTR range sites or trunk cable corridors. Appendix A provides tables of fish species that may occur in each of the four range sites and/or cable corridors, including the species covered in this section. Candidate ESA species have sufficient information on their biological status and threats available to propose them as endangered or threatened under the ESA, but the development of a proposed listing regulation is precluded by other higher priority listing activities (USFWS, 2009).

3.2.8.1.1 ESA Species

Federally endangered or candidate fish with distribution ranges that overlap at least one of the four proposed USWTR locations or their trunk cable areas are:

- Shortnose sturgeon, *Acipenser brevirostrum*
- Smalltooth sawfish, *Pristis pectinata*
- Atlantic sturgeon, *Acipenser oxyrinchus oxyrinchus* (candidate species)

**Shortnose Sturgeon**

The endangered shortnose sturgeon is an anadromous species that does not appear to make long distance offshore migrations. Shortnose sturgeon occur in most major river systems along the eastern seaboard of the United States. In the southern portion of their range, they are found in the St. Johns River in Florida; the Altamaha, Ogeechee, and Savannah Rivers in Georgia; and, in South Carolina, in the river systems that empty into Winyah Bay and the Santee/Cooper River complex that forms Lake Marion. Data are lacking for the rivers of North Carolina. In the northern portion of their range, shortnose sturgeon are found in the Chesapeake Bay system; the
Delaware River from Philadelphia, Pennsylvania, to Trenton, New Jersey; the Hudson River in New York; the Connecticut River; the lower Merrimack River in Massachusetts; the Piscataqua River in New Hampshire; the Kennebec River in Maine; and the St. John River in New Brunswick, Canada (NMFS, 1998d).

South of Chesapeake Bay, the largest sustaining populations of shortnose sturgeon inhabit rivers, bays/sounds, and nearshore areas in the vicinity of river mouths (Moser and Ross, 1995; Collins et al., 1996; Collins and Smith, 1997; Hoehn, 1998; Collins et al., 2002; Center for Biological Diversity, 2007). These southern populations are relatively small, with estimated adult populations ranging from fewer than 50 (i.e., Cape Fear River) to more than 1,000 individuals (i.e., Savannah and Altamaha rivers) (Center for Biological Diversity, 2007). These include the following populations:

- Savannah River, South Carolina, and Altamaha River, Georgia (>1,000 fish)
- Winyah Bay, South Carolina/North Carolina, and Ogeechee River, Georgia (<1,000 fish)
- Cape Fear River drainage, North Carolina; Santee and Cooper rivers/ Ashepoo, Combahee, and Edisto rivers (“ACE” Basin), South Carolina; Satilla River, Georgia; and St. Marys and St. Johns rivers, Florida (<100 fish)

Shortnose sturgeon appear to spend most of their life in their natal river systems, only occasionally entering the marine environment. When captured in the ocean, they are usually taken close to shore (NMFS, 1998d). Therefore, they are not expected to be found as far offshore as the range sites and occurrence in the offshore portions of the trunk cable corridor would be rare.

With respect to the USWTR Site A, shortnose sturgeon are extremely rare and restricted to the lower St. Johns River basin from the Atlantic Ocean upstream to Lake George and Lake Crescent (Hoehn, 1998). The Florida Fish and Wildlife Research Institute (FWRI) and USFWS began research on the population status and distribution of the species in St. Johns River in 2001. After approximately 4,500 hours of gill-net sampling of the estuarine section of the river (between the confluence of the Oklawaha River below Lake George and Jacksonville) from January through August of 2002 and 2003, only one shortnose sturgeon was captured, near Federal Point between Palatka and Bostwick (FFWCC-FWRI, 2007b). In addition, after 21,381 hours of gill-net sampling for other species from 1980 through 1993, there were no incidental captures of sturgeon (FFWCC-FWRI, 2007b). Based on a lack of suitable reproductive habitat (required rocky or gravel substrate or limestone outcappings), reproduction documentation, occurrence of specimens in numerous thermal refuges (springs), and lack of large adults (all known specimens have been less than 4.5 kg [10 lbs]), it is highly unlikely that any sizable population of the shortnose sturgeon currently exists in the St. Johns River or its tributaries (FFWCC-FWRI, 2007b). Given this marginal habitat and low population density, it can be determined that the
shortnose sturgeon has not actively spawned in the system and that the infrequent catches are transients from other river systems (FFWCC, 2005d; Holder, 2007).

Since the current distribution of this species is in estuarine/coastal areas, and because the species has not been reported other than in coastal areas, except on extremely rare occasions, the shortnose sturgeon is not expected to be present within the USWTR range at any of the sites. The shortnose sturgeon may occur in nearshore areas of the trunk cable corridor area at all sites, although these occurrences would be rare based on the limited number of individuals observed in these areas.

**Smalltooth Sawfish**

The endangered smalltooth sawfish was once prevalent throughout Florida waters and found from Texas to North Carolina. However, the current Atlantic range is limited to areas south of St. John’s County, Florida through the Florida Keys (NMFS, 2006o), with the highest concentrations in areas around the marine and estuarine sections of the Everglades National Park (Simpfendorfer and Wiley, 2006). The Mote Marine Laboratory Sawfish Encounter Database had 667 verified smalltooth sawfish encounters from 1999 to 2005, with the vast majority occurring within Florida waters (Simpfendorfer and Wiley, 2006). Most of the Florida east coast encounters occur south of 27°N, from Cape Canaveral to St. Lucie Inlet (Simpfendorfer and Wiley, 2005b). No encounters were recorded in the Site A USWTR range or corridor.

Sawfish, in general, inhabit the shallow coastal waters of most warm seas throughout the world. They are found very close to shore in muddy and sandy bottoms, seldom descending to depths greater than 10 m (32 ft). They are often found in sheltered bays, on shallow banks, and in estuaries or river mouths (NMFS, 2006o). The current distribution of the smalltooth sawfish is limited to peninsular Florida, and because the species is rarely found offshore or north of St. Augustine, Florida, the smalltooth sawfish is not expected to occur within any of the USWTR trunk cable corridor areas or within the boundaries of any of the proposed range sites.

**Atlantic Sturgeon**

Atlantic sturgeon is a candidate species that ranges from Canada to Florida. It is also listed as a species of concern (NMFS, 2009d). Populations of the Atlantic sturgeon declined under heavy fishing pressure from the 1950s to the 1990s, when a federal moratorium on harvest was placed in effect (NMFS, 2009f). The Atlantic sturgeon is managed under a specific FMP by the Atlantic States Marine Fisheries Commission (ASFMC) (ASFMC, 1990, 1998, 2006).

Atlantic sturgeon are anadromous and spend most of their adult life in the marine environment. Adults generally migrate upriver from February to March in southern systems and from April to May in mid-Atlantic systems (ASSRT, 2007). Following spawning, females leave for marine environments within four to six weeks after spawning and males leave in fall (NMFS, 2009f).
Atlantic sturgeon deposit their eggs on hard surfaces on the bottom where they adhere for four to six days until hatching (Shepard, 2006). Juvenile sturgeon remain in the freshwater/estuary system for three to five years before migrating to the nearshore coastal marine environment as adults. Data indicate that subadult and adult Atlantic sturgeon may travel widely once they enter the marine environment. Coastal features or shorelines where migratory Atlantic sturgeon commonly aggregate include the Bay of Fundy, Massachusetts Bay, Rhode Island, New Jersey, Delaware, Delaware Bay, Chesapeake Bay, and North Carolina (ASSRT, 2007). Atlantic sturgeon are long lived with a lifespan of up to 60 years for females and about 30 years for males (Shepard, 2006).

Atlantic sturgeon are currently found in 35 rivers along the Atlantic coast of the U.S. (NMFS, 2009f), covering the geographic range where the four sites occur. However, they are not expected to be found as far offshore as any of the range sites and occurrence in the inshore area of the trunk cable would be rare at all four sites.

3.2.8.1.2 Species of Concern

The ranges of 11 species of concern overlap at least one of the four proposed range sites or trunk cable corridors. These include:

- Alewife, *Alosa pseudoharengus*
- Atlantic sturgeon (candidate species previously discussed)
- Barndoor skate, *Dipturus laevis*
- Blueback herring, *Alosa aestivalis*
- Dusky shark, *Carcharhinus obscurus*
- Ivory tree coral, *Oculina varicosa*
- Nassau grouper, *Epinephelus striatus*
- Night shark, *Carcharhinus signatus*
- Sand tiger shark, *Carcharias taurus*
- Speckled hind, *Epinephelus drummondhayi*
- Warsaw grouper, *Epinephelus nigritus*

**Alewife and Blueback Herring**

Alewife and blueback herring are managed collectively as ‘river herring’ by the FMP for Shad and River Herring, due to the difficulty in distinguishing the two species (VIMS, 2003, ASFMC 2008). Both species are species of concern, collectively support commercial fisheries (VIMS, 2004a, b), and have experienced a 90 percent drop in commercial landings from 1985 to 1998 (ASFMC, 2008). The observed population decline is believed to be due to a combination of freshwater habitat loss and degradation, overfishing, and increased predation from the recovering striped bass population (NMFS, 2007r). Both species are anadromous (VIMS, 2007a, b), spending most of their lives in the marine environment. The breeding habits of the two species
do not differ largely, except that the blueback runs later in the season, does not run up as far, and does not spawn until the water is much warmer (Bigelow and Schroeder, 1953).

The alewife occurs from Newfoundland to South Carolina and is most abundant in the mid-Atlantic and Northeast (VIMS, 2007b). Alewife are a highly-migratory, pelagic schooling species (VIMS, 2004a). Alewife spawn in coastal rivers in the southern portions of their range and migrate northward with water temperatures, overwintering in deeper waters further from shore (VIMS, 2004a).

Blueback herring are pelagic schooling fish that are distributed from Canada to the St. Johns River in Florida, with their highest abundance from the Chesapeake Bay and southward (VIMS, 2003, 2004b, 2007a). Blueback herring spawn from late March to mid-May and school at sea the rest of the year, overwintering near the bottom (NMFS, 2007r).

Both blueback herring and alewife are expected to occur in all the range and corridor areas of all four alternative USWTR sites, with the sole exception being that alewife is not expected to occur at Site A, which is beyond the southern extent of its range.

**Barndoor Skate**

The barndoor skate is a bottomfish ranging from Canada to North Carolina (Packer et al., 2003), but is most commonly found in the Gulf of Maine and southern New England (NMFS, 2007t). Barndoor skate are found over mud, sand and gravel substrates (Bigelow and Schroeder, 1953) at a wide depth distribution (Packer et al., 2003), preferring depths of 10 to 140 m (32 to 460 ft) (NMFS, 2007t). They migrate into shallower and more northern waters in summer (Bigelow and Schroeder, 1953; NMFS, 2007t). The numbers of this slow-growing species have declined, as it is caught as bycatch in commercial trawl nets and scallop dredges (Packer et al., 2003, NMFS, 2007t). It is expected to occur in the range and trunk cable corridor areas of Sites C and D.

**Dusky Shark**

The dusky shark, also known as the bronze whaler or black whaler, occurs worldwide from the surf zone to depths of 400 m (1,312 ft) (Compagno, 1984a; Branstetter, 2002a). Along the east coast of the U.S., the dusky shark ranges from Massachusetts to the Caribbean Sea (Compagno, 1984a; Castro, 1993). Major nursery areas have been identified in coastal waters from Massachusetts to the South Carolina coast (Castro, 1993; McCandless et al., 2002). The dusky shark undertakes seasonal, temperature-related migrations on both coasts of the U.S., migrating northward in summer as the waters warm and retreating southward in fall (Compagno, 1984a; NMFS, 2003c). Its stock is considered overfished, and is subject to continued recreational overfishing (NMFS, 2006k). It is expected to occur on the range and in trunk cable areas of all four sites.
Ivory Tree Coral

Ivory tree coral ranges from Cape Hatteras, North Carolina to the Caribbean (NMFS, 2007u), forming unique thicket-type structures in hard bottom habitats at depths of approximately 70 to 152 m (223 to 500 ft) (NMFS, 2007u). The main U.S. population of concern is off east-central Florida in an area known as the Oculina banks (NMFS, 2007u). Documented ivory tree coral declines have been linked to habitat damage (NMFS, 2007u).

In recent years ivory tree coral has declined in the Onslow Bay area because it has been outcompeted by brown algae (i.e., Sargassum, Dictyopterus, Zonaria, and Dictyota), forcing it into deeper, darker water (Miller and Hay, 1996; Street et al., 2005). Ivory tree coral may occur in parts of the proposed trunk cable corridor of Sites A, B, and C.

Nassau Grouper

The Nassau grouper occurs from Puerto Rico to northern North Carolina waters (NMFS, 2008c). They are a top predator and are generally found associated with coral habitats or caves or large overhangs from inshore to a depth of about 100 m (328 ft) (NMFS, 2008c). There is some evidence of specific spawning aggregation sites, disturbance of which could have a strong impact on stocks (NMFS, 2008c). It is illegal to possess Nassau groupers in the U.S., but there is still fishing pressure in the Caribbean (NMFS, 2008c). Recently, the SAFMC established eight Snapper-Grouper MPAs (see Subchapter 3.2.4) to provide protection for species including the slow-growing Nassau grouper. This species may occur in reef habitats within the range and trunk cable area of Sites A, B, and C.

Night Shark

Night sharks inhabit waters from Delaware south to Argentina, including the Gulf of Mexico (Barzan, 1999), and have been recorded making seasonal migrations (Compagno, 1984a). Night sharks are a deepwater species found in depths from 275 to 365 m (900 to 1,200 ft) during the day, migrating up to 185 m (610 ft) at night (Compagno, 1984a; NMFS, 2009c). No information exists on nursery locations for this species (NMFS 1999d). The night shark is listed as a Prohibited Species in the U.S. and is listed as a candidate species (NMFS, 1999d). The species is caught as by-catch on pelagic longline fisheries and subject to continued overfishing pressure due to its low rate of population increase (NMFS 2006k). It is expected to occur in the benthopelagic areas of the range and trunk cable area of Sites A, B, C, and D.

Sand Tiger Shark

In the western Atlantic, the sand tiger shark occurs from Newfoundland to Argentina (NMFS, 2009g). They are generally coastal and found in demersal areas of shallow bays and coral or rocky reefs at depths less than 20 m (66 ft), but also can be found to depths of 191 m (627 ft) over the continental shelf (Compagno 1984b; NMFS 1999d; Branstetter 2002b). The sand tiger shark is managed under the HMS FMP (NMFS, 2009g). In Florida, sand tiger sharks are born.
from November to February and migrate northward to summer habitat from Delaware Bay to Cape Cod, MA (Castro, 1983). Atlantic populations declined due to shark fishing in the 1980s and 1990s, and this slow-growing and slow-reproducing species has not shown signs of recovering (NMFS, 2009g). It is expected to occur in reef habitats within the range and trunk cable corridor of all four sites.

**Speckled Hind**

Speckled hind ranges from North Carolina to the Bahamas (Manooch, 1988). It typically inhabits hard bottom habitats in warm waters with depths of 25 to 400 m (82 to 1,312 ft), being most commonly found from 60 to 120 m (197 to 394 ft) (Manooch, 1988; SAFMC, 2007d; 2003). Smaller individuals are found in waters further inshore. Eggs are pelagic and larvae remain in surface waters until maturation, when they migrate to bottom habitats (Manooch, 1988). Adults, which are typically solitary, are found in high and low profile hard bottom habitats (SAFMC 1998a, 2003). Spawning aggregations are formed from July to September offshore with specific locations recorded off South Carolina (Manooch, 1988; SAFMC, 2003). Speckled hind is a species of concern from North Carolina-southward (NMFS, 2004) due to high numbers of bycatch in commercial fisheries and declining catch numbers (NMFS, 2009h). EFH has been designated for the speckled hind under the Final Habitat Plan for the South Atlantic Region by the SAFMC (SAFMC, 1998a), and recent Snapper-Grouper MPAs have been designated to aid in species recovery (see Subchapter 3.2.4). Speckled hind is expected to occur in the demersal habitats within the range and trunk cable corridor of Sites A, B, and C.

**Warsaw Grouper**

The Warsaw grouper is found from Massachusetts to the Gulf of Mexico, most often being found south of North Carolina (Manooch, 1988; NMFS, 2004; SAFMC, 2003). Adults utilize irregular benthic habitats (steep cliffs, notches, valleys, rocky ledges, and drop-offs) at depths ranging from 55 to 525 m (180 to 1,700 ft) (Manooch, 1988; NMFS, 2009e; SAFMC, 1998a). Juveniles are found closer to shore around jetties or shallow reefs (SAFMC, 2003). Eggs and larvae are pelagic, occurring from North Carolina to the southern tip of Florida (SAFMC, 1998a). Few data exist on the reproductive habits and spawning locations of this species, or if they form spawning aggregations (Coleman et al., 2000). Spawning has been reported off Cuba from April to May (SAFMC, 2003). Warsaw groupers are caught as incidental catch in the deepwater snapper/grouper fishery and overfishing is still occurring in the SAB (NMFS, 2006k). The Warsaw grouper is expected to occur within the range trunk cable corridor of all four sites.

### 3.2.8.2 Sea Turtles

As previously mentioned in Subchapter 3.2.5, all five sea turtle species found in the Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs are listed as threatened or endangered.

- Loggerhead sea turtle (*Caretta caretta*) – threatened
Green sea turtle (*Chelonia mydas*) – endangered (while green sea turtles are listed as threatened, the Florida and Mexican Pacific coast nesting populations are listed as endangered)

Kemp’s (Atlantic) Ridley sea turtle (*Lepidochelys kempi*) – endangered

Hawksbill sea turtle (*Eretmochelys imbricata*) – endangered

Leatherback sea turtle (*Dermochelys coriacea*) – endangered

### 3.2.8.3 Seabirds

The USFWS identifies two species of seabirds as endangered or threatened in some or all of the range areas:

- Bermuda petrel (*Pterodroma cahow*)
- Roseate tern (*Sterna dougallii*)

The Bermuda petrel is listed as endangered throughout its entire range in the U.S. (USFWS, 2006b). The Bermuda petrel was thought to be extinct for nearly 300 years until it was rediscovered in the first half of the twentieth century (National Geographic, 2001; BirdLife International, 2006d). It has been listed as endangered since 1970, primarily due to its small population size, which is estimated at 250 birds (USFWS, 2006c; IUCN, 2006). A record number of young (40) fledged in 2003 and another 35 fledged in 2005, indicating that the Bermuda petrel is slowly but steadily recovering (BirdLife International, 2006).

When not breeding in Bermuda, the Bermuda petrel may be distributed throughout the North Atlantic, but is primarily found in the warm waters of the Gulf Stream between Bermuda and North Carolina. In recent years, several confirmed sightings have occurred off of the coast of North Carolina, where the Gulf Stream separates from the U.S. coast and flows away from shore into the Atlantic (National Geographic, 2001; BirdLife International, 2006). With such a low worldwide population estimate (250 individuals) in addition to a distributional overlap with the black-capped petrel (*Pterodroma hasitata*), whose appearance is similar, it is difficult to identify the full range of the species (BirdLife International, 2006; NatureServe, 2006a).

Sightings of the Bermuda petrel occur off the North Carolina coast and in the Cherry Point, OPAREA and possibly the VACAPES OPAREA in late spring and summer; however, non-breeding adults and juveniles may also be present in this region at other times of the year (National Geographic, 2001; Avibase, 2003). Outside of the breeding season, Bermuda petrels are most likely to move north of Bermuda and follow the western/northern wall of the Gulf Stream while foraging, increasing the likelihood that individuals could occur in the VACAPES OPAREA (BirdLife International, 2006).

The northeastern breeding population of roseate terns is listed as endangered under the ESA. The range of this population extends along the U.S. Atlantic coast from Canada south to North Carolina (USFWS, 1993b, 2001c). Roseate terns in this population are known to occur in Maine, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, North Carolina, and Virginia
as well as in Newfoundland, Nova Scotia, and Quebec. Beyond the northeastern region, the roseate tern is listed as threatened in the western hemisphere and adjacent oceans, essentially wherever it is not listed as endangered. Threatened populations are known to occur in Florida, Georgia, North Carolina, South Carolina, Puerto Rico, and the USVI (NatureServe, 2006c). The global population is estimated to be 40,000 breeding pairs. The northeastern population has been fluctuating at around 3,500 pairs, recording a low of 3,125 pairs in 1992 and a high of 3,775 pairs in 1996 (BirdLife International, 2006; USFWS, 1993b). In 1993, the Caribbean population was estimated to be between 5,000 and 8,500 pairs, with 350 of those pairs breeding in the Florida Keys (USFWS, 1993b).

In the Atlantic, the northeastern breeding population is concentrated in isolated colonies mainly between Cape Cod, Massachusetts, and Long Island, New York. Smaller groups of breeding or wandering birds may be encountered farther south along the U.S. Atlantic coast and may be a mix of both the northeastern population and the Caribbean population (Sibley, 2000). Fifty percent of the northeastern population of roseate terns breeds within Buzzard’s Bay, Massachusetts (Perkins et al., 2003). Additionally, a Caribbean population breeds in the Florida Keys, the Bahamas, the West Indies, and in other locations in central and northern South America. Non-breeding populations are found in and around the Bahamas, Cuba, and the Lesser Antilles (USFWS, 1993; NatureServe, 2006c). Based on this information, the roseate tern may occur at any of the four OPAREAs.

In addition, the Atlantic coastal population of least terns (Sterna antillarum) is not listed under the ESA but the interior U.S. population of least terns has been listed as endangered under the ESA since 1985 (USFWS, 1985). The least tern occurs regularly throughout all of the Atlantic OPAREAs during the breeding season of May through June. Least terns breed adjacent to all of the Atlantic OPAREAs from Maine south to Florida (NatureServe, 2006b). As the least tern population migrates to South America to overwinter (NatureServe, 2006b), they are not expected to be as common in the vicinity of the Atlantic OPAREAs during the non-breeding season, although stray individuals may be observed.

### 3.2.8.4 Mammals

Federally endangered marine mammals that may occur within the vicinity of the four proposed range locations are as follows:

- Fin whale, *Balaenoptera physalus*
- Humpback whale, *Megaptera novaeangliae*
- North Atlantic right whale, *Eubalaena glacialis*
- Sei whale, *Balaenoptera borealis*
- Blue whale, *Balaenoptera musculus*
- Sperm whale, *Physeter macrocephalus*
- West Indian manatee, *Trichechus manatus*
Subchapter 3.2.6 provided information on these marine mammal species, including the likelihood of the species’ occurring in the proposed USWTR locations A, B, C, or D in the Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs, respectively.
3.3 Acoustical Environment

Within the oceans the only form of energy that travels efficiently is sound; for instance, radio and other electromagnetic waves are attenuated in water at a much greater degree than sound. The ability to use sound as an effective sensing medium in the ocean is dependent on the level of background noise (ambient noise) as it relates to the signal, or sound being received, and the physical factors of the ocean that affect the rate at which sound energy is lost.

This subchapter:

- Describes the phenomena and sources of sound within the marine environment (Subchapter 3.3.1).
- Discusses a screening process to define the marine animal species that need to be considered from an acoustical effect perspective (Subchapter 3.3.2).
- Provides an estimation of the density of those screened marine mammal species that will be considered from an acoustical effect perspective (Subchapter 3.3.3).

3.3.1 Sound in the Environment

Ambient sound in the environment comes from physical, biological, and anthropogenic sources. Table 3.3-1 provides example intensities (source level) of various underwater sound producers. Figure 3.3-1 illustrates the frequencies of each sound source.

3.3.1.1 Physical Sources of Sound

Physical processes that create sound in the ocean include rain, wind, waves, lightning striking the sea surface, undersea earthquakes, and eruptions from undersea volcanoes (Scowcroft et al., 2006). Generally, these sound sources contribute to a rise in the ambient sound levels on an intermittent basis. Rain produces sound in much the same manner as does wind; however, rain sound differs from wind sound in that its peak contribution to the field occurs at a slightly higher frequency, typically between 1 and 3 kilohertz (kHz). Even at moderate rain rates, the sound generated at these frequencies can easily exceed contributions from wind. For instance, the onset of rain raises high-frequency sound levels by 10 dB or more (U.S. Air Force, 2002).

Wind produces sound in frequencies between 0.1 and 30 kHz, while wave generated sound is a significant contributor in the infrasonic range (i.e., 0.001 to 0.020 kHz) (Simmonds et al., 2004). In addition, seismic activity results in the production of low-frequency sounds that can be heard for great distances (Discovery of Sound in the Sea [DOSITS], 2007). For example, in the Pacific Ocean, sounds from a volcanic eruption have been heard thousands of miles away (DOSITS, 2007).
INTERMITTENT AND LOCAL EFFECTS

Earthquakes and Explosions

Biologics

Precipitation

Ships, Industrial Activity

Sea Ice

Molecular Agitation

Bubbles and Spray (Surface Agitation)

Ocean Traffic

Turbulent Pressure Fluctuations (Surface Waves-Second Order Pressure Effects)

PREVAILING NOISES

Wind-Dependent and Spray Noise

Heavy Precipitation

Heavy Traffic Noise

Figure 3.3-1

Source: adapted from Wenz, 1962.
Table 3.3-1
Source Levels of Common Underwater Sound Producers

| Source                              | Source Level  
<table>
<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>(decibels referenced to 1 micro Pascal at 1 meter)</td>
</tr>
<tr>
<td>Jet ski</td>
<td>75-125</td>
</tr>
<tr>
<td>Dolphin whistles</td>
<td>125-173</td>
</tr>
<tr>
<td>Humpback whale song</td>
<td>144-174</td>
</tr>
<tr>
<td>Blue whale</td>
<td>165</td>
</tr>
<tr>
<td>Snapping shrimp</td>
<td>183-189</td>
</tr>
<tr>
<td>Supertanker (340 meters long)</td>
<td>190</td>
</tr>
<tr>
<td>ATOC Acoustic Thermometry Source</td>
<td>195</td>
</tr>
<tr>
<td>Fishing vessel (12 meters long)</td>
<td>150</td>
</tr>
<tr>
<td>Earthquake</td>
<td>210</td>
</tr>
<tr>
<td>Mid-frequency Naval Sonar</td>
<td>235</td>
</tr>
<tr>
<td>Sperm whale click</td>
<td>236</td>
</tr>
<tr>
<td>Lightning strike</td>
<td>260</td>
</tr>
</tbody>
</table>

Notes: ATOC = Acoustic Thermometry of Ocean Climate
Sources: Scowcroft et al., 2006; Inter-Agency Committee on Marine Science and Technology (IACMST), 2006; NOAA Pacific Marine Environmental Laboratory, 2007; and Simmonds et al., 2004

3.3.1.2 Biological Sources of Sound

Marine animals use sound to navigate, communicate, locate food, reproduce, and protect themselves underwater (Scowcroft et al., 2006). For example, reproductive activity, including courtship and spawning, accounts for the majority of sounds produced by fish. During the spawning season, croakers vocalize for many hours and often dominate the acoustic environment (Scowcroft et al., 2006). In addition, toothed whales and dolphins (odontocetes) produce a wide variety of sounds including clicks, whistles, and pulsed sounds. Marine life of various types can raise sound levels near 20 dB (e.g., dolphin whistles), in the range of a few kHz (e.g., crustaceans and fish), and in the tens to hundreds of kHz (e.g., dolphin clicks). For instance, bottlenose dolphin clicks and whistles have a dominant frequency range of 110 to 130 kHz and 3.5 to 14.5 kHz, respectively (Au, 1993; Ketten, 1998). In addition, sperm whale clicks range in frequency from 0.1 kHz to 30 kHz, with dominant energy in two bands (2 to 4 kHz and 10 to 16 kHz) (Thomson and Richardson, 1995). Figure 3.3-1 illustrates the variability from all of these potential sound sources.

3.3.1.3 Anthropogenic Sources of Sound

Anthropogenic (man-made) sound is introduced into the ocean by a number of sources, including vessel traffic, industrial operations onshore (pile driving), seismic profiling for oil exploration, oil drilling, and sonar operation for scientific research. In open oceans, the primary persistent anthropogenic sound source tends to be commercial shipping, since over 90 percent of global
trade depends on transport across the seas (Scowcroft et al., 2006). Specifically, there are approximately 20,000 large commercial vessels at sea worldwide at any given time. The large commercial vessels produce relatively loud and predominately low-frequency sounds. Most of these sounds are produced as a result of propeller cavitation (when air spaces created by the motion of propellers collapse) (Southall, 2005). In 2004, NOAA hosted a symposium entitled “Shipping Noise and Marine Mammals.” During Session I, Trends in the Shipping Industry and Shipping Noise, statistics were presented that indicate foreign waterborne trade into the United States has increased 2.45 percent each year over a 20 year period (1981 to 2001) (Southall, 2005). International shipping volumes and densities are expected to continually increase in the foreseeable future (Southall, 2005). The increase in shipping volumes and densities will most likely increase overall ambient noise levels in the ocean. However, it is not known whether these increases would have an effect on marine mammals (Southall, 2005).

High intensity, low frequency impulsive sounds are emitted during seismic surveys to determine the structure and composition of the geological formations below the sea bed in order to identify potential hydrocarbon reservoirs (i.e., oil and gas exploration) (Simmonds et al., 2004). One type of sound source is airguns. These devices rapidly release compressed air with source levels between 215 and 230 dB with a reference pressure of 1 micro Pascal (dB re 1 μPa), and the highest energies falling in the range of 0.01 to 0.3 kHz, into the water. Airgun shots are fired at 6 to 20 second (sec) intervals along transect lines at speeds ranging from 2 to 3 m/s (4 to 6 kt) at a depth of 4 to 10 m (13 to 33 ft) (Simmonds et al., 2004).

Commercial vessels have the highest sound levels at lower frequencies. Since sound propagation is most favorable at lower frequencies, particularly in deep water, surface ships can often be heard at distances greater than 100 km (54 NM). Thus, at many deep-water locations, it is not unusual for a low-frequency sound to be influenced by contributions from tens or even hundreds of surface ships (U.S. Air Force, 2002).

### 3.3.2 Acoustic Screening of Marine Species

As sound travels through water, it causes oscillatory motion of the water molecules and perturbations in the pressure. The number of complete oscillatory cycles that occur within one second of time is called the frequency, which has units of cycles per second (or hertz [Hz]). Navy sound sources are categorized as low, mid-, or high frequency:

- **Low frequency** – Below 1 kHz
- **Mid-frequency** – From 1 to 10 kHz (proposed USWTR operations would include mid-frequency sound sources)
- **High frequency** – Above 10 kHz (proposed USWTR operations include high frequency sound sources)
Animals hear at many different frequencies, which can vary not only between species but also from individual to individual. From an acoustical impact perspective, for a marine animal to be affected by the mid- and high frequency sound sources operating on the USWTR, it must:

- Be within the geographic area influenced by the active acoustics on one of the four potential USWTR sites.
- Possess structures that mechanically respond to sound energy produced by sources operating within the USWTR sites.

Species that did not meet these criteria were excluded from further consideration of acoustic effects in this OEIS/EIS.

With respect to the first criterion, Subchapter 3.2 presents a discussion of those marine animals that could be present at the four potential USWTR sites. Pinnipeds (seals and sea lions), for example, were addressed and ruled out from further analysis because they would not be present at the sites and, thus, are not of concern from an acoustical effect perspective.

With respect to the second criterion, in order for sound to have an effect on an animal, some organ or tissue must be capable of mechanically responding to the oscillatory sound wave. This means that the animal must possess mechanical structures that respond to the mid- and high frequencies generated by sources within the USWTR. Although most aquatic animals possess structures that respond to low frequency hydrodynamic motion (gross water motion), fewer animals possess structures that respond to mid- and high frequencies, where the influence of sound particle motion is diminished and sound pressure dominates. To mechanically respond to mid- and high frequency sound pressure, an animal must possess tissues that not only respond to those frequencies but also have an acoustic impedance different from water (an impedance mismatch). Thus, many organisms would be unaffected, even if they were in areas with high mid-frequency sound levels, because they do not have significant acoustic impedance mismatches or cannot detect mid-frequency sounds.

These factors immediately limit the types of organisms that could be adversely exposed to mid- and high frequency sound levels. For example, phytoplankton and zooplankton species have no sufficient impedance mismatches or tissues to respond mid- and high frequencies (the sound pulse would essentially pass through them without being detected). Therefore, phytoplankton and zooplankton do not have the potential to be physically affected by the operation of mid-frequency sound sources on the USWTR, and thus are not evaluated further in this OEIS/EIS.

In contrast, all vertebrates have specialized organs for hearing. Vertebrates, especially those species whose bodies contain air-filled cavities (e.g., lungs, sinuses), offer a high impedance contrast with water, and hence are potentially susceptible to mid- and high frequency sound sources on the USWTR.
In the case of species for which direct evidence of acoustic sensitivity is lacking, reasonable indirect evidence was used to support the evaluation (e.g., there is no direct evidence that a species hears mid-frequency sound but good evidence that the species produces mid-frequency sound). In cases where important biological information was not available or was insufficient for one species, but data were available for a related species, the comparable data were used. Particular attention was given to species with either special protected-population status or limited potential for reproductive replacement in the event of mortality.

### 3.3.2.1 Plankton and Benthic Invertebrates

Plankton has been categorically eliminated from further consideration in this OEIS/EIS because:

- They do not have delicate organs or tissues whose acoustic impedance is significantly different from water or that can respond to mid- and high frequency sound waves.
- There is no evidence of auditory capabilities in the frequency range to be used on the USWTR.

While some gelatinous plankton have air-filled bladders, they would not be affected by sources operating on the USWTR because of their extremely small size relative to the sound wavelengths.

Very little is known about sound detection and use of sound by invertebrates (Budelmann, 1992a, b; Popper et al., 2001). The limited data show that some crabs are able to detect sound, and there has been the suggestion that some other groups of invertebrates are also able to detect sounds. In addition, cephalopods (octopus and squid) and decapods (lobster, shrimp, and crab) are thought to sense low frequency sound (Budelmann, 1992b). Lovell et al. (2005) determined that prawns can hear between 100 and 3,000 Hz, with best hearing capabilities at 100 Hz. Packard et al. (1990) reported sensitivity to sound vibrations between 1-100 Hz for three species of cephalopods. Wilson et al. (2007) documents a lack of physical or behavioral response for squid exposed to experiments using high intensity sounds designed to mimic killer whale echolocation signals. In contrast, McCauley et al. (2000) reported that caged squid exhibit behavioral responses when exposed to impulsive sounds from a seismic airgun.

There has also been the suggestion that invertebrates do not detect pressure since few, if any, have air cavities that would function like the fish swim bladder in responding to pressure. It is important to note that some invertebrates, and particularly cephalopods, have specialized end organs, called statocysts, for determination of body and head motions that are similar in many ways to the otolithic end organs of fish. The similarity includes these invertebrates having sensory cells which have some morphological and physiological similarities to the vertebrate sensory hair cell, and the “hairs” from the invertebrate sensory cells are in contact with a structure that may bear some resemblance to vertebrate otolithic material (Budelmann, 1992a, b).
As a consequence of having statocysts, it is possible that these species could be sensitive to particle motion (Popper et al., 2001).

It is also important to note that invertebrates may have other organs that potentially detect the particle motion of sound, the best known of which are special water motion receptors known as chordotonal organs (e.g., Budelmann, 1992a). These organs facilitate the detection of potential predators and prey and provide environmental information such as the movement of tides and currents. In fact, fiddler crab (Uca sp.) and spiny lobster (Panulirus sp.) have both been shown to use chordotonal organs to respond to nearby predators and prey.

Given that the mid- and high frequency sounds of USWTR sources are not considered to be in the primary detection range of those invertebrate species that may possess the ability to detect sound, the potential for effects is negligible for invertebrate species that may inhabit the area during USWTR operations. Invertebrates, therefore, are not addressed further from an acoustical perspective in this OEIS/EIS.

3.3.2.2 Fish

Marine fish spend at least part of their life in salt water. All fish have two sensory systems that are used to detect sound in the water including the inner ear, which functions very much like the inner ear found in other vertebrates, and the lateral line, which consists of a series of receptors along the body of the fish (DoN, 2008p). The inner ear generally detects higher frequency sounds while the lateral line detects water motion at low frequencies (below a few hundred Hz) (Hastings and Popper, 2005). A sound source produces both a pressure wave and motion of the medium particles (water molecules in this case), both of which may be important to fish. Fish detect particle motion with the inner ear. Pressure signals are initially detected by the gas-filled swim bladder or other air pockets in the body, which then re-radiate the signal to the inner ear (DoN, 2008p). Because particle motion attenuates relatively quickly, the pressure component of sound usually dominates as distance from the source increases. A more detailed discussion of the lateral line can be found at the end of this section. Broadly, fishes can be categorized as either hearing specialists or hearing generalists (DoN, 2008p). Fishes in the hearing specialist category have a broad frequency range with a low auditory threshold due to a mechanical connection between an air filled cavity, such as a swimbladder, and the inner ear. Specialists detect both the particle motion and pressure components of sound and can hear at levels above 1 kHz. Generalists are limited to detection of the particle motion component of low frequency sounds at relatively high sound intensities (DoN, 2008p). It is possible that a species will exhibit characteristics of generalists and specialists and will sometimes be referred to as an “intermediate” hearing specialist. For example, most damselfish are typically categorized as generalists, but because some larger damselfish have demonstrated the ability to hear higher frequencies expected of specialists, they are sometimes categorized as intermediate.

Although hearing capability data only exists for fewer than 100 of the 29,000 fish species (DoN, 2008p), current data suggest that most species of fish detect sounds from 0.05 to 1.0 kHz, with
few fish hearing sounds above 4 kHz (DoN, 2008p; NRC, 2003). Moreover, studies indicate that hearing specializations in marine species are quite rare and that most marine fish are considered hearing generalists (Popper, 2003; Amoser and Ladich, 2005). Specifically, the following species are all believed to be hearing generalists: elasmobranchs (i.e., sharks and rays) (Casper et al., 2003; Casper and Mann, 2006; Myrberg, 2001), scorpaeniforms (i.e., scorpionfishes, searobins, sculpins) (Lovell et al., 2005), scombrids (i.e., albacores, bonitos, mackerels, tunas) (Iversen, 1967, 1969; Popper, 1981; Song et al., 2006), damselfishes (Egner and Mann, 2005; Kenyon, 1996; Wright et al., 2005, 2007), and more specifically, midshipman fish (*Porichthys notatus*) (Sisneros and Bass, 2003), Atlantic salmon (*Salmo salar*) (Hawkins and Johnstone, 1978), and Gulf toadfish (*Opsanus beta*) (Remage-Healey et al., 2006). Moreover, it is believed that the majority of marine fish have their best hearing sensitivity at or below 0.3 kHz (Popper, 2003). However, it has been demonstrated that marine hearing specialists, such as some Clupeidae, can detect sounds above 100 kHz. Table 3.3-2 provides a list of marine fish hearing sensitivities.

In contrast to marine fish, several thousand freshwater species are thought to be hearing specialists. Nelson (1994) estimates that 6,600 of 10,000 freshwater species are otophysans (catfish and minnows), which are hearing specialists. Interestingly, many generalist freshwater species, such as perciforms (percids, gobiids) and scorpaeniforms (sculpins) are thought to have derived from marine habitats (Amoser and Ladich, 2005). It is also thought that Clupeidae may have evolved from freshwater habitats (Popper et al., 2004). This supports the theory that hearing specializations likely evolved in quiet habitats common to freshwater and the deep sea because only in such habitats can hearing specialists use their excellent hearing abilities (Amoser and Ladich, 2005).

Some investigators (e.g., Amoser and Ladich, 2005) hypothesized that, within a family of fish, different species can live under different ambient noise conditions, which requires them to adapt their hearing abilities. Under this scenario, a species’ probability of survival would be greater if it increased, the range over which the acoustic environment, consisting of various biotic (sounds from other aquatic animals) and abiotic (wind, waves, precipitation) sources, can be detected (Amoser and Ladich, 2005). In the marine environment, Amoser and Ladich (2005) cite the differences in the hearing ability of two species of Holocentridae as a possible example of such environmentally-derived specialization. Both the shoulderbar soldierfish (*Myripristis kuntee*) and the Hawaiian squirrelfish (*Adioryx xantherythrus*) can detect sounds at 0.1 kHz. However, the high frequency end of the auditory range extends towards 3 kHz for the shoulderbar soldierfish but only to 0.8 kHz for the Hawaiian squirrelfish (Coombs and Popper, 1979). However, as these two species live in close proximity on the same reefs, it is not certain that differing environmental conditions cause the hearing variations (DoN, 2008p). Generally, a clear correlation between hearing capability and the environment cannot be asserted or refuted due to limited knowledge of ambient noise levels in marine habitats and a lack of comparative studies.
Table 3.3-2

Marine Fish Hearing Sensitivities

<table>
<thead>
<tr>
<th>Family</th>
<th>Description of Family</th>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Hearing Range (kHz)</th>
<th>Greatest Sensitivity (kHz)</th>
<th>Sensitivity Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albulidae</td>
<td>Bonefishes</td>
<td>Bonefish</td>
<td>Albula vulpes</td>
<td>0.1 0.7</td>
<td>0.3</td>
<td>generalist</td>
</tr>
<tr>
<td>Anguillidae</td>
<td>Eels</td>
<td>European eel</td>
<td>Anguilla anguilla</td>
<td>0.01 0.3</td>
<td>0.04-0.1</td>
<td>generalist</td>
</tr>
<tr>
<td>Ariidae</td>
<td>Catfish</td>
<td>Hardhead sea catfish</td>
<td>Ariopsis (Arius) felis*</td>
<td>0.05 1</td>
<td>0.1</td>
<td>generalist</td>
</tr>
<tr>
<td>Batrachoididae</td>
<td>Toadfishes</td>
<td>Midshipman</td>
<td>Opsi chthys notatus</td>
<td>0.065 0.385</td>
<td></td>
<td>generalist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gulf toadfish</td>
<td>Opsanus beta</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clupeidae</td>
<td>Herrings, shads, menhaden, sardines</td>
<td>Alewife</td>
<td>Alosa pseudoharengus</td>
<td>0.12</td>
<td></td>
<td>specialist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blueback herring</td>
<td>Alosa aestivalis</td>
<td>0.12</td>
<td></td>
<td>specialist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>American shad</td>
<td>Alosa sapidissima</td>
<td>0.1 0.18</td>
<td>0.2-0.8 and 0.025-0.15</td>
<td>specialist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gulf menhaden</td>
<td>Brevortia patronus</td>
<td>0.1</td>
<td></td>
<td>specialist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bay anchovy</td>
<td>Anchoa mitchilli</td>
<td>4</td>
<td></td>
<td>specialist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Scaled sardine</td>
<td>Harengula jaguana</td>
<td>4</td>
<td></td>
<td>specialist</td>
</tr>
<tr>
<td></td>
<td>Spanish sardine</td>
<td>Sardinella aurita</td>
<td></td>
<td>4</td>
<td></td>
<td>specialist</td>
</tr>
<tr>
<td></td>
<td>Pacific herring</td>
<td>Clupea pallasii</td>
<td></td>
<td>0.1 5</td>
<td></td>
<td>specialist</td>
</tr>
<tr>
<td>Chondrichthyes</td>
<td>Cartilaginous fishes, rays, sharks, skates</td>
<td></td>
<td></td>
<td>0.2 1</td>
<td></td>
<td>generalist</td>
</tr>
<tr>
<td>[Class]</td>
<td></td>
<td>Cod</td>
<td>Gadus morhua</td>
<td>0.002 0.5</td>
<td>0.02</td>
<td>generalist</td>
</tr>
<tr>
<td>Gadidae</td>
<td>Cods, gadiforms, grenadiers, hakes</td>
<td>Black goby</td>
<td>Gobius niger</td>
<td>0.1 0.8</td>
<td></td>
<td>generalist</td>
</tr>
<tr>
<td>Gobidae</td>
<td>Gobies</td>
<td>Shoulderbar soldierfish</td>
<td>Myripristis kuntee</td>
<td>0.1 3.0</td>
<td>0.4-0.5</td>
<td>specialist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hawaiian squirrelfish</td>
<td>Adioryx xantherythrus</td>
<td>0.1 0.8</td>
<td></td>
<td>generalist</td>
</tr>
<tr>
<td>Holocentridae</td>
<td>Squirrelfish and soldierfish</td>
<td>Tautog</td>
<td>Tautoga onitis</td>
<td>0.01 0.5</td>
<td>0.037-0.050</td>
<td>generalist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blue-head wrasse</td>
<td>Thalassoma bifasciatum</td>
<td>0.1 1.3</td>
<td>0.3-0.6</td>
<td>generalist</td>
</tr>
<tr>
<td>Labridae</td>
<td>Wrasses</td>
<td>Schoolmaster snapper</td>
<td>Lutjanus apodus</td>
<td>0.1 1.0</td>
<td>0.3</td>
<td>generalist</td>
</tr>
<tr>
<td>Lutjanidae</td>
<td>Snappers</td>
<td>Dab</td>
<td>Limanda limanda</td>
<td>0.03 0.27</td>
<td>0.1</td>
<td>generalist</td>
</tr>
<tr>
<td>Myctophidae</td>
<td>Lanternfishes</td>
<td>Warming’s lanternfish</td>
<td>Ceratoscopelus warmingii</td>
<td></td>
<td></td>
<td>specialist</td>
</tr>
<tr>
<td>Pleuronectidae</td>
<td>Flatfish</td>
<td>European place</td>
<td>Pleuronectes platessa</td>
<td>0.03 0.2</td>
<td>0.11</td>
<td>generalist</td>
</tr>
<tr>
<td>Pomadasyidae</td>
<td>Grunts</td>
<td>Blue striped grunts</td>
<td>Haemulon sciurus</td>
<td>0.1 1.0</td>
<td></td>
<td>generalist</td>
</tr>
<tr>
<td>Family</td>
<td>Description of Family</td>
<td>Common Name</td>
<td>Scientific Name</td>
<td>Hearing Range (kHz)</td>
<td>Greatest Sensitivity (kHz)</td>
<td>Sensitivity Classification</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------</td>
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<td>---------------------------</td>
<td>---------------------</td>
<td>---------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Pomacentridae</td>
<td>Damselfish</td>
<td>Sergeant major damselfish</td>
<td>Abudefduf saxatilis</td>
<td>0.1 1.6</td>
<td>0.1-0.4</td>
<td>Generalist/intermediate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bicolor damselfish</td>
<td>Stegastes partitus</td>
<td>0.1 1.0</td>
<td>0.5</td>
<td>Generalist/intermediate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nagasaki damselfish</td>
<td>Pomacentrus nagasakienis</td>
<td>0.1 2.0</td>
<td>&lt;0.3</td>
<td>Generalist/intermediate</td>
</tr>
<tr>
<td>Salmonidae</td>
<td>Salmons</td>
<td>Atlantic salmon</td>
<td>Salmo salar</td>
<td>&lt;0.1 0.58</td>
<td>generalist</td>
<td></td>
</tr>
<tr>
<td>Sciaenidae</td>
<td>Drums, weakfish, croakers</td>
<td>Atlantic croaker</td>
<td>Micropogonias undulates</td>
<td>0.1 1.0</td>
<td>0.3</td>
<td>generalist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spotted sea trout</td>
<td>Cynoscion nebulosus</td>
<td>generalist</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kingfish</td>
<td>Menticirrhus americanus</td>
<td>generalist</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spot</td>
<td>Leostomus xanthanus</td>
<td>0.2 0.7</td>
<td>0.4</td>
<td>generalist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Black drum</td>
<td>Pogonostomus cromis</td>
<td>0.1 0.8</td>
<td>0.1-0.5</td>
<td>generalist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Weakfish</td>
<td>Cynoscion regalis</td>
<td>0.2 2.0</td>
<td>0.5</td>
<td>specialist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Silver perch</td>
<td>Bairdiella chrysoura</td>
<td>0.1 4.0</td>
<td>0.6-0.8</td>
<td>specialist</td>
</tr>
<tr>
<td>Scombridae</td>
<td>Albacores, bonitos, mackerels, tunas</td>
<td>Bluefin tuna</td>
<td>Thunnus thynnus</td>
<td>1.0</td>
<td>generalist</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yellowfin tuna</td>
<td>Thunnus albacares</td>
<td>0.5 1.1</td>
<td>generalist</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kawakawa</td>
<td>Euthynnus affinoides</td>
<td>0.1 1.1</td>
<td>0.5</td>
<td>generalist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Skipjack tuna</td>
<td>Katsuwonus pelamis</td>
<td>generalist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scorpaenidae</td>
<td>Scorpionfishes, searobins, sculpins</td>
<td>Sea scorpion</td>
<td>Taurulus bualis</td>
<td>generalist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serranidae</td>
<td>Seabasses, groupers</td>
<td>Red hind</td>
<td>Epinephelus guttata</td>
<td>0.1 1.1</td>
<td>0.2</td>
<td>generalist</td>
</tr>
<tr>
<td>Sparidae</td>
<td>Porgies</td>
<td>Pinfish</td>
<td>Lagodon rhomboides</td>
<td>0.1 1.0</td>
<td>0.3</td>
<td>generalist</td>
</tr>
<tr>
<td>Triglidae</td>
<td>Scorpionfish, searobins, sculpins</td>
<td>Leopard searobin</td>
<td>Prionotus scatur</td>
<td>0.1 0.8</td>
<td>0.39</td>
<td>generalist</td>
</tr>
</tbody>
</table>

Notes: * Referenced as *Arius felis* by Popper and Tavolga, 1981

Sources: Astrup, 1999; Astrup and Møhl, 1993; Casper and Mann, 2006; Casper et al., 2003; Coombs and Popper, 1979; Dunning et al., 1992; Egner and Mann, 2005; Gregory and Clabburn, 2003; Hawkins and Johnstone, 1978; Higgs et al., 2004; Iversen, 1967, 1969; Jorgensen et al., 2004; Kenyon, 1996; Lovell et al., 2005; Mann et al., 1997, 2001, 2005; Myrberg, 2001; Nestler et al., 2002; Popper, 1981; Popper and Carlson, 1998; Popper and Tavolga, 1981; Ramcharitar and Popper, 2004; Ramcharitar et al., 2001, 2004, 2006; Remage-Healey, et al., 2006; Ross et al., 1996; Sisneros and Bass, 2003; Song et al., 2006; Wright et al., 2005, 2007; Seaworld, 2007; DoN, 2008p.
It has also been shown that susceptibility to the effects of anthropogenic sound can be influenced by developmental and genetic differences in the same species of fish. In an exposure experiment, Popper et al. (2007) found that experimental groups of rainbow trout (*Oncorhynchus mykiss*) had substantial differences in hearing thresholds. While fish were attained from the same supplier, it is possible different husbandry techniques may be reason for the differences in hearing sensitivity. These results emphasize that caution should be used in extrapolating data beyond their intent.

Among all fishes studied to date, perhaps the greatest variability is found within the family Sciaenidae (i.e., drumfish, weakfish, croaker), where there is extensive diversity in inner ear structure and the relationship between the swim bladder and the inner ear. Specifically, the Atlantic croaker’s (*Micropogonias undulatus*) swim bladder has forwardly directed diverticulae that come near the ear but do not actually touch it. However, the swim bladders in the spot (*Leiostomus xanthurus*) and black drum (*Pogonias cromis*) are further from the ear and lack anterior horns or diverticulae. These differences are associated with variation in both sound production and hearing capabilities (Ladich and Popper, 2004; Ramcharitar et al., 2006b). Ramcharitar and Popper (2004) discovered that the black drum responded to sounds from 0.1 to 0.8 kHz and was most sensitive between 0.1 and 0.5 kHz, while the Atlantic croaker responded to sounds from 0.1 to 1 kHz and was most sensitive at 0.3 kHz. Additional sciaenid research by Ramcharitar et al. (2006) investigated the hearing sensitivity of weakfish (*Cynoscion regalis*) and spot. Weakfish were found to detect frequencies up to 2 kHz, while spot detected frequencies only up to 0.7 kHz.

The sciaenid with the greatest hearing sensitivity discovered thus far is the silver perch (*Bairdiella chrysoura*), which has demonstrated auditory thresholds similar to goldfish, responding to sounds up to 4 kHz (Ramcharitar et al., 2004). Silver perch swim bladders have anterior horns that terminate close to the ear. The Ramcharitar et al. (2004) research supports the suggestion that the swim bladder can potentially expand the frequency range of sound detection. Furthermore, Sprague and Luczkovich (2004) calculated silver perch are capable of producing drumming sounds ranging from 128 to 135 dB. Since drumming sounds are produced by males during courtship, it can be inferred that silver perch detect sounds within this range.

The most widely noted hearing specialists are otophysans, which have bony Weberian ossicles, (bones that connect the swim bladder to the ear), along which vibrations are transmitted from the swim bladder to the inner ear (Amoser and Ladich, 2003; Ladich and Wysocki, 2003). However, only a few otophysans inhabit marine waters. In an investigation of a marine otophysan, the hardhead sea catfish (*Ariopsis felis*), Popper and Tavolga (1981) determined that this species was able to detect sounds from 0.05 to 1 kHz, which is considered a much lower and narrower frequency range than that common to freshwater otophysans (i.e., above 3 kHz) (Ladich and Bass, 2003). The difference in hearing capabilities in the respective freshwater and marine catfish appears to be related to the inner ear structure (Popper and Tavolga, 1981).

Experiments on marine fish have obtained responses to frequencies up to the range of ultrasound; that is, sounds between 40 to 180 kHz (University of South Florida, 2007). These responses were
from several species of the Clupeidae (i.e., herrings, shads, and menhadens) (Astrup, 1999); however, not all clupeid species tested have responded to ultrasound. Astrup (1999) and Mann et al. (1998) hypothesized that these ultrasound detecting species may have developed such high sensitivities to avoid predation by odontocetes. Studies conducted on the following species showed avoidance to sound at frequencies over 100 kHz: alewife (*Alosa pseudoharengus*) (Dunning et al., 1992; Ross et al., 1996), blueback herring (*A. aestivalis*) (Nestler et al., 2002), Gulf menhaden (*Brevoortia patronus*) (Mann et al., 2001) and American shad (*A. sapidissima*) (Popper and Carlson, 1998). The highest frequency to solicit a response in any marine fish was 180 kHz for the American shad (Gregory and Clabburn, 2003; Higgs et al., 2004). The *Alosa* species have relatively low thresholds (about 145 dB re 1 μPa), which should enable the fish to detect odontocete clicks at distances up to about 200 m (656 ft) (Mann et al., 1997). For example, echolocation clicks ranging from 200 to 220 dB could be detected by shad with a hearing threshold of 170 dB at distances from 25 to 180 m (82 to 591 ft) (University of South Florida, 2007). In contrast, the Clupeidae bay anchovy (*Anchoa mitchilli*), scaled sardine (*Harengula jaguana*), and Spanish sardine (*Sardinella aurita*) did not respond to frequencies over 4 kHz (Gregory and Clabburn, 2003; Mann et al., 2001).

Wilson and Dill (2002) demonstrated that there was a behavioral response seen in Pacific herring (*Clupea pallasii*) to energy levels associated with frequencies from 1.3 to 140 kHz, although it was not clear whether the herring were responding to the lower-frequency components of the experiment or to the ultrasound. However, Mann et al. (2005) advised that acoustic signals used in the Wilson and Dill (2002) study were broadband and contained energy of less than 4 kHz to ultrasonic frequencies. Contrary to the Wilson and Dill (2002) conclusions, Mann et al. (2005) found that Pacific herring could not detect ultrasonic signals at received levels up to 185 dB re 1 μPa. Pacific herring had hearing thresholds (0.1 to 5 kHz) that are typical of Clupeidae that do not detect ultrasound signals.

Species that can detect ultrasound do not perceive sound equally well at all detectable frequencies. Mann et al. (1998) reported that the American shad can detect sounds from 0.1 to 180 kHz with two regions of best sensitivity: one from 0.2 to 0.8 kHz, and the other from 25 to 150 kHz. The poorest sensitivity was found from 3.2 to 12.5 kHz.

Although few non-clupeid species have been tested for ultrasound (Mann et al., 2001), the only other non-clupeid species shown to possibly be able to detect ultrasound is the cod (*Gadus morhua*) (Astrup and Møhl, 1993). However, in Astrup and Møhl’s (1993) study it is feasible that the cod was detecting the stimulus using touch receptors that were over driven by very intense fish-finding sonar emissions (Astrup, 1999; Ladich and Popper, 2004). Nevertheless, Astrup and Møhl (1993) indicated that cod have ultrasound thresholds of up to 38 kHz at 185 to 200 dB re 1 μPa, which likely only allows for detection of odontocete’s clicks at distances no greater than 10 to 30 m (33 to 98 ft) (Astrup, 1999).

As mentioned above, investigations into the hearing ability of marine fishes have most often yielded results exhibiting poor hearing sensitivity. Experiments on elasmobranch fish (i.e., sharks and rays) have demonstrated poor hearing abilities and frequency sensitivity from 0.02 to
1 kHz, with best sensitivity at lower ranges (Casper et al., 2003; Casper and Mann, 2006; Myrberg, 2001). Though only five elasmobranch species have been tested for hearing thresholds, it is believed that all elasmobranchs will only detect low frequency sounds because they lack a swim bladder, which resonates sound to the inner ear. Theoretically, fishes without an air-filled cavity are limited to detecting particle motion and not pressure and therefore have poor hearing abilities (Casper and Mann, 2006).

By examining the morphology of the inner ear of bluefin tuna (*Thunnus thynnus*), Song et al. (2006) hypothesized that bluefin tuna probably do not detect sounds to much over 1 kHz (if that high). This research concurred with the few other studies conducted on tuna species. Iversen (1967) found that yellowfin tuna (*T. albacares*) can detect sounds from 0.05 to 1.1 kHz, with best sensitivity of 89 dB (re 1 μPa) at 0.5 kHz. Kawakawa (*Euthynnus affinis*) appear to be able to detect sounds from 0.1 to 1.1 kHz but with best sensitivity of 107 dB (re 1 μPa) at 0.5 kHz (Iversen, 1969). Additionally, Popper (1981) looked at the inner ear structure of a skipjack tuna (*Katsuwonus pelamis*) and found it to be typical of a hearing generalist. While only a few species of tuna have been studied, and in a number of fish groups both generalists and specialists exist, it is reasonable to suggest that unless bluefin tuna are exposed to very high intensity sounds from which they cannot swim away, short- and long-term effects may be minimal or nonexistent (Song et al., 2006).

Some damselfish have been shown to be able to hear frequencies of up to 2 kHz, with best sensitivity well below 1 kHz. Egner and Mann (2005) found that juvenile sergeant major damselfish (*Abudelfuf saxatilis*) were most sensitive to lower frequencies (0.1 to 0.4 kHz); however, larger fish (greater than 50 millimeters) responded to sounds up to 1.6 kHz. Still, the sergeant major damselfish is considered to have poor sensitivity in comparison even to other hearing generalists (Egner and Mann, 2005). Kenyon (1996) studied another marine generalist, the bicolor damselfish (*Stegastes partitus*), and found the bicolor damselfish responded to sounds up to 1.6 kHz with the most sensitive frequency at 0.5 kHz. Further, larval and juvenile Nagasaki damselfish (*Pomacentrus nagasakiensis*) have been found to hear at frequencies between 0.1 and 2 kHz, however, they are most sensitive to frequencies less than 0.3 kHz (Wright et al., 2005, 2007). Thus, damselfish appear to be primarily generalists with some ability to hear slightly higher frequencies expected of specialists (DoN, 2008p).

Female midshipman fish apparently use the auditory sense to detect and locate vocalizing males during the breeding season. Interestingly, female midshipman fish go through a shift in hearing sensitivity depending on their reproductive status. Reproductive females showed temporal encoding up to 0.34 kHz, while nonreproductive females showed comparable encoding only up to 0.1 kHz (Sisneros and Bass, 2003).

The hearing capability of Atlantic salmon indicates a rather low sensitivity to sound (Hawkins and Johnstone, 1978). Laboratory experiments yielded responses only to 0.58 kHz and only at high sound levels. Salmon’s poor hearing is likely due to the lack of a link between the swim bladder and inner ear (Jorgensen et al., 2004).
Furthermore, investigations into the inner ear structure of fishes belonging to the order Scorpaeniformes have suggested that these fishes have generalist hearing abilities (Lovell et al., 2005). Although an audiogram (which provides a measure of hearing sensitivity) has yet to be performed, the lack of a swimbladder is indicative of these species having poor hearing ability (Lovell et al., 2005). However, studies of the leopard robin (*Prionotus scitulus*), another species in this order that do contain swim bladders, indicated that they are hearing generalists as well (Tavolga and Wodinski, 1963) which makes extrapolation on hearing from this species to all members of the group very difficult to do (DoN, 2008p).

As mentioned above, the lateral line is the second component of the sensory system used by fish to detect acoustic signals. The lateral line system of a fish allows for sensitivity to sound (Hastings and Popper, 2005). This system is a series of receptors along the body of the fish that detects water motion relative to the fish that arise from sources within a few body lengths of the animal. The sensitivity of the lateral line system is generally from below 1 Hz to a few hundred Hz (Coombs and Montgomery, 1999; Webb et al., 2008). The only study on the effect of exposure to sound on the lateral line system (conducted on one freshwater species) suggests no effect on these sensory cells by intense pure tone signals (Hastings et al., 1996). While studies on the effect of sound on the lateral line are limited, work by Hasting et al. (1996) showed limited sensitivity to within a few body lengths and to sounds below a few hundred Hertz, indicating that the mid-frequency sonar of the Proposed Action is unlikely to affect a fish’s lateral line system. Therefore, further discussion of the lateral line in this analysis is unwarranted.

Of the fish species with distributions overlapping the USTWR sites for which hearing sensitivities are known, most are hearing generalists. Because the majority of fish species can detect sounds to 1 kHz or below, which is below the level of projected sound sources on USWTR, the potential for fish to experience direct effects from USWTR operations involving sound would be minor.

### 3.3.2.3 Sea Turtles

Five species of sea turtles could potentially occur within the proposed USWTR sites, as described in Subchapter 3.2. The Florida and Mexican Pacific coast nesting populations of the green sea turtle are listed as endangered; all other green sea turtles are listed as threatened. The hawksbill, Kemp’s ridley, and leatherback turtles are also listed as endangered species. The loggerhead turtle is listed as a threatened species under the ESA. The few studies completed on the auditory capabilities of sea turtles suggest that they could be capable of hearing low frequency, but not mid-frequency, sounds.

Sea turtle hearing sensitivity, in air and water, is not well studied. Reception of sound is through bone conduction, with the skull and shell acting as receiving structures (Lenhardt et al., 1983). Typically, sea turtles hear frequencies from 30 to 2,000 Hz and have a range of maximum sensitivity between 100 to 800 Hz (Ridgway et al., 1969; Lenhardt, 1994). Green turtles can hear sounds ranging from 60 to 1,000 Hz and are most sensitive to airborne sounds ranging from 300 to 400 Hz (Ridgway et al., 1969). Bartol et al. (1999) reported that juvenile loggerhead
turtles hear sounds between 250 (lowest frequency that could be tested due to equipment) and 1,000 Hz (most sensitive at 250 Hz) using the auditory brainstem response (ABR) technique, while (Lenhardt, 2002) found that adults can hear sounds from 30 Hz to 1,000 Hz (most sensitive at 400 to 500 Hz) using startle response (i.e., contract neck or dive) and ABR techniques. Bartol and Ketten (2006) found that six subadult green sea turtles from Hawaii detected frequencies between 100 to 500 Hz with the most sensitive hearing between 200 to 400 Hz using the ABR technique. Two juvenile green turtles they tested in Maryland had a slightly expanded range of hearing, with responses to sounds ranging from 100 to 800 Hz and the most sensitive hearing range from 600 to 700 Hz, while two juvenile Kemp’s ridleys had a hearing range of 100 to 500 Hz, with the most sensitive hearing falling between 100 to 200 Hz (Bartol and Ketten, 2006).

There is limited auditory data available for the leatherback turtle. Eckert et al. (1998) attempted to collect hearing sensitivity data on nesting leatherbacks during egg-laying using auditory-evoked potentials. Generally, if a detectable auditory-evoked potential (AEP) is found, the subject animal can hear the test stimuli. However, if no AEP is detected, the response may simply lack sufficient signal level to be detected above considerable electrophysiological and electrical ambient noise. Eckert et al. (1998) were unable to collect data that conformed to the criteria for an auditory brainstem response in leatherbacks due to cross-talk between the projecting system (headphones, output amplifier) and receiving system (electrode, input amplifier). Cook and Forrest (2005) demonstrated nesting leatherbacks can produce sounds as high as 1,200 Hz while nesting, but they could not determine whether these sounds were associated solely with respiration or were also communicative in nature. Communicative sounds must fall within the audible range of the species. The authors noted that peak frequencies of the sounds they recorded from nesting leatherbacks were between 300 to 500 Hz, consistent with the low-frequency hearing range found in other turtle species discussed above.

Adult loggerheads have also been observed to initially respond (i.e., increase swimming speeds) and avoid air guns when received sound levels range from 151 to 175 dB re 1 μPa, but they eventually habituate to these sounds (Lenhardt, 2002). One turtle being studied did exhibit temporary threshold shift (TTS) for up to two weeks after exposure to these levels (Lenhardt, 2002). Juveniles also have been found to avoid low frequency sound (less than 1,000 Hz) produced by airguns (O’Hara and Wilcox, 1990). McCauley et al. (2000) found that green and loggerhead sea turtles exposed to seismic air guns began to noticeably increase their swimming speed, as well swimming direction, when received levels reached 155 dB re 1 μPa²’s for green turtles and 166 dB re 1 μPa²’s for loggerhead turtles. Though auditory data has never been collected for the leatherback turtle, there is an anecdotal observation of this species responding to the sound of a boat motor (USARPA and NMFS, 1995b). It is unclear what frequencies of the sound this species was detecting. In terms of sound production, nesting leatherback turtles have been recorded producing sounds (sighs or belch-like sounds) up to 1,200 Hz with most energy ranging from 300 to 500 Hz (Mrosovsky, 1972; Cook and Forrest, 2005).

Because the best hearing range for sea turtles is most likely less than 1 kHz, below the level of projected sound sources on the USWTR, the potential for sea turtles to experience direct acoustic
effects from USWTR operations is negligible. Thus, sea turtles are not addressed further, from a direct acoustic effects perspective, in this OEIS/EIS.

### 3.3.2.4 Marine Mammals

Several groups of marine mammals can be found in the four proposed USWTR sites. The most numerous of them are delphinid whales (dolphins), followed by other toothed whales, baleen whales, and porpoises. Pinniped species are not likely to occur at the proposed USWTR sites; therefore, they are excluded from further evaluation.

Manatees can be found in the Gulf of Mexico and Atlantic coastal waters of the southeastern U.S. north to North Carolina. Manatees have the capability of hearing active sonar mid-frequency and high frequency sonar. Because manatees inhabit bays, rivers, lakes, and coastal waters, they would lie outside of the operating range of the USWTR (i.e., operational requirements for the USWTR require a depth of 37 to 274 m [120 to 900 ft]). Although manatees would not be present on the USWTR sites, they could be in coastal ocean waters (very close to shore).

Mysticete whales produce low frequency sounds that may be used as contact calls, for mating displays, for maintaining the cohesion of the migratory herd, and possibly for navigation and food-finding. Although there are no direct data on auditory thresholds for any mysticete species, anatomical evidence strongly suggests that their inner ears are well adapted for low frequency hearing. Models for some mysticetes suggest that they are capable of hearing within the mid-frequency range. Anatomical models predicted a functional range of hearing from 15 Hz to 18 kHz for right whales (Parks et al., 2007), a total range of hearing for the humpback whale from 30 Hz to 18 kHz (Helweg et al., 2000) and a region of best sensitivity for the humpback whale between 700 Hz and 10 kHz (Houser et al., 2001a). The suspicion that some mysticetes hear well at mid-frequencies is also supported by behavioral observations (e.g., the frequencies at which humpback whales sing).

Like mysticetes, odontocetes depend on acoustic perception and production for communication, food-finding, and probably for navigation and orientation. Many species are known to use high frequency clicks for echolocation. All odontocetes studied to date hear best in the mid- to high frequency range, and some are expected to be found at the USWTR sites. Odontocetes are, therefore, included for further evaluation.

### 3.3.2.5 Seabirds

As described in Subchapter 3.2, few of the bird species that occur off the coasts of Virginia, North Carolina, South Carolina, and Florida are present year-round. Most only congregate in these waters seasonally, while others migrate through the area or are only occasionally found there (i.e., vagrants).
There are limited data on hearing in seabirds and even less on underwater hearing. Studies with terrestrial species have shown that birds are highly sensitive to low frequency sound in the air, with an in-air maximum auditory sensitivity between 1 and 5 kHz for most bird species (NMFS, 2003). While it is likely that many diving birds can hear mid-frequency sound, there is no evidence that seabirds use sound underwater. A study examining the use of visual and acoustic deterrents to three species of seabirds showed that all three species responded to visual alerts, while only one species responded to acoustic alerts (Melvin et al., 1999). Further, overall acoustic deterrents have not been shown to be effective (Bull, 2006).

In addition, little published literature exists on the effects of underwater sound to diving birds. A review of available articles indicates that the most extensive research has focused on pile-driving and seismic surveys. During these studies, airguns have not caused any harm and explosives have resulted in injury only when the seabirds occurred near the detonation (Turnpenny and Nedwell, 1994). In general, seabirds spend a short period of time underwater and rarely fully submerge themselves while feeding. If they do submerge themselves, they typically perform such activities for a short period of time. For example, the northern gannet has the longest recorded dive depth and dive time of 15 m (49 ft) in 30 seconds (Mowbray, 2002). Few seabirds exploit the water column deeper than 20 m (66 ft), although some diving birds (primarily penguins and auks) regularly exceed 50 m (164 ft) (Wilson et al., 2002). It is therefore highly unlikely that a seabird would be exposed to active sonar while foraging due to the very short dive time and shallow dive depth. Seabirds in the water column are likely to move to other areas if disturbed. As the strength of sonar diminishes with distance, the ability to quickly and easily leave an area of disturbance would rapidly distance seabirds from any potential impacts.

The range area was checked to determine the presence of threatened and endangered species in order to consider disturbances to sensitive species. There are two seabird species listed as endangered or threatened that may be found in the range areas (see Subchapter 3.2.8.3). The Bermuda petrel does not occur at USWTR Sites A or B and is not expected to occur at the USWTR sites C and D, as is a pelagic species that occurs over deep offshore waters. The roseate tern is rare at all four USWTR sites and is unlikely to be found in the USWTR range, as foraging ranges do not extend more than 25 to 30 km (13 to 16 NM) from shore (USFWS, 2001c).

Seabirds were analyzed for potential effects associated with exposure to the active sonar as part of the environmental documentation of an Environmental Assessment issued by NMFS (2003). Although the potential hearing capability of seabirds was outside the proposed high frequency of 20 kHz, it was concluded effects were unlikely even if some diving birds were able to hear the signal for the following reasons:

- There is no evidence seabirds use underwater sound.
- Seabirds spend a small fraction of time submerged.
- Seabirds could rapidly fly away from the area and disperse to other areas if disturbed.
Based on these conclusions, it is scientifically appropriate to extend these reasons to mid-frequency active sonar. While it is possible that seabirds are likely to hear some mid-frequency sounds in-air, there is no scientific evidence to suggest birds can hear these sounds underwater. For these reasons, seabirds are not addressed further, from an acoustical perspective, in this report.

3.3.2.6 Summary of Acoustical Screening

The foregoing screening analysis determined whether a given species could occur within the geographic area influenced by the active acoustics on one of the four USWTR sites, and if it possessed some sensory mechanism that would allow it to perceive the USWTR’s mid-frequency sounds. Those animals that were found to not occur in the geographic area or that could not perceive mid-frequency sound are excluded from further analysis from an acoustical perspective (Subchapter 4.3). Following is a summary of the acoustical screening results:

- **Invertebrates** – Invertebrates were categorically eliminated from further consideration from an acoustical perspective because mid-frequency sound of USWTR active sonar is not considered to be in the primary hearing register of those invertebrate species that may possess the ability to sense sound and the potential for effects is negligible for invertebrate species that may inhabit the area during USWTR operations.

- **Fish** – It is expected that most marine fish species cannot hear mid-frequency sound, and therefore cannot detect the mid-frequency active sonar used in USWTR. The results of several studies have indicated that acoustic communication and orientation of fishes, in particular of hearing specialists, may be limited by noise regimes in their environment. Further, some fish may respond behaviorally to varying sound frequencies, including possibly mid-frequency sources (similar to the sonar sources that would be used on the USWTR). Given these factors, fish are included for further analysis (Subchapter 4.3.11).

- **Sea Turtles** – Sea turtles were excluded from further analysis from an acoustic perspective because the best hearing range for sea turtles is most likely less than 1 kHz, which is below the level of projected sound sources on the USWTR. Thus, the potential for sea turtles to experience acoustic effects from USWTR operations is negligible. Sea turtles are not, therefore, addressed further from an acoustic-effects perspective in this OEIS/EIS.

- **Seabirds** – Seabirds were excluded from further analysis from an acoustic perspective because while it is likely that many diving birds can hear mid-frequency sound, there is no evidence that seabirds use sound underwater, or are deterred by sound. In addition, seabirds spend a very small fraction of their time submerged, and they can rapidly disperse to other areas if disturbed. For these
reasons, seabirds are not addressed further from an acoustical perspective in this OEIS/EIS.

- **Marine Mammals** – Pinniped species are not likely to occur at the proposed USWTR sites; therefore, they were excluded from further evaluation from an acoustical perspective. Although manatees would not be present on the USWTR sites in some very limited instances they could be in coastal ocean waters. Mysticetes and odontocetes are expected to occur at the proposed USWTR sites. Most mysticete and odontocete species studied to date and manatees are suspected to hear in the mid- to high frequency range. Thus, mysticetes, odontocetes, and manatees are included for further evaluation from an acoustical perspective (Subchapters 4.3.8 and 4.3.9).

The method used to estimate potential acoustical effects on marine mammals includes several key steps, the first of which is to estimate the number and species of marine mammals that would be present in each USWTR area. As discussed in Chapter 2, the actual USWTR sites are much smaller areas within the larger OPAREAs. To accurately reflect the spatial resolution of the data, densities presented are for broad depth regimes in the entire Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs that correspond to the depths present at the potential USWTR sites off the east coast of the U.S. The following subchapter describes how densities were derived and presents tables that contain estimated densities for each OPAREA.

### 3.3.3 Estimated Marine Mammal Densities

Quantification of marine mammal density and abundance was primarily accomplished by evaluating line-transect survey data which was collected by NMFS, the Northeast and Southeast Fisheries Science Centers (NEFSC and SEFSC). The NEFSC and SEFSC are the technical centers within NMFS that are responsible for collecting and analyzing data to assess marine mammal stocks in the U.S. Atlantic EEZ.

These data sets were analyzed and evaluated in conjunction with regional subject matter experts, NMFS technical staff, and scientists with the University of St. Andrews, Scotland, Centre for Environmental and Ecological Modelling (CREEM). Methods and results are detailed in Navy OPAREA Density Estimate (NODE) reports covering all U.S. Atlantic coast OPAREAs. The potential USWTR locations are included in four of these OPAREAs (i.e., Jacksonville, Charleston, Cherry Point, and VACAPES).

Density estimates from previous Navy environmental documents were recently updated using the most advanced methodology currently available. Spatial modeling using Program DISTANCE (RUWPA), a program based on Buckland et al. (2001, 2004), is the primary method of density estimation used to produce the updated NODE reports. Together with appropriate line-transect survey data, this method provides the most accurate/up-to-date density information for marine mammals in U.S. Navy OPAREAs. The updated density estimate data presented in this final
OEIS/EIS are taken from the NODE report for the Southeast OPAREAs (DoN, 2007a), providing density estimates for the Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs.

The density estimates in the Southeast OPAREAs NODE report were calculated by a team of experts using survey data collected and provided by NMFS and with expert modeling support provided by CREEM. Researchers at CREEM are recognized as the international authorities on density estimation and have been at the forefront in development of new techniques and analytical methods for animal density, including spatial modeling techniques. Spatial modeling techniques have an advantage over traditional line-transect/distance sampling techniques in that they can provide relatively fine scale estimates for areas with limited or no available survey effort by creating models based on habitat parameters associated with observations from other surveys with similar spatial or temporal characteristics. Analysis of line-transect data in this manner allows for finer-scale spatial and/or temporal resolution of density estimates, providing indications of regions within the study area where higher and lower concentrations of marine mammals may occur rather than the traditional approach of generating a single estimate covering a broad spatial strata. These generic spatial strata tend to mask the finer scale habitat associations suggested by the specific ecology of an individual species.

Density estimates for cetaceans were derived in one of three ways, in order of preference:

- Through spatial models using line-transect survey data provided by the NMFS
- Using abundance estimates from Mullin and Fulling (2003), Fulling et al. (2003), and/or Mullin and Fulling (2004)
- Based on the cetacean abundance estimates found in the most current NOAA stock assessment report (SAR) (Waring et al., 2007)

For the model-based approach, density estimates were calculated for each species within areas containing survey effort. A relationship between these density estimates and the associated environmental parameters such as depth, slope, distance from the shelf break, SST, and chlorophyll *a* concentration was formulated using generalized additive models (GAMs). This relationship was then used to generate a two-dimensional density surface for the region by predicting densities in areas where no survey data exist. For the Southeast, all analyses for cetaceans were based on sighting data collected through shipboard surveys conducted by NMFS NEFSC and SEFSC between 1998 and 2005. Species-specific density estimates derived through spatial modeling were compared with abundance estimates found in the most current NOAA SAR to ensure consistency. NMFS technical staff reviewed all spatial models and density estimates. Table 3.3-3 contains a list of each species and the means by which their density was derived. For a more detailed description of the methodology involved in calculating the density estimates provided in this final OEIS/EIS, please refer to the NODE report for the Southeast OPAREAs (DoN, 2007a).
| Model-Derived Density Estimates | Fin whale (*Balaenoptera physalus*)  
|                                | Sperm whale (*Physeter macrocephalus*)  
|                                | Beaked whales (Family Ziphiidae)  
|                                | Bottlenose dolphin (*Tursiops truncatus*)  
|                                | Atlantic spotted dolphin (*Stenella frontalis*)  
|                                | Striped dolphin (*Stenella coeruleoalba*)  
|                                | Common dolphin (*Delphinus delphis*)  
|                                | Risso's dolphin (*Grampus griseus*)  
|                                | Pilot whales (*Globicephala spp.*)  
| SAR or Literature-Derived Density Estimates | North Atlantic right whale (*Eubalaena glacialis*)  
|                                | Humpback whale (*Megaptera novaeangliae*)  
|                                | Minke whale (*Balaenoptera acutorostrata*)  
|                                | *Kogia* spp.  
|                                | Rough-toothed dolphin (*Steno bredanensis*)  
|                                | Pantropical spotted dolphin (*Stenella attenuata*)  
|                                | Clymene dolphin (*Stenella clymene*)  
| Species for Which Density Estimates are not Available | Blue whale (*Balaenoptera musculus*)  
|                                | Sei whale (*Balaenoptera borealis*)  
|                                | Bryde’s whale (*Balaenoptera brydei/edeni*)  
|                                | Killer whale (*Orcinus orca*)  
|                                | Pygmy killer whale (*Feresa attenuata*)  
|                                | False killer whale (*Pseudorca crassidens*)  
|                                | Melon-headed whale (*Peponocephala electra*)  
|                                | Spinner dolphin (*Stenella longirostris*)  
|                                | Fraser’s dolphin (*Lagenodelphis hosei*)  
|                                | White-beaked dolphin (*Lagenorhynchus albirostris*)  
|                                | Atlantic white-sided dolphin (*Lagenorhynchus acutus*)  
|                                | Harbor porpoise (*Phocoena phocoena*)  
|                                | West Indian manatee (*Trichechus manatus*)  

**Notes:**

1. Abundance estimates were geographically and seasonally partitioned
2. Abundance estimates were uniformly distributed geographically and seasonally
3. See DoN, 2007a for additional discussion

Source: DoN, 2007a
Temporal Distribution

Training at the proposed locations may occur throughout the year. In order to account for seasonal variability in the temporal distribution of marine mammals, it was necessary to partition the year appropriately. Density estimation was calculated by seasons defined by astronomical conventions, as follows:

- **Winter** – December 1 through February 28
- **Spring** – March 1 through May 31
- **Summer** – June 1 through August 31
- **Fall** – September 1 through November 30

### 3.3.3.1 Use of the “May Occur” Designation

For a given species, season, and depth stratum, the density estimate, based on available data, may be zero, and yet the data show that some sightings have been reported. There are also cases where reasoned judgment suggests that there is some likelihood that additional survey effort and data may yield sightings in heretofore unreported areas.

Applying reasoned judgment combined with other available information, the qualifying category of “may occur” is used to indicate that while the available data suggest that on any given day a species’ density is likely to be zero, over time, and particularly as new data become available, individuals of the species may indeed occur in this season and stratum.
3.4 Socioeconomic Environment

This subchapter describes the socioeconomic environment at the four proposed USWTR sites. Activities within the sites that influence regional and local economies include federal agency usage, commercial fishing, recreational fishing, commercial shipping, recreational boating and scuba diving.

3.4.1 Federal Agency Usage

3.4.1.1 Site A

Site A is situated wholly within the Jacksonville OPAREA, which has been used extensively for military exercises. FACSFAC Jacksonville is the scheduling authority for the region.

3.4.1.2 Site B

Site B is situated wholly within the Charleston OPAREA, which has been used extensively for military exercises. FACSFAC Jacksonville is the scheduling authority for the region.

3.4.1.3 Site C

The proposed Site C USWTR falls wholly within the Cherry Point OPAREA, a major area of federal agency usage. The OPAREA has been used extensively for military exercises, primarily by the Navy. FACSFAC VACAPES is the scheduling authority for the region.

3.4.1.4 Site D

Site D is situated wholly within the VACAPES OPAREA. The VACAPES OPAREA is a major area of federal agency usage. The area has been used extensively for military/NASA training, testing, and ordnance and rocket firing exercises. FACSFAC VACAPES is the scheduling authority for the region.

The NASA Wallops Flight Facility (WFF) is located on Virginia’s eastern shore and comprises three properties: the main base, the Mainland, and the Wallops Island launch site. WFF is NASA’s principal facility for management and implementation of suborbital research programs (NASA, 2006). The facility supports science and exploration missions for NASA and other federal agencies, and supports Navy development tests and exercises. Normal operating hours at WFF are Monday through Friday, 6:00 am through 6:00 pm (NASA, 2006).

The U.S. Department of the Interior (DoI) proposes to allow oil and gas drilling in federal waters on the outer continental shelf in a lease sale area about 80 km (50 mi) off the coast of Virginia.
Under a proposed final five-year oil and gas leasing program for 2007 to 2012, the lease sale off Virginia is scheduled for late 2011, although environmental and seismic studies could proceed before that year. The proposed lease sale area overlaps the seaward portion of Site B offshore of Virginia (Figure 3.4-1).

The proposed lease sale area is located within the Mid-Atlantic Planning Area.

### 3.4.2 Commercial Fishing

Data were collected on commercial fisheries landings, types of fishing gear used, fishing effort, and known popular fishing areas. The SAFMC manages fisheries in federal waters off of eastern Florida and Georgia (Site A), and off South Carolina (Site B). Both the MAFMC and the SAFMC manage fisheries in federal waters off the coast of North Carolina (Site C). The MAFMC manages fisheries in federal waters off the coasts of Virginia and Maryland (Site D). Both the ASFMC and NMFS manage select species at all four proposed USWTR sites.

FMPs are in force for several fisheries and regulate both commercial and recreational fishing. The objectives of the plans vary, but are generally geared towards ensuring the long-term sustainability of the subject fish species and meeting specific management goals. FMPs generally utilize geographic and seasonal fishery closures, catch limits and quotas, size and age limits, gear restrictions, and access controls to manage the fishery resources.

As described in Subchapter 3.2.4, the MAFMC has developed seven FMPs to promote the long-term health and stability of the managed fisheries (MAFMC, 2007). These FMPs include the following:

- Atlantic mackerel, squid, and butterfish
- Bluefish
- Spiny dogfish
- Atlantic surfclam and ocean quahog
- Summer flounder, scup, and black sea bass
- Tilefish
- Monkfish.

The nine FMPs developed by the SAFMC include the following (SAFMC, 2007b, 2008):

- South Atlantic snapper/grouper
- Coastal migratory pelagics
- Shrimp
- Calico scallop
Outer Continental Shelf Oil & Gas Leasing Program Area 2007-2012

Figure 3.4-1
- Spiny lobster
- Golden crab
- Coral, coral reefs, and live/hard bottom habitat
- *Sargassum*
- Dolphinfish and wahoo.

The Interstate Fisheries Management Program (ISFMP) of the ASMFC manages 22 coastal fish species or species groups (ASMFC, 2007):

- American eel
- American lobster
- Atlantic croaker
- Atlantic herring
- Atlantic menhaden
- Atlantic sturgeon
- Black sea bass
- Bluefish
- Horseshoe crab
- Northern shrimp
- Red drum
- Scup
- Shad and river herring
- Spanish mackerel
- Spiny dogfish and coastal sharks
- Spot
- Spotted sea trout
- Striped bass
- Summer flounder
- Tautog
- Weakfish
- Winter flounder.

NMFS regulates highly migratory species (HMS) (NMFS, 2007c), including:

- Billfish
- Large coastal sharks
- Small coastal sharks
- Pelagic sharks
- Swordfish
- Tunas
3.4.2.1 Site A

Extensive commercial fishing occurs along the east coast of Florida and the coast of Georgia, extending from the shore to well seaward of the proposed Site A USWTR. Dominant fisheries include shrimp, crab, mackerel, mullet, and swordfish. Gear types commonly used within the fisheries include otter trawls, hand lines, cast nets, pots and traps, and long lines (NMFS, 2007b). Bottom otter trawls, hand lines, cast nets, and pots and traps are used over the continental shelf, whereas pelagic long lines primarily target highly migratory species near and beyond the continental shelf edge (DoN, 2008n).

The majority of the commercial fishing grounds within the Jacksonville OPAREA are found over the continental shelf, or near areas of relief or bottom structure (DoN, 2008n). The commercial fishing grounds are similar to those used by recreational fishermen (DoN, 2008n). Popular fishing areas and their relative locations to the proposed Site A USWTR are shown in Figure 3.4-2. There are five charted popular fishing areas within the proposed Site A USWTR, including Roll Down.

The SAFMC manages fisheries in federal waters off the coasts of Florida and Georgia. The nine FMPs developed by the SAFMC identified in Subchapter 3.2.4 are applicable to the federal waters off the Florida and Georgia coasts. NMFS also regulates highly migratory species fisheries off Florida and Georgia (NMFS, 2007c).

State Landings

NMFS collects landings data from several sources, including state-mandated fishery or mollusk trip-tickets; landing weighout reports provided by seafood dealers; federal logbooks of fishery catch and effort; shipboard and portside interviews; and biological sampling of catches (NMFS, 2007b). These data are incorporated into the NMFS Statistics and Economics Division commercial landings databases. Two caveats are relevant to the interpretation of this data:

- Landings data do not indicate the location of capture. For example, fish landed in Florida could have been taken offshore of another state, but landed in Florida.

- Federal statutes prohibit public disclosure of landings that would allow identification of the data contributors and possibly put them at a competitive disadvantage. Total landings by state are accurate and comprise the sum of both non-confidential and confidential landings. However, whenever confidential landings occur, NMFS combines the confidential landings with other, non-confidential landings and usually reports the combined landings as unclassified. Therefore, landings reported by individual taxonomic groups or individual gear
types may be misleading due to the exclusion of confidential landings from some groups or types.

NMFS (2007b) landings data for the coastal and offshore waters of the east coast of Florida and off the coast of Georgia were evaluated to determine the magnitude and value of the commercial marine fisheries. The most recent commercial fishing information for Florida available from NMFS was for the year 2006 (NMFS, 2007b, c). NMFS provides landings information for Florida separated by east and west coasts. Information specific to eastern Florida and Georgia is presented below. Detailed county economic information was not available for Florida or Georgia as it was for North Carolina (see Subchapter 3.4.2.3).

**Eastern Florida**

Over the ten-year period ending in 2006, the commercial landings of food and baitfish, measured by weight, averaged about 13 million kg (28 million lbs) per year. Commercial landings ranged between a high of nearly 15 million kg (33 million lbs) in 1997 and a low of less than 10 million kg (22 million lbs) two years later, in 2002. Over the ten-year period, landings typically deviated from the average by approximately 14 percent. The landings data show a marked overall declining trend of about 24 percent over the ten years.

Landings by value decreased along the east coast of Florida between 1997 and 2006 (NMFS, 2007b). The dollar values of landings declined at a substantial overall rate of over 27 percent during the decade. Dollar values averaged over $42 million. Values ranged from a high of over $52 million in 2000 to a low of approximately $33 million three years later, in 2003.

Marine fish and shellfish landings along the east coast of Florida are far less seasonal, compared to South Carolina, North Carolina, Maryland, and Virginia marine fisheries. In 2006, over 22 percent of the landings, measured by weight, were recorded in December and January, the months with the highest landings along the east coast of Florida. The value of landings was highest in August and December with 11 percent of the total annual landings occurring in each of these months. Landings in other months ranged between 6 percent and 9 percent of the annual value and weight. Lowest values and weights occurred in February and March.

Over the ten-year period ending in 2006, the 10 species of finfish and shellfish that generated the most revenue comprised over 70 percent of the commercial landings along the east coast of Florida, (Table 3.4-1). Landings for these ten principal species averaged almost $30 million, a considerable amount compared to the average annual commercial landings of more than $42 million for all species.
In terms of commercial landings by measured value, white shrimp was the dominant species, comprising over 19 percent of the average landings along the east coast of Florida. Rock shrimp was the second most dominant species, comprising 9 percent of the average annual landings. The eight other principal species accounted for about 42 percent of the total landings.

In 1995, NMFS began collecting and reporting data so that catches made in state waters (usually 0 to 5.6 km [0 to 3 NM] from shore) could be differentiated from those of federal waters (5.6 to 370 km [3 to 200 NM] from shore) and the high seas (greater than 370 km [200 NM] from shore). While the landings reported are preliminary and still subject to change (NOAA Fisheries, 2004), they provide an indication of how the catch is distributed between these zones.

In terms of weight, about 44 percent of the landings along the east coast of Florida in 2006 were from state waters; approximately 56 percent were from federal waters (Table 3.4-2). When compared to the value of catches from state waters, the relative importance of catches from federal waters was slightly more pronounced, representing almost 60 percent of the value of the landings.
In 2006, shellfish dominated the catch in state waters, comprising approximately 55 percent of the landings by weight and 70 percent by value. In federal waters, finfish dominate, comprising about 56 percent of the catch by weight and 76 percent of the catch by value. However, finfish comprised nearly the same share of the revenue as shellfish accounting for approximately 49 percent of the value of the landings. Most (60 percent) of the finfish and shellfish landed on the east coast of Florida were caught in federal waters.

Table 3.4-2
2006 Commercial Landings by Distance – Florida East Coast

<table>
<thead>
<tr>
<th></th>
<th>Landings by Weight</th>
<th>Landings by Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thousands of Kilograms</td>
<td>Thousands of Pounds</td>
</tr>
<tr>
<td>State Waters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finfish</td>
<td>2,402</td>
<td>5,295</td>
</tr>
<tr>
<td>Shellfish</td>
<td>2,894</td>
<td>6,381</td>
</tr>
<tr>
<td>Total</td>
<td>5,296</td>
<td>11,676</td>
</tr>
<tr>
<td>Exclusive Economic Zone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finfish</td>
<td>3,743</td>
<td>8,252</td>
</tr>
<tr>
<td>Shellfish</td>
<td>2,910</td>
<td>6,415</td>
</tr>
<tr>
<td>Total</td>
<td>6,653</td>
<td>14,667</td>
</tr>
<tr>
<td>Grand Total</td>
<td>11,949</td>
<td>26,343</td>
</tr>
</tbody>
</table>

Notes: Numbers may not total exactly due to rounding. No landings from the high seas were reported.

Source: NMFS, 2007b.

Georgia

Between 1997 and 2006, the commercial landings of food and baitfish in Georgia, measured by weight, averaged about 5 million kg (11 million lbs). Commercial landings peaked in 1997 at approximately 7 million kg (15 million lbs), while the lowest landings occurred in 2006, when about 4 million kg (8 million lbs) of finfish and shellfish were landed.

Harvests were variable over the decade, with annual landings typically having deviated from the average by about 19 percent. The landings data show a marked overall declining trend of approximately 36 percent over the ten years.

The dollar values of the landings averaged approximately $18 million over the ten-year period. Total values ranged from a low of about $4 million in 2006 to a high of approximately $7 million in 1997. Landings by value decreased at a rate of almost 57 percent over the ten years.
Marine finfish and shellfish landings in Georgia are seasonal. In terms of landings by month, with 28 percent of total landings by weight, September and October were the peak months in Georgia during 2006. Lowest landings by weight were reported for March and April, with a combined total of about 8 percent of the 2006 landings. The highest landings by value were reported in September and October, when 29 percent of the value of the catch was landed, while the lowest landing by value were reported in March and April, with approximately 7 percent of the catch.

Between 1997 and 2006, 99 percent of the commercial landings in Georgia, measured by value, were attributed to ten species of finfish and shellfish (Table 3.4-3). Over the ten-year period, landings for these ten principal species averaged approximately $18 million in annual commercial landings.

<table>
<thead>
<tr>
<th>Species</th>
<th>Landings by Value Thousand $</th>
<th>Percentage of Total Landings</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Principal Species</td>
<td>17,750</td>
<td>99.0</td>
</tr>
<tr>
<td>White shrimp</td>
<td>11,132</td>
<td>62.1</td>
</tr>
<tr>
<td>Blue crab</td>
<td>2,778</td>
<td>15.5</td>
</tr>
<tr>
<td>Brown shrimp</td>
<td>1,935</td>
<td>10.8</td>
</tr>
<tr>
<td>Dendrobranchiata shrimp</td>
<td>618</td>
<td>3.4</td>
</tr>
<tr>
<td>Unclassified finfishes</td>
<td>510</td>
<td>2.8</td>
</tr>
<tr>
<td>Quahog clam</td>
<td>301</td>
<td>1.7</td>
</tr>
<tr>
<td>Snails (conchs)</td>
<td>187</td>
<td>1.0</td>
</tr>
<tr>
<td>Vermilion snapper</td>
<td>149</td>
<td>0.8</td>
</tr>
<tr>
<td>Other marine shrimp</td>
<td>91</td>
<td>0.5</td>
</tr>
<tr>
<td>Unclassified shellfish</td>
<td>49</td>
<td>0.3</td>
</tr>
<tr>
<td>Other Species</td>
<td>178</td>
<td>1.0</td>
</tr>
<tr>
<td>Total – All Species</td>
<td>17,928</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2009i.

White shrimp was the dominant species by value in Georgia, and blue crab was the second most dominant species. With average landings of over $11 million, white shrimp comprised about 62 percent of the landings. Blue crabs comprised about 16 percent of the landings, with average landings of nearly $3 million. The eight other principal species accounted for over 21 percent of the total landings.
By weight, about 66 percent of the landings in Georgia in 2006 were from state waters; approximately 34 percent were from federal waters (Table 3.4-4). By value, landings from state waters accounted for nearly 53 percent of the total value of the Georgia marine fisheries, whereas landings from federal waters amounted to over 47 percent.

In 2006, shellfish dominated the catch measured by weight and by value in Georgia state waters, representing approximately 98 percent of the catch. Finfish comprised just 2 percent of the catch.

### Table 3.4-4

2006 Commercial Landings by Distance – Georgia

<table>
<thead>
<tr>
<th></th>
<th>Landings by Weight</th>
<th></th>
<th>Landings by Value</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thousands of</td>
<td>Thousands</td>
<td>% of Area</td>
<td>% of Total</td>
</tr>
<tr>
<td></td>
<td>Kilograms</td>
<td>of Pounds</td>
<td>Landings</td>
<td>Landings</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State Waters</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finfish</td>
<td>46</td>
<td>102</td>
<td>1.9</td>
<td>1.2</td>
</tr>
<tr>
<td>Shellfish</td>
<td>2,422</td>
<td>5,339</td>
<td>98.1</td>
<td>64.4</td>
</tr>
<tr>
<td>Total</td>
<td>2,468</td>
<td>5,441</td>
<td>100.0</td>
<td>65.6</td>
</tr>
<tr>
<td>Exclusive Economic Zone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finfish</td>
<td>83</td>
<td>182</td>
<td>6.4</td>
<td>2.2</td>
</tr>
<tr>
<td>Shellfish</td>
<td>1,211</td>
<td>2,670</td>
<td>93.6</td>
<td>32.2</td>
</tr>
<tr>
<td>Total</td>
<td>1,294</td>
<td>2,852</td>
<td>100.0</td>
<td>34.4</td>
</tr>
<tr>
<td>Grand Total</td>
<td>3,762</td>
<td>8,293</td>
<td>100.0</td>
<td>11,533</td>
</tr>
</tbody>
</table>

Notes: Numbers may not total exactly due to rounding. No landings from the high seas were reported. Source: Elizabeth S. Pritchard, NMFS Office of Science and Technology, email to author, February 2, 2009.

The majority of the catch in federal waters, by weight and by value, was shellfish. By weight, nearly 94 percent of the landings from federal waters were shellfish, and over 6 percent were finfish. When measured by value, shellfish accounted for over 92 percent of the total landings from federal waters.

**Fishing Gear and Fishing Effort**

**Eastern Florida**

The principal gears used to harvest finfish and shellfish landed along the east coast of Florida are otter trawls, pots and traps, hand lines, and long lines (Table 3.4-5). From 1997 through 2006, 37 percent of landings by value, of the fish landed in the state were captured using otter trawls, while pots and traps, hand lines, and long lines were used to capture 15, 13, and 10 percent, respectively.
Table 3.4-5
1997-2006 Average Annual Commercial Landings by Gear Type – Florida East Coast

<table>
<thead>
<tr>
<th>Gear Type</th>
<th>Landings by Value Thousand $</th>
<th>Percentage of Total Landings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Otter trawl bottom</td>
<td>15,636</td>
<td>37.0</td>
</tr>
<tr>
<td>Pots and traps</td>
<td>6,243</td>
<td>14.8</td>
</tr>
<tr>
<td>Hand lines</td>
<td>5,672</td>
<td>13.4</td>
</tr>
<tr>
<td>Long lines</td>
<td>4,416</td>
<td>10.4</td>
</tr>
<tr>
<td>Cast nets</td>
<td>2,108</td>
<td>5.0</td>
</tr>
<tr>
<td>Gill nets</td>
<td>1,513</td>
<td>3.6</td>
</tr>
<tr>
<td>Rod and reel</td>
<td>1,473</td>
<td>3.5</td>
</tr>
<tr>
<td>By hand, other</td>
<td>1,341</td>
<td>3.2</td>
</tr>
<tr>
<td>Diving outfits</td>
<td>1,214</td>
<td>2.9</td>
</tr>
<tr>
<td>Beam trawls</td>
<td>800</td>
<td>1.9</td>
</tr>
<tr>
<td>Butterfly nets</td>
<td>514</td>
<td>1.2</td>
</tr>
<tr>
<td>Other gear types</td>
<td>1,378</td>
<td>3.3</td>
</tr>
<tr>
<td><strong>Total – All Gear</strong></td>
<td><strong>42,309</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.

Georgia

The principal commercial gears used to harvest the marine fishery resources of Georgia are otter trawls, and pots and traps (Table 3.4-6). Most fish and shellfish landed in Georgia, as measured by value, were captured using otter trawls, with nearly 78 percent of the fish and shellfish landed in the state having been captured by otter trawls. Approximately 16 percent of the landed fish and shellfish were captured using pots and traps.
Table 3.4-6

1997-2006 Average Annual Commercial Landings by Gear Type – Georgia

<table>
<thead>
<tr>
<th>Gear Type</th>
<th>Landings by Value Thousand $</th>
<th>Percentage of Total Landings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Otter trawl bottom</td>
<td>13,912</td>
<td>77.7</td>
</tr>
<tr>
<td>Pots and traps</td>
<td>2,778</td>
<td>15.5</td>
</tr>
<tr>
<td>Hand lines</td>
<td>437</td>
<td>2.4</td>
</tr>
<tr>
<td>By hand, other</td>
<td>324</td>
<td>1.8</td>
</tr>
<tr>
<td>Electric or hydraulic reel</td>
<td>207</td>
<td>1.2</td>
</tr>
<tr>
<td>Cast nets</td>
<td>156</td>
<td>0.9</td>
</tr>
<tr>
<td>Gill nets</td>
<td>52</td>
<td>0.3</td>
</tr>
<tr>
<td>Unspecified trawls</td>
<td>10</td>
<td>0.1</td>
</tr>
<tr>
<td>Other gear types</td>
<td>24</td>
<td>0.1</td>
</tr>
<tr>
<td>Total – All Gear</td>
<td>17,901</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2009i.

Fisheries within Range Site A

Table 3.4-7 presents the geographical overlap of the fishing grounds within Site A compared to the extent of the grounds off the coastline of Florida. Hook-and-line type fishing vessels are abundant in Site A. Handline landings are higher off the east coast of Florida compared to North Carolina, Maryland, and Virginia. A variety of fish species were caught in the east coast of Florida hand lines fishery between 1997 and 2006. King and cero mackerel dominated the catch from this fishery, comprising more than 47 percent of the catch, measured by value.

Table 3.4-7

Geographical Overlap of Fishing Grounds Within Site A

<table>
<thead>
<tr>
<th>Gear Type</th>
<th>Percentage Overlap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom long line for reef fish</td>
<td>8</td>
</tr>
<tr>
<td>Bottom long line for shark</td>
<td>5</td>
</tr>
<tr>
<td>Bottom trawling for shrimp, scallops</td>
<td>10</td>
</tr>
<tr>
<td>Hand line, rod and reel, trolling</td>
<td>12</td>
</tr>
</tbody>
</table>
Trawling for shrimp is quite common in Florida. Brown and white shrimp fisheries occur from inshore out to a depth of about 18.3 m (60 ft) and do not overlap Site A. Pink shrimp are most abundant between depths of 11 and 37 m (36 and 121 ft), but can occur as deep as 65 m (213 ft) (SAFMC, 2004a) and do overlap Site A.

Rock shrimp and royal red shrimp are found in the deeper water off of Florida and these fisheries occur in Site A. Rock shrimp are caught between the latitudes of 35°N and 27°N. The majority are caught around 28°N off of Cape Canaveral (SAFMC, 1996). The largest concentrations of rock shrimp are found at depths between 35 and 55 m (115 and 180 ft). Most rock shrimp are caught south of the range area, although some may be caught within more shallow areas of the range site in years of abundance.

The royal red shrimp fishery is concentrated in waters from 329 to 421 m (1,079 to 1,381 ft) deep; however, the fishery can occur from 180 to 730 m (590 to 2,395 ft). This depth of concentrated fishing, while greater than the USWTR site (289 m [948 ft]), is quite close to Site A because the shelf drops off quite quickly. This is a gear-intensive fishery with more than a mile of cable required to drag trawls over the bottom. There is the potential to damage cables or sensor nodes if gear were to be dropped on them or if trawls were drawn over them. A boat can overturn quickly in dangerous conditions and crews will attempt to drop their gear (estimated at a value of $40,000) rather than capsizing. Off the east coast of Florida, royal red shrimp are most often fished from Jacksonville to Ft. Pierce.

Trawling for calico scallops in Florida is focused south of Site A, although calico scallops do occur even further north of Site A and, in years of abundance, bottom trawling occurs within Site A. Calico scallops are found at depths between 9 and 366 m (30 and 1,200 ft). Pelagic longline fishing does not occur in Site A as it is not allowed within the site area. Bottom longline gear, however, is allowed and does occur in Site A at depths of 91 to 273 m (300 to 895 ft). Pot and trap fishing and gillnetting occur inshore off of Jacksonville, Florida and the fishing areas do not overlap Site A.

3.4.2.2 Site B

Principal fishery resources on the continental shelf offshore of South Carolina include several open ocean and migratory pelagic, demersal, and reef finfish species, as well as shrimp. The largest and most economically valuable fishery in South Carolina is that for white and brown shrimp (South Carolina Sea Grant, 2007). Methods employed to catch these penaeid shrimp range from large shrimp trawlers to cast nets and drop nets (South Carolina Department of Natural Resources [SCDNR], 2007). This fishery occurs primarily inshore of the proposed range area. A rock shrimp fishery, however, may occur sporadically off of South Carolina in waters from 27 to 55 m (90 to 180 ft), and therefore overlap the more shallow areas of the proposed range (SAFMC, 2004; SCDNR, 2007).
Other fisheries include pelagic and bottom longliners targeting fishes near the shelf edge. Over the continental shelf, many commercial species are fished over areas of bottom relief, such as canyons, outcroppings, rock rubble, artificial reefs, and shipwrecks. Species commonly fished in these areas are those in the snapper-grouper complex. Hook-and-line and pot trapping methods are most often employed. These areas can be very similar to those used by recreational fishermen and are considered to be popular fishing areas, or fish havens (DoN, 2008n). Popular fishing areas and their relative locations to the proposed Site B USWTR are shown in Figure 3.4-3. As shown in Figure 3.4-3, there are 10 charted popular fishing areas within the proposed USWTR site.

**State Landings**

NMFS (2007b) landings data for the coastal and offshore waters of South Carolina were evaluated to determine the magnitude and value of the commercial marine fisheries. The most recent commercial fishing information for South Carolina available from NMFS was for the year 2006 (NMFS, 2007b). Monthly landing statistics, however, were only available as recently as 2005 (NMFS, 2007b). Detailed county economic information was not available for South Carolina as it was for North Carolina (see Subchapter 3.4.2.3).

Over the ten-year period ending in 2006, the commercial landings of food and baitfish, measured by weight, averaged about 6 million kg (14 million lbs) per year. Commercial landings ranged between a high of over 8 million kg (18 million lbs) in 1999 and a low of less than 4 million kg (10 million lbs) six years later, in 2005.

Harvests were variable over the ten-year period ending in 2006, with annual landings typically deviating from the average by approximately 20 percent. The landings data show an overall declining trend of about 43 percent over the ten years.

Just as landings by weight declined over the decade, the dollar values of landings also declined at a substantial overall rate of approximately 46 percent during the period (NMFS, 2007b). Dollar values averaged over $24 million. Values ranged from a high of over $32 million in 1997 to a low of approximately $15 million in 2005.

Marine finfish and shellfish landings in South Carolina are seasonal. In 2006, landings were highest in September and October, as measured by weight, with over 11 percent of the total annual landings occurring in each of these months. The value of landings was highest in May with nearly 13 percent of the total annual landings. In terms of both weight and value, the lowest landings occurred in April, with approximately 3 percent of the landings by weight and about 5 percent of the landings by value.

Over the ten-year period ending in 2006, the ten species of finfish and shellfish that generated the most revenue comprised over 83 percent of the commercial landings in South Carolina,
Popular Fishing Areas in the Charleston OPAREA & Vicinity

South Carolina

Charleston OPAREA

Biological Regime Boundary
- 36.6M (20fm or 120ft)
- 91.4M (50fm or 300ft)
- Continental Shelf Break

Popular Fishing Area
- Site B USWTR
- Charleston OPAREA

Figure 3.4-3
measured by value (Table 3.4-8). Landings for these ten principal species averaged almost $20 million, a substantial amount of the average annual commercial landings of more than $24 million for all species.

Table 3.4-8
1997-2006 Average Annual Landings of 10 Principal Species – South Carolina

<table>
<thead>
<tr>
<th>Species</th>
<th>Landings by Value Thousand $</th>
<th>Percentage of Total Landings</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Principal Species</td>
<td>21,808</td>
<td>90.4</td>
</tr>
<tr>
<td><em>White shrimp</em></td>
<td>9,467</td>
<td>39.3</td>
</tr>
<tr>
<td><em>Blue crab</em></td>
<td>4,591</td>
<td>19.0</td>
</tr>
<tr>
<td><em>Brown shrimp</em></td>
<td>2,510</td>
<td>10.4</td>
</tr>
<tr>
<td><em>Quahog clam</em></td>
<td>1,874</td>
<td>7.8</td>
</tr>
<tr>
<td><em>Eastern oyster</em></td>
<td>1,058</td>
<td>4.4</td>
</tr>
<tr>
<td><em>Swordfish</em></td>
<td>583</td>
<td>2.4</td>
</tr>
<tr>
<td><em>Gag</em></td>
<td>532</td>
<td>2.2</td>
</tr>
<tr>
<td><em>Unclassified finfishes</em></td>
<td>514</td>
<td>2.1</td>
</tr>
<tr>
<td><em>Scamp</em></td>
<td>413</td>
<td>1.7</td>
</tr>
<tr>
<td><em>American shad</em></td>
<td>267</td>
<td>1.1</td>
</tr>
<tr>
<td>Other Species</td>
<td>2,312</td>
<td>9.6</td>
</tr>
<tr>
<td>Total - All Species</td>
<td>24,120</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.

In terms of commercial landings by value, white shrimp was the dominant species, comprising over 39 percent of the average landings in South Carolina. Blue crab was the second most dominant species, comprising 19 percent of the average annual landings. The eight other principal species accounted for about 32 percent of the total landings.

In terms of weight, about 78 percent of the landings in South Carolina in 2006 were from state waters; approximately 22 percent were from federal waters (Table 3.4-9). When compared to the value of catches from federal waters, the relative importance of catches from state waters was slightly less pronounced, representing almost 62 percent of the value of the landings.

Shellfish dominated the catch in state waters, comprising approximately 95 percent of the landings by weight and 61 percent by value. In federal waters, finfish dominated, comprising about 96 percent of the catch by weight and 52 percent of the catch by value.
### Table 3.4-9

**2006 Commercial Landings by Distance – South Carolina**

<table>
<thead>
<tr>
<th></th>
<th>Landings by Weight</th>
<th>Landings by Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thousands of Kilograms</td>
<td>Thousands of Pounds</td>
</tr>
<tr>
<td><strong>State Waters</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finfish</td>
<td>204</td>
<td>450</td>
</tr>
<tr>
<td>Shellfish</td>
<td>3,736</td>
<td>8,237</td>
</tr>
<tr>
<td>Total</td>
<td>3,940</td>
<td>8,687</td>
</tr>
<tr>
<td><strong>Exclusive Economic Zone</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finfish</td>
<td>1,054</td>
<td>2,323</td>
</tr>
<tr>
<td>Shellfish</td>
<td>46</td>
<td>102</td>
</tr>
<tr>
<td>Total</td>
<td>1,100</td>
<td>2,425</td>
</tr>
<tr>
<td>Grand Total</td>
<td>5,040</td>
<td>11,112</td>
</tr>
</tbody>
</table>

**Notes:** Numbers may not total exactly due to rounding. No landings from the high seas were reported. Source: NMFS, 2007b.

### Fishing Gear and Fishing Effort in South Carolina

The principal gears used to harvest finfish and shellfish landed in South Carolina are otter trawls, pots and traps, and unspecified gear (Table 3.4-10). From 1997 to 2006, over 44 percent of the finfish and shellfish landed in state waters were captured using otter trawls, while pots and traps were used to capture 18 percent. An average of 11 percent of the gear used over the decade was unspecified.

### Fisheries within Range Site B

Table 3.4-11 presents the geographical overlap of the fishing grounds within Site B compared to the extent of the grounds off the coastline of South Carolina. Hook-and-line, pelagic longline and bottom longline type fishing vessels are the most common in Site B.

The most common gear types used in the state are otter trawls and pots and traps; however, both of these fishing methods occur primarily inshore of the range site. Rock shrimp trawling may occur sporadically at depths of 27 to 55 m (90 to 180 ft), yet this fishery has not occurred in recent years. Landings of rock shrimp have not been reported in South Carolina since 1989. This fishery is more active in Florida waters.
Table 3.4-10

1997-2006 Average Annual Commercial Landings by Gear Type – South Carolina

<table>
<thead>
<tr>
<th>Gear Type</th>
<th>Landings by Value Thousand $</th>
<th>Percentage of Total Landings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Otter trawl bottom</td>
<td>10,630</td>
<td>44.0</td>
</tr>
<tr>
<td>Pots and traps</td>
<td>4,386</td>
<td>18.2</td>
</tr>
<tr>
<td>Unspecified Gear</td>
<td>2,595</td>
<td>10.7</td>
</tr>
<tr>
<td>By Hand, Other</td>
<td>2,134</td>
<td>8.8</td>
</tr>
<tr>
<td>Rod and reel</td>
<td>1,695</td>
<td>7.0</td>
</tr>
<tr>
<td>Long lines</td>
<td>1,304</td>
<td>5.4</td>
</tr>
<tr>
<td>Tongs, grabs and rakes</td>
<td>370</td>
<td>1.5</td>
</tr>
<tr>
<td>Hand lines</td>
<td>340</td>
<td>1.4</td>
</tr>
<tr>
<td>Gill nets</td>
<td>244</td>
<td>1.0</td>
</tr>
<tr>
<td>Dredge</td>
<td>192</td>
<td>0.8</td>
</tr>
<tr>
<td>Other gear types</td>
<td>262</td>
<td>1.1</td>
</tr>
<tr>
<td><strong>Total - All Gear</strong></td>
<td><strong>24,150</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.

Table 3.4-11

Geographical Overlap of Fishing Grounds within Site B

<table>
<thead>
<tr>
<th>Gear Type</th>
<th>Percentage Overlap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pelagic longline</td>
<td>4</td>
</tr>
<tr>
<td>Handline, rod and reel, trolling</td>
<td>9</td>
</tr>
<tr>
<td>Bottom longline</td>
<td>8</td>
</tr>
</tbody>
</table>

Snapper-grouper fishing is a common activity in the range site. Snapper-grouper fishermen fish in waters over Site B, between 91 and 183 m (300 and 600 ft), using bottom longlines, handlines, hook-and-line gear, and hydraulic reels. Fishermen target areas of bottom relief which are plentiful in Site B.

Other common fishing methods employed in Site B are pelagic and bottom longline fishing. Pelagic longline fishing occurs over the continental shelf break and in other areas of the Gulf Stream. Bottom longline fishing occurs in Site B at depths of 91 to 273 m (300 to 895 ft). Longliners target swordfish, tuna, sharks, and, to a lesser extent, reef fish.
3.4.2.3 Site C

Principal fishery resources on the continental shelf offshore of North Carolina include several open ocean and migratory pelagic, demersal, and reef finfish species, as well as shrimp, and scallops. Most commercial fishing in the Cherry Point OPAREA occurs on the continental shelf (DoN, 2008l). Pelagic and bottom longliners, rod and reel, and bottom trawlers target fishes near and beyond the shelf edge. Many commercial fishery species are fished over areas of bottom relief, such as canyons, outcroppings, rock rubble, artificial reefs, and shipwrecks. These can be very similar to areas used by recreational fishermen and are considered to be popular fishing areas, or fish havens (DoN, 2008l). These popular fishing areas and their relative locations to the proposed Site C USWTR are shown in Figure 3.4-4. Ten charted popular fishing areas are located within the proposed USWTR site, including Swansboro Hole, Grouper Hole, Yellowfin Hole, Deep Ledge, and Scallop Bed.

State Landings

The most recent available commercial fishing information for North Carolina from NMFS was for the year 2006 (NMFS, 2007b). Over the ten-year period from 1997 to 2006, the commercial landings of food and baitfish in North Carolina, measured by weight, averaged about 65 million kilograms (kg) (144 million pounds [lbs]) per year (NMFS, 2007b). Commercial landings ranged between a high of about 104 million kg (230 million lbs) in 1997 to a low of approximately 31 million kg (69 million lbs) nine years later, in 2006.

Harvests were variable over the ten-year period ending in 2006, with annual landings, measured by weight, typically deviating from the average by approximately 32 percent. The landings data show an overall declining trend of about 60 percent over the ten years.

Just as landings by weight declined over the decade, the dollar values of landings also declined at a substantial overall rate of approximately 37 percent during the period (NMFS, 2007b). Dollar values averaged over $90 million. Values ranged from a high of over $109 million at the beginning of the ten-year period, in 1997, to a low of about $65 million towards the end of the period, in 2005.

Marine fish and shellfish landings in North Carolina are seasonal, both in terms of landings by weight and landings by value (NMFS, 2007b). In 2006, approximately one-third of the landings, measured by weight, were recorded in August, September, and October, the months with the highest landings; about 5 percent of the landings were recorded in April, December, and January, the months with the lowest landings. However, the value of landings peaked in May and July, with almost 23 percent of the total landings occurring within these months. Overall, landings by weight increased from lows in November, December and January until they peaked in October with the exception of a decrease in landings in April and May.
Popular Fishing Areas in the Cherry Point OPAREA & Vicinity

Biological Regime Boundary
- 36.6 m (20 fm or 120 ft)
- 91.4 m (50 fm or 300 ft)
- 2000 m (1100 fm or 6600 ft)
- Continental Shelf Break

Popular Fishing Area
- Site C USWTR
- Cherry Point OPAREA

Figure 3.4-4
Over the ten-year period ending in 2006, the ten species of finfish and shellfish that generated the most revenue comprised almost 78 percent of the commercial landings in North Carolina, measured by value (Table 3.4-12). Landings for these ten principal species averaged about $70 million, a substantial amount compared to the average annual commercial landings of approximately $90 million for all species.

### Table 3.4-12

<table>
<thead>
<tr>
<th>Species</th>
<th>Landings by Value Thousand $</th>
<th>Percentage of Total Landings</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Principal Species</td>
<td>69,864</td>
<td>77.5</td>
</tr>
<tr>
<td>Blue crab</td>
<td>32,409</td>
<td>35.9</td>
</tr>
<tr>
<td>Brown shrimp</td>
<td>5,993</td>
<td>6.6</td>
</tr>
<tr>
<td>Summer flounder</td>
<td>5,826</td>
<td>6.5</td>
</tr>
<tr>
<td>Southern flounder</td>
<td>5,205</td>
<td>5.8</td>
</tr>
<tr>
<td>White shrimp</td>
<td>4,052</td>
<td>4.5</td>
</tr>
<tr>
<td>Other marine shrimp</td>
<td>3,963</td>
<td>4.4</td>
</tr>
<tr>
<td>Quahog clam</td>
<td>3,870</td>
<td>4.3</td>
</tr>
<tr>
<td>Menhaden</td>
<td>3,629</td>
<td>4.0</td>
</tr>
<tr>
<td>Atlantic croaker</td>
<td>3,265</td>
<td>3.6</td>
</tr>
<tr>
<td>King and cero mackerel</td>
<td>1,652</td>
<td>1.8</td>
</tr>
<tr>
<td>Other Species</td>
<td>20,331</td>
<td>22.5</td>
</tr>
<tr>
<td>Total – All Species</td>
<td>90,194</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes: Numbers may not total exactly due to rounding. Source: NMFS, 2007b.

In terms of commercial landings by value, the blue crab was the dominant species, comprising almost 36 percent of the total landings in North Carolina between 1997 and 2006. Brown shrimp was the second most dominant species, comprising about 7 percent by value of the total landings. The eight other principal species accounted for about 35 percent of the total landings.

The data indicate that, in terms of weight, about 64 percent of the landings in North Carolina in 2006 were from state waters; approximately 36 percent were from federal waters (Table 3.4-13). Landings measured by value show similar ratios of importance to total North Carolina landings.

Shellfish dominated the catch in state waters, comprising 72 percent by weight. The economic value of landings from state waters was also dominated by shellfish, which accounted for 77 percent of the dollars generated from all landings from state waters. In federal waters, finfish represented over 94 percent of the value of the landings. Finfish also dominated the catch by weight in federal waters with 95 percent of the catch. Overall, most (64 percent) finfish and shellfish were caught in state waters.
Table 3.4-13
2006 Commercial Landings by Distance – North Carolina

<table>
<thead>
<tr>
<th></th>
<th>Landings by Weight</th>
<th>Landings by Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thousands of Kilograms</td>
<td>Thousands of Pounds</td>
</tr>
<tr>
<td><strong>State Waters</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finfish</td>
<td>5,613</td>
<td>12,375</td>
</tr>
<tr>
<td>Shellfish</td>
<td>14,447</td>
<td>31,851</td>
</tr>
<tr>
<td>Total</td>
<td>20,060</td>
<td>44,226</td>
</tr>
<tr>
<td><strong>Exclusive Economic Zone</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finfish</td>
<td>10,524</td>
<td>23,201</td>
</tr>
<tr>
<td>Shellfish</td>
<td>551</td>
<td>1,214</td>
</tr>
<tr>
<td>Total</td>
<td>11,075</td>
<td>24,415</td>
</tr>
<tr>
<td>Grand Total</td>
<td>31,135</td>
<td>68,641</td>
</tr>
</tbody>
</table>

Notes: Numbers may not total exactly due to rounding.
No landings from the high seas were reported.
Source: NMFS, 2007b.

**Fishing Gear and Fishing Effort in North Carolina**

The principal gears used to harvest the finfish and shellfish landed in North Carolina are pots and traps, otter trawls, and gill nets (Table 3.4-14). Between 1997 and 2006, approximately 36 percent of the finfish and shellfish landed in the state were captured using pots and traps, while otter trawls, and gill nets were used to capture 27 and 12 percent, respectively. However, in waters greater than 5.6 km (3 NM) from the coast, south of Cape Hatteras, (the area of Site C), rod and reel and trolling gear dominated from 1995 to 2004 (Figures 3.4-5 and 3.4-6).
Table 3.4-14
1997-2006 Average Annual Commercial Landings by Gear Type – North Carolina

<table>
<thead>
<tr>
<th>Gear Type</th>
<th>Landings by Value Thousand $</th>
<th>Percentage of Total Landings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pots and traps</td>
<td>32,249</td>
<td>36.2</td>
</tr>
<tr>
<td>Otter trawl</td>
<td>24,047</td>
<td>27.0</td>
</tr>
<tr>
<td>Gill nets</td>
<td>10,839</td>
<td>12.2</td>
</tr>
<tr>
<td>Hand lines</td>
<td>3,599</td>
<td>4.0</td>
</tr>
<tr>
<td>Long lines</td>
<td>3,199</td>
<td>3.6</td>
</tr>
<tr>
<td>Troll lines</td>
<td>2,637</td>
<td>3.0</td>
</tr>
<tr>
<td>Purse seines</td>
<td>2,493</td>
<td>2.8</td>
</tr>
<tr>
<td>Pound nets</td>
<td>2,057</td>
<td>2.3</td>
</tr>
<tr>
<td>Rakes</td>
<td>1,854</td>
<td>2.1</td>
</tr>
<tr>
<td>By hand, other</td>
<td>1,745</td>
<td>2.0</td>
</tr>
<tr>
<td>Clam dredge</td>
<td>1,263</td>
<td>1.4</td>
</tr>
<tr>
<td>Beach haul seine</td>
<td>1,073</td>
<td>1.2</td>
</tr>
<tr>
<td>Other gear types</td>
<td>1,935</td>
<td>2.2</td>
</tr>
<tr>
<td>Total – All Gear</td>
<td>88,990</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.
Commercial Trips Made by Major Gears from 1995 to 2004 for Ocean Areas Greater than 3 miles from shore, South of Cape Hatteras, North Carolina (North Carolina Division of Marine Fisheries [NCDMF], 2005b)

Note: Trips are shown for top 5 gear types of each year.
The NCDMF maintains a database of commercial fishing activity, which provided information to determine the number of commercial fishing vessels operating in and the number of commercial fishing trips that were reported for the Onslow Bay region. The findings for 2003 are presented in Table 3.4-15. During that year, 1,088 commercial fishing vessels landed their catches.
Table 3.4-15

2003 Commercial Fishing Vessels and Trips – North Carolina

<table>
<thead>
<tr>
<th>County</th>
<th>Less than 5.6 km (3 NM)</th>
<th>Greater than 5.6 km (3 NM)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Vessels</td>
<td>Number of Trips</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carteret</td>
<td>171</td>
<td>943</td>
</tr>
<tr>
<td>Onslow</td>
<td>62</td>
<td>1,447</td>
</tr>
<tr>
<td>Pender</td>
<td>16</td>
<td>68</td>
</tr>
<tr>
<td>New Hanover</td>
<td>49</td>
<td>792</td>
</tr>
<tr>
<td>Brunswick</td>
<td>86</td>
<td>1,532</td>
</tr>
<tr>
<td>Total</td>
<td>384</td>
<td>4,782</td>
</tr>
</tbody>
</table>


These vessels made approximately 10,110 trips during the subject period. A trip can last from a few hours to a few days, depending on the fishery (Gibson, 1996). Approximately 47 percent of the trips yielded catches made mostly in ocean waters less than 5.6 km (3 NM) from shore. The remainder of the trips, about 53 percent, resulted in catches made mostly in ocean waters at a greater distance from shore. These data suggest the relative magnitude of fishing activity, but cannot be used to quantify the actual use of the proposed range area by fishing vessels.

**Fisheries within Range Site C**

The majority of fish and shellfish caught in Onslow Bay are shrimp and snapper-grouper complex species. Trawling occurs at Site C for shrimp and occasionally calico scallops. Most shrimp fishing is done inshore, but fishermen will regularly check the calico scallop beds that are within Site C. Shrimp trawl nets are used to check for calico scallops which are found from 9 to 366 m (30 to 1,200 ft).

Calico scallops have been landed in North Carolina in only five years since 1974. Calico scallop abundances are highly variable and catches can be lucrative when scallops are abundant. Calico scallops have not been landed in North Carolina since 1990, when they earned $530,590. In 1988 landings peaked at $702,134.

Pink shrimp are also caught in the Site C USWTR area. They are most abundant in depths between 11 and 37 m (36 and 121 ft), but can occur as deep as 65 m (213 ft) (SAFMC, 1996). As of this writing, pink shrimp are not in a high abundance in Site C. Rock shrimp are also found in small quantities off of North Carolina. They typically occur in depths between 35 and 55 m (115
and 180 ft) (FFWCC, 2005a). Rock shrimp were last landed in North Carolina in 1998 when a total of 2,544 kg (1,154 lbs) brought $1,154 (NMFS, 2006h).

Royal red shrimp, a deep-water shrimp, have not been landed in North Carolina, at least in the last 50 years, according to NMFS records (NMFS, 2006h). However, royal red shrimp have been landed in states north of Cape Hatteras and could have been caught off of North Carolina. Royal reds are primarily caught in Florida, however, abundance is highly variable and in some years royal red shrimp can be caught further north. Royal reds are fished at depths up to 421 m (1,381 ft).

Shrimp and calico scallop abundances are known to fluctuate and it can be expected that shrimp and calico scallop fisheries will occur in the Site C USWTR area over the lifetime of the range. Fishing effort could be heavily increased in the range area during years of calico scallop or shrimp abundance.

The snapper-grouper fishery is very important to the counties of Onslow Bay (Figure 3.4-2). Snapper-grouper fishermen fish in waters over Site C, between 91 and 183 m (300 and 600 ft), on the edge of the continental shelf 64 to 97 km (35 to 52 NM) from the coast of Onslow Bay. Snapper-grouper fishermen fish with bottom longlines, hook-and-line gear, and hydraulic reels. Fishermen target rocky areas which are plentiful in Site C. The snapper-grouper fishery was in decline in the first half of the decade from 1994 to 2004, but plateaued in the latter half (NCDMF, 2005b). Figure 3.4-7 presents data separated by taxonomic groups of the snapper-grouper complex.

The Navy evaluated available information on the use of fishing gear types within the four USWTR sites and spatially interpolated the estimated areas of gear use in a geographic information system (GIS). A ratio of the area of gear use within the range site and the total area of gear use off a state’s coastline was calculated for each USWTR site. This ratio was calculated for each gear type and represents the estimated percent of fishing grounds for each gear type within Site C compared to the extent of the total grounds for each gear type off the coastline of North Carolina (Table 3.4-13). A caveat to this analysis is that it does not take into account areas of fishing concentration.
Figure 3.4-7

Number of North Carolina Commercial Fishing Participants, Vessels, and Trips for Snapper-Grouper Complex Taxonomic Groups from 1994 to 2004
The most common gear used in Site C is bottom long line, handline and offshore trolling. While the range site occupies approximately eight percent of the calico scallop trawling grounds, calico scallops have not been landed in North Carolina since 1990. Similarly, rock shrimp have not been landed in North Carolina since 1998. Thus, the trawling gear used in these two fisheries is likely not often used in the range area, although it may occasionally be used to check for species abundance and commercial fishing viability.

3.4.2.4 Site D

The USWTR site in the VACAPES OPAREA is located off the coasts of both Maryland and Virginia; therefore fisheries in both states are described here. Fishery resources on the continental shelf offshore of Maryland and Virginia in the VACAPES OPAREA include several pelagic and demersal finfish, mollusks, and crustaceans (DoN, 1995b). Commercial fishing activity on these resources include sink gillnets and bottom trawls used principally on demersal finfish; dredges employed to harvest mollusks; purse seines, mid-ocean trawls, driftnets, and longlines used on pelagic resources; and traps employed on demersal finfish and crustaceans.

The majority of the commercial fishing grounds within the VACAPES OPAREA are found over the continental shelf, especially in the northern portion of the OPAREA, or near areas of relief or bottom structure (DoN, 2008m). The commercial fishing grounds are similar to those used by recreational fishermen (DoN, 2008m). Figure 3.4-8 depicts popular fishing areas and their relative locations to the proposed Site D USWTR. There are seven charted popular fishing areas.

---

### Table 3.4-16

<table>
<thead>
<tr>
<th>Gear Type</th>
<th>Percentage Overlap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom long line for reef fish</td>
<td>11</td>
</tr>
<tr>
<td>Bottom long line for shark</td>
<td>4</td>
</tr>
<tr>
<td>Bottom trawl for calico scallops</td>
<td>8</td>
</tr>
<tr>
<td>Bottom trawl for rock shrimp</td>
<td>12</td>
</tr>
<tr>
<td>Hand line for snapper-grouper</td>
<td>8</td>
</tr>
<tr>
<td>Offshore trolling</td>
<td>8</td>
</tr>
<tr>
<td>Pelagic long line for fish</td>
<td>2</td>
</tr>
<tr>
<td>Pelagic long line for shark</td>
<td>3</td>
</tr>
<tr>
<td>Pots and traps</td>
<td>3</td>
</tr>
</tbody>
</table>

---
Popular Fishing Areas in the VACAPES OPAREA & Vicinity

- Biological Regime Boundary
- Popular Fishing Area
- Site D USWTR
- Site D USWTR
- VACAPES OPAREA

Figure 3.4-8
within the proposed Site D USWTR, including Poormans Canyon, South Poormans Canyon, 29 Fathom Lumps, Rock Pile, and 20 Fathom Washington Lump (Figure 3.4-8).

**State Landings**

NMFS landings data for Maryland and Virginia coastal and offshore waters were evaluated to determine the magnitude and value of the commercial marine fisheries. The most recent commercial fishing information available from NMFS for Maryland and Virginia was for the year 2006 (NMFS, 2007b). Detailed county economic information was not available for Maryland or Virginia as it was for North Carolina (see Subchapter 3.4.2.3).

**Virginia**

Between 1997 and 2006, the commercial landings of food and baitfish in Virginia, measured by weight, averaged over 221 million kg (488 million lbs). Commercial landings peaked in 1998 at nearly 269 million kg (593 million lbs), while the lowest landings occurred in 2006, when about 193 million kg (426 million lbs) of finfish and shellfish were landed.

Harvests remained moderately stable over the decade, with annual landings typically having deviated from the average by 13 percent. The landings data show a marked overall declining trend of approximately 23 percent over the ten years.

The dollar values of the landings averaged nearly $124 million over the ten-year period. Total values ranged from a low of nearly $101 million in 1997 to a high of over $160 million in 2004. Whereas landings by weight decreased at a rate of approximately 23 percent over the ten years, landings by value showed an increasing trend approaching 37 percent.

Similar to North Carolina (Site C), marine finfish and shellfish landings in Virginia are seasonal. However, the seasonality is more pronounced in the Virginia fisheries. In terms of landings by month, with over 39 percent of total landings by weight, July and August were the peak months in Virginia during 2006. High landings were also reported for June and September, with an additional 24 percent of total landings. Lowest landings by weight were reported for January and February, with a combined total of less than 1 percent of the 2006 landings. The highest landings by value were reported in April and May, when nearly 26 percent of the value of the catch was landed, while the lowest landing by value were reported in December and January, with approximately 6 percent of the landings by value of the catch.

Between 1997 and 2006, more than 95 percent of the commercial landings in Virginia, measured by value, were attributed to ten species of finfish and shellfish (Table 3.4-17). Over the ten-year period, annual commercial landings for these ten principal species averaged approximately $118 million.
Sea scallop was the dominant species by value in Virginia, and menhaden was the second most dominant species. With average landings of over $51 million, sea scallops comprised over 41 percent of the landings. Menhaden comprised nearly 22 percent of the average landings, with average landings of over $27 million. The eight other principal species accounted for over 32 percent of the total landings.

By weight, about 49 percent of the landings in Virginia in 2006 were from state waters; approximately 51 percent were from federal waters (Table 3.4-18). By value, landings from state waters accounted for nearly 35 percent of the total value of the Virginia marine fisheries, whereas landings from federal waters amounted to over 65 percent.

In 2006, finfish dominated the catch measured by weight in Virginia state waters, representing approximately 89 percent of the catch. Shellfish comprised just 11 percent of the catch. In terms of value, however, finfish accounted for nearly 60 percent and shellfish comprised over 40 percent of the total value of the landings in Virginia state waters.
Table 3.4-18
2006 Commercial Landings by Distance – Virginia

<table>
<thead>
<tr>
<th></th>
<th>Landings by Weight</th>
<th>Landings by Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thousands of Kilograms</td>
<td>Thousands of Pounds</td>
</tr>
<tr>
<td><strong>State Waters</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finfish</td>
<td>83,347</td>
<td>183,745</td>
</tr>
<tr>
<td>Shellfish</td>
<td>10,653</td>
<td>23,486</td>
</tr>
<tr>
<td>Total</td>
<td>94,000</td>
<td>207,231</td>
</tr>
<tr>
<td><strong>Exclusive Economic Zone</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finfish</td>
<td>95,139</td>
<td>209,741</td>
</tr>
<tr>
<td>Shellfish</td>
<td>4,194</td>
<td>9,245</td>
</tr>
<tr>
<td>Total</td>
<td>99,332</td>
<td>218,986</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td>193,332</td>
<td>426,217</td>
</tr>
</tbody>
</table>

Notes: Numbers may not total exactly due to rounding. No landings from the high seas were reported.
Source: NMFS, 2007b.

Although the majority of the catch in federal waters, by weight, was finfish, shellfish accounted for a larger share of the value of the Virginia commercial fishery landings. By weight, nearly 96 percent of the landings from federal waters were finfish, and over 4 percent were shellfish. However, when measured by value, shellfish accounted for approximately 74 percent of the total landings from federal waters.

**Maryland**

Between 1997 and 2006, the commercial landings of food and baitfish in Maryland, measured by weight, averaged about 26 million kg (58 million lbs). Commercial landings peaked in 1997 at approximately 35 million kg (76 million lbs), while the lowest landings occurred in 2000, when about 22 million kg (49 million lbs) of finfish and shellfish were landed.

Harvests were variable over the decade, with annual landings typically having deviated from the average by about 16 percent. The landings data show a marked overall declining trend of approximately 19 percent over the ten years.

The dollar values of the landings averaged approximately $56 million over the ten-year period. Total values ranged from a low of about $49 million in 2002 to a high of approximately $64 million in 1997. Landings by value decreased at a rate of over 12 percent over the ten years.
Marine finfish and shellfish landings in Maryland are seasonal. In terms of landings by month, with 28 percent of total landings by weight, September and October were the peak months in Maryland during 2006. Lowest landings by weight were reported for January and December, with a combined total of about 5 percent of the 2006 landings. The highest landings by value were reported in June and July, when 30 percent of the value of the annual catch was landed, while the lowest landing by value were reported in January and December, with approximately 7 percent of the catch.

Between 1997 and 2006, approximately 93 percent of the commercial landings in Maryland, measured by value, were attributed to ten species of finfish and shellfish (Table 3.4-19). Over the ten-year period, landings for these ten principal species averaged nearly $52 million in annual commercial landings.

<table>
<thead>
<tr>
<th>Species</th>
<th>Landings by Value Thousand $</th>
<th>Percentage of Total Landings</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Principal Species</td>
<td>51,793</td>
<td>92.6</td>
</tr>
<tr>
<td>Blue crab</td>
<td>35,731</td>
<td>63.9</td>
</tr>
<tr>
<td>Clams or bivalves</td>
<td>4,375</td>
<td>7.8</td>
</tr>
<tr>
<td>Eastern oyster</td>
<td>3,797</td>
<td>6.8</td>
</tr>
<tr>
<td>Striped bass</td>
<td>3,673</td>
<td>6.6</td>
</tr>
<tr>
<td>Sea scallop</td>
<td>1,149</td>
<td>2.1</td>
</tr>
<tr>
<td>White perch</td>
<td>715</td>
<td>1.3</td>
</tr>
<tr>
<td>Softshell clam</td>
<td>714</td>
<td>1.3</td>
</tr>
<tr>
<td>Catfishes and bullheads</td>
<td>551</td>
<td>1.0</td>
</tr>
<tr>
<td>Atlantic croaker</td>
<td>550</td>
<td>1.0</td>
</tr>
<tr>
<td>Menhaden</td>
<td>539</td>
<td>1.0</td>
</tr>
<tr>
<td>Other Species</td>
<td>4,128</td>
<td>7.4</td>
</tr>
<tr>
<td>Total – All Species</td>
<td>55,921</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes: Numbers may not total exactly due to rounding. Source: NMFS, 2007b.

Blue crab was the dominant species by value in Maryland, and clams or bivalves were the second most dominant species/group. With average landings of approximately $36 million, blue crab comprised nearly 64 percent of the landings. Clams or bivalves comprised nearly 8 percent of the landings, with average landings of over $4 million. The eight other principal species accounted for nearly 21 percent of the total landings.
By weight, about 82 percent of the landings in Maryland in 2006 were from state waters; approximately 18 percent were from federal waters (Table 3.4-20). By value, landings from state waters accounted for 76 percent of the total value of the Maryland marine fisheries, whereas landings from federal waters amounted to 24 percent.

### Table 3.4-20

2006 Commercial Landings by Distance – Maryland

<table>
<thead>
<tr>
<th></th>
<th>Landings by Weight</th>
<th>Landings by Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thousands of Kilograms</td>
<td>Thousands of Pounds</td>
</tr>
<tr>
<td>State Waters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finfish</td>
<td>5,211</td>
<td>11,487</td>
</tr>
<tr>
<td>Shellfish</td>
<td>13,750</td>
<td>30,312</td>
</tr>
<tr>
<td>Total</td>
<td>18,960</td>
<td>41,799</td>
</tr>
<tr>
<td>Exclusive Economic Zone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finfish</td>
<td>488</td>
<td>1,076</td>
</tr>
<tr>
<td>Shellfish</td>
<td>3,783</td>
<td>8,341</td>
</tr>
<tr>
<td>Total</td>
<td>4,272</td>
<td>9,417</td>
</tr>
<tr>
<td>Grand Total</td>
<td>23,232</td>
<td>51,216</td>
</tr>
</tbody>
</table>

Notes: Numbers may not total exactly due to rounding. No landings from the high seas were reported. Source: NMFS, 2007b.

In 2006, shellfish dominated the catch measured by weight in Maryland state waters, representing approximately 72 percent of the catch. Finfish comprised just 28 percent of the catch. In terms of value, shellfish accounted for approximately 80 percent and finfish comprised about 20 percent of the total value of the landings in state waters.

The majority of the catch in federal waters, by weight and by value, was shellfish. By weight, approximately 89 percent of the landings from federal waters were shellfish, and about 11 percent were finfish. When measured by value, shellfish accounted for approximately 86 percent of the total landings from federal waters.

### Fishing Gear and Fishing Effort

#### Virginia

The principal commercial gears used to harvest the marine fishery resources of Virginia are dredges, purse seines, and pots and traps (Table 3.4-21). Most fish and shellfish landed in Virginia, as measured by value, were captured using dredges, with over 38 percent of the fish
and shellfish landed in the state having been captured by dredges. Approximately 21 percent of the landed fish and shellfish were captured using purse seines, and pots and traps captured over 18 percent.

Table 3.4-21

<table>
<thead>
<tr>
<th>Gear Type</th>
<th>Landings by Value Thousand $</th>
<th>Percentage of Total Landings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dredge</td>
<td>47,446</td>
<td>38.3</td>
</tr>
<tr>
<td>Purse seines</td>
<td>26,382</td>
<td>21.3</td>
</tr>
<tr>
<td>Pots and traps</td>
<td>22,653</td>
<td>18.3</td>
</tr>
<tr>
<td>Otter trawl bottom</td>
<td>10,644</td>
<td>8.6</td>
</tr>
<tr>
<td>Gill nets</td>
<td>7,499</td>
<td>6.0</td>
</tr>
<tr>
<td>Pound nets</td>
<td>4,103</td>
<td>3.3</td>
</tr>
<tr>
<td>Tongs, grabs, picks, scrapes</td>
<td>2,765</td>
<td>2.2</td>
</tr>
<tr>
<td>and rakes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haul seines</td>
<td>1,075</td>
<td>0.9</td>
</tr>
<tr>
<td>Hand lines</td>
<td>654</td>
<td>0.5</td>
</tr>
<tr>
<td>By hand</td>
<td>133</td>
<td>0.1</td>
</tr>
<tr>
<td>Long lines</td>
<td>108</td>
<td>0.1</td>
</tr>
<tr>
<td>Other gear types</td>
<td>513</td>
<td>0.4</td>
</tr>
<tr>
<td>Total – All Gear</td>
<td>123,973</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.

**Maryland**

The principal commercial gears used to harvest the marine fishery resources of Maryland are pots and traps, and lines trot with bait (Table 3.4-22). The majority of fish and shellfish landed in Maryland, as measured by value, were captured using pots and traps, with nearly 37 percent of the fish and shellfish landed in the state having been captured by pots and traps. Nearly 14 percent of the landed fish and shellfish were captured using lines trot with bait.
Table 3.4-22

1997-2006 Average Annual Commercial Landings by Gear Type – Maryland

<table>
<thead>
<tr>
<th>Gear Type</th>
<th>Landings by Value Thousand $</th>
<th>Percentage of Total Landings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pots and traps</td>
<td>20,641</td>
<td>36.9</td>
</tr>
<tr>
<td>Lines trot with baits</td>
<td>7,704</td>
<td>13.8</td>
</tr>
<tr>
<td>Dredge</td>
<td>6,644</td>
<td>11.9</td>
</tr>
<tr>
<td>Pound nets</td>
<td>3,058</td>
<td>5.5</td>
</tr>
<tr>
<td>Gill nets</td>
<td>2,297</td>
<td>4.1</td>
</tr>
<tr>
<td>Tongs, grabs, picks, scrapes and rakes</td>
<td>2,295</td>
<td>4.1</td>
</tr>
<tr>
<td>Otter trawl bottom</td>
<td>973</td>
<td>1.7</td>
</tr>
<tr>
<td>Hand lines</td>
<td>688</td>
<td>1.2</td>
</tr>
<tr>
<td>Diving outfits</td>
<td>511</td>
<td>0.9</td>
</tr>
<tr>
<td>Long lines</td>
<td>343</td>
<td>0.6</td>
</tr>
<tr>
<td>Fyke and hoop nets</td>
<td>342</td>
<td>0.6</td>
</tr>
<tr>
<td>Haul seines</td>
<td>88</td>
<td>0.2</td>
</tr>
<tr>
<td>Other gear types</td>
<td>10,336</td>
<td>18.5</td>
</tr>
<tr>
<td>Total – All Gear</td>
<td>55,921</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2009i.

Fisheries Within Range Site D

Table 3.4-23 presents the geographical overlap of the fishing grounds within Site D compared to the extent of the grounds off the coastlines of Maryland and Virginia. Several fishing methods occur in the shallow waters of Site D. Fishing methods occurring over much of the Site D area include bottom otter trawling (from 5.6 km [3 NM] from shore to about a water depth of 366 m [1,200 ft]), pelagic longlining (from 37 m to 91 m [121 ft to 300 ft]), bottom longlining (91 m to 273 m [300 ft to 896 ft]), gillnetting (0 m to 40 m [0 ft to 131 ft]), and hook-and-line fishing (0 m to 200 m [0 ft to 656 ft]). However, purse seining, one of the most popular methods of fishing in Maryland and Virginia, only occurs in depths to 20 m (66 ft) and the fishing area does not overlap Site D.
Sea scallops are fished with scallop dredges out to about 55 m (180 ft) but generally not past 91 m (300 ft). The mid-Atlantic is a very productive scalloping ground. Thirty-two percent of all sea scallops caught in the United States was caught in the mid-Atlantic in 2004 (NMFS, 2007b). There is overlap with some of the sea scallop fishing areas and Site D. Sea scallop landings have increased a substantial amount in the past ten years. In 1997, sea scallop landings in the United States were valued at $89 million. By 2006, landings had increased to $386 million.

The area of anchored gillnet fishing for monkfish (goosefish) also overlaps Site D in the shallow waters of the range (to 100 m [330 ft]). Site D is a very common area for this fishery. Also in the shallow area of Site D, hydraulic dredges are used to fish ocean quahogs (to 91 m [300 ft]) and surfclam (to 18 m [60 ft]). Pots and traps also make up a sizable percentage of the landings in Maryland and Virginia and are fished in the shallow (as deep as 91 m [300 ft]) areas of the proposed range site.

### 3.4.3 Recreational Fishing

Recreational fishing is popular along the eastern seaboard of the United States. In 2006, Florida, North Carolina, and Maryland were ranked as the top three states where most anglers in the United States fished, and Virginia and South Carolina ranked seventh and eighth, respectively (NMFS, 2007b). Florida was the top state in 2006 for fishing by resident anglers. North Carolina, Maryland, Virginia, and South Carolina ranked third, fourth, eighth and tenth, respectively (NMFS, 2007b). Florida, North Carolina, and South Carolina were the top three states in 2006.
for fishing by out-of-state anglers, while Maryland and Virginia ranked sixth and seventh, respectively (NMFS, 2007b). The top two states with the highest number of out-of-state anglers compared to in-state anglers in 2006 were Rhode Island and South Carolina. North Carolina ranked third, Florida seventh, Maryland eleventh, and Virginia twelfth, (NMFS, 2007b). Florida and North Carolina were the top ranking states in 2006 for the number of trips taken in ocean (non-inland) waters. South Carolina, Virginia, and Maryland ranked sixth, tenth, and thirteenth, respectively (NMFS, 2007b).

While recreational fishing is popular in each of the OPAREAs, most recreational fishing and boating occurs within a few miles of shore and is expected to be relatively infrequent in the vicinity of any of the proposed USWTR sites. Table 3.4-24 presents the average annual recreational fishing trips in the state territorial sea and in the federal exclusive economic zone. Between 1997 and 2006, approximately 80 percent of recreational fishing trips in the ocean waters off the east coast of Florida, and the coasts of Georgia, South Carolina, North Carolina, Virginia, and Maryland were trips to the state territorial waters, whereas only about 20 percent were trips to the exclusive economic zone.

Table 3.4-24
1997-2006 Average Annual Recreational Fishing Trips

<table>
<thead>
<tr>
<th>State</th>
<th>Trips</th>
<th>Percentage of Ocean Trips</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>State Territorial Sea</td>
<td>Exclusive Economic Zone</td>
</tr>
<tr>
<td>East Florida</td>
<td>4,194,457</td>
<td>1,544,678</td>
</tr>
<tr>
<td>Georgia</td>
<td>147,645</td>
<td>33,406</td>
</tr>
<tr>
<td>South Carolina</td>
<td>955,163</td>
<td>116,651</td>
</tr>
<tr>
<td>North Carolina</td>
<td>3,901,722</td>
<td>526,434</td>
</tr>
<tr>
<td>Virginia</td>
<td>487,465</td>
<td>184,786</td>
</tr>
<tr>
<td>Maryland</td>
<td>189,033</td>
<td>110,739</td>
</tr>
<tr>
<td>Total</td>
<td>9,875,485</td>
<td>2,516,693</td>
</tr>
</tbody>
</table>

Note: Ocean is state territorial sea and federal exclusive economic zone combined. Source: NMFS, 2009i.

3.4.3.1 Site A

Recreational fishing is an important industry along the east coast of Florida. In 2006, Marine Recreational Fishery Statistics Surveys (MRFSS) field personnel identified 241 species of marine fish landed along the east coast of Florida (NMFS, 2007b). Also in 2006, roughly half of the saltwater fishing trips were taken on private, rental, charter, and party/head boats, with the
remainder taken from shore (NMFS, 2007b). Popular fishing areas and their relative locations to the proposed Site A USWTR are shown in Figure 3.4-2. Five charted popular fishing areas are located within the proposed Site A.

Both private and charter recreational bottom fishing vessels target hard bottom and artificial reefs. Artificial reefs can be constructed from sunken ships, planes, railroad cars, and construction debris to enhance recreational fishing opportunities (see Figure 3.5-1). There are no artificial reefs in the range area, but there are currently 106 artificial reef complexes in the corridor area (FFWCC, 2005b). There has been active artificial reef development off the City of Jacksonville for over 40 years and the City of Jacksonville has been permitted 21 areas offshore of Jacksonville for the construction and placement of artificial reefs by the USACE (Morton, 2008). Artificial reefs are very popular for both bottom fishing and sport diving. These areas receive high amounts of vessel traffic. Hard bottom habitat is described in Subchapter 3.2.4. Hard bottom habitat and other bottom features provide many “lesser-known” fishing locations that are not charted on the popular fishing areas as shown in Figure 3.4-2.

Recreational fishermen also target pelagic species offshore of Florida such as tuna, mackerel, dolphinfish, wahoo, cobia, and billfish. Pelagic fish can be associated with bottom features (see popular fishing areas in Figure 3.4-2) or with oceanographic features. The western front of the Gulf Stream, as well as eddies that regularly break away from the Gulf Stream, offer distinct oceanographic habitats where a number of these species congregate and are targeted by fishermen. The west front of the Gulf Stream would be present within the Site A USWTR most of the year. Eddies breaking off the Gulf Stream could be present sporadically during some years, but can persist for months when present. Floating mats of Sargassum also attract pelagic game fish species, and these mats would most likely be present on some part of the proposed Site A USWTR during all parts of the year; fishermen will target these Sargassum mats.

The MRFSS conducted by NMFS provide estimates of fishing effort, catch, and participation by recreational anglers in the marine waters of the U.S. The following discussion of recreational fishing along the east coast of Florida is based on the findings of the MRFSS (NMFS, 2007b). The most recent available recreational fishing information for Florida from NMFS was for the year 2006.

State Landings

Eastern Florida

Over the decade from 1997 through 2006, the recreational landings of finfish caught in state and federal waters along the east coast of Florida averaged approximately 9 million kg (19 million lbs). Recreational landings ranged from a high of over 10 million kg (23 million lbs) in 2000 to a low of about 7 million kg (15 million lbs) in 2005.
Federal landings over the decade showed an increase until 2000 with nearly 6 million kg (14 million lbs) and were in slight decline over the remainder of the decade, with a low in 2005 of 3 million kg (6 million lbs). In 2006, however, an increase of 5 million kg (10 million lbs) occurred.

Data from the MRFSS database were used to characterize the composition of recreational landings of finfish caught in federal waters over the decade from 1997 to 2006. Two species groups accounted for 69 percent of the recreational landings by weight. Dolphinfish was the most important species group, in terms of recreational landings by weight, accounting for over 38 percent of the total recreational landings from federal waters off the east coast of Florida. Dolphinfish landings peaked in 2001 with 2.6 million kg (5.7 million lbs). The decade’s low dolphinfish landings occurred in 2005 with 1.2 million kg (2.7 million lbs). Tunas and mackerels comprised the second-ranked group, accounting for over 24 percent of the total landings by weight. Highest landings of tunas and mackerels occurred in 1999 with 1.9 million kg (4.3 million lbs). Lowest landings occurred in 2005 with 0.7 million kg (1.4 million lbs).

**Georgia**

Marine recreational landings for Georgia, by weight, averaged approximately 223,000 kg (492,000 lbs) during the 1997 to 2007 decade. Recreational landings in Georgia were at a decade low in 2002, at approximately 74,000 kg (164,000 lbs). The peak annual recreational landing figure for the decade was nearly 325,000 kg (716,000 lbs), recorded two years earlier, in 2000.

In federal waters, landings in 2002 were the decade’s lowest at approximately 32,000 kg (70,000 lbs). Landings in federal waters over the decade peaked the next year, in 2003, with about 229,000 kg (506,000 lbs) – over seven times greater than the weight of the landings of the previous year. In terms of landings by weight in Georgia, tunas and mackerels comprised the first-ranked species group over the decade in the federal waters recreational fishery. Tunas and mackerels accounted for nearly 29 percent of the total recreational landings from federal waters landed in Georgia. Tunas and mackerels landings peaked in 2000 with approximately 127,000 kg (279,000 lbs). Landings were lowest six years later, in 2003, with less than 8,000 kg (17,000 lbs). Other high ranking species groups over the decade were sea basses (22 percent) and snappers (12 percent).

**Fishing Effort**

**Eastern Florida**

About 1,570,000 fishing trips were taken in 2006 by individual marine recreational anglers fishing in the federal waters along the east coast of Florida (Table 3.4-25). The estimated number of participants in recreational fishing in marine fishing areas of eastern Florida, including the state territorial sea and federal waters, was nearly 5 million persons.
The were fewer seasonal variations in recreational fishing effort, in terms of trips and number of participants, along the east coast of Florida than in the waters of South Carolina, North Carolina, Maryland, or Virginia. Unlike the other states, Florida shows substantial activity during the winter months and generally stable recreational fishing effort throughout the year. For effort measured in terms of trips to federal waters in 2006, effort peaked during the six-month period from March through August, when just over 60 percent of the annual trips were taken.

Table 3.4-25

2006 Recreational Fishing Effort – Florida East Coast

<table>
<thead>
<tr>
<th>Months</th>
<th>Trips</th>
<th></th>
<th>Participants</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percentage</td>
<td>Number</td>
<td>Percentage</td>
</tr>
<tr>
<td>January – February</td>
<td>125,456</td>
<td>8.0</td>
<td>743,169</td>
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</tr>
<tr>
<td>March – April</td>
<td>325,203</td>
<td>20.7</td>
<td>962,948</td>
<td>19.5</td>
</tr>
<tr>
<td>May – June</td>
<td>445,163</td>
<td>28.3</td>
<td>1,047,177</td>
<td>21.2</td>
</tr>
<tr>
<td>July – August</td>
<td>332,270</td>
<td>21.2</td>
<td>970,598</td>
<td>19.6</td>
</tr>
<tr>
<td>September – October</td>
<td>203,244</td>
<td>12.9</td>
<td>593,399</td>
<td>12.0</td>
</tr>
<tr>
<td>November – December</td>
<td>139,153</td>
<td>8.9</td>
<td>631,348</td>
<td>12.8</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1,570,489</td>
<td>100.0</td>
<td>4,948,639</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes: Reported trips are marine recreational fishing trips to federal waters only. Reported participants are marine recreational anglers visiting any marine fishing areas, including the state territorial sea and federal waters. Numbers may not total exactly due to rounding. Source: NMFS, 2007b.

Georgia

Approximately 33,000 fishing trips were taken in 2006 by individual recreational anglers fishing in federal waters off the coast of Georgia (Table 3.4-26). According to MRFSS estimates, nearly 339,000 persons participated in recreational fishing in marine fishing areas, including the state territorial sea and federal waters.

In 2006, recreational fishing effort, in terms of trips and number of participants, was concentrated in the period from March through August. Over 78 percent of the reported trips were taken during this six-month period of 2006. Participation during these months was over 74 percent of the year’s reported total.
Table 3.4-26

2006 Recreational Fishing Effort – Georgia

<table>
<thead>
<tr>
<th>Months</th>
<th>Trips</th>
<th></th>
<th>Participants</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percentage</td>
<td>Number</td>
<td>Percentage</td>
</tr>
<tr>
<td>January – February</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
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<tr>
<td>March – April</td>
<td>5,763</td>
<td>17.6</td>
<td>71,108</td>
<td>21.0</td>
</tr>
<tr>
<td>May – June</td>
<td>13,786</td>
<td>42.2</td>
<td>100,062</td>
<td>29.5</td>
</tr>
<tr>
<td>July – August</td>
<td>5,972</td>
<td>18.3</td>
<td>79,744</td>
<td>23.5</td>
</tr>
<tr>
<td>September – October</td>
<td>6,542</td>
<td>20.0</td>
<td>50,279</td>
<td>14.8</td>
</tr>
<tr>
<td>November – December</td>
<td>620</td>
<td>1.9</td>
<td>37,640</td>
<td>11.1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>32,683</td>
<td>100.0</td>
<td>338,833</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes: Reported trips are marine recreational fishing trips to federal waters only. Reported participants are marine recreational anglers visiting any marine fishing areas, including the state territorial sea and federal waters. Numbers may not total exactly due to rounding.

Source: NMFS, 2009i.

Fishing Tournaments

Organized fishing tournaments, targeting a single species or multiple species, are popular in Florida. The maximum distance usually traveled by offshore tournament participants is 139 km (75 NM) from the tournament host site. The sites fished by anglers within the tournament geographical boundaries are dependent on several factors including the species targeted, tournament rules, and weather. The level of participation varies between individual tournaments, seasons, and years. The major recreational fishing tournaments hosted in Florida occur between mid-May and late July.

3.4.3.2 Site B

In 2006, MRFSS field personnel identified 109 species of marine fish landed in South Carolina (NMFS, 2007b). Also in 2006, roughly one-quarter of the saltwater fishing trips were taken on private, rental, charter, and party/head boats, with the remainder taken from shore (NMFS, 2007b). Popular fishing areas and their relative locations to the proposed Site B USWTR are shown in Figure 3.4-3. Ten charted popular fishing areas are located within the proposed Site B.

Both private and charter recreational bottom fishing vessels target hard bottom and artificial reefs. Artificial reefs can be constructed from sunken ships, planes, railroad cars, and construction debris to enhance recreational fishing opportunities. Artificial reefs are very popular for both bottom fishing and sport diving. These areas receive high amounts of vessel traffic,
particularly in the summer months. Hard bottom habitat is described in Subchapter 3.2.4. Hard bottom habitat and other bottom features provide many “lesser-known” fishing locations that are not charted on the popular fishing areas as shown in Figure 3.4-3.

Recreational fishermen also target pelagic species offshore of South Carolina, such as tuna, mackerel, dolphinfish, wahoo, cobia, and billfish. Pelagic fish can be associated with bottom features (see popular fishing areas in Figure 3.4-3) or with oceanographic features. South Carolina’s offshore features serve to support and sustain many resident and migratory fisheries species. Structural features on the continental shelf include natural hard bottoms, as well as artificial reefs and shipwrecks. No artificial reefs and 1 major shipwreck occur within the proposed Site B USWTR, and 13 artificial reefs and 30 major shipwrecks occur within the proposed trunk cable corridor.

The Charleston Bump, a unique habitat located southeast of Charleston on the Blake Plateau, deflects the Gulf Stream offshore in the South Atlantic Bight, resulting in ocean upwelling that brings nutrients to the surface waters. This increases the primary productivity of South Carolina’s coastal ocean waters, supporting and concentrating a food chain from zooplankton to small fish to commercially and recreationally important reef and pelagic fish that prey on them (South Carolina Sea Grant, 2007). Additionally, floating mats of *Sargassum* also attract pelagic game fish species and these mats would most likely be present on some part of the proposed Site B USWTR during all parts of the year; fishermen will target these *Sargassum* mats.

The following discussion of recreational fishing in South Carolina is based on the findings of the MRFSS (NMFS, 2007b). The most recent available recreational fishing information for South Carolina from NMFS was for the year 2006.

**State Landings**

Over the decade from 1997 to 2006, the recreational landings of finfish caught in state and federal waters off of South Carolina averaged approximately 1.0 million kg (2.2 million lbs). Recreational landings ranged from a high of over 1.4 million kg (3 million lbs) in 1997 to a low of about 0.5 million kg (1.2 million lbs) in 2002. Federal landings were variable. In 2001, a high occurred of 0.6 million kg (1.4 million lbs) while a low occurred just a year later, in 2002, of 0.3 million kg (0.6 million lbs).

Data from the MRFSS database were used to characterize the composition of recreational landings of finfish caught in federal waters during the decade from 1997 to 2006. Three species groups accounted for 71 percent of the recreational landings by weight. Tunas and mackerels comprise the most important species group in terms of recreational landings by weight, accounting for over 40 percent of the total recreational landings from federal waters off of South Carolina. Landings of tunas and mackerels declined over the decade. Landings peaked in 1997 with 0.36 million kg (0.80 million lbs) and reached a low in 2005 with 0.07 million kg (0.16
million lbs). Sea bass comprised the second-ranked group, accounting for over 15 percent of the total landings by weight. Dolphin fish were the third-ranked group, also with approximately 15 percent of the landings.

**Fishing Effort**

About 147,000 fishing trips were taken in 2006 by individual marine recreational anglers fishing in the federal waters off of the coast of South Carolina (Table 3.4-27). In 2006, the estimated number of participants in recreational fishing in marine fishing areas off of South Carolina, including state territorial sea and federal waters, was nearly 1.5 million persons.

Table 3.4-27

2006 Recreational Fishing Effort – South Carolina

<table>
<thead>
<tr>
<th>Months</th>
<th>Trips</th>
<th>Percentage</th>
<th>Participants</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td></td>
<td>Number</td>
<td></td>
</tr>
<tr>
<td>March - April</td>
<td>14,161</td>
<td>9.6</td>
<td>91,800</td>
<td>6.4</td>
</tr>
<tr>
<td>May - June</td>
<td>57,961</td>
<td>39.4</td>
<td>367,988</td>
<td>25.8</td>
</tr>
<tr>
<td>July - August</td>
<td>37,281</td>
<td>25.4</td>
<td>355,766</td>
<td>24.9</td>
</tr>
<tr>
<td>September - October</td>
<td>24,703</td>
<td>16.8</td>
<td>395,568</td>
<td>27.7</td>
</tr>
<tr>
<td>November - December</td>
<td>12,952</td>
<td>8.8</td>
<td>216,577</td>
<td>15.2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>147,058</strong></td>
<td><strong>100.0</strong></td>
<td><strong>1,427,699</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Notes: No trips or participants were reported for the January – February period.
Reported trips are marine recreational fishing trips to federal waters only.
Reported participants are marine recreational anglers visiting any marine fishing areas, including the state territorial sea and federal waters.
Numbers may not total exactly due to rounding.

Source: NMFS, 2007b.

Recreational fishing effort off of South Carolina is seasonal. In 2006, no trips or participants were reported for the January through February time frame and few trips or participants (9.6 percent and 6.4 percent, respectively) were reported March through April. Eighty-two percent of the year’s trips and 78 percent of the year’s participation occurred in the six-month period from May through October.

**Fishing Tournaments**

Organized fishing tournaments, targeting a single species or multiple species, are popular in South Carolina. The maximum distance usually traveled by offshore tournament participants is 139 km (75 NM) from the tournament host site. The sites fished by anglers within the
tournament geographical boundaries are dependent on several factors including the species targeted, tournament rules, and weather. The level of participation varies between individual tournaments, seasons, and years. The major recreational fishing tournaments hosted in South Carolina occur between mid-April and early September.

### 3.4.3.3 Site C

Marine recreational fishing in North Carolina is a substantial industry with a high level of activity. Several unique factors in the Cherry Point OPAREA heighten recreational fishing opportunities. One is the proximity of the continental shelf break, which is only 41 km (22 NM) from Cape Hatteras. Another is the location and behavior of the Gulf Stream, which is relatively close to shore along southern North Carolina before turning out to sea at Cape Hatteras. In 2006, MRFSS field personnel identified 152 species of marine fish landed in North Carolina (NMFS, 2007b). Also in 2006, roughly 60 percent of the saltwater fishing trips were taken on private, rental, charter, man made, and party/head boats, with the remainder taken from shore (NMFS, 2007b).

Recreational fishermen, including those participating in tournaments, focus their efforts in specific locations, especially when bottom-fishing. These popular fishing areas (Figure 3.4-4) are often associated with habitat features that concentrate fishes. Most popular fishing areas are located between shore and the shelf break; this is not surprising, given the limited range of many recreational fishing boats and the difficulty of fishing for demersal fishes in deep water beyond the shelf break. Ten popular fishing areas are located within the proposed Site C USWTR.

Both private and charter recreational bottom fishing vessels south of Cape Hatteras target hard bottom and artificial reefs. The state of North Carolina has constructed 21 artificial reefs in Onslow Bay from sunken ships, planes, railroad cars, and construction debris to enhance recreational fishing opportunities. The artificial reefs are very popular for both bottom fishing and sport diving. They are well marked by surface buoys and are displayed on navigational charts. These areas receive high amounts of vessel traffic, particularly in the summer months. No artificial reefs occur within the proposed Site C USWTR or within the proposed trunk cable corridor. Five major shipwrecks occur within the proposed Site C USWTR and ten major shipwrecks occur within the proposed trunk cable corridor. Hard bottom habitat (described in Section 3.2.4) and other bottom features provide many “lesser-known” fishing locations that are not charted on the popular fishing areas in Figure 3.4-4.

Recreational fishermen also target pelagic species offshore of North Carolina such as tuna, mackerel, dolphinfish, and billfish. Pelagic fish can be associated with bottom features (see popular fishing areas, Figure 3.4-4) or with oceanographic features. The western front of the Gulf Stream, as well as eddies that regularly break away from the Gulf Stream, offer distinct oceanographic habitats where a number of these species congregate and are targeted by fishermen. The west front of the Gulf Stream would be present within the Site C USWTR most
of the year. Eddies breaking off the Gulf Stream could be present sporadically during some years, but can persist for months when present. Floating mats of *Sargassum* also attract pelagic game fish species, and these mats would most likely be present on some part of the proposed Site C USWTR during all parts of the year. Fishermen will target these *Sargassum* mats.

The following discussion of recreational fishing off of North Carolina is based on the findings of the MRFSS (NMFS, 2007b). The most recent available recreational fishing information for North Carolina from NMFS was for the year 2006.

**State Landings**

During the decade from 1997 through 2006, the recreational landings of finfish caught in state and federal waters off the coast of North Carolina, measured by weight, averaged approximately 8 million kg (19 million lbs). Recreational landings ranged from a low of nearly 6 million kg (13 million lbs) in 1998 to a high of over 10 million kg (22 million lbs) eight years later, in 2006.

Data from the MRFSS database were used to characterize the composition of North Carolina recreational landings of finfish caught in federal waters during the decade from 1997 to 2006. Two species groups account for approximately 93 percent of the recreational landings by weight. Tunas and mackerels was the most important species group in terms of recreational landings by weight, accounting for 58 percent of the total recreational landings from federal waters off North Carolina. Tunas and mackerels averaged 3.7 million kg (8.1 million lbs) over the decade, reaching a low of 2.1 million kg (4.6 million lbs) in 2002 and a high of 4.6 million kg (10.3 million lbs) in 2000.

Dolphinfish (of genus *Coryphaena*) comprised the second-ranked group, approximately 35 percent of total recreational landings by weight from federal waters off North Carolina. Dolphinfish landings averaged 2.2 million kg (4.8 million lbs) over the decade, reaching a low of 1.3 million kg (3.0 million lbs) in 2004 and a high of 2.9 million kg (6.4 million lbs) in 2002.

**Fishing Effort**

Based on MRFSS estimates, individual marine recreational anglers fishing in the federal waters off the coast of North Carolina took approximately 712,457 fishing trips in 2006 (Table 3.4-28). The estimated number of participants in recreational fishing in marine fishing areas in 2006, including state territorial sea and federal waters, was more than 2.2 million persons.

In 2006, recreational fishing effort, in terms of trips and number of participants, was concentrated in the period from May through October. Over 80 percent of the annual effort, measured in the number of participants, occurred during this six-month period. The number of trips to federal waters peaked during the four months of May through August, when nearly 65 percent of the annual trips were taken.
Table 3.4-28

2006 Recreational Fishing Effort – North Carolina

<table>
<thead>
<tr>
<th>Months</th>
<th>Trips</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percentage</td>
</tr>
<tr>
<td>January – February</td>
<td>13,236</td>
<td>1.9</td>
</tr>
<tr>
<td>March – April</td>
<td>26,489</td>
<td>3.7</td>
</tr>
<tr>
<td>May – June</td>
<td>224,472</td>
<td>31.5</td>
</tr>
<tr>
<td>July – August</td>
<td>236,976</td>
<td>33.3</td>
</tr>
<tr>
<td>September – October</td>
<td>113,783</td>
<td>16.0</td>
</tr>
<tr>
<td>November – December</td>
<td>97,501</td>
<td>13.7</td>
</tr>
<tr>
<td>TOTAL</td>
<td>712,457</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes: Reported trips are marine recreational fishing trips to federal waters only. Reported participants are marine recreational anglers visiting any marine fishing areas, including the state territorial sea and federal waters. Numbers may not total exactly due to rounding.

Source: NMFS, 2007b.

Fishing Tournaments

Organized fishing tournaments, targeting a single species or multiple species, are popular in North Carolina. The maximum distance usually traveled by offshore tournament participants is 139 km (75 NM) from the tournament host site. The sites fished by anglers within the tournament geographical boundaries are dependent on several factors including the species targeted, tournament rules, and weather. The level of participation varies between individual tournaments, seasons, and years. The major recreational fishing tournaments hosted in North Carolina occur between mid-May and early November. The greatest number of tournaments occurs in the summer months, from July through September, while no tournaments are typically scheduled during the winter months of December through early April (Coastal Guide, 2007; NCDMF, 2007).

3.4.3.4 Site D

Recreational fishing is a major industry in Maryland and Virginia. In 2006, MRFSS field personnel identified 41 species of marine fish landed in Maryland and 43 species landed in Virginia (NMFS, 2007b). Also in 2006, from each of these states, nearly 80 percent of the saltwater fishing trips were taken on private, rental, charter, and party/head boats, with the remainder taken from shore (NMFS, 2007b). As previously noted, the commercial fishing
grounds are similar to those used by recreational fishermen and are shown in Figure 3.4-8. Seven charted popular fishing areas are located within the proposed Site D USWTR.

Bottom fishing vessels off of the Maryland and Virginia coasts target bottom structures and artificial reefs. Artificial reefs can be constructed from sunken ships, planes, railroad cars, and construction debris to enhance recreational fishing opportunities. Artificial reefs, shipwrecks, and other bottom features provide many “lesser-known” fishing locations that are not charted in the popular fishing areas shown on Figure 3.4-8.

Eight artificial reef sites lie within Delaware Bay and three artificial reef sites are offshore of Delaware within the VACAPES OPAREA, each associated with multiple reefs. The three artificial reef complexes within the VACAPES OPAREA corridor are all located south of Delaware Bay and are mainly comprised of recycled ballasted tires, concrete, construction equipment, and military vehicles (DNREC, 2005). The artificial reefs located nearshore primarily support blue mussels, *Mytilus edulis*, black sea bass, scup, weakfish, bluefish, striped bass, and tautog (DNREC, 2005). No artificial reefs and 5 major shipwrecks occur within the proposed Site D USWTR, and 7 artificial reefs and 18 major shipwrecks occur within the proposed trunk cable corridor.

Recreational fishermen also target pelagic species such as tuna, dolphinfish, and mackerel offshore of Maryland and Virginia. Pelagic fish can be associated with bottom features (see popular fishing areas in Figure 3.4-8) or with oceanographic features. The eddies that regularly break away from the Gulf Stream offer distinct oceanographic habitats where a number of these pelagic game fish species congregate and are targeted by fishermen. Eddies breaking off the Gulf Stream could be present sporadically during some years, but can persist for months when present over the proposed Site D USWTR. Floating mats of *Sargassum* also attract pelagic game fish species, and these mats would most likely be present on some part of the proposed Site D USWTR during all parts of the year; fishermen will target these *Sargassum* mats.

The following discussion of recreational fishing off the coast of Maryland and Virginia is based on the findings of the MRFSS (NMFS, 2007b). The most recent available recreational fishing information for Virginia and Maryland from NMFS was for the year 2006 (NMFS, 2007b).

**State Landings**

**Maryland**

Marine recreational landings for Maryland, by weight, averaged approximately 1.0 million kg (2.0 million lbs) during the 1997 to 2006 decade. The peak annual recreational landings for the decade occurred in 1997 at over 1.3 million kg (2.9 million lbs). Recreational landings in Maryland were at a decade low in 2004 with 0.5 million kg (1.0 million lbs).
Landings in federal waters fluctuated with a high of 1.3 million kg (2.8 million lbs) in 1997 and a low of 0.4 million kg (0.9 million lbs) in 2004. Landings were highest in 1997 and 1998 and again in 2001 and 2002 with sharp declines (about half of the landings) in all other years.

In terms of landings by weight, tunas and mackerels comprised the first-ranked species group over the 1997 to 2006 decade in the federal waters recreational fishery off the coast of Maryland. Tunas and mackerels accounted for over 62 percent of the total recreational landings from federal waters landed in Maryland, with an average of 0.5 million kg (1.1 million lbs). Tunas and mackerels landings fluctuated over the decade ranging from a high of 1.0 million kg (2.2 million lbs) in 2001 to a low of 0.2 million kg (0.4 million lbs) in 2000. Other high ranking species groups were seabasses (13 percent), bluefish (10 percent), dolphinfish (5 percent), and cartilaginous fishes (3 percent).

**Virginia**

Marine recreational landings for Virginia, by weight, averaged approximately 1.6 million kg (3.5 million lbs) during the 1997 to 2007 decade. Recreational landings in Virginia were at a decade low in 2003, at less than 1.0 million kg (2.3 million lbs). The peak annual recreational landing figure for the decade was over 2.5 million kg (5.6 million lbs), recorded in 1997.

In federal waters, landings over the decade increased until they peaked in 2001 with 1.5 million kg (3.5 million lbs). After 2001, a sharp decline occurred throughout the remainder of the decade. Landings in 2006 were the decade’s lowest with 0.3 million kg (0.5 million lbs).

In terms of landings by weight, tuna and mackerel comprised the first-ranked species group during the decade from 1997 to 2006 in the federal waters recreational fishery off the coast of Virginia. Tunas and mackerels accounted for over 38 percent of the total recreational landings from federal waters landed in Virginia. Tunas and mackerels landings peaked in 2001 with approximately 0.95 million kg (2.10 million lbs). Landings were lowest in 2003 with 0.08 million kg (0.17 million lbs). Other high ranking species groups over the decade were sea basses (16 percent), ‘other fishes’ (14 percent), and drums (6 percent).

**Fishing Effort**

**Maryland**

Almost 73,000 fishing trips were taken in 2006 by individual recreational anglers fishing in federal waters off the coast of Maryland (Table 3.4-29). According to MRFSS estimates, nearly 2 million persons participated in recreational fishing in marine fishing areas, including the state territorial sea and federal waters (NMFS, 2007b).
Table 3.4-29
2006 Recreational Fishing Effort – Maryland

<table>
<thead>
<tr>
<th>Months</th>
<th>Trips</th>
<th></th>
<th>Participants</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percentage</td>
<td>Number</td>
<td>Percentage</td>
</tr>
<tr>
<td>March - April</td>
<td>689</td>
<td>0.9</td>
<td>272,938</td>
<td>13.3</td>
</tr>
<tr>
<td>May - June</td>
<td>21,718</td>
<td>29.8</td>
<td>573,288</td>
<td>27.8</td>
</tr>
<tr>
<td>July - August</td>
<td>35,610</td>
<td>48.9</td>
<td>646,026</td>
<td>31.4</td>
</tr>
<tr>
<td>September - October</td>
<td>13,682</td>
<td>18.8</td>
<td>382,624</td>
<td>18.6</td>
</tr>
<tr>
<td>November - December</td>
<td>1,174</td>
<td>1.6</td>
<td>183,693</td>
<td>8.9</td>
</tr>
<tr>
<td>TOTAL</td>
<td>72,873</td>
<td>100.0</td>
<td>2,058,569</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes: No trips or participants were reported for the January – February period.
Reported trips are marine recreational fishing trips to federal waters only.
Reported participants are marine recreational anglers visiting any marine fishing areas, including the state territorial sea and federal waters.
Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.

In 2006, recreational fishing effort, in terms of trips, was concentrated in July and August with 49 percent of the trips occurring during these months. However, in terms of number of participants, fishing effort was more spread out over the period from May to October, with 78 percent of participants fishing during this time period.

**Virginia**

Approximately 119,000 fishing trips were taken in 2006 by individual recreational anglers fishing in federal waters off the coast of Virginia (Table 3.4-30). According to MRFSS estimates, nearly 2 million persons participated in recreational fishing in marine fishing areas, including the state territorial sea and federal waters off the coast of Virginia.

In 2006, recreational fishing effort, in terms of trips and number of participants, was concentrated in the period from May through August. Approximately 82 percent of the trips were taken during this four-month period of 2006. Participation during these months was 64 percent of the year’s total.

**Fishing Tournaments**

Organized fishing tournaments, targeting a single species or multiple species, are popular in Maryland and Virginia. The maximum distance usually traveled by offshore tournament participants is 139 km (75 NM) from the tournament host site. The sites fished by anglers within the tournament geographical boundaries are dependent on several factors including the species targeted, tournament rules, and weather. The level of participation varies between individual
tournaments, seasons, and years. The major recreational fishing tournaments hosted in Maryland and Virginia occur between mid-June and late October. The greatest number of tournaments occurs in the summer months, from July through September.

Table 3.4-30
2006 Recreational Fishing Effort – Virginia

<table>
<thead>
<tr>
<th>Months</th>
<th>Trips</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percentage</td>
</tr>
<tr>
<td>March – April</td>
<td>8,383</td>
<td>7.0</td>
</tr>
<tr>
<td>May – June</td>
<td>48,431</td>
<td>40.7</td>
</tr>
<tr>
<td>July – August</td>
<td>48,833</td>
<td>41.0</td>
</tr>
<tr>
<td>September – October</td>
<td>6,930</td>
<td>5.8</td>
</tr>
<tr>
<td>November – December</td>
<td>6,564</td>
<td>5.5</td>
</tr>
<tr>
<td>TOTAL</td>
<td>119,141</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes: No trips or participants were reported for the January – February period. Reported trips are marine recreational fishing trips to federal waters only. Reported participants are marine recreational anglers visiting any marine fishing areas, including the state territorial sea and federal waters. Numbers may not total exactly due to rounding.

Source: NMFS, 2007b.

3.4.4 Commercial Shipping and Recreational Boating

3.4.4.1 Commercial Shipping

The waters off the U.S. Atlantic coast support a large volume of maritime traffic heading to and from ports, as well as traffic traveling north and south to various U.S. ports. Commercial shipping comprises a large portion of this traffic and a number of commercial ports are located along the U.S. coast. Nearshore shipping lanes aid ocean-going vessels in avoiding navigational conflicts and collisions in areas leading into and out of major ports. Offshore, there are no designated shipping lanes; vessels generally follow routes determined by their destination, depth requirements, and the current weather conditions.

As stated in Chapter 2, shipping traffic data have been reexamined since previous versions of this document. A qualitative assessment based on an analysis of shipping densities by NAVOCEANO and a quantitative assessment based on analyses of ICOADS and AMVER data were utilized instead of HITS data because these databases were deemed to be more representative of actual shipping activity.
The report obtained from the NAVOCEANO (2007) plotted shipping data compiled over a five-year period and characterized areas of the ocean according to five density regimes (infrequent, light, moderate, heavy, very heavy). All of the proposed USWTR action alternative sites were in the “light” category (2-11 ships per day per 343 km² [100 NM²]).

The ICOADS and AMVER data sets, and a third data set averaging the other two, all provided similar qualitative results. The Cherry Point site showed nearly double the intensity of any other site in both the ICOADS and ICOADS-AMVER average analyses. The discrepancy between Cherry Point and other sites was not as great in the AMVER analysis. VACAPES, Charleston, and Jacksonville (in respective order) ranked below Cherry Point in all three proxy analyses (see Figure 3.4-9).

### 3.4.4.2 Recreational Boating

#### Site A

Recreational activities along the east coast of Florida primarily comprise game and sport fishing, charter boat fishing, sailing, power cruising, sport diving, and other recreational boating activities. Recreational fishing and other recreational boats range throughout the coastal waters and throughout all four seasons. Many sites that are known as popular fishing areas (see Figure 3.4-2) also attract divers (DoN, 2008n). Popular fishing areas and other dive sites – including artificial reefs, coral patches, and shipwrecks – are utilized throughout the year by recreational vessels and commercial chartered boats, but use is highest during the summer. Florida ranks first in the nation for the number of recreational boats registered in the state, with 973,859 registered in 2005 (USCG, 2006).

Travel between the most popular cruising destinations along the Florida coast does not require traversing of the proposed Site A USWTR. However, larger recreational vessels, in particular sailboats and motor cruisers in the 15-m (50-ft) and larger class, do travel considerable distances offshore. Further, depending on local wind conditions, sailboats in the 23-m (75-ft) and larger class may traverse the vicinity of the proposed range. Certain ocean passages for cruising vessels also might favor courses through the vicinity of the proposed site.

#### Site B

In the vicinity of the proposed Site B range, recreational activities primarily comprise game and sport fishing, charter boat fishing, sailing, power cruising, sport diving, and other recreational boating activities. Recreational fishing and other recreational boats range throughout the coastal waters and throughout all four seasons. Many sites that are known as popular fishing areas (see Figure 3.4-3) also attract divers (DoN, 2008n). Popular fishing areas and other dive sites – including artificial reefs, coral patches, and shipwrecks – are utilized throughout the year by recreational vessels and commercial chartered boats, but use is highest during the summer. South
The analysis of ICOADS/AMVER data performed by Wang et al. 2007 provided data with cell values of the percentage of total global emissions. This analysis was deemed to be a reliable proxy for shipping intensity, however, data cannot be directly translated into density values of the number of ships per unit area per unit time.

Carolina ranks 8th in the nation for the number of recreational boats registered in the state, with 416,763 registered in 2005 (USCG, 2006).

Travel between the most popular cruising destinations along the South Carolina coast does not require traversing of the proposed Site B USWTR. However, larger recreational vessels, in particular sailboats and motor cruisers in the 15-m (50-ft) and larger class, do travel considerable distances offshore. Further, depending on local wind conditions, sailboats in the 23-m (75-ft) and larger class may traverse the vicinity of the proposed range. Certain ocean passages for cruising vessels also might favor courses through the vicinity of the proposed site.

**Site C**

Recreational activities in the Cherry Point OPAREA primarily comprise game and sport fishing, charter boat fishing, whale watching, sailing, power cruising, sport diving, and other recreational boating activities. Recreational fishing and other recreational boats range throughout the North Carolina coastal waters, depending on season and weather conditions. North Carolina ranks 11th in the nation for the number of recreational boats registered in the state, with 362,784 boats registered (USCG, 2006).

Travel between the most popular cruising destinations along the North Carolina coast does not require traversing of the proposed Site C USWTR. However, larger recreational vessels, in particular sailboats and motor cruisers in the 15-m (50-ft) and larger class, do travel considerable distances offshore. To clear Cape Lookout and Frying Pan Shoals these boats may traverse the Cherry Point OPAREA at distances between 45 and 55 km (25 and 30 NM) or greater offshore of the New River Inlet. Further, depending on local wind conditions, sailboats in the 23-m (75-ft) and larger class may traverse the vicinity of the proposed Site C range. Certain ocean passages for cruising vessels (e.g., from some North Carolina ports to the Bahamas or Bermuda) also might favor courses through the vicinity of the proposed site.

**Site D**

In the vicinity of the proposed Site D range, recreational activities are primarily comprised of game and sport fishing, charter boat fishing, whale watching, sailing, power cruising, sport diving, and other recreational boating activities. Virginia ranks 19th and Maryland ranks 24th in the nation for the number of recreational boats registered in these states, with 245,073 and 205,812 boats registered (respectively) in 2005 (USCG, 2006). Five artificial reefs are located offshore of the Virginia coast (Virginia Marine Resources Commission [VMRC], 2002). Three of these offshore artificial reefs – Blackfish Bank, Parramore Reef, and Wachapreague Reef – are located north of the mouth of Chesapeake Bay, shoreward of the proposed USWTR site. All three are situated within 17 km (9 NM) of shore, and at distances between 52 and 72 km (28 and 39 NM) from the proposed range site.
Travel between the most popular cruising destinations along the Maryland-Virginia coast does not require traversing of the proposed Site D USWTR. However, larger recreational vessels, in particular sailboats and motor cruisers in the 15-m (50-ft) and larger class, do travel considerable distances offshore. Further, depending on local wind conditions, sailboats in the 23-m (75-ft) and larger class may traverse the vicinity of the proposed range. Certain ocean passages for cruising vessels also might favor courses through the vicinity of the proposed site.

### 3.4.5 Scuba Diving

Scuba diving and snorkeling are popular recreational activities along the entire U.S. coastline but especially off the southeastern states, including Florida, South Carolina, and North Carolina, where warm water, much of it provided by the proximity of the Gulf Stream, is the primary attraction for divers. Although diving occurs year-round, it varies in intensity with season (i.e., there are more diver trips in summer than in winter). Divers visit certain dive sites on a frequent and/or regular basis. Scuba diving in the vicinity of the proposed USWTR sites consists of diving on wrecks, artificial reefs and hard bottom structures. Coral reefs at depths within recreational diving limits are not contained within any of the proposed USWTR sites. Many sites that are known as popular fishing areas also attract divers (see Figures 3.4-2, 3.4-3, 3.4-4 and 3.4-8).

In the Cherry Point and VACAPES OPAREAs, the preponderance of shipwrecks (see Subchapter 3.5; Figures 3.5-3 and 3.5-4) provides ideal diving locations. More than 1,000 ships have been lost along the North Carolina coast in the past four centuries (DoN, 2008l), with the highest concentrations of shipwrecks in the vicinity of Cape Hatteras. A number of shipwrecks are found in Onslow Bay and around the point of Cape Fear (Association of Underwater Explorers, 2006). The VACAPES OPAREA contains approximately 160 shipwrecks (DoN, 2008m). Shipwrecks in the Jacksonville and Charleston OPAREAs are fewer in number; however, other types of dive sites are popular, including live/hard bottom, artificial reefs, and the Gray’s Reef NMS (Discover Diving, 1999; NOAA, 2007c; Coastal Scuba, 2002). Dive boats from southeastern North Carolina, South Carolina, Georgia, and northeastern Florida visit dive sites located within the Jacksonville and Charleston OPAREAs (Florida Scuba Connection, 1998; Divers Supply, 2001; Mermaid Diving, 2002; Onslow Bay Departures, 2002).
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3.5 Cultural Resources at Sea

Potential cultural resources occurring at sea could include both archaeological sites and shipwrecks. **Archaeological sites may be present from Paleo-Indian habitation during the last ice age, when sea levels were much lower. These sites would occur in depths of less than approximately 100 m (330 ft).** Sediment deposition rates along the Atlantic coast range from 0.3 to 1.6 cm (1 to 6 in) per year for Florida bays (Wingard et al., 2007) and for the continental shelf near Cape Hatteras, North Carolina range from 10 to 425 cm (4 to 167 in) per thousand years, with a mean of 106 cm (3.5 ft) per thousand years (values based on Alperin et al., 2002). These sedimentation rates provide an estimate of about 1 m (3.2 ft) every 1,000 years for the continental shelf and 3 m to 16 m (10 to 52 ft) every 1,000 years for areas closer to shore. The sediments accumulated beginning about 12,000 years ago would be more than enough to cover Paleo-Indian remains and provide a buffer between trenching activities and potential artifacts. Therefore, it is anticipated that these sites would be buried under sediments that have accumulated over the centuries (i.e., they would be buried well below the affected environment ranging from 1 to 3 m [3 to 10 ft], depending on site, where the trunk cable would be trenched as part of the proposed action) and it is anticipated that there would be no archaeological sites in the affected environment. Therefore, the following discussion of cultural resources at sea at each proposed USWTR location relates only to shipwrecks, as they are the only predicted cultural resources to be potentially impacted by the proposed action.

The National Historic Preservation Act (NHPA) extends to federal undertakings outside the U.S. where (1) the undertaking may directly and adversely affect a property on the World Heritage List or on the applicable country’s equivalent of the National Register, and (2) only requires that the head of the agency take into account the effect of the undertaking on such property for purposes of avoiding or mitigating any adverse effects (16 USC 470a-2). No shipwrecks within any of the proposed USWTR sites appear on the World Heritage List.

In accordance with the Sunken Military Craft Act, information was requested from the Naval History and Heritage Command (NHHC), Underwater Archaeology Branch and Cultural Resources Management Section. On April 9, 2009, the NHHC provided available data regarding the location of Navy shipwrecks and wrecked aircraft. These data were mapped and compared to the locations of the four alternative USWTR sites. No Navy shipwrecks or wrecked aircraft are located within any of the proposed USWTR sites.

3.5.1 Site A

The continental shelf off the southeastern U.S. has the potential for containing many shipwrecks. Merchantmen, ships-of-war, blockade-runners, cruise ships, and fishing vessels dating from the eighteenth century to the present have been sunk, lost, or run aground in the Jacksonville OPAREA. There are approximately 16 shipwrecks off the coast of northern Florida (DoN, 2008n).
NOAA’s Automated Wreck and Obstruction Information System (AWOIS) and Captain Segull’s Nautical Fishing Charts (Captain Segull, 2004) were queried to determine the best representation of the potential for shipwrecks and obstructions to exist in the area of the proposed range (NOAA, 2004b, 2006c). Figure 3.5-1 depicts the results. As shown in the figure, most shipwreck and obstruction locations are inshore of the proposed USWTR location, with two shipwrecks located within Site A.

### 3.5.2 Site B

As noted for Site A, the continental shelf off the southeastern U.S. has the potential for containing many shipwrecks. Merchantmen, ships-of-war, blockade-runners, cruise ships, and fishing vessels dating from the eighteenth century to the present have been sunk, lost, or run aground off the coast of South Carolina, particularly in the vicinity of Charleston Harbor (Figure 3.5-2). Off the coast of Charleston, South Carolina there are various Civil War ships sunk (i.e., Housatonic, Palmetto State, the Norseman, the Stonewall Jackson, Raccoon, Keokuk, Weehawken, U.S.S. Patapsco, HMS Acteon, and the Ruby) (NUMA, 2006).

NOAA’s AWOIS and Captain Segull’s Nautical Fishing Charts (Captain Segull, 2004) were queried to determine the best representation of the potential for shipwrecks and obstructions to exist in the area of the proposed range (NOAA, 2004b, 2006c); Figure 3.5-2 depicts the results. As shown in the figure, there is one shipwreck present in Site B.

### 3.5.3 Site C

The South Atlantic continental shelf has the potential to contain many shipwrecks. The prominent capes (Hatteras, Lookout, and Fear) and their attending shoals (Diamond, Lookout, and Frying Pan); the powerful currents, winds, and treacherous seas; and the conflicts of wars are all responsible for the numerous shipwrecks off the coast of North Carolina (Newton et al., 1971).

Over a thousand ships have been lost along the North Carolina coast in the past four centuries, earning those waters the nickname “The Graveyard of the Atlantic.” Some of these shipwrecks date to Colonial times (DoN, 2008l). The highest concentrations of shipwrecks are in the vicinity of Cape Hatteras, where the intersection of cold northern currents and the northbound Gulf Stream forms the shallows of the Diamond Shoals (Newton et al., 1971). Extending seaward over submerged, shallow, shifting sand bars for 31 km (17 NM), the Diamond Shoals create hazardous sea conditions for mariners.

NOAA’s AWOIS and Captain Segull Nautical Fishing Charts (Captain Segull, 2004) were queried to determine the best representation of the potential for shipwrecks and obstructions to exist within the proposed Site C USWTR area (NOAA, 2004b, 2006c). Figure 3.5-3 depicts the results, with four shipwrecks in Site C.
Approximate Locations of Shipwrecks and Artificial Reefs in the Jacksonville OPAREA

Figure 3.5-1

- Shipwreck *
- Artificial Reef (not to scale) **
- Artificial Reef (not to scale) ***

* NOAA Automated Wreck and Obstruction Information System, 2006; Captain Seagull's Sportfishing Charts - #CHCC23 - 2004 and Naval History & Heritage Command - Known U.S. Navy Sunken Military Watercraft in or near Potential USWTR Areas

** Site A USWTR

*** Jacksonville OPAREA


***** Department of the Navy, 2008.

Figure 3.5-1

- 36.6 M (20 fm or 120 ft)
- 91.4 M (50 fm or 300 ft)
- 2000 M (1100 fm or 6600 ft)
- Continental Shelf Break
Approximate Locations of Shipwrecks and Artificial Reefs in the Cherry Point OPAREA

Figure 3.5-3

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* NOAA Automated Wreck and Obstruction Information System, 2006; Captain Seagull's Sportfishing Charts - #CHCC23 - 2004 and Naval History & Heritage Command - Known U.S. Navy Sunken Military Watercraft in or near Potential USWTR Areas


*** FWC - DMF, 2008

**** Department of the Navy, 2008.
3.5.4 Site D

The VACAPES OPAREA contains approximately 160 shipwrecks (DoN, 2008). NOAA’s AWOIS and Captain Segull’s Nautical Fishing Charts (Captain Segull, 2005) were queried to determine the best representation of the potential for shipwrecks and obstructions to exist in the area of the proposed range (NOAA, 2004b, 2006c). Figure 3.5-4 depicts the results. The database indicates that are four shipwrecks located within the proposed range site.
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3.6 Landside Environment

As described in Chapter 1, all text in this OEIS/EIS that describes the affected environment specific to NEPA (i.e., the landside environment) is in italics. Thus, this subchapter on the affected landside environment is italicized.

3.6.1 Site A

This section discusses the existing environment in and around the proposed cable landfall site for the proposed Site A at Naval Station (NS) Mayport (Figure 2-13). The trunk cable would be installed via a 10-cm (4-in) horizontal directionally drilled conduit from a point approximately 915 m (3,000 ft) offshore to a point inshore of the sand dunes. The trunk cable would then be placed in an excavated trench from the inshore exit point to the cable termination facility (CTF).

3.6.1.1 Land Use

NS Mayport is a 1,380-hectare (3,410-acre) facility located in northeastern Duval County, Florida. The northern one-third of NS Mayport is heavily developed as a military industrial and residential complex. This complex includes a 2.4-km (1.5-m) runway capable of handling any aircraft in the DoD inventory, along with a 66-hectare (162-acre) port facility capable of accommodating 34 ships (NS Mayport, 2004). NS Mayport services fleet assets including nuclear-powered aircraft carriers, cruisers, destroyers, and guided-missile frigates. The station’s two aviation wings conduct more than 135,000 flight operations each year. These operations include long-range maritime surveillance by fixed-wing aircraft and ASW by rotary-wing aircraft (GlobalSecurity, 2004). The oceanfront beach is used primarily for housing, personnel support, and recreational activities (DoN, 2003a).

The Village of Mayport borders the installation to the northwest and is situated on a narrow strip of land along the St. Johns River. The southern edge of NS Mayport is bordered by State Road A1A, Wonderwood Drive, and Kathryn Abbey Hanna Park (City of Jacksonville). North of the St. Johns River are Huguenot Park (City of Jacksonville), Little Talbot Island State Park, and Fort George Island Cultural State Park. Much of the land to the north of the installation is part of the Timucuan Ecological and Historic Preserve (National Park Service). The boundaries of the Timucuan Ecological and Historic Preserve also extend onto the southeastern portion of NS Mayport and overlap with approximately 1,150 acres of the installation (DoN, 2008b).

A separate subchapter on coastal zone management has been prepared (Subchapter 3.7). Appendix F of this final OEIS/EIS contains the Coastal Consistency Determination (CCD) submitted to the Florida Department of Environmental Protection (FLDEP) and the Negative Determination submitted to the Georgia Department of Natural Resources. Copies of the transmittal letters are contained in Appendix G.
3.6.1.2 Socioeconomics

Demographics

Table 3.6-1 presents the ethnic characteristics of Duval County compared to the state of Florida. Compared to the state as a whole, the county has a greater population of black or African-Americans (27.8 percent compared to 14.6 percent in the state). The percentages of the other ethnic groups are similar, except for the substantially lower number of Hispanics or Latinos in the county (4.1 percent) compared to Florida (16.8 percent). As shown in Table 3.6-2, Duval County has higher household and family income levels, at 4.5 to 5.0 percent higher than the state as a whole.

Table 3.6-1

Duval County Ethnic Characteristics

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>% Black</th>
<th>% Hispanic or Latino</th>
<th>% American Indian, Alaskan Native</th>
<th>% Asian, Pacific Islander</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duval County</td>
<td>27.8</td>
<td>4.1</td>
<td>0.3</td>
<td>0.1</td>
</tr>
<tr>
<td>Florida</td>
<td>14.6</td>
<td>16.8</td>
<td>0.3</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Source: U.S. Census Bureau, 2004

Table 3.6-2

Duval County Income and Poverty Status

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Median Household Income</th>
<th>Median Family Income</th>
<th>Persons in Poverty(^1)</th>
<th>Families in Poverty(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Persons</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Families</td>
<td>%</td>
</tr>
<tr>
<td>Duval County</td>
<td>40,703</td>
<td>47,689</td>
<td>90,726</td>
<td>11.9</td>
</tr>
<tr>
<td>Florida</td>
<td>38,819</td>
<td>45,625</td>
<td>1,948,913</td>
<td>12.5</td>
</tr>
</tbody>
</table>

Notes: \(^1\) 1999 income below poverty level. Population for whom poverty status is determined.

Source: U.S. Census Bureau, 2004

Environmental Justice

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, directs all federal departments and agencies to conduct programs, policies, and activities that substantially affect human health or the environment in a manner that does not exclude communities from participation in, deny communities the benefits of, nor subject communities to discrimination under such actions because of their race, color, or national origin. Factors used in determining consistency with this policy focus on the racial, income, and...
ethnic composition of nearby communities. Ethnic makeup and income of the study area population in the vicinity of the proposed Site A USWTR landfall site are described above. The analysis to determine the proposed project’s consistency with this policy is presented in Subchapter 4.6.

EO 13045, Protection of Children from Environmental Health Risks and Safety Risks, requires each federal agency to identify and assess environmental health risks and safety risks to children. “Environmental health risks and safety risks” are defined as “risks to health or to safety that are attributable to products or substances that the child is likely to come in contact with or ingest.” Federal actions that are covered and affected by this EO are those substantive actions that concern an environmental health risk or safety risk that an agency has reason to believe may disproportionately affect children. The analysis to determine the proposed project’s consistency with this policy is presented in Subchapter 4.6.

3.6.1.3 Natural Resources

Navigable Waters

The Rivers and Harbors Act (RHA) was enacted to ensure that navigable waters are not obstructed or fouled by the placement of material or disposal of refuse in them. Under Section 10 of the act, 33 USC §403, a USACE permit is required for structures and/or work in or affecting navigable waters of the U.S. The RHA governs the placement of the communications devices and cable for the USWTR in the waters adjacent to NS Mayport, which are navigable waters. The trenched placement of a cable in the navigable waterway adjacent to NS Mayport will require both a RHA permit and a Clean Water Act (CWA) permit. The CWA regulates the discharge of dredged or fill material in waters of the United States, and as the act of trenching to constitutes a discharge of dredged material, a CWA permit would be required.

Wetlands

In May 2004, wetland areas of the installation were mapped (DoN, 2008b). The wetlands were delineated in accordance with the 1987 Corps of Engineers Wetlands Delineation Manual (USACE, 1987). Approximately 789 hectares (1,950 acres) of freshwater and tidal saltwater wetlands habitats were identified. Of this total, 696 hectares (1,720 acres) are saltwater habitats and 93 hectares (230 acres) are freshwater wetland habitats. These wetland areas are characterized as salt marshes, freshwater marshes, forested swamps, and tidal streams. The majority of wetlands at NS Mayport consist of salt marsh and tidal creeks (DoN, 2004c). Additionally, wetlands exist along the southern shore of the NS Mayport entrance channel that are classified as emergent, estuarine, intertidal, persistent, and irregularly flooded (DoN, 2004c). Figure 3.6-1 presents the National Wetlands Inventory (NWI) information for NS Mayport. Based on this figure and a wetland delineation performed in 2004 (DoN, 2008b), there are no wetlands at the proposed cable termination facility or in the cable corridor.
Figure 3.6-1

Site A National Wetlands Inventory (NWI)

- Trunk cable in drill pipe
- Buried cable
- Cable Termination Facility
- Marine intertidal shore

Source: National Fish and Wildlife Service, 1982

Legend:
- NWI - Estuarine and Marine Wetland
- NWI - Freshwater Forested/Scrub Wetland
- NWI - Freshwater Emergent Wetland
- Road
- Building
Threatened and Endangered Species

Species listed as threatened or endangered under the ESA potentially occurring at NS Mayport or in nearshore areas are provided on Table 3.6-3.

Table 3.6-3

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Federal Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Birds</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piping plover</td>
<td>Charadrius melodus</td>
<td>Threatened</td>
</tr>
<tr>
<td>Wood stork</td>
<td>Mycteria americana</td>
<td>Endangered</td>
</tr>
<tr>
<td><strong>Reptiles</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loggerhead sea turtle</td>
<td>Caretta caretta</td>
<td>Threatened</td>
</tr>
<tr>
<td>Green sea turtle</td>
<td>Chelonia mydas</td>
<td>Endangered</td>
</tr>
<tr>
<td>Hawksbill sea turtle</td>
<td>Eremochelys imbricata</td>
<td>Endangered</td>
</tr>
<tr>
<td>Kemp’s ridley sea turtle</td>
<td>Lepidochelys kempi</td>
<td>Endangered</td>
</tr>
<tr>
<td>Leatherback sea turtle</td>
<td>Dermochelys coriacea</td>
<td>Endangered</td>
</tr>
<tr>
<td><strong>Fish</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shortnose sturgeon</td>
<td>Acipenser brevirostrum</td>
<td>Endangered</td>
</tr>
<tr>
<td>Smalltooth swordfish</td>
<td>Pristis pectinata</td>
<td>Endangered</td>
</tr>
<tr>
<td>Atlantic sturgeon</td>
<td>Acipenser oxyrhinchus</td>
<td>Candidate</td>
</tr>
<tr>
<td><strong>Mammals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Florida manatee(^1)</td>
<td>Tricheus manatus latirostris</td>
<td>Endangered</td>
</tr>
</tbody>
</table>

Source: DoN, 2008b.
Notes: \(^1\) This Species of Concern (SOC) is included because a determination to list this species may occur during the course of the EIS. Florida manatee occurs in Atlantic coast off northeast Florida (DoN, 2008n).

An inventory conducted in 1995 by the Florida Natural Areas Inventory concluded that no federal or state threatened or endangered plant species were located on NS Mayport (DoN, 2003a). This is largely attributable to the lack of appropriate habitat on the station.
Birds

The piping plover (*Charadrius melodus*) breeds in only three geographic regions of North America – the Great Lakes, the northern Great Plains, and the Atlantic Coast. The northern Great Plains and Atlantic Coast populations were designated as threatened and the Great Lakes population was designated as endangered under the ESA in 1986 (USFWS, 2000). Atlantic Coast plovers nest on coastal beaches, sand flats at the ends of sand spits and barrier islands, gently sloped foredunes, sparsely vegetated dunes, and washover areas cut into or between dunes. Plovers arrive on the breeding grounds from mid-March through mid-May and remain for three to four months per year (USFWS, 2002).

Designated critical habitat for wintering piping plovers is found to the north of NS Mayport and the St. Johns River on Fort George Island within Huguenot Memorial Park (USFWS, 2008). They are infrequent visitors to NS Mayport and Duval County beaches, but were observed at NS Mayport as recently as 2007 (DoN, 2008b). Otherwise, they are not expected to occur routinely within the NS Mayport (DoN, 2008b).

The federally endangered wood stork (*Mycteria americana*) nests and forages in estuarine wetlands. It is typically seen in North Florida during the nesting season from March through August (DoN, 2008b). Wood storks have been observed along the entrance channel, east of the NS Mayport turning basin (DoN, 2007c).

The American bald eagle (*Haliaeetus leucocephalus*) has also been documented on site. The bald eagle was delisted from the federal threatened and endangered species list on July 28, 2007 and is primarily protected under the Bald and Golden Eagle Protection Act of 1940 (BGEPA) (16 USC 668a-668d), and the Migratory Bird Treaty Act (MBTA) (16 USC 703-711).

Reptiles

Four species of sea turtles, the loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*), green (*Chelonia mydas*), and Kemp’s ridley (*Lepidochelys kempi*) potentially occur at NS Mayport. Beaches extending from the south jetties of NS Mayport south through Jacksonville Beach within Duval County are nesting habitat for loggerhead, leatherback, and green turtles (DoN, 2008b). There have been no nests documented for Kemp’s ridley in Duval County for the last 25 years (DoN, 2008b).

In the southeastern U.S., loggerhead nesting season begins in early May and lasts through early September (FFWCC, 2002), averaging 55 to 60 days for most clutches in Florida (USFWS, 2007a). Surveys conducted in 2006 and 2007 identified 103 and 36 loggerhead nests, respectively, along Duval County beaches (FFWCC-FWRI, 2006a, 2008a). Loggerheads have nested and continue to nest at NS Mayport beaches. Surveys began in 1998 with two nests recorded and have since grown to 21 nests and 1,177 loggerhead hatchlings in 2006, which is the largest on record at the Station (DoN, 2007c).
Leatherbacks typically nest along the beaches from Brevard County south to Broward County, south of NS Mayport, and nest in low numbers along the beaches of Duval County. Nesting occurs from March through July with an incubation period of 55 to 75 days (DoN, 2007c). Two leatherback nests were documented in Duval County in 2003, but none were recorded in recent years (e.g., FFWCC-FWRI, 2008).

Green turtle nesting season takes place from April through September with an incubation period of approximately two months (FFWCC 2002; DoN 2007c). Surveys conducted in 2006 and 2007 identified four green turtle nests in both years along Duval County beaches (FFWCC-FWRI, 2006a, 2008); however, there are no records of them nesting at NS Mayport beaches (DoN, 2008b). Green turtles have been recorded in the NS Mayport turning basin (USACE, 2001).

Federally threatened loggerhead sea turtles nest on the beach at NS Mayport. Known locations of sea turtle nests are marked with protective fencing (DoN, 2003a). The nesting season typically runs from May 1 through October 31 of each year.

Fish

The shortnose sturgeon (Acipenser brevirostrum) recovery plan completed in 1998 contained no population data available for the St. Johns River in Florida and recommended research on this population (NMFS, 1998d). As described in Subchapter 3.2.8.1, intensive sampling for shortnose sturgeon in the area yielded only one individual and it is highly unlikely that any sizable population of the shortnose sturgeon currently exists in the St. Johns River or its tributaries (FFWCC-FWRI, 2007b). There is no documented reproduction in the St. Johns River and no large adults have been positively identified, indicating that the infrequent catches are transients from other river systems (FFWCC, 2005d; Holder, 2007). Shortnose sturgeon are known to use warm-water springs in other southern rivers, but none have been observed in the numerous warmwater springs found in the St. Johns River system (FFWCC-FWRI, 2007b). Therefore, the occurrence of shortnose sturgeons within the NS Mayport turning basin, entrance channel, and federal navigation channel is considered very unlikely (DoN, 2008b), as is their occurrence in the nearshore areas off the proposed cable landfall site.

Smalltooth sawfish (Pristis pectinata) inhabit coastal and estuarine shallow waters close to shore with muddy and sandy bottoms, particularly at river mouths. Regular occurrence of the species is restricted to the southern tip of Florida from the Caloosahatchee River (near Fort Myers) down to the Florida Keys (NMFS, 2006o). Therefore, it is considered very unlikely that smalltooth sawfish would occur within the nearshore areas off proposed cable landfall site.

The St. Johns River constitutes the southern end of the Atlantic sturgeon (Acipenser oxyrhinchus oxyrhinchus) range (ASSRT, 2007). Due to habitat degradation, the St. Johns River is suspected to serve as only a nursery for existing Atlantic sturgeon that still utilize the waterway system (NMFS and USFWS, 1998b). Only 37 percent of Atlantic sturgeon riverine habitat still exists in the St. Johns River. It is not currently used for spawning and historical use of the river is
unknown (ASSRT, 2007). Therefore, it is unlikely that the Atlantic sturgeon will inhabit the nearshore areas in the vicinity of the proposed cable landfall.

**Mammals**

The Florida manatee (*Tricheus manatus latirostris*) is a federally-listed endangered species. Two groups of manatees reside in the Jacksonville area. One group remains in the area all winter while the other group moves south during the winter (DoN, 2007c). Individual manatees have been observed on average six times per year near the water treatment plant outfall along the south side of the entrance channel of NS Mayport (DoN, 2007c). They have also been observed in the turning basin of NS Mayport on occasion (DoN, 2007c) and may occur within nearshore areas (DoN, 2008b). There is designated critical habitat for the Florida manatee in the vicinity of NS Mayport. This area encompasses the entire St. Johns River from its headwater to the mouth of the Atlantic Ocean.

**Essential Fish Habitat**

As described in Subchapter 3.2.4, nearshore EFH is defined as state waters (i.e., waters from estuaries to 5.5 km [3 NM] from shore) which include tidal freshwater; estuarine emergent vegetated wetlands (flooded salt and brackish marshes, marsh, and tidal creeks); submerged rooted vascular plants (seagrasses); oyster reefs and shell banks; soft sediment bottom, hard bottom, ocean high salinity surf zones, artificial reefs, and estuarine water column (SAFMC, 1998a). EFH off Site A comprises a small percentage (0.3 percent) of the corridor. The linear path in which the trunk cable will be laid has not been mapped, but may cross nearshore EFH, such as hard bottom or SAV EFH at the USWTR landfall site at NS Mayport.

**Migratory Birds**

A migratory bird is defined as any species or family of birds that lives, reproduces, or migrates within or across international borders at some point during its annual life cycle. There are 836 bird species protected by the MBTA.

The NS Mayport is located within the Atlantic Flyway, a major migration route along the east coast of the U.S. During the fall and spring migratory seasons, large numbers of birds are found in this general corridor. As at the other sites, migratory shorebirds feed on invertebrates on the beach portion of NS Mayport and seek shelter in vegetation adjacent to the beach. Thus, suitable habitat for migratory birds may exist in the vicinity of the proposed landfall site at NS Mayport. This habitat could support nesting least tern (*Sternula antillarum*), Wilson’s plover (*Charadrius wilsonia*), and American oystercatcher (*Haematopus palliates*), and the more common gulls, terns, and skimmers that are found along the Atlantic coast.
Vegetation and Soils

A beach dune community occurs along the length of NS Mayport’s Atlantic oceanfront. The community is of marginal quality, mostly due to encroachment by roads, exotic turf grasses, and other development activities (e.g., houses, parking facilities). Three vegetative communities comprise the beach dune community: (1) foredune, (2) herbaceous flat, and (3) shrub zone (DoN, 2003a).

- The foredune, or the most seaward portion of the dune, is dominated by sea oats (Uniola paniculata), beach hydrocotyle (Hydrocotyle bonariensis), gulf croton (Croton punctatus), and seaside evening primrose (Oenothera humifusa).

- The herbaceous flat, immediately landward of the foredune, is dominated by sea oats, camphor weed (Heterotheca subaxillaris), sand bean (Strophostyles helvolae), prickly pear (Opuntia stricta), beach hydrocotyle (Hydrocotyle bonariensis), and contains a small area dominated by salt meadow cord grass (Spartina patens).

- The shrub zone, landward of the herbaceous flat, is dominated by wax myrtle (Morella cerifera), beach elder (Iva imbricata), cabbage palm (Sabal palmetto), salt bush (Baccharis angustifolia), muscadine (Vitis rotundifolia), and passion flower (Passiflora incarnata).

Landward of the dunes, vegetation predominantly consists of landscape turf grasses, shrubs, and trees typical of an urban area.

In general, the soils located on NS Mayport are high in permeability and tend to be low in organic content and available water with the exception of the mucky peat soils (DoN, 2008b). Soils present near the proposed cable landfall site are primarily classified as arents, which are somewhat poorly drained, nearly level, non-hydric soils found in the coastal plain (USDA NRCS, 2004) and are generally characterized by being reworked during manmade earth moving operations (DoN, 2008b). There are also soils characterized as urban.

With its position immediately south of the stabilized entrance of the St. John’s River, much of the beachfront at NS Mayport is sheltered from erosion-inducing wave action. Therefore, the shoreline is relatively stable. However, south of this sheltered area, coastal erosion rates are estimated at approximately 1.7 m (5.5 ft) per year (Foster et al., 2000). The progressively southward spreading erosion pattern has essentially been held in check by numerous beach nourishments since 1963 (DoN, 2008b).

Floodplain Management

EO 11988 sets forth federal agency responsibilities for reducing the risk of flood loss or damage to personal property, minimizing the impact of flood loss, and restoring the natural and
beneficial functions of floodplains. The proposed Site A USWTR landside site lies within the 100-year floodplain. The proposed cable termination facility construction and burial of the trunk cable are not likely to further exacerbate flooding.

3.6.1.4 Cultural Resources

The National Historic Preservation Act (NHPA) was passed in 1966 to provide for the protection, enhancement, and preservation of any property that possesses significant architectural, archaeological, historical, or cultural characteristics. Under the regulatory program implementing the NHPA, a federal agency must first determine if the undertaking will affect a resource that is on or eligible for listing on the National Register of Historic Places.

A comprehensive survey was conducted during August 1993 to determine the extent and location of cultural resources at NS Mayport. One site, the St. John’s Lighthouse located on the western boundary of NS Mayport (USACE, 1995), has been listed in the National Register of Historic Places (NRHP), while four others have been determined eligible for listing in the NRHP (DoN, 2003a). None of these areas would be impacted by the cable installation, as there would be no overlap with the landfall site, located on the eastern end of the installation at the entrance to the St. Johns River (Figure 2-14).

Underwater resources, including shipwrecks, cannons, Native American canoes, and other resources have been found in the vicinity of the St. Johns River entrance and associated tributary rivers and creeks (DoN, 2008b); however there are no known underwater cultural resources on the Atlantic shore near the proposed cable route.

3.6.1.5 Air Quality

NS Mayport is located in an area that is in attainment for all the criteria pollutants and is further classified as being an attainment/maintenance area for ozone. Maintenance areas are areas previously classified as non-attainment that have successfully reduced air pollutant concentrations to below the standard, but must maintain some of the non-attainment area plans to stay in compliance with the standards (Florida Department of Environmental Protection [FLDEP], 2002).

3.6.1.6 Hazardous Materials

There are no known areas of hazardous waste contamination at the site of the proposed USWTR landside facility at NS Mayport. There are two areas of petroleum contamination (#351, #413) and a solid waste management unit (SWMU-14), which is primarily petroleum contamination close to the proposed USWTR landside facility (Mitchell, 2008). The petroleum contamination areas can be easily avoided, as they are small and localized under buildings. SWMU-14 is underneath a very large concrete apron previously used for fire-fighting and can also be avoided.
3.6.2 Site B

This subchapter discusses the existing environment in and around the proposed cable landfall site for the proposed Site B USWTR at the Fort Moultrie National Monument. The trunk cable conduit at Site B would be installed similarly to Site A, under the dunes to the east of the CTF with the seaward end of the conduit connected to underground cable in a trench. Commercial power and telecommunications connections for the cable would be made at the Fort Moultrie National Monument. The communications signals would be routed to the ROC at FACS FAC VACAPES and electronics would be housed at the terminal end of the communications link.

3.6.2.1 Land Use

Fort Moultrie is the name of a series of forts on Sullivan's Island, South Carolina, built to protect the city of Charleston, South Carolina. Fort Moultrie is a historical unit of the National Park Service. The Fort Moultrie National Monument is 81 hectares (200 acres).

A separate subchapter on coastal zone management has been prepared (Subchapter 3.7). If Site B is selected, a CCD would be submitted to, and concurrence sought from, the South Carolina Department of Health and Environmental Control (SCDHEC).

3.6.2.2 Socioeconomics

Demographics

Table 3.6-4 presents the ethnic characteristics of Charleston County compared to the state of South Carolina. Compared to the state as a whole, the county has a slightly greater population of black or African-Americans (35.0 percent compared to 29.9 percent in the state). The percentages of the other ethnic groups are similar.

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>% Black</th>
<th>% Hispanic or Latino</th>
<th>% American Indian, Alaskan Native</th>
<th>% Asian, Pacific Islander</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charleston County</td>
<td>35.0</td>
<td>2.4</td>
<td>0.6</td>
<td>1.4</td>
</tr>
<tr>
<td>South Carolina</td>
<td>29.9</td>
<td>2.4</td>
<td>0.7</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Source: U.S. Census Bureau, 2000

As shown in Table 3.6-5, Charleston County has higher household and family income levels, at 2.2 to 6.6 percent higher than the state as a whole. However, a greater percentage of people and families are in poverty than South Carolina as a whole.
Table 3.6-5

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Median Household Income</th>
<th>Median Family Income</th>
<th>Persons in Poverty</th>
<th>Families in Poverty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Persons</td>
<td>%</td>
</tr>
<tr>
<td>Charleston County</td>
<td>37,810</td>
<td>47,139</td>
<td>50,830</td>
<td>16.4</td>
</tr>
<tr>
<td>South Carolina</td>
<td>37,082</td>
<td>44,227</td>
<td>565,694</td>
<td>14.1</td>
</tr>
</tbody>
</table>

Notes: 1 1999 income below poverty level. Population for whom poverty status is determined.
Source: U.S. Census Bureau, 2004

Environmental Justice

Factors used in determining consistency with EO 12898 focuses on the racial, income, and ethnic composition of nearby communities. Ethnic makeup and income of the study area population in the vicinity of the proposed Site B USWTR are described above. The analyses to determine the proposed project’s consistency with EOs 12898 and 13045 are presented in Subchapter 4.6.

3.6.2.3 Natural Resources

Navigable Waters

As described for Site A, the RHA governs the placement of the communications devices and cable for the USWTR in the waters adjacent to the Fort Moultrie National Monument. The trenched placement of a cable in the navigable waterway adjacent to the Fort Moultrie National Monument will require both a RHA permit and a CWA permit.

Wetlands

Wetland communities identified in and around Fort Moultrie include marine intertidal unconsolidated shoreline along the coast and palustrine emergent and scrub-shrub wetlands behind the shoreline. The area behind Sullivan’s Island contains palustrine and estuarine wetlands. Figure 3.6-2 presents the NWI information for Sullivan’s Island. Based on this figure, there are no wetlands at the proposed cable termination facility or in the cable corridor.
Threatened and Endangered Species

Table 3.6-6 lists federally listed plants and animals recorded in Charleston County, South Carolina.

Of the plants listed, pondberry (*Lindera melissifolia*) is not expected to be found at the Site B landfall site, as it is associated with wetland habitats such as bottomland and hardwoods in the interior areas, and the margins of sinks, ponds and other depressions in the more coastal sites (Clemson University, 2007). Although it is listed by the USFWS, it is not on South Carolina’s rare, threatened, and endangered inventory list for Charleston County (SCDNR, 2007) nor was it recorded in the area during a natural resources survey (Byrne, 2007).

Table 3.6-6

Federally Listed Plants and Animals Potentially Occurring at or Near Fort Moultrie

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Federal Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plants</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sea-beach amaranth</td>
<td><em>Amaranthus pumilus</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Canby’s dropwort</td>
<td><em>Oxypolis canbyi</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Pondberry</td>
<td><em>Lindera melissifolia</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>American chaffseed</td>
<td><em>Schwalbea americana</em></td>
<td>Endangered</td>
</tr>
<tr>
<td><strong>Birds</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piping plover</td>
<td><em>Charadrius melodus</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Wood stork</td>
<td><em>Mycteria americana</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Red-cockaded woodpecker</td>
<td><em>Picoides borealis</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Bachman’s warbler</td>
<td><em>Vermivora bachmanii</em></td>
<td>Endangered</td>
</tr>
<tr>
<td><strong>Reptiles</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loggerhead sea turtle</td>
<td><em>Caretta caretta</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Green sea turtle</td>
<td><em>Chelonia mydas</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Kemp’s ridley sea turtle</td>
<td><em>Lepidochelys kempii</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Leatherback sea turtle</td>
<td><em>Dermochelys coriacea</em></td>
<td>Endangered</td>
</tr>
<tr>
<td><strong>Fish</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shortnose sturgeon</td>
<td><em>Acipenser brevirostrum</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Smalltooth swordfish</td>
<td><em>Pristis pectinata</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Atlantic sturgeon</td>
<td><em>Acipenser oxyrhinchus</em></td>
<td>Candidate</td>
</tr>
<tr>
<td><strong>Mammals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Indian manatee</td>
<td><em>Tricheus manatus</em></td>
<td>Endangered</td>
</tr>
</tbody>
</table>

Source: USFWS, 2007b
Birds

Of the threatened and endangered bird species listed for Charleston County, the red-cockaded woodpecker (*Picoides borealis*) is unlikely to be found at the Site B landfall site and was not recorded on site (Byrne, 2007), as their nesting/roosting habitat consists of open stands of pine containing trees 60 years old and older (USFWS, 2007b). Red-cockaded woodpeckers need live, large older pines in which to excavate their cavities.

Bachman’s warbler (*Vermivora bachmanii*) is also unlikely to be found at the Site B landfall site, as it is dependent on old-growth bottomland forest or areas that have been disturbed with dense understories of palmetto and cane, and was not recorded on site (Byrne, 2007). It has been documented at Cape Romain National Wildlife Refuge, located about 60 km (37 mi) northeast of Fort Moultrie National Monument (USFWS, 2007c).

Piping plovers have not been observed over-wintering on Sullivan’s Island during surveys conducted on the South Carolina coast in 1997, 1998, and 1999 (Dodd et al., 1999). There is no designated critical wintering habitat for the piping plover in the vicinity of Site B (USFWS, 2008). Kiawah Island, south of Charleston, is an important wintering area for piping plover (Dodd et al., 1999).

Wood storks typically nest in the upper branches of black gum (*Nyssa biflora*) or cypress (*Taxodium distichum*) trees that are in standing water. In South Carolina, colony sites are surrounded by extensive wetlands, in particular palustrine forested wetlands (Murphy, 2008). Wood storks are tactile feeders, feeding almost exclusively on fish between 2 and 25 cm (1 to 10 in) in length (USFWS, 1996). They frequently feed in large groups in open wetlands where prey species are available and water depths are less than 50 cm (20 inches). Wood storks are unlikely to be found in the vicinity of the proposed cable landfall site owing to the absence of appropriate habitat.

Reptiles

The federally threatened loggerhead sea turtle is the only sea turtle know to nest on Sullivan Island and the adjacent Isle of Palms. In 2007, three turtle nests were found on Sullivan Island (Island Turtle Team, 2007). More extensive loggerhead nesting has been documented on the beach at Folly Beach, on the southern side of Charleston Harbor. There is a turtle watch program that provides daily monitoring of nesting turtles (Folly Beach Turtle Watch Program, 2007). Known locations of sea turtle nests are marked.

Fish

Shortnose sturgeons were documented in what is now the metro Charleston area during the late 1800s (NMFS, 1998d), and more recently were collected in this heavily altered (dammed and urbanized) drainage in the 1980s during research on the American shad fishery. Population
Final OEIS/EIS Undersea Warfare Training Range

dynamics are unknown. Based on the limited number of individuals in the area, shortnose sturgeon may rarely occur in the nearshore areas off the proposed cable landfall site.

Records of the smalltooth sawfish from South Carolina are sparse (NMFS, 2006o). Due to the scarcity of this species and their preference for estuarine shallow waters close to shore with muddy and sandy bottoms, it is considered very unlikely that smalltooth sawfish would occur in the nearshore area off the proposed cable landfall site.

The Atlantic sturgeon has been documented in the Cooper River, which flows into Charleston Bay and subadult Atlantic sturgeon form winter aggregations in the shipping channel outside Charleston Harbor (ASSRT, 2007). Atlantic sturgeon may potentially be present in nearshore waters off of proposed cable landfall site.

Mammals

The Florida manatee has been sighted around Charleston Harbor and may occur in nearshore waters off the proposed cable landfall site

Essential Fish Habitat

As described in Subchapter 3.2.4, EFH off Site B comprises a small percentage (0.7 percent) of the corridor. The linear path in which the trunk cable will be laid has not been mapped, but may cross nearshore EFH, such as estuaries, coastal embayments, wetlands, water column, oyster reefs, SAV, and other hard and soft benthic substrates.

Migratory Birds

Fort Moultrie is located within the Atlantic Flyway, a major migration route along the east coast of the U.S. During the fall and spring migratory seasons, large numbers of birds are found in this general corridor. As at the other sites, migratory shorebirds feed on invertebrates on the beach portion of Fort Moultrie and seek shelter in vegetation adjacent to the beach. Thus, habitat for migratory birds exists in the vicinity of the proposed landfall site at Fort Moultrie, although a study on migratory North American birds concluded that the prevalent wooded habitat around Charleston Harbor is of relatively low value to migratory birds (Post, 2001).

Vegetation and Soils

Sullivan’s Island is one of three barrier islands east of the Cooper River. Sullivan’s Island is unique in that the beachfront lands which have accreted over the years are owned by the Town of Sullivan’s Island and held in a perpetual easement by the Low Country Open Land Trust protecting the natural environment along the Atlantic Ocean (Town of Sullivan’s Island, 2007). A beach dune community occurs along the undeveloped portion of the island.
The soil survey of Charleston County, South Carolina, identifies the soil series at Sullivan Island as coastal beaches and dune land along the edge of the island, made land behind the beach area, and tidal marsh behind the made land (USDA and SCAES, 1971). Coastal beaches and dune land consist of sandy shoreline and sand dunes that border the Atlantic Ocean (USDA and SCAES, 1971). The shoreline areas are nearly level fine sand beaches that are flooded twice daily by tides. The dunes, which are formed by wind, are mounded areas of dry, loose very pale brown to yellow sand. Made land is present in areas that have been excavated, filled, or otherwise disturbed by man (USDA and SCAES, 1971). This area may contain variable amounts of sand, silt, and clay, or a mixture of these materials. The soft tidal marsh behind Sullivan’s Island has a surface layer of dark colored soft clay, clay loam, muck, or peat and is saturated (USDA and SCAES, 1971). It is underlain by gray to dark gray soft textured fine clayey material that is permanently saturated. This area is covered by water at high tide.

Floodplain Management

The proposed Fort Moultrie USWTR landside site lies within the 100-year floodplain. The proposed cable termination facility construction and burial of the trunk cable are not likely to further exacerbate flooding.

3.6.2.4 Cultural Resources

Sullivan's Island has played an important role in the region's history since the earliest days of English settlement in South Carolina (Town of Sullivan’s Island, 2007). Fort Moultrie was deactivated in 1947 and most of the property was dispersed by the War Assets Administration, either being sold to private individuals or turned over to the State of South Carolina or the Township of Sullivan’s Island. At the present time, the old section of Fort Moultrie, as well as Battery Jasper, is part of the Fort Sumter National Monument, administered by U.S. National Park Service as a historic site (Town of Sullivan’s Island, 2007).

3.6.2.5 Air Quality

Fort Moultrie is located in an area that is in attainment for all the criteria pollutants and is also an attainment/maintenance area for ozone (SCDHEC, 2007). Maintenance areas are areas previously classified as non-attainment areas that have successfully reduced air pollutant concentrations to below the standard, but must maintain some of the non-attainment area plans to stay in compliance with the standard.

3.6.2.6 Hazardous Materials

There are no known areas of hazardous waste contamination at the site of the proposed USWTR landside facility at Fort Moultrie.
3.6.3 Site C

This section discusses the existing environment in and around the proposed cable landfall site at Onslow Beach. A trunk cable would run from a junction box located at the nearshore edge of the range to the vicinity offshore and north of Riesley Pier on Onslow Beach at Camp Lejeune. The trunk cable would then run through a 10-cm (4-in) underground conduit, which would be installed via horizontal directional drilling. The conduit would extend from a point approximately 915 m (3,000 ft) offshore, underneath the shoreline, beach, and Intracoastal Waterway. The conduit would be trenchled from the Intracoastal Waterway to the CTF. The CTF would be built in the vicinity of Mockup Road to house the power supplies, system electronics, and communications gear.

3.6.3.1 Land Use

Onslow Beach is a barrier island within the boundaries of MCB Camp Lejeune, in Onslow County, North Carolina. MCB Camp Lejeune comprises over 48,500 hectares (120,000 acres), including 23 km (14 mi) of Atlantic Ocean shoreline.

The majority of the Onslow Beach shoreline is restricted from recreational use and is reserved for amphibious landing training and other beachfront training maneuvers. With respect to the specific landfall site (i.e., vicinity of Riesley Pier), the area to the north of the pier is used for authorized recreational use. The beach south of the pier is a designated military training area, conditionally available for permitted recreational uses.

A separate subchapter on coastal zone management has been prepared (Subchapter 3.7). If Site C is selected a CCD would be submitted to, and concurrence sought from, the North Carolina Department of Environment and Natural Resources.

3.6.3.2 Socioeconomics

Demographics

Table 3.6-7 presents the ethnic characteristics of Onslow County compared to the state of North Carolina. The table indicates that the minority populations represent a relatively small proportion of the total population. Compared to the state of North Carolina as a whole, the county has generally similar population ethnicity characteristics; the largest relative difference is in the greater percentage (2.6 percent more) of Hispanics or Latinos residing in the county compared to the state. The relative proportions of the three other ethnicities are all lower in Onslow County in comparison to all of North Carolina.
Table 3.6-7

Onslow County Ethnic Characteristics

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>% Black</th>
<th>% Hispanic or Latino</th>
<th>% American Indian, Eskimo, Aleut</th>
<th>% Asian, Pacific Islander</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onslow County</td>
<td>18.2</td>
<td>7.2</td>
<td>0.8</td>
<td>0.3</td>
</tr>
<tr>
<td>North Carolina</td>
<td>21.4</td>
<td>4.6</td>
<td>1.2</td>
<td>1.9</td>
</tr>
</tbody>
</table>


As shown in Table 3.6-8, Onslow County has considerably lower household and family income levels than the state as a whole; these county income levels are about 13.6 and 20.8 percent less, respectively, than the state levels. However, the county percentages of the numbers of persons in poverty and the numbers of families in poverty are comparable to those of North Carolina.

Table 3.6-8

Onslow County Income and Poverty Status

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Median Household Income</th>
<th>Median Family Income</th>
<th>Persons in Poverty(^1)</th>
<th>Families in Poverty(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Persons</td>
<td>%</td>
<td>Persons</td>
<td>%</td>
</tr>
<tr>
<td>Onslow County</td>
<td>33,756</td>
<td>36,692</td>
<td>16,917</td>
<td>12.9</td>
</tr>
<tr>
<td>North Carolina</td>
<td>39,061</td>
<td>46,335</td>
<td>958,667</td>
<td>12.3</td>
</tr>
</tbody>
</table>

Notes: \(^1\) 1999 income below poverty level. Population for whom poverty status is determined.


Environmental Justice

Factors used in determining consistency with EO 12898 focus on the racial, income, and ethnic composition of nearby communities. Ethnic makeup and income of the study area population in the vicinity of the proposed Site C USWTR are described above. The analyses to determine the proposed project’s consistency with EOs 12898 and 13045 are presented in Subchapter 4.6.

3.6.3.3 Natural Resources

Navigable Waters

As for Sites A and B, the RHA governs the placement of the communications devices and cable for the USWTR in the waters adjacent to Onslow Beach. Navigation considered with respect to the Onslow Beach landfall site is the movement of recreational and commercial boating/shipping along the Atlantic Intracoastal Waterway (AIWW) and Onslow Bay (coastal Atlantic Ocean).
The trenched placement of a cable in the navigable waterway adjacent Onslow Beach will require both a RHA permit and a CWA permit.

Wetlands

The USFWS NWI map indicates that the beach portion of the affected environment is classified as marine, intertidal, irregularly flooded unconsolidated shore (M2USP) (Figure 3.6-3). Other wetlands to the west of Onslow Beach include estuarine intertidal scrub-shrub, broad-leaved deciduous irregularly flooded (E2SS1P), and estuarine intertidal emergent persistent regularly flooded (E2EM1N) (Figure 3.6-3). A USACE Section 404 permit is required for the placement of dredged or fill material in waters of the U.S. Waters of the U.S. generally consist of all surface waters other than waters isolated from navigable waters.

Threatened and Endangered Species

The USFWS Raleigh, North Carolina, field office lists several federally listed threatened and endangered species as occurring in Onslow County and surveys performed at Camp Lejeune have identified which of these species are present (Table 3.6-9).

Plants

Seabeach amaranth (Amaranthus pumilus) was listed as threatened under the ESA on April 7, 1993. It is an annual plant that grows from South Carolina to New York on Atlantic barrier islands and ocean beaches, primarily in disturbed areas such as overwash flats, accreting areas near inlets, and on lower foredunes and upper strands of non-eroding beaches, and may serve as a dune-building pioneer species (USFWS, 2002).

Three main seabeach amaranth aggregations have been identified on Onslow Beach. These are located in the immediate vicinity of the Onslow North Tower, in the washover flat south of the Onslow South Tower, and at New River inlet. Two hundred germinations were estimated in 1998, 25 in 1999, and 12 in 2000. Fifteen to 20 plants were found in 2001. The aggregation at the Onslow North Tower was detected in the late 1980s and rediscovered during a 1998 survey. A grouping of several plants occurred 320 m (1,050 ft) south of the tower, and another two individuals were found at 480 m (1,575 ft) and 640 m (2,100 ft) north of the tower (USFWS, 2002).

Because seabeach amaranth is an annual plant, and its location cannot be reliably predicted from year to year, all possible habitat locations are surveyed each summer beginning in June to ensure that populations receive adequate protection (DoN, 2006a). Once identified, seabeach amaranth sites are marked with signs to prevent traffic from harming the plants.
Site C National Wetlands Inventory (NWI)

- NWI - Estuarine and Marine Wetland
- NWI - Freshwater Forested/Shrub Wetland
- Building
- Road

Table 3.6-9

Federally Listed Plants and Animals Potentially Occurring at or Near Onslow Beach, North Carolina

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Federal Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plants</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seabeach amaranth</td>
<td><em>Amaranthus pumilus</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Rough-leaved loosestrife</td>
<td><em>Lysimachia asperulaefolia</em></td>
<td>Endangered</td>
</tr>
<tr>
<td><strong>Birds</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red-cockaded woodpecker</td>
<td><em>Picoides borealis</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Piping plover</td>
<td><em>Charadrius melodus</em></td>
<td>Threatened</td>
</tr>
<tr>
<td><strong>Reptiles</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leatherback sea turtle</td>
<td><em>Dermochelys coriacea</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Green sea turtle</td>
<td><em>Chelonia mydas</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Loggerhead sea turtle</td>
<td><em>Caretta caretta</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Kemp’s ridley sea turtle</td>
<td><em>Lepidochelys kempi</em></td>
<td>Endangered</td>
</tr>
<tr>
<td><strong>Fish</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shortnose sturgeon</td>
<td><em>Acipenser brevirostrum</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Smalltooth swordfish</td>
<td><em>Pristis pectinata</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Atlantic sturgeon</td>
<td><em>Acipenser oxyrhinchus</em></td>
<td>Candidate</td>
</tr>
<tr>
<td><strong>Mammals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Indian manatee</td>
<td><em>Tricheus manatus</em></td>
<td>Endangered</td>
</tr>
</tbody>
</table>

Source: DoN, 2006a.

Rough-leaved loosestrife (*Lysimachia asperulaefolia*) typically occurs at the ecotone between savanna or flatwoods and pocosins, inland from the proposed cable termination facility. Plants do best in habitat where shrubby vegetation is kept low by frequent natural or prescribed fires and Camp Lejeune applies prescribed fire at a return treatment interval of two to three years to manage it (DoN, 2006a). Due to the absence of rough-leaved loosestrife in the vicinity of the cable termination facility, there would be no overlap with the proposed landfall site.

Pondberry, a federally-listed endangered plant, was reported on Camp Lejeune in a single location; however, the presence of pondberry on Camp Lejeune has yet to be confirmed (DoN, 2006a).
Birds

Piping plover have been documented foraging on Onslow Beach during the winter, spring and fall migration periods, and during the nesting season, although to date no nests have been found (DoN, 2006a). Suitable nesting habitat is available and since 2000 bi-weekly shorebird surveys along the accessible portion of Onslow Beach have been conducted. There is no designated critical wintering habitat for the piping plover in the vicinity of Site C (USFWS, 2008a).

The red-cockaded woodpecker makes its home in mature pine forests. Camp Lejeune currently supports 81 active red-cockaded woodpecker clusters (DoN, 2006a). All of these clusters are located in forested areas, inland from the cable termination facility. Due to the absence of red-cockaded woodpeckers in the vicinity of the cable termination facility, there would be no overlap with the proposed landfall site.

Reptiles

The loggerhead and green sea turtles are known to nest on Onslow Beach. Loggerhead and green turtle nesting generally occurs from May through November (USFWS, 2002). Nesting is known to occur on Onslow Beach at an approximate density of 3.5 nests per km (5.6 nests per mi) (USFWS, 2002). Nest density is slightly lower in the central portion of the recreational beach, just north of the proposed cable location. During the nesting season, reproducing females, adult males, as well as juvenile and hatchling sea turtles would be expected to utilize the nearshore areas of Onslow Bay.

As described in North Carolina Administrative Code 15A.03I.0107, the nearshore waters of the Atlantic Ocean roughly adjacent to Camp Lejeune comprise a seasonal (June 1 – August 31) sea turtle sanctuary that extends approximately 1 km (0.6 mi) offshore. Within this area, the use of commercial fishing equipment is prohibited. However, the North Carolina Division of Marine Fisheries (NCDMF), through issuance of proclamations, can modify the gear prohibitions. The sanctuary is intended to protect nesting sea turtles from fisheries-related injury. Military operations or uses are not affected by the sanctuary designation.

Fish

Shortnose sturgeon have not been documented near Onslow Beach and the closest population, estimated at about 50 individuals, is located in the Cape Fear River (NMFS, 1998d). As there are no shortnose sturgeon in the vicinity and as this species typically spends limited time in marine habitats, shortnose sturgeon are considered unlikely to occur in the nearshore areas off the proposed cable landfall site.

Since 1915 there have been only three published records of the smalltooth sawfish in North Carolina waters; one each in 1937, 1963, and 1999 (NMFS, 2006a). Due to the scarcity of this species and their preference for estuarine shallow waters close to shore with muddy and sandy
bottoms, it is considered very unlikely that smalltooth sawfish would occur in the nearshore area off the proposed cable landfall site.

The Atlantic sturgeon has been documented in the Pamlico Sound north of Onslow Beach and the Cape Fear River to the south. Given that Atlantic sturgeon are found in marine habitats, they may potentially be present in nearshore waters off of proposed cable landfall site.

**Essential Fish Habitat**

EFH associated with the USWTR landfall site at Onslow Beach occur in the AIWW includes: estuarine emergent wetlands (salt marshes), submerged aquatic vegetation, intertidal flats, palustrine emergent and forest wetlands, and the estuarine water column (DoN, 2004a). Nearshore EFH off the coast of North Carolina (Atlantic Ocean) is described in Subchapter 3.2.4 and comprises only a small fraction (0.4 percent) of the corridor area.

**Migratory Birds**

Onslow Beach is located within the Atlantic Flyway, a major migration route along the east coast of the U.S. During the fall and spring migratory seasons, large numbers of birds are found in this general corridor. Migratory shorebirds feed along the exposed wet sand in wash zones; in the intertidal zone; in the wrack lines; in washover passes; and in mud-, sand-, and algal flats of the beach by probing for invertebrates at or just below the surface. The small sand dunes, debris, and sparse vegetation adjacent to the beach provide shelter from wind and extreme temperatures. Thus, habitat exists at Onslow Beach that supports migratory birds. Migratory water birds observed nesting on Onslow Beach include least tern, Wilson’s plover, and American oystercatcher. While not documented, gull-billed tern (Sterna nilotica), common tern (Sterna hirundo), and black skimmer (Rynchops niger) could potentially nest in or near the proposed project area.

**Vegetation and Soils**

The affected beachfront environment consists primarily of overwash flats, foredunes, primary dunes, and maritime scrub/shrub areas. Vegetation is similar to that of other barrier islands, with dune grasses dominating all areas east of and including the primary dunes, and live oak (Quercus virginiana), catbriers (Smilax bona-nox and Smilax glauca), and red bays (Persea borbonia) and magnolia (Magnolia virginiana) dominating the scrub/shrub areas.

The soil survey of Onslow County, North Carolina, identifies the soil series at Onslow Beach as Newhan fine sand, dredged (USDA-NRCS, 1992). Coastal erosion is inherent to dynamic barrier islands. The long-term estimated erosion rate through 1992 in the vicinity of the project area ranges from a loss of 0.6 to 1.5 m (2 to 5 ft) per year (NCDCM, 1992). With average annual erosion rates nearing the New River Inlet approaching 6 m (20 ft), the project area falls within a more stable portion of Onslow Beach.
**Floodplains**

EO 11988 sets forth federal agency responsibilities for reducing the risk of flood loss or damage to personal property, minimizing the impact of flood loss, and restoring the natural and beneficial functions of floodplains. The proposed Site C USWTR landside site lies within the 100-year floodplain. The proposed cable termination facility construction and burial of the trunk cable are not likely to further exacerbate flooding.

3.6.3.4 Cultural Resources

There is one site at Onslow Beach that is eligible for inclusion in the National Register of Historic Places (DoN, 2004a). The site is a prehistoric Early through Late Woodland occupation and is 1.25 m (4 ft) beneath the sand. This site is near the southwest end of the beach (DoN, 2004a) and would not be impacted by installation of the cable further north along Mockup Road (Figure 2-21).

3.6.3.5 Air Quality

The Clean Air Act (CAA) of 1970 and subsequent amendments specify regulations for control of the nation’s air quality. Federal and state ambient air standards have been established for each criterion pollutant. The 1990 amendments to the CAA require federal facility compliance with all applicable substantive and administrative requirements for air pollution control.

The CAA Amendments of 1990 expanded the scope and content of the CAA’s conformity provisions by providing a more specific definition of conformity. As stipulated in Section 176(c), conformity is defined as “conformity to the State Implementation Program’s purpose of eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment areas of such standards.” The USEPA published final rules on general conformity that apply to federal actions in areas designated nonattainment for any of the criteria pollutants under the CAA (40 CFR Parts 51 and 93) in the November 30, 1993 Federal Register. Since Onslow Beach is located within an attainment area, this rule is not applicable.

3.6.3.6 Hazardous Materials

There are no known areas of hazardous waste contamination at the site of the proposed USWTR landside facility at Onslow Beach.

3.6.4 Site D

The Wallops Flight Facility (WFF) is part of NASA’s Goddard Space Flight Center. The facility is comprised of three parts: Wallops Main Base, Wallops Mainland, and Wallops Island. For this action, only the Wallops Island portion of the facility is of concern. It is a barrier island located in Accomack County, Virginia, on the eastern shore of the Delmarva Peninsula. It is
separated from the mainland by Cat Creek and is approximately 11.3 km (7 mi) long, with a width ranging from 1.2 to 2.4 km (0.75 to 1.5 mi) (Figure 3.6-4).

3.6.4.1 Land Use

The Navy site for the USWTR landside facilities at Wallops Island would be a CTF installed inland of the riprap sea wall shown in Figures 3.6-4 and 3.6-5. The CTF would connect to the AEGIS Combat Systems Center (ACSC) via terrestrial data cable. The new CTF would be a permanent building located on a fenced parcel near the midpoint of the island, with communications towers and commercial phone lines available. The trunk cable would be installed through the SSI in a trench or encapsulated pipe and fed into the CTF.

Operations occurring at the WFF include rocket launchings, balloon launchings, aircraft and drone operation, chaff releases, large- and small-caliber gun firings at barge targets, and the use of lasers and radars.

Wallops Island is situated in a primarily agricultural area that is sparsely populated. Most of the land in the vicinity of Wallops Island that is not being farmed is either woodland or marsh. Wallops Island is zoned as part of the Barrier Island District (Accomack County Zoning Administration, 1973). No residences or farms exist on the island (National Aeronautics and Space Administration [NASA], 1992).

A separate subchapter on coastal zone management has been prepared (Subchapter 3.7). A CCD was also prepared. If the Wallops Island site were selected, the determination would be submitted to, and concurrence sought from, the Virginia Department of Environmental Quality.

3.6.4.2 Socioeconomics

Demographics

Table 3.6-10 presents the ethnic characteristics of Accomack County compared to the state of Virginia. Compared to the state as a whole, the county has a substantially greater population of black or African-Americans (31.4 percent compared to 19.6 percent in the state). The percentages of the other ethnic groups are generally similar, except for the proportionally lower number of Asian and Pacific Islanders in the county (0.3 percent) compared to Virginia (3.7 percent).
Site D National Wetlands Inventory (NWI)


Figure 3.6-4
Table 3.6-10

Accomack County Ethnic Characteristics

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>% Black</th>
<th>% Hispanic or Latino</th>
<th>% American Indian, Alaskan Native</th>
<th>% Asian, Pacific Islander</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accomack County</td>
<td>31.4</td>
<td>5.4</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Virginia</td>
<td>19.6</td>
<td>4.7</td>
<td>0.3</td>
<td>3.7</td>
</tr>
</tbody>
</table>


As shown in Table 3.6-11, Accomack County has substantially lower household and family income levels than the state as a whole; these county income levels are about 35.2 and 35.7 percent less, respectively, than the Virginia state levels.

Table 3.6-11

Accomack County Income and Poverty Status

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Median Household Income</th>
<th>Median Family Income</th>
<th>Persons in Poverty1</th>
<th>Families in Poverty1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Persons</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Families</td>
<td>%</td>
</tr>
<tr>
<td>Accomack County</td>
<td>30,250</td>
<td>34,821</td>
<td>6,788</td>
<td>18.0</td>
</tr>
<tr>
<td>Virginia</td>
<td>46,677</td>
<td>54,169</td>
<td>656,641</td>
<td>9.6</td>
</tr>
</tbody>
</table>


Environmental Justice

Factors used in determining consistency with EO 12898 focus on the racial, income, and ethnic composition of nearby communities. Ethnic makeup and income of the study area population in the vicinity of the proposed Site D USWTR are described above. The analyses to determine the proposed project’s consistency with EOs 12898 and 13045 are presented in Subchapter 4.6.

3.6.4.3 Natural Resources

Navigable Waters

As described for the other sites, the RHA governs the placement of the communications devices and cable for the USWTR in the waters adjacent to Wallops Island. The trenched placement of a cable in the navigable waterway adjacent to the shore will require both a RHA permit and a CWA permit.
Wetlands

Extensive marsh wetland systems are found on Wallops Island (URS and EG&G, 2005). The Main Base has tidal and nontidal wetlands along its perimeter in association with water bodies, there are nontidal wetlands in the interior and marsh wetlands on the western edge and along water bodies (URS and EG&G, 2005). Isolated emergent and scrub/shrub wetland communities are depicted on the USFWS NWI maps as occurring in the affected area (PEM1R and PSS3/1R). Figure 3.6-4 presents the NWI information.

Threatened and Endangered Species

Table 3.6-12 lists ESA species potentially found at or near Wallops Island based on a site-wide Environmental Assessment (URS and EG&G, 2005).

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Federal Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piping plover</td>
<td><em>Charadrius melodus</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Reptiles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loggerhead sea turtle</td>
<td><em>Caretta caretta</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Leatherback sea turtle</td>
<td><em>Dermochelys coriacea</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Green sea turtle</td>
<td><em>Chelonia mydas</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Kemp’s ridley sea turtle</td>
<td><em>Lepidochelys kempii</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Hawksbill</td>
<td><em>Eretmochelys imbricata</em></td>
<td>Endangered</td>
</tr>
</tbody>
</table>


Birds

The federally threatened piping plover (*Charadrius melodus*) and state endangered Wilson’s plover use Wallops Island as a breeding area (NASA, 1992; URS and EG&G, 2005). As recommended by the Chincoteague National Refuge, NASA has designated a protected closure area on the southern and northern ends of Wallops Island (Figure 3.6-5). The northern and southern beaches have been closed to vehicle and human traffic during the plover’s nesting season (March 15 through September 1) since 1986. Both breeding areas are currently actively managed and monitored by the Chincoteague National Wildlife Refuge and Virginia Department of Game and Inland Fisheries (VDGIF).

Reptiles

According to the VDGIF, loggerhead and green turtles are known to occur in the vicinity of Wallops Island (VDGIF, 2002). The first documented case of sea turtle nesting on Wallops
Island occurred in July 2002 (Miller 2002) when a loggerhead turtle nested on the north end of Wallops Island (more than 3,000 m [6,600 ft] north of the USWTR landfall site). The nest was ultimately not successful (Miller, 2002). Other sea turtle nests have not been found on Wallops Island; however, sea turtle crawl tracks, a sign of nesting activity, have been seen infrequently (URS and EG&G, 2005). Suitable habitat for sea turtle nesting exists on the northern and southern ends of the island where a natural beach exists. Sea turtle nesting is precluded on the portion of Wallops Island where the riprap seawall has been installed, near the cable termination facility due to an absence of suitable beach seaward of the structure.

**Essential Fish Habitat**

As described in Subchapter 3.2.4, 3 percent of the corridor area in Site D is designated as nearshore EFH, which includes seagrass beds, salt marshes, and wetlands. The linear path in which the trunk cable will be laid has not been mapped, but may cross nearshore EFH at the USWTR landfall site at Wallops Island.

**Migratory Birds**

Like the Onslow Beach site, Wallops Island is located within the Atlantic Flyway, a major migration route along the east coast of the U.S. During the fall and spring migratory seasons, large numbers of birds are found in this general corridor. As at Onslow Beach, migratory shorebirds feed on invertebrates on the beach portion of Wallops Island and seek shelter in vegetation adjacent to the beach. During spring and fall migrations, approximately 15 species of shorebirds feed on microscopic plants and animals in the inter-tidal zone. Abundant species include the sanderling, semi-palmated plover, red knot, short billed dowitcher, and dunlin (URS and EG&G, 2005). Nesting shorebird and water bird species that may use habitats near the project area include black skimmer, American oystercatcher, and occasional least, gull-billed, or common terns (Barrier Island Avian Partnership, 1996).

**Vegetation and Soils**

Approximately 50 percent of Wallops Island is salt marsh, 20 percent is sand and beach, 20 percent is developed, and the remaining 10 percent is covered with shrubs and trees (NASA, 1992). As the southern end of the island is gradually eroding and the northern end of the island is gradually accreting sand, a 1.8- to 3-m (6- to 10-ft) high riprap seawall has been erected along the ocean side of the island in an effort to stabilize it. Figure 3.6-2 depicts the location of the seawall. Vegetation on the island is similar to nearby barrier islands. Vegetative communities within and around the affected environment include scrub/shrub and emergent communities. No forested systems are located between the ACSC and the ocean.

Soils information on the affected environment is listed in Table 3.6-13. All data are derived from the Soil Survey of Accomack County, Virginia (USDA NRCS, 1982).
Table 3.6-13
Soil Series Occurring at the Wallops Island Site

<table>
<thead>
<tr>
<th>Soil Series</th>
<th>Depressions &amp; undulating areas associated with dunes</th>
<th>Percent Slope/ Flooding Regime</th>
<th>Hydric Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fisherman-Camocca Complex</td>
<td>0 – 6 % slopes Frequently flooded</td>
<td>F – Non-hydric</td>
<td></td>
</tr>
<tr>
<td>Camocca fine sand</td>
<td>0 – 2 % slopes Frequently flooded</td>
<td>C – Hydric</td>
<td></td>
</tr>
<tr>
<td>Assateague fine sand</td>
<td>Excessively drained</td>
<td>2 – 35 % slopes</td>
<td></td>
</tr>
<tr>
<td>Beaches</td>
<td>–</td>
<td>Rarely flooded</td>
<td></td>
</tr>
</tbody>
</table>


Floodplain Management

As with the other sites, the proposed Wallops Island USWTR landside site lies within the 100-year floodplain. The proposed CTF construction and burial of the trunk cable are not likely to further exacerbate flooding.

3.6.4.4 Cultural Resources

A Cultural Resources Assessment of Wallops Flight Facility was prepared in 2003 (URS and EG&G, 2005). Two historic sites were identified on Wallops Island. No buildings at Wallops Island are currently listed in the Virginia Department of Historic Resources’ (VDHR) inventory of historic properties. Likewise, none of the buildings, structures or facilities is listed on the National Register of Historic Places, or is recognized as a National Historic Landmark. The Virginia Research Center for Archaeology (VRCA) performed a preliminary archaeological survey of the property where the ACSC now exists, with negative findings. The VRCA considers Wallops Island to be low in potential for historical archeological resources, but to have good potential for prehistoric artifacts; however, no archaeological sites have ever been reported on the island. In addition, the VDHR noted that many of the areas with moderate to high archaeological potential are unlikely to be disturbed by construction or site use. (URS and EG&G, 2005).

3.6.4.5 Air Quality

As with Site C, the Wallops Island site occurs within an area that is in attainment for the criteria pollutants listed under the CAA. As such, the final rule on general conformity that applies to federal actions in areas designated nonattainment is not applicable.
3.6.4.6 Hazardous Materials

There are no known areas of hazardous waste contamination at the site of the proposed USWTR landside facility at Wallops Island. There is a permitted RCRA Subpart X (open burn) unit at the southern end of Wallops Island. The Environmental Office at the Wallops Flight Facility manages hazardous waste generation, including inspection, onsite transportation, storage, and shipment of all hazardous waste and would be consulted to ensure that no contamination exists at the cable termination facility site.
3.7 Coastal Zone Management

The coastal zone is rich in natural, commercial, recreational, ecological, industrial, and aesthetic resources. As such, it is protected by legislation for the effective management of its resources. The Coastal Zone Management Act (CZMA) of 1972 (16 USC § 1451, et seq., as amended) provides assistance to states, in cooperation with federal and local agencies, for developing land and water use programs in the coastal zone. This includes the protection of natural resources and the management of coastal development.

The CZMA establishes national policy to protect resources in the coastal zone. CZMA policy is implemented via NOAA-approved coastal management programs. Federal lands are excluded from the jurisdiction of such approved coastal management programs. The CZMA and its implementing regulations, however, provide that federal agencies must determine if it is reasonably foreseeable that their proposed actions, whether inside or outside of a state's coastal zone, will directly or indirectly affect any land or water use or natural resource within that coastal zone. The CZMA requires that federal activities affecting any coastal use or resource of a state must be consistent to the maximum extent practicable with the enforceable policies of the state's NOAA-approved coastal management plan.

The landward boundaries of the coastal zone vary by state, reflecting both the natural and built environments. The seaward boundaries generally extend to the outer limits of the jurisdiction of the state, but not more than 5.6 km (3 NM) into the Atlantic Ocean.

3.7.1 Site A

NOAA approved the Florida Coastal Management Program (FCMP), the state of Florida’s federally approved management program, in 1981. The state of Florida’s federal consistency review is conducted jointly by its FCMP member agencies and is coordinated by the Florida Department of Community Affairs, which is the lead coastal agency pursuant to Section 306(c) of the CZMA. The state has limited its federal consistency review of federally licensed and permitted activities to the federal licenses or permits specified in Section 380.23(3)(c) of the Florida Code requested for activities located in, or seaward of, one of the state’s 35 coastal counties (FCMP, 2004).

The FCMP consists of a network of 23 Florida statutes administered by 11 state agencies and four of the five water management districts. The program is designed to ensure the wise use and protection of the state’s water, cultural, historic, and biological resources; to minimize the state’s vulnerability to coastal hazards; to ensure compliance with the state’s growth management laws; to protect the state’s transportation system; and to protect the state’s proprietary interest as the owner of sovereign submerged lands (FCMP, 2004).
Of the 23 Florida statues implemented by the FCMP, the following subject areas are most relevant to the proposed USWTR landside facilities at Naval Station Mayport:

- Growth policy, county and municipal planning, and land development regulation
- State and regional planning
- Land and water management
- State lands
- Historical resources
- Conservation or recreation
- Saltwater fisheries
- Wildlife
- Soil and water conservation environmental control

The remaining enforceable statues have little or no relevance to the proposed USWTR landside facilities. These statutes address the following areas:

- Multipurpose outdoor recreation and land acquisition, management, and conservation
- Commercial development and capital improvements
- Emergency management
- State parks and preserves
- Beach and shore preservation
- Transportation administration
- Recreational trails system
- Transportation finance and planning
- Water resources
- Pollutant discharge prevention and removal
- Energy resources
- Public health, general provisions
- Mosquito control

Naval Station Mayport falls within the city of Jacksonville, which is a participating agency in the FCMP. In the Conservation/Coastal Element of its 2010 Comprehensive Plan, the city outlines 11 goals with supporting policies that direct the management and conservation of coastal resources (City of Jacksonville Planning and Development Department, 2003). The city addresses the following resource areas:

- Air quality
- Water quality
- Native ecological communities
- Wetlands conservation
- Unique or sensitive environments
3.7 Site B

The South Carolina Coastal Management Program (SCCMP) was approved by NOAA in 1979. The primary authority for the SCCMP is the 1977 Coastal Tidelands and Wetlands Act and the program’s lead agency is the Office of Ocean and Coastal Resource Management (OCRM) of the South Carolina Department of Health and Environmental Control (SCDHEC). The South Carolina coastal zone comprises the coastal waters and submerged lands seaward to the state’s jurisdictional limits, and the lands and waters of the eight coastal counties; specifically, Beaufort, Berkeley, Charleston, Colleton, Dorchester, Horry, Jasper, and Georgetown counties (SCDHEC, 2007).

OCRM has direct permitting authority over the critical areas of the coast, defined as all coastal waters, tidelands, beaches, and oceanfront sand dune systems. Critical area policies under the SCCMP have been designated by OCRM in the following categories, with those policies relevant to the proposed project in bold (SCDHEC, 2006):

- **General guidelines for beaches and the beach/dune system**
- **Abandoned vessels and structures**
- **Specific project standards for tidelands and coastal waters, with relevant policies pertaining to cables, pipelines, and transmission lines; and dredging and filling**
- **Specific project standards for beaches and dunes**

The office also has indirect management authority of coastal resources throughout the coastal zone; here the OCRM has authority to review any project requiring a state permit, a federal permit or license, or federal funding, as well as direct federal activities to determine if the project or activity is consistent with the policies and procedures of the SCCMP. The SCCMP identifies resource policies for each of the following “activities subject to management,” with those relevant to the proposed project in bold (SCDHEC, 1995):

- **Residential development**
- **Transportation facilities**
  - Ports
  - **Roads and highways (including bridges and transit facilities)**
  - Airports

- **Sandy beaches and shorelines**
- **Coastal storm-related public safety and health**
- **Historical resources**
- **Level-of-service standards**
- **Siting and operation of boat facilities**
- **Compatible development**
– Railways
– Parking facilities

• Coastal industries
  – Agriculture
  – Forestry (silviculture)
  – Mineral extraction
  – Manufacturing
  – Fish and seafood processing
  – Aquaculture

• Commercial development
• Recreation and tourism
  – Parks
  – Commercial recreation

• Marine related facilities
  – Marinas
  – Boat ramps
  – Docks and piers
  – Dock master plans

• Wildlife and fisheries management
  – Wildlife and fisheries management
  – Artificial reefs
  – Impoundments

• Dredging
  – Dredging
  – Dredged material disposal
  – Underwater salvage

• Public services and facilities
  – Sewage treatment
  – Solid waste disposal
  – Public/Quasi-public buildings
  – Dams and reservoirs
  – Water supply

• Erosion control
• Energy and energy-related facilities
• Activities in areas of special resource significance
  – Barrier islands
  – Dune areas (outside the critical areas)
  – Navigation channels
  – Public open space
  – Wetlands (outside the critical areas)

• Stormwater management guidelines
3.7.3 Site C

The North Carolina Coastal Area Management Act (CAMA) of 1974 was passed in accordance with the federal CZMA. Approved by NOAA in September 1978, it established a cooperative program of coastal area management between local and state governments. General coastal area policy guidelines issued by North Carolina are listed below with those guidelines relevant to the proposed project in bold:

- Shoreline erosion policies
- Shorefront access policies
- Coastal energy policies
- Post-disaster policies
- Floating structure policies
- Mitigation policies
- Coastal water quality policies
- Policies on use of coastal airspace
  - Policies on water- and wetland-based target areas for military training areas
  - Policies on beneficial use and availability of materials resulting from the excavation or maintenance of navigational channels
  - Policies on ocean mining.

While local governments have the initiative for planning under the CAMA, the state has designated areas of environmental concern in the following four broad categories:

- Estuarine and ocean systems
- Ocean hazard areas
- Public water supplies
- Natural and cultural resource areas.
Each of these areas of environmental concern is relevant in the evaluation of the proposed project and is included in coastal zone consistency analysis and determination.

The CAMA required local governments in each of the 20 coastal counties in the state to prepare and implement a land use plan and ordinances for its enforcement. Upon approval by the North Carolina Coastal Resources Commission, the plan becomes part of the North Carolina Coastal Management Plan.

Coastal zone management policies adopted in each plan must be consistent with established state and federal policies. Specifically, policy statements are required on resource protection; resource production and management; economic and community development; continuing public participation; and storm hazard mitigation, post-disaster recovery, and evacuation plans.

Onslow County recently updated its land use plan (Onslow County, 2004). Currently, zoning controls are applicable to only one special area, Golden Acres in Stump Sound Township. However, the 2004 Citizen’s Comprehensive Plan for Onslow County makes recommendations regarding the need for more comprehensive zoning and general guidance of development patterns. The citizen committees stressed the importance of open space, farm preservation, and the management of water-oriented activities among other issues relevant to growth in coastal areas (Onslow County, 2004).

### 3.7.4 Site D

The Commonwealth of Virginia has developed and implemented a federally approved Coastal Resources Management Program (CRMP) describing current coastal legislation and enforceable policies. Virginia’s CRMP is a networked program with several agencies administering the enforceable policies. These policies, with those relevant to the proposed project in bold, are listed as follows:

- Fisheries management
- Subaqueous lands management
- Wetlands management
- Dunes management
- Non-point source pollution control
- Point source pollution control
- Shoreline sanitation
- Air pollution control
- Coastal lands management.

Advisory policies for geographic areas of particular concern recommended for consideration by Virginia include coastal natural resource areas, coastal natural hazard areas, and waterfront development areas.
Coastal lands management is addressed via the Virginia Chesapeake Bay Preservation Act and the Chesapeake Bay Preservation Area Designation and Management Regulations, which establish a cooperative program between state and local governments to reduce nonpoint source pollution. The objectives of the program are to improve water quality in Chesapeake Bay and its tributaries, and promote sound land use planning and management practices on environmentally sensitive lands, known as Chesapeake Bay preservation areas (CBPAs). CBPAs are classified into two categories:

- **Resource protection areas (RPAs)**, within which development is limited to water-dependent uses and redevelopment. RPAs include tidal wetlands, nontidal wetlands connected by surface flow and contiguous to tidal wetlands or perennial streams, tidal shores, and 30-m (100-ft) vegetated buffers adjacent to these features and along both sides of perennial streams (riparian buffers).

- **Resource management areas (RMAs)**, where development is permitted in accordance with performance criteria contained in the regulations and incorporated in local ordinances. RMAs include floodplains, highly erodible soils (including steep slopes), highly permeable soils, nontidal wetlands not included in RPAs, and any other lands the locality deems necessary to protect the quality of state waters.
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