3.2 BIOLOGICAL ENVIRONMENT

Biological resources existing in the study region located near Guam include marine flora and fauna and the deep offshore environments these organisms inhabit. Marine biological resources including plankton, invertebrate and fish communities, marine birds, and special-status species such as sea turtles and marine mammals are discussed in relation to the proposed project area. Special topics such as marine protected areas (MPAs), essential fish habitat (EFH), the migratory bird treaty act (MBTA) are also discussed for the study areas. Assessment of the current conditions of the biological resources in the study region will allow for a determination of baseline conditions that may be affected by project activities.

3.2.1 Plankton Communities

The ROI for plankton communities is the general offshore region of Guam, which includes the ODMDS study areas and the area between them and the Island of Guam. Planktonic organisms are those which drift through the water with little chosen directional movement, and consequently are often at the mercy of wind and ocean currents. Phytoplankton are small unicellular algae species such as diatoms and dinoflagellates that photosynthesize and are responsible for a majority of the primary production that occurs in the ocean. These tiny plants form the base of the food web in the ocean environment. Zooplankton are animals that are typically larger than phytoplankton and generally more mobile. The distribution of plankton is usually concentrated in the neritic zone where nutrients and light are abundant and primary production drives secondary production. Plankton can be found in the deep pelagic region, but distribution is patchy and dependent upon resource availability (Nybakken 2001).

In coastal zones wind causes upwelling and enriches the nutrient concentrations in surface waters. Thus, heavier densities of phytoplankton and zooplankton are typically found in coastal waters. Fluctuations in phytoplankton abundance vary seasonally. The rainy season in Guam is from July-November, and the dry months are December-June. Upwelling triggered by tradewinds or storms will bring nutrient-rich deep water to the surface, leading to increased phytoplankton blooms in the coastal areas. Thus, higher densities of zooplankton would most likely be found shortly after the rainy season. Upwelling can also occur in the open ocean by similar means of a steady directional wind that transports surface water away from the area of interest, allowing for deep, nutrient-rich waters to replace nutrient-poor surface water (Wickstead 1965).

In tropical waters like Guam, there is a significant amount of sunlight year round due to little change in the position of the sun in the equatorial region. This causes thermal stratification in the water column, which leads to a large density and temperature gradient. Therefore, there is little or no mixing between the surface waters and deep nutrient-rich water. In tropical seas primary production is constant year round because the light conditions are optimal for phytoplankton to photosynthesize; however, the production rates remain low in these regions due to the limited upward transport of more nutrient-rich water (Nybakken 2001).

3.2.1.1 Phytoplankton

Phytoplankton are the most abundant primary producers in the marine environment. Primary productivity is defined as the amount of carbon dioxide fixed by an organism in a given volume of water, and organisms which are responsible for primary production are termed autotrophic (make their own food). The most common reaction in which primary production occurs is photosynthesis. Photosynthesis is the process in which solar energy is converted into chemical energy in a reaction using water, carbon dioxide, nutrients, and light energy to form sugar and oxygen. There are factors that can limit photosynthesis, and thus affect primary productivity, such as the quality and availability of sunlight, nutrient availability, and seawater temperatures.

Photosynthetic rates can vary from low producing systems (oligotrophic) which produce on the order of less than 0.1 mg of carbon/m^2/per day, to high producing systems in which photosynthetic rates are on the order of 10 mg of carbon/m^2/day (Department of the Navy [DON] 2005). Examples of phytoplankton typically found in tropical marine environments include diatoms, dinoflagellates, and coccolithophores (Tomas et al. 1997).

3.2.1.2 Zooplankton

A large diversity of organisms are classified as zooplankton, ranging from those which feed on phytoplankton (e.g., copepods) to active predators of fish larvae (e.g., arrow worms). Zooplankton grazers feeding on phytoplankton are considered the herbivores of the sea and are the organisms responsible for secondary production. Secondary production is defined as the change in biomass of organisms that consume primary producers; this may include organisms such as marine mammals and fishes that live by heterotrophic (rely on other organisms for food) processes, and will be discussed in later sections. There are two primary functional classifications of zooplankton: meroplankton and holoplankton. Meroplankton usually have a planktonic larval phase, but as they mature become sufficiently motile to swim against the currents. They are most common in the neritic zone, defined as the area from the low tide mark to the edge of the continental shelf. Some examples of meroplankton include the planktonic stages of fish and invertebrates including eggs and larvae. In contrast, holoplankton spend their entire life as plankton, and include such organisms as copepods and large jellyfish. Typically, holoplankton are oceanic or found in the pelagic zone (Nybakken 2001).

Zooplankton species compositions can vary spatially as well as seasonally due to the seawater temperature and salinity fluctuations. In tropical waters there are typically warmer water temperatures, lower salinity, and lower viscosity, therefore making it difficult for plankton to float in the water column (Wickstead 1965).

Examples of zooplankton that are typically found in tropical waters include cladocerans, ostracods, copepods, mysid shrimp, cumaceans, cirripede nauplii and cyprids, and amphipods. The zooplankton mentioned above are found primarily in coastal or shallow waters, however, some species of copepods and ostracods can be found in sparse numbers in oceanic waters. Some of these species are known to be bottom dwelling plankton such as the small crustaceans known as cumaceans. Many zooplankton migrate vertically while following their food source. Some examples of larger crustaceans found in pelagic areas are euphausiids and penaeid shrimp (Wickstead 1965).

3.2.2 Invertebrate Communities

The ROI for invertebrate communities is the ocean floor within the ODMDS study areas. Invertebrate communities consist of organisms living in, on, or above the bottom of the ocean. These organisms are often characterized by body size and where they live in relation to the seafloor. For the study region, the focus is on those invertebrates that live in the sediments (infauna and meiofauna), as these organisms are less able to move from an area if disturbed.

3.2.2.1 Benthic Macroinfauna

Benthic macroinfauna are small invertebrates that live within sediments and can be retained on a 0.5mm sieve. These organisms are important marine ecological community members because they burrow within and oxygenate sediments, may filter large volumes of water, contribute organic materials to the overall marine system, and serve as food for bottom-feeding fish and other invertebrates.

Benthic macroinfauna data from each of the study areas were assessed using various indices common to ecological community structure evaluations, including composition (species present), density (number of individuals/m^2), species richness (number of species) and

Shannon-Wiener species diversity index (number of different species relative to the total number of individuals; weighted for evenness of species composition). A cluster analysis was also performed to determine similarities between species assemblages of invertebrate macroinfauna among stations. The benthic infaunal communities were characterized for the North Study Area (Stations 1, 2, and 3), Northwest Study Area (Stations 6, 7, and 8), and the sample stations located inshore of the two alternative Study Areas (Stations 4 and 9), and the proposed reference site (Station 5). Three replicate samples were taken at each of the stations within a study area. It should be noted that large quantities of foraminifera (both living specimens and empty shells) were present in all of the samples. The following species composition descriptions are specific for both alternative sites and a reference site.

North Study Area

At Station 1, the density per replicate ranged from 16 individuals/m^2 in Rep 1 to 26 individuals/m^2 in Rep 3 (Table 3-15). Species richness ranged from 8 species in Rep 1 to 10 species in Rep 3. The Shannon-Wiener species diversity ranged from 2.01 in Rep 3 to 2.15 in Rep 2.

At Station 2, the density per replicate ranged from 10 individuals/m^2 in Rep 3 to 22 individuals/m^2 in Rep 1 (Table 3-15). Species richness ranged from 5 species in Rep 3 to 9 species in Rep 1. The Shannon-Wiener species diversity ranged from 1.56 in Rep 3 to 2.02 in Rep 2.

At Station 3, the density per replicate ranged from 8 individuals/m^2 in Rep 2 to 13 individuals/m^2 in Reps 1 and 3 (Table 3-15). Species richness ranged from 4 species in Rep 2 to 7 species in Reps 1 and 3. The Shannon-Wiener species diversity ranged from 1.33 in Rep 2 to 1.91 in Reps 1 and 3.

In summary, a total of 37 different species were collected in the North Study Area. Station 3 had the lowest density of organisms and diversity while Station 1 had the highest. Polychaetes dominated the benthic populations at Stations 1 and 3 while Station 2 was comprised of a mix of polychaetes and miscellaneous phyla (Table 3-15). Overall, crustaceans and molluscs were in low abundance. Echinoderms were absent at all of the stations.

Table 3-15. Macroinfauna Community Composition in the North Study Area

Parameter	North Alternative Site											
	Station GO1				Station GO2				Station GO3			
	Rep 1	Rep 2	Rep 3	Mean	Rep 1	Rep 2	Rep 3	Mean	Rep 1	Rep 2	Rep 3	Mean
Density (number/m^2)	16	18	26	20	22	18	10	17	13	8	13	11
Species Richness (# of species)	8	9	10	9	9	8	5	7	7	4	7	6
Shannon-Wiener diversity	2.03	2.15	2.01	2.06	1.97	2.02	1.56	1.85	1.91	1.33	1.91	1.72
% Polychaetes	100	91	44		22	64	50		88	0	75	
% Crustaceans	0	9	6		7	0	0		0	80	0	
% Molluscs	0	0	6		14	0	0		0	20	0	
% Echinoderms	0	0	0		0	0	0		0	0	0	
% Misc. Phyla	0	0	44		57	36	50		12	0	25	

Northwest Study Area

At Station 6, the density per replicate ranged from 18-19 individuals/m^2 and species richness ranged from 8-9 species in each of the replicates (Table 3-16). The Shannon-Wiener species diversity ranged from 1.97 in Rep 3 to 2.10 in Rep 1.

At Station 7, the density per replicate ranged from 11 individuals/m^2 in Rep 2 to 21 individuals/m^2 in Reps 1 and 3 (Table 3-16). Species richness ranged from 5 species in Rep 2 to 12 species in Rep 1. The Shannon-Wiener species diversity ranged from 1.48 in Rep 2 to 2.46 in Rep 1.

At Station 8, the density per replicate ranged from 8-10 individuals/m^2 and species richness ranged from 4-6 species in each of the replicates (Table 3-16). The Shannon-Wiener species diversity ranged from 1.33 in Rep 3 to 1.79 in Rep 2.

In summary, a total of 30 different species were collected in the Northwest Study Area. Station 8 had the lowest densities of organisms and diversity. Stations 6 and 7 had similar values. At all of the stations, the majority of the benthic populations were comprised of polychaetes (Table 3-16). There were no molluscs or echinoderms present in any of the stations.

Table 3-16. Macroinfauna Community Composition in the Northwest Study Area

Parameter	Northwest Alternative Site											
	Station GO6				Station GO7				Station GO8			
	Rep 1	Rep 2	Rep 3	Mean	Rep 1	Rep 2	Rep 3	Mean	Rep 1	Rep 2	Rep 3	Mean
Density (number/m^2)	18	19	18	18	21	11	21	18	8	10	8	9
Species Richness (# of species)	9	8	8	8	12	5	7	8	5	6	4	5
Shannon-Wiener diversity	2.10	1.98	1.97	2.02	2.46	1.48	1.63	1.86	1.61	1.79	1.33	1.58
% Polychaetes	64	50	73		69	57	23		60	67	60	
% Crustaceans	9	25	9		31	0	31		20	17	0	
% Molluscs	0	0	0		0	0	0		0	0	0	
% Echinoderms	0	0	0		0	0	0		0	0	0	
% Misc. Phyla	27	25	18		0	43	46		20	16	40	

Inshore/Proposed Reference Site

At Station 4, the density per replicate ranged from 2 individuals/m^2 in Rep 3 to 16 individuals/m^2 in Reps 1 and 2 (Table 3-17). Species richness ranged from 1 species in Rep 3 to 10 species in Rep 2. The Shannon-Wiener species diversity ranged from 0 in Rep 3 to 2.30 in Rep 2.

At Station 9, the density per replicate ranged from 10 individuals/m^2 in Rep 2 to 14 individuals/m^2 in Rep 1 (Table 3-17). Species richness ranged from 6-8 species in each of the replicates. The Shannon-Wiener species diversity ranged from 1.73 in Rep 3 to 2.04 in Rep 1.

At Station 5, the proposed reference site, the density per replicate ranged from 13 individuals/m^2 in Rep 1 to 48 individuals/m^2 in Rep 2 (Table 3-17). Species richness ranged from 6 species in Rep 1 to 15 species in Rep 2. The Shannon-Wiener species diversity ranged from 1.67 in Rep 1 to 2.35 in Rep 2.

In summary, a total of 35 different species were collected in the stations located inshore of the two alternative study areas, including the proposed reference site. Stations 4 and 9 had similar organism densities and species richness; however, Station 4 had a slightly lower diversity than Station 9. Station 5, the proposed reference site, had the highest organism density and species diversity with a mean value of 30 and 2.08, respectively. Polychaetes comprised the majority of species at all of the stations (Table 3-17). No molluscs were present at Station 4 or 9 and only one Pelecypoda was found at Station 5. Echinoderms were absent from all of the stations from this study area.

Table 3-17. Macroinfauna Community Composition at the Inshore and Proposed Reference Sites

Parameter	Inshore/Proposed Reference Site											
	Station GO4				Station GO5				Station GO9			
	Rep 1	Rep 2	Rep 3	Mean	Rep 1	Rep 2	Rep 3	Mean	Rep 1	Rep 2	Rep 3	Mean
Density (number/m^2)	16	16	2	11	13	48	29	30	14	10	13	12
Species Richness (# of species)	9	10	1	7	6	15	11	32	8	6	6	7
Shannon-Wiener diversity	2.16	2.30	0.00	1.49	1.67	2.35	2.22	2.08	2.04	1.79	1.73	1.85
% Polychaetes	70	50	0		75	50	72		78	83	75	
% Crustaceans	10	10	0		13	20	22		0	17	0	
% Molluscs	0	0	0		12	0	0		0	0	0	
% Echinoderms	0	0	0		0	0	0		0	0	0	
% Misc. Phyla	20	40	100		0	30	6		22	0	25	

Regional Analysis for Benthic Macroinfauna

Results of the cluster analysis, an assessment to determine the degree of similarity of macrofauna species assemblages amongst stations, indicate that there was no difference in species composition between the North and Northwest Study Areas. Further, the results show the proposed reference site had similar macrofauna assemblages to the North and Northwest Study Areas, suggesting this is a suitable reference site.

3.2.2.2 Benthic Meiofauna

Benthic meiofauna are described as small organisms that live within the sediment and can be retained on a 63µm sieve, but pass through a 0.5-mm sieve. Nematodes and harpactacoid copepods make up the majority of meiofauna; therefore, the presence of only these two taxa were accounted for in the samples collected to characterize the study areas and potential reference sites. The benthic meiofauna communities were characterized for the North Study Area (Stations 1, 2, and 3), Northwest Study Area (Stations 6, 7, and 8), and the sample stations located inshore of the two study areas (Stations 4 and 9), including the proposed reference study site (Station 5). Two replicate samples were taken at each of the stations within a study area.

North Study Area

At Station 1, Rep 3, one nematode was found. There were no harpactacoid copepods in the sediment sample collected at Station 1. No meiofaunal nematodes or harpactacoid copepods were present at Stations 2 or 3.

Northwest Study Area

No meiofaunal nematodes or harpactacoid copepods were present at Stations 6, 7, or 8.

Inshore/Proposed Reference Site

No meiofaunal nematodes or harpactacoid copepods were present at Stations 4, 5, or 9.

Regional Summary

Meiofaunal organisms were absent throughout all of the study areas with the exception of Station 1 in the North study site. Only one nematode was found in a sample collected at this station. In addition to the absence of nematodes and harpactacoid copepods in the majority of the samples, it must be noted that when the samples were analyzed there were no other meiofaunal organisms present. Similar to the macroinfauna samples, there were large quantities of foraminifera (both living specimens and empty shells) present in all of the samples.

3.2.3 Fish Communities and Essential Fish Habitat (EFH)

The ROI for Fish Communities and EFH is the water column and ocean floor within the ODMDS study areas.

3.2.3.1 Deep-sea Demersal Species

The demersal fish community in the deep offshore environment are those that reside directly in the action area, as these species live on or near the bottom where a potential ODMDS would be located. Species assemblages were assessed using three gear types: beam trawl, traps, and photography. All specimens collected by trawl and traps were retained for identification to species level by Scripps Institution of Oceanography scientists. Fish captured by images in photographs and video were generally unable to be identified to an advanced taxonomic level due to the quality of the camera equipment. These typically fell into two morphological types that were referred to as Ophidiiform (e.g., cuskeels that are relatively short and “tadpole”

shaped, often with a bulbous head) and Anguilliform (e.g., true eels that are long and slender). The following sections provide brief descriptions of the specimens collected during the Site Characterization Study conducted in April 2008.

Bassogigas gillii

This species is a type of fish commonly called a cuskeel, although it is not a true eel. The dorsal and ventral fins are continuous with the caudal fin. Individuals typically reach a size of at least 33.5 in (85 cm), and the deepest recorded depth of capture is 7,050 ft (2,150 m), although the specimen caught in this study likely came from a depth of about 8,530 ft (2,600 m). This species has been collected from all major oceans but is considered uncommon (Smith and Heemstra 1986; Nielsen et al. 1999).

Bathypterois longipes

This species is in a group of fishes commonly called tripod fish, named for the elongated extensions of the pelvic and caudal fin which form a tripod on which the fish rests on the seafloor. This particular species is known as the abyssal spiderfish. Tripod fish swim very little, and feed by facing into the current and waiting for small planktonic organisms to contact their outstretched (and also elongated) pectoral fins. Maximum recorded size is 9.8 in (24.9 cm) and the depth range is 8,580 – 18,400 ft (2,615 - 5,610 m) (Merrett 1990).

Cyclothone pallida

The genus *Cyclothone* is one of the most abundant of all types of fishes and is estimated to be the most abundant vertebrate genus in the world. The common name of bristlemouth is derived from the presence of numerous fine teeth. Its maximum size is approximately 3 in (75 mm), and this species has a very large mouth and several rows of photophores (bio-luminescent spots) along the body. *Cyclothone pallida* is found in all major oceans. *Cyclothone* typically live in the 1,300 – 3,300 ft (400-1,000 m) mesopelagic depth range, although they may be found much deeper. The specimens collected by beam trawl in this study were likely captured in the water column while the net was being deployed or retrieved, as opposed to the ocean floor (Smith and Heemstra 1986; Gon 1990).

Eptatretus carlhubbsi

The giant hagfish (*Eptatretus carlhubbsi*) is the largest known hagfish. In the order Myxiniforme, hagfish are primitive jawless fishes that are unique in that they have a cranium, but lack a vertebral column. Colloquially known as “slime eels” the fish is known for its ability to produce copious amounts of slime when agitated. The largest recorded size for this species is 46 in (116 cm), and the deepest recorded depth is 5,160 ft (1,574 m) (Fernholm 1998). The largest specimen collected in this study was 50 in (127 cm); two smaller specimens were collected at a depth of about 8,530 ft (2,600 m) at Station 6.

Tauredophidium hextii

This uncommon species of cuskeel is quite unique in that it has three long spines on the operculum, does not have eyes, and is the only species in the genus *Tauredophidium*. The specimen collected in this study was a gravid adult female very near the maximum recorded size of 4 in (10.5 cm). The recorded depth range for the fish is from 4,920 – 8,725 ft (1,500 - 2,660 m), while the trawl depth in this study ranged from 8,740 – 8,900 ft (2,665 - 2,713 m) (Nielsen et al. 1999).

North Study Area

Sampling was done by three methods: Beam Trawling; Fish Traps; and Photo Surveys.

Beam trawl sampling in the North Study Area was conducted over a one-hour period at Station 1, Station 2, and Station 3. At each station, the 12-ft beam trawl was in contact with the bottom for 60 minutes each, covering an area of 0.006 mi^2 (0.015 km^2) at Station 1, 0.005 mi^2 (0.014 km^2) at Station 2 and 0.005 mi^2 (0.013km^2) at Station 3. The trawls collected a total of only four fish. The beam trawl at Station 1 resulted in the capture of one damaged, partial fish that was unidentifiable. The beam trawl at Station 2 resulted in the capture of two fishes. The first fish was identified as a *Stomiiforme* (dragonfishes and allies) and had a total length of 100 mm and a mass of 2.5 grams. This fish was too damaged to be identified further. The second fish was identified as *Bathypterois longipes* (Tripod fish) and had a total length of 110 mm and a mass of 10.0 grams. The beam trawl at Station 3 resulted in the capture of one fish. The fish was identified as *Cyclothone pallid* (Tan bristlemouth) and had a total length of 53 mm and a mass of 1.0 gram. The Stomiiforme is a mid-water column organism.

The fish traps that were set in the North Study Area were limited to Station 1. A total of two giant hagfish (*Eptatretus carlhubbsi*) were collected.

The stations in the North Study Area had a total of five fish observed by camera, all of which were at Station 1. There were at least three different species observed, including three individual Ophidiform (cuskeel) specimens, one Anguilliform (likely from the family Halosauridae: *Aldovandria* sp., deep sea spiny eel), and one specimen that was possibly a small shark or an Ophidiiform with very large horizontally positioned pectoral fins.

Northwest Study Area

Sampling was done by three methods: Beam Trawling; Fish Traps; and Photo Surveys.

Beam trawl sampling in the Northwest Study Area was conducted over a one-hour period at Station 6 and Station 8 and collected a total of five fish. The trawls collected a total of only five fish. At Station 6, the 12-ft beam trawl was in contact with the bottom for 69 minutes covering an area of 0.007 mi^2 (0.017 km^2) and Station 8 it was in contact with the bottom for 60 minutes covering an area of 0.005 mi^2 (0.012km^2). The beam trawl at Station 6 resulted in the capture of four fishes. Three of the fish were identified as *Cyclothone pallid* (Tan bristlemouth) and had a total length of 66, 60, and 62 mm and each had a mass of 1.0 gram. The Tan bristlemouth lives suspended in the water column, and as such, it is likely that these fish were captured when the net was in transit to or from the bottom. The fourth fish was identified as *Bassogigas gillii* (a type of Cuskeel) and had a total length of 538 mm and a mass of 1,100 grams. The beam trawl at Station 8 resulted in the capture of one fish. The fish was identified as an Ophidiiform and had a total length of 57 mm and a mass of 1.0 gram.

Fish traps in the Northwest Study Area yielded two hagfish. One was identified as a giant hagfish while the other was too immature and damaged to be identified beyond family Myxinidae.

The stations in the Northwest Study Area yielded a total of five fish observed by camera. All specimens were fairly small Ophidiiforms, with one photographed at Station 6, one photographed at Station 7, and three photographed at Station 8.

Inshore/Proposed Reference Site

Sampling was done by three methods: Beam Trawling; Fish Traps; and Photo Surveys.

Beam trawl sampling at the inshore stations and proposed reference station was conducted over a one-hour period at Station 9 and Station 5, respectively. At Station 5, the 12-foot beam trawl was in contact with the bottom for 60 minutes covering an area of 0.005 mi^2 (0.012 km^2)

and at Station 9, it was in contact with the bottom for 75 minutes covering an area of 0.006 mi^2 (0.015 km^2). The beam trawl at Station 9 resulted in the capture of one fish. The fish was identified as *Tauredophidium hextii* (a type of Cuskeel) and had a total length of 57 mm and a mass of 1.0 gram. Two attempts were made to trawl at Station 5, but both times the gear snagged on bottom obstructions, the equipment was damaged, and no fish were collected.

Fish traps were not deployed at either of the inshore or proposed reference stations.

The stations in the inshore and proposed reference area had a total of four fish observed by camera. Station 5 yielded photographs of two relatively large Anguilliforms (likely *Aldovandria* sp.) and one Ophidiiform specimen. One small Ophidiiform specimen was photographed at Station 9.

3.2.3.2 Commercial and Recreational Fishery Species

In Guam, the majority of the commercial fishery is a pelagic trolling fishery operated by small trolling boats less than 33 ft (10 m) long (Allen and Bartram 2008). They are owner–operated, often by fishers who earn the majority of their living by other means than fishing. This creates difficulties when attempting to distinguish between commercial and recreational fishing efforts, however, almost all of the small scale fisherman do sell a portion of their catch.

Large scale commercial fisheries are limited due to the prohibition of longline fishing around the island of Guam (50 CFR 665.26). The small boat fisheries of Guam can be categorized in to five groups based on the biology and harvest method of the species. These groups include pelagic fish, bottomfish, reef-fish, bigeye scad, and marine invertebrates.

The DAWR maintains a network of FADs in the waters surrounding Guam as an aid to the fishing community. The main purpose of the FADs was to enhance fishing and recreational diving and minimize anchor damage to the reef habitats (DAWR 2005b). The FADs create habitat for juvenile fish to aggregate, which in turn attracts larger fish, and thereby enhances the presence and abundance of commercially important species for fisherman. Fish distributions of shallow (0 to 165 ft [0 to 50 m]) schooling fish, intermediate depth (165 to 330 ft [50 to 100 m]), and deep water (330 to 1,650 ft [100 to 500 m]) scattered fish have been documented to increase as far as 0.8 nm (1.5 km) from FADs (Josse et al. 2000). Figure 2-3 displays the locations of FADs offshore of Guam.

<u>Pelagic Fishery</u>

Pelagic fishes are open-ocean migratory species. The most common species in the Guam pelagic fishery are mahimahi (*Coryphaena hippurus*), ono (*Acanthocybium solandri)*, skipjack tuna (*Katsuwonus pelamis)*, yellowfin tuna *(Thunnus albacares),* and Pacific blue marlin (*Makaira mazara)* and make up 90-95% of the trolling catch (Amesbury 2006). Catch data show distinct seasonality in these species abundance offshore of Guam (Pacific Islands Fisheries Science Center [PIFSC] 2009). Harvesting methods include line trolling from a moving boat, longline, and ika-shibi (nighttime fishing that uses lights as a lure; commonly used to catch squid) (Myers 1993). The general EFH for adult and juvenile pelagic fish with Fishery Management Plans (FMPs) is from the shoreline to the outer limit of the Exclusive Economic Zone (EEZ) and the water column to depths of 3,300 ft (1,000 m). The eggs and larvae also have EFH from the shoreline extending to the outer limit of the EEZ, and in the water column extending to depths of 650 ft (200 m), also known as the epipelagic zone (Western Pacific Regional Fishery Management Council [WPRFMC] 2004). Over 27 species or broad groups of fishes (e.g., oilfish family) are included in the Pacific Pelagic Management Unit, including tunas, marlins, and sharks (WPRFMC 2006). The following descriptions are of FMP species known to occur most frequently (in effect, highest fisheries catch) in waters in or near the study region.

Mahimahi are found in tropical and subtropical waters greater than 300 ft (91 m) deep worldwide. They tend to inhabit surface waters, with an optimal vertical distribution in the water column from the surface to 280 ft (85 m). This species feeds mainly on flying fish, crabs, squid, mackerel, zooplankton, and crustaceans. Mahimahi can be found in schools, spawn in the open ocean, and their eggs and larvae are pelagic (Palko et al. 1982). Mahimahi have been documented to travel over 12.5 mi (20 km) in a day (Kingsford 1999). This species is the most sought out species in the pelagic fishery (Meyers 1993). Catch data indicate the seasonal run for mahimahi offshore of Guam begins to increase in October but occurs predominantly December through May (PIFSC 2009).

Ono are found solitary or in small schools in tropical and subtropical waters between 240 and 300 ft (73 and 91 m) deep. Their diet consists primarily of squid and other fish occurring in the pelagic region (Collette et. al 1983). Because the ono is not a large schooling fish, sport-fisherman often regard it as a prize catch. Ono tend to be found in surface waters, with an optimal vertical distribution in the water column from the surface to 40 ft (12 m). Catch data indicate the seasonal run for ono offshore of Guam occurs predominantly November through April, though landings do occur throughout the year (PIFSC 2009).

The skipjack tuna is a very common offshore species residing in deep tropical waters throughout the world. This species travels in large schools in numbers up to 50,000 individuals. Skipjack tuna can travel up to 66 mi (106 km) in a day (Yuen 1970). Skipjack tuna inhabit surface waters, with an optimal vertical distribution in the water column from the surface to 850 ft (260 m). They spawn throughout the year and the eggs and larvae are pelagic. This fish is often caught using purse-seine nets due to the large schooling capability of the species. The skipjack feeds mainly on cephalopods, crustaceans, and molluscs (Collette et. al 1983). Skipjack tuna is the second most sought after fish in the pelagic fishery of Guam (Meyers 1993). Catch data indicate the seasonal run for skipjack tuna offshore of Guam increases in March, peaks in May, then steadily declines with landings occurring throughout the year (PIFSC 2009).

The yellowfin tuna is a highly migratory species found in open tropical and subtropical waters greater than 500 ft (152 m) deep. They are most abundant in surface waters, with an optimal vertical distribution in the water column from 3-656 ft (1-200 m). Individuals are known to school with other species of fish of similar size, as well as with other yellowfin tuna. Yellowfin tuna have been documented to travel up to 48 mi (77 km) in a day (Schaefer 2007). Yellowfin tuna are rarely seen near reefs as they remain most often in open water. Spawning takes place during the summer months and their eggs and larvae are pelagic. The diet of yellowfin tuna consists of squid, crustaceans, and other fish (Collette et. al. 1983). Yellowfin tuna are typically fished using surface and local trollers. They are not as commonly caught in Guam due to the low availability of surface trollers in the area. The yellowfin tuna are the foundation of the Guam-based foreign longline fishery are considered of high importance to the domestic purse seine fishery (Meyers 1993). Catch data indicate the seasonal run for yellowfin tuna offshore of Guam increases in March, peaks during June and July, then steadily declines with landings occurring throughout the year (PIFSC 2009).

Blue marlin inhabit tropical and subtropical waters typically greater than 1,200 ft (366 m) deep. There are some seasonal migratory patterns into temperate waters; however, spawning occur in tropical waters. Blue marlin can be found far out in the open ocean, and are rarely seen near land masses or islands unless there is a steep drop off nearby. They tend to inhabit surface waters, with an optimal vertical distribution in the water column from the surface to 650 ft (198 m). Their diet consists of squid, crustaceans, and cephalopods. This species can be seen in smaller schools or groups, but larger fish are usually solitary (Nakamura 1985). Some smaller individuals are caught in trolls year round, but most blue marlins in Guam are caught by charter fleets (Meyers 1993). Catch data indicate the seasonal run for marlin offshore of Guam increases in April, peaks during July, then steadily declines through November with occasional

landings occurring December through March (PIFSC 2009). Blue marlin are most abundant June through September (URS 2001).

The annual total catch of all pelagic fishes is composed primarily of the species mentioned above; however, there are other less frequently or incidentally caught species that contribute to the annual total landing. These species include the rainbow runner (*Elagatis bipinnulatus),* great barracuda (*Sphyraena barracuda*), kawakawa (*Euthynnus affinis*), dogtoothe tuna (*Gymnosarda unicolor*), sailfish (*Istiophorus platypterus*), and shortbill spearfish (*Tetrapturus angustirostris*) (WPRFMC 2007).

Bottomfish Fishery

Bottomfishing is conducted from an anchored or drifting boat by hook and line, excluding the assistance of floodlights. In Guam this is a small scale commercial and recreational fishery with most of the boats measuring less than 25 ft (7.6 m) in length and owned by local residents. Some participants in the bottom fishery may be tourists aboard large charter boats. There are two major areas of bottomfishing in Guam: the shallow water area (less than 490 ft [150 m] of water) and the deep water area (in depths of 490-820 ft [150-250 m]). Typically the shallow water area is the larger fishery due to the ease of fishing closer to shore. In the shallow water area abundant species include the red-gilled emperor (*Lethrinus rubrioperculatus*), snappers (Family *Lutjanidae)*, groupers (Family *Serranidae*), and jacks (Family *Carangidae*). The deep water species that are targeted include groupers and snappers of the genera *Pristipomoides*, *Etelis*, *Aphareus*, *Epinephelus*, and *Cephalopholis*. Bottomfish may also be some of the same species known as reef fishes, occurring farther from the reef in deep coastal waters of approximately 985 ft (300 m) (Myers 1993). Catch for both the shallow and deeper water bottomfish fisheries generally increases in April and declines in October and November (PIFSC 2009). Bottomfish are most commonly harvested by small spin casting reels for very shallow fishing efforts, and electric reels with multiple hooks per line are used in the deeper water areas.

EFH for bottomfish includes the entire water column extending from the shore to depths of 1,310 ft (400 m). EFH is broadly defined because bottomfish inhabit different habitats during various stages of their life history; eggs and larvae of bottomfish tend to be pelagic, while adults settle to a benthic habitat (WPRFMC 2006). Species with FMPs for the Bottomfish and Seamount Groundfish Fisheries include 22 species, primarily in the snapper, jack and grouper families. The following are descriptions of some commonly fished bottomfish species and groups with FMPs in Guam.

The red-gilled emperor is found in tropical waters in the Pacific Ocean. This species is not considered migratory. Red-gilled emperors are most abundant in water depths of 40-525 ft (12-160 m). The defined essential fish habitat is over sand and rubble on the outer rims of reefs. Diet for this species consists of benthic invertebrates, crustaceans, molluscs, and small fishes (Carpenter et. al 1989).

Snappers (Family *Lutjanidae*) are commonly found in tropical and subtropical regions of all oceans. The black-banded snapper (*Lutjanus semicinctus*) and the checkered snapper (*Lutjanus decussates*) are the most commonly found Lutjanids in Guam. The black-banded snapper is most abundant in water depths ranging from 33-98 ft (10-30 m). They feed mainly on smaller fish around coral reefs. This species is commonly found in small groups or as solitary individuals (Allen 1985). The checkered snapper is most abundant depths of in 7-100 ft (2-30 m). They can be found in near-shore and off-shore coral reefs in schools or individually (Allen 1985).

There are many different species of groupers (Family Serranidae) found in tropical waters. A few of the most common grouper species that are found near Guam include the lunartail grouper (*Variola louti)*, one-blotch grouper (*Epinephelus melanostigma*), blacktip grouper

(*Epinephelus fasciatus*). The lunartail, also known as the bueli in Guam, is found in tropical and subtropical waters from 13-656 ft (4-200 m). They commonly occur above coral reefs feeding on crabs, shrimps, reef fish species, and stomatopods (NMFS 2008). The one-blotch grouper can be found in water depths of 0-23 ft (0-7 m), and is common along reef flats and shallow lagoon regions (Heemstra et. al 1993). The blacktip grouper has a similar habitat to that of the lunartail grouper and occurs in water 13-525 ft (4-160 m) deep. This species is most abundant on outer reef slopes in depths of approximately 50 ft (15 m). The preferred diet of the blacktip grouper is crustaceans and other small fish (Heemstra et. al 1993).

Deeper water bottomfish species such as the green jobfish and the black jack can be found in tropical waters as deep as 1,060 ft (324 m). The green jobfish is commonly found either in groups or individually in open waters and is considered a benthopelagic species. Green jobfish feed mainly on other fish, cephalopods, shrimp, and crabs (Allen 1985). Black jack are found in sub-tropical waters including regions around the equator. They are also considered a benthopelagic species and their eggs and larvae are found in the pelagic region of the ocean. The optimal depth range for the black jack is 40-1,060 ft (12-324 m), and they are occasionally seen along the outer boundaries of reefs. The diet of the black jack fish consists primarily of other fish (Paxton et. al 1989).

Coral Reef Fish Fishery

The coral habitats surrounding Guam consist of fringing reefs, patch reefs, submerged reefs, shallow offshore banks, barrier reefs, and lagoon habitats. The combined area of coral reef and lagoon is approximately 69 km^2 in nearshore waters between 0-3 nm, and an additional 110 km^2 in federal waters greater than 3 nm offshore (Hunter 1995). Approximately 270 species of hard corals provide habitat to sustain a coral reef fishery of approximately 1,000 species (Birkeland et al. 2000). Annual Guam coral mass spawning usually take place at night, following a summer full moon in June, July, or August. During this time period, critical life history stages such as fertilization, larval competency, and settlement or metamorphosis occur. Common reef fish include parrotfishes (Family *Scaridae*), surgeonfish (Family *Acanthuridae*), wrasses (Family *Labridae*), and groupers (Family *Serranidae*). Parrotfish are typically found in reef flats, lagoons, and along upper edges of outer channel or seaward reef slopes. Surgeonfish occur along the seaward reef margin, outer reef flats, the upper edge of lagoon reefs, and in areas of shallow clear water that receive some wave action. Juvenile wrasses live in coral-rich areas of shallow lagoon reefs then move off of the reef flats into deeper water along reef slopes as adults. Groupers inhabit a variety of reef habitats ranging from shallow reef flats to deep lagoons and the outer reef slope (Guam Division of Aquatic and Wildlife Resources 2009). Reef fish are harvested by hook and line, spears, and nets. The majority of the fishery in Guam is shore-based, but the portion that includes the use of boats will be considered in this document, as the project area is located offshore.

Most coral reef fish species have large amounts of diversity within the family of fish. One unifying characteristic is that they are all tropical species which can be found in shallow reef areas. Therefore, the essential fish habitat includes the water column and all the benthic substrate to a depth of approximately 295 ft (90 m) from the shoreline to the outer limit of the EEZ (WPRFMC 2004). The following are descriptions of coral reef fish with FMPs that are known to occur in Guam.

Parrotfish are found in tropical waters in depths of 0-165 ft (0-50 m). Adults can be found in larger schools with fish of similar size, but juveniles are usually solitary. Adults prefer the outer regions of reefs for habitat, while the preferred habitat of juveniles is within protected shallow reefs. Parrotfish are herbivorous grazers who eat algae and coral polyps (Parenti and Randall 2000).

Surgeonfish are reef-associated species found in tropical waters. The most common species is the elongate surgeonfish (*Acanthurus mata*). The optimal depth range is from 16-330 ft (5-100 m) and the preferred habitat is around steep slopes or rocky bottoms near reefs. The adults are typically seen in schools. They feed mainly on mid-water column plankton and zooplankton (Randall 1987).

The blue streak cleaner wrasse (*Labroides dimidiatus*) is a common wrasse species found in tropical waters in depths ranging from 0-130 ft (0-40 m). This species is found in coral rich areas. Diet of the blue streak cleaner wrasse consists of crustaceans and parasites found on other fish (Randall et al. 1990).

Many coral reef organisms, including reef fish, corals, other invertebrates and algae tend to have pelagic egg, larval, or juvenile stages (Galarza et al. 2009). The capacity of reef organisms to disperse between reefs is affected by multiple factors including, distance and ocean currents, as well as a wide range of biological factors. The ability for these organisms during their pelagic life stages to disperse and recruit onto coral reefs at some distances from their native reef is called connectivity (The Nature Conservancy 2008). Recent studies have suggested that although an individual organism in its pelagic life stage may travel significant distances, recruitment of these individuals does not have a large ecological effect on a population; rather, most individuals settle in close proximity to their native reef (Almany et al. 2007, Jones et al. 2007, Jones et al. 2005, Palumbi 2003, Barber et al. 2002, and Bradbury and Snelgrove 2001). Both Almany et al. (2007) and Jones et al. (2005) indicate a high percentage (up to 60%) of self-recruitment to native reef habitat occurs on small scales (less than about 1,000 ft [300 m]) for species that have long larval durations. The revelation that coral reef ecosystems rely on self-recruitment from native organisms is substantiated in recent genetic testing of individuals from separate reefs. Genetic analyses have shown connectivity of extreme dispersal distances (hundreds to thousands of kilometers) is atypical and genetic differences may be apparent in populations separated by as little as 0.3 mi (0.5 km) (Palumbi 2003 and Barber et al. 2002). Connectivity is often considered when designing and managing marine reserves effectively. Shanks et al. (2003) suggest that for the effective management of coral reef organisms, marine reserves need to be established approximately 12.4 mi (20 km) apart and be approximately 2.5 – 3.7 mi (4 – 6 km) in size; this would allow for recruitment of individuals with larger dispersal distances or self-recruitment of individuals with shorter dispersal distances, respectively.

Marine Invertebrate Fishery

The marine invertebrates that comprise the fishery in Guam include crustaceans, cephalopods, echinoderms, and shelled molluscs. The major focus of the marine invertebrate fishery around Guam is crustaceans (lobsters and crabs), and thus crustaceans the focus of this section. The most common and sought after species include the green spiny lobster (*Panulirus penicillatus)* and slipper lobster (Family *Scyllaridae)*. Eggs and larvae are dispersed in the water column to depths of 490 ft (150 m) from the shoreline to the outer limit of the EEZ (WPRFMC 2004). The method of collection for the majority of the marine invertebrates is by spears or hand, and is generally done by reef gleaners without the assistance of boats (Myers 1993). At this time there is not a substantial crustacean fishery in waters surrounding Guam, so EFH has not been designated for this region (WPRFMC 1995 [Amendment 9]).

3.2.4 Marine Birds

The ROI for marine birds is the general region of Guam, which includes the ODMDS study areas, the Island of Guam, and the offshore area between them. Birds that live in association with marine habitats fall into three main groups: shorebirds (such as plovers, sandpipers), water birds (such as ducks, cormorants, and loons) and seabirds (such as albatross, petrels, puffins, penguins, frigate birds and boobies). Seabirds are those species that obtain most of their food from the ocean and are found over water for more than half of the year.

All marine birds that occur in the project area are protected under the (MBTA and EO 13186, which directs Federal agencies to avoid or minimize negative effects on migratory birds, protect their habitats, and consider effects on migratory birds in NEPA documents. None of the bird species are federally listed as threatened or endangered, but there is concern that several are declining in number to dangerous levels. A total of 27 seabird species have been recorded in Guam's marine habitats, most of which are visitors migrating to or from more permanent home locations. During the last century, most resident pelagic seabirds have decreased in numbers (e.g., brown noddies and white terns) or have been lost entirely (e.g., brown boobies). Extensive predation by non-native brown tree snakes (*Boiga irregularis*) since the 1950s is one of the major causes of these avifauna population declines (Wiles 2003). In response to predation nesting by brown noddies and white terns, both common residents of Guam, is now largely constrained to offshore locations that are free of snakes, including Cocos Island, smaller islets and rocks. The Brown Treesnake Control Program was established in Guam to work towards eradication of this invasive predator (U.S. Department of Defense 2008).

A comprehensive checklist of birds associated with marine habitats on Guam is presented in Table 3-18 (Wiles 2003). The distribution, abundance, and ecology of ten key species is described in this section as representative of the range of natural history patterns that occur within the ODMDS study region. Because of the importance of Guam to many marine bird species, one or more of the following criteria were used to select key species:

- Species that have offshore waters habitats
- Species that are common residents or common visitors to Guam
- Species that are rare visitors, Guam only

Based on these criteria, the following 10 species were selected: short-tailed shearwater (*Puffinus tenuirostris*), brown noddy (*Anous stolidus*), black noddy (*Anous minutus*), white tern (*Gygis alba*), wedge-tailed shearwater (*Puffinus pacificus*), brown booby (*Sula leucogaster*), red-footed booby (*Sula sula*), great crested tern (*Thalasseus bergii*), streaked shearwater (*Calonectris leucomelas*), and black-naped tern (*Sterna sumatrana*). Additionally, the Matsudaira's storm-petrel (*Oceanodroma matsudaira*) was positively identified during sampling for this study and therefore is highlighted in this section.

Table 3-18. Birds Associated with Marine Habitats on Guam

Common Name	Taxon, Scientific Name	Status, Habitat, Range, Other Notes
DIOMEDEIDAE		
Albatross	*Phoebastria* sp.	RV, OW
PROCELLARIIDAE		
Tahiti Petrel	*Pterodroma rostrata* (Peale, 1848)	RV-1, OW, G
Juan Fernandez Petrel	*Pterodroma externa* (Salvin, 1875)	RV-1, OW, G
Streaked Shearwater	*Calonectris leucomelas* (Temminick, 1835)	RV, OW, G
Wedge-tailed Shearwater	*Puffinus pacificus* (Gmelin, 1789)	UV, may have nested on Guam before 1930, OW, SNM
Short-tailed Shearwater	*Puffinus tenuirostris* (Temminick, 1835)	CV, migrates northward past Guam in large numbers during May, OW, SM
Townsend's Shearwater	*Puffinus auricularis* (Townsend, 1890)	RV, OW, SM, all records have been of the subspecies *P. a. newelli* (Henshaw, 1900)
Audubon's Shearwater	*Puffinus lherminieri* (Lesson, 1839)	RV, OW, SM
HYDROBATIDAE		
Leach's Storm-Petrel	*Oceanodroma leucorhoa* (Vieillot, 1818)	RV-1, OW, SM
Matsudaira's Storm-Petrel	*Oceanodroma matsudaira* (Kuroda, 1922)	RV, all records are from Feb to Sept, OW, SNM
PHAETHONTIDAE		
White-tailed Tropicbird	*Phaethon lepturus* (Daudin, 1802)	RV, nested on Guam until approximately 1982, OWL, SNM
Red-tailed Tropicbird	*Phaethon rubricauda* (Boddaert, 1783)	RV, OWL, SNM
SULIDAE		
Masked Booby	*Sula dactylatra* (Lesson, 1831)	RV, OW, SNM
Brown Booby	*Sula leucogaster* (Boddaert, 1783)	UV, nested on Guam until late 1970s, OW and LG, a few birds still regularly roost on Orote Is., SNM
Red-footed Booby	*Sula sula* (Linnaeus, 1766)	UV, OW, SNM
PHALACROCORACIDAE		
Cormorant	*Phalacrocorax* sp.	RV-1, seen flying over inner Apra Harbor
FREGATIDAE		
Great Frigatebird	*Fregata minor* (Gmelin, 1789)	RV, OWL and LG, SNM
Lesser Frigatebird	*Fregata ariel* (Gray, 1845)	one possible record only, OW, SNM
ARDEIDAE		
Yellow Bittern	*Ixobrychus sinensis* (Gmelin, 1789)	CR, most common in IH, but also nests on offshore islets and feeds occasionally on shallow reef flats and in MG, SM
Great Egret	*Ardea alba* (Linnaeus, 1758)	RV, most common in FW, but feeds occasionally on reef flats, SM
Little Egret	*Egretta garzetta* (Linnaeus, 1766)	RV, most common in FW, but feeds occasionally on reef flats, SNM
Pacific Reef-Egret	*Egretta sacra (Gmelin, 1789)*	UR, forages on BRF and in MG, nests on Cocos Is. and offshore islets, SNM
Black-crowned Night-Heron	*Nycticorax nycticorax* (Linnaeus, 1758)	RV-1, MG, SM
ANATIDAE		
Eurasian Wigeon	*Anas penelope* (Linnaeus, 1758)	RV, most common in FW, but occurs rarely on reef flats, SNM
Northern Shoveler	*Anas clypeata* (Linnaeus, 1758)	RV, most common in FW, but occurs rarely on reef flats, SNM
Northern Pintail	*Anas acuta* (Linnaeus, 1758)	UV, most common in FW, but occurs rarely on reef flats, SNM
Surf Scoter	*Melanitta perspicillata* (Linnaeus, 1758)	RV-1, OW, G

Common Name	Taxon, Scientific Name	Status, Habitat, Range, Other Notes
CHARADRIIDAE		
Black-bellied Plover	*Pluvialis squatarola* (Linnaeus, 1758)	RV, BFR and IH, SM
Pacific Golden-Plover	*Pluvialis fulva* (Gmelin, 1789)	CV, BRF, MG and IH, SNM
Mongolian Plover	*Charadrius mongolus* (Pallas, 1776)	UV, most common on BRF, but also occurs in MG and IH, SNM
Greater Sand-Plover	*Charadrius leschenaultii* (Lesson, 1826)	RV, BRF, SM
Snowy Plover	*Charadrius alexandrinus* (Linnaeus, 1758)	RV, BRF and IH, SM
Common Ringed Plover	*Charadrius hiaticula* (Linnaeus, 1758)	RV, BRF and IH, SM
Little Ringed Plover	*Charadrius dubius* (Scopoli, 1786)	RV, BRF, G
HAEMATOPODIDAE		
Eurasian Oystercatcher	*Haematopus ostralegus* (Linnaeus, 1758)	RV-1, BRF and IH, G
RECURVIROSTRIDAE		
Black-winged Stilt	*Himantopus himantopus* (Linnaeus, 1758)	RV, most common in FW, but occurs rarely in MG, SM
SCOLOPACIDAE		
Common Greenshank	*Tringa nebularia* (Gunnerus, 1767)	RV, most common in FW, but occurs occasionally on BRF, SNM
Nordmann's Greenshank	*Tringa guttifer* (Nordmann, 1835)	one possible record only, BRF, G
Marsh Sandpiper	*Tringa stagnatilis* (Bechstein, 1803)	RV, most common in FW, but occurs occasionally on BRF, SM
Common Redshank	*Tringa totanus* (Linnaeus, 1758)	RV, BRF and FW, SNM
Spotted Redshank	*Tringa erythropus* (Pallas, 1764)	two possible records, BRF, G
Wood Sandpiper	*Tringa glareola* (Linnaeus, 1758)	UV, most common in FW, but occurs rarely on BRF and in MG, SNM
Wandering Tattler	*Heteroscelus incanus* (Gmelin, 1789)	UV, most common on BRF, but also occurs in MG and FW, SNM
Gray-tailed Tattler	*Heteroscelus brevipes* (Vieillot, 1816)	CV, most common on BRF, but also occurs in MG and FW, SNM
Common Sandpiper	*Actitis hypoleucos* (Linnaeus, 1758)	UV, BRF, MG and FW, SNM
Terek Sandpiper	*Xenus cinereus* (Güldenstädt, 1775)	RV, BRF, SNM
Little Curlew	*Numenius minutus* (Gould, 1841)	RV-1, BRF, SM
Whimbrel	*Numenius phaeopus* (Linnaeus, 1758)	CV, BRF, MG and IH, SNM
Bristle-thighed Curlew	*Numenius tahitiensis* (Gmelin, 1789)	RV, BRF, SNM
Far Eastern Curlew	*Numenius madagascariensis* (Linnaeus, 1766)	RV, BRF and MG, SM
Eurasian Curlew	*Numenius arquata* (Linnaeus, 1758)	RV, MG and IH, SM
Black-tailed Godwit	*Limosa limosa* (Linnaeus, 1758)	RV, most common on BRF, but also occurs in IH, SM
Bar-tailed Godwit	*Limosa lapponica* (Linnaeus, 1758)	RV, most common on BRF, but also occurs in MG and IH, SM
Ruddy Turnstone	*Arenaria interpres* (Linnaeus, 1758)	CV, BRF, MG and IH, SNM
Great Knot	*Calidris tenuirostris* (Horsfield, 1821)	RV, BRF, SM
Red Knot	*Calidris canutus* (Linnaeus, 1758)	RV, BRF and FW, G
Sanderling	*Calidris alba* (Pallas, 1764)	RV, most common on BRF, but also occurs in MG and IH, SM
Red-necked Stint	*Calidris ruficollis* (Pallas, 1776)	UV, most common on BRF, but also occurs in IH, SM
Long-toed Stint	*Calidris subminuta* (Middendorff, 1853)	RV, most common in IH, but also occurs occasionally on BRF, SM
Pectoral Sandpiper	*Calidris melanotos* (Vieillot, 1819)	RV, BRF and IH, SM
Sharp-tailed Sandpiper	*Calidris acuminata* (Horsfield, 1821)	RV, BRF and IH, but also occurs occasionally in MG, SNM

Common Name	Taxon, Scientific Name	Status, Habitat, Range, Other Notes
Dunlin	*Calidris alpina* (Linnaeus, 1758)	RV, BRF and FW, SM
Curlew Sandpiper	*Calidris ferruginea* (Pontoppidan, 1763)	RV, BRF and FW, G
Ruff	*Philomachus pugnax* (Linnaeus, 1758)	RV, most common in IH, but also occurs occasionally on BRF, SM
Swinhoe's Snipe	*Gallinago megala* (Swinhoe, 1861)	RV, most common in IH, but also occurs rarely in MG, SM
LARIDAE		
Black-headed Gull	*Larus ridibundus* (Linnaeus, 1766)	RV, most common on BRF, but also occurs occasionally in IH, SM
Slaty-backed Gull	*Larus schistisagus* (Stejneger, 1884)	RV-1, BRF, G
Gull-billed Tern	*Sterna nilotica* (Gmelin, 1789)	RV, BRF and IH, SM
Great Crested Tern	*Thalasseus bergii* (Lichtenstein, 1823)	UV, OW, SM
Common Tern	*Sterna hirundo* (Linnaeus, 1758)	RV, Apra Harbor and OW, SNM
Black-naped Tern	*Sterna sumatrana* (Raffles, 1822)	RV, LG and OW, G
Little Tern	*Sterna albifrons* (Pallas, 1764)	RV, BRF and FW, SM
Sooty Tern	*Sterna fuscata* (Linnaeus, 1766)	RV, OWL, SNM
White-winged Tern	*Chlidonias leucopterus* (Temminck, 1815)	RV, most common in IH, but occurs occasionally on BRF, SM
Brown Noddy	*Anous stolidus* (Linnaeus, 1758)	CR, Apra Harbor, OWL, and offshore islets and rocks, SNM
Black Noddy	*Anous minutus* (Boie, 1844)	CV, OW and Cocos Is., SNM
White Tern	*Gygis alba* (Sparrman, 1786)	CR, OWL and LG, nests on Cocos Is. and at a few inland sites, SNM
COLUMBIDAE		
Island Collared-Dove	*Streptopelia bitorquata* (Temminck, 1810)	CR, I, most common in IH, but occasionally nests in MG and feeds on beaches, SM
Mariana Fruit-Dove	*Ptilinopus roseicapilla* (Lesson, 1831)	EX, was most common in IH, but also occurred in MG, SM
MELIPHAGIDAE		
Micronesian Honeyeater	*Myzomela rubratra* (Lesson, 1827)	EX, was most common in IH, but also occurred in MG, SNM
MONARCHIDAE		
Guam Flycatcher	*Myiagra freycineti* (Oustalet, 1881)	EXT, was most common in IH, but also occurred in MG, G
Rufous Fantail	*Rhipidura rufifrons* (Latham, 1801)	EX, was most common on IH, but also occurred in MG, SM

Table Adapted From Wiles 2003

Status:
RV = rare visitor
RV-1 = rare visitor with only one record from Guam
UV = uncommon visitor
CV = common visitor
UR = uncommon resident
CR = common resident
I = introduced
EX = extirpated
EXT = extinct

Habitat:
BRF = beaches, rocky shorelines, and shallow or exposed reef flats
FW = freshwater habitats
IH = inland habitats
LG = lagoons
MG = mangroves
OW = offshore waters
OWL = offshore waters and over land

Documented distribution in the Marianas Islands:
G = Guam only
SM = southern Marianas (Rota to Faralon de Medinilla)
SNM = southern and northern Marianas

Short-tailed Shearwater

The short-tailed shearwater (*Puffinus tenuirostris*) is a member of a group of medium to large seabirds, which is believed to be one of the few bird families with a well-developed sense of smell. The wedge-tailed and streaked shearwater highlighted in this study are members of the same family. The common name, shearwater, is an apt reference to their graceful shearing flight, moving from centimeters above the water's surface to high in the sky. In Australia, they are known as the mutton bird because it is one of the few native birds that are commercially harvested for meat and oil. Short-tailed shearwaters are trans-equatorial migrants that breed in southeastern Australian and Tasmanian waters and migrate to northern North Pacific latitudes for wintering. Individuals have been known to fly 9,300 mi (15,000 km) in one trip over as small as a six week time period, and as a result, exhausted and starved birds are often washed up on the shores of Japan, the Aleutian Islands, North America and Australia. The Short-tailed shearwater is considered a common visitor of Guam as it migrates northward in large numbers during the months of April and May. It can be found in open water habitats and has been documented in the southern Marianas Islands, Rota to Farallon de Medinilla (Wiles 2003). The total population is presently estimated at approximately 23 million.

The short-tailed shearwater is completely dark brown in plumage, with occasional traces of white in the center of its upper wings. Their body length is 16-17 inches (40-43 cm), and physical features include a dark, short bill, rounded tail and dark grey, webbed feet that trail slightly behind when in flight. With a wing span of approximately 3.3 ft (1 m), the birds can fly up to 40 knots (75 kph). They are pursuit-plungers and feed on krill, squid and fish. The average lifespan is 15-19 years and individual birds have the same breeding partner each season (Spear 2007).

Massive breeding colonies are established annually off the southern and south-eastern coasts of Australia from September to May. Short-tailed shearwaters, like all other petrels, lay only one egg per season in soft sandy burrows. Males take the first incubation shift of 12-14 days while the female leaves to feed. These behaviors continue back and forth between the male and female until the young chick hatches. Incubation periods average 53 days. The adults depart early April, leaving behind the young birds. Two to three weeks later, the young birds begin their migratory flight unassisted by experienced birds (Spear 2007).

Brown Noddy

The brown noddy or common noddy (*Anous stolidus*) is a tropical seabird from the tern family. *Anous* is Greek for "unmindful" while *stolidus* means "impassive" in Latin. To sailors, they were well known for their apparent indifference to hunters or predators. These birds are often unwary and find safety in enormous numbers. It is one of three species of dark noddies worldwide, along with lesser (*Anous tenuirostris*) and black (*Anous minutus*) noddies, all characterized by a dark body with a white cap, the reverse plumage pattern of most terns. The dark noddies are the only marine terns that build substantial nests, and along with the closely related white tern (*Gygis alba*) they are the only tree- and shrub-nesting species in the family Laridae. Noddies exhibit several behaviors that are more characteristic of gulls than of other terns, including feeding chicks by regurgitation. The brown noddy is the largest of the noddies, and is considered a common resident of Guam, particularly Apra Harbor and the southern and northern Marianas Islands (Wiles 2003). Its habitat consists of open water, over land, and offshore islets and rocks. The name noddy comes from the male's habit of bobbing his head at a female when it is time to mate. The brown noddy typically breeds in the Atlantic and Pacific Oceans within 30 degrees of the equator. The non-breeding range includes worldwide distribution, ranging from Hawaii to the Tuamotu Archipelago and Australia in the Pacific Ocean, from the Red Sea to the Seychelles and Australia in the Indian Ocean and in the Caribbean to

Tristan da Cunha in the Atlantic Ocean. An estimate of the worldwide population is 500,000 to 1,000,000 pairs of birds (Enticott 1997).

The brown noddy is a medium-sized seabird with very dark brown plumage, an ashy-white forehead, slender wings, a long, narrow, wedge-shaped tail, dark legs/feet and a dark, slender, pointed bill. Adults are sexually monomorphic, while juvenile noddies have a more restricted white cap on the forehead than adults. Brown noddy body lengths range from 16-18 inches (40-45 cm) with a wingspan of 31-34 inches (79-86 cm) and an average life span of 25 years. Brown noddies vocalize with a low-pitched guttural call at nest and in flight. They feed on surface fish and squid often found in association with tuna or other predatory fish schools, catching them by surface-seizing, dipping or plunge diving. They are often observed feeding in mixed species flocks (Enticott 1997).

The brown noddy utilizes a wide variety of nesting locations, including the ground, trees, shrubs, cliffs and human-made structures. A single egg is laid and incubates for 33-36 days by both parents. Incubation shift lengths vary between geographical locations, and chicks fledge between 40-56 days after hatching (Enticott 1997).

Black Noddy

The black noddy (*Anous minutus*), also known as the Hawaiian or white-capped noddy, is a medium-sized, abundant, and gregarious tern that often nests, roosts, and forages in densely packed groups. It resembles the closely-related brown noddy (*Anous stolidus*), but is smaller with darker plumage, a whiter cap, a longer, straighter beak and shorter tail. The black noddy has a worldwide distribution in tropical and subtropical seas, with colonies widespread in the Pacific Ocean and more scattered across the Caribbean, central Atlantic and in the northeast Indian Ocean. They nest on numerous islands throughout the Pacific Ocean (including the Hawaiian archipelago), on a few additional islands in the Atlantic Ocean and at Ashmore Reef (Australia) in the Indian Ocean. On several islands they are the most numerous seabirds and the copious guano produced by their large populations may alter both the island vegetation structure and the coral reef ecosystem in the surrounding ocean. The black noddy is considered a common visitor of the open water habitats of Guam, particularly Cocos Island, and has documented distribution in the southern and northern Marianas Islands (Wiles 2003). Worldwide population of Black Noddies is estimated at 1 to 1.5 million breeding pairs.

The Black Noddy has black to brown plumage, a white cap, white lower half-eye ring, black legs and feet, and a long, straight, thin, and pointed black bill which is slightly decurved. They measure 14-15 inches (35-39 cm) in length with a wingspan of 26-28 inches (66-72 cm) and an average life span of 16-18 years. Individuals have slender wings and a wedge-shaped tail. Black noddies have a swift flight pattern with rapid wing beats usually placing them direct and low over the ocean, and they rarely soar high. They generally forage in nearshore waters and feed by dipping the surface from the wing or by making shallow dives. Black noddies are often seen feeding in large, mixed species flocks associated with schools of large predatory fishes which drive small fish and invertebrates to the surface.

Established pairs nest in large, dense colonies and return to the same nest site yearly. Breeding is highly variable and egg laying occurs year-round. One speckled egg is laid each season in nests often created in the branches of trees by a series of dried leaves covered with bird droppings. Both the male and the female incubate the egg for 36 days in shifts averaging about one half day. Chicks are brooded for several days after hatching with feedings approximately once every 11 hours. Black noddies are unusual among seabirds in that a pair can raise two broods in the same nesting season. Both parents feed the chick regurgitated fish or whole fish as they get older. Fledging occurs approximately 36 days after hatching and Post-fledging feeding continues for several weeks.

White Tern

The white tern (*Gygis alba*) is a small seabird known for laying its eggs on bare, thin branches in a small fork or depression without a nest. This balancing act is a predator-avoidance behavior, as the branches they choose are too small for rats or even small lizards to climb. The distribution of white terns ranges widely across the Pacific and Indian Oceans, and includes some Atlantic islands. It nests on coral islands, usually on trees with thin branches, but is also known to nest on rocky ledges and man-made structures. The white tern is considered a common resident of the open water and lagoon habitats of Guam, and has documented distribution in the southern and northern Marianas Islands (Wiles 2003). They are known to nest on Cocos Island, located 1.0 mi (1.6 km) off the southern tip of Guam.

The white tern has all white plumage with black eye-rings, creating the appearance of large eyes. The long, pointed, thick bill is mostly black with some blue at the base. They have a shallow, notched tail, slate-blue legs and feet with yellow or white webs. Sexually monomorphic adults measure 11-13 inches (28-33 cm) in length, with a wingspan of 28-34 inches (70-87 cm), and an average lifespan of 16 to 18 years. The White Tern feeds alone or in mixed species flocks, primarily on juvenile or smaller fish which it catches by plunge diving (Gaston 2004).

Peak breeding activity takes place in late spring and summer. Both parents incubate the single speckled egg for 36 days in shifts of 48-72 hours. The newly hatched chicks have well developed feet to hang on to their precarious nesting site in high winds. The brooded chick is fed only whole fish or squid, unlike many other seabird chicks that receive regurgitated food. Chicks average 48 days from hatching to fledging. After fledging, the parents continue to feed the young bird for up to two months (Enticott 1997).

Wedge-tailed Shearwater

The wedge-tailed shearwater (*Puffinus pacificus*) is the largest of the shearwaters and ranges across the tropical Pacific and Indian Ocean roughly between latitudes 35°N and 35°S. The species' common name is derived from its large wedge-shaped tail which aids in gliding. It breeds in islands off Japan, the Islas Revillagigedo, the Hawaiian Islands, the Seychelles and off Western Australia. Because of its unique vocalizations (loud groans, moans and wails), which primarily occur at night in breeding colonies, the wedge-tailed shearwater is sometimes referred to as the "moaning bird". This species is considered an uncommon visitor to Guam and has documented distribution in the southern and northern Marianas Islands (Wiles 2003). Its habitat consists of strictly open water, and it is thought to have nested on Guam before the 1930s. The total population is presently estimated at approximately 5 million (Wiles 2003).

Two color morphs of wedge-tailed shearwaters exist in all populations and bear no relation to sex or breeding conditions. The pale morphs predominate in the North Pacific while the dark morph is found elsewhere. The darker morph has the same dark grey-brown plumage over the whole body, while the pale morph has grey-brown plumage on the back, head and upper wing, and whiter plumage below. Both morphs have a characteristic wedge-shaped tail, and a slender, slate-grey hooked bill. Its flesh colored legs and feet are set far back on the body as an adaptation for swimming. Sexually monomorphic adults measure 16-18 inches (41-46 cm) in length with a wingspan of 38-41 inches (97-104 cm), and an average life span of 10-11 years. Wedge-tailed shearwaters feed on small fish and squid driven to the surface by schools of large predatory fish. They feed during the day singly or in multi-species flocks (Enticott 1997).

Monogamous wedge-tailed shearwaters nest either in burrows or on covered surfaces of small tropical and subtropical islands in the Indian and Pacific Oceans. Bird colonies in the northern hemisphere begin breeding around February, while southern hemisphere birds begin around September. After the single large white egg is laid, the male usually undertakes the first incubation shift that can last up to 13 days. Hatching occurs after a 53 day incubation period

followed by a six day brooding period. Parent desertion of the chick typically occurs shortly before fledging, 103-115 days after hatching (Enticott 1997).

Brown Booby

The brown booby (*Sula leucogaster*) is a large seabird of the gannet family, Sulidae. Boobies received their name because they can be easily caught while asleep. This species breeds on islands and coasts in the pantropical areas of the Atlantic and Pacific oceans. It winters at sea over a wider area. The brown booby nested on Guam until the late 1970s and is now considered an uncommon visitor with documented distribution in the southern and northern Marianas Islands (Wiles 2003). Its habitat consists of open water as well as lagoons. A few birds still roost on Orote Island in Guam.

The Brown Booby's head and upper body are covered in dark brown plumage, with the remainder of the body being a contrasting white. Sexes are distinguishable by face, bill, and leg color. These body parts are yellow in females and grayish-green in males, which in addition, have a bluish throat. Juveniles are similar to adults but with paler plumage and a pale, dirty grey undersurface. The beaks of the brown booby are quite sharp and contain many jagged edges. They have short wings and long, tapered tails. Brown boobies reach 28-30 inches (71-76 cm) in length, have a wingspan of 54-57 inches (137-145 cm), and a life span of 16 years. This species feeds by plunging head first into the ocean at high speed. They are strictly solitary, daytime feeders of small fish or squid which gather in groups near the surface and may catch leaping fish while skimming (Lopez-Ortiz 2009).

The brown booby is the only ground-nesting booby that regularly builds a substantial nest during its breeding season, which occurs between March and November. These birds nest in large colonies, laying two chalky blue eggs on a mound of broken shells and vegetation on the ground. They lack a brood patch and instead incubate the eggs for 43 days using their feet. Parents share incubation shifts of 12 hours. The first chick hatches several days before the second, and ejects its sibling from the nest shortly after hatching. Fledging occurs 85-103 days after hatching while parental care and feeding continues for one to two months (Gaston 2004).

Red-footed Booby

The red-footed booby (*Sula sula*) is the smallest of the booby species and the only one that lives in trees (Lopez-Ortiz 2009). Red-footed boobies, also known as white-tailed or Webster's boobies, are large, powerful, and agile fliers that can travel up to 93 mi (150 km) in search of food. In contrast, they are clumsy in takeoffs and landings. This species breeds on islands in most tropical oceans. They do not migrate, but live year-round in tropical and subtropical regions of the Atlantic, Pacific, and Indian Oceans. The red-footed booby is considered an uncommon visitor in the open water habitats of Guam with documented distribution in the southern and northern Marianas Islands (Wiles 2003).

Red-footed boobies are polymorphic and as the name implies, have red legs and feet with a pale blue bill (Enticott 1997). This species has two plumage forms that may occur sympatrically. The white phase is mostly white with black on the flight feathers. The brown form is brown with a white belly, rump, and tail. Adults are sexually monomorphic while juveniles are wholly brown or blackish gray with a black bill. The red-footed booby is 26-30 inches (66-77 cm) in length with a wingspan of 36-40 inches (91-101 cm), and an average life span of 22 years. They are spectacular divers, plunging into the ocean at high speeds to catch prey. They mainly eat small fish or squid which gather in groups near the ocean surface. They hunt singly, in large groups or in flocks of mixed species. Although active during the day, prime feeding time for this species is at night, which is aided by large eyes (Lopez-Ortiz 2009).

These gregarious birds nest in large colonies late January through September, laying one chalky blue egg every 15 months in nests made of twigs and sticks on tops of shrubs or trees. Monogamous adults incubate the egg with their feet, in 24 hour shifts for 42-45 days. Young mature slowly over three month period and fledge 95-101 days after hatching. Post-fledging care and feeding can continue for one to four months.

Great Crested Tern

The great crested tern (*Thalasseus bergii*), was originally described as *Sterna bergii* in 1823, but was recently reclassified to its current genus *Thalasseus* (Bridge et al. 2005). It is considered an uncommon visitor in the open water habitats of Guam with documented distribution in the southern Marianas, Rota to Farallon de Medinilla (Wiles 2003). They are found the tropics and subtropics from South Africa around the Indian Ocean to the western Pacific Ocean and Australia.

The great crested tern is a large tern, 18-19 inches (45-48 cm) long with a 39 in (100 cm) wingspan. Although sexually monomorphic, this species exhibits seasonal variation. The summer adult has a black cap with a long crest, a narrow white forehead band, black legs and a long sharp yellow-orange bill. The back and upper wings are medium grey with a paler rump, while the underparts are white. The primary flight feathers of the great crested tern darken during the summer. In winter, the head becomes more extensively white and the crest is peppered with white. Juvenile birds have heavily marked upperparts and wings, with patterning of brown, white and some grey. The closed wings in particular appear to have dark bars. The head and underparts are similar to the winter adult. Like all terns of the same genus, the greater crested tern feeds by directly plunge diving for fish (Gaston 2004).

The greater crested tern breeds in dense colonies on coasts and protected islands between October and December. One or two eggs are laid in nests constructed as shallow scrapes in bare sand, rock or coral, usually on open flat ground. After a 28-day incubation by both sexes, chicks remain in the nest for about four days, and fledge within two months. Fledglings leave the breeding colony with at least one parent within 19 days (Enticott 1997).

Streaked Shearwater

The streaked shearwater (*Calonectris leucomelas*) also known as the white-faced shearwater, is a pelagic seabird that also occurs in inshore waters. This species is considered a rare visitor in the open water habitats of Guam and has not been documented in any of the other Marianas Islands (Wiles 2003). The streaked shearwater occurs in the Pacific Ocean, with breeding stations in Japan and South Korea. After breeding, it moves south and winters in the Philippine and Indonesian seas and around New Guinea.

The Streaked Shearwater is large with scaled, dark gray-brown upperparts and white underparts. The white head has variable light to heavy pale brown streaks while the uppertail coverts can be white, forming a pale "horseshoe". With a pale bill and pink legs and feet, the streaked shearwater measures 19 in (48 cm) in size with a 48 in (122 cm) wingspan. This species can be found as part of large mixed species feeding aggregations, surface-seizing or shallow plunging for fish and squid (Enticott 1997).

Streaked shearwaters nest in dense breeding colonies on forested islands from March to November. One to two eggs are laid in ground burrows and incubated for 55-64 days. Adults remain with their chick for four days on average after hatching. Chicks fledge 66-80 days after hatching (Enticott 1997).

Black-naped Tern

The black-naped tern (*Sterna sumatrana*) is a small, oceanic tern with a tropical and subtropical distribution, breeding from Aldabra Atoll, Seychelles in the western Indian Ocean to Fiji, Samoa in the Pacific Ocean. This gregarious bird often flocks with other terns along sandy and coral beaches, rarely over mud, and never far inland. The black-naped tern is considered a rare visitor in the open water and lagoon habitats of Guam and has not been documented in any of the other Marianas Islands (Wiles 2003).

The black-naped tern is characterized by very white plumage with a distinctive black nape band and narrow bill. Upperparts are pale gray with a white head and a black spot in front of its eye. This tern is approximately 12 in (30 cm) in length with a wing span of 8-9 in (21-23 cm). Juveniles have a grayish brown nape and rounded unforked tail (Gaston 2004).

The black-naped tern nests in shallow depressions on the rocky surface of small outcrops. They breed during spring and summer, laying one to two eggs. Incubation by both parents lasts for 21 to 23 days. Chicks fledge in slightly less than one month and depart accompanied by both parents (Gaston 2004).

Matsudaira's Storm-Petrel

The Matsudaira's storm-petrel (*Oceanodroma matsudaira*) was positively identified at station 2 during sample collection for this study. This species is considered a rare visitor in the open water habitats of Guam from February to September, and has been documented to occur in the southern and northern Marianas Islands (Wiles 2003). The Matsudaira's storm-petrel is a pelagic species that breeds in subtropical waters of the western Pacific. It leaves these waters in June and migrates through the Indonesian archipelago, passing through northwest Australia and Papua New Guinea, to spend the non-breeding season in the tropical Indian Ocean.

The Matsudaira's storm-petrel is 9.8 inches (25 cm) in height, with sooty-brown plumage and diagnostic white primary shafts. It has a forked tail, black legs/feet/bill and long angular wings characteristic of its genus. This species is known to follow ships and feed on galley scraps (Enticott 1997).

The Matsudaira's Storm-Petrel breeds in colonies in the months between January and July, nesting in burrows on high ground on offshore islands. Breeding is thought to begin in January with most fledging taking place in June (Enticott 1997).

3.2.5 Marine Mammals

The ROI for marine mammals is the general region of Guam, which includes the ODMDS study areas, the Island of Guam, and the offshore area between them. The *Marine Mammal and Sea Turtle Survey and Density Estimates for Guam and the Commonwealth of the Northern Mariana Islands Final Report* (SRS-Parsons JV et al. 2007) was the result of studies conducted to determine marine mammal and sea turtle densities in the Mariana Islands region. This report was used as a reference for marine mammals that may be in the proposed ODMDS vicinity. The Mariana Islands Sea Turtle and Cetacean Survey (MISTCS) was conducted from January 16th to April 12th of 2007 in the area of 10°-18°N Latitude and 142°-148°E Longitude, and encompassed a total of 170,500 square nm (584.800 km^2). The study was comprised of four legs, in which multiple visual survey transects, measuring more than 5,900 nm (11,000 km) in length, were conducted using standard line-transect protocol based on (Buckland et al. 2001, 2004).

During the MISTCS there were a total of 149 visual sightings, on and off-effort, of 13 species. One hawksbill sea turtle was sighted, and the remainder of the sightings were of 12 cetacean species. The sperm whale was the species that had the highest frequency of sightings, followed by the Bryde's and sei whales. Survey results indicated that the most frequently

sighted delphinids were the pantropical spotted dolphin, followed by the false killer whale and striped dolphin. There were 17 sightings of unidentified dolphins and whales which was included in the total number of sightings. Groups that were sighted ranged from 1 to 115 individuals in size and varied depending upon the species. The range of bottom depth for the sightings was highly variable, ranging from 470 to 32,400 ft (144 to 9,874 m), and was largely species dependent (SRS-Parsons JV et al. 2007). The following descriptions are for species which are not federally listed as threatened or endangered. Descriptions of threatened and endangered marine mammals are included in the Threatened, Endangered and Special Status Species section (Section 3.2.6).

3.2.5.1 Cetaceans

Bryde's Whale (*Balaenoptera edeni*)

The Bryde's whale is very similar in physical description and behavior to the sei whale (described in section 3.2.6). Bryde's whales measure between 40 to 50 ft (12 to 15 m) in length, and weigh around 13 tons (12 metric tons). There is a smaller pygmy species of Bryde's whale that inhabits the Western Pacific and Southeast Asia.

The Bryde's whale inhabits tropical and subtropical waters. They are not known to be migratory, but move between inshore and offshore waters in pursuit of food. Bryde's whales feed almost exclusively on pelagic fish and are known to make deep dives that last up to 20 minutes. Breeding occurs year round.

The International Whaling Commission (IWC) recognizes three management stocks of Bryde's whales in the North Pacific: Western North Pacific, Eastern North Pacific, and East China Sea. Between January 16th and February 2nd 2007, three Bryde's whales were observed by MISTCS in the study area. From March 1st to March 20th 2007, six Bryde's whales were sighted in areas of deep water, ranging from 8,360 to 24,190 ft (2,549 to 7,373 m). During the MISTCS there were several sightings over and around the Mariana Trench. This species is expected to occur in or near the study region.

False Killer Whale (*Pseudorca crassidens*)

Adult false killer whales may reach a length of 19 ft (5.7 m) and can weigh up to 1,540 lbs (700 kg). False killer whales resemble the short-finned pilot whale, but lack the bulbous forehead, and the teeth are nearly twice as large. False killer whales are found in tropical to temperate seas worldwide. Their diet includes a variety of pelagic fish, squid and possibly other cetaceans, such as dolphins. According to NOAA, false killer whales have low reproduction rates of around seven years (NOAA 2008b). They are highly social animals and often travel in large pods. During the 2007 MISTCS, several false killer whales were sighted in deep waters over the Mariana Trench and west of the West Mariana Ridge. Several of these sightings included calves. It is also significant to note that they were sighted relatively close to shore, 12 mi (20 km) off the mouth of Apra Harbor in waters with a bottom depth greater than 3,300 ft (1,000 m) (SRS-Parsons JV et al. 2007). This species is expected to occur in or near the study region.

Killer Whale (*Orcinus orca*)

Adult killer whales reach between 23 to 32 ft (7 to 9.7 m) in length and can weigh up to 6 tons (5.4 metric tons). They are found in all oceans, but killer whales prefer cooler waters or areas of coldwater upwelling. Killer whales were not sighted during the 2007 MISTCS, but historically killer whales have been observed in the study region. In the summer of 1987, two large male and two female killer whales were observed offshore between Orote Point and Facpi Point,

Guam (Eldredge 2003). Large concentrations of killer whales have been observed north of the Mariana Islands and near Samoa (Reeves et al. 1999).

Short Finned Pilot Whale (*Globicephala melas*)

Pilot whales range throughout tropical and subtropical waters, traveling in pods of 5 to 43 individuals. Males tend to be much larger than females, reaching approximately 20 ft (6.1 m) in length, whereas females average 16 ft (4.9 m) in length. Adults weigh between 2,200-6,600 lbs (1,000-3,000 kg). Pilot whales feed primarily on squid and fish from moderately deep waters near 1,000 ft (300 m) depth. According to NOAA (2008b), the IWC recognizes four stocks: West Coast, Hawaii, Northern Gulf of Mexico, and Western North Atlantic. This species is one of the most commonly observed cetaceans around Guam (Reeves et al. 1999). According to the 2007 MISTCS, there was an estimated 909 short-finned pilot whales in the MISTCS study area. There was also an offshore sighting of a group of 6 to 10 pilot whales near the mouth of Apra Harbor between legs 3 and 4 of the survey.

Blainville's Beaked Whale (*Mesoplodon densirostris*)

Blainville's beaked whales have been observed in groups of 3 to 7, but are most commonly seen alone or in pairs. Adults may weigh up to 2,250 lbs (1033 kg) and reach 14.5 ft (4.5 m) in length. Dives of up to 45 minutes have also been recorded for this species (NOAA 2008b). Due to their rarity, little is known of the Blainville's reproductive or migratory behavior. Blainville's beaked whales are found throughout tropical and temperate waters. They are thought to feed primarily on pelagic fish. Only two sightings of this species have been recorded in the MISTCS study area, in deep waters ranging from 6,960 to 13,070 ft (2,122 to 3,984 m).

Cuvier's Beaked Whale (*Ziphius cavirostris*)

The Cuvier's beaked whale varies greatly in color, ranging from fawn to dark brown or black. They are highly elusive, and most studies have been done on individuals that were stranded. Adults reach sizes of approximately 24.5 ft (7.5 m) in length and up to 6,600 lbs (3,000 kg) in weight. Cuvier's beaked whales are thought to occur in the deep tropical to subtropical waters of the Pacific. Like Blainville's beaked whale, there is no data on stock structure. Mention of this particular species of beaked whale was omitted from the 2007 MISCTS. However, the species has been reported in the Mariana and Bonin Islands area (Masaki 1972), and therefore may occur in the study region.

Pygmy Killer Whale (*Feresa attenuate*)

As the name suggests, the pygmy killer whale is often confused with killer and false killer whales, but can be distinguished by rounded dorsal fins. Pygmy's weigh up to 375 lbs (170 kg) and reach up to 8.5 ft (2.6 m) in length. According to NOAA, pygmy's become very aggressive in captivity (NOAA 2008b).

Pygmy killer whales can be found deep in sub tropical to tropical waters in all areas of the world. They are thought to follow their prey source, which consists mainly of fish and squid. The reproductive and migratory behaviors of this species are very poorly known. According to the 2007 MISCTS, one sighting of a pygmy killer whale was observed near the Mariana Trench, south of Guam. The bottom depth of this area was 14,560 ft (4,440 m). This is consistent with data that suggest the pygmy prefers deep, tropical waters. Although sightings of pygmy killer whales within the study region are low, the area does fall within their distributional range.

Dwarf Sperm Whale (*Kogia sima)* and Pygmy Sperm Whale *(Kogia breviceps)*

The dwarf sperm whale is a cousin to the larger sperm whale. Dwarf sperm whales are usually 300-600 lbs (135-270 kg) and approximately 9 ft (2.7 m) in length. They have a cosmopolitan

distribution in tropical and temperate waters, and are most common in waters along the continental shelf. Their geographical range includes waters off of Australia, New Zealand, Indonesia, and off the western coast of South America. Little is known about the seasonal migration patterns of the dwarf sperm whale (NOAA 2008b). This species of whale is rare in the ODMDS study area. There have been two occurrences in which an individual was washed on shore. The first washed ashore at Asan in 1970 and the second was found at Rizal Beach in 1974 (Eldredge 2003).

The pygmy sperm whale has similar physical characteristics and morphology to the dwarf sperm whale, making it hard to distinguish between the two species in the field. The geographical ranges of the two species overlap in some areas. There is evidence that the dwarf and pygmy sperm whales can dive up to 1,000 ft (300 m) to feed. The main diet of the two species is cephalopods, crustaceans, and fish. The dwarf sperm whale may be found in shallower depths than the pygmy whale based on their preferred prey (NOAA 2008b). There was a dead pygmy sperm whale found at NSD Beach at Naval Station Apra Harbor in Guam in 1989 (Eldredge 2003). However, there were no visual sightings of either the dwarf or pygmy sperm whale during the MISTCS in 2007. Although sightings in the project area are rare, Guam is part of the known distributional range for both the dwarf and pygmy sperm whales, thus occurrence in the study region is possible.

Melon-Headed Whale (*Peponocephala electra*)

The melon- headed whale is a small member of the dolphin family. The average length of this species is around 9 ft (2.7 m), and a typical body weight is 460 lbs (210 kg). They are commonly found in groups of 100-1,000 individuals, and are common in tropical waters from 20°S and 40°N latitudes all over the world. They are frequently found in deep waters extending off the continental shelf. Melon-headed whales are deep divers, and their diet consists of mesopelagic fish, crustaceans, and squid. It is estimated that they will dive as deep as 5,000 ft (1,525 m) to feed (NOAA 2008b). During the 2007 MISTCS there were two visual sightings of a melon-headed whale, one during the time span of January 16, 2007 to February 3, 2007, and one during the March 1, 2007 to March 21, 2007 surveys. There was a live stranding in 1980 in Inarajan Bay of Guam. More recently, in July of 2004 there were approximately 500 individuals spotted off of Rota. This species is expected to occur regularly in the study region.

Rough-toothed Dolphin *(Steno bredanensis)*

The rough-toothed dolphin is one of the smaller members of the Delphinidae family. They are on average 8.5 ft (2.5 m) long and weigh 350 lbs (160 kg). The rough-toothed dolphin is found in tropical and warm waters worldwide. They are generally an offshore species and are rarely found near land or coastal areas. There is not a lot of information on the specific depth range that the dolphin usually feeds in. However, the rough-toothed dolphin has been found off the Gulf of Mexico over waters of the continental shelf with bottom depths of 3,110-3,640 ft (950-1,110 m) (DON 2005). They are usually not found near land except for islands with steep drop-offs (SRS-Parsons JV et al. 2007). The main prey items for the rough-toothed dolphin are squid and fish found in their preferred depth range. They live in groups of 10-20 individuals. The rough-toothed dolphin reaches maturity around 11 years of age, and has a maximum longevity of 32 years (NOAA 2008b). During the MISTCS, rough-toothed dolphins were spotted once during February and once during March, and thus this species is expected to occur in the study region.

Spinner Dolphin (*Stenella longirostris*)

Spinner dolphins are approximately 6.5 ft (2 m) long and weigh on average between 130-170 lbs (60-75 kg). Spinner dolphins mate and calve year round, reaching maturity around seven

years old. These dolphins are found in all tropical and sub-tropical oceans, and are very common around the Hawaiian Islands and the American Samoa (URS Corporation 2001). They occur in both oceanic and coastal waters. The oceanic populations are usually found where there is a shallow thermocline, as their prey are more likely to be concentrated in the pelagic waters above the thermocline (DON 2005). They feed primarily at night on deep-mid ocean fish and squid found at depths of 650-1,000 ft (200-300 m) (NOAA 2008b). Their optimal habitat for feeding is in the deep ocean, and during the day they can be found in protected bays and coastal waters while resting (NOAA 2008b). Observations of the spinner dolphin were recorded at Pugua Patch Reef in Guam in April and May 1986, and in June 1988. In the 1990's, groups of spinner dolphins were common around Double Reef and Merizo (Eldredge 2003). During the 2007 MISTCS one spinner dolphin was visually sighted in March. This species is expected to occur regularly in the study region.

Striped Dolphin (*Stenella coeruleoalba*)

The striped dolphin has a distinct stripe down its side from eye to tail with lighter coloring on the belly and darker coloration on the back. They are highly aerobic animals that reach up to 8.5 ft (2.6 m) in length. Striped dolphins occur in tropical and warmer temperate waters. They are commonly found in areas off of the continental slope extending out to oceanic waters. They feed typically in benthic and pelagic waters extending off of the continental shelf. There is evidence that striped dolphins feed at depths 660-2,300 ft (200-700 m) deep and may feed at night (DON 2005). One dead female striped dolphin was found at Dadi Beach in Agat Bay, Guam in 1985 (Eldredge 2003). In the 2007 MISTCS there were visual sightings of striped dolphins in February and March in the Mariana Island region. This species is expected to occur in the study region.

Pantropical Spotted Dolphin (*Stenella attenuate)*

The pantropical spotted dolphin is a relatively small species ranging in size from 6-7 ft (1.8-2.1 m) and 250 lbs (110 kg) as adults. These dolphins are commonly found in all tropical and subtropical oceans. They spend most of their time in water depths ranging from 300-1,000 ft (91-300 m), and deeper depths at night while feeding. This species is typically found 660 ft (200 m) off of the continental shelf (DON 2005). The main prey items are mesopelagic cephalopods and fishes. There is no other distinguishable migratory pattern for the pantropical spotted dolphin other than they seem to move inshore during the fall and winter and move offshore during the spring. They travel in groups of 100-1,000 individuals, and the mating and calving season is year round (NOAA 2008b). In the 2007, MISTCS, the pantropical spotted dolphin, was visually sighted on each leg of the survey between January and April, and the majority of sightings were offshore. This species is expected to occur regularly in the study region.

Risso's Dolphin (*Grampus griseus*)

These dolphins, also known as the grey dolphin, are a medium to larger sized species ranging from 8.5-13 ft (2.6-4.0 m) in length, and weighing around 660-1,000 lbs (300-450 kg). They are typically found in tropical, subtropical, and temperate waters. They can be found in waters extending off the continental shelf and prefer areas in which water depth is greater than 3,300 ft (1,000 m). Risso's dolphins have a cosmopolitan distribution and are common in the Southern hemisphere around Australia, New Zealand, South Africa, and the Western coast of South America. Not much information is available on the migratory patterns of the species besides the idea that food availability and oceanographic conditions may direct their movements (NOAA 2008b). There were no visual sightings during the 2007 MISTCS study; however, this species is expected to occur within the Mariana Island area. Sightings were reported during the winters between 1993-1995 at the Mariana islands and Guam (Eldredge 2003).

Bottlenose Dolphin (*Tursiops truncates*)

Bottlenose dolphins are found in most temperate and tropical waters. They range in size from 8-12.5 ft (2.4 - 3.8 m), and weigh 350-450 lbs (160-200 kg). They are grey in color with lighter tones on their belly. The bottlenose dolphin is common throughout the Indian and Pacific Oceans. This species is generally found in coastal waters ranging from 1,650 ft (500 m) to 0.6 mi (1 km) offshore, but some populations are found farther offshore in oceanic waters. Predation, climate change, and food availability predict the migratory patterns of this dolphin species. There are two calving seasons, one occurring in spring and one in the fall. They feed mainly on fish, squid, and shrimp (DON 2005). During the MISTCS, bottlenose dolphins were visually sighted on three of the four legs of the survey between January and March. This species is expected to occur regularly in the study region.

3.2.6 Threatened, Endangered and Special Status Species

3.2.6.1 Marine Mammals

The Marine Mammal Protection Act (MMPA) of 1972 protects all marine mammals from harvesting within the borders of the U.S., regardless of status. Therefore, all marine mammals encountered in the offshore region of Guam must be given due consideration. The emergence of terms, legislation, and monitoring organizations created after the MMPA, such as the Endangered Species Act (ESA) of 1973, the USFWS Endangered Species Program, and the International Union for the Conservation of Nature (IUCN) require that certain species be given greater protection and consideration (IUCN 2008). These populations are more sensitive and negatively impacted by factors such as habitat loss, pollution, harvesting, and global warming. Therefore, regulation that protects these species from extinction is fundamental. The following descriptions are for all federally listed threatened or endangered marine mammals. Table 3-19 summarizes listing status and likelihood of occurrence in the study region for all marine mammals known to reside in the region of influence.

Blue Whale (*Balaenoptera musculus*)

The blue whale is the largest known living animal. The blue whale is listed as endangered throughout its habitat range mainly due to vessel strikes and fishery activities. Individuals can reach lengths of 100 ft (30 m) and weights of 160 tons (145 metric tons). Blue whales are usually found as single individuals or in groups of two to three. They feed on krill by using a gulping method. The female whales will reach maturity at 5-15 years of age. Blue whales calve within the winter months, and there is usually a 2 year period between calves.

The geographic range of the blue whale includes much of the North Pacific Ocean, and the optimal habitat of the Blue Whale ranges from coastal to oceanic waters in temperate and tropical areas. Feeding grounds have been identified off of the coasts of California, Southern Australia, and coastal upwelling zones in the Eastern tropical and equatorial Pacific. There are acoustic recordings of blue whales off the island of O'ahu, suggesting that there are blue whales somewhere within the EEZ, which is 200 nm (370 km) offshore Hawaii (URS Corporation 2001). Blue whales were not visually sighted during the MISTCS study, but their occurrence in the study region is considered possible.

Sperm Whale (*Physter macrocephalus*)

The sperm whale is listed as an endangered species throughout its geographical range due to historical hunting and whaling practices. The whales are also sensitive to anthropogenic noise caused by shipping and oil and gas activities.

The sperm whale averages 40 to 50 ft (12 to 15 m) in length, with the head accounting for 40% of its body length. This physical attribute, along with its grey body color, make the species very

recognizable. The average dive for this species is 35 minutes long and 1,312 ft (400 m) deep; however, they can dive for as long as an hour and dive as deep as 3,280 ft (1,000 m). The optimal depth range for sperm whales is 1,968 ft (600 m) or more, and it is uncommon to find them in waters shallower than 984 ft (300 m). Since these whales are found in deeper water, their prey are typically found in deeper water; they feed mainly on large squid but will also feed on fish, sharks, and skates (NOAA 2008b).

The geographic range of sperm whales is between 60 N and 60˚ S latitudes, and they were historically found in tropical to polar waters throughout the world. Females may be seen near oceanic islands, but usually far from land. Juvenile males can be found with the females until they mature, at 4-21 years of age. The mature males are generally found near the ice-pack edges at both poles, except for during the breeding winter months when they return to warmer waters. The general migration patterns of the sperm whale is to travel north in the summer. However, in tropical stocks no apparent migratory patterns have been distinguished (NOAA 2008b). In 1980, sightings of sperm whales around Guam were recorded from May to July, and more recently there have been individual sightings (URS Corporation 2001). They are the most common whale in the Micronesian area, and there have been numerous sightings around the Northern Hawaiian Islands (Eldredge 2003). Sperm whales are widely distributed in the tropics; however, their numbers decrease westward towards the middle of the tropical Pacific Ocean (NOAA 2008b). Sperm whales are expected to occur in the study region.

Humpback Whale (*Megaptera novaeangliae*)

Humpback whales are federally endangered throughout their range. Adult humpback whales are large, weighing anywhere from 25 to 40 tons (23 to 46 metric tons) and measuring 36 to 52 ft (11 to 16 m) in length. They typically travel over deep, oceanic waters during migrations (Clapham and Mead 1999). Their feeding and breeding habitats occur mostly in shallow, coastal waters over continental shelves. Humpbacks can be found in all oceans to the edges of polar ice, and follow definite migration paths from their summer feeding grounds to warmer waters in the winter for calving. Recent studies indicate that there are three stocks or populations in the North Pacific: Eastern, Central, and Western North Pacific (Baker et al. 1993).

Individuals near Guam would presumably be associated with the Western North Pacific stock. A group of six or more were photographed at the entrance to Apra Harbor in January 1996 (Eldredge 2003). During the 2007 MISTCS, one humpback was observed between February 6th and February 25th (SRS-Parsons JV et al. 2007). This species is expected to occur in the study region.

North Pacific Right Whale (*Eubalaena japonica*)

The federally endangered North Pacific Right whales are larger than their Atlantic cousins. Approximately 55 ft (17 m) long and weighing up to 11 tons (10 metric tons), North Pacific Right whales feed on small crustaceans (copepods) and shrimp-like animals known as euphausiids. They tend to populate in sub-polar to temperate waters, particularly between 20°N and 60°N latitudes.

In the late 1800s, North Pacific Right whale populations were severely depleted by commercial whaling activities, and stocks have been slow to recover since that time. Consequently, much of their migration and breeding behavior remains unknown. It is thought the whales migrate from high-latitude feeding grounds in summer to more temperate waters during the winter, possibly offshore, and related to where concentrations of prey are at their highest. No calving grounds have been found in the eastern North Pacific.

In April 2008, the NMFS identified two areas within the Southern Bering Sea as areas of critical habitat for the North Pacific right whale. Right whales were not observed during the 2007

MISCTS, and are not known to occur within the study region historically. Although the probability of occurrence of right whales within the study region is low, mention of the species is important due to their highly endangered status and potential for any occurrence.

Sei Whale (*Balaenoptera borealis*)

Sei whales are federally endangered, with low numbers due to hunting and whaling practices that occurred during the 19th and 20th centuries. Sei whales are generally 46 to 49 ft (14 to 15 m) long, and weigh up to 30 tons (27 metric tons). Considered the fastest of the great whales, Sei's have been recorded up to 16 mph (25 kph) when pursued by whalers.

Sei whales seem to prefer more temperate waters and do not venture into the polar ice regions. They keep a seasonal migration pattern and tend to gravitate towards canyons, continental shelf breaks or other areas of steep bathymetric relief (Kenney et al. 1997; Schilling et al. 1992; Gregr and Trites 2001; Best and Lockyer 2002). This species feeds on krill, fish and copepod crustaceans by skimming the water with their mouths open. Sei whales typically do not dive deeper than approximately 1,000 ft (300 m). Winter breeding areas are unknown, but are thought to occur somewhere in deep tropical waters.

It is difficult to estimate population numbers for the sei whale because they are easily confused with Bryde's whales, which are similar in physical appearance and distribution (Reeves et al. 1999). Although the IWC acknowledges only one stock, there is evidence to suggest there may be multiple sei whale stocks (NMFS 1998; Carretta et al. 2004).

According to the MISTCS, there have been several quality sightings to authenticate their presence in the study region. During the survey periods between January 16th to February 2nd and March 1st through March 20th, a total of twelve sei whales were observed in the area. Sei whales were sighted in deep waters, ranging from 10,380 to 30,580 ft (3,164 to 9,322 m). There is evidence that two tagged sei whales from the Northern Mariana Islands were later killed several hundred kilometers south of the Western Aleutian Islands (Horwood 1987). Although difficult to identify, the presence of sei whales in the study region is possible.

Fin Whale (*Balaenoptera physalus*)

The fin whale is federally listed as endangered due to low population numbers. Adult fin whales measure up to 88 ft (27 m) long and weigh between 50 to 70 tons (45 and 64 metric tons). Second only to the blue whale in size and weight, it is also one of the fastest, capable of speeds up to 23 mph (37 kph).

Fin whales are found in continental shelf and oceanic waters all over the world. They may migrate to colder waters in the Arctic and Antarctic for feeding during the summer, and to subtropical waters for mating and calving during the winter. Fin whales feed on krill, euphausiids and small schooling fish by circling and gulping their prey. They are known to dive to depths of up to 1,800 ft (550 m). Peak calving occurs between October and January (Hain et al. 1992).

The IWC recognizes a widespread North Pacific stock and a smaller stock located in the East China Sea (Donovan 1991). There are no known occurrences of Fin whales within the study region, but the location of the study region within the population's distribution range and the species sensitive endangered status warrants recognition of the possibility of occurrences.

Table 3-19. List of Threatened, Endangered and Special Status Marine Mammal Species

Common Name	Taxon	Occurrence	IUCN	ESA
Cetaceans				
Humpback whale	*Megaptera novaeanliae*	Regular	EN	EN
Blue whale	*Balaenoptera musculus*	Rare	EN	EN
Fin whale	*Balaenoptera physalus*	Rare	EN	EN
Sperm whale	*Physeter macrocephalus*	Rare	EN	EN
North pacific right whale	*Eubalaena japonica*	Rare	EN	EN
Sei whale	*Balaenoptera borealis*	Regular	EN	EN
Bryde's whale	*Balaenoptera edeni/brydei**	Regular	DD	NL
Pygmy sperm whale	*Kogia breviceps*	Regular	LR	NL
Dwarf sperm whale	*Kogia sima*	Regular	LR	NL
Cuvier's beaked whale	*Ziphius cavirostris*	Regular	DD	NL
Blainville's beaked whale	*Mesoplodon densirostris*	Regular	DD	NL
Ginkgo-toothed beaked whale	*Mesoplodon ginkgodens*	Rare	DD	NL
Hubbs' beaked whale	*Mesoplodon carlhubbsi*	Extralimital	DD	NL
Longman's beaked whale	*Indopacetus pacificus*	Regular	DD	NL
Rough-toothed dolphin	*Steno bredanensis*	Regular	DD	NL
Common bottlenose dolphin	*Tursiops truncatus*	Regular	DD	NL
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	Extralimital	DD	NL
Pantropical spotted dolphin	*Stenella attenuata*	Regular	LR	NL
Spinner dolphin	*Stenella longirostris*	Regular	LR	NL
Striped dolphin	*Stenella coeruleoalba*	Regular	LR	NL
Short-beaked common dolphin	*Delphinus delphis*	Rare	LR	NL
Risso's dolphin	*Grampus griseus*	Regular	DD	NL
Melon-headed whale	*Peponocephala electra*	Regular	LR	NL
Fraser's dolphin	*Lagenodelphis hosei*	Regular	DD	NL
Pygmy killer whale	*Feresa attenuata*	Regular	DD	NL
False killer whale	*Pseudorca crassidens*	Regular	LR	NL
Killer whale	*Orcinus orca*	Regular	LR	NL
Short-finned pilot whale	*Globicephala macrorhynchus*	Regular	LR	NL
Other Marine Mammals				
Hawaiian monk seal	*Monachus schauinslandi*	Extralimital	EN	EN
Dugong	*Dugong dugon*	Extralimital	EN	EN

EN= endangered; DD= dangerously depleted; LR= low risk ; NL= not listed

Hawaiian Monk Seal (*Monachus schauinslandi*)

The Hawaiian monk seal is listed as an endangered species under the Endangered Species Act (ESA). The population has been declining for the past 20 years due to habitat loss, entanglement in nets, and low survival rate of the pups. The seals are mainly found in the Northern Hawaiian Islands. They dive to depths of 250-300 ft (75-91 m) to feed. Their diet consists of fish, eels, and crustaceans. Pups are born between February and July, with the peak in April and May (NOAA 2008b). The Hawaiian monk seal was not visually sighted during the 2007 MISTCS. The Marine Resource Assessment from the DON (2005) states that there were no known occurrences of the Monk Seal in the Mariana study area. The likelihood of occurrence of this species in the study region is low.

Dugong (*Dugong dugon*)

The Dugong is listed as an endangered species as of January 16, 2004. Dugongs are similar to manatees, but are more streamlined and have a fluked tail similar to a dolphin's. The average size of a dugong is around 11 ft (3.3 m) in length, and they weigh around 880 lbs (400 kg). The dugong has a large geographical range that spans tropical and subtropical waters from East Africa to the Solomon Islands. The Dugong is an herbivorous mammal, feeding mainly on flowering sea grasses of the Order Potamogetonaceae Family Cymodoceaceae, which are found in the Indo-Pacific region (USFWS 2008 [Marine Mammal - Dugong Section]). They usually reside in coastal waters, protected bays, wide and shallow mangrove channels, and the lees between islands. In the Micronesian area Dugongs have been sighted around Guam and Yap, but occur in highest densities in Palau (FR 2003). A single sighting in the Cocos Lagoon at the southern end of Guam was reported in 1975, and more sightings were reported along the southern coast of Guam in 1985 (Eldredge 2003). It is possible that this species would occur in the study region.

3.2.6.2 Sea Turtles

All sea turtles are listed as either threatened or endangered under the ESA. Five species have distributions that extend in to Guam including the green, hawksbill, leatherback, loggerhead and olive ridley. However, only the green sea turtle is considered common to the area, and the hawksbill is considered extremely rare (DON 2005). The leatherback, loggerhead and olive ridley sea turtles are considered infrequent visitors to the region.

Most species live nearshore except during transit between foraging and nesting areas, when extremely long-distance migrations take place. As the potential ODMDS would be located approximately 11-14 nm (20-26 km) from shore, the site is not likely to be frequented often by any sea turtle species, but those passing through the area may swim over or near the designated ODMDS. The life history characteristics and known occurrence in the region of influence are described for each species.

Green Turtle (*Chelonia mydas*)

The green turtle was protected under the ESA in 1978, with breeding populations in Florida and the Pacific coast of Mexico listed as endangered, and all others as threatened (NMFS and USFWS 2007a). In the central Pacific, green sea turtles occur around most of the islands, including the Hawaiian Island chain, American Samoa and Guam. Adult green turtles that feed throughout the main Hawaiian Islands undergo a long migration to French Frigate Shoals in the Northwest Hawaiian Islands, where the majority of nesting and mating occurs for this region. Relatively limited nesting activity has been documented on the beaches of Guam; in 2007 an estimated 45 females nested (NMFS and USFWS 2007a). Nesting activity on Guam was tracked for 11 years and was reported as stable, and in effect, neither increasing nor decreasing.

Adults feed primarily on seagrass and a variety of algae, and consequently remain primarily nearshore where these preferred food sources are found in great abundance. Some adults have been documented feeding on invertebrates, but the majority of food items consist of plant material (NOAA 2001). Green sea turtle nearshore abundance estimates for Guam made by aerial surveys ranged from 150-250 individuals (NMFS and USFWS 2007a). Although primarily found nearshore, some non-breeding individuals have been sighted 500-800 mi (800-1,300 km) from shore. The occurrence of green sea turtles offshore in deep water is expected during long-distance transits to or from nesting sites.

Hawksbill (*Eretmochelys imbricata*)

The hawksbill sea turtle has a circumtropical distribution, and is endangered throughout its range (NMFS and USFWS 1998a). This species is in danger of extinction in the Pacific, with the primary cause of mortality being illegal subsistence harvesting. Information about Pacific populations is extremely limited due to the rare occurrence of this species. It is known that nesting occurs throughout the insular Pacific, including limited nesting activity on beaches in Guam (NMFS and USFWS 1998a).

Adult hawksbills are found in nearshore and offshore areas, foraging in benthic habitats made up of hard substrates. Diving depths of up to 600 ft (183 m) are not uncommon for adults, while juveniles are typically found diving in shallow reef areas closer to shore. Juveniles are thought to feed on the surface rather than diving to forage in the benthos. The ecology of this species in the Pacific is virtually unknown. In the Caribbean hawksbills specifically forage for sponges. Like other sea turtle species, long migrations are made between foraging and nesting areas (NMFS and USFWS 1998a).

Leatherback (*Dermochelys coriacea*)

The leatherback sea turtle was listed as endangered in 1970 (NMFS and USFWS 1998b). The decline in numbers of leatherback sea turtles is mainly attributed to nesting habitat degradation, illegal harvest of adults and eggs, incidental take, and pollution (Eckert 1995). Leatherback sea turtles are broadly distributed throughout the Atlantic, Pacific, Caribbean and Gulf of Mexico, with a relatively high tolerance for extreme temperatures. This high temperature tolerance allows for long migrations through areas with varying oceanographic conditions. The majority of leatherback nesting in the western Pacific occurs in Papua New Guinea, Indonesia, and the Solomon Islands. Greatly reduced nesting activity in these areas has led to major concerns for leatherback populations (NMFS and USFWS 1998b). Leatherbacks were sighted during aerial surveys of the offshore waters near Guam, although only 2.6% of the total sightings were of leatherbacks (NMFS and USFWS 1998b).

Leatherbacks are known to be deep divers (over 300 ft [91 m]), and spend a large amount of time offshore foraging in deeper waters (Eckert et al. 1989). The hypothesized reason for the offshore preference is that leatherback sea turtles feed on jellyfish and other pelagic animals that are found most commonly offshore (Eckert 1995). Although generally a deep-diving pelagic species, seasonal movement into coastal waters to feed on large jellyfish that are associated with rivers and frontal boundaries has been documented.

Loggerhead (*Caretta caretta*)

The loggerhead sea turtle was listed as threatened in 1978. There are concerns for this species due to numerous human activities that impact nesting areas and can lead to adult mortality. Loggerhead sea turtles have a wide distribution including the Atlantic, Pacific and Indian oceans. Loggerheads nest in the temperate and subtropical regions of their geographic distribution, and in the U.S. the most common nesting areas include the coastal region between North Carolina and Florida, including the Florida Gulf coast. A pelagic existence can last between 7 and 12 years for juveniles before migration back to nearshore coastal areas to mature until adulthood. There are no known nesting beaches for this species in the eastern or central Pacific, including Guam. There have been no reports of adult sightings near Guam (NMFS and USFWS 1998c).

Juvenile and subadult loggerheads are described as opportunistic omnivores, feeding on planktonic prey items such as jellyfish. Juveniles and subadults are therefore concentrated in offshore areas where these prey items are abundant. Evidence of trans-Pacific journeys by young loggerheads exists, and individuals are thought to make long migrations while

developing. Adults are found closer to shore, foraging in benthic habitats, although there have been reports of individuals diving in waters deeper than 660 ft (200 m) (NOAA 2001).

Adult mortality can be caused by a number of factors, including, but certainly not limited to coastal development that destroys foraging habitat and numerous types of fisheries that involve bycatch (NMFS and USFWS 1998c). A review conducted by the NMFS in 2007 recommended this species remain listed as threatened until a longer time series of data is available (NMFS and USFWS 2007b).

Olive Ridley (*Lepidochelys olivacea*)

The olive ridley sea turtle is listed as threatened throughout all of its range, with the exception of nesting populations in Mexico that are endangered. This species is one of the smaller-bodied and most abundant sea turtle species. It is found in tropical and warm temperate waters world-wide, with primary nesting areas occurring in the Indian Ocean. No known nesting occurs in any U.S. or U.S. territory waters (NMFS and USFWS 1998d). One nest was discovered in Hawaii, although the progress was tracked and the eggs did not hatch, indicating a possible fluke nesting occurrence. Typical nesting behavior includes aggregates of nests termed arribadas. Although not expected to occur in abundance, it is possible that this species is found in Guam. Sightings in the western Pacific are rare, but are reportedly increasing (NOAA 2001).

Very little information is known about the earliest life stages of olive ridleys, although a pelagic existence is assumed. Adults feed on a variety of benthic and pelagic food items, and the results of feeding studies indicate an omnivorous diet. Adults have been reported foraging at great depths (990 ft [300 m]) for highly prized food items such as crabs. This species is thought to lead a highly pelagic lifestyle (NOAA 2001).

3.2.7 Marine Protected Areas (MPAs)

MPAs are defined as any marine environment that has been reserved by Federal, State, territorial, tribal or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein (FR 2000). In Guam, there are numerous ecological reserve areas (ERAs), marine preserves, a territorial seashore reserve and a national historic park.

3.2.7.1 Ecological Reserve Areas (ERAs)

ERAs are regions in which current natural conditions, such as unique biological and physical features, are preserved. In 1984, two ERAs were established by the Navy as a mitigation measure for the construction of Kilo Wharf. These were the Orote Peninsula ERA and the Haputo ERA.

The Orote Peninsula ERA is located along the southwestern shore of Orote Peninsula, extending from Orote Point to Agat Bay. The Orote Peninsula ERA includes terrestrial lands from the 0 mean lower low water (MLLW) line to the upper edge of the cliffs and aquatic lands from the shoreline to a depth of 120 ft (36.5 m) MLLW offshore (Figure 3-33). The submerged portion of the Orote Peninsula ERA contains pristine coral communities (NAVFACPAC 1986). The Orote Peninsula ERA is located approximately 14.2 nm (26.3 km) from the North Study Area (Station 2) and approximately 9.5 nm (17.6 km) from the Northwest Study Area (Station 7). Barge traffic transporting dredged material from Apra Harbor to either of the study areas would transit within 0.4 nm (0.7 km) of the northern portion of the Orote Peninsula ERA.

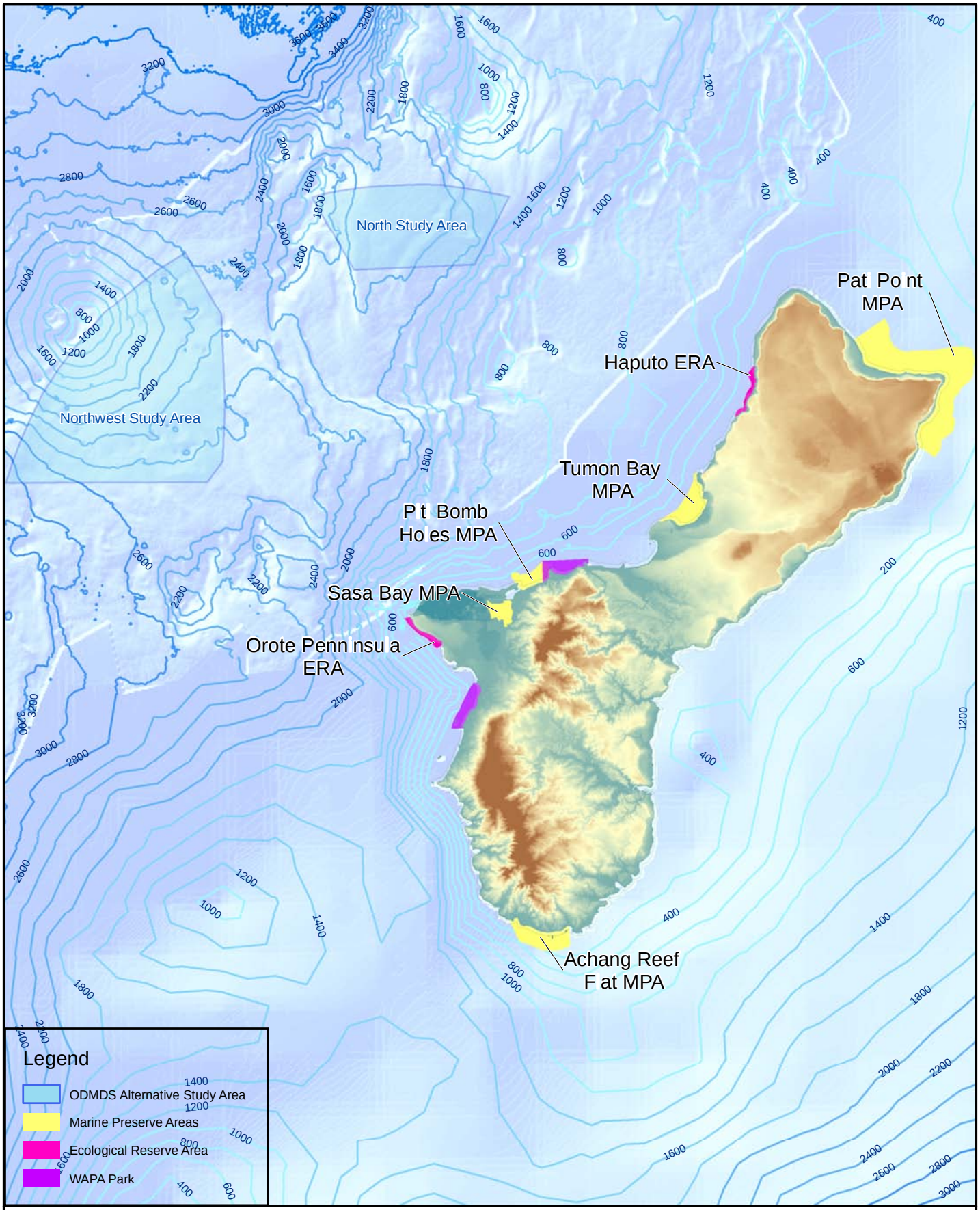

Figure 3-33.
Marine Protection Areas

The Haputo ERA is located along the northwestern shore of Guam on the Naval Computer and Telecommunications Station property, from Haputo Beach north to and including Double Reef (Pugua Patch Reef). The Haputo ERA includes terrestrial lands from the 0 MLLW line to the upper edge of the cliffs and aquatic lands from the shoreline to a depth of 120 ft (36.5 m) MLLW offshore. Double Reef supports highly diversified coral and cryptofauna communities (Amesbury et al.). The Haputo ERA is located approximately 14.5 nm (26.9 km) from the North Study Area (Station 2) and approximately 20.0 nm (37.0 km) from the Northwest Study Area (Station 7). The Haputo ERA is located 13.1 and 15.3 nm (24.3 and 28.3 km) from the planned barge transit routes between Apra Harbor and the North and Northwest Study Areas, respectively.

3.2.7.2 Marine Preserves

Marine preserves are areas in which activities such as fishing or other taking of aquatic animals and habitat are restricted or prohibited altogether in order to restore the reef fish community. In 1997, five marine preserves were designated in Guam. These include Pati Point, Tumon Bay, Piti Bomb Holes, Sasa Bay and Achang Reef Flat (Division of Aquatic and Wildlife Resources [DAWR] 2006). All of the preserves extend offshore to a depth of 600 ft (183 m) MLLW and inshore 33 ft (10 m) from the mean high tide mark or along the nearest public right-of-way, whichever comes first.

Pati Point Marine Preserve contains approximately 4,900 acre (1,980 ha) of reef environment. It is located on the northeastern tip of Guam, extending from Mergagan Point in the north to Anao Point in the south (Figure 3-33). Pati Point Marine Preserve has narrow reef flats and steep fore-reef slopes containing a diverse coral community, and the beaches in the preserve are vital green sea turtle habitat (DAWR 2005). Pati Point Marine Preserve is located on the opposite side of Guam from the two study areas. The shortest over-water distance between Pati Point Marine Preserve and each of the study areas (as well as the planned barge transit routes) is approximately 19.6 nm (36.3 km) for the North Study Area (Station 2) and 25.8 nm (47.8 km) for the Northwest Study Area (Station 7).

Tumon Bay Marine Preserve is centrally located on the western side of Guam and comprises 1,117 acres (450 hectares). It extends from Amantes Point (Two Lovers Point) in the north to Ypao Point (Hospital Point) in the south (Figure 3-33). Tumon Bay Marine Preserve consists of a broad reef flat, gently sloping fore-reef, and a broad bank/shelf habitat (DAWR 2005). Tumon Bay Marine Preserve is located approximately 14.5 nm (26.9 km) from the North Study Area (Station 2) and 17.1 nm (31.7 km) from the Northwestern Study Area. The Tumon Bay Marine Preserve is located 9.8 and 10.9 nm (18.1 and 20.2 km) from the planned barge transit routes between Apra Harbor and the North and Northwest Study Areas, respectively.

Piti Bomb Holes Marine Preserve is also centrally located on the western side of Guam, approximately 6 mi (9 km) south of Tumon Bay Marine Preserve (Figure 3-33). Extending from Asan Point to the outlet channel from the Cabras power plant, Piti Bomb Holes Marine Preserve comprises 896 acre (363 ha) of broad reef flat and fore reef slope. Within the reef flat, “bomb holes”, or sinkholes, extend up to 32 ft (10 m) deep MLLW and are populated with hard and soft corals and unique fish and invertebrate communities (DAWR 2005). Piti Bomb Holes Marine Preserve is located approximately 13.1 nm (24.3 km) from the North Study Area (Station 2) and 12.4 nm (23.0 km) from the Northwest Study Area (Station 7). The Piti Bomb Holes Marine Preserve is located 4.7 and 5.4 nm (8.7 and 10.0 km) from the planned barge transit routes between Apra Harbor and the North and Northwest Study Areas, respectively.

Sasa Bay Marine Preserve is located inside Outer Apra Harbor, on the eastern side between Dry Dock Island to the north and Polaris Point to the south (Figure 3-33). Sasa Bay Marine Preserve comprises 770 acre (312 ha) and includes the largest mangrove stand in the Marianas. Although the coral habitat is degraded due to elevated sedimentation loads from

Sasa and Aguada Rivers, the preserve provides foraging habitat for green and hawksbill sea turtles (DAWR 2005). Depending on project specific dredging locations within Apra Harbor, barge traffic transporting dredged material from Apra Harbor to either of the study areas may transit as close as 0.25 nm (0.5 km) to the western boundary of the Sasa Bay Marine Preserve.

Achang Reef Flat Marine Preserve is located at the southern tip of the Guam and contains approximately 1,200 acre (485 ha) of mangrove, seagrass, coral, sand and channel habitat. Achang Reef Flat Marine Preserve extends from Ajayan Channel in the east to Achang Bay to the west (Figure 3-33). The seagrass beds provide foraging habitat for green sea turtles (DAWR 2005). Achange Reef Marine Preserve is located on the opposite side of Guam from the two study areas. The shortest over-water distance between Achang Reef Marine Preserve and each of the two study areas is approximately 21.1 nm (39.1 km) for the North Study Area (Station 2) and 26.2 nm (48.5 km) for the Northwest Study Area (Station 7). The Achange Reef Marine Preserve is located approximately 13.1 nm (24.3 km) from the planned barge transit routes between Apra Harbor and either study area.

3.2.7.3 Territorial Seashore Reserve

In 1974, the GOVGUAM established the Guam Territorial Seashore Protection Act. This Act established the Guam Territorial Seashore Reserve in order to promote public safety, health and welfare and to protect public and private property, wildlife, marine life, other ocean resources and the natural environment (GOVGUAM 2003). The Guam Territorial Seashore Reserve includes all land and waters of Guam extending seaward to the -60 ft (-18 m) MLLW contour and inshore 33 ft (10 m) from the mean high tide mark or along the nearest public right-of-way, whichever comes first. Cabras Island and villages constructed along the shoreline prior to the establishment of the Act are excluded. The closest distance from the North (Station 2) and Northwest (Station 7) study areas to the Guam Territorial Seashore Reserve is 12.7 nm (23.5 km) and 9.5 nm (17.6 km), respectively.

Barge traffic transporting dredged material from Apra Harbor to either of the study areas would transit within 0.1 nm (0.2 km) the Territorial Seashore Reserve boundary along the northern portion of Orote Point.

3.2.7.4 National Historic Park

The War in the Pacific National Historic Park (WAPA) was established in 1978 as a memorial to those participating in the World War II Pacific theater campaigns. The WAPA is centrally located on the west side of Guam consisting of seven separate sites significant to the 1944 invasion and recapture of Guam. Of these seven sites, two sites, Asan Beach and Agat Beach include waters of the Philippine Sea (see Figure 3-33). The Asan Beach site extends along the shoreline from just west of Asan Point east to Adelup Point. The Agat Beach site extends along the shoreline from Apaca Point in the north to just south of Agat Village. The WAPA boundaries extend approximately 0.5 mi (0.8 km) offshore to water depths of approximately 60 ft (18 m) (National Park Service 2004). The Asan Beach site is located approximately 13.1 nm (24.3 km) from the North Study Area (Station 2) and approximately 13.5 nm (25.0 km) from the Northwest Study Area. The Agat Beach site is located approximately 17.8 nm (33.0 km) from the North Study Area (Station 2) and approximately 13.1 nm (24.3 km) from the Northwest Study Area. The WAPA is located 4.0 and 5.8 nm (7.4 and 10.7 km) from the planned barge transit routes between Apra Harbor and the Northwest and North Study Areas, respectively.

3.3 SOCIOECONOMIC ENVIRONMENT

Unless stated otherwise, the ROI for all aspects of the socioeconomic environment is the general region of Guam, which includes the ODMDS study areas, the Island of Guam, and the offshore area between them.

3.3.1 Commercial Fishing and Mariculture

Commercial fishing contributes less than $1 million (commercial landings value) annually on average to the total economy of Guam, which was $3.4 billion in 2002 (Allen and Bartram 2008). However, if other factors are considered (related economic contributions beyond landings value), the value of commercial fishing may be closer to $3 million (GFCA 2009). The military and tourism sectors are the major economic generators. Nonetheless, fishing is an important social and cultural activity for the people of Guam.

Guam is categorized as a "fishing community" by the WPRFMC. This designation is given based on the number of the population who are dependent upon fishing for subsistence, the economic importance of fishery resources to the islands, and the geographic, demographic, and cultural attributes of the communities. Fishing is a strong cultural tradition in Guam, particularly for the indigenous Chamorro people. Chamorro place a high value on sharing their catch with family and friends (Allen and Bartram 2008).

Most fishers rely on fishing for only a minor portion of their income. It is often difficult to distinguish among commercial, recreational, and subsistence fishermen in Guam. Most of the commercial operators use small boats similar to recreational fishing boats and many recreational fishers also sell part of their catch.

Most small-scale commercial fishing on the western side of Guam takes place in shallower waters, near reefs and near FADs, all located within 6 nm (11.1 km) of the shore. FADs, which were described in Section 3.2.3, have been widely used in the Pacific region since the end of the 1970s. Their use is based on the known fact that tuna schools and other pelagic species congregate or aggregate around floating objects in the water (Chapman 2004). Most of the time, anchored FADs located around a remote island archipelago act as single aggregation devices, with only modest levels of exchange of fish between adjacent FADs (4 nm [7.3 km] to 16.8 nm [31.1 km] apart) (Dagorn et al. 2007). Some tuna have been known to move frequently between two FADs separated by 5.4 nm (10 km) (Ohta & Kakuma, 2005). The locations of these are shown in Chapter 2 (see Figure 2-3) as a siting feasibility constraint for the ODMDS alternatives. In the event a FAD is lost, it is typically replaced within two weeks time (Chapman 2004).[1]

The 200 nm EEZ around Guam prohibits commercial fishing by foreign boats and ships. In addition, there is a prohibition on longline fishing in the waters 50 nm around Guam; this area is shown in Figure 3-34 (National Marine Fisheries Service 2007).

The major fisheries species in the waters of Guam are described in Section 3.2.3. The management of Guam nearshore fisheries is provided by the WPRFMC. The council has implemented two fisheries plans, one for deep-water snapper and the other for pelagic species (Chapman 2004).

[1] According to GFCA, a private FAD was once placed somewhere near Perez Bank and operated for approximately 18 months until it broke-off in the late 90's (GFCA 2009).

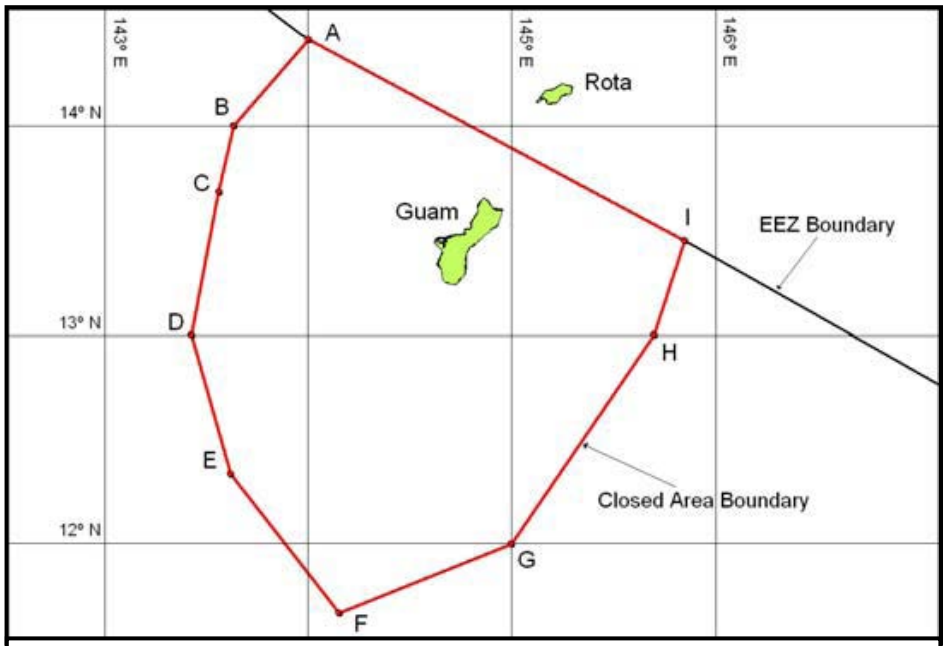

Figure 3-34.
Guam Prohibited Longline Fishing Area

Source: NMFS 2007

Deep-water snapper and tuna fishing are conducted in the waters around Guam by approximately 20 small scale full time operations. Another 180 small scale vessels operate part time or occasionally. Typically, there are 20 small scale fishing vessels operating in deeper water when weather permits (Chapman 2004).

There are no public sector tuna fishing companies in Guam. Nor are there any medium-scale fishing operations, partially due to the 50 nm longline exclusion zone around Guam. There is no export of domestically caught tuna. Foreign vessels do transship some of their fish through Guam; however, none of these fish were caught in the EEZ (Chapman 2004). Regional transshipment of tuna and other fish through the Jose D. Leon Guerrero Commercial Port in Apra Harbor is an important $150 million a year industry (Allen and Bartram 2008). The Commercial Port provides fuel, marine supplies, and maintenance services for vessels.

No registered mariculture operations were identified offshore of Guam.

3.3.2 Military Use

The ROI for military use is the vicinity of the ODMDS Alternative study areas. There are in-water military training areas established around Guam and ship traffic shares the shipping lanes with all other ocean going traffic. The only training areas in the vicinity of the ODMDS Alternative study areas are two drop zones as shown on Figure 3-35 (Marianas Training Range Complex Draft EIS[2], pending). These sites are used for the air-to-surface insertion of personnel and equipment. The majority of in-water training sites are located within or south of Apra Harbor, more than 9 nm distance from the ODMDS alternatives.

[2] Document being prepared for Commander, U.S. Pacific Fleet, Executive Agent. Final EIS anticipated in 2010.

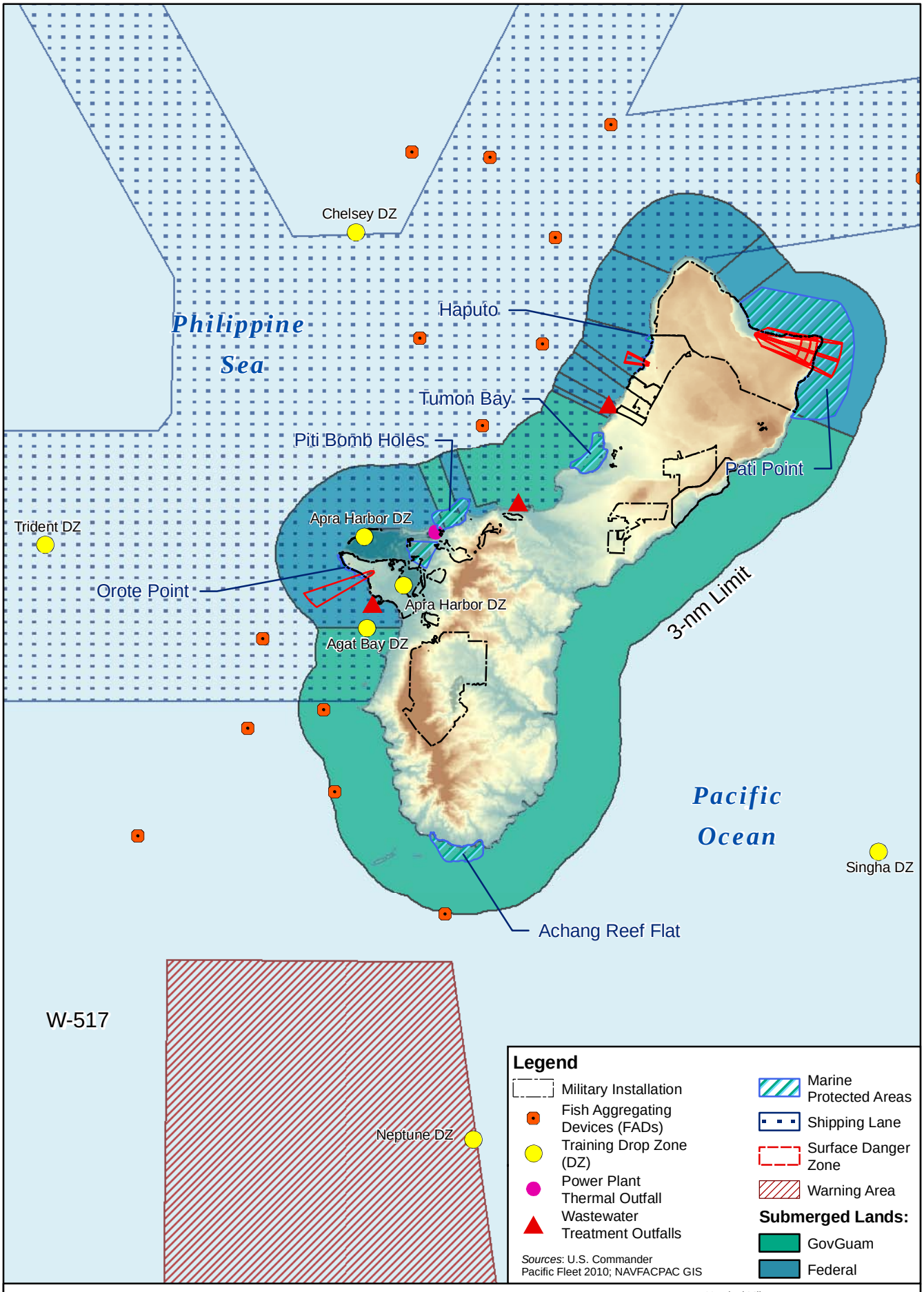

Figure 3-35.
Military Training Areas in the Vicinity of ODMDS Alternative Study Areas

3.3.3 Recreational Use

Tourism has become a $1.3 billion industry and is Guam's largest source of income after US military spending (Guam Visitors Bureau [GVB] 2007; CIA 2008). Guam tourism generates 60% of gross revenues and provides 20,000 jobs, approximately 35% of the island's employment. Japan and Korea comprise 90% of Guam's visitors. The U.S. contributes 4%, Taiwan 2%, and CNMI and Micronesia 3% (GVB 2007). Retail shopping and beautiful beaches are the major draws bringing tourists to Guam. Recreational fishing and water sports are also important draws for tourists as well as residents and military personnel. These activities occur within the region of influence of the study areas.

Recreational Fishing

Recreational fishing has been growing in Guam over the years. Popular fishing sites are characterized by relative ease of access, ability to anchor or secure the boat, and abundant presence of target fishes. Fishermen focusing on areas of bottom relief not only catch reef-associated fishes but also coastal pelagic species that may be attracted to the habitat.

Charter operations began in the 1970s with approximately five charter boats. By 1996, this had increased to 43 boats (Chapman 2004). Today there are about 25 charter boats with an additional 100 private sportfishing boats in Guam. There are numerous gamefishing tournaments each year (Chapman 2004). Charter fishing has accounted for 15-20% of all bottomfishing trips between 1995 through 2004. These trips generally 2 to 4 hours, with the majority of the catch released back to the ocean.

The majority of vessels used around Guam are less than 25 ft (8 m) long and operate in shallow waters (<500 ft [150 m]). There are five boat launch sites on the west coast of Guam:

- Agana Boat Basin – is centrally located on the western leeward coast and is used for fishing areas off the central and northern leeward coasts and the northern banks.
- Merizo Boat Ramp – provides access to the southern coasts, Apra Harbor, Cocos Lagoon, and the southern banks.
- Seaplane Ramp in Apra Harbor - provides access to the southern coasts, Apra Harbor, Cocos Lagoon, and the southern banks.
- Umatacneatac Boat Ramp - provides access to the southern coasts, Apra Harbor, Cocos Lagoon, and the southern banks.
- Agat Marina - provides access to the southern coasts, Apra Harbor, Cocos Lagoon, and the southern banks.

Rough seas limit small boats during most of the year and limit subsistence and recreational bottomfish fisheries to summer months when the sea conditions are calm. Galvez Bank, located off the southeastern shore outside the military restricted area, is fished the most often due to accessibility and distance. White Tuna Bank and Santa Rosa Bank off the southern coast, and Rota Bank north of Guam are remote and only fished during good weather conditions. Guam's system of 16 moored FADs that are used by commercial fishermen are also used by recreational fisherman.

Fishing for the crustaceans, mainly crabs and lobster, occurs for subsistence and recreation in inshore territorial waters. Shore-based fishing accounts for most of the fish and invertebrates harvested from coral reefs.

Water Sports

With its warm, turquoise waters and coral reefs, water attractions are popular in Guam and include diving, jet skiing, wind surfing, sea kayaking, water tours, dolphin watching, and submarine rides (GVB 2008). Much of the water sports activity takes place in the bays of Guam's west coast and around Cocos Island off the southern shore.

Diving is a major draw for tourists and includes photography, spear fishing, wreck and reef diving, and snorkeling (GVB 2008). Reef and shipwreck dive sites are found all along Guam's shores. Eighteen of the 20 most popular dive sites are located along the west coast and in Apra Harbor in depths ranging from 2 to 300 ft (0.6 to 91.4 m) (GVB 2008). These sites are located well inshore of the study areas.

3.3.4 Commercial Shipping

Five surface ship safety lanes (shipping lanes) are used by commercial ship traffic approaching Guam and Apra Harbor (see Figure 2-3). All ship traffic is restricted to these lanes. The study areas were located to avoid the shipping lanes and have been placed between those that approach from the north and west. Existing shipping lanes will be used to transport dredged material to either of the study areas that would contain a designated ODMDS. Barges transporting dredged material are subject to the same navigation rules and regulations that govern all other ship traffic including requirements for a notice to mariners, and respecting rights-of-way.

Apra Harbor lies on the western side of Guam's central section. It is a natural harbor, protected by Orote Peninsula on the south and Cabras Island and the Glass Breakwater on the north. The Glass Breakwater provides wind and wave protection from the Philippine Sea. The harbor is comprised of two main areas: Apra Outer Harbor and Apra Inner Harbor. The Inner Harbor is located to the southeast of the Outer Harbor; it is separated from Outer Apra Harbor by the Guam Shipyard and Polaris Point.

The west-facing entrance to Apra Outer Harbor is 1,500 ft (457 m) wide and over 100 ft (30.5 m) deep. Although the Outer Harbor has many areas where depths exceed 100 ft (30.5 m), it also contains several shoal and reef areas in the eastern portion of the harbor, close to the entrance to the Inner Harbor. While these shallow areas pose only a limited threat to normal operations, they are a significant hazard to navigation during periods of high winds. Vessels entering Apra Inner Harbor are limited to a maximum draft of 32 ft (9.8 m). Apra Outer Harbor contains several mooring buoys and anchorages used by military and commercial vessels.

The port handles both containerized and conventional cargo from the United States and other countries. It handles approximately two million tons of cargo a year (PAG 2008). The type and number of vessel calls between FY2000 and FY2007 are tabulated in Tables 3-20 and 3-21. Apra Harbor is the main berthing facility on the island, consisting of a commercial harbor, a naval complex, and a repair facility. Most of the outer harbor and the entire inner harbor are under the jurisdiction of the U.S. Navy; use of these waters is restricted because they are adjacent to Naval Base Guam facilities.

Table 3-20. Vessel Calls by Type to Apra Harbor for FY2000 to FY2007

Fiscal Year (FY)	Container Ships	Breakbulk RoRo Bulk	Barges	Fishing	Total
FY00	114	295	112	1906	2529
FY01	111	311	111	1960	2693
FY02	105	310	102	1481	2139
FY03	106	339	94	1332	1983
FY04	109	280	97	1044	1648
FY05	103	245	60	800	1327
FY06	109	299	17	771	1289
FY07	127	165	19	670	1281

Source: PAG

Table 3-21. Containers Handled at Apra Harbor FY2000 to FY2007

Fiscal Year	Number of Containers Handled
FY00	77,728
FY01	80,635
FY02	78,328
FY03	82,310
FY04	78,224
FY05	83,867
FY06	84,321
FY07	99,630

Source: PAG

3.3.5 Oil and Natural Gas Development

No oil or other mineral extraction platforms were identified offshore of Guam.

3.3.6 Archaeological, Historical, and Cultural Resources

Cultural resources are defined as any prehistoric or historic district, site, building, structure, or object considered to be important to a culture, subculture, or community for scientific, traditional, religious or any other reason. Cultural resources include prehistoric and historic archaeological resources, architectural resources, and traditional cultural resources.

Archaeological and architectural resources determined to be significant under cultural resource legislation are subject to protection or consideration by a federal agency. Significant cultural resources are those that are eligible or potentially eligible to the National Register of Historic Places (NRHP). The criteria for significance are contained in 36 CFR 60.4 and include association with significant historic events; association with significant people; embodiment of distinctive characteristics; and ability to yield information important in prehistory or history. The determination of significance is made in consultation with the State Historic Preservation Officer (SHPO). Significant historic resources usually must be at least 50 years old; however, certain

structures at technical or scientific facilities associated with important historic periods (e.g., the Cold War, the Space age, the Nuclear Age) may be considered to be eligible to the National Register.

The War in the Pacific National Historic Park (WAPA) was established in 1978 as a memorial to those participating in the World War II Pacific theater campaigns. The WAPA is centrally located on the west side of Guam consisting of seven separate sites significant to the 1944 invasion and recapture of Guam. Of these seven sites, two sites, Asan Beach and Agat Beach include waters of the Philippine Sea. The Asan Beach site extends along the shoreline from just west of Asan Point east to Adelup Point. The Agat Beach site extends along the shoreline from Apaca Point in the north to just south of Agat Village. The WAPA boundaries extend approximately 0.5 mi (0.8 km) offshore to water depths of approximately 60 ft (18 m) (National Park Service 2004). The WAPA includes several submerged cultural resources, including: treads from amphibious tractors, two amphibious tractors, an ammunition dump, a pontoon barge, a tank turret, and a World War II equipment dump.

The Asan Beach site is located approximately 13.1 nm (24.3 km) from the North Study Area (Station 2) and approximately 13.5 nm (25.0 km) from the Northwest Study Area. The Agat Beach site is located approximately 17.8 nm (33.0 km) from the North Study Area (Station 2) and approximately 13.1 nm (24.3 km) from the Northwest Study Area. The WAPA is located 4.0 and 5.8 nm (7.4 and 10.7 km) from the planned barge transit routes between Apra Harbor and the Northwest and North Study Areas, respectively.

Underwater historical resources (e.g., shipwrecks, plane crashes) on the ocean floor between the west coast of Guam and the study areas are unlikely to be impacted by this action. Sixty-three shipwrecks have been documented in the vicinity of the island of Guam (Carrell 1991), although 31 of these are in Apra Harbor alone. Although no underwater archaeological surveys have specifically been conducted for this study region, underwater archaeological sites are unlikely to be located within the project area given its distance from land and reefs and the depth of the ocean bottom.

3.3.7 Public Health and Welfare

Health and welfare concerns for the population of Guam relative to the proposed designation of an ODMDS near Guam involve the potential for release of toxic substances, increases in ciguatoxin outbreaks, hazards to navigation, conflicts between marine traffic and disposal operations equipment, and visual effects.

Potential health hazards may result if dredged material disposed in the ocean releases toxic substances that are bioaccumulated in marine organisms, including fish and shellfish, which are then consumed by humans. As discussed in Chapter 1, ocean disposal is only allowed when USEPA and USACE determine, on a case-by-case basis, that the dredged material is environmentally suitable (e.g., non-toxic) according to testing criteria (40 CFR Parts 225 and 227), as determined from physical, chemical, and bioassay/bioaccumulation testing. All material to be dredged would be tested for the presence of contaminants as well as the potential for toxicity and bioaccumulation prior to dredging in accordance with national testing guidance.

Ciguatera is a disease typically attributed to the ingestion of tropical reef fishes that contain a toxin originating from the benthic dinoflagellate, Gambierdiscus toxicus (Withers 1982). G. toxicus tends to grow as an epiphyte (a plant that grows attached to the surface of another plant), attaching itself to various macroalgae found in coral reef environments. This was confirmed by a study conducted by Yasumoto et al. (1979) that determined that G. toxicus is generally not found free-swimming; rather it occurs in close association and in greater abundance with algae located on coral reef.

There has been no specific environmental parameter shown to directly cause an increase in G. toxicus. Instead, it appears that stressors to the environment which may lead to macroalgae growth (for example, increased nutrients and freshly denuded surfaces for macroalgae attachment) subsequently lead to opportunistic G. toxicus growth (Lehane and Lewis 2000, Anderson and Lobel 1987, Withers 1982, Yasumoto et al. 1980). However, in a review conducted by Anderson and Lobel (1987), they indicated G. toxicus did not occur in extremely shallow waters (<0.5 m) or in areas with high light intensity. A review by Lehane and Lewis (2000) confirmed this fact, indicating G. toxicus preferred water depths of one to four meters with 11% full sunlight.

Ciguatoxic fish tend to be herbivorous fish which feed on benthic algae, coral or detritus in and around tropical coral reefs. Ciguatoxin can be accumulated into fish that prey on herbivorous fish (Withers 1982; Lehane and Lewis 2000). Pelagic, or open ocean, fish (e.g., marlin, mahimahi) have not been shown to contain the ciguatoxin (Withers 1982).

The disposal of dredged material has the potential to raise the elevation of the seafloor and create a navigation hazard in the vicinity of the disposal site. Siting criteria defined in Chapter 1 provide that disposal will only be permitted at sites or in areas selected to minimize the interference of disposal activities with areas of heavy commercial or recreational navigation because the depths at the study areas range from approximately 2,625 ft (800 m) to 8,860 ft (2,700 m), the deposition of dredged material, estimated to be a maximum of 0.4 in (1 cm) per year, is not expected to result in a navigation hazard.

There is a potential for disposal barges to interfere with shipping traffic as they travel to and from the disposal sites. Five shipping lanes are present west of Guam (see Figure 2.3). Active shipping lanes were eliminated from consideration for siting of the preferred ODMDS; however, disposal barges will use shipping lanes to travel to the ODMDS.

Dredged material that is deposited at a disposal site would affect the visual aesthetics of an area if it became visible above the surface of the ocean or at depths visible to boaters or divers below the surface. Because of the depths of the study areas, disposed material would not be visible above or below the water surface.

Visual impacts would more likely be imposed by disposal barges transiting to and from the disposal site. One of Guam's most important qualities is the scenic beauty of its white-sand beaches and ocean vistas. Scenic beauty is often cited by tourists as a reason for visiting Guam. The most popular tourist destination on Guam's west coast is Tumon Bay, located north of Apra Harbor. North of Tumon Bay is Two Lovers Point, another major tourist attraction that provides a viewpoint 400 ft (122 m) above the sea.

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