3.7 Marine Vegetation

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3.7 Marine Vegetation

MARINE VEGETATION SYNOPSIS

The United States Department of the Navy considered all potential stressors, and the following have been analyzed for marine vegetation:

- Acoustic (underwater explosives)
- Physical disturbance and strike (vessels, in-water devices, military expended materials, and seafloor devices)
- Secondary (impacts associated with sediments and water quality)

Preferred Alternative (Alternative 1)

- No Endangered Species Act-listed marine vegetation species are found in the Mariana Islands Training and Testing Study Area.
- Acoustic: Underwater explosives could affect marine vegetation by destroying individual plants or damaging parts of plants. The impacts of these stressors are not expected to result in detectable changes in survival or propagation, and are not expected to result in population-level impacts on marine plant species.
- Physical Disturbance and Strike: Physical disturbance and strikes could affect marine vegetation by destroying individual plants or damaging parts of plants. The impacts of these stressors are not expected to result in population-level impacts on marine plant species.
- Secondary: Secondary stressors are not expected to result in detectable changes in growth, survival, propagation, or population-level impacts because changes in sediment and water quality are not likely to be detectable.
- Pursuant to the Essential Fish Habitat (EFH) requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of explosives and other impulsive sources, vessel movement, in-water devices, military expended materials, and seafloor devices during training and testing activities may have an adverse effect on EFH by reducing the quality and quantity of marine vegetation that constitutes EFH or Habitat Areas of Particular Concern.

3.7.1 Introduction

This section analyzes potential impacts to marine vegetation found in the Mariana Islands Training and Testing (MITT) Study Area (Study Area). The species and taxonomic groups that occur in the Study Area are discussed in this section and the baseline affected environment is discussed in Section 3.7.2 (Affected Environment). The analysis of environmental consequences is presented in Section 3.7.3 (Environmental Consequences), and the potential impacts of the Proposed Action are summarized in Section 3.7.4 (Summary of Potential Impacts [Combined Impacts of All Stressor] on Marine Vegetation).

For this Environmental Impact Statement (EIS)/Overseas EIS (OEIS), marine vegetation is evaluated as groups of species characterized by their distribution. Training and testing activities of the United States (U.S.) Department of the Navy (Navy) are evaluated for their potential impacts on six major taxonomic groups of marine vegetation as appropriate (Table 3.7-1). Marine vegetation, including marine algae and flowering plants, are found throughout the Study Area. Marine vegetation species included as components of habitats that are designated as EFH under the Magnuson-Stevens Fishery Conservation and Management Act are described in the Essential Fish Habitat Assessment (EFHA), and conclusions from the EFHA are summarized in each substressor section. The EFHA for the MITT Study Area is a supporting technical document (U.S. Department of the Navy 2014), and the U.S. Navy has consulted with the National Marine Fisheries Service on the EFHA (refer to Appendix C, Agency Correspondence). No Endangered Species Act (ESA)-listed species are found in the MITT Study Area.

The distribution and condition of abiotic (non-living) substrate associated with attached macroalgae and the impact of stressors are described in Section 3.3 (Marine Habitats). Additional information on the biology, life history, and conservation of marine vegetation can be found on the websites of the following agencies and groups:

- National Marine Fisheries Service (NMFS), Office of Protected Resources (including ESA-listed species distribution maps)
- Conservation International
- Algaebase
- National Resources Conservation Service
- National Museum of Natural History

To cover all marine vegetation types represented in the Study Area, the major groups are discussed in Section 3.7.2 (Affected Environment). The major taxonomic groups include five groups of marine algae and one group of flowering plants (Table 3.7-1).

Table 3.7-1: Major Groups of Marine Vegetation in the Mariana Islands Training and Testing Study Area

Marine Vegetation Groups[1]		Presence in Study Area	
Phylum (Common Name)	**Description**	**Open Ocean**	**Coastal Waters**
Phylum Dinophyta (Dinoflagellates)	Most are photosynthetic single-celled algae that have two whip-like appendages (flagella); Some live inside other organisms. Some produce toxins that can result in red tides or ciguatera poisoning.	Euphotic Zone[2]	Euphotic Zone
Phylum Cyanobacteria (Blue green algae)	These organisms may form mats that attach to reefs and produce nutrients for other marine species through nitrogen fixation.	Euphotic Zone	Euphotic Zone, seafloor
Phylum Chlorophyta (Green algae)	Marine species occur as unicellular algae, filaments, and large seaweeds; some form calcium deposits.	Euphotic Zone	Euphotic Zone, seafloor
Phylum Heterokontophyta (Diatoms, brown and golden-brown algae)	Diatoms are single-celled algae that form the base of the marine food web; brown and golden-brown algae are large multi-celled seaweeds that may form extensive canopies, providing habitat and food for many marine species.	Euphotic Zone	Euphotic Zone, seafloor
Phylum Rhodophyta (Red algae)	Single-celled algae and multi-celled large seaweeds; some form calcium deposits.	Euphotic Zone	Seafloor
Phylum Spermatophyta (Flowering Plants)	Flowering plants in the Study Area (i.e., seagrasses and mangroves) are adapted to salty marine environments in mudflats and marshes, providing habitat and food for many marine species.	None	Seafloor, Intertidal subtidal

[1] Taxonomic groups are based on the Catalogue of Life (Bisby et al. 2010).
[2] Euphotic zone is the portion of the water column where sunlight can penetrate and photosynthesis can occur.

3.7.2 Affected Environment

Features that influence the distribution and abundance of marine vegetation in the coastal waters and open ocean areas of the Study Area are the availability of light, water quality, water clarity, salinity level, seafloor type (important for rooted or attached vegetation), artificial substrates, currents, tidal schedule, and temperature (Green and Short 2003). Marine ecosystems depend almost entirely on the energy produced by marine vegetation through photosynthesis (Castro and Huber 2000), which is the transformation of the sun's energy into chemical energy. In the lighted surface waters of the open ocean and coastal waters, marine algae and flowering plants provide oxygen, food, and habitat for many organisms in addition to forming the base of the marine food web (Dawes 1998).

Of the known major groups found in the Mariana Islands, there are approximately 26 species of blue green algae, 109 species of red algae, 31 species of brown algae, 71 species of green algae, 10 species of seagrasses, 10 species of mangroves (Ellison 2008, Gilman et al. 2006, Lobban and Tsuda 2003), and an estimated 1,200 species of dinoflagellates (Castro and Huber 2000).

The marine vegetation species in the group of seagrasses and mangroves has more limited distributions; all of these occur in shallow (less than 85 feet [ft.] [25.9 meters {m}]) water. The relative distribution of seagrass is influenced by the availability of suitable soft substrates, such as sand or mud, in low-wave-energy areas at depths that allow sufficient light exposure (Spalding et al. 2003), and fresh water input (Houk and van Woesik 2008).

The baseline description for marine vegetation in the Study Area (see Section 3.7.2, Affected Environment), is based on references from scientific research and information published by regulatory agencies. In Section 3.7.3 (Environmental Consequences), the alternatives were evaluated based on the potential and the degree to which exposure to training and testing activities could impact marine vegetation.

3.7.2.1 General Threats

Environmental stressors on marine vegetation are products of human activities (industrial, residential, and recreational) and natural occurrences. The impacts of these environmental stressors on marine vegetation and the existing conditions of this resource are important to consider in determining if Navy training and testing activities contribute to these stressors. Species-specific information is discussed where applicable. Physical disturbance and strike stressors, secondary stressors (addressed in Sections 3.7.3.2 and 3.7.3.3, respectively), and the cumulative impacts of these threats are analyzed in Chapter 4 (Cumulative Impacts).

Human-made stressors that act on marine vegetation include excessive nutrient input (pollutants, such as fertilizers), siltation (the addition of fine particles to the ocean), pollution (oil, sewage), climate change, overfishing (Ellison 2008, Mitsch et al. 2009, Steneck et al. 2002), and the introduction of invasive species, such as other types of non-native vegetation or herbivorous species (Hemminga and Duarte 2000, Spalding et al. 2003). The seagrass and mangrove group is more sensitive to stressors compared to the algal taxonomic groups. The great diversity of algae makes it difficult to generalize but, overall, they are resilient and are able to colonize disturbed environments created by stressors (Levinton 2009b).

Seagrasses and mangroves are all susceptible to the human-induced stressors on marine vegetation, and their presence in the Study Area has decreased as a result (Food and Agriculture Organization of the United Nations 2007, Gilman et al. 2006, Spalding et al. 2003). Seagrasses can be uprooted by dredging and scarred by boat propellers (Hemminga and Duarte 2000, Spalding et al. 2003) and uprooted and broken by anchors (Francour et al. 1999). Seagrass that is scarred from boat propellers can take years to recover (Dawes et al. 1997). Likewise, the global mangrove resource has decreased over the last 50 years to about two-thirds of what it used to be due to aquaculture, changes in hydrology (water movement and distribution), and sea level rise (Feller et al. 2010). Although not occurring in the Study Area, a main threat to mangroves worldwide is removal of mangrove for the establishment of shrimp aquaculture ponds. Shrimp aquaculture accounts for the loss of 20 to 50 percent of mangroves worldwide (McLeod and Salm 2006).

A stressor of particular concern for marine vegetation is pollution. Runoff from land-based sources, natural seeps, and accidental spills (e.g., oil tanker spills) are some of the major sources of pollution in the marine environment (Levinton 2009a). The types and amounts of contaminant spilled, weather conditions, season, location, oceanographic conditions, and the method used to remove the contaminant (containment or chemical dispersants) are some of the factors that determine the severity of the impacts. Sensitivity to contaminants varies among marine vegetation species and within species, depending on the life stage; generally, early-life stages are more sensitive than adult stages (Hayes et al. 1992). Additionally, those species that are completely submerged are less susceptible to contaminants which remain on the surface, such as oil, since they largely escape direct contact with the pollutant. In the Study Area, mangroves would be the most susceptible marine vegetation species because contact with oil can cause death, leaf loss, and germination failure (Hoff 2002).

The discussion above represents general threats to marine vegetation. Additional threats to individual species within the Study Area are described below in the accounts of those species.

3.7.2.2 Marine Vegetation Groups

3.7.2.2.1 Phylum Cyanobacteria (Blue-Green Algae)

Blue-green algae are single-celled and filamentous (fine threads) forms of photosynthetic (using the sun's energy to produce food) bacteria that inhabit the lighted surface waters and seafloors of the world's oceans (Bisby et al. 2010). Blue-green algae are key primary producers in the marine environment, and provide valuable ecosystem services such as producing oxygen and nitrogen. The blue-green algae *Prochlorococcus* is responsible for a large part of the oxygen produced globally by photosynthetic organisms. Other species of blue-green algae have specialized cells that convert nitrogen gas into a form that can be used by other marine plants and animals (nitrogen fixation) (Hayes et al. 2007, Whitton and Potts 2008). In nutrient-poor waters of the Study Area where coral reef ecosystems are present, blue-green algae may be a source of food for herbivorous marine life Areas lacking herbivorous fish, or other animals which feed on blue-green algae, are likely to have a higher abundance of highly productive and invasive blue-green algae (Cheroske et al. 2000).

3.7.2.2.2 Phylum Dinophyta (Dinoflagellates)

Dinoflagellates are single-celled organisms with two flagella (whiplike structures used for locomotion) in the phylum Dinophyta (Bisby et al. 2010). Dinoflagellates are a marine algae, with an estimated 1,200 species living in surface waters of the ocean worldwide (Castro and Huber 2000). Most dinoflagellates use the sun's energy to produce food through photosynthesis; some species also ingest small food particles or do both. Photosynthetic dinoflagellates are important primary producers in coastal waters (Waggoner and Speer 1998). Organisms such as zooplankton, small organisms with an external supportive covering (exoskeleton), feed on dinoflagellates.

Dinoflagellates are also valuable for their close relationship with reef-building corals. Some species of dinoflagellates, the zooxanthellae, live inside corals. This mutually beneficial relationship provides shelter and food (in the form of coral waste products) for the dinoflagellates; in turn, the corals receive essential nutrients produced by dinoflagellates (Spalding et al. 2001). Dinoflagellates are responsible for some types of algal blooms, which can be harmful to invertebrates, fish, birds, marine mammals, and humans. These algal blooms usually result from sudden increases in nutrients (e.g., terrestrial runoff of fertilizers), temperature changes, and increase in algal productivity due to sunlight (Levinton 2009c). Additional information on harmful algal blooms can be accessed on the Centers for Disease Control and the National Oceanic and Atmospheric Administration (NOAA) websites.

3.7.2.2.3 Phylum Chlorophyta (Green Algae)

Green algae are single-celled and multi-cellular plants in the phylum Chlorophyta that may form large colonies of individual cells (Bisby et al. 2010). Green algae are predominately found in freshwater, with only 10 percent of the estimated 7,000 species living in the marine environment (Castro and Huber 2000). These species are important primary producers that play a key role at the base of the marine food web. Green algae are found in areas with a wide range of salinity, such as bays and estuaries, and are eaten by various organisms, including zooplankton (small animals that float in the water), snails, and herbivorous fish. In the Study Area, the green algae, *Caulerpa racemosa* and *Caulerpa lentillifera,* are harvested for human consumption.

3.7.2.2.4 Phylum Heterokontophyta (Brown Algae)

Brown and golden-brown algae are single-celled (diatoms) and large multi-celled marine species with structures varying from fine filaments to thick leathery forms (Castro and Huber 2000). In the Study Area there are 31 species of brown algae (Lobban and Tsuda 2003). Most species are attached to the seafloor in coastal waters, and include species such as *Sargassum ilicifolium, Sargassum obtusifolium,* and *Sargassum polycystum* (Lobban and Tsuda 2003). Additionally, several species of diatoms occur in the Study Area such as *Nitzschia martiana* (Lobban and Tsuda 2003).

3.7.2.2.5 Phylum Rhodophyta (Red Algae)

Red algae are predominately marine algae, with approximately 4,000 species worldwide (Castro and Huber 2000). Red algal species exist in a range of forms, including single and multicellular forms (Bisby et al. 2010), from fine filaments to species with thick calcium carbonate crusts. Within the Study Area, they occur in coastal waters, primarily in reef environments and intertidal zones. Some species of red algae that occur in the Study Area include *Erythrotrichia carnea* and *Yamadaella caenomyce* (Lobban and Tsuda 2003). In the Study Area, the species *Gracilaria tsudae* had previously been harvested for human consumption until being implicated in the deaths of three individuals in 1991 (Tsuda 2009).

Many Rhodophyta species support coral reefs by trapping loose sediments, and cementing coral fragments to provide the base structures for coral growth and a living protective cover (Castro and Huber 2000). Coralline algae secrete calcium carbonate to build a hard shell around its cell walls. There are both encrusting forms, which grow as a crust over hard structures such as rocks and the shells of organisms like clams and snails, and upright forms of coralline algae (Kennedy 2012). Some species of red crustose coralline algae in the Study Area include *Hydrolithon onkodes, Lithophyllum pygmaeum,* and *Pneophyllum conicum* (Minton et al. 2009).The percentage cover of red coralline algae is estimated from surveys to be less than 20 percent for Guam and Tinian and increases to approximately 31 to 50 percent on portions of the southwestern side of Saipan (Minton et al. 2009).

3.7.2.2.6 Phylum Spermatophyta (Flowering Plants)

Seagrasses and mangroves are flowering marine plants in the phylum Spermatophyta (Bisby et al. 2010). These marine flowering plants create important habitat, and are a food source for many marine species.

3.7.2.2.6.1 Seagrasses

Seagrasses are unique among flowering plants in their ability to grow submerged in shallow marine environments. Except for some species that inhabit the rocky intertidal zone, seagrasses grow in shallow, subtidal, or intertidal sediments, and can extend over a large area to form seagrass beds (Garrison 2004, Phillips and Meñez 1988). They provide suitable nursery habitat for commercially important organisms (e.g., crustaceans, fish, and shellfish) and also are a food source for some protected species (e.g., sea turtles) (Heck et al. 2003). The structure of seagrass beds can prevent coastal erosion, promotes nutrient cycling through the breakdown of detritus (Dawes 1998), and improves water quality. Seagrasses also contribute a high level of primary production to the marine environment, which supports high species diversity and biomass (Spalding et al. 2003).

Seagrass beds are distributed within the Study Area (see Figures 3.3-1 to 3.3-4). Seagrasses that occur in the coastal areas of the Study Area from the southern Mariana Islands include *Enhalus acoroides, Halodule uninervis,* and *Halophila minor* (Tsuda et al. 1977). Both Guam and Saipan have extensive seagrass meadows surrounding the coastlines (National Centers for Coastal Ocean Science and National Oceanic and Atmospheric Administration 2005), including extensive beds in Agat Bay (including the Agat Unit of the War in the Pacific National Historical Park) (Daniel and Minton 2004), south of Apra Harbor, Agana Bay, and Cocos Lagoon on Guam (Daniel and Minton 2004, Eldredge et al. 1977) (Figure 3.7-1). According to NOAA satellite surveys, there are no seagrass beds in Apra Harbor (Figure 3.7-2); however, smaller beds of seagrasses may be present in this area. The NOAA satellite surveys do not show seagrass beds around Tinian (Figure 3.7-3). However, a literature review provided information that Tinian possesses seagrass beds along the northeastern, eastern, the southwestern, and northwestern coastlines (Kolinski 2001, U.S. Department of the Navy 2003), and that seagrasses were largely absent from Tinian’s north and south coasts (Kolinski 2001). Seagrasses are more scattered on the island of Saipan (Figure 3.7-4), with seagrass beds reported along Tanapag Beach (along the northwest coast) and in Puerto Rico Mudflats (northwest shoreline, north of Tanapag Beach) (Scott 1993, Tsuda et al. 1977). There is no record of seagrasses for the islands north of Saipan (Tsuda 2009), which is also documented in the NOAA satellite surveys for FDM (Figure 3.7-5).

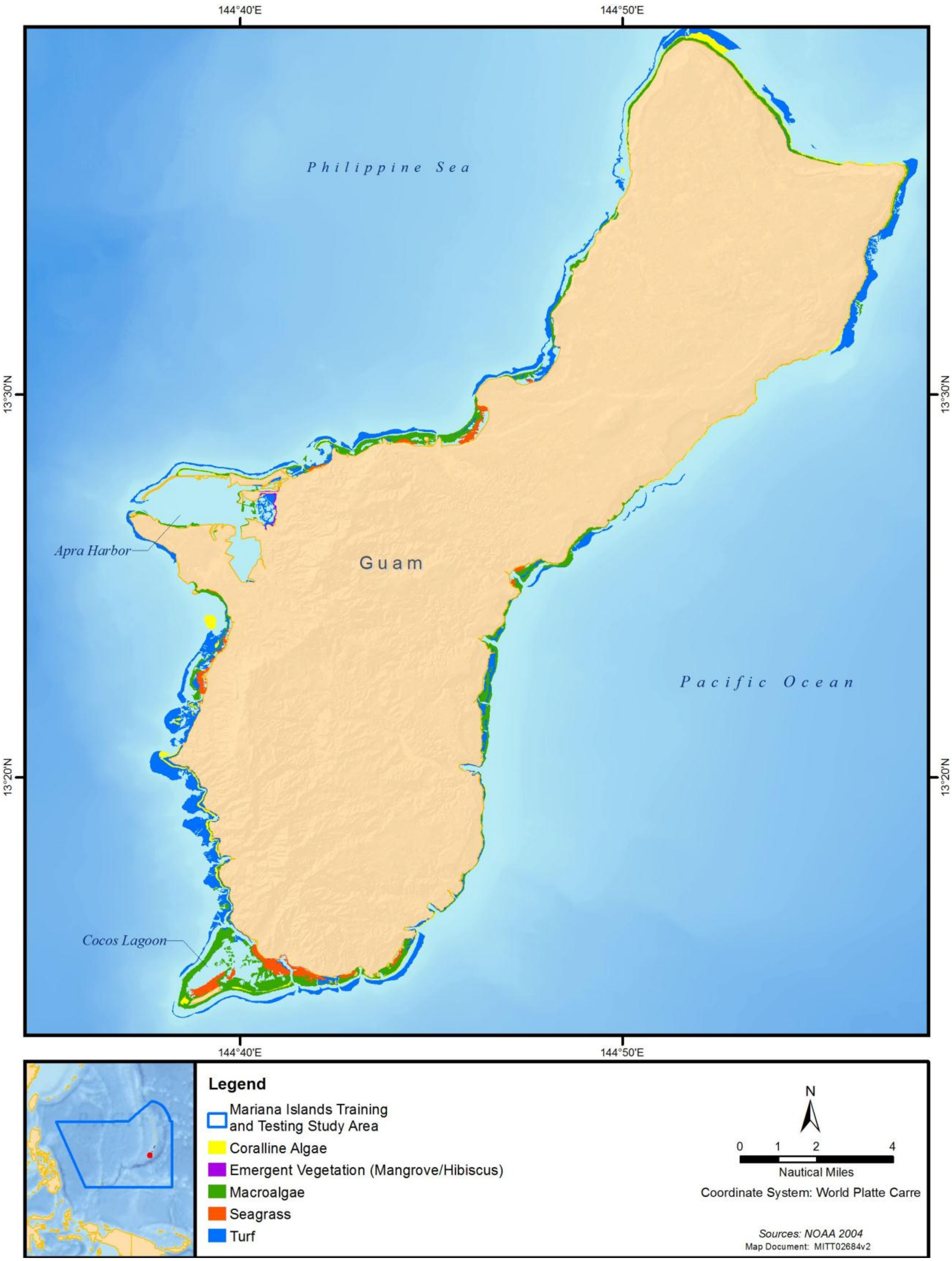

Figure 3.7-1: Marine Vegetation Surrounding Guam

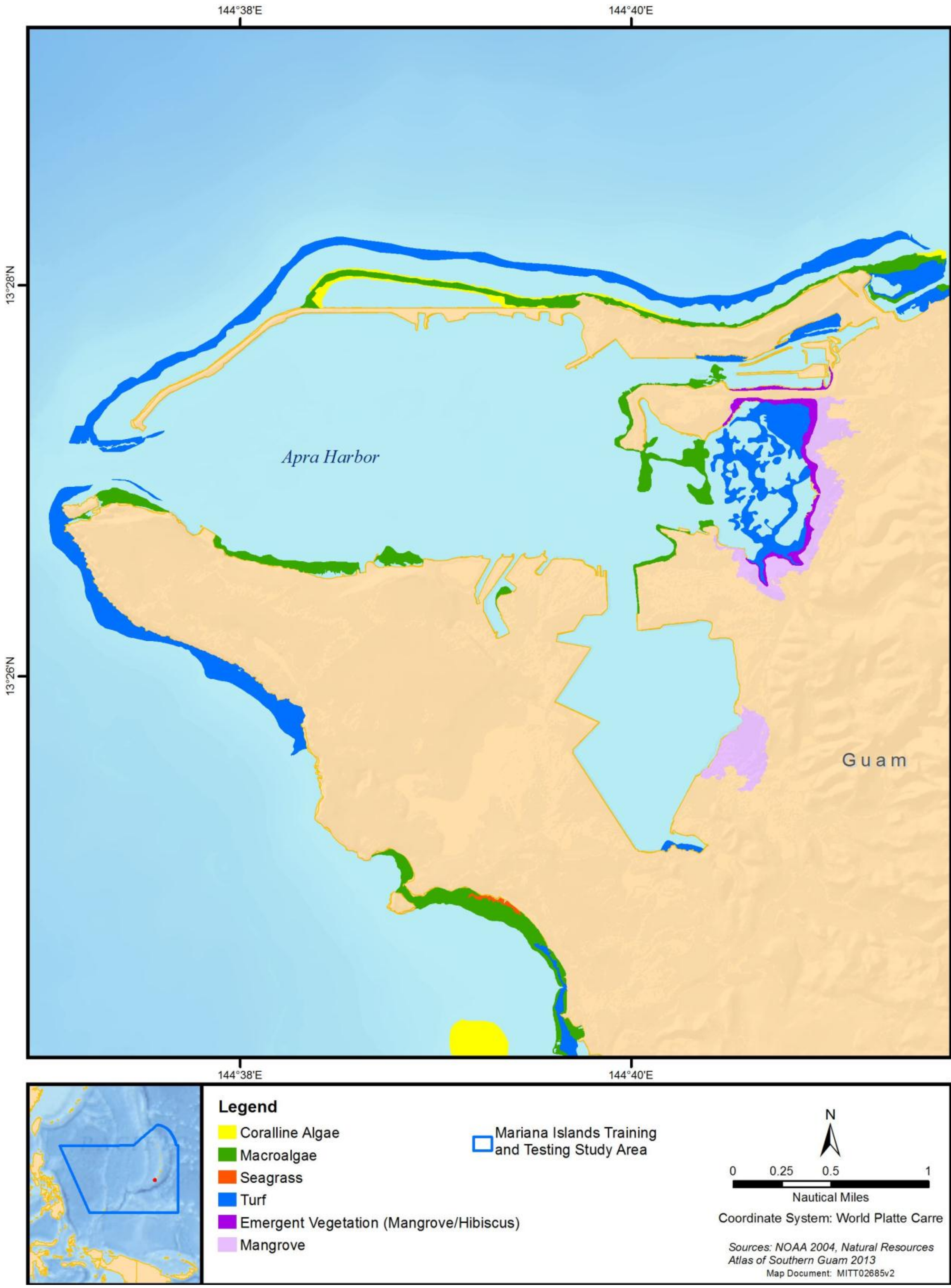

Figure 3.7-2: Marine Vegetation in the Vicinity of Apra Harbor

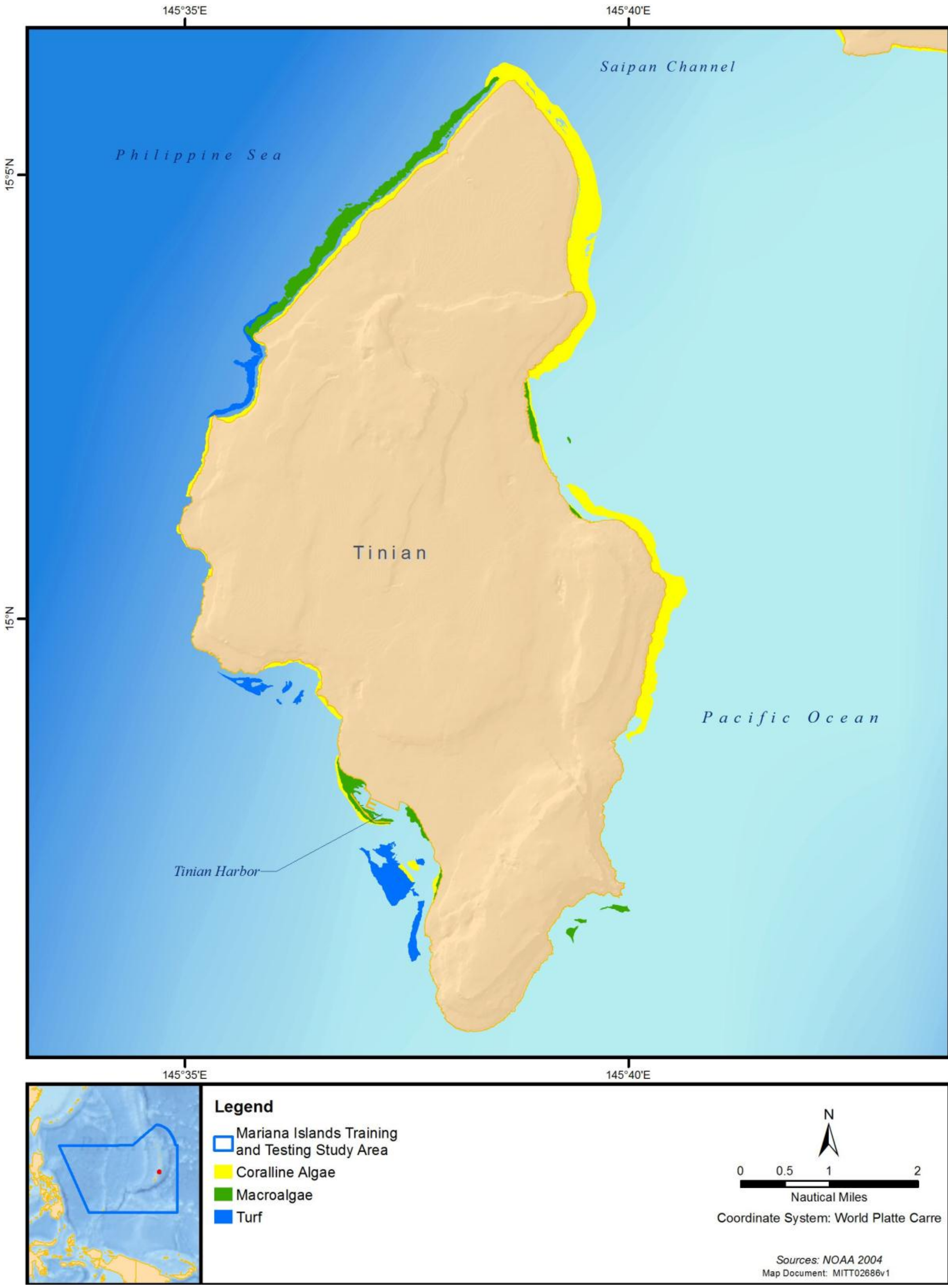

Figure 3.7-3: Marine Vegetation Surrounding Tinian

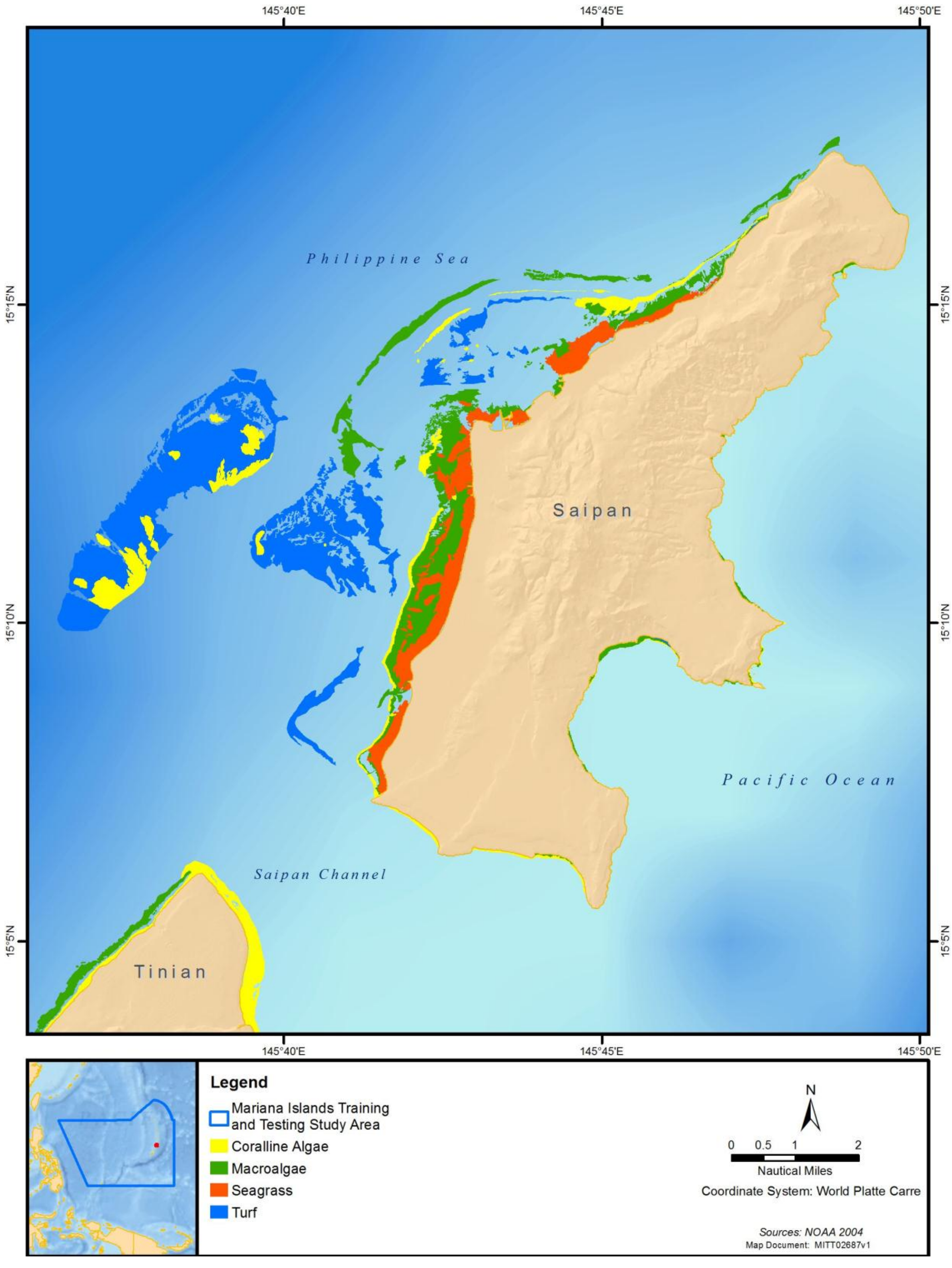

Figure 3.7-4: Marine Vegetation Surrounding Saipan

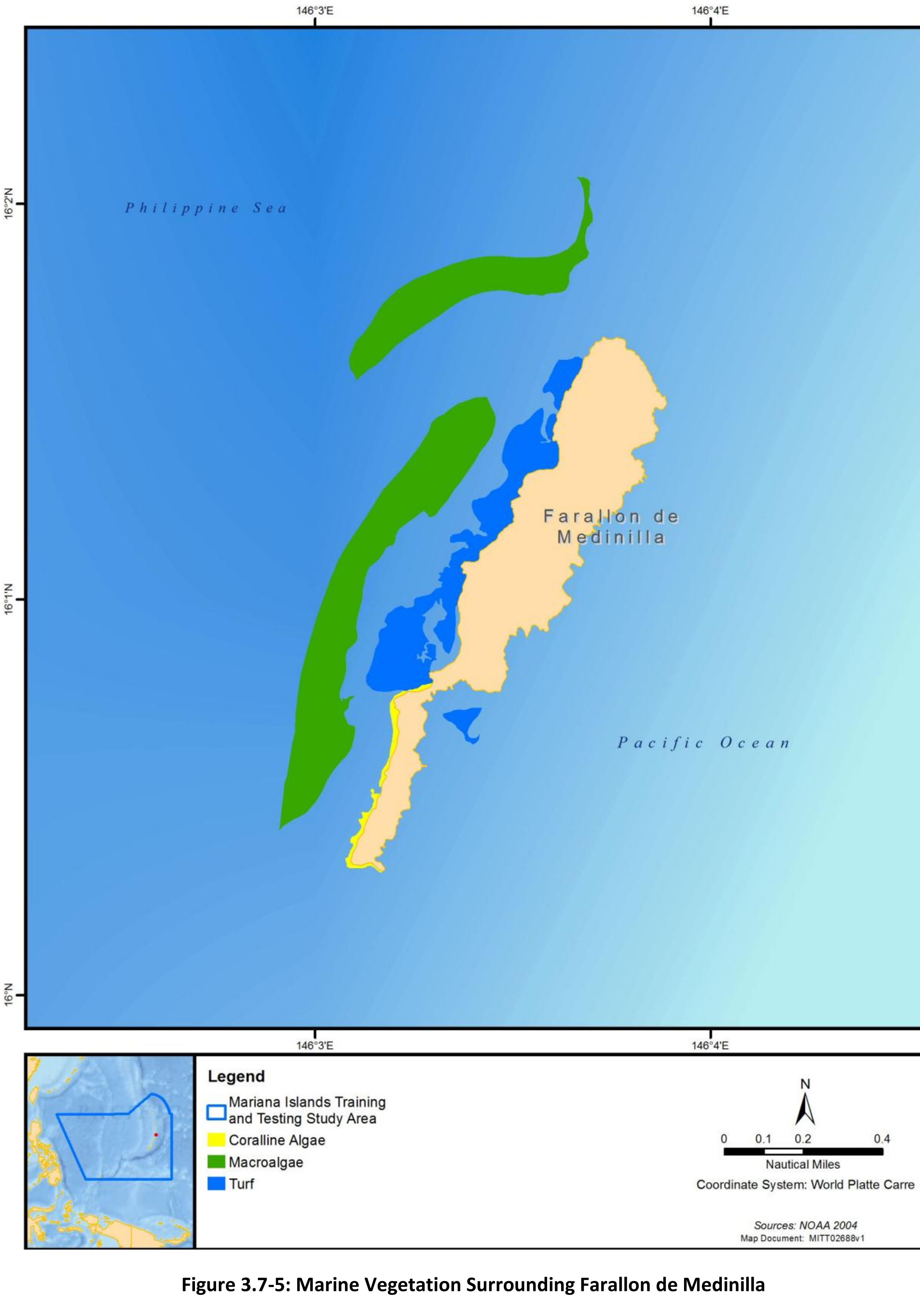

Figure 3.7-5: Marine Vegetation Surrounding Farallon de Medinilla

3.7.2.2.6.2 Mangroves

Mangroves are a group of woody plants that have adapted to brackish water environments in the tropics and subtropics (Ruwa 1996). Mangroves provide critical ecosystem services in their role as primary producers, including contributions to the decomposition of matter (Bouillon 2009), sediment stabilization (Ruwa 1996), nursery habitat (Mitsch et al. 2009), and providers of habitat for commercially important species (e.g., fish, shrimp, and crabs) (Aburto-Oropeza et al. 2008, Hogarth 1999). Nearshore fisheries associated with mangroves are generally more productive than those not associated with mangroves due to the nutrient storage in the plants and the physical complexity of the habitat that mangroves provide for fish and their prey (Ruwa 1996).

Mangroves provide important nursery habitat for many species of fish and invertebrates. Conservation of mangrove habitats is important due to the use of these areas as nurseries for commercial fish species and coral reef fish species (Laegdsgaard and Johnson 1995). Additionally, researchers have found that coral reef fish were twice as abundant on reefs adjacent to mangrove forests compared to reefs without mangroves (Roach 2004).

Mangrove forest are native to the Study Area; however, they are only present on the islands of Guam and Saipan, with the mangroves of Guam being the most extensive and diverse totaling approximately 170 ac. (68 hectares [ha]) (Scott 1993). However, a recent survey documented only 84.5 ac. (34.2 ha) (Bhattarai and Giri 2011). Guam has 10 species of mangroves including *Rhizophora mucronata, Rhizophora apiculata, Avicennia marina*, *Bruguiera gymnorhiz, Lumnitzera littorea, Nypa fructicans, Xylocarpus moluccensis, Heritiera littoralis, Heritiera tiliaceus,* and *Acrostichum aureum* (Guam Department of Agriculture 2005). The mangrove forest on Saipan is dominated by a single species, *Bruguiera gymnorhiza.*

3.7.3 Environmental Consequences

This section presents the analysis of potential impacts on marine vegetation, from implementation of the project alternatives, including the No Action Alternative, Alternative 1, and Alternative 2. General characteristics of all stressors were introduced in Section 3.0.5.2 (Identification of Stressors for Analysis), and living resources' general susceptibilities to stressors are discussed in Appendix H (Biological Resource Methods). Each marine vegetation stressor is introduced, analyzed by alternative, and analyzed for training activities and testing activities.

The stressors vary in intensity, frequency, duration, and location within the Study Area. Because marine vegetation is not susceptible to energy, entanglement, or ingestion stressors, those stressors will not be assessed. Only the training and testing activity stressors and their components that occur in the same geographic location as marine vegetation are analyzed in this section. Based on the general threats to marine vegetation discussed in Section 3.7.2 (Affected Environment), the stressors applicable to marine vegetation are:

- Acoustic (underwater explosives)
- Physical disturbance and strike (vessels, in-water devices, military expended materials, and seafloor devices)
- Secondary (impacts associated with sediments and water quality)

Details of all training and testing activities, stressors, components that cause the stressor, and geographic occurrence within the Study Area, are summarized in Section 3.0.5.2 (Identification of Stressors for Analysis) and detailed in Appendix A (Training and Testing Activities Descriptions).

3.7.3.1 Acoustic Stressors

This section analyzes the potential impacts of acoustic stressors that may occur during training and testing activities on marine vegetation within the Study Area. The acoustic stressors that may impact marine vegetation include explosives that are detonated on or near the surface of the water, or underwater; therefore, only these types of explosions are discussed in this section.

3.7.3.1.1 Impacts from Explosives

This section analyzes the potential impacts of training and testing activities conducted by the military that involve underwater explosions in the water column and on the seafloor in the Study Area. Various types of explosives are used during training and testing activities. The type, number, and location of activities that use explosives under each alternative are discussed in Section 3.0.5.2.1.2 (Explosives). Explosive sources are the only acoustic stressor applicable to this resource because of the potential for explosives to result in physical damage to marine vegetation.

The potential for an explosion to injure or destroy marine vegetation would depend on the amount of vegetation present, the number of munitions used, and their net explosive weight (NEW). In areas where marine vegetation and locations for explosions overlap, vegetation on the surface of the water, in the water column, or rooted in the seafloor may be impacted. Seafloor macroalgae and single-celled algae may overlap with underwater and sea surface explosion locations. If these vegetation types are near an explosion, only a small number of them are likely to be impacted relative to their total population level. The low number of explosions relative to the amount of seafloor macroalgae and single-celled algae in the Study Area also decreases the potential for impacts on these vegetation types. Based on these factors, the impact on these types of marine vegetation would not be detectable, and they will not be discussed further. In addition, some seafloor macroalgae are resilient to high levels of wave action (Mach et al. 2007), which may aid in their ability to withstand underwater explosions that occur near them. Underwater explosions also may temporarily increase the turbidity (sediment suspended in the water) of nearby waters, incrementally reducing the amount of light available to marine vegetation. Reducing light availability will decrease, albeit temporarily, the photosynthetic ability of marine vegetation.

Seagrasses may potentially be uprooted or damaged by sea surface or underwater explosions. Re-growth of seagrasses after uprooting can take up to 10 years (Dawes et al. 1997). Explosions may also temporarily increase the turbidity (sediment suspended in the water) of nearby waters, but the sediment would settle to pre-explosion conditions within a number of days. Sustained high levels of turbidity may reduce the amount of light that reaches vegetation which it needs to survive. This scenario is not likely given the low number of explosions planned in areas with seagrass. It should be noted that seagrasses generally grow in waters that are sheltered from wave action, such as estuaries, lagoons, and bays (Phillips and Meñez 1988) where most activities are not conducted. Detonations are unlikely to occur in areas with mangroves or seagrasses. Detonations in the Study Area, at the underwater detonation (UNDET) sites (Figure 3.7-2) would occur in previously disturbed areas over unvegetated seafloor.

3.7.3.1.1.1 No Action Alternative

Training Activities

Under the No Action Alternative, mine neutralization systems that use explosive ordnance disposal divers and remotely operated vehicles may involve explosions on the seafloor. Table 3.7-2 lists training and testing activities that include seafloor explosions, along with the location of the activity and the associated explosives charges. These activities may impact seafloor vegetation. Within the coastal waters of the Study Area, 50 mine neutralization training activities with explosive ordnance would occur every year, using a total of 50 explosive charges, with each charge ranging from 1 to 10 pounds (lb.) (0.5 to 4.5 kilograms [kg]) NEW. These activities would occur in areas that have been previously disturbed and are unlikely to support marine vegetation.

If marine vegetation (not including seagrasses) did occur within blast zones, the vegetation may have a clearly detectable response (e.g., algal mats dispersing, rupture of individual plant cells), followed by a recovery period lasting weeks to months after exposure. Although marine vegetation growth in the immediate area of explosions would be inhibited, long-term survival, annual reproductive success, or lifetime reproductive success of the population would not be impacted since recovery is likely.

Some seafloor macroalgae in coastal areas are adapted to natural disturbances such as storms and wave action that can exceed 33 ft. (10.1 m) per second (Mach et al. 2007), and would be expected to quickly recover from local UNDETs. It is reasonable to assume that training activities involving stressors that result in impacts similar to natural events would be followed by a similar recovery period. Impacts from explosions that exceed natural disturbance intensity or frequency may include uprooting of plants and substrate damage, which would prolong recovery times. However, the military further reduces impacts on overall vegetation communities by using unvegetated areas that are already disturbed.

Table 3.7-2: Annual Training and Testing Activities that Include Seafloor Explosions

Activity	Explosive Charge (NEW)[1]	Underwater Detonations			Location
		No Action[1]	Alternative 1	Alternative 2	
Training					
Mine Neutralization (Explosive Ordnance Disposal)	1–20 lb.	20	20	20	Agat Bay Mine Neutralization Site Piti Point Mine Neutralization Site Outer Apra Harbor Underwater Detonation Site
Underwater Demolition Qualification/ Certification	1–20 lb.	30	30	30	
Testing					
Mine Countermeasure Mission Package Testing	5 lb.	0	24	28	Study Area

[1] Under the No Action Alternative, the NEW would not exceed 10 lb. Under Alternatives 1 and 2 only Agat Bay Mine Neutralization Site NEW would increase to a maximum of 20 lb.
Notes: lb. = pound(s), MIRC = Mariana Islands Range Complex, NEW = net explosive weight

There are no seagrass beds or mangroves located in the vicinity of the UNDET area in Apra Harbor or in the open ocean locations (Figures 2.7-1 and 3.7-1). Underwater and surface explosions conducted for training activities are not expected to cause any risk to marine algae or seagrass because: (1) the relative coverage of marine vegetation in these areas is low, (2) the impact area of underwater explosions is very small relative to marine vegetation distribution (see Section 3.3.3.1, Acoustic Stressors [Explosives], in Section 3.3, Marine Habitats), and (3) seagrass does not overlap with areas where the stressor occurs. Based on these factors, potential impacts on multi-cellular marine algae from underwater and surface explosions are not expected to impact the long-term survival, annual reproductive success, and lifetime reproductive success, and are not expected to result in population level impacts; and there are no potential impacts on seagrass species.

Testing Activities

Under the No Action Alternative, there are no testing activities that include the use of explosives that would have an acoustic impact on marine vegetation.

3.7.3.1.1.2 Alternative 1

Training Activities

Under Alternative 1, there is a proposed increase in UNDETs from 10 lb. NEW to 20 lb. NEW at the Agat Bay Mine Neutralization Site. Underwater detonations at the Piti Point Mine Neutralization and Outer Apra Harbor UNDET sites would remain at 10 lb. NEW. Under Alternative 1, about 50 mine neutralization training activities with explosive ordnance would occur every year. These activities would occur in areas that have been previously disturbed and are unlikely to support marine vegetation. In addition, a shock wave generator would be used, however, based on the small amount of explosives (0.033 lb. [0.015 kg]) used in a shock wave generator; no impacts to marine vegetation are expected.

Under Alternative 1, underwater explosions conducted for training activities may injure or kill individual marine vegetation; however, exposure to these detonations would be limited to the vicinity of the explosions. The UNDET area in Apra Harbor is located in a sandy habitat where there are no seagrass beds or other marine vegetation located (Figures 2.7-1, 3.3-2, and 3.7-2). The offshore underwater mine neutralization sites are located in areas with water depths that are unlikely for marine vegetation to occur in (Figure 2.7-1). Despite the increase in underwater and surface explosions, the potential impacts on exposed marine algae are expected to be the same as under the No Action Alternative because the overlap with the resource is limited. Underwater and surface explosions conducted for training activities are not expected to pose a risk to seagrass because: (1) the impact area of underwater explosions is very small relative to seagrass distribution and (2) the low number of charges reduces the potential for impacts. For the same reasons as stated in Section 3.7.3.1.1.1 (No Action Alternative) for marine algae and here for seagrass, the use of surface and underwater explosions is not expected to impact the long-term survival, annual reproductive success, and lifetime reproductive success of marine vegetation, and is therefore not expected to result in population-level impacts.

Testing Activities

Alternative 1 would introduce testing activities that would involve the use of 6,012 explosives. As presented in Tables 2.8-2 to 2.8-4, these testing activities occur in waters between 3 and 12 nautical miles (nm) from shore within the Study Area, which are not likely to support marine vegetation such as attached macro algae or seagrasses. However, there would be 24 UNDETs (explosive neutralizers) used during mine countermeasure mission package testing activities. The maximum NEW of each detonation would be 5 lb. which could impact an area of 145 square feet (ft.^{2}) (13 square meters [m^2]). Underwater explosions associated with testing activities under Alternative 1 would disturb approximately 3,480 ft.^{2} (310 m^2) per year of substrate in the Study Area (Table 3.3-4).

Under Alternative 1, underwater explosions conducted for testing activities may injure or kill individual marine plants; however, exposure to these detonations would be limited to the vicinity of the explosions and would not pose a risk to marine vegetation communities. Marine vegetation within blast zones could have a clearly detectable response (e.g., algal mats dispersing, rupture of individual plant cells), followed by a recovery period lasting weeks to months. The long-term survival, annual reproductive success, and lifetime reproductive success of marine vegetation would not be impacted. The explosions occur in open water and in the outer part of Apra Harbor. Some seafloor macroalgae in coastal areas are adapted to natural disturbances such as storms and wave action that can exceed 33 ft. (10.1 m) per second (Mach et al. 2007), and would be expected to quickly recover from local UNDETs. These activities would be on a small spatial scale relative to its distribution in marine ecosystems. This analysis assumes that testing activities under Alternative 1 involving stressors that result in impacts similar to natural events would be followed by a similar recovery period. Impacts of explosions that exceed natural disturbance intensities may uproot plants and damage substrates, which would delay recovery. The military further reduces impacts on overall vegetation communities by using already disturbed areas.

3.7.3.1.1.3 Alternative 2

Training Activities

Under Alternative 2, the number of mine neutralization (explosive ordnance disposal) training activities in the Study Area would remain the same as under Alternative 1.

Under Alternative 2, underwater explosions conducted for training activities may injure or kill individual marine plants; however, exposure to these detonations would be limited to the vicinity of the explosions and would not pose a risk to marine vegetation communities. Marine vegetation within blast zones could have a clearly detectable response (e.g., algal mats dispersing, rupture of individual plant cells). The long-term survival, annual reproductive success, and lifetime reproductive success of marine vegetation would not be impacted. The UNDET area in Apra Harbor is located in a sandy habitat where no seagrass beds or other marine vegetation are located (Figures 2.7-1, 3.3-2, and Figure 3.7-2). The offshore underwater mine neutralization sites are located in areas with water depths that are unlikely for marine vegetation to occur in (Figure 2.7-1). Despite the increase in underwater and surface explosions, the potential impacts on exposed marine algae are expected to be the same as under the No Action Alternative because the overlap with the resource is limited. Underwater and surface explosions conducted for training activities are not expected to pose a risk to seagrass because: (1) the impact area of underwater explosions is very small relative to seagrass distribution, and (2) the low number of charges reduces the potential for impacts. For the same reasons as stated in Section 3.7.3.1.1.1 (No Action Alternative) for marine algae and here for seagrass, the use of surface and underwater explosions is not expected to impact the long-term survival, annual reproductive success, and lifetime reproductive success of marine vegetation, and is therefore not expected to result in population-level impacts.

Testing Activities

Alternative 2 would introduce testing activities that would involve the use of 7,451 explosives, all of which could occur throughout the Study Area, although the majority occurs in waters greater than 3 nm from shore. Because these detonations occur in deeper waters near the water surface, most marine vegetation would not experience intense shock wave impacts. However, there would be 28 UNDETs (explosive neutralizers) used during mine countermeasure mission package testing activities, which may impact marine vegetation. The maximum NEW of each detonation would be 5 lb., which could impact an area of 145 $ft.^2$ (13 m^2). Underwater explosions associated with testing activities under Alternative 2 would disturb approximately 4,060 $ft.^2$ (365 m^2) per year of substrate in the Study Area (see Table 3.3-4).

Under Alternative 2, underwater explosions conducted for testing activities may injure or kill individual marine plants; however, exposure to these detonations would be limited to the vicinity of the explosions and would not pose a risk to marine vegetation communities. Marine vegetation within blast zones could have a clearly detectable response (e.g., algal mats dispersing, rupture of individual plant cells), followed by a recovery period lasting weeks to months. The long-term survival, annual reproductive success, and lifetime reproductive success of marine vegetation would not be impacted. The explosions occur in open water and in the outer part of Apra Harbor. Some seafloor macroalgae in coastal areas are adapted to natural disturbances such as storms and wave action that can exceed 33 ft. (10.1 m) per second (Mach et al. 2007), and would be expected to quickly recover from local UNDETs. These activities would be on a small spatial scale relative to the distribution of vegetative communities in marine ecosystems. This analysis assumes that testing activities under Alternative 2 involving stressors that result in impacts similar to natural events would be followed by a similar recovery period. Impacts of explosions that exceed natural disturbance intensities may uproot plants and damage substrates, which would delay recovery. The military further reduces impacts on overall vegetation communities by using already disturbed areas.

3.7.3.1.2 Substressor Impact on Marine Vegetation as Essential Fish Habitat from Explosives (Preferred Alternative)

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of explosives during training and testing activities may have an adverse effect on EFH by reducing the quality and quantity of marine vegetation that is part of a habitat that is defined as EFH or a Habitat Area of Particular Concern. The MITT EFHA report states that the impact on attached macroalgae is determined to be minimal and temporary to short term throughout the Study Area. Given the available information, the impact on submerged rooted vegetation beds is determined to be minimal and long term.

3.7.3.2 Physical Disturbance and Strike Stressors

This section analyzes the potential impacts of the various physical disturbance and strike stressors used during training and testing activities within the Study Area. The physical disturbance and strike stressors that may impact marine vegetation include (1) vessels, in-water devices, and towed in-water devices; (2) military expended materials; and (3) seafloor devices.

The evaluation of impacts to marine vegetation from physical disturbance and strike stressors focuses on proposed activities that may cause vegetation to be damaged by an object that is moving through the water (e.g., vessels and in-water devices), dropped into the water (e.g., military expended materials), or deployed on the seafloor (e.g., anchors). Not all activities are proposed throughout the Study Area. Wherever appropriate, specific geographic areas of potential impact are identified.

Single-celled algae may overlap with physical disturbance or strike stressors, but the impact would be minimal relative to their total population level; therefore, they will not be discussed further. Seagrasses and macroalgae on the seafloor are the only types of marine vegetation that occur in locations where physical disturbance or strike stressors may be encountered. Therefore, only seagrasses and macroalgae are analyzed further for potential impacts of physical disturbance or strike stressors. Since the occurrence of marine algae is an indicator of marine mammal and sea turtle presence, some mitigation measures designed to reduce impacts on these resources may indirectly reduce impacts on marine algae; see Section 5.3.2.2 (Physical Disturbance and Strike).

3.7.3.2.1 Impacts from Vessels and In-Water Devices

Several different types of vessels (ships, submarines, boats, amphibious vehicles) and in-water devices (towed devices, unmanned underwater vehicles) are used during training and testing activities throughout the Study Area, as described in Chapter 2 (Description of Proposed Action and Alternatives). Vessel movements occur intermittently, are variable in duration, ranging from a few hours to a few weeks, and are dispersed throughout the Study Area. Events involving large vessels are widely spread over offshore areas, while smaller vessels are more active in nearshore areas.

The potential impacts of military vessels and in-water devices used during training and testing activities on marine vegetation are based on the vertical distribution of the vegetation. Surface vessels include ships, boats, and amphibious vehicles; and seafloor vessels include unmanned underwater vehicles and autonomous underwater vehicles. Vessels may impact vegetation by striking or disturbing vegetation on the sea surface or seafloor (Spalding et al. 2003).

Vegetation on the seafloor such as seagrasses and macroalgae may be disturbed by amphibious combat vehicles. Seagrasses are susceptible to vessel propeller scarring (Sargent et al. 1995). Seagrasses could take up to 10 years to fully regrow and recover from propeller scars (Dawes et al. 1997). Seagrasses may also be susceptible to increases in turbidity; however, short-term or seasonal increases have not been found to impact survivorship (Moore et al. 1997). Seafloor macroalgae may be present in locations where these vessels and in-water devices occur, but the impacts would be minimal because of their resilience, distribution, and biomass. Because some seafloor macroalgae in coastal areas are adapted to natural disturbances, such as storms and wave action that can exceed 33 ft. (10 m) per second (Mach et al. 2007), macroalgae will quickly recover from vessel and in-water device movements. However, if the disturbance caused by vessels and in-water device movement exceeds the natural disturbance level for a particular area of marine vegetation then the recovery time would be longer.

Towed in-water devices include towed targets that are used during activities such as Missile Exercises and Gun Exercises. These devices are operated at low speeds either on the sea surface or below it. The analysis of in-water devices will focus on towed surface targets because of the potential for impacts on marine algae. Unmanned underwater vehicles and autonomous underwater vehicles are used in training and testing activities in the Study Area. They are typically propeller-driven, and operate within the water column or crawl along the seafloor. The propellers of these devices are encased, eliminating the potential for seagrass propeller scarring. Algae on the seafloor could be disturbed by these devices although, for the same reasons given for vessel disturbance, unmanned underwater vehicles are not expected to compromise the health or condition of algae.

3.7.3.2.1.1 No Action Alternative

Training Activities

Estimates of relative vessel use and location for the No Action Alternative are provided in Section 3.0 (Introduction to Affected Environment and Environmental Consequences). While these estimates provide a prediction of use, actual military vessel use depends upon military training requirements, deployment schedules, annual budgets, and other unpredictable factors. Testing and training concentrations are most dependent upon locations of military shore installations and established testing and training areas. Under the No Action Alternative the concentration of use and the manner in which the military tests and trains would remain consistent with the range of variability observed over the last decade.

A variety of vessels, in-water devices, and towed in-water devices would be used throughout the Study Area during training activities, as described in Chapter 2 (Description of Proposed Action and Alternatives). Most activities would involve one vessel, but activities may occasionally use two vessels. Unlike most vessels used in offshore training activities that occur in deep water, amphibious vehicles are designed to move personnel and equipment from ship to shore in shallow water.

Disturbances to marine vegetation caused by training activities may result in opportunities for invasive or nuisance species to colonize these areas. Per Chief of Naval Operations Instruction (OPNAVINST)

5090.1D, the Navy would prevent their introductions if possible, respond rapidly to control these species, monitor their populations, and restore the native species and habitats.

Marine vegetation in the path of moving vessels or in-water devices may have a clearly detectable response (e.g., rupture of individual plant cells), followed by a recovery period lasting weeks to months. Although marine vegetation growth near vessels or in-water devices used for training activities under the No Action Alternative would be inhibited during recovery, long-term survival, reproductive success, or lifetime reproductive success would not be impacted.

Amphibious landings would be associated with amphibious warfare training activities, which would include amphibious assault, amphibious assault-battalion landing, and amphibious raid training activities and could occur 10 times under the No Action Alternative. Boats and vessels (including MK V Special Operations Craft, Mechanized and Utility Landing Craft, Air Cushioned Landing Craft) may transport personnel or equipment to the shore or beach in the Study Area. This beaching activity could affect marine habitats, as the boat contacts and disturbs the sediment where it lands. Amphibious Assault and Amphibious Raid training could be conducted in the nearshore area, including the surf zone up to the high tide line at Unai Chulu, Unai Babui, and Unai Dankulo, Tinian, as well as Dry Dock Island in Apra Harbor and Dadi Beach on Guam. Amphibious Raid activities could also be conducted on Rota, but they are restricted to approaches via boat docks (no beach landings).

Amphibious vessels would approach the shore and could beach, which would disturb sediments and increase turbidity. However, amphibious landing activities would be scheduled at high tide, which would reduce the potential for the vessels to disturb sediments or marine vegetation. The impact of vessels on marine vegetation in the surf zone would be minor because of the dispersed nature of the amphibious landings and the surf and tidal disturbance to which the vegetation in these areas are accustomed. Additionally, prior to amphibious landings the area is surveyed to determine the best location for the landing to minimize the potential for impacts to marine vegetation.

Under the No Action Alternative, the impacts of vessel, in-water device, and towed in-water device physical disturbances and strikes during training activities would be minimal disturbances of seaweeds. Seagrass bed damage is not likely but, if it occurs, the impacts would be minor, such as short-term turbidity increases.

The net impact of vessel, in-water device, and towed in-water device physical disturbances and strikes on marine vegetation is expected to be negligible under the No Action Alternative, based on: (1) the quick recovery of most vegetation types; (2) the short-term nature of most vessel movements and local disturbances of the surface water, with some temporary increase in suspended sediment in shallow areas; and (3) the deployment of in-water devices at depths where they would not likely come in contact with marine vegetation.

Testing Activities

Under the No Action Alternative, the Office of Naval Research will conduct one testing activity involving vessels, vehicles, and in-water devices at the North Pacific Acoustic Lab Philippine Sea Experiment site. No new ship systems are proposed under the No Action Alternative; rather, these systems are analyzed under Alternative 1 testing activities.

Marine vegetation within the path of moving vessels or in-water devices could have a clearly detectable response (e.g., rupture of individual plant cells), followed by a recovery period lasting weeks to months after exposure. Under the No Action Alternative, in-water device physical disturbance or strike from testing activities would not pose a risk to seagrass since the area of action and seagrasses do not overlap.

3.7.3.2.1.2 Alternative 1

Training Activities

Alternative 1 proposes to introduce new vessels (not replacement class vessel for existing vessels). The Littoral Combat Ship and the Joint High Speed Vessel are fast vessels that may operate in near shore waters, but would not be expected to contact marine vegetation on the seafloor. The military would introduce unmanned undersea in-water devices and surface systems under Alternative 1, which may contact marine vegetation on the seafloor. The number of amphibious warfare training activities with amphibious landings would increase by approximately 30 percent compared to the No Action Alternative.

Under Alternative 1, the number of vessels with potential impacts on marine vegetation would increase compared with the No Action Alternative mainly due to the addition of the unmanned undersea and surface systems, but the concentration of use and the manner in which the military trains would remain consistent with that described under the No Action Alternative. The types of vegetation that would overlap with the vessels and the potential impacts of vessel operations would be the same as under the No Action Alternative. Marine vegetation within the path of moving vessels or in-water devices could have a clearly detectable response (e.g., rupture of individual plant cells), followed by a recovery period lasting weeks to months after exposure.

Amphibious landings would be associated with amphibious warfare training activities, which would include amphibious assault, amphibious assault – battalion landing, and amphibious raid training activities. These training activities would occur at Unai Chulu, Unai Babui, and Unai Dankulo on the northern portion of Tinian. Amphibious vessels would approach the shore and could beach, which would disturb sediments and increase turbidity. However, amphibious landing activities would be scheduled at high tide, which would reduce the potential for the vessels to disturb sediments or marine vegetation. The impact of vessels on marine vegetation in the surf zone would be minor because of the dispersed nature of the amphibious landings and the surf and tidal disturbance which the vegetation in these areas are accustomed. Additionally, prior to amphibious landings the area is surveyed to determine the best location for the landing to minimize the potential for impacts to marine vegetation.

Disturbances to marine vegetation caused by training activities may result in opportunities for invasive or nuisance species to colonize these areas. Per OPNAVINST 5090.1D, the Navy will would prevent their introductions if possible, respond rapidly to control these species, monitor their populations, and restore the native species and habitats.

Under Alternative 1, the impacts of vessel, in-water device, and towed in-water device physical disturbances and strikes during training activities would result in minimal disturbances of seaweeds. Seagrass bed damage is not likely but, if it occurs, the impacts would be minor, such as short-term turbidity increases.

The net impact of vessel, in-water device, and towed in-water device physical disturbances and strikes on marine vegetation is expected to be negligible under Alternative 1, based on: (1) the quick recovery of most vegetation types; (2) the short-term nature of most vessel movements and local disturbances of the surface water, with some temporary increase in suspended sediment in shallow areas; and (3) the deployment of in-water devices at depths where they would not likely come in contact with marine vegetation.

Testing Activities

Under Alternative 1, events using vessels and in-water devices would increase from 1 under the No Action Alternative to 479. Marine vegetation within the path of moving vessels or in-water devices could have a clearly detectable response (e.g., rupture of individual plant cells), followed by a recovery period lasting weeks to months after exposure.

Disturbances to marine vegetation caused by testing activities may result in opportunities for invasive or nuisance species to colonize these areas. Per OPNAVINST 5090.1D, the Navy will would prevent their introductions if possible, respond rapidly to control these species, monitor their populations, and restore the native species and habitats.

Alternative 1 also proposes to introduce new vessels (not replacement class vessel for existing vessels) which are described in Section 2.7.3.2 (Ships). Some of the new vessels may operate in nearshore waters. Because these areas typically support marine vegetation at the surface and on the seafloor, the potential for marine vegetation disturbance in nearshore environments would increase under Alternative 1. Despite this increased disturbance of marine vegetation, the areas where new ship systems would be tested are areas where existing ship maneuvers and training already occur.

In addition to manned ships, the military also proposes to use unmanned undersea and surface systems under testing activities. All of the vehicles described in Section 2.7.3.3 (Unmanned Vehicles and Systems) use advanced propeller systems with encased propellers would prevent damage to seabeds (including seafloor flora). Under Alternative 1, vessel and in-water device use during training activities would not pose a risk of physical disturbance or strike to seagrass, since these activities do not overlap with known seagrass beds.

3.7.3.2.1.3 Alternative 2

Training Activities

Under Alternative 2, the number of events utilizing vessels with potential impacts on marine vegetation would increase to 2,800 events compared with 786 events under the No Action Alternative, but the concentration of use and the manner in which the military trains would remain consistent with that described under the No Action Alternative. The types of vegetation that would overlap with the vessels and the potential impacts of vessel operations would be the same as under the No Action Alternative. In nearshore environments, the number of amphibious assault training activities in amphibious warfare training areas would be the same as under the No Action Alternative. Impacts on marine vegetation in shallow water, including the surf zones, would not increase under Alternative 2. Under Alternative 2, increased vessel and in-water device use during training activities would not pose a risk of physical disturbance or strike to seagrass.

Testing Activities

Under Alternative 2, events using vessels and in-water devices would increase from 1 under the No Action Alternative to 537. Marine vegetation within the path of moving vessels or in-water devices could have a clearly detectable response (e.g., rupture of individual plant cells), followed by a recovery period lasting weeks to months after exposure.

Disturbances to marine vegetation caused by testing activities may result in opportunities for invasive or nuisance species to colonize these areas. Per OPNAVINST 5090.1D the Navy will would prevent their introductions if possible, respond rapidly to control these species, monitor their populations, and restore the native species and habitats.

3.7.3.2.1.4 Substressor Impact on Marine Vegetation as Essential Fish Habitat from Vessels and In-Water Devices (Preferred Alternative)

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of vessels and in-water devices during training and testing activities would have no impact on attached macroalgae or submerged rooted vegetation that is part of a habitat that is defined as EFH or a Habitat Area of Particular Concern. The MITT EFHA report states that any impacts on marine vegetation incurred by vessel movements and in-water devices would be minimal and short term.

3.7.3.2.2 Impacts from Military Expended Materials

This section analyzes the strike potential to marine vegetation of the following categories of military expended materials: (1) non-explosive practice munitions; (2) fragments from explosive munitions; and (3) expended materials other than ordnance, such as sonobuoys, vessel hulks, and expendable targets. For a discussion of the types of activities that use military expended materials, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.2.3 (Physical Disturbance and Strike Stressors) and Chapter 2 (Description of Proposed Action and Alternatives).

In areas where marine vegetation and locations for military expended materials overlap, vegetation that occurs in the water column, or rooted in the seafloor may be impacted. If these vegetation types are in the immediate vicinity of military expended material, only a small number of them are likely to be impacted relative to their total population level. The low number of military expended materials relative to the total amount of seafloor macroalgae and single-celled algae in the Study Area also decreases the potential for impacts to these vegetation types.

Military expended materials can impact seagrass and other types of algae on the seafloor in coastal areas. Most types of military expended materials are deployed in the open ocean. In coastal water training areas, only projectiles (small and medium), target fragments, and countermeasures could be introduced into areas where shallow water vegetation such as seagrass and algae may be impacted.

Military expended materials can potentially impact seagrass on the seafloor by disturbing, crushing, or shading, which may interfere with photosynthesis. In the event that seagrass is not able to photosynthesize its ability to produce energy is compromised. However, the intersection of seagrasses and military expended materials is limited. Otherwise, seagrasses generally grow in waters that are sheltered from wave action such as estuaries, lagoons and bays (Phillips and Meñez 1988). Locations for the majority of training and testing activities where military materials are expended do not provide this type of habitat. The potential for detectable impacts on seagrasses from expended materials would be low given the small size (e.g., countermeasures) of the majority of the materials, low velocity at deployment (e.g., countermeasures), and the decrease in speed as they hit the sea surface. Falling materials could cause sediment, the surface that seagrasses need to grow, to be suspended. The resuspension of the sediment could impact water quality and decrease light exposure but since it would be short-term (hours), stressors from expended materials would not likely impact the general health of seagrasses.

The following are descriptions of the types of military expended materials that can potentially impact seagrass.

Small-, Medium-, and Large-Caliber Projectiles. Small-, medium-, and large-caliber non-explosive practice munitions, or fragments from explosive projectiles expended during training and testing activities rapidly sink to the seafloor. Due to the small size of projectiles and their casings, damage to marine vegetation is unlikely. Large-caliber projectiles are primarily used in the offshore (at depths greater than 85.3 ft. [26 m]) while small and medium projectiles may be expended in both offshore and coastal areas (at depths less than 85.3 ft. [26 m]). Seagrasses generally do not occur where these materials are expended because these activities do not normally occur in water that is shallow enough for seagrass to grow (85.3 ft. [26 m]).

Bombs, Missiles, and Rockets. Bombs, missiles, and rockets, or their fragments (if explosive) are expended offshore (at depths greater than 85.3 ft. [26 m]) during training and testing activities, and rapidly sink to the seafloor. Seagrass generally does not occur where these materials are expended because of water depth limitations for activities that expend these materials.

Decelerators/Parachutes. Decelerators/parachutes of varying sizes are used during training and testing activities. The types of activities that use decelerators/parachutes, the physical characteristics of these expended materials, where they are used, and the number of activities that would occur under each alternative are discussed in Chapter 2 (Description of Proposed Action and Alternatives) and Section 3.0 (Affected Environment and Environmental Consequences).

Targets. Many training and testing activities use targets. Targets that are hit by munitions could break into fragments. Target fragments vary in size and type, but most fragments are expected to sink. Pieces of targets that are designed to float are recovered when possible. Target fragments would be spread out over large areas in water too deep to support the existence of seagrasses. Seagrass could not occur where these materials are expended.

Vessel Hulk. Vessel hulks are a notable type of military expended material because of their size. Vessel hulks are expended at sea during sinking exercises (SINKEX). Sinking exercises use a target (vessel hulk) against which live explosive or non-explosive munitions are fired; the SINKEX is conducted in a manner that results in the sinking of the target. This activity would only be conducted in designated areas (SINKEX box) with bottom depths greater than 9,842.7 ft. (3,000 m). Seagrass could not occur where these materials are expended.

Countermeasures. Defensive countermeasures such as chaff and flares are used to protect against missile and torpedo attack. Chaff is made of aluminum-coated glass fibers and flares are pyrotechnic devices. Chaff, chaff canisters, and flare end caps are expendable materials. Chaff and flares are dispensed from aircraft or fired from ships. Seagrass could not occur where these materials are expended.

3.7.3.2.2.1 No Action Alternative

Training Activities

Under the No Action Alternative, the majority of military expended material would be used in open ocean areas, where marine vegetation would not be expected to occur. Table 3.3-6 provides numbers and impact radius for all military expended materials used for training activities under the No Action Alternative. Explosive military expended materials would typically fragment into small pieces. Ordnance that fails to function as designed and inert munitions would result in larger pieces of military expended material settling to the seafloor.

Military expended materials in the coastal portions of the Study Area would be limited to small-caliber projectiles, flares, and target fragments. These materials would be small and would typically be colonized with marine vegetation. The small size of these military expended materials would not be expected to impact marine vegetation. In heavily used coastal areas around Farallon de Medinilla (FDM), monitoring since 1999 has determined that impacts to the marine habitats from military expended materials have been insignificant. This was based on few areas of disturbance detected during monitoring; most of the observed disturbance areas have been located in natural rubble environments, the size of disturbed areas was less than 2 m^2, and substantial or complete recovery was observed within one year (Smith et al. 2013). Additionally, marine plant species found in shallow waters off the coasts of the Mariana Islands are adapted to natural disturbance, and recover quickly from storms, as well as to high-energy wave action and tidal surges in oceanside areas. As noted previously, seagrass beds and mangroves in coastal areas would require longer recovery periods. Military expended material strikes would have little impact and would not likely result in the mortality of algae or population level impacts.

Military expended materials used for training activities are not expected to pose a risk to marine algae or seagrass because: (1) the relative coverage of marine algae in the Study Area is low, (2) new growth may result from marine algae exposure to military expended materials, (3) the impact area of military expended materials is very small relative to marine algae distribution, and (4) seagrass overlap with areas where the stressor occurs is very limited. Based on these factors, potential impacts on marine algae and seagrass from military expended materials are not expected to result in detectable changes in their growth, survival, or propagation, and are not expected to result in population-level impacts.

Testing Activities

Under the No Action Alternative, testing activities would not expend materials in shallow-water habitats.

3.7.3.2.2.2 Alternative 1

Training Activities

Under Alternative 1, the number of military expended materials would increase by 225 percent over the No Action Alternative. The majority of military expended material would be used in open ocean areas, where marine vegetation would not be expected to occur. Table 3.3-7 provides numbers and impact radius for all military expended materials used for training activities under the Alternative 1. Explosive military expended materials would typically fragment into small pieces. Ordnance that fails to function as designed and inert munitions would result in larger pieces of military expended material settling to the seafloor.

Military expended materials in the coastal portions of the Study Area would be limited to small-caliber projectiles, flares, and target fragments. Despite the increase in expended materials over the No Action Alternative, the small size of these military expended materials still would not be expected to impact marine vegetation. In heavily used coastal areas around FDM, monitoring conducted since 1999 has determined that impacts to the marine habitats from military expended materials have been insignificant. Additionally, marine plant species found in shallow waters off the coasts of the Mariana Islands are adapted to natural disturbance, and recover quickly from storms, as well as to high-energy wave action and tidal surges in oceanside areas. As noted previously, seagrass beds and mangroves in coastal areas would require longer recovery periods. Strikes would have little impact and would not likely result in the mortality of algae or population level impacts.

In comparison to the No Action Alternative, the increase in activities presented in Alternative 1 may increase the risk to marine algae and seagrass of exposure to military expended materials. Despite the increase in the number of military expended materials, the potential impacts on seagrass are expected to be the same as under the No Action Alternative because overlap with the resources is limited. For the same reasons as stated in Section 3.7.3.2.2.1 (No Action Alternative), the use of military expended materials is not expected to result in detectable changes in marine algae or seagrass growth, survival, or propagation, and are not expected to result in population-level impacts.

Testing Activities

Under the Alternative 1, testing activities would not expend materials in shallow-water habitats.

3.7.3.2.2.3 Alternative 2

Training Activities

Under Alternative 2, the number of military expended materials would increase by 230 percent over the No Action Alternative. The majority of military expended material would be used in open ocean areas, where marine vegetation would not be expected to occur. Table 3.3-7 provides numbers and impact radius for all military expended materials used for training activities under the Alternative 2. Explosive military expended materials would typically fragment into small pieces. Ordnance that fails to function as designed and inert munitions would result in larger pieces of military expended material settling to the seafloor.

Military expended material in the coastal portions of the Study Area would be limited to small-caliber projectiles, flares, and target fragments. Despite the increase over the No Action Alternative, the small size of these military expended materials still would not be expected to impact marine vegetation. In heavily used coastal areas around FDM, monitoring since 1999 has determined that impacts to the marine habitats from military expended materials have been insignificant. Additionally, marine plant species found in shallow waters off the coasts of the Mariana Islands are adapted to natural disturbance, and recover quickly from storms, as well as to high-energy wave action and tidal surges in oceanside areas. As noted previously, seagrass beds and mangroves in coastal areas would require longer recovery periods.

In comparison to the No Action Alternative, the overall increase in activities presented in Alternative 2 may increase the risk of marine algae and seagrass exposure to military expended materials. However, the differences in species overlap and potential impacts of surface explosions on marine algae and seagrass during testing activities would not be discernible from those described in Section 3.7.3.2.2.1 (No Action Alternative). For the same reasons as stated in Section 3.7.3.2.2.1 (No Action Alternative) for marine algae and seagrass, the use of military expended materials is not expected to result in detectable changes to marine algae or seagrass growth, survival, or propagation, and is not expected to result in population-level impacts.

Testing Activities

Under the Alternative 2, testing activities would not expend materials in shallow-water habitats.

3.7.3.2.2.4 Substressor Impact on Marine Vegetation as Essential Fish Habitat from Military Expended Materials (Preferred Alternative)

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, military expended materials used for training and testing activities may adversely affect EFH by reducing the quality and quantity of marine vegetation that is part of a habitat that is defined as EFH or a Habitat Area of Particular Concern. The MITT EFHA states that any impacts of military expended materials on attached macroalgae or submerged rooted vegetation would be minimal and long term.

3.7.3.2.3 Impacts from Seafloor Devices

Marine vegetation on the seafloor may be impacted by seafloor devices. Seagrasses and seafloor algae in the Study Area may be impacted by activities involving seafloor devices.

Seafloor device operation, installation, or removal could impact seagrass by physically removing vegetation (e.g., uprooting), crushing, temporarily increasing the turbidity (sediment suspended in the water) of waters nearby, or shading seagrass which may interfere with photosynthesis. If seagrass is not able to photosynthesize, its ability to produce energy is compromised. However, the intersection of seagrasses and seafloor devices is limited, and suspended sediments would settle in a few days.

Precision anchoring training exercises involve releasing anchors at established anchorages throughout the Study Area. The intent of these training exercises is to practice anchoring a vessel within 100 yards (91.4 m) of the planned anchorage location. These training activities typically occur within predetermined shallow water anchorage locations near ports. In these locations, the seafloors consist of unconsolidated sediments and are devoid of marine vegetation. The level of impact would depend on the size of the anchor used, which would vary according to vessel type.

3.7.3.2.3.1 No Action Alternative

Training Activities

Under the No Action Alternative, 480 mine shapes would be used during mine laying training activities. Mine shapes would be used primarily in Warning Area 517, which is located over predominately soft bottom habitat in the open ocean offshore area (Figure 2.1-2). Based on the small area affected by mine shapes (approximately 8–15 $ft.^2$ [0.7–1.4 m^2]), and the lack of marine vegetation in the areas which mine shapes are used, the use of mine shapes during training activities would not be expected to affect marine vegetation. Additionally, the Portable Underwater Tracking Range (PUTR) would be deployed under the No Action Alternative. This would involve anchoring of approximately seven transponders normally in waters of depths greater than approximately 5,900 ft. (1,798 m). These locations would include seafloors consisting of soft bottom habitat of unconsolidated sediments and would likely not support marine vegetation. Based on the use of areas that have been previously disturbed and are unlikely to support marine vegetation, the PUTR anchoring activities would not be expected to affect marine vegetation.

Seafloor device installation in shallow water habitats under the No Action Alternative training activities would pose a negligible risk to marine vegetation. Any damage from seafloor devices would be followed by a recovery period lasting weeks to months. Although marine vegetation growth near seafloor devices installed during training activities under the No Action Alternative would be inhibited during recovery, population-level impacts are unlikely because of the small, local impact areas, the frequency of training activities, and the wider geographic distribution of seagrasses in and adjacent to training areas.

Testing Activities

Under the No Action Alternative, seafloor devices are only utilized during testing activities at the North Pacific Acoustic Lab's Deep Water site. The deep water experimental site consists of an acoustic tomography array, a distributed vertical line array, and moorings in the deep-water environment (depths greater than 3,280 ft. [1,000 m]) of the northwestern Philippine Sea. The impact of seafloor devices on marine vegetation is unlikely based on the depth of these activities and the lack of vegetation present.

3.7.3.2.3.2 Alternative 1

Training Activities

Under Alternative 1, 480 mine shapes would be used during mine laying training activities. Mine shapes would be used primarily in Warning Area 517, which is located over predominately soft bottom habitat in the open ocean offshore area (Figure 2.1-2). Based on the small area affected by mine shapes (approximately 8–15 $ft.^2$ [0.7–1.4 m^2]), and the lack of vegetation present in these areas, the use of mine shapes during training activities would not be expected to affect marine vegetation. Additionally there would be 18 precision anchoring activities which would occur within predetermined shallow water anchorage locations near ports. These locations would include seafloors consisting of soft bottom habitat of unconsolidated sediments and would likely not support marine vegetation. The level of impact on the marine vegetation would depend on the size of the anchor used, which would vary according to vessel type. However, based on the use of areas that have been previously disturbed and are unlikely to support marine vegetation, precision-anchoring activities would not be expected to affect marine vegetation.

Seafloor devices installed in shallow-water habitats under Alternative 1 training activities would pose a negligible risk to marine vegetation. Any damage from deposition of military expended materials would be followed by a recovery period lasting weeks to months. Although marine vegetation growth near seafloor devices installed for training activities under Alternative 1 would be inhibited during recovery, the long-term survival, reproductive success, and lifetime reproductive success would not be impacted.

Testing Activities

Under Alternative 1, seafloor devices are utilized during pierside integrated swimmer defense activities, testing activities at the North Pacific Acoustic Lab's Deep Water site, and during the mine countermeasure mission package testing. The deep water experimental site consists of an acoustic tomography array, a distributed vertical line array, and moorings in the deep-water environment (depths greater than 3,280 ft. [1,000 m]) of the northwestern Philippine Sea, which is at a depth unlikely to support marine vegetation. Seafloor devices installed in shallow-water habitats under Alternative 1 testing activities would pose a negligible risk to marine vegetation. Any damage from deposition of military expended materials would be followed by a recovery period lasting weeks to months. Although marine vegetation growth near seafloor devices installed for testing activities under Alternative 1 would be inhibited during recovery, the long-term survival, reproductive success, and lifetime reproductive success would not be impacted.

3.7.3.2.3.3 Alternative 2

Training Activities

Under Alternative 2, no additional seafloor devices would be used or implemented. Therefore, seafloor devices under Alternative 2 would have the same impacts on marine vegetation as under Alternative 1.

Testing Activities

Under Alternative 2, seafloor devices are utilized during pierside integrated swimmer defense activities and testing activities at the North Pacific Acoustic Lab's Deep Water site and during the mine countermeasure mission package testing. The deep water experimental site consists of an acoustic tomography array, a distributed vertical line array, and moorings in the deep-water environment (depths greater than 3,280 ft. [1,000 m]) of the northwestern Philippine Sea, which is at a depth unlikely to support marine vegetation. Seafloor devices installed in shallow-water habitats under Alternative 2 testing activities would pose a negligible risk to marine vegetation. Any damage from deposition of military expended materials would be followed by a recovery period lasting weeks to months. Although marine vegetation growth near seafloor devices installed for testing activities under Alternative 2 would be inhibited during recovery, the long-term survival, reproductive success, and lifetime reproductive success would not be impacted.

3.7.3.2.3.4 Substressor Impact on Marine Vegetation as Essential Fish Habitat from Seafloor Devices (Preferred Alternative)

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of seafloor devices during training and testing activities may adversely affect EFH by reducing the quality and quantity of marine vegetation that is part of a habitat that is defined as EFH or a Habitat Area of Particular Concern. The MITT EFHA report states that any impacts of seafloor devices on attached macroalgae or submerged rooted vegetation would be minimal and short term.

3.7.3.3 Secondary Stressors

This section analyzes potential impacts on marine vegetation exposed to stressors indirectly through changes in sediments and water quality. Section 3.1 (Sediments and Water Quality) considered the impacts on marine sediments and water quality from explosives and explosive byproducts, metals, chemicals other than explosives, and other materials (marine markers, flares, chaff, targets, and miscellaneous components of other materials). One example of a localized impact associated with water quality impacts could be the increase of cyanobacteria associated with munitions deposits in marine sediments. Cyanobacteria may proliferate when iron is introduced to the marine environment, and this proliferation can negatively affect surrounding habitats by releasing toxins, or stimulating the growth of nuisance species (Schils 2012). Introducing iron into the marine environment from munitions or infrastructure is not associated with red tide events; rather, these harmful events are more associated with natural causes (e.g., upwellings) and the effects of human activities (e.g., agricultural runoff and other coastal pollution) (Hayes et al. 2007; Whitton and Potts 2008).

Strike warfare activities such as BOMBEX (Land) and MISSILEX involve the use of live munitions by aircrews that practice on ground targets on FDM. These warfare training activities occur on the FDM land mass and are limited to the designated impact zones along the central corridor of the island. Explosives that detonate on land could loosen soils and subsequently get transported into surface drainage areas or nearshore waters. It should be noted that FDM is highly susceptible to natural causes of erosion because it is comprised of highly weathered limestone overlain by a thin layer of clay soil.

Sediments entering the nearshore environment as a result of natural processes or explosives could cause temporary water quality impacts, some of which may be in foraging areas used by marine organisms. By limiting the location and extent of target areas, along with the types of ordnance allowed within specific impact areas, the military minimizes the potential for soil transport and, thus, water quality impacts.

Erosion as a result of training activities at FDM may contribute to deposition of soils into the nearshore areas of FDM, causing increased turbidity. Turbidity can impact vegetation communities by reducing the amount of light that reaches these organisms. However, as listed in the High-Order Explosions at FDM and Explosive Byproducts subsection of Section 3.1.3.6.1 (No Action Alternative), the impacts of explosive byproducts on sediment and water quality would be indirect, short term, local, and negative. Explosive ordnance could loosen the soil on FDM and runoff from surface drainage areas containing soil and explosive byproducts could contaminate sediments and the surrounding ocean water. However, chemical, physical, or biological changes in sediment or water quality would not be detectable. Therefore, impacts on marine vegetation from erosion or sedimentation are not anticipated.

As described in Section 3.1.3.1.5.3 (Farallon de Medinilla Specific Impacts), the Navy has conducted annual marine dive surveys in waters surrounding FDM from 1999 to 2010. Throughout all dive surveys, the coral fauna at FDM was observed to be healthy and robust. The nearshore physical environment and basic habitat types at FDM have remained unchanged over the 13 years of survey activity. These conclusions are based on (1) a limited amount of physical damage, (2) very low levels of partial mortality and disease (less than 1 percent of all species observed), (3) absence of excessive mucus production, (4) good coral recruitment, (5) complete recovery by 2012 of the 2007 bleaching event, and (6) a limited number of macrobioeroders and an absence of invasive crown of thorns starfish (Acanthaster planci). These factors suggest that sedimentation that may result from military use of FDM is not sufficient as to adversely impact water quality, and as such, marine habitats.

The analysis included in Section 3.1 (Sediments and Water Quality) determined that neither state or federal standards or guidelines for sediments or water quality would be violated by the No Action Alternative, Alternative 1, or Alternative 2. Because of these conditions, population-level impacts on marine vegetation are likely to be inconsequential and not detectable. Therefore, because these standards and guidelines are structured to protect human health and the environment, and the proposed activities do not violate them, no indirect impacts are anticipated on marine vegetation from the training and testing activities proposed by the No Action Alternative, Alternative 1, or Alternative 2.

3.7.4 Summary of Potential Impacts (Combined Impacts of All Stressors) on Marine Vegetation

3.7.4.1 Combined Impacts of All Stressors

Activities described in this EIS/OEIS that have potential impacts on vegetation are widely dispersed, and not all stressors would occur simultaneously in a given location. The stressors that have potential impacts on marine vegetation include acoustic (explosions) and physical disturbance or strike (vessel and in-water devices, military expended materials, and seafloor devices). Unlike mobile organisms, vegetation cannot flee from stressors once exposed. Marine algae are the vegetation most likely to be exposed to multiple stressors in combination because they occur in large expanses. Discrete areas of the Study Area (mainly within offshore areas with depths greater than 85.3 ft. [26 m]) could experience higher levels of activity involving multiple stressors, which could result in a higher potential risk for impacts on marine algae within those areas.

The potential for exposure of seagrasses and attached macroalgae to multiple stressors would be less because activities are not concentrated in coastal (areas with depths less than 85.3 ft. [26 m]) distributions of these species. The combined impacts of all stressors would not be expected to affect marine vegetation populations because: (1) activities involving more than one stressor are generally short in duration, (2) such activities are dispersed throughout the Study Area, and (3) activities are generally scheduled where previous activities have occurred. The aggregate effect on marine vegetation would not observably differ from existing conditions.

3.7.4.1.1 Essential Fish Habitat Determinations

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of metal, chemical, and other material contaminants during training and testing activities would have no adverse impact on marine vegetation that is part of a habitat that is defined as EFH or a Habitat Area of Particular Concern. The use of explosives and other impulsive sources, vessel movement, in-water devices, military expended materials, and seafloor devices during training and testing activities may adversely affect EFH by reducing the quality and quantity of marine vegetation that is part of a habitat that is defined as EFH or a Habitat Area of Particular Concern. The MITT EFHA states that individual stressor impacts on marine vegetation were either no effect or minimal and ranged in duration from temporary to long term, depending on the habitat impacted. As a result of consultation with NMFS for EFH, the Navy will not increase the amount of explosive used at the Outer Apra Harbor UNDET site from 10 lb. NEW to 20 lb. NEW. If the proposed increase becomes necessary at a later date, the Navy will conduct the appropriate level of analysis to assess potential effects on nearby EFH. The MITT EFHA report is available on the MITT project website (www.mitt-eis.com), and Appendix C (Agency Correspondence) provides agency correspondence and supporting documentation.

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