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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 (explosions)
- Physical disturbance or strikes (vessel and in-water devices, military expended materials, and seafloor devices)

Preferred Alternative

- No Endangered Species Act listed marine vegetation species are found in the Hawaii-Southern California Training and Testing Study Area.
- Explosions and 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 detectable changes in growth, survival, or propagation, and are not expected to result in population-level impacts on marine plant species.
- 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 or air quality are not likely to be detectable.
- These conclusions are based on the fact that the areas of impact are very small compared to the relative distribution and the locations where explosions or physical disturbance or strikes occur.

3.7.1 INTRODUCTION

This section analyzes potential impacts on marine vegetation found in the Hawaii-Southern California Training and Testing (HSTT) Study Area (Study Area). Marine vegetation, including marine algae and flowering plants, are found throughout the Study Area. Navy training and testing activities are evaluated for their potential impacts on species designated under the Endangered Species Act (ESA) and for their impacts on six major taxonomic groups of marine vegetation, as appropriate (Table 3.7-1). No ESA-listed species are found in the Study Area. Marine vegetation species regulated under the Magnuson-Stevens Fishery Conservation and Management Act are described in the Essential Fish Habitat Assessment.

The distribution and condition of offshore abiotic (non-living) substrates associated with attached macroalgae and the impact of stressors on those substrates 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 that are representative of the Study Area, the major taxonomic groups are discussed in Section 3.7.2. The major taxonomic groups consist of five groups of marine algae and one group of flowering plants (Table 3.7-1).

Table 3.7-1: Major Taxonomic Groups of Marine Vegetation in the Study Area

Marine Vegetation Groups[1]		Vertical Distribution in the Study Area[2]	
Common Name (Taxonomic Group)	**Description**	**Open Ocean**	**Coastal Waters**
Dinoflagellates (phylum Dinophyta)	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.	Sea surface	Sea surface
Blue-green algae (phylum Cyanobacteria)	Many form mats that attach to reefs and produce nutrients for other marine species through nitrogen fixation.	Sea surface	Seafloor
Green algae (phylum Chlorophyta)	Marine species occur as unicellular algae, filaments, and large seaweeds.	None	Sea surface, seafloor
Diatoms, brown and golden-brown algae (phylum Heterokontophyta)	Single-celled algae that form the base of the marine food web; brown and golden-brown algae are large multi-celled seaweeds that form extensive canopies, providing habitat and food for many marine species.	Sea surface	Sea surface, seafloor
Red algae (phylum Rhodophyta)	Single-celled algae and multi-celled large seaweeds; some form calcium deposits.	Sea surface	Seafloor
Seagrass, cordgrass, and mangroves (phylum Spermatophyta)	Flowering plants are adapted to salty marine environments in mudflats and marshes, providing habitat and food for many marine species.	None	Seafloor

[1]Species groups are based on the Catalogue of Life (Bisby et al. 2010).
[2]Presence in the Study Area includes open ocean areas (North Pacific Subtropical Gyre and North Pacific Transition Zone) and coastal waters of two Large Marine Ecosystems (California Current and Insular Pacific-Hawaiian). "None" indicates absence of the taxonomic group within the Study Area portion (see map of the Study Area in Figure 3.0-2).

3.7.2 AFFECTED ENVIRONMENT

Factors that influence the distribution and abundance of vegetation in the large marine ecosystems and open ocean areas of the Study Area are the availability of light and nutrients, water quality, water clarity, salinity level, seafloor type (important for rooted or attached vegetation), currents, tidal schedule, and temperature (Green and Short 2003). Marine ecosystems in the Study Area depend almost entirely on the energy produced by photosynthesis of marine plants and algae (Castro and Huber 2000), which is the transformation of the sun's energy into chemical energy. In surface waters of the open ocean and coastal waters, as well as within the portion of the water column illuminated by sunlight, marine algae and flowering plants provide oxygen, food, and habitat for many organisms (Dawes 1998).

Marine vegetation along the California coast is represented by more than 700 varieties of seaweeds (such as corallines and other red algae, brown algae including kelp, and green algae), seagrasses (Leet et al. 2001; Wyllie-Echeverria and Ackerman 2003), and canopy-forming kelp species (Wilson 2002). Extensive mats of red algae provide habitat in areas of exposed sediment along the California coast (Adams et al. 2004; United States [U.S.] Department of the Navy (Navy) and San Diego Unified Port District 2011). Although historically important, large-scale harvesting of kelp beds no longer occurs along the California coast. Small-scale commercial operations, however, continue to harvest kelp, primarily for abalone feed (Wilson 2002). The canopy coverage of kelp beds varies under changing oceanographic conditions, and is also influenced by the level of harvesting and coastal pollution (Wilson 2002).

Red coralline algae and green calcareous (calcium-containing) algae (*Halimeda* species) secrete calcareous skeletons that bind sediments in coral reefs in Hawaii (Spalding et al. 2003). In the Northwestern Hawaiian Islands, beyond the coral reef habitat, algal meadows dominate the terraces and banks at depths of 98–131 feet (ft.) (30–40 meters [m]). There are approximately 1,740 square miles (mi.^{2}) (4,507 square kilometers [km^2]) of this type of substrate, an estimated 65 percent of which is covered by algal meadows (Parrish and Boland 2004). In Hawaii, there are two species of seagrasses and at least 204 species of red algae, 59 species of brown algae, and 92 species of green algae (Friedlander et al. 2005). Seaweeds are important in native Hawaiian culture, and are used in many foods (Preskitt 2002a). Coastal pollution, invasive species, and an increasing demand for fresh seaweed threaten native species (Friedlander et al. 2005).

Certain species of microscopic algae (dinoflagellates and diatoms, for example) can form algal blooms, which can pose serious threats to human health and wildlife species. Harmful algal blooms can deplete oxygen within the water column and block sunlight that other organisms need to live, and some algae within algal blooms release toxins that are dangerous to human and ecological health (Center for Disease Control and Prevention 2004). These algal blooms have a negative economic impact of hundreds of millions of dollars annually world-wide (National Centers for Coastal Ocean Science 2010).

The marine vegetation in the taxonomic groups of seagrass, cordgrass, and mangroves has more limited distributions; none of them occur in open ocean areas. The relative distribution of seagrass is influenced by the availability of suitable substrate in low-wave-energy areas at depths that allow sufficient light exposure. Cordgrasses form dense colonies in salt marshes that develop in temperate areas in protected, low-energy environments, along the intertidal portions of coastal lagoons, tidal creeks or rivers, or estuaries, wherever the sediment can support plant root development (Mitsch et al. 2009).

3.7.2.1 General Threats

Environmental stressors on marine vegetation are products of human activities (industrial, residential, and recreational) and natural occurrences. Species-specific information is discussed, where applicable, in Sections 3.7.3.2 and 3.7.3.3, 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, trash), climate change, overfishing (Mitsch et al. 2009; Steneck et al. 2002), shading from structures (National Marine Fisheries Service 2002), habitat degradation from construction and dredging (National Marine Fisheries Service 2002), and invasion by exotic species (Hemminga and Duarte 2000; Spalding et al. 2003). The seagrass, cordgrass, and mangrove taxonomic group is more sensitive to stressors than the algal taxonomic groups. The great diversity of algae makes generalization difficult but, overall, algae are resilient and colonize disturbed environments (Levinton 2009b).

Seagrasses, cordgrasses, and mangroves are all susceptible to the human-made stressors on marine vegetation, and their presence in the Study Area has decreased because of these stressors. Each of these types of vegetation is sensitive to additional unique stressors. Seagrasses are uprooted by dredging and scarred by boat propellers (Hemminga and Duarte 2000; Spalding et al. 2003). Seagrass that is scarred from boat propellers can take years to recover. Cordgrasses are damaged by sinking salt marsh habitat, a process known as marsh subsidence. Likewise, the global mangrove resource has decreased by 50 percent from aquaculture, changes in hydrology (water movement and distribution), and sea level rise (Feller et al. 2010).

Oil in runoff from land-based sources, natural seeps, and accidental spills (such as offshore drilling and oil tanker leaks) are some of the major sources of oil pollution in the marine environment (Levinton 2009a). The types and amounts of oil spilled, weather conditions, season, location, oceanographic conditions, and the method used to remove the oil (containment or chemical dispersants) are some of the factors that determine the severity of the effects. Sensitivity to oil varies among species and within species, depending on the life stage; generally, early-life stages are more sensitive than adult stages (Hayes et al. 1992).

Oil pollution can impact seagrasses directly by smothering the plants, or indirectly by lowering their ability to combat disease and other stressors (U.S. National Response Team 2010). Seagrasses that are totally submerged are less susceptible to oil spills because they largely escape direct contact with the pollutant. Depending on various factors, oil spills such as the Gulf War oil spill in 1991 (Kenworthy et al. 1993) can have no impact on seagrasses, or can have long-term impacts, such as the four-year decrease in eelgrass density caused by the *Exxon Valdez* oil spill in 1989 (Peterson 2001). Algae are relatively resilient to oil spills, while mangroves are highly sensitive to oil exposure. Contact with oil can cause death, leaf loss, and failure to germinate (Hoff et al. 2002). Salt marshes can also be severely impacted by oil spills, and the effects can be long term (Culbertson et al. 2008).

3.7.2.2 Taxonomic Groups

3.7.2.2.1 Dinoflagellates (Phylum Dinophyta)

Dinoflagellates are single-celled organisms with two flagella (whiplike structures used for locomotion) in the phylum Dinophyta (Bisby et al. 2010). Dinoflagellates are predominantly marine algae, with an estimated 1,200 species living in surface waters of the ocean worldwide (Castro and Huber 2000). Most dinoflagellates can use the sun's energy to produce food through photosynthesis and also can ingest small food particles. Photosynthetic dinoflagellates are important primary producers in coastal waters (Waggoner and Speer 1998). Organisms such as zooplankton (microscopic animals that drift passively in the water column), feed on dinoflagellates.

Dinoflagellates are also valuable for their close relationship with reef-building corals. Some species of dinoflagellates 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 cause some types of harmful algal blooms which result from sudden increases in nutrients (e.g., fertilizers) from land into the ocean or changes in temperature and 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 websites.

3.7.2.2.2 Blue-Green Algae (Phylum Cyanobacteria)

Blue-green algae are single-celled, photosynthetic 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; Sze 1998). In nutrient-poor waters of coral reef ecosystems in the Hawaiian archipelago in the Hawaiian portion of the Study Area, blue-green algae are an important source of food. Coral reefs in Hawaii exposed to physical and biological disturbance may be colonized by highly productive or invasive blue-green algae that may persist if animals that feed on them are not present (Cheroske et al. 2000).

3.7.2.2.3 Green Algae (Phylum Chlorophyta)

Green algae are single-celled organisms 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 and snails.

Green seaweeds harvested for human consumption in Hawaii's coastal waters include *Ulva fasciata, Enteromorpha prolifera,* and *Codium edule* (Preskitt 2002a). Invasive marine green algal species are found in coastal waters of the Study Area. *Caulerpa taxifolia* and *Codium fragile tomentosoide* are found in the Southern California portion of the Study Area (Global Invasive Species Database 2005). The invasive green algae *Avrainvillea amadelpha* has been recorded in the main Hawaiian Islands (Preskitt 2010). Native Hawaiian green algal species that may become invasive include *Cladophora sericea*, *Caulerpa taxifolia*, *Dictyosphaeria cavernosa*, *Ulva fasciata*, and *Enteromorpha flexuasa* (Preskitt 2010).

3.7.2.2.4 Brown Algae (Phylum Heterokontophyta)

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). Most species are attached to the seafloor in coastal waters, although a free-floating type of brown algae (*Sargassum*) occurs in the Study Area.

3.7.2.2.4.1 Diatoms

Diatoms are single celled organisms with cell walls made of silicon dioxide. Two major groups of diatoms are generally recognized, centric diatoms and pinnate diatoms. Centric diatoms exhibit radial symmetry (symmetry about a point), while the pinnate diatoms are bilaterally symmetrical (symmetry about a line). Diatoms such as *Coscinodiscus* species (spp.) commonly occur in the Study Area. Some strains of another genus of diatoms, *Pseudo-nitzschia*, produce a toxic compound called domoic acid. Humans, marine mammals, and seabirds become sick or die when they eat organisms that feed on *Pseudo-nitzschia* strains that produce the toxic compound. The Southern California portion of the Study Area off the coasts of Los Angeles and Orange Counties had some of the highest concentrations of the toxic compound ever recorded in U.S. waters (Schnetzer et al. 2007). *Pseudo-nitzschia* blooms in the Southern California Bight during 2003 and 2004 were linked to over 1,400 marine mammal strandings (Schnetzer et al. 2007). Pollutants carried from land to the ocean by rainwater (Kudela and Cochlan 2000) and decreases in the movement of cool, nutrient-rich waters by the wind are believed to be the main causes of these harmful algal blooms in the Southern California portion of the Study Area (Kudela et al. 2004).

3.7.2.2.4.2 Kelp and *Sargassum*

Kelp is the most conspicuous brown algae occurring extensively along the coast in the Southern California portion of the Study Area. The giant kelp (*Macrocystis pyrifera*) can live up to eight years, and can reach lengths of 197 ft. (60 m). The leaf-like fronds can grow up to 24 inches (in.) (61 centimeters [cm]) per day (Leet et al. 2001). Bull kelp (*Nereocystis luetkeana*) can grow up to 5 in. (13 cm) per day.

Bull kelp attaches to rocky substrate, and can grow up to 164 ft. (50 m) in length in nearshore areas. In turbid waters, the offshore edge of kelp beds occurs at depths of 50–60 ft. (15–18 m), which can extend to a depth of 100 ft. (30 m) in the clear waters around the Channel Islands off the coast of Southern California (Wilson 2002). The kelp beds along the California coast and in waters off the Channel Islands are the most extensive and elaborate submarine forests in the world (Rodriguez et al. 2001).

Six species of canopy-forming kelp occur in the coastal waters of the California coast: the giant kelp (*Macrocystis pyrifera*), bull kelp (*Nereocystis luetkeana*), elk horn kelp (*Pelagophycus porra*), feather boa kelp (*Egregia menziesii*), chain bladder kelp (*Stephanocystis osmundacea*), and winged kelp (*Alaria marginata*) (Dayton 1985). The dominant kelp in the Southern California portion of the Study Area is giant kelp. Since the first statewide survey in 1967, the total area of kelp canopies has generally declined; the greatest decline occurred along the mainland coast of Southern California (Wilson 2002).

Kelp is managed by the California Department of Fish and Game, which issues exclusive leases to harvest designated beds for up to 20 years. Although they are not limited in the amount, harvesters cannot take kelp from deeper than 4 ft. (1.2 m) below the water's surface to protect the reproductive structures at the kelp's base (Wilson 2002). Edible brown seaweeds that are collected in Hawaii's coastal waters include *Sargassum echinocarpu*m and *Dictyopteris plagiograma* (Preskitt 2002a). Collection is regulated by the State of Hawaii Department of Land and Natural Resources.

Invasive marine brown algal species are found in coastal waters of the Southern California portion of the Study Area. *Undaria pinnatifida*, native to Japan, is found along the California coast (Global Invasive Species Database 2005). Two introduced species of *Sargassum* inhabit the Study Area. The brown alga *Sargassum muticum*, was introduced from the Sea of Japan, and now occupies portions of the California coast (Monterey Bay Aquarium Research Institute 2009). *Sargassum horneri,* which is native to western Japan and Korea, occurs in Long Beach Harbor and in Southern California waters off San Diego, Orange County, San Clemente Island, and Santa Catalina Island (Miller et al. 2007).

3.7.2.2.5 Red Algae (Phylum Rhodophyta)

Red algae are predominately marine, 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 thick calcium carbonate crusts. Within the Study Area, they occur in coastal waters, primarily in reef environments and intertidal zones of Hawaii and California. Abbott (1999) identified 343 species of red algae in Hawaiian waters. Representative native species in Hawaii include *Laurencia* spp., *Gracilaria coronopifolia*, *Hypnea cervicornis*, and *Gracilaria parvispora*. Representative non-native species include *Acanthophora spicifera*, *Gracilaria salicornia*, *Hypnea musciformis*, *Kappaphycus alvarezii*, and *Gracilaria tikvahiaea*. Many Rhodophyta species support coral reefs by hardening the reef and by cementing coral fragments (Veron 2000), and are food for various sea urchins, fishes, and chitons. In California waters, common species include *Endocladia muricata*, *Mastocarpus papillatus*, and *Mazaella* spp.

3.7.2.2.6 Seagrasses, Cordgrasses, and Mangroves (Phylum Spermatophyta)

Seagrasses, cordgrasses, 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 because they 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). Seagrass beds provide important ecosystem services as a structure-forming keystone species (Harborne et al. 2006). They provide suitable nursery habitat for commercially important organisms (e.g., crustaceans, fish, and shellfish) and also is a food source for numerous species (e.g., turtles) (Heck et al. 2003; National Oceanic and Atmospheric Administration 2001). Seagrass beds combat coastal erosion, promote nutrient cycling through the breakdown of detritus (Dawes 1998), and improve 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).

Seagrasses that occur in the coastal areas of the Southern California portion of the Study Area in the California Current Large Marine Ecosystem include eelgrass (*Zostera marina* and *Zostera asiatica*), surfgrass (*Phyllospadix scouleri* and *Phyllospadix torreyi*), widgeon grass (*Ruppia maritima*), and shoal grass (*Halodule wrightii*) (Spalding et al. 2003). The distribution of underwater vegetation is patchy along the California coast. In the Southern California portion of the Study Area, eelgrass and surfgrass are the dominant native seagrasses (Wyllie-Echeverria and Ackerman 2003).

In Hawaii, the most common seagrasses are Hawaiian seagrass (*Halophila hawaiiana*) and paddle grass (*Halophila decipiens*). Hawaiian seagrass is a native species found at 1.6 to 3.1 ft. (0.5 to 0.9 m) in subtidal, sandy areas surrounding reefs, in bays, or in fishponds. It occurs in coastal waters of Oahu near Mamala Bay (southern coast), in Maunalua Bay (southeastern coast), in Kaneohe Bay (northeast coast), in coastal waters of Maui, in the inner reef flats of southern Molokai, at Anini Beach on the northern shore of Kauai, and at Midway Atoll in the Northwestern Hawaiian Islands (Phillips and Meñez 1988). Paddle grass is possibly a nonnative species that occurs only on Oahu in waters to 115 ft. (35 m) deep; it is apparently restricted to the southern shore of Oahu (Maragos 2000; Preskitt 2001, 2002b).

3.7.2.2.6.2 Cordgrasses

Cordgrasses are temperate salt-tolerant land plants that inhabit salt marshes, mudflats, and other soft-bottom coastal habitats (Castro and Huber 2000). Salt marshes develop in intertidal, protected low-energy environments, usually in coastal lagoons, tidal creeks, rivers, or estuaries (Mitsch et al. 2009). The structure and composition of salt marshes provide important ecosystem services. Salt marshes support commercial fisheries by providing habitat for wildlife, protecting the coastline from erosion, filtering fresh water discharges into the open ocean, taking up nutrients, and breaking down or binding pollutants before they reach the ocean (Dreyer and Niering 1995; Mitsch et al. 2009). Salt marshes also are carbon sinks (carbon reservoirs) and facilitate nutrient cycling (Bouillon 2009; Chmura 2009). Carbon sinks are important in reducing the impact of climate change (Laffoley and Grimsditch 2009), and nutrient cycling facilitates the transformation of important nutrients through the environment. In salt marshes and mudflats along the California coast, native cordgrass species include California cordgrass (*Spartina foliosa*). Atlantic cordgrass (*Spartina alterniflora*) is a native cordgrass species from the Atlantic and Gulf coasts, and is considered an invasive species in California because it produces seeds at higher rates than the native cordgrass, and can quickly colonize mudflats (Howard 2008).

3.7.2.2.6.3 Mangroves

Mangroves are a group of woody plants that have adapted to brackish water environments in the tropics and subtropics (Ruwa 1996). Mangroves inhabit marshes and mudflats in tropical and subtropical areas. The red mangrove, *Rhizophora mangle*, and several other species of mangroves were introduced to Hawaii (Allen 1998). Since the introduction of this species, mangroves have invaded intertidal areas formerly devoid of trees. The red mangrove is now well-established in the main Hawaiian Islands. The red mangrove is considered to be an invasive species in the main Hawaiian Islands, and various resource agencies have eradication programs targeting the red mangrove and other mangrove infestations. No mangroves are found within California coastal environments.

3.7.3 ENVIRONMENTAL CONSEQUENCES

This section evaluates how and to what degree the activities described in Chapter 2 (Description of Proposed Action and Alternatives) potentially impact marine vegetation. General characteristics of all Navy stressors were introduced in Section 3.0.5.3 (Identification of Stressors for Analysis), and living resources' general susceptibilities to stressors were introduced in Section 3.0.5.7 (Biological Resource Methods). Each marine vegetation stressor is introduced, analyzed by alternative, and analyzed for training activities and testing activities. Table H-3 in Appendix F shows the warfare areas and associated stressors that were considered for analysis of marine vegetation.

The stressors vary in intensity, frequency, duration, and location within the Study Area. Based on the general threats to marine vegetation discussed in Section 3.7.2 (Affected Environment) the stressors applicable to marine vegetation are:

- Acoustic (explosives)
- Physical disturbance or strikes (vessels and in-water devices, military expended materials, seafloor devices)
- Secondary stressors (sediments and water quality)

Because marine vegetation is not susceptible to energy, entanglement, or ingestion stressors, those stressors will not be assessed. Only the Navy training and testing activity stressors and their components that occur in the same geographic location as marine vegetation are analyzed in this section. Training and testing activities pose no direct threat to some types of marine vegetation habitats. Details of all training and testing activities, stressors, components that cause the stressor, and geographic occurrence within the Study Area, are summarized in Section 3.0.5.3 (Identification of Stressors for Analysis) and detailed in Appendix A (Navy Activities Descriptions).

3.7.3.1 Acoustic Stressors

This section analyzes the potential impacts of acoustic stressors that may occur during Navy 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 of Explosives and Other Impulsive Sources

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 3.0.5.3.1.2 (Explosions). Explosive sources are the only acoustic stressor applicable to this resource because explosives could physically damage 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. 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. In addition, 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.

The potential for seagrass to overlap with underwater and surface explosions is limited to bayside areas of Silver Strand Training Complex (SSTC), as well as to protected areas along oceanside portions of SSTC. For instance, eelgrass is known to occur off Breakers Beach, but no explosives training occurs in known locations. Eelgrass primarily occurs in bayside areas, and may overlap with explosives training areas. Seagrasses could be uprooted or damaged by sea surface or underwater explosions. They are much less resilient to disturbance than *Sargassum* and other marine algae; regrowth 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. This scenario is not likely because of the low number of explosions planned in areas with seagrass.

3.7.3.1.2 No Action Alternative

3.7.3.1.2.1 Training Activities

Under the No Action Alternative, training activities that use explosives do not generally occur near shorelines, bays, rivers, or estuaries. In addition, the majority of underwater explosions in the Study Area would likely occur over unvegetated seafloor because it is the predominant bottom-type in the areas proposed for these activities. However, areas of marine algae may overlap with underwater explosions. In the Southern California Range Complex (SOCAL), nearshore explosions occur within SSTC Boat Lanes and training areas surrounding San Clemente Island. An area off Breakers Beach supports eelgrass, however, no explosives training occurs in this area. Eelgrass and other seagrasses are found in portions of SSTC bayside areas where Navy training involves simulated explosives, but no actual detonations. Within the coastal waters of Hawaii, explosives training occurs at Puuloa Underwater Range, Barbers Point Underwater Range, Lima Landing area, and Ewa Training Minefield. These areas, all located on the underwater portion of the Ewa Plain, are characterized by benthic algae beds (primarily green algae) and uncolonized pavement (U.S. Department of the Navy 1998). MK-8 marine mammal training occurs within Hawaiian coastal waters; however, the training in Hawaii does not involve explosives.

Underwater and surface explosions conducted for training activities are not expected to cause any risk to kelp beds, other marine algae, or seagrass because: (1) the relative coverage of marine algae is low, (2) new growth may result from marine algae exposure to explosives, (3) the impact area of underwater explosions is very small relative to kelp beds and other marine algae distribution, and (4) seagrass does not overlap with areas where the stressor occurs. Based on these factors, potential impacts on Sargassum marine algae from underwater and surface explosions are not expected to result in detectable changes to its growth, survival, or propagation, and are not expected to result in population-level impacts; and there are no potential impacts on seagrass species.

3.7.3.1.2.2 Testing Activities

Under the No Action Alternative, testing activities that involve explosions are limited to open ocean portions of the Study Area, primarily within SOCAL. Therefore, seagrasses would not be impacted by explosions because the depth of water where testing activities occur is too deep to support benthic vegetation. Only marine algae floating at the surface or suspended near the surface would be impacted by explosions. As stated previously, this type of algae is capable of recovering quickly from wave action, and will likely demonstrate rapid recovery rates after explosions.

Underwater and surface explosions conducted for testing activities are not expected to pose a risk to marine algae or seagrass because: (1) the relative coverage of marine algae is low, (2) new growth may result from marine algae exposure to explosives, (3) the impact area of underwater explosions is very small relative to kelp beds and other marine algae distribution, and (4) seagrass does not overlap with areas where the stressor occurs. Based on these factors, potential impacts on marine algae from underwater and surface explosions are not expected to result in detectable changes to its growth, survival, or propagation, and are not expected to result in population-level impacts; and there are no potential impacts on seagrass species.

3.7.3.1.3 Alternative 1

3.7.3.1.3.1 Training Activities

Under Alternative 1, the total number of explosive training events would increase by approximately 12 percent relative to the No Action Alternative. Most of these increases would occur within SOCAL open ocean training areas. The number of explosions within SSTC Boat Lanes would increase slightly, from 408 under the No Action Alternative to 414 under Alternative 1.This increase would only occur as part of Mine Neutralization – Explosive Ordinance Disposal training activities. All other activities within SSTC involving explosions would not increase relative to the No Action Alternative. As stated previously, SSTC Boat Lanes where explosives occur do no overlap with eelgrass or other seagrass habitats.

The potential impacts on marine algae from exposure to underwater and surface explosions are as described in Section 3.7.3.1.2.1 (No Action Alternative). The impact of underwater explosions from mine neutralization activities on bottom habitats provides some perspective on the potential impact area. The impact footprint of underwater explosions on bottom habitats is 0.04 square nautical miles (nm^2), see Table 3.3-3, Section 3.3.3.1.1.1 (Training Activities). This impact footprint is small relative to the distribution of marine algae, such as kelp, in the Study Area.

In comparison to the No Action Alternative, the increase in activities presented in Alternative 1 may increase the risk to marine algae from exposure to underwater and surface explosions. The majority of the difference is because of the increase in medium-caliber projectiles, which are the smallest type of explosive described in Chapter 2. 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, (2) the low number of charges reduces the potential for impacts, and (3) disturbance would be temporary. 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 result in detectable changes to their growth, survival, or propagation, and are not expected to result in population-level impacts.

3.7.3.1.3.2 Testing Activities

Under Alternative 1, underwater and surface explosions in the Study Area would increase by approximately 200 percent compared to the No Action Alternative (see Table 3.0-9). As under the No Action Alternative, testing activities would continue to occur in open ocean portions of SOCAL and Hawaii Range Complex (HRC). No explosives are used during testing activities within SSTC training areas, therefore, seagrasses in and around San Diego Bay would not be impacted.

The general conditions described for testing activities, the overlap with marine algae, lack of overlap with seagrass, and the potential impacts on marine algae from exposure to underwater and surface explosions are as described in Section 3.7.3.1.2 (No Action Alternative). The impact footprint of underwater explosions on bottom habitats is 0.06 nm^2, see Table 3.3-4, Section 3.3.3.1.2.1 (Training Activities). This impact footprint is small relative to the distribution of marine algae in the Study Area.

In comparison to the No Action Alternative, the increase in activities presented in Alternative 1 may increase the risk to marine algae from exposure to underwater and surface explosions. The majority of the difference is due to the increase in medium-caliber projectiles, which are the smallest type of explosive described in Table 3.0-8 (Explosives Detonated on or Near the Water Surface During Training and Testing Activities in the Study Area). 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. For the same reasons as stated in Section 3.7.3.1.2 (No Action Alternative), the use of surface and underwater explosions is not expected to result in detectable changes in marine algae growth, survival, or propagation, and are not expected to result in population-level impacts.

3.7.3.1.4 Alternative 2

3.7.3.1.4.1 Training Activities

Under Alternative 2, the same number of training activities and underwater detonations would occur as under Alternative 1. Therefore, underwater detonations under Alternative 2 would have the same impacts on marine vegetation as under Alternative 1.

In comparison to the No Action Alternative, the increase in activities presented in Alternative 2 may increase the risk of marine algae from exposure to underwater and surface explosions. It should be noted that the majority of the difference is because of the increase in medium-caliber projectiles, which are the smallest type of explosive described in Chapter 2. 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, (2) the low number of charges reduces the potential for impacts, and (3) disturbance would be temporary.

3.7.3.1.4.2 Testing Activities

Under Alternative 2, underwater and surface explosion use in the Study Area would increase by 11-fold compared to the No Action Alternative; see Table 3.0-9 (Explosives for Training and Testing Activities in the Study Area). As under the No Action Alternative, testing activities would continue to occur in open ocean portions of SOCAL and HRC. No explosives are used during testing activities within SSTC training areas, therefore, seagrasses in and around San Diego Bay would not be impacted.

The general conditions described for testing activities, the overlap with *Sargassum*, lack of overlap with seagrass, and the potential impacts on marine algae from exposure to underwater and surface explosions are as described in Section 3.7.3.1.1.1 (No Action Alternative). The impact footprint of underwater explosions on bottom habitats is 0.04 nm^2, see Table 3.3-6, Section 3.3.3.1.1 (Underwater Explosions). This impact footprint is small relative to the distribution of marine algae in the Study Area.

In comparison to the No Action Alternative, the 11-fold increase in activities presented in Alternative 1 may increase the risk to *Sargassum* from exposure to underwater and surface explosions. The majority of the difference is because of the increase in medium-caliber projectiles, which are the smallest type of explosive described in Table 3.0-8 (Explosives Detonated on or Near the Water Surface During Training and Testing Activities in the Study Area). Despite the increase in underwater and surface explosions, the potential impacts to exposed marine algae are expected to be the same as under the No Action Alternative because the overlap with the resource is limited. For the same reasons as stated in Section 3.7.3.1.1.1 (No Action Alternative), surface and underwater explosions are not expected to result in detectable changes in marine algae growth, survival, or propagation, and are not expected to result in population-level impacts.

3.7.3.2 Physical Disturbance and Strike Stressors

This section analyzes the potential impacts on marine vegetation of the various types of physical disturbance and strike stressors during training and testing activities within the Study Area. Three types of physical stressors are evaluated for their impacts on marine vegetation, including: (1) vessels, in-water devices, and towed in-water devices; (2) military expended materials; and (3) seafloor devices.

The evaluation of the impacts of physical strike and disturbance stressors on marine vegetation 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., mine shapes and 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 on the sea surface 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 Strike and Disturbance).

3.7.3.2.1 Impacts of Vessel 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. 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 Navy 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). In the open ocean, marine algae on the sea surface such as kelp paddies have a patchy distribution. Marine algae could be temporarily disturbed if struck by moving vessels or by the propeller action of transiting vessels. Fragmentation would be on a small spatial scale, and algal mats would be expected to re-form. These strikes could also injure the organisms that inhabit kelp paddies or other marine algal mat, such as sea turtles, seabirds, marine invertebrates, and fish (see Sections 3.5, 3.6, 3.8, and 3.9, respectively). In open-ocean areas, marine algae on the sea surface may be disturbed by vessels and in-water devices. Marine algae could be temporarily disturbed if struck by transiting vessels or by their propellers. It is resilient to winds, waves, and severe weather that could sink the mat or break it into pieces. If an algal mat mat is struck, broken pieces may grow into new algal mats because marine algae reproduces by vegetative fragmentation (i.e., new plants develop from pieces of the parent plant) (South Atlantic Fishery Management Council 1998). Impacts on marine algae by strikes may collapse the pneumatocysts (air sacs) that keep the mats afloat. Evidence suggests that some floating marine algae will continue to float even when up to 80 percent of the pneumatocysts are removed (Zaitsev 1971).

Vegetation on the seafloor such as seagrasses and macroalgae may be disturbed by amphibious combat vehicles. Seagrasses are resilient to the lower levels of wave action that occur in sheltered estuarine shorelines, but 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). 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. A literature search of at-risk marine macroalgae species in the Study Area (International Union for Conservation of Nature and Natural Resources 2011) did not indicate that this type of vegetation is more resilient to stressors than other marine vegetation. Because 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. Macroalgae that is floating in the area may be disturbed by amphibious combat vehicle activities, but the impact would not be detectable because of the low number of activities (see Table 2.8-1), and will not be considered further.

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, Alternative 1, and Alternative 2

Training Activities

Estimates of relative vessel use and location for each alternative are provided in Section 3.0.5.3.3.1 (Vessels). These estimates are based on the number of activities predicted for each alternative. While these estimates provide a prediction of use, actual Navy 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 Navy shore installations and established testing and training areas. Under Alternatives 1 and 2, the Study Area would be expanded, but the concentration of use and the manner in which the Navy tests and trains would remain consistent with the range of variability observed over the last decade. Consequently, the Navy is not changing the rate of vessel use and, therefore, the level of expected strikes would not change either. The difference in events from the No Action Alternative to Alternative 1 and Alternative 2, shown in Table 3.0-30, is not likely to change the probability of a vessel strike in any meaningful way.

Under all alternatives, 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. Most activities would involve one vessel, but activities may occasionally use two vessels. Most vessel traffic would occur in SSTC, in and near Pearl Harbor, off portions of Marine Corps Base Camp Pendleton, and on portions of San Clemente Island. Within SSTC, shallow-water vessel movements in defined boat lanes would continue to occur with minimal impacts on marine vegetation because these boat lanes overlie cobble and bare substrates.

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. In San Diego Bay, eelgrass beds are avoided to the maximum possible extent. Because of the dredging history of San Diego Bay near the Navy ship berths, impacts of vessel movements on marine vegetation are expected to be minimal (U.S. Department of the Navy and San Diego Unified Port District 2011). Because of the quantity of vessel traffic in Hawaiian nearshore waters since the 1940s (especially in waters off Oahu and within Pearl Harbor), the existing vegetation community profile is well-adapted to vessel disturbances.

On the open ocean, vessel strikes of marine vegetation would be limited to floating marine algae. Vessel movements may disperse or injure algal mats. Because algal distribution is patchy, mats may re-form, and events would be on a small spatial scale, Navy training activities involving vessel movement would not impact the general health of marine algae. Navy protective measures would ensure that vessels avoid large algal mats, eelgrass beds, or other sensitive vegetation that other marine life depend on for food or habitat; these measures would safeguard this vegetation type from vessel strikes. In addition, Navy protective measures would require helicopter crews that tow in-water devices for mine warfare exercises to monitor the water surface before and during exercises to identify and avoid marine algae.

Marine vegetation in the path of moving vessels or in-water devices 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. 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.

Under all Alternatives, the impacts of vessel, in-water device, and towed in-water device physical disturbances and strikes during training activities would be minimal disturbances of algal mats and seaweeds. Eelgrass 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 all alternatives, based on: (1) Navy protective measures; (2) the quick recovery of most vegetation types; (3) 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 (4) the deployment of in-water devices at depths where they would not likely come in contact with marine vegetation.

Testing Activities

Under all alternatives, the Navy would test a variety of vessels, vehicles, and in-water devices. Most of the testing activities involving vessel movements and in-water devices occur at sea within the SOCAL Range Complex and HRC, or within the transit corridor between the two range complexes. Some of the testing occurs pierside in San Diego Bay or Pearl Harbor.

On the sea surface, vessel and towed surface target strikes of marine vegetation would be limited to floating marine algal mats. Vessel movements may disperse or injure algal mats. However, algal mats may re-form, and testing events would be on a small spatial scale. Therefore, Navy testing activities involving vessel movement and towed surface targets are not expected to impact the general health of marine algae. No testing activities would occur near seagrasses, such as eelgrass beds in San Diego Bay.

The net impact of vessel, in-water device, and towed in-water device physical disturbances and strikes on marine vegetation during testing activities is expected to be negligible under all alternatives, based on: (1) Navy protective measures; (2) the quick recovery of most vegetation types; (3) 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 (4) the deployment of in-water devices at depths where they would not likely come in contact with marine vegetation.

3.7.3.2.2 Impacts of Military Expended Materials

This section analyzes the strike potential to marine fish of the following categories of military expended materials: (1) non-explosive practice munitions, (2) fragments of high-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 3.0.5.3.3.3 (Military Expended Materials Strikes).

Military expended materials can impact floating marine algae in the open ocean, and 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 seafloor macroalgae may be impacted.

The following are descriptions of the types of military expended materials that could impact marine algae and seagrass. Marine algae could overlap with military expended materials anywhere in the Study Area. SSTC is the only location where these materials could overlap with seagrasses. Potential impacts on marine algae and seagrass are as discussed in Section 3.7.3.2.2. Tables 3.3-63 through 3.3-65 present the numbers and locations of activities that expend military materials during training and testing activities by location and alternative.

Small-, Medium-, and Large-Caliber Projectiles. Small-, medium-, and large-caliber non-explosive practice munitions, or fragments of high-explosive projectiles expended during training and testing activities rapidly sink to the seafloor. The majority of these projectiles would be expended in the open ocean areas of SOCAL and HRC. Because of the small sizes of the projectiles and of their casings, damage to marine vegetation is unlikely. Large-caliber projectiles are primarily used in offshore areas at depths greater than 26 m (83.3 ft.), while small- and medium-caliber projectiles would be expended in both offshore and coastal areas at depths less than 26 m (83.3 ft.). Marine algae could occur where these materials are expended, but seagrasses generally do not because these activities do not normally occur in water that is shallow enough for seagrass to grow (26 m [83.3 ft.]).

Bombs, Missiles, and Rockets. Bombs, missiles, and rockets, or their fragments (if high-explosive) are expended offshore (at depths greater than 26 m [83.3 ft.]) during training and testing activities, and rapidly sink to the seafloor. Marine algae could occur where these materials are expended, but seagrass generally does not because of water depth limitations for activities that expend these materials.

Parachutes. Parachutes of varying sizes are used during training and testing activities. The types of activities that use 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 Section 3.0.5.3.4.3 (Parachutes). Marine algae could occur in any of the locations where these materials are expended.

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. Marine algae and seagrass could occur where these materials are expended.

Vessel Hulk. Vessel hulks is a notable type of military expended material because of its size. Vessel hulks are expended at sea during sinking exercises. Sinking exercises use a target (vessel hulk) against which live high-explosive or non-explosive munitions are fired; the sinking exercise 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 3,000 m (9,842.7 ft.), see Figure 3.0-2. Floating marine algal mats could occur where these materials are expended, but seagrass could not.

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 may overlap with chaff and flares that are expended in the Gulf of Mexico Large Marine Ecosystem in the Key West Range Complex. Floating marine algal mats could occur in any of the locations that these materials are expended.

3.7.3.2.2.1 No Action Alternative

Training Activities

Tables 3.0-63 through 3.0-65 list the numbers and locations of military expended materials, most of which are small- and medium-caliber projectiles. The numbers and footprints of military expended materials are detailed in Table 3.3-5.

In HRC, projectiles would be expended in shallow-water habitats around Kaula Rock during air-to-ground gunnery exercises. Small-caliber projectiles would be expended over the course of 18 events per year, expending about 15,000 small- and medium-caliber projectiles per year. While most of these will remain on the small island, a small number could be expected to settle in the shallow water around Kaula Rock. Common algae found in rocky intertidal habitats include sea lettuce, coralline red algae, red fleshy algae, brown algae, and fleshy green algae (U.S. Department of the Navy 2005). Common plants that inhabit the sandy beach intertidal habitat include the beach morning glory (*Ipomoea* spp.), beach heliotrope

(*Tournefortia argentea*), milo (*Thespesia populnea*), and hau (*Hibiscus tiliaceus*) (Maragos 2000). The footprint of expended projectiles would be very small, and would have no impact on intertidal vegetation. No other activity would introduce projectiles or casings into shallow water in Hawaii.

Floating marine algal mats and other types of algae that occur on the sea surface in the open ocean may be temporarily disturbed if struck by military expended materials. This type of disturbance would not likely be different from conditions created by waves or rough weather. If enough military expended materials land on algal mats, the mats can sink, but sinking occurs as a natural part of the aging process of marine algae and would, therefore, not impact the population (Schoener and Rowe 1970). Strikes would have little impact and would not likely result in the mortality of marine algae or other algae, although these strikes may injure the organisms that inhabit marine algae, such as sea turtles, birds, marine invertebrates, and fish (see Sections 3.5, 3.6, 3.8 and 3.9, respectively).

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.

<u>Testing Activities</u>

Tables 3.0-63 through 3.0-65 list the numbers and locations of military expended materials, most of which are small- and medium-caliber projectiles. The numbers and footprints of military expended materials are detailed in Tables 3.3-5 through 3.3-7. Under the No Action Alternative, testing activities would expend materials in shallow-water habitats. No testing activities would expend materials in shallow-water habitats of SSTC; however, some testing events would expend medium-caliber rounds in SOCAL testing areas as part of Naval Air Systems Command testing of the Airborne Projectile-based mine clearance system.

Under the No Action Alternative, military expended materials used for testing 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 does not overlap with areas where the stressor occurs. Based on these factors, potential impacts on marine algae from military expended materials are not expected to result in detectable changes in its growth, survival, or propagation, and are not expected to result in population-level impacts; and there are no potential impacts on seagrass.

3.7.3.2.2.2 Alternative 1

<u>Training Activities</u>

Tables 3.0-63 through 3.0-65 list the numbers and locations of military expended materials, most of which are small- and medium-caliber projectiles. The numbers and footprints of military expended materials are detailed in Table 3.3-6. As indicated in Section 3.0.5.3.3.3 (Military Expended Materials Strikes), under Alternative 1, the total amount of military expended materials is more than twice the amount expended in the No Action Alternative. The activities and type of military expended materials under Alternative 1 would be expended in the same geographic locations as the No Action Alternative.

Floating marine algal mats and other types of algae that occur on the sea surface in the open ocean may be temporarily disturbed if struck by military expended materials. This type of disturbance would not likely be different from conditions created by waves or rough weather. If enough military expended materials land on algal mats, the mats can sink, but sinking occurs as a natural part of the aging process of marine algae and would, therefore, not impact the population (Schoener and Rowe 1970). Strikes would have little impact, and would not likely result in the mortality of floating algal mats or other algae, although these strikes may injure the organisms that inhabit marine algal mats, such as sea turtles, birds, marine invertebrates, and fish (see Sections 3.5, 3.6, 3.8 and 3.9, respectively).

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 exposed algal mats and seagrass are expected to be the same as under the No Action Alternative because overlap with the resources are 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

Tables 3.0-63 through 3.0-65 list the numbers and locations of military expended materials, most of which are small- and medium-caliber projectiles. The numbers and footprints of military expended materials are detailed in Table 3.3-6. As indicated in Section 3.0.5.3.3.3 (Military Expended Materials Strikes), under Alternative 1, the total amount of military expended materials is nearly four-times the amount expended in the No Action Alternative. Testing activities under Alternative 1 would be in the same locations as under the No Action Alternative, and military materials would be expended in the same locations as under the No Action Alternative. Military expended materials would typically be of the same type listed under the No Action Alternative.

Under Alternative 1, increased deposition of military expended materials during testing activities would not increase the risk of physical disturbance or strike to seagrass. Under Alternative 1, increased deposition of military expended materials during testing activities could increase the risk of physical disturbance or strike to marine algae. Any damage from deposition of military expended materials would be followed by a recovery period lasting weeks to months. Marine algae could have a detectable response to physical disturbances or strikes by military expended materials, but would recover completely, with no impact on its growth, survival, reproductive success, or lifetime reproductive success.

3.7.3.2.2.3 Alternative 2

Training Activities

The numbers and locations of training activities under Alternative 2 are identical to those of training activities under Alternative 1. Therefore, impacts on and comparisons to the No Action Alternative also are identical, as described in Section 3.7.3.2.2.1 (No Action Alternative).

Testing Activities

The numbers and locations of testing activities under Alternative 2 are identical to those of training activities under Alternative 1. Therefore, impacts on and comparisons to the No Action Alternative also are identical, as described in Section 3.7.3.2.2.1 (No Action Alternative).

3.7.3.2.3 Impacts of Seafloor Devices

For a discussion of the types of activities that use seafloor devices, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.3.3.4 (Seafloor Devices). Six training and testing activities require the installation or removal of devices and infrastructure on the seafloor: (1) elevated causeway system and causeway pier insertion and retraction activities; (2) anti-terrorism/force protection underwater surveillance system training; (3) the installation of fixed intelligence, surveillance, and reconnaissance sensor systems; (4) precision anchoring training; (5) offshore petroleum discharge system training; and (6) salvage operations. Marine vegetation on the seafloor may be impacted by seafloor devices, while vegetation on the sea surface such as marine algal mats is not likely to be impacted; therefore, it will not be discussed further. Seagrasses and seafloor macroalgae in the Study Area may be impacted by the use of 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. For seafloor devices, in particular, the potential for overlap with seagrass in the Study Area is limited to elevated causeway system and causeway pier insertion and retraction activities and offshore petroleum discharge system training activities. The bayside Bravo training area contains an estimated 1.13 ac. (0.45 ha) of eelgrass habitats; however, the designated Bravo Beach training lane (where the training activity would occur) is a previously disturbed and previously used zone within the Bay.

3.7.3.2.3.1 No Action Alternative

<u>Training Activities</u>

Under the No Action Alternative, elevated causeway systems training in Bravo may remove eelgrass within the footprint of the pile. Furthermore, the Navy is participating in mitigation programs for eelgrass restoration if this type of disturbance occurs within eelgrass habitats (U.S. Department of the Navy 2011).

Four anti-terrorism/force protection underwater surveillance training events would occur every year in San Diego Bay. Typical events last five days, and day operations may range from 8 to 24 hours per training day. These training activities would involve placing clump anchors around existing piers and ships. These areas are characterized as deep subtidal habitats greater than 20 ft. (6 m) in depth, subject to periodic dredging since the 1940s (U.S. Department of the Navy and San Diego Unified Port District 2011). These areas are too deep to support eelgrass.

Precision anchoring training events would occur 72 times per year within SSTC anchorages. Six offshore petroleum discharge system training events would occur every year. These training events would primarily occur in SSTC boat lanes, but may also occur in the Bravo Beach designated boat lane and waters outside of boat lanes in waters off SSTC.

Marine plant species found within the nearshore waters off San Diego and in waters around San Clemente Island are adapted to natural disturbance, and recover quickly from storms, as well as from wave and surge action. Bayside marine plant species, such as eelgrass, are found in areas where wave action is minimal. Pile driving and installation of seafloor devices may impact vegetation in benthic habitats, but the impacts would be temporary and would be followed by rapid (within a few weeks) recovery, particularly in oceanside boat lanes in nearshore waters off San Diego and in designated training areas adjoining San Clemente Island. In bayside areas, recovery of eelgrass from direct disturbance by pile driving would occur over longer timeframes (e.g., over a period of months). Eelgrass beds show signs of recovery after a cessation of physical disturbance; the rate of recovery is a function of the severity of the disturbance (Neckles et al. 2005). Eelgrass recovery in San Diego Bay is generally associated with improving water quality and a cessation of major disturbance activities in former eelgrass beds, such as dredging (Chavez 2009). Pile driving and installation of seafloor devices, in contrast to dredging, have a minor impact limited to the area of the actual pile and footprint of the mooring.

Seafloor device installation in shallow water habitats under the No Action Alternative training activities would pose a negligible risk to marine vegetation. Any impacts would be short-term, and devices would be installed in areas subject to other training activities or prior disturbance (e.g., SSTC boat lanes and Pearl Harbor training areas). Any damage from deposition of military expended materials would be followed by a recovery period lasting weeks to months. Although marine vegetation growth in the vicinity of seafloor devices installed during training activities under the No Action Alternative would be inhibited during recovery, long-term survival, reproductive success, and lifetime reproductive success would not be impacted.

Testing Activities

Testing activities under the No Action Alternative would install seafloor devices within the Study Area. Space and Naval Warfare Systems Command activities that may impact marine vegetation by installing seafloor devices include fixed system underwater communications testing (nine events in San Diego Bay, nine events at Point Loma and in Imperial Beach, and nine events in San Clemente Island Testing areas), fixed autonomous oceanographic research and meteorology and oceanography testing activities (45 events per year at Point Loma and Imperial Beach locations and 45 events in San Clemente Island Testing areas), and fixed intelligence, surveillance, and reconnaissance sensor system testing activities (nine events per year at Point Loma and Imperial Beach locations and 14 events in San Clemente Island Testing areas).

These testing activities would involve the temporary installation of several arrays on the seafloor, buried 2 to 6 in. (5 to 15 cm) in sandy seafloor substrates or suspended in the water column with a mooring structure. Typical tests last five days, and day operations occur over an eight-hour period. Arrays may stay in the water for several months.

Seafloor devices installed in shallow-water habitats under the No Action Alternative testing activities would pose a negligible risk to marine vegetation. Any impacts would be short-term, and devices would be installed in areas subject to other testing activities or prior disturbance (e.g., SSTC boat lanes and Pearl Harbor testing areas). 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 during testing activities under the No Action Alternative would be inhibited during recovery, long-term survival, reproductive success, or lifetime reproductive success would not be impacted.

3.7.3.2.3.2 Alternative 1

Training Activities

Under Alternative 1, no additional elevated causeway system training events or any other new activity that involves pile driving are proposed. Precision anchoring events within SSTC anchorages would remain the same as under the No Action Alternative, at 72 events per year. Offshore petroleum discharge system training would also remain the same as under the No Action Alternative, at six events per year, as would salvage operations training (remaining steady at three events per year). The number of anti-terrorism/force protection underwater surveillance training would be increased by two events per year (for a total of six events per year) in San Diego Bay over the number of training events for this activity under the No Action Alternative.

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 during 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

Alternative 1 testing events would increase relative to the No Action Alternative. Fixed-system, underwater communications testing would increase by one event per year in each testing area used for this testing activity (San Diego Bay, Point Loma and Imperial Beach, and San Clemente Island testing areas). Fixed autonomous oceanographic research and meteorology and oceanography testing activities would increase by 10 events per year to account for 50 events in Point Loma and Imperial Beach locations and 50 events in San Clemente Island testing areas. Fixed intelligence, surveillance, and reconnaissance sensor system testing activities would increase by one event per year at Point Loma and Imperial Beach locations, and would increase by two per year at San Clemente Island testing areas.

As noted previously, the Navy uses sandy substrates devoid of marine vegetation to the extent possible. Marine plant species found within San Diego Bay and in waters off San Clemente Island 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, eelgrass beds would require longer recovery periods in bayside areas.

Seafloor devices installed in shallow-water habitats during 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 in the vicinity of seafloor devices installed during 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 elevated causeway system training events or other new activities that involve pile driving are proposed. Precision anchoring events within SSTC anchorages would remain the same as under the No Action Alternative, at 72 events per year. Offshore petroleum discharge system training would also remain the same as under the No Action Alternative, at six events per year, as would salvage operations training (remaining at three events per year). Anti-terrorism/force protection underwater surveillance training would increase by two events per year (to six events per year) in San Diego Bay over the number of training events for this activity under the No Action Alternative.

Seafloor devices installed in shallow-water habitats during Alternative 2 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 during training activities under Alternative 2 would be inhibited during recovery, the long-term survival, reproductive success, or lifetime reproductive success would not be impacted.

Testing Activities

Alternative 2 testing events would increase relative to the No Action Alternative. Fixed-system underwater communications testing would increase by two events per year in each testing area used for this testing activity (San Diego Bay, Point Loma and Imperial Beach, and San Clemente Island testing areas). Fixed autonomous oceanographic research and meteorology and oceanography testing activities would increase by 20 events per year to account for 55 events in Point Loma and Imperial Beach locations and 55 events in San Clemente Island testing areas. Fixed intelligence, surveillance, and reconnaissance sensor system testing activities would increase by two events per year at Point Loma and Imperial Beach locations and increase by four per year at San Clemente Island testing areas.

The Navy uses sandy substrates devoid of marine vegetation to the extent possible. Marine plant species found within San Diego Bay and in waters off San Clemente Island 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, eelgrass beds in bayside areas would require longer recovery periods.

Seafloor devices installed in shallow-water habitats during 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 in the vicinity of seafloor devices installed during testing activities under Alternative 2 would be inhibited during recovery, the long-term survival, reproductive success, or lifetime reproductive success would not be impacted.

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 explosion by-products, metals, chemicals other than explosives, and other materials (marine markers, flares, chaff, targets, and miscellaneous components of other materials). The analysis determined that neither state or federal standards or guidelines for sediments nor 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.

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

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 (underwater and surface explosions) and physical disturbances or strikes (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 it occurs in large expanses. Discrete areas of the Study Area (mainly within offshore areas with depths greater than 26 m

(85.3 ft.) in portions of range complexes and testing ranges) 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 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.

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