Essential Fish Habitat Programmatic Consultation for Overwater Structures between the National Oceanic and Atmospheric Administration's National Marine Fisheries Service and the United States Army Corps of Engineers, South Coast Branch, Los Angeles District

Introduction

Under Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), federal agencies are required to consult with the Secretary of Commerce on any actions that may adversely affect essential fish habitat (EFH). Consultation can be addressed programmatically to broadly consider as many adverse effects as possible through programmatic EFH Conservation Recommendations. 50 CFR 600.920 (j) states that programmatic consultation is appropriate for specified activities, if sufficient information is available that will allow NOAA's National Marine Fisheries Service (NMFS) to develop EFH Conservation Recommendations, which address reasonable and foreseeable adverse impacts to EFH resulting from activities of a program. The purpose of a programmatic consultation is to implement the EFH consultation requirements efficiently and effectively by incorporating many individual actions that may adversely affect EFH into one consultation.

This Programmatic Consultation applies to permit applications (standard permits, letters of permission, nationwide permits, or general permits of those types of authorization) in the South Coast Branch of the Los Angeles District (LAD) of the United States Army Corps of Engineers' (Corps) Regulatory Program (Regulatory). The geographical scope for the Overwater Programmatic includes all tidally influence waters of the United States and immediate fringes within Orange and San Diego Counties.

Due to the similarity of activity effects on EFH, NMFS has determined that a category of activities authorized under the Program may be covered under a single programmatic consultation. This programmatic consultation applies to new or expanded overwater structure construction, modification, maintenance, and associated indirect activities. Hereafter, it will be referred to as the Overwater Programmatic. The scope of activities covered in this programmatic consultation includes the following and will NOT cover any dredging activities:

1. Piers/Docks – Covers all activities associated with upgrade/retrofit, expansion, reconfiguration and new construction of piers and docks. This includes pile removal, replacement, and installation.

2. Wharves/Marinas – Covers all activities associated with wharf and marina upgrade/retrofit, expansion and reconfiguration of existing overwater structures, including pile removal and installation.

3. Moorings/Floats/Buoys – Covers all activities associated with temporary and permanent mooring, float, and buoy placement.

Corps LAD Regulatory Program Description

The following permits are considered together as they are administered together by Corps Regulatory through a single permit application.

RIVERS AND HARBORS ACT OF 1899 (SECTION 10)
Authorities**:** 33 U.S.C. § 401-413: Rivers and Harbors Act of 1899; 33 CFR 323: Permits for Structures or Work Affecting Navigable Waters of the United States.

CLEAN WATER ACT (SECTION 404)
Authorities: 33 U.S.C. §1251 et seq.: Federal Water Pollution Control Act; 33 FCR 322: Permits for Discharges of Dredged or Fill Material into the Waters of the United States.

MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT, (SECTION 103)
Authorities: 33 U.S.C. §1401 et seq.: Marine Protection, Research and Sanctuaries Act; 33 CFR 324: Permits for Ocean Dumping of Dredged Material.

A Section 10 permit is required for all work, including structures, seaward of the annual high water line in navigable waters of the United States, defined as waters subject to the ebb and flow of the tide, as well as a few of the major rivers used to transport interstate or foreign commerce. A Section 404 permit is required for activities that involve the discharge of dredged or fill material into waters of the United States, including not only navigable waters, but also coastal waters, inland rivers, lakes, streams, and wetlands. A Section 103 permit is required to transport dredged material for the purpose of disposal in the ocean.

The LAD routinely permits (Section 10, 404, and 103) a variety of projects that occur in estuarine and nearshore waters designated as EFH. Included in these projects are the construction, maintenance, replacement and expansion of such structures as piers, wharves, bulkheads, dolphins, marinas, ramps and floats.

Description of Essential Fish Habitat Affected by the LAD Program Overwater Structure Activities

EFH guidelines (50 CFR 600.05 – 600.930) outline the process for federal agencies, NMFS and the Fishery Management Councils to satisfy the EFH consultation requirement under section 305 (b(2)-(4)) of the MSA. EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity (16 U.S.C. 1802(10)).

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

Substrate includes sediment, hard bottom, structures underlying the water, and associated biological communities.

Necessary means the habitat required to support a sustainable fishery and the managed species' contribution to healthy ecosystem.

Adverse effect refers to any impact that reduces the quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810 (a)).

Affected Fishery Management Plans

Federally managed species occurring in estuarine and nearshore waters within the geographical scope of the Overwater Programmatic are administered by three fishery management plans (FMP). These are the Pacific Coast Groundfish FMP, the Coastal Pelagic Species FMP, and Highly Migratory Species FMP.

Pacific Coast Groundfish FMP

Based on research and habitat modeling developed for the Pacific Coast Groundfish FMP, there are fifty-three species that utilize the estuarine and embayment habitats within the permitting boundaries of the LAD, to fulfill one or more necessary life history stages (spawning, breeding, feeding or growth to maturity). This document uses the best science available to understand the potential adverse effects to EFH resulting from specific activities. Below is the list of species that have been identified as potentially affected by overwater structure activities (Table 1). For detailed life history descriptions for each species, please see Appendix B Part 2 of the Pacific Coast Groundfish FMP. A subset of these species has been discussed below given their stronger affinity for nearshore and embayment habitat.

Table 1: Pacific Groundfish Species with necessary habitat within LAD permitting boundary:

Aurora rockfish	**California skate**	Gopher rockfish	Longspine thornyhead	Ratfish	Soupfin shark
Bank rockfish	Canary rockfish	**Grass rockfish**	Mexican rockfish	Rex sole	Spiny dogfish
Blue rockfish	Chilipepper rockfish	Green-spotted rockfish	Olive rockfish	Rock sole	Splitnose rockfish
Boccaccio	Cowcod	Honeycomb rockfish	Pacific cod	Rougheye rockfish	**Starry flounder**
Big skate	Curlfin sole	Kelp greenling	Pacific ocean perch	Sablefish	Stripetail rockfish
Brown rockfish	Dark blotched rockfish	Kelp rockfish	Pacific rattail	Sand sole	Treefish
Cabezon	Dover sole	**Leopard shark**	Pacific sanddab	Sharpchin rockfish	Widow rockfish
Calico rockfish	**English sole**	**Lingcod**	Pacific whiting	Shortbelly rockfish	Yellowtail rockfish
California scorpionfish	Finscale codling	Longnose skate	Petrale sole	Shortspine thornyhead	

***Bold species will be discussed in further detail**

The habitat and trophic requirements of the following species are adapted from McCain (2003), Talent (1985), CDFG (2001), and Love *et al.* (2002). Additional citations have also been included in the summary species sections.

Leopard Shark – *Triakus semifasicata*

Leopard sharks are common in California bays and estuaries and along southern California beaches. They may also be found in soft-bottom habitats near rocky reefs and kelp beds. Leopard sharks are demersal, showing preference for benthic habitats in waters less than 4 meters deep, leaving them susceptible to shallow water activities. Leopard sharks often enter shallow bays and onto intertidal flats during high tides and retreat on ebb. For example, leopard sharks have been observed following the tide onto mudflats to forage for food (Ackerman et al, 2000). Estuaries and shallow coastal waters are used as pupping and feeding/rearing grounds. In addition, warmer waters found within coastal embayments in southern California increase metabolism and reproductive success (Hight and Lowe 2007). Visual, shore-based observations of leopard shark aggregations have been made in POLA, Marina del Rey, and Carpinteria Marsh (Merkel and Associates 2009, Chesney 2002, Sahugun 2010). In addition, leopard sharks have been documented in fish surveys conducted in Mugu Lagoon, San Diego Bay, and Morro Bay (Onuf 1987, Tetra Tech 2009, Tenera 2001, Peeling 1974). More recently, leopard sharks have also been observed utilizing the newly restored Bolsa Chica Wetlands.

These sharks utilize several major food sources and preference is dependent upon the size of the shark. Neonate pups occur in and just beyond the surf zone in areas of southern California, and within smaller coastal embayments. Juveniles and adults are opportunistic benthic and littoral feeders. Prey includes crab, shrimp, clams, fish, fish eggs, polychaete worms, and octopi. Presence of mud-burrowing prey in their diets suggests that the leopard shark feed close to or in the mud/benthos. Large adults are mostly piscivorous (fish eaters); eating anchovies, herring, sculpins, croakers, surfperch, rockfish, flatfish, and small elasmobranches; while smaller adults and juveniles consume greater proportions of crustaceans, clam siphons; innkeeper worms, *Urechis caupo*, and fish eggs. Diet analyses of leopard sharks in Humboldt Bay revealed that fish eggs (*Atherinopsis californiensis)* and cancrid crabs were the most important prey items (Ebert and Ebert, 2005). Studies also indicate that the seasonal abundance and movements of leopard sharks in bays and estuaries are likely influenced by prey availability (CDFG 2006).

Leopard sharks may be vulnerable to habitat disturbance in areas with high human populations. Future management should take into account the overall vulnerability of this species in shallow, nearshore habitats, especially areas thought to be important nursery grounds (CDFG 2006).

Brown Rockfish – *Sebastes auriculatus*

Brown rockfish are common in shallow water and occur from the surface to 128 meters. However, they are most abundant in waters less than 53 meters and are widely distributed in shallow water bays such as Mugu Lagoon (Tetra Tech 2009). Pelagic juveniles are found over a wide depth range. Brown rockfish use estuaries as nursery grounds. Off California, young brown rockfish recruit to hard substrate, low relief areas, patches of drift algae on the bottom, and on the walls of submarine canyons. Brown rockfish are demersal, living on hard bottom such as low profile siltstone or sandstone. They aggregate near sand-rock interfaces and rocky bottoms of artificial and natural reefs over a fairly wide depth range; in eelgrass beds; oil platforms; sewer pipes; and old tires. In shallow waters, they are associated with rocky areas and kelp beds, while in deeper water they stay near rocky substrate. Brown rockfish prey on small fish, crab, shrimp, isopods, and polychaete worms.

Grass Rockfish – *S. rastrelliger*

Grass rockfish range from central Baja California to central Oregon. They are one of the shallowest dwelling rockfish, found in intertidal and subtidal waters up to 46 meters in depth. They are generally associated with high relief rocky reef habitats but occasionally visit areas of cobble and sand. For example, in southern California, they have been observed in Mugu Lagoon (Tetra Tech 2009). Juveniles and adults can frequently be found in tide pools. Grass rockfish feed primarily on bottom-dwelling organisms such as crab, gammarid amphipods, isopods, and small fish.

California Scorpionfish – *Scorpaena guttana*

California scorpionfish range from Santa Cruz, California to southern Baja California. They are benthic and found within intertidal waters to as deep as 120 meters. They are most common in habitats associated with rocky reef, often within rock crevices, but are also known to occur in soft bottom habitats throughout southern California. Although primarily a solitary species it is known to aggregate near prominent features and are often associated with anthropogenic features such as pipes and wrecks. Young juvenile scorpionfish live in shallow water, using habitats with dense algae and benthic organisms as refugia. Small cancrid crabs are likely the most important food source for California scorpionfish, although other items such as small fish, octopus, and shrimp are eaten. SAIC (2010) documented presence of California scorpionfish in the Ports of Los Angeles and Long Beach. Similarly, they have been documented to occur in San Diego Bay (VRG 2010), Alamitos Bay (Valle *et al*. 1999), and other locations throughout southern California.

Cabezon – *Scorpaenichthys marmoratus*

Cabezon populations along the eastern Pacific coast range from Point Abreojos, Baja California to Sitka, Alaska. They can be found on hard bottoms in shallow water from intertidal pools to depths of 90 meters. Individuals frequent subtidal habitats in or around rocky reef areas and kelp beds. Eelgrass beds and sandy bottoms are also used, though perhaps less frequently. Cabezon have been observed utilizing eelgrass beds near the mouths of various bays in southern California (e.g., San Diego Bay, Newport Bay, and Morro Bay) (Chesney personal observation). Eggs, juveniles and adults are demersal; larvae and small juveniles are pelagic and planktivorous. In California, juveniles first appear in kelp canopies, tide pools, and other shallow rocky habitats such as breakwaters from April through June.

Juveniles and adults are carnivorous, and feed opportunistically. Small juveniles prey primarily on amphipods, shrimp, crab, and other small crustaceans, while adults prey upon crab, lobster, mollusks, small fish and fish eggs. Juveniles are consumed by rockfish, lingcod and other sculpins, and adults have been found to be preyed upon by harbor seals and sea lions.

English Sole – *Parophrys vetulus*

English sole eggs and larvae are pelagic. Juveniles settle in estuaries and shallow nearshore habitats all along the coast moving into deeper waters as they mature. Adults are common in San Pedro Bay, California and spawning adults and eggs have been found in Santa Monica Bay, California. SAIC (2010) documented their presence in the Ports of Los Angeles and Long Beach. They use nearshore coastal and estuarine habitats as nursery areas. As they mature they tend to move into deeper waters. Adults and juveniles prefer soft bottom habitats composed of fine sands and mud but are reported to occur in eelgrass habitats, as well.

English sole larvae likely prey on various stages of copepods and other zooplankton with a preference for appendicularians. Juveniles and adults are diurnal feeders, using sight smell and occasionally digging through the benthos to locate prey.   Juveniles prey upon harpacticoid copepods, gammarid amphipods, mysids, polychaetes, small bivalves, clam siphon, and other benthic invertebrates.

Starry Flounder – *Platichthys stellatus*

Juveniles and adults are found from 120 kilometers upstream to the outer continental shelf at 375 meters, but most adults are found in less than 150 meters. The primary spawning activity occurs in estuaries or sheltered inshore bays. Eggs and larvae are epipelagic, whereas juveniles and adults are demersal. Eggs occur at or near the surface over waters 20-70 meters deep. Larvae are found in estuaries to 37 kilometers offshore, while juveniles are found primarily in estuaries. Juveniles prefer sandy to muddy substrates, while adults prefer sandy to coarse substrates.

Starry flounder larvae are planktivorous, whereas juveniles and adults are carnivorous. At 5-12 mm in length, larvae prey on copepods, eggs, barnacle larvae and diatoms. Small juveniles feed on copepods, amphipods, and annelid worms. Large fish feed on a wider variety of items including crab and more mobile organisms. Starry flounder likely compete for food resources with other soft-bottom benthic fishes of estuaries and shallow nearshore bays.

Lingcod – *Ophiodon elongatus*

Lingcod are found only off the coast of North America. They are distributed in nearshore waters from northern Baja California to the Shumagin Islands along the Alaskan Peninsula. They are found over a variety of substrates at depths ranging from 3 to 400 meters, but are most common in rocky areas from 1 to 100 meters. Adults are found in deeper rocky and reef areas whereas juveniles reside in shallow bays and on nearshore sand and mud bottoms. Juveniles occur over a wide range of habitats including mud, sand, gravel, and eelgrass. Pelagic juvenile lingcod feed initially on small copepods and their diet quickly shifts to larger copepods, crab larvae, amphipods, euphausiids, and herring larvae. As small benthic juveniles, lingcod feed on herring, flatfish, shiner perch, and other fish. As large juveniles and adults, lingcod feed almost exclusively on fish. In California waters, juvenile rockfish are the most important prey for adult lingcod.

California Skate – *Raja inornata*

The California skate ranges from southern Baja to the Strait of Juan de Fuca. They are common off most of the California coast, as well as inshore and in shallow bays (less than 20 meters deep). They typically occupy inshore soft bottom substrates, where egg cases are deposited. The California skate feeds primarily on shrimp and other invertebrates.

<u>Pacific Coast Groundfish Habitat Areas of Particular Concern (HAPC)</u>

HAPC are described in the regulations as subsets of EFH which are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area (50 CFR 600.815(a)(8)). Designated HAPC are not afforded any additional regulatory protection under MSA; however, federally permitted projects with potential adverse impacts to HAPC will be more carefully scrutinized during the consultation process. Most of the Pacific Coast Groundfish HAPCs are based on habitat type and may vary spatially and or temporally depending upon environmental conditions. For this reason, the mapped extent of these areas offers only a first approximation of their location. Defining criteria are provided in the following descriptions of HAPCs, which can be used in conjunction with maps to determine if a specific location is within one of these HAPCs.

Estuaries

Estuaries are protected nearshore areas such as bays, sounds, inlets, and river mouths, influenced by ocean and freshwater. Because of tidal cycles and freshwater runoff, salinity varies within estuaries and results in great diversity, offering freshwater, brackish and marine habitats within close proximity (Haertel and Osterberg 1967). Estuaries tend to be shallow, protected, nutrient rich, and are biologically productive, providing important habitat for marine organisms. The inland extent of the estuary HAPC is defined as Mean Higher High Water (MHHW), or the upriver extent of saltwater intrusion, defined as upstream and landward to where ocean-derived salts measure less than 0.5 ppt during the period of average annual low flow. The seaward extent is an imaginary line closing the mouth of a river, bay, or sound; and to the seaward limit of wetland emergent plants, shrubs, or trees occurring beyond the lines closing rivers, bays, or sounds. Although not pertinent to southern California, this HAPC also includes those estuary influenced offshore areas of continuously diluted seawater. This definition is based on Cowardin, *et al*. (1979). In southern California a diversity of habitats are included within the estuary HAPC. These habitats include shallow subtidal, intertidal flats (sand and mud), tidal creeks and channels, and salt marsh.

Subtidal habitats include harbors and sheltered bays with open water. These are the habitats in which the majority of overwater development occurs. These habitats are inundated throughout the tidal cycle and have less variable physical environments than intertidal areas (Desmond 1996). Seagrass beds are a marine wetland habitat that is frequently found within shallow subtidal areas. These support a variety of fish species that inhabit open-ocean, intertidal flats, tidal creeks, and salt marshes and are discussed in further detail below.

Intertidal sand and mudflats are generally lacking in vascular plant assemblages, but may contain significant amounts of microphytes. Microphytobenthos (MPB) is a matrix of unicellular eukaryotic algae and cyanobacteria that exist in the upper portion of aquatic substrates. It is distributed across a multitude of environments, but governed on a local scale by factors including irradiance, depth, topography, wave action and benthic fauna (Swanberg 1991). Because light is absorbed quickly in sediment, the depth limit of MPB may be only a few millimeters. Across those few millimeters, strong chemical gradients exist because MPB acts as a transport for nutrients between the water column and sediments. The matrix serves as a sink for silica, because diatoms use it to construct their shells. MPB also absorbs inorganic phosphates and nitrates because they are nutrients that aid in growth (Bartoli *et al.* 2003). Because of MPB's role as a primary producer, there is a net flux of oxygen into the water column. However, phytoplankton produces more oxygen in subtidal areas while MPB is more productive in intertidal zones (MacIntyre *et al*. 1996). The additional oxygen in the sediment increases the denitrification rate, though not enough to become a source (Webster *et al*. 2002). These fluxes potentially limit the growth of macrophytes (Sundbäck 2002) and have ramifications throughout the food web. When estuaries become hypoxic, either through natural or anthropogenic causes, MPB is resilient and recovers rapidly. Therefore, MPB can provide oxygen and form the base of a food web for incoming colonists in the recovering area (Larson and Sundbäck 2008).

In addition to its chemical role, MPB also physically and biologically influences ecosystems. The primary physical function is substrate stabilization. MPB grows in high energy areas where sediments can be eroded. Not only does this erosion have harmful effects to coastal systems, it also increases turbidity, potentially causing hypoxia, benthic invertebrate burial and possible mortality in vertebrates unable to avoid it. The MPB mat is primarily composed of diatoms and spreads across the bottom forming a net against erosion (Miller *et al*. 1996, Stal 2010). MPB also forms the base of an aquatic food web. Deposit feeders such as snails, polychaete worms, crustaceans and others are a major consumer of MPB (Herman et al. 2000). When strong currents lift MPB into the water column, suspension feeders like clams and polychaete worms consume it. Meiofauna, the organisms including nematodes and oligochates that live within the sediments and microfauna, ciliate protozoans, also consume MPB (Montagna 1995). Despite all these consumers, it is unlikely MPB is controlled by top-down processes, rather, light is the primary limiting factor affecting growth (MacIntyre *et al*. 1996, Miller *et al*. 1996).

Mudflats provide habitat for the most diverse invertebrate assemblages of the coastal wetlands, which include gastropods and bivalves, polychaetes, amphipods, and crabs (Levin *et al*. 1998). In the Tijuana Estuary, mudflats are used with the highest frequency by foraging shorebirds. Although most fish can only use these habitats when they are flooded, burrowing gobiids can reside in the mudflats through the tidal cycle. During high tides these habitats are utilized by a variety of fish that migrate daily from subtidal habitats. These subtidal to intertidal movements are primarily related to feeding and in some cases predator avoidance (Miller and Dunn 1980, Ruiz *et al*. 1993).

Animal assemblages within salt marshes are quite diverse and include both resident and transient species. The epifaunal assemblages are dominated by gastropod and bivalve mollusks, insects, amphipods, isopods, and crabs (Scatolini and Zedler 1996). Fish species found within California coast salt marshes include killifish, silversides, and gobies. In San Diego Bay, West and Zedler (2000) found that killifish which were able to access the marsh habitats had fuller guts and subsequently grew larger. These results can be expected across species if access to marsh habitats is available.

Tidal creeks and channels connect marshes to subtidal basins and to the ocean, these serve as corridors for animals and energy. They provide access to the marshes, are migratory pathways, and vital links to a variety of habitats used by various species. Additionally these channels serve as habitat and transition areas for commercially important larval and juvenile fishes (Nordby 1982). Williams *et al*. (1998) found that within the Tijuana Estuary California halibut were consistently most dense in tidal channels, particularly in areas closest to the mouth of the estuary, again demonstrating the importance of multiple estuarine habitats for individual species.

Seagrasses

Seagrass species found on the West Coast of the U.S. include eelgrass species (*Zostera* spp.), widgeongrass (*Ruppia maritima*), and surfgrass (*Phyllospadix* spp.). These grasses are vascular plants, not seaweeds, forming dense beds of leafy shoots year-round in the lower intertidal and subtidal areas. Eelgrass is found on soft-bottom substrates in intertidal and shallow subtidal areas of estuaries and occasionally in other nearshore areas, such as the Channel Islands and Santa Barbara littoral. Surfgrass is found on hard-bottom substrates along higher energy coasts. Studies have shown seagrass beds to be among the areas of highest primary productivity in the world (Herke and Rogers 1993, Hoss and Thayer 1993).

In general, eelgrass beds provide a wide array of ecological functions important in maintaining a healthy estuarine and coastal ecosystem (Anderson 1989, Peterson and Lipcius 2003). Eelgrass habitat functions as an important structural environment for resident bay and estuarine species, offering refuge from predation and high current velocity (Orth 1977, Peterson and Quammen 1982), along with serving as a food source. Eelgrass functions as a nursery area for many commercially and recreational important finfish and shellfish species, including those that are resident within bays and estuaries, as well as oceanic species that enter estuaries to breed or spawn (Hoffman 1986, Heck *et al.* 1989, Dean *et al.* 2000, Semmens 2008). Eelgrass also provides a unique habitat that supports a high diversity of non-commercially important species whose ecological roles are less well understood (Peterson *et al.* 1984, Murphy *et al*. 2000, Malavasi *et al.* 2007).

As the basis for a nearshore detrital-based food web, eelgrass provides a large proportion of the total primary production for some nearshore ecosystems. Eelgrass is also a source of secondary production, providing a substratum for supporting epiphytic plants (Penhale 1977), animals (Orth 1973), and microbial organisms (Pedersen *et al.* 1999) that in turn are grazed upon by other invertebrates (Orth *et al.* 1984, Nelson 1997), larval and juvenile fish (Thom 1989), and birds (Bayer 1980). Thus, eelgrass contributes functions to the ecosystem at multiple trophic levels (Phillips and Watson 1984, Thayer *et al.* 1984). In addition to habitat and resource attributes, eelgrass serves beneficial physical and chemical roles in bays and estuaries. Eelgrass beds dampen wave and current action (Fonseca and Fisher 1986, Fonseca *et al.* 1983, Fonseca and Cahalan 1992), trap suspended particulates (Ward 1983), and reduce erosion by stabilizing the sediment (Thayer *et al.* 1984). They also improve water clarity, cycle nutrients (Kenworthy *et* *al.* 1982, Kenworthy and Thayer 1984, Penhale and Smith 1977), and generate oxygen during daylight hours (Murray and Wetzel 1987).

Many of the biological and physical functions of eelgrass discussed above, result in ecosystem services with significant economic value (Costanza *et al.* 1997). Erosion control provided by eelgrass through soil stabilization can protect shoreline property and infrastructure. Nursery functions and nutrient cycling contribute to income from commercial and recreational fisheries. Constanza *et al.* (1997) estimated the economic value of ecosystem services of several marine and terrestrial habitat types; eelgrass per hectare dollar value was second only to coastal estuaries among the marine habitat types and was higher than all terrestrial habitat types with the exception of floodplains. It is estimated that seagrasses provide services in excess of 1.9 trillion dollars in the form of nutrient cycling (Waycott *et al*. 2009). Seagrass beds are also a promising habitat for carbon sequestration that, if restored on a large enough scale, may reduce carbon from the atmosphere and could affect climate change (Mateo *et al*. 1997, Williams 1999).

The dynamic nature of eelgrass growth and distribution, have made it quite challenging to map and evaluate expansions and contractions. In many cases, eelgrass may have been present in an area for consecutive years, but due to a variety of factors, it may be absent from that same area for multiple years. As a result, management of eelgrass has become particularly challenging in southern California where coastal development continues to impact habitats considered suitable for eelgrass, but when the resource was absent at the time of a project-specific survey. Eelgrass is likely the most common and productive seagrass species subject to overwater structure impacts within the boundary of the LAD.

Kelp Canopy

Of the habitats associated with the rocky substrate on the continental shelf, kelp forests are of primary importance to the ecosystem and serve as important groundfish habitat. Kelp forest communities are found relatively close to shore along the open coast. These subtidal communities provide vertically structured habitat throughout the water column: a canopy of tangled blades from the surface to a depth of 10 feet, a mid-water, stipe region, and the holdfast region at the seafloor. Kelp stands provide nurseries, feeding grounds, and shelter to a variety of managed species and their prey (Ebeling, *et al.* 1980, Feder *et al.* 1974). In southern California, giant kelp communities are the most productive relative to other habitats, including wetlands, shallow and deep sand bottoms, and rock-bottom artificial reefs (Bond *et al.* 1998). Their net primary production is an important component to the energy flow within food webs (Foster and Schiel 1985). NMFS expects very few overwater structures will adversely affect kelp communities given their predominantly open coast distribution. Most overwater structure projects occur within protected waters. Therefore, a detailed description of kelp does not seem warranted for this programmatic consultation.

Rocky Reefs

Rocky habitats are generally categorized as either nearshore or offshore in reference to the proximity of the habitat to the coastline. Rocky habitat may be composed of bedrock, boulders, or smaller rocks, such as cobble and gravel. Hard substrates are one of the least abundant benthic habitats, yet they are among the most important habitats for groundfish species. Rocky reefs provide the appropriate substratum for colonization of diverse algal and invertebrate assemblages creating a complex physical and biogenic habitat that provides important shelter and foraging opportunities for many species of groundfish. NMFS expects very few overwater structures will adversely affect natural rocky reef communities given their predominantly open coast distribution. Most overwater structure projects occur within protected waters. Therefore, a detailed description of rocky reefs does not seem warranted for this programmatic consultation.

Areas of Interest

Areas of interest are discrete areas that are of special interest due to their unique geological and ecological characteristics. Within the geographical scope of the LAD, the San Juan Seamount, specific areas of the Channel Islands National Marine Sanctuary, and specific areas of the Cowcod Conservation Area have been designated as HAPC.

Seamounts rise steeply to heights of over 1,000 m from their base and are typically formed of hard volcanic substrate. They are unique in that they tend to create complex current patterns (Lavelle, *et al.* 2003, Mullineaux and Mills 1997) and have highly localized species distributions (de Forges *et al.* 2000). Seamounts have relatively high biodiversity and up to a third of species occurring on these features may be endemic (de Forges *et al.* 2000). Because the faunal assemblages on these features are still poorly studied, and species new to science are likely to be found, human activities affecting these features need careful management. Currents generated by seamounts retain rockfish larvae (Mullineaux and Mills 1997, Dower and Perry 2001) and zooplankton, a principal food source for rockfish (Genin *et al.* 1988, Haury *et al.* 2000). Several species observed on seamounts, such as deep-sea corals, are particularly vulnerable to anthropogenic impacts (Monterey Bay National Marine Sanctuary 2005). Due to the offshore nature of these areas of interest, it is unlikely that overwater structures will impact this HAPC.

<u>Coastal Pelagic Species FMP</u>

The habitat and trophic requirements of the following pelagic species is adapted from the CPS FMP (1998).

The Coastal Pelagic Species FMP includes five species, all of which have been identified as within the boundary and potentially affected by the activities of the LAD. The Pacific sardine and northern anchovy are two commercially and ecologically important Coastal Pelagic Species, which have EFH within the LAD boundary, both of which will be discussed in further detail due to their higher affinity for nearshore and embayment habitats.

Northern Anchovy - *Engraulis mordax*

Northern anchovy are distributed from the Queen Charlotte Islands, British Columbia to Magdalena Bay, Baja California, and have recently colonized the Gulf of California. The population has been subdivided into three subpopulations (northern, central, southern). The central subpopulation ranges from San Francisco, California to Punta Baja, Baja California. The bulk of the central population is located in the Southern California Bight between Point Conception in the north and Point Descano, Mexico in the south.

Northern anchovy are small, short-lived fish typically found in schools near the surface. Northern anchovy rarely exceed four years of age and 18cm total length. Northern anchovy eat phytoplankton and zooplankton by either filter feeding or biting, depending on the size of the food item. Methot (1981) found that nearshore habitat areas (<90 meters) between Pt. Conception, California and Pt. Banda, Baja California represented 23% of the available habitat for central stock juvenile northern anchovy. Densities of juvenile anchovy in nearshore areas were about ten times higher than in other habitat areas. He concluded that nearshore habitats supported at least 70% of the juvenile anchovy population (Methot 1981, Smith 1985).

Anchovy spawn during every month of the year, but spawning increases in the late winter and early spring and peaks from February to April. The eggs, found near the surface, are typically ovoid and translucent and require two to four days to hatch. Within the central subpopulation, individuals sexually mature at age two.

Northern anchovy are subject to natural predation throughout all life stages. Eggs and larvae are epipelagic and fall prey to an assortment of invertebrates and vertebrate planktivores. Juvenile anchovy are vulnerable to a wide variety of predators, including many recreationally and commercially important fishes. As adults, anchovy are preyed upon by various fish, birds and mammals, including many federally listed as threatened or endangered species.

Pacific Sardine – *Sardinops sagax*

Sardines are small pelagic schooling fish that inhabit coastal subtropical and temperate waters. Pacific sardine have at times been the most abundant fish species in the California current. The Pacific sardine is broken into three subpopulations: the northern subpopulation, relevant to this programmatic, covers the region between northern Baja and Alaska. It is thought that Pacific sardine migrate extensively during periods of high abundance, moving as far north as British Columbia in the summer and as far south as northern Baja in the fall. Stock size has been found to be positively correlated with sea surface temperatures.

Pacific sardine may reach 13 years in age and 41 cm in length, but are seldom longer than 30 cm. and 8 years in age. Pacific sardine spawn year round in loosely aggregated schools in the upper 50 meters of the water column, with individuals spawning up to 40 times annually. The primary historical spawning area for Pacific sardine was off the U.S. coast between Point Conception and San Diego, California, out to about 100 miles offshore, with evidence of spawning as far as 250 miles offshore. Juveniles occur in nearshore waters off of northern Baja California and southern California.

Sardines are planktivores that consume both phytoplankton and zooplankton. When biomass is high, Pacific sardine may consume a significant proportion of the total organic production in the California current system. Pacific sardine are taken by a variety of predators throughout all life stages, much like the northern anchovy. In all probability, Pacific sardine are fed on by similar predators (including federally listed species) that utilize anchovy.

Highly Migratory Species FMP

Of the 13 species managed under the Highly Migratory Species (HMS) FMP, one has been identified as having essential fish habitat (EFH) within the jurisdictional boundaries of the LAD that may likely be affected by overwater structures.

Common Thresher Shark –*Alopias vulpinus*

Common thresher sharks are epipelagic in neritic and oceanic waters of the Atlantic Ocean, Mediterranean Sea, Indian Ocean and central and western Pacific; in the eastern Pacific from Goose Bay, British Columbia south to off Baja California; also off Panama and Chile. They tend to occur in temperate and warm oceans, penetrating into tropical waters, being most abundant over continental and insular shelves and slopes (Compagno 1984). Adults, juveniles, and postpartum pups occur within the U.S. West Coast Exclusive Economic Zone (EEZ). This species is often associated with areas characterized by high biological productivity and 'green' water, the presence of strong frontal zones separating regions of upwelling and adjacent waters, and strong horizontal and vertical mixing of surface and subsurface waters, and habitats conducive to production and maintenance of schooling pelagic prey upon which it feeds (Gubanov 1978, Kronman 1998).

Most years, concentrations of young thresher sharks occur within two to three miles off the beaches from Santa Barbara County through Santa Monica Bay. Young appear to prefer open coast and semi-enclosed bays with high concentrations of schooling prey on which they feed, such as small northern anchovy, hake, squid, and other small schooling fishes and invertebrates. Adults are generally found in deeper waters ranging from 70 to 3400 meters and are known to feed primarily on northern anchovy, pacific mackerel and sardine.

Effects to EFH

Overview

Alterations to the nearshore light, wave energy, and substrate regimes affect the nature of EFH and nearshore food webs that are important to a wide variety of marine finfish and shellfish (Armstrong *et al.*1987, Beal 2000; Burdick and Short 1995, Cardwell and Koons 1981, Fresh and Williams 1995, Kenworthy and Haunert 1991, Olson *et al*. 1996, Parametrix and Battelle 1996, Penttila and Doty 1990, Shafer 1999; Simenstad et al. 1978, 1979, 1980, 1998, Thom and Shreffler 1996, Weitkamp 1991).

Overwater structures and associated activities affect the ecological functions of habitat through the alteration of habitat controlling factors. These alterations can, in turn, interfere with habitat processes supporting the key ecological functions of fish spawning, rearing, foraging, and refugia. The matrix presented in Table 2, adapted from Nightingale and Simenstad (2001), identifies the potential mechanisms of impact overwater structures can pose to nearshore habitats. Whether any of these impacts occur and to what degree they occur at any one site depends upon the nature of site-specific habitat controlling factors and the type, characteristics, and use patterns of a given overwater structure located at a specific site. Throughout this analysis it can be assumed that all construction related activities (e.g. turbidity from pile removal and installation) are considered temporary impacts, whereas all permanent structures, including piles, are considered to have long-term impacts.

Each of the types of effects discussed below is considered in terms of their direct, indirect, and cumulative effects. NMFS defines the impacts as follows (modified from the National Environmental Policy Act (NEPA) Regulations):

1. Direct - Direct effects are caused by the action and occur at the same time and place.

2. Indirect - Indirect effects are caused by the action or associated actions and may occur later in time or farther removed in distance, but are still reasonably foreseeable.

3. Cumulative - Cumulative impacts are the impacts on the environment, which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time.

Table 2. Overwater structure nearshore habitat impact mechanisms (Nightingale and Simenstad 2001)

Habitat Controlling Factors	Overwater Structure and Activities	Direct Impacts	Indirect Impacts
Light Regime	• Piers/Docks • Wharves/Marinas • Floats/Moored Vessels • Pilings	• Reduced light levels • Altered ambient light patterns	• Limited plant growth and recruitment • Altered plant and animal assemblages • Altered animal behavior
Wave Energy Regime	• Piers/Docks • Wharves/Marinas • Floats/Moored Vessels • Pilings	• Altered wave and tidal energy patterns	• Altered plant and animal assemblages • Altered substrate type • Altered sediment transport and distribution
Substrate	• Propeller and anchor scour • Floats and moored vessels (grounding) • Piling install/removal	• Substrate disturbance and smothering	• Altered plant and animal assemblages • Altered substrate type • Altered sediment transport and distribution
Water Quality	• Discharges from marinas/wharves • Boat and upland run-off • Piling install/removal	• Increased Non-indigenous species • Increased toxics • Increased nutrients and bacterial introductions	• Altered plant and animal assemblages • Limited growth and recruitment • Exotic species replacement of natives

Shading Effects

Direct Impacts

The underwater light environment is a naturally light-reduced ecosystem. Light is attenuated with depth as a result of refraction at the water's surface and through scatter and absorption of light by phytoplankton, detritus and dissolved organic matter in the water column. Depending on the biological, physical, and chemical properties of the water, the light available at depth may be dramatically reduced from that available at the surface. Because light energy drives the photosynthetic process controlling plant growth and survival, it is one of the principal limiting factors of primary productivity (Govindjee and Govindjee 1975, Underwood and Kromkamp, 1999, MacIntyre *et al*. 1996). Marine and estuarine primary producers, including seagrass, salt marsh plants, and algae are particularly susceptible to light limitation (Kearny *et al.* 1983, Dennison *et al.* 1993, Shafer 1999, Shafer and Robinson 2001, Whitcraft and Levin 2007, Shafer *et al*. 2008).

Seagrasses have unusually high light requirements ranging from 10% to 37% of in-water surface irradiance (Kenworthy and Fonseca 1996). One explanation for the high light requirements of seagrass is the optical properties of the leaves. Optically active pigments (Chlorophylls a and b) are arranged in a complex manner within the chloroplasts, effectively reducing the light harvesting efficiency of the chlorophyll within the leaves (Larkum *et al.* 2006). These high light requirements make seagrasses particularly vulnerable to deteriorated water quality and light competition from micro- and macroalgal blooms induced by eutrophication, and shading from overwater structures (Zimmerman 2006).

Minimum light requirements for seagrass growth vary among species, due to physiological and morphological differences, and within species due to photoacclimation of populations to local light conditions (Duarte 1991, Lee *et al.* 2007). Thom *et al*. (2008) determined that eelgrass in the Pacific Northwest requires an average of at least 7 mol/m^2/day throughout the summer months, and an overall average of 3 mol/m^2/day for long term survival. In San Francisco Bay, similar results were described by Zimmerman *et al.* (1991), where eelgrass depth limits were strongly correlated with turbidity and light requirements. At the most turbid site, eelgrass maximum depth was only 0.5 meters, and plants required a period of light saturation of 11.1 hours. At the least turbid site eelgrass maximum depth was 2 meters, and plants required only 6.7 hours of light saturation. Merkel's (2000) study in San Diego Bay examined the effects of light and temperature on eelgrass, and determined that eelgrass distribution and abundance in San Diego Bay was not temperature, but light limited. Light conditions monitored at sites with and without eelgrass demonstrated significantly different levels of photosynthetically active radiation (PAR). The sites where eelgrass occurred typically had higher mean PAR values than the sites where eelgrass was absent. The study identified a threshold for eelgrass growth in San Diego Bay was 8.5 mol/m^2/day.

In the already reduced light environment that marine and estuarine primary producers occur, the addition of overwater structures further reduces underwater light penetration through shading. Under-structure light levels have been found to fall below the threshold for the photosynthesis of diatoms, algae, and most importantly eelgrass (Kenworthy and Haunert 1991). Thus, shading by such structures may adversely affect vegetation, habitat complexity, and overall net primary production (Haas *et al*. 2002, Struck *et al.* 2004).

Shading by overwater structures has empirically been demonstrated to decrease shoot density and biomass in temperate, tropical, and subtropical seagrass species, including (*Zostera marina* L., *Thalassia testudinum, Halodule wrightii*,and *Posidonia australis*) (Walker *et al*. 1989, Czerny and Dunton 1995, Loflin 1995, Burdick and Short 1999, Shafer 1999). Burdick and Short (1995, 1999) found that 75% of the floating docks in and around eelgrass beds resulted in complete seagrass loss underneath the dock, while the remainder resulted in significantly reduced cover. Given the variety of ecological functions associated with eelgrass, reductions in its extent may adversely affect estuarine and nearshore ecosystems.

Whitney and Darley (1983) found that microalgal communities in shaded areas are generally less productive than unshaded areas, with productivity positively correlated with ambient irradiance. Stutes *et al*. (2006) found a significant effect of shading on both sediment primary production and metabolism (i.e. sediment respiration). Intertidal salt marsh plants are also impacted by shading: the density of *Spartina alterniflora* was significantly lower under docks than adjacent to docks in South Carolina estuaries, with stem densities decreased by 71% (Sanger *et al.* 2004). Kearny *et al.* (1983) found the *S. alterniflora* was completely shaded out under docks that were less than 40 cm high and that the elimination of the macrophytic communities under the docks ultimately led to increased sediment erosion.

Reductions in benthic primary productivity may in turn adversely affect invertebrate distribution patterns. For example, Struck *et al*. (2004) observed invertebrate densities under bridges at 25-52% of those observed at adjacent unshaded sites. These results were found to be correlated with diminished macrophyte biomass, a direct result of increased shading. Overwater structures that attenuate light may adversely affect estuarine marsh food webs by reducing macrophyte growth, soil organic carbon, and altering the density and diversity of benthic invertebrates (Whitcraft and Levin 2007). Reductions in primary and invertebrate productivity may additionally limit available prey resources to federally managed fish species and other important commercial and recreational species. Prey resource limitations likely impact movement patterns and the survival of many juvenile fish species. Adverse impacts to estuarine productivity may therefore have effects that cascade through the nearshore food web.

Fishes rely on visual cues for spatial orientation, prey capture, schooling, predator avoidance, and migration. Juvenile and larval fish are primarily visual feeders with starvation being the major cause of larval mortality in marine fish populations. Early life history stages are likely critical determining factors for recruitment and survival, with survival linked to the ability to locate and capture prey and to avoid predation (Britt 2001). The reduced-light conditions found under overwater structures limit the ability of fishes, especially juveniles and larvae, to perform these essential activities. For example, Able *et al*. (1999) found that caged fish under piers had growth rates similar to those held in a laboratory setting without food. In contrast, growth rates of fish caged in pile fields and open water were significantly higher. Able *et al*. (1998) also demonstrated that juvenile fish abundance and species richness was significantly lower under piers in an urban estuary. Although some visual predators may use alternative modes of perception, feeding rates sufficient for growth in dark areas usually demand high prey concentrations and encounter rates (Grecay and Targett 1996). Little research has been conducted on fishery utilization of overwater structures in Southern California. Preliminary investigations were conducted in San Diego Bay, but they were limited to gross characterization of biological conditions, were far from a rigorous test of shading effects, and could not be used to determine relative habitat values (Merkel 1999).

The shadow cast by an overwater structure may increase predation on some fish species by creating a light/dark interface that allows ambush predators to remain in a darkened area (barely visible to prey) and watch for prey to swim by against a bright background (high visibility) (Helfman 1981). Prey species moving around the structure are unable to see predators in the dark area under the structure and are more susceptible to predation. Protected embayments are generally acknowledged as nursery areas for fish. Altering ecosystem structure in such a way to confer additional advantages to predators will reduce the nursery function of these systems. Although shading may not preclude use by certain fish species, it results in the permanent reduction in light, a fundamental regulating factor of ecosystem function in nearshore habitats. Furthermore, the reduced vegetation (i.e., eelgrass) densities associated with overwater structures decrease the available refugia from predators, and prey availability. As coastal development and overwater structure expansion continues, the underwater light environment will continue to degrade resulting in adverse effects to EFH and nearshore ecosystems.

The overall morphology of the shadow cast by a structure is dependent on the height, width, construction material, and polar orientation of the structure. Work by Battelle Marine Science Laboratory in Washington has determined that shading influence from docks can range from four to ten times the total surface area of the dock depending upon dock orientation and season (Washington DNR 2005). Therefore, the extent and the magnitude of the shading impacts to primary producers and subsequently to the upper trophic levels in the system is both site-specific and directly influenced by the specific design of the overwater structure.

A number of studies have determined that modifications to the design of overwater structures can significantly increase the quantity of light transmitted through or around these structures to the underlying habitat, decreasing the impacts of shading and the size of the shaded footprint (Beal *et al.* 1999, Burdick and Short 1999, Blanton *et al.* 2000, Steinmetz *et al.* 2002, Fresh *et al.* 2006, Landry *et al.* 2008). Burdick and Short (1999) demonstrated that orientating docks along a north-south plane minimized the shading effect on eelgrass. Several studies have demonstrated that structures at least 5 feet above mean higher high water (MHHW) have a significantly reduced impact on primary producers (Beal *et al.* 1999, Burdick and Short 1999, Shafer *et al.* 2008). Docks built no wider than 4 feet in width have also been found to reduce shading impacts (Shafer *et al.* 2008). The use of light transmitting material and increased spacing between deck boards has also been found to increase the light transmitted through overwater structures, helping to decrease shading impacts resulting from these structures (Blanton *et al.* 2002, Fresh *et al.* 2006, Landry *et al.* 2008, Shafer *et al.* 2008). Dock construction guidelines following these principles have been developed and implemented with success in other regions (NMFS and USACE 2001).

Indirect Impacts

Although shading impacts from overwater structures is considered the primary factor affecting primary producers, several other factors may also result in indirect impacts to these communities. Indirect effects may be associated with construction and maintenance of the overwater structure, or resulting from the long-term associated uses of the structure. As most overwater structures are designed to support boating activities, impacts from boats are a primary source of indirect effects, especially for seagrasses. For example, the presence of the boat itself increases the shading impact footprint. Simenstad *et al.* (1998) demonstrated that indirect effects from construction of overwater structures and boating activities contributed to the elimination of eelgrass, but also appeared to prohibit recruitment back to the area in the long-term.

Wave Energy and Substrate Effects

Direct Impacts

Changes to wave energy and water transport from overwater structures may have substantial impacts to nearshore detrital foodwebs through alterations in substrate size, distribution and abundance (Hanson *et al*. 2003). Altering sediment transport can create barriers to natural processes that build spits and beaches as well as provide substrate necessary for plant propagation, animal rearing and spawning (Thom *et al*. 1994, 1997).

Structures, such as pilings, used to support the majority of overwater structures have been found to have adverse effects to EFH through alterations of wave energy, and substrate composition (Nightingale and Simenstad 2001, Thom and Shreffler 1996, Williams 1988). When placed in moving water, pilings may disrupt flow, either increasing flow rates immediately around their base, or by slowing the flow of water over the area of the dock. The increased flow may cause scour and erosion around the base of the pilings and the decreased flow may result in increased sedimentation across a larger area (Kelty and Bliven 2003). For example, three dimensional sediment and current transport modeling has indicated that multi-slip docks increase sedimentation, reduce flushing and subsequently increase concentrations of contaminants (Edinger and Martin 2010). The resulting changes in sediments caused by scour or deposition may affect fish, shellfish or habitat (Bowman and Dolan 1982).

Dock pilings have been found to alter adjacent substrates with increased shellhash deposition from piling communities and changes to substrate bathymetry. Alterations in animal communities around pilings have been indirectly linked to loss of eelgrass beds, due to shellhash accumulation (Thom and Shreffler 1996). The accumulation of debris and shell from barnacles, molluscs, and other marine organisms at the base of the pilings may inhibit the ability of seagrasses to recolonize the area surrounding the pilings (Fresh *et al*. 1995, Shafer and Lundin 1999). The presence of pilings can also alter sediment distribution and bottom topography, creating small depressions that preclude eelgrass growth (Fresh *et al*. 1995). These changes may alter the plant and animal communities within a given site (Penttila and Doty 1990). Similarly, dock uses and construction activities are known to limit underwater light and redistribute sediments through prop scouring, vessel shading, and pile driving (Thom *et al*. 1996).

Placement of pilings in seagrass beds results in the direct physical removal of seagrass during dock construction. However different installation and removal techniques may influence the extent and magnitude of the impact. Jetting uses high-pressure water pumps to blow a deep hole in the bottom for placement or removal and can have adverse impacts to the substrate, while increasing turbidity and potentially suspending contaminants. When jetting is used, the new pilings are set into the hole and sand is back-filled around the base of the piling. Jetting tends to cause greater disruption than driving piles with a drop hammer. Jetting may disrupt adjacent vegetation resulting in bare areas around pilings that are subject to scour. Using a low pressure pump to produce a starter hole and subsequent insertion of a sharpened pile with a drop hammer in a sandy area reduces the physical removal and disturbance of seagrasses in the area of the piling and results in little to no sand deposition around the pilings. Regardless of the technique employed, these activities directly impact the substrate and associated biota.

Depending on the piling material, the number of piles, and their spacing, the chronic impacts may be substantial. The long-term presence of pilings, with and without associated overwater decking, may impact adjacent seagrass communities by altering currents, sediment accumulation or scouring, attracting bioturbators, and leaching from chemically treated timber (Beal *et al.* 1999). Bare areas around the base of pilings placed in seagrass beds ranged between 35-78 inches in diameter in St. Andrews Bay, Florida (Shafer and Robinson 2001).

Just as pile installation may adversely impact EFH, similar impacts may be observed in pile removal. Direct pull or use of a clamshell to remove broken or old piles may suspend large amounts of sediment and contaminants. When the piling is pulled from the substrate using these two methods, sediments clinging to the piling will slough off as it is raised through the water column, producing a potentially harmful plume of turbidity and/or contaminants. The use of a clamshell may suspend additional sediment if it penetrates the substrate while grabbing the piling. The associated turbidity plumes of suspended particulates may reduce light penetration and lower the rate of photosynthesis for submerged aquatic vegetation (Dennison 1987) and the primary productivity of an aquatic area if suspended for extended periods of times (Cloern 1987). If suspended sediments loads remain high, fish may suffer reduced feeding ability (Benfield and Minello 1996) and be prone to fish gill injury (Nightingale and Simenstad 2001).

While there is a potential to adversely affect EFH during pile removal, many of those removed are old creosote-treated timber piles. In some cases, the long-term benefits to EFH obtained by removing a consistent source of contamination may outweigh the temporary adverse effects of turbidity. The primary effects of pile removal are the re-suspension of sediments and release of contaminants that may be contained within the pile and associated substrate.

Mooring buoys are a common method for anchoring boats; however their chains can drag across the seafloor tearing up vegetation. In addition to uprooting seagrass, mooring chains can alter sediment composition ultimately impacting the benthic biota (Ostendorp *et al*. 2008). Walker *et al*. (1989) investigated the impacts of mooring buoys in Western Australia and found that 5.4 hectares of seagrass had been lost to mooring. The location of the damage within the bed may influence the extent of damage, with more significant impacts associated with mooring in the center of the bed versus along the edge. Seagrass loss from boat moorings is increasing, which correlates with increased vessel use (Hastings *et al*. 1995). Examples of mooring chain damages are evident throughout the world (Jackson *et al.* 2002, Hiscock *et al.* 2005, Otero 2008)

Williams and Bechter (1996) examined the effects of 5 different mooring systems on marine vegetation. Their study concluded that mid-line float systems and all-rope lines had the least impact on substrate and aquatic vegetation. Disturbance impact of the remaining mooring types (e.g. swinging chain moorings) ranged from 86% to 100% disturbance.

Other regions have begun incorporating best management practices (BMPs) for moorings in order to reduce impacts to eelgrass beds (Short 2009). Examples include clumping mooring lines together to minimize the extent of eelgrass damage (Herbert *et al*. 2009), the use of cyclone moorings that prevent swinging of chains (Shafer 2002), and elastic lines that stretch instead of requiring long lengths of chain.

Indirect impacts

As most overwater structures are designed to support boating activities, impacts from boats are a primary source of indirect effects, especially for seagrasses. At low tide, grounded floating docks and moored vessels have also been documented to damage benthic communities (Kennish 2002). Grounding of large objects poses the risk of smothering and destroying shellfish populations, scouring vegetation, and potentially lowering the levels of dissolved oxygen (Nightingale and Simenstad 2001). Simenstad *et al.* (1998) demonstrated that indirect effects from construction of overwater structures and boating activities contributed to the elimination of eelgrass, but also appeared to prohibit recruitment back to the area in the long-term.

By their very design, the majority of overwater structures originates on land above mean higher high water (MHHW), cross over the intertidal zone, and continue over shallow water in order to permit pedestrian access to boats from land. As a result, boats are drawn into these shallow waters for temporary and permanent docking, anchoring, and mooring. Furthermore, a large majority of recreational boating activities, including fishing, waterskiing, tubing, jet skiing, etc., occurs in these shallow waters adjacent to the shoreline. Therefore it is not surprising that with increases in coastal populations, and with increased boat ownership, has come an increase in damage to shallow water habitats, especially SAV, from boat groundings and propeller scarring.

When a vessel strays from marked channels or its operator is unable to visualize the shallow banks due to impaired water quality, entering into waters too shallow for the draft of the boat, the propeller comes in contact with the sediment surface, scouring the sediments, disturbing benthic biota, and increasing turbidity in the area. If seagrass is present, the plant canopy may be cropped or the plants may be uprooted entirely, forming what is referred to as a propeller scar. At the extreme, a boat may run completely aground. Often when a boat begins to run aground the operator may attempt to use the propeller to motor off the bed, resulting in even greater damage. Damage resulting from both prop scars and boat groundings involve the physical removal of seagrass, algae, and the benthic fauna. Unfortunately, once the sediment-trapping seagrass rhizome network is removed, the sediments may be further scoured and eroded, possibly causing an expansion of the scar into the surrounding area and preventing successful recruitment of seagrasses back into the scar (Rasheed 2004). Several studies have shown that natural recovery of propeller scarred seagrass may take over 60 years (Rasheed 1999, Fonseca *et al.* 2004).

Another indirect effect to sensitive marine and estuarine habitats from boat use is increased shoreline erosion associated with boat wakes. Many studies have related boat wakes with shore erosion (e.g., Zabawa *et al*. 1980, Camfield *et al*. 1980, Hagerty *et al*., 1981). Larger vessels with deeper draft in particular can generate problematic wakes. As these waves travel to shore and eventually contact the shoreline, the energy transfer may scour and erode sediments and cause damage to seagrass and saltmarsh vegetation.

In addition, boat anchoring impacts the substrate. Though overwater structures including single-family docks, wharfs, and marinas are most often designed for use as a boat landings, these structures are associated with other boating activities that encourage boats to anchor or moor in their vicinity. A single anchoring may have minor, localized effects, but the cumulative effect of multiple anchoring in high traffic areas can have long-term effects on seagrass beds. Francour *et al.* (1999) found that approximately 20 shoots were removed when an anchor was set and another 14 during retrieval, resulting in reduced cover and overall bed fragmentation. Further damage may result after an anchor is set in high wind or sea conditions when the boat drags the anchor along the bottom, and especially when the anchor is dragged through sensitive seagrass habitat (Sargent *et al.* 1995). Hall type anchors tend to disturb seagrass beds the least, though even minimal disturbances can have lasting effects (Milazzo *et al.* 2004).

Anchor damage is common in seagrass beds worldwide and has been implicated in many studies of global seagrass decline. During a period of two decades, anchor scars fragmented and reduced seagrass coverage in the U.S. Virgin Islands, causing a reduction in the carrying capacity for sea turtles to just 11-31 individuals. When scars were fenced off to exclude boats and prevent further anchoring, scars were found to recover much faster (Williams 1988b). The Whitsunday Islands adjacent to the Great Barrier Reef in Australia are heavily impacted by recreational boating and tourism. Subsequently, extensive seagrass communities there have been significantly impacted by anchor damage (Campbell *et al*. 2002). Port Townsend Bay has implemented a voluntary no-anchoring zone to protect their eelgrass from additional scarring (Jefferson County Marine Resources Committee 2010). And in California, several construction projects in the vicinity of eelgrass have been required to submit anchoring plans to minimize loss of eelgrass (California Coastal Commission 2003).

Water Quality Effects

Direct Impacts

Activities associated with overwater structures (marinas, wharves, piers etc.) and treated wood used to support overwater structures have been found to have adverse effects on water quality. Research has demonstrated that contaminants introduced into marine environments and taken up by marine organisms, are generally passed or magnified through the foodweb subsequently affecting animal reproduction and population viability (Johnson *et al*. 1991, 1993, O'Neill *et al*. 1995, West 1997). In addition, sediment re-suspension associated with overwater structures has resulted in alteration of temperature regimes, levels of dissolved oxygen, and pH.

Treated wood used in the construction of many overwater structures has been found to have adverse effects on EFH (particularly groundfish) and marine ecosystems as a whole. In treated wood products, the main active ingredients of concern to fishery resources are copper, in metal treated wood products, and polycyclic aromatic hydrocarbons (PAHs), in creosote treated wood. Copper leaches from treated wood products in a dissolved state. Once in the aquatic system, it can rapidly bind to organic and inorganic materials in suspension. The adsorbed material may then settle and become incorporated into the sediments. Resuspension of these sediments is of great concern because the copper can be made available for uptake by other organisms (Hecht *et al*. 2007). Copper has been found to have significant effects on fish behavior and olfaction (Baldwin *et al*. 2003, Sandhal *et al*. 2007). Creosote is a distillate of coal tar and is a variable mixture of 200-250 compounds consisting of simple PAHs, multi-aromatic fused rings, cyclic nitrogen-containing heteronuclear compounds and phenolic substances (EPA 2008). PAHs are released from wood treated with creosote and are known to cause cancer, reproductive anomalies, and immune dysfunction; to impair growth and development; and to cause other impairments in fish exposed to sufficiently high concentrations over periods of time (Johnson *et al.* 1999, Karrow *et al*. 1999).

Indirect Impacts

In addition to the direct impacts resulting from the use of treated wood, several indirect sources of contaminants are associated with overwater structures. Nutrient and contaminant loading from vessel discharges, engine operations, boat scraping/painting, boat washdowns, haulouts, paint sloughing, and vessel maintenance pose threats to water quality and sediment contaminations (Cardwell and Koons 1981, Hall 1988, Krone *et al.* 1989). Boat motors have been associated with contamination of waterways due to discharges of oil and gasoline (Milliken and Lee 1990).

Copper based paints are frequently used on boat hulls in marine environments as an antifouling agent. These pesticidal paints slowly leach copper from the hull to in order to deter attachment of fouling species which may slow boats and increase fuel consumption. Copper that is leached into the marine environment does not break down and may accumulate in aquatic organisms, particularly in systems with poor tidal flushing, such as those found in southern California. Many of the 303(d) listed water bodies in California are listed due to high levels of copper (USEPA 2001). At low concentrations metals such as copper may inhibit development and reproduction of marine organisms, and at high concentrations they can directly contaminate and kill fish and invertebrates. These metals have been found to adversely impact phytoplankton (NEFMC 1998), larval development in haddock, and reduced hatch rates in winter flounder (Bodammer 1981, Klein-MacPhee *et al.* 1984). Other animals can acquire elevated levels of copper indirectly through trophic transfer, and may exhibit toxic effects at the cellular level (DNA damage), tissue level (pathology), organism level (reduced growth, altered behavior and mortality) and community level (reduced abundance, reduced species richness, and reduced diversity) (Weis *et al.* 1998, Weis and Weis 2004, Eisler 2000). San Diego Bay has been recognized to have some of the highest copper levels in a natural waterbody. Ninety-two percent of the 2,163 kilograms of copper that enter the waters at the Shelter Island Yacht Basin, in San Diego Bay, has been attributed to passive leaching of copper from antifouling paints (Neira *et al*. 2009).

Noise Effects

Direct Impacts

Pile driving generates intense underwater sound pressure waves that may adversely affect the ecological functioning of EFH (Popper and Hastings 2009). These pressure waves have been shown to injure and kill fish. Injuries associated directly with pile driving are poorly studied, but include rupture of the swimbladder and internal hemorrhaging. Sound pressure levels (SPL) 100 decibels (dB) above the threshold for hearing are thought to be sufficient to damage the auditory system in many fishes. Short-term exposure to peak SPL above 190 dB (re: 1 μPa) are thought to injure physical harm on fish. However, 155 dB (re: 1 μPa) may be sufficient to temporarily stun small fish. Of the reported fish kills associated with pile driving, most have occurred during use of an impact hammer on hollow steel piles.

Caltrans (2001) examined fish that died during exposure to underwater sound waves associated with pile driving. The results demonstrated that mortality was caused by the exposure to the pile-driving sound. Dead fish from several species were found within 50 meters from the impact location. Subsequent necropsy determined that internal bleeding and swim bladder damage was the primary cause of mortality. In 2004, Caltrans conducted a similar study to determine the effectiveness of air-bubble curtains used during pile driving in minimizing the impacts to fish. In general, the study found that air-bubble curtains decreased overall trauma to exposed fish.

Non-indigenous Species Associations with Overwater Structures

Indirect Impacts

Non-indigenous species (NIS) are a significant environmental threat to biological diversity (Vitousek *et al*. 1996, Simberloff *et al*. 2005). The cost of NIS to the US economy was estimated to be in excess of $137 billion in 2005 (Pimentel *et al*. 2005). With the expansion of worldwide shipping, the transport of marine NIS via ballast water tanks on ships is now the most significant pathway of introduction of aquatic invasive species into marine ecosystems. Large scale surveys in CA (CDFG 2008) found that each commercial harbor area had significant numbers of NIS. Baseline studies done by the Ports of Long Beach and Los Angeles (MEC Report 2000) identified 60 NIS infauna and macroinvertebrate species in the harbors, which was approximately 15% of the total number of species collected. In addition, substantial numbers of NIS were also found in smaller bays and harbors throughout CA. Southern CA harbors and bays contained a higher relative number of NIS to native species compared to central and northern CA areas.

Although not the cause of direct introductions, artificial overwater structures and associated substrate provide increased opportunity for NIS colonization and exacerbate the increase in abundance and distribution of NIS (Bulleri and Chapman 2010). “It is clear that artificial structures can pave the way and act as stepping stones or even corridors for some marine aliens” (Mineur *et al.* 2012). In a survey of NIS within sheltered waters of CA, the largest numbers of exotic species were found on floating piers and associated structures (Cohen *et al.* 2002). For example, non-indigenous ascidians form a major part of the fouling community biomass on floating docks in southern California harbors (Lambert and Lambert 2003). Several species first appeared during the El Nino events of the 1990s. Subsequent surveys indicate that they have persisted, several have dramatically increased in abundance and distribution, and an additional species has successfully invaded (Lambert and Lambert 2003).

Glasby *et al.* (2007) argue that artificial structures, such as floating docks and pilings, provide entry points for invasion and increase the spread and establishment of NIS in estuaries. Within Elkhorn Slough, Wasson *et al.* (2005) found that hard substrate harbored significantly more exotic species than soft substrate. In Maine, Tyrell and Byers (2007) found that exotic tunicates were disproportionately enhanced on artificial surfaces. Dafforn *et al.* (2009b) found that, overall, native species were disproportionally less numerous than NIS on shallow moving surfaces. These results would implicate floating structures, such as floating docks, pontoons, mooring balls, and vessel hulls as potential "hotspots" for NIS. Dafforn *et al.* (2009a) also found NIS were more abundant on artificial substrates exposed to copper and/or anti-fouling paints, indicating that artificial structures associated with overwater structures such as vessel hulls may also promote NIS. Given the relative lack of natural hard bottom habitat in estuaries, the addition of artificial hard structures within this type of habitat may provide an invasion opportunity for non-indigenous hard substratum species (Glasby *et al*. 2007, Wasson *et al*. 2005, Tyrell and Byers, 2007). Therefore, NMFS believes that artificial substrate in estuaries may contribute to further proliferation of NIS. Some researchers have recommended that coastal managers should consider limiting the amount of artificial hard substrates in estuarine environments (Wasson *et al*. 2005, Tyrell and Byers 2007).

Silva *et al*. (2002) documented the presence of the Asian kelp *Undaria pinnatifida,* a non-native algae in Los Angeles and Long Beach harbors, Channel Islands Harbor, Port Hueneme, Santa Barbara Harbor, and Catalina Island. It was discovered in southern California in the spring of 2000, and by the summer of 2001 had been collected at several California sites from Los Angeles to Monterey Harbor. With the exception of the Catalina site, all observations were found on floating docks, piers, pilings, or other artificial substrate in a protected environment. More recent observations made by various site-specific surveys in southern California continue to observe this trend. For example, a site-specific survey conducted at POLA Berths 145-147 indicated that the dominant flora in the project vicinity was *Undaria pinnatifida*, which was found exclusively on pilings (Merkel and Associates 2009). The most recent biological baseline survey conducted in the Ports of Los Angeles and Long Beach documented *Undaria* at all eight inner harbor sites and at 7 of 12 outer harbor locations, indicating an expanded distribution since 2000 (SAIC 2010). Another recent example in the Long Beach Harbor is the occurrence of the non-native, brown seaweed (*Sargassum horneri*). It was first found in 2003, but by 2004, it moved to both sides of the harbor's back channel. Since then, the non-native species has been found in Orange County, the Channel Islands, and as far south as San Diego Bay.

Peeling (1974) noted the dominance of various hydroids and tunicates in deeper portions of pilings in San Diego Bay. Specifically, *Bugula neritina*, a colonial bryozoan, and two tunicate species, *Styela clava* and *S. plicata*, were identified. *B. neritina* is a common member of fouling communities in harbors and bays on the Pacific Coast, from intertidal to shallow subtidal depths. It is common on dock sides, buoys, pilings and rocks, settling often on shells and sometimes on seaweeds, sea grasses, sea squirts and other bryozoans (Cohen 2005). *Styela plicata* is an exotic species reported on harbor floats and pilings from Santa Barbara to San Diego (Cohen 2005). *Styela clava* is common on rocks, floats and pilings in protected waters, and on oyster and mussel shells, and is occasionally found on seaweeds. It mainly occurs in the low intertidal to shallow subtidal zones. At high densities and/or abundance, these non-native species may adversely affect other native organisms by competing for space, food, or by consuming planktonic larvae, thus reducing rates of settlement (Cohen 2005).

Long-term impacts of NIS can change the natural community structure and dynamics, lower the overall fitness and genetic diversity of natural stocks, and pass and/or introduce exotic lethal disease. Overall, exotic species introductions create five types of negative impacts to EFH and associated federally management fish species: 1) habitat alteration, 2) trophic alteration, 3) gene pool alteration, 4) spatial alteration, and 5) introduction of diseases/pests.

Non-native plants and algae can degrade coastal and marine habitats by changing natural habitat qualities. Habitat alteration includes the excessive colonization of exotic species (e.g. *Caulerpa taxifola*) which preclude the growth of native organisms (e.g., eelgrass). *Caulerpa taxifolia* is a green alga native to tropical waters that typically grows in limited patches. A particularly cold tolerant clone (tolerant of temperatures at least as low as 10 °C for a period of three months) of this species has already proven to be highly invasive in the Mediterranean Sea and efforts to control its spread have been unsuccessful. In areas where the species has become well established, it has caused ecological and economic devastation by overgrowing and eliminating native seaweeds, seagrasses, reefs, and other communities. In the Mediterranean, it is reported to have harmed tourism and pleasure boating, devastated recreational diving, and had a significant impact on commercial fishing both by altering the distribution of fish as well as creating a considerable impediment to net fisheries. *C. taxifolia* had been detected, but eradicated in two locations in southern California (Huntington Harbor and Agua Hedionda), which alone cost over 7 million dollars.

Zoobotryon verticillatum, an invasive bryozoan, may also alter native habitats. *Z. verticillatum* initially settles onto hard substrate and may dis-attach upon reaching a critical size. In various bays of southern California, *Z. verticillatum* may be observed in large masses that roll along the bottom with tidal and wind driven currents. NMFS has observed negative interactions between *Z. verticillatum* and eelgrass in South San Diego Bay. The exact mechanism is unclear but it is likely competition for space, physical smothering, and/or light reduction.

The introduction of NIS may also alter community structure by predation on native species or by population explosions of the introduced species (Byers 1999). Introduced NIS increases competition with indigenous species or forage on indigenous species, which can reduce fish and shellfish populations. Although hybridization is rare, it may occur between native and introduced species and can result in gene pool deterioration (Currant *et al*. 2008). Spatial alteration occurs when territorial introduced species compete with and displace native species (Blossey and Notzold 1995). The introduction of bacteria, viruses, and parasites is another threat to EFH as it may reduce habitat quality. New pathogens or higher concentrations of disease can be spread throughout the environment resulting in deleterious habitat conditions, reduced species survival and overall fitness.

Overwater Structures as Physical Habitat

The provision of hard substrate associated with overwater structures has been reported as a habitat benefit based upon the assumption that these artificial structures mimic natural hard substrate habitat. Several studies (Cynick 2008, Able *et al*. 1998, Holloway and Connell 2002) have documented the use of overwater structures (piers, piles, and docks) by fish and invertebrate communities typically associated with neighboring rocky reef habitats. Merkel & Associates (2008) conducted an existing conditions survey within San Diego Bay in a soft-bottom estuarine habitat impacted by overwater structures and shoreline development. These developments included areas of rip-rap, bulkheads, docks, and pilings. The survey found that the bulkhead walls and piles were covered with invertebrate communities. Organisms observed included native barnacles, mussels, non-native zoobotryon, and non-native tunicates. These findings validate that overwater structures do have ecological value by providing habitat for both native and non-native species.

However, an increasing body of evidence is showing significant differences between the biota associated with artificial structures and those on natural reef (see review provided by Bulleri and Chapman 2010). Within southern California, the majority of the overwater structures occur within protected embayments comprised of primarily soft bottom habitats. The novel habitat provided by overwater structures appears to harbor species that are either non-native or native to reef habitats generally found along open coasts. Although the structures do provide habitat, it appears they have altered the natural embayment habitat and, in some cases, may have facilitated the invasion of NIS and utilization by species native to other habitats within the region. Consequently, while providing an artificial hard substrate within a soft bottom habitat will increase habitat heterogeneity, the susceptibility to NIS invasion may increase (Wasson 2005).

Cumulative Impacts

Throughout California, human activities associated with urban development, recreational boating, fishing, and commercial shipping continue to degrade, disturb, and/or destroy important various nearshore and protected embayment habitats. Halpern *et al.* (2009) mapped cumulative impacts at the scale of the California Current marine ecosystem. Southern California ranked as one of the highest areas for cumulative impacts despite the fact that past development that converted coastal habitats (e.g. estuaries) was not accounted for in the analysis.

Most recent estimates have the current world population at approximately 7 billion humans with a predicted increase to 8.9 billion by 2050. Presently, 40% of the world's population resides within 100 kilometers of the coast. Since 1990 southern California's population has grown from 14.6 million to 16.5 million, a growth of at least 12% (CA Census Data 2009). At that rate, southern California's population will exceed 23 million by 2050. As the population increases, so does the need for development. Infrastructure such as bridges, roads, and highways must be reconfigured and expanded. Shipping and cargo capacities of ports and harbors will increase, which will require expansion and modification of overwater port facilities. As the population directly along the coast increases, recreational needs will increase, likely requiring the expansion of marina and recreational dock facilities. Increasing the number of overwater structures with adverse effects to the marine environment magnifies the extent of adverse impacts.

As a result of southern California's large population and intense economic and recreational activity, there is very little coastal space that has not been subject to construction, mineral extraction, or other form of habitat alteration. Dredge and fill activities, shoreline armoring, and overwater structures are the primary causes of habitat alteration within southern California coastal embayments. At the Ports of Long Beach, Los Angeles, and San Diego, increasing global economic trade have resulted in the need for larger, deeper draft ships to transport cargo. This has led to a demand for new construction dredging to widen and deepen channels, turning basins, and slips to accommodate these larger vessels. These activities have led to permanent loss of shallow water habitats and chronic effects on water quality. In addition to the ports, other bays and harbors of southern California have experienced significant adverse impacts associated with shoreline, intertidal, and shallow subtidal development.

Table 3 summarizes shoreline disturbance and development within bays and active harbors in the jurisdiction of the LAD. These data were gathered from two sources. The first source was the Environmental Sensitivity Index developed by NOAA's Office of Response and Restoration. These data were developed to assist in oil-spill responses by standardizing the categorization of shoreline as it relates to environmental sensitivity. Updated aerial imagery supplemented the ESI data where gaps existed. In concert, these data were used to comprehensively identify and map shoreline disturbances defined as: 1. exposed, solid, man-made structures, such as sea-walls 2. Rip rap 3. Sheltered, solid, man-made structures, such as bulkheads, docks, and piers. Although not considered to be altered in the analysis, NMFS notes that much of the limited soft shoreline found in southern California bays and harbors is sandy beach habitat that is under intense recreational use and beach management (e.g., beach nourishment, grooming, etc.).

These calculations were made to achieve a better understanding of the level of existing estuarine shoreline modification and may lead to new information on the cumulative impacts of individual projects. The utility of this information may be limited, but NMFS believes it is important to demonstrate the level of alteration that has occurred along the shorelines of these embayments. Much research has demonstrated the impacts of shoreline modification on subtidal and intertidal habitats (Lotze *et al.* 2006, Airoldi *et al.* 2008). NMFS believes there is a significant correlation between shoreline modification and adverse impacts to nearshore ecosystems.

In addition, NMFS quantified the spatial extent of existing overwater structures in a few selected embayments (Newport Bay, Mission Bay, and San Diego Bay) in southern California. Polygons representing existing overwater structures docks, piers, wharfs, marinas, floating breakwaters, etc. were manually digitized and the total area of these polygons was calculated. It must be acknowledged that calculated areas are estimates only and do not represent exact acreages. In some instances, polygons representing specific projects may have covered a larger area than is actually shaded and in some instances a smaller area than is actually shaded. In most cases, the acreage estimate is likely a significant underestimate as it does not account for the indirect shading impacts associated with overwater structures (e.g., vessel shading). Calculated values were determined merely to provide a rough estimate of disturbance caused by existing overwater structures. The spatial analysis indicated that 42.09 acres of overwater structures occur in Newport Bay, 17.79 acres in Mission Bay, and 528.38 acres in San Diego Bay. Figures 1, 2, and 3 illustrate the extent of shoreline modification and overwater structures. In addition, a composite of various eelgrass surveys approximating the maximum extent of eelgrass is illustrated.

Coupled with overwater structure expansion, southern California embayments have experienced high levels of ecological stress from hydrologic modification, and continual decline in valuable shallow water habitats. These habitats are designated EFH for many federally managed fish species and are essential for many recreational fishes. Therefore, they need to be managed rigorously and carefully as coastal development continues. The challenge of the future will be to manage these systems in a responsible and sustainable manner that will foster economic stability and growth, while protecting and conserving valuable marine resources.

It is important to note that there are estuarine systems in southern California that have been either conserved or restored, many of which are undeveloped and contain little or no shoreline modification. Some examples of these systems are: Batiquitos Lagoon, Bolsa Chica Wetland, San Dieguito Lagoon, and Los Penasquitos Marsh. With the exception of Los Penasquitos, the above systems were restored as mitigation for coastal development projects. All of these systems are now protected as Reserves and are planned to remain undeveloped.

Table 3: Summary of shoreline development in bays and harbors of southern California within the LAD boundary

Bay/Harbor Name	Kilometers of Shoreline	Kilometers of Altered Shoreline	Percentage of Altered Shoreline
San Diego Bay	127.6	111.2	87%
Mission Bay	57.1	16.0	28%
Alamitos Bay	42.5	26.5	62%
Long Beach Harbor	68.0	66.92	98%
Los Angeles Harbor	65.9	65.1	99%
Morro Bay	31.5	7.5	24%
Marina Del Rey	23.1	21.2	92%
Channel Islands Harbor	33.6	30.3	90%
Santa Barbara Harbor	2.7	2.2	81%
Ventura Harbor	12.6	10.2	81%
Oceanside Harbor	9.5	6.3	67%
Newport Bay	58.8	34.8	59%
Anaheim Bay	71.1	32.9	46%
King Harbor	6.9	4.3	63%

Note: In order to delineate where anthropogenically altered shoreline exists in Southern California we used ESRI's ArcGIS software and the Environmental Sensitivity Index shapefiles developed by NOAA's Office of Response and Restoration. Subsequently, aerial imagery was used to identify shoreline that was not categorized as "altered" in the ESI shapefile. These were visually identified as continuous overwater structures within a natural shoreline. Additionally, due to constant shoreline modification, there were cases where ESI shoreline did not match the more current shoreline shown by the aerial imagery. In these cases the shoreline was manually edited in the geographic information system (GIS) to reflect the current shoreline of the bay and then categorized as "altered" where appropriate. To calculate the percentage of altered shoreline present in each bay/harbor, geometric calculations for length of shoreline in kilometers were used. Calculations for each bay/harbor included the length of all shoreline types, which were summed to give total length of shoreline for that bay. The total altered shoreline sum was then divided by total shoreline to give the percentage of altered shoreline.

Primary Productivity Cumulative Impact

Although the area of primary producers directly impacted by an individual overwater structure may be small, the cumulative impacts resulting from the total area of all overwater structures throughout a waterbody is substantial. Alexander and Robinson (2004) showed the cumulative impact of overwater structures on marsh plants and discussed the implications of further coastal development. Combining their GIS analysis with results on macrophyte loss, overwater structures decreased primary productivity by $0.84\text{-}1.5 \times 10^6$ gC/y and statewide by $1.0 – 1.7 \times 10^7$ gC/y (Alexander and Robinson 2006). Sanger and Holland (2002) found unmitigated cumulative impacts equivalent to 150 acres/year of vegetated salt marsh lost from dock projects statewide in South Carolina with that number expected to increase with demand for docks (Sanger and Holland 2002, Sanger *et al*. 2004). These results are likely an underestimate as they do not include sediment productivity (Stutes *et al*. 2006). Many small scale habitat disturbances can translate to large scale impacts on commercially valuable species, such as crustaceans (Jordan *et al*. 2009). In addition to the direct impact of shading on the primary producers, many overwater structures in an area contribute to fragmentation of marine and estuarine flora. Fragmentation of eelgrass beds may cause further destabilization of these habitats, making them more susceptible to other stressors or disturbances, such as eutrophication, disease or severe storms (Burdick and Short 1999). Reductions in vegetation may compromise the physical integrity of remaining habitat by decreasing the attenuation of wave energy and sediment stabilization, leaving shaded, unvegetated, or sparsely vegetated areas more susceptible to habitat loss by erosion (Knutson 1988, Walker *et al*. 1989).

Global climate change and population growth over the next century will likely add more environmental stress to eelgrass habitat from anticipated increases in seawater temperature and sea level, with secondary changes to tidal range, current circulation patterns and velocities, salinity intrusion, ocean acidification, storm activity, frequency and magnitude of flooding, as well as coastal development (Short and Neckles 1999). While it is difficult to predict specific impacts to eelgrass in different areas of California, available information indicates that individual elements of climate change will affect seagrass productivity, distribution, and function throughout its range (Short and Neckles 1999). Sea levels are expected to rise over 3 feet by 2100. While this may seem relatively benign as it relates to eelgrass distribution, many eelgrass beds in southern California are at or very near their lower depth limits. The importance of eelgrass both ecologically and economically, coupled with ongoing human pressure and potentially increasing degradation and loss from climate change, highlights the need to protect, maintain, and, where feasible, enhance eelgrass habitat.

Although likely less of an ecological concern compared to cumulative eelgrass impacts, overwater structures may have cumulative adverse impacts to coastal plankton productivity. Over the past century, climatic variability and increasing sea surface temperature are causing global phytoplankton population decreases (Boyce *et al*. 2010). Overwater structures are likely not affecting the same drivers of offshore plankton productivity, but the influence of estuarine and nearshore sources of primary productivity may become more critical. Although the coastal zone represents only 8% of the earth, it provides 20% of the oceanic production (Liu *et al*. 2000). Global marine productivity may constrain some fisheries (Chassot 2010). For example, poor ocean productivity and associated disruptions of the pelagic food chain were cited as principal reasons for the sudden collapse of the Sacramento River Chinook salmon fishery (Lindley *et al.* 2009). Longstanding degradation of freshwater and estuarine habitats was also considered likely contributing factors to the collapse of the stock.

<u>Substrate Cumulative Impact</u>

Although not directly attributed to construction of overwater structures, the associated use of such structures by vessels may adversely affect benthic habitat. For example, propeller scarring has been documented to adversely impact benthic habitats (Burdick and Short, 1999, Shafer, 1999, Thom *et al*. 1996). Sargent *et al.* (1995) conducted a state-wide survey of propeller scarring in Florida that found approximately 1.7 out of 2.7 million acres of seagrass were scarred to a certain degree. The impacts were directly linked to increased human population and boating activity. In 2008, scientists at Everglades National Park surveyed aerial imagery of Florida Bay and analyzed results with GIS to determine the effects of boat scarring on seagrass beds. Their efforts found over 12,000 scars ranging from 6.6 to 5,250 feet for a total length of 325 miles. Because more scars were found in this survey than when previously conducted in 1995, the authors concluded that propeller scarring was on the rise. Furthermore, a separate analysis showed both studies may have underestimated the number of propeller scars. Factors that correlated with high scarring rates were high vessel traffic and insufficient channel markings (SFNRC Technical Series 2008). This problem is not confined to Florida (Fonseca 1998, Shafer 2002, Kelty and Bliven 2003, Thom *et al*. 1996, Burdick and Short 1999) and is likely a problem along coastal estuaries of the Pacific coast. In addition, due to their associated use by vessels, increases in overwater structures will likely increase the need for maintenance dredging, which will further increase the extent of benthic disturbance.

Pilings, grounding of floating structures, and scours associated with mooring anchors and propellers, have indirect adverse impacts to submerged vegetation and benthic habitats. Each pile, scour or grounding creates an impacted space in the habitat, functionally separating a biological community, and creating patches of viable habitat separated by low quality, impacted habitat. The fragmentation of continuous habitats is arguably one of the most important factors contributing to loss of biological diversity (Wilcox and Murphy 1985). Comparisons between fragmented and continuous eelgrass habitat identified significant differences in the macrofaunal community composition via modification of both the physical nature of the habitat and biological interactions that took place within them (Frost *et al*. 1999). The cumulative impacts of these activities will be dependent upon the duration, frequency, and distribution of impact. As habitat patches become more sparsely distributed the ability of the native biological community to recover from disturbance becomes less likely.

Overwater structures alter local hydrology and therefore sediment deposition. Sediment composition is a key variable in structuring the benthic biota. Research has shown benthic community shifts underneath overwater structures (Cantor 2009). Local turbidity and settling of organics are also modified. On the scale of an entire estuarine system, the change in substrate from a single small dock project is likely minimal. However, many estuarine areas in southern California are densely packed with overwater structures. Changes in benthic communities in valuable nearshore intertidal and subtidal habitats may result in a trophic cascade. These shifts have been driven by human activities before, typically with economic consequences (Osterblom *et al*. 2007).

As discussed in a previous section, docks are sources of contaminants via leaching of copper antifouling paints or PAHs from creosote treated piles. In addition, docked boats can lead to spills of hydrocarbons, sewage and other toxins. The risk of harm to aquatic communities increases with the number of boats in a harbor, the concentration of contaminants and potential synergistic effects. Evaluation of synergistic effects to aquatic communities can be difficult to tease apart but are valuable for assessing impacts outside a controlled setting. Peachey (2005) showed that exposure to PAHs and UV radiation has a synergistic mortality effect on marine crab larvae. Primary productivity is reduced when plants are in the presence of copper and PAHs showing an alternative pathway for overwater structures to inhibit productivity (Sudhakar Babu *et al*. 2001). While many of synergistic relationships among contaminants have yet to be determined, it is evident that increasing overwater coverage will have additional harm to aquatic communities.

NIS Cumulative Impact

Invasive species represent a persistent threat to ecosystems and communities worldwide (Mooney and Hobbs 2000). The economic impacts of NIS alone are significant. Pimentel *et al.* (2000, 2005) estimated the annual cost to Americans at 137 billion dollars from damages to agriculture, forestry and public health. Ecologically, the impacts of NIS are still being realized but include competing and hybridizing with native species, changing local habitat structure, and disrupting energy flow through the ecosystem.

The San Francisco Bay/Delta Estuary, possibly the world's most invaded estuary (Cohen and Carlton 1998), is an example of how species invasions can change an entire ecosystem. More than 230 NIS have become established in the system, and there are an additional 100-200 species that may be nonindigenous but whose origin cannot yet be determined. The known invasive species cover a wide range of taxonomic groups: 69 percent of the species are invertebrates such as mollusks, crustaceans, and tubeworms; 15 percent are fish and other vertebrates; 12 percent are vascular plants; and 4 percent are microbial organisms. NIS dominate many estuarine habitats, accounting for 40 to 100 percent of the common species at many sites in the estuary, whether calculated as a percentage of the number of species present, the number of individuals, or of total biomass (Cohen and Carlton 1995). The pace of invasion is accelerating. Roughly half of the NIS in California has arrived in the last 35 years. Between 1851 and 1960, a new species was established in the San Francisco Bay every 55 weeks. The primary means of introduction can be attributed to the shipping and boating industry.

Established populations of NIS may also facilitate additional invasions that would otherwise be unable to invade. For example, Heiman *et al*. (2008) found that non-native tubeworm reefs in Elkhorn Slough created structural habitat that provided the hard substrate necessary for the invasion of other NIS. These types of invasions are an example of an 'invasional meltdown' in which NIS facilitate ongoing and subsequent invasions by increasing survival or population size, of other NIS (Simberloff and Von Holle 1999). Overwater structures can act in a similar way by providing the structure necessary for settlement of invasive species. By continually increasing overwater structures, invasive species will have additional opportunities to establish themselves in southern California waters.

Ballast water exchange is a principal invasion vector in aquatic species (Lavoie *et al*. 1999). When a cargo ship is not loaded, it loads surrounding water into designated tanks for stabilization then releases the water after its voyage. Often invasive species are taken up in ballast water and released at novel ports where they can propagate throughout the local systems. Increasing overwater structures in major ports corresponds to more frequent shipping stops and ballast water exchange. Researchers have focused on methods for sterilizing ballast water, but thus far none have been implemented on a large scale (Waite *et al*. 2003)

Non-indigenous invertebrates comprise about 15% of the infauna and macroinvertebrate species occurring in the Ports of Los Angeles and Long Beach, some of which are abundant. The relative abundance of these species has increased in the harbors since the 1970s (SAIC 2010). Although southern California bays and estuaries have not experienced the same level of invasion as San Francisco Bay, the invasion potential remains high and management will help dictate the future of NIS in southern California.

EFH Adverse Effects Determination

Based upon the above effects analysis, NMFS has determined that the activities covered under this programmatic consultation would adversely affect EFH for various federally managed fish species under the Coastal Pelagic Species, Pacific Coast Groundfish Species, and Highly Migratory Species FMPs. Moreover, increases in overwater structures will adversely affect estuary and seagrass HAPC. Given the significant alteration of existing shoreline habitat, NMFS believes additional impacts to EFH associated with expanded overwater coverage would be substantial.

EFH Conservation Recommendations

Pursuant to section 305(b)(4)(A) of the MSA, NMFS offers the following EFH conservation recommendations to avoid, minimize, mitigate, or otherwise offset the adverse effects to EFH.

General Recommendations

1. All overwater structure construction (including in-kind replacement) should be required to follow eelgrass monitoring requirements put forth in the Southern California Eelgrass Mitigation Policy (SCEMP). Exceptions may be granted for areas that Corps and NMFS believe are highly unlikely to support eelgrass habitat.

2. Given the significant alteration of existing shoreline and shallow water habitats in southern California, all overwater structures should be water dependent. Proposed projects should clearly explain their water dependency and why the project is in the public's best interest.

3. As part of the project application, the proponent should describe how their proposal addresses the specific conservation recommendations identified below. NMFS recognizes that not all conservation recommendations will be relevant in all situations. Therefore, the proponent should clearly articulate when a particular recommendation is not applicable to the proposed project. Based upon the project application, the Corps should determine if the project implements appropriate conservation recommendations and, therefore, can be covered by this programmatic consultation.

Mooring Anchors and Persistently Moored Vessels

For all projects, the project proponent should strive to implement avoidance measures to the extent feasible. When avoidance measures are not feasible, minimization measures should be implemented.

Avoidance:

1. All new anchored moorings and persistently moored vessel should be placed in areas in which suitable submerged aquatic vegetation (SAV) (e.g. eelgrass, kelp) habitat is absent. This will prevent adverse shading impacts to SAV.

2. Persistently moored vessels should be placed in waters deep enough so that the bottom of the vessel remains a minimum of 18 inches off the substrate during extreme low tide events. This will prevent adverse grounding impacts to benthic habitat.

Minimization:

1. Mooring anchors placed within suitable SAV habitat should be of the type which use midline floats to prevent chain scour to the substrate. This will prevent adverse impacts to SAV and other benthic habitat.

2. Persistently moored vessels that are moored over SAV or rocky reef habitats with less than 18 inches between the bottom of the vessel and the substrate at low tides should utilize float stops. This will prevent adverse grounding impacts to benthic habitat.

Pile Removal and Installation

Minimization:

1. When feasible, remove piles with a vibratory hammer rather than a direct pull or clamshell method.

2. Slowly remove pile to allow sediment to slough off at or near the mudline.

3. Hit or vibrate the pile first to break the bond between the sediment and the pile to minimize the likelihood of the pile breaking and to reduce the amount of sediment sloughed.

4. Encircle the pile with a silt curtain that extends from the surface of the water to the substrate, where appropriate and feasible.

5. If contaminated sediment occurs in the footprint of the proposed project, cap all holes left by the piles with clean native sediments.

6. Drive piles during low tide periods when substrates are exposed in intertidal areas. This minimizes the direct impacts to fish from sound waves and minimizing the amount of sediments re-suspended in the water column.

7. Use a vibratory hammer to install piles, when possible. Under those conditions where impact hammer are required (i.e. substrate type and seismic stability) the pile should be driven as deep as possible with a vibratory hammer prior to the use of the impact hammer. This will minimize noise impacts.

Pile-supported Overwater Structures

For all projects, the project proponent should strive to implement avoidance measures to the extent feasible. When avoidance measures are not feasible, minimization measures should be implemented.

Avoidance:

1. To the maximum extent practicable, site overwater structures in areas not occupied by or determined to be suitable for sensitive habitat (e.g. SAV, salt marsh, intertidal flats).

2. Any cross or transverse bracing should be placed above the MHHW to avoid impacts to water flow and circulation.

Minimization:

1. Minimize, to the maximum extent practicable, the footprint of the overwater structure. The overwater structure should be the minimum size necessary to meet the water-dependent purpose of the project.

2. Design structures in a north-south orientation, to the maximum extent practicable, to minimize persistent shading over the course of a diurnal cycle.

3. For residential dock and pier structures, the height of the structure above water should be a minimum of 5 feet above MHHW.

4. For residential dock and pier structures, the width of the structure should be limited to a maximum of 4 feet wide. Exceptions may be provided to comply with the Americans with Disabilities Act.

5. For residential dock and pier structures, one turnaround is permitted not exceeding 10 feet in length and 6 feet wide, or 60 square feet. The turnaround is intended to accommodate efficient unloading/loading of boating equipment and is not intended to be used for non water-dependent uses.

6. For residential dock and pier structures, a terminal platform should not exceed 5 feet long by 20 feet wide, or 100 square feet.

7. Extend the structure's terminal platform into nearest adjacent deep water to minimize the need for dredging and to minimize the likelihood of boat grounding, propeller scar/scour in shallow water habitat

8. Use the fewest number of piles as practicable for necessary support of the structure to minimize pile shading, substrate impacts, and impacts to water circulation. Pilings should be spaced a minimum of 10 feet apart on center.

9. Gaps between deck boards should be a minimum of ½ inch. If the overwater structure is placed over SAV or salt marsh habitat, 1 inch deck board spacing or use of light transmitting material with a minimum of 40% transmittance should be used. Exceptions may be provided to comply with the Americans with Disabilities Act.

10. The use of floating dock structures should be minimized to the extent practicable and should be restricted to terminal platforms placed in the deepest water available at the project site.

11. Incorporate materials into the overwater structure design to maximize light transmittance. When suitable SAV habitat is within the project vicinity, the use of appropriate grating should be used to permit sufficient light for SAV production.

<u>Compensatory Mitigation</u>

As defined in 33 CFR Part 332, riparian areas are lands adjacent to streams, rivers, lakes, and estuarine-marine shorelines. Riparian areas provide a variety of ecological functions and services and help improve or maintain local water quality. Continued modification of estuarine-marine shorelines as a result of overwater structures further reduces the ecological functions and services provided by these unique habitats. Overwater structures directly reduce the amount of light in the aquatic environment. Light is the principal, physical function that drives nearshore productivity. Thus, overwater structures decrease the productivity of southern California's nearshore waters. In addition, the cumulative impacts of overwater structures adversely affect EFH in a number of ways described in the above effects analysis. Shallow-water estuarine habitats are ecologically important, but have generally been under-valued (Ray 2005). Without compensation for the degradation of aquatic resources, the proposed activity may be contrary to public interest. Therefore, NMFS believes compensatory mitigation options should be pursued for new or expanded overwater structure projects. If, for any given project, the Corps does not believe compensatory mitigation is warranted, NMFS recommends that the Corps should provide a detailed response explaining the rationale for not requiring compensation. NMFS recommends that, at a minimum, such a response would include the Corps' scientific opinion as to whether the overwater structure results in unavoidable adverse impact to waters of the U.S. Also, if the Corps acknowledges an unavoidable adverse impact, then the Corps should describe the threshold for which an exceedance would trigger the need for compensation.

To date, most compensatory mitigation implemented for impacts to aquatic resources in the marine realm have been based upon reductions in the quantity of a particular habitat. With the exception of structural habitats associated with primary producers (e.g. seagrass and salt marsh habitat), overwater structures and associated structures generally do not result in a reduction in quantity. Instead, these activities generally result in a reduction in habitat quality. Reductions in quality are inherently more difficult to quantify. Rigorous quantification of reductions in quality may be cost prohibitive for many projects. Therefore, NMFS recommends the development and adoption of a framework for quantifying reduction in quality that incorporates expert opinion from qualified representatives of the Corps, NMFS, other interested resource agencies, and the project proponent.

This framework should be based upon an examination of the basic ecological components of the affected ecosystem. For example, key ecological components of protected embayments are primary productivity, native biodiversity, hydrology, water quality, and sediment quality. Additional factors, such as habitat type, depth, degree of N/S alignment, height above water, light transmission, proportion of floating structures, and density/number of piles, may also warrant consideration. Each of the ecological components would then be evaluated for reductions in value using a scale between 0 and 1. The resultant numerical factor would then be multiplied by the affected area to yield an areal unit of habitat loss. If using an in-lieu fee mitigation approach, the calculated impact area can then be multiplied by a restoration cost per unit area based on a representative list of significant estuarine and nearshore enhancement projects. For permittee-responsible mitigation, the areal unit of habitat loss would serve as the basis for development of a mitigation plan.

Projects that have documented potential impacts to eelgrass habitats should be required to follow regulations and guidance put forth in the Southern California Eelgrass Mitigation Policy (http://swr.nmfs.noaa.gov/hcd/policies/EELPOLrev11_final.pdf). For all other overwater structure projects, NMFS recommends three options for consideration that may offset adverse impacts to EFH and aquatic resources.

Mitigation Option #1: Development and implementation of an in-lieu fee program

NMFS has determined that adverse impacts to EFH and aquatic resources will occur as a result of increases in overwater coverage and associated structures. Due to the relatively small scale and geographic fragmentation of individual projects, NMFS believes that Mitigation Option #1 will be the most effective and streamlined option to mitigate for adverse impacts to EFH. This option would afford a means to mitigate for impacts associated with smaller projects that would otherwise be economically and ecologically difficult to mitigate for individually. Additionally, an in-lieu fee program would streamline the Corps permitting and consultation process for individual projects.

1. *In-lieu fee program framework*: NMFS recommends the development of an in-lieu fee program framework. The Corps would serve as the lead on the Interagency Review Team (IRT) that would provide program oversight and selection of the program sponsor. The program sponsor may be a governmental or non-profit natural resource management entity (e.g. The Nature Conservancy). In accordance with the 2008 Compensatory Mitigation Rule there is a requirement for a compensation planning framework, which details how the in-lieu fee program will select and secure project sites and implement mitigation projects in a watershed context. The framework is essentially a plan designed to support resource restoration, and must include an analysis of historic aquatic resource losses and current conditions, a description of the general amounts, types and locations of aquatic resources the program will seek to provide and a prioritization strategy for selecting and implementing compensatory mitigation activities. NMFS recommends that the Corps, in cooperation with NMFS and other interested resource agencies, develop such a framework and identify potential sponsors. With sufficient cooperation, NMFS believes the following objectives may be accomplished within one year; IRT selection and establishment, program and compensation planning framework, sponsor selection, and development of performance standards and guidelines.

Mitigation Option #2: Permittee-responsible compensatory mitigation

Adverse impacts to aquatic resources may be mitigated on a permittee-responsible basis. However, for some projects, it may not be feasible to identify a permittee-responsible mitigation project that adequately offsets impacts. If an adequate stand-alone mitigation project is not identified, then the proposed project should be delayed until such a project is identified, an established in-lieu fee mitigation program is capable of taking fees as mitigation, or a mitigation bank is available to sell credits. Projects with significant public benefits that would be significantly impacted by a delay in implementation may serve as exceptions, but should provide some level of financial assurances that some form of compensatory mitigation will be implemented. Permittee-responsible mitigation may be conducted on- or off-site.

1. <u>On-site mitigation (in-kind):</u> This type of mitigation would occur at or adjacent to the project or impact site.

    i. Adverse impacts to intertidal and shallow subtidal soft-bottom habitats may be offset on-site through restoration, enhancement, and/or creation of these habitats adjacent to the overwater structure.

2. <u>Off-site mitigation (in-kind):</u> This type of mitigation would occur out of the impact site but should remain within the affected coastal embayment and/or littoral cell.

i. Adverse impacts to intertidal and shallow subtidal soft-bottom habitats may be mitigated for off-site through removal of an existing overwater structure, where substructure habitat could be restored.

ii. The effects analysis above identified the extensive network of shoreline armoring and modification throughout southern California embayments. As mitigation for increased overwater structure coverage, it is possible that many of these armored banks could be eliminated and restored to their original soft-bottom inter- and subtidal habitats.

iii. Other options include intertidal sand and mudflat restoration, salt marsh restoration, improving tidal exchange, and SAV enhancements.

3. <u>Out-of-kind mitigation:</u> If in-kind mitigation cannot be identified or is deemed technically infeasible, out-of-kind mitigation may be considered. Out-of-kind mitigation should still address impacts within the context of the coastal embayment and/or littoral cell. Estuarine ecosystems are quite complex and have many habitat controlling factors (i.e. water quality, hydrology). Consequently, it is feasible that out-of-kind mitigation may have a cascading benefit on the habitat impacted by a given activity. For example, Gee *et al*. (2010) found that upland restoration and water control management in a wetland habitat had significant benefits to water quality throughout an estuary. Improved water quality will promote expansion of eelgrass and other SAV, increases in secondary benthic production, and provide overall benefits to EFH and associated federally managed species.

Offsetting Option #3: Development of an overwater structure coverage RGP or ledger

USACE may establish an overwater structure coverage RGP and/or ledger that would allow programmatic overwater coverage accounting within a specified coastal embayment and/or littoral cell. There would be no net increase of overwater coverage within the designated geographic region. A project which decreases overwater coverage would be tracked and credited. These credits could then be used for a project proposing to increase overwater coverage.

> <u>*RGP and ledger example: Coronado Cays Homeowners Association RGP-085*</u>:
> *The RGP covers the action to replace about one half of the existing docks, pilings, gangways, and or associated structural components within the Cays HOA without cumulatively increasing the current amount of shade cover of these structures over the San Diego Bay /Pacific Ocean for the life of the five-year RGP. Individual property owners may have an increase in shade coverage, however the Cays HOA will maintain an overall net zero increase in shade coverage for all docks, pilings, gangways, and / or associated infrastructure. Up to 1,600 pilings and up to several hundred private docks, pilings, gangways, and or their associated infrastructure would be replaced during the life of the RGP within the leased area from the City of Coronado, California.*

NMFS recommends that RGPs or ledger systems be used in areas where permittees can be identified and held responsible for adherence to permit conditions such as ledger management and reporting requirements.

Notification and Reporting Requirements

The Corps should notify NMFS of the proposed project prior to permit issuance. Notification may occur by typical Corps notification processes (e.g., Public Notice, Letter of Permission, Pre-Construction Notification) or via email. The notification should indicate that the proposed project is covered by the Overwater Programmatic and should indicate which EFH Conservation Recommendations are being implemented relevant to the project. The Corps may assume NMFS concurrence if they do not receive written or email comments regarding their decision within 10 days of notification.

To avoid adverse effects to EFH that may occur from improper utilization of this programmatic consultation, NMFS recommends that the USACE provide annual reports to NMFS on all activities conducted under this programmatic consultation. Reports should be submitted to NMFS within 90 days of the end of each calendar year. Reports should include a summary of annual overwater structure activities (total number of projects, total acreages of new overwater coverage, and summary of conservation recommendations implemented). In addition, the Corps should provide the acreage of overwater structure coverage for those projects in which the Corps has determined that compensatory mitigation is not warranted.

At any time, NMFS may revoke or revise this programmatic consultation if it is determined that it is not being implemented as intended or if new information becomes available indicating a significant discrepancy in either the effects analysis or effectiveness of EFH Conservation Recommendations.

EFH Statutory Requirement

Please be advised that regulations (50 CFR 600.920(k)) to implement the EFH provisions of the MSA require your office to provide a written response to this letter within 30 days of its receipt and prior to the final action. A preliminary response is acceptable if final response cannot be completed within 30 days. Your final response must include a description of how the EFH Conservation Recommendations will be implemented and any other measures that will be required to avoid, mitigate, or offset the adverse impacts of the activity. If your response is inconsistent with the EFH Conservation Recommendations, then USACE may develop and propose alternative Conservation Recommendations subject to NMFS approval, otherwise those activities for which adverse effects are not fully compensated will not be covered under this programmatic consultation.

Fish and Wildlife Coordination Act Comments

The purpose of the Fish and Wildlife Coordination Act (FWCA) is to ensure that wildlife conservation receives equal consideration, and is coordinated with other aspects of water resources development [16 U.S.C. 661]. The FWCA establishes a consultation requirement for federal departments and agencies that undertake any action that proposes to modify any stream or other body of water for any purpose, including navigation and drainage [16 U.S.C 662(a)]. Consistent with this consultation requirement, NMFS provides recommendations and comments to federal action agencies for the purpose of conserving fish and wildlife resources. The FWCA allows the opportunity to offer recommendations for the conservation of species and habitats beyond those currently managed under MSA.

Many fishes undergo ontogenetic niche shifts during their development, typically driven by predator avoidance and resource acquisition (Werner and Hall 1988, Cocheret de la Morinière *et al*. 2003). Early life stages are typically spent in heterogeneous habitats with shelter from predation and high abundances of forage items (Irlandi and Crawford 1997). As individuals grow, they may reach a size refuge allowing them to pursue higher quality prey. Coastal embayments are an example of early life stage habitat for fishes that undergo ontogenetic shifts (Able 2005). Mostly enclosed by land, wave and current energy are diminished, allowing smaller fishes to spend less energy on movement and more on growth and development. These calmer waters also support seagrasses, vascular plants and macroalgae that provide shelter from predation and form the foundation of a productive ecosystem. Threatened by development and other anthropogenic causes, coastal embayments represent an important link for many coastal fishes.

Marine fishes dominate Southern California embayments, as little rain falls in the region yielding low freshwater inputs. Commercially and recreationally important species such as California halibut (*Paralichthys californicus*), are common in these embayments (Barry and Cailliet 1981, Pondella and Williams 2009). Recreational fishes including kelp bass (*Paralabrax clathratus*), barred sand bass (*Paralabrax nebulifer*), spotted sand bass (*Paralabrax maculatofasciatus*) and California corbina (*Menticirrhus undulatus*) are also found in these habitats (Allen 1982, Monaco *et al*. 1992).

Sciaenids (e.g. croakers, corbina, corvina) are also common in many bays and estuaries. White croaker (*Genyonemus lineatus*) was the most abundant species observed in bays and harbors (Allen *et al*., 2007). Sciaenids are generally bottom dwellers that inhabit sandy or muddy areas, frequently off beaches or in sheltered bays, estuaries, and river mouths. Other species occur offshore on the continental shelf (usually in less than 50 m depth) and are an important component of trawl fisheries. The annual landing of sciaenids is very substantial, both from trawlers and from gill net fishermen. Indeed, the various species of corvina are a common element of fish markets throughout the region. They are generally carnivorous, feeding on a variety of small fishes and benthic invertebrates.

Some adults reproduce directly in the lagoon, while others, such as California halibut, spawn in open water and rely on coastal currents to carry the larvae into these protected areas (Allen 1988). Valle *et al*. (1999) found densities of California halibut and barred sand bass of over 15 and 5 individuals per 100 square meters within Alamitos Bay, California. Kramer (1991) conducted a two year survey of California halibut at Mission Bay and Agua Hedionda lagoon to determine the relative importance of bays as nurseries areas, and to examine movement patterns between bays and open coast. The study found that juveniles were dependent upon bays as nursery habitats; nearly all individuals sampled between 76 and 115 days of age occurred in bays rather than open coasts. Protected embayments provide nursery values to halibut by decreasing the risk of mortality of newly-settled halibut and increasing growth of larger juveniles that feed upon abundant small fishes in the bays (Kramer 1991).

In addition to the shelter from wave action and predators, estuaries are beneficial to individual growth rates. Embayments are typically shallower than shelf waters, making them more susceptible to temperature fluctuation. Typically, these waters are warmer: increasing growth rates during early life stages (Malloy and Targett 1991, Brandt *et al*. 1992). Even with little freshwater inflow, these embayments are flushed tidally, increasing water quality and supplying food to the biological community. As a result, estuaries are productive and can support high densities of primary producers and consumers, providing juvenile fishes a higher probability of foraging success. Bioenergetic growth models have shown prey density to be positively correlated with growth rates (Mittelbach 1988, Brandt and Kirsch 1993) making estuaries ideal locations for development.

In San Diego Bay, Allen *et al*. (2002) found that 70% of the individuals sampled were juveniles. Similarly, Pondella (2009) demonstrated that 62% of all fishes sampled were juveniles, suggesting that San Diego Bay continues to be a nursery area for the great majority of the fishes found there. In terms of percent juveniles captured, the top four species (northern anchovy, California halibut, kelp bass and barred sand bass) are all critical commercial and recreational species. The high catch of juvenile fishes in San Diego Bay highlights the continued importance of San Diego Bay as a nursery area for bay, estuarine and nearshore species. Additionally, as the largest estuary in southern California, San Diego Bay provides important habitat for bay and estuary fishes, many of which are unique to the region. Southern California indigenous bay and estuary fishes represented 49% of the total catch in the survey conducted by Pondella (2009), highlighting the need for conservation measures that will minimize the impacts to these habitats.

As described in the EFH effects analysis, NMFS has determined that estuary/embayment and seagrass habitat will be negatively impacted by overwater structure activities. Given the importance of these habitats to a variety of fish and wildlife species, NMFS believes that overwater structures may cumulatively have a substantial impact on aquatic resources. As such, EFH Conservation Recommendations provided also serve as FWCA recommendations to compensate for these negative impacts.

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Figure 1: Extent of altered shoreline and overwater structures in Newport Bay

Figure 2: Extent of altered shoreline and overwater structures in Mission Bay

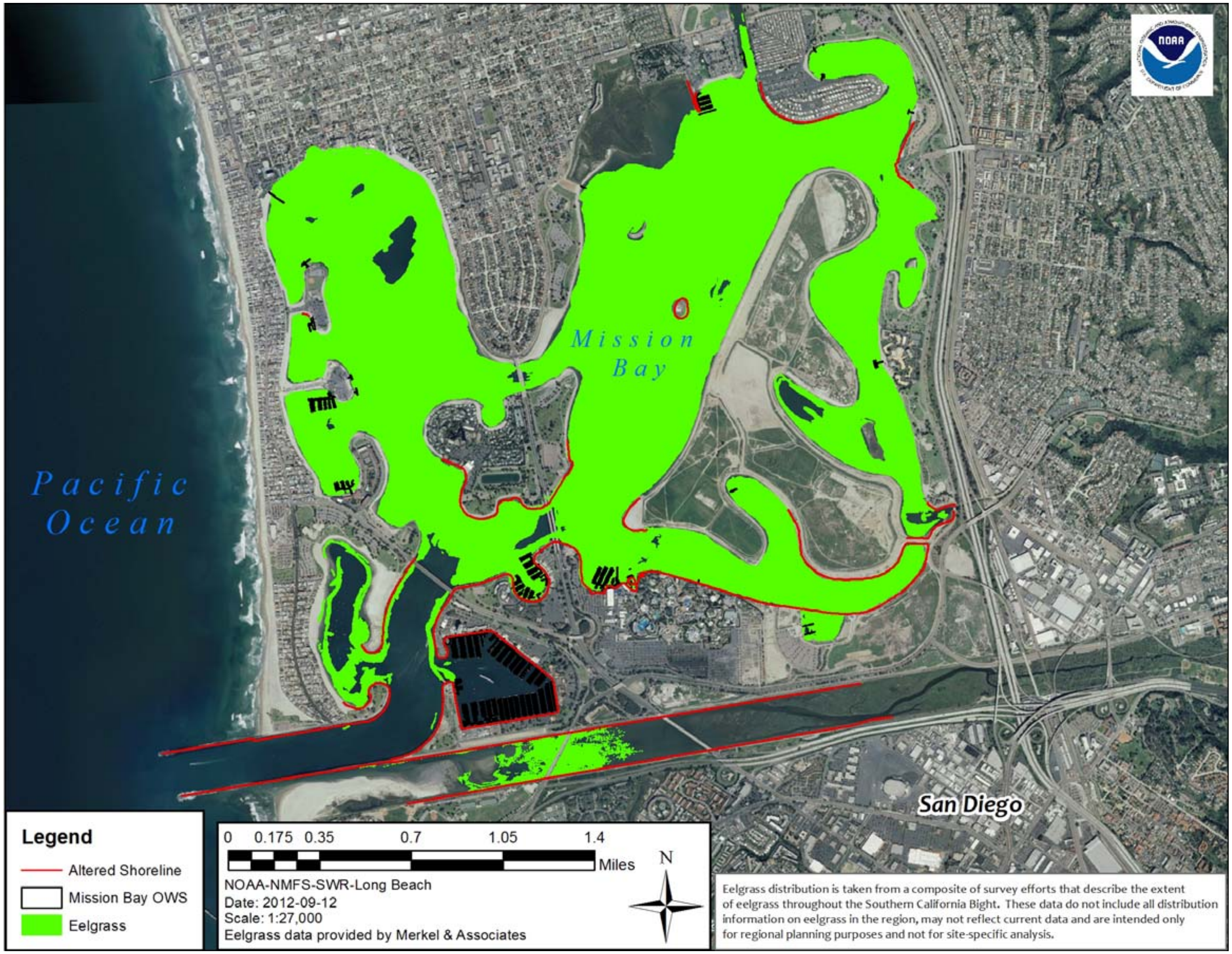

Figure 3: Extent of altered shoreline and overwater coverage in San Diego Bay