Pacific Northwest Marine

ECOREGIONAL ASSESSMENT

PREPARED BY:
The Nature Conservancy
in Oregon

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Pacific Northwest Marine Ecoregional Assessment

Prepared by

The Nature Conservancy

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Executive Summary

The purpose of the Pacific Northwest Marine Ecoregional Assessment was to identify priority areas for conserving biodiversity within the Pacific Northwest (PNW) Marine Ecoregion. This assessment used an approach developed by The Nature Conservancy and other scientists to establish conservation priorities within ecoregions which are defined by their distinct habitats and native species. This report documents the assessment process including the steps taken to design conservation scenarios for the ecoregion presenting a comprehensive, ecoregion-wide analysis that identifies and prioritizes places of conservation importance.

The assessment area extends from Cape Flattery, Washington south to Cape Mendocino, California and covers 97,925 square kilometers. It includes tidal estuaries and the nearshore ocean, extending seaward to the toe of the continental slope (~3000m.) It covers only the portion of the ecoregion in U.S. territorial waters; a comparable Canadian ecoregional assessment is being conducted by the British Columbia Marine Conservation Analysis project (2009). The PNW Marine Ecoregion encompasses over 1239 km of the shoreline with 60 freshwater rivers and streams creating estuaries that vary in size from a few hectares to over 46,000 hectares in the Columbia River. The physical characteristics of the ecoregion are dominated by the continental shelf, a relatively shallow, flat submerged portion of the North American continent extending to a depth of ~200 m. The western boundary of the continental shelf ends at the shelf-slope break, a region with relatively high primary and secondary productivity. Seaward of the shelf-slope break, the depth increases quickly forming the continental slope and at the base or toe of the slope is the western boundary of the assessment area. In addition to the submarine canyons that carve through the shelf to the slope, the continental shelf has four prominent, submarine banks of varying sizes, all offshore of the Oregon coastal area. Upwelling combined with topography of the seafloor act to bring resources to surface waters making these banks productive foraging grounds for marine mammals, seabirds and fishes.

The PNW Marine Ecoregion sits within the California Current Ecosystem, the eastern boundary current along the west coast of North America. The California Current is a broad, south flowing current that originates along the west coast of Vancouver Island, Canada and flows uninterrupted for several thousand kilometers to Baja California where it gradually dissipates and heads offshore. The most important ecological process in the ecoregion is the upwelling of deep, nutrient rich waters that move onshore in spring and summer. Dense phytoplankton blooms are driven by coastal upwelling, followed by successive increases in zooplankton species, forage fish, fin fish and finally by top level predators that include marine mammals, seabirds and numerous fish species. The regular annual cycles of upwelling are fit into longer climate cycles that contribute to the variability of productivity and species in the coastal ocean.

Diverse marine habitats along the Pacific Northwest coast support a wide variety of resident and migratory species. Bays and estuaries provide essential marine links to freshwater and terrestrial habitats via the twice daily tidal exchange of nutrients between land and sea. Along the coastline throughout the ecoregion, sand beaches provide important foraging habitat for migratory shorebirds, and resting habitat for marine mammals. Hundreds of seastacks, islands and seaside cliffs provide critical nesting habitat for the region's seabirds and migratory stopover locations for species that feed in the intertidal zone. Seastacks and islands also provide haul out and breeding sites for marine mammals, including sea lions, seals and elephant seals. Beyond the surf zone, continental shelf and slope ecosystems form some of the richest marine ecosystems in the world driven by the high productivity and the variety of habitats that support hundreds of different species of plants and animals. Broad soft bottomed habitats at all depths are broken up by rocky reef complexes that can be a mix of hard rock, gravels, cobbles and rock pinnacles. Nearshore habitats are important foraging and migratory corridors for cetaceans including the eastern population of gray whales and humpback whales. At depths ranging to 1200 m or more, diverse long-lived rockfish species inhabit sandy and rocky habitats forming the basis for active fisheries.

Ocean resources are an integral part of the coastal economy in all three states within the ecoregion. The ecoregion's rich productivity supports local communities that in some cases are highly dependent upon fishery-based businesses. Coastal recreation is closely tied to the ocean and shorelines with relaxing and beachwalking being listed as the most popular activities in Oregon's coastal state parks. There is a growing awareness of the ocean and coastal ecosystems as a source of natural capital that provides substantial benefits to coastal communities above and beyond the natural resources that are extracted from them.

Commercial fisheries occur within state and adjacent federal waters, and are mostly limited to a maximum of 1200 m depth for bottom dwelling (demersal) fishes; midwater trawl and pelagic fisheries, however, are not restricted by depth. Commercial fisheries are regulated by NOAA and managed by the Pacific Fisheries Management Council. There are several major commercial ports of call in the ecoregion: Westport, Astoria, Newport, Coos Bay, and Crescent City, as well as a number of smaller ports that serve commercial and recreational fishing fleets. In Washington there are four coastal tribal nations that have used these marine waters for hundreds of generations and continue to be an important group of fishers along the coast. Treaty rights dictate tribal co-management and rights to marine resources in their usual and accustomed areas.

A potentially significant economic force that is just beginning to be realized in the ecoregion is alternative energy production. Several promising technologies are being readied for deployment along the Oregon coast to harness wave and tidal energy and convert it to electrical power. There is potential to capture energy in the nearshore ocean, but the placement of the facilities is not without impacts to marine habitats and displacement of current users of those areas.

The identification of conservation areas in this ecoregional assessment follows these steps: (1) identify and select conservation targets; (2) assemble and compile spatial data; (3) set goals for conservation targets; (4) create a cost (suitability) index; (5) generate draft analyses; (6) refine the draft analyses through expert review. A computer program, Marxan was used to select a set of areas that meet the goals for target species and habitat types at the lowest "cost" where cost represented a suite of economic, social and environmental factors. Cost was minimized in the analysis by selecting sites rated as most suitable for long-term conservation that nevertheless met conservation goals.

Conservation targets were selected to represent the full range of biodiversity in the ecoregion, and to capture any elements of special concern. Benthic, shoreline, and estuarine habitats, as well as coastal upwelling and primary productivity, were all chosen to represent coarse scale ecological systems and processes. Fine filter targets were selected if their global rank (G rank) indicated they were imperiled, federally listed as threatened or endangered under the U.S. Endangered Species Act, or if considered a species of special concern. There were 60 fish species, 12 marine mammal species and 30 seabird species targets identified as targets in the assessment. Overall there were 358 conservation targets selected in the assessment of which 237 targets had sufficient data to be used in the analysis. Data for conservation targets came from a number of sources including NOAA trawl surveys, USFWS seabird surveys, State agencies, satellite information and Natural Heritage Programs. Conservation goals used a default setting of 30% of area or occurrences unless more specific information from recovery plans dictated other values; goals for critical habitats such as kelp beds were higher.

The Marxan analysis used in the assessment employed an index of suitability to determine the relative ease of enabling conservation in the ecoregional analysis. Factors used to develop the index where divided between terrestrial and marine aspects and included protected area status, commercial fishing use, dredge disposal dumping grounds, ports, invasive species in estuaries, salmon use in estuaries, road density, shoreline armoring, point source pollution and land conversion. Marxan uses suitability to develop solutions that meet conservation goals while simultaneously avoiding conflicting use areas to the extent possible.

Protected area status is an important part of any ecoregional assessment with protected areas such as National Wildlife Refuges, National Parks and Conservancy preserves being examples of key sites that offer conservation benefits. In the PNW Marine Ecoregion protected areas covered 19,093 square kilometers, half of which is the Olympic Coast National Marine Sanctuary. Essential Fish Habitat (EFH) areas were classified as protected areas in the assessment. Within State waters, very little of the area is in a protective category as National Wildlife Refuges are generally small and Marine Protected Areas are just beginning to be designated by respective states. A Gap Analysis was conducted to determine current contributions of protected areas to conservation of biodiversity with the results being that only 10% of the conservation targets were met at the 80% goal level and above in existing protected areas. At the other end of the spectrum, 33% of the conservation targets had 0% of their conservation goals met within protected areas and another 34% of the targets had less than 20% of their goals met.

Results from the assessment were portrayed in two separate conservation scenarios, each using similar ecological data but differing in their application of suitability factors across the ecoregion. The scenario that employed only ecological data and no suitability factors exhibited more definitiveness in terms of identifying areas of high conservation priority. This contrasted with the scenario that included the suitability factors with the ecological data in the analysis. Overall, results from each of the scenarios showed considerable agreement in terms of selecting areas of conservation importance.

The assessment is only the first step in developing conservation strategies for the Pacific Northwest nearshore ocean. It is the intention of The Nature Conservancy to use the data compiled in this effort to begin discussions with stakeholders throughout the ecoregion about specific conservation issues of mutual interest.

Chapter 1 - Introduction

1.1 Background

Globally, demands on natural resources continue to rise with increasing human populations. With human populations reaching 6.8 billion in 2008 (US Census Bureau, 2010), the growing pressures on animals, plants and natural habitats forces society to make difficult decisions regarding their use to protect against species and habitat losses. [Currently 17,315 species are listed on the International Union for Conservation of Nature (IUCN) Red list (International Union for Conservation of Nature [IUCN] 2010)]. In order to ensure the viability of marine and coastal ecosystems, resource managers must determine how to provide access to commercially valuable species and minimize damage, degradation or destruction of these populations and the habitats that sustain them. Addressing uses and protection in a comprehensive and strategic manner is the basis for ecosystem-based management, a term coined to describe a management process where ecological, social and economic interests are all considered (McLeod et al 2005). To help establish a vision for conserving the diversity of species and habitats in marine habitats, we need the best available science and tools to synthesize, analyze and compile data from many sources. Towards this end, The Nature Conservancy uses a quantitative and rigorous analysis to assist and inform government agencies and other conservation partners with difficult decisions regarding use and conservation of natural resources for all ecoregions in North America as well as other selected ecoregions throughout the world. These comprehensive biological assessments that span specific geographies, called 'ecoregional assessments', evaluate a representative spectrum of biological diversity (species and habitats) in a given ecoregion, identifying areas of biological significance where conservation efforts could have the greatest potential for success (i.e., greatest gain for the least cost), and compile existing data sources in formats that are useable, transferable and accessible for future analyses and projects.

This is the first ecoregional assessment of marine species and habitat types in the most northerly portion of the California Current System. The Pacific Northwest Marine Ecoregional Assessment began in 2007 in the Oregon Chapter to assist a state-driven process to identify priority areas in the Oregon territorial sea (out to 3 nm) that had the potential to be designated as a network of marine reserves. This assessment is preceded by a complementary ecoregional assessment, the Pacific Northwest Coast Ecoregional Assessment (Vander Schaaf et al. 2006) that identified conservation priorities in the terrestrial and freshwater portion of the same ecoregion. To the north, the British Columbia Marine Conservation Analysis (BCMCA) is simultaneously undertaking an ecoregional assessment for the portion of the Pacific Northwest Marine Ecoregion that occurs in Canadian waters. To the south, the Northern California Marine Ecoregional Assessment (The Nature Conservancy [TNC] 2006) provides continuity with regards to analytical methods and data. The Pacific Northwest Marine Ecoregional Assessment greatly benefited from the participation, expertise and critical thinking from scientists and managers at the Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, National Oceanic and Atmospheric Administration (NOAA), University of Washington, Oregon State University, and US Fish and Wildlife Service, as well as many individuals in other organizations, agencies or universities.

1.2 Purpose

The purpose of this marine ecoregional assessment is to identify priority areas for conserving representative biodiversity within the Pacific Northwest Marine Ecoregion (Figure 1). This assessment is a spatially explicit, quantitative analysis of biological diversity on the west coast from Cape Flattery, Washington to Cape Mendocino in Northern California, and can be used to guide planning processes and inform conservation planners and decision-makers. This analysis has no regulatory authority and was intended to guide decision making and compile the best available data for species and habitats in the ecoregion. The assessment should be used in conjunction with other biological, social and economic data and analyses to guide policy actions with multiple objectives, for example coastal and marine spatial planning.

As with all other ecoregional assessments undertaken by The Nature Conservancy, the assessment is coarse scale, (the ecoregional scale is approx. 1:100,000) and additional spatially-explicit data and local information should be sought to address conservation issues or marine resource management at the site scale (< 200 km, or 1:24,000). This analysis is the first comprehensive analysis of species and habitat diversity within coastal, pelagic and continental shelf habitats in the Pacific Northwest Marine Ecoregion, and data gaps and limitations described herein must be taken into consideration by users. This report was prepared with the expectation and understanding that it will be updated as the state of scientific knowledge and data availability improves, analytical methods and models are advanced, and other scientific or management conditions change.

The results of this assessment will be available to all parties that are engaged in marine resource planning in the Pacific Northwest Marine Ecoregion. The Nature Conservancy will use the assessment results to prioritize conservation projects and funding allocations for this and neighboring ecoregions. Governments, land trusts, and others are encouraged to use the results of this assessment to guide conservation strategies within the ecoregion.

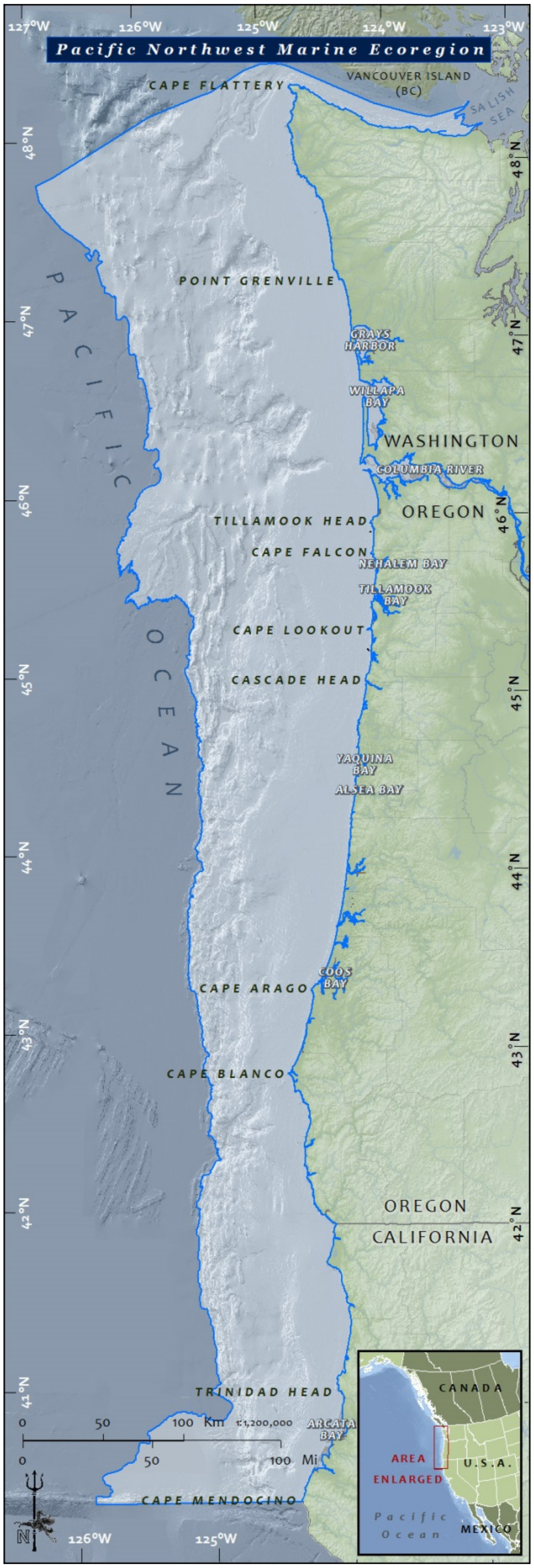

Figure 1. Map of PNW Marine Ecoregion

This report and most of the data (with metadata) are available from The Nature Conservancy, and is also available online (http://east.tnc.org/).

1.3 Ecoregion Overview

Marine ecoregions were developed to improve upon existing global classification systems (Spalding et al. 2007). Ecoregions are strong, cohesive mapping units and encompass ecological or life history processes for most sedentary species. Marine ecoregions are defined by Spalding et al. (2007) as "areas of relatively homogeneous species composition, clearly distinct from adjacent systems. The species composition is likely to be determined by the predominance of a small number of ecosystems and/or a distinct suite of oceanographic or topographic features. The dominant biogeographic forcing agents defining the marine ecoregions vary from location to location but may include isolation, upwelling, nutrient inputs, freshwater influx, temperature regimes, exposure, sediments, currents and bathymetric or coastal complexity". Some ecoregions may have endemic species but this is not a requirement (Spalding et al. 2007). The north-south boundaries of ecoregions are diffuse and somewhat dynamic in time and space, responding to long-term variability in climate and oceanography (TNC 2006).

There are 232 ecoregions in the world that cover coastal and shelf waters. This assessment lies within the Temperate Northern Pacific Realm, the Cold Temperate Northeast Pacific Province (No. 10), and is officially named the 'Oregon, Washington, Vancouver Coast and Shelf Ecoregion' (No. 57). In this assessment, we refer to this ecoregion as the PNW Marine Ecoregion to distinguish it from the PNW Coast Ecoregional Assessment that was published in August 2006. One of three ecoregions in the California Current Ecosystem, the entire ecoregion extends from Cape Scott, British Columbia, Canada to Cape Mendocino, California, USA.

1.3.1 Geographic Setting

The PNW Marine Ecoregional assessment area extends from Cape Flattery, WA (48.392° N, 124.736° W) south to Cape Mendocino, CA (40.44 ° N, 124.405° W), including the Juan de Fuca Strait to 123.133° W at Dungeness Spit. The assessment boundary begins at the higher high water mark, including tidal estuaries, and extends seaward to the toe of the continental slope (~ 2,500 m depth). This assessment covers only the portion of the ecoregion in US territorial waters; a Canadian ecoregional assessment is being conducted by the British Columbia Marine Conservation Analysis project (BCMCA 2009). The eastern boundary of the assessment area overlaps with the westernmost boundary of the Pacific Northwest Coast Ecoregional Assessment (Vander Schaaf et al. 2006) that included all shoreline, estuarine, and offshore areas to 10 meters deep. The southern boundary overlaps with the northern boundary of the 'Northern California Ecoregional Assessment', whose northern boundary is just above Point St. George (42.348° N, 124.375°W) which approximates the Oregon/California border (TNC 2006).

The PNW Marine Ecoregion encompasses over 1239 km of the shoreline (WA 449 km + OR 584 km + CA 205 km), with 60 freshwater rivers and streams creating estuaries that vary in size from a few hectares to over 46,596 hectares in the Columbia River.

The geology of the ecoregion is comprised of rocks of both continental and oceanic origin, with volcanic material forming ~ 65 million years ago. The headlands and offshore intertidal reefs were formed 37 to 12 million years ago and beginning 1.5 million years ago, glaciers deposited geological thick unconsolidated sand and gravel along the coast as they melted and retreated, and increased elevation from the isostatic uplift, for example Olympic Peninsula (Strickland and Chasan 1989). Glaciers reached their maximal southward extent in the northern third of Washington State.

The ecoregion is geologically active as the Juan de Fuca plate slides under the North America plate. The submarine plate activities create thermal vents, especially in canyons and along the shelf-slope break, and spawn regular earthquakes that can generate tsunamis that have the potential to alter coastlines and estuaries.

The physical characteristics of this ecoregion are dominated by the continental shelf, a relatively shallow, flat submerged portion of the North American continent extending to a depth of ~200 m (~660 ft). In Washington, the continental shelf varies in width between 25-60 km which is slightly narrower than in Oregon and Northern California where the shelf is 20-96 km wide. The western boundary of the continental shelf ends at the shelf-slope break, a region with relatively high primary and secondary productivity. Seaward of the shelf-slope break, the depth increases quickly forming the continental slope and at the base, or toe of the slope, is the western boundary of the PNW Marine Ecoregion assessment area. The shelf-slope break and continental slope region contains several large submarine canyons, most of whom have not been explored fully but are known to contain a rich diversity of marine life. Beyond the slope and outside the assessment boundary lie the deep abyssal oceanic waters that contain several oceanographic features including the Thompson and President Jackson Seamounts, Gorda Ridge and the terminus of the Cape Mendocino Ridge.

There are eight submarine canyons in the ecoregion: five in Washington, two in Oregon and one in northern California (Map 1). In Washington, the five prominent submarine canyons are Juan de Fuca, Quinault, Grays, Guide, and Willapa Canyons. In Oregon, there are two canyons: Astoria and Rogue Canyons. Astoria Canyon is very large, approximately 120 km (75 miles) long, beginning at 100 m depth, 18 km (10 miles) west of the Columbia River and descending to 2,085 m depth (6,840 ft). The Rogue Canyon is much smaller but also feeds directly down the continental slope onto the deep ocean floor (Department of Land Conservation and Development [DLCD] 1985). The seafloor descends sharply to meet the Cascadia Basin some 2,000 meters below. The upper slope is characterized by gently sloping benches and low-relief hills. Blocks of rocky material, probably hard mudstone, have been rapidly uplifted by the underthrusting oceanic plate and the building of an accretionary wedge at the bottom of the slope. Sediments have accumulated behind these blocks to form the Cascade Bench off the north coast and the Klamath Bench off the south coast and northern California. The lower slope below 2,000 meters is quite steep and intersects the deep-sea bed of the Cascadia Basin at 2,200 meters off the north coast and 3,000 meters off the central and south coast. There is one submarine canyon in the ecoregion boundary within northern California, Eel River Canyon, just north of Cape Mendocino.

In addition to submarine canyons, the continental shelf has four prominent, rocky, submarine banks of varying sizes, all in Oregon: Nehalem Bank/Shale Pile, Newport Rockpile/Stonewall Bank, Heceta Bank, and Coquille Bank (Map 1). These offshore banks create locally shallow areas amidst the otherwise deeper water of the continental shelf and are basically broad, underwater seamounts that can be very large. For example, Heceta Bank is 16 km across from east to west by 25 km north by south (10 by 15 miles), and is at a depth of 60 – 120 m depth (180 – 360 ft). Seabirds and marine mammals can be found in these areas, including highly migratory species such as black-footed albatross (*Phoebastria nigripes*), sooty shearwaters (*Puffinus griseus*) and pink-footed shearwaters (*Puffinus* *creatopus*) (Ainley et al. 2005). Coastal upwelling and iregular topography of the seafloor bring food to the surface and make these banks attractive foraging grounds. For example, Heceta Bank is a valuable commercial fishing location in Oregon and was designated as Essential Fish Habitat in 2006 by NOAA, closing the area to bottom trawling to protect the demersal habitat (NOAA 2006).

1.3.2 Ecoregional Sections

The PNW marine ecoregion is bound together as a whole by its common processes that are defined by the California Current (see Section 1.3.3) and by the species whose collective ranges span its length. Within the ecoregion, however, there are several more or less distinct sections that the ecoregional assessment recognizes and uses in the analysis. The four sections that comprise the PNW Marine Ecoregion are separated from one another by prominent coastal headlands but the ecological distinctions of each section often extend far out to sea (Map 1). The sections and their area relative to the entire ecoregion are noted in Table 1. Brief descriptions of each section follow.

Table 1. Ecoregional Sections of the Pacific Northwest Marine Ecoregion

Section	Square Kilometers	% of Ecoregion
International Boundary – Point Grenville	17,897	18.28
Point Grenville – Cape Lookout	32,090	32.77
Cape Lookout – Cape Blanco	25,535	26.08
Cape Blanco – Cape Mendocino	22,403	22.88
Total	97,925	100

<u>International Boundary—Point Grenville Section</u>
The northern-most section that runs from the International Boundary and the Straits of Juan de Fuca to Point Grenville contains a rock-strewn rugged coastline that harbors upwelled waters resulting in enhanced productivity over a broad continental shelf. This section is also affected by freshwater flows through the Straits and contains several noteworthy submarine canyons at the shelf-slope break.

<u>Point Grenville—Cape Lookout Section</u>
On Washington's south coast, beginning at Point Grenville and running to Cape Lookout in Oregon, the distinguishing feature of this section is the sand dominated benthic habitats and sandy beaches formed by accretion of sediments originally derived from the Columbia River and transported by alongshore currents. The Columbia Plume is the defining factor for this section and is characterized by a lens of freshwater floating over the ocean, supporting diverse forage fish populations and huge numbers of predators.

<u>Cape Lookout—Cape Blanco Section</u>
The central Oregon coast section is noted for its offshore shallow banks which concentrate habitats sought by commercial fishermen. Sand continues to dominate the nearshore shelf habitats and sand dunes are prominent on shore.

Cape Blanco—Cape Mendocino Section

The southern section, running from Cape Blanco to Cape Mendocino, is noted for its narrow continental shelf and strong upwelling zones all along a rocky coastline. Cape Blanco is considered to be a defining headland where northerly and southerly distributions of species tend to divide; this is also where giant kelp *Macrocystis integrifolia* reaches its northern extent.

1.3.3 Oceanography

The ecology of the ecoregion is driven by ocean currents flowing across the shelf that vary in strength, direction, timing and depth. The PNW Marine Ecoregion is located within the California Current Ecosystem, an eastern boundary current on the west coast of North America that is one of the top five boundary current systems in the world. The California Current is a broad, south flowing current that originates along the west coast of Vancouver Island, Canada, at the terminus of the West Wind Drift and North Pacific Gyre, and flows uninterrupted for several thousand kilometers to Baja California, gradually dissipating and heading offshore. The strength of the California Current varies seasonally, flowing more strongly in summer than winter, and influences shelf habitats within 80 km (50 miles) of shore. In the winter, the California Current is countered by the Davidson Current that flows northward along Vancouver Island, as well as by other currents that flow beneath both of these surface currents (Hickey 1979). The spatial and temporal variability in sea temperature, salinity, oxygen and currents produces gradients across the continental shelf, increasing the overall productivity and species diversity.

Coastal upwelling is an important phenomenon within the California Current System because it generates an enormous amount of primary productivity. The coupling of the prevailing northwest winds and the clockwise spinning of the earth moves surface waters offshore, replacing warm, nutrient-poor surface waters with colder, nutrient-rich waters from depth (Hickey 1998). The upwelling phenomenon is strongest in spring and summer, and occurs as seasonal winds shift in direction from southeast to northwest. Dense phytoplankton blooms are supported by nutrients brought to the surface during coastal upwelling, followed by successive increases in zooplankton species, forage fish, fin fish and finally by top level predators that include marine mammals, seabirds, sharks and numerous fish species. As seasonal winds shift to the southeast in the fall and winter, upwelling is replaced by downwelling along the coast and the intense primary production of the coastal region slows down.

The regular annual cycles of upwelling fit into longer, multi-year climate cycles and contribute to the variability of productivity and species in the coastal ocean. Shifting ocean circulation patterns change sea surface temperatures across the equatorial Pacific Ocean, which in turn affect the temperate waters of North and South America. The El Nino Southern Oscillation (ENSO) is a complex oceanographic pattern that occurs every five to seven years that causes warm water to pool in the eastern Pacific Ocean and results in changes in the distribution and depth of the thermocline and associated species that feed higher trophic levels. During El Nino events, warmer waters are found at the surface and the thermocline is very deep. During La Nina events, cooler waters are near the surface and the thermocline is much shallower, causing dramatic changes in the distribution of important species guilds such as copepods that feed many other fishes (Peterson and Keister, 2003). Even longer duration climate patterns occur over decades in the North Pacific, termed the Pacific Decadal Oscillation, and can also dramatically affect fish species including Pacific salmon (*Oncorhynchus* spp.) as the region flip-flops between cold and warm temperature regimes (Mantua et al 1997). The complexity and periodicity of these cycles are only recently beginning to be understood with the realization that the Pacific Ocean is more dynamic than we had believed making predictions of abundances of important species even more challenging.

Sea conditions on the shelf and coastal storms alter coastal estuaries and shorelines, as well as create hazards to navigation. The prevailing winds and relatively shallow depth of the inner shelf can generate extremely heavy sea conditions, with wave heights reaching 15-29 m during winter storms (Strickland and Chasan 1989). Statistics for the intensity of 100 year storms suggest that they generate 176 km/h winds (95 knots) and wave heights of 20 m, sometimes reaching 36 m. All harbor mouths in Washington and Oregon can be hazardous for shipping because of steep or breaking waves caused by shoaling, and by strong outgoing river currents against incoming ocean waves. The entrance to the Columbia River is known for its dangerous passage as there are exceptionally strong wave and current interactions in this location. Much less frequently, tsunamis, or long-period sea waves, are produced by submarine earthquakes or volcanic eruptions and generally travel unnoticed across the ocean for thousands of kilometers until reaching shallow waters where they build up great height. Tsunamis have hit the west coast as recently as 1964 causing significant damage to harbors and having the potential to reset estuary and coastal processes at a coast-wide scale.

1.3.4 Marine habitats

The Pacific Northwest Marine Ecoregion is characterized by high annual precipitation that contributes to a large volume of freshwater flowing into the nearshore marine environment from the Columbia River as well as scores of other rivers from the Olympic and Coast Mountains and Cascade Range. The Columbia River alone accounts for 77% of the freshwater input north of San Francisco and south of the Strait of Juan de Fuca, resulting in the Columbia Plume which is one of the most prominent ecological features in the ecoregion (Hickey et al 2005). The lens of freshwater from the Columbia Plume stretches north along the Washington shelf in the winter and to the south during summer but it is also frequently bi-directional having profound effects on productivity in the ocean. These freshwater flows carry terrestrial nutrients and sediments to nearshore habitats and locally alter the salinity profile in the ocean. The carbon and nitrogen inputs from these freshwater flows enhance kelp forest communities, invertebrate populations and cascade through the food web.

Bays and estuaries are important ecological features in this ecoregion and there are many within the assessment boundary, including Grays Harbor, Willapa Bay, Lower Columbia River estuary, Tillamook Bay, Coos Bay and Humboldt Bay, as well as numerous smaller estuaries. Bays and estuaries offer transitional habitats between freshwater and marine environments and are critical rearing habitats for diadromous fishes, such as Pacific salmon and lamprey, foraging habitat for migrating shorebirds and waterfowl, and spawning/rearing habitat for crabs, sharks, Pacific herring (*Clupea pallasii*) and Pacific halibut (*Hippoglossus stenolepis*).

Along the coastline, sand beaches provide important foraging habitat for migratory shorebirds, and resting habitat for marine mammals. Southern Washington and much of Oregon have extensive sand beaches that are separated by rocky headlands and estuaries. North of Point Grenville, Washington, and south of Coos Bay, Oregon, the coastline is punctuated with more rocky intertidal areas, rock cliffs and offshore rocks. Hundreds of seastacks, rock islets and rock islands provide critical nesting habitat for the region's native seabird species and migratory stopover locations for species that feed in the intertidal. In Washington, 300,000 - 423,000 nesting birds from 18 species breed in 440 nesting areas (Speich and Wahl 1989). In Oregon, approximately1.3 million seabirds breed on 393 known islands. The vast majority of the remaining viable seabird colonies are within the National Wildlife Refuges in Washington and Oregon. The largest colony in Oregon is at Three Arch Rocks National Wildlife Refuge, with over 225,000 seabirds from 10 species nesting in this one location (Naughton et al. 2007). The largest colonies in Washington are in the Quillayute Needles National Wildlife Refuge. In California, the offshore rocks are managed by the Bureau of Land Management (Strickland and Chasan 1989) and also have concentrations of nesting seabird colonies. Seastacks and rock islands also provide haul out and rookeries for marine mammals, including two species of sea lions, harbor seals and migrating northern elephant seals (*Mirounga angustirostris*).

Beyond the surf zone, continental shelf and slope ecosystems form some of the richest marine ecosystems in the world because of the coastal upwelling and the variety of habitat types that support hundreds of different species of plants and animals. Broad areas of the continental shelf covered by soft substrates are found at all depths and are broken up by rocky reef complexes that are made up of hard rock, gravels, cobbles and rock pinnacles. The sandy substrate habitats support rich shellfish populations, including Dungeness crabs and clams. As described previously, submarine canyons and underwater banks form distinctive habitats that support populations of fish species that are keyed into unique habitat characteristics. Nearshore, shallow marine habitats of less than 40 m are inhabited by a diversity of species, including marine invertebrates, plants, fish, mammals and birds that are all residing in or forage within the photic zone. These habitats can be very exposed to prevailing winds and seas, and may be occupied by species especially adapted to this type of high energy sites. Nearshore habitats can be important foraging and migratory corridors for cetaceans and pinnipeds, including the eastern population of gray whales and humpback whales. At depths ranging to 1200 m or more, diverse long-lived rockfish species inhabit sandy and rocky habitats and have created valuable, active commercial and tribal fisheries. Beyond the continental shelf at 200 m or more, the shelf-slope break occurs and depth increases rapidly. Here, pelagic and bathypelagic predators inhabit frontal areas created by bottom currents and topography. The continental slope continues to depths beyond current commercial fishing operations and the combinations of pressure, low oxygen, decreased light and low temperatures have resulted in an entirely different suite of marine species especially adapted to this unique environment. Finally, along the toe of the continental slope where the ecoregion graduates into the abyssal plain, our thin knowledge becomes exceedingly minimal and can best be characterized as random snapshots in a world of darkness.

1.3.5 Socioeconomic setting

Ocean resources are an integral part of the coastal economy in all three states within the ecoregion. The entire ecoregion is used extensively for recreational and commercial fishing for more than 100 species of groundfish such as Pacific halibut and Dover sole (*Microstomus pacificus*), midwater species including pink shrimp and pacific whiting (hake), and pelagic species such as albacore tuna, herring, sardine and Pacific salmon. The ecoregion's rich productivity supports, or has supported local communities that in some cases are highly dependent upon fisheries-based industries. For example, nearly 11% of personal income in Clatsop County, Oregon, came from fishing in 2003 (Swedeen et al 2008), which suggests that personal incomes in port towns like Warrenton, Oregon likely have an even higher reliance on fishing- related work than the County average. Shellfish aquaculture is important in several areas along the coast including Willapa, Tillamook, Coos and Humboldt Bays. Finally, coastal recreation is highly dependent upon the ocean and shorelines with relaxing and beachwalking listed as the most popular activities in Oregon coastal state parks (Shelby and Tokarczyk 2002).

There is a growing awareness of the ocean and coastal ecosystems as a source of natural capital that provides substantial benefits to coastal communities above and beyond the natural resources that are extracted from them (Swedeen et al 2008). The natural capital view of the marine ecoregion broadens our view of the values derived from the ocean and includes the fisheries resources that are extracted from the sea as well as other services that human communities depend on but might not put a monetary value to. These include regulating services (climate, water cycling and waste decomposition); supporting services for ecosystem function (primary productivity, nutrient cycling); and cultural services (spiritual, recreation, education and experiential learning). While it is difficult to quantify and beyond the scope of this conservation assessment, the ecoregion is important to human communities for a wide variety of goods and services, some of which are not commercially exploited.

In Washington there are four coastal tribal nations that have used these marine waters for many generations and occupy tribal village sites along the coast that have been in continuous use for at least 10,000 years. The Washington tribes are the Quinault Nation, Hoh Tribe, Quileute Tribe and Makah Nation. The coastal tribes in Oregon and Northern California also have close connections to the ocean but do not have the same treaty rights to marine resources that the Washington tribes do and hence, are less involved in the ongoing use and management of fisheries. Tribal cultural connections to the ecoregion, especially in the Usual and Accustomed Areas, are essential to the affected tribes and must be considered when developing comprehensive conservation strategies for the marine ecoregion.

Commercial fisheries occur within state and adjacent federal waters, and are mostly limited to a maximum of 1200 m depth. Commercial fisheries in federal waters are regulated by NOAA and managed in this ecoregion by the Pacific Fisheries Management Council, and include hook and line for salmon, demersal and midwater trawl for groundfish and rockfish, longline for halibut and rockfish, traps for crabs, prawns and black cod (sablefish), and divers for geoducks. In state waters, commercial fisheries are managed by state agencies and include gillnets for salmon, traps for crabs and prawns, and diving for geoduck; trawling is prohibited Washington State waters but allowed in Oregon and California. The NOAA National Marine Fisheries Service's (NOAA Fisheries Service) Northwest Region manages groundfish, halibut and salmon on the west coast, including groundfish Essential Fish Habitat. The NOAA Fisheries Service Southwest Region manages coastal pelagic species and highly migratory species such as tuna, sardine and anchovy.

Catch limits for the 90+ species of fish in the West Coast groundfish fishery are managed by NOAA's Northwest Region, with advice from the Pacific Fisheries Management Council, one of eight regional fishery management councils established by the Magnuson Fishery Conservation and Management Act of 1976. Pacific halibut is unique among the fished species on the west coast, as it is managed by the United States and Canada in a bilateral commission called the International Pacific Halibut Commission (IPHC). Every year, the IPHC sets total allowable catch limits for halibut caught in U.S. and Canadian territorial waters, with all U.S. waters off Washington, Oregon and California managed in one zone (2A). The Pacific Fishery Management Council describes the annual halibut catch division each year in a catch-sharing plan. The treaty tribes usually adopt Council and NOAA decisions.

The number of fishing vessels engaged in the west coast fisheries varies by year but averages 3800-4000 (National Oceanic and Atmospheric Administration [NOAA] 2006). There are approximately 1200-1500 in the groundfish fishery, 1200-1400 in crab fisheries, and 215-330 in shrimp fisheries.

There are several major commercial ports of call in the ecoregion: Grays Harbor, Astoria, Newport, Coos Bay, and Crescent City, as well as a number of smaller ports that serve commercial and recreational fishing fleets. These ports support commercial vessels operating in coastal waters as well as north to Canada and farther offshore. Port development activities include dredging and disposal that can be significant sources of pollution and increased sedimentation in nearshore waters; ports are also proponents of increased shipping trade that has recently involved proposals for new Liquified Natural Gas (LNG) terminals in several sites.

Coastal tourism and recreation is an important economic driver in the ecoregion, with vacationing, surfing, beach walking, bird watching and storm watching among the popular recreational activities. The tourism industry directly and indirectly supports many small, coastal communities and is on a par with fishing in terms of sources of personal income in Oregon coastal counties (Swedeen 2008).

A potentially significant economic driver that is just beginning to be realized in the ecoregion is renewable energy production. Several promising technologies are being readied for deployment along the Oregon coast to harness wave energy and convert it to electrical power. There is huge potential to capture energy in the nearshore ocean, but the placement of the facilities is not without potential impacts to marine habitats and to other current human users in these locations (Oregon Wave Energy Trust 2010).

1.4 Planning Process

This assessment used an approach developed by The Nature Conservancy (Groves et al. 2000) and other scientists to establish conservation priorities within ecoregions, the boundaries of which are defined by their distinct habitats and native species. This report documents the assessment process, including the steps taken to design conservation scenarios for the ecoregion. It also presents a comprehensive, ecoregion-wide analysis that identifies and prioritizes places of conservation importance.

This ecoregional assessment was led by a small, core team in Oregon and Washington that was responsible for determining the basic direction of the assessment process, setting timelines for work products, and maintaining progress towards the completion of the assessment. The core team oversaw geographic information systems (GIS) and data management aspects of the assessment, including review and guidance from estuarine, coastal and marine experts.

The identification of conservation areas at the ecoregion scale in this ecoregional assessment follows steps detailed elsewhere (Groves et al. 2000, 2002) and include: (1) identify and select conservation targets; (2) assemble and compile spatial data; (3) set goals for conservation targets, (4) create a cost (suitability) index; (5) generate draft analyses; and (6) refine the draft analyses through expert review. Conservation targets are species and habitats that characterize the biological diversity of the ecoregion. The conservation goals for the targets are levels of conservation that would protect the targets for a 50-100 year period; goals can be expressed either as numbers of individuals or as an overall percent area of the habitat in a protected status.

As in previous ecoregional assessments, we used a freely available computer-driven optimization program developed specifically for conservation site selection called Marxan (Ball and Possingham 2000), was used to identify a set of sites that meet the conservation goals set for targets at the lowest "cost". In Marxan, cost is defined by the smallest overall area of the selected sites and is represented by a suite of economic, social and environmental factors that may impact the ability to provide effective conservation in selected areas. Cost is minimized by selecting the sites rated as most suitable for long-term conservation that nevertheless met conservation goals. Site suitability was calculated using an index of existing management status, human use, and proximity to potential impacts. Marxan compares each unit of assessment in the ecoregion against all others and analyzes millions of possible site combinations to select the most efficient set of conservation areas. Marxan outputs are also used to generate maps that depict the relative conservation importance of a particular location across the ecoregion. In the Pacific Northwest Marine Ecoregional Assessment we chose to develop and identify several conservation scenarios based on Marxan products to show 1) the relative conservation value of different areas of the ecoregion without regard for site suitability, and 2) relative conservation values that took into account the overall suitability of the areas. It is hoped that these analyses and products will allow for and promote continued dialogue between stakeholders in the ecoregion to advance conservation in a meaningful manner with strategies that reflect the needs of species and local communities.

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Chapter 2 – Ecoregional Conservation Targets and Goals

Conservation targets are selected to represent the full range of biodiversity in an ecoregion, and to capture any elements of special concern. They include animals, plants, natural communities, habitat types and ecological processes. Since thousands of species may be present in an ecoregion, the first challenge is to select a subset of targets, at multiple scales, to represent biological diversity over an entire ecoregion. In this assessment, we used the criteria developed by The Nature Conservancy (Groves et al. 2000) to create our target list. The concept of coarse-filter and fine-filter conservation targets hypothesizes that conserving multiple examples of all communities and ecological systems - coarse-filter targets - will also conserve the majority of species that occupy them – fine filter targets. This method of using coarse-filter targets attempts to compensate for the lack of detailed spatial information on the vast number of poorly-studied marine invertebrates, plants and animals that lack adequate spatial location information. Where spatial data are available for a species over the entire ecoregion, a fine-filter target is chosen if it satisfies at least one of several criteria:

- A species is rare or declining;
- A species is a keystone species;
- A species is a focal species, that is wide-ranging, of high ecological importance or sensitive to human disturbance; and
- The majority of a species reproductive or feeding range occurs in this ecoregion.

Benthic, shoreline, and estuarine habitats, as well as coastal upwelling and primary productivity, were all chosen to represent coarse scale ecological systems and processes present on the continental shelf within the Northern California Current. Fine-filter targets were selected if their global rank (G rank) indicated they were imperiled, if they were federally listed as threatened or endangered under the U.S. Endangered Species Act, or if we considered them a species of special concern, such as state listed, declining, endemic, disjunct, vulnerable, keystone, or wide-ranging species (Groves et al. 2000). Team members developed an initial list and then invited regional experts to identify omissions and errors.

An initial list of conservation targets included those from the Pacific Northwest Coast Ecoregional Assessment (Vander Schaaf et al 2006), which were compiled by a graduate student from Oregon State University (Robison 2002). We annotated the list to include offshore and other species or habitats based on expert opinion and peer review. In total, we identified 358 targets, of those spatial occurrence data were available for 237 targets that were used in the Marxan analysis. The final list of targets is contained in Appendix 1. Table 2 displays the breakdown of conservation targets by target group and notes the numbers of targets that had sufficient data to be used in the analysis.

Table 2. Conservation Targets in the PNW Marine Ecoregional Assessment

Type	Target Group	Target Type	Total number of targets*	Total number of species or types as targets	Total number of species or types in analysis
Coarse Filter	Benthic habitats	Benthic habitats	64	54	54
	Shoreline	Shoreline habitats	51	41	41
	Estuaries	Estuarine habitats	24	19	19
	Special habitats	Submarine canyon walls	1	1	1
		Upwelling (SST)	1	1	1
		Chlorophyll a	2	2	2
		Islands	2	1	2
		Kelp communities	1	1	1
		Rocky reefs	1	1	1
Fine Filter	Species (invertebrates)	Native oysters	1	1	1
		Other Invertebrates	20	20	0
		Deepwater Corals & Sponges	15	8	15
	Species (plants)	Marine plant or algae species	15	15	0
	Species (fish)	Fish	60	46	60
	Species (mammals)	Marine mammals: migratory	12	12	0
		Marine mammals: haul-outs	4	4	4
		Stellar sea lion Rookeries	1	1	1
	Species (birds)	Snowy plover: nest sites	1	1	1
		Seabirds: colonies	30	15	30
		Seabirds: migratory	49	47	0

	Listed species Critical Habitats	Orca critical habitat	1	1	1
		Steller sea lion critical habitat	1	1	1
		Snowy plover critical habitat	1	1	1
			358	294	237

*may include species represented both by presence and abundance data. See Section 2.2 for more information

2.1 Coarse Filter Targets

2.1.1 Benthic habitats

Benthic habitats are one of the primary coarse filter target datasets that are extremely important in the analysis as they are intended to represent the many marine species which live within the sediments, have a sedentary existence on the rocks or soft bottom habitats or are demersal species that swim within a few meters of the bottom. The benthic habitat layer is a combination of three physical variables: bathymetry (depth), lithology (substrate) and geomorphology. Bathymetry data were downloaded from the National Ocean Services (NOS) Hydrographic Data Base website. Hydrographic data provide background data for engineers, scientific, and other commercial and industrial activities and primarily consist of water depths, but also include features (e.g. rocks, wrecks), shoreline identification, and bottom type information (National Ocean Services [NOS] 2009). The NOS data were provided in a 30 x 30 m grid. Substrate data were obtained from the Active Tectonics and Seafloor mapping lab at Oregon State University (Romsos et al. 2007), with additional data from the Center for Habitat Studies, Moss Landing Marine Laboratories (Greene et al. 2004). Additional substrate data were developed under contract with the OSU mapping lab using historical NOS smooth sheet charts to update the benthic substrate data in Oregon and Washington state waters.

The four bathymetric classes used in our assessment were inner shelf (nearshore-shallow: 0-40 m), mid shelf (continental shelf: 40-200m), mesobenthal (upper continental slope: 200-700 m) and bathybenthal (lower to toe of continental slope: 700-3500 m) (adapted from Greene et al. 2004). The four geomorphology types developed by OSU and used in the assessment were flats, canyon, ridge and middle slope. The five substrate or lithology classifications used in the assessment were “soft”, mud, sand, gravel, and rock.

The benthic habitat classification and mapping was developed exclusively by the Conservancy for use in this assessment (D. Kelly, personal communication). The technique uses a moving window analysis to identify polygons of similar geomorphology and substrate characteristics within a depth class. Occurrences within a very small area (<1ha) were omitted as were any potential benthic habitat classes (based on all possible combinations) that occupied less that 10 ha within an ecological section. The analysis resulted in 64 benthic habitat classes that formed a continuous habitat map for the ecoregion (Map 2).

Recently, high resolution surveys of nearshore benthic habitats using multi beam and side scan sonar have been taking place in state waters in selected areas. Initially these detailed surveys were primarily focused on research but their broader utility and importance for ecosystem-based management has been recognized for a number of other uses. For example, in Oregon, high resolution surveys have been conducted at Heceta Banks and at most of the newly designated and proposed marine reserves. In Washington waters, similar surveys have been conducted within the Olympic Coast National Marine Sanctuary. These surveys, when completed across the continental shelf along the Pacific Northwest coast will significantly improve the benthic habitat characterization for the ecoregion and will strengthen future assessments here.

2.1.2 Shoreline habitats

Shoreline habitats were mapped along the ecoregion's coastline during several different statewide projects. The shoreline data layer used in the analysis was a combination of two environmental attributes - dominant geological substrate and exposure - because coastal intertidal community structure is strongly influenced by both substrate type and wave energy. For example, vastly different kelp species inhabit low vs. high energy sites, *Fucus* vs. *Postelsia,* respectively, soft vs. hard substrates, *Laminaria* vs. *Nereocystis*, respectively (Kozloff 1983). The substrate data were downloaded from the Shorezone project (Washington Department of Fish and Wildlife and Washington Department of Natural Resources), and the NOAA Environmental Sensitivity Index (ESI). Shorezone is the more recent habitat mapping project aimed at collecting comprehensive data to classify shoreline habitats via videography and onboard scientists using a helicopter based platform. The ESI index chose the dominant coastline type using a more simplistic system of parameters primarily for the purpose of assisting in oil spill response on the outer coast. The geological categories for shoreline substrate were organics/fines, mud flat, sand beach, sand flat, sand and gravel beach, gravel beach, rock with sand beach, rock with sand/gravel beach, rock with gravel beach, rock platform, rocky shore/cliff, and undefined. The "man-made" category for substrate was omitted from the analysis with no goal being set for this habitat type. The exposure categories were modeled for Washington state (Berry et al. 2000) and were manually edited for Oregon and California coastlines with the categories being, from least to most exposure: very protected (VP), protected (P), exposed (E), very exposed (VE). In all, there were 51 unique combinations of shoreline habitats used in this assessment.

2.1.3 Estuarine habitats

Estuarine habitats were defined in this assessment as a combination of geological substrate and vegetation types within the intertidal range. There were a total of 24 estuarine habitats classified for the assessment with no deep water, subtidal habitats included among them (Map 4). The habitat types were derived from State efforts in estuary habitat mapping and were crosswalked to a common classification. Similar data were also used in the Pacific Northwest Coast Ecoregional Assessment (Vander Schaaf et al 2006) and updated for this assessment.

2.1.4 Kelp communities

Kelp community data were obtained from previous ecoregional assessments, namely the Pacific Northwest Coast Ecoregional Assessment (Vander Schaaf et al 2006) for Washington and Oregon, and the Northern California Marine Ecoregional Assessment (TNC 2006). For purposes of this assessment, kelp is defined as macroalgae beds which are almost entirely *Nereocystis luetkeana*, commonly known as bull kelp in the Pacific Northwest. The spatial extent of kelp beds varies quite extensively from year to year so we used the greatest extent portrayed at any given location over all the years that kelp was surveyed (Map 4).

2.1.5 Nearshore rocky reefs

Nearshore rocky reefs are important habitats for a wide diversity of marine species that depend on hard substrates and associated organisms either for reproduction, growth or during migration. These complex habitats support long-lived species such as rockfish (*Sebastes* spp.) that are prominent in the diverse assemblage of fishes in the ecoregion as well as offer substrate for deepwater corals and sponges that provide food and shelter for other rocky reef animals. The rocky reef habitat data were derived from benthic substrate layers that were compiled from multiple data sources (see above Section 2.1.1) and include several distinct benthic habitat types, distinguished by depth and location on the shelf.

2.1.6 Submarine canyon walls

Deepwater canyons are biologically rich areas on the continental shelf and slope with the high vertical relief that provides unique and varied habitats for both sessile and mobile marine animals as well as marine algae. Canyon walls are especially important for deepwater corals and sponge populations that are recognized as important structure forming biogenic features in temperate seas worldwide. Results from The Nature Conservancy's peer review workshops, held in January 2009 (Newport, Oregon) and March 2009 (Seattle, Washington), also revealed that canyon walls were important hotspots for marine biodiversity and thus they were added as a separate conservation target in this assessment.

The canyon wall data layer was created from bathymetry and geomorphology data used in the benthic habitat characterization (section 2.1.1); the bottom of the canyons were removed from the created data layer as peer review identified that the canyon walls were the most important feature in conserving biodiversity.

2.1.7 Upwelling

Coastal upwelling zones are some of the most productive ecosystems in the world and home to some of the world's largest fisheries (Chan et al. 2008). As explained earlier in Section 1.3.3, coastal upwelling occurs on continental shelf habitats with eastern boundary currents and is a driver for very high productivity and species diversity. The California Current is one of five major upwelling zones in the world and is considered third in overall productivity behind the Humboldt Current (Peru) and the Benguela-Canary Current (Africa) (Carr and Kearns 2003).

Remotely collected sea surface temperatures (SST) were used by The Conservancy to map the relative strength of coastal upwelling during summer months across the entire ecoregion. Data were obtained from the AVHRR (Advanced Very High Resolution Radiometer) satellite online database for the years 1998-2004. In this assessment, we assessed relative strength of the upwelling by mapping the difference by one standard deviation of the monthly mean SST values. To analyze and display data for this conservation target, first we visually inspected AVHRR data to remove aberrant values from the daily temperature values; aberrant refers to anomalously high values that may have been influenced by cloudy days. Then, we calculated a grand mean ± one standard deviation for monthly SST values for all cloud-free days from June 1 – August 31 over the 6-year period. Across the entire ecoregion sea surface temperatures ranged between 7° and 20.5° C for these months. The grand mean value was 14.5 ° ± 1.54° C for 1 Standard Deviation and the resulting spatially explicit deviation was mapped to show where upwelling was strongest, relative to other locations in the ecoregion (Map 4); the shapefile produced in this effort was used as the data source for the analysis.

2.1.8 Chlorophyll-a (primary productivity)

Chlorophyll-a concentration is an excellent measure of primary productivity in the marine environment. Primary productivity is the basis of the marine food chain and represents marine plants, algae and bacteria growing in the photic zone, between 0-200 m in depth. The concentration of chlorophyll increases with increasing concentrations of these diverse species known collectively as phytoplankton. The plant pigment concentration levels can be quantified from satellite observation using ocean color sensors because, in most of the world's oceans, color in the visible light region (wavelengths of 400-700 nm) varies with the concentration of chlorophyll and other plant pigments present in the water.

Chlorophyll data were obtained from the Sea-viewing Wide Field-of-View Sensor (SeaWiFS) Project, a NASA Earth-orbiting sensor that gathers remote-sensing imagery for ocean color (NASA Goddard Space Flight Center, Maryland). Monthly chlorophyll-a data were downloaded for all cloud-free days in June - September, 1998-2005. A shapefile was created of the standard deviations from the mean monthly chlorophyll-a values showing where above average primary productivity was occurring. Two conservation targets were developed from the data, one representing >2 standard deviations and one representing 1-2 standard deviations from the normal value (Map 4).

2.2 Fine Filter Targets

2.2.1 Seabirds and Shorebirds

This ecoregion has a rich diversity of breeding seabirds, with most breeding on offshore rocky islands and pinnacles along the coast. Seabirds breeding in the ecoregion belong to one of three orders (Procellariiformes, Pelecaniformes, Charadriiformes) and include 18 species (United States Fish and Wildlife Service [USFWS] 2005). There are also upwards to 50 species of seabirds that migrate through the ecoregion or utilize the continental shelf for foraging (ibid) and 40 or more species of shorebirds that utilize ocean shores and estuaries (Rintoul et al 2006; USFWS 2000). For the PNW Marine Ecoregion assessment, 16 bird species were analyzed as conservation targets including Western snowy plover, a federally Threatened shorebird that nests on sand beaches in the ecoregion.

Seabird nesting colonies were selected as the species location information used in the analysis (Map 3). Seabird colony information was obtained from the Catalog of Washington Seabird Colonies (Speich and Wahl 1989), Oregon seabird colony catalog (Naughton et al 2007) and the Northern California Marine Ecoregional Assessment (TNC 2006).

2.2.2 Marine Mammals

Marine mammals represent a diverse group of animals in the PNW marine ecoregion that utilize essentially all of habitats present there. Some prominent species such as gray whales make regular migrations through the entire ecoregion, while other species such as harbor seals are permanent residents. The target list (Table 2) reflects the important marine mammal species present in the ecoregion (Rintoul et al. 2006, Robison 2002) but the analysis was limited to those species that breed or regularly haul out at coastal sites and islands. Marine mammal breeding and non-breeding haul out site locations were obtained from the NOAA Marine Mammal Laboratory and State data sources for four species: Steller and California sea lions, harbor seals and Northern elephant seals. Haul out sites were distinguished from nursery or pupping sites and different conservation goals set for each type of site (Map 3).

Sea otters, represented in the ecoregion by two subspecies, Southern sea otter *Enhydras lutris nereis* and Northern sea otter *Enhydras lutris kenyoni,* have been successfully transplanted to the Washington coast north of Point Grenville over the past 20 years. There are no extant populations in Oregon or Northern California although individual animals are reported there on an occasional basis. The species is a conservation target in the assessment but sufficient location data were not available for the analysis.

2.2.3 Groundfish

NOAA Fisheries trawl survey data were used for the spatial locations of finfish and other invertebrate species identified as conservation targets (see also section 2.2.7 Deepwater corals and sponges). The trawl survey data have been collected since the 1970s and has resulted in an extensive dataset that includes over 1000 species locations using a randomized pattern and bottom trawl gear. This assessment initially identified 60 fish species as conservation targets of which 46species had sufficient occurrences in the trawl survey datasets. 14species were represented in at least 10% of the trawl samples such that abundance data or catch per unit effort (CPUE) on an area basis could be developed and used in the analysis as well. Map 3 portrays two of the fish targets, Widow rockfish *Sebastes entomelas* a rockfish and Pacific sanddab *Citharichthys sordidus* a flatfish, to show representative distributions across the ecoregion. A complete description of the groundfish analysis methods used as well as species distribution maps is available in a separate report (Bailey and Ferdana 2007).

2.2.4 Snowy plover

Snowy plovers are listed as Endangered under the Endangered Species Act (ESA) in the United States. In the ecoregion they nest on sand beaches on the outer coast. Data for the locations of known nesting sites were obtained from Natural Heritage Program databases and were used in the analysis for this assessment. Map 3 portrays snowy plover nesting locations in the ecoregion. Critical habitat data was used to develop an additional separate conservation target, as detailed in the USFWS recovery plan for Snowy plover (USFWS 2001).

2.2.5 Orca critical habitat

Critical marine habitat for resident Orcas or killer whales (*Orcinus orca)* was included as a conservation target. In Washington, the “J”, “K”, and “L” pods are three distinct resident Orca groups living in Puget Sound and coastal waters that are currently listed as Endangered under ESA because of their small population size, threats from contaminants and changes in their food supply (National Marine Fisheries Service [NMFS] 2008). Data were obtained from the NOAA Marine Mammal Laboratory (Alaska Fisheries Science Center, Seattle WA). The critical habitat identified in the southern resident killer whale recovery plan (NMFS 2008) that was applicable to this ecoregional assessment was restricted to waters in the Strait of Juan de Fuca.

2.2.6 Steller sea lion critical habitat

Steller sea lions (*Eumetopias jubatus)* that breed in the eastern Gulf of Alaska are listed as Threatened under the ESA because of dramatic reductions in the local breeding population and slow recovery in the last ten years (NMFS 2008). Within the ecoregion, critical marine habitat for Steller sea lions was identified as those locations or habitats where animals haul out and/or are supported during their north/south migration. Data were obtained from the NOAA Marine Mammal Laboratory (Alaska Fisheries Science Center, Seattle WA).

2.2.7 Deepwater coral and sponges

Deepwater corals and sponges provide biogenic habitat in deepwater environments, supporting many other species including fish and invertebrates. Deepwater glass sponges (Family Hexactinellidae) grow in aggregations on rocky reefs along the entire continental shelf but are strongly associated with underwater canyons. Glass sponges are filter feeders, consuming bacteria and depending upon dissolved silica, dissolved oxygen and hard substrates for their survival (Johnson, P., personal communication). They are extremely fragile organisms that can be damaged by fishing methods that involve bottom contact gear; they are also limited by the concentration levels of dissolved silica and oxygen. Other than sea pens (Order Pennatulacea), most deepwater sponges occur on hard substrates across the continental shelf and slope; they can be damaged by bottom and midwater trawl nets, taking decades to recover. Sea pens are found on soft bottom substrates and are easily disturbed by trawling (Whitmire and Clarke 2007).

The observed locations of deepwater coral and sponges were obtained from NOAA Fisheries trawl survey databases (Map 3). The NOAA Fisheries provided family and genus taxonomic levels but we summarized all data to Order or Class for consistency across survey years and methods. We used presence data for the deepwater corals and sponges, and calculated CPUE when appropriate (see section 2.2.3 above.)

2.2.8 Native Oyster

Known populations of Olympia oyster (*Ostrea lurida*) data were obtained from previous ecoregional assessments and Conservancy fieldwork (Vander Schaaf, 2009, personal communication). The native oyster is an important ecological target in the ecoregion due to its habitat forming character in estuaries. Currently there are documented Olympia oyster populations at three sites in Oregon and one site in Washington (Map 3).

2.2.9 Islands

Offshore rocks and islands provide important resting and breeding habitat for seabirds and marine mammals, as well as support diverse invertebrate and marine plant communities in shallow waters. Offshore rocks and islands data were obtained from the USFWS, benthic habitat data layers and Conservancy data base (Map 4).

2.3 Assemble and compile spatial data

A considerable amount of time and effort was spent on assembling data to be used in the assessment. Data were often not in a form that was readily usable in a GIS platform so it was be converted to spatial information that was then translated into GIS shapefiles. All data for this analysis had valid metadata or information that detailed its origins and its intended use. Because the ecoregional assessment spans several geopolitical boundaries, data were often spliced together from different sources which entailed careful consideration of data definitions to insure that like data was combined and that data representing different factors were not incorrectly combined. Another important factor in data compilation was insuring that the original intent of collected data was compatible with the data was used in the assessment. Perfectly valid data that was collected for a specific purpose was not always useful in its present form for the assessment without additional analyses. In this assessment, every effort was made to discuss the intended use of data with the original authors or collectors of the information.

Data were gathered from a variety of sources, both within and outside The Nature Conservancy, to map the distribution or occurrence of each target. Occurrences included the locations of species, populations or communities, and the spatial extent of habitats. All targets were represented in a Geographic Information System (ArcGIS 9.3, ESRI) as either point or polygon features. Over the course of the assessment, many decisions were made regarding the best way to map species or habitat occurrences depending on the life stage available, or habitat type represented by the spatial data. Data were included in this assessment if they were verifiable, had accurate geographic coordinates, and were ecologically relevant. If data were only available for a small portion of a target's range, the data were not included in the analysis to prevent a sampling bias in Marxan (it always picks a rare occurrence in order to meet a goal). Data were usually not included when the last observed date was before 1980, a target was extirpated from the ecoregion, the sighting of a target was not verified by a credible observer, or the type of data were not relevant to that target group (e.g., breeding birds require breeding evidence). Additional location information for selected species came from State Heritage Programs which followed NatureServe methodologies and were usable in their existing form. Data were obtained or downloaded from a number of sources including:

State Natural Heritage Programs (Washington, Oregon, California)
Oregon Department of Fish and Wildlife
Oregon State University
Moss Landing Marine Lab
California SeaGrant Program
Washington Department of Fish and Wildlife
Washington State Department of Natural Resources
U.S. Fish and Wildlife Service
National Oceanic and Atmospheric Administration
Alaska Fisheries Science Center
Northwest Fisheries Science Center
National Ocean Services Hydrographic Data Base
ShoreZone
SeaWIFS satellite
AVHRR satellite

2.4 Set Goals for Conservation Targets

The analytical tool that was used for optimal site selection, Marxan, required a numerical conservation objective (or goal) for each target. These conservation objectives, or goals, were expressed as number of occurrences or area and they largely determined the number of assessment units or the amount of area included in the solution set. A numeric conservation goal was a general estimate of how much of a target may be required for its long-term persistence (Tear et al. 2005). Selecting a meaningful numeric value represented our best effort at estimating the portion of the population or habitat coverage necessary for ensuring its long-term survival, and was set based on the current distribution and/or rarity of each target. A numeric goal also provided a benchmark for measuring the progress of conservation in the ecoregion over time with respect to the targets included in the assessment.

A recent study (Levin et al. 2009) found that the relationship between habitat area and species richness for the US West Coast groundfish fishery was well described by a data curve with a slope of 0.226. Increasing area resulted in increasing diversity represented by numbers of fish species up to 20-30% of the area where the slope of the curve began to level off. This corroborates the well-established species-area curve in ecology that shows a relationship between number of species or diversity and amount of habitat (Conner and McCoy 1979). By extension, this relationship has been used to represent the declining risk of species extinction with the amount of habitat protected.

Based on published studies that suggest a goal of 30 percent results in the retention of between 70 and 85 percent of a species within its range (Dobson 1966), we selected an initial goal of 30 percent of the current extent of coarse-filter habitats (benthic, estuarine and shoreline) and current extent of fine-filter targets. Unfortunately, many species have declined or their distributions are not well understood and only a fraction of the occurrences may exist or remain in the ecoregion. To account for declines in some targets we set elevated goals of 50 percent for kelp, seabird colonies, ESA listed species, commercially fished species that are considered "overfished" by the Pacific Fisheries Management Council and NOAA (i.e. widow rockfish, canary rockfish, yelloweye rockfish, darkblotched rockfish, bocaccio, Pacific ocean perch) coastal upwelling zones, and most marine mammals (Pacific Fisheries Management Council [PFMC] 2009). The goals for all conservation targets were set for both ecoregional and section levels. The four sectional goals were established based on a species' distributions within the ecoregion to ensure stratification of protected examples of targets across their range.

Conservation goals were modified from the levels noted above if core team members, regional experts for marine taxa and habitats or the peer review process identified sufficient justification to adjust individual targets. Recovery goals provided in federal Endangered Species Act recovery plans were used for the killer whale and Steller sea lion critical habitat goals. The goals for all conservation targets are included in Appendix 1.

2.5 Targets not included in the analysis

Of the 358 targets that were initially identified for the assessment, a number of theses had insufficient data to be included in the analysis. The most significant data gaps were for marine plants or algae (other than canopy-forming kelp), marine invertebrates, forage fish, as well as most migratory marine mammals and pelagic seabirds. One offshore ecological habitat that was not included in the analysis but that has important ecological process implications for a portion of the ecoregion was the Columbia River Plume. Spatial data for this process was incomplete at the time of the analysis and disagreement to its spatial extent by experts precluded using the Plume as a conservation target at this time.

2.5.1 Data gaps and Limitations

Data gaps and data limitations exist in any comprehensive assessment made of conservation priorities on an ecoregional basis. The PNW Marine Ecoregional Assessment was no exception to this even though considerable energy was expended in collecting both ecological as well as human use data for the analysis. Nevertheless the assessment still fell short of the goal of using all relevant data so this section is intended to document identified gaps that may be filled in additional studies or second iteration efforts. Data was also not evenly distributed across the ecoregion as very limited data has been collected on species in depths that are greater than commercial trawling routinely occurs (approx. 1200 m). This resulted in variable densities of data and corresponding diversity of conservation data (Map 5) that has implications on some findings in the analysis.

There are thousands of species in the ecoregion that could be used as conservation targets in an assessment of this sort but, not surprisingly, very little detailed spatial information is available for nearly all species that have limited or no commercial value. A readily identified data gap in this assessment was the omission of two groups of migratory species, seabirds and cetaceans, which are regular and seasonal visitors to the ecoregion and an important component of the ecosystem's predator-prey dynamics. Large datasets from ship-based studies or observations were available for some seabirds and cetaceans but experts in these taxa often questioned the ecological relevance of point or transect data without the concomitant understanding of how these animals were interacting with the habitat or prey in the location they were sighted. Recent advances in using satellite telemetry or data loggers on wide-ranging pelagic predators in combination with persistent oceanographic features provides some promise for including these taxa in future assessments (Rob Suryan, personal communication). Spatially-explicit data for nesting locations and colony sizes for resident seabirds as well as marine mammal haulout sites were deemed to be most suitable as conservation targets, and critical habitats for some listed species were used (e.g., Steller sea lions).

Another group of species that were of great interest but ultimately not well represented on the conservation target list were forage fish including herring, smelt species, anchovy, sardine and eulachon. These highly migratory, schooling species are some of the principal drivers of secondary productivity in the nearshore food web and thus the overall ecology and productivity for the ecoregion. Researchers shared extensive prepublication datasets for these species and advice as how to best use the information (Bob Emmett, personal communication) but in the end we did not incorporate these species into the assessment because they did not meet the criteria for sampling intensity. These species form an essential albeit complex aspect of the marine environment. Their abundance and distribution varies seasonally as well as on a year to year basis and this dynamic nature could not be adequately captured in the analysis.

There were also several habitat types that were not fully represented in the assessment, largely due to the lack of detailed survey work taking place in a uniform manner across the ecoregion. Rocky reefs on the continental shelf are essential habitat for many rockfish species which were considered key conservation targets in this assessment. Because of complex reef topography, portions of this habitat were inadequately surveyed in the NOAA trawl surveys to avoid damaging the habitat or losing sampling gear there. High resolution side scan sonar and multi-beam sonar are just beginning to identify the extent of these and other habitats on the shelf; only about 15% of Oregon's territorial waters have been surveyed to date and offshore shelf habitats are even less well covered. As habitat surveys across more of the continental shelf and slope become complete, a much better picture of these habitats will be revealed. The current benthic habitat data layer is a huge improvement over what was available just 10 years ago but with the advent of these newer technologies, both bathymetry and substrate specificity will be greatly refined in the future. This will allow much better predictions of species use and abundances in the coastal ocean.

Several other potential conservation targets that were not included in the analysis were sea otters, due to incomplete and outdated information; crustaceans and other keystone invertebrates, due to a general lack of distribution information; and zooplankton species such as krill (Euphasiids) and copepods, again due to the lack of distribution information and their year to year variability. Frontal zones, characterized by steep environmental gradients in pelagic waters at the shelf-slope break off the coast, were not incorporated as a conservation target in this assessment as location information was not readily available and was complicated by its variable nature on a seasonal and year to year basis. These zones are important feeding areas for seabirds and marine mammals and at times support large concentrations of prey species that are the energetic engine of the continental shelf habitat.

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Chapter 3 – Protected Areas

Protected areas in the ocean and along the shore contribute to the conservation of biological diversity by protecting species and habitats from existing and potential impacts. Terrestrial based protected areas that contribute to marine biodiversity conservation generally border the shoreline providing a buffer for the marine realm from land based influences. National Wildlife Refuges, State Parks and protected estuaries as well as other select sites provide significant protection to biological resources that are present within their borders. There are also a few private nature preserves in coastal areas whose primary purpose is to protect biodiversity. These protected areas also contribute to biodiversity conservation in areas adjacent to the designated marine site by providing refugia for species that may move between sites and by providing a buffer where potential impacts such as pollution or development are lessened. Marine protected areas in the PNW Marine Ecoregion are varied in their classification and management, and include state and federally designated sites that have differing levels of protection for marine biodiversity. Marine protected areas are only recently becoming designated in a systematic fashion along the West Coast as both Oregon and California are currently undergoing separate processes to identify and protect suitable sites in state waters that reach out to 3 nautical miles. As all marine waters, exclusive of some estuaries, are government owned and managed there are no privately held protected areas in the ocean. Overall, the terrestrial and marine protected areas identified in this ecoregional assessment cover 1,909,295 hectares or 7372 square miles, ranging in size from 1 to 825,889 hectares. These sites are listed in Appendix 2 and portrayed in Map 1. A summary of protected area designations and the area covered can be found in Table 3.

A Gap Analysis was run utilizing the identified conservation targets and their locations within the ecoregions. The purpose of the analysis was to determine to what extent existing protected areas provided sufficient conservation of the targets using the conservation goals established for them. This analysis can show what conservation targets are already being adequately represented in management areas as well as what targets are not presently having their conservation needs met within the protected areas network. The Marxan analytical tool provides a simple means for conducting this analysis using the data that was already collected for the project and using the conservation goals that have been established for each target.

3.1 Existing Protected Areas

The largest designated protected area in the ecoregion is off the Washington coast, the Olympic Coast National Marine Sanctuary, and covers 825,889 hectares (3189 square miles) of marine coastal and offshore waters. Sanctuaries are administered by the National Oceanic and Atmospheric Administration (NOAA) and while there are several on the west coast, there is only one in this ecoregion. Management of the Olympic Coast Sanctuary is directed by a management plan that specifically prohibits the discharge of material in the Sanctuary, as well as the disturbance of, construction on or alteration of the seabed. Disturbance of cultural resources or exploration, development and production of oil, gas or minerals is also prohibited. Of particular note for the Sanctuary, however, is that there are many exceptions to the prohibitions including the allowance of fishing by treaty tribes. The Sanctuary does not have the authority over other fisheries managed by the NOAA-National Marine Fisheries Service.

A more widespread system of protected areas in the ecoregion is the US Fish and Wildlife National Wildlife Refuges (NWR), a network of lands and waters that are designated for the conservation and management of fish, wildlife and plant resources. It is of note that the first refuge west of the Mississippi River was established in the ecoregion at Three Arch Rocks (Oregon) in 1907. Public access and use of a Refuge is allowed only where the uses are compatible with its mission and many refuges have no public access except by permission. In this ecoregion, there are 12 National Wildlife Refuges. In Oregon, the largest seabird colonies occur on the Three Arch Rocks NWR and in Washington at the Quillayute Needles NWR. The National Wildlife Refuges are important seabird nesting sites, waterfowl foraging habitats and marine mammal rookeries and haul-outs; some also offer protection for intertidal communities and estuaries.

Along the Washington coast, the Olympic National Park extends 117 km (73 miles) along sandy and rocky beaches. The Olympic National Park was created in 1909 by President Roosevelt as a National Monument, and legally designated a National Park in 1938. It became an International Biosphere Reserve in 1976, a UNESCO World Heritage Site in 1988 and is an IUCN Category II National Park. This Park has three distinct ecosystems – glacier-capped mountains, magnificent old-growth forests and the Pacific coast – and the Pacific Coast portion runs from Shi Shi Beach to South Beach. The Olympic National Park is managed as a 'natural area' and the primary objective of their fisheries management program is "to preserve and protect native fishes and their habitats, and provide recreational fishing opportunities for enjoyment of park visitors". Marine fishing and shellfish regulations prohibit harvest of seaweed, unclassified invertebrates and fish, the use of seines, traps, drugs, explosives and nets, and harvest is closed for abalone, geoducks, octopus, oysters, sand shrimp, scallops, sea cucumbers, sea urchins, shrimp and all other intertidal invertebrates. All other fisheries are open subject to minimum size and possession limits, legal gear, bait restrictions, and season (Olympic National Park 2008).

Within State waters and along the coastline there are numerous state protected areas that include state parks, the South Slough National Estuarine Research Reserve (Oregon), and designated state marine conservation areas. Also there are several privately held nature reserves that are dedicated to protecting biological diversity. These areas are generally smaller in area but most have more stringent protection regulations and thus offer significant conservation value in the ecoregion. The States of California and Oregon are each developing a network of Marine Protected Areas or Marine Reserves that are explicitly designed to protect marine biodiversity. When these planning processes are completed the sites will contribute substantially to conserving marine resources in State waters.

Another type of marine management area in northern California, Oregon and Washington are the NOAA National Marine Fisheries Service fisheries closures for Essential Fish Habitat. These closures cover 995,827 ha (3847 square miles) of ocean habitat and actively prohibit bottom contact gear use within their boundaries. Fisheries management agencies also prescribe a complex set of regulations that include seasonal closures, gear restrictions and catch limitations for commercial and recreational fisheries. While these regulations may act as de facto protection in many cases, they are not considered in the context of this assessment as designated protected areas because they can and do change upon review on an irregular basis.

In the United States, there has been a long-term moratorium on new oil and gas leases in state waters and adjacent federal waters with drilling and production only allowed on existing leases. This moratorium continues seaward to the Outer Continental Shelf on the west coast of United States even though President Obama lifted the 20-year moratorium on March 31, 2010 and the

Administration will consider new areas for potential development in Alaska, the mid and south Atlantic region, and the Gulf of Mexico, while protecting sensitive areas.

Table 3. Summary of protected areas and their total areas in northern California, Oregon, and Washington

Type of protection	Number in ecoregion	Total area (ha)	Total area (sq. mi.)
National Marine Sanctuary	1	825,889	3189
National Estuarine Research Reserves	1	3745	14
National Wildlife Refuge	17	18815	73
Essential Fish Habitat areas	17	995827	3844
State Parks	54	21043	81
State Management Areas	44	9703	37
Private Nature Reserves (TNC, others)	45	5862	23
Other protected areas	18	25976	100

3.2 Gap Analysis

The purpose of the Gap Analysis was to determine how effective the existing protected areas in the ecoregion were at protecting the conservation targets identified in this assessment or, in other words, their contribution to biodiversity conservation. Using the existing protected areas all location data for the conservation targets used in our assessment were intersected with the boundaries of the protected areas. We then used the Marxan algorithm to evaluate how well these areas protected the identified conservation targets. Marxan is a particularly useful tool to answer this type of question because it can easily evaluate conservation scenarios using selected areas within the ecoregion. The algorithm was used to assess how well the protected areas capture locations of the conservation targets at the assigned conservation goal levels.

Because most of the conservation target data were defined by polygons that include buffers to represent spatial uncertainty, rules were established to decide if a particular target was protected in the Gap Analysis. The three rules for inclusion of a target within a protected area were: 1) buffered species locations with their centroid within a protected area, 2) target occurrences that had more than 50% of the total polygon within a protected area, and 3) habitat (coarse filter) targets completely contained within the boundaries of a protected area.

Marxan utilizes “Assessment Units” (AU; see Chapter 5) that are 1 square mile in size in state waters and 9 square miles in federal waters to compile conservation data and run the Marxan algorithm (Map 1). A basic criterion was established to determine whether or not an Assessment Unit was deemed “protected” based on how much of an existing protected area it contains. The area of protected sites within a given Assessment Unit had to be at least 50% of the total area of the Assessment Unit, for the Assessment Unit would be considered protected in the Gap Analysis.

Overall 5.7 percent of the AUs were considered protected for the purposes of the Gap Analysis. This included 344 AUs in federal waters (8.8 percent of the AUs in federal waters) and 218 AUs (3.7

percent of the AUs in state waters). The state waters AUs also included areas of adjacent terrestrial lands that may contribute to the total protected area such as land-based State Parks.

Moving from AUs to the individual conservation targets, the Gap Analysis showed that only 70 targets (9.5%) of the 735 targets (with goals) had at least 80% of their conservation goal met (Table 4); 48 targets (6.5%) had their conservation goals fully met and another 22 targets (3.0%) had their conservation goals met at a greater than 80% but less than 100% goal level. For this list of conservation targets see Appendix 3.

Table 4. Gap analysis for the percentage of conservation goals met for individual conservation targets in existing protected areas

% Conservation Goals Met	Number of Targets	% of Targets
0%	246	33.5
1-20%	255	34.7
>20-40%	126	17.1
>40-60%	58	7.9
>60-80%	30	4.1
>80-<100%	22	3.0
100%	48	6.5
Total	735	100.0

The 70 conservation targets with a greater than 80% level were not distributed evenly across the ecoregion. A comparison of these targets by the ecological section they occurred in is portrayed in Table 5 below. The southern-most section, Cape Mendocino – Cape Blanco, had fewer than 5% of the section's targets at the 80-100% goal level, about half of the number or percent of conservation targets meeting similar goal levels in the Cape Blanco – Cape Lookout and Cape Lookout – Point Grenville sections. In the northern-most section, Point Grenville – International Boundary, nearly 20% of the conservation targets met or nearly met (80-100%) their goals, a fourfold jump from the southern-most ecological section.

Table 5. Distribution of conservation targets by section (goals met at greater than the 80% level within existing protected areas)

Ecological Section	Number of Targets Met	Total Number of Targets in Section	% Targets Met in Section
Cape Mendocino-Cape Blanco	8	186	4.3
Cape Blanco – Cape Lookout	16	190	8.4

Cape Lookout-Point Grenville	17	198	8.6
Point Grenville—International Boundary	29	161	18.0
Total	70	735	9.5

In addition to a north-south gradient in meeting conservation goals at the 80-100% level, we found differences among conservation target types (habitats and species; Table 6). In general, certain types of targets were less likely to be fully conserved in the existing protected area network than others, largely because of the habitats that are present in existing protected areas. As a percentage of the total number of targets, the deepwater coral and sponges had the highest protection in existing protected areas at 22%. Second to corals and sponges was the shoreline target, with 17%. Benthic habitats (10.5%) and marine birds (7.0%) both had much fewer targets meeting conservation goals. It was somewhat surprising to find that marine birds only had 7.0% of their target goals met despite their breeding locations within the National Wildlife Refuges but this may in part be due to snowy plover critical habitat because it still remains largely unprotected. Marine mammals had zero of their conservation goals met, even at the 80% level, in the existing protected area network and fish targets were only met 3.0% of the time.

Table 6. Types of conservation targets met within existing protected areas. Special habitats include islands, kelp, rocky reefs, submarine canyon walls, upwelling and high chlorophyll zones.

Type of Conservation Target	Number of Targets Met	Total Number of Targets in Type	% Targets Met in Type
Benthic Habitats	17	162	10.5
Shoreline Habitats	19	110	17.3
Estuary Habitats	2	54	3.7
Birds	7	100	7.0
Fish	6	199	3.0
Mammals	0	19	0
Coral and Sponges	13	59	22.0
Special Habitats	6	32	18.8

3.3 Tribal Areas

In Washington, the four coastal tribes have fishing treaties with the U.S government under the Boldt Decision (United States v. Washington, 384 F. Supp. 312 W.D. Wash. 1974). NMFS recognizes these four tribes as having usual and accustomed grounds in the marine areas managed by the NOAA Groundfish Fisheries Management Plan: Makah, Hoh, Quileute Tribes, and the Quinault Indian Nation. The tribal treaty right is generally interpreted as giving the tribes the right to 50% of the natural resources present, and these resources must be harvested within a tribe's usual and accustomed areas. The treaty tribes are co-managers of these natural resources with NMFS. The Northwest Fisheries Indian Commission is responsible for the co-management role and assists treaty tribes with management of the fisheries. The U.S. courts recognize two separate aspects to the tribal treaty rights: geographical, providing the right to fish throughout their entire usual and accustomed fishing grounds, and a fair share aspect, providing the treaty tribes with the "right to a fair share of the catch passing" through the usual and accustomed grounds.

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Chapter 4 – Analysis Methods

Optimal site selection of conservation areas analyzes the trade-off between conservation values and conservation costs to arrive at an efficient set of sites that satisfies conservation goals (Possingham et al. 2000, Cabeza and Moilanen 2001). The optimization site selection algorithm Marxan searches for the lowest "cost" set of assessment units that will meet goals for all conservation targets. In general terms, Marxan works to minimize the overall conservation footprint that usually equates to cost while maximizing the conservation benefits or meeting conservation goals. Cost (termed "suitability" in Marxan) refers to the set of economic, social and environmental uses and protections that are present in a particular geography and that must be considered during conservation planning (e.g., an existing commercial port or a marine reserve). The cost aspect of a Marxan solution also includes any unmet conservation goals such that the optimal solution acts to balance suitability cost with the cost of not meeting conservation goals. Suitability cost was calculated using an index of existing management status and human use factors (see Section 4.3) that describes the human dimension aspects of conserving biodiversity.

4.1 Assessment Units

All data describing the target locations for conservation targets and the conservation suitability were attributed to Assessment Units (AUs) that completely cover the area of analysis in the ecoregion (Map 1). Marxan requires that all data be attributed to assessment units (AUs) as they are the basic units of analysis for the optimization algorithm. The PNW Marine ecoregional assessment used a grid system established by the Mineral Management Service (MMS) for the AU coverage. [Note: MMS has been merged into a new agency, the Bureau of Ocean Energy Management.] The MMS grid was initially developed to facilitate offshore leasing for oil and gas development in federal waters. The grid consists of contiguous cells that are approximately three statute miles on a side or 2304 ha. In state waters, the federal MMS grids were divided into nine AUs that are approximately one statute mile on a side or 256 ha. There were 5924 one mile square assessment units in state waters and 3917 nine miles square assessment units in federal waters.

4.2 Marxan Analysis

An ecoregional assessment entails hundreds of different targets existing at thousands of locations, therefore the relative biodiversity value and relative conservation suitability of thousands of assessment units (AUs) must be evaluated. This complexity precludes simple inspection by experts to arrive at the most efficient set of potential conservation areas. To deal with this complexity, we used the optimal site selection algorithm, Marxan (Ball and Possingham 2000). Marxan (and its predecessors SPEXAN and SITES) has been used for a variety of terrestrial and marine conservation assessments around the world (Beck and Odaya 2001, Andelman and Willig 2002, Noss et al. 2002, Lawler et al. 2003, Leslie et al. 2003, Carroll et al. 2003). Marxan finds reasonably efficient solutions to the problem of selecting a system of spatially cohesive reserves (Possingham et al. 2000, McDonnell et al. 2002). The Marxan algorithm strives to minimize the "objective function", or the sum of: the suitability values for all selected AUs, the penalties for not meeting target representation goals, and the length of boundaries defining the extent of the conservation solution.

Marxan begins by selecting a random set of AUs, i.e., a random conservation solution. The algorithm then iteratively explores improvements to this initial solution which is defined by "cost" by randomly adding or removing AUs. After each iteration the new solution is compared with the previous solution and the better one or less cost one is accepted. The algorithm uses a method called simulated annealing (Kirkpatrick et al. 1983) to search for the optimal solution, thus greatly increasing the chances of converging on a highly efficient conservation solution. The algorithm was run for 100 million iterations in the PNW Marine Ecoregional Assessment, which is two orders of magnitude more iterations than is typically done for terrestrial assessments. This increased number of iterations was beneficial to the results as it appeared to reduce the variability between runs. In the PNW Marine Ecoregional Assessment there were less conservation data overall used in the analysis and there were far less specific species data with a resultant greater reliance on coarse filter habitat data. This was coupled with fewer inputs for the suitability index which resulted in somewhat greater uncertainty in the overall outcome. Ten replicate runs of the algorithm were executed for the conservation scenarios such that each scenario was ultimately developed after a total of 1 billion iterations of the Marxan algorithm.

Some additional parameters that have to be selected before running Marxan include:

1. the number of repeat runs,
2. species penalty factor, which is the penalty for not meeting stated conservation goals,
3. boundary length modifier, a weighting factor which determines how much clumping or dispersion is favored in the model output.

We ran Marxan many different times and determined that 10 repeat runs for each solution was sufficient. The species penalty factor was set at 1 for all targets. After experimentation, we selected a boundary length modifier of 0.07 to achieve some level of clumping while still allowing for numerous distinct conservation areas that had biological relevance as seascapes.

The conservation solution as defined by the area of the ecoregion it covers was mainly determined by the conservation goals set for the targets – the higher the goals, the larger the solution in terms of overall area identified. The goals used for the scenarios developed represent an educated guess based on scientific analysis for the conservation of biodiversity (Comer 2001, Levin 2009). Other conservation goal levels would describe different conservation solutions and these can be examined in future iterations of the PNW marine ecoregion using the datasets that have been compiled for this assessment.

4.3 Suitability Index

Each AU was assigned a value of conservation suitability (Map 6). This value or index consists of a set of weighted factors that influence the relative likelihood of successful conservation at any given AU. Because determining the monetary cost of conservation for every assessment unit would be an extremely demanding task, we used a surrogate measure for cost called a suitability index. Thus, a place with a high "cost" for maintaining or restoring biodiversity has low suitability for conservation and conversely, a place with a low cost would be considered to have high suitability. The suitability index influences the selection of AUs when the Marxan algorithm must choose between potential locations (i.e. there are more target occurrences available than needed to meet conservation goals).

The index included factors likely to impact the quality of the habitat for native species as well as factors likely to impact the cost of managing the area for conservation. A consideration in building the suitability index was the availability of spatially explicit data for each of the potential factors. Suitability factors must have data that span the ecoregion or at least span an ecological section; many potential suitability factors were rejected because they don't meet these criteria. The suitability index was based on the judgments of the team and other experts in both the selection of factors and their relative weight in the suitability index equations (Section 4.3.2). As might be expected, some factors have a positive influence on suitability such as the presence of existing protected areas, while other factors are considered to negatively influence suitability such as point sources of pollution. The suitability index can be considered to be the human dimension aspect of the ecoregional assessment whereby current and historic uses of the ecoregion are broadly factored into the analysis with the biodiversity factors in order to identify areas that reflect greatest ecological gain for the least overall cost.

We readily admit that the suitability index cannot account for the many complex local situations that influence successful conservation, but some larger scale analysis of important factors is useful for assessing conservation opportunities across an entire ecoregion.

4.3.1 Suitability Index Factors

Two distinct suitability indices were developed for this assessment; first, a terrestrial index was developed using terrestrially-based factors such as road density, terrestrial protected areas, and land use. The terrestrial suitability index was used to determine the terrestrial influence to estuaries, the immediate shoreline and the nearshore ocean environment out to 1 mile or the first "full" AU adjacent to land. While the entirety of a coastal watershed has effects on estuarine and nearshore environments, it is beyond the scope of this assessment to consider any terrestrial effects that may originate upslope from the immediate coastal area. The second suitability index developed was a strictly marine suitability index that included the following data: ports, marine protected areas, commercial trawl fishing effort, dredge disposal sites, point source pollution, shoreline armoring and salmon presence in estuaries. The marine suitability index was applied across the ecoregion including estuaries and any AUs that touched the shore, although its greatest importance was in the analysis of the offshore marine environment. Where both terrestrial and marine suitability indices were applied to shorelines and the immediately adjacent AUs in estuaries and the along the nearshore, the combined indices were summed for the purposes of the Marxan analysis.

4.3.1.1 Terrestrial Suitability Factors

A terrestrial suitability index was developed for each AU for which there was a portion of land above mean high tide contained within it. The index was computed by buffering the AU by a mile in each direction and summing the suitability factors within that buffered area. The buffered area could potentially be nine square miles although typically it is less due to the presence of adjacent marine (non-terrestrial) AUs that would have none of the terrestrial factors present. The rationale for buffering the terrestrial AUs to develop the suitability index was that adjacent AUs had a substantial influence on suitability as factors such as runoff can easily cross several AUs and influence the marine environment along the coast.

Road Density

The density of roads was used to capture impacts from runoff from terrestrial to marine sources created by impermeable surfaces (e.g., pavement and concrete). As noted above, road density was determined for each AU by calculating the density of roads in each AU adjacent to it, that is, eight surrounding AUs and summing these densities. The unit used for road density was kilometers per hectare; it was used as a continuous variable, not binned into levels or groups.

Protected Areas

Designated protected areas as defined by having Gap level 1 and 2 management codes (Kagan et al 1999) were used in the assessment as positive factors for conservation suitability. Data for protected areas were taken from the PNW Coast Ecoregional Assessment (Vander Schaaf et al 2006) and from the Northern California Marine Ecoregional Assessment (TNC 2006). Examples of terrestrial protected areas included US Fish & Wildlife Refuges, many State Parks, and Conservancy nature preserves.

Land Conversion

The percentage of converted lands that are adjacent to marine and estuarine ecosystems directly affects the function and maintenance of these ecosystems (Desbonnet et al. 1994, Doyle et al. 2001, Lemieux et al. 2004, Levings and Jamieson 2001). Land use land cover data, gathered from several sources, were used to identify areas of significant land conversion from natural habitats. For this analysis we used two types of conversion: developed agriculture such as row crops and cranberry bogs, and urban areas. Urban areas were further distinguished between medium and high density development.

4.3.1.2 Marine Suitability Factors

The marine suitability index, unlike the terrestrial suitability index, was applied to all AUs in the analysis with no summation of effects or factors present in adjacent AUs. Some of the individual suitability factors, such as ports, were also attributed to adjacent AUs beyond their immediate location in order to recognize their direct influence on these other AUs. The marine suitability index relied on more suitability factors than the terrestrial index, overall, but generally AUs that were farther offshore in federal waters only had one or two factors that influenced the index, these being marine protected areas and trawl fishing effort. Several potential marine suitability factors that were not included in the analysis were submarine cables, shipping lanes, potential alternative energy sites, and Oregon estuary management categories. Reasons for not using these factors included lack of complete data across the ecoregion, uncertainty of level of impact and disagreement among experts as to the importance of the factors. The factors used in the marine suitability index are discussed below.

Trawl Fisheries Effort

NOAA National Marine Fisheries Service trawl logbook fishery data (2000-2006) were used to quantify the amount of historical fishing effort on the continental shelf in the ecoregion. We used this richly detailed data set to address human use in the ecoregion that was attributed specifically to bottom and midwater trawl activities in federal waters. The trawl data was analyzed across the entire ecoregion and summarized to five minute blocks of latitude and longitude (Bailey and Ferdana 2007). The total number of trawl hours for each block was then attributed to the corresponding AUs (Map 7). There was no corresponding dataset available for fishing effort in State waters which was a shortcoming in assessing human uses in the ecoregion.

Ports

Every major estuary in the ecoregion has a port facility with some being of substantial size and supporting a lot of activity. Ports have the potential to impact the ecoregion through ongoing port maintenance actions and the boats that frequent the ports have the potential to impact estuaries and coastal waters through pollution attributed to normal operating activities. Two datasets were used to develop the suitability value for each port and the affected estuary: 1) Pacific Fisheries Information Network (PACFIN) number of fishing vessels/port and 2) Army Corps of Engineers data for numbers of slips which included marinas, shipping terminals and industrial complexes. Privately owned slips on residential properties were generally not captured in the analysis.

Point Source Pollution

Point source pollution as characterized by sewer outfalls, industrial inputs and other sources are well known impacts to the nearshore and some estuaries. We used datasets from the Environmental Protection Agency (EPA) as well as state datasets to identify point sources.

Dumping Grounds

Designated dumping grounds where dredge disposal from port and channel projects may occur as well as disposal grounds for military ordinance in past years may have occurred clearly compromises conservation actions at these sites. NOAA nautical charts were the primary sources for this data which were attributed to the pertinent AUs based on the percent of area covered.

Shoreline Armoring

Shoreline armoring has the effect of putting a barrier between the land and the sea or estuary and thus preventing the natural exchange of nutrients and organisms that flows between them. Armoring data were collected from multiple sources including Shorezone classification (WA), Oregon State Parks, NAP imagery for Oregon estuaries and data from other assessments (TNC 2006). The factor was quantified as a linear distance (km) of hardened shoreline consisting of jetties, seawalls and other armoring for each affected AU.

Invasive Species

In estuaries, invasive species have played a varied role in affecting the naturalness of the habitats and the conservation potential remaining there. The U.S. Environmental Protection Agency Western Ecology Division, Newport, Oregon, has compiled counts of invasive species in major estuaries, categorizing them as to their degree of threat to native habitats. We used both the number of invasive species (species count) and the potential threat in developing this factor that was in turn attributed to estuary AUs (Lee and Ruesser 2011).

Protected Areas

Protected areas that contribute a significant level of conservation (Gap level 1 and 2) to biodiversity resources are included as positive values in the suitability index. In the PNW Marine Ecoregion, protected areas included the shoreline portions of Olympic National Park, US Fish and Wildlife National Wildlife Refuges, offshore Essential Fish Habitat (EFH) areas from NOAA fish management policies, State marine protected areas and other designated protected areas such as the South Slough National Estuarine Research Reserve. The Olympic Coast National Marine Sanctuary, the largest designated management area in the ecoregion, was not included in the suitability index in the analysis because it lacked substantial protection to marine resources based on the high level of commercial trawl fishing that occurs within its boundaries. Other omissions in the protected areas analysis were the two newly designated Marine Reserves in Oregon waters; these areas had not been closed to extractive use yet and were omitted for this reason.

In this assessment, we considered NOAA's Essential Fish Habitat/Habitat Areas of Particular Concern (NOAA 2006) to be Gap level 2 even though these areas were only administratively designated and not designated through legislative actions. These areas protect biologically important continental shelf habitats from bottom contact gear and are considered by most experts to be reasonably permanent designations.

<u>Salmon in Estuaries</u>
Pacific salmon are iconic, keystone species in Pacific Northwest estuaries and in the nearshore ocean. Because salmon location data in the ocean were very incomplete we chose to attribute salmon data to estuaries in the ecoregion. The Wild Salmon Center has collected and analyzed salmon data throughout the range of Pacific salmon species on an individual run basis, with a run being defined as species, timing and location specific (Wild Salmon Center 2009). The composite value computed by the Wild Salmon Center for each run was summed for individual runs in each estuary giving an overall importance value for the estuary in terms of salmon (Appendix 5). The composite value was based on viability, life history diversity, and percent natural spawners for each run. Only salmon runs that were from immediate coastal watersheds were used in the compilation. Because of the huge importance of the Columbia River estuary and the Straits of Juan de Fuca in terms of salmon, no composite values were calculated for these water bodies. Instead we gave both the Columbia estuary and the Straits a value of 1.0 and then normalized all other estuary scores with each other, to compute the salmon suitability factor as a positive value attributed to the representative estuary AUs.

4.3.2 Calculation of the Suitability Indices

Table 7. Weighted Factors for the Terrestrial Suitability Index

Factor	**Relative Weight**	+/- **Attribute**
Road density	0.5	-
Land use		
Urban (ha)	1.0	-
Agriculture (ha)	0.5	-
Protected area		
GAP1 (ha)	1.0	+
GAP2 (ha)	0.5	+

The terrestrial suitability equation is:

{((road density normalized 0-1000) * 0.5)**) + (**((urban ha*1) + (ag ha*0.5) normalized from 0-1000)) * 1))**) + (**((GAP1 ha*1) + (GAP2 ha*.5) normalized from 0-1000)) *-1))**)}**

Table 8. Weighted Factors for the Marine Suitability Index

Factor	**Relative Weight**	**+/- Attribute**
Sewer outflows (#)	0.125	-
Shoreline armoring (km)	0.25	-
Invasive species (#)	0.25	-
Ports (#)	1.0	-
Dumping grounds (%)	0.2	-
Trawl fishing effort		
Bottom trawling (hrs)	1.0	-
Midwater trawling (hrs)	0.25	-
Protected areas		
GAP1 (%)	1.0	+
GAP2 (%)	0.75	+
Salmon (WSC score)	0.25	+

The marine suitability equation is:

{((#Sewer outflows*0.125 normalized 0-1000) **+** (Shoreline armoring km*0.25 normalized 0-1000) **+** (#Invasives*0.25 normalized 0-1000) **+** (#Ports*1 normalized 0-1000) **+** (Dumping Grounds %*0.2 normalized 0-1000) **+ (**(Bottom trawling hours*1) + Midwater Trawling hours*.25) normalized 0-1000**) + (**(GAP1 %*1) + (GAP2 %*.75) normalized 0-1000**)** + (salmon*0.25 normalized 0-1000**)}**

4.4 Identifying Priority Conservation Areas

The goal of the conservation analysis conducted for the PNW Marine Ecoregion was to develop several relevant conservation scenarios that explored differing uses of the both the biological and suitability data collected for the assessment. Compiling and analyzing the data in this manner allow them to be used for a variety of ongoing and future conservation planning purposes from setting state and regional priorities to identifying seascape-scale projects with partners. This approach differed from traditional ecoregional assessments that typically identify a specific conservation portfolio that would be considered a final solution for conservation priorities. For the PNW Marine Ecoregion it was felt that it would not be useful to develop a specific portfolio of priority conservation areas due to the recognition that several key aspects of the biological data were not fully available for analysis and some critical human use or suitability data had not been assembled.

The conservation scenarios that are described in Chapter 5 provide a careful summation and analysis of the existing data that balanced both biological and suitability concerns. The assessment identified priority conservation areas in a manner that showed their relative importance on an AU by AU basis without being fixed in a more strictly dichotomous distinction of being either in the portfolio or not in the portfolio. Within the Marxan analysis, these sorts of results are termed "summed solutions" and they are fully discussed in Chapter 5. The overall utility of showing the results of the analysis in this relative manner was that it allows further discussions with interested parties in the ecoregion using the results as a starting point for prioritizing conservation actions depending upon identified threats or management needs. It also allows for additional analyses to be conducted as more data become available.

4.5 Expert Review

Expert review is necessary to identify shortcomings of the input data and provide a platform for rigorous peer review. Two workshops were held in early 2009 with regional experts and species specialists to invite critical feedback of targets, methodologies and data sources. A total of 110 participants (Appendix 4) were invited to workshops in Newport, Oregon and Seattle, Washington, and more than 340 individual comments were recorded. Experts reviewed data sources and analyses, as well as draft conservation solutions to correct errors of omission or inclusion by the computer-driven process. The reviews resulted in modifications being made to a number of the conservation targets that were used in the assessment. Modified targets included those that were focused on special habitats such as kelp and rocky reefs as well as targets that were directed at ecological processes that are key drivers in the ecoregion such as areas with significant chlorophyll present and persistent upwelling. The reviewers also assisted the assessment team by clarifying the limitations of the NOAA trawl survey data which were a major source of fish species data.

4.6 Conservation Scenarios

The prioritization of potential conservation areas is an essential element of conservation planning (Margules and Pressey 2000). The importance of prioritization is made evident by the extensive research conducted to develop better prioritization techniques (Margules and Usher 1981, Anselin et al. 1989, Kershaw et al. 1995, Pressey et al. 1996, Freitag and Van Jaarsveld 1997, Benayas et al. 2003). Consequently, many different techniques are available for addressing the prioritization problem. Using Marxan, a relative priority is assigned to all AUs in the ecoregion will help planners explore options for conservation. The relative priorities were expressed as two indices – irreplaceability and conservation utility.

In this assessment we have developed two conservation scenarios, 1) an irreplaceability scenario (without suitability) and 2), a conservation utility scenario (with suitability). Comparisons between these two scenarios can be instructive as they portray the tradeoffs made when optimal conservation design across a landscape is affected by the human constraints placed on implementing conservation. As noted in Section 4.4, the goal of this ecoregional assessment was not to develop a portfolio of priority conservation areas but rather to identify the relative importance of areas using both of the scenarios described below.

4.6.1 Irreplaceability Scenario

Irreplaceability indicates the relative biodiversity value of a place (i.e., an assessment unit). The number of targets and the abundance or rarity of a target within any given AU is used to represent that AU's biodiversity value. The biodiversity data consisting of the targets described in Chapter 2 were attributed to each AU and goals were set as described in the same chapter. Running the

Marxan algorithm without the suitability index provides the irreplaceability index for the AUs that comprise the ecoregion. In general, AUs that have greater biodiversity and contain targets that are rare are considered irreplaceable in terms of being part of the overall conservation solution. The irreplaceability solution can also be thought of as being an ecologically important areas solution that identifies ecological "hotspots" based on biodiversity value on an ecoregional basis within an optimization framework.

4.6.2 Conservation Utility Scenario

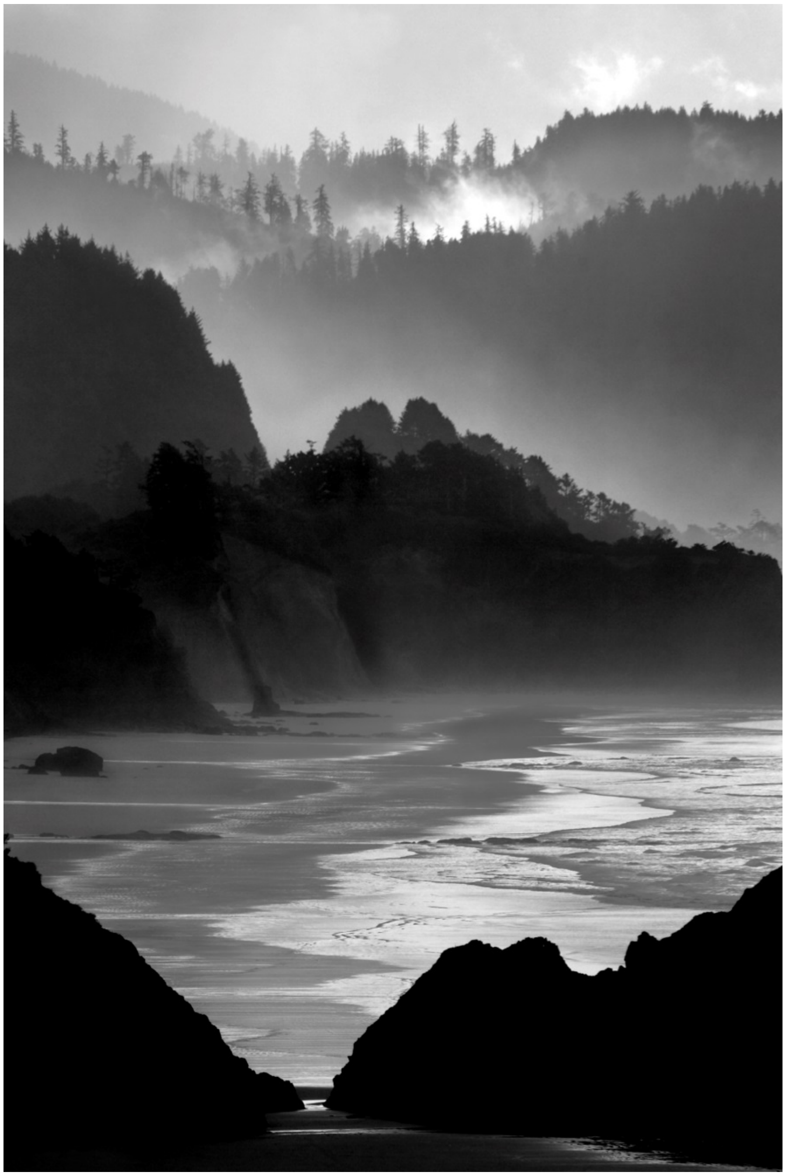
Conservation utility is a function of both biodiversity value and the likelihood of successful conservation as represented by the suitability index (Chapter 4). Running Marxan with the suitability index affecting the outcome leads to an output termed the conservation utility index for individual AUs. The conservation utility solution seeks to balance the biodiversity value of individual AUs with their inherent conservation costs as portrayed by their suitability index value. The conservation utility solution sometimes tempers the biodiversity value of an AU with the human uses that occur there. Typically, ecoregional assessment solutions developed by the Conservancy use the conservation utility solution as the starting point for developing the final portfolio of priority conservation areas.

4.7 Marxan solutions

The Marxan algorithm has a number of data outputs that can be used in ecoregional assessments, all of which can be readily translated into GIS shapefiles and attribute tables. The two most common Marxan outputs are a summed solution and a best solution. The best solution is merely the least cost solution of the 10 repeat runs that make up a complete Marxan run with a particular set of parameters. For the PNW Marine Ecoregion analysis, we have chosen to display the analysis results in a summed solution format which is expressed on an AU basis as the percent of times that an AU is captured in the solution over the 10 repeat runs developed for the run. Thus, each AU can have a value ranging from 0 to 10 in terms of the number of times it is captured in the complete Marxan run with 10 implying the AU is very important from a conservation perspective and 0 implying the AU is relatively unimportant. The ability to show relative importance of the AUs turns out to be a powerful analytical tool in terms of identifying priority areas and for setting conservation priorities.

The best solution is merely the single repeat run out of the 10 runs from a complete Marxan run that has the lowest overall cost attributed to it. The best solution is not necessarily the solution that meets conservation goals better than other solutions and it is not necessarily the solution that shows the smallest footprint or overall area. Rather, lowest cost is determined by both meeting conservation goals while at the same time as minimizing the costs that arise from suitability factors that are summed for each AU by the suitability index. The best solution is also used as a means to assess how well conservation goals are being met for a complete run. In the PNW Marine Ecoregion analysis, Marxan was run in such a manner that conservation goals were effectively met for over 95% of the conservation targets. For the purposes of analysis we define "effectively met goals" as meeting conservation goals at 95% or greater of the assigned goal level for any individual conservation target.

The solutions that are derived from Marxan can be used to inform conservation priorities within an ecoregion directly without further analysis or additional input from experts and other sources. In this assessment, we chose to do just that; in other words, the results presented below have not been modified by additional review but they were informed by the peer review workshops that we held last year. Our intent is to portray optimized site selection solutions for marine conservation that can be used as a starting point for further analysis by interested groups as well as be used for comparison purposes for other conservation solutions that are being considered in the ecoregion.



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Chapter 5 – Results

5.1 Irreplaceability Scenario

Using the irreplaceability scenario (i.e., without the Suitability Index), assigned conservation goals were met for 720 (or 98%; 720/735) of the conservation targets (Map 8), a very high rate for this sort of analysis (Appendix 6). The fifteen targets where goals were not met were:

Shoreline habitats (6)
Benthic habitats (5)
Deepwater corals (3)
Estuary habitat (1)

These results meant that our best-run solution without the suitability index selected AUs in 32.3% of the ecoregion's 97,595 km2 area.

Across the entire assessment area, there were several large clusters of AUs in the Irreplaceability Scenario, including:

- Olympic Coast National Marine Sanctuary, WA
- Cape Lookout-Point Grenville shelf break area
- Point George, CA
- Essential Fish Habitats (EFH)
  a) Siletz Deepwater--Heceta Bank
  b) Cape Arago—Bandon Highspot
  c) Eel River Canyon

Broken down by jurisdiction, 25.2% of the AUs were in state waters, and 33.3% were in federal waters (Table 9). We examined these results by depth class in each of the four ecological sections (Table 1, in section 1.3.2) and found these clusters of selected AUs (Map 8):

1) International Boundary – Point Grenville: from 0-40 m within State waters in the inner shelf, the selections clustered at Tunnel Island (Copalis NWR), offshore of LaPush, Cape Flattery, offshore from the Sekiu River in the Juan de Fuca Strait, and near Port Angeles. In the deeper depth classes, the selected AUs clustered within the Olympic Coast National Marine Sanctuary, Biogenic Area 1 (NOAA's Essential Fish Habitat), and in 40-200 m depth, in a very large area that runs from Tunnel Island to the Columbia River.

2) Point Grenville -- Cape Lookout: shallow AUs were clustered from Point Grenville to Moclips, Willapa Bay, mouth of the Columbia River, Tillamook Head, and Tillamook Bay to Cape Lookout. Offshore clusters included Astoria Canyon and a large area off Washington that included several deepwater canyons south to the Columbia River.

3) Cape Lookout – Cape Blanco: from 0-40 m, AUs were clustered seaward of Siletz Bay, Heceta Head, Winchester Bay, Cape Arago/lower Coos Bay and Cape Blanco. Beyond 40 m depths, clustering was reduced but included four Essential Fish Habitat Areas (Siletz Deepwater, Daisy Bank, Heceta Bank, and Bandon High Spot) as well as offshore of Cape Arago and Siletz Reef.

4) Cape Blanco – Cape Mendocino: from 0-40 m, clustering was found at Orford Reef-Redfish Rocks, Mac Reef, Cape Ferrelo, Point George, Trinidad Head, and from South Humboldt Bay to Eel River delta. In deeper depth classes, clustering occurred at the Rogue River canyon, from Point George south to Trinidad Head, and Eel River Canyon.

One observation about the irreplaceability scenario is that it shows a high degree of "clumping" of AUs or contagion that is relatively unusual for Marxan solutions with a similar boundary length modifier that regulates this output effect. We suspect that this enhanced clumping is a function of a couple of factors; one, it represents where there is more data than not and two, it shows the effects of running 100 million iterations for each Marxan run which was considerably more iterations than we typically ran for terrestrial assessments. Within State waters (less than 3 nm from shore) or within the inner shelf depth class (0-40m), it appears that some of the target drivers for this scenario were seabird colonies, islands, kelp and marine mammal occurrences. In offshore areas, it appears that rocky reefs partially drove the area selection in this solution.

Table 9. Percentages of the assessment area selected by Marxan for the Irreplaceability Scenario and Conservation Utility Scenario compared within state and federal waters and in each of the four ecological sections

				Ecological Sections			
	In Whole Ecoregion (ha)	**In State waters (ha)**	**In Federal waters (ha)**	**IBPG (ha)**	**PGCL (ha)**	**CLCB (ha)**	**CBCM (ha)**
Area of Assessment	10,465,448	1,317,632	9,147,816	1,895,001	3,449,679	2,707,200	2,413,568
Conservation Solution							
Conservation Utility Scenario -Best Solution	3,334,964	304,640	3,030,324	616,787	1,123,809	856,832	737,536
% of Area	**31.9**	**23.1**	**33.1**	**32.5**	**32.6**	**31.7**	**30.6**
Irreplaceability Scenario -Best Solution	3,381,636	332,544	3,049,092	624,260	1,136,640	870,912	749,824
% Area	**32.3**	**25.2**	**33.3**	**32.9**	**32.9**	**32.2**	**31.1**

5.2 Conservation Utility Scenario

The Conservation Utility Scenario used the same data as the Irreplaceability Scenario (i.e., targets, goals, Marxan methods and settings) and also included the Suitability Index for each AU. Because this scenario incorporates this Index representing existing human uses and impacts into the analysis, it has the potential to greatly change the "cost" values being analyzed in the running of the algorithm.

In this scenario, conservation goals were effectively met for 98% (725 out of 735) of the targets that had goals initially set in the analysis (Appendix 6). The ten targets that did not have their goals met were similar to the Irreplaceability Scenario:

Shoreline habitats (5)
Benthic habitats (3)
Deepwater coral (1)
Estuary habitat (1)

The best run solution identified 31.9% of the ecoregion to meet conservation goals. When broken down by AUs, the best run included 23.1% of the state (nearshore) AUs and 33.3% of the federal (offshore) AUs. Table 9 shows summary results for the final Marxan runs.

We examined these results by depth class in each of the four ecological sections and found these clusters of selected AUs (Map 9):

1) <u>International Boundary – Point Grenville</u>: from 0-40m within State waters in the inner shelf, the selections clustered at Port Angeles, Pillar Point and offshore of the Sekiu River in the Straits as well as along the coastal unit of Olympic National Park, near LaPush and at Tunnel Island. Farther offshore selected clusters included the Biogenic area 1 (NOAA Essential Fish Habitat or EFH), Juan de Fuca submarine canyon, and an extensive cluster around the shelf/slope break (200-700m) offshore from Point Grenville and continuing south to the mouth of the Columbia River.

2) <u>Point Grenville–Cape Lookout</u>: selected clusters in shallow waters (0-40m) include Point Grenville, Willapa Bay-Long Beach Peninsula, Tillamook Head, Tillamook Bay and Cape Meares-Cape Lookout. Offshore the shelf-slope break was selected along much of the section as well as the following EFH areas: Astoria Canyon, Nehalem Bank, Grays Canyon and Biogenic 3.

3) <u>Cape Lookout—Cape Blanco</u>: from 0-40m in depth clusters included Otter Rock (Depot Bay), Cape Perpetua, Lakeside, Cape Arago-Coos Bay, Bandon and Cape Blanco-Orford Reef. Offshore areas were somewhat less well defined but included EFH areas: Siletz Deepwater, Heceta Bank, Coos Bay Deepwater and Bandon Highspot. Other clusters were offshore Cape Perpetua and offshore Coos Bay along the shelf-slope break.

4) <u>Cape Blanco-Cape Mendocino</u>: clusters at Port Orford-Redfish Rocks, Cape Sebastian-Mac Reef, Cape Ferrelo, Point George, Eureka and Blunts Reef EFH were selected in the state waters. Rogue Canyon EFH and the adjacent shelf-slope break area was a selected cluster offshore of

Oregon while offshore California, the shelf-slope break from Point George south to Eel Canyon EFH was identified. There was also a large cluster selected in deep waters immediately north of the Cape Mendocino EFH.

Not surprisingly, the conservation utility scenario, that includes the suitability index, showed greater concentrations of selected AUs around the EFH conservation areas as they were deemed more protected than surrounding ocean areas. There was also evidence of some clumping of AUs at several nearshore areas in state waters. Finally, there appeared to be selected AUs that trend along the 200m boundary between the midshelf (40-200m) and mesobenthal (200-700m) depths. These selected AUs also extend into the narrow mesobenthal depth band that represents the beginning of the continental slope or the shelf-slope break as it descends steeply into deeper waters. This area contains important foraging waters for many diverse species including seabirds, marine mammals and many fishes.

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Chapter 6 – Discussion

6.1 Comparison of conservation scenarios

Clear differences are evident between the two scenarios used in this analysis (Irreplaceability and Conservation Utility) but there are also significant similarities as well. The irreplaceability scenario (i.e. without suitability index) showed less variability in its runs as reflected by the greater number of AUs selected for a high percentage (>80%) of the runs when compared with the conservation utility scenario (i.e. with suitability index). The higher degree of clustering displayed in the irreplaceability scenario (Map 8) is somewhat related to the density of the conservation data across the ecoregion (Map 5). With relatively less data overall and with a more uneven distribution of data than in other ecoregional assessments, there was greater likelihood of AUs being selected because they had more target data associated with them when suitability is not a factor. This also shows the greater importance of the suitability index in this assessment in terms of its effects on the analysis. Another clear difference between the two scenarios is the clustering of AUs around the NOAA EFH in the conservation utility scenario. These clusters were chosen in more than 80% of the 10 runs. Because of existing fisheries closures, these areas are highly suitable for meeting conservation goals for the conservation targets in this assessment, for example, groundfish.

While there are discernible differences in the scenarios, the similarities seem to outweigh them with many of the same general areas being targeted by both scenarios. This is true for the shallow and deepwater areas. Again, this is partly due to data disparities in the ecoregion that results in Marxan solutions generally selecting AUs that have relatively more data that AUs that have less data. With the Marxan algorithm striving for least cost solutions, i.e. highest efficiency in terms of maximizing the conservation gains on the fewest number of AUs, then it is easy to see that relative data density can become quite important in the ecoregion. In comparing the two scenarios, it is instructive to see how similar in size is the overall area captured by them (Table 9). The conservation utility analysis, captures 31.9% of the ecoregion in the best solution while the irreplaceability analysis, captures 32.3 % of the ecoregion; this 0.4% difference is very minor. Areas of state and federal waters and comparisons within the four ecological sections of ecoregion show similar results.

Another factor that weighs in on both scenarios was the relative importance of the depth contour that roughly corresponds to the shelf-slope break. The shelf-slope break occurs generally along the mesobenthal depths (200-700m) and can be relatively narrow through much of the ecoregion, sometimes only a single AU wide or 3 miles. A large and diverse number of fine filter targets as well as benthic habitat targets are found at the shelf-slope break. Both scenarios selected AUs where the mesobenthal depth band was narrow in order to meet conservation goals (Maps 8 and 9). Where the band is narrow, the shelf-slope break is steep and thus challenging to deploy trawl bottom gear. Since the suitability index can be based almost entirely on fishing effort in deepwater or offshore areas, limited fishing leads to the selection of these habitats.

Overall both scenarios identified areas that had nearshore and offshore linkages including larger estuaries in some cases although the conservation utility scenario reduced the sizes of the included estuaries presumably due to suitability constraints. One of the more interesting areas identified occurs off the Columbia River which is the source of 77% of the coastal drainage on the west coast (Hickey et al 2003). The Washington nearshore area from the mouth of the Columbia northward intermittently to Point Grenville plus a large portion of the continental shelf offshore of this area which corresponds to the Columbia Plume in winter months was identified in both scenarios. In addition, offshore northwest Oregon was identified for its conservation importance which corresponds to the Columbia Plume signature in summer months. The submarine canyons that are prominent off the Washington Coast and also include the Astoria, Rogue and Eel River Canyons farther south were identified in the scenarios as well. One prominent area that was not highlighted in the assessment for unknown reasons was Stonewall Bank offshore of Newport on the central Oregon coast. For whatever reason, this well-known area of biological importance did not have survey data available and was likely missed due to lack of data.

6.2 Comparison of results with other ecoregional assessments

The Pacific Northwest Marine Ecoregion shares common borders and overlaps with two completed ecoregional assessments, the Pacific Northwest Coast Ecoregional Assessment (Vander Schaaf et al 2006) and the Northern California Marine Ecoregional Assessment (TNC 2006). A third ecoregional analysis, the British Columbia Marine Ecoregional Analysis (BCMCA) is in progress for the coast waters of British Columbia. The two completed assessments identified final portfolios of priority conservation areas instead of using summed runs solutions or scenarios as portrayed in this current work. The completed assessments also utilized different datasets than the current assessment and neither of the earlier assessments analyzed trawl survey data nor trawl logbook data which were major portions of the offshore data used in the current assessment. Nevertheless the results can fairly easily be compared to look for agreement.

The Northern California Marine Ecoregional Assessment (TNC 2006) included the California portions of the continental shelf from Cape Mendocino to the California-Oregon border both in shallow and deep waters. The overall results in this PNW Marine Ecoregional Assessment had strong agreement with the Northern California marine assessment in that it identified AUs at Cape Mendocino and Eel River Canyon EFH, shallow waters by Humboldt Bay and Point George and offshore waters by Big Lagoon County Park. These areas as well as several other sites identified in the PNW Marine Ecoregional Assessment are all identified in the Northern California assessment.

The Pacific Northwest Coast Ecoregional Assessment (Vander Schaaf et al 2006) extended along all of the Oregon and Washington coastlines and beyond into Vancouver Island, overlapping with the current assessment in estuaries and on the immediate shoreline. Along the shoreline, there was good agreement between the Coast assessment and the current work although the selected AUs in the Marine assessment tended to be clustered more due to the inclusion of nearshore areas as well. The current work differs from the Coast assessment in that it was much more discriminating in the larger estuaries in terms of identifying less area as being of conservation priority. This was especially true in Grays Harbor, Willapa Bay and the lower Columbia River. Many of the mid-sized estuaries in Oregon also had fewer selected AUs identified by the current assessment although all of those that were highlighted for their importance in the Coast assessment still have at least part of their area identified in this effort. Given the more comprehensive nature of the marine data used in this Marine assessment, we feel that it was likely a more informed portrayal of priority shoreline and estuaries in Oregon and Washington than the Coast assessment.

6.3 Uncertainty in the results

There were two major sources of uncertainty in our analysis. First, there were errors in the biological data. The target occurrence data undoubtedly had both errors of omission and commission but the error rates were unknown. The accuracy of the benthic and estuary habitat data was also unknown. Second, the suitability index was not an empirical model because variable selection and the parameter estimates for the index were based on professional and judgment. The index was validated through expert opinion, but it was not verified or ground-truthed with additional data. In addition, the various GIS data used to compute the suitability index had errors, and the error rates for these were unknown as well. We would have liked to express the uncertainty of the irreplaceability or utility values by calculating confidence limits around them, but no technique for doing so currently exists. Even if such a technique were available, it would probably require some knowledge of the input data error rates.

Previous ecoregional assessments (Vander Schaaf et al. 2006, Pryce et al. 2006, Iachetti et al. 2006) have also explored the sensitivity of the conservation utility analysis to changes in the suitability index. Each of these analyses found that AU utility and its rank changed in response to changes in the suitability index, in other words, the AU rankings were sensitive to the index values. Similarity measures that compared "before" and "after" utility maps of the entire ecoregion indicated that the overall map was relatively insensitive to changes in suitability index parameters. That is, the average change over all AUs was small. However, the utility and rank of some individual AUs did change significantly. The number of AUs that changed significantly depended of which index parameter was changed and the amount of change to that parameter. These findings were similar to our comparisons of the irreplaceability and utility values.

Before we can explore the sensitivity of our results to errors in the biological data, we need to understand the potential errors. For occurrence data, error rates were target-specific (or taxon-specific) and a function of several factors: data age, survey methods, survey interval, survey intensity, survey extent, and the nature of the species and its habitat. To complicate the analysis further, error rates for a single target could have been uneven across the ecoregion. To obtain meaningful results from a sensitivity analysis, we needed, at the very least, a set of target-specific (or taxon-specific) error rates or error rate models. Error rates were also needed for the habitat data – ideally, omission and commission rates by habitat type category. All this suggested a level of complexity that was beyond the capacity of this ecoregional assessment. Therefore, we were forced to assume the error rates in the biological data were acceptable for the level of detail we were striving for in this regional-scale assessment and did not have an undue influence on the irreplaceability and conservation utility scenarios discussed above.

6.4 Setting Conservation Priorities

The priority areas identified in the scenarios (Maps 8 and 9) provided a starting place for discussions on ocean conservation and marine resource management to take place among various stakeholder groups in the ecoregion. The resulting two scenarios were based on comprehensive input data that allowed for querying of individual AUs or a number of AUs as desired. These can be looked at in aggregate with their data summed together to see what biological targets were present and what constraints may be affecting the suitability of selected areas. The data in the assessment represent differing geographic scales ranging from very specific point locations such as seabird colonies to the fisheries trawl survey information that was summarized to large blocks representing 5 minutes of latitude and longitude (5 nm X 5 nm). The conservation planning model used by The Nature Conservancy employs more specific Conservation Action Plans (CAP) to define conservation strategies for sites identified in ecoregional assessments. CAP planning efforts take a more focused look at sites and site specific data.

Given that the shallow water and estuary data were generally at a finer scale than offshore data and the shallow water and estuary data were generally more abundant and varied, we feel that areas identified by the Marxan analysis within State waters can be used to inform conservation priorities for stakeholders and programs that may operate there. The Pacific Northwest Coast Ecoregional Assessment (Vander Schaaf et al 2006) also identified conservation priorities in estuaries and along the immediate shoreline. While there is good agreement between the 2006 work and the present assessment, with the newer data in the Marine assessment, we generally recommend using it to stakeholders working in estuaries or along the coastline.

In the offshore, deepwater portion of the ecoregion which is represented by the larger assessment units, the conservation priorities portrayed by the scenarios truly offer an opportunity to have an informed discussion about the identification of potential conservation areas in continental shelf and slope areas. The data that drove the assessment in the offshore waters were largely derived from the NOAA Fisheries Service trawl surveys and from suitability factors that represent commercial trawling effort and the EFH sites that restrict bottom contact gear. The clustered AUs in the two scenarios contained representative benthic habitats and occurrences of fish and coral species that may be caught in benthic trawls. Some stakeholders argued that the omitted data were very important and as such the results were less valuable. We are the first to agree that data omissions that included such important groups as pelagic seabirds, fishes, and cetaceans can be problematic for advancing conservation priorities and strategies. However, we believe that understanding the results from the available data was also instructive.

6.5 Recommendations for Future Analyses and Next Steps

The PNW Marine Ecoregional Assessment was a first iteration effort that compiled much of the available conservation data and intersected it with sufficient suitability data to develop the two conservation scenarios (Chapter 5). There are always additional conservation target data that could be modified or added to an ecoregional analysis and there are other changes that could be made to conservation goals in order to favor a particular outcome but overall, the assessment team felt that this early effort was credible and offered a good platform for future conservation work.

Data gaps were evident in the analysis (see Section 2.5.1) and some could possibly modify results to a significant degree or result in solutions that altered selected AUs by an estimated 5-10%. The biological data gaps were almost entirely due to a lack of data, especially across the ecoregion. Some taxon groups such as seabirds, cetaceans, deepwater fishes and pelagic species have had several multi-year studies and still defy our abilities to track their movements, know their abundances or characterize their pelagic habits. Some of these pelagic species may be considered so wide ranging that an ecoregional assessment is not the appropriate scale for their conservation; for instance, different scales may be needed for breeding and non-breeding populations. On the other hand there are regionally important species such as rockfish, forage fish and marine algae that we could not fully account for in the current assessment. As data improves for these taxa or at least our own means for adequately including them in the analysis improves, re-running the Marxan algorithm may be timely. With more comprehensive data in these latter groups (rockfish, forage fish, marine algae) and regional experts to evaluate the analysis, we feel that developing a more specific portfolio of priority conservation areas may then be feasible and timely.

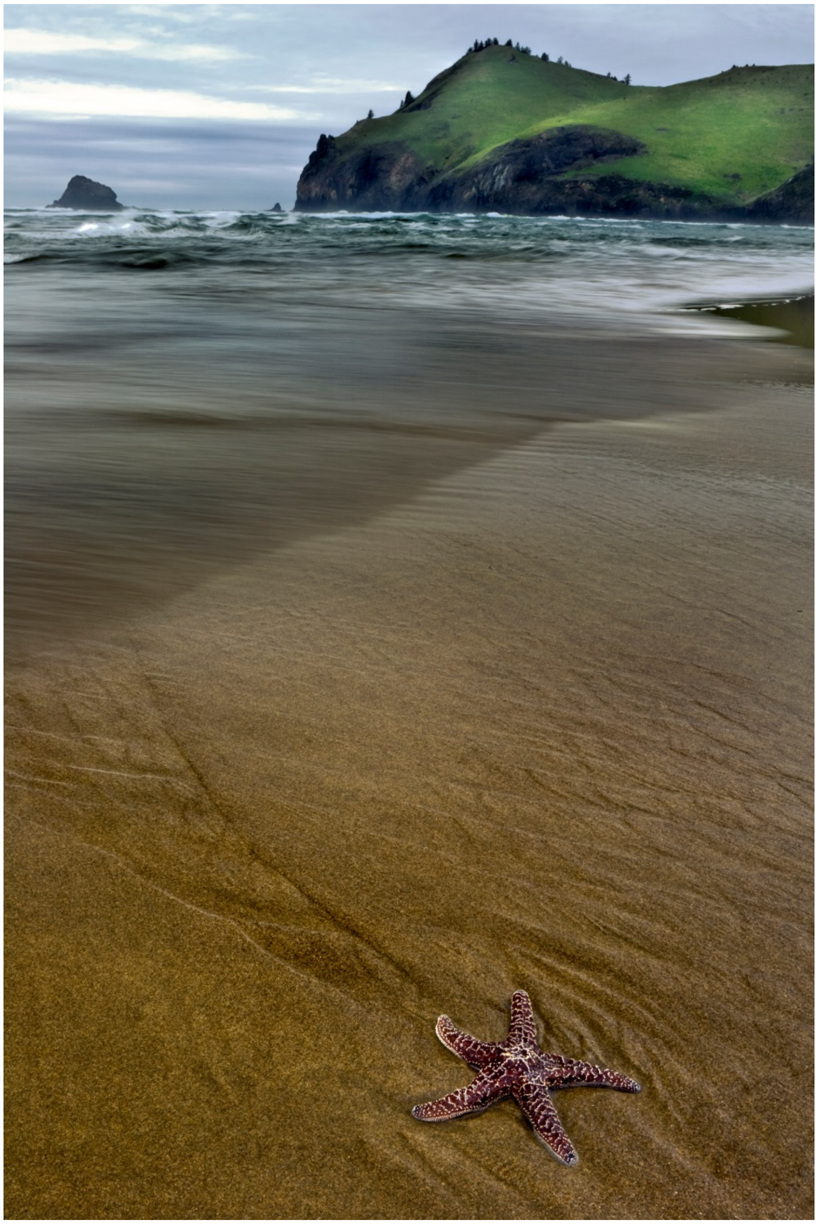
In addition to the biological data that were limiting in some cases, there were also a number of suitability factors that play strongly in this sort of analysis that need more critical thinking in terms of their effects on conservation actions. The socio-economic activities that drive this ecoregion are reasonably well known and can be divided between current activities like land-based development and nearshore/offshore fisheries and future activities that include alternative energy production, aquaculture and others. These broad-based activities are currently in a state of dramatic change that makes it difficult to predict their impacts on the ecoregion in the future except to say that it is likely that all will continue to be important forces. Complicating this even further is the fact that fishing has an international component as well that is even more difficult to quantify or predict the direction that regulations make take there. Alternative energy development is a factor in site suitability that was not included in the current analysis because spatial data were not available but it will likely play a role in the future

A final limitation in the current assessment was the inability to factor in climate change and its potential impacts to the PNW marine ecoregion. It is now widely accepted that climate change is having profound impacts on oceans with dramatic examples being offered in polar seas and in tropical oceans. In temperate oceans such as in this ecoregion, the impacts are not nearly as dramatic so far although we are beginning to witness some of insidious effects linked to ocean acidification. Climate change will also result in sea level rise and has also been linked to increased storm frequency that could modify our coastlines over time. Finally, there are early indications that climate change could alter the circulation patterns, currents and annual ocean cycles such as coastal upwelling that are the defining ecological processes in the California Current Ecosystem. Our assessment methodology could not begin to take into account or model these potential impacts and we defer to initiatives to do so.

The next steps for the PNW Marine Ecoregional Assessment include using the data and the methodology to inform some of the ongoing marine conservation work in the respective states and to bring the results to discussions with strategic stakeholders across the ecoregion. Coastal and Marine Spatial Planning efforts undertaken throughout the west coast will benefit from the data and information that have been compiled and analyzed in this assessment. For example, in Washington, coastal treaty tribes and their fishing communities are primary stakeholders in marine waters and fisheries management. The tribes could be brought into a conversation about what the current assessment tells us and how it can be improved with their input. In Oregon, the marine reserve delineation process was another avenue for such dialogue in helping to craft solutions to the issue. Inputs from user groups can help validate and/or improve data that were used to characterize their industry.

6.6 Conclusion

This Pacific Northwest Marine Ecoregional Assessment was the first comprehensive attempt in this marine ecoregion to analyze biodiversity information in conjunction with human use factors and identify potential conservation scenarios that optimize conservation value while minimizing impacts to current uses. Two scenarios displayed both where there are areas of high marine biodiversity as well as where conservation may be most effectively implemented in a spatially efficient manner. Input was solicited from knowledgeable experts in large workshop formats as well as in one to one meetings to insure that the best data were being used and for their intended purpose. Much work remains to be done to develop effective marine conservation in the ecoregion but it is hoped that this assessment will serve to catalyze both dialogue and action among stakeholders who use and value the sea.



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Glossary

Anadromous: fish that hatch in freshwater, migrate to saltwater, and then come back to freshwater to spawn. Some species are semilparous (spawn and die).

Assessment unit: the area-based polygon units used in the optimal site-selection algorithm and attributed with the conservation suitability and amount of all targets located within them. These units are non-overlapping and cover each ecoregion and EDU.

Base layer: a data layer in a GIS that contains basic information such as political boundaries, etc.

Bathymetry: the study or measurement of underwater depths of the ocean floor. Bathymetric charts are developed in order classify benthic habitats based on several factors including depth.

Benthic habitat: refers to habitats that are associated with or occurring on the bottom of a body of water. Such habitats are characterized by depth, substrate and landforms (geomorphology) that combine to form places where animals and plants live on or in the bottom of the ocean.

Biodiversity: the full range of natural variety and variability within and among organisms, and the ecological complexes in which they occur. This term encompasses multiple levels of organization, including genes, subspecies, species, communities, and ecological systems or ecosystems.

Candidate species: plants and animals that the U.S. Fish and Wildlife Service believe should be considered for status review. A status review may conclude that the species should be added to the federal list of threatened and endangered species.

Coarse-filter: refers to the biological communities or ecological systems, which if protected in sufficient quantity, should conserve the vast majority of species in the ecoregion.

Conservation target: See *Target*

Core team: the interdisciplinary group that is accountable for the completion of the ecoregional assessment.

Cost: a component of the MARXAN algorithm that encourages MARXAN to minimize the area of the portfolio by assigning a penalty to factors that negatively affect biodiversity, such as proximity to roads and development. In this assessment, terrestrial and freshwater costs were assigned to each assessment unit in the ecoregion. Used synonymously with "vulnerability" and "suitability," which is actually the inverse of the cost.

Declining: species that have exhibited significant, long-term reduction in habitat/and or numbers, and are subject to continuing threats in the ecoregion.

Disjunct: See *Distribution*

Distribution: In ecoregional assessments, distribution is thought of relative to the ecoregion and used as a guide to establish numeric differentials in goal setting (higher with endemic species, to lower with peripheral species).

Endemic = >90% of global distribution in ecoregion

Limited = <90% of global distribution is within the ecoregion, and distribution is limited to 2-3 ecoregions

Disjunct = distribution in ecoregion quite likely reflects significant genetic differentiation from main range due to historic isolation; roughly >2 ecoregions separate this ecoregion from other more central parts of its range

Widespread = global distribution >3 ecoregions

Peripheral = <10% of global distribution in ecoregion

Ecological integrity: the probability of an ecological community or ecological system to persist at a given site is partially a function of its integrity. The ecological integrity or viability of a community is governed primarily by three factors: demography of component species populations; internal processes and structures among these components; and intactness of landscape-level processes which sustain the community or system.

Ecoregion: a relatively large area of land or ocean that contains geographically distinct assemblages of natural communities, with boundaries that are approximate. These communities share a large majority of their species, dynamics, and environmental conditions, and function together effectively as a conservation unit at global and continental scales.

Element code (EL Code): a unique 10-character alphanumeric code created and used by Heritage Programs and NatureServe to universally classify species, communities, and terrestrial systems. The Global Element ID code list is now being used by Natureserve, in addition to El Codes.

Element occurrence (EO): a term originating from the methodology of the Natural Heritage Network that refers to a unit of land or water on which a population of a species or example of an ecological community occurs. For communities, these EOs represent a defined area that contains a characteristic species composition and structure.

Endangered species: any species which is in danger of extinction throughout all of its range; a species that is listed as Endangered by the U.S. Fish and Wildlife Service under the Endangered Species Act.

Endemic: See *Distribution*

Evolutionarily Significant Unit (ESU): used to identify “distinct population segments” of Pacific salmon (*Oncorhynchus spp.*) stocks under the U.S. Endangered Species Act. The basic spatial unit used to help describe a species diversity within its range and aid in the recovery of a listed species.

Extirpation: the extinction of a species or a group of organisms in a particular local area.

Fine-filter: species of concern or aggregations that complement the coarse filter, helping to ensure that the coarse filter strategy adequately captures the range of viable, native species and biological communities. Endangered or threatened, declining, vulnerable, wide-ranging, very rare, endemic, and keystone species are some potential fine filter targets.

GAP (National Gap Analysis Program): Gap analysis is a scientific method for identifying the degree to which native animal species and natural communities are represented in our present-day mix of conservation lands. Those species and communities not adequately represented in the existing network of conservation lands constitute conservation "gaps." The purpose of the Gap Analysis Program (GAP) is to provide broad geographic information on the status of ordinary species (those not threatened with extinction or naturally rare) and their habitats in order to provide land managers, planners, scientists, and policy makers with the information they need to make better-informed decisions. URL:

GAP status: the classification scheme or category that describes the relative degree of management or protection of specific geographic areas for the purpose of maintaining biodiversity. The goal is to assign each mapped land unit with categories of management or protection status, ranging from 1 (highest protection for maintenance of biodiversity) to 4 (no or unknown amount of protection).

Biodiversity Management Status Categories of the GAP Analysis Program	
Category	**Description**
Status 1	An area having permanent protection from degradation of natural ecosystems, habitats and communities and a mandated management plan in operation to maintain the natural state of those systems. *(E.g. marine reserves or other no-take areas with high ecosystem protection)*
Status 2	An area having permanent protection from protection from degradation of natural ecosystems, habitats and communities and mandated to maintain a primarily natural state, but subject to limited use or management practices that affect the quality of existing natural communities. *(E.g. Marine Parks, marine conservation areas or other limited take areas with moderate to high ecosystem protection)*
Status 3	An area having permanent protection from degradation of natural ecosystems, habitats and communities, but subject to extractive uses of either a broad, low-intensity type or localized intense type. *(E.g. some marine conservation areas; National Marine Sanctuaries; National Estuarine Research Reserves; or other areas that provide limited ecosystem protection)*
Status 4	Lack of irrevocable designation or mandate to prevent degradation or natural ecosystems, habitats and communities; intensive uses allowed. *(E.g. areas without permanent designation for habitat protection including temporary fishery closures)*

Geographic Information System (GIS): a computerized system of organizing and analyzing spatially-explicit data and information.

Geomorphology: landforms or terrains that define the physical shape of habitats and the processes that creates them.

Global rank: an assessment of a biological element's (species or plant association) relative imperilment and conservation status across its geographic distribution. The ranks range from G1 (critically imperiled) to G5 (secure). These ranks are assigned by the Natural Heritage Network and are determined by the number of occurrences or total area of coverage (plant associations only), modified by other factors such as condition, historic trend in distribution or condition, vulnerability, and impacts.

G1	Critically Imperiled – Critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction. Typically 5 or fewer occurrences or very few remaining individuals (<1,000) or acres (<2,000) or linear miles (>10).
G2	Imperiled – Imperiled globally because of rarity or because of some factor(s) making it very vulnerable to extinction or elimination. Typically 6-20 occurrences or few remaining individuals (1,000-3,000) or acres (2,000-10,000) or linear miles (10-50).
G3	Vulnerable – Vulnerable globally either because very rare and local throughout its range, found only in a restricted range, or because of other factors making it vulnerable to extinction or elimination. Typically 21-100 occurrences or between 3,000 and 10,000 individuals.
G4	Apparently Secure – Uncommon but not rare (although it may be rare in parts of its range) but possible cause for long-term concern. Typically more than 100 occurrences and more than 10,000 individuals.
G5	Secure – Common, widespread, and abundant (although it may be rare in parts of its range, particularly on the periphery). Not vulnerable in most of its range. Typically with considerably more than 100 occurrences and more than 10,000 individuals.

Goal: in ecoregional assessments, a numerical value associated with a species or system that describes how many populations (for species targets) or how much area (for systems targets) the portfolio should include to represent each target, and how those target occurrences should be distributed across the ecoregion to better represent genetic diversity and hedge against local extirpations.

Ground truthing: assessing the accuracy of GIS data through field verification.

Impact: the combined concept of ecological stresses to a target and the sources of that stress to the target. Impacts are described in terms of severity and urgency. Sometimes used synonymously with "threat."

Imperiled species: species that have a global rank of G1-G2 by Natural Heritage Programs. Regularly reviewed and updated by experts, these ranks take into account number of occurrences, quality and condition of occurrences, population size, range of distribution, impacts and protection status.

Integration: a portfolio assembly step whereby adjacent sites that contain high-quality occurrences of both freshwater and terrestrial targets are combined.

Irreplaceability: an index that indicates the conservation value of a potential conservation area based on the rarity and number of targets in a given assessment unit. It is operationally defied as the percentage of alternative reserve systems for which a particular assessment unit is chosen. When generating the irreplaceability values, a suitability index is not used.

Limited: See *Distribution*

Marine ecological systems/ecosystems: dynamic spatial assemblages of plants and animals that 1) occur together on the landscape; 2) are tied together by similar ecological processes (e.g. upwelling, productivity), underlying environmental features (e.g. substrate) or environmental gradients (e.g. bathymetry); and 3) form a robust, cohesive, and distinguishable unit on the ground. Ecological systems are characterized by both biotic and abiotic components.

Marxan: Marine Reserve Design Using Spatially Explicit Annealing. Software consisting of computerized optimal site selection algorithms that select conservation sites based on their biological value and suitability for conservation.
URL: www.ecology.uq.edu.au/Marxan.htm

Occurrence: spatially referenced locations of species, plant associations, or ecological systems. May be equivalent to Natural Heritage Program element occurrences, or may be more loosely defined locations delineated through the identification of areas by experts.

Pelagic habitat: refers to open ocean areas not in close proximity to the sea floor but rather at any depth above it all way to the ocean's surface. Pelagic habitat excludes the immediate coastal area that is dominated by the surf zone.

Population: a group of individuals of a species living in a certain area that maintains some degree of reproductive isolation.

Primary productivity: the production of organic compounds from atmospheric or aquatic carbon dioxide, principally through the process of photosynthesis, with chemosynthesis being much less important. Algae, the organisms responsible for most of the primary production in marine ecoregions, form the base of the food chain.

Secondary productivity: the generation of consumer organisms that is driven by the transfer of organic material between trophic levels. It is commonly defined as all productivity above the level of the primary producers which base their production on sunlight through photosynthesis.

Sensitivity analysis: analysis done to determine what happens to model outputs in response to a systematic change of model inputs. Sensitivity analysis serves two main purposes: (1) to measure how much influence each parameter has on the model output; and (2) to evaluate the

Smooth sheets: a final, neatly drafted, accurate plot of a hydrographic survey. The Office of Coastal Survey was originally responsible for drafting navigational charts which resulted in the smooth sheet editions.

Suitability: the likelihood of successful conservation at a particular place relative to other places in the ecoregion. The lower the suitability "value" the more suitable an assessment unit is for conservation. For this assessment, GIS layers which were part of the terrestrial and marine suitability indices included management status, land use, road density, dams and mines. For this assessment the inverse of the suitability score was equal to the vulnerability. See *Cost* for further explanation.

Substrate: the physical material found on the ocean floor that provides the inherent physical structure for biological life in benthic habitast. Substrate types may include rock, cobble, gravel, sand, or mud as well as materials that have biological derivations such as shell or coral.

Target: also called conservation target. An element of biodiversity selected as a focus for the conservation assessment. The three principle types of targets are species, communities, and ecological systems.

Threatened species: any species that is likely to become an endangered species throughout all or a significant portion of its range; a species listed as Threatened by the U.S. Fish and Wildlife Service under the Endangered Species Act.

Umbrella species: species that by being protected may also protect the habitat and populations of other species.

Upwelling: an oceanographic phenomenon that involves wind-driven motion of warmer, usually nutrient-depleted surface water that is replaced by dense, cooler, and nutrient-rich water. The increased nutrients results in high levels of primary productivity and thus fishery production.

Viability: the ability of a species to persist for many generations or an ecological community or system to persist over some time period.

Vulnerability: an index which reflects the relative likelihood that target species will be lost from an area. In this assessment, it is equal to the inverse of suitability. See *Cost* for more details.

Vulnerable: vulnerable species are usually abundant, may or may not be declining, but some aspect of their life history makes them especially vulnerable (e.g., migratory concentration or rare/endemic habitat).

Widespread: See *Distribution*

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Appendix 1 Conservation Targets and Goals

DEFINITIONS	
CPUE =	Catch per Unit Effort
PA =	Protected Area
CH =	Critical Habitat

TGT ID	Target	Common Name	Scientific Name	Analysis Target	Goal	Type	Category
1	Bathybenthal Canyon Mud	Bathybenthal Canyon Mud		Y	0.3	Benthic Habitat	Coarse
2	Bathybenthal Canyon Rock	Bathybenthal Canyon Rock		Y	0.3	Benthic Habitat	Coarse
3	Bathybenthal Canyon Sand	Bathybenthal Canyon Sand		Y	0.3	Benthic Habitat	Coarse
4	Bathybenthal Flats Mud	Bathybenthal Flats Mud		Y	0.3	Benthic Habitat	Coarse
5	Bathybenthal Flats Rock	Bathybenthal Flats Rock		Y	0.3	Benthic Habitat	Coarse
6	Bathybenthal Flats Sand	Bathybenthal Flats Sand		N	0	Benthic Habitat	Coarse
7	Bathybenthal Middle slope Mud	Bathybenthal Middle slope Mud		Y	0.3	Benthic Habitat	Coarse
8	Bathybenthal Middle slope Rock	Bathybenthal Middle slope Rock		Y	0.3	Benthic Habitat	Coarse
9	Bathybenthal Middle slope Sand	Bathybenthal Middle slope Sand		N	0	Benthic Habitat	Coarse
10	Bathybenthal Ridge Mud	Bathybenthal Ridge Mud		Y	0.3	Benthic Habitat	Coarse
11	Bathybenthal Ridge Rock	Bathybenthal Ridge Rock		Y	0.3	Benthic Habitat	Coarse
12	Inner shelf Canyon Rock	Inner shelf Canyon Rock		N	0	Benthic Habitat	Coarse
13	Inner shelf Canyon Sand	Inner shelf Canyon Sand		Y	0.3	Benthic Habitat	Coarse
14	Inner shelf Flats Gravel	Inner shelf Flats Gravel		Y	0.3	Benthic Habitat	Coarse
15	Inner shelf Flats Mud	Inner shelf Flats Mud		Y	0.3	Benthic Habitat	Coarse
16	Inner shelf Flats Rock	Inner shelf Flats Rock		Y	0.3	Benthic Habitat	Coarse
17	Inner shelf Flats Sand	Inner shelf Flats Sand		Y	0.3	Benthic Habitat	Coarse
18	Inner shelf Flats Soft	Inner shelf Flats Soft		Y	0.3	Benthic Habitat	Coarse
19	Inner shelf Middle slope Gravel	Inner shelf Middle slope Gravel		Y	0.3	Benthic Habitat	Coarse
20	Inner shelf Middle slope Mud	Inner shelf Middle slope Mud		N	0	Benthic Habitat	Coarse
21	Inner shelf Middle slope Rock	Inner shelf Middle slope Rock		Y	0.3	Benthic Habitat	Coarse
22	Inner shelf Middle slope Sand	Inner shelf Middle slope Sand		Y	0.3	Benthic Habitat	Coarse
23	Inner shelf Middle slope Soft	Inner shelf Middle slope Soft		Y	0.3	Benthic Habitat	Coarse
24	Inner shelf Ridge Gravel	Inner shelf Ridge Gravel		N	0	Benthic Habitat	Coarse
25	Inner shelf Ridge Mud	Inner shelf Ridge Mud		N	0	Benthic Habitat	Coarse
26	Inner shelf Ridge Rock	Inner shelf Ridge Rock		Y	0.3	Benthic Habitat	Coarse
27	Inner shelf Ridge Sand	Inner shelf Ridge Sand		Y	0.3	Benthic Habitat	Coarse
28	Mesobenthal Canyon Mud	Mesobenthal Canyon Mud		Y	0.3	Benthic Habitat	Coarse
29	Mesobenthal Canyon Rock	Mesobenthal Canyon Rock		Y	0.3	Benthic Habitat	Coarse
30	Mesobenthal Canyon Sand	Mesobenthal Canyon Sand		Y	0.3	Benthic Habitat	Coarse
31	Mesobenthal Canyon Soft	Mesobenthal Canyon Soft		N	0	Benthic Habitat	Coarse
32	Mesobenthal Flats Gravel	Mesobenthal Flats Gravel		N	0	Benthic Habitat	Coarse
33	Mesobenthal Flats Mud	Mesobenthal Flats Mud		Y	0.3	Benthic Habitat	Coarse
34	Mesobenthal Flats Rock	Mesobenthal Flats Rock		Y	0.3	Benthic Habitat	Coarse
35	Mesobenthal Flats Sand	Mesobenthal Flats Sand		Y	0.3	Benthic Habitat	Coarse
36	Mesobenthal Flats Soft	Mesobenthal Flats Soft		Y	0.3	Benthic Habitat	Coarse
37	Mesobenthal Middle slope Gravel	Mesobenthal Middle slope Gravel		N	0	Benthic Habitat	Coarse
38	Mesobenthal Middle slope Mud	Mesobenthal Middle slope Mud		Y	0.3	Benthic Habitat	Coarse
39	Mesobenthal Middle slope Rock	Mesobenthal Middle slope Rock		Y	0.3	Benthic Habitat	Coarse

Appendix 1 Conservation Targets and Goals

TGT ID	Target	Common Name	Scientific Name	Analysis Target	Goal	Type	Category
40	Mesobenthal Middle slope Sand	Mesobenthal Middle slope Sand		Y	0.3	Benthic Habitat	Coarse
41	Mesobenthal Middle slope Soft	Mesobenthal Middle slope Soft		Y	0.3	Benthic Habitat	Coarse
42	Mesobenthal Ridge Mud	Mesobenthal Ridge Mud		Y	0.3	Benthic Habitat	Coarse
43	Mesobenthal Ridge Rock	Mesobenthal Ridge Rock		Y	0.3	Benthic Habitat	Coarse
44	Mesobenthal Ridge Sand	Mesobenthal Ridge Sand		Y	0.3	Benthic Habitat	Coarse
45	Mesobenthal Ridge Soft	Mesobenthal Ridge Soft		Y	0.3	Benthic Habitat	Coarse
46	Mid shelf Canyon Gravel	Mid shelf Canyon Gravel		N	0	Benthic Habitat	Coarse
47	Mid shelf Canyon Mud	Mid shelf Canyon Mud		Y	0.3	Benthic Habitat	Coarse
48	Mid shelf Canyon Rock	Mid shelf Canyon Rock		Y	0.3	Benthic Habitat	Coarse
49	Mid shelf Canyon Sand	Mid shelf Canyon Sand		Y	0.3	Benthic Habitat	Coarse
50	Mid shelf Flats Gravel	Mid shelf Flats Gravel		Y	0.3	Benthic Habitat	Coarse
51	Mid shelf Flats Mud	Mid shelf Flats Mud		Y	0.3	Benthic Habitat	Coarse
52	Mid shelf Flats Rock	Mid shelf Flats Rock		Y	0.3	Benthic Habitat	Coarse
53	Mid shelf Flats Sand	Mid shelf Flats Sand		Y	0.3	Benthic Habitat	Coarse
54	Mid shelf Flats Soft	Mid shelf Flats Soft		Y	0.3	Benthic Habitat	Coarse
55	Mid shelf Middle slope Gravel	Mid shelf Middle slope Gravel		Y	0.3	Benthic Habitat	Coarse
56	Mid shelf Middle slope Mud	Mid shelf Middle slope Mud		Y	0.3	Benthic Habitat	Coarse
57	Mid shelf Middle slope Rock	Mid shelf Middle slope Rock		Y	0.3	Benthic Habitat	Coarse
58	Mid shelf Middle slope Sand	Mid shelf Middle slope Sand		Y	0.3	Benthic Habitat	Coarse
59	Mid shelf Middle slope Soft	Mid shelf Middle slope Soft		Y	0.3	Benthic Habitat	Coarse
60	Mid shelf Ridge Gravel	Mid shelf Ridge Gravel		Y	0.3	Benthic Habitat	Coarse
61	Mid shelf Ridge Mud	Mid shelf Ridge Mud		Y	0.3	Benthic Habitat	Coarse
62	Mid shelf Ridge Rock	Mid shelf Ridge Rock		Y	0.3	Benthic Habitat	Coarse
63	Mid shelf Ridge Sand	Mid shelf Ridge Sand		Y	0.3	Benthic Habitat	Coarse
64	Mid shelf Ridge Soft	Mid shelf Ridge Soft		Y	0.3	Benthic Habitat	Coarse
97	Gravel Beach E	Gravel Beach Exposed		Y	0.3	Shoreline Type	Coarse
98	Gravel Beach P	Gravel Beach Protected		Y	0.3	Shoreline Type	Coarse
99	Gravel Beach VE	Gravel Beach Very Exposed		Y	0.3	Shoreline Type	Coarse
100	Gravel Beach VP	Gravel Beach Very Protected		Y	0.3	Shoreline Type	Coarse
101	Gravel Flat E	Gravel Flat Exposed		Y	0.3	Shoreline Type	Coarse
102	Gravel Flat P	Gravel Flat Protected		Y	0.3	Shoreline Type	Coarse
103	Man-made E	Man-made Exposed		N	0	Shoreline Type	Coarse
104	Man-made P	Man-made Protected		N	0	Shoreline Type	Coarse
105	Man-made VE	Man-made Very Exposed		N	0	Shoreline Type	Coarse
106	Man-made VP	Man-made Very Protected		N	0	Shoreline Type	Coarse
107	Mud Flat E	Mud Flat Exposed		Y	0.3	Shoreline Type	Coarse
108	Mud Flat P	Mud Flat Protected		Y	0.3	Shoreline Type	Coarse
109	Mud Flat VE	Mud Flat Very Exposed		N	0	Shoreline Type	Coarse
110	Mud Flat VP	Mud Flat Very Protected		Y	0.3	Shoreline Type	Coarse
111	Organics/fines E	Organics/fines Exposed		Y	0.3	Shoreline Type	Coarse
112	Organics/fines P	Organics/fines Protected		Y	0.3	Shoreline Type	Coarse
113	Organics/fines VP	Organics/fines Very Protected		Y	0.3	Shoreline Type	Coarse
114	Rock Platform E	Rock Platform Exposed		Y	0.3	Shoreline Type	Coarse
115	Rock Platform P	Rock Platform Protected		Y	0.3	Shoreline Type	Coarse

Appendix 1 Conservation Targets and Goals

TGT ID	Target	Common Name	Scientific Name	Analysis Target	Goal	Type	Category
116	Rock Platform VE	Rock Platform Very Exposed		Y	0.3	Shoreline Type	Coarse
117	Rock with Gravel Beach E	Rock with Gravel Beach Exposed		Y	0.3	Shoreline Type	Coarse
118	Rock with Gravel Beach P	Rock with Gravel Beach Protected		Y	0.3	Shoreline Type	Coarse
119	Rock with Gravel Beach VE	Rock with Gravel Beach Very Exposed		Y	0.3	Shoreline Type	Coarse
120	Rock with Sand Beach E	Rock with Sand Beach Exposed		Y	0.3	Shoreline Type	Coarse
121	Rock with Sand Beach P	Rock with Sand Beach Protected		Y	0.3	Shoreline Type	Coarse
122	Rock with Sand Beach VE	Rock with Sand Beach Very Exposed		Y	0.3	Shoreline Type	Coarse
123	Rock with Sand and Gravel Beach E	Rock with Sand and Gravel Beach Exposed		Y	0.3	Shoreline Type	Coarse
124	Rock with Sand and Gravel Beach P	Rock with Sand and Gravel Beach Protected		N	0	Shoreline Type	Coarse
125	Rock with Sand and Gravel Beach VE	Rock with Sand and Gravel Beach Very Exposed		Y	0.3	Shoreline Type	Coarse
126	Rocky Shore/Cliff E	Rocky Shore/Cliff Exposed		Y	0.3	Shoreline Type	Coarse
127	Rocky Shore/Cliff P	Rocky Shore/Cliff Protected		Y	0.3	Shoreline Type	Coarse
128	Rocky Shore/Cliff VE	Rocky Shore/Cliff Very Exposed		Y	0.3	Shoreline Type	Coarse
129	Rocky Shore/Cliff VP	Rocky Shore/Cliff Very Protected		Y	0.3	Shoreline Type	Coarse
130	Sand Beach E	Sand Beach Exposed		Y	0.3	Shoreline Type	Coarse
131	Sand Beach P	Sand Beach Protected		Y	0.3	Shoreline Type	Coarse
132	Sand Beach VE	Sand Beach Very Exposed		Y	0.3	Shoreline Type	Coarse
133	Sand Beach VP	Sand Beach Very Protected		Y	0.3	Shoreline Type	Coarse
134	Sand Flat E	Sand Flat Exposed		Y	0.3	Shoreline Type	Coarse
135	Sand Flat P	Sand Flat Protected		Y	0.3	Shoreline Type	Coarse
136	Sand Flat VE	Sand Flat Very Exposed		Y	0.3	Shoreline Type	Coarse
137	Sand Flat VP	Sand Flat Very Protected		Y	0.3	Shoreline Type	Coarse
138	Sand and Gravel Beach E	Sand and Gravel Beach Exposed		Y	0.3	Shoreline Type	Coarse
139	Sand and Gravel Beach P	Sand and Gravel Beach Protected		Y	0.3	Shoreline Type	Coarse
140	Sand and Gravel Beach VE	Sand and Gravel Beach Very Exposed		Y	0.3	Shoreline Type	Coarse
141	Sand and Gravel Beach VP	Sand and Gravel Beach Very Protected		Y	0.3	Shoreline Type	Coarse
142	Sand and Gravel Flat E	Sand and Gravel Flat Exposed		Y	0.3	Shoreline Type	Coarse
143	Sand and Gravel Flat P	Sand and Gravel Flat Protected		Y	0.3	Shoreline Type	Coarse
144	Undefined E	Undefined Exposed		N	0	Shoreline Type	Coarse
145	Undefined P	Undefined Protected		N	0	Shoreline Type	Coarse
146	Undefined VE	Undefined Very Exposed		N	0	Shoreline Type	Coarse
147	Undefined VP	Undefined Very Protected		N	0	Shoreline Type	Coarse
160	Islands Rocks Area	Islands Rocks Area		Y	0.3	Islands	Coarse
161	Islands Rocks Count	Islands Rocks Count		Y	0.3	Islands	Coarse
200	Algal Beds	Algal Beds		Y	0.3	Estuary Substrate/Vegetation	Coarse
201	Aquatic bed	Aquatic bed		Y	0.3	Estuary Substrate/Vegetation	Coarse
202	Bedrock	Bedrock		N	0	Estuary Substrate/Vegetation	Coarse
203	Boulder	Boulder		Y	0.3	Estuary Substrate/Vegetation	Coarse
204	Channel	Channel		Y	0.3	Estuary Substrate/Vegetation	Coarse
205	Cobble Gravel	Cobble Gravel		Y	0.3	Estuary Substrate/Vegetation	Coarse
206	Cobble Gravel Flat	Cobble Gravel Flat		Y	0.3	Estuary Substrate/Vegetation	Coarse
207	Dune grass	Dune grass		N	0	Estuary Substrate/Vegetation	Coarse
208	Flat	Flat		Y	0.3	Estuary Substrate/Vegetation	Coarse
209	Fresh Marsh	Fresh Marsh		Y	0.3	Estuary Substrate/Vegetation	Coarse

Appendix 1 Conservation Targets and Goals

TGT ID	Target	Common Name	Scientific Name	Analysis Target	Goal	Type	Category
210	Mud	Mud		Y	0.3	Estuary Substrate/Vegetation	Coarse
211	Mud Flat	Mud Flat		Y	0.3	Estuary Substrate/Vegetation	Coarse
212	Rock	Rock		N	0	Estuary Substrate/Vegetation	Coarse
213	Saltmarsh	Saltmarsh		Y	0.3	Estuary Substrate/Vegetation	Coarse
214	Sand	Sand		Y	0.3	Estuary Substrate/Vegetation	Coarse
215	Sand Flat	Sand Flat		Y	0.3	Estuary Substrate/Vegetation	Coarse
216	Sand Mud	Sand Mud		Y	0.3	Estuary Substrate/Vegetation	Coarse
217	Sand Mud Flat	Sand Mud Flat		Y	0.3	Estuary Substrate/Vegetation	Coarse
218	Seagrass	Seagrass		Y	0.3	Estuary Substrate/Vegetation	Coarse
219	Shell	Shell		N	0	Estuary Substrate/Vegetation	Coarse
220	Shrub Marsh	Shrub Marsh		Y	0.3	Estuary Substrate/Vegetation	Coarse
221	Unconsolidated	Unconsolidated		Y	0.3	Estuary Substrate/Vegetation	Coarse
222	Undefined Beach Bar	Undefined Beach Bar		N	0	Estuary Substrate/Vegetation	Coarse
223	Wood Debris Organic fines	Wood Debris Organic fines		Y	0.3	Estuary Substrate/Vegetation	Coarse
1001	Black Oystercatcher CNT	Black Oystercatcher Count	Haematopus bachmani	Y	0.5	Seabird Breeding Bird Count	Fine
1002	Brandts Cormorant CNT	Brandt's Cormorant Count	Phalacrocorax penicillatus	Y	0.5	Seabird Breeding Bird Count	Fine
1003	Caspian Tern CNT	Caspian Tern Count	Sterna caspia	Y	0.5	Seabird Breeding Bird Count	Fine
1004	Cassins Auklet CNT	Cassin's Auklet Count	Ptychoramphus aleuticus	Y	0.5	Seabird Breeding Bird Count	Fine
1005	Common Murre CNT	Common Murre Count	Uria aalge	Y	0.5	Seabird Breeding Bird Count	Fine
1006	Double crested Cormorant CNT	Double-crested Cormorant Count	Phalacrocorax auritus	Y	0.5	Seabird Breeding Bird Count	Fine
1007	Fork tailed storm petrel CNT	Fork-tailed Storm-petrel Count	Oceanodroma furcata	Y	0.5	Seabird Breeding Bird Count	Fine
1008	Horned Puffin CNT	Horned Puffin Count	Fratercula corniculata	Y	0.5	Seabird Breeding Bird Count	Fine
1009	Leachs Storm Petrel CNT	Leachs Storm Petrel Count	Oceanodroma leucorhoa	Y	0.5	Seabird Breeding Bird Count	Fine
1010	Pelagic Cormorant CNT	Pelagic Cormorant Count	Phalacrocorax pelagicus	Y	0.5	Seabird Breeding Bird Count	Fine
1011	Pigeon Guillemot CNT	Pigeon Guillemot Count	Cepphus columba	Y	0.5	Seabird Breeding Bird Count	Fine
1012	Rhinoceros Auklet CNT	Rhinoceros Auklet Count	Cerorhinca monocerata	Y	0.5	Seabird Breeding Bird Count	Fine
1013	Ring billed Gull CNT	Ring-billed Gull Count	Larus delawarensis	Y	0.5	Seabird Breeding Bird Count	Fine
1014	Tufted Puffin CNT	Tufted Puffin Count	Fratercula currhata	Y	0.5	Seabird Breeding Bird Count	Fine
1015	Western Glaucous winged Gull CNT	Western Glaucous-winged Gull Count	Larus glaucescens	Y	0.5	Seabird Breeding Bird Count	Fine
2001	Black Oystercatcher PA	Black Oystercatcher Presence	Haematopus bachmani	Y	0.5	Seabird Presence	Fine
2002	Brandts Cormorant PA	Brandts Cormorant Presence	Phalacrocorax penicillatus	Y	0.5	Seabird Presence	Fine
2003	Caspian Tern PA	Caspian Tern Presence	Sterna caspia	Y	0.5	Seabird Presence	Fine
2004	Cassins Auklet PA	Cassins Auklet Presence	Ptychoramphus aleuticus	Y	0.5	Seabird Presence	Fine
2005	Common Murre PA	Common Murre Presence	Uria aalge	Y	0.5	Seabird Presence	Fine
2006	Double crested Cormorant PA	Double crested Cormorant Presence	Phalacrocorax auritus	Y	0.5	Seabird Presence	Fine
2007	Fork tailed storm petrel PA	Fork-tailed Storm-petrel Presence	Oceanodroma furcata	Y	0.5	Seabird Presence	Fine
2008	Horned Puffin PA	Horned Puffin Presence	Fratercula corniculata	Y	0.5	Seabird Presence	Fine
2009	Leachs Storm Petrel PA	Leachs Storm-petrel Presence	Oceanodroma leucorhoa	Y	0.5	Seabird Presence	Fine
2010	Pelagic Cormorant PA	Pelagic Cormorant Presence	Phalacrocorax pelagicus	Y	0.5	Seabird Presence	Fine
2011	Pigeon Guillemot PA	Pigeon Guillemot Presence	Cepphus columba	Y	0.5	Seabird Presence	Fine
2012	Rhinoceros Auklet PA	Rhinoceros Auklet Presence	Cerorhinca monocerata	Y	0.5	Seabird Presence	Fine
2013	Ring billed Gull PA	Ring-billed Gull Presence	Larus delawarensis	Y	0.5	Seabird Presence	Fine
2014	Tufted Puffin PA	Tufted Puffin Presence	Fratercula currhata	Y	0.5	Seabird Presence	Fine
2015	Western Glaucous winged Gull PA	Western Glaucous-winged Gull Presence	Larus glaucescens	Y	0.5	Seabird Presence	Fine

Appendix 1 Conservation Targets and Goals

TGT ID	Target	Common Name	Scientific Name	Analysis Target	Goal	Type	Category
3001	Kelp	Kelp		Y	0.5	Kelp	Fine
3101	Upwelling	Upwelling		Y	0.3	Upwelling	Fine
3201	California sea lion	California Sea Lion	Zalophus californianus	Y	0.5	Marine Mammal Haulouts	Fine
3202	Harbor seal	Harbor Seal	Phoca vitulina	Y	0.3	Marine Mammal Haulouts	Fine
3203	Northern elephant seal	Northern Elephant Seal	Mirounga angustirostris	Y	0.5	Marine Mammal Haulouts	Fine
3204	Steller sea lion	Steller Sea Lion	Eumetopias jubatus	Y	0.5	Marine Mammal Haulouts	Fine
3205	Steller sea lion rookeries	Steller Sea Lion Rookeries	Eumetopias jubatus	Y	1	Stellar Sea Lion Rookeries	
3500	Snowy Plover Nesting	Snowy Plover Occupied Nesting Habitat	Charadrius alexandrinus nivosus	Y	0.5	Snowy Plover Nesting Habitat	Fine
3501	WESTERN SNOWY PLOVER CH	Snowy Plover Critical Habitat	Charadrius alexandrinus nivosus	Y	0.3	Snowy Plover Critical Habitat	Fine
3600	Olympia Oyster	Olympia Oyster	Ostrea lurida	Y	0.3	Olympia Oyster Locations	Fine
3701	bocaccio CPUE	Bocaccio CPUE	Sebastes paucispinis	Y	0.5	Trawl Species CPUE	Fine
3702	canary rockfish CPUE	Canary Rockfish CPUE	Sebastes pinniger	Y	0.5	Trawl Species CPUE	Fine
3703	darkblotched rockfish CPUE	Darkblotched Rockfish CPUE	Sebastes crameri	Y	0.5	Trawl Species CPUE	Fine
3704	dover sole CPUE	Dover Sole CPUE	Microstomus pacificus	Y	0.3	Trawl Species CPUE	Fine
3705	english sole CPUE	English Sole CPUE	Parophyrs vetulus	Y	0.3	Trawl Species CPUE	Fine
3706	greenstriped rockfish CPUE	Greenstriped Rockfish CPUE	Sebastes elongatus	Y	0.3	Trawl Species CPUE	Fine
3707	lingcod CPUE	Lingcod CPUE	Ophiodon elongatus	Y	0.3	Trawl Species CPUE	Fine
3708	pacific ocean perch CPUE	Pacific Ocean Perch CPUE	Sebastes alutus	Y	0.5	Trawl Species CPUE	Fine
3709	redstripe rockfish CPUE	Redstripe Rockfish CPUE	Sebastes proriger	Y	0.3	Trawl Species CPUE	Fine
3710	rex sole CPUE	Rex Sole CPUE	Errex zachirus	Y	0.3	Trawl Species CPUE	Fine
3711	sablefish CPUE	Sablefish CPUE	Anoplopoma fimbria	Y	0.3	Trawl Species CPUE	Fine
3712	southern rock sole CPUE	Southern Rock Sole CPUE	Lepidopsetta bilineata	Y	0.3	Trawl Species CPUE	Fine
3713	spotted ratfish CPUE	Spotted Ratfish CPUE	Hydrolagus colliei	Y	0.3	Trawl Species CPUE	Fine
3714	yellowtail rockfish CPUE	Yellowtail Rockfish CPUE	Sebastes flavidus	Y	0.3	Trawl Species CPUE	Fine
3800	big skate PA	Big Skate Presence	Raja binoculata	Y	0.3	Trawl Species Presence	Fine
3801	black rockfish PA	Black Rockfish Presence	Sebastes melanops	Y	0.3	Trawl Species Presence	Fine
3802	blue rockfish PA	Blue Rockfish Presence	Sebastes mystinus	Y	0	Trawl Species Presence	Fine
3803	blue shark PA	Blue Shark Presence	Prionace glauca	Y	0	Trawl Species Presence	Fine
3804	bocaccio PA	Bocaccio Presence	Sebastes paucispinis	Y	0.5	Trawl Species Presence	Fine
3805	brown rockfish PA	Brown Rockfish Presence	Sebastes auriculatus	Y	0.3	Trawl Species Presence	Fine
3806	cabezon PA	Cabezon Presence	Scorpaenichthys marmoratus	Y	0	Trawl Species Presence	Fine
3807	canary rockfish PA	Canary Rockfish Presence	Sebastes pinniger	Y	0.5	Trawl Species Presence	Fine
3808	chub mackerel PA	Chub Mackerel Presence	Scomber japonicus	Y	0.3	Trawl Species Presence	Fine
3809	copper rockfish PA	Copper Rockfish Presence	Sebastes caurinus	Y	0.3	Trawl Species Presence	Fine
3810	darkblotched rockfish PA	Darkblotched Rockfish Presence	Sebastes crameri	Y	0.5	Trawl Species Presence	Fine
3811	dover sole PA	Dover Sole Presence	Microstomus pacificus	Y	0.3	Trawl Species Presence	Fine
3812	english sole PA	English Sole Presence	Parophyrs vetulus	Y	0.3	Trawl Species Presence	Fine
3813	eulachon PA	Eulachon Presence	Thaleichthys pacificus	Y	0.3	Trawl Species Presence	Fine
3814	green sturgeon PA	Green Sturgeon Presence	Acipenser meditostris	Y	0	Trawl Species Presence	Fine
3815	greenstriped rockfish PA	Greenstriped Rockfish Presence	Sebastes elongatus	Y	0.3	Trawl Species Presence	Fine
3816	jack mackerel PA	Jack Mackerel Presence	Trachurus symmetricus	Y	0.3	Trawl Species Presence	Fine
3817	lingcod PA	Lingcod Presence	Ophiodon elongatus	Y	0.3	Trawl Species Presence	Fine
3818	northern anchovy PA	Northern Anchovy Presence	Engraulis mordax	Y	0.3	Trawl Species Presence	Fine
3819	pacific cod PA	Pacific Cod Presence	Gadus macrocephalus	Y	0.3	Trawl Species Presence	Fine

Appendix 1 Conservation Targets and Goals

TGT ID	Target	Common Name	Scientific Name	Analysis Target	Goal	Type	Category
3820	pacific hagfish PA	Pacific Hagfish Presence	Eptatretus stouti	Y	0.3	Trawl Species Presence	Fine
3821	pacific hake PA	Pacific Hake Presence	Merluccius productus	Y	0.3	Trawl Species Presence	Fine
3822	pacific herring PA	Pacific Herring Presence	Clupea pallasi	Y	0.3	Trawl Species Presence	Fine
3823	pacific lamprey PA	Pacific Lamprey Presence	Lampetra tridentata	Y	0.3	Trawl Species Presence	Fine
3824	pacific ocean perch PA	Pacific Ocean Perch Presence	Sebastes alutus	Y	0.5	Trawl Species Presence	Fine
3825	pacific sand lance PA	Pacific Sand Lance Presence	Ammodytes hexapterus	Y	0	Trawl Species Presence	Fine
3826	pacific sanddab PA	Pacific Sanddab Presence	Citharichthys sordidus	Y	0.3	Trawl Species Presence	Fine
3827	pacific sandfish PA	Pacific Sandfish Presence	Trichodon trichodon	Y	0	Trawl Species Presence	Fine
3828	pacific sardine PA	Pacific Sardine Presence	Sardinops sagax	Y	0.3	Trawl Species Presence	Fine
3829	plainfin midshipman PA	Plainfin Midshipman Presence	Porichthys notalus	Y	0.3	Trawl Species Presence	Fine
3830	quillback rockfish PA	Quillback Rockfish Presence	Sebastes maliger	Y	0.3	Trawl Species Presence	Fine
3831	redstripe rockfish PA	Redstripe Rockfish Presence	Sebastes proriger	Y	0.3	Trawl Species Presence	Fine
3832	rex sole PA	Rex Sole Presence	Errex zachirus	Y	0.3	Trawl Species Presence	Fine
3833	sablefish PA	Sablefish Presence	Anoplopoma fimbria	Y	0.3	Trawl Species Presence	Fine
3834	sixgill shark PA	Sixgill Shark Presence	Hexanchus griseus	Y	0.3	Trawl Species Presence	Fine
3835	soupfin shark PA	Soupfin Shark Presence	Galeorhinus galeus	Y	0.3	Trawl Species Presence	Fine
3836	southern rock sole PA	Southern Rock Sole Presence	Lepidopsetta bilineata	Y	0.3	Trawl Species Presence	Fine
3837	spotted ratfish PA	Spotted Ratfish Presence	Hydrolagus colliei	Y	0.3	Trawl Species Presence	Fine
3838	surf smelt PA	Surf Smelt Presence	Hypomesus pretiosus	Y	0.3	Trawl Species Presence	Fine
3839	thresher shark PA	Thresher Shark Presence	Alopias vulpinus	Y	0	Trawl Species Presence	Fine
3840	tiger rockfish PA	Tiger Rockfish Presence	Sebastes nigrocinctus	Y	0.3	Trawl Species Presence	Fine
3841	walleye pollock PA	Walleye Pollock Presence	Theragra chalcogramma	Y	0.3	Trawl Species Presence	Fine
3842	whitebait smelt PA	Whitebait Smelt Presence	Allosmerus elongatus	Y	0.3	Trawl Species Presence	Fine
3843	widow rockfish PA	Widow Rockfish Presence	Sebastes entomelas	Y	0.5	Trawl Species Presence	Fine
3844	yelloweye rockfish PA	Yelloweye Rockfish Presence	Sebastes ruberrimus	Y	0.5	Trawl Species Presence	Fine
3845	yellowtail rockfish PA	Yellowtail Rockfish Presence	Sebastes flavidus	Y	0.3	Trawl Species Presence	Fine
3900	Alcyonacea PA	Alcyonacea Presence	Order Alcyonacea	Y	0.3	Coral Presence	Fine
3901	Antipatharia PA	Antipatharia Presence	Order Antipatharia	Y	0.3	Coral Presence	Fine
3902	Gorgonacea PA	Gorgonacea Presence	Order Gorgonacea	Y	0.3	Coral Presence	Fine
3903	Pennatulacea PA	Pennatulacea Presence	Order Pennatulacea	Y	0.3	Coral Presence	Fine
3904	Scleractinia PA	Scleractinia Presence	Order Scleractinia	Y	0.3	Coral Presence	Fine
4001	Demospongiae PA	Demospongiae Presence	Class Demospongiae	Y	0.3	Sponge Presence	Fine
4002	Hexactinellida PA	Hexactinellida Presence	Class Hexactinellida	Y	0.3	Sponge Presence	Fine
4003	Porifera PA	Porifera Presence	Phylum Porifera (no class ID)	Y	0.3	Sponge Presence	Fine
4004	Demospongiae CPUE	Demospongiae CPUE	Class Demospongiae	Y	0.3	Sponge CPUE	Fine
4005	Hexactinellida CPUE	Hexactinellida CPUE	Class Hexactinellida	Y	0.3	Sponge CPUE	Fine
4006	Porifera CPUE	Porifera CPUE	Phylum Porifera (no class ID)	Y	0.3	Sponge CPUE	Fine
4050	Antipatha CPUE	Antipatha CPUE	Order Antipatharia	Y	0.3	Coral CPUE	Fine
4051	Gorgonace CPUE	Gorgonace CPUE	Order Gorgonacea	Y	0.3	Coral CPUE	Fine
4052	Pennatula CPUE	Pennatula CPUE	Order Pennatulacea	Y	0.3	Coral CPUE	Fine
4053	Scleracti CPUE	Scleracti CPUE	Order Scleractinia	Y	0.3	Coral CPUE	Fine
4100	Chlorophyll Low	Chlorophyll-a Moderate Concentration		Y	0.3	Chlorophyll 1-2SD above average	Fine
4102	Chlorophyll High	Chlorophyll-a High Concentration		Y	0.3	Chlorophyll >2SD above average	Fine
4150	Rocky substrate	Rocky substrate		Y	0.3	Rocky Substrate	Fine

Appendix 1 Conservation Targets and Goals

TGT ID	Target	Common Name	Scientific Name	Analysis Target	Goal	Type	Category
4200	Canyon walls	Canyon walls		Y	0.3	Canyon Walls	Fine
4250	Steller sea lion CH	Steller sea lion Critical Habitat	Eumetopias jubatus	Y	0.9	Stellar Sea Lion Critical Habitat	
4300	Killer whale CH	Killer whale Critical Habitat	Orcinus orca	Y	0.2	Orca Critical Habitat	

Appendix 2 Marine and Terrestrial Protected Areas

MARINE-BASED PROTECTED AREAS

Area Name	Agency	Hectares	GAP	State
Copalis Rock NWR	US Fish and Wildlife Service	12	1	WA
Flattery Rocks NWR	US Fish and Wildlife Service	46	1	WA
Quillayute Needles NWR	US Fish and Wildlife Service	80	1	WA
Castle Rock NWR	US Fish and Wildlife Service	6	1	CA
Oregon Rocks NWR	US Fish and Wildlife Service	152	1	OR
Three Arch Rocks NWR	US Fish and Wildlife Service	6	1	OR
Pirate Cove Research Reserve	OR Dept Fish & Wildlife	3	1	OR
Whale Cove Habitat Refuge	OR Dept Fish & Wildlife	13	1	OR
Olympic 2	NOAA-NMFS	54744	2	WA
Biogenic 1	NOAA-NMFS	123342	2	WA
Biogenic 2	NOAA-NMFS	23389	2	WA
Grays Canyon	NOAA-NMFS	16415	2	WA
Biogenic 3	NOAA-NMFS	20553	2	WA
Astoria Canyon	NOAA-NMFS	177320	2	OR
Siletz Deepwater	NOAA-NMFS	53791	2	OR
Daisy Bank/Nelson Island	NOAA-NMFS	6594	2	OR
Newport Rockpile/Stonewall Bank	NOAA-NMFS	17124	2	OR
Heceta Bank	NOAA-NMFS	42266	2	OR
Deepwater off Coos Bay	NOAA-NMFS	56456	2	OR
Bandon High Spot	NOAA-NMFS	18203	2	OR
Rogue Canyon	NOAA-NMFS	88497	2	OR
Eel River Canyon	NOAA-NMFS	86965	2	CA
Blunts Reef	NOAA-NMFS	5768	2	CA
Mendocino Ridge	NOAA-NMFS	186349	2	CA
Nehalem Bank/Shale Pile	NOAA-NMFS	18052	2	OR
Boiler Bay Research Reserve	OR Dept Fish & Wildlife	18	2	OR
Brookings Research Reserve	OR Dept Fish & Wildlife	61	2	OR
Cape Arago Research Reserve	OR Dept Fish & Wildlife	108	2	OR
Cape Kiwanda Marine Gardens	OR Dept Fish & Wildlife	5	2	OR
Cape Perpetua Marine Gardens	OR Dept Fish & Wildlife	16	2	OR
Gregory Point Research Reserve	OR Dept Fish & Wildlife	24	2	OR
Harris Beach Marine Gardens	OR Dept Fish & Wildlife	7	2	OR

Appendix 2 Marine and Terrestrial Protected Areas

Area Name	Agency	Hectares	GAP	State
Haystack Rock Marine Gardens	OR Dept Fish & Wildlife	34	2	OR
Neptune Research Reserve	OR Dept Fish & Wildlife	22	2	OR
Otter Rock Marine Gardens	OR Dept Fish & Wildlife	21	2	OR
Yachats Marine Gardens	OR Dept Fish & Wildlife	6	2	OR
Yaquina Head Marine Gardens	OR Dept Fish & Wildlife	33	2	OR
South Slough National Estuarine Research Reserve	NOAA/OR Dept State Lands	1925	2	OR
Olympic Coast National Marine Sanctuary	NOAA-NMS	825,889	3	WA

TERRESTRIAL-BASED PROTECTED AREA

Area Name	Agency	Hectares	GAP	State
Table Bluff Ecological Reserve	CA Dept of Fish and Game	62	1	CA
Bone Creek	Cascade Land Conservancy	1	1	WA
Cascade Land Conservancy	Cascade Land Conservancy	18	1	WA
Cedar River Estuary	Cascade Land Conservancy	154	1	WA
Clearwater Creek	Cascade Land Conservancy	16	1	WA
Elk River	Cascade Land Conservancy	17	1	WA
Grays Harbor Bluff	Cascade Land Conservancy	15	1	WA
Hogan's Corner	Cascade Land Conservancy	25	1	WA
Hoko River	Cascade Land Conservancy	14	1	WA
Lynn Point	Cascade Land Conservancy	31	1	WA
Nemah Point	Cascade Land Conservancy	116	1	WA
Nemah River Estuary	Cascade Land Conservancy	137	1	WA
Norris Slough	Cascade Land Conservancy	434	1	WA
North Bay Bog	Cascade Land Conservancy	35	1	WA
North Shore Grays Harbor	Cascade Land Conservancy	731	1	WA
O'Leary Creek	Cascade Land Conservancy	10	1	WA
Oyster Island	Cascade Land Conservancy	31	1	WA
Pysht Estuary	Cascade Land Conservancy	397	1	WA
Queets Estuary	Cascade Land Conservancy	11	1	WA
Queets Island	Cascade Land Conservancy	4	1	WA
Seal Slough	Cascade Land Conservancy	153	1	WA
Stafford Creek	Cascade Land Conservancy	5	1	WA
Teal Duck	Cascade Land Conservancy	94	1	WA

Appendix 2 Marine and Terrestrial Protected Areas

Area Name	Agency	Hectares	GAP	State
Three Creeks	Cascade Land Conservancy	93	1	WA
Del Norte Coast Redwoods State Park	National Park Service	661	1	CA
Humboldt Lagoons State Park	National Park Service	194	1	CA
Olympic National Park	National Park Service	13643	1	WA
Prairie Creek Redwoods State Park	National Park Service	1702	1	CA
Redwood National Park	National Park Service	3749	1	CA
Long Beach Peninsula	The Nature Conservancy	8	1	WA
Bastendorff Bog Preserve	The Nature Conservancy	4	1	OR
Big Creek Preserve	The Nature Conservancy	77	1	OR
Blind Slough Swamp Preserve	The Nature Conservancy	257	1	OR
Bradley Bog Preserve	The Nature Conservancy	19	1	OR
Cascade Head Preserve	The Nature Conservancy	122	1	OR
Cox Island Preserve	The Nature Conservancy	80	1	OR
Ellsworth Creek Preserve	The Nature Conservancy	2358	1	WA
Gearhart Bog Preserve	The Nature Conservancy	23	1	OR
Humptulips River Delta Preserve	The Nature Conservancy	9	1	WA
Lanphere-Christensen Dunes	The Nature Conservancy	38	1	CA
Manila Beach	The Nature Conservancy	38	1	CA
Nesika Beach Preserve	The Nature Conservancy	18	1	OR
Puget Island Preserve	The Nature Conservancy	9	1	WA
Sutton Lake Marsh Preserve	The Nature Conservancy	7	1	OR
Bandon Marsh NWR	US Fish & Wildlife Service	426	1	OR
Nestucca Bay-Neskowin Unit NWR	US Fish & Wildlife Service	168	1	OR
Cape Perpetua	United States Forest Service	381	1	OR
Cummins Creek Wilderness	United States Forest Service	565	1	OR
Rock Creek Wilderness	United States Forest Service	508	1	OR
Dungeness National Wildlife Refuge	US Fish & Wildlife Service	525	1	WA
Grays Harbor National Wildlife Refuge	US Fish & Wildlife Service	596	1	WA
Cape Meares NWR	US Fish & Wildlife Service		1	OR
Nestucca Bay NWR	US Fish & Wildlife Service	231	1	OR
Oregon Islands-Crook Pt.Unit NWR	US Fish & Wildlife Service	63	1	OR
Siletz Bay NWR	US Fish & Wildlife Service	218	1	OR
Willapa National Wildlife Refuge	US Fish & Wildlife Service	6467	1	WA

Appendix 2 Marine and Terrestrial Protected Areas

Area Name	Agency	Hectares	GAP	State
New River ACEC	Bureau of Land Management	459	2	OR
North Spit ACEC	Bureau of Land Management	293	2	OR
Sutton Lake ACEC	Bureau of Land Management	85	2	OR
Yaquina Head ONA/ACEC	Bureau of Land Management	41	2	OR
Big Lagoon Wildlife Area	CA Dept of Fish and Game	628	2	CA
Crescent City Marsh Wildlife Area	CA Dept of Fish and Game	122	2	CA
Eel River Wildlife Area	CA Dept of Fish and Game	776	2	CA
Elk Creek Wetlands Wildlife Area	CA Dept of Fish and Game	59	2	CA
Elk River Wildlife Area	CA Dept of Fish and Game	42	2	CA
Eureka Slough Wildlife Area	CA Dept of Fish and Game	2	2	CA
Fay Slough Wildlife Area	CA Dept of Fish and Game	209	2	CA
Lake Earl Wildlife Area	CA Dept of Fish and Game	4	2	CA
Lake Earl Wildlife Area	CA Dept of Fish and Game	1383	2	CA
Luffenholtz Creek Fisheries Area	CA Dept of Fish and Game	4	2	CA
Mad River Slough Wildlife Area	CA Dept of Fish and Game	221	2	CA
North Beach Fisheries Area	CA Dept of Fish and Game	1	2	CA
Pebble Beach Fisheries Area	CA Dept of Fish and Game	1	2	CA
Samoa Peninsula Protected Area	CA Dept of Fish and Game	4	2	CA
Waukell Creek Wildlife Area	CA Dept of Fish and Game	8	2	CA
Del Norte Coast Redwoods State Park	CA Dept of Parks and Recreation	1869	2	CA
Humboldt Lagoons State Park	CA Dept of Parks and Recreation	799	2	CA
Jedediah Smith Redwoods State Park	CA Dept of Parks and Recreation	213	2	CA
Patricks Point State Park	CA Dept of Parks and Recreation	259	2	CA
Prairie Creek Redwoods State Park	CA Dept of Parks and Recreation	3120	2	CA
Tolawa Dunes State Park	CA Dept of Parks and Recreation	1734	2	CA
Unknown Capitol Land Trust	Capitol Land Trust	42	2	WA
Cascade Land Conservancy	Cascade Land Conservancy	4	2	WA
Unknown Columbia Land Trust	Columbia Land Trust	17	2	WA
Coos County Park	County Government	44	2	OR
South Jetty County Park	County Government	30	2	OR
Grays Harbor Audubon Society	Grays Harbor Audubon Society	3	2	WA
South Slough NERR	NOAA	1820	2	OR
ODF Fund #52	OR Department of Forestry	66	2	OR

Appendix 2 Marine and Terrestrial Protected Areas

Area Name	Agency	Hectares	GAP	State
Bastendorff Bog Preserve	OR Division of State Lands	1	2	OR
Bandon	OR State Parks	430	2	OR
Bandon Ocean State Wayside	OR State Parks	29	2	OR
Beverly Beach State Park	OR State Parks	66	2	OR
Bob Straub	OR State Parks	218	2	OR
Boiler Bay State Scenic Viewpoint	OR State Parks	20	2	OR
Buena Vista Ocean Wayside	OR State Parks	28	2	OR
Bullards Beach State Park	OR State Parks	571	2	OR
Cape Arago State Park	OR State Parks	321	2	OR
Cape Blanco State Park	OR State Parks	830	2	OR
Cape Kiwanda State Park	OR State Parks	53	2	OR
Cape Lookout State Park	OR State Parks	745	2	OR
Cape Meares State Park	OR State Parks	108	2	OR
Cape Sebastian State Park	OR State Parks	451	2	OR
Carl G Washburne Memorial State Park	OR State Parks	802	2	OR
Clay Myers	OR State Parks	69	2	OR
Devils Punch Bowl State Natural Area	OR State Parks	24	2	OR
Ecola State Park	OR State Parks	1042	2	OR
Floras Lake State Park	OR State Parks	511	2	OR
Fogarty Creek State Recreation Area	OR State Parks	69	2	OR
Fort Stevens State Park	OR State Parks	1381	2	OR
Harris Beach	OR State Parks	70	2	OR
Humbug Mountain State Park	OR State Parks	691	2	OR
Neptune State Park	OR State Parks	124	2	OR
Netarts Bay State Park	OR State Parks	343	2	OR
Ona Beach State Park	OR State Parks	82	2	OR
Oswald West State Park	OR State Parks	1155	2	OR
Otter Point State Wayside	OR State Parks	22	2	OR
Pistol River State Park	OR State Parks	179	2	OR
Port Orford Head State Wayside	OR State Parks	10	2	OR
Rocky Creek State Wayside	OR State Parks	24	2	OR
Samuel H. Boardman	OR State Parks	717	2	OR
South Beach State Park	OR State Parks	173	2	OR

Appendix 2 Marine and Terrestrial Protected Areas

Area Name	Agency	Hectares	GAP	State
Sunset Beach State Park	OR State Parks	61	2	OR
Umpqua Lighthouse	OR State Parks	158	2	OR
William M Tugman State Park	OR State Parks	224	2	OR
Blind Slough Swamp Preserve	The Nature Conservancy	97	2	OR
Gearhart Bog Preserve	The Nature Conservancy	81	2	OR
Nesika Beach Preserve	The Nature Conservancy	14	2	OR
Cascade Head Scenic Research Area	United States Forest Service	2438	2	OR
Neskowin Crest RNA	United States Forest Service	490	2	OR
Oregon Dunes NRA	United States Forest Service	2937	2	OR
Reneke Creek RNA	United States Forest Service	107	2	OR
Sand Lake RNA	United States Forest Service	84	2	OR
Humboldt Bay NWR	US Fish and Wildlife Service	1107	2	CA
Julia Butler Hansen Refuge for the Columbian White-tailed Deer	US Fish and Wildlife Service	1254	2	OR
Lewis and Clark NWR	US Fish and Wildlife Service	4404	2	OR
Julia Butler Hansen Refuge for the Columbian White-tailed Deer	US Fish and Wildlife Service	1170	2	WA
Ridgefield NWR	US Fish and Wildlife Service	1886	2	WA
Indian Dan State Wildlife Recreation Area	WA Dept. of Fish & Wildlife	173	2	WA
Johns River State Wildlife Recreation Area	WA Dept. of Fish & Wildlife	13	2	WA
Oyhut Wildlife Recreation Area	WA Dept. of Fish & Wildlife	237	2	WA
Shillapoo Wildlife Recreation Area	WA Dept. of Fish & Wildlife	687	2	WA
Vancouver Lake Park	WA Dept. of Fish & Wildlife	6	2	WA
Bone River NAP	WA Dept. of Natural Resources	1096	2	WA
Chehalis River Surge Plain NAP	WA Dept. of Natural Resources	341	2	WA
Elk River NRCA	WA Dept. of Natural Resources	1845	2	WA
Elkhorn Creek NRCA	WA Dept. of Natural Resources	229	2	WA
Niawiakum River NAP	WA Dept. of Natural Resources	258	2	WA
North Bay NAP	WA Dept. of Natural Resources	261	2	WA
Shipwreck Point	WA Dept. of Natural Resources	198	2	WA
South Nemah NRCA	WA Dept. of Natural Resources	399	2	WA
Fort Canby State Park	WA State Parks	8	2	WA
Fort Columbia Historical State Park	WA State Parks	239	2	WA
Grayland Beach State Park	WA State Parks	108	2	WA
Griffiths-Priday State Park	WA State Parks	31	2	WA

Appendix 2 Marine and Terrestrial Protected Areas

Area Name	Agency	Hectares	GAP	State
Hoko River State Park	WA State Parks	91	2	WA
Leadbetter Point State Park	WA State Parks	453	2	WA
Ocean City State Park	WA State Parks	81	2	WA
Oyhut State Park	WA State Parks	0	2	WA
Pacific Beach State Park	WA State Parks	2	2	WA
South Beach State Park	WA State Parks	64	2	WA
Twin Harbors Beach State Park	WA State Parks	65	2	WA
Westport Light State Park	WA State Parks	104	2	WA

Appendix 3 GAP Analysis for Protected Areas by Conservation Target

This list only includes the 70 conservation targets which had at least 80% of their conservation goal met in existing protected areas.

DEFINITIONS

CMCB = Cape Mendocino to Cape Blanco Section
CBCL = Cape Blanco to Cape Lookout Section
CLPG = Cape Lookout to Point Grenville Section
PGIB = Point Grenville to International Boundary Section
PA = Protected Area
CPUE = Catch per Unit Effort
CNT = Count

Conservation Target Name	Goal	Amount Captured	Assessment Units picked with target	Goal Met	% Goal met
Alcyonacea_PA_PGIB	6221	11520	5	yes	185.2
Antipatha_CPUE_CLPG	49414	40984	11	no	82.9
Antipatha_CPUE_PGIB	5015	8467	6	yes	168.8
Antipatharia_PA_PGIB	22810	25344	11	yes	111.1
Bathybenthal_Canyon_Mud_CMCB	58044	58810	58	yes	101.3
Bathybenthal_Middle_slope_Rock_CMCB	1182	1590	11	yes	134.5
Bathybenthal_Ridge_Rock_CMCB	1407	2465	8	yes	175.2
Brandts_Cormorant_CNT_PGIB	229	446	1	yes	194.8
Brandts_Cormorant_PA_PGIB	1	1	1	yes	100.0
canary_rockfish_CPUE_CBCL	1261828	1234157	35	no	97.8
canary_rockfish_CPUE_CMCB	936292	838998	17	no	89.6
Canyon_Wall_PGIB	51930	46408	32	no	89.4
Demospongiae_CPUE_PGIB	3938826	9667930	29	yes	245.5
Demospongiae_PA_PGIB	43853	66816	29	yes	152.4
Fresh_Marsh_CLPG	749	1045	22	yes	139.5
Gorgonace_CPUE_PGIB	402987	1251505	11	yes	310.6
Gorgonacea_PA_PGIB	21427	20736	9	no	96.8
Gravel_Beach_VE_CLPG	3681	3582	6	no	97.3
Gravel_Beach_VP_CBCL	607	1003	2	yes	165.3
Hexactenellida_PA_CLPG	4838	4608	2	no	95.2
Inner_shelf_Canyon_Sand_PGIB	30	46	12	yes	150.4
Islands_Rocks_Count_CLPG	79	78	6	no	98.5
Islands_Rocks_Count_PGIB	670	986	38	yes	147.2
Kelp_CLPG	50484	100968	1	yes	200.0
Leachs_Storm_Petrel_CNT_CMCB	232382	186610	1	no	80.3
lingcod_CPUE_CMCB	1471009	1440071	19	no	97.9
Mesobenthal_Canyon_Mud_CMCB	2461	1992	3	no	81.0
Mesobenthal_Canyon_Rock_PGIB	124	217	6	yes	175.9
Mesobenthal_Canyon_Sand_PGIB	139	114	4	no	81.8
Mesobenthal_Middle_slope_Rock_PGIB	2129	2652	14	yes	124.5
Mid_shelf_Canyon_Mud_PGIB	462	492	8	yes	106.5
Mid_shelf_Canyon_Rock_CBCL	13	41	5	yes	325.5
Mid_shelf_Canyon_Rock_PGIB	989	1801	15	yes	182.2
Mid_shelf_Flats_Rock_CBCL	38893	47801	33	yes	122.9
Mid_shelf_Middle_slope_Rock_CBCL	431	631	15	yes	146.2

Mid_shelf_Middle_slope_Rock_CLPG	108	305	6	yes	281.4
Mid_shelf_Middle_slope_Rock_PGIB	2072	2541	18	yes	122.7

Conservation Target Name	Goal	Amount Captured	Assessment Units picked with target	Goal Met	% Goal met
Mid_shelf_Ridge_Rock_CBCL	3874	5581	25	yes	144.1
Mid_shelf_Ridge_Rock_CLPG	1493	2769	8	yes	185.5
Mid_shelf_Ridge_Rock_PGIB	3504	4596	18	yes	131.2
Mid_shelf_Ridge_Sand_PGIB	7859	7601	21	no	96.7
Mud_Flat_VP_CBCL	604	1882	5	yes	311.6
Organics fines_P_CLPG	330779	304217	57	no	92.0
Pigeon_Guillemot_CNT_CLPG	486	467	7	no	96.2
Porifera_CPUE_PGIB	5550189	9104648	35	yes	164.0
Porifera_PA_PGIB	78182	80640	35	yes	103.1
Rhinoceros_Auklet_CNT_CLPG	1	1	1	yes	200.0
Rhinoceros_Auklet_PA_CBCL	1	1	1	yes	100.0
Rhinoceros_Auklet_PA_CLPG	1	1	1	yes	200.0
Rock_Platform_VE_CLPG	302	372	2	yes	122.9
Rock_with_Gravel_Beach_E_PGIB	5939	6015	6	yes	101.3
Rock_with_Sand_and_Gravel_Beach_E_PGIB	39248	32356	29	no	82.4
Rock_with_Sand_and_Gravel_Beach_VE_CBCL	665	1047	2	yes	157.4
Rock_with_Sand_Beach_E_PGIB	13333	10901	13	no	81.8
Rocky_Shore Cliff_E_PGIB	16568	13401	19	no	80.9
Rocky_Shore Cliff_VE_CLPG	7461	12107	5	yes	162.3
Rocky_substrate_CBCL	65075	59886	47	no	92.0
Rocky_substrate_PGIB	18624	15736	64	no	84.5
Sand_and_Gravel_Beach_VP_CBCL	2489	2729	3	yes	109.7
Sand_and_Gravel_Flat_P_CLPG	1392	3719	4	yes	267.1
Sand_Beach_E_CBCL	3118	3405	2	yes	109.2
Sand_Flat_E_PGIB	17826	24327	21	yes	136.5
Sand_Flat_P_CBCL	445	438	1	no	98.4
Sand_Flat_VP_CBCL	491	1497	2	yes	305.2
Scleracti_CPUE_CLPG	3457060	4015314	1	yes	116.1
Scleracti_CPUE_PGIB	408144	1037823	4	yes	254.3
Shrub_Marsh_CLPG	827	1386	23	yes	167.6
spotted_ratfish_CPUE_CMCB	951682	1349555	21	yes	141.8
tiger_rockfish_PA_CBCL	6221	11520	5	yes	185.2
yellowtail_rockfish_CPUE_CBCL	500177	404177	32	no	80.8

Appendix 4 Peer Review Participants: Individuals, Agencies, Organizations

Newport, OR Workshop 1-27-09	Seattle, WA Workshop 3-2-09	Name	Association
yes		John Meyer	COMPASS
yes		Henry Lee	Environmental Protection Agency
yes		Walt Nelson	Environmental Protection Agency
yes		Jim Golden	Golden Marine Consulting
yes		Michael Donnellan	OR Department of Fish and Wildlife
yes		Paul Engelmeyer	National Audubon Society
yes		Bob Emmett	National Marine Fisheries Service
yes		Patty Burke	NOAA - Northwest Fisheries Science Center
yes		Ric Brodeur	NOAA - Northwest Fisheries Science Center
yes		Liz Clarke	NOAA - Northwest Fisheries Science Center
yes		Andy Lanier	Oregon Coastal-Ocean Management Program
yes		Curt Whitmire	NOAA Hatfield
yes		Arlene Merems	ODFW Newport
yes		Cristen Don	ODFW Newport
yes		Tanya Haddad	Oregon Coastal-Ocean Management Program
yes		Dave Fox	Oregon Department of Fish and Wildlife
yes		Bill Pearcy	Oregon State University
yes		Chris Goldfinger	Oregon State University
yes		Mark Hixon	Oregon State University
yes		Hal Batchelder	Oregon State University
yes		Kipp Shearmann	Oregon State University
yes		Gayle Hansen	Oregon State University @ WED/PCEB; EPA
yes		Bruce Mate	Oregon State University-Hatfield
yes		Chris Romsos	Oregon State University
yes		Fran Recht	Pacific States Marine Fisheries Commission
yes		Leesa Cobb	Port Orford Ocean Resources Team
yes		Brianna Goodwin	Port Orford Ocean Resources Team
yes		Craig Cornu	South Slough NERR
yes		Debbie Reusser	USGS-Western Fisheries Research Center
yes		Sean Rooney	Washington State University Vancouver
yes		Brian Tissot	Washington State University Vancouver
	yes	Dave Nicholson	BCMCA, Canada
	yes	Jodie Toft	Natural Capital Project
	yes	Shannon Fitzgerald	NOAA - Alaska Fisheries Science Center
	yes	Kirstin Holsman	NOAA - Northwest Fisheries Science Center
	yes	Melissa Haltuch	NOAA - Northwest Fisheries Science Center
	yes	Phil Levin	NOAA - Northwest Fisheries Science Center
	yes	Steve Copps	NOAA - Northwest Fisheries Science Center
	yes	Tom Good	NOAA - Northwest Fisheries Science Center
	yes	Ed Bowlby	Olympic Coast National Marine Sanctuary
	yes	Mary Sue Brancato	Olympic Coast National Marine Sanctuary
	yes	Anne Salomon	Simon Fraser University
	yes	Greg Jensen	University of Washington
	yes	Laura Payne	University of Washington
	yes	Megan Dethier	University of Washington
	yes	Terrie Klinger	University of Washington
	yes	Don Gunderson	University of Washington
	Yes	Dan Ayres	WA Dept Fish and Wildlife

Appendix 4 Peer Review Participants: Individuals, Agencies, Organizations

Newport, OR Workshop 1-27-09	Seattle, WA Workshop 3-2-09	Name	Association
	yes	Corey Niles	WA Dept Fish and Wildlife
	yes	Theresa Tsou	WA Dept Fish and Wildlife
	yes	Cinde Donaghue	WA Dept Natural Resources
	yes	Jennifer Hennesey	WA Dept of Ecology
	yes	Kathy Taylor	WA Dept of Ecology
	yes	Nathalie Hamel	WA Dept of Ecology
	yes	Eric Buhle	NOAA
	yes	Paul Johnson	University of Washington
	yes	Amanda Bradford	University of Washington
	yes	Tina Wyllie-Echeverria	University of Washington
	yes	Sandy Wyllie-Echeverria	University of Washington
	yes	Jody Kennedy	Surfrider Foundation

Appendix 5 - Salmon Suitability Factor

Importance Values for Coast Salmon Species in Pacific Northwest Estuaries
(Data from Wild Salmon Center 2009)

Estuary	# of Salmon populations	Composite Score	Normalized Score (excluding south of Juan De Fuca and Columbia)
Strait of Juan de Fuca	137	2432.5	1.000
Columbia River	155	2217.5	1.000
Klamath River	34	595.5	1.000
Quillayute River	19	353	0.593
Rogue River	15	319.5	0.537
Grays Harbor	19	308	0.517
Eel River	16	252	0.423
Willapa Bay	15	246.5	0.414
Umpqua	14	230	0.386
Queets River	10	181	0.304
Tillamook Bay	6	115.5	0.194
Nehalem	6	111.5	0.187
Siletz Bay	6	109	0.183
Hoh River	6	106.5	0.179
Coquille	6	99	0.166
Nestucca Bay	5	96.5	0.162
Alsea Bay	5	87.5	0.147
Siuslaw	5	87.5	0.147
Quinault River	5	83	0.139
Yaquina Bay	4	82.5	0.139
Smith River	4	75	0.126
Coos Bay	4	73	0.123
Chetco River	3	67.5	0.113
Elk River	3	65.5	0.110
Redwood Creek	4	64	0.107
Neskowin Creek	3	62.5	0.105
Sand Lake	3	62.5	0.105
Euchre Creek	3	62	0.104
Netarts Bay	3	59.5	0.100
Sixes River	3	59	0.099
Mad River	3	58	0.097
Ecola Creek	3	54.5	0.092
Necanicum	3	54.5	0.092
Ozette River	4	54.5	0.092
New River	3	54	0.091
Humboldt Bay	3	51.5	0.086
Salmon	3	46.5	0.078
Kalaloch Creek	2	42.5	0.071
Pistol River	2	42.5	0.071
Sooes River	2	40.5	0.068
Little River	2	37.5	0.063
Yachats River	2	36	0.060
Winchuck River	2	35	0.059

Appendix 5 - Salmon Suitability Factor

Mosquito Creek	2	32.5	0.055
Bear River	2	31.5	0.053
Estuary	**# of Salmon Populations**	**Composite Score**	**Normalized Score (excluding south of Juan De Fuca and Columbia)**
Goodman Creek	2	31.5	0.053
Copalis River	2	29	0.049
Siltcoos Lake	1	27	0.045
Tahkenitch Creek	1	27	0.045
Tenmile Creek South	1	27	0.045
Wilson Creek	1	27	0.045
Hunter Creek	1	22.5	0.038
Waatch River	1	22.5	0.038
Raft River	1	18	0.030
Big Creek	1	15	0.025
Big Lagoon	1	15	0.025
Tenmile Creek North	1	15	0.025
Beaver Creek	1	14	0.024
Moclips River	1	14	0.024
Sutton Creek	1	14	0.024

Appendix 6 Marxan Results for Conservation Scenarios

DEFINITIONS		
CMCB =	Cape Mendocino to Cape Blanco Section	PA = Protected Area
CBCL =	Cape Blanco to Cape Lookout Section	CPUE = Catch per Unit Effort
CLPG =	Cape Lookout to Point Grenville Section	CNT = Count
PGIB =	Point Grenville to International Boundary Section	

Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occurrences	Target Met	% Target Met	Amount	Occurrences	Target Met	% Target Met
100001	Bathybenthal_Canyon_Mud_CMCB	58044	58095.5	86	yes	100.09	58008.9	77	no	99.94
100004	Bathybenthal_Flats_Mud_CMCB	211880	211575.0	192	no	99.86	211125.3	186	no	99.64
100005	Bathybenthal_Flats_Rock_CMCB	6822	6606.9	7	no	96.84	6720.0	15	no	98.50
100007	Bathybenthal_Middle_slope_Mud_CMCB	92745	92701.2	160	no	99.95	92482.6	151	no	99.72
100008	Bathybenthal_Middle_slope_Rock_CMCB	1182	1217.3	3	yes	102.98	1211.0	9	yes	102.45
100010	Bathybenthal_Ridge_Mud_CMCB	47314	47123.1	77	no	99.60	46780.7	69	no	98.87
100011	Bathybenthal_Ridge_Rock_CMCB	1407	1266.1	3	no	89.95	1402.8	7	no	99.67
100014	Inner_shelf_Flats_Gravel_CMCB	27	26.8	11	yes	100.19	29.7	9	yes	110.99
100015	Inner_shelf_Flats_Mud_CMCB	455	451.4	15	no	99.21	491.3	16	yes	107.98
100016	Inner_shelf_Flats_Rock_CMCB	3531	3602.5	75	yes	102.03	3755.1	75	yes	106.35
100017	Inner_shelf_Flats_Sand_CMCB	8302	8305.4	82	yes	100.04	8279.3	72	no	99.72
100018	Inner_shelf_Flats_Soft_CMCB	34734	34731.0	174	no	99.99	34711.5	167	no	99.94
100021	Inner_shelf_Middle_slope_Rock_CMCB	13	22.0	12	yes	174.48	27.8	12	yes	219.89
100022	Inner_shelf_Middle_slope_Sand_CMCB	15	30.2	15	yes	202.08	33.0	15	yes	221.38
100023	Inner_shelf_Middle_slope_Soft_CMCB	45	146.6	2	yes	328.90	45.9	1	yes	102.96
100026	Inner_shelf_Ridge_Rock_CMCB	575	808.7	33	yes	140.53	807.0	31	yes	140.23
100027	Inner_shelf_Ridge_Sand_CMCB	706	843.4	36	yes	119.53	743.1	34	yes	105.32
100028	Mesobenthal_Canyon_Mud_CMCB	2461	2963.2	11	yes	120.43	3332.3	11	yes	135.42
100033	Mesobenthal_Flats_Mud_CMCB	66122	67267.4	84	yes	101.73	65968.1	75	no	99.77
100034	Mesobenthal_Flats_Rock_CMCB	371	624.2	7	yes	168.42	934.0	8	yes	251.99
100036	Mesobenthal_Flats_Soft_CMCB	4135	5339.5	11	yes	129.14	5940.1	9	yes	143.66
100038	Mesobenthal_Middle_slope_Mud_CMCB	20347	31488.5	73	yes	154.76	27591.9	71	yes	135.61
100039	Mesobenthal_Middle_slope_Rock_CMCB	229	409.2	4	yes	178.98	196.6	4	no	85.99
100041	Mesobenthal_Middle_slope_Soft_CMCB	169	186.8	14	yes	110.48	249.9	11	yes	147.81
100042	Mesobenthal_Ridge_Mud_CMCB	9817	16527.7	42	yes	168.36	15976.6	39	yes	162.75
100043	Mesobenthal_Ridge_Rock_CMCB	42	73.9	1	yes	177.06	65.3	1	yes	156.32
100045	Mesobenthal_Ridge_Soft_CMCB	202	647.1	14	yes	319.79	597.4	10	yes	295.20
100047	Mid_shelf_Canyon_Mud_CMCB	145	150.7	9	yes	103.85	179.7	7	yes	123.84
100048	Mid_shelf_Canyon_Rock_CMCB	18	16.7	3	no	94.99	16.2	2	no	92.21
100049	Mid_shelf_Canyon_Sand_CMCB	30	81.2	11	yes	271.56	45.9	7	yes	153.53
100050	Mid_shelf_Flats_Gravel_CMCB	22	31.9	2	yes	144.21	31.9	2	yes	144.21

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occurrences	Target Met	% Target Met	Amount	Occurrences	Target Met	% Target Met
100051	Mid_shelf_Flats_Mud_CMCB	26809	26868.2	92	yes	100.22	26719.3	84	no	99.67
100052	Mid_shelf_Flats_Rock_CMCB	1790	2079.9	66	yes	116.18	2076.3	65	yes	115.98
100053	Mid_shelf_Flats_Sand_CMCB	14545	14513.0	74	no	99.78	14499.6	65	no	99.69
100054	Mid_shelf_Flats_Soft_CMCB	75531	75525.9	135	no	99.99	75592.1	122	yes	100.08
100056	Mid_shelf_Middle_slope_Mud_CMCB	1100	1313.1	37	yes	119.35	1219.9	28	yes	110.88
100057	Mid_shelf_Middle_slope_Rock_CMCB	87	179.2	8	yes	205.50	169.3	6	yes	194.17
100058	Mid_shelf_Middle_slope_Sand_CMCB	136	289.5	17	yes	212.46	258.9	9	yes	189.97
100059	Mid_shelf_Middle_slope_Soft_CMCB	6931	12202.7	28	yes	176.07	9379.6	23	yes	135.33
100061	Mid_shelf_Ridge_Mud_CMCB	3175	3246.3	40	yes	102.25	3653.5	36	yes	115.08
100062	Mid_shelf_Ridge_Rock_CMCB	305	433.7	6	yes	142.40	470.5	3	yes	154.48
100063	Mid_shelf_Ridge_Sand_CMCB	550	682.8	15	yes	124.14	1055.0	8	yes	191.82
100064	Mid_shelf_Ridge_Soft_CMCB	3735	7891.6	19	yes	211.26	5455.6	14	yes	146.05
100097	Gravel_Beach_E_CMCB	2170	6477.2	2	yes	298.47	4528.7	2	yes	208.68
100098	Gravel_Beach_P_CMCB	13586	13492.7	6	no	99.32	14880.8	6	yes	109.53
100099	Gravel_Beach_VE_CMCB	13453	13523.5	27	yes	100.52	13718.4	27	yes	101.97
100100	Gravel_Beach_VP_CMCB	234	511.6	1	yes	218.86	511.6	1	yes	218.86
100108	Mud_Flat_P_CMCB	16644	19615.3	17	yes	117.85	16472.5	13	no	98.97
100110	Mud_Flat_VP_CMCB	12671	11796.8	8	no	93.10	11668.2	8	no	92.08
100112	Organics fines_P_CMCB	21239	23418.2	20	yes	110.26	21340.5	18	yes	100.48
100113	Organics fines_VP_CMCB	20130	25029.3	10	yes	124.34	20732.6	8	yes	102.99
100116	Rock_Platform_VE_CMCB	1425	1509.3	8	yes	105.94	2004.6	9	yes	140.71
100118	Rock_with_Gravel_Beach_P_CMCB	470	1565.5	1	yes	333.33	1565.5	1	yes	333.33
100119	Rock_with_Gravel_Beach_VE_CMCB	5273	5116.8	11	no	97.04	5182.1	12	no	98.28
100122	Rock_with_Sand_Beach_VE_CMCB	531	1004.9	7	yes	189.27	635.1	5	yes	119.62
100125	Rock_with_Sand_and_Gravel_Beach_VE_CMCB	917	1389.5	8	yes	151.49	1318.4	7	yes	143.74
100127	Rocky_Shore Cliff_P_CMCB	717	899.8	2	yes	125.52	899.8	2	yes	125.52
100128	Rocky_Shore Cliff_VE_CMCB	26050	42260.0	50	yes	162.22	40868.2	50	yes	156.88
100130	Sand_Beach_E_CMCB	753	873.0	1	yes	116.00	1635.5	1	yes	217.33
100131	Sand_Beach_P_CMCB	4548	5838.9	6	yes	128.37	5313.5	8	yes	116.82
100132	Sand_Beach_VE_CMCB	50649	52004.4	47	yes	102.68	50703.2	46	yes	100.11
100135	Sand_Flat_P_CMCB	1311	1572.5	3	yes	119.91	1572.5	3	yes	119.91
100136	Sand_Flat_VE_CMCB	251	376.1	1	yes	149.62	376.1	1	yes	149.62
100138	Sand_and_Gravel_Beach_E_CMCB	1417	1874.9	4	yes	132.28	2576.2	2	yes	181.76
100139	Sand_and_Gravel_Beach_P_CMCB	3286	6868.7	6	yes	209.01	5709.5	5	yes	173.74
100140	Sand_and_Gravel_Beach_VE_CMCB	21621	25324.3	29	yes	117.13	21474.3	30	no	99.32
100143	Sand_and_Gravel_Flat_P_CMCB	528	673.1	3	yes	127.59	432.3	2	no	81.95
100160	Islands_Rocks_Area_CMCB	468715	907200.0	72	yes	193.55	880136.0	68	yes	187.78
100161	Islands_Rocks_Count_CMCB	681	1018.0	72	yes	149.49	1123.0	68	yes	164.90

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occurrences	Target Met	% Target Met	Amount	Occurrences	Target Met	% Target Met
100200	Algal_Beds_CMCB	9	17.6	2	yes	187.43	25.1	3	yes	267.31
100204	Channel_CMCB	69	117.8	3	yes	171.19	104.0	3	yes	151.16
100205	Cobble_Gravel_CMCB	8	9.2	3	yes	119.33	9.5	3	yes	122.96
100206	Cobble_Gravel_Flat_CMCB	55	106.3	2	yes	194.78	68.8	3	yes	126.12
100210	Mud_CMCB	838	854.6	12	yes	102.00	827.5	10	no	98.78
100211	Mud_Flat_CMCB	0	1.6	1	yes	339.58	1.6	1	yes	339.58
100213	Saltmarsh_CMCB	1130	1228.9	23	yes	108.74	1141.7	24	yes	101.02
100214	Sand_CMCB	629	668.5	18	yes	106.29	618.4	14	no	98.33
100216	Sand_Mud_CMCB	114	141.0	7	yes	123.67	118.3	7	yes	103.76
100217	Sand_Mud_Flat_CMCB	1	0.7	2	yes	112.12	2.1	2	yes	310.61
100218	Seagrass_CMCB	464	1144.7	21	yes	246.49	673.7	16	yes	145.06
100220	Shrub_Marsh_CMCB	22	35.3	1	yes	161.23	24.3	2	yes	110.82
100221	Unconsolidated_CMCB	9	10.2	2	yes	108.94	10.2	2	yes	108.94
100223	Wood_Debris_Organic_fines_CMCB	9	8.6	2	yes	100.47	8.6	2	yes	100.47
101001	Black_Oystercatcher_CNT_CMCB	174	183.0	37	yes	105.48	178.0	37	yes	102.59
101002	Brandts_Cormorant_CNT_CMCB	4554	5554.0	17	yes	121.97	5156.0	16	yes	113.23
101004	Cassins_Auklet_CNT_CMCB	2588	4951.0	5	yes	191.34	5039.0	5	yes	194.74
101005	Common_Murre_CNT_CMCB	162529	193078.0	15	yes	118.80	209950.0	16	yes	129.18
101006	Double_crested_Cormorant_CNT_CMCB	1831	2972.0	10	yes	162.36	2002.0	11	yes	109.37
101007	Fork_tailed_storm_petrel_CNT_CMCB	210	369.0	5	yes	176.13	360.0	3	yes	171.84
101008	Horned_Puffin_CNT_CMCB	1	2.0	2	yes	200.00	2.0	2	yes	200.00
101009	Leachs_Storm_Petrel_CNT_CMCB	232382	338016.0	11	yes	145.46	273446.0	8	yes	117.67
101010	Pelagic_Cormorant_CNT_CMCB	3025	4182.0	34	yes	138.25	3743.0	34	yes	123.74
101011	Pigeon_Guillemot_CNT_CMCB	1439	1948.0	40	yes	135.42	1698.0	39	yes	118.04
101012	Rhinoceros_Auklet_CNT_CMCB	757	1477.0	9	yes	195.11	1475.0	7	yes	194.85
101014	Tufted_Puffin_CNT_CMCB	424	708.0	14	yes	166.98	736.0	12	yes	173.58
101015	Western_Glaucous_winged_Gull_CNT_CMCB	5141	9268.0	23	yes	180.28	9392.0	23	yes	182.69
102001	Black_Oystercatcher_PA_CMCB	37	37.0	37	yes	100.00	37.0	37	yes	100.00
102002	Brandts_Cormorant_PA_CMCB	15	17.0	17	yes	117.24	16.0	16	yes	110.34
102004	Cassins_Auklet_PA_CMCB	4	5.0	5	yes	142.86	5.0	5	yes	142.86
102005	Common_Murre_PA_CMCB	13	15.0	15	yes	120.00	16.0	16	yes	128.00
102006	Double_crested_Cormorant_PA_CMCB	10	10.0	10	yes	105.26	11.0	11	yes	115.79
102007	Fork_tailed_storm_petrel_PA_CMCB	3	5.0	5	yes	166.67	3.0	3	yes	100.00
102008	Horned_Puffin_PA_CMCB	1	2.0	2	yes	200.00	2.0	2	yes	200.00
102009	Leachs_Storm_Petrel_PA_CMCB	8	11.0	11	yes	137.50	8.0	8	yes	100.00
102010	Pelagic_Cormorant_PA_CMCB	34	34.0	34	yes	101.49	34.0	34	yes	101.49
102011	Pigeon_Guillemot_PA_CMCB	39	40.0	40	yes	103.90	39.0	39	yes	101.30
102012	Rhinoceros_Auklet_PA_CMCB	7	9.0	9	yes	138.46	7.0	7	yes	107.69

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occurrences	Target Met	% Target Met	Amount	Occurrences	Target Met	% Target Met
102014	Tufted_Puffin_PA_CMCB	10	14.0	14	yes	140.00	12.0	12	yes	120.00
102015	Western_Glaucous_winged_Gull_PA_CMCB	19	23.0	23	yes	124.32	23.0	23	yes	124.32
103001	Kelp_CMCB	13404278	16128218.0	53	yes	120.32	13366262.0	43	no	99.72
103101	Upwelling_CMCB	509868	696881.9	648	yes	136.68	554114.1	567	yes	108.68
103201	California_sea_lion_CMCB	34	39.0	14	yes	116.42	40.0	14	yes	119.40
103202	Harbor_seal_CMCB	21	38.0	21	yes	180.95	40.0	25	yes	190.48
103203	Northern_elephant_seal_CMCB	1	1.0	1	yes	200.00	1.0	1	yes	200.00
103204	Stellar_sea_lion_CMCB	32	40.0	17	yes	125.00	41.0	16	yes	128.13
103205	Steller_sea_lion_rookeries_CMCB	7	7.0	6	yes	100.00	7.0	6	yes	100.00
103500	Snowy_Plover_Nesting_CMCB	14	14.0	14	yes	100.00	14.0	14	yes	100.00
103501	WESTERN_SNOWY_PLOVER_CH_CMCB	279	549.5	25	yes	197.23	403.8	20	yes	144.94
103701	bocaccio_CPUE_CMCB	135040	238792.0	114	yes	176.83	222951.2	115	yes	165.10
103702	canary_rockfish_CPUE_CMCB	936292	1685056.1	229	yes	179.97	1597795.4	231	yes	170.65
103703	darkblotched_rockfish_CPUE_CMCB	390447	394446.8	251	yes	101.02	407354.3	259	yes	104.33
103704	dover_sole_CPUE_CMCB	8189597	12423365.5	475	yes	151.70	10549872.5	371	yes	128.82
103705	english_sole_CPUE_CMCB	1098536	1121328.9	344	yes	102.07	1115422.2	300	yes	101.54
103706	greenstriped_rockfish_CPUE_CMCB	158439	310909.6	183	yes	196.23	278661.9	204	yes	175.88
103707	lingcod_CPUE_CMCB	1471009	3480153.3	328	yes	236.58	3480091.2	290	yes	236.58
103708	pacific_ocean_perch_CPUE_CMCB	71895	89848.1	148	yes	124.97	81312.6	137	yes	113.10
103709	redstripe_rockfish_CPUE_CMCB	271023	374766.4	71	yes	138.28	271417.1	66	yes	100.15
103710	rex_sole_CPUE_CMCB	1962177	2527662.5	368	yes	128.82	2465110.3	337	yes	125.63
103711	sablefish_CPUE_CMCB	4950351	7183334.0	373	yes	145.11	5450450.6	307	yes	110.10
103713	spotted_ratfish_CPUE_CMCB	951682	2670572.2	265	yes	280.62	2507351.0	255	yes	263.47
103714	yellowtail_rockfish_CPUE_CMCB	90985	195880.9	133	yes	215.29	174771.3	128	yes	192.09
103800	big_skate_PA_CMCB	105216	160256.0	146	yes	152.31	151040.0	142	yes	143.55
103801	black_rockfish_PA_CMCB	8755	10496.0	9	yes	119.88	9216.0	4	yes	105.26
103804	bocaccio_PA_CMCB	182912	207360.0	114	yes	113.37	183040.0	115	yes	100.07
103805	brown_rockfish_PA_CMCB	3610	3840.0	15	yes	106.38	3584.0	14	no	99.29
103807	canary_rockfish_PA_CMCB	244992	244992.0	229	yes	100.00	245504.0	231	yes	100.21
103808	chub_mackerel_PA_CMCB	132557	179712.0	142	yes	135.57	185088.0	155	yes	139.63
103809	copper_rockfish_PA_CMCB	8064	11008.0	19	yes	136.51	8192.0	16	yes	101.59
103810	darkblotched_rockfish_PA_CMCB	320128	320256.0	251	yes	100.04	320256.0	259	yes	100.04
103811	dover_sole_PA_CMCB	447974	635648.0	475	yes	141.89	473856.0	371	yes	105.78
103812	english_sole_PA_CMCB	214886	301056.0	344	yes	140.10	283648.0	300	yes	132.00
103813	eulachon_PA_CMCB	121728	141824.0	130	yes	116.51	148224.0	139	yes	121.77
103815	greenstriped_rockfish_PA_CMCB	173568	257792.0	183	yes	148.53	263168.0	204	yes	151.62
103816	jack_mackerel_PA_CMCB	145997	217856.0	115	yes	149.22	205568.0	131	yes	140.80
103817	lingcod_PA_CMCB	209280	303104.0	328	yes	144.83	291328.0	290	yes	139.20

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occur-rences	Target Met	% Target Met	Amount	Occur-rences	Target Met	% Target Met
103818	northern_anchovy_PA_CMCB	29414	49408.0	65	yes	167.97	45312.0	57	yes	154.05
103819	pacific_cod_PA_CMCB	4147	13824.0	6	yes	333.33	13824.0	6	yes	333.33
103820	pacific_hagfish_PA_CMCB	99610	174336.0	81	yes	175.02	151040.0	86	yes	151.63
103821	pacific_hake_PA_CMCB	362650	515584.0	414	yes	142.17	410880.0	349	yes	113.30
103822	pacific_herring_PA_CMCB	171187	224512.0	277	yes	131.15	220416.0	261	yes	128.76
103823	pacific_lamprey_PA_CMCB	26880	40192.0	29	yes	149.52	45568.0	26	yes	169.52
103824	pacific_ocean_perch_PA_CMCB	250880	252928.0	148	yes	100.82	252160.0	137	yes	100.51
103826	pacific_sanddab_PA_CMCB	167962	221952.0	283	yes	132.14	208128.0	261	yes	123.91
103828	pacific_sardine_PA_CMCB	57754	86016.0	72	yes	148.94	83200.0	69	yes	144.06
103829	plainfin_midshipman_PA_CMCB	43622	48128.0	52	yes	110.33	45056.0	48	yes	103.29
103830	quillback_rockfish_PA_CMCB	7450	22528.0	40	yes	302.41	15360.0	28	yes	206.19
103831	redstripe_rockfish_PA_CMCB	72960	139008.0	71	yes	190.53	135680.0	66	yes	185.96
103832	rex_sole_PA_CMCB	301901	405504.0	368	yes	134.32	375040.0	337	yes	124.23
103833	sablefish_PA_CMCB	423552	613632.0	373	yes	144.88	461568.0	307	yes	108.98
103834	sixgill_shark_PA_CMCB	4147	13824.0	6	yes	333.33	13824.0	6	yes	333.33
103837	spotted_ratfish_PA_CMCB	222797	311552.0	265	yes	139.84	306944.0	255	yes	137.77
103838	surf_smelt_PA_CMCB	4454	7168.0	4	yes	160.92	4608.0	2	yes	103.45
103840	tiger_rockfish_PA_CMCB	6221	6912.0	3	yes	111.11	6912.0	3	yes	111.11
103842	whitebait_smelt_PA_CMCB	101069	136704.0	182	yes	135.26	123648.0	171	yes	122.34
103843	widow_rockfish_PA_CMCB	192512	210432.0	126	yes	109.31	197632.0	116	yes	102.66
103844	yelloweye_rockfish_PA_CMCB	48384	55296.0	24	yes	114.29	58112.0	27	yes	120.11
103845	yellowtail_rockfish_PA_CMCB	99456	171264.0	133	yes	172.20	167936.0	128	yes	168.85
103900	Alcyonacea_PA_CMCB	26266	39168.0	17	yes	149.12	36864.0	16	yes	140.35
103901	Antipatharia_PA_CMCB	38016	50688.0	22	yes	133.33	39168.0	17	yes	103.03
103902	Gorgonacea_PA_CMCB	53760	81152.0	37	yes	150.95	87552.0	38	yes	162.86
103903	Pennatulacea_PA_CMCB	131712	173312.0	93	yes	131.58	137728.0	82	yes	104.57
103904	Scleractinia_PA_CMCB	1075	2304.0	1	yes	214.29	2304.0	1	yes	214.29
104001	Demospongiae_PA_CMCB	50458	78336.0	34	yes	155.25	66816.0	29	yes	132.42
104002	Hexactenellida_PA_CMCB	691	2304.0	1	yes	333.33	2304.0	1	yes	333.33
104003	Porifera_PA_CMCB	46387	89856.0	39	yes	193.71	69120.0	30	yes	149.01
104004	Demospongiae_CPUE_CMCB	20489090	60568243.2	34	yes	295.61	26841922.6	29	yes	131.01
104005	Hexactenellida_CPUE_CMCB	7223	24076.8	1	yes	333.33	24076.8	1	yes	333.33
104006	Porifera_CPUE_CMCB	21513943	19061982.7	39	no	88.60	18792691.2	30	no	87.35
104050	Antipatha_CPUE_CMCB	1235	3976.7	5	yes	321.95	3075.8	3	yes	249.02
104051	Gorgonace_CPUE_CMCB	8538484	11526043.2	32	yes	134.99	8758130.6	28	yes	102.57
104052	Pennatula_CPUE_CMCB	978900	1602068.9	75	yes	163.66	1104702.9	69	yes	112.85
104100	Chlorophyll_Low_CMCB	63402	70141.6	208	yes	110.63	64434.4	220	yes	101.63
104102	Chlorophyll_High_CMCB	65417	66438.6	252	yes	101.56	65433.4	222	yes	100.02

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occur-rences	Target Met	% Target Met	Amount	Occur-rences	Target Met	% Target Met
104150	Rocky_substrate_CMCB	16382	17347.2	141	yes	105.89	17858.6	142	yes	109.01
104200	Canyon_Wall_CMCB	51828	128101.9	117	yes	247.17	84063.5	73	yes	162.20
104250	Steller_sea_lion_CH_CMCB	802	812.1	10	yes	101.31	804.1	8	yes	100.31
200001	Bathybenthal_Canyon_Mud_CBCL	71881	71685.6	95	no	99.73	71244.9	91	no	99.11
200002	Bathybenthal_Canyon_Rock_CBCL	36	50.6	2	yes	141.94	55.3	3	yes	155.12
200004	Bathybenthal_Flats_Mud_CBCL	79631	79283.6	114	no	99.56	79222.7	110	no	99.49
200005	Bathybenthal_Flats_Rock_CBCL	670	563.1	6	no	84.05	696.4	9	yes	103.94
200007	Bathybenthal_Middle_slope_Mud_CBCL	84929	84966.7	134	yes	100.04	84951.3	132	yes	100.03
200008	Bathybenthal_Middle_slope_Rock_CBCL	401	599.5	7	yes	149.66	564.7	10	yes	140.99
200010	Bathybenthal_Ridge_Mud_CBCL	47745	48087.5	79	yes	100.72	47766.8	77	yes	100.04
200011	Bathybenthal_Ridge_Rock_CBCL	545	794.8	4	yes	145.83	882.9	3	yes	161.99
200014	Inner_shelf_Flats_Gravel_CBCL	58	76.4	16	yes	131.80	62.7	14	yes	108.05
200015	Inner_shelf_Flats_Mud_CBCL	27	37.2	8	yes	136.28	27.4	6	yes	100.66
200016	Inner_shelf_Flats_Rock_CBCL	2147	2205.5	68	yes	102.74	2111.1	63	no	98.35
200017	Inner_shelf_Flats_Sand_CBCL	22788	22816.3	161	yes	100.12	22798.3	146	yes	100.05
200022	Inner_shelf_Middle_slope_Sand_CBCL	30	53.4	9	yes	176.96	33.7	9	yes	111.74
200026	Inner_shelf_Ridge_Rock_CBCL	202	345.8	37	yes	171.02	284.8	31	yes	140.85
200027	Inner_shelf_Ridge_Sand_CBCL	2628	2954.0	83	yes	112.42	2617.1	73	no	99.60
200028	Mesobenthal_Canyon_Mud_CBCL	857	2485.4	10	yes	290.14	2512.1	11	yes	293.25
200029	Mesobenthal_Canyon_Rock_CBCL	11	35.0	1	yes	331.34	35.0	1	yes	331.34
200030	Mesobenthal_Canyon_Sand_CBCL	147	134.7	3	no	91.57	215.6	3	yes	146.54
200033	Mesobenthal_Flats_Mud_CBCL	121174	121277.9	126	yes	100.09	122890.7	121	yes	101.42
200034	Mesobenthal_Flats_Rock_CBCL	7914	9660.4	41	yes	122.06	8722.2	39	yes	110.21
200035	Mesobenthal_Flats_Sand_CBCL	19844	30961.4	38	yes	156.03	23430.4	31	yes	118.07
200038	Mesobenthal_Middle_slope_Mud_CBCL	16289	29550.5	90	yes	181.42	24738.8	87	yes	151.88
200039	Mesobenthal_Middle_slope_Rock_CBCL	6149	6144.7	36	no	99.93	6651.4	34	yes	108.17
200040	Mesobenthal_Middle_slope_Sand_CBCL	1948	3506.7	13	yes	180.05	2868.3	12	yes	147.28
200042	Mesobenthal_Ridge_Mud_CBCL	10358	18148.7	43	yes	175.21	16547.3	36	yes	159.75
200043	Mesobenthal_Ridge_Rock_CBCL	3778	7115.0	32	yes	188.30	7826.8	30	yes	207.14
200047	Mid_shelf_Canyon_Mud_CBCL	59	68.5	7	yes	116.98	121.5	8	yes	207.53
200048	Mid_shelf_Canyon_Rock_CBCL	13	29.0	4	yes	230.71	14.0	3	yes	111.38
200049	Mid_shelf_Canyon_Sand_CBCL	49	67.5	3	yes	139.01	146.1	6	yes	300.70
200050	Mid_shelf_Flats_Gravel_CBCL	4508	5591.8	9	yes	124.05	5563.3	8	yes	123.42
200051	Mid_shelf_Flats_Mud_CBCL	85221	88590.9	124	yes	103.95	91675.3	116	yes	107.57
200052	Mid_shelf_Flats_Rock_CBCL	38893	51474.3	85	yes	132.35	51754.2	85	yes	133.07
200053	Mid_shelf_Flats_Sand_CBCL	148043	148825.2	250	yes	100.53	148221.2	228	yes	100.12
200055	Mid_shelf_Middle_slope_Gravel_CBCL	26	54.4	1	yes	205.95	54.4	1	yes	205.95
200056	Mid_shelf_Middle_slope_Mud_CBCL	332	589.0	28	yes	177.39	771.3	30	yes	232.28

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occur- rences	Target Met	% Target Met	Amount	Occur- rences	Target Met	% Target Met
200057	Mid_shelf_Middle_slope_Rock_CBCL	431	1010.4	25	yes	234.25	1015.2	26	yes	235.35
200058	Mid_shelf_Middle_slope_Sand_CBCL	133	302.8	13	yes	228.19	393.0	16	yes	296.20
200060	Mid_shelf_Ridge_Gravel_CBCL	144	275.4	4	yes	191.56	274.4	3	yes	190.87
200061	Mid_shelf_Ridge_Mud_CBCL	1605	3545.8	46	yes	220.97	3438.2	51	yes	214.27
200062	Mid_shelf_Ridge_Rock_CBCL	3874	9320.5	39	yes	240.58	8619.7	39	yes	222.49
200063	Mid_shelf_Ridge_Sand_CBCL	668	1885.1	30	yes	282.28	1896.4	31	yes	283.96
200097	Gravel_Beach_E_CBCL	3647	4287.7	5	yes	117.56	5099.3	5	yes	139.82
200098	Gravel_Beach_P_CBCL	3670	4243.6	10	yes	115.63	3742.8	7	yes	101.98
200099	Gravel_Beach_VE_CBCL	6283	9255.1	14	yes	147.30	8136.1	12	yes	129.49
200100	Gravel_Beach_VP_CBCL	607	1020.1	1	yes	168.05	1020.1	1	yes	168.05
200108	Mud_Flat_P_CBCL	174	247.4	2	yes	142.03	333.2	1	yes	191.30
200110	Mud_Flat_VP_CBCL	604	1239.5	4	yes	205.24	1108.5	3	yes	183.55
200111	Organics fines_E_CBCL	364	957.5	1	yes	262.94	1213.9	2	yes	333.34
200112	Organics fines_P_CBCL	58157	61221.7	29	yes	105.27	60693.9	25	yes	104.36
200113	Organics fines_VP_CBCL	92034	92009.9	30	no	99.97	92162.0	25	yes	100.14
200115	Rock_Platform_P_CBCL	299	289.3	3	no	96.72	272.4	2	no	91.06
200116	Rock_Platform_VE_CBCL	8426	9710.2	12	yes	115.24	9175.6	11	yes	108.90
200119	Rock_with_Gravel_Beach_VE_CBCL	1899	2256.6	3	yes	118.86	1970.3	2	yes	103.78
200121	Rock_with_Sand_Beach_P_CBCL	509	1028.1	3	yes	202.01	640.6	1	yes	125.87
200122	Rock_with_Sand_Beach_VE_CBCL	3137	4029.8	11	yes	128.47	3128.0	8	no	99.72
200125	Rock_with_Sand_and_Gravel_Beach_VE_CBCL	665	1489.5	3	yes	223.94	938.0	2	yes	141.02
200126	Rocky_Shore Cliff_E_CBCL	346	837.7	2	yes	242.20	422.8	2	yes	122.25
200127	Rocky_Shore Cliff_P_CBCL	16986	17104.3	22	yes	100.70	19758.0	19	yes	116.32
200128	Rocky_Shore Cliff_VE_CBCL	19854	32888.4	28	yes	165.65	30887.1	27	yes	155.57
200129	Rocky_Shore Cliff_VP_CBCL	7974	8226.7	13	yes	103.17	7860.3	8	no	98.57
200130	Sand_Beach_E_CBCL	3118	3288.8	5	yes	105.49	6046.5	6	yes	193.94
200131	Sand_Beach_P_CBCL	21497	23874.1	19	yes	111.06	23694.5	15	yes	110.22
200132	Sand_Beach_VE_CBCL	62417	62396.4	53	no	99.97	62485.1	47	yes	100.11
200133	Sand_Beach_VP_CBCL	2293	3884.1	7	yes	169.42	2148.9	3	no	93.74
200135	Sand_Flat_P_CBCL	445	1482.2	4	yes	333.33	724.0	3	yes	162.81
200137	Sand_Flat_VP_CBCL	491	792.5	1	yes	161.58	792.5	1	yes	161.58
200138	Sand_and_Gravel_Beach_E_CBCL	1338	1436.0	3	yes	107.32	1476.7	3	yes	110.35
200139	Sand_and_Gravel_Beach_P_CBCL	11969	12388.7	17	yes	103.51	11854.0	18	no	99.04
200140	Sand_and_Gravel_Beach_VE_CBCL	9894	9853.0	22	no	99.59	10055.3	20	yes	101.63
200141	Sand_and_Gravel_Beach_VP_CBCL	2489	3720.2	7	yes	149.46	3355.5	5	yes	134.81
200160	Islands_Rocks_Area_CBCL	137918	295298.0	27	yes	214.11	293603.0	30	yes	212.88
200161	Islands_Rocks_Count_CBCL	224	375.0	27	yes	167.56	357.0	30	yes	159.52
200200	Algal_Beds_CBCL	172	184.2	21	yes	106.78	166.3	18	no	96.42

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occur-rences	Target Met	% Target Met	Amount	Occur-rences	Target Met	% Target Met
200201	Aquatic_bed_CBCL	133	134.5	15	yes	101.14	149.3	16	yes	112.21
200203	Boulder_CBCL	27	62.7	9	yes	236.32	65.6	8	yes	246.99
200204	Channel_CBCL	1394	1578.5	45	yes	113.21	1403.5	36	yes	100.66
200205	Cobble_Gravel_CBCL	7	15.3	7	yes	212.24	17.0	8	yes	236.02
200208	Flat_CBCL	107	118.5	17	yes	111.14	123.2	14	yes	115.54
200209	Fresh_Marsh_CBCL	35	50.8	6	yes	144.56	52.1	7	yes	148.19
200210	Mud_CBCL	37	43.0	8	yes	117.49	48.9	8	yes	133.72
200211	Mud_Flat_CBCL	306	286.2	19	no	93.64	339.2	15	yes	111.00
200213	Saltmarsh_CBCL	1211	1190.9	40	no	98.34	1230.0	35	yes	101.58
200214	Sand_CBCL	250	255.9	25	yes	102.50	248.2	25	no	99.43
200215	Sand_Flat_CBCL	178	223.1	12	yes	125.01	179.6	17	yes	100.63
200216	Sand_Mud_CBCL	116	118.3	12	yes	101.73	178.9	9	yes	153.79
200217	Sand_Mud_Flat_CBCL	286	326.8	23	yes	114.30	292.2	16	yes	102.21
200218	Seagrass_CBCL	343	393.0	31	yes	114.50	339.6	30	no	98.93
200220	Shrub_Marsh_CBCL	14	18.9	3	yes	132.26	17.0	3	yes	118.82
200221	Unconsolidated_CBCL	32	40.7	8	yes	125.57	34.7	8	yes	106.97
200223	Wood_Debris_Organic_fines_CBCL	37	48.9	9	yes	133.85	57.2	10	yes	156.78
201001	Black_Oystercatcher_CNT_CBCL	92	94.0	20	yes	102.73	100.0	21	yes	109.29
201002	Brandts_Cormorant_CNT_CBCL	3436	5928.0	12	yes	172.53	6068.0	13	yes	176.60
201004	Cassins_Auklet_CNT_CBCL	10	20.0	1	yes	200.00	20.0	1	yes	200.00
201005	Common_Murre_CNT_CBCL	113547	126541.0	11	yes	111.44	133883.0	13	yes	117.91
201006	Double_crested_Cormorant_CNT_CBCL	1102	1698.0	9	yes	154.08	1438.0	7	yes	130.49
201009	Leachs_Storm_Petrel_CNT_CBCL	672	1344.0	3	yes	200.00	1344.0	3	yes	200.00
201010	Pelagic_Cormorant_CNT_CBCL	2196	2718.0	18	yes	123.77	2238.0	17	yes	101.91
201011	Pigeon_Guillemot_CNT_CBCL	1199	1311.0	28	yes	109.39	1209.0	27	yes	100.88
201012	Rhinoceros_Auklet_CNT_CBCL	13	26.0	2	yes	200.00	26.0	2	yes	200.00
201014	Tufted_Puffin_CNT_CBCL	111	200.0	10	yes	181.00	211.0	9	yes	190.95
201015	Western_Glaucous_winged_Gull_CNT_CBCL	5014	8162.0	22	yes	162.78	7646.0	22	yes	152.49
202001	Black_Oystercatcher_PA_CBCL	20	20.0	20	yes	102.56	21.0	21	yes	107.69
202002	Brandts_Cormorant_PA_CBCL	7	12.0	12	yes	171.43	13.0	13	yes	185.71
202004	Cassins_Auklet_PA_CBCL	1	1.0	1	yes	200.00	1.0	1	yes	200.00
202005	Common_Murre_PA_CBCL	9	11.0	11	yes	129.41	13.0	13	yes	152.94
202006	Double_crested_Cormorant_PA_CBCL	6	9.0	9	yes	163.64	7.0	7	yes	127.27
202009	Leachs_Storm_Petrel_PA_CBCL	2	3.0	3	yes	200.00	3.0	3	yes	200.00
202010	Pelagic_Cormorant_PA_CBCL	16	18.0	18	yes	116.13	17.0	17	yes	109.68
202011	Pigeon_Guillemot_PA_CBCL	27	28.0	28	yes	105.66	27.0	27	yes	101.89
202012	Rhinoceros_Auklet_PA_CBCL	1	2.0	2	yes	200.00	2.0	2	yes	200.00
202014	Tufted_Puffin_PA_CBCL	6	10.0	10	yes	166.67	9.0	9	yes	150.00

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occur-rences	Target Met	% Target Met	Amount	Occur-rences	Target Met	% Target Met
202015	Western_Glaucous_winged_Gull_PA_CBCL	21	22.0	22	yes	104.76	22.0	22	yes	104.76
203001	Kelp_CBCL	1500554	2085734.0	22	yes	139.00	1712890.0	17	yes	114.15
203101	Upwelling_CBCL	223389	223349.5	380	no	99.98	225021.3	362	yes	100.73
203201	California_sea_lion_CBCL	4	7.0	5	yes	175.00	6.0	4	yes	150.00
203202	Harbor_seal_CBCL	14	19.0	17	yes	134.75	23.0	20	yes	163.12
203203	Northern_elephant_seal_CBCL	1	2.0	1	yes	200.00	2.0	1	yes	200.00
203204	Stellar_sea_lion_CBCL	3	4.0	2	yes	133.33	5.0	3	yes	166.67
203500	Snowy_Plover_Nesting_CBCL	11	11.0	11	yes	104.76	11.0	11	yes	104.76
203501	WESTERN_SNOWY_PLOVER_CH_CBCL	235	393.3	19	yes	167.26	378.9	17	yes	161.16
203600	Olympia_Oyster_CBCL	3	8.0	8	yes	242.42	4.0	4	yes	121.21
203701	bocaccio_CPUE_CBCL	110094	134944.7	191	yes	122.57	156098.6	180	yes	141.79
203702	canary_rockfish_CPUE_CBCL	1261828	1649431.4	350	yes	130.72	1767564.9	343	yes	140.08
203703	darkblotched_rockfish_CPUE_CBCL	1010168	1342545.0	332	yes	132.90	1235779.7	339	yes	122.33
203704	dover_sole_CPUE_CBCL	6525425	9016268.6	475	yes	138.17	8651374.8	439	yes	132.58
203705	english_sole_CPUE_CBCL	1292661	1294122.7	413	yes	100.11	1293952.7	377	yes	100.10
203706	greenstriped_rockfish_CPUE_CBCL	542006	784965.7	327	yes	144.83	820425.8	336	yes	151.37
203707	lingcod_CPUE_CBCL	1095504	1633876.7	389	yes	149.14	1603581.2	365	yes	146.38
203708	pacific_ocean_perch_CPUE_CBCL	767490	769757.0	187	yes	100.30	779847.4	186	yes	101.61
203709	redstripe_rockfish_CPUE_CBCL	1167794	1609146.7	167	yes	137.79	1776041.6	154	yes	152.09
203710	rex_sole_CPUE_CBCL	2038292	2472206.8	452	yes	121.29	2405477.7	417	yes	118.01
203711	sablefish_CPUE_CBCL	5698984	8686324.6	416	yes	152.42	7678718.8	400	yes	134.74
203712	southern_rock_sole_CPUE_CBCL	27737	27867.1	96	yes	100.47	27718.9	88	no	99.93
203713	spotted_ratfish_CPUE_CBCL	439091	631800.8	416	yes	143.89	607898.1	390	yes	138.44
203714	yellowtail_rockfish_CPUE_CBCL	500177	793600.4	279	yes	158.66	829406.1	281	yes	165.82
203800	big_skate_PA_CBCL	198758	291840.0	268	yes	146.83	277248.0	235	yes	139.49
203801	black_rockfish_PA_CBCL	19277	19712.0	37	yes	102.26	19712.0	29	yes	102.26
203804	bocaccio_PA_CBCL	336000	380672.0	191	yes	113.30	373760.0	180	yes	111.24
203807	canary_rockfish_PA_CBCL	523904	525824.0	350	yes	100.37	524032.0	343	yes	100.02
203808	chub_mackerel_PA_CBCL	240691	370176.0	190	yes	153.80	371712.0	188	yes	154.44
203810	darkblotched_rockfish_PA_CBCL	557952	558080.0	332	yes	100.02	557824.0	339	no	99.98
203811	dover_sole_PA_CBCL	597888	723712.0	475	yes	121.04	681728.0	439	yes	114.02
203812	english_sole_PA_CBCL	386227	544000.0	413	yes	140.85	526592.0	377	yes	136.34
203813	eulachon_PA_CBCL	333389	481536.0	353	yes	144.44	478720.0	334	yes	143.59
203815	greenstriped_rockfish_PA_CBCL	361651	530176.0	327	yes	146.60	526336.0	336	yes	145.54
203816	jack_mackerel_PA_CBCL	264960	392960.0	239	yes	148.31	375808.0	228	yes	141.84
203817	lingcod_PA_CBCL	368102	539904.0	389	yes	146.67	525568.0	365	yes	142.78
203818	northern_anchovy_PA_CBCL	25267	37376.0	58	yes	147.92	26624.0	40	yes	105.37
203819	pacific_cod_PA_CBCL	126797	178944.0	83	yes	141.13	181248.0	84	yes	142.94

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occur-rences	Target Met	% Target Met	Amount	Occur-rences	Target Met	% Target Met
203820	pacific_hagfish_PA_CBCL	211738	357888.0	158	yes	169.02	272640.0	121	yes	128.76
203821	pacific_hake_PA_CBCL	575693	706816.0	457	yes	122.78	665600.0	416	yes	115.62
203822	pacific_herring_PA_CBCL	289536	368896.0	337	yes	127.41	373504.0	307	yes	129.00
203823	pacific_lamprey_PA_CBCL	87782	119808.0	52	yes	136.48	117504.0	51	yes	133.86
203824	pacific_ocean_perch_PA_CBCL	426752	430848.0	187	yes	100.96	428544.0	186	yes	100.42
203826	pacific_sanddab_PA_CBCL	304589	371200.0	338	yes	121.87	368896.0	305	yes	121.11
203828	pacific_sardine_PA_CBCL	118195	122112.0	53	yes	103.31	143104.0	63	yes	121.07
203829	plainfin_midshipman_PA_CBCL	12442	32768.0	56	yes	263.37	32000.0	61	yes	257.20
203830	quillback_rockfish_PA_CBCL	16358	23040.0	18	yes	140.85	19456.0	12	yes	118.94
203831	redstripe_rockfish_PA_CBCL	219648	366336.0	167	yes	166.78	340480.0	154	yes	155.01
203832	rex_sole_PA_CBCL	517555	633856.0	452	yes	122.47	618752.0	417	yes	119.55
203833	sablefish_PA_CBCL	586752	710656.0	416	yes	121.12	681984.0	400	yes	116.23
203834	sixgill_shark_PA_CBCL	8294	11520.0	5	yes	138.89	16128.0	7	yes	194.44
203835	soupfin_shark_PA_CBCL	10368	13824.0	6	yes	133.33	13824.0	6	yes	133.33
203836	southern_rock_sole_PA_CBCL	116506	116736.0	96	yes	100.20	116736.0	88	yes	100.20
203837	spotted_ratfish_PA_CBCL	449126	575488.0	416	yes	128.13	566784.0	390	yes	126.20
203840	tiger_rockfish_PA_CBCL	6221	16128.0	7	yes	259.26	16128.0	7	yes	259.26
203841	walleye_pollock_PA_CBCL	104909	188160.0	87	yes	179.36	192768.0	89	yes	183.75
203842	whitebait_smelt_PA_CBCL	61517	81408.0	126	yes	132.33	74752.0	100	yes	121.51
203843	widow_rockfish_PA_CBCL	428672	444160.0	231	yes	103.61	435456.0	221	yes	101.58
203844	yelloweye_rockfish_PA_CBCL	229888	236544.0	132	yes	102.90	249856.0	136	yes	108.69
203845	yellowtail_rockfish_PA_CBCL	276480	413440.0	279	yes	149.54	411904.0	281	yes	148.98
203900	Alcyonacea_PA_CBCL	38016	59904.0	26	yes	157.58	52992.0	23	yes	139.39
203901	Antipatharia_PA_CBCL	70502	85248.0	37	yes	120.92	80640.0	35	yes	114.38
203902	Gorgonacea_PA_CBCL	49075	52992.0	23	yes	107.98	52992.0	23	yes	107.98
203903	Pennatulacea_PA_CBCL	286157	368640.0	192	yes	128.82	344064.0	176	yes	120.24
203904	Scleractinia_PA_CBCL	13286	18432.0	8	yes	138.73	16384.0	8	yes	123.31
204001	Demospongiae_PA_CBCL	155981	199680.0	92	yes	128.02	185600.0	85	yes	118.99
204002	Hexactenellida_PA_CBCL	8986	13824.0	6	yes	153.85	11520.0	5	yes	128.21
204003	Porifera_PA_CBCL	136166	198144.0	86	yes	145.52	163584.0	71	yes	120.14
204004	Demospongiae_CPUE_CBCL	71938884	91320161.3	92	yes	126.94	82755261.4	85	yes	115.04
204005	Hexactenellida_CPUE_CBCL	99989	264890.9	6	yes	264.92	315555.8	5	yes	315.59
204006	Porifera_CPUE_CBCL	50336419	47342085.1	86	no	94.05	57506388.5	71	yes	114.24
204050	Antipatha_CPUE_CBCL	76250	75036.6	23	no	98.41	77713.8	21	yes	101.92
204051	Gorgonace_CPUE_CBCL	261021	598060.7	29	yes	229.12	399407.5	26	yes	153.02
204052	Pennatula_CPUE_CBCL	5092436	5904793.2	150	yes	115.95	8630778.6	147	yes	169.48
204053	Scleracti_CPUE_CBCL	878131	852440.8	5	no	97.07	885487.8	7	yes	100.84
204100	Chlorophyll_Low_CBCL	64469	64695.2	255	yes	100.35	64502.9	238	yes	100.05

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occur-rences	Target Met	% Target Met	Amount	Occur-rences	Target Met	% Target Met
204102	Chlorophyll_High_CBCL	7196	7226.6	79	yes	100.43	7232.5	80	yes	100.51
204150	Rocky_substrate_CBCL	65075	89352.7	192	yes	137.31	89242.0	184	yes	137.14
204200	Canyon_Wall_CBCL	240	800.7	4	yes	333.34	723.1	3	yes	301.05
300001	Bathybenthal_Canyon_Mud_CLPG	111594	112344.5	178	yes	100.67	111440.2	173	no	99.86
300002	Bathybenthal_Canyon_Rock_CLPG	68	226.6	4	yes	333.38	215.5	3	yes	316.99
300003	Bathybenthal_Canyon_Sand_CLPG	158	510.8	2	yes	322.99	266.2	1	yes	168.33
300004	Bathybenthal_Flats_Mud_CLPG	234226	234103.7	235	no	99.95	234092.6	240	no	99.94
300005	Bathybenthal_Flats_Rock_CLPG	6	15.1	1	yes	266.55	15.1	1	yes	266.55
300007	Bathybenthal_Middle_slope_Mud_CLPG	129054	128973.8	261	no	99.94	129065.5	250	yes	100.01
300008	Bathybenthal_Middle_slope_Rock_CLPG	566	763.1	5	yes	134.87	762.1	4	yes	134.69
300010	Bathybenthal_Ridge_Mud_CLPG	77829	77912.7	139	yes	100.11	77897.3	139	yes	100.09
300011	Bathybenthal_Ridge_Rock_CLPG	26	30.9	1	yes	118.69	30.9	1	yes	118.69
300014	Inner_shelf_Flats_Gravel_CLPG	1344	1428.0	35	yes	106.22	1365.4	35	yes	101.56
300015	Inner_shelf_Flats_Mud_CLPG	183	190.8	12	yes	104.09	183.0	10	no	99.85
300016	Inner_shelf_Flats_Rock_CLPG	477	763.4	50	yes	159.93	478.8	50	yes	100.32
300017	Inner_shelf_Flats_Sand_CLPG	50691	50775.7	249	yes	100.17	50692.8	236	yes	100.00
300022	Inner_shelf_Middle_slope_Sand_CLPG	27	50.0	9	yes	185.09	59.9	7	yes	221.49
300026	Inner_shelf_Ridge_Rock_CLPG	24	58.2	12	yes	246.49	45.5	11	yes	192.46
300027	Inner_shelf_Ridge_Sand_CLPG	430	443.0	21	yes	103.07	431.0	22	yes	100.27
300028	Mesobenthal_Canyon_Mud_CLPG	4637	8932.3	35	yes	192.64	10211.6	29	yes	220.23
300033	Mesobenthal_Flats_Mud_CLPG	49095	50451.8	88	yes	102.76	56028.7	86	yes	114.12
300034	Mesobenthal_Flats_Rock_CLPG	2146	2103.5	9	no	98.03	2246.0	7	yes	104.68
300035	Mesobenthal_Flats_Sand_CLPG	3294	4064.0	18	yes	123.37	4944.9	13	yes	150.11
300038	Mesobenthal_Middle_slope_Mud_CLPG	17856	43811.6	99	yes	245.37	34699.6	86	yes	194.33
300039	Mesobenthal_Middle_slope_Rock_CLPG	1512	1951.3	7	yes	129.07	1815.8	5	yes	120.11
300040	Mesobenthal_Middle_slope_Sand_CLPG	48	160.8	8	yes	333.40	51.5	3	yes	106.80
300042	Mesobenthal_Ridge_Mud_CLPG	15874	32901.6	84	yes	207.26	30111.6	67	yes	189.69
300043	Mesobenthal_Ridge_Rock_CLPG	1432	2266.8	8	yes	158.30	2237.0	7	yes	156.21
300044	Mesobenthal_Ridge_Sand_CLPG	99	330.6	14	yes	333.36	103.3	9	yes	104.17
300047	Mid_shelf_Canyon_Mud_CLPG	151	362.9	14	yes	239.71	346.5	13	yes	228.87
300049	Mid_shelf_Canyon_Sand_CLPG	10	27.3	4	yes	281.86	27.3	4	yes	281.86
300050	Mid_shelf_Flats_Gravel_CLPG	889	779.5	18	no	87.65	594.1	15	no	66.80
300051	Mid_shelf_Flats_Mud_CLPG	95841	140663.1	114	yes	146.77	138551.7	115	yes	144.56
300052	Mid_shelf_Flats_Rock_CLPG	5044	5316.3	46	yes	105.40	7728.4	52	yes	153.23
300053	Mid_shelf_Flats_Sand_CLPG	142519	158333.7	165	yes	111.10	156143.6	152	yes	109.56
300056	Mid_shelf_Middle_slope_Mud_CLPG	503	1076.0	34	yes	214.13	900.1	39	yes	179.13
300057	Mid_shelf_Middle_slope_Rock_CLPG	108	275.5	7	yes	254.41	360.0	12	yes	332.50
300058	Mid_shelf_Middle_slope_Sand_CLPG	127	379.2	16	yes	298.57	288.4	12	yes	227.14

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occurrences	Target Met	% Target Met	Amount	Occurrences	Target Met	% Target Met
300061	Mid_shelf_Ridge_Mud_CLPG	6682	13715.9	63	yes	205.26	14226.8	76	yes	212.91
300062	Mid_shelf_Ridge_Rock_CLPG	1493	1894.5	12	yes	126.90	4088.1	24	yes	273.82
300063	Mid_shelf_Ridge_Sand_CLPG	2021	6329.3	34	yes	313.21	4161.8	26	yes	205.95
300097	Gravel_Beach_E_CLPG	6077	6687.6	5	yes	110.05	6063.3	5	no	99.78
300098	Gravel_Beach_P_CLPG	26852	27111.1	23	yes	100.96	26808.8	23	no	99.84
300099	Gravel_Beach_VE_CLPG	3681	4838.2	7	yes	131.44	4262.1	7	yes	115.79
300100	Gravel_Beach_VP_CLPG	2368	3638.7	1	yes	153.68	3972.5	2	yes	167.78
300101	Gravel_Flat_E_CLPG	1443	2630.7	5	yes	182.37	1487.3	4	yes	103.10
300102	Gravel_Flat_P_CLPG	1609	1625.4	3	yes	101.02	1687.1	3	yes	104.86
300107	Mud_Flat_E_CLPG	3923	4083.9	8	yes	104.11	3921.2	8	no	99.96
300108	Mud_Flat_P_CLPG	53494	53693.6	25	yes	100.37	53161.7	29	no	99.38
300110	Mud_Flat_VP_CLPG	1028	3425.4	1	yes	333.33	3425.4	1	yes	333.33
300111	Organics fines_E_CLPG	11929	13023.1	11	yes	109.18	11859.4	8	no	99.42
300112	Organics fines_P_CLPG	330779	330647.9	87	no	99.96	330545.3	91	no	99.93
300113	Organics fines_VP_CLPG	39526	40174.1	12	yes	101.64	39606.1	13	yes	100.20
300115	Rock_Platform_P_CLPG	136	185.7	2	yes	136.18	154.4	2	yes	113.22
300116	Rock_Platform_VE_CLPG	302	347.5	2	yes	114.87	495.8	2	yes	163.93
300117	Rock_with_Gravel_Beach_E_CLPG	428	495.4	2	yes	115.89	446.3	3	yes	104.40
300118	Rock_with_Gravel_Beach_P_CLPG	824	1503.9	4	yes	182.45	1404.9	4	yes	170.45
300119	Rock_with_Gravel_Beach_VE_CLPG	304	1013.5	3	yes	333.34	1013.5	3	yes	333.34
300120	Rock_with_Sand_Beach_E_CLPG	1120	3734.9	4	yes	333.33	1955.4	2	yes	174.52
300121	Rock_with_Sand_Beach_P_CLPG	464	440.0	2	no	94.76	559.0	1	yes	120.39
300122	Rock_with_Sand_Beach_VE_CLPG	400	360.6	1	no	90.12	546.6	1	yes	136.62
300126	Rocky_Shore Cliff_E_CLPG	2221	3447.9	5	yes	155.27	4284.4	6	yes	192.94
300127	Rocky_Shore Cliff_P_CLPG	18868	19928.1	27	yes	105.62	19116.6	28	yes	101.32
300128	Rocky_Shore Cliff_VE_CLPG	7461	17971.1	12	yes	240.88	16516.0	11	yes	221.37
300129	Rocky_Shore Cliff_VP_CLPG	809	915.2	2	yes	113.10	915.2	2	yes	113.10
300130	Sand_Beach_E_CLPG	2568	2686.0	6	yes	104.60	2569.3	6	yes	100.06
300131	Sand_Beach_P_CLPG	61282	61342.7	44	yes	100.10	60893.1	44	no	99.37
300132	Sand_Beach_VE_CLPG	20370	20910.1	19	yes	102.65	20316.4	17	no	99.74
300133	Sand_Beach_VP_CLPG	1597	2581.4	4	yes	161.69	2581.4	4	yes	161.69
300134	Sand_Flat_E_CLPG	8393	14009.1	13	yes	166.92	8708.9	14	yes	103.77
300135	Sand_Flat_P_CLPG	12617	12491.9	11	no	99.01	12947.2	16	yes	102.62
300136	Sand_Flat_VE_CLPG	30929	31149.7	25	yes	100.71	30822.8	25	no	99.66
300137	Sand_Flat_VP_CLPG	1102	1231.2	2	yes	111.77	1231.2	2	yes	111.77
300138	Sand_and_Gravel_Beach_E_CLPG	354	734.5	2	yes	207.67	969.1	3	yes	274.01
300139	Sand_and_Gravel_Beach_P_CLPG	10459	10691.9	19	yes	102.23	10542.9	18	yes	100.81
300140	Sand_and_Gravel_Beach_VE_CLPG	7646	12979.4	14	yes	169.76	9971.8	13	yes	130.42

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occurrences	Target Met	% Target Met	Amount	Occurrences	Target Met	% Target Met
300142	Sand_and_Gravel_Flat_E_CLPG	727	1046.0	3	yes	143.86	1156.3	4	yes	159.04
300143	Sand_and_Gravel_Flat_P_CLPG	1392	1545.8	3	yes	111.03	2786.5	6	yes	200.14
300160	Islands_Rocks_Area_CLPG	60632	143565.0	15	yes	236.78	163841.0	17	yes	270.22
300161	Islands_Rocks_Count_CLPG	79	177.0	15	yes	223.48	181.0	17	yes	228.54
300200	Algal_Beds_CLPG	48	105.3	14	yes	221.17	101.0	13	yes	212.14
300201	Aquatic_bed_CLPG	63	68.2	8	yes	107.73	70.8	7	yes	111.80
300203	Boulder_CLPG	9	24.1	6	yes	258.63	20.5	5	yes	219.94
300204	Channel_CLPG	6434	6433.5	76	no	99.99	6408.9	76	no	99.61
300205	Cobble_Gravel_CLPG	9	28.4	3	yes	304.61	28.3	2	yes	303.22
300206	Cobble_Gravel_Flat_CLPG	3	6.5	2	yes	257.14	5.0	2	yes	199.21
300208	Flat_CLPG	147	187.8	16	yes	128.09	164.1	11	yes	111.93
300209	Fresh_Marsh_CLPG	749	886.1	20	yes	118.35	830.5	27	yes	110.93
300210	Mud_CLPG	982	1364.7	63	yes	138.93	994.0	63	yes	101.19
300211	Mud_Flat_CLPG	115	234.5	19	yes	203.90	126.8	16	yes	110.25
300213	Saltmarsh_CLPG	1674	1685.7	67	yes	100.70	1693.6	64	yes	101.17
300214	Sand_CLPG	7704	7667.1	68	no	99.52	7680.9	70	no	99.70
300215	Sand_Flat_CLPG	1589	1611.7	53	yes	101.42	1588.4	54	no	99.96
300216	Sand_Mud_CLPG	813	817.5	35	yes	100.55	817.8	35	yes	100.58
300217	Sand_Mud_Flat_CLPG	2259	2323.3	57	yes	102.85	2237.4	53	no	99.05
300218	Seagrass_CLPG	10834	10820.8	95	no	99.88	10826.3	95	no	99.93
300220	Shrub_Marsh_CLPG	827	978.7	20	yes	118.35	922.8	19	yes	111.58
300221	Unconsolidated_CLPG	137	172.9	12	yes	126.39	148.5	13	yes	108.55
300223	Wood_Debris_Organic_fines_CLPG	37	2.6	1	no	6.93	14.9	4	no	40.43
301001	Black_Oystercatcher_CNT_CLPG	42	54.0	10	yes	130.12	58.0	11	yes	139.76
301002	Brandts_Cormorant_CNT_CLPG	6816	9156.0	10	yes	134.33	12428.0	13	yes	182.34
301003	Caspian_Tern_CNT_CLPG	12856	20496.0	3	yes	159.43	22862.0	3	yes	177.83
301005	Common_Murre_CNT_CLPG	86985	144673.0	11	yes	166.32	171783.0	13	yes	197.49
301006	Double_crested_Cormorant_CNT_CLPG	13741	25718.0	6	yes	187.16	25296.0	5	yes	184.09
301009	Leachs_Storm_Petrel_CNT_CLPG	58	116.0	1	yes	200.00	116.0	1	yes	200.00
301010	Pelagic_Cormorant_CNT_CLPG	984	1128.0	10	yes	114.63	1040.0	9	yes	105.69
301011	Pigeon_Guillemot_CNT_CLPG	486	773.0	17	yes	159.22	636.0	18	yes	131.00
301012	Rhinoceros_Auklet_CNT_CLPG	1	1.0	1	yes	200.00	1.0	1	yes	200.00
301013	Ring_billed_Gull_CNT_CLPG	200	400.0	1	yes	200.00	400.0	1	yes	200.00
301014	Tufted_Puffin_CNT_CLPG	1890	3161.0	8	yes	167.29	3160.0	8	yes	167.24
301015	Western_Glaucous_winged_Gull_CNT_CLPG	10774	19410.0	14	yes	180.16	17305.0	15	yes	160.62
302001	Black_Oystercatcher_PA_CLPG	10	10.0	10	yes	100.00	11.0	11	yes	110.00
302002	Brandts_Cormorant_PA_CLPG	9	10.0	10	yes	111.11	13.0	13	yes	144.44
302003	Caspian_Tern_PA_CLPG	2	3.0	3	yes	150.00	3.0	3	yes	150.00

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occur-rences	Target Met	% Target Met	Amount	Occur-rences	Target Met	% Target Met
302005	Common_Murre_PA_CLPG	9	11.0	11	yes	122.22	13.0	13	yes	144.44
302006	Double_crested_Cormorant_PA_CLPG	5	6.0	6	yes	120.00	5.0	5	yes	100.00
302009	Leachs_Storm_Petrel_PA_CLPG	1	1.0	1	yes	200.00	1.0	1	yes	200.00
302010	Pelagic_Cormorant_PA_CLPG	9	10.0	10	yes	111.11	9.0	9	yes	100.00
302011	Pigeon_Guillemot_PA_CLPG	17	17.0	17	yes	103.03	18.0	18	yes	109.09
302012	Rhinoceros_Auklet_PA_CLPG	1	1.0	1	yes	200.00	1.0	1	yes	200.00
302013	Ring_billed_Gull_PA_CLPG	1	1.0	1	yes	200.00	1.0	1	yes	200.00
302014	Tufted_Puffin_PA_CLPG	6	8.0	8	yes	133.33	8.0	8	yes	133.33
302015	Western_Glaucous_winged_Gull_PA_CLPG	14	14.0	14	yes	103.70	15.0	15	yes	111.11
303001	Kelp_CLPG	50484	100968.0	1	yes	200.00	100968.0	1	yes	200.00
303101	Upwelling_CLPG	38245	38366.8	206	yes	100.32	39188.0	201	yes	102.47
303201	California_sea_lion_CLPG	4	4.0	4	yes	100.00	5.0	5	yes	125.00
303202	Harbor_seal_CLPG	33	35.0	35	yes	107.03	34.0	30	yes	103.98
303204	Stellar_sea_lion_CLPG	3	4.0	4	yes	160.00	4.0	4	yes	160.00
303205	Steller_sea_lion_rookeries_CLPG	1	1.0	1	yes	100.00	1.0	1	yes	100.00
303500	Snowy_Plover_Nesting_CLPG	8	8.0	8	yes	106.67	10.0	10	yes	133.33
303501	WESTERN_SNOWY_PLOVER_CH_CLPG	332	420.9	14	yes	126.78	741.9	12	yes	223.45
303600	Olympia_Oyster_CLPG	9	17.0	17	yes	182.80	10.0	10	yes	107.53
303701	bocaccio_CPUE_CLPG	89840	125786.3	128	yes	140.01	129621.0	116	yes	144.28
303702	canary_rockfish_CPUE_CLPG	1166662	1302263.5	251	yes	111.62	1173997.7	255	yes	100.63
303703	darkblotched_rockfish_CPUE_CLPG	1338595	1862890.4	276	yes	139.17	1913289.1	283	yes	142.93
303704	dover_sole_CPUE_CLPG	4601849	7632853.6	319	yes	165.86	6748007.7	321	yes	146.64
303705	english_sole_CPUE_CLPG	669874	832205.2	267	yes	124.23	867633.8	269	yes	129.52
303706	greenstriped_rockfish_CPUE_CLPG	352473	561829.8	238	yes	159.40	743996.0	233	yes	211.08
303707	lingcod_CPUE_CLPG	595623	1385019.9	271	yes	232.53	1117595.4	272	yes	187.63
303708	pacific_ocean_perch_CPUE_CLPG	1785739	2729502.8	200	yes	152.85	2676255.6	193	yes	149.87
303709	redstripe_rockfish_CPUE_CLPG	323135	669493.1	108	yes	207.19	929564.6	117	yes	287.67
303710	rex_sole_CPUE_CLPG	1730227	2154863.9	289	yes	124.54	2300922.3	287	yes	132.98
303711	sablefish_CPUE_CLPG	3810795	5582656.3	342	yes	146.50	6087426.1	353	yes	159.74
303712	southern_rock_sole_CPUE_CLPG	1312	3004.9	90	yes	229.07	2794.0	81	yes	213.00
303713	spotted_ratfish_CPUE_CLPG	289524	412591.3	297	yes	142.51	422271.8	296	yes	145.85
303714	yellowtail_rockfish_CPUE_CLPG	1488014	3925376.6	258	yes	263.80	3102861.1	265	yes	208.52
303800	big_skate_PA_CLPG	163430	260608.0	146	yes	159.46	266240.0	152	yes	162.91
303801	black_rockfish_PA_CLPG	29722	59904.0	26	yes	201.55	57600.0	25	yes	193.80
303804	bocaccio_PA_CLPG	210816	294912.0	128	yes	139.89	267264.0	116	yes	126.78
303807	canary_rockfish_PA_CLPG	457472	457472.0	251	yes	100.00	458496.0	255	yes	100.22
303808	chub_mackerel_PA_CLPG	222106	307200.0	144	yes	138.31	295936.0	140	yes	133.24
303810	darkblotched_rockfish_PA_CLPG	519040	519168.0	276	yes	100.02	518912.0	283	no	99.98

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	**Target Name**	**Goal**	**Amount**	**Occurrences**	**Target Met**	**% Target Met**	**Amount**	**Occurrences**	**Target Met**	**% Target Met**
303811	dover_sole_PA_CLPG	452275	614144.0	319	yes	135.79	604416.0	321	yes	133.64
303812	english_sole_PA_CLPG	321408	490240.0	267	yes	152.53	482560.0	269	yes	150.14
303813	eulachon_PA_CLPG	303590	465408.0	226	yes	153.30	468224.0	237	yes	154.23
303815	greenstriped_rockfish_PA_CLPG	290995	482816.0	238	yes	165.92	473344.0	233	yes	162.66
303816	jack_mackerel_PA_CLPG	204902	290560.0	159	yes	141.80	284672.0	160	yes	138.93
303817	lingcod_PA_CLPG	320563	499456.0	271	yes	155.81	489472.0	272	yes	152.69
303818	northern_anchovy_PA_CLPG	88166	146688.0	93	yes	166.38	153088.0	102	yes	173.64
303819	pacific_cod_PA_CLPG	235699	420352.0	210	yes	178.34	381952.0	196	yes	162.05
303820	pacific_hagfish_PA_CLPG	20045	27648.0	12	yes	137.93	20736.0	9	yes	103.45
303821	pacific_hake_PA_CLPG	441907	616448.0	320	yes	139.50	602112.0	320	yes	136.25
303822	pacific_herring_PA_CLPG	258816	371200.0	194	yes	143.42	372224.0	198	yes	143.82
303823	pacific_lamprey_PA_CLPG	20736	55296.0	24	yes	266.67	43776.0	19	yes	211.11
303824	pacific_ocean_perch_PA_CLPG	384128	397312.0	200	yes	103.43	389376.0	193	yes	101.37
303826	pacific_sanddab_PA_CLPG	240922	325632.0	176	yes	135.16	322560.0	180	yes	133.89
303828	pacific_sardine_PA_CLPG	159898	200704.0	120	yes	125.52	238592.0	140	yes	149.22
303829	plainfin_midshipman_PA_CLPG	44928	94464.0	41	yes	210.26	82944.0	36	yes	184.62
303830	quillback_rockfish_PA_CLPG	19277	50176.0	44	yes	260.29	59648.0	57	yes	309.43
303831	redstripe_rockfish_PA_CLPG	140237	248832.0	108	yes	177.44	267520.0	117	yes	190.76
303832	rex_sole_PA_CLPG	373939	540928.0	289	yes	144.66	524032.0	287	yes	140.14
303833	sablefish_PA_CLPG	484685	667136.0	342	yes	137.64	678144.0	353	yes	139.91
303834	sixgill_shark_PA_CLPG	4838	16128.0	7	yes	333.33	13824.0	6	yes	285.71
303835	soupfin_shark_PA_CLPG	22733	22784.0	17	yes	100.23	24320.0	15	yes	106.98
303836	southern_rock_sole_PA_CLPG	61901	139776.0	90	yes	225.81	104704.0	81	yes	169.15
303837	spotted_ratfish_PA_CLPG	363110	559360.0	297	yes	154.05	544768.0	296	yes	150.03
303838	surf_smelt_PA_CLPG	24883	32256.0	14	yes	129.63	27648.0	12	yes	111.11
303841	walleye_pollock_PA_CLPG	154982	235008.0	102	yes	151.64	241408.0	111	yes	155.76
303842	whitebait_smelt_PA_CLPG	95232	152064.0	66	yes	159.68	113152.0	50	yes	118.82
303843	widow_rockfish_PA_CLPG	335872	359424.0	156	yes	107.01	357120.0	155	yes	106.33
303844	yelloweye_rockfish_PA_CLPG	213632	291328.0	154	yes	136.37	285696.0	148	yes	133.73
303845	yellowtail_rockfish_PA_CLPG	280550	473600.0	258	yes	168.81	475392.0	265	yes	169.45
303900	Alcyonacea_PA_CLPG	32486	48384.0	21	yes	148.94	48384.0	21	yes	148.94
303901	Antipatharia_PA_CLPG	65664	82944.0	36	yes	126.32	80640.0	35	yes	122.81
303902	Gorgonacea_PA_CLPG	31795	55296.0	24	yes	173.91	57600.0	25	yes	181.16
303903	Pennatulacea_PA_CLPG	252518	349696.0	158	yes	138.48	328960.0	149	yes	130.27
303904	Scleractinia_PA_CLPG	6912	11520.0	5	yes	166.67	6912.0	3	yes	100.00
304001	Demospongiae_PA_CLPG	107827	161280.0	70	yes	149.57	154368.0	67	yes	143.16
304002	Hexactenellida_PA_CLPG	4838	11520.0	5	yes	238.10	11520.0	5	yes	238.10
304003	Porifera_PA_CLPG	99763	138240.0	60	yes	138.57	145152.0	63	yes	145.50

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occur-rences	Target Met	% Target Met	Amount	Occur-rences	Target Met	% Target Met
304004	Demospongiae_CPUE_CLPG	39168417	77866076.2	69	yes	198.80	83561402.9	67	yes	213.34
304005	Hexactenellida_CPUE_CLPG	24703	77690.9	5	yes	314.49	77690.9	5	yes	314.49
304006	Porifera_CPUE_CLPG	47934338	84962580.5	60	yes	177.25	94952632.3	63	yes	198.09
304050	Antipatha_CPUE_CLPG	49414	99788.5	15	yes	201.94	97350.9	13	yes	197.01
304051	Gorgonace_CPUE_CLPG	2117370	3303657.1	25	yes	156.03	3664795.3	25	yes	173.08
304052	Pennatula_CPUE_CLPG	1678235	2515404.0	133	yes	149.88	2195064.1	120	yes	130.80
304053	Scleracti_CPUE_CLPG	3457060	5142894.3	4	yes	148.76	5140028.2	3	yes	148.68
304100	Chlorophyll_Low_CLPG	110643	110581.8	304	no	99.95	111508.7	300	yes	100.78
304102	Chlorophyll_High_CLPG	35075	35095.6	175	yes	100.06	35375.1	196	yes	100.86
304150	Rocky_substrate_CLPG	12910	15685.5	103	yes	121.50	20038.3	107	yes	155.21
304200	Canyon_Wall_CLPG	43897	72353.4	82	yes	164.82	72024.4	76	yes	164.08
400001	Bathybenthal_Canyon_Mud_PGIB	38278	38295.7	73	yes	100.05	38243.1	71	no	99.91
400004	Bathybenthal_Flats_Mud_PGIB	151497	151350.0	122	no	99.90	151483.7	125	no	99.99
400007	Bathybenthal_Middle_slope_Mud_PGIB	54593	54500.0	128	no	99.83	54582.2	130	no	99.98
400010	Bathybenthal_Ridge_Mud_PGIB	25695	25762.1	53	yes	100.26	25467.5	57	no	99.11
400013	Inner_shelf_Canyon_Sand_PGIB	30	35.2	14	yes	115.47	30.5	14	yes	100.23
400014	Inner_shelf_Flats_Gravel_PGIB	35	37.4	9	yes	105.77	77.0	13	yes	217.79
400015	Inner_shelf_Flats_Mud_PGIB	17	17.1	6	no	99.07	24.6	7	yes	142.39
400016	Inner_shelf_Flats_Rock_PGIB	2832	2856.8	70	yes	100.88	3472.0	86	yes	122.60
400017	Inner_shelf_Flats_Sand_PGIB	37577	37601.7	190	yes	100.06	37559.0	196	no	99.95
400019	Inner_shelf_Middle_slope_Gravel_PGIB	129	202.2	19	yes	157.00	163.4	19	yes	126.88
400021	Inner_shelf_Middle_slope_Rock_PGIB	1872	2996.6	60	yes	160.07	2688.8	55	yes	143.63
400022	Inner_shelf_Middle_slope_Sand_PGIB	2750	2987.6	65	yes	108.63	2751.1	69	yes	100.03
400026	Inner_shelf_Ridge_Rock_PGIB	952	1104.6	41	yes	116.00	1045.2	50	yes	109.77
400027	Inner_shelf_Ridge_Sand_PGIB	878	905.1	45	yes	103.10	993.4	55	yes	113.15
400028	Mesobenthal_Canyon_Mud_PGIB	4299	8601.3	39	yes	200.07	6121.9	37	yes	142.40
400029	Mesobenthal_Canyon_Rock_PGIB	124	122.1	6	no	98.87	336.3	10	yes	272.21
400030	Mesobenthal_Canyon_Sand_PGIB	139	372.0	4	yes	267.32	463.9	6	yes	333.33
400033	Mesobenthal_Flats_Mud_PGIB	22629	27958.8	69	yes	123.55	29547.4	62	yes	130.57
400034	Mesobenthal_Flats_Rock_PGIB	1451	3226.3	23	yes	222.28	3052.7	23	yes	210.31
400035	Mesobenthal_Flats_Sand_PGIB	6935	6968.7	45	yes	100.48	6939.0	40	yes	100.05
400038	Mesobenthal_Middle_slope_Mud_PGIB	14510	28397.7	75	yes	195.71	25112.4	69	yes	173.07
400039	Mesobenthal_Middle_slope_Rock_PGIB	2129	4043.6	23	yes	189.91	4992.6	24	yes	234.48
400040	Mesobenthal_Middle_slope_Sand_PGIB	3883	4006.0	35	yes	103.18	3861.7	32	no	99.46
400042	Mesobenthal_Ridge_Mud_PGIB	9187	15007.2	36	yes	163.34	10238.9	29	yes	111.44
400044	Mesobenthal_Ridge_Sand_PGIB	1862	6205.2	14	yes	333.30	6097.5	9	yes	327.51
400047	Mid_shelf_Canyon_Mud_PGIB	462	735.0	19	yes	159.18	915.5	18	yes	198.28
400048	Mid_shelf_Canyon_Rock_PGIB	989	2867.6	25	yes	290.07	2211.6	28	yes	223.72

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	**Target Name**	**Goal**	**Amount**	**Occur-rences**	**Target Met**	**% Target Met**	**Amount**	**Occur-rences**	**Target Met**	**% Target Met**
400049	Mid_shelf_Canyon_Sand_PGIB	214	330.7	5	yes	154.37	383.9	11	yes	179.23
400050	Mid_shelf_Flats_Gravel_PGIB	208	207.4	17	no	99.75	246.2	20	yes	118.41
400051	Mid_shelf_Flats_Mud_PGIB	32497	33825.1	48	yes	104.09	36347.0	56	yes	111.85
400052	Mid_shelf_Flats_Rock_PGIB	2620	3070.6	40	yes	117.21	3772.2	47	yes	144.00
400053	Mid_shelf_Flats_Sand_PGIB	113223	113178.1	178	no	99.96	113091.8	173	no	99.88
400055	Mid_shelf_Middle_slope_Gravel_PGIB	100	113.2	26	yes	113.43	99.9	22	yes	100.09
400056	Mid_shelf_Middle_slope_Mud_PGIB	664	1116.1	40	yes	168.14	1195.6	33	yes	180.11
400057	Mid_shelf_Middle_slope_Rock_PGIB	2072	4547.4	49	yes	219.52	4206.6	52	yes	203.07
400058	Mid_shelf_Middle_slope_Sand_PGIB	4083	4129.6	74	yes	101.14	4080.4	75	no	99.93
400060	Mid_shelf_Ridge_Gravel_PGIB	6	7.7	2	yes	123.95	9.9	2	yes	160.84
400061	Mid_shelf_Ridge_Mud_PGIB	4649	9172.8	51	yes	197.32	7698.8	46	yes	165.61
400062	Mid_shelf_Ridge_Rock_PGIB	3504	6800.9	38	yes	194.10	7713.4	40	yes	220.14
400063	Mid_shelf_Ridge_Sand_PGIB	7859	16480.9	62	yes	209.71	15569.4	57	yes	198.11
400101	Gravel_Flat_E_PGIB	264	881.0	1	yes	333.34	881.0	1	yes	333.34
400107	Mud_Flat_E_PGIB	532	1565.4	2	yes	294.14	404.7	3	no	76.04
400108	Mud_Flat_P_PGIB	747	852.1	1	yes	114.05	852.1	1	yes	114.05
400111	Organics fines_E_PGIB	2768	1993.2	2	no	72.02	2935.9	4	yes	106.08
400112	Organics fines_P_PGIB	657	1589.6	1	yes	241.94	1589.6	1	yes	241.94
400113	Organics fines_VP_PGIB	3859	6139.1	4	yes	159.10	5455.9	3	yes	141.39
400114	Rock_Platform_E_PGIB	4738	6559.3	6	yes	138.43	8957.2	7	yes	189.04
400117	Rock_with_Gravel_Beach_E_PGIB	5939	6712.4	6	yes	113.02	10383.6	10	yes	174.83
400118	Rock_with_Gravel_Beach_P_PGIB	334	1112.4	2	yes	333.33	776.1	1	yes	232.58
400120	Rock_with_Sand_Beach_E_PGIB	13333	13299.7	17	no	99.75	16315.6	20	yes	122.37
400121	Rock_with_Sand_Beach_P_PGIB	375	1248.7	1	yes	333.34	1248.7	1	yes	333.34
400123	Rock_with_Sand_and_Gravel_Beach_E_PGIB	39248	39794.0	31	yes	101.39	41219.8	35	yes	105.02
400126	Rocky_Shore Cliff_E_PGIB	16568	24075.2	30	yes	145.31	34936.2	44	yes	210.87
400130	Sand_Beach_E_PGIB	3002	2413.4	3	no	80.40	3698.0	4	yes	123.20
400134	Sand_Flat_E_PGIB	17826	17807.1	17	no	99.89	18508.4	19	yes	103.83
400135	Sand_Flat_P_PGIB	1267	2385.3	2	yes	188.30	1824.1	1	yes	144.00
400138	Sand_and_Gravel_Beach_E_PGIB	8865	10627.0	9	yes	119.88	9512.1	9	yes	107.30
400139	Sand_and_Gravel_Beach_P_PGIB	1123	2677.0	5	yes	238.40	1506.0	3	yes	134.12
400142	Sand_and_Gravel_Flat_E_PGIB	8166	8403.3	11	yes	102.91	8266.4	10	yes	101.23
400143	Sand_and_Gravel_Flat_P_PGIB	1979	2088.3	3	yes	105.52	1983.8	3	yes	100.24
400160	Islands_Rocks_Area_PGIB	628049	1448464.0	52	yes	230.63	1575032.0	69	yes	250.78
400161	Islands_Rocks_Count_PGIB	670	803.0	52	yes	119.87	1403.0	69	yes	209.43
400208	Flat_PGIB	12	13.3	5	yes	109.09	13.1	4	yes	107.21
400213	Saltmarsh_PGIB	26	26.8	4	yes	103.95	26.4	3	yes	102.40
400223	Wood_Debris_Organic_fines_PGIB	40	48.0	5	yes	120.12	48.0	5	yes	120.12

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occur-rences	Target Met	% Target Met	Amount	Occur-rences	Target Met	% Target Met
401001	Black_Oystercatcher_CNT_PGIB	96	111.0	20	yes	116.23	153.0	27	yes	160.21
401002	Brandts_Cormorant_CNT_PGIB	229	446.0	1	yes	194.76	446.0	1	yes	194.76
401004	Cassins_Auklet_CNT_PGIB	43800	72200.0	4	yes	164.84	72200.0	4	yes	164.84
401005	Common_Murre_CNT_PGIB	3938	7220.0	9	yes	183.37	7875.0	11	yes	200.00
401006	Double_crested_Cormorant_CNT_PGIB	578	956.0	9	yes	165.40	1130.0	12	yes	195.50
401007	Fork_tailed_storm_petrel_CNT_PGIB	1159	2118.0	3	yes	182.74	2118.0	3	yes	182.74
401009	Leachs_Storm_Petrel_CNT_PGIB	12650	25300.0	5	yes	200.00	25300.0	5	yes	200.00
401010	Pelagic_Cormorant_CNT_PGIB	1108	1371.0	15	yes	123.79	1538.0	21	yes	138.87
401011	Pigeon_Guillemot_CNT_PGIB	213	339.0	13	yes	159.53	368.0	15	yes	173.18
401012	Rhinoceros_Auklet_CNT_PGIB	12005	24010.0	4	yes	200.00	24010.0	4	yes	200.00
401014	Tufted_Puffin_CNT_PGIB	9010	14681.0	12	yes	162.95	15716.0	14	yes	174.44
402001	Black_Oystercatcher_PA_PGIB	19	20.0	20	yes	108.11	27.0	27	yes	145.95
402002	Brandts_Cormorant_PA_PGIB	1	1.0	1	yes	100.00	1.0	1	yes	100.00
402004	Cassins_Auklet_PA_PGIB	3	4.0	4	yes	160.00	4.0	4	yes	160.00
402005	Common_Murre_PA_PGIB	6	9.0	9	yes	163.64	11.0	11	yes	200.00
402006	Double_crested_Cormorant_PA_PGIB	7	9.0	9	yes	128.57	12.0	12	yes	171.43
402007	Fork_tailed_storm_petrel_PA_PGIB	2	3.0	3	yes	150.00	3.0	3	yes	150.00
402009	Leachs_Storm_Petrel_PA_PGIB	3	5.0	5	yes	200.00	5.0	5	yes	200.00
402010	Pelagic_Cormorant_PA_PGIB	15	15.0	15	yes	100.00	21.0	21	yes	140.00
402011	Pigeon_Guillemot_PA_PGIB	11	13.0	13	yes	123.81	15.0	15	yes	142.86
402012	Rhinoceros_Auklet_PA_PGIB	2	4.0	4	yes	200.00	4.0	4	yes	200.00
402014	Tufted_Puffin_PA_PGIB	9	12.0	12	yes	141.18	14.0	14	yes	164.71
403001	Kelp_PGIB	41830154	41765787.0	66	no	99.85	41883579.0	74	yes	100.13
403101	Upwelling_PGIB	138662	168183.4	252	yes	121.29	175016.2	243	yes	126.22
403201	California_sea_lion_PGIB	5	5.0	3	yes	100.00	5.0	3	yes	100.00
403202	Harbor_seal_PGIB	27	36.0	28	yes	134.83	49.0	38	yes	183.52
403203	Northern_elephant_seal_PGIB	1	1.0	1	yes	200.00	1.0	1	yes	200.00
403204	Stellar_sea_lion_PGIB	6	7.0	3	yes	116.67	8.0	4	yes	133.33
403701	bocaccio_CPUE_PGIB	848538	1610102.7	98	yes	189.75	996557.5	93	yes	117.44
403702	canary_rockfish_CPUE_PGIB	5218392	9192074.8	158	yes	176.15	7182478.8	156	yes	137.64
403703	darkblotched_rockfish_CPUE_PGIB	397544	490009.7	142	yes	123.26	510428.2	134	yes	128.40
403704	dover_sole_CPUE_PGIB	3074293	4536901.2	210	yes	147.58	4923705.1	205	yes	160.16
403705	english_sole_CPUE_PGIB	677739	759948.0	154	yes	112.13	769309.5	155	yes	113.51
403706	greenstriped_rockfish_CPUE_PGIB	408880	945898.8	146	yes	231.34	735414.3	134	yes	179.86
403707	lingcod_CPUE_PGIB	932226	1588805.9	162	yes	170.43	1985146.0	159	yes	212.95
403708	pacific_ocean_perch_CPUE_PGIB	2746859	4252003.8	136	yes	154.80	3227783.8	137	yes	117.51
403709	redstripe_rockfish_CPUE_PGIB	988368	2410249.8	112	yes	243.86	1850434.1	83	yes	187.22
403710	rex_sole_CPUE_PGIB	727622	1067447.5	173	yes	146.70	1058284.2	169	yes	145.44

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occur-rences	Target Met	% Target Met	Amount	Occur-rences	Target Met	% Target Met
403711	sablefish_CPUE_PGIB	2673187	5302787.2	231	yes	198.37	4488033.7	228	yes	167.89
403712	southern_rock_sole_CPUE_PGIB	17479	50648.1	43	yes	289.76	28145.1	41	yes	161.02
403713	spotted_ratfish_CPUE_PGIB	663826	1222604.4	173	yes	184.18	1342532.0	166	yes	202.24
403714	yellowtail_rockfish_CPUE_PGIB	2316177	4658935.0	137	yes	201.15	3961850.0	140	yes	171.05
403800	big_skate_PA_PGIB	117965	197120.0	106	yes	167.10	179456.0	93	yes	152.13
403801	black_rockfish_PA_PGIB	13978	18944.0	10	yes	135.53	20992.0	10	yes	150.18
403804	bocaccio_PA_PGIB	192640	221696.0	98	yes	115.08	214784.0	95	yes	111.50
403807	canary_rockfish_PA_PGIB	298496	298496.0	158	yes	100.00	298496.0	158	yes	100.00
403808	chub_mackerel_PA_PGIB	95155	144384.0	68	yes	151.74	153088.0	78	yes	160.88
403810	darkblotched_rockfish_PA_PGIB	281088	290304.0	142	yes	103.28	282624.0	136	yes	100.55
403811	dover_sole_PA_PGIB	276564	418304.0	210	yes	151.25	412638.0	208	yes	149.20
403812	english_sole_PA_PGIB	193766	289280.0	154	yes	149.29	296192.0	157	yes	152.86
403813	eulachon_PA_PGIB	146688	190976.0	90	yes	130.19	215552.0	106	yes	146.95
403815	greenstriped_rockfish_PA_PGIB	176563	299520.0	146	yes	169.64	286720.0	136	yes	162.39
403816	jack_mackerel_PA_PGIB	80410	141824.0	74	yes	176.38	123648.0	59	yes	153.77
403817	lingcod_PA_PGIB	197837	307712.0	162	yes	155.54	305408.0	161	yes	154.37
403818	northern_anchovy_PA_PGIB	11750	25344.0	11	yes	215.69	18432.0	8	yes	156.86
403819	pacific_cod_PA_PGIB	193229	296192.0	157	yes	153.29	298496.0	158	yes	154.48
403820	pacific_hagfish_PA_PGIB	11750	20736.0	9	yes	176.47	16128.0	7	yes	137.25
403821	pacific_hake_PA_PGIB	246912	383744.0	195	yes	155.42	383744.0	195	yes	155.42
403822	pacific_herring_PA_PGIB	176256	261632.0	142	yes	148.44	259328.0	141	yes	147.13
403823	pacific_lamprey_PA_PGIB	14746	19456.0	12	yes	131.94	18432.0	16	yes	125.00
403824	pacific_ocean_perch_PA_PGIB	296064	301056.0	136	yes	101.69	295936.0	140	no	99.96
403826	pacific_sanddab_PA_PGIB	146074	192512.0	112	yes	131.79	190208.0	111	yes	130.21
403828	pacific_sardine_PA_PGIB	67046	89600.0	62	yes	133.64	96256.0	56	yes	143.57
403829	plainfin_midshipman_PA_PGIB	14515	16128.0	7	yes	111.11	20736.0	9	yes	142.86
403830	quillback_rockfish_PA_PGIB	19891	21248.0	11	yes	106.82	31232.0	18	yes	157.01
403831	redstripe_rockfish_PA_PGIB	104755	229376.0	112	yes	218.96	187648.0	85	yes	179.13
403832	rex_sole_PA_PGIB	221414	333056.0	173	yes	150.42	330752.0	172	yes	149.38
403833	sablefish_PA_PGIB	293537	466688.0	231	yes	158.99	465630.0	231	yes	158.63
403834	sixgill_shark_PA_PGIB	2765	4608.0	10	yes	166.67	6912.0	11	yes	250.00
403835	soupfin_shark_PA_PGIB	12595	37376.0	26	yes	296.75	32768.0	24	yes	260.16
403836	southern_rock_sole_PA_PGIB	66048	92928.0	43	yes	140.70	88320.0	41	yes	133.72
403837	spotted_ratfish_PA_PGIB	225562	333056.0	173	yes	147.66	329728.0	168	yes	146.18
403840	tiger_rockfish_PA_PGIB	2765	4608.0	2	yes	166.67	4608.0	2	yes	166.67
403841	walleye_pollock_PA_PGIB	163354	241920.0	121	yes	148.10	257280.0	125	yes	157.50
403842	whitebait_smelt_PA_PGIB	28877	32000.0	29	yes	110.82	29440.0	19	yes	101.95
403843	widow_rockfish_PA_PGIB	185472	186624.0	81	yes	100.62	191232.0	83	yes	103.11

Appendix 6 Marxan Results for Conservation Scenarios

			Irreplaceability (without Suitability Index)				Conservation Utility (with Suitability Index)			
Target ID	Target Name	Goal	Amount	Occur-rences	Target Met	% Target Met	Amount	Occur-rences	Target Met	% Target Met
403844	yelloweye_rockfish_PA_PGIB	180480	194048.0	86	yes	107.52	194816.0	89	yes	107.94
403845	yellowtail_rockfish_PA_PGIB	182477	274688.0	137	yes	150.53	286208.0	142	yes	156.85
403900	Alcyonacea_PA_PGIB	6221	20736.0	9	yes	333.33	20736.0	9	yes	333.33
403901	Antipatharia_PA_PGIB	22810	36864.0	16	yes	161.62	48384.0	21	yes	212.12
403902	Gorgonacea_PA_PGIB	21427	29952.0	13	yes	139.78	39168.0	17	yes	182.80
403903	Pennatulacea_PA_PGIB	85709	138240.0	60	yes	161.29	149760.0	65	yes	174.73
403904	Scleractinia_PA_PGIB	9677	13824.0	6	yes	142.86	13824.0	6	yes	142.86
404001	Demospongiae_PA_PGIB	43853	105984.0	46	yes	241.68	99072.0	43	yes	225.92
404003	Porifera_PA_PGIB	78182	170496.0	74	yes	218.07	158976.0	69	yes	203.34
404004	Demospongiae_CPUE_PGIB	3938826	9992908.8	46	yes	253.70	8837867.5	43	yes	224.38
404006	Porifera_CPUE_PGIB	5550189	12319326.7	74	yes	221.96	14139348.5	69	yes	254.75
404050	Antipatha_CPUE_PGIB	5015	4628.7	5	no	92.30	7361.2	8	yes	146.79
404051	Gorgonace_CPUE_PGIB	402987	1249362.4	10	yes	310.03	1249938.4	11	yes	310.17
404052	Pennatula_CPUE_PGIB	201999	217513.6	33	yes	107.68	442158.2	40	yes	218.89
404053	Scleracti_CPUE_PGIB	408144	1051411.9	6	yes	257.61	1192356.8	5	yes	292.14
404100	Chlorophyll_Low_PGIB	32501	35840.7	155	yes	110.28	32761.4	176	yes	100.80
404102	Chlorophyll_High_PGIB	31752	31756.7	156	yes	100.02	32177.1	145	yes	101.34
404150	Rocky_substrate_PGIB	18624	31769.7	144	yes	170.58	33631.6	162	yes	180.58
404200	Canyon_Wall_PGIB	51930	89669.2	82	yes	172.67	104873.5	85	yes	201.95
404300	Killer_whale_CH_PGIB	28122	28153.6	120	yes	100.11	28189.7	117	yes	100.24