

WRITTEN TESTIMONY OF
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U.S. HOUSE OF REPRESENTATIVES
SUBCOMMITTEE ON FISHERIES, WILDLIFE AND OCEANS
OCTOBER 23, 2007

HEARING ON H.R.1187

THE GULF OF THE FARALLONES AND THE CORDELL BANK NATIONAL
MARINE SANCTUARIES BOUNDARY MODIFICATION AND PROTECTION ACT

As a marine scientist with over 30 years of experience, I have a special interest in preserving the cleanest, most pristine and bountiful waters of our planet. It is important for researchers like me to be able to observe marine life in healthy and intact ecosystems. As a scientist, I know that the healthiest ecosystems need to be protected to ensure the survival of threatened and endangered marine species and commercially valuable species. As a Professor who teaches Marine Biology to non-science majors, it is equally important to be able to show students living examples of magnificent species such as blue whales. The Sanctuary expansion areas in H.R. 1187 serve these purposes, and in my testimony I wish to mainly address the science behind the need to include these areas in the Marine Sanctuary system.

I wish to emphasize three points in my remarks:

- 1) the existing Gulf of the Farallones and the Cordell Bank National Marine Sanctuaries lie within one of four of the most productive ocean ecosystems on Earth (the California Current Upwelling Ecosystem), and the only one in the United States,
- 2) the source waters and food for the organisms within the two Sanctuaries lie unprotected outside the existing boundaries, as does critical habitat for marine organisms that cross over the boundary, and
- 3) H.R. 1187 will protect the source of water, nutrients, food and habitats for the exceptionally diverse marine life that resides in or utilizes the Sanctuaries, including fisheries species and endangered or threatened species. Without protection for the northern half of the California Current Upwelling Ecosystem, marine life within the existing Sanctuaries is placed at risk.

Below, I will address each point in detail.

- 1) The Gulf of the Farallones and Cordell Bank National Marine Sanctuaries lie within one of the most productive ocean ecosystems on Earth: the California Current Upwelling Ecosystem. The California Current Upwelling System is one of only four coastal upwelling ecosystems on Earth and it is the only coastal upwelling ecosystem in the United States. Upwelling systems are collectively responsible for 20% of the total world

fish catch, even though they occupy less than 1% of the total area of the world's oceans (Cushing 1969, Bakun and Parrish 1982, Botsford et al. 2003).

Special oceanographic processes that lead to exceptional biological productivity define upwelling ecosystems worldwide. In response to winds blowing over the ocean, shallow sunlit waters are fertilized with nutrients welled up from deeper colder waters. The nutrients stimulate the growth of the microscopic marine plants (phytoplankton) at the base of open ocean food webs, resulting in dense concentrations of food for marine animals.

2) A critical center of upwelling- providing the source waters for the Gulf of the Farallones and Cordell Bank National Marine Sanctuaries downstream- lies outside of the existing boundaries. The proposed 1740 square nautical mile expansion from Point Arena to Bodega Bay includes this critical upwelling center. Deep, cold, nutrient-rich water wells up to the ocean's surface at Point Arena and flows to the south and into the existing National Marine Sanctuaries (Largier et al 1993, Kaplan and Largier 2006, Kuebel-Cervantes and Allen 2006), initiating and fertilizing blooms along the way of the marine plants and supporting growth at all higher levels. Appended Figure 1 shows ocean currents moving downstream from Point Arena south to the present Gulf of the Farallones and Cordell Bank National Marine Sanctuaries. The upwelling leads to such a great abundance of food that many top predators, including marine mammals and great white sharks, can thrive in the region.

The area to be included within the modified boundary (Point Arena to Bodega Bay) is not only the source of water, nutrients, and food for the existing Sanctuaries, but it also consistently generates the most intense upwelling in North America. Ocean production is positively correlated with upwelling intensity: the more intense the upwelling, the more productive the ocean. The intensity of the upwelling from Point Arena to Bodega Bay is characterized according to NOAA's upwelling index (http://www.pfeg.noaa.gov/products/PFEL/modeled_indices/upwelling/NA/daily_upwell-graphs.html#p09daily.gif). Cold water is also an indication of upwelling strength. Appended Figure 2 shows water temperatures are coldest around Point Arena, also signifying the intensity of the upwelling.

The rich food generated by the upwelling provides a feast for a diverse assemblage of local and migratory marine life in the Gulf of the Farallones and Cordell Bank National Marine Sanctuaries. Overall, the California Current Upwelling Ecosystem supports more than one-third of the world's whale and dolphin species in the region between Bodega Bay and Monterey Bay (Keiper et al. 2005). The Gulf of the Farallones has the largest concentration of breeding seabirds in the continental U.S. (12 species) and is home to five species of seals and sea lions. Thirty-five species of marine mammals migrate through the Sanctuary where they feed on the rich food, as do 163 species of birds. The Cordell Bank National Marine Sanctuary is home to at least 240 fish species, 69 species of seabirds, and 28 marine mammal species, with other species migrating through. The nearshore fish community includes many commercially valuable, but also threatened, species of rockfish, lingcod, and greenling.

In the fall, a species of seabird (sooty shearwater) migrates from the north to the south through the Sanctuaries on route to South America and to New Zealand, which protects the shearwaters as important elements of indigenous Maori culture. The shearwaters are so numerous that the flocks resemble smoke over the ocean's surface.

Black-footed albatross migrate between their feeding ground on Cordell Bank and their nesting sites on Midway Atoll in the central Pacific.

Humpback and blue whales, both endangered with extinction, feed on the rich abundant food in the Sanctuary waters, generated by the upwelling. The blue whales represent the largest concentration of this species on Earth.

This highly productive marine ecosystem also gave rise to the oldest known coastal human settlement in northern California (at Duncan's Landing), which was dated at 8600 years (Kennedy et al. 2005).

3) Critical habitat and mobile marine species that cross over from the Sanctuaries lie unprotected in the expansion area. Similarly to the areas protected in the existing Sanctuaries, the expansion area hosts diverse populations of local and migratory fishes, birds, and marine mammals, attracted to the rich food.

NOAA's Biogeography Program (NOAA 2003) revealed the ecological importance of the 'hotspots' for high species diversity and high abundances of fishes and birds within the expansion area. Some of the highest habitat suitability for the following species extends north of the boundary: commercial fish species (juvenile bocaccio, dover sole adults and juveniles, rockfish, Dungeness crab), harbor seals, Risso's dolphin (seasonally). Two sites near Point Arena remain major winter haulout areas for the diminishing population of Steller sea lions (threatened). The area visited most by gray whales occurred between Fort Ross and Point Arena, outside the existing boundaries. Similarly, the seasonal high use area for the northern fur seal (conservation status: vulnerable) was just to the north and west of the Sanctuaries.

Resident species in the expansion area include rockfish, lingcod, flatfish, Dungeness crab, sea lions, seals, and seabirds. Coastal seabirds and migratory shorebirds using the Pacific flyway frequent this stretch of coast. Secluded stretches of coast offer haul out areas for harbor seals and Steller sea lions (threatened) as well as nesting sites for many species of local seabirds. Gray whales pass through this corridor during their annual migration between breeding areas in Mexico and feeding grounds in Alaska. Other migratory species visiting the area seasonally to forage in the food-rich waters include endangered and threatened species such as humpback and blue whales, northern fur seals, coho salmon, black-footed albatross and leatherback sea turtles. Chinook or king salmon from northern California watersheds also frequent this area in spring and summer to feed on shrimp-like krill, anchovies, and sardines.

In addition to fishes, birds, and marine mammals, extensive underwater forests of kelp (a giant seaweed) grow close to shore in the expansion area, where they serve as a critical nursery grounds for rockfishes. The kelp forests also support thriving populations of commercially valuable red sea urchins and red abalone (Karpov 2001, Rogers-Bennett 2003). The red abalone are abundant enough for an active recreational fishery, the only remaining abalone fishery on the west coast.

Species of ancient deep-sea corals (bamboo corals) also live throughout the region. These corals provide scientists clues to climate change. The corals lay down growth rings like trees, providing incomparable records of past climate conditions (Roark et al. 2005). In addition these corals provide important habitat for deep-sea fishes. These corals are structurally fragile and susceptible to disturbance from oil and mineral exploration and extraction.

The Bodega Canyon lies within the modified boundary and is a specialized habitat for a variety of species. The Bodega Canyon is one of several submarine canyons along the west coast. Cutting into the continental shelf, these canyons are critical conduits for transporting organic matter that provisions deep-sea animals (Vetter 1995). The steep walls of the canyons support a diverse assemblage of marine species including deep-water corals. Small shrimp-like animals ('zooplankton', especially the type known as 'krill') emerge from Bodega Canyon every night, attracting predators that aggregate on the down current side of submarine canyons to feed (Chess 1989). Krill is an important link in the Cordell Bank food web. Krill is the primary diet for blue whales and a seabird species (Cassin's auklet) and a dietary staple for rockfishes, coho and king salmon.

Endangered blue whales are the largest animals ever known and each day they must consume two tons of food largely in the form of krill. To maintain this consumption rate, they seek dense krill aggregations. The krill in turn depend on the algal blooms sustained by upwelling. Krill concentrate downstream of intense upwelling centers, such as Point Arena, and at the edges of submarine canyons, including Bodega Canyon. California blue whales predictably can be found foraging at the edge of submarine canyons (Croll et al. 2005). Protecting these critical foraging areas is important to securing the continued survival of these magnificent whales.

Expanding the boundary for the Sanctuaries is crucial to achieving their management goal of protecting the *ecosystem* for the marine life within, as stated in the Draft Joint Management Plan. *The expansion area is an integral part of the California Current Upwelling Ecosystem which also encompasses the existing Sanctuaries.* The abundant food for the species living in the Sanctuaries is produced upstream of the existing boundaries. And, many of the larger and mobile species travel outside of the Sanctuaries to utilize habitats in the expansion area. Critical parts of the ecosystem, such as the upwelling center at Point Arena and Bodega Canyon, are not protected in the existing Sanctuaries. Ecosystem-based management has strong support from both scientists and the public in recognition that species do not live in isolation of their environment or other species, including humans.

The California Current Upwelling Ecosystem not only sustains phenomenal biological productivity, it also generates weather patterns along the west coast. The thick cloud cover over the ocean and coast- the 'marine layer' noted by Pacific coast weathermen- results from the cold surface waters of the upwelling, in conjunction with the summer Pacific High Pressure System. Such clouds are known to have an important influence on the heat budget of Earth (Rogers et al. 1995, Faloon et al. 2005, Wen et al. 2006). This thick cloud layer can be strongly altered by pollution and by disruption to the upwelling system.

As the reports of the recent Pew and U.S. Oceans Commissions relate, our oceans are under incredible environmental stress. There is an immediate need to protect and manage oceans, especially our most productive waters and most diverse marine communities. The expansion area and the California Current Upwelling Ecosystem have been threatened by pollution historically and recently. In the late 1970s and 1980s there were attempts to lease oil tracts off the counties of Sonoma and Mendocino. Scientists from the University of California determined that minute concentrations of chemicals from oil and mineral extraction (in the 'production water') are toxic to sea life including economically valuable marine species (herring, sea urchins, Pacific oysters) that live in the Sanctuaries and expansion area.

The Gulf of the Farallones Draft Management Plan cites the evident risks from the movement of oil tankers carrying an estimated 544 million gallons annually along the California coast. Commercial vessels that draw greater than 50 feet of water are fueled with bunker oil, which is similar to crude oil. Since 1971, there have been 10 vessel oil spills in the Gulf of the Farallones National Marine Sanctuary, which killed tens of thousands of seabirds. The debilitating effects of oiling sea birds and marine mammals are well known by scientists and the public. The Sanctuary would be able to collect penalties and settlements after spills and dedicate them to restoration projects in the expansion area, as it has in the existing Sanctuary.

In 1986, 1995, and as recently as 2003, there were proposals to build ocean sewage outfalls along the Sonoma Coast, and there was a massive raw sewage spill in the Russian River in 1985. In the 1970s, the Russian River estuary was threatened with a proposal to dredge the estuary and build a marina. In recent years, there was an attempt to capture water in the important marine nursery area of the Gualala River and ship it to water markets in southern California. Today energy companies are planning the construction of wave action energy plants just outside the expanded boundaries, and proposals within the proposed expansion areas are likely. Giving the Sanctuary program authority to address these issues will ensure that these ecological unique waters remain clean and abundant with marine life.

The diverse marine life of the region (including iconic species such as the California sea lion) attracts great public interest, which generates an important tourism economy and serves as a hook for science education. The Gulf of the Farallones National Marine Sanctuary has attracted over 100 dedicated volunteers a year in its beach watch program alone. The volunteer contributions have been estimated at over \$200,000 worth of effort

annually. The beach watch program has been sustained for 10 years, with more than 90% of the volunteers returning each year. The interpretive center in San Francisco for the Gulf of the Farallones National Marine Sanctuary hosts over 40,000 visitors yearly.

The expanded boundary would bring the superb public education programs of the National Marine Sanctuaries farther north along the Pacific coast to reach rural and disadvantaged children. The Sanctuaries work closely with local schools and provide teacher training for activities such as monitoring tideline and beach communities and building a new curriculum that integrates geography and marine science through tracking tagged migratory animals online. They also have been exceptional research and education partners for institutions of higher education in the region.

Public interest, strengthened by the extensive public service provided by the two Sanctuaries, has generated great support for the Sanctuaries, including the boundary modification. A capacity crowd attended a field hearing in Sonoma County three years ago where Congresswoman Woolsey asked for public comment on legislation she was developing to expand the two Sanctuaries. There was virtually no opposition to her proposal.

A total of 36 organizations support the legislation. These include the Boards of Supervisors of Mendocino, Sonoma and Marin Counties and the City and County of San Francisco, the Port of Oakland, the California Coastal Commission and State Lands Commission. Conservation support includes the Sierra Club, the Ocean Conservancy and the Environmental Defense. Twenty-five respected marine scientists have signed on to letters supporting the bill.

Notably, the Pacific Coast Federation of Fishermen's Associations and the local Bodega Bay Fishermen's Marketing Association also support the bill. These fishermen recognize that protecting the quality of the source waters and the food pipeline for the Sanctuaries and critical fishery habitat that is currently unprotected is important for sustainable fisheries in the area. The Sanctuary designation protects fisheries while allowing fishing, which would be prohibited in some marine protected area designations.

In summary: *Expanding the Gulf of the Farallones and Cordell Bank National Marine Sanctuaries to include the Point Arena upwelling center is necessary to protect and study the source water for these two existing Sanctuaries. Nutrients and food produced in the Point Arena upwelling center are delivered by water currents moving south to the Gulf of the Farallones and Cordell Bank. By expanding the Gulf of the Farallones and the Cordell Bank National Marine Sanctuaries north to Point Arena, the wellspring for the biological productivity, the food pipeline, and critical habitat for seabirds, marine mammals, and fisheries species that range northward from the existing Sanctuaries will be protected. Expanding the two Sanctuaries in H.R. 1187 will help achieve the goal of ecosystem-based management on a regional scale.*

As a marine scientist and educator, and as Director of one of the Nation's oldest marine laboratories (Bodega Marine Laboratory) situated within the proposed boundary

modification, I find the ecological uniqueness of the region a compelling reason to protect the source waters and critical habitat for the marine life that frequents the Gulf of the Farallones and Cordell Bank National Marine Sanctuaries. Together, the area encompasses a major portion of the only coastal upwelling ecosystem in the United States, which is one of only four on Earth. As a citizen and a resident of this exceptional and unique stretch of the Nation's coast, I find the diversity and abundance of marine life and the high productivity that puts food on the table very valuable to protect now and for future generations.

I thank the subcommittee for the opportunity to share this information and offer any assistance I can provide in the next stages of its actions concerning H.R. 1187.

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Figure 1. The source waters for the Gulf of the Farallones and the Cordell Bank National Marine Sanctuaries lie in the expansion area from Point Arena to Bodega Bay. Point Arena is an important center of ocean upwelling, providing nutrients and food. Surface currents are shown flowing southward from Point Arena, California. 'BML' refers to Bodega Marine Laboratory, situated just north of the existing Sanctuary boundary. Arrows point in the direction of the surface currents. Color indicates the speed of the current (red = faster).

Data from the coastal radar of the Bodega Ocean Observing Node at the Bodega Marine Laboratory, University of California at Davis. Funding was provided by the Bodega Marine Laboratory and the State of California's Coastal Ocean Currents Monitoring Program.

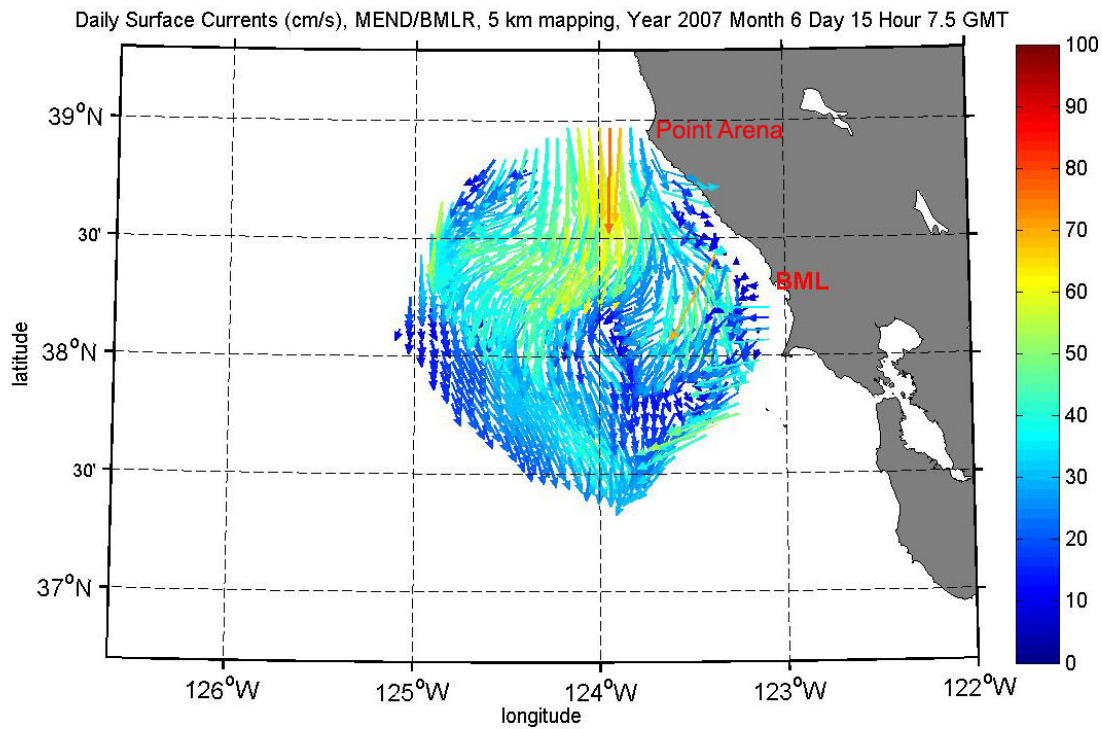


Figure 2. Sea Surface Temperatures (SST) for the northern half of the California Current Upwelling Ecosystem. Data from the National Marine Fisheries Service. The darker the blue, the colder the water, indicating the strength of the upwelling. The expansion area from Point Arena to Bodega Bay is the area of strongest upwelling.

June 17 2007, SST, 8 day average

