The Puget Sound/Georgia Basin Region Selected as a Priority Conservation Area in the Baja California to Bering Sea Initiative

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Abstract

Within the context of a continental-scale planning initiative, the Puget Sound/ Georgia Basin area and the Coastal Pacific region of Vancouver Island and Olympic Peninsula were selected by a tri-national team of scientists and resource managers as priority conservation areas. The Baja California to Bering Sea Initiative represents a cooperative agreement of the three countries to establish a common conservation vision for the region. These regions were selected based on their unique ecology – the Puget Sound/Georgia Basin area was identified because it is an inland sea encompassing complex benthic habitats, extensive tidal flats, eel grass beds, large salmonid runs, and because it is important to the killer whale, a species of common conservation concern of the three nations. The outer coast was selected based on productive fisheries and its importance to seabirds and marine mammals. At the same time, the growing human populations along the coast and expanding marine tourism industry are resulting in environmental concerns that need to be addressed by cooperative action of the US and Canadian governments.

Introduction

An array of studies in recent years have demonstrated that marine ecosystem deterioration and species decline are occurring at the ocean-basin scale worldwide (e.g., Christensen et al 2003; Jackson et al 2001; Myers and Worm 2003; Pandolfi et al 2003; Roman and Palumbi 2003). Closer to home, some Northeast Pacific species experiencing widespread population decline include salmonids (*Oncorlynchus* spp.) on the US West Coast (Arkoosh et al 2004), rockfishes (*Sebastes* spp.) from Alaska to California (Parker et al 2000), sea otter (*Enhydra lutris*) (Doroff et al 2003) and Steller sea lion (*Eumetopias jubatus*) (Gerber and VanBlaricom 2001) throughout the Aleutian Islands, and the leatherback turtle (*Dermochelys coriacea*) that travels between Central America and Alaska (NMFS and USFWS 1998).

Continental-scale problems like these cannot be solved by piecemeal, localized conservation efforts. They need to be reviewed, discussed and analyzed from a continental-scale viewpoint, and the solution needs to be applied continent-wide in order to preserve habitat linkages as well as continentally unique features (Soule and Terborgh 1999). The “Baja California to the Bering Sea” (B2B) initiative is seeking to work at this continental scale to protect the marine waters on North America’s west coast. To date, the initiative has reached a major milestone of identifying Priority Conservation Areas (PCA). This paper presents an overview of the PCA identification process, its results and the rationales for the selection of two PCAs on the British Columbia-Washington border.

From Baja California to the Bering Sea

The "Baja California to the Bering Sea" (B2B) initiative is a tri-national effort to conserve the marine biodiversity of North America's Pacific Coast. The B2B area is defined as the exclusive economic zones (EEZ) of Canada, Mexico and the US between 22°N and 65°N. The North American Commission for Environmental Cooperation (CEC) coordinates this initiative and enlists the involvement of more than a dozen organizations across the three nations, including Marine Conservation Biology Institute (MCBI). The CEC was created by the governments of Canada, Mexico and the US under the North American Agreement on Environmental Cooperation, a side agreement to the North American Free Trade Agreement (NAFTA), to address environmental concerns common to the three nations. MCBI is a non-profit conservation organization based in the US.

The B2B initiative began in 2000 when the CEC identified the B2B region as one of its Priority Regions for Biodiversity Conservation of North America. In 2001, MCBI and the CEC gathered scientists, resource users and conservationists from the three nations at a workshop in Monterey, California, to define the goal of the B2B initiative and the necessary baseline data for conservation planning at this continental scale. The participants agreed that the immediate need was to identify the areas of highest priority for conservation when dealing with a geographic area this vast (4.8 million km^2). Also needed was a geographic information system (GIS) that includes physical and oceanographic data common to all three nations as well as best available data of marine species and of existing conservation measures. This meeting concluded that the identification of Priority Conservation Areas (PCA) should incorporate considerations of biodiversity as well as benefits to human societies.

In 2002, at a Data Potluck workshop in Portland, Oregon, nearly 80 participants from 30 governmental, non-governmental and academic institutions offered and exchanged datasets relevant to the B2B spatial scale. These datasets contain bathymetry, surface current, sea surface temperature, chlorophyll, marine mammal tracks and marine protected areas. MCBI compiled these spatial data into a common projection and resolution, and performed analyses to identify benthic and pelagic features that affect marine species, such as sea surface temperature fronts and eddies in the B2B region, which are often important pelagic habitats or transporters of nutrients (Etnoyer et al 2004, Morgan et al 2005). This served as the groundwork for the identification of PCAs.

In 2003, 45 marine experts from the three nations met at a workshop at Simon Fraser University, British Columbia, to identify PCAs.

Identifying Priority Conservation Areas

Participants of the 2003 workshop came from government agencies, non-governmental organizations (NGOs) and academia, representing interests of resource uses, management, science and conservation. The meeting facilitators, MCBI and the CEC, first presented the goal and criteria for PCA identification. The criteria for PCA selection were 1) high ecological value, 2) high anthropogenic threats and 3) high opportunities for conservation success, where ecological value was determined by species richness, habitat diversity, continental endemism, presence of umbrella species, and productivity. The participants reviewed the baseline data, and analyses thereof, derived from the Data Potluck. They also informed each other of species hotspots, unique current patterns, and specific habitats that should be taken into account in identifying PCAs. The facilitators suggested that the participants focus on features of regional (100-1,000 km^2) and subregional (10-100 km^2) scales when considering continental priorities, because areas smaller than 10 km^2 would be hardly visible on a continental map and should be addressed in regional conservation planning.

The participants then followed the next four steps to identify areas of high ecological value, evaluate threats and opportunities, and select PCAs.

Step 1: Identify areas of high ecological significance by expertise

The participants were divided into three types by their expertise: pelagic expert, benthic expert and coastal management expert. On a digital map, participants of the same expertise discussed and selected ecologically significant regions (ESRs) throughout the B2B area that were crucial for pelagic, benthic and the human communities. The facilitators overlaid all teams' ESRs, and the heavily overlapped locations are ecologically valuable for benthic and pelagic sealife as well as humans.

Step 2: Refine areas of high ecological significance by geographic region

The overlaid result of Step 1 was divided into four geographic regions: Alaska, Canada, the lower US, and Mexico. The experts were also divided by region into four corresponding groups, with representation from the benthic, pelagic and coastal management fields in each group. They discussed and evaluated the high ecological value sites selected in Step 1 within their respective geographic region, using the available GIS data and their personal knowledge of species, habitats, and physical and oceanographic features. Each group refined and confirmed the selected ESRs on a digital map. The workshop facilitators combined the four teams' selections to show the locations that were commonly viewed as highly ecologically valuable for the B2B region.

Step 3: Discuss and rate the level of threats and opportunities

Having discussed what places in the B2B region are ecologically valuable from the standpoints of both geographic area and expertise, the participants were again divided into four groups: Alaska, Canada, the lower US and Mexico. They rated the anthropogenic threats and conservation opportunities in the ESRs from Step 2. Anthropogenic threats that the participants discussed were: 1) extraction of non-renewable resources, 2) exploitation of renewable resources, 3) coastal land use change, 4) pollution at coast and at sea, 5) damaging recreational use, and 6) physical alteration of coastline. Conservation opportunities were determined by previous designation as a site of conservation interest, existing protected status, sustainable practices, local support, etc.

Step 4: Identify Priority Conservation Areas

The experts were divided into six groups so that every group had at least one member from each of these four geographic areas: Alaska, Canada, the lower US and Mexico. Integrating the information exchanged in the previous steps about ecological value, threats and opportunities, each group selected PCAs across the B2B region. The facilitators suggested that the experts select no more than 20% of the ESRs as PCAs. The six groups' selections were overlaid, and the participants reviewed the degree of overlap across the groups.

The iteration of mapping sessions and plenary discussions to review the map overlays in these four steps followed the Collaborative Spatial Delphi methodology (Balram et al 2003). Through networked computers, the participants saw in real time the areas of consensus on the overlaid digital maps after each mapping exercise. They then discussed the rationales of the selected areas and clarified disagreements in the selections. This process aggregated and cross-checked the experts' knowledge, and the collective knowledge fed into subsequent mapping sessions (Balram et al 2003).

Final PCAs were defined as areas selected by three or more groups in Step 4. The boundaries of the final PCAs should not be viewed as rigid demarcation between high-priority and low-priority areas. Rather, they are experts' approximations of continentally unique areas to serve as foci in conserving marine biodiversity between Baja California and the Bering Sea. At each PCA, the exact geographic extent of any conservation measure that follows the PCA identification should be fine-tuned at the local level with input from stakeholders and agencies with jurisdictional authority. On-the-ground design of conservation measures should use the qualitative data captured throughout the steps of PCA identification, i.e., the rationales behind the selection of each PCA (documented in Morgan et al 2005), as the basis instead of the coordinates of the PCA boundaries.

From Baja California to the Bering Sea, 28 Priority Conservation Areas were selected, totaling an area of 384,000 km^2, or 8% of the Pacific EEZ of the three nations between 22°N and 65°N (Figure 1). The PCAs vary in their geophysical characteristics, ecosystem composition, degree of threats and types of

conservation opportunities, but collectively they represent the ecologically sensitive regions on North America's west coast that need urgent conservation attention (Morgan et al 2005; Tsao et al in review).

Rationales for the Selection of PCAs on the British Columbia-Washington Border

Two PCAs fall on the border between British Columbia and Washington. In PCA 13 "Southern Strait of Georgia and San Juan Islands," the transboundary waters surrounding the Canadian Gulf Islands and the US San Juan Islands are an inseparable ecosystem, critical to a variety of marine life. The high-relief, rocky bottom around the islands is a key geophysical feature, but this PCA also encompasses tidal flats and a large river delta at the mouth of the Fraser River, where large amounts of freshwater and nutrient feed into the PCA. This inland sea experiences strong currents and intense mixing, transporting nutrients and dispersing larvae.

Eelgrass (*Zostera* spp.) and kelp beds in this PCA are important spawning and foraging habitats for fish, birds and mammals. Besides sponges and hydrocorals, many rockfish species also inhabit the benthos, including bocaccio (*Sebastes paucispinis*), yellowtail (*S. flavidus*), copper (*S. caurinus*) and Puget Sound rockfish (*S. emphaeus*). Other bottom-dwelling fishes include lingcod (*Ophiodon elongates*), wolf eel (*Anarrhichthys ocellatus*), cabezon (*Scorpaenichthys marmoratus*) and kelp greenling (*Hexagrammos decagrammus*). However, declines in groundfish stocks in this area have been raising concerns (Federal Register 1999, Musick et al 2000). Salmonids are also an important component of this ecosystem. The Fraser River/Georgia Basin region produces 10 million sockeye salmon (*Oncorhyncus nerka*) annually (DFO 1999a). Salmon migrating through here support a large number of salmon-eating mammals.

Several marine bird species nest in this PCA. Marbled (*Brachyramphus marmoratus*) and ancient (*Synthliborampus antiquus*) murrelets forage in this area, following winter breeding in Mexico and southern California. This PCA is also home to cormorants (*Phalacrocorax* spp.), puffins (*Fratercula* spp.), many shorebirds and marine waterfowl. Black brant geese (*Branta bernicla*) in British Columbia are part of a larger Pacific population ranging along the Pacific coastline from Alaska to Mexico (Sedinger et al. 1994).

Mammals in this ecosystem include resident killer whale (*Orcinus orca*), seal (*Phoca vitulina*) and sea lion (*Zalophus californicus*). Gray whales (*Eschrichtius robustus*) feed here following mating and calving in Baja California, Mexico.

The highest anthropogenic impacts on this environment arise from the dense human populations along the coast and expanding marine tourism industry, causing reduction of suitable habitats for fishes and disturbance to marine mammals.

This PCA sees strong grassroots support for marine conservation in the island communities in British Columbia and Washington. This is exemplified by the efforts of San Juan County, Islands Trust and various local organizations to establish marine stewardship areas, as well as the citizen-driven transboundary collaboration of the Orca Pass initiative. Many federal-level designations of protected status exist on the terrestrial parts of the PCA, including the San Juan Islands National Wildlife Refuge (managed by US Fish and Wildlife Service), Gulf Islands National Park Reserve (managed by Parks Canada), and Alaksen National Wildlife Area (managed by Canadian Wildlife Service).

The other PCA on the British Columbia-Washington border is PCA 14 "Barkley Sound/ Pacific Coastal Washington." This transboundary PCA is in the open ocean on the west side of southern Vancouver Island and Washington's outer coast. High-energy waves influence the rocky shorelines interspersed with tidal flats. At the mouth of the Strait of Juan de Fuca, a submarine canyon extends to the southwest. Other portions of the PCA are on the approximately 40-km wide continental shelf. The plume from the Fraser River carries rich nutrients to this PCA, and the Juan de Fuca eddy that originates at the mouth of the Strait transports the nutrients offshore across the shelf.

Glass sponges, black (*Anipathes* spp.)and gorgonian corals are found along the continental slope off the Washington coast. Scientists recently discovered a field of stony coral *Lophelia pertusa* in this PCA, potentially providing habitat for bottom-dwelling rockfishes (L. Morgan, personal observation).

The Barkley Sound/Pacific Coastal Washington PCA is home to an assortment of fishes, including salmon, herring (*Clupea pallasi*) and hake (*Merluccius productus*), eulachon (*Thaleichthys pacificus*), mackerel and sardine (*Sardinops sagax*) (DFO 2003). Flatfishes such as Pacific halibut (*Hippoglossus stenolepis*) and Dover sole (*Microstomus pacificus*) are present. Yellowtail, copper, quillback (*Sebastes maliger*) and various other rockfishes which enjoy high-relief habitat are also found here. Commercial fisheries target salmon, Pacific Ocean perch (*Sebastes alutus*), rougheye rockfish (*S. aleutianus*) and hake. There are 400,000 sockeye salmon migrating through Barkley Sound to the various streams feeding into it (DFO 1999b), and other salmon from Georgia Strait use this PCA as a migratory pathway as well.

The productive PCA is important for sea turtles, seabirds and mammals. Feeding leatherback sea turtles are occasionally sighted in the Strait of Juan de Fuca and on the Washington coast. Large concentrations of seabirds forage in the area, including the common murre (*Uria aalge*), rhinoceros auklet (*Cerorhinca monocerata*)and tufted puffin that(*Fratercula cirrhata*) have breeding colonies here. Gray and humpback (*Megaptera novaeangliae*) whales regularly travel through on their way north to feeding grounds in Alaska. The Strait of Juan de Fuca is a key habitat for killer whale. Other mammal habitants are the California sea

lion (*Zalophus californianus*), Pacific harbor seal (*Phoca vitulina*) and sea otter.

There are no major human populations adjacent to this PCA, but vessel traffic is frequent and raises the potential of oil pollution. Coastal land use change and tourism activities are increasing, posing potential threats to the ecosystem. Several federal-level protected areas are designated along the west coast of Vancouver Island and of the Olympic Peninsula, such as the Pacific Rim National Park (managed by Parks Canada), Olympic Coast National Park (managed by US National Parks Service), and three National Wildlife Refuges (at Flattery Rocks, Quillayute Needles and Copalis, managed by US Fish and Wildlife Service). The US Olympic Coast National Marine Sanctuary has a large overlap with PCA 14 but, like most national marine sanctuaries, it offers little protection for living marine resources (Chandler and Gillelan 2004).

Next Steps

Following the identification of PCAs, conservation of the B2B area should continue at all geographic levels. At the continental level, studies to examine representative habitat and deep-sea areas will strongly complement the PCA identification. This is because the criteria used to select PCAs placed heavier weighting on distinctive habitats and areas where threat and conservation information is available. As a result, representative habitats without charismatic species and offshore areas where threats are difficult to assess are not well represented in the suite of 28 PCAs.

On international boundaries, the conservation of PCAs should involve both nations. International collaboration is by nature time-consuming and challenging because of different political and legal systems and cultures (Goodwin 2000; Hildebrand et al 2002; Liverman et al 1999). In progressing toward protection of the PCAs, resource users and managers should plan around these challenges and set realistic objectives.

At the local level, high-resolution data of bathymetry, oceanography, marine species and ecosystem functions, as well as a thorough understanding of the integration of human uses and cultures with the ecological aspects of the areas, are required to select and apply appropriate conservation measures, ranging from tightening fishing quotas to designating marine reserves. The rationales for the selection of each PCA (documented in Morgan et al 2005) can serve as a basis for discussions between resource users and managers when defining conservation goals. It is essential to involve stakeholders, including First Nations and Tribes, in the on-the-ground conservation planning. Although many existing protected areas offer little protection of biodiversity, resource managers and users may consider using them as a foundation, strengthening existing management to achieve further conservation.

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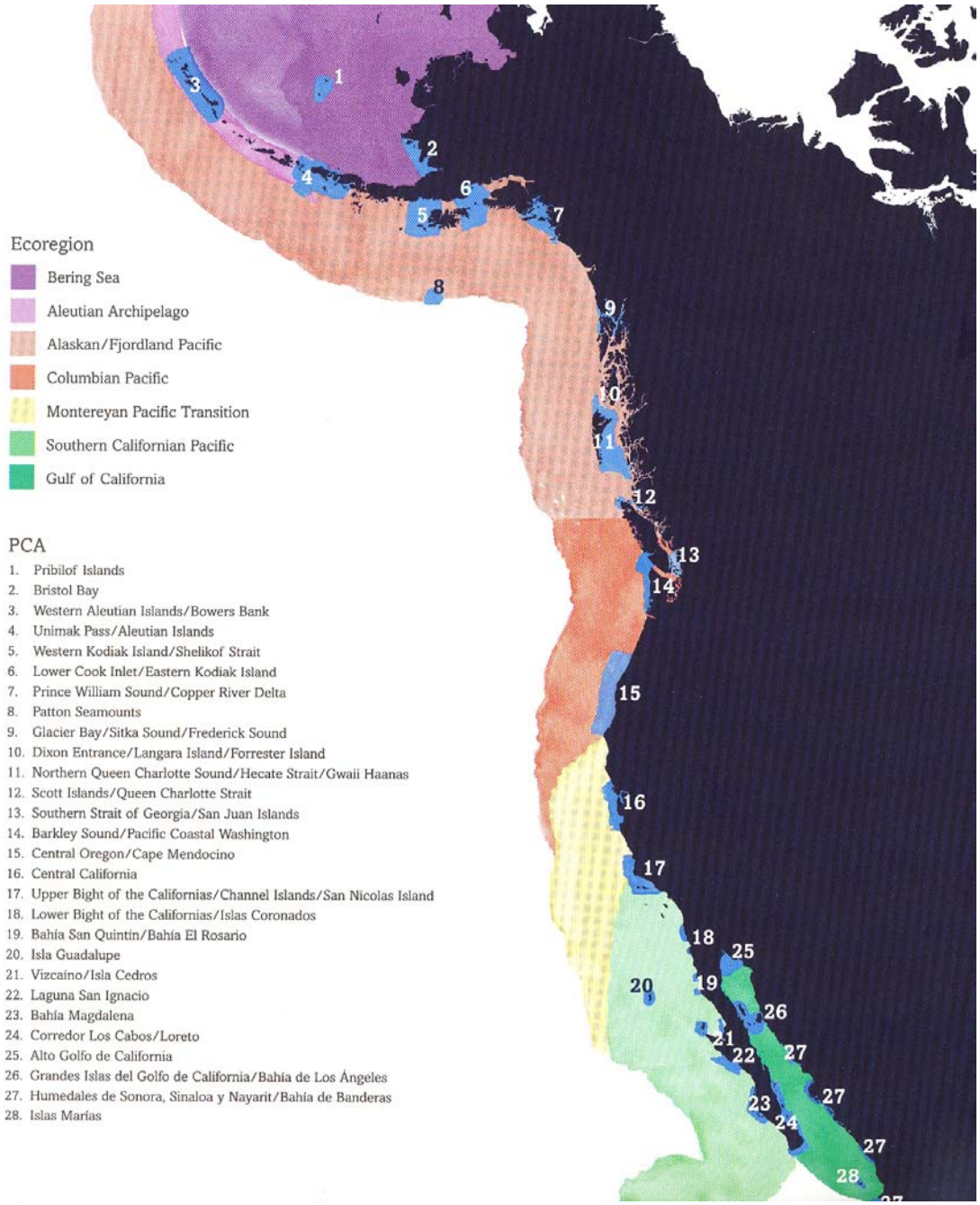
Figures

Figure 1: Twenty-eight Priority Conservation Areas from Baja California to the Bering Sea (reprinted from Morgan et al 2005). Marine ecoregions are identified by the CEC (Wilkinson et al in review).


Ecoregion
Bering Sea
Aleutian Archipelago
Alaskan/Fjordland Pacific
Columbian Pacific
Montereyan Pacific Transition
Southern Californian Pacific
Gulf of California
PCA
1. Pribilof Islands
2. Bristol Bay
3. Western Aleutian Islands/Bowers Bank
4. Unimak Pass/Aleutian Islands
5. Western Kodiak Island/Shelikof Strait
6. Lower Cook Inlet/Eastern Kodiak Island
7. Prince William Sound/Copper River Delta
8. Patton Seamounts
9. Glacier Bay/Sitka Sound/Frederick Sound
10. Dixon Entrance/Langara Island/Forrester Island
11. Northern Queen Charlotte Sound/Hecate Strait/Gwaii Haanas
12. Scott Islands/Queen Charlotte Strait
13. Southern Strait of Georgia/San Juan Islands
14. Barkley Sound/Pacific Coastal Washington
15. Central Oregon/Cape Mendocino
16. Central California
17. Upper Bight of the Californias/Channel Islands/San Nicolas Island
18. Lower Bight of the Californias/Islas Coronados
19. Bahía San Quintín/Bahía El Rosario
20. Isla Guadalupe
21. Vizcaíno/Isla Cedros
22. Laguna San Ignacio
23. Bahía Magdalena
24. Corredor Los Cabos/Loreto
25. Alto Golfo de California
26. Grandes Islas del Golfo de California/Bahía de Los Ángeles
27. Humedales de Sonora, Sinaloa y Nayarit/Bahía de Banderas
28. Islas Marías