Identification of Ecologically and Biologically Significant Areas in the Pacific North Coast Integrated Management Area: Phase II – Final Report

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Abstract

Clarke, C.L., and Jamieson, G.S. 2006. Identification of ecologically and biologically significant areas in the Pacific North Coast Integrated Management Area: Phase II – Final Report. Can. Tech. Rep. Fish. Aquat. Sci. 2686: v + 25 p.

This report presents the second phase of Ecologically and Biologically Significant Area (EBSA) identification for the Pacific North Coast Integrated Management Area (PNCIMA). In Phase I, experts identified areas worthy of enhanced protection for each species and habitat feature based on five EBSA dimensions: Uniqueness, Aggregation, Fitness Consequences, Naturalness and Resilience. These areas were called Important Areas (IAs). In Phase II three categories of unique physical features were used as the basis for EBSAs. Physical features are useful in these types of area identification exercises because they often form the basis of the ecological communities and provide recognizable physical boundaries for management. The physical features chosen for PNCIMA include oceanographic features, bottleneck areas and the sponge bioherms. For PNCIMA, 15 of these features were identified and mapped and are presented as EBSAs. The overlap of these features with the remaining IAs was analysed; the one excluded was "River Mouths and Estuaries. In total, 95 of the original IAs overlapped with the 15 EBSAs for a correlation of 73%. The biological congruence of each of the EBSAs with the IAs was also examined. The 15 EBSAs had a total area of 45,182 km^2 (44.3% of PNCIMA). Individual EBSAs were profiled and their rationalisation using EBSA criteria was provided. It should be noted that Large Ocean Management Area (LOMA)-scale EBSAs are largely non-existent in the archipelago-fjord complex that characterises the mainland coast of British Columbia. This should not imply that regionally important EBSAs do not exist there, but rather that EBSAs there would be more appropriately identified through Coastal Management Area-scale EBSA analyses, which we encourage to be done as part of the PNCIMA process.

Résumé

Clarke, C.L. et Jamieson, G.S. 2006. Identification de zones d'importance écologique et biologique dans la zone de gestion intégrée de la côte nord du Pacifique. Phase II – Rapport Final. Can. Tech. Rep. Fish. Aquat. Sci. 2686: v + 25 p.

Le présent rapport détaille la seconde phase de l'identification des zones d'importance écologique et biologique (ZIÉB) dans la zone de gestion intégrée de la côte nord du Pacifique (ZGICNP). Au cours de la phase I, les experts ont identifié des zones méritant une protection accrue pour chaque espèce et habitat en fonction de cinq critères définis pour les ZIÉB : unicité, agrégation, conséquence de la valeur sélective, caractère naturel et capacité de récupération/résistance. Ces zones ont été baptisées zones importantes (ZI). Au cours de la phase II, trois catégories de caractéristiques physiques uniques ont été utilisées comme base des ZIÉB. Les caractéristiques physiques sont utiles dans le cadre l'identification des zones car elles constituent la base des communautés écologiques et qu'elles fournissent des frontières physiques reconnaissables pour la gestion. Les caractéristiques physiques choisies pour la ZGICNP comprennent des caractéristiques océanographiques, des goulots et les biohermes de spongiaires. Pour la ZGICNP, 15 de ces caractéristiques ont été identifiées, cartographiées et présentées comme ZIÉB. Le chevauchement de ces caractéristiques avec les ZI restantes a été analysé; les estuaires ont été exclus. Au total, 95 des ZI originales chevauchaient les 15 ZIÉB, soit une corrélation globale de 73 %. On a également examiné la congruence biologique de chacune des ZIÉB avec les ZI. Les 15 ZIÉB avaient une superficie totale de 45 182 km^2 (44,3 % de la ZGICNP). On a profilé chacune des ZIÉB et détaillé leur rationalisation à l'aide des critères utilisés pour les ZIÉB. Il faut noter que les ZIÉB à l'échelle des zones étendues de gestion des océans (ZEGO) sont largement inexistantes dans le complexe d'archipels et de fjords qui caractérise le littoral de la Colombie-Britannique. Cela ne signifie pas que des ZIÉB d'importance régionale n'existent pas dans cette région mais plutôt que les éventuelles ZIÉB qui y sont présentes seraient plus adéquatement identifiées à l'aide d'analyses de ZIÉB à l'échelle des zones de gestion côtière, analyses que nous conseillons d'effectuer dans le cadre du processus relatif à la ZGICNP.

Introduction

Ecologically and Biologically Significant Areas (EBSAs) are areas worthy of enhanced management or risk aversion. An area can be identified as an EBSA if it ranks highly on one or more of three dimensions, Uniqueness, Aggregation and Fitness Consequences, and can be weighted by two other dimensions, Naturalness and Resilience (DFO 2004). In Phase I of the PNCIMA EBSA identification process, regional scientific experts were surveyed to identify areas of PNCIMA that met the five criteria using a modified Delphic process; these areas were called Important Areas (IAs). Thematic layers produced included species of fish, invertebrates, marine mammals, and reptiles, oceanographic features, provincial ecounits and Parks Canada areas of interest. Experts were also asked to provide rankings of each IA they identified according to each of the five EBSA criteria. The final list of 132 species-related IAs is captured in 40 thematic layers (Clarke and Jamieson 2006).

Phase II in the EBSA identification process is presented here, and uses the physical and oceanographic features of PNCIMA as the basis for of EBSA identification. The February, 2006, Gulf of St. Lawrence Integrated Management Area (GOSLIM) review of their suggested EBSAs also reviewed the ongoing EBSA identification processes from other regions (DFO 2006b). During that review it was concluded that major oceanographic features as well as bathymetric and topographic constraining of species distributions to specific areas (i.e,. bottleneck areas) could provide a basis for the identification of EBSAs. Areas of high ocean productivity typically had overlapping aggregations of many species that were utilising this productivity, giving these areas particular regional ecological significance. Similarly, bottleneck areas, in contrast to situations where habitat fidelity does not occur within a larger suitable habitat, are areas of high ecological significance.

The physiographic and oceanographic features for PNCIMA indicated as IAs in Phase I form the majority of the EBSAs identified for PNCIMA. In addition, bottleneck areas that were identified as IAs for a number of species and some unique areas (sponge reefs) were included in the list of EBSAs. We analysed biological congruence with the physiographic features by comparing the occurrence and overlap of IAs from Phase I. From this process, we developed and provide a list of IAs to be considered as final EBSAs in PNCIMA. The ecological and biological significance of each area is explained in their profiles below.

EBSA Identification Criteria

Unique physiographic features may be considered ecologically important because in many cases, they provide the physical basis and serve as relatively easily measurable proxies for biological ecosystem attributes. These physical features describe the specific physical environmental conditions that rationalise ecologically significant communities. An additional advantage of largely identifying EBSAs based on physical features of the marine environment is greater ease in determining boundaries. In many cases, these features have known and mapped boundaries that will be useful in the planning and management process.

There are three categories of physical features that are significant for the PNCIMA region:

1) Physical oceanographic features such as eddies and current systems are mechanisms by which marine productivity is concentrated or the means by which greater recruitment can be achieved (W. Crawford and D. Mackas, DFO, Sidney, pers. comm.). The presence of these features is often fundamental to the population dynamics and spatial structure of the associated higher trophic level biological community (e.g., Crawford & Jamieson, 1996). During Phase I, experts identified ten oceanographic IAs for their unique characteristics (Uniqueness), both regionally and nationally, and for their characteristics that concentrate productivity (Aggregation).
2) Bottleneck areas are places where congestion (Aggregation) occurs by virtue of the surrounding physical geography. Migrating species are concentrated in these areas and unique communities are created by their seasonal presence and the ecosystems associated with them. For migrating species, the absence of alternate migration routes means that access to these areas is often essential to the fitness of these populations (Fitness Consequences). The main Large Ocean Management Area (LOMA)-scale bottleneck area identified in PNCIMA (Uniqueness) is the relatively narrow gap between Vancouver Island and the mainland of British Columbia, consisting of Johnstone and Queen Charlotte Straits. Within this bottleneck there are many local areas of high currents and unique biophysical properties that produce unique ecological communities. Estuaries and the immediate waters off the mouths of the rivers should also be considered as bottleneck areas for anadromous species, as these species congregate there before moving either to sea as smoults (in the case of salmon) or upstream as adults. There are many estuarine bottlenecks in PNCIMA and all of these areas should be treated as EBSAs, though no attempt has been made to define them spatially here because of their relatively small sizes at a LOMA-scale. Anadromous species typically have large geographic ranges and therefore they need to be managed at a LOMA rather than at the smaller Coastal Management Area (CMA) scale, and so bottlenecks that influence them, even if relatively small, are flagged here.
3) PNCIMA is home to a set of globally unique biogenic habitat, the hexactinellid sponge bioherms. They are believed to be the only extensive communities of their kind in the world (Uniqueness), are long-lived and are extremely sensitive to physical disturbance because of their fragile body structure and sedentary nature (Resilience).

Analysis

A comparison of the oceanographic layer from Phase I and the remaining thematic IAs was performed, similar to that described for GOSLIM (DFO 2006b), with results in

Tables 1 and 2. Overall 82 out of 132 IAs are captured by the oceanographic IAs (62.12%). These ten IAs cover approximately 41,838 km^2, which corresponds to 41% of PNCIMA.

Spatial layers that were not significantly captured (less than 20%) include those for anadromous species (eulachon; salmon); the sponge bioherms, and selected near shore species (geoduck, Manila clam, Olympia oyster, and sea cucumber). These layers are either associated with freshwater or require specific substrate characteristics. The latter IAs include small, discrete areas that may be better managed at a CMA-scale rather than the LOMA scale that is the focus here. Thus, while some coastal areas have been identified as EBSAs (estuaries) or included in larger EBSAs, we recognize that there are likely other relatively small coastal IAs areas that were not identified as EBSAs in this LOMA-scale exercise.

When broad groupings of IAs were compared, plankton-based IAs had the best coverage with oceanographic IAs (86.67%). Not surprisingly, freshwater-associated species had the worst coverage (21.43%); while macroinvertebrates (41.18%), structural species (42.86%) and benthic species (53.57%) all showed relatively poor correlation.

When bottleneck and sponge bioherms IAs were included with oceanographic IAs as EBSAs, other IAs that were correlated with this new EBSA set increased numerically from 82 to 95, for an overall inclusion rate of 73.0%. This is only a 1.7% increase in the total PNCIMA area identified as EBSAs (42.7% of the LOMA), in comparison to the oceanographic IAs alone (41%).

The PNCIMA LOMA covers a total of 102,067 km^2. The 15 areas identified here as EBSAs (Figure 1) cover 43,627 km^2. The regional ESSIM workshop on significant areas suggested $\leq$40% of the total area be assigned EBSA status (DFO 2006a). PNCIMA has a relatively small total size and a complex geography and ecology relative to the other national IM areas and therefore we consider being on the higher side of the desired EBSA area proportion is both realistic and justifiable.

An analysis to identify which of the initial biological IA layers (Phase 1: Clarke & Jamieson 2006) overlap each identified EBSA was then performed (Figure 3). Thematic IAs that overlapped each of the identified EBSAs are listed and the specific details of the biological importance of each EBSA to each relevant species is described in the profiles below and summarized in Table 3. EBSAs with the highest number of IAs that at least partially overlapped them were the Shelf Break (16), Scott Islands (12), Chatham Sound (9), North Island Straits (8), and McIntyre Bay (8). Upon further examination, the Chatham Sound area was found to have a much better overlap with the existing IAs if its boundary were extended slightly to the north from the existing oceanographic IA. This modified area is included in the list of EBSAs presented here. This change corresponds to an increase in area of 1,555 km^2 and brings the total EBSA area to 45,182 km^2 (44.3% of PNCIMA).

The Caamano Sound and Hecate Strait Front EBSAs were each overlapped by only one IA layer, and so while these areas were moderately significant oceanographic IAs, they had the least biological significance among the IAs considered in relation to the identified three primary EBSA criteria.

The main criterion used in identification of each of PNCIMA EBSAs, and their relative ranking based on the number of Phase I Important Areas they include, is presented in Table 4.

Profiles of Identified EBSA

1. Hecate Strait Front

Biophysical description (Fig. 2A): This narrow region in Hecate Strait is a tidal front from spring through fall.

Biological significance: (Uniqueness, Aggregation)

a) This EBSA contains a concentration of zooplankton (Perry & Waddell, 1997; I. Perry, DFO, Nanaimo, pers. comm.).

2. McIntyre Bay

Biophysical description (Fig. 2B): Eddies that occur here have been shown to concentrate decapod larvae and support aggregations of a diversity of plankton (Crawford and Jamieson, 1996; I. Perry, DFO, Nanaimo, pers. comm.).

Biological significance: (Uniqueness, Aggregation)

a) Identified as a bird IA because it supports high concentrations of seabirds, geese, and ducks (Ure and Beazley, 2004).
b) Overlaps an area considered to be potential critical habitat for northern resident killer whales. This population has been designated threatened under the Species at Risk Act (SARA). Interannually, northern resident killer whales are repeatedly found here and seem to be concentrated in this area between May-July.
c) Overlaps an area of known concentration of humpback whales. The humpback whale is listed as threatened under the Species at Risk Act (Environment Canada, 2004) and Vulnerable on the IUCN's Red List (IUCN, 2004).
d) Adult eulachon spend two to three years at depth in open marine waters before returning to freshwater to spawn (DFO, 2000). Part of the BC eulachon stock is concentrated in Dixon Entrance in the summer months and overlaps the McIntyre Bay EBSA.
e) The McIntyre Bay EBSA includes a Pacific halibut rearing area (West Coast Offshore Exploration Panel, 1985) identified as an IA.
f) During the summer months, adult herring feed in high densities at around 100 m depth (D. Hay, T. Theirrault, J. Schweigert, DFO, Nanaimo, pers. comm.). One

of the summer feeding areas identified as a herring IA overlaps with the McIntyre Bay EBSA.

g) The largest razor clam stock in BC occurs from Massett to Rose Spit in Haida Gwaii (G. Gillespie, DFO, Nanaimo, pers. comm.) within the bounds of this EBSA.
h) McIntyre Bay has been identified as a significant area of aggregation for adult Dungeness crab. In addition, the larger oceanographic eddy found in this location has been identified as a significant area of retention for crab larvae (Crawford and Jamieson, 1996).

3. Dogfish Bank

Biophysical description (Fig. 2C): Dogfish Bank is the largest shallow bank in the region and serves as a larval rearing area for a high diversity of invertebrate species (W. Crawford, DFO, Sidney, pers. comm.).

Biological significance: (Uniqueness, Aggregation)

a) A number of seabirds utilize Dogfish Bank for a variety of life history functions. High densities of shearwaters occur seasonally in the shallow waters of Dogfish Bank in Hecate Strait (Morgan, 1997). The highest densities of phalaropes, Herring gulls and Ancient Murrelets are found over Dogfish Bank in the spring and summer (Morgan, 1997). Migrating sea ducks use the area off the east coast of Rose Spit as a staging area (Ure and Beazley, 2004). Evidence from a satellite-tagging program has shown that Black and White-winged Scoters spend up to six weeks in this area in the spring (S. Boyd, CWS, Delta, pers. comm.).
b) Dogfish Bank includes part of a larger shallow water rearing area in Hecate Strait identified as an IA for Pacific cod and flatfish.
c) Dogfish Bank also represents the major recent fishing grounds for Dungeness crab with significant adult aggregations found in its shallow waters.

4. Learmouth Bank

Biophysical description (Fig. 2D): Learmouth Bank is an isolated bank off the northern coast of the Queen Charlotte Islands. This bank acts to retain a diversity of plankton in the surrounding water (W. Crawford, DFO, Sidney, pers. comm.).

Biological significance: (Uniqueness, Aggregation)

a) High concentrations of Alcids occur around Learmouth Bank, feeding on the rich plankton northwest of Langara Island (K. Morgan, CWS, Sidney, pers. comm.).
b) Researchers believe that migrating gray whales travel through Queen Charlotte Sound to the Queen Charlotte Islands and from northern Graham Island to Alaska. The Learmouth Bank EBSA includes a portion of this northern migration route.

5. Brooks Peninsula

Biophysical description (Fig 2E): The continental shelf of Vancouver Island is at its narrowest off Brooks Peninsula, this area often has an offshore flow of nearshore waters and it is a significant north/south boundary area for many eastern Pacific species.

Biological significance: (Uniqueness, Aggregation)

a) The area around Brooks Peninsula supports a high species diversity of breeding and migrating bird species, including Phalaropes, Common Murre, Tufted Puffin, Sooty Shearwater, Glaucous-winged Gull, Rhinoceros Auklet and Black-legged Kittiwake (K. Morgan, CWS, Sidney, pers. comm.). There is a large seabird breeding colony at Solender Island.

b) Sea otters are abundant there, and this species is listed as threatened by COSEWIC and the IUCN. There are two areas within PNCIMA where sea otters have established (Sea Otter Recovery Team, 2002), and the proposed Brooks Peninsula EBSA includes a portion of one of these areas.

c) There are only three spawning populations of green sturgeon known in North America and all have been listed as threatened under the US Endangered Species Act. A significant number of animals tagged in the US have recently been shown to utilize the Brooks Peninsula area (Welch *et al*., 2004). This is the only place in PNCIMA where this species has been shown to concentrate, but this may be due to limited data availability. From the acoustic tracking studies project underway by Pacific Ocean Shelf Tracking (POST), it appears that individual green sturgeon may spend approximately six weeks in this area. It is hypothesized that this area acts as a type of staging area for sturgeon travelling to or from Alaska (D. Welch, POST & DFO, Nanaimo, pers. comm.).

d) A larger lingcod spawning and rearing area overlaps the Brooks Peninsula EBSA (West Coast Offshore Exploration Panel, 1985. This area was identified as an IA for lingcod and is the only area of its kind known from PNCIMA.

6. Cape St. James

Biophysical description (Fig. 2F)*:* Haida eddies are formed in the waters off the tip of Cape St. James. These eddies concentrate plankton and transport them from PNCIMA into the Gulf of Alaska (W. Crawford, DFO, Sidney; I. Perry, DFO, Nanaimo, pers. comm.).

Biological significance: (Uniqueness, Aggregation)

a) The Cape St. James EBSA overlaps with another larger area identified as a humpback whale IA because of its high whale concentrations. This identification was based on historical whaling records, data from the BCCSN and expert personal experience.

b) The Steller sea lion is listed as endangered on the IUCN Red List. There are only three known rookeries in B.C. waters where Steller sea lions aggregate in the spring to pup (P. Olesiuk, DFO, Nanaimo, pers. comm.; Heise *et al*., 2003). One of these rookeries is found on the Kerouard Islands within the bounds of the Cape St. James EBSA.

c) An important spawning area for Pacific halibut (West Coast Offshore Exploration Panel, 1985) also occurs within the Cape St. James EBSA

d) Cold-water coral communities are typically long-lived, slow growing and highly sensitive to physical disturbance (Freiwald *et al*., 2004). The identification of aggregations of corals in B.C. to date is based on work by Ardron and Jamieson (2004) analyzing groundfish trawl bycatch data. Their analysis identified 12 areas that contain 90% of the coral and sponge trawl bycatch by weight. Nine of these areas fall within the PNCIMA boundary and one is found within the bounds of the Cape St. James EBSA.

7. Shelf Break

Biophysical Description (Fig. 2G): The Shelf Break EBSA runs the length of the continental shelf in PNCIMA and includes the canyons/troughs of Queen Charlotte Sound. This area is known for its high aggregation of macrozooplankton (D. Mackas, DFO, Sidney, pers. comm.).

Biological significance: (Uniqueness, Aggregation)

a) A number of islands and bays on the east coast of the Queen Charlotte Islands support large seabird breeding colonies. These include Langara Island, Frederick Island, Hippa Island, Englefield Bay, Anthony Island and Marble Island. Species such as Cassin's Auklet, Ancient Murrelet, Rhinoceros Auklet, Tufted Puffin, Leach's and Fork-tailed Storm-petrels breed at these colonies (M. Hipfner, CWS, pers. comm.). These IAs have each been given a 10 km radius foraging area around the breeding colonies, but with little current information on seabird foraging areas, IAs may ultimately need to be larger for some species than is indicated here (M. Hipfner, CWS, pers. comm.). Some of these IAs overlap with part of the Shelf Break proposed EBSA.
b) Sperm whales (*Physeter macrocephalus*), listed as vulnerable by the IUCN, are largely offshore, deep water animals (>1000 m depth). Fin whales (*Balaenoptera physalus*) have been identified as endangered by the IUCN. The Shelf Break was identified as an IA for sperm, blue, fin and Sei whales as a result of research modelling physical factors and the whaling database (Gregr & Trites, 2001). The western boundary of this IA was only limited by the extent of PNCIMA; it actually extends out beyond the shelf break.
c) The Shelf Break EBSA also contains an IA identified for humpback whales as an important feeding area. Humpback whales are found feeding around the mouths of the Queen Charlotte Sound deep water troughs at the shelf break.
d) The Shelf Break EBSA includes the known gray whale migration routes along the outer coasts of Vancouver Island and Queen Charlotte Islands as well as the potential migration corridors between the islands.
e) A large fur seal feeding area occurs in Queen Charlotte Sound (P. Olesiuk, DFO, Nanaimo, pers. comm.) and overlaps the Shelf Break EBSA.
f) Feeding adult eulachon are aggregated in the Hecate Strait trough region of this EBSA Adult eulachon spend two to three years at depth in open marine waters before returning to spawn (DFO, 2000).
g) The Shelf Break EBSA overlaps two areas identified as IAs for sablefish. One spawning and rearing area runs parallel to the west coast of the Queen Charlotte Islands and a second large spawning and rearing area that covers most of Queen Charlotte Sound.
h) The northwest Queen Charlotte Island spawning area was identified as an IA for Dover sole. This area overlaps a small part of the larger Shelf Break EBSA.

i) A series of four IAs identified for rockfish overlap the Shelf Break EBSA. These areas are important spawning grounds for Pacific Ocean perch, Yellowtail rockfish, and Yellowmouth rockfish (West Coast Offshore Exploration Panel, 1985).
j) Hake are a migratory species, moving northwards into BC waters from May-September to feed on krill. Their northern limit to distribution is Queen Charlotte Sound in most years, but hake can reach as far north as Dixon Entrance during warm El Nĩno years (K. Cooke, DFO, Nanaimo, pers. comm.). The Shelf Break EBSA includes the IA identified for hake in Queen Charlotte Sound.
k) Six of the identified coral-sponge bycatch areas fall within the boundaries of the Shelf Break EBSA.
l) Tanner crabs support an exploratory fishery and as yet, there is not much information available about these species. IA identification for tanner crabs is based on research surveys done on the continental shelf break. The entire shelf break region was identified as an IA for these species, though this area may be modified following future research.
m) Although several leatherback turtle sightings are reported annually it remains difficult to draw any conclusions about possible significant areas for this species (L. Spaven, DFO, pers. comm.). A large IA congruent with the Shelf Break EBSA was suggested that includes areas where turtles have been repeatedly sighted (N. Pinnell, VAMSC, Vancouver; L. Spaven, DFO, Nanaimo, pers. comm.).

8. Scott Islands

Biophysical description (Fig. 2H): The waters surrounding the Scott Islands are an area of significant tidal mixing that drives high productivity (W. Crawford, DFO, Sidney. pers. comm.).

Biological significance: (Uniqueness, Aggregation)

a) The Scott Islands are the most important breeding grounds for sea birds in British Columbia and support the densest aggregation in the North Pacific (Rodway *et al*., 1991). The Scott Islands have been identified as a globally significant Important Bird Area (IBA) by Birdlife International. Globally significant proportions of Cassin's Auklet, Rhinoceros Auklet, and Tufted Puffin are found there. Nationally significant populations of Common Murres, Brandt's Cormorant, Pelagic Cormorant, Pigeon Guillemot, Glaucous-winged Gull, Leach's Storm-Petrel and Fork-tailed Storm-Petrel breed on these islands (Amey *et al*., 2004). Triangle Island hosts the largest bird breeding colony in BC. Based on this information and the occurrence of the Black-footed albatross, Northern Fulmar, Sooty Shearwater, Herring and Thayer's gulls, this area was identified as an IA (K. Morgan, CWS, Sidney, pers. comm.). Large numbers of seabirds from the Scott Islands' breeding colonies, along with seabirds from elsewhere, forage in the surrounding area (Amey *et al*., 2004) and therefore this IA includes both the breeding colonies at its core and the adjacent wider foraging grounds.
b) The Scott Islands is an IA identified for humpback whales because it is an area of known concentration of this species.

c) A small part of the North Pacific gray whale population, referred to as summer resident gray whales, is repeatedly observed in certain northern areas outside the migration period (Calambokidis *et al*., 2000). These whales remain in B.C. waters to feed instead of migrating to northern feeding grounds (J. Ford, DFO, Nanaimo, pers. comm.; Heise *et al* 2003). This EBSA contains an IA identified as a feeding area for the summer resident gray whale population.
d) The largest Steller sea lion breeding rookery is found in the Scott Islands group. A large fur seal feeding IA was identified in Queen Charlotte Sound (P. Olesiuk, DFO, Nanaimo, pers. comm.) and overlaps a portion of the Scott Islands proposed EBSA.
e) One of only two areas within PNCIMA where sea otters have established (Sea Otter Recovery Team, 2002) is found within this EBSA.
f) A spawning and rearing area around Cook Bank was identified as an IA for Pacific cod (West Coast Offshore Exploration Panel, 1985).
g) A single IA was identified for spawning and rearing for lingcod and it overlaps the Scott Islands EBSA (West Coast Offshore Exploration Panel, 1985).
h) The large Queen Charlotte Sound spawning and rearing area for sablefish contains the Scott Islands EBSA (West Coast Offshore Exploration Panel, 1985).
i) A large portion of the IA identified for flatfish as a spawning and rearing area (West Coast Offshore Exploration Panel, 1985) is included in this EBSA.
j) An important feeding area for hake is located within the Scott Islands EBSA. This species is present in this area between May and September.
k) A summer feeding area important for herring is located within the bounds of the Scott Islands EBSA (D. Hay, T. Theirrault, J. Schweigert, DFO, Nanaimo, pers. comm.).

9. North Island Straits

Biophysical description (Fig. 2I): This EBSA includes Johnstone and Queen Charlotte Straits, which are both migration corridors and bottleneck areas.

Biological significance: (Uniqueness, Aggregation, Fitness Consequence)

a) The islands at the mouth of Queen Charlotte Strait, which include the Storm Islands, Reid Islets, Tree Islets, Pine Island and the Buckle Group, are considered the most important breeding colonies in BC for storm-petrels and Rhinoceros Auklet (Rodway and Lemon, 1991). They also host significant proportions of Fork-tailed Storm-petrels and Leach's storm-petrels (37 and 53% respectively). This IA also includes both the breeding colonies as its core and the adjacent wider foraging grounds and overlaps the North Island Straits EBSA.
b) The draft SARA recovery strategy identified areas of critical habitat for resident killer whales which are also areas known for Chinook and Chum salmon fishing (Killer Whale Recovery Team, 2005; J. Ford, DFO, Nanaimo, pers. comm.). The Johnstone Strait core area flagged in the Draft Recovery Strategy (Killer Whale Recovery Team, 2005) was identified as a killer whale IA (J. Ford, DFO, Nanaimo, pers. comm.). Whales are present in this area between July and November each year. This core area is contained within the North Island Straits EBSA boundaries.

c) Summer resident gray whales utilize the entrance to Queen Charlotte Strait as a feeding area (J. Ford, DFO, Nanaimo, pers. comm.; Heise *et al* 2003).
d) The entrance to Queen Charlotte Strait is part of a larger humpback whale IA that extends to the north that has high concentrations of these whales.
e) This area is important for three species of BC salmon: Sockeye, Steelhead and Coho. Early results from the Pacific Ocean Shelf Tracking (POST) project indicate that juveniles from southern BC Sockeye and Steelhead stocks move rapidly out of estuaries and migrate through Johnstone/Queen Charlotte Straits (D. Welch, POST & DFO, Nanaimo, pers. comm.). Coho salmon remain in marine areas closer to the entrance of their natal streams (D. Welch, POST & DFO, Nanaimo, pers. comm.), and the Broughton Archipelago-Johnstone Strait area was identified as an IA for the Keough and Nimpkish Coho stocks.
f) Tagging studies have shown that a major migration route for herring is through the bottleneck of Queen Charlotte Strait and Johnstone Strait (B. McCarter, DFO, Nanaimo, pers. comm.). Their high aggregation in this area and lack of alternate routes is the rationale for identification of this area as a high value IA.
g) The North Island Straits EBSA supports high density and highly productive green sea urchin populations. This area is also considered a core fishing region, producing high yields (DFO, 2003).
h) Drury Inlet (Statistical Area 12), located in Queen Charlotte Strait, has the largest shrimp catch and the most productive prawn trap fishing area in PNCIMA, as well as containing the rarer humpback shrimp (D. Rutherford, DFO, Nanaimo, pers. comm.).

10-13. Sponge reefs

Biophysical description (Fig. 2J): Four non-contiguous structural reef complexes in Queen Charlotte Sound.

Biological significance: (Unique, Aggregation, low Resilience)

a) Sponge reef bioherms were only recently discovered (1987-1988) in the deep water troughs of Hecate Strait and Queen Charlotte Sound (Conway *et al*., 1991). While reef-building hexactinellid sponges are common in the fossil record, the bioherm structures they form were most abundant prior to the late Jurassic – about 145 million years ago. Now, living examples only occur on the BC coast (Institute for Geology and Palaeontology, http://www.porifera.org/a/ciintro.html). They are believed to be hundreds, if not thousands, of years old (Conway, 1999). These reef-forming species are unique at a global scale. The sponges that comprise the hexactinellid sponge reefs are habitat-forming species, long-lived and being fragile, are highly sensitive to physical disturbance. Individual species are not unique to the bioherms, but the bioherms themselves are unique. In addition to their significance based on their own ecology, sponge reefs are also habitat-forming structures that provide high habitat complexity and likely support diverse communities not found elsewhere. The four known PNCIMA hexactinellid sponge reef complexes are found in Hecate Strait and Queen Charlotte Sound, and have been identified as marine protected areas of interest by Jamieson and Chew (2002).

b) The sponge reef EBSAs are surrounded by four of the coral-sponge bycatch areas identified by Ardron and Jamieson (2004).

14. Chatham Sound

Biophysical description (Fig. 2K): The entire mainland coast is an area of concentrated phytoplankton biomass and high primary productivity (D. Mackas, DFO, Sidney, pers. comm.). Two areas within this larger region were identified as IAs because they are areas of particularly high productivity as a result of tidal mixing: Chatham Sound and Caamano Sound (W. Crawford, DFO, Sidney, pers. comm.).

Biological significance: (Uniqueness, Aggregation)

a) Surveys and satellite telemetry studies have also shown that Black and White-winged Scoters use both the head of the Nass River and the Prince Rupert area as staging areas on their yearly migration (S. Boyd, CWS, Delta, pers. comm.).
b) This EBSA overlaps an IA identified for the northern resident killer whales. The whales are found aggregated in this area between May and July each year feeding on salmon.
c) Between August and December each year, humpback whales are known to be concentrated in a larger IA that includes this EBSA.
d) An important fur seal feeding area which supports dense aggregations occurs in eastern Hecate Strait and parts of this area overlap with this EBSA.
e) There are five major spawning areas for herring stocks in BC and three of these areas are within the boundaries of PNCIMA (T. Theirrault, DFO, Nanaimo, pers. comm.). After hatching, herring larvae are advected with the currents out from the hatching site and juveniles are found in the areas surrounding the hatching areas. The major spawning areas and the surrounding rearing areas were identified as IAs. One of these major spawning and rearing areas overlaps this EBSA.
f) A small portion of a spawning and rearing IA identified for Walleye Pollock overlaps with this EBSA.
g) The area surrounding Prince Rupert harbour supports dense aggregations of green sea urchins.
h) The area extending from Prince Rupert harbour to Chatham Sound is a major Dungeness crab fishing ground and supports significant aggregations.
i) The Prince Rupert/Chatham Sound area has the largest diversity of shrimp species and abundant humpback shrimp in PNCIMA.

15. Caamano Sound

Biophysical description (Fig. 2L): Identified for its high productivity as a result of tidal mixing (W. Crawford, DFO, Sidney, pers. comm.).

Biological significance: (Uniqueness, Aggregation)

a) The entire central and northern coast of BC was identified as a moderately ranked killer whale IA because these animals socialize and travel in these areas (J. Ford, DFO, Nanaimo, pers. comm.; L. Spaven, DFO, Nanaimo, pers. comm.). This large IA overlaps the Caamano Sound EBSA.

16. River Mouths and Estuaries

Biophysical description: These areas include the immediate waters off river mouths and associated estuaries for PNCIMA rivers that support anadromous species.

Biological significance: (Aggregation, Fitness Consequence)

a) These areas are bottlenecks in the sense that anadromous species, and often specific stocks, have to utilise specific geographically-restricted areas on an annual basis.

b) Salmon moults utilise estuaries and the immediate waters around river mouths to adjust to a changed osmotic balance when moving from freshwater to saltwater. Adult salmon congregate off river mouths in the summer and fall while they wait for river levels to rise or water temperatures to fall sufficiently so they can move upstream to spawn.

c) Eulachon spawning runs still occur in a number of estuaries in PNCIMA. Eggs and larvae are concentrated upstream in estuaries and are advected out to open ocean. Spawning adults return to these areas after spending 2-3 years at sea.

Discussion

It should be noted that Large Ocean Management Area (LOMA)-scale EBSAs are largely non-existent in the archipelago-fjord complex that characterises the mainland coast of British Columbia. This should not imply that regionally important EBSAs do not exist there, but rather that EBSAs there would be more appropriately identified through Coastal Management Area-scale EBSA analyses, which we encourage to be done as soon as possible as part of the PNCIMA process. The LOMA-scale EBSAs identified here (Table 4) are largely based on features that determine the ecoregion's overall productivity and characteristics, and as such do not well describe the smaller, often localised nearshore features so important to CMA-level ecosystem dynamics. It is through CMA-level EBSA determinations that important areas for nearshore species (e.g., geoduck, Manila clam, Olympia oyster, and sea cucumber) and layers associated with freshwater or specific substrate characteristics (e.g. soft vs. rocky substrate) are expected to be identified.

The framework in which EBSA advice will be presented and used by managers to provide enhanced management has yet to be developed. EBSAs are just one component in the suite of science advice in support of ecosystem-based management being provided to managers for their consideration. Nevertheless, DFO (2004) discusses to some extent what is meant by various terms used in this report. Some of these discussions are as follows:

1. *Significance*: The roles of a species, habitat feature, community attribute, area, etc. in the ecosystem, and is used in a relative sense. All species, habitat features, areas etc. have *some* ecological function. However, to identify an area or species as “significant” is to conclude that if the area or species were perturbed severely, the ecological consequences (in space, in time, or outward through the food web) would be greater than an equal perturbation of most other areas or species, although the nature of those consequences could differ greatly among specific cases.
2. *Protection*: An area does not have to qualify as an EBSA to justify protection as a Marine Protected Area or a National Marine Conservation Areas. In particular, one justification for giving an area legal protection is to protect some *representative* marine areas, which, exactly by being representative, may not be especially unique, host particularly high concentrations of species or habitat features, or be the site for critical life history activities. An EBSA does not have any special legal status. Rather, the identification provides guidance on the standard of management that is considered to be appropriate.
3. *Enhanced protection*: Canada’s Oceans Act authorizes DFO to provide enhanced protection to areas of the oceans and coasts which are ecologically or biologically significant. As DFO progresses with integrated management approaches to ocean areas, it is necessary to operationalise the term “significant” in this context. Consistent standards are needed to guide selection of areas where protection should be enhanced, while allowing sustainable activities to be pursued where appropriate.
4. *Management*: There is a continuum of activities in the process of bringing EBSAs into management. All steps are science-based, in the sense that they work from scientifically sound information. However, the role of science changes along the continuum from initial science-led processes in identifying such areas to lesser involvement by science in incorporation of socioeconomic considerations in the development and implementation of management plans for such areas.

Literature Cited

Ardron, J., and Jamieson, G.S. 2004. Reducing bycatch of corals and sponges in British Columbia's groundfish trawl fishery: twelve proposed protection areas. ?? 31 pp.

Amey, K., Dunn, M., Morgan, K., and Komaromi, J. 2004. Seasonal use of the Scott Island Marine Area by breeding and non-breeding seabirds, 1981-2001. Technical Report Series No. 389. Canadian Wildlife Service, Pacific and Yukon Region, British Columbia.

Clarke, C.L., and Jamieson, G.S. Identification of ecologically and biologically significant areas in the Pacific North Coast Integrated Management Area: Phase I – Identification of important areas. Can. Tech. Rep.Fish. Aquat. Sci. 2678: 59 p.

Calambokidis, J., Darling, J.D., Deecke, V., Gearin, P., Gosho, M., Megill, W., Tombach, C.M., Goley, D., Toropova, C., and Gisborne, B. 2000. Range and movements of seasonal resident gray whales from California to Southeast Alaska. Final Report.

Conway, K.W. 1999. Hexactinellid sponge reefs on the British Columbia continental shelf: Geological and biological structure with a perspective on their role in the shelf ecosystem. CSAS Research Document 99/192.

Conway, K.W., Barrie, J.V., Austin, W.C., and Luternauer, J.L. 1991. Holocene sponge bioherms on the western Canadian continental shelf. Continental Shelf Research 11(8-10): 771-790.

Crawford, W.R., and Jamieson, G.S. 1996. Modelling advection of Dungeness crab (*Cancer magister*) in Dixon Entrance and Northern Hecate Strait, British Columbia. IN High Latitude Crabs: Biology, Management and Economics. Alaska Sea Grant College Program Report. 96-02: 489-506.

DFO. 2000. Status of the eulachon *Thaleichthys Pacificus* in Canada. Canadian Stock Assessment Secretariat, Research Document 2000/145. Ottawa, Canada.

DFO. 2003. Green sea urchin. DFO Science Stock Status Report 2003/039. 5pp.

DFO. 2004. Identification of Ecologically and Biologically Significant Areas. DFO Canadian Scientific Advisory Secretariat Ecosystem Status Report 2004/006: 15 p.

DFO. 2006a. DFO/FSRS Workshop on Inshore Ecosystems and Significant Areas of the Scotian Shelf, January 16-19, 2006. DFO Canadian Scientific Advisory Secretariat Proceedings Series. 2006/002.

DFO. 2006b. Proceedings of the Zonal Workshop on the Identification of Ecologically and Biological Significant Areas (EBSA) within the Gulf of St. Lawrence and Estuary. DFO Canadian Scientific Advisory Secretariat Proceedings Series. 2006/011

DFO. 2006c. Pacific Region integrated fisheries management plan: Shrimp trawl April 1, 2006 – March 31, 2007. http://www-ops2.pac.dfo-mpo.gc.ca/xnet/content/MPLANS/plans06/Shrimp_trawl_2006-07_IFMP.pdf

DFO 2006d. Appendix 8: 2006/2007 Groundfish Trawl Commercial Harvest Plan. (http://www-ops2.pac.dfo-mpo.gc.ca/xnet/content/MPLANS/plans06/Groundfish06-07/Appendix%208%20Trwl%20Har%20Plan.pdf),

Environment Canada. 2004. Species at risk list. www.speciesatrisk.gc.ca

Freiwald, A., Fossa, J.H., Grehan, A., Koslow, T., and Roberts, J.M. 2004. Cold water coral reefs: Out of sight – no longer out of mind. UNEP World Conservation Centre, Cambridge, UK. 84 pp.

Gregr, E.J., and Trites, A.W. 2001. Predictions of critical habitat for five whale species in the waters of coastal British Columbia. Can. J. Fish. Aquat. Sci. 58: 1265-1285.

Heise, K.A., Sloan, N.A., Olesiuk, P.F., Bartier, P.M., and Ford, J.K.B. 2003. Living Marine Legacy of Gwaii Haanas. IV. Marine mammal baseline to 2003 and marine mammal management issues throughout the Haida Gwaii region. Parks Canada Technical Reports in Ecosystem Science. Report 038. 150 pp.

IUCN. 2004. 2004 IUCN Red List of Threatened Species. www.redlist.org

Jamieson, G.S., and Chew, L. 2002. Hexactinellid sponge reefs: Areas of interest as marine protected areas in the North and Central coast areas. CSAS Research Document 2002/122.

Killer Whale Recovery Team. 2005. DRAFT National Recovery Strategy for Northern and Southern Resident Killer Whales (*Orcinus orca*). Prepared for Public Consultations for Fisheries and Oceans Canada, on behalf of the Resident Killer Whale Recovery Team. 70 pp.

Morgan, K.H. 1997. The distribution and seasonality of marine birds of the Queen Charlotte Islands. IN: The ecology, status and conservation of marine and shoreline birds of the Queen Charlotte Islands. K. Vermeer and K.H. Morgan (eds). Occasional Paper No. 93. Canadian Wildlife Service, Ottawa, Canada.

Pacific Ocean Shelf Tracking. 2004. Salmon: 2004 Field Season Results. http://www.postcoml.org/applications/salmon.php

Perry, R.I., and Waddell, B.J. 1997. Zooplankton in Queen Charlotte Island waters: distribution and availability to marine birds. In: K. Vermeer and K.H. Morgan (eds). The ecology, status and conservation of marine and shoreline birds of the Queen Charlotte Islands. Occasional Paper Number 93, Canadian Wildlife Service, Ottawa, Canada. Pages 18-28.

Rodway, M.S., and Lemon, M.J.F. 1991. British Columbia Seabird Colony Inventory: Report #8 – Queen Charlotte Strait and Johnstone Strait. Technical Report Series no. 123. Canadian Wildlife Service, Pacific and Yukon Region, British Columbia. 82 pp.

Rodway, M.S., Lemon, M.J.F., and Summers, K.R. 1991. Seabird breeding populations in Scott Islands on the west coast of Vancouver Island, 1982-89. *In*: The ecology, status, and conservation of marine and shoreline birds on the west coast of Vancouver Island. K. Vermeer, R.W. Butler and K.H. Morgan (eds). Occasional Paper No. 75, Canadian Wildlife Service, Ottawa, Canada. pp. 52- 59.

Sea Otter Recovery Team. 2002. National recovery strategy for the sea otter (*Enhydra lutris*) in British Columbia. DRAFT, December 2002. 35 pp.

Ure, D., and Beazley, K. 2004. Selecting indicators for monitoring aquatic integrity in Kejimkujik national park and national historic site. http://www.sampaa.org/PDF/ch4/4.3.pdf

West Coast Offshore Exploration Panel. 1985. Map Folio. Government Responses to requirements for additional information. West Coast Exploration. Vancouver, Canada.

Welch, D., Kristianson, G., and Tsang, P. 2004. Report on the 2004 Pacific Ocean Shelf Tracking (POST) Project. – Objectives, Goals and Results. NPAFC Doc 811. 8 pp.

Tables

Table 1: Comparison of overlap between oceanographic features and biological IAs identified in Phase I (Clarke and Jamieson 2006) of the PNCIMA EBSA-identification process. The 'IAs' column indicates the total number of IAs identified for that species or species group, the 'Overlap' column indicates the number that overlap with oceanographic layers, and '%' shows the numerical percentage of this overlapping.

Biological layer	**IA's**	**Overlap**	**%**
Birds	15	13	86.67
Blue whale	1	1	100.00
Coral & Sponge Bycatch	9	5	55.56
Dungeness Crab	2	2	100.00
Eulachon	12	2	16.67
Fin Whale	1	1	100.00
Fur Seals	2	2	100.00
Geoduck	1	0	0.00
Gray Whale	7	5	71.43
Green urchin	2	1	50.00
Hake	3	3	100.00
Halibut	3	3	100.00
Herring	12	6	50.00
Humpback Whale	7	5	71.43
Leatherback Turtle	1	1	100.00
Lingcod	1	1	100.00
Manila Clam	1	0	0.00
Olympia Oyster	1	0	0.00
Pacific Cod	3	2	66.67
Pollock	5	3	60.00
Razor Clam	1	1	100.00
Resident Killer Whale	6	3	50.00
Rockfish	6	6	100.00
Sablefish	3	3	100.00
Salmon	1	0	0.00
Sea otters	2	1	50.00
Sea cucumber	2	0	0.00
Sei whale	1	1	100.00
Shrimp	5	2	40.00
Sole	4	3	75.00
Sperm whale	1	1	100.00
Sponge reef	5	1	20.00
Steller sea lion	3	2	66.67
Sturgeon	1	1	100.00
Tanner crab	2	1	50.00
Totals	132	82	62.12

Table 2: Comparison of overlaps between oceanographic features and biological grouped IAs identified in Phase I (Clarke and Jamieson 2006) of the PNCIMA EBSA-identification process. Groups relate to diet, food web, behaviour, human use, etc. Some IA layers were used in more than one grouping.

Grouping	IA's	Overlap	%
marine mammals, birds & turtles	47	36	76.60
fisheries	71	40	56.34
fish	50	30	60.00
macroinvertebrates	17	7	41.18
coral & sponge	14	6	42.86
plankton	30	26	86.67
benthos	44	31	70.45
structural	14	6	42.86
land-associated	30	21	70.00
prey	8	4	50.00
FW	14	3	21.43
pelagic	69	49	71.01
benthic	84	45	53.57
"at risk"	53	33	62.26

Table 3: Name, physical description and biological rationale for each PNCIMA EBSA. Biological congruence refers to the number of Phase I Important Areas in each EBSA.

EBSA	Description	Rationale	Biological congruence	Area (km²)
Hecate St. Front	Tidal front	Accumulates zooplankton;	1	2352
McIntyre Bay	Formation of eddies	Eddies support decapod larvae and concentrate plankton; eulachon, birds, killer whale, humpback whale, halibut, herring, razor clam, and Dungeness crab	8	1413
Dogfish Banks	Largest shallow bank in region	Larval rearing area for macro-invertebrates; birds, Pacific cod, sole, Dungeness crab	5	2403
Learmouth Bank	Isolated bank	Traps plankton in the region; birds, gray whale	2	232
Brooks Peninsula	Source of offshore flow	North/south range boundary for many species; green sturgeon, birds, sea otter, and lingcod	4	469
Cape St James	Haida eddy formation	Concentrates plankton and transports them into the Gulf of Alaska via the Haida eddies; humpback whale, Steller sea lion, Pacific halibut, and coral	4	3377
Shelf Break	Upper continental shelf and deep troughs	Aggregation of macro-zooplankton; eulachon, birds, sperm whale, humpback whale, gray whale, blue whale, Sei whale, fin whale, fur seal, sablefish, sole, rockfish, coral, hake, tanner crab, turtle	16	22947
Scott Islands	Tidal mixing	Drives high productivity; birds, humpback whale, gray whale, Steller sea lion, fur seal, sea otter, Pacific cod, lingcod, sablefish, sole, hake, herring	12	6728
North Island Straits	Bottleneck area	Migration corridor; salmon, birds, killer whale, gray whale, humpback whale, herring, shrimp, green urchin	8	1525
Sponge Reefs	Sponge reef bioherms in the deep water troughs	Reef-building species, globally unique, long-lived and highly sensitive to disturbance; sponges	1	264
Chatham Sound	Coastal tidal mixing and upwelling	Drives high productivity; birds, killer whale, humpback whale, fur seal, pollock, herring, herring, green urchin, Dungeness crab, shrimp	9	1122
Caamano Sound	Coastal tidal mixing and upwelling	Drives high productivity; killer whale	1	795

Table 4: PNCIMA EBSAs classified by primary criterion used in their definition, and then ordered by the number of Phase I Important Areas contained within each of them (biological congruence). It should be noted that for many EBSAs, relevant IAs were identified for a number of criteria, so classification by one criterion alone can be confusing.

Criterion	Rank	EBSAs	Biological Congruence
Unique	1	Sponge Reefs (4)	1
Fitness Consequence	1	North Island Straits	8
	2	River Mouths and Estuaries*	
Aggregation	1	Shelf Break	16
	2	Scott Islands	12
	3	Chatham Sound	9
	4	McIntyre Bay	8
	5	Dogfish Banks	5
	6	Cape St James	4
	6	Brooks Peninsula	4
	7	Learmouth Bank	2
	8	Hecate Strait Front	1
	8	Caamano Sound	1

* refers to a number of LOMA-scale anadromous species, notably salmon species and eulachon which return to specific river systems, and because each river has its own species mix, no single correlation could be made for this EBSA group's biological congruence.

Figures

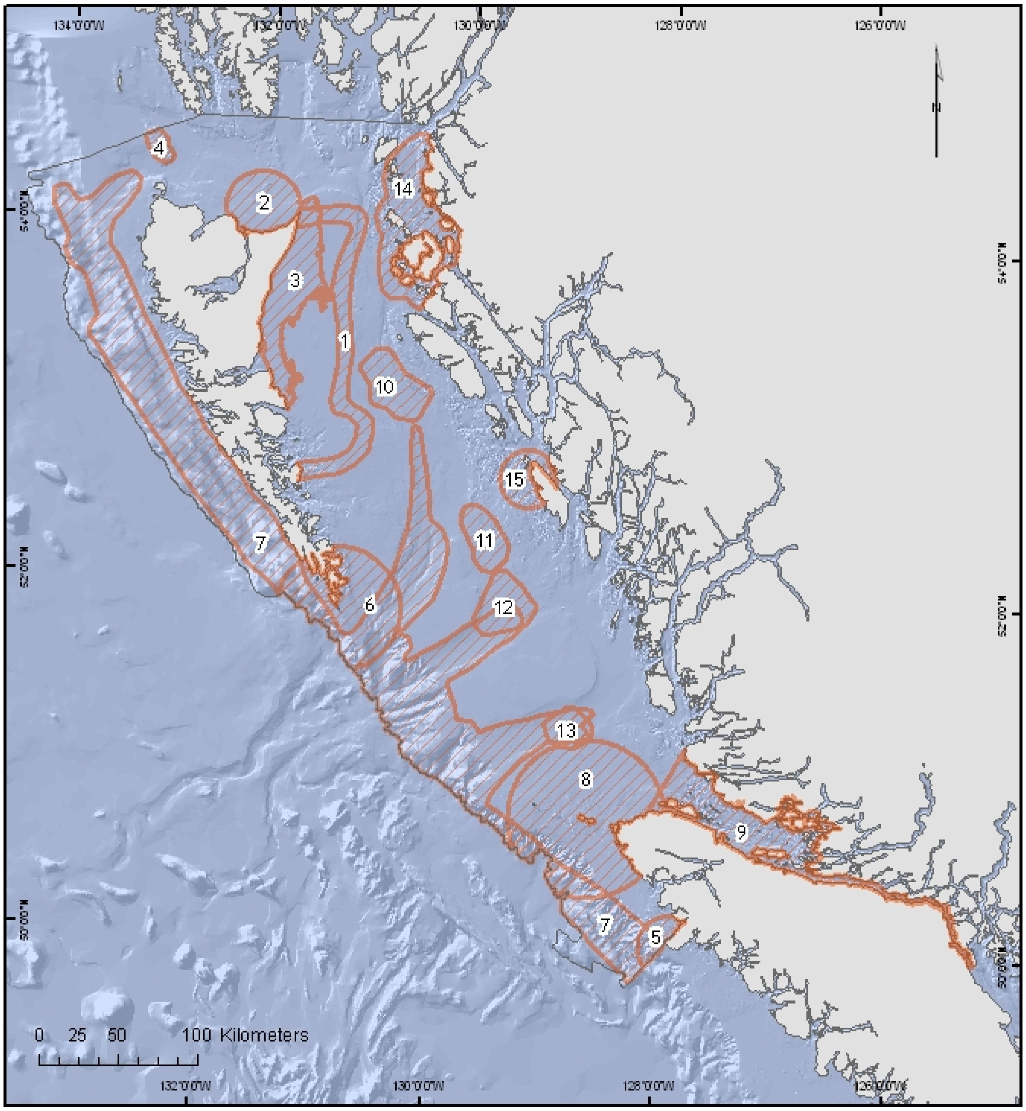

Figure 1: All EBSAs for PNCIMA, excluding River Mouths and Estuaries: 1) Hecate Strait Front, 2) McIntyre Bay, 3) Dogfish Bank, 4) Learmouth Bank, 5) Brooks Peninsula, 6) Cape St James, 7) Shelf Break, 8) Scott Islands, 9) North Island Straits, 10-13) Sponge reef bioherms, 14) Chatham Sound, and 15) Caamano Sound. A more detailed description of each EBSA can be found in Table 3.

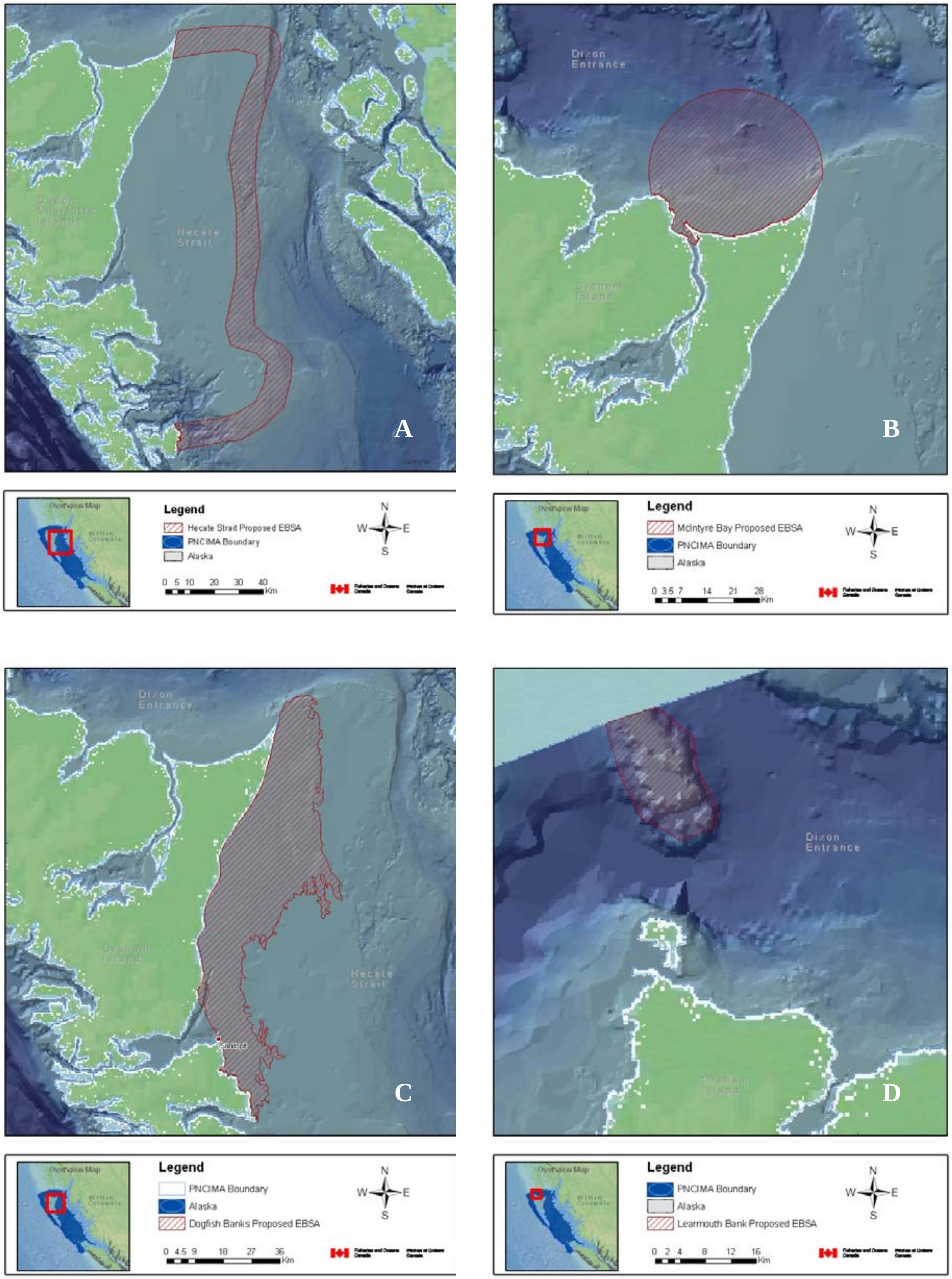

Figure 2: Individual proposed EBSAs. A) Hecate Strait Front, B) McIntyre Bay, C) Dogfish Bank, D) Learmouth Bank.

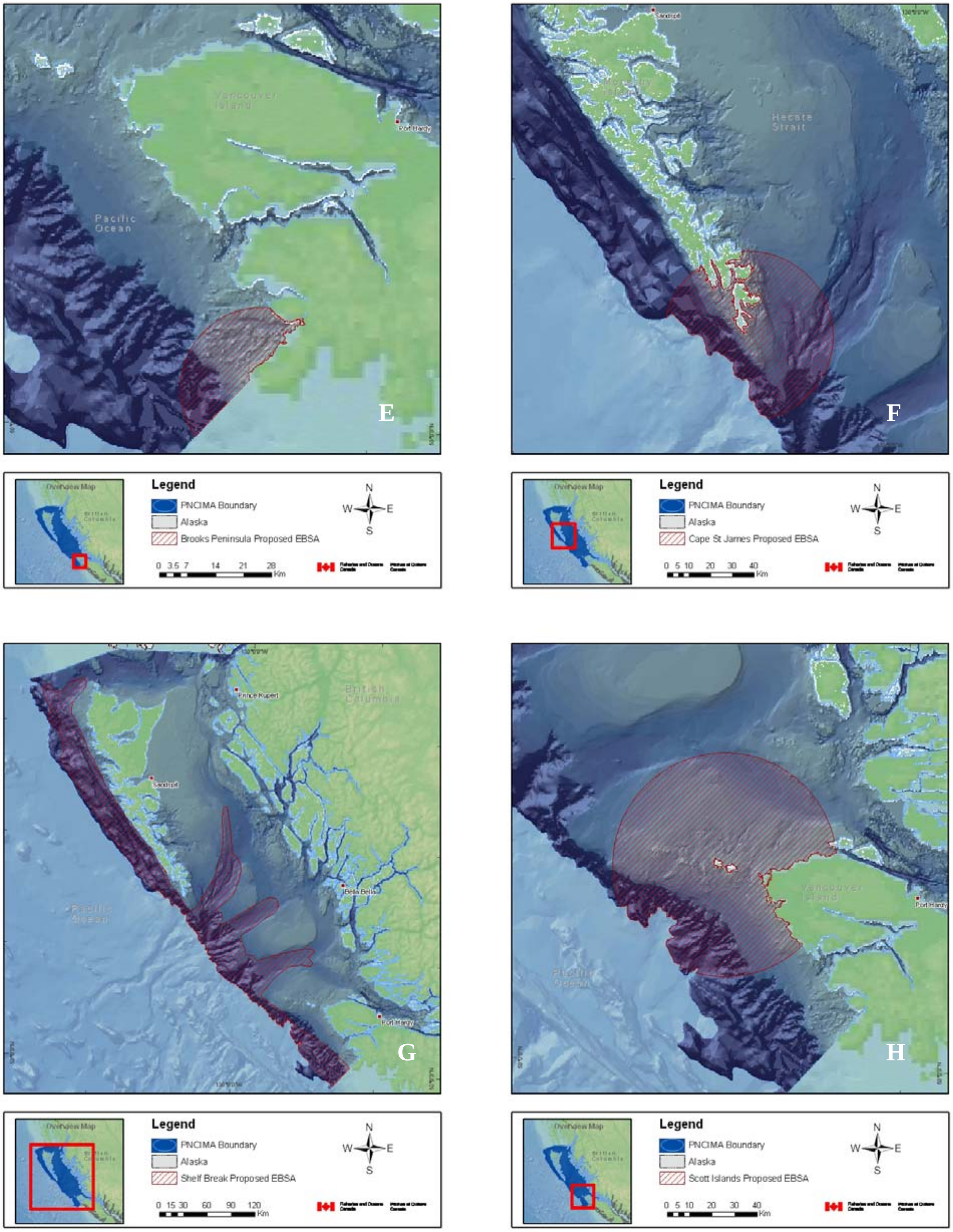

Figure 2 cont'd: Individual proposed EBSAs. E) Brooks Peninsula, F) Cape St. James, G) Shelf Break, H) Scott Islands

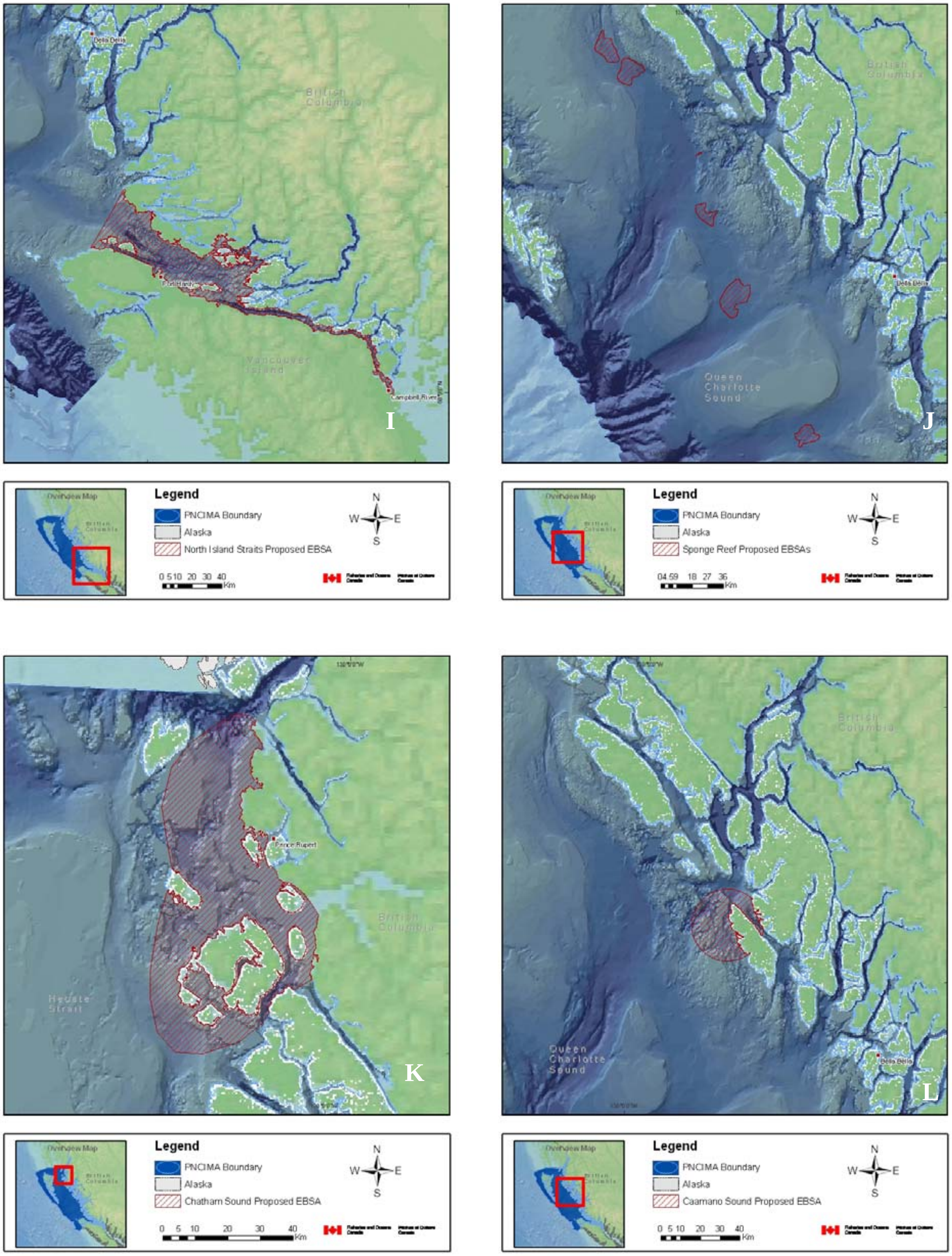

Figure 2 cont'd: Individual proposed EBSAs. I) North Island Straits, J) Sponge Reefs, K) Chatham Sound, L) Caamano Sound.

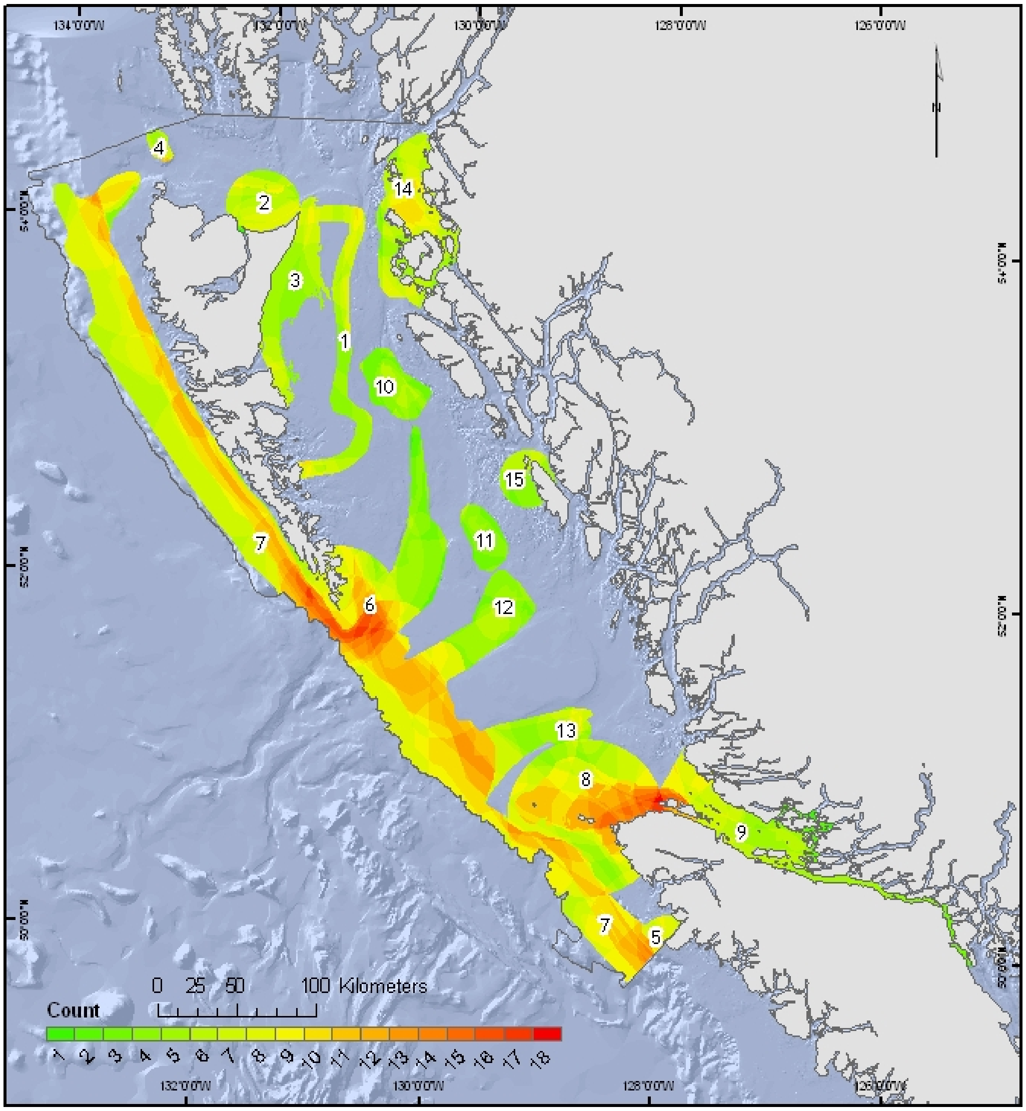

Figure 3: Counts of overlaid Important Areas (IAs) in each of the different identified EBSAs, excluding River Mouths and Estuaries using the colour coded-scale. 1) Hecate Strait Front, 2) McIntyre Bay, 3) Dogfish Bank, 4) Learmouth Bank, 5) Brooks Peninsula, 6) Cape St. James, 7) Shelf Break, 8) Scott Islands, 9) North Island Straits, 10-13) Sponge Reefs, 14) Chatham Sound, 15) Caamano Sound.