Nearshore Aquatic Community Structure and Function: Overview and Status of Knowledge in the Queen Charlotte Basin

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OBJECTIVES AND ORGANIZATION

A. What do we know (from the refereed literature) about the intertidal/nearshore aquatic communities in the Queen Charlotte Basin?

   1. Biophysical or habitat aspects
   2. Community structure
   3. Functional aspects
   4. Spatial and temporal scales of change

B. Reviewed by major habitat types, primarily on wave exposure and substrate

C. Summary of knowledge gaps

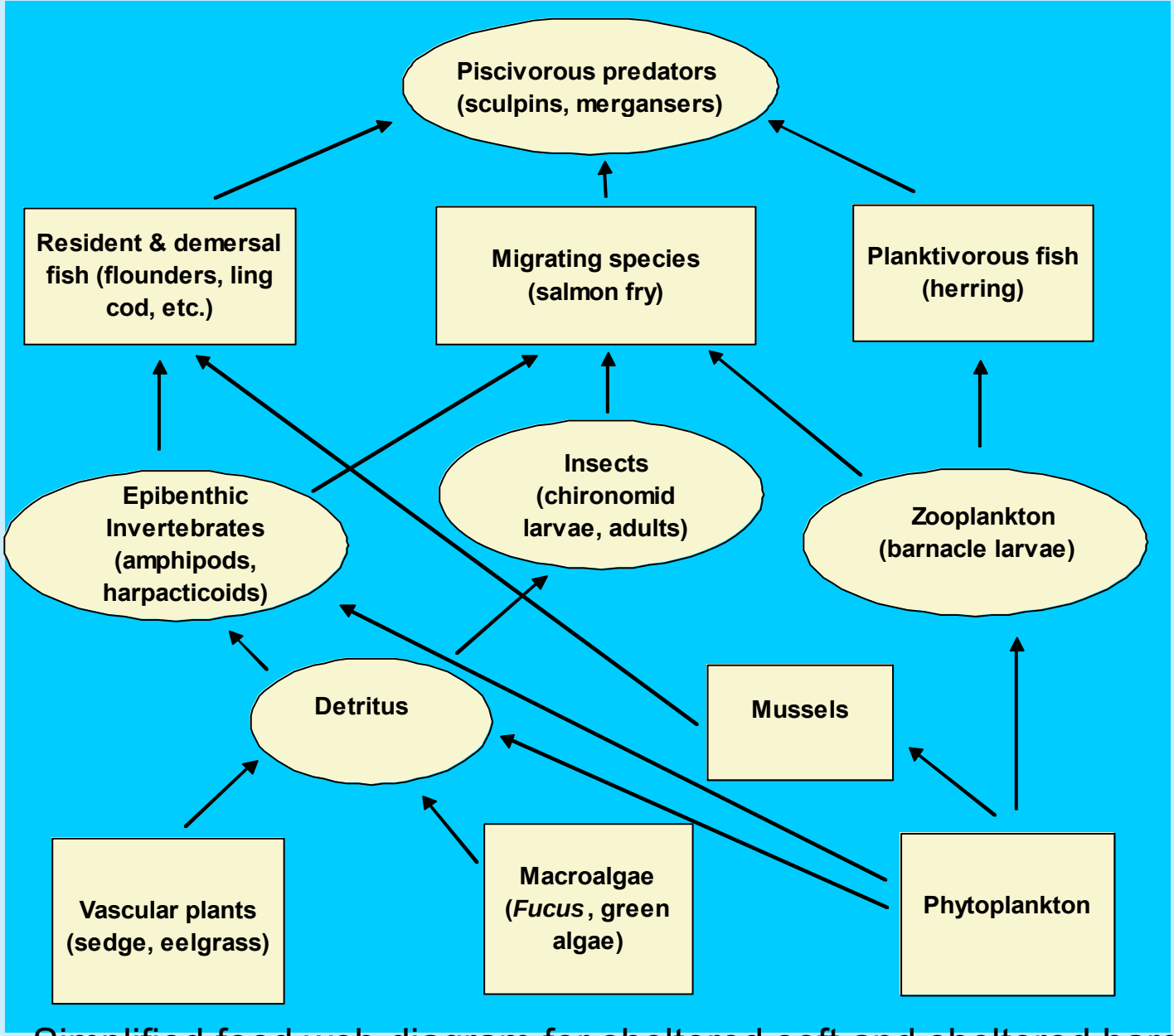
SHELTERED SOFT SUBSTRATE (MUD, SAND, GRAVEL)

- low wave action, often brackish, stratified
- no refereed publications available from QCB on community ecology
- inventory of biota from parts of North and South Central Coast, Gwaii Haanas (Harper et al. 1994, Emmett et al. 1995, CERF 2000, Sloan et al. 2001)
- CERF (2000) provided structural data but only for organisms on the substrate surface
- Parker (1968) and Hargreaves et al. (1988) gave observations of salmon fry on shorelines in Fitzhugh Sound and seaward passes (Hakai, Lama, Nalau) and Masset Inlet, respectively
- no data on temporal changes

Based on Knowledge from Northeast Pacific

- important rearing habitat for rearing salmonids (Healey 1982, Levings et al. 1986, DFO 2003 (Broughton Archipelago))
- detritus driven food webs, often with eelgrass as a base (e.g. Sibert et al. 1974, Webb 1991)
- rockweed (attached to gravel) is an important structural species (Marsden and DeWreede 2002), benthic diatoms on mud flats are food source for grazers such as amphipods (Pomeroy and Levings 1980)

Intertidal, sheltered, soft substrate (estuary).
Bearskin Bay, Skidegate Inlet, Graham Island.
Juvenile salmon rearing habitat.



Simplified food web diagram for sheltered soft and sheltered hard substrates and estuaries. (adapted from Levings et al. 2003)

SHELTERED HARD SUBSTRATE

- low wave action, often brackish, stratified
- no refereed publications available from QCB on community ecology
- inventory of biota from parts of North and South Central Coast, Gwaii Haanas (Harper et al. 1994, Emmett et al. 1995, CERF 2000, Sloan et al. 2001)
- important spawning habitat for herring; maps available (Hay et al. 1989)
- CERF (2000) provided structural data
- Parker (1968) gave observations of salmon fry on shorelines in Fitzhugh Sound and seaward passes (Hakai, Lama, Nalau)
- 23% of Queen Charlotte Islands fish species use the intertidal (Northcote et al. 1989)
- no data on temporal changes

Based on Knowledge from Northeast Pacific

- important rearing habitat for salmonids (Healey 1982, Levings et al. 1986)
- structural aspects of algal communities including succession documented for Bath Island, Strait of Georgia (Levings et al. 1983)
- food web – trophic structure similar to sheltered soft substrate beach except benthic diatoms not prominent
- rearing and spawning habitat for intertidal fish (Marliave 1981, Green 1971)

Sheltered hard substrate; gravel, sand (Discovery Passage)

Intertidal sheltered hard substrate (estuary).
Bearskin Bay, Skidegate Inlet, Graham Island.
Rockweed is the dominant algae.

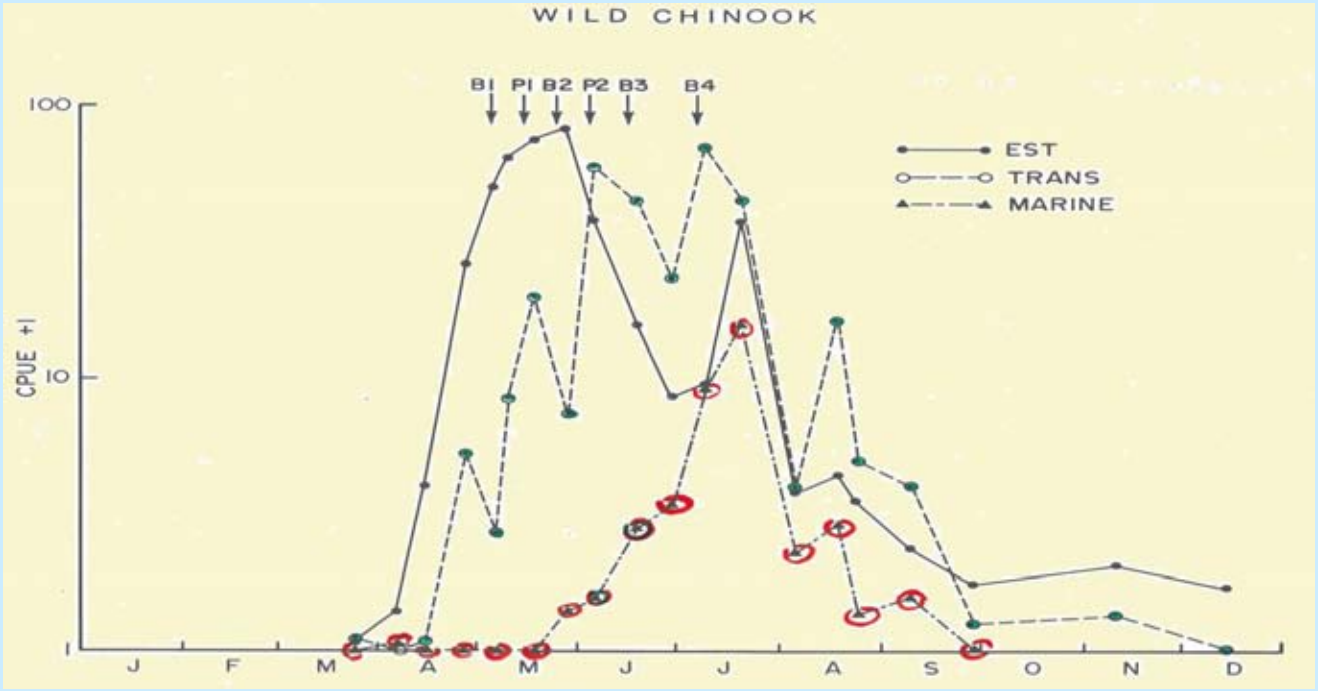
ESTUARIES

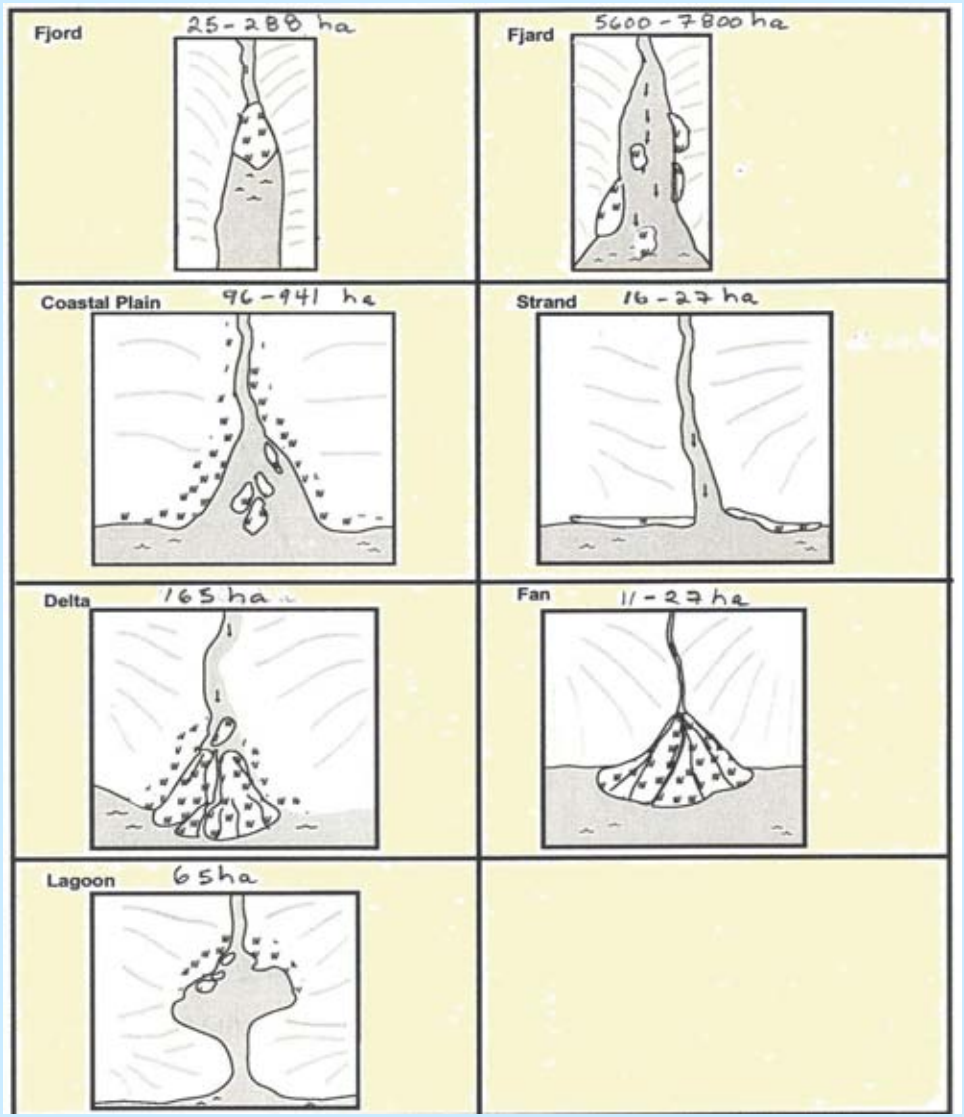
- MacKenzie et al. (2000) recognized seven types on the North Coast. Areas ranged from 11 to 7800 ha
- Circulation and pelagic biology of fjords have received limited study (eg Gardner 1980)
- inventory of biota from parts of North and South Central Coast, Gwaii Haanas (Harper et al. 1994, Emmett et al. 1995, CERF 2000, Sloan et al. 2001); also focused resource species surveys
- no refereed publications available from QCB on community ecology
- Stockner and Levings (1982) documented food webs supporting juvenile salmon at the Yakoun River estuary, Graham Island. Productivity and biomass at most trophic levels were described
- no temporal data

KNOWLEDGE FROM THE NORTHEAST PACIFIC

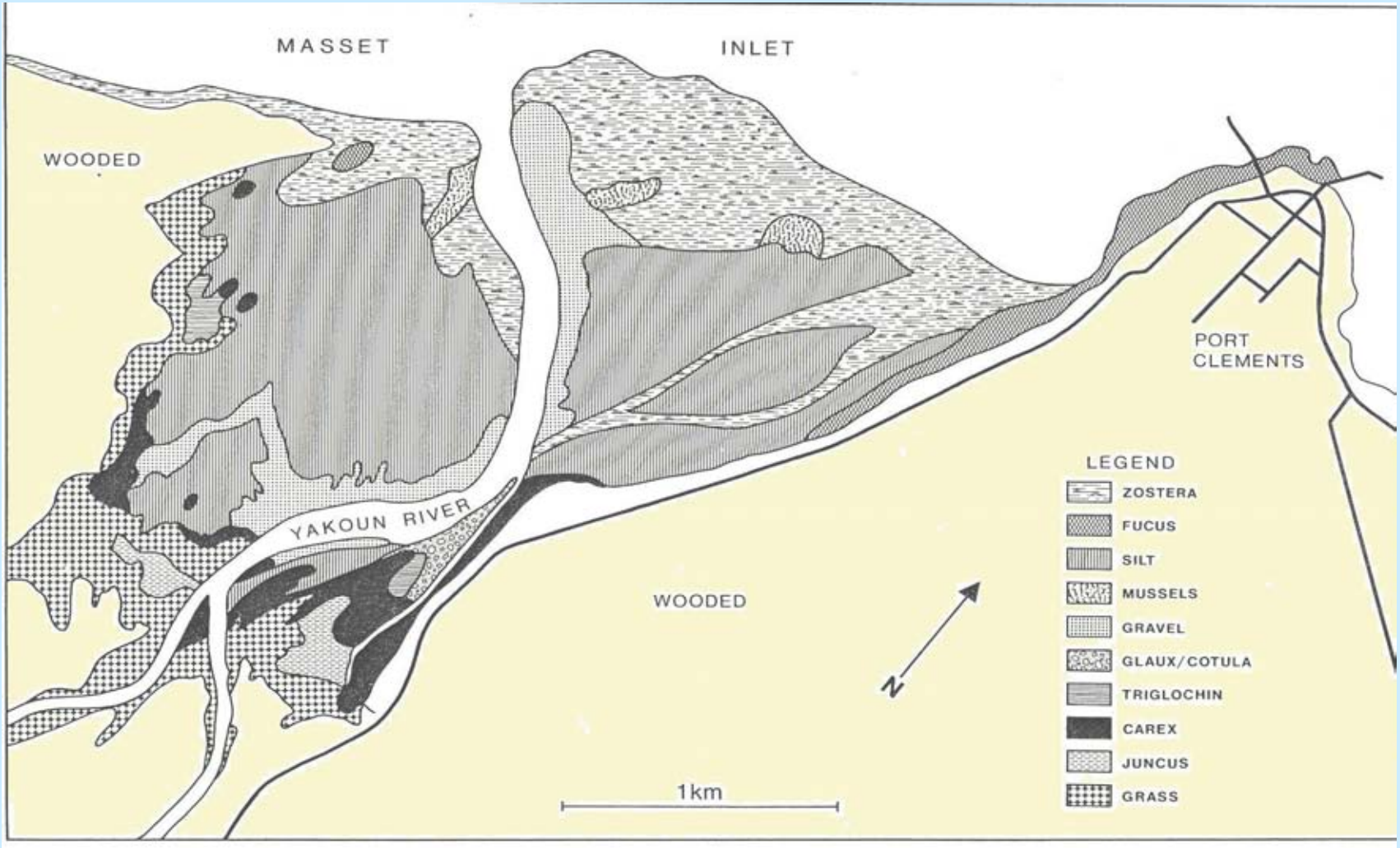
- **detailed studies at various estuaries in the Strait of Georgia have confirmed the importance of detritus from vascular plants (sedge, eelgrass) in food webs supporting salmon (Sibert 1979,Levings and Stanhope 1985, Simenstad and Wissmar 1985)**

- **juvenile salmon residence varies with species; chinook stay the longest (eg Levings et al 1986)**





Estuary types or forms found on the North Coast. Short hatching indicates the location of estuarine plant communities. (Mackenzie et al. 2000).



Habitat map of the Yakoun River estuary, Graham Island (from Stockner and Levings 1982)

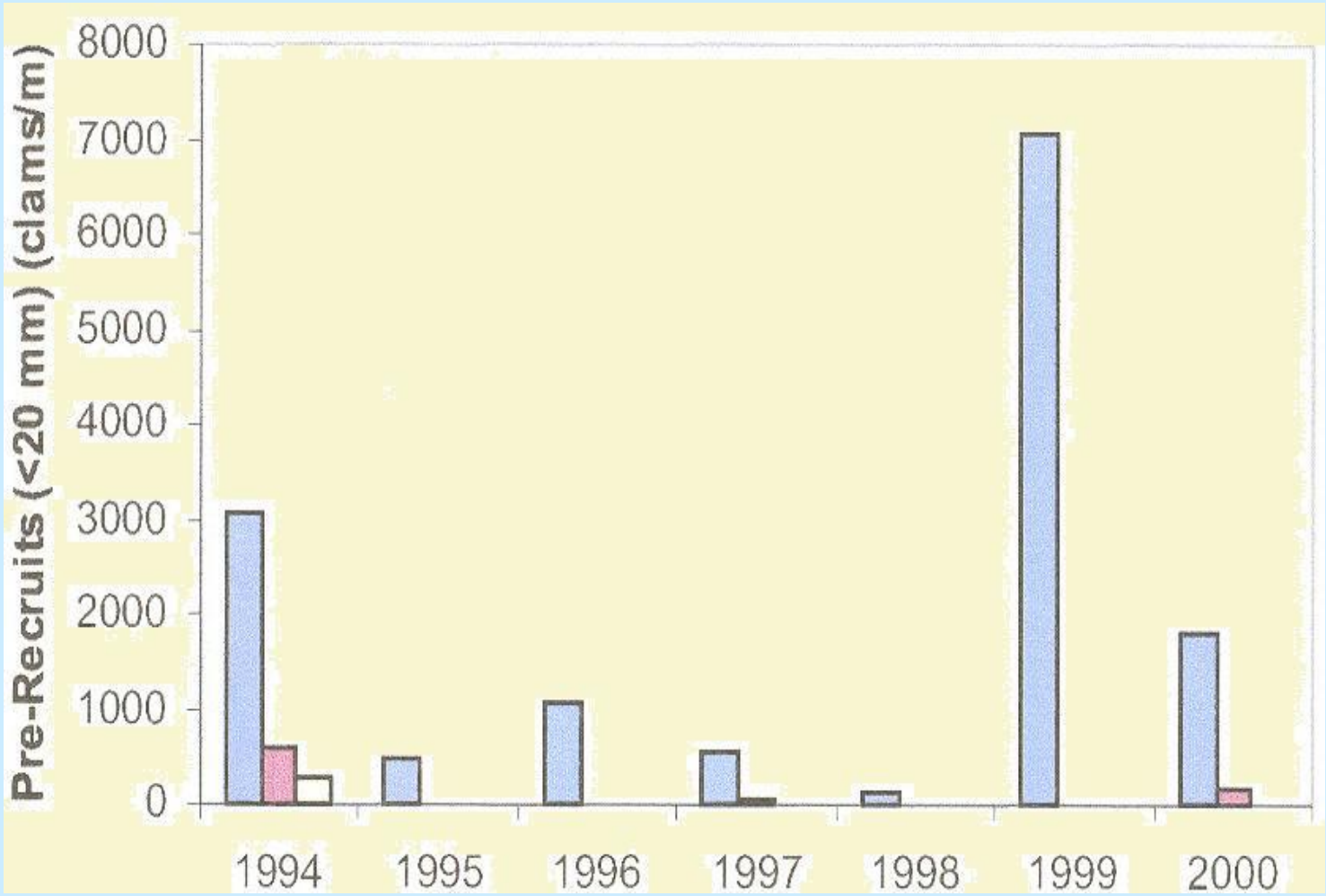
EXPOSED SOFT SUBSTRATE (SAND)

- extensive on east and north coast of Graham Island
- no refereed publications available from QCB on community ecology
- inventory of biota from parts of North and South Central Coast, Gwaii Haanas (Harper et al. 1994, Emmett et al. 1995, CERF 2000, Sloan et al. 2001); also focused resource species surveys
- CERF (2000) provided structural data but only for organisms on the substrate surface; most organisms not sampled
- razor clams settle out mainly in the lower intertidal (Bourne 1979, Jones et al. 2001); temporal variation in recruitment

Based on Knowledge from Northeast Pacific

- very few data; one paper on amphipod life history from Washington (Hughes 1982)

Intertidal, exposed soft substrate - sand. Burnette Bay, south Central Coast. Photo courtesy of Eric Lamb and Coastal Ecosystem Research Foundation.



Temporal variation in razor clam recruitment on Graham Island (from Jones et al. 2001)

EXPOSED HARD SUBSTRATE

- inventory of biota from parts of North and South Central Coast, Gwaii Haanas (Harper et al. 1994, Emmett et al. 1995, CERF 2000, Sloan et al. 2001); also focused resource species surveys

- community ecology publications scarce (Scagel 1961 re kelp in Queen Charlotte Strait;kelp and red sea urchins (Langara Island;Jamieson and Campbell 1985)

- no data on temporal change

- Based on Knowledge from Northeast Pacific

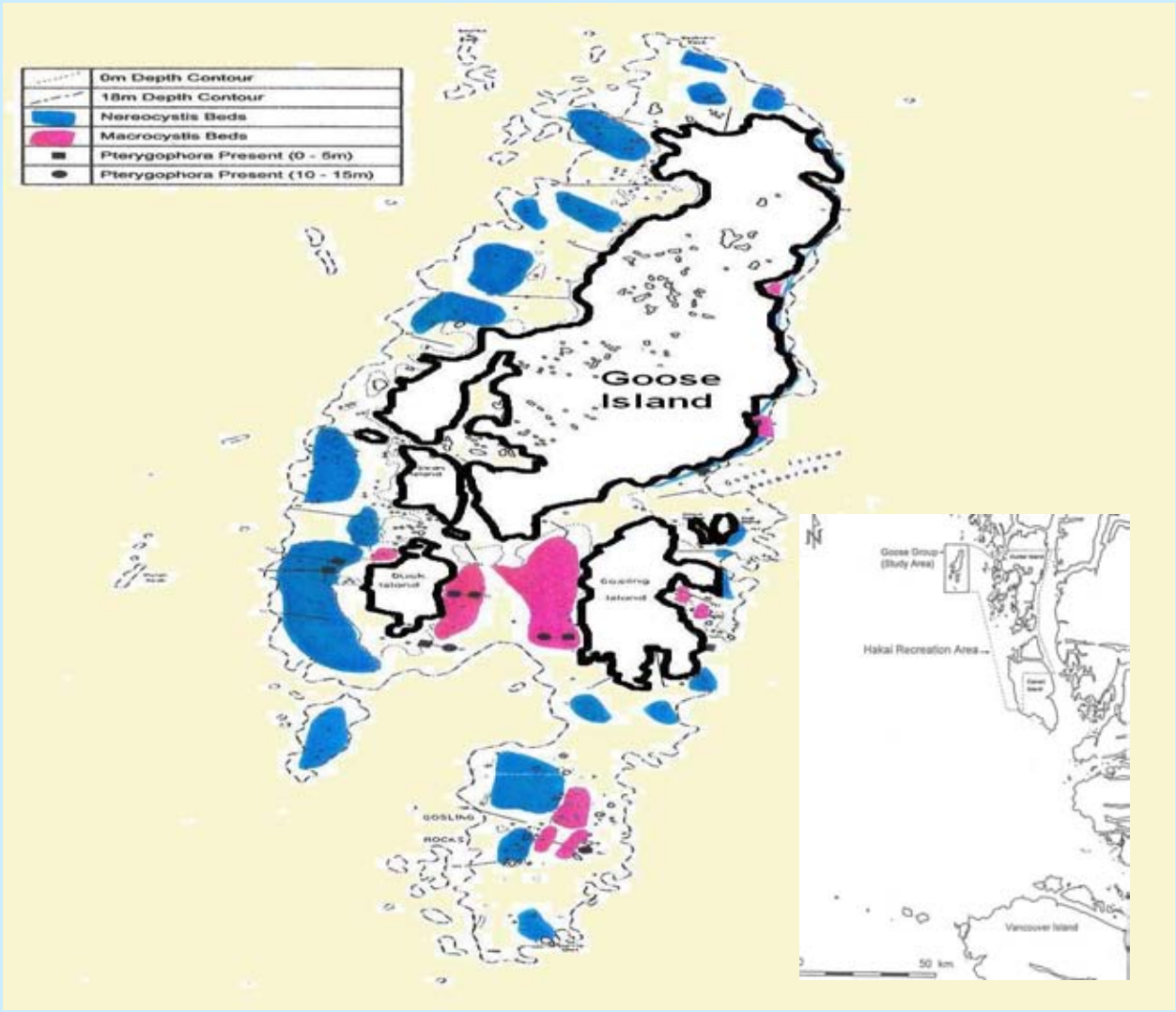
- red sea urchins from the Strait of Georgia and the Tofino area, BC, showed high variability in larval settlement site (0.5-8.0 km) (Sloan et al. 1987)

- diversity of community varied with degree of exposure in Barkley Sound (Jamieson et al. 2001)

- sea otter population links with urchin-kelp dynamics (Watson 1998)

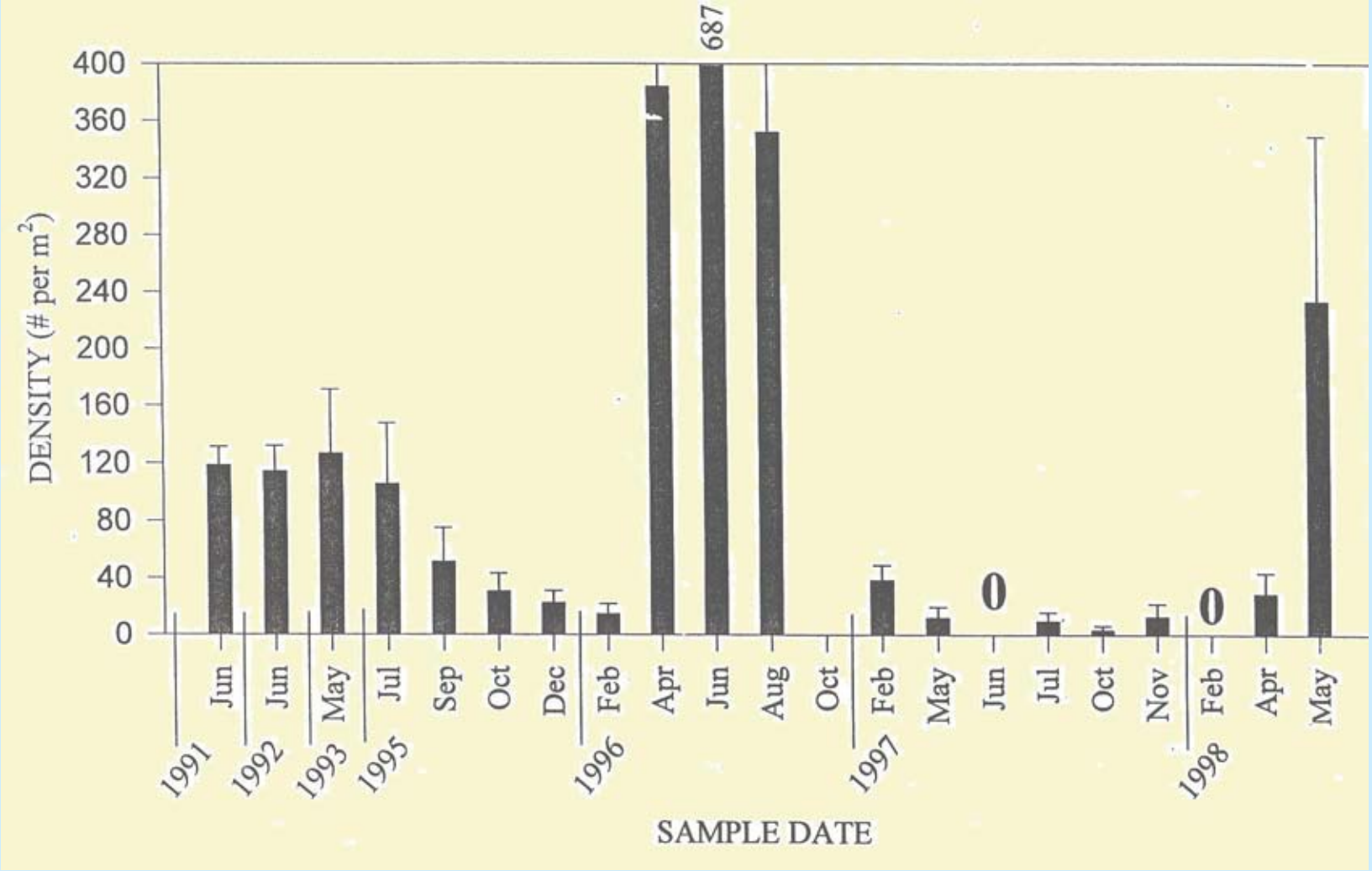
- kelp survival varied with chiton predation (Markel and DeWreede, 1998) and El Nino in Barkley Sound (Milligan et al. 1999)

- Shaffer (2000) found understory algae in kelp beds (Juan de Fuca Strait) were critical habitat for abalone (SARA species)



Kelp bed mapping from Goose Island area, North Central coast (from Emmett et al. 1995)

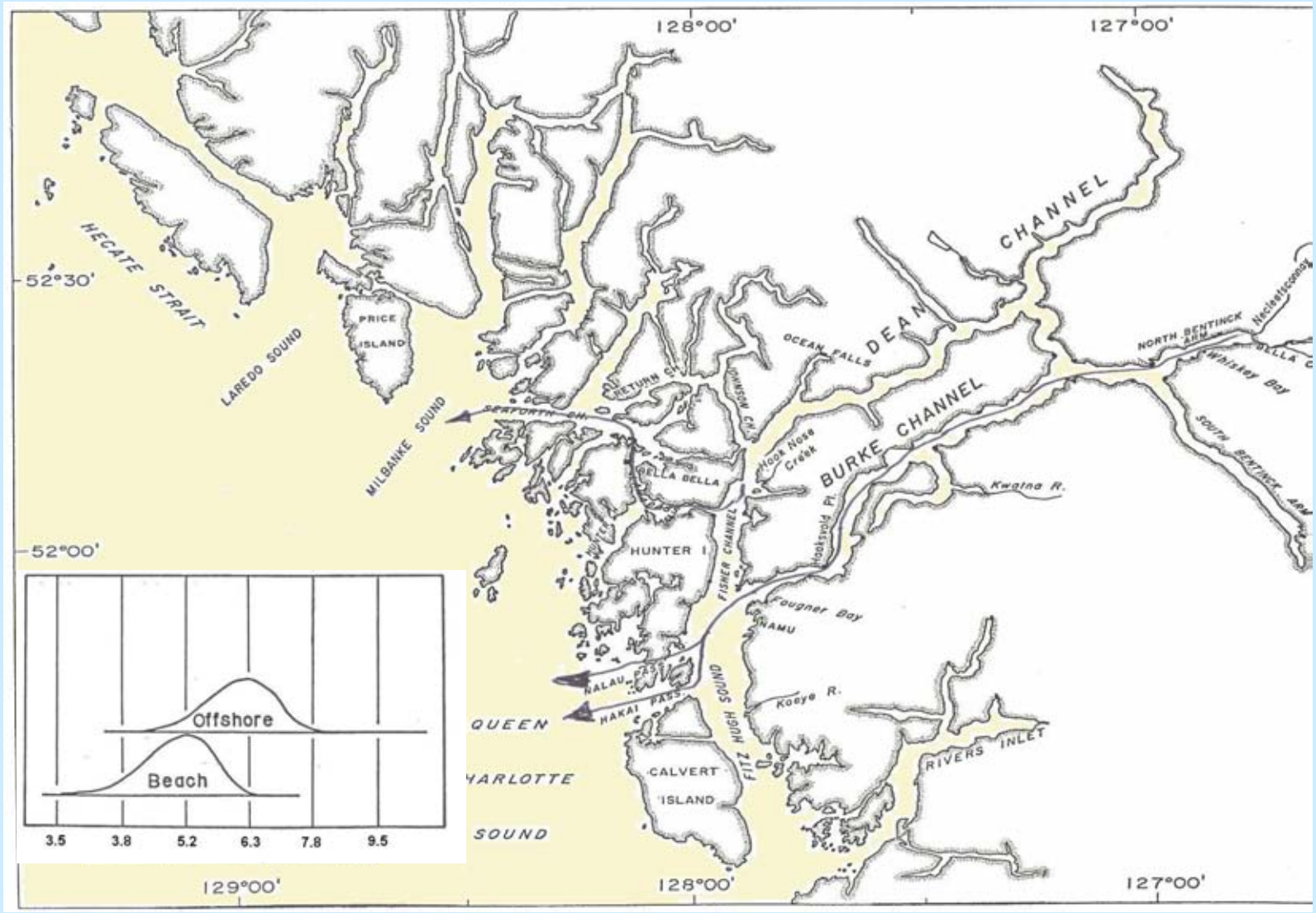
Intertidal kelp bed (*Hedophyllum sessile*) at Barkley Sound. Photo courtesy Dr. Bob deWreede, UBC Botany Department



Temporal variation in recruitment of *Hedophyllum sessile* at Barkley Sound (from Milligan et al. 1999)

Exposure	Intertidal Range (m)	Mean gooseneck barnacle matrix thickness (cm)	Mean number of species	Mean number of individuals	Mean Evenness Index	Mean Species Richness Index
Leeward	2.29 - 3.50	12.5	30	1392	0.29	1.83
Windward	1.89 - 5.13	18.0	40	1996	0.18	2.25

Communities on exposed rocky shore (west coast of Vancouver Island) (from Jamieson et al. 2001) (900 cm^2 sample; only organisms > 1.0 mm included)



Migration routes and length of pink salmon fry in Fitzhugh Sound. Beach: within 10 m of shore. Offshore: 40 m off (from LeBrasseur and Parker 1964, Parker 1968)

SUMMARY

- knowledge of the structure and function of nearshore/intertidal aquatic communities of the QCB is poor. There are few papers in the refereed ecological literature dealing with the area and none are comprehensive.

- relative to other areas in the northeast Pacific (California to Alaska), the nearshore/intertidal area of the QCB is perhaps the least studied habitat. Biodiversity studies using inventory methods have received most attention but biological interactions, functions and rates of key ecological processes (examples: benthic primary and secondary production, food web dynamics, rates of temporal changes) are unknown.

- **British Columbia, especially the North and Central Coast, has a high ratio of number of salmon bearing streams per unit of coastline in comparison to other parts of the world; e.g. there are 537 salmon bearing streams on the Central Coast alone (Haggarty et al. 2003)**

- **all young salmon must pass the estuary/outer coast/island complex en route to the open ocean. General null hypothesis: nearshore areas in the QCB are not key salmonid habitats. There are no data to confirm or reject this hypothesis. This is a major data gap for ocean management planning in the area**

- **these are important shortfalls in knowledge relative to baseline/monitoring for oil and gas exploration since numerous authors (e.g. Sloan 1999, Skalski et al. 2001 re: EVOS, Birtwell and McAllister 2002) have stressed that detailed, site-specific knowledge of ecological processes and rates of change are essential to forecast, relate causes to effects, document cumulative effects, or develop risk assessments.**