

Hypothesis:

Predation by marine mammals is an important contributor to the Fraser sockeye situation

Workshop on the Decline of Fraser River Sockeye
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Marine mammals of Pacific Canada

25 Cetaceans, 5 Pinnipeds, 1 Mustelid



Approach

- Identify known or potential salmonid predators
- Review current status and distribution
- Estimate extent of predation on sockeye, particularly for Fraser River stocks
- Assess population trend to infer whether sockeye predation rates may be increasing or decreasing

Killer whale

Orcinus orca



Killer whale ecotypes: specialized populations

Residents: fish feeders, primarily salmon



Transients: mammal specialists, do not feed on fishes

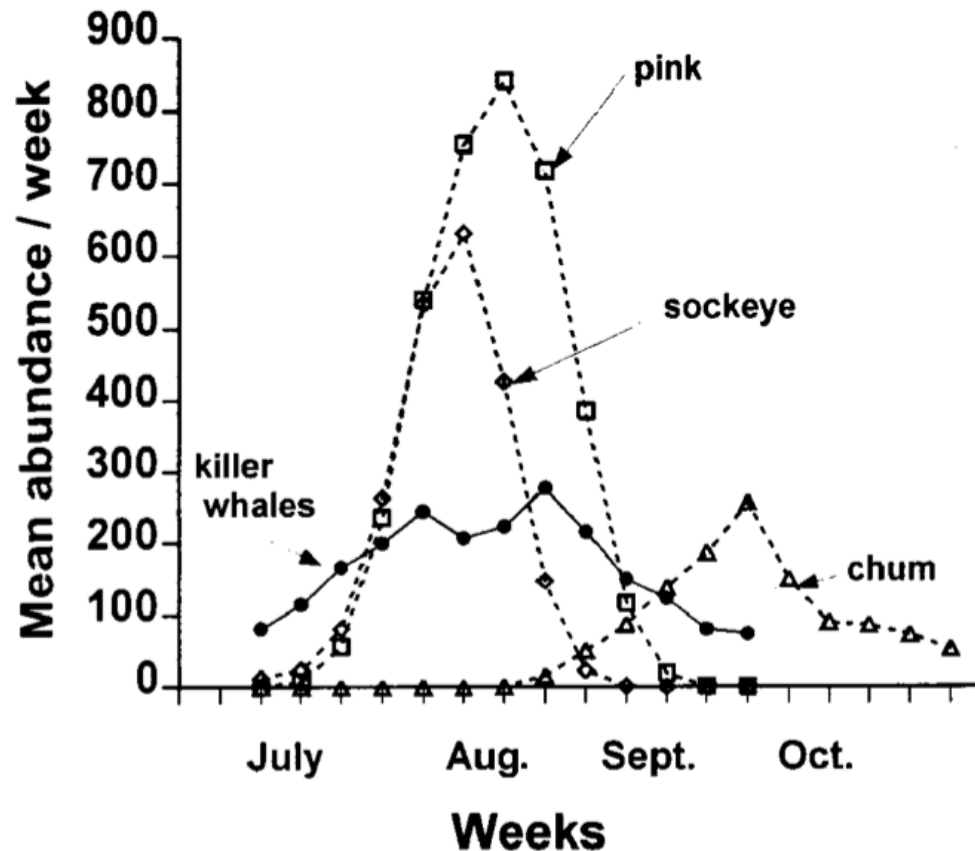


Offshores: fish feeders, especially sharks

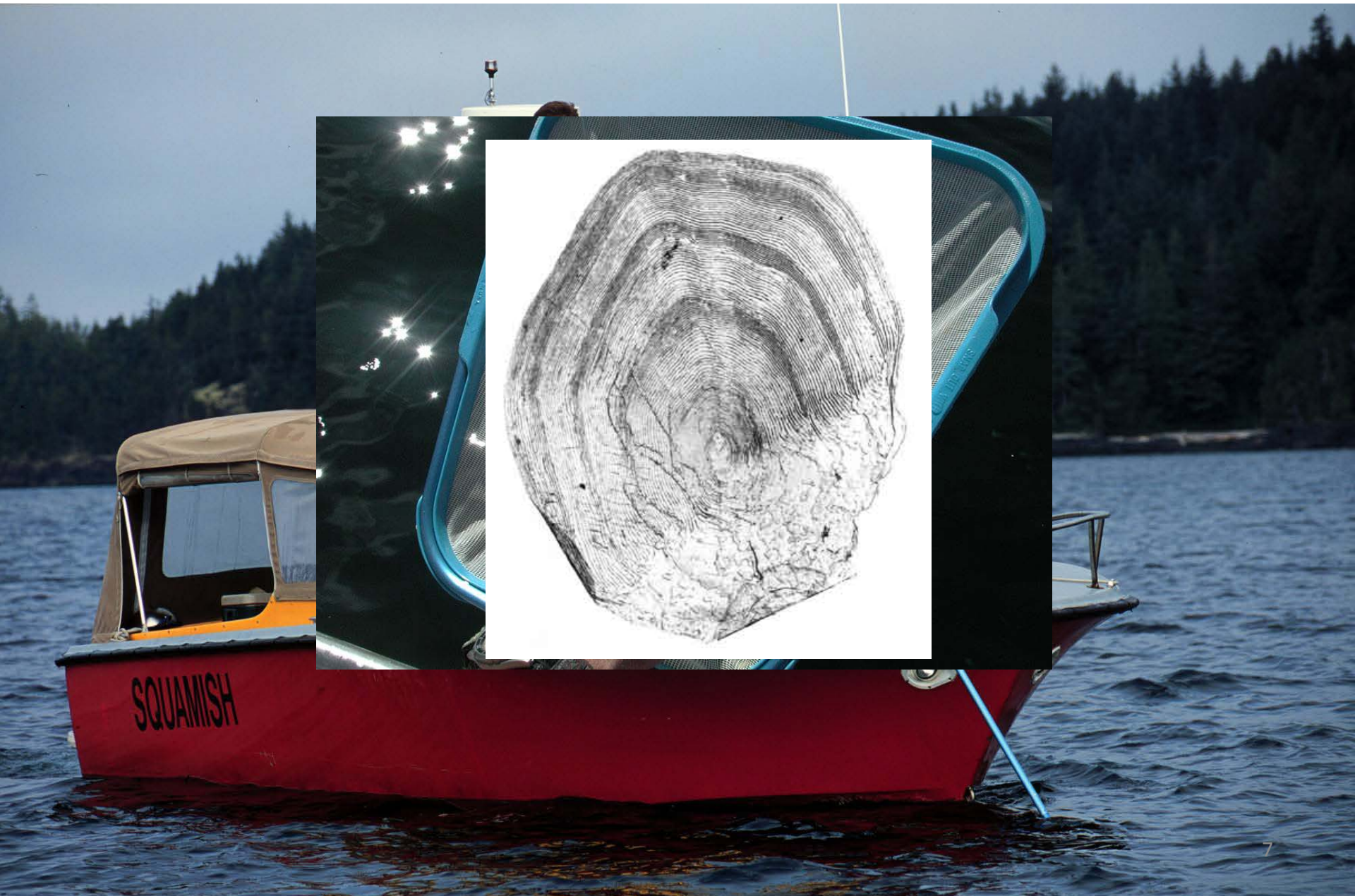


Movement patterns of resident killer whales associated with salmon migration

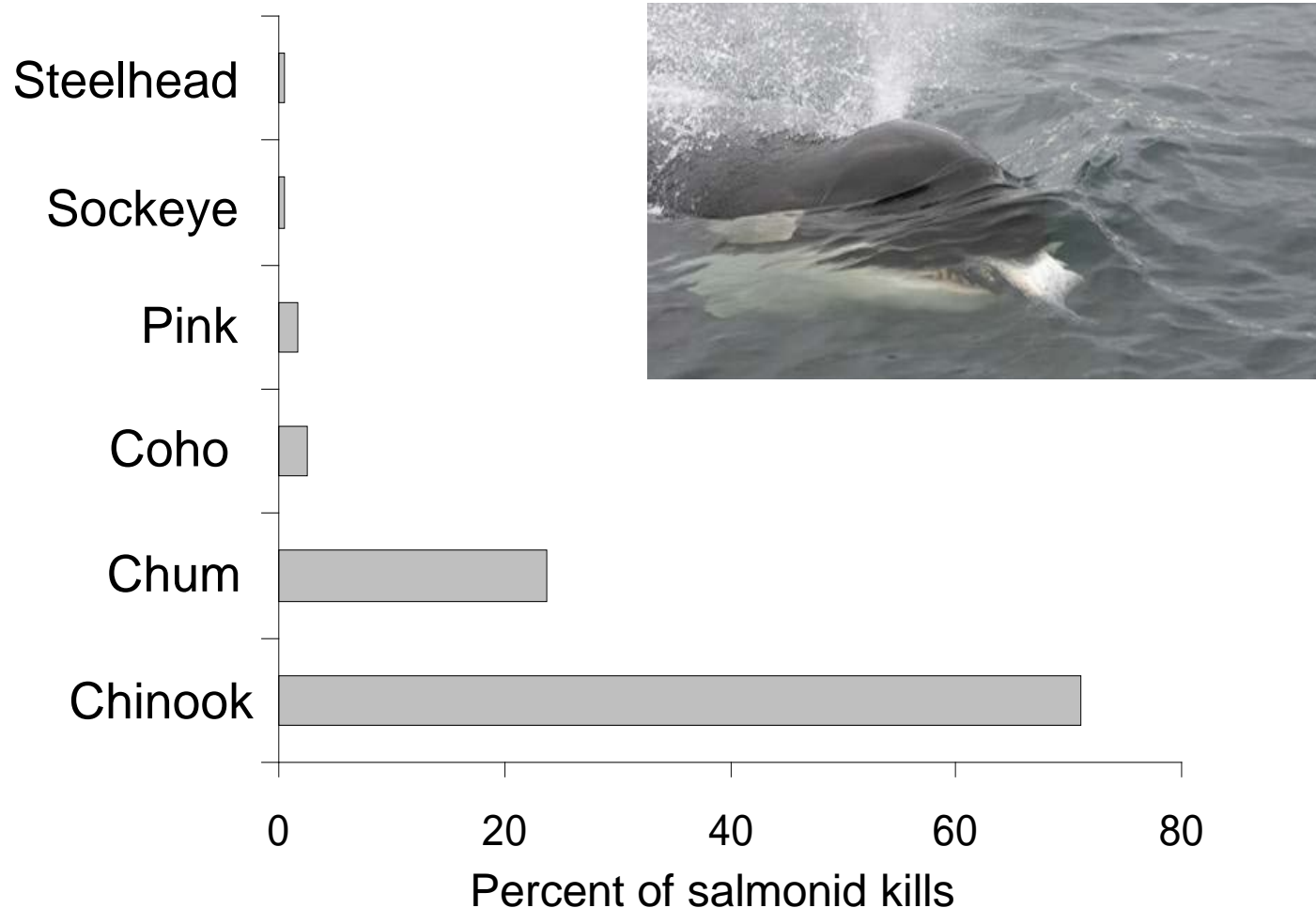
Mean numbers of salmon (x1000) and whale-days, Johnstone Strait 1984-88



Prey fragment sampling to determine diet



Salmonid species identified from predation events by resident killer whales, coast wide (n = 806)



Conclusion: Killer whale



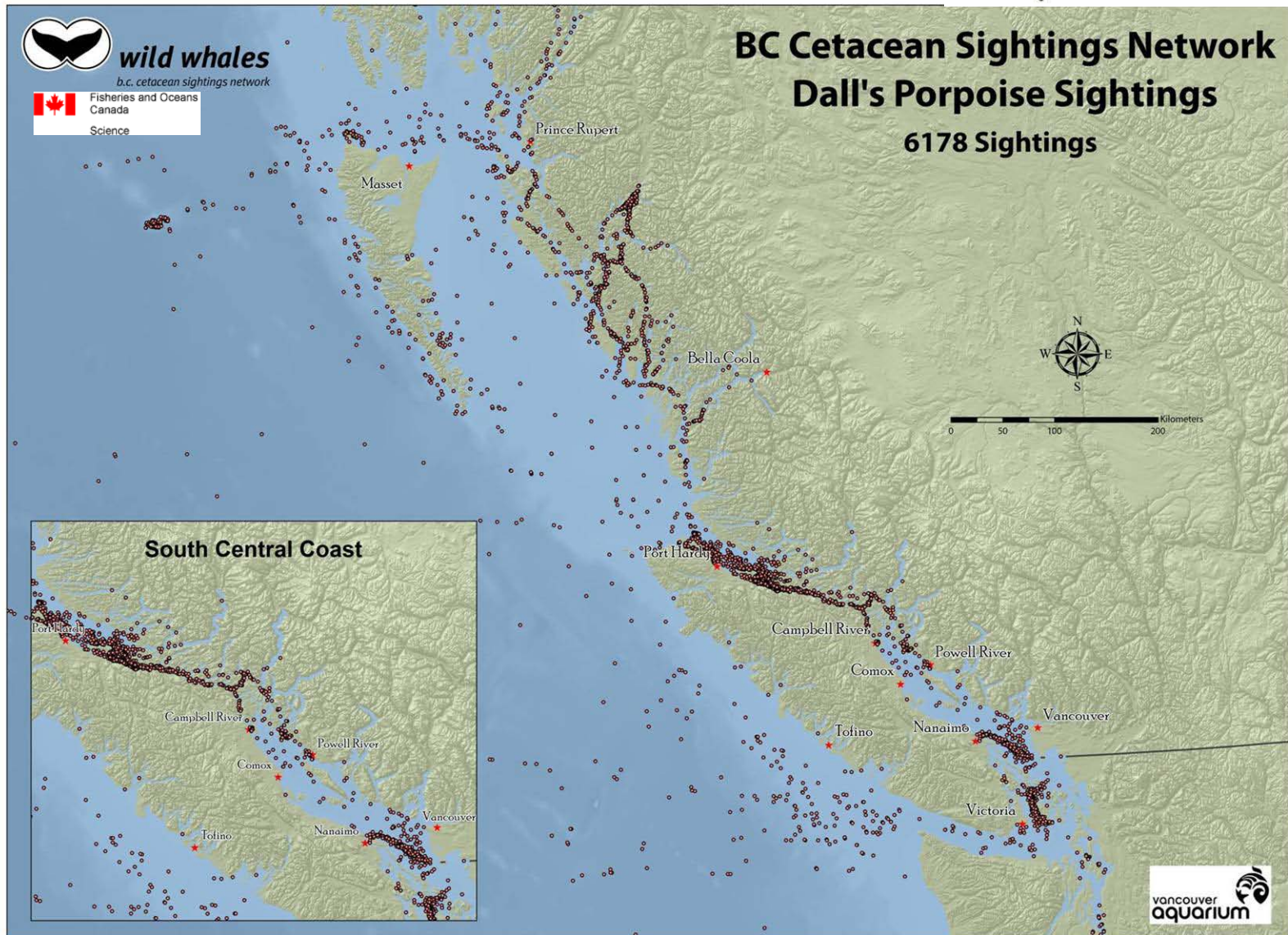
- Salmonids only consumed by resident ecotype
- Diet dominated by Chinook salmon, less so chum
- No evidence of change in Chinook selectivity over past decade
- Role in Fraser sockeye decline insignificant

Dall's porpoise

Phocoenoides dalli



Distribution: Dall's porpoise



Status: Dall's porpoise

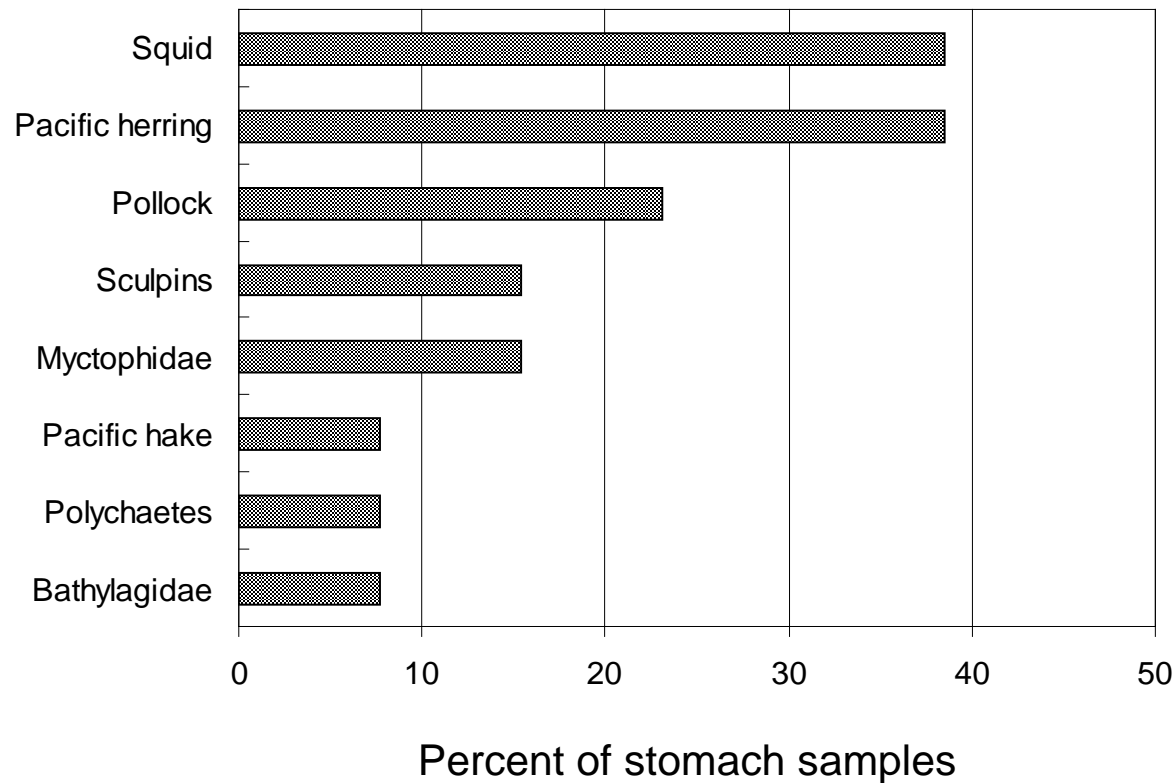


- North Pacific: 1,186,000 (CV = 0.92)
- Coastal British Columbia: 4,910 (2700-8,940)
- Abundance trend unknown

Diet: Dall's porpoise



Stomach contents analysis, S Vanc Island, n = 13



Conclusion: Dall's porpoise

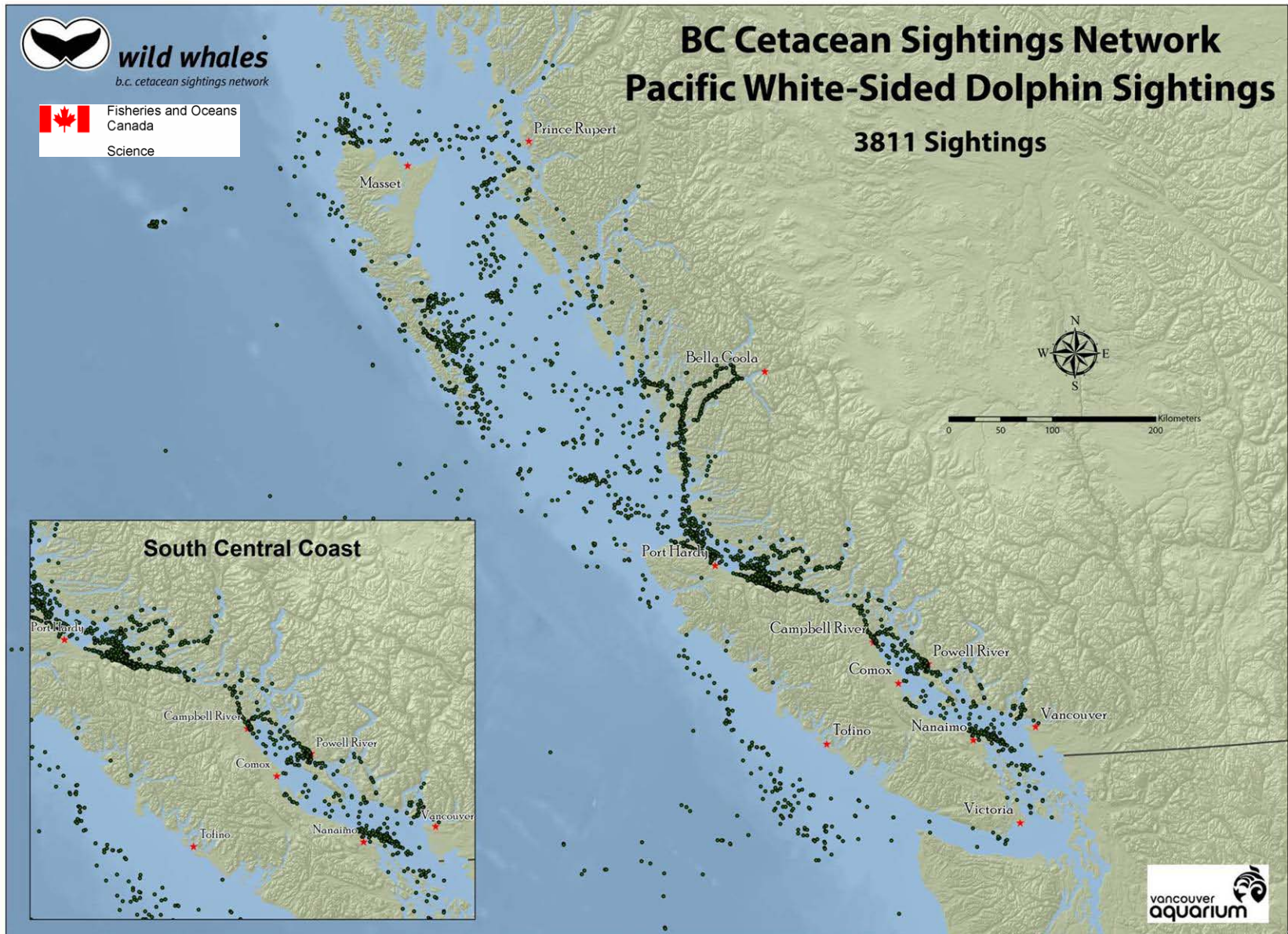


- Potential predator of out-migrating salmonid smolts, but unlikely to take returning adults
- No evidence of salmonid predation from analyses of local stomach contents
- Role in sockeye decline likely insignificant

Pacific white-sided dolphin
Lagenorhynchus obliquidens



Distribution: Pac. White-sided dolphin



Status: Pac. white-sided dolphin

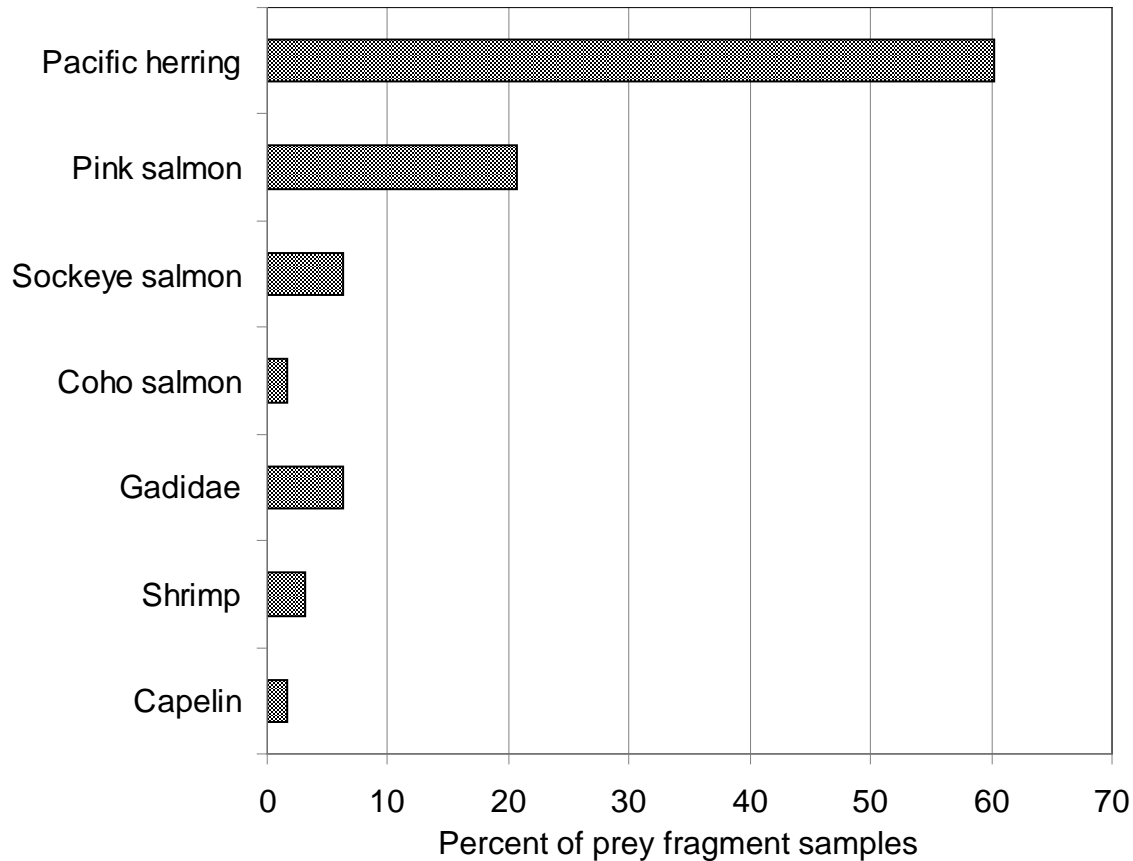


- North Pacific: > 1,000,000
- Coastal British Columbia: 25,900 (12,900-52,100)
- Largely absent from nearshore waters for 20-30 years prior to mid 1980s
- Abundance increased throughout late 1980s and 1990s, mostly through inshore shift in distribution

Diet: Pacific white-sided dolphin



Diet composition from prey fragment sampling, 1994-95 (n = 63 samples)



Conclusion: Pac. white-sided dolphin



- Only cetacean in region with potential to consume significant numbers of out-migrating as well as returning adult sockeye
- No evidence of substantial change in abundance or distribution over past decade
- Further studies needed to define seasonal and geographic variation in diet
- Potential role in sockeye decline cannot be assessed

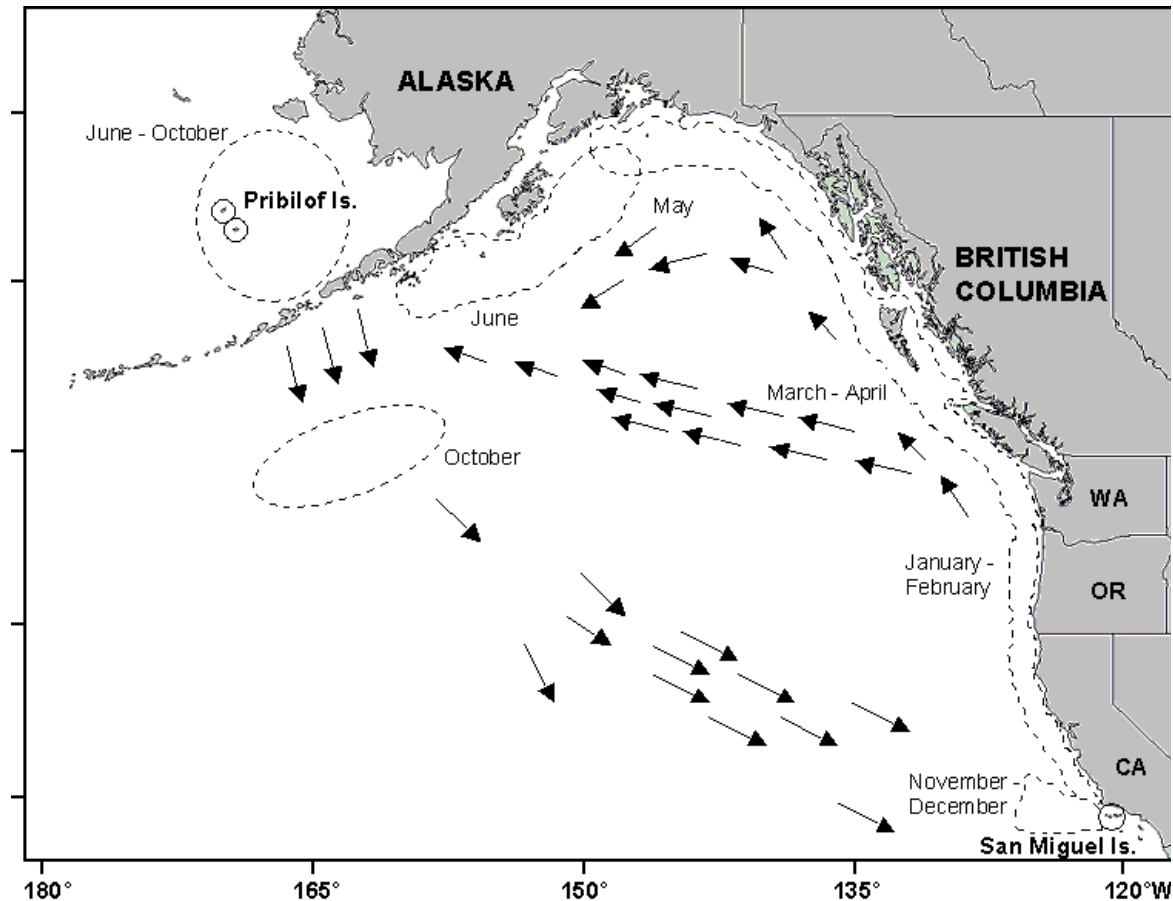
Northern fur seal

Callorhinus ursinus



Distribution: Northern fur seal

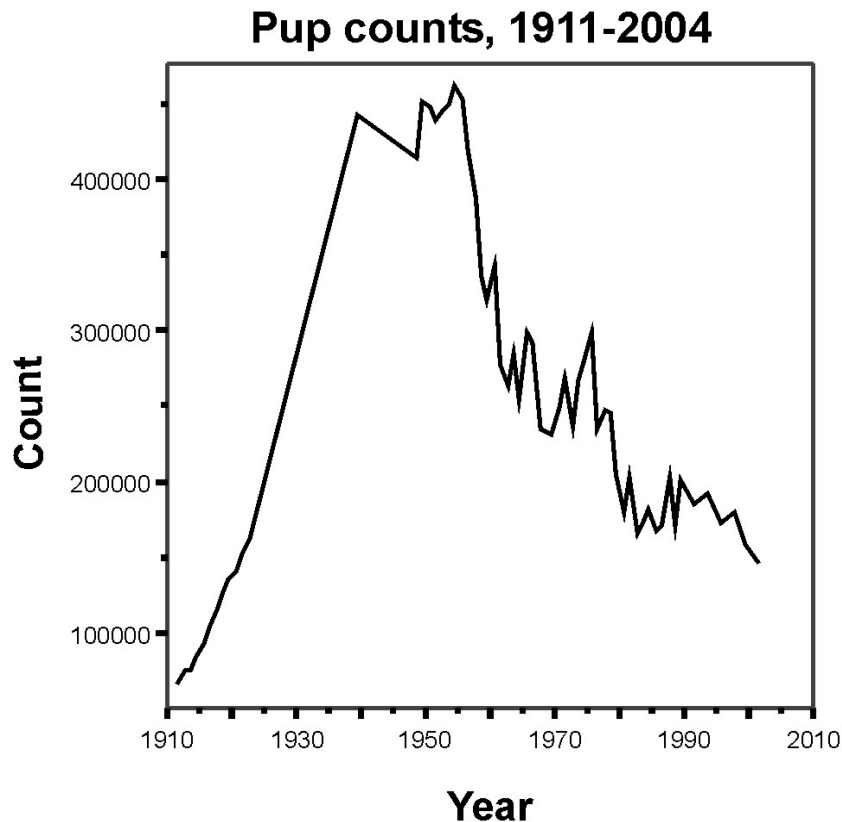
Approximate migratory pattern of northern fur seals
in the eastern North Pacific



COSEWIC 2010. COSEWIC assessment and update status report on the northern fur seal *Callorhinus ursinus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 33 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Status: Northern fur seal

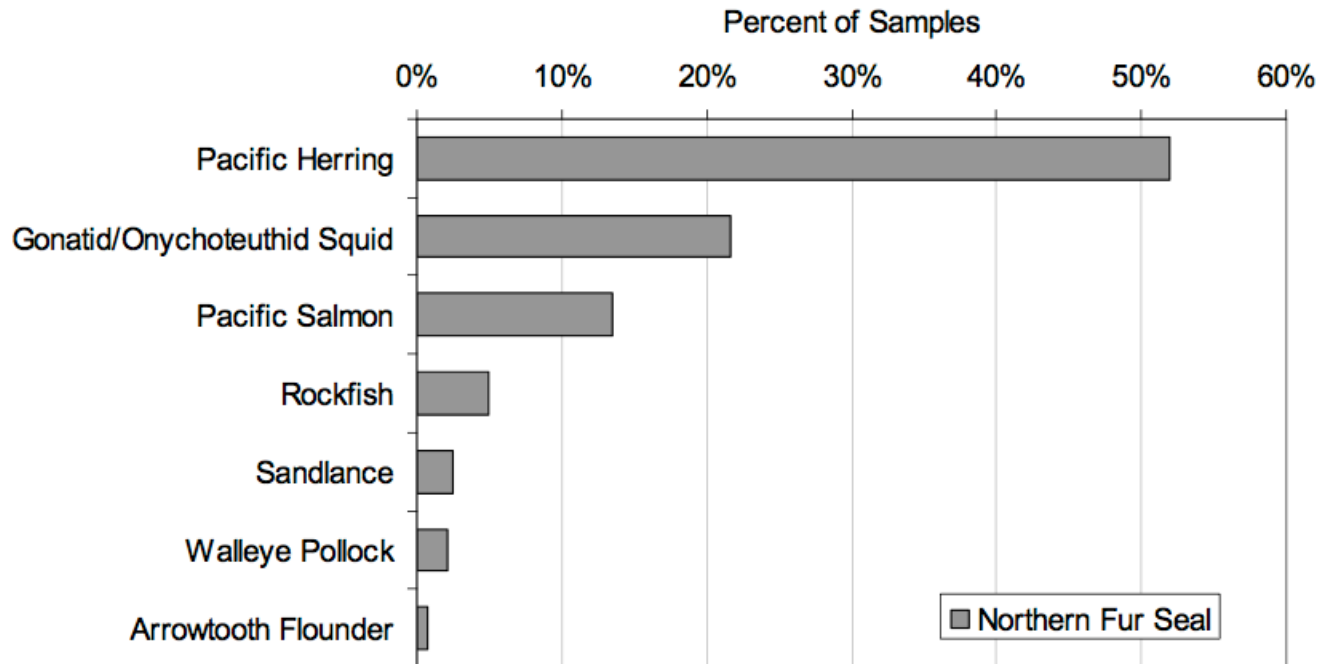
- Population has declined by ca. 30% over past 3 decades
- Current population approx. 600,000



COSEWIC 2010. COSEWIC assessment and update status report on the northern fur seal *Callorhinus ursinus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 33 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Diet: Northern fur seal

Prey species of northern fur seals wintering off British Columbia
and SE Alaska (n = 354 stomach samples, 1958-74)



- Salmonids ID'd (small sample): 48% pink, 24% coho, 14% Chinook, 10% chum, 5% steelhead, 0% sockeye

Perez, M. and M.A. Bigg. 1986. Diet of northern fur seals (*Callorhinus ursinus*) off western North America. Fish. Bull. 84

Olesiuk, P.F. 2007. Preliminary assessment of the recovery potential of northern fur seals (*Callorhinus ursinus*) in British Columbia. Can. Science Advisory Sec., Fisheries and Oceans Canada, Ottawa. Res Doc 2007/076.

Conclusion: Northern fur seal

- Given declining fur seal abundance and apparent low predation rates on sockeye salmon, role in recent Fraser sockeye declines probably not significant

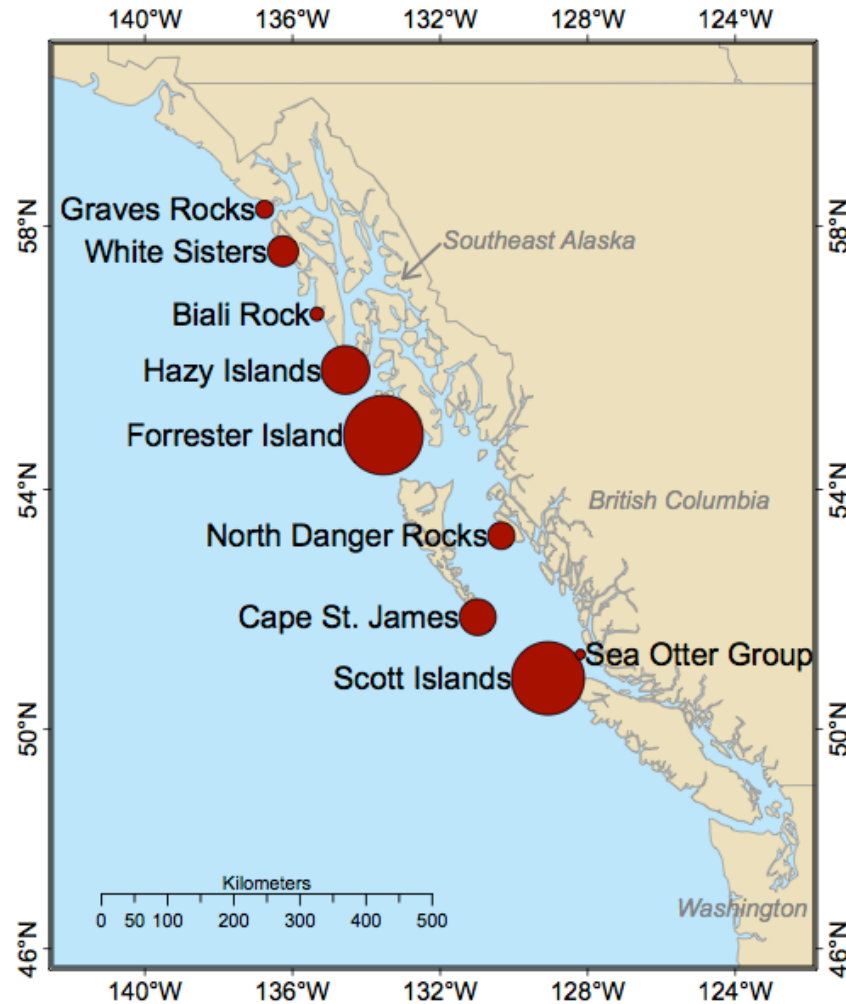
Steller sea lion

Eumetopias jubatus



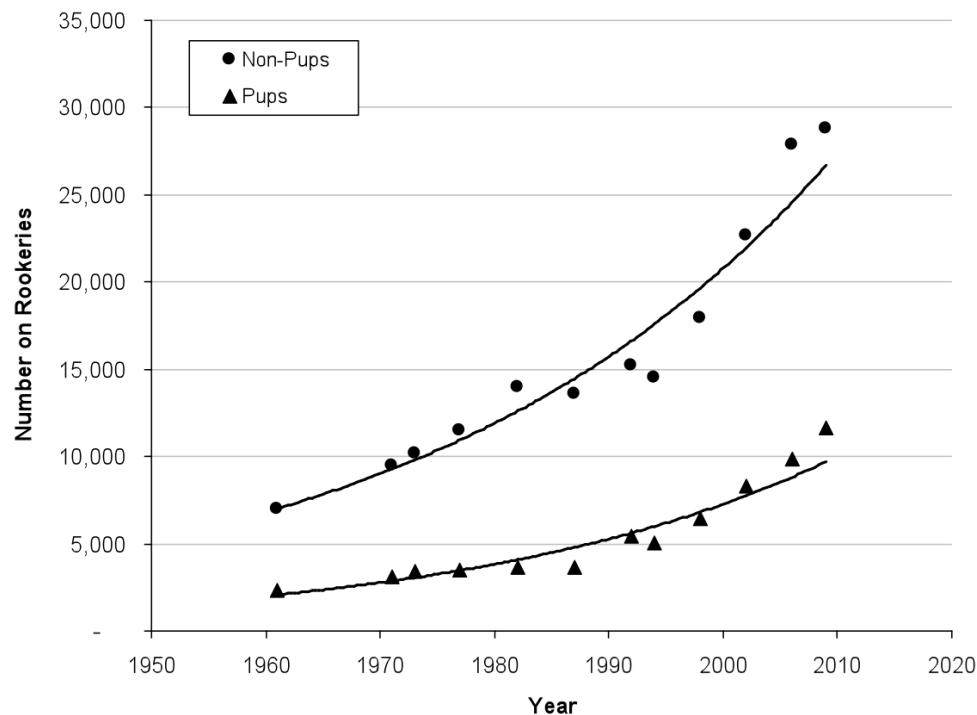
Steller sea lion distribution

Breeding rookeries in British Columbia and SE Alaska



Status: Steller sea lion

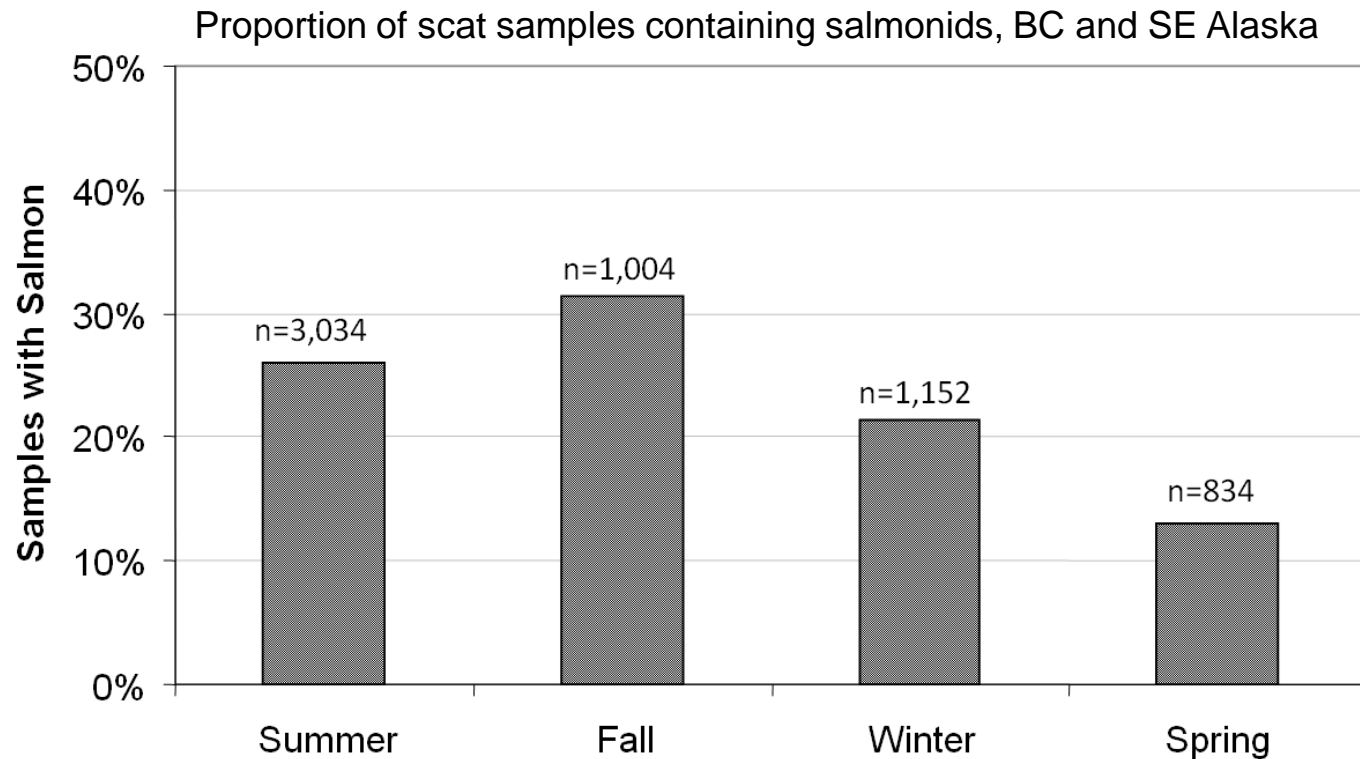
- Population depleted to 25-30% of historical abundance by control programs and harvests, 1912-1967
- Abundance increasing at 3.5% per annum (5% in recent years)
- Four-fold increase since 1960 to approx. 60,000 in 2009 (BC and SE Alaska)



Olesiuk, P.F. 2008. Abundance of Steller sea lions (*Eumetopias jubatus*) in British Columbia. Can. Science Advisory Sec., Fisheries and Oceans Canada, Ottawa. Res Doc 2008/063; Olesiuk, unpubl. data.

Diet: Steller sea lion

- Opportunistic predator on wide variety of prey species, including salmonids



Olesiuk, P.F. Unpublished data

Conclusion: Steller sea lion

- Salmonids are a significant component of diet especially in summer and fall, though proportion comprised of sockeye is unknown
- Increasing abundance is likely associated with increasing predation rates on salmonids
- Studies are currently underway to identify proportion of different salmonid species in diet and estimate consumption rates from bioenergetic models
- Potential role in sockeye decline cannot be assessed until these studies are completed

California sea lion

Zalophus californianus

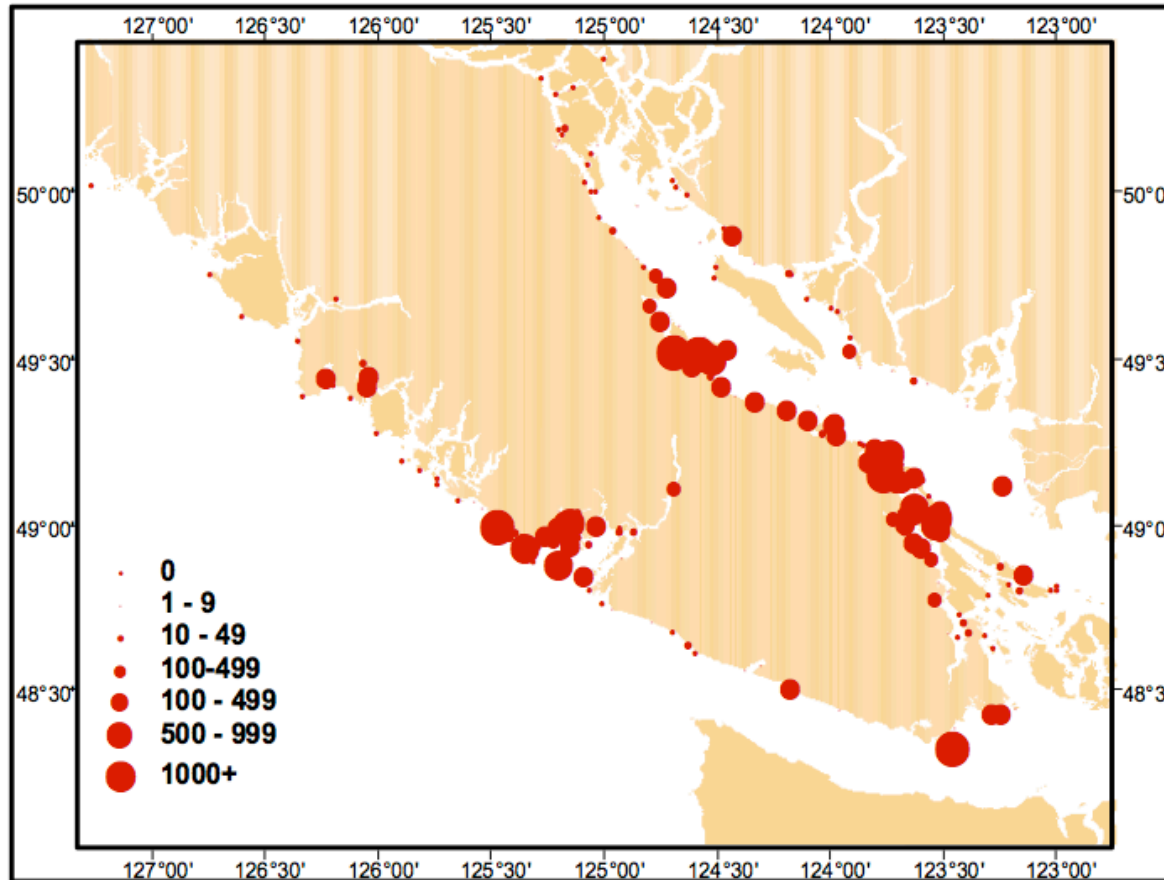


Status: California sea lion

- Males migrate to southern coast of Vancouver Island and the Strait of Georgia during winter
- Wintering animals started appearing in area during 1960s, peaked at 4500 in 1984, declined to 1500 by 2004
- Abundance of Steller sea lions wintering in this area has increased in recent years as abundance of California sea lions has declined

California sea lion abundance and distribution

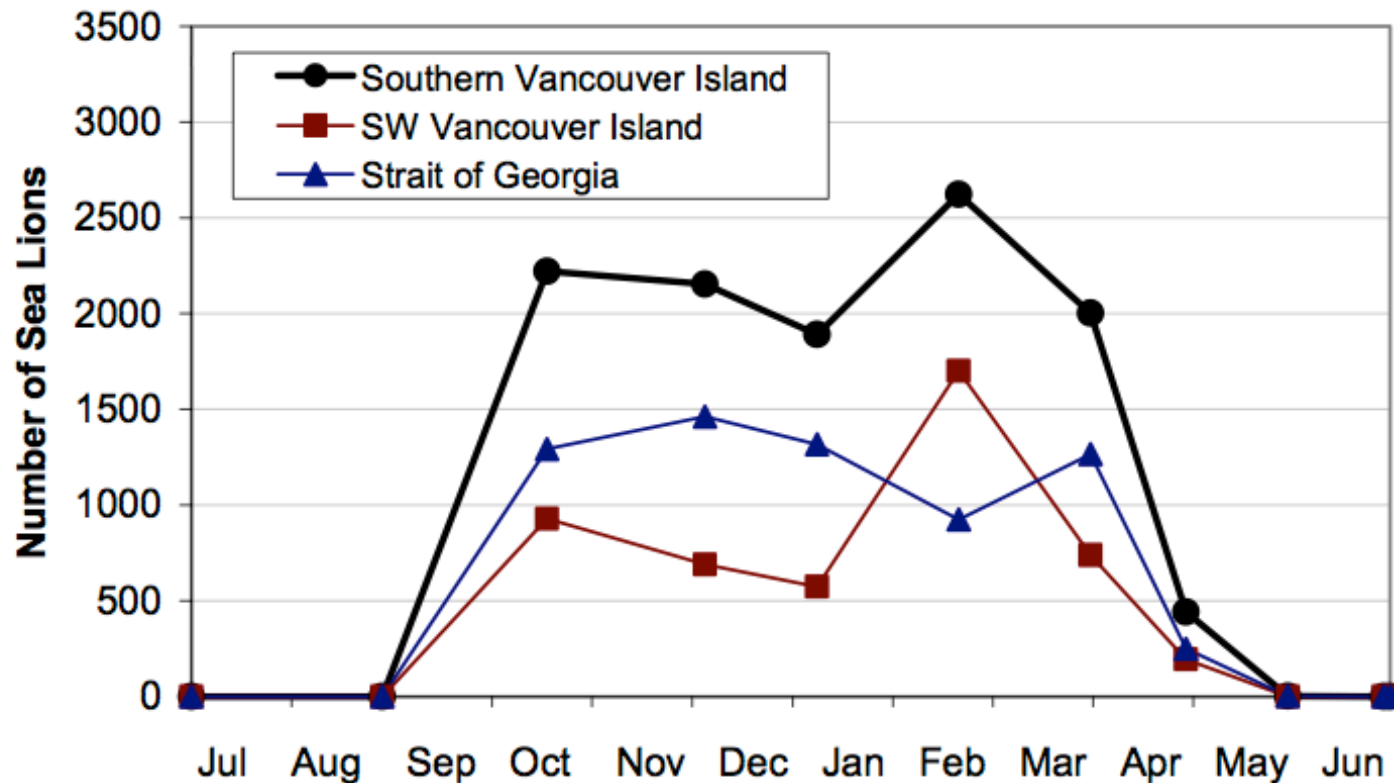
Wintering haul out sites for California sea lions



Olesiuk, P.F. 2004. Status of sea lions (*Eumetopias jubatus* and *Zalophus californianus*) wintering off southern Vancouver Island. Nat'l Marine Mammal Peer Review Committee Working Paper.

California sea lion abundance and distribution

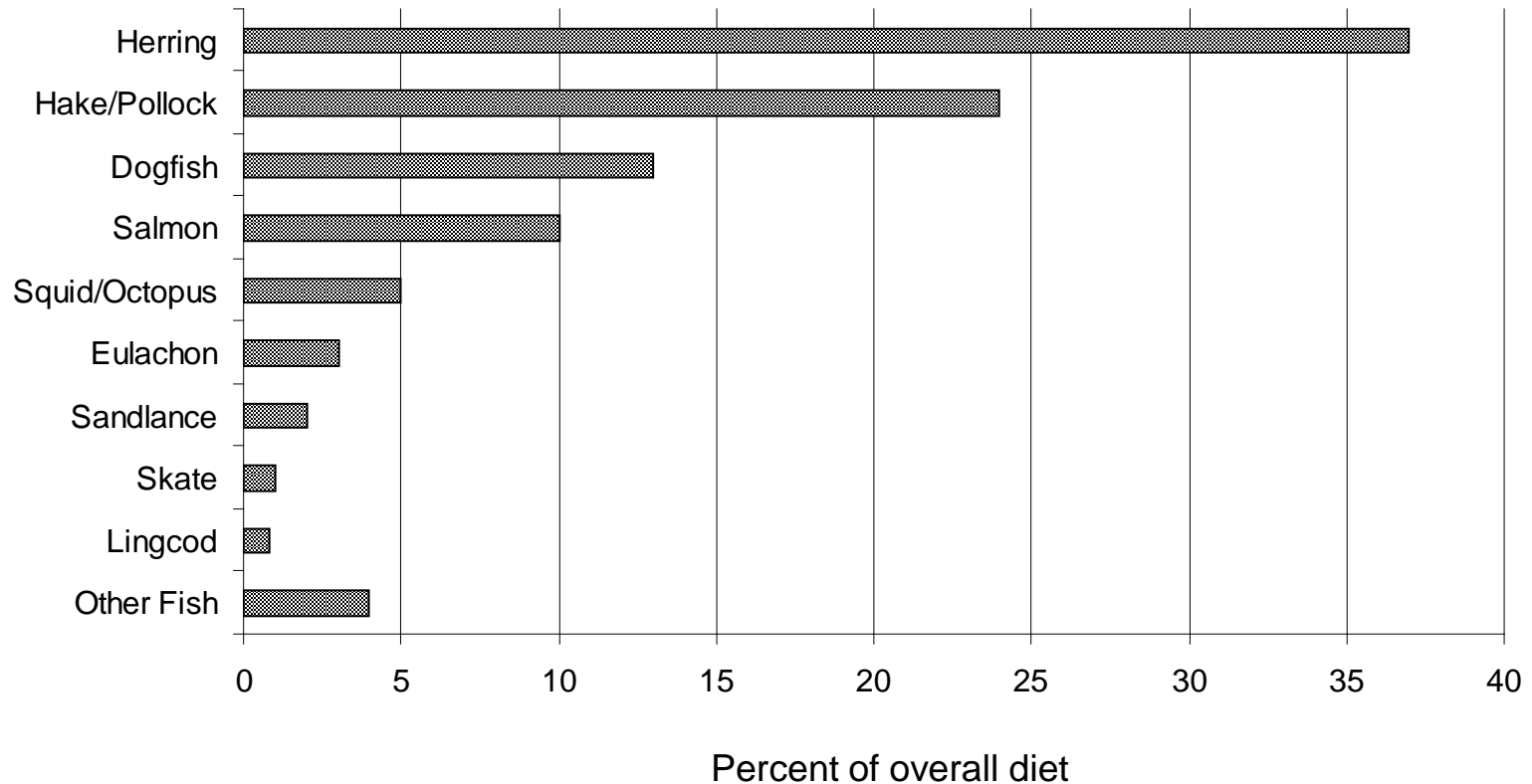
Abundance of California sea lions, 1984-85



Olesiuk, P.F. 2004. Status of sea lions (*Eumetopias jubatus* and *Zalophus californianus*) wintering off southern Vancouver Island. Nat'l Marine Mammal Peer Review Committee Working Paper.

Diet: California sea lions in winter

Diet composition of sea lions wintering off southern Vancouver Island



Conclusion: California sea lion

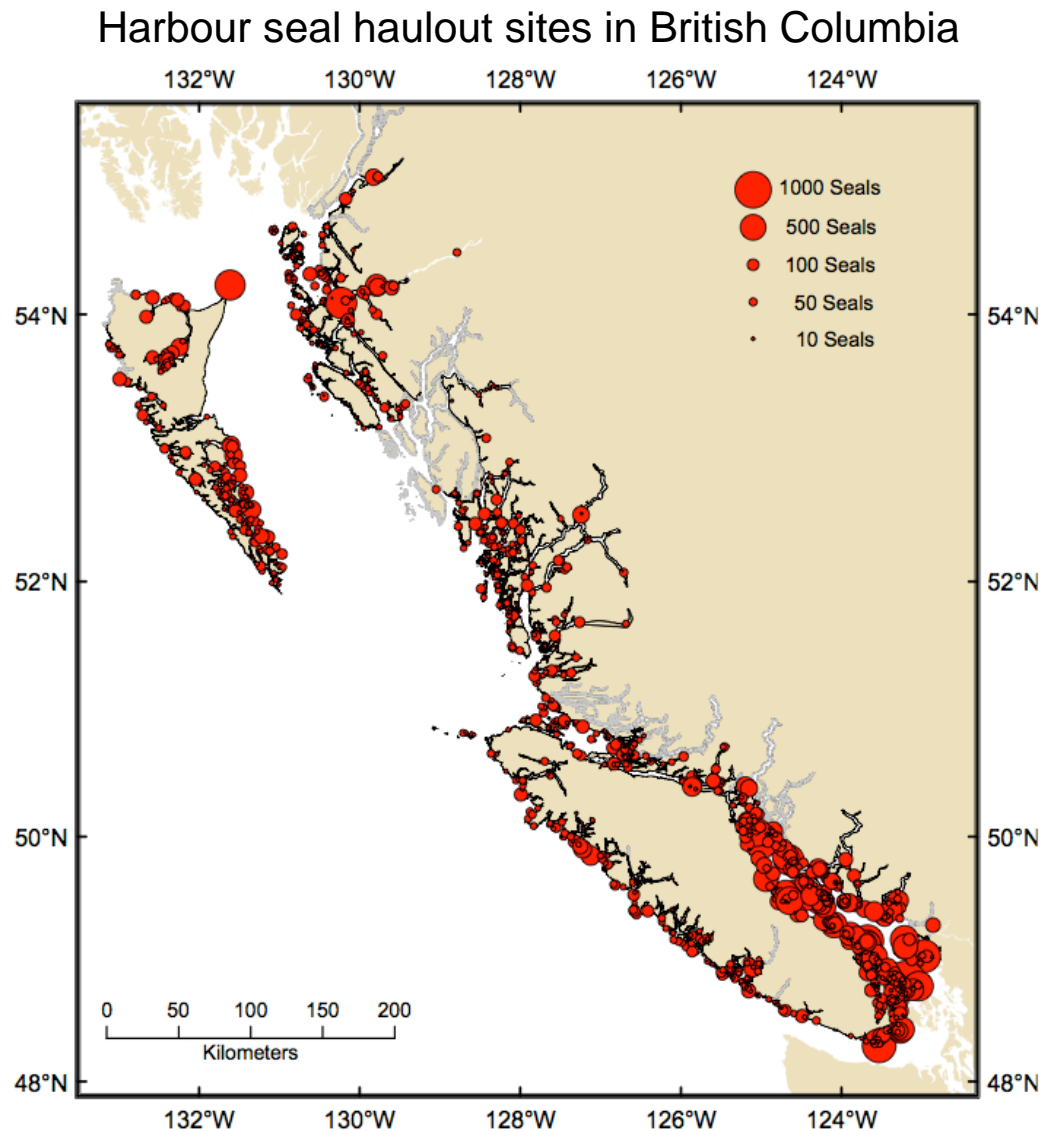
- Very few California sea lions (or Steller sea lions) are present in Strait of Georgia during period of out-migration of sockeye smolts or return migration of adults
- Predation by California sea lions unlikely to have played role in Fraser sockeye declines

Harbour seal

Phoca vitulina

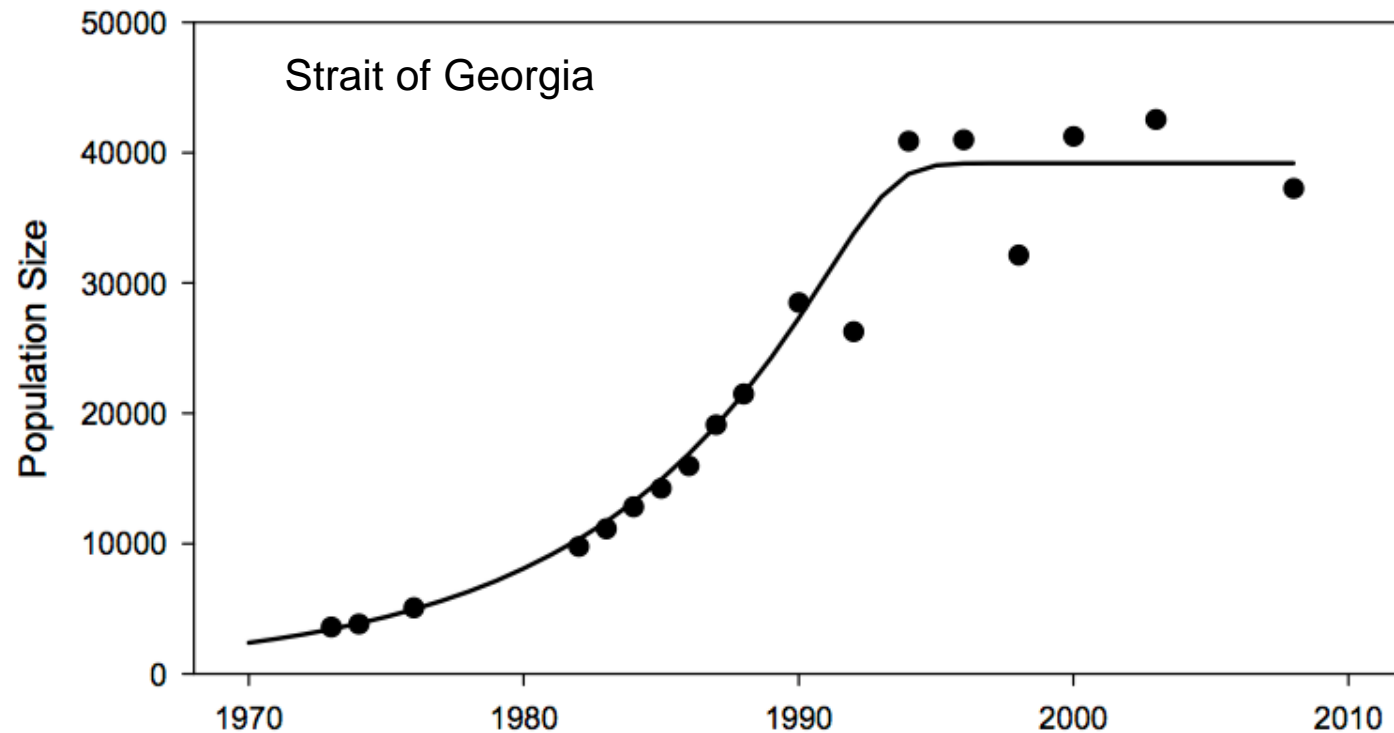


Distribution: Harbour seal



Status: Harbour seal

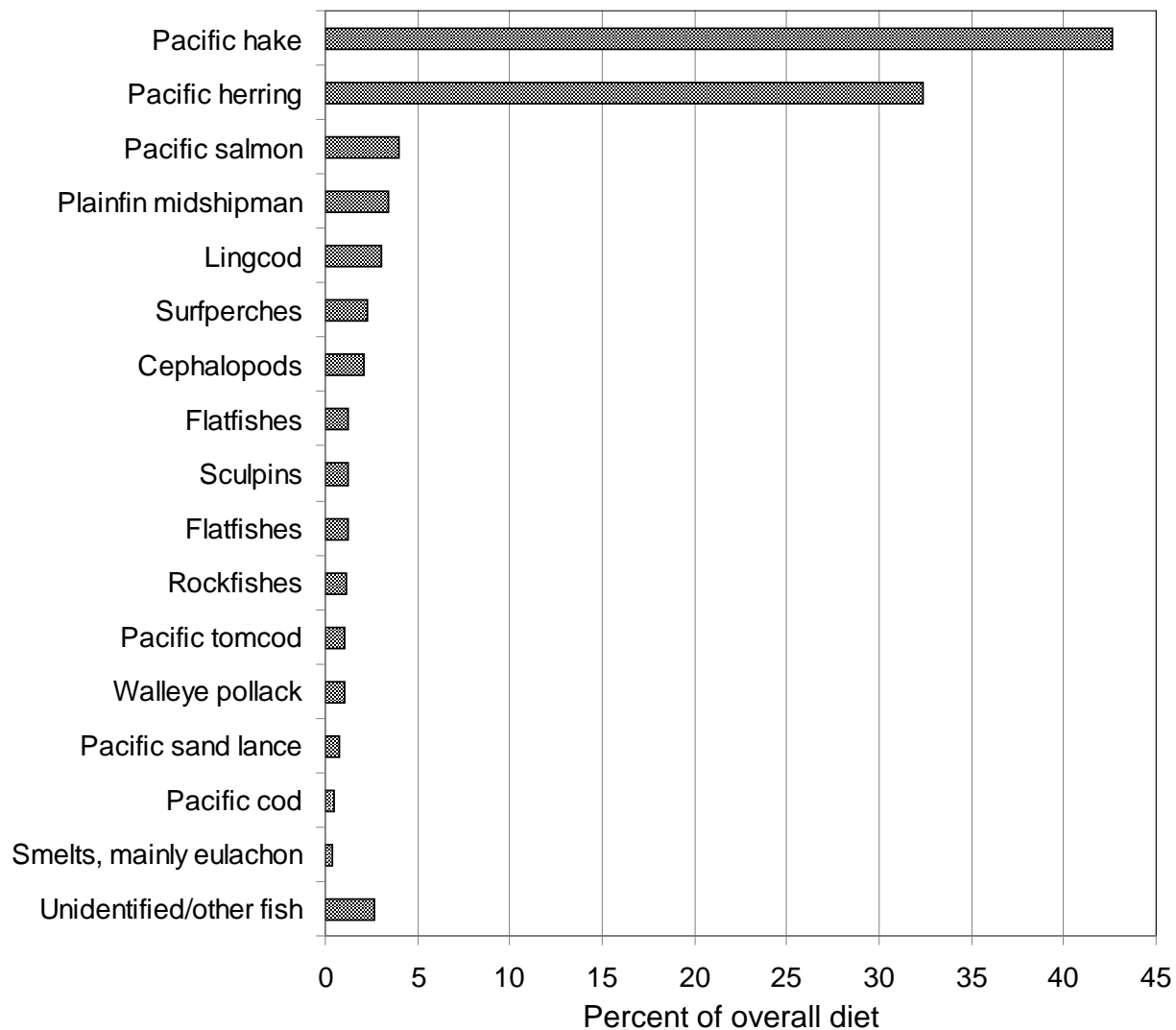
- Population severely depleted by control programs and harvest, ended in 1970
- Abundance increased 10-fold since early 1970s
- Increased at 11.5% per year before stabilizing in 1990s
- Current abundance: ca. 40,000 Strait of Georgia, 105,000 BC coast



Diet: Harbour seal

Average prey composition for harbour seals, Strait of Georgia

(n = 2,841 scat samples, collected 1982-88)

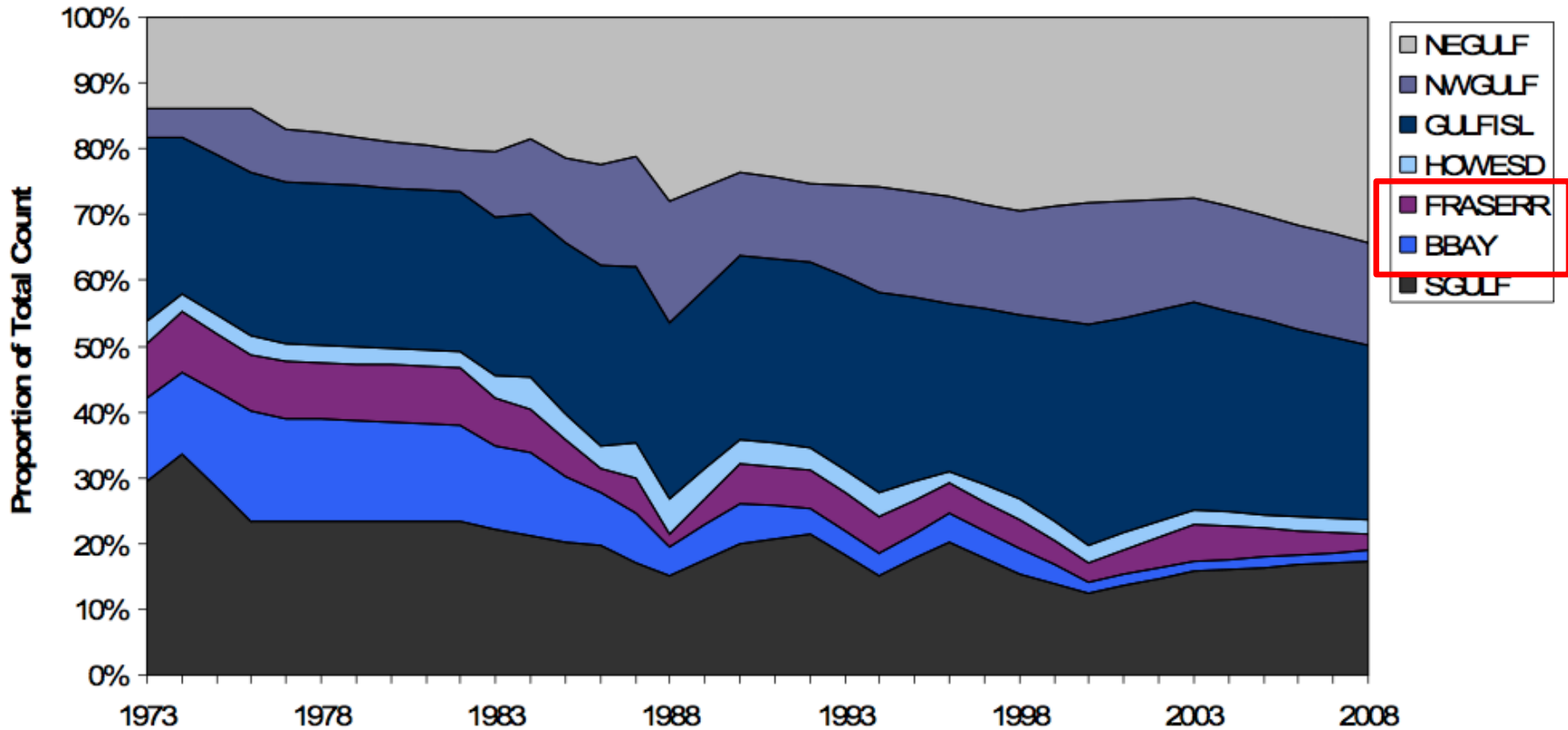


Diet: Harbour seal

- Salmonid predation is more significant (up to 65% of diet) in estuaries during late summer and fall
- Harbour seal predation can be major source of mortality for returning adults in some estuaries (e.g., Puntledge River)
- This is likely only a problem in cases where:
 - run size is small
 - habitat modification increases vulnerability of salmon
- Extensive predation on out-migrating smolts and fry appears to be restricted to artificial situations

Status: Harbour seal

Relative regional abundance, Str of Georgia



Conclusion: Harbour seal

- Given stable population abundance over last 15 years, apparently declining abundance in Fraser River estuary, and apparently minor role of salmonids in diet, harbour seal unlikely to have had significant role in recent sockeye declines
- Research needs:
 - Field studies to determine current diet composition of harbour seals in Strait of Georgia as well as coast wide

Overall conclusions:

- Of 31 marine mammal species in region, only Steller sea lions and Pacific white-sided dolphins appear to be potentially significant predators of sockeye salmon
- Increasing abundance of Steller sea lions has resulted in greater predation rates generally, though impact on sockeye unknown
- Potential increased predation by Steller sea lions may be contributing factor in long term declines of sockeye, but unlikely to be an important contributor to poor returns in 2009
- Lack of data on abundance trends and diet of Pacific white-sided dolphins precludes assessment of potential role in Fraser sockeye declines

Research needs:

- Additional data are needed on current abundance, distribution and seasonal diets of piscivorous marine mammals throughout coastal waters, especially on proportions of different salmonid species
- Diet information should be incorporated into bioenergetic models to estimate consumption rates for each species

