GAP and related GOA studies:

An ecosystem-based approach to addressing Steller sea lion declines

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Steller Sea Lion Mitigation Committee Meeting Seattle WA
28 August 2006

Aleutians East Borough

KODIAK, ALASKA

MARINE ADVISORY PROGRAM

GAP

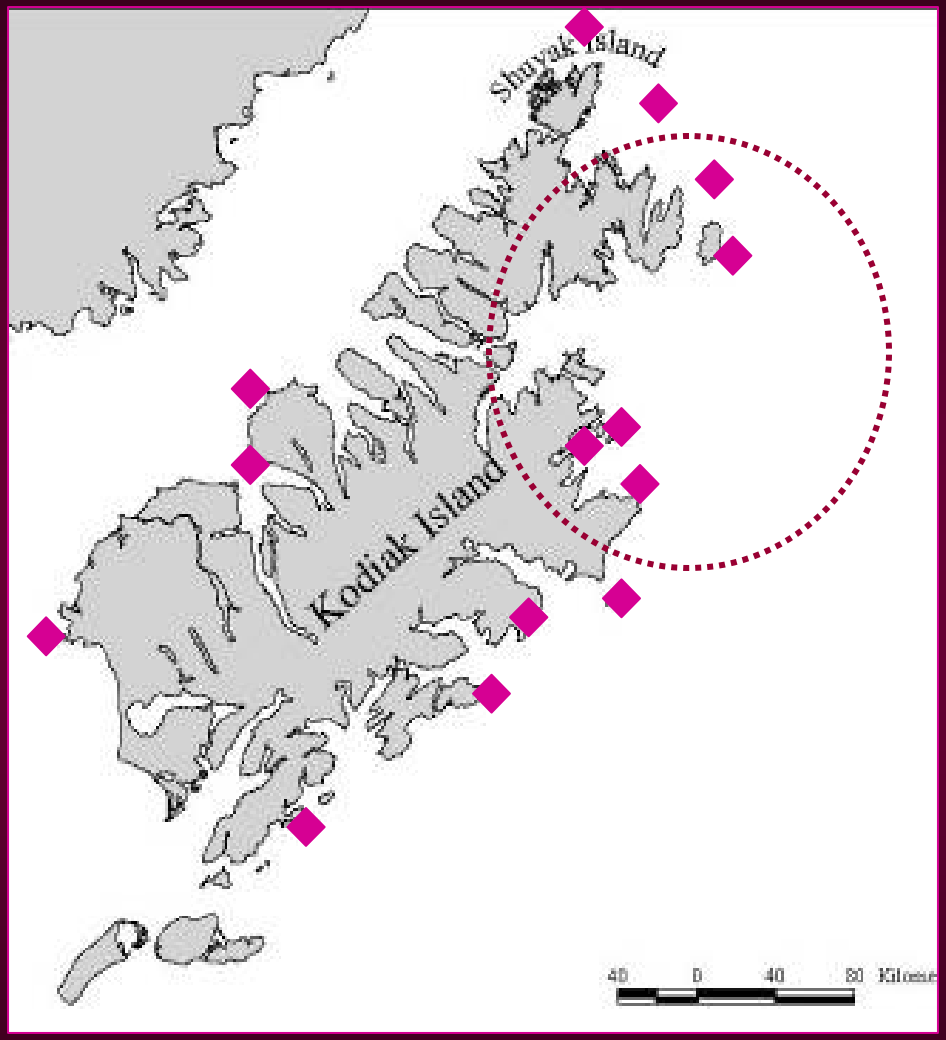
Gulf Apex Predator-prey Program

PIs: Kate Wynne, Bob Foy, Loren Buck

University of Alaska Fairbanks SFOS • Kodiak

- **Multi-year, integrated studies of apex predators, their prey, and marine environment in Kodiak region (2000 to present)**
- **Synchronized multi-species assessment of abundance, distribution, dietary overlap, and productivity**
- **Long-term monitor of seasonal and inter-annual variability in trophic interactions, dynamics and energy flow in near-coastal system**

Studies of
Steller sea lions,
their prey,
predators,
competitors,
and
the environment
in which they live



GAP
Focus

Tufted puffins, black-legged kittiwakes, glaucous-wing gulls

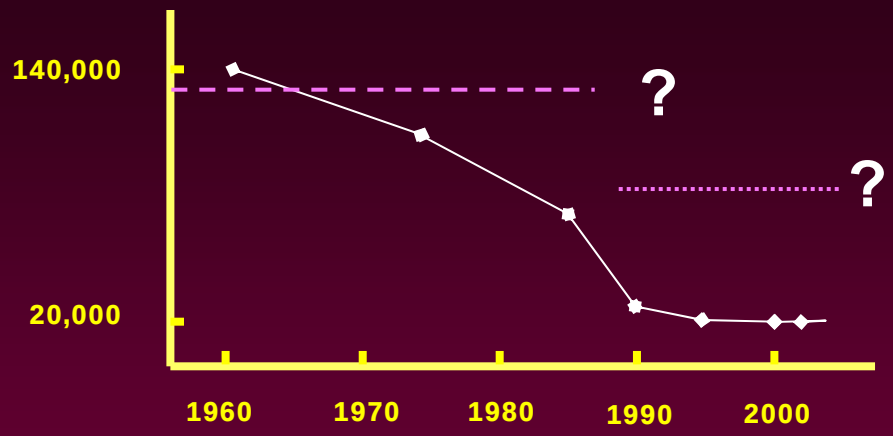
Walleye pollock, Arrowtooth flounder, Pacific cod, halibut, salmon, skates

Steller sea lions, harbor seals, whales

www.sfos.uaf.edu/gap

Coordinated Steller sea lion research effort

- Aleutians East Borough
- NMML
- ADFG
- Craig Matkin, NGOS
- Andrew Trites, et al. NPUMMC



Prey limitation ?

Reduced prey quantity, quality, or availability

- natural changes
- human competition
- non-human competition

Directly Gathering

Baseline SSL Information

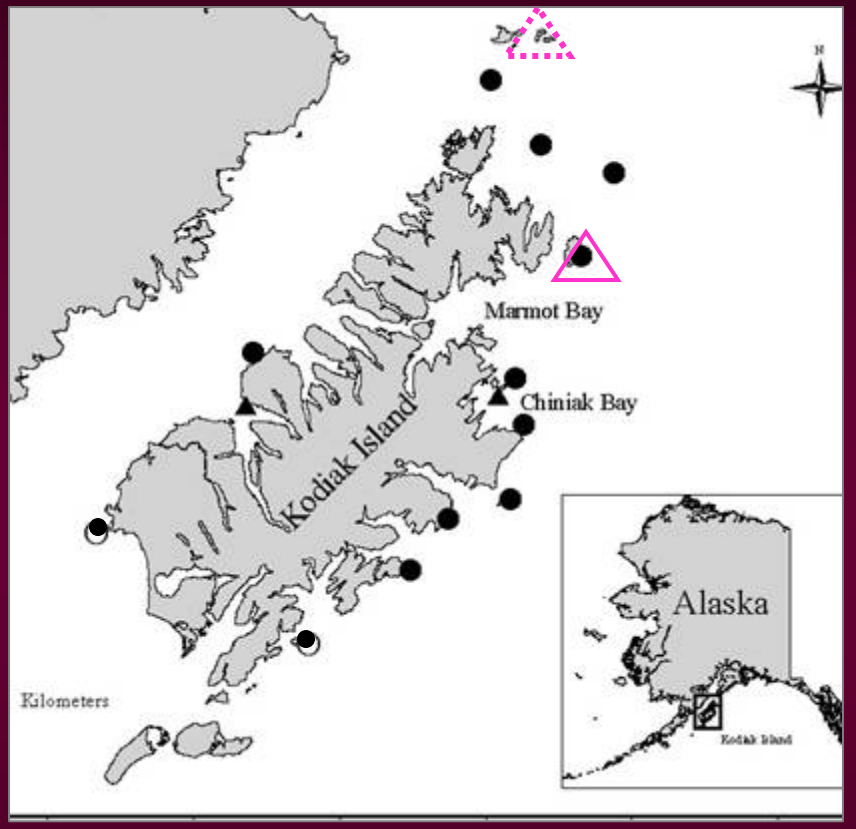
- Diet, distribution, population trend
- Terrestrial habitat use and movements
- Life History

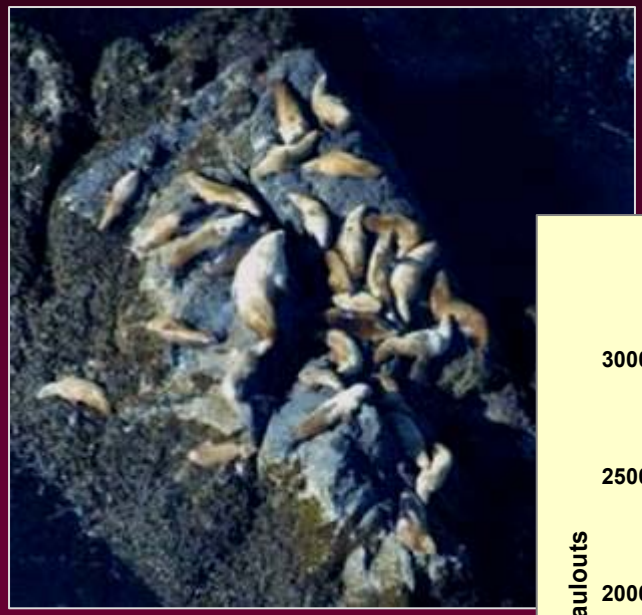
Indirectly Addressing

- Trophic-level interactions
- Environmental Variability
- Predation

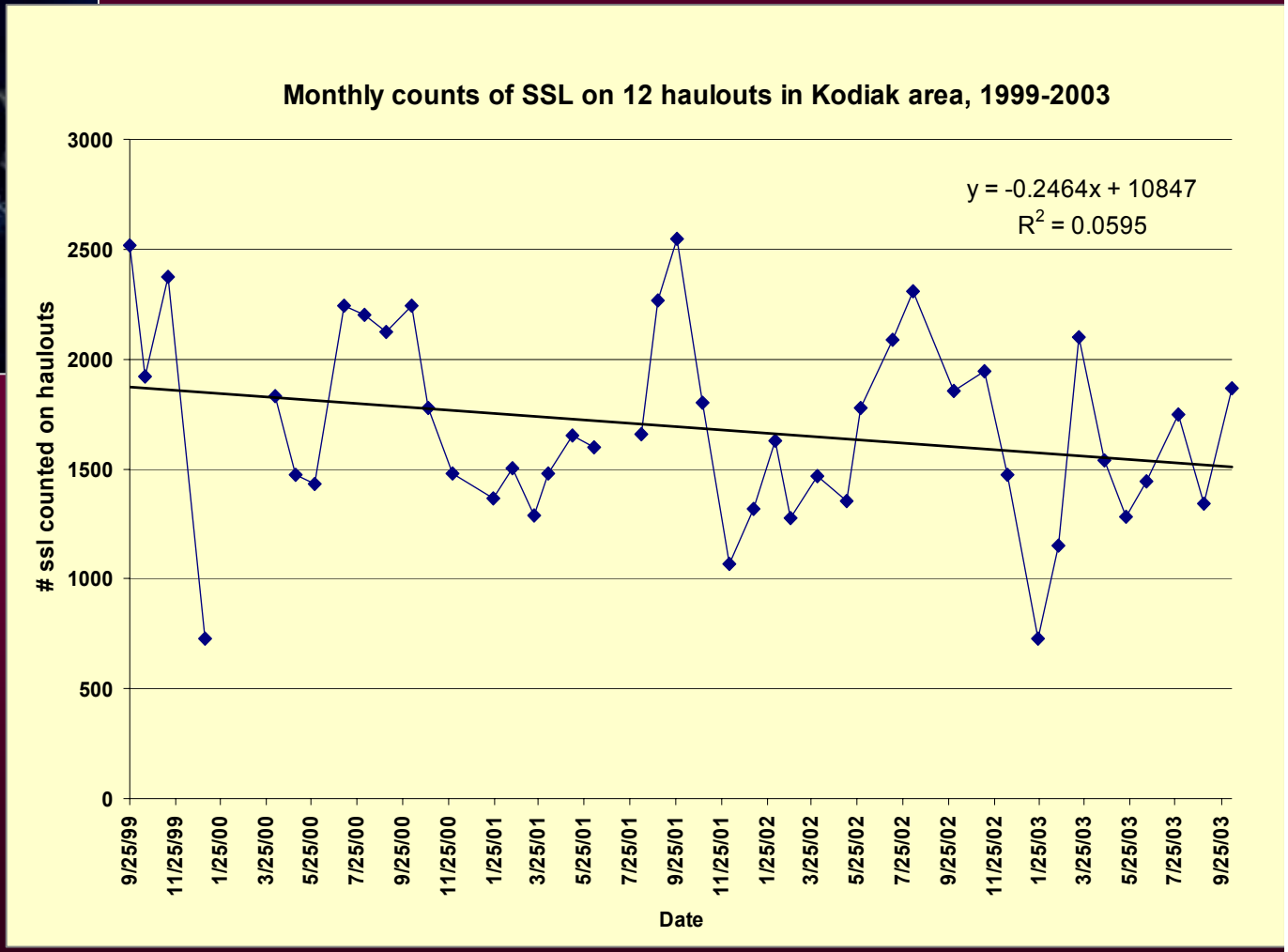
SSL population trend and distribution

Repeated aerial survey of critical seasonal and yr-round haulouts



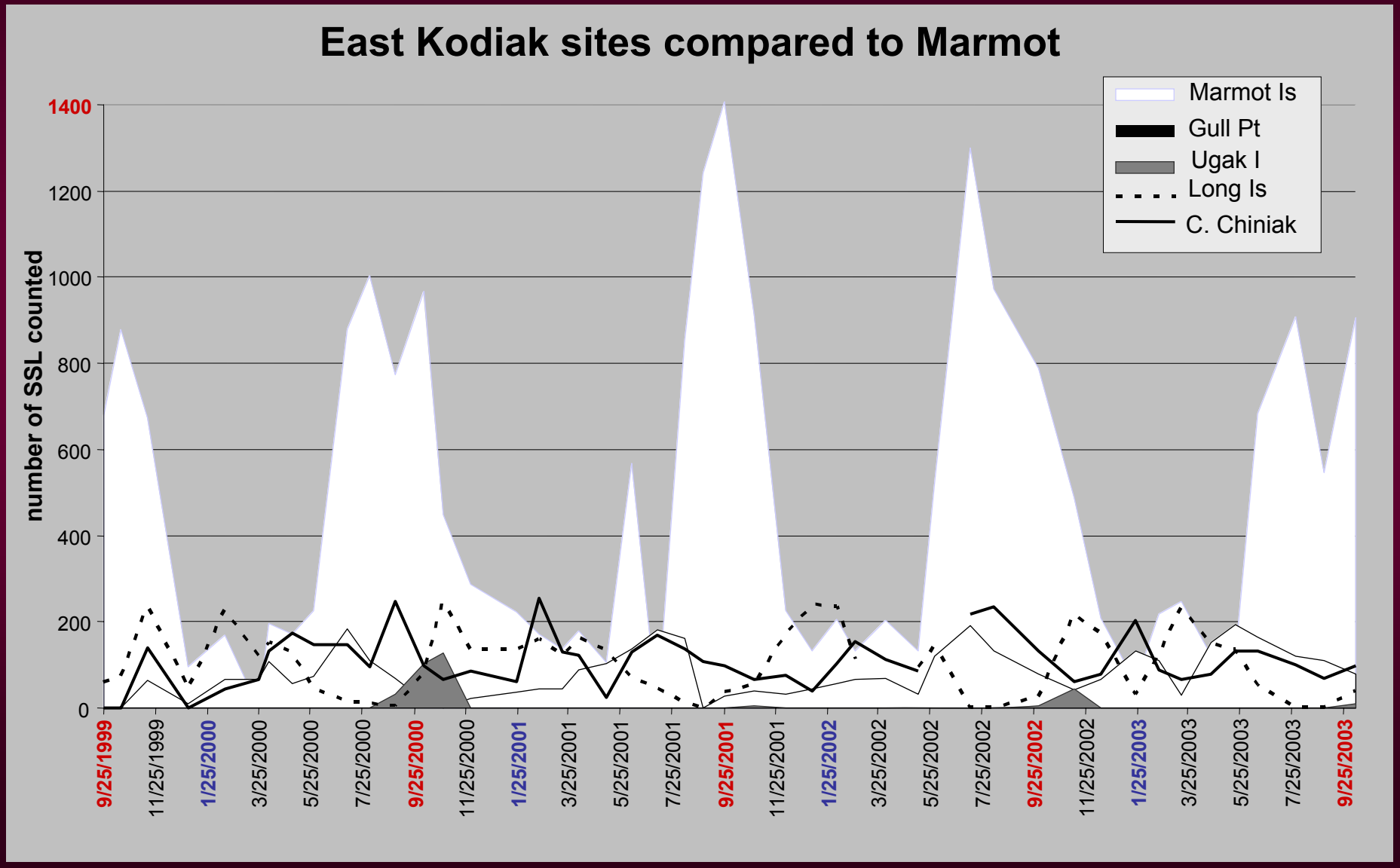


Regional counts and trend in number Kodiak Archipelago

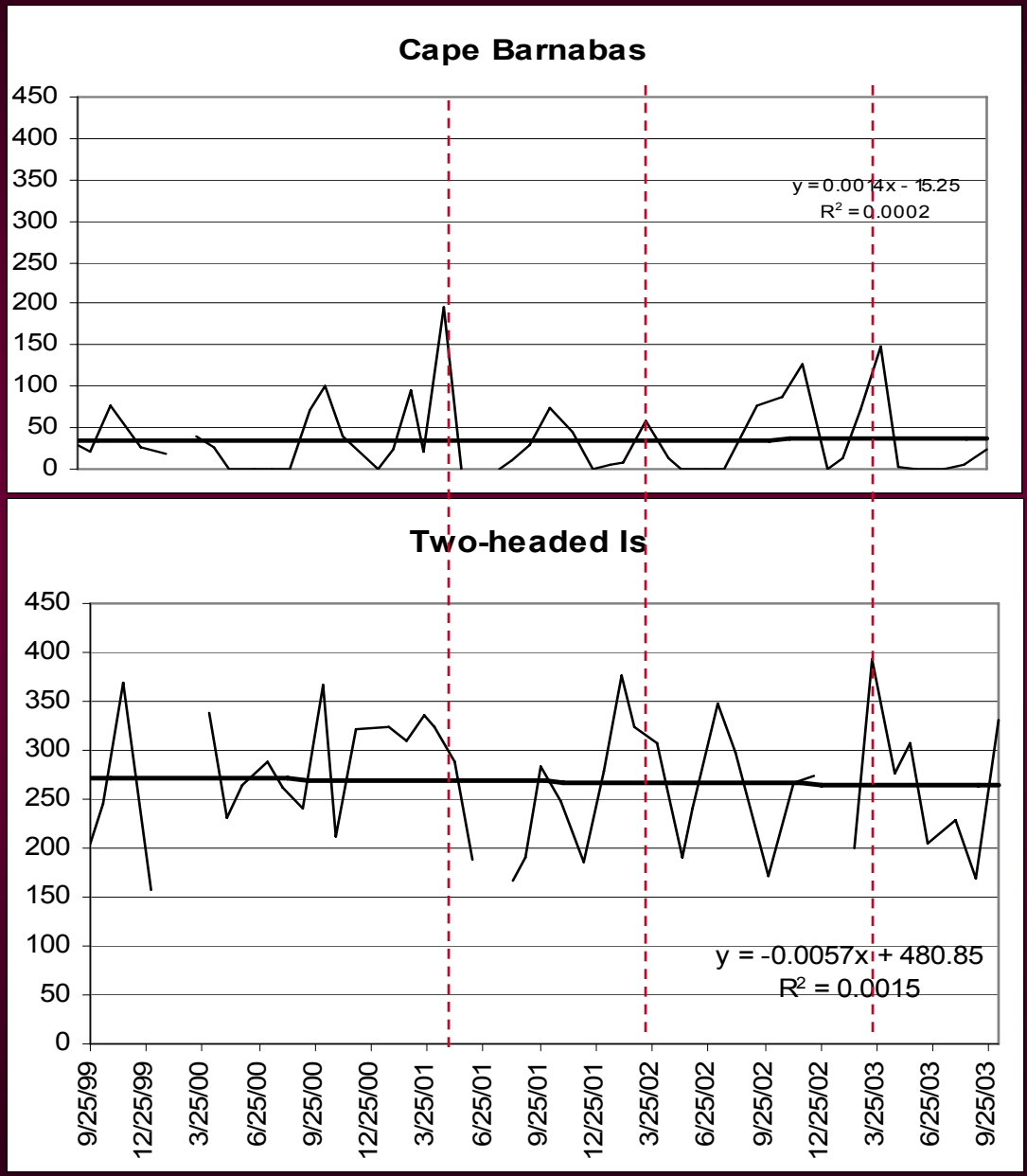


Sept 1999- Sept 2003

Rookery *vs* Haulout



Site-specific trends in number and location



Why seasonally variable ?

- Site structure
  - slope/exposure for pup development
  - shelter from rockslides, wx
  - reproductive activity and recovery
- Weather effects on haulout pattern
- Prior disturbance

Marmot winter haulout
Cave Cove

And / or

Distribution and # hauling out are related to **PREY AVAILABILITY**

- Opportunistically utilize seasonal prey aggregations
- Meet specific needs of weaning pups (shallow, nearshore) and repro females (close to pups)
- Ongoing GAP effort and goal to link SSL distribution with diet and prey availability data

Steller sea lions in the Shumagin Islands

Understanding diets….

- Scats
- Limitations
- Utility
- Working with others
  - DNA, FA, stable isotopes

Kodiak SSL Diet

1999-2006 n= ± 3200

Prey Species IDed

Arrowtooth flouunder (ATF)
P.cod
Pollock
Sandlance
Salmonid
Irish lords + sculpins
Soles
Halibut
Other flats (starry fldr)
Snailfish
Cephalopod
Capelin
Herring

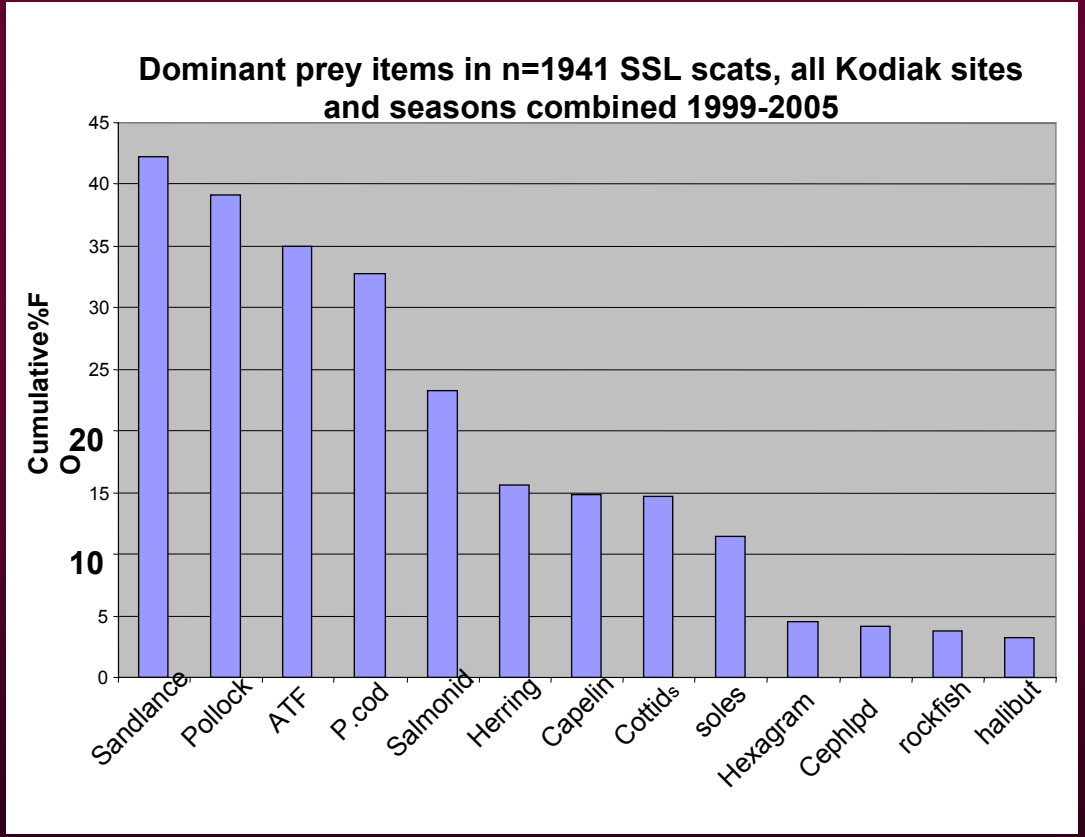
Sandfish
Skates
Eulachon
Rockfish
Greenling
Gunnels
Atka mackerel
Pricklebacks
Sticklebacks
Ronquil
Tubesnout

Unid gadid
Sablefish
Tomcod
Cockscomb
Eelpout
Smooth lumpsucker
Dogfish
Poacher
UnID fish
polychaete
searcher
myctophid
rainbow smelt

Diet diversity

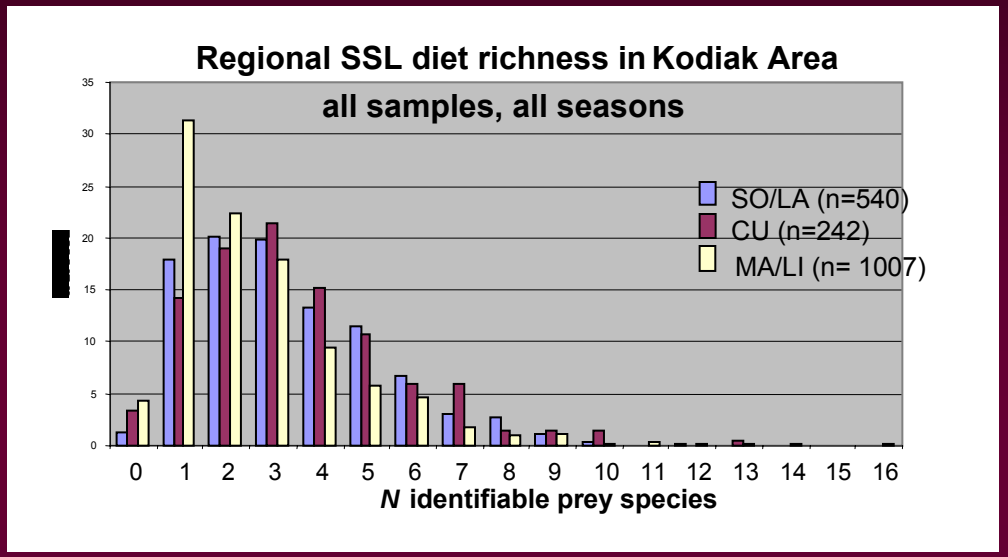
Diverse diet: overall 9 sps in >10% of scats, 5 in >20% of scats

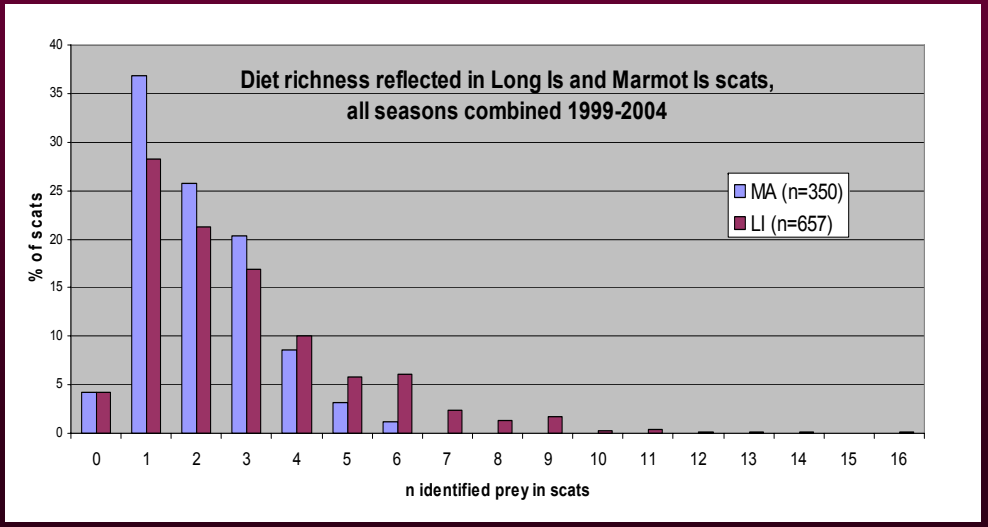
- diverse diet is a good thing (Merrick 1997)
- mix of seasonal aggregations, resident base of cottids, hexigrammids
- broad suite of availability: meet variable skill levels at dive depths, seasonal

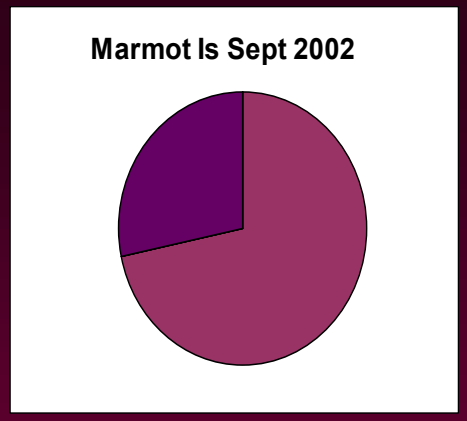


Dietary Richness

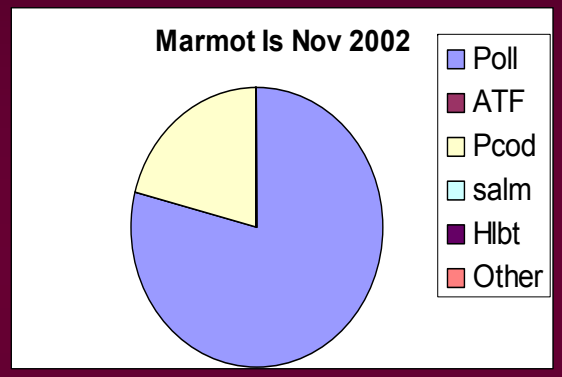
- 0 - 16 different prey items identified in individual scats
- Assume reflection of prey consumed within a few days
- Assume scats with only one identifiable prey = focused use

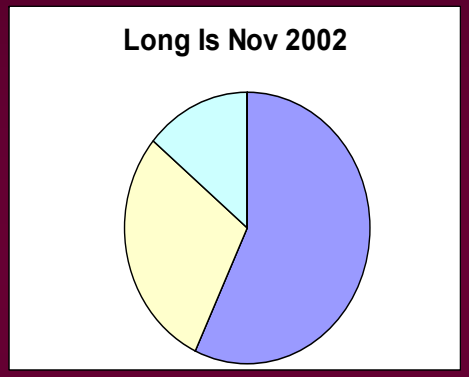






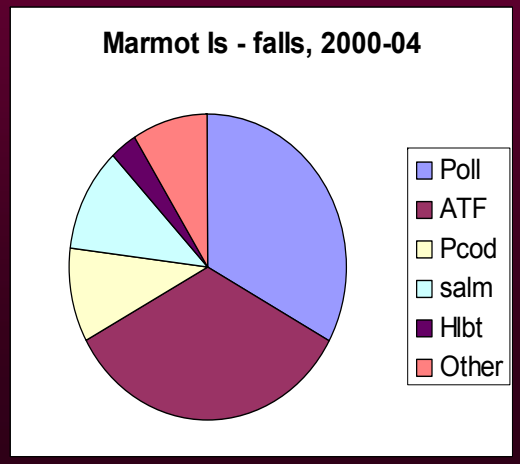
2002 samples only

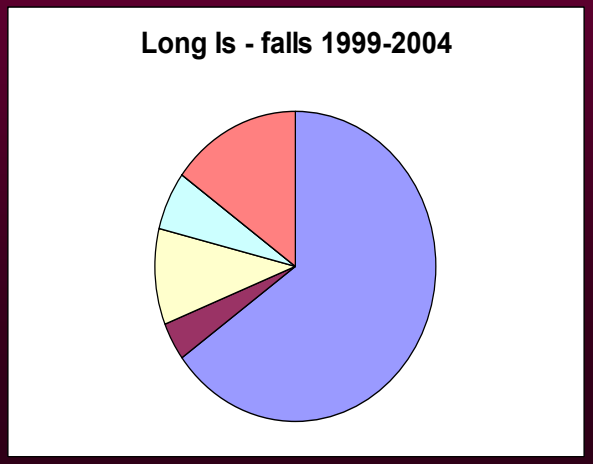




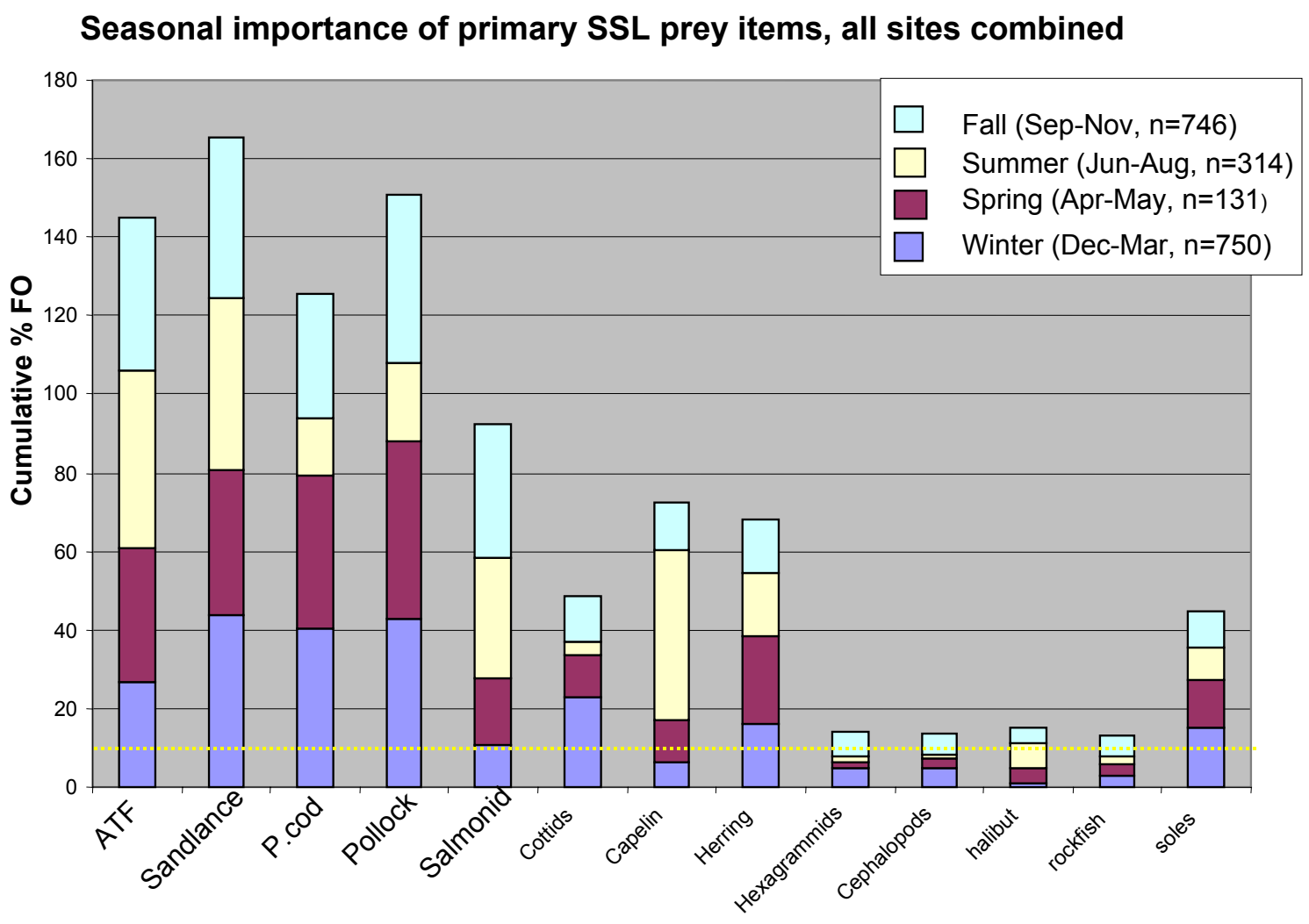
When a single prey species was recovered from scats, the prey was …

All fall samples combined

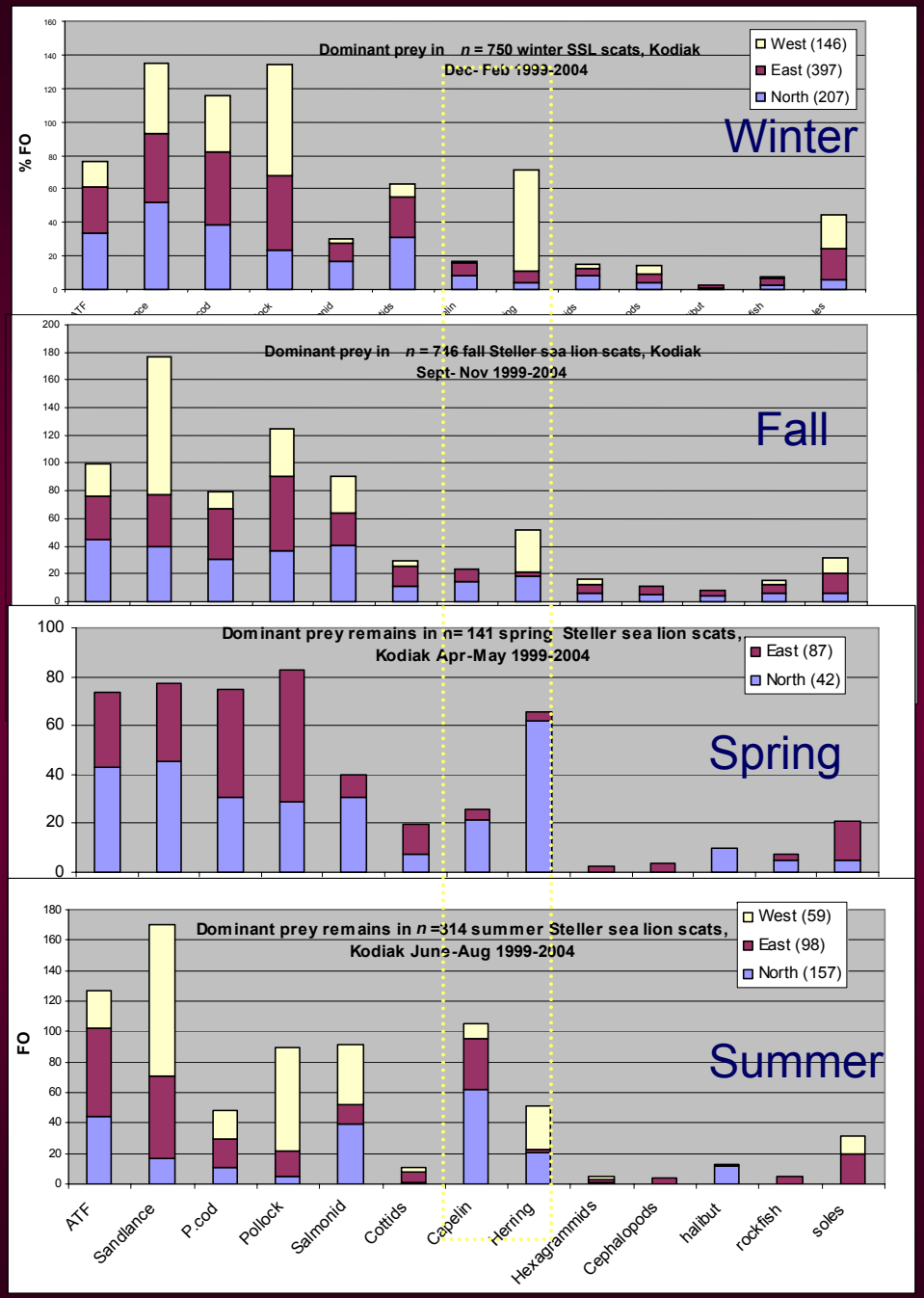


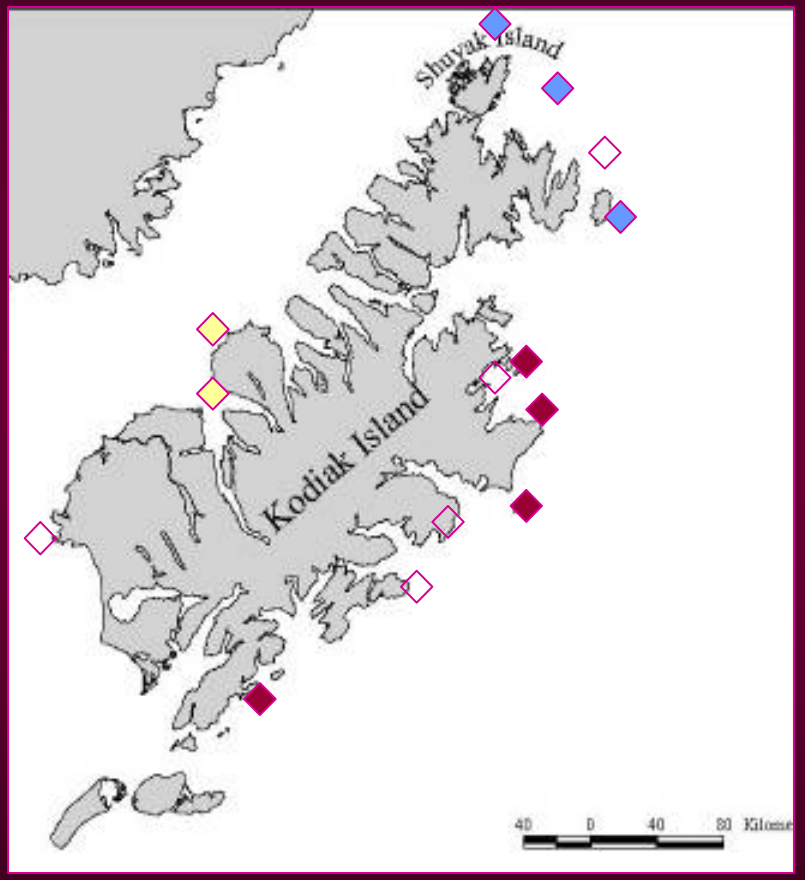


Seasonal variability



Regional Variability





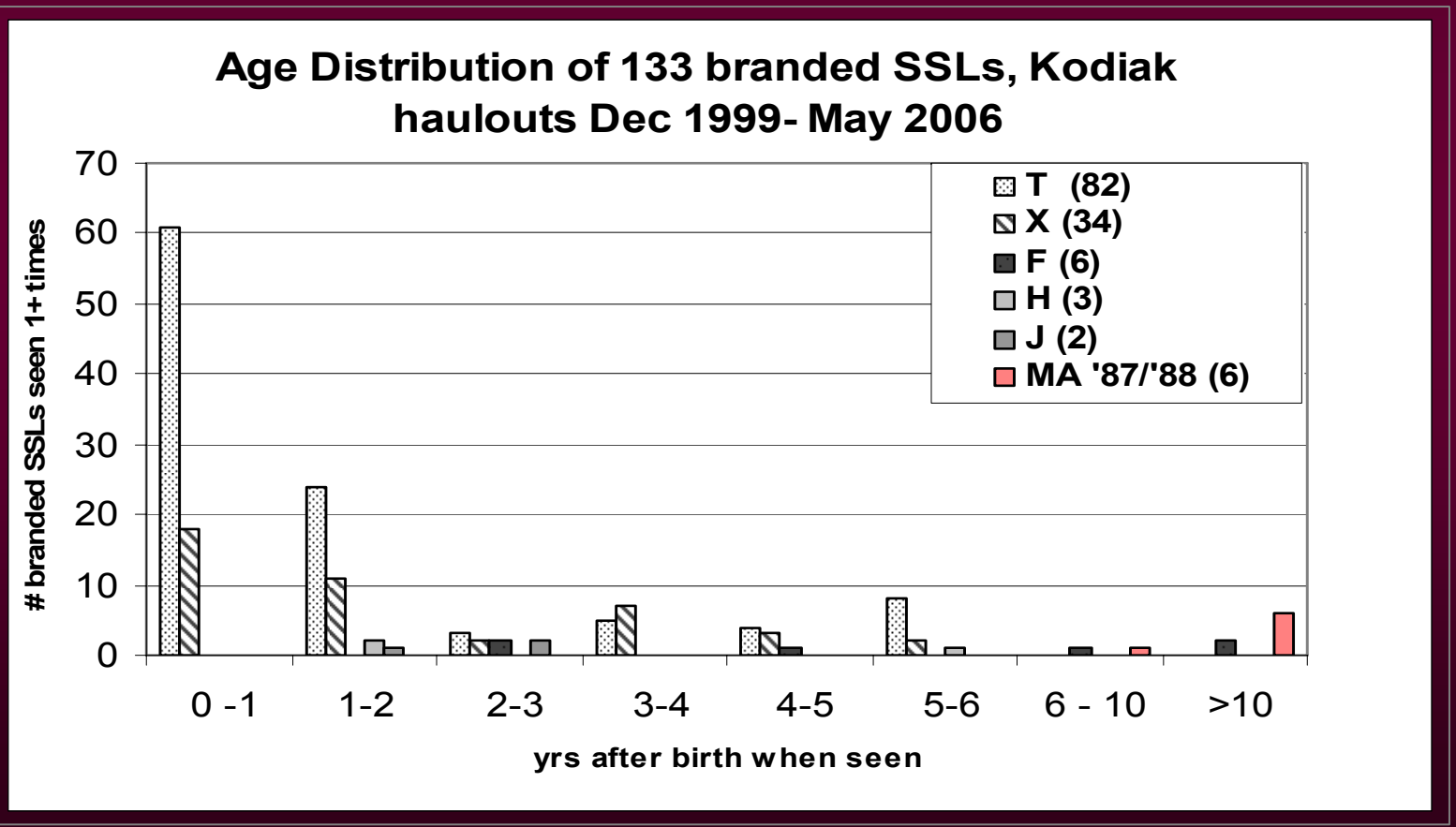
So what?

- Variability and diversity => opportunists
- We can't YET comment on
  - physiological implications or energetic expense (where they got meal, age/sex)
  - biomass consumption from scats
- But can identify relative importance of species and seek patterns in variability
- Despite high diversity, area of slowest recovery……so, is it food?

Brand Resighting

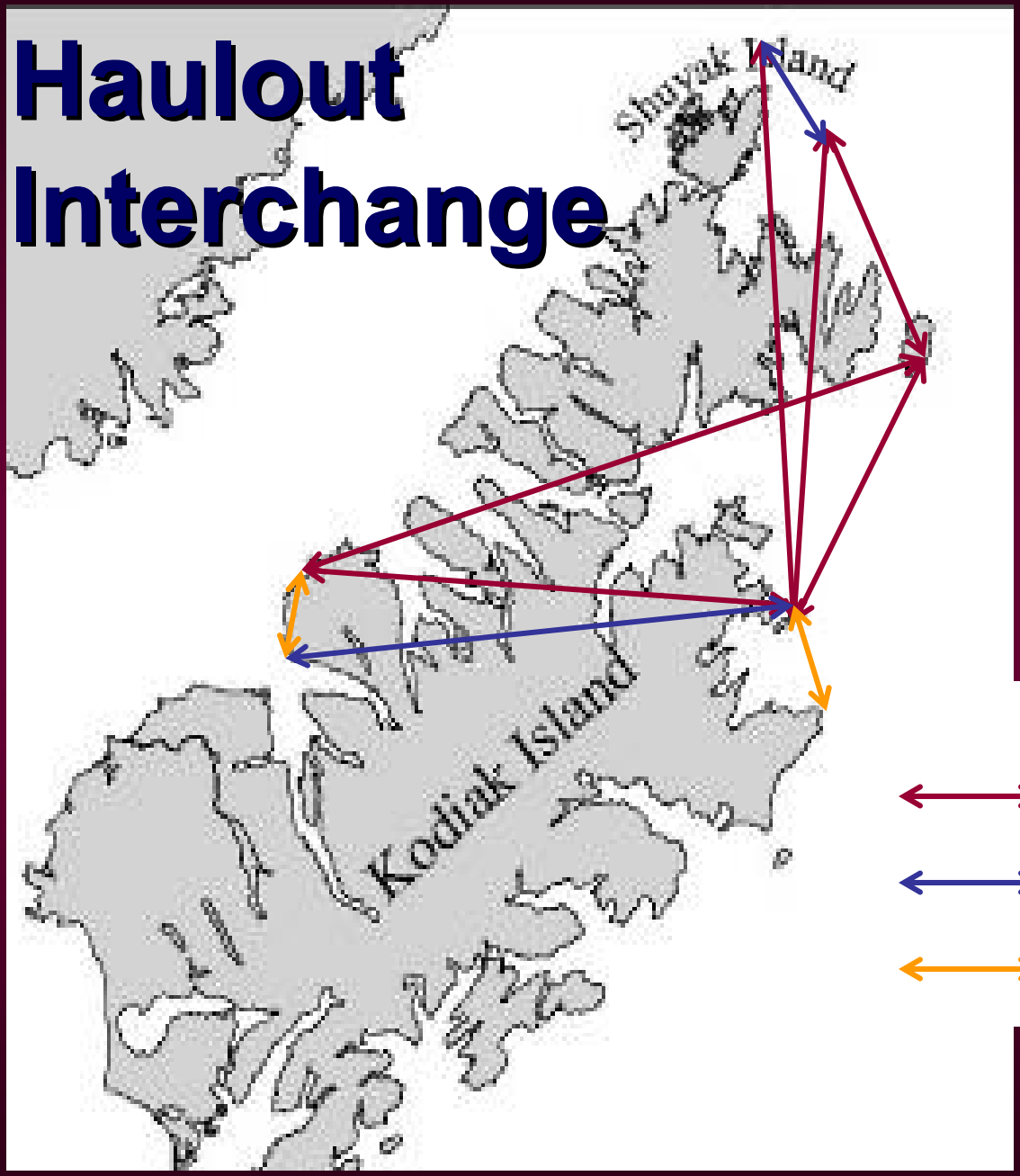
Brand resightings

n= 300 sightings of 133 branded SSLs



Sea lion movements, survival, and productivity (NMML)

Haulout Interchange



Marmot (T) Brands (11)

Sugarloaf (X) Brands (7)

Both T and X Brands (3)

H 193

2001	Born, branded on Hazy Is.
2002	June SW Brothers, Juneau
2003	June near Sitka
2006	May, Long Is Kodiak

F 115

2003	Born, branded Lowrie Is.
2003-04	often, Lowrie Is
2005	May, Chiswells
2006	(April) Long Is Kodiak

84

1987	Born, branded Marmot Is.
Repeated mom, June Marmot rookery	
2005	Dec., Sea Otter Is, Kodiak
2006	Marmot Is, 19 yr old mom

Age at first reproduction ?

Born Marmot 2000

Nursing pup on Sea Otter Is. @ 5 yrs old

Age at weaning ?

Sympatric Piscivores

- Potential Steller sea lion competitors ?
- Indicators of environmental change ?
- Indicators of prey limitation ?

Potential Competitors

If …..share a LIMITED prey resource

Indicators of prey limitation ?

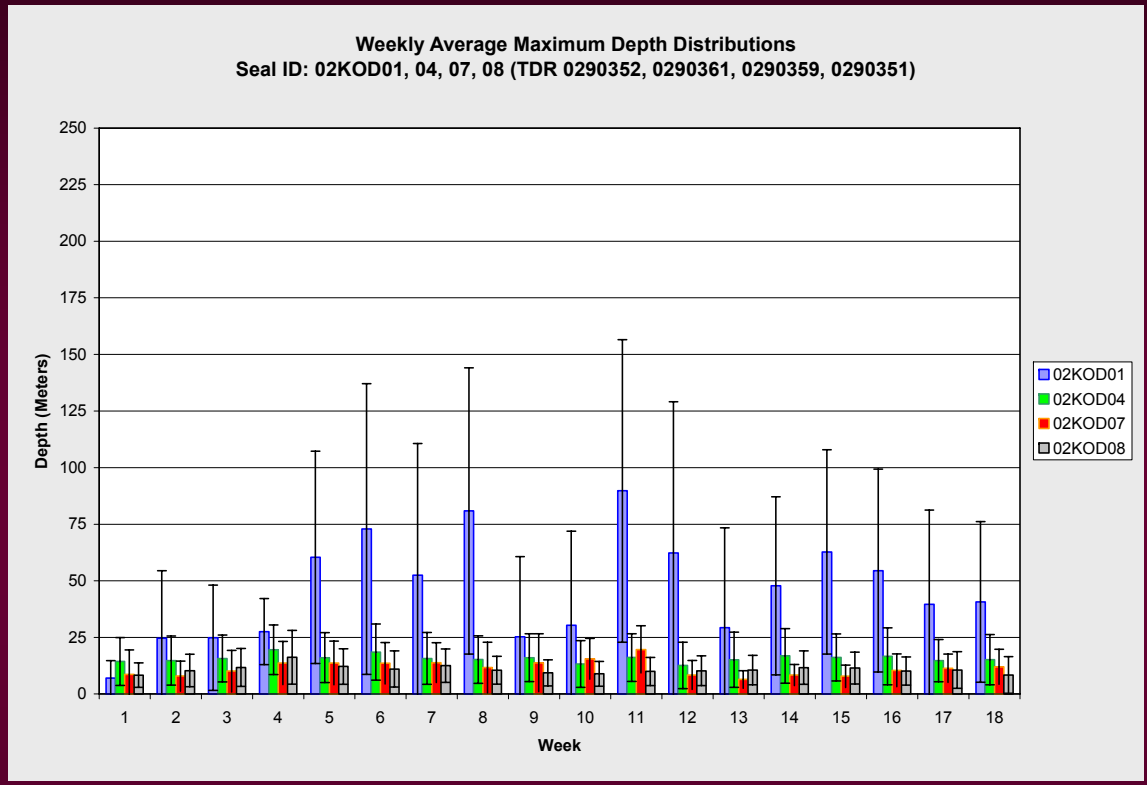
Differential population trajectories in piscivores with overlapping diets ?

Within species across GOA

Between sympatric species

Harbor seals

- ✓ Sympatric
- ✓ Overlapping dive depths
- ✓ Diet overlap

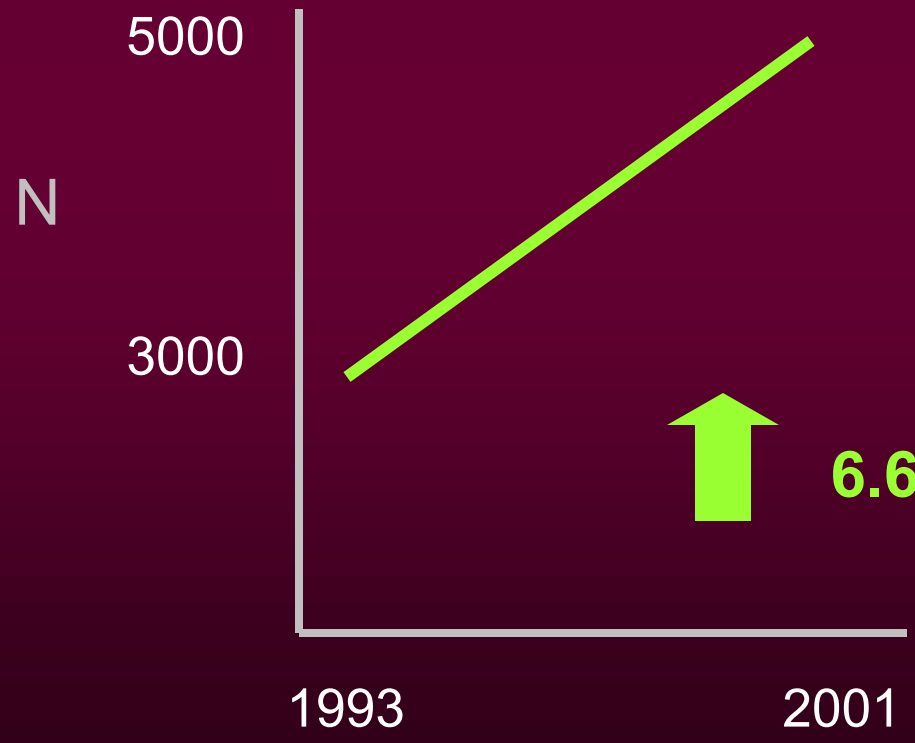


Tugidak 1990-99 (321 scats) *L. Jemison, ADFG*

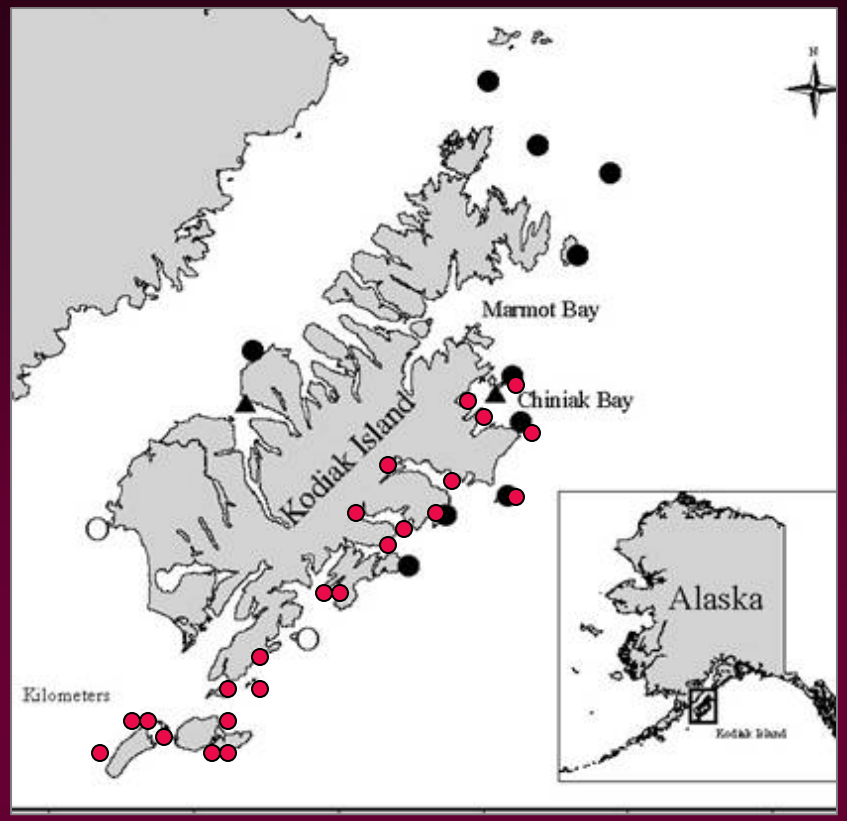
> 10%FO: arrowtooth flounder, soles, flats, pollock, P.cod, cottids, Irish Lord, sandlance, hexagrammids, salmon, cephalopods

But .....

Harbor seal population trend in Kodiak



6.6% per year

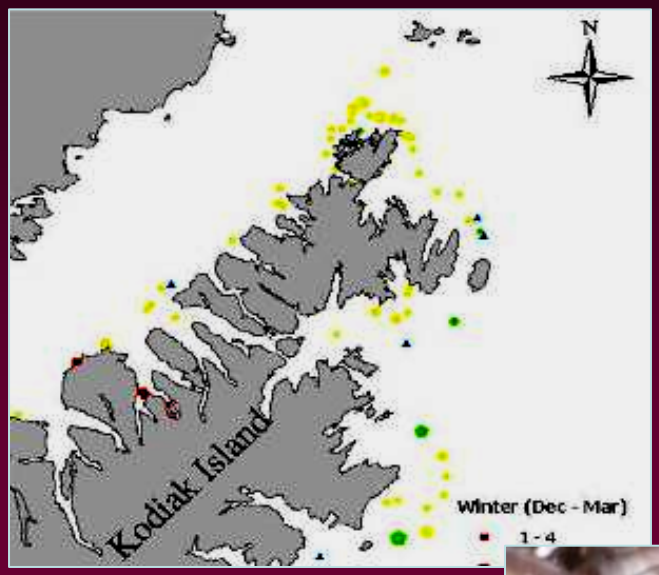


Piscivorous whales

Significant consumers throughout the GOA

Potential bottom-up cascade effects of whale harvest / recovery ?

Port Hobron : 1800 humpbacks harvested from nearshore Kodiak waters in 10 years, 1929 - 1942



Humpbacks

SSL

- 157 humpback whales in Kodiak in 2002 remove estimated 9,500 tons prey
- estimated 343 in 1920

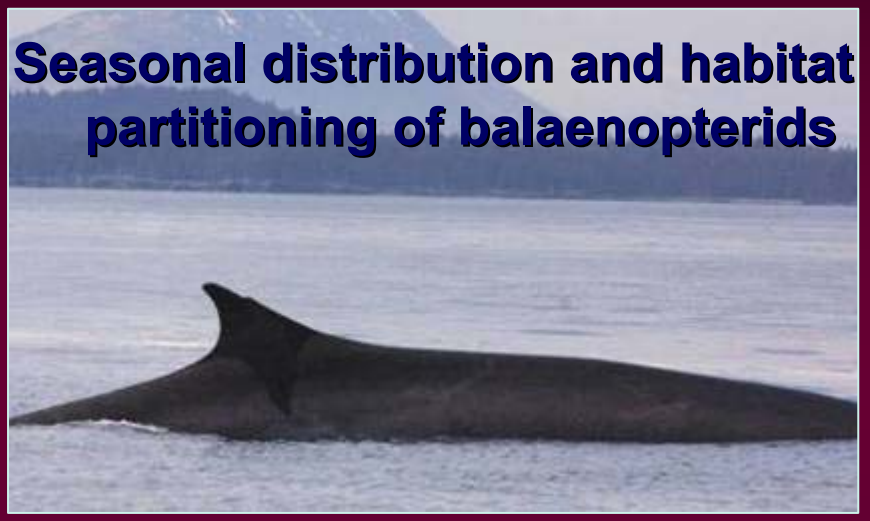
Prey overlap

Population ↑

Range overlap

Potential impact on sympatric Steller sea lions ?

GAP Whales

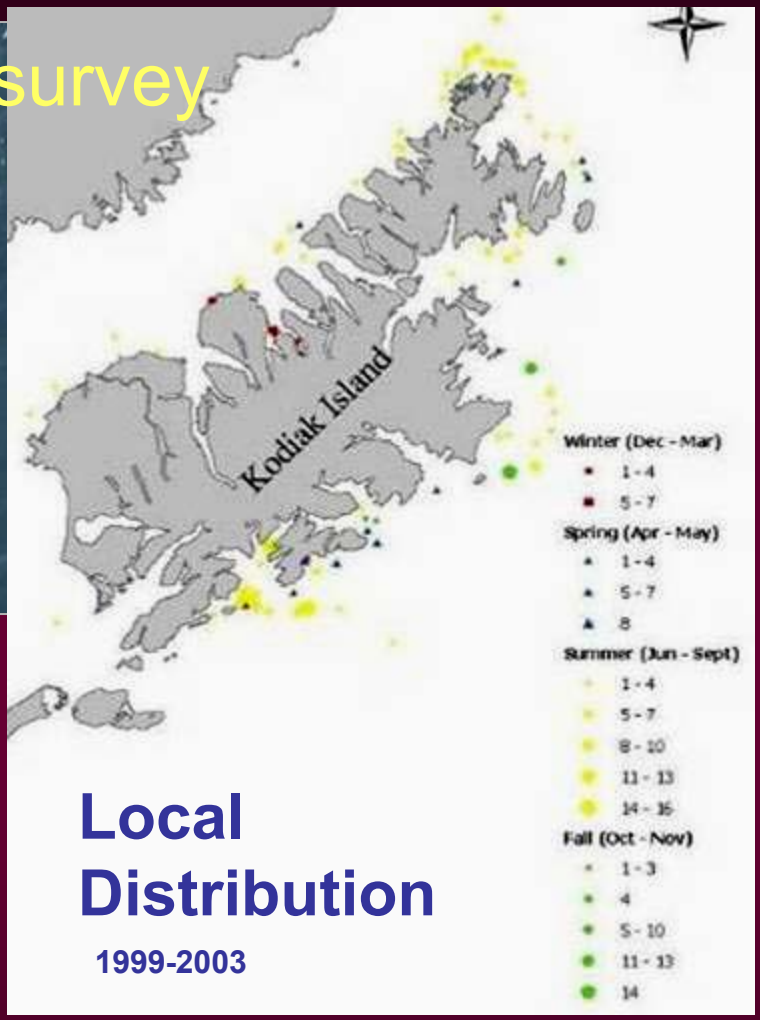


- Prey overlap ?
- Temporal and spatial foraging overlap
- Population trends ↑
- Seasonal abundance and distribution ?

Potential effect on Steller sea lion carrying capacity ?

Seasonal distribution via aerial survey

Abundance *via* Photo ID



Local Distribution

1999-2003

Stock assessment *via* skin biopsy

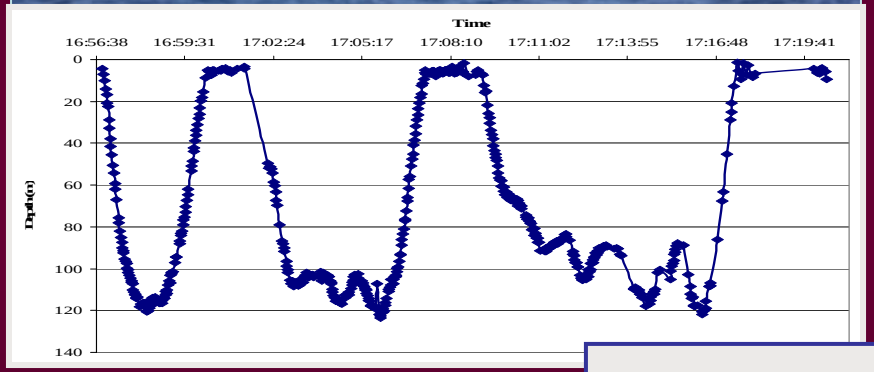
Humpback Diet ?

What do they eat?

Bottom-up effects of population change ?

Whale Tagging

Real-Time Sampling



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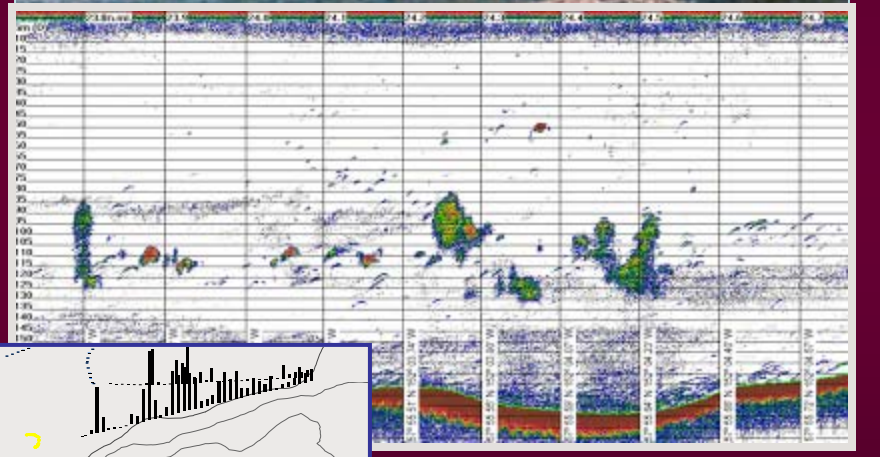
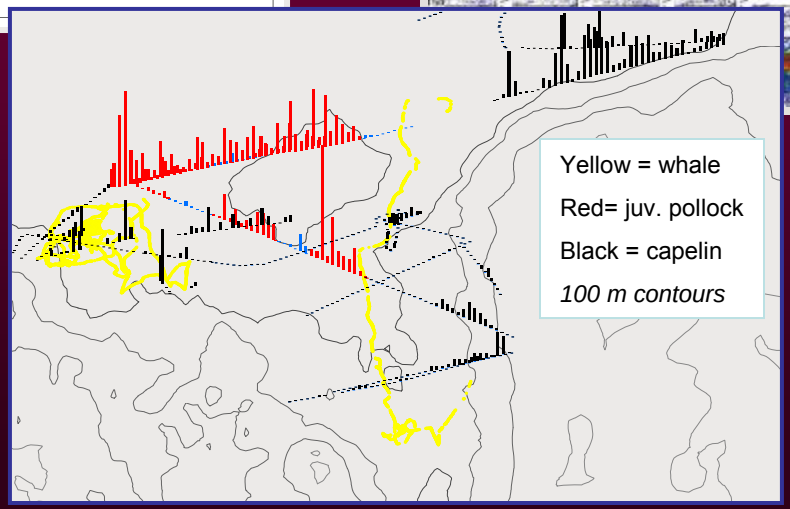




Whale

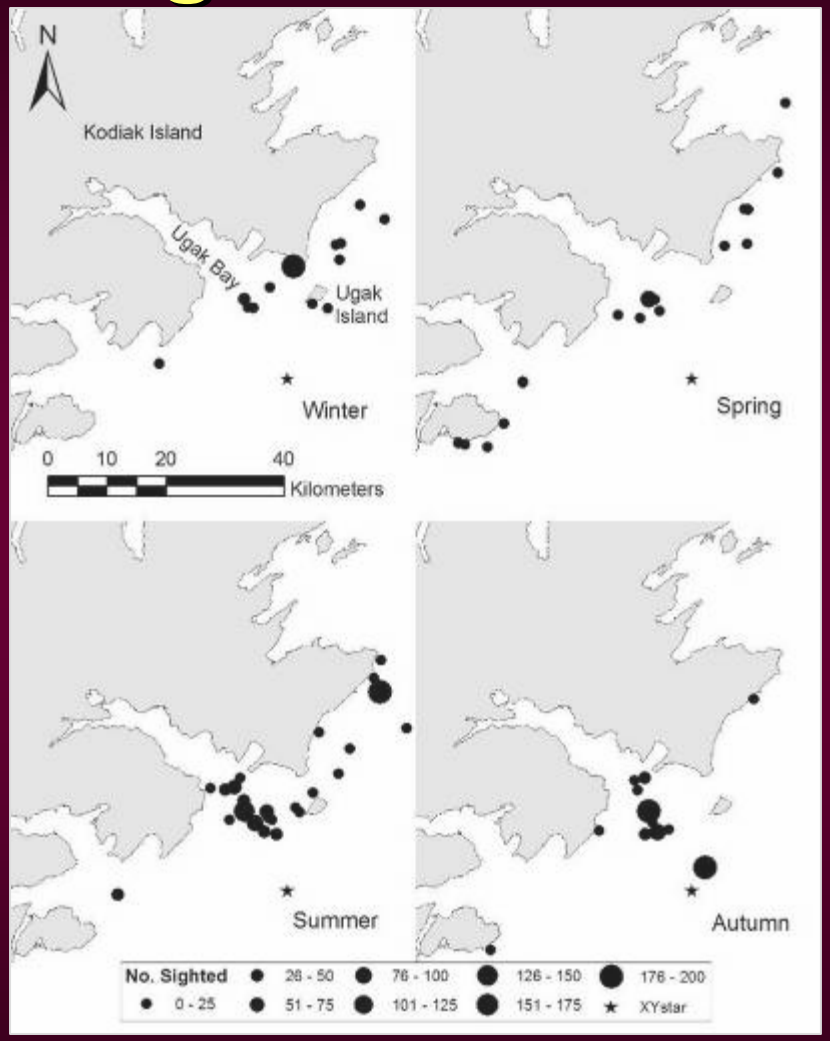
Prey

Indicators of Environmental Change

Year-round grays feeding in Kodiak

Is this an indicator of change

- Gray whale population?
- Climate?
- Arctic productivity?



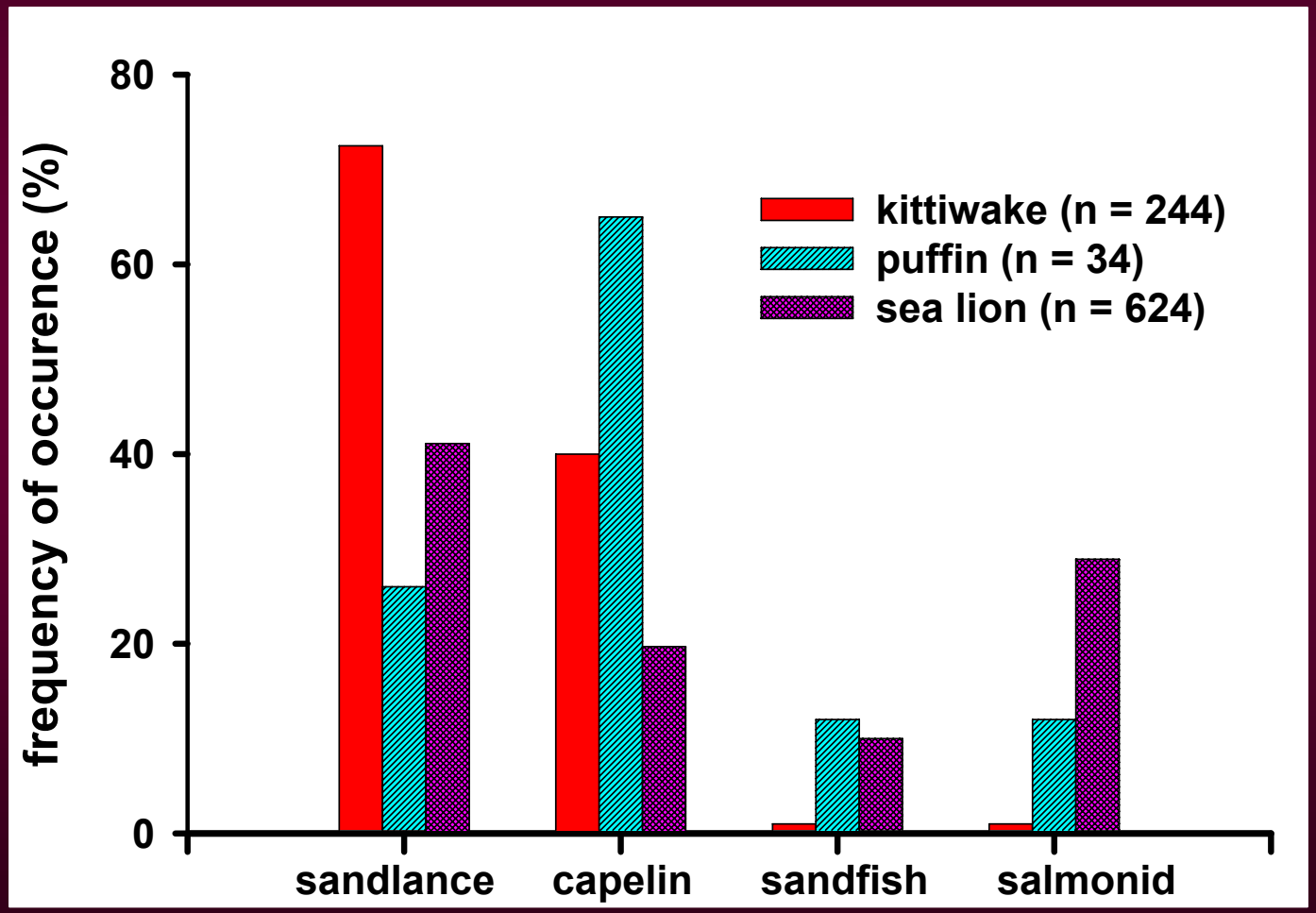
Kodiak Gray Whale Distribution
1999-2003

Moore, S., K. Wynne, J. Clement and J. Grebmeier. *In Review* Marine Mammal Science

Piscivorous Birds

- Indicators of environmental change
- Potential SSL competitors

Frequency of occurrence of the four most common species in the diets of black-legged kittiwakes and tufted puffins and their frequency of occurrence in the diets of Steller sea lions in the Kodiak area, 2000-2001



So What?

Are Steller sea lions currently prey-limited in Kodiak?

Ask their neighbors

Sympatric Piscivore	Diet Overlap	Sim Dive Depth ?	Population Trajectory
Harbor seal	Yes	Yes	↑
Humpback	< 30cm	non-pups	↑
TuftPuffin	< 20 cm	non-pups	?
BL kittiwakes	< 20 cm	pups	↔
Arrowtooth	Yes	non-pups	↑

Potential SSL Predators

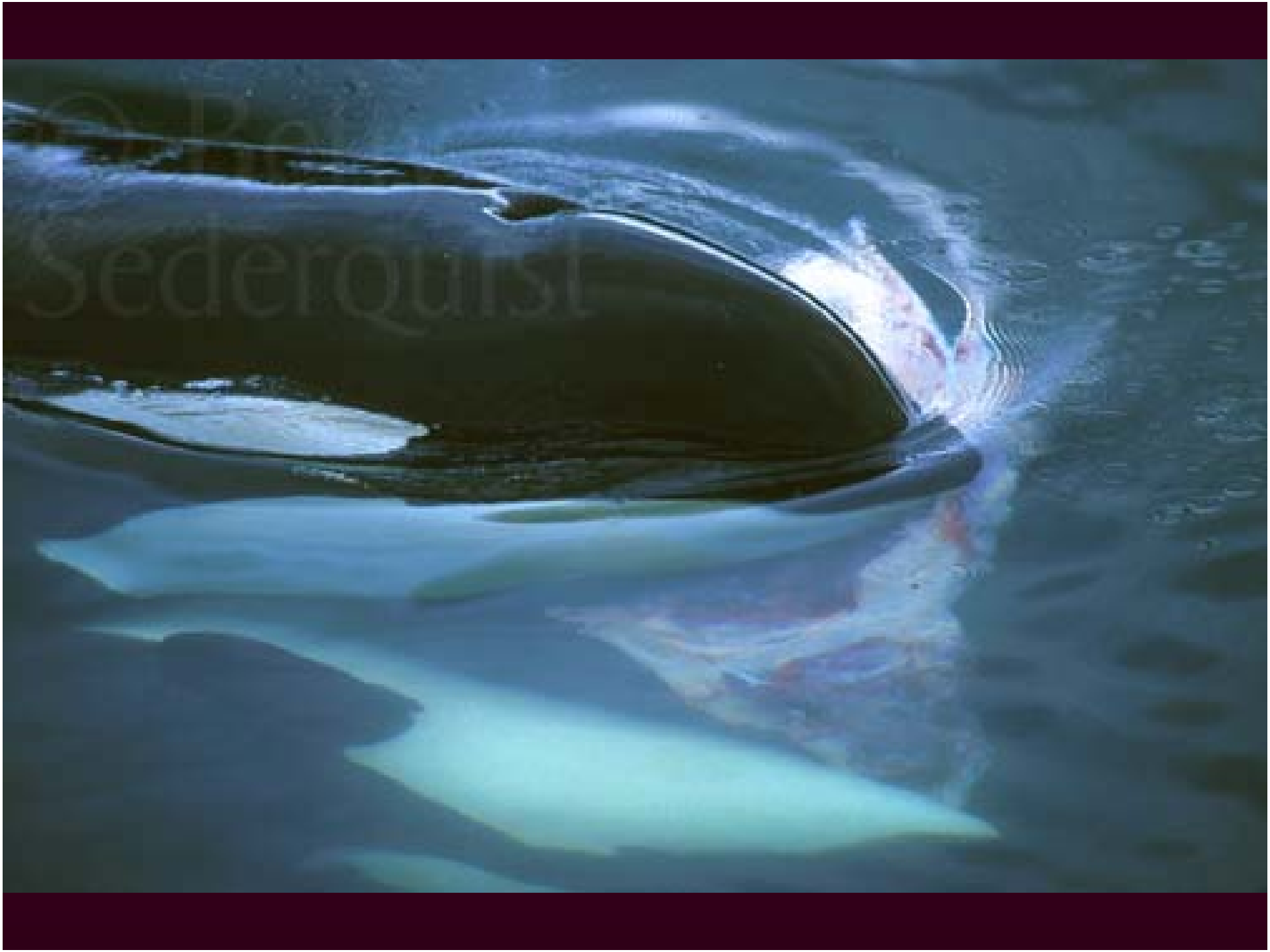
Killer whale photoID and diet studies

Shark diets

- Sleeper (25)
- Salmon (3)

Kodiak Killers

- Record presence in harbor
- Document Steller sea lion kills
- Monitor pod structure and productivity



2006- 07 Plans

- Integrate diet – prey- telemetry datasets
- Pinniped foraging ecology: seal – Steller sea lion diet overlap and niche partitioning?
- Cetacean foraging ecology and prey partitioning between fin and humpback whales
- Steller sea lion weaning phenology

Questions?

Photo By Kathy Hough, NMML

Species present or dominant in wSSL diet studies

	10 Stoms 1940s	150 Stoms 1950s	16 Stoms 1960s	157 Stoms 1970s	190 Stoms 1980s	3762 Scats 1990s	5000+ Scats 2000s
Pollock	++		++	++	++	++	++
P. Cod	+			+	+	++	++
Flatfish	++	+	+	+	++	++	++
Greenling		+	+			++	+
Rockfish		+	+	+	+	+	+
Smelts		+	++	+		+	++
Sandlance	++	+	+		+	++	++
Herring			+	+	+	+	+
Salmon	++	+		+	+	++	++
Sculpins	+	+	+	+	+	++	++
Cephalopods	+	++	+	+	+	+	+