

EAST, WEST, NORTH & SOUTH:

Spatio-Temporal Variation in the Diet & Prey Characteristics of Rhinoceros Auklets in the N. Pacific Ocean



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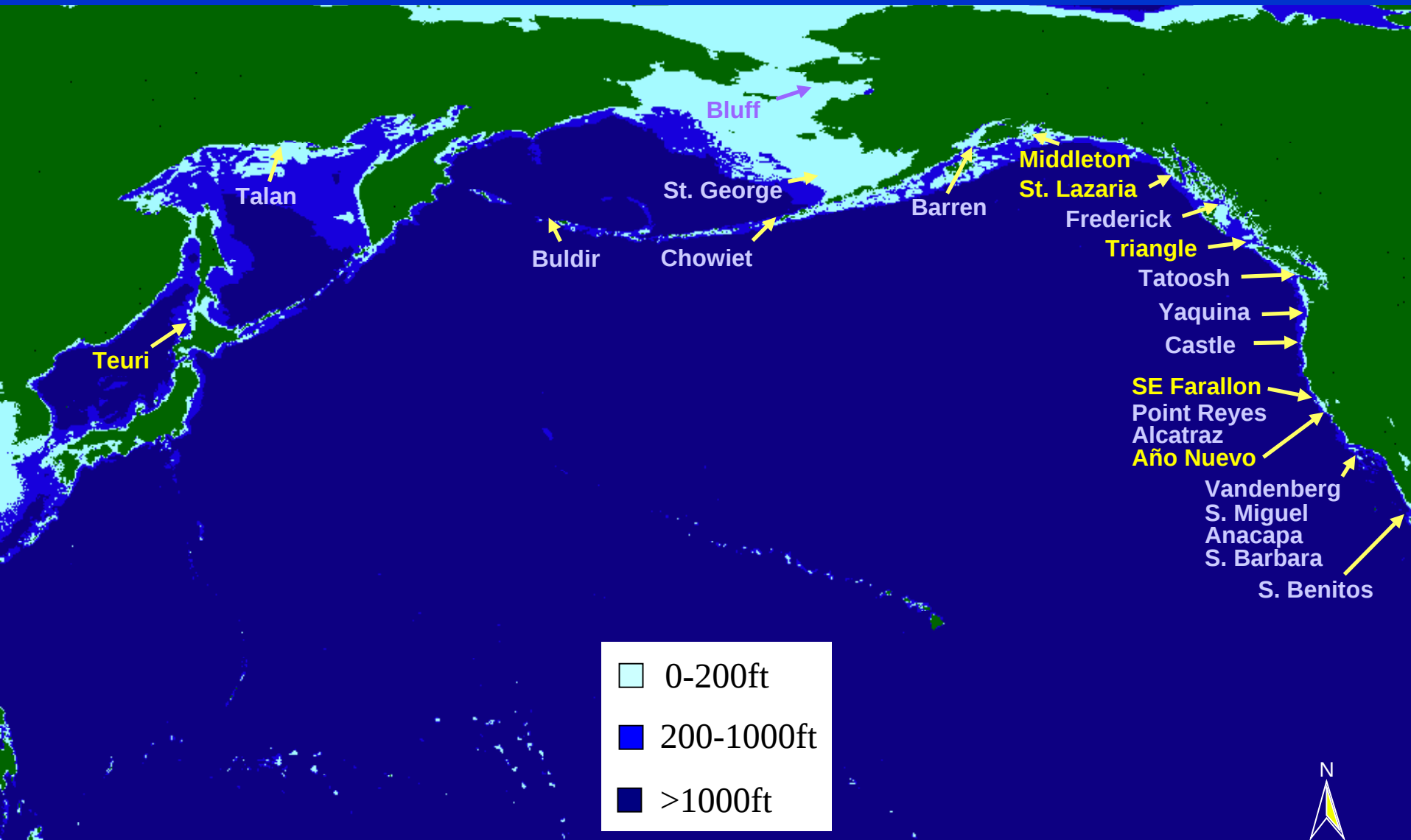
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Yutaka Watanuki (Hokkaido University, Japan)

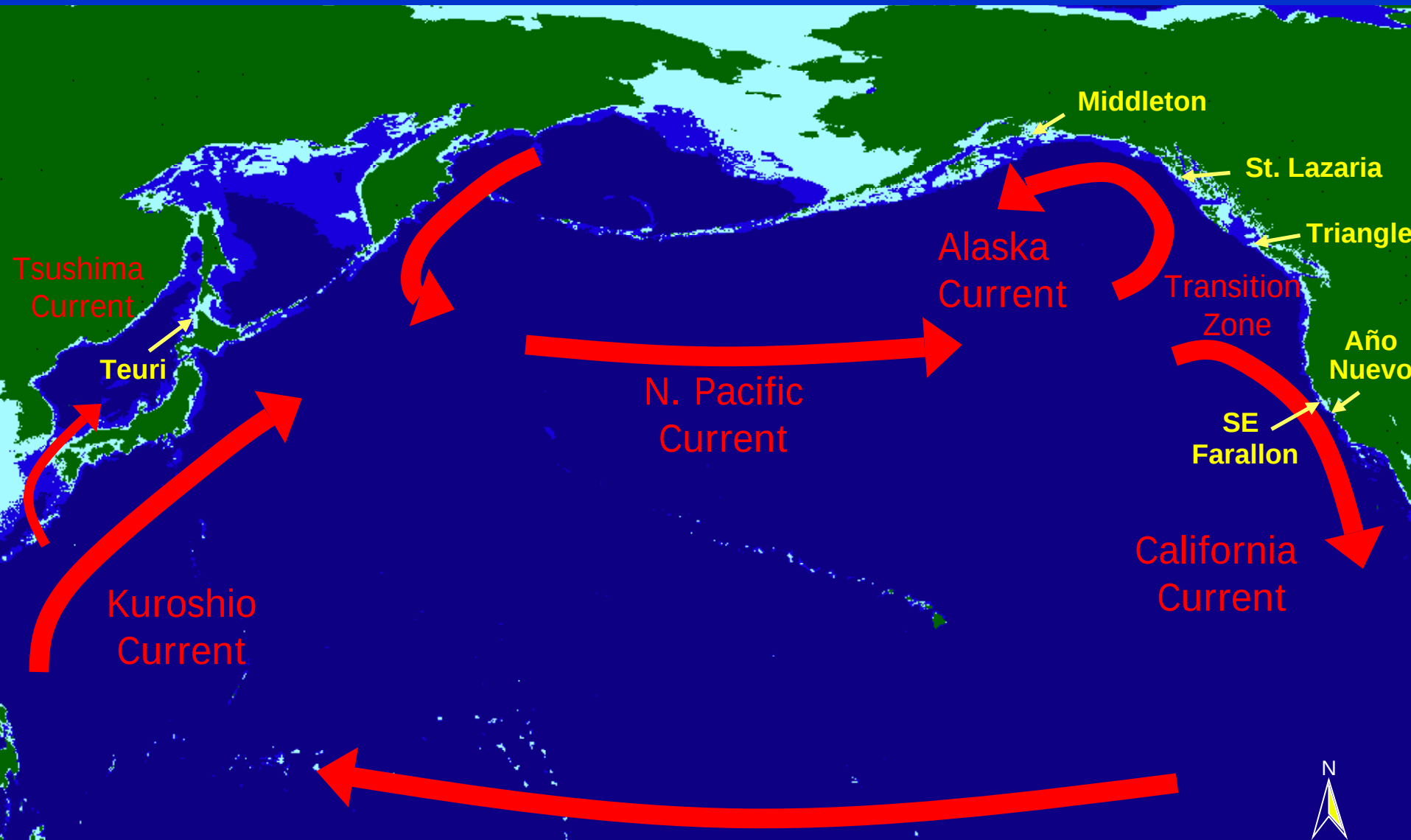
Objectives

- Investigate trends in spatial and temporal variation of marine bird diet in relation to oceanographic variability
 - 6 study sites for Rhinoceros Auklet throughout N. Pacific
 - Long-term datasets spanning 25 years
- Discuss importance of basin-wide network of marine bird “bio-sampling” stations to monitor predator & prey responses to ocean climate change

N. Pacific Seabird Colonies with “Long-term” Data



North Pacific Currents



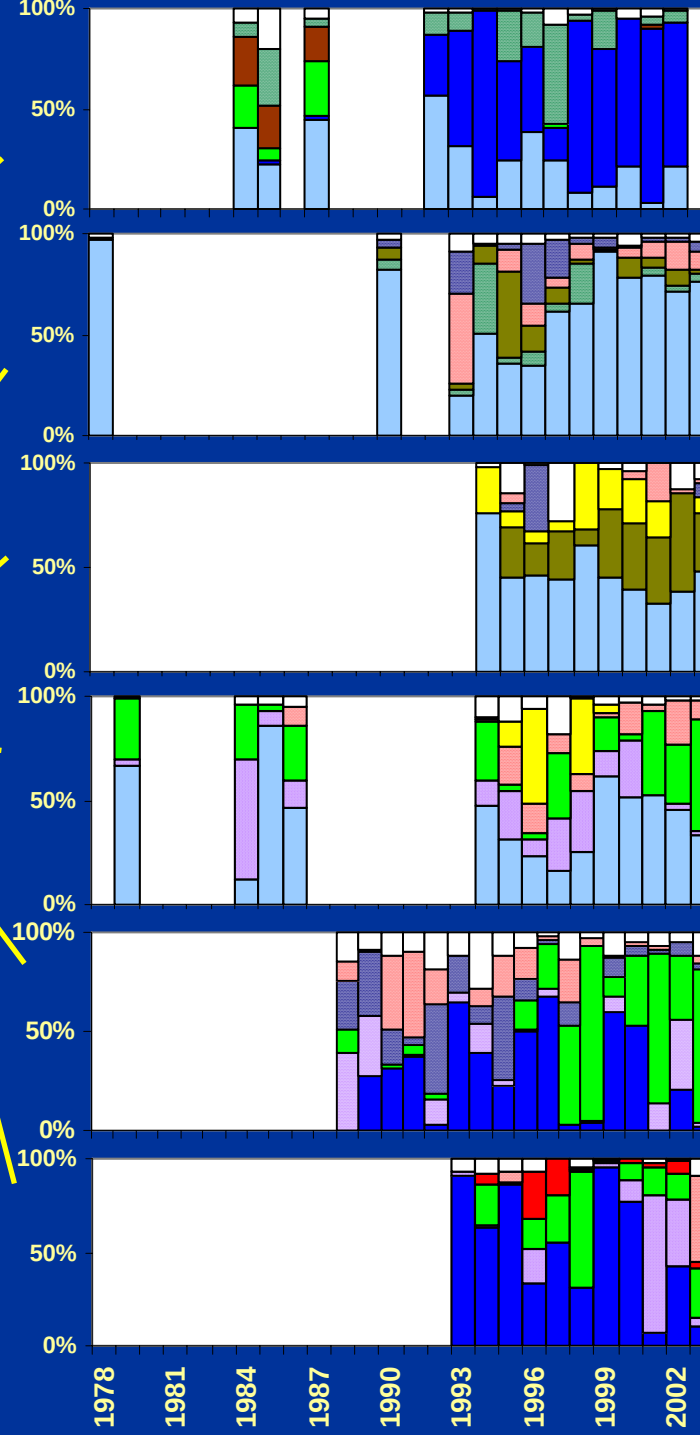
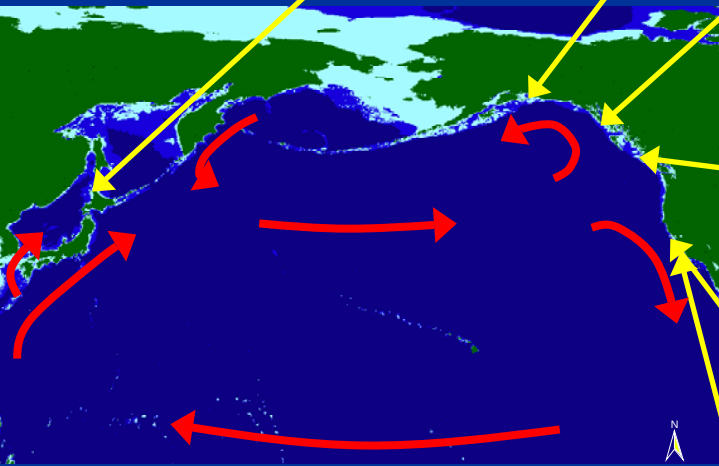
Tertiary Consumer: Rhinoceros Auklet (*Cerorhinca monocerata*)

- Ranges throughout N. Pacific rim
- Diving seabird attains depths of 60m (avg 15m)
- Preys on mid-water schooling fishes
- Fishes sampled from auklets provisioning young in summer



Tim Zurowski

% Mass Rhinoceros Auklet Diet



- other
- squid (*Loligo*)

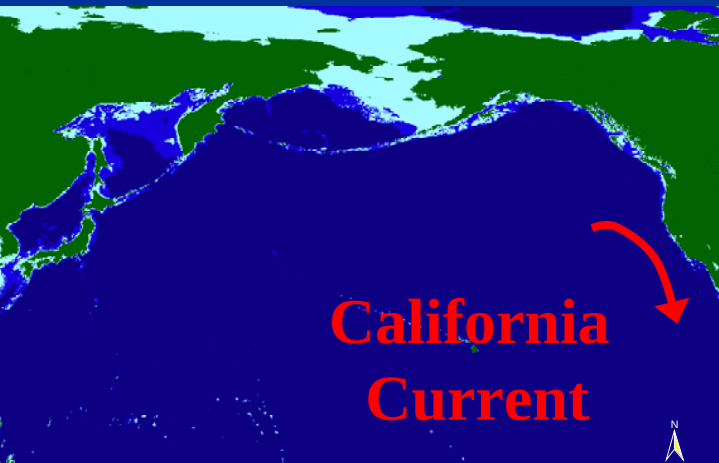
Juvenile predatory fishes:

- greenling (*Hexagrammidae*)
- sablefish (*Anoplopoma*)
- salmon (*Oncorhynchus*)
- rockfish (*Sebastes*)

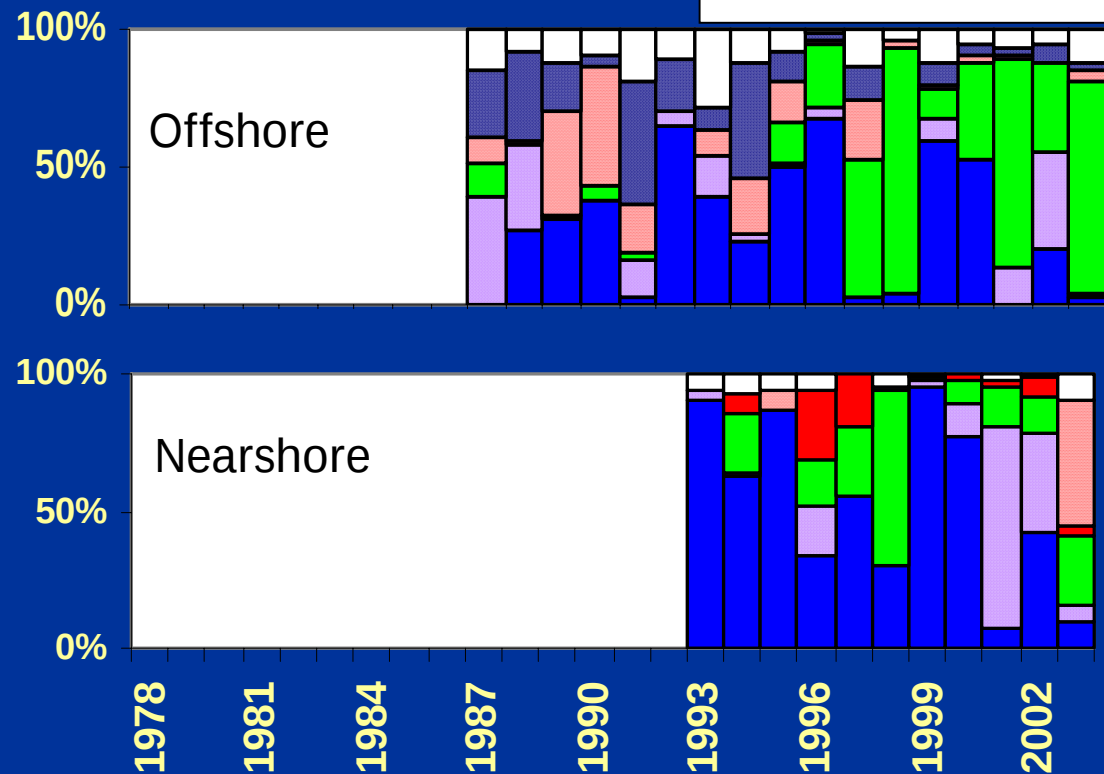
Small coastal pelagic fishes:

- sardine (*Sardinops*)
- herring (*Clupea*)
- capelin (*Mallotus*)
- saury (*Cololabis*)
- sandlance (*Ammodytes*)
- anchovy (*Engraulis*)

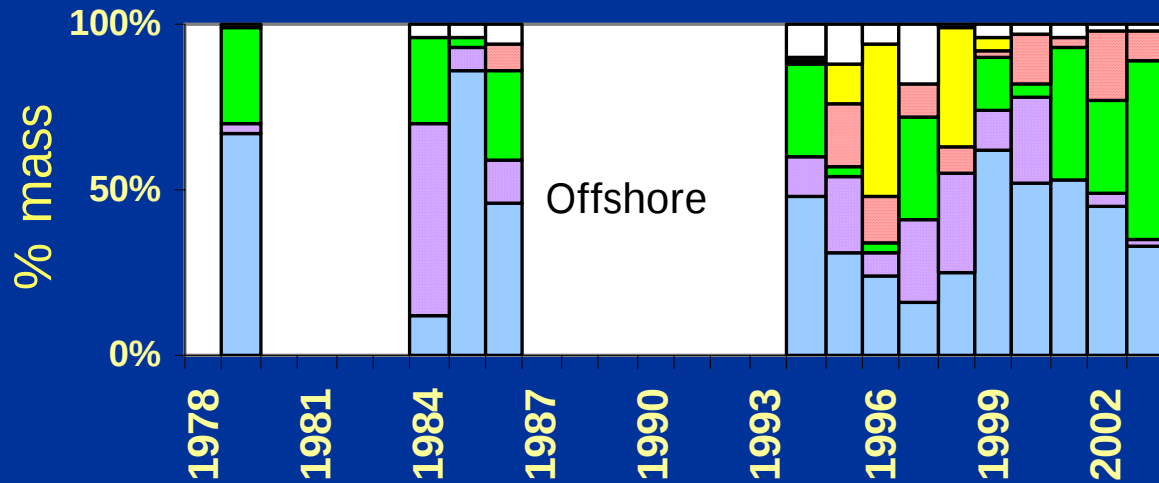
California Current Forage Fishes



% mass

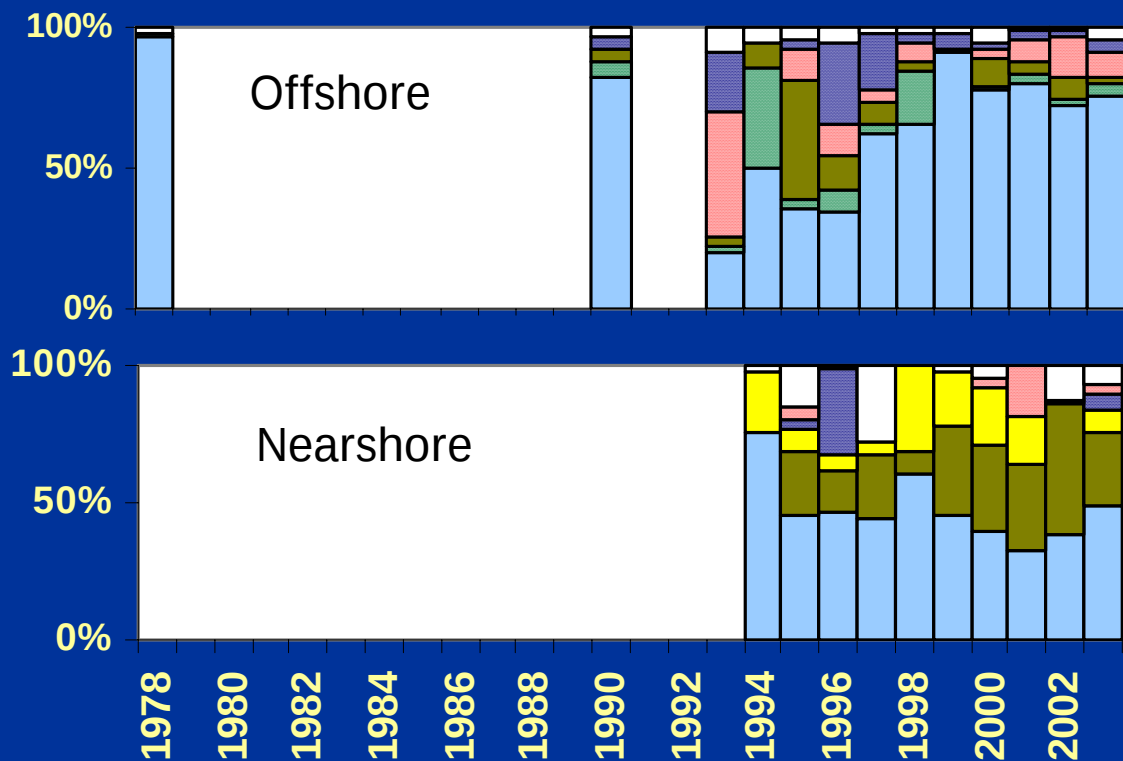


Transition Zone Forage Fishes





% mass



other

Juvenile predatory fishes:

greenling (*Hexagrammidae*)

sablefish (*Anoplopoma*)

salmon (*Oncorhynchus*)

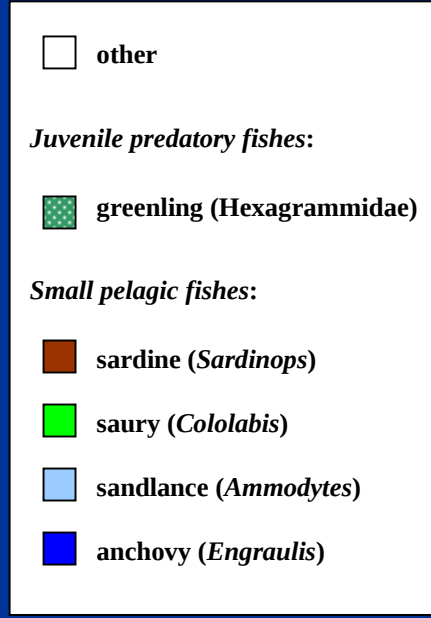
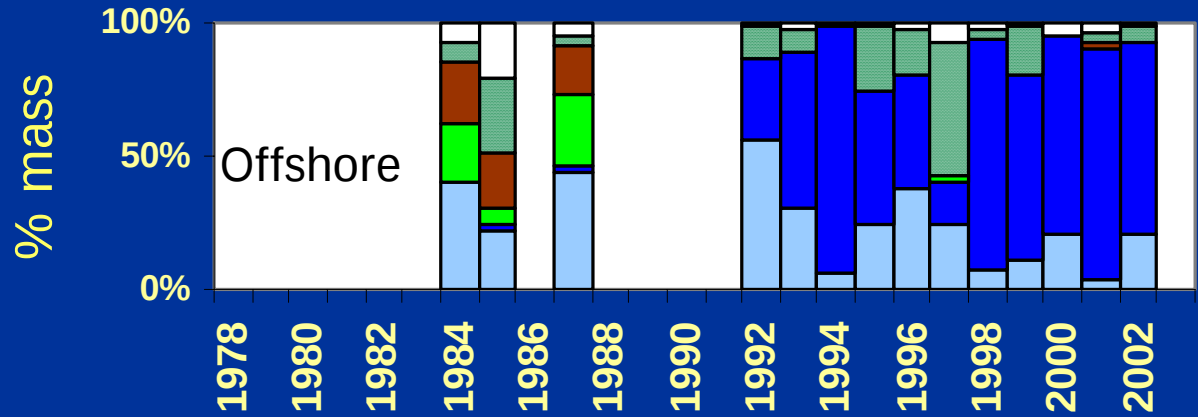
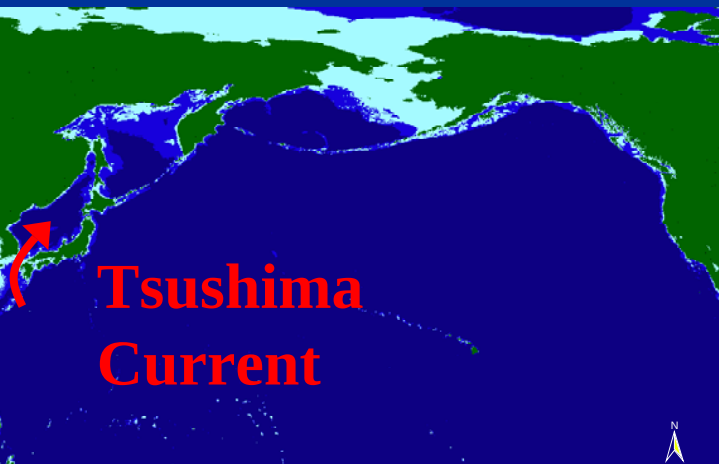
Small pelagic fishes:

herring (*Clupea*)

capelin (*Mallotus*)

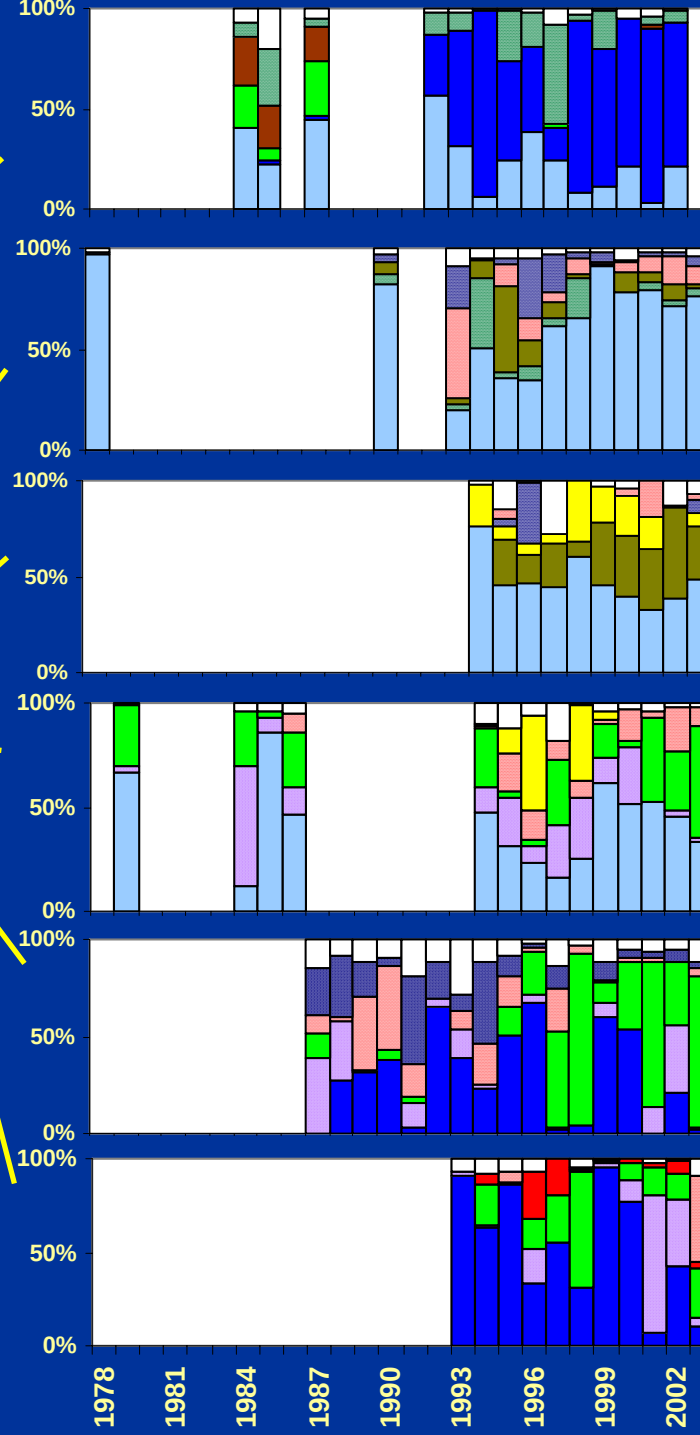
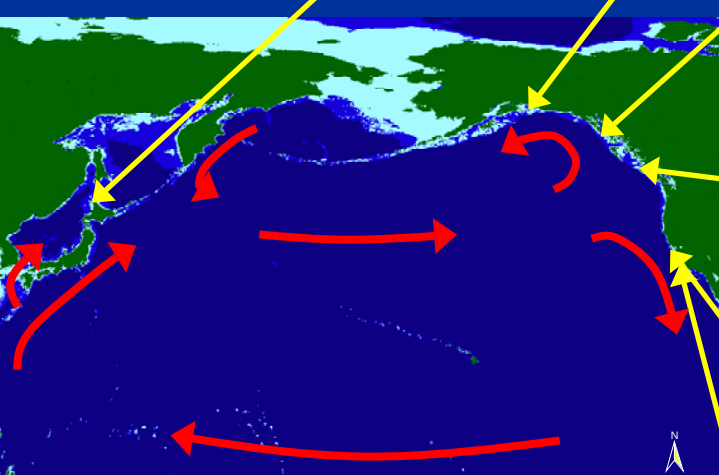
sandlance (*Ammodytes*)

Alaska
Current
Forage Fishes



Tsushima Current Forage Fishes

% Mass Rhinoceros Auklet Diet



other
squid (*Loligo*)

Juvenile predatory fishes:

greenling (*Hexagrammidae*)
sablefish (*Anoplopoma*)
salmon (*Oncorhynchus*)
rockfish (*Sebastes*)

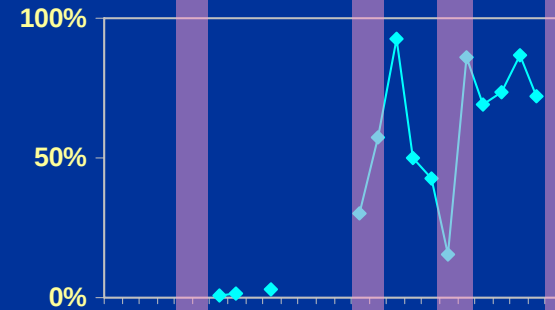
Small coastal pelagic fishes:

sardine (*Sardinops*)
herring (*Clupea*)
capelin (*Mallotus*)
saury (*Cololabis*)
sandlance (*Ammodytes*)
anchovy (*Engraulis*)

Anchovy (*Engraulis*) % mass

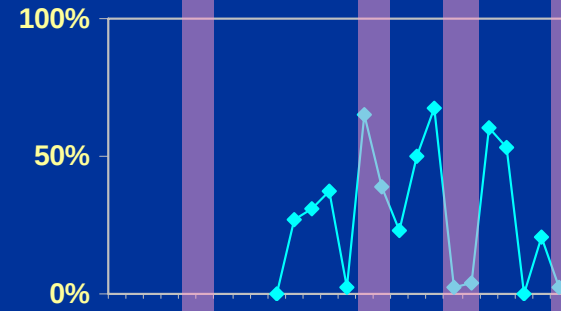


El Niño
events

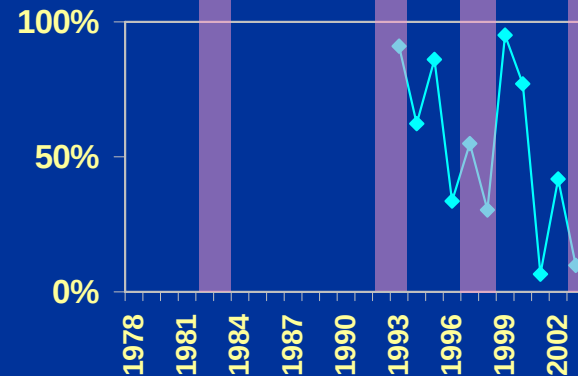


Tsushima
Current

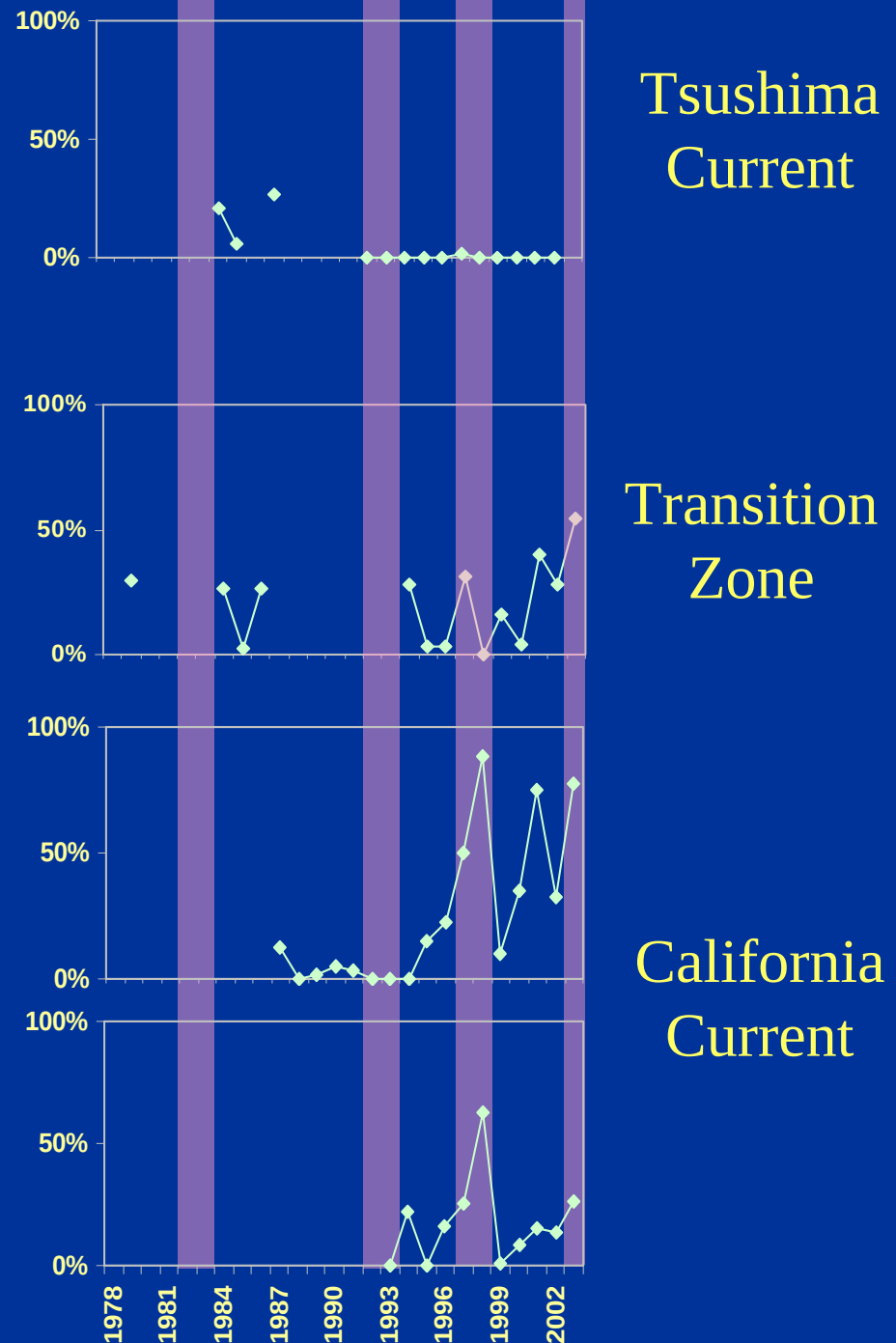
1992-1993
1997-1998
2003



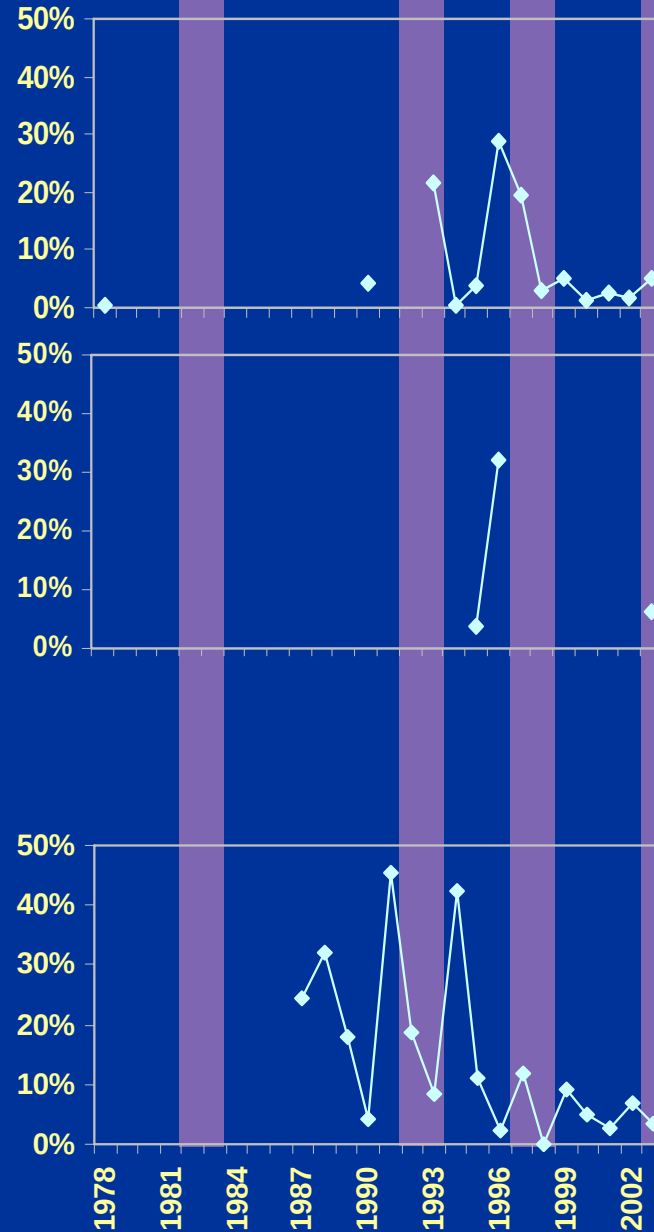
California
Current



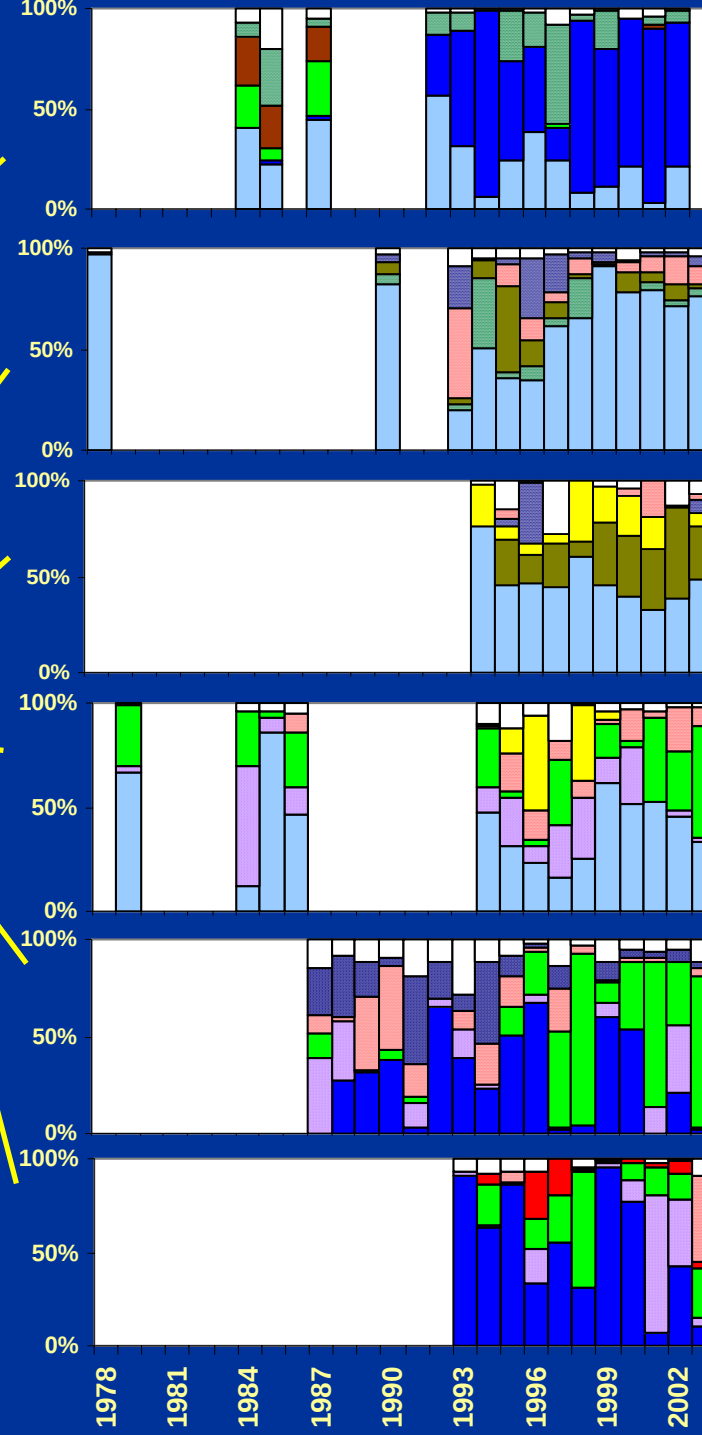
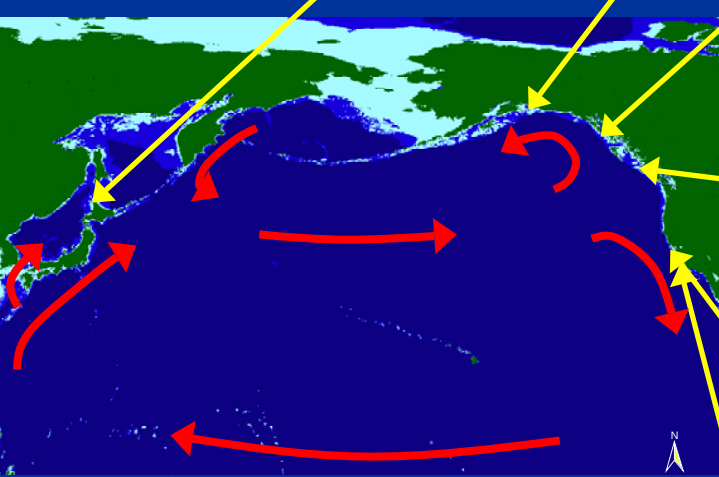
Pacific Saury (*Cololabis*) % mass



Sablefish (*Anoplopoma*) % mass



% Mass Rhinoceros Auklet Diet



other
squid (*Loligo*)

Juvenile predatory fishes:

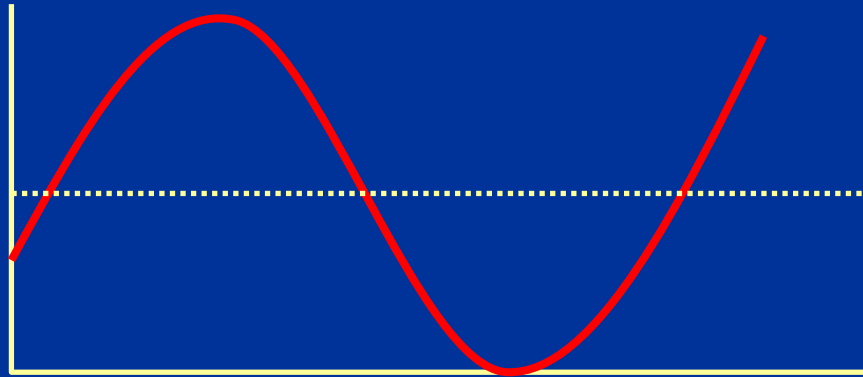
greenling (*Hexagrammidae*)
sablefish (*Anoplopoma*)
salmon (*Oncorhynchus*)
rockfish (*Sebastes*)

Small coastal pelagic fishes:

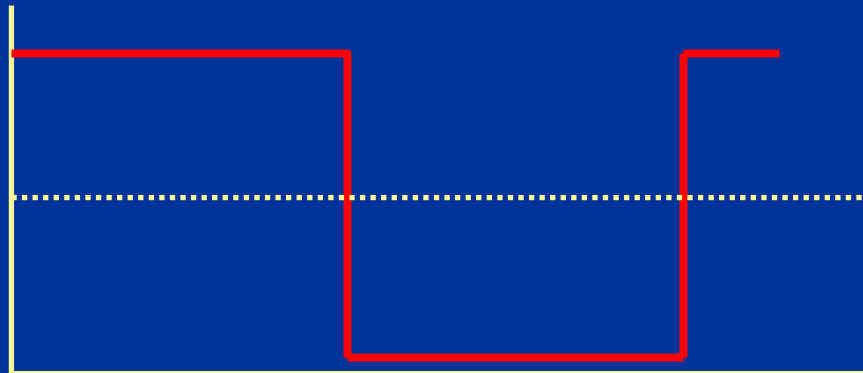
sardine (*Sardinops*)
herring (*Clupea*)
capelin (*Mallotus*)
saury (*Cololabis*)
sandlance (*Ammodytes*)
anchovy (*Engraulis*)

Some Regime-shift Models

Model 1

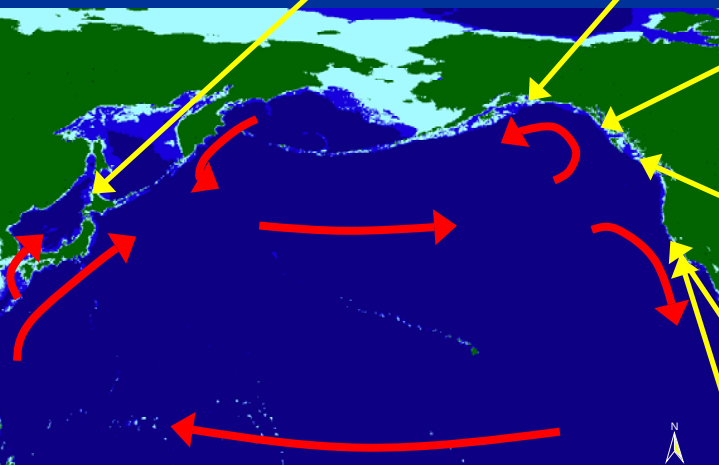


Model 2

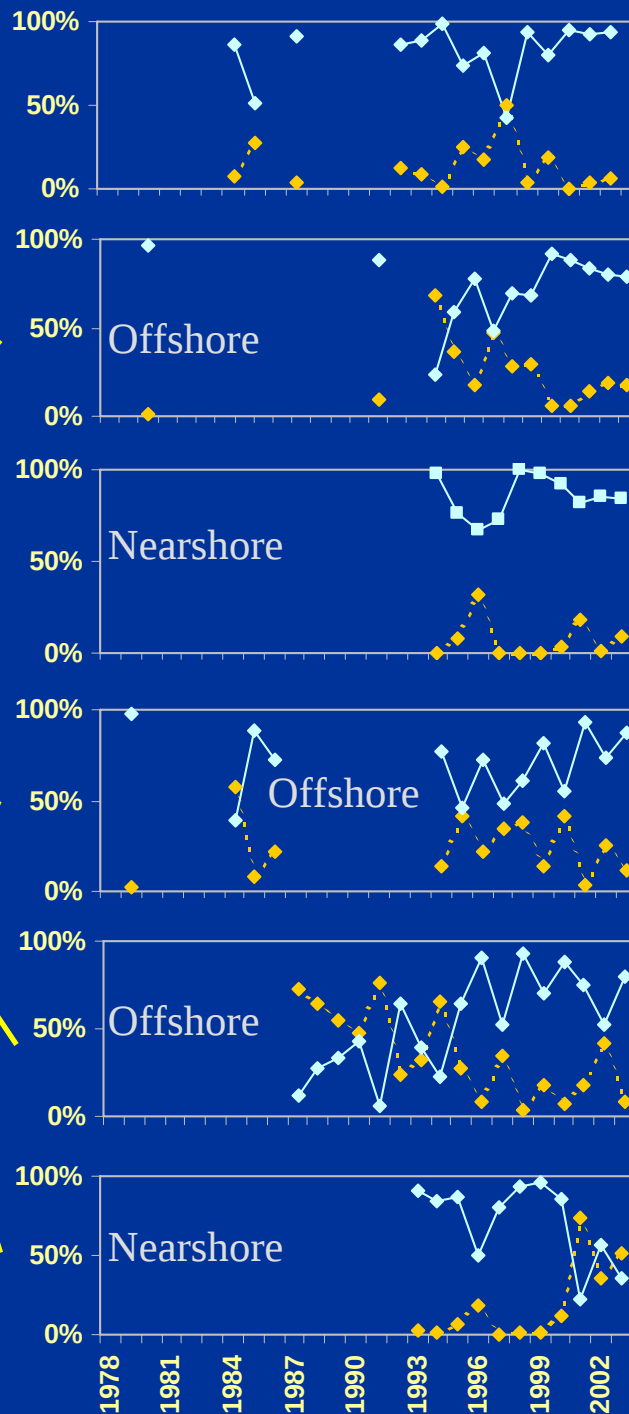


Time

% mass of Juvenile Predatory Fishes vs.



Smaller Pelagic Schooling Fishes



- Juvenile predatory fishes:
 - greenling (*Hexagrammidae*)
 - sablefish (*Anoplopoma*)
 - salmon (*Oncorhynchus*)
 - rockfish (*Sebastes*)
- Small coastal pelagic fishes:
 - sardine (*Sardinops*)
 - herring (*Clupea*)
 - capelin (*Mallotus*)
 - saury (*Cololabis*)
 - sandlance (*Ammodytes*)
 - anchovy (*Engraulis*)

Summary

- El Niño effects more apparent in lower latitudes
- Gradual, sweeping fluctuations in prey composition apparent throughout time series (*Model 1*)
- Need longer time series, more sampling locations!

Future Directions

- Examine effects of oceanic variability on forage fish communities in more detail
- Examine diet of multiple marine bird predators simultaneously
- Network of marine bird “bio-sampling” stations throughout N. Pacific basin



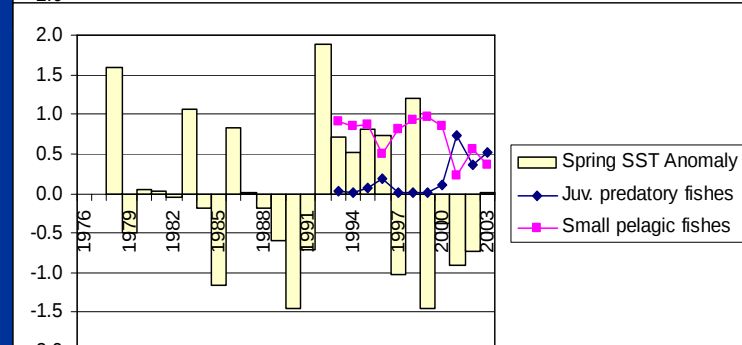
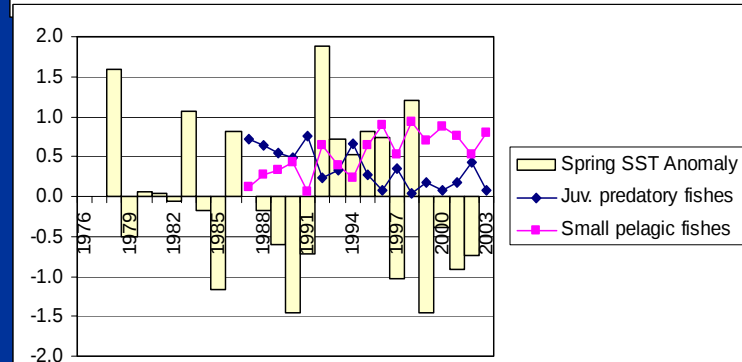
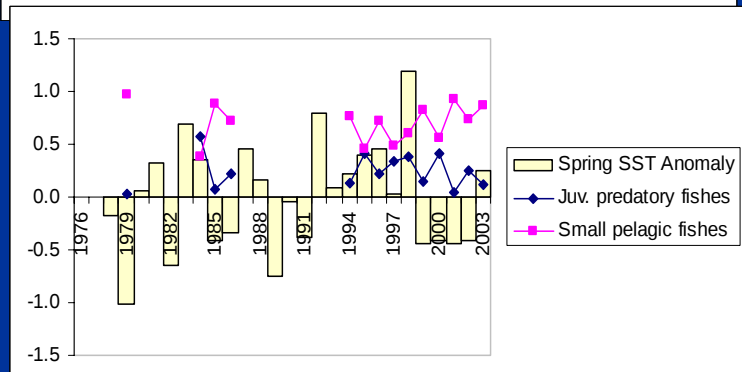
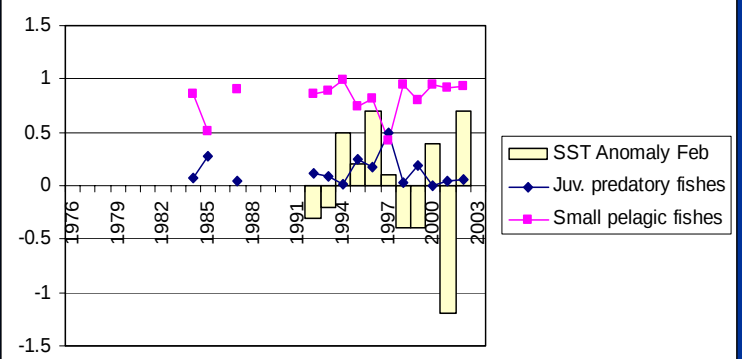
% mass of
Juvenile
Predatory Fishes
vs.

Smaller Pelagic
Schooling Fishes

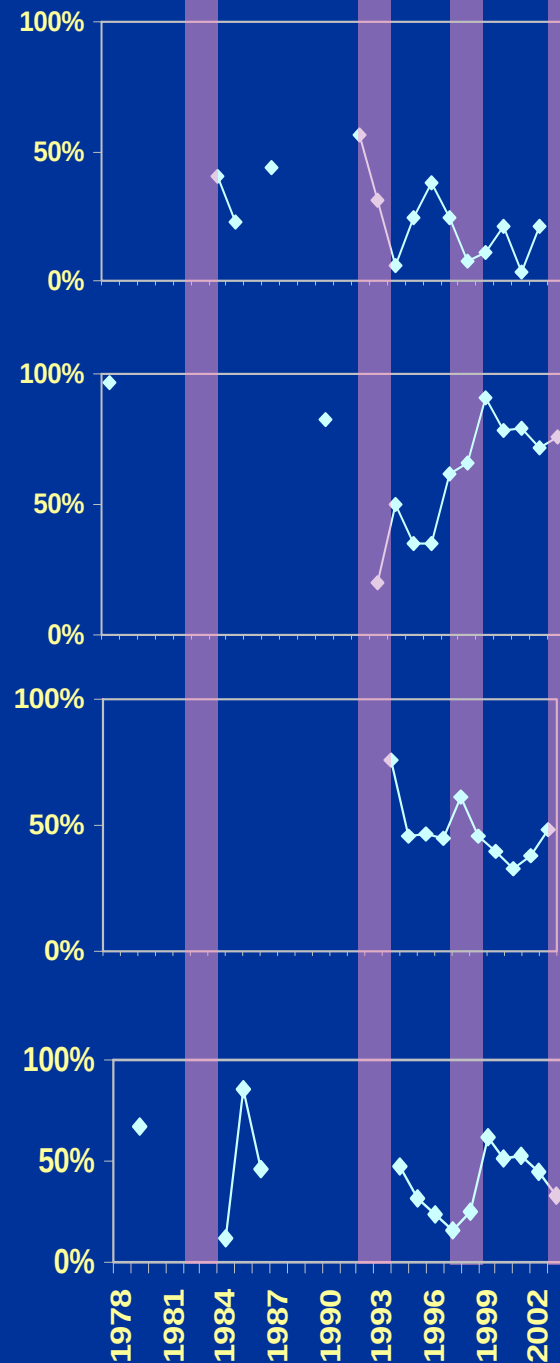
Tsushima
Current

Transition
Zone

California
Current



Sandlance (*Ammodytes*) % mass

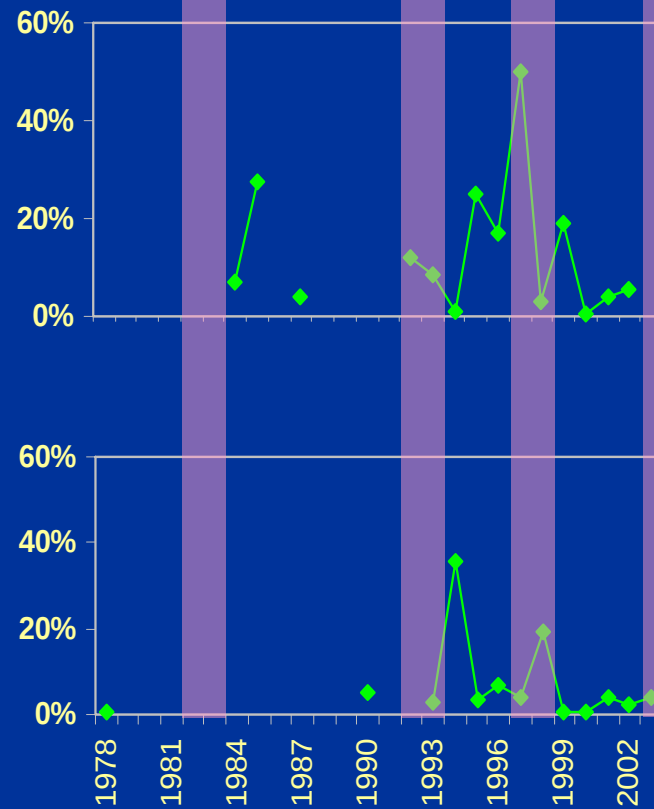


Tsushima
Current

Alaska
Current

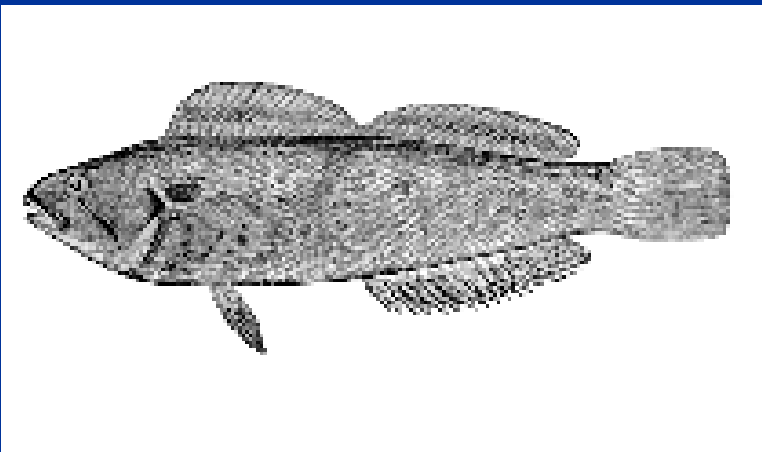
Transition
Zone

Greenling (Hexagrammidae) % mass

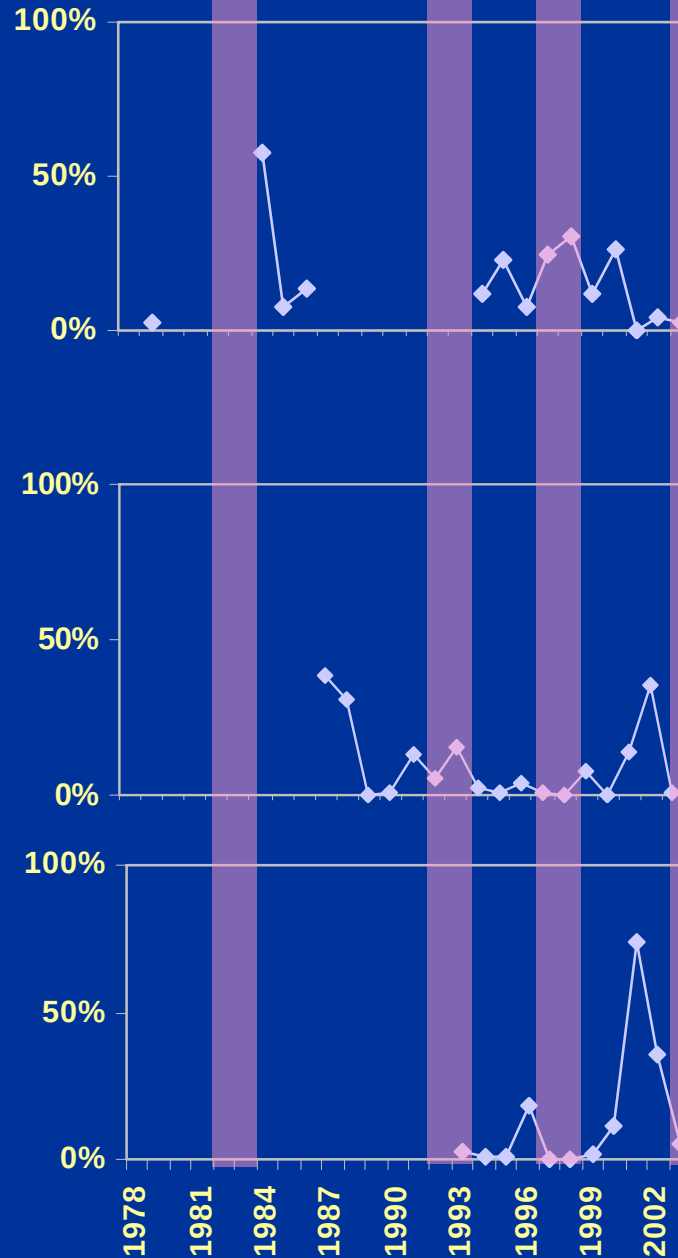


Tsushima
Current

Alaska
Current



Rockfish (*Sebastes*) % mass



Transition
Zone

California
Current

Chick Provisioning Amounts

- Bill load mass varies significantly between colonies and years in the N. Pacific

however,

- Bill load mass changes in a synchronous manner:
 - between colonies in the California Current over time
(more strongly between ANI & SEFI, but also with TRI)
 - between colonies in the Alaska Current over time
(more strongly between MIDD & LAZ, but also with TRI)