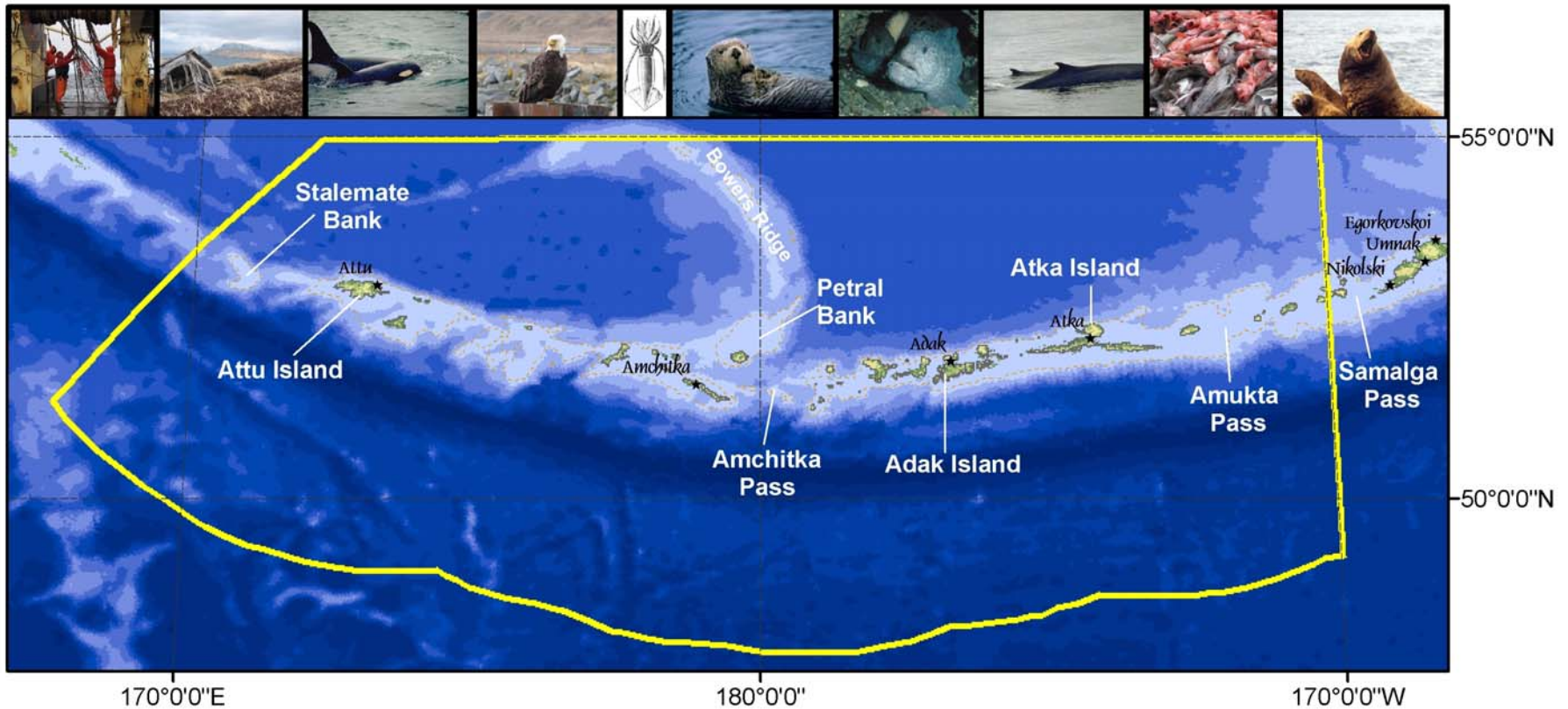
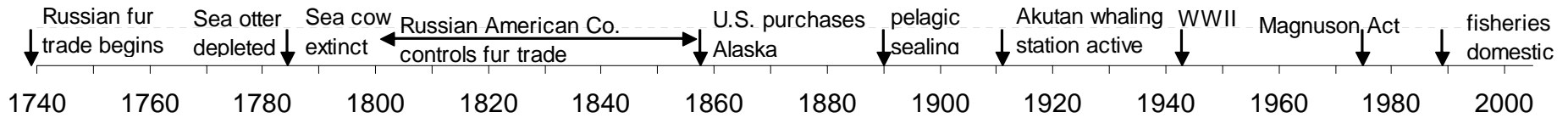


# Aleutian Islands Fishery Ecosystem Plan



For the NPFMC Ecosystem Committee  
SSC, AP, and Council  
March 2007

# Aleutian Islands Ecosystem Processes: Visualizing relationships in Section 3



## 3.1 Historical context

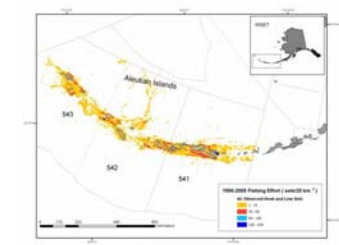
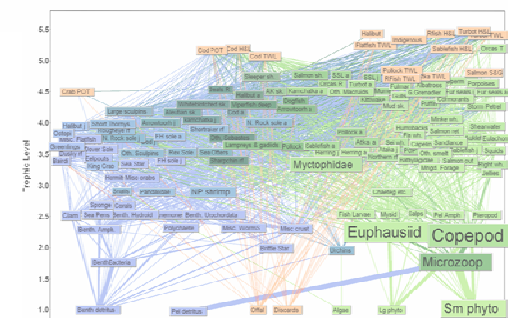
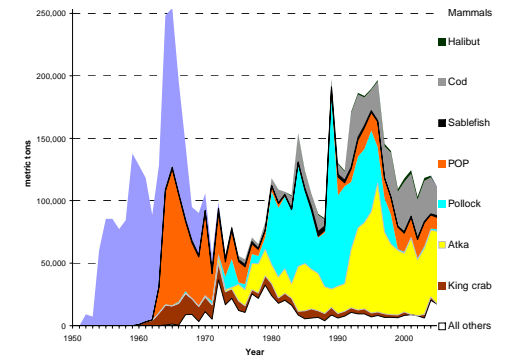
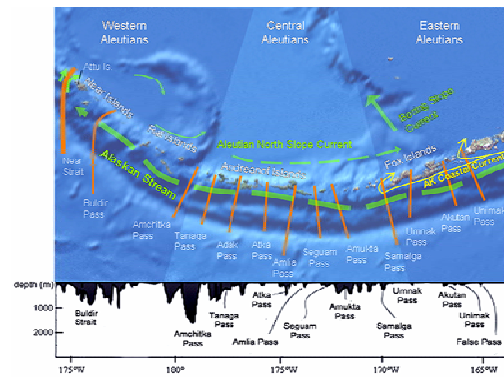
## 3.2 Physical relationships

## 3.3 Biological relationships

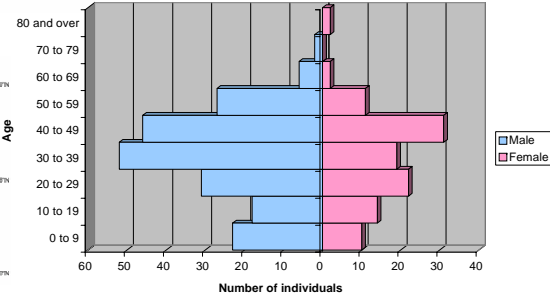
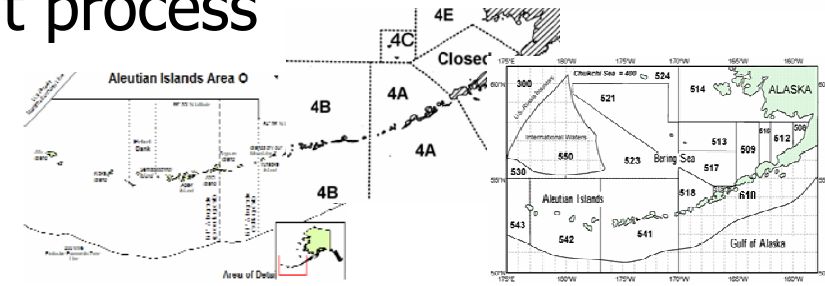
## 3.4 Socioeconomic relationships

## 3.5 Management process

## 3.6 Interactions



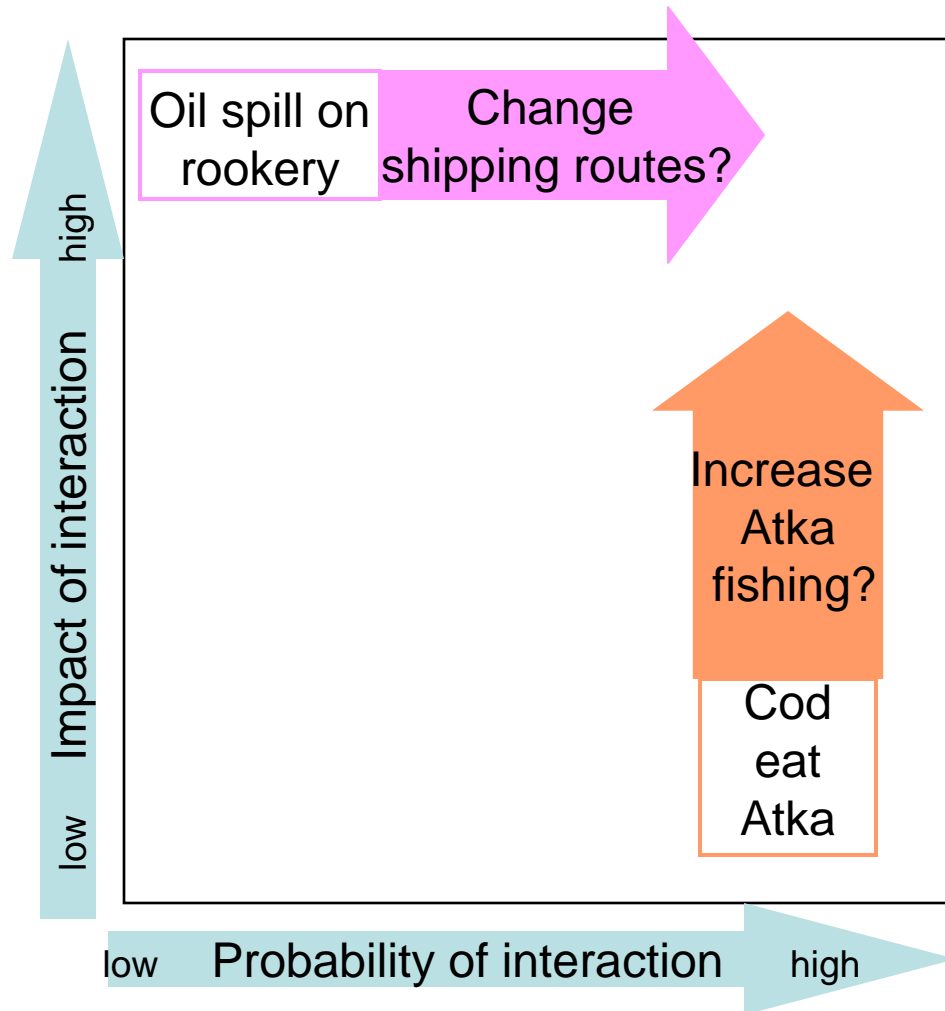
2000 Population Structure  
Adak  
Data source: US Census



# Interactions → Ecosystem Assessment

## Section 4

### 4.1 Risk Assessment



### 4.2 Indicators

Vessel traffic near rookeries  
Changing storm tracks  
Increased shipping

% Atka in cod diet  
Cod condition, weight at age  
Cod and Atka biomass (SAFE)

# Next steps

1. Take your feedback, community feedback, and team feedback to edit the current sections (1-5).
2. AI FEP Team workshop April 5-6 where we use these results to...
3. Highlight implications for human use of ecosystem (section 6)
4. Suggest priorities for analysis and further research (section 7)
  - within the next year
  - over longer timeframes (2 years, 5 years, 10 years, etc.)
5. Make Recommendations for the Council and (section 8)
6. Summarize the “value added” by FEP process (section 9)

Final review in June 2007





“Would you please elaborate on ‘then something bad happened’?”

# AI FEP Team membership

Kerim Aydin, NMFS AFSC	Ecosystem / food web modeling
Steve Barbeaux, NMFS AFSC	Pollock biology, assessment
Forrest Bowers, ADF&G	Crab and state fisheries
Vernon Byrd, USFWS, AKRO	Birds and mammals
Diana Evans, NPFMC	FEP policy, implementation
Sarah Gaichas, NMFS AFSC	Ecosystem / food web modeling
Carol Ladd, NOAA PMEL	Physical oceanography
Sandra Lowe, NMFS AFSC	Atka mackerel bio, assessment
John Olson, NMFS AKRO	Habitat, GIS
Jennifer Sepez, NMFS AFSC	Anthropology, socioeconomics
Paul Spencer, NMFS AFSC	Rockfish biology, assessment
Francis Wiese, NPRB	Research, seabirds



Ecosystem Dynamics of  
the Aleutian Islands:

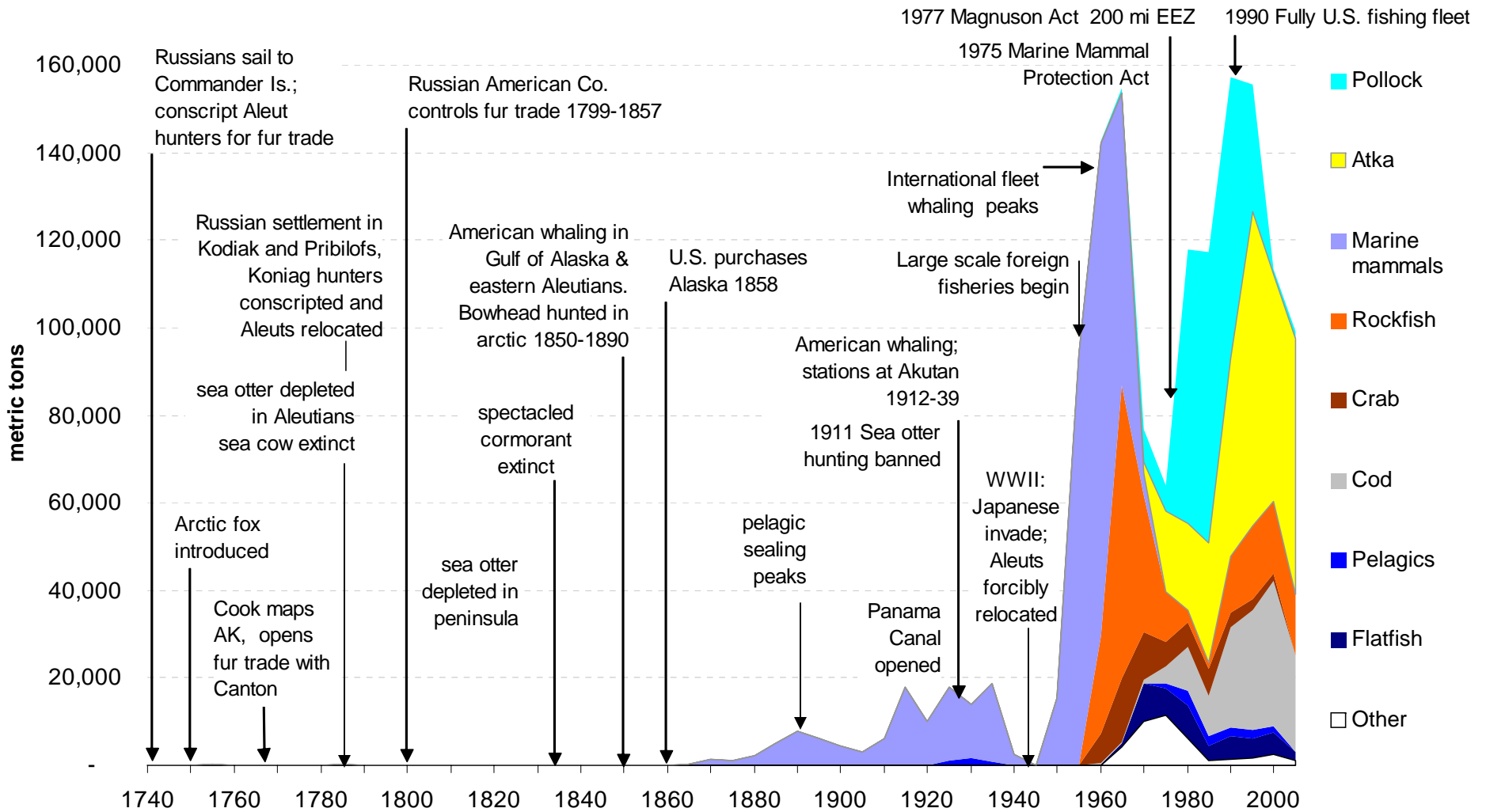
Food webs, space, and scale

Dr. Ivonne Ortiz, UW SAFS

Ivonne's dissertation work is the basis for much of  
biological interactions section of the FEP.

Thank you Ivonne.

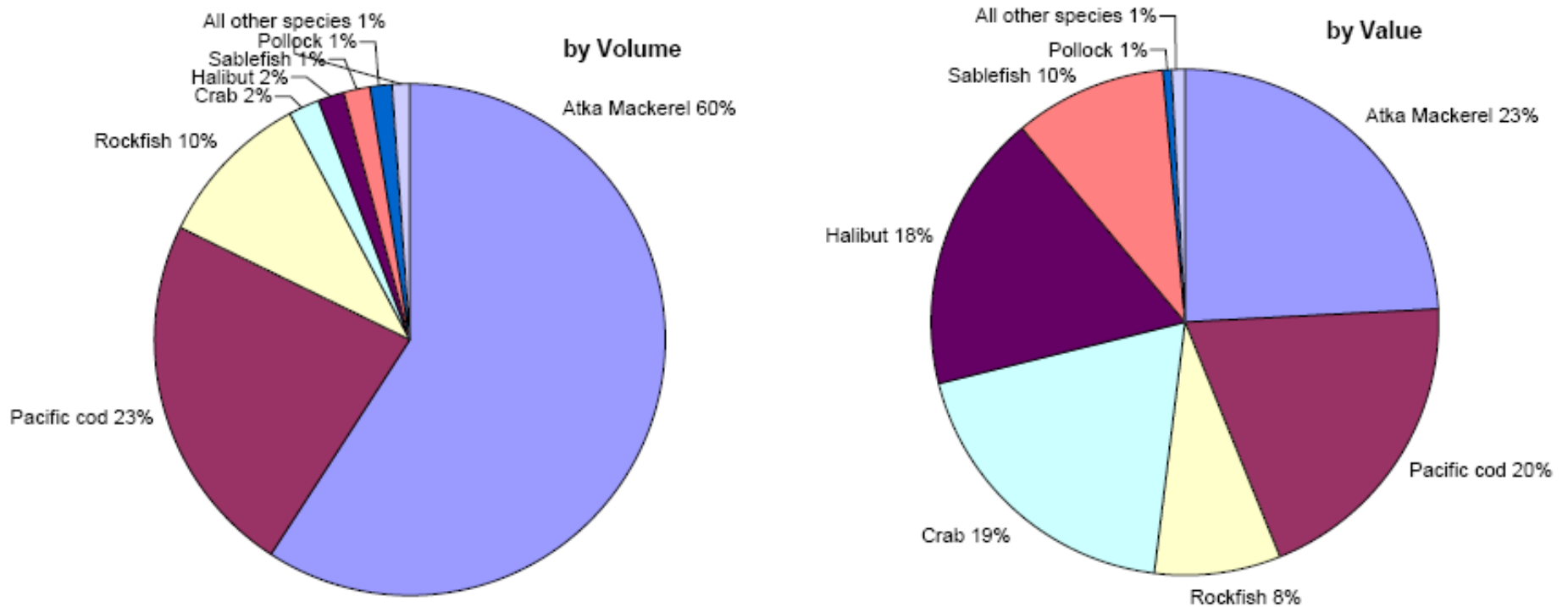
# Aleutian Islands Exploitation History





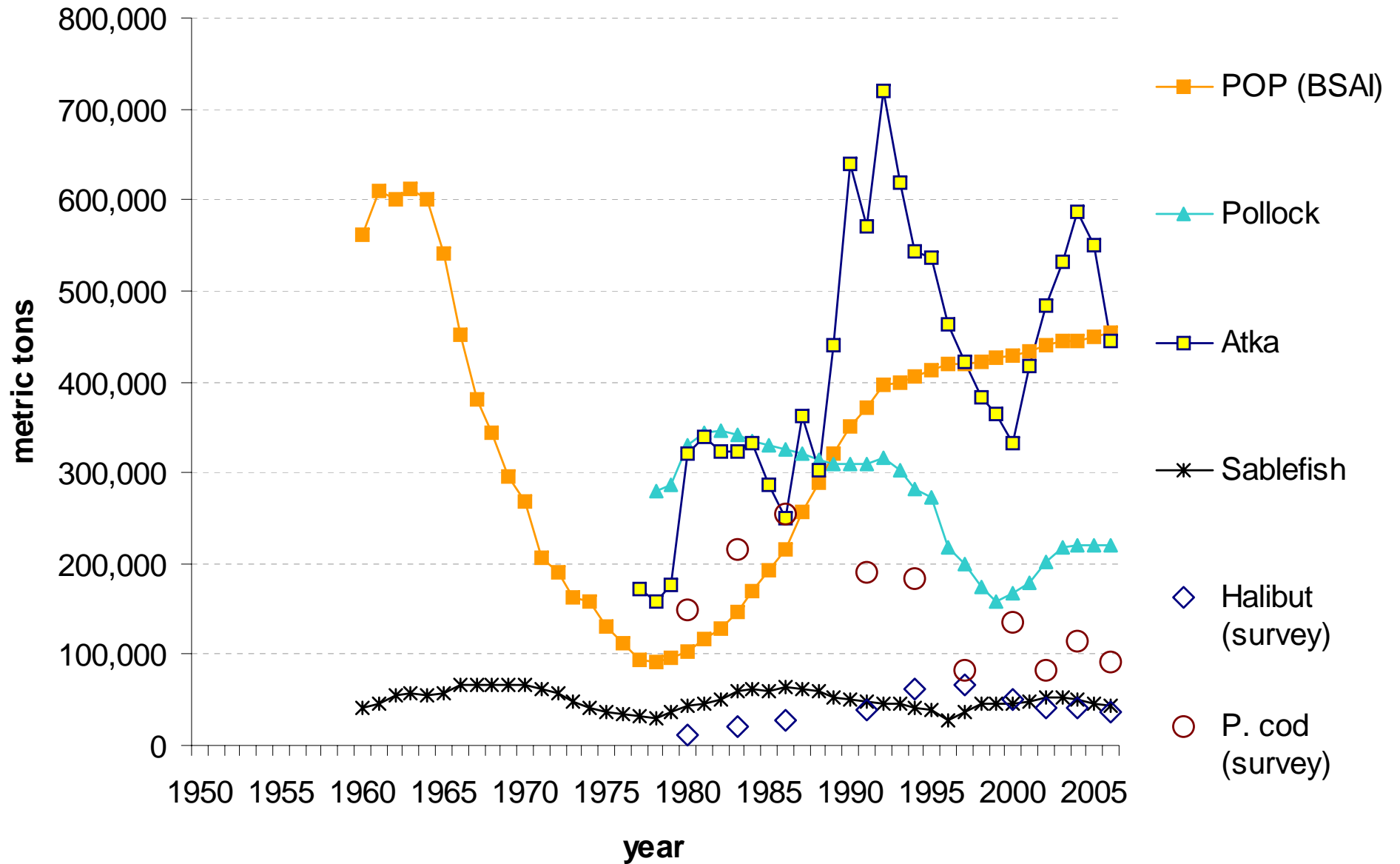


# 2005 volume and value of AI fisheries



**Figure 3-22** Fishery resources harvested in the Aleutian Islands Ecosystem (areas 541, 542, and 543) by volume and by value, in 2005.

# AI Fish stock assessment trends





# Aleutian Islands Physical relationships

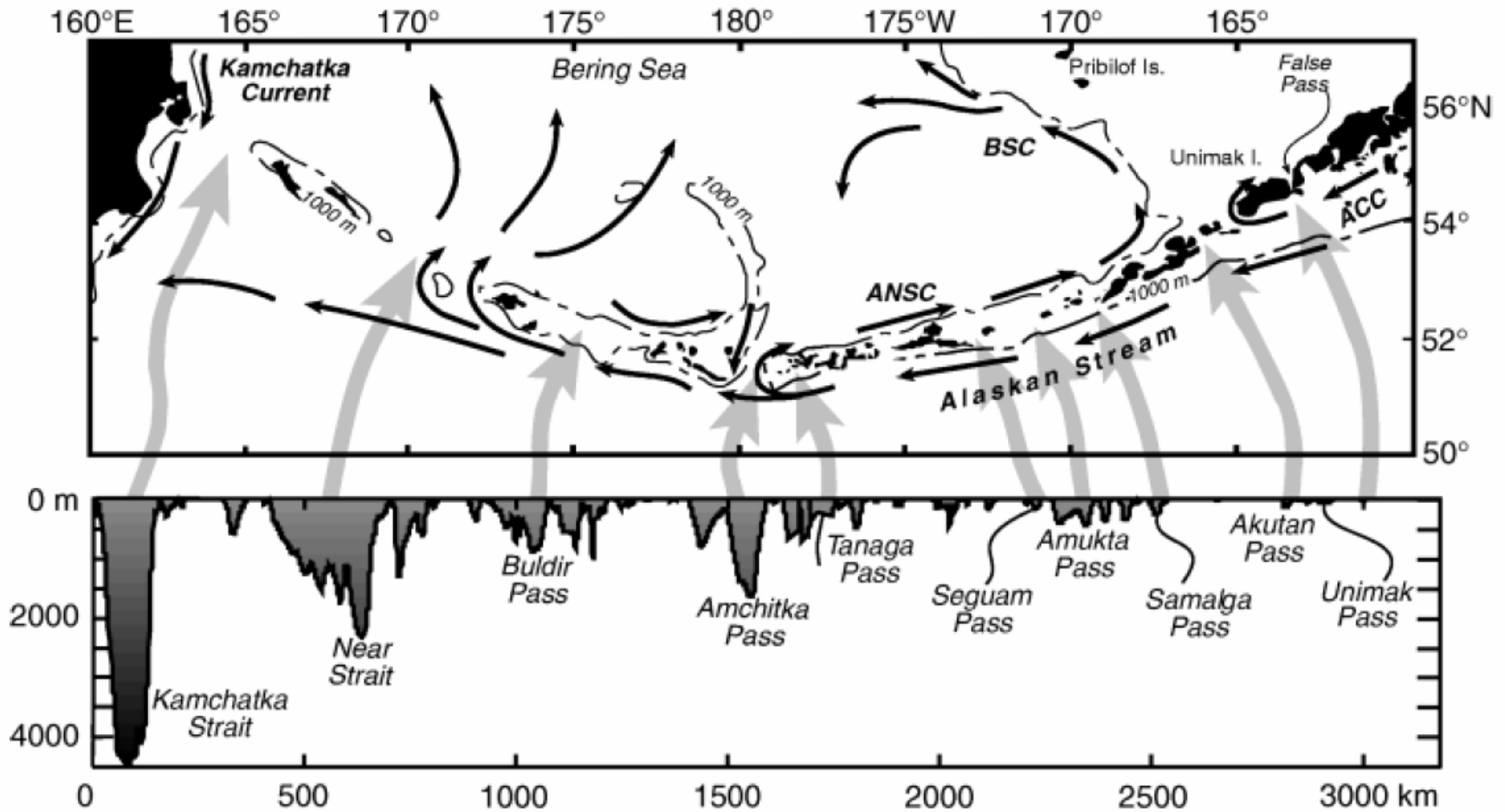


2,500 km island arc with over 300 islands and 40 volcanoes  
Near constant seismic activity as the Pacific plate slides under the North American Plate





# Aleutian Islands Physical relationships

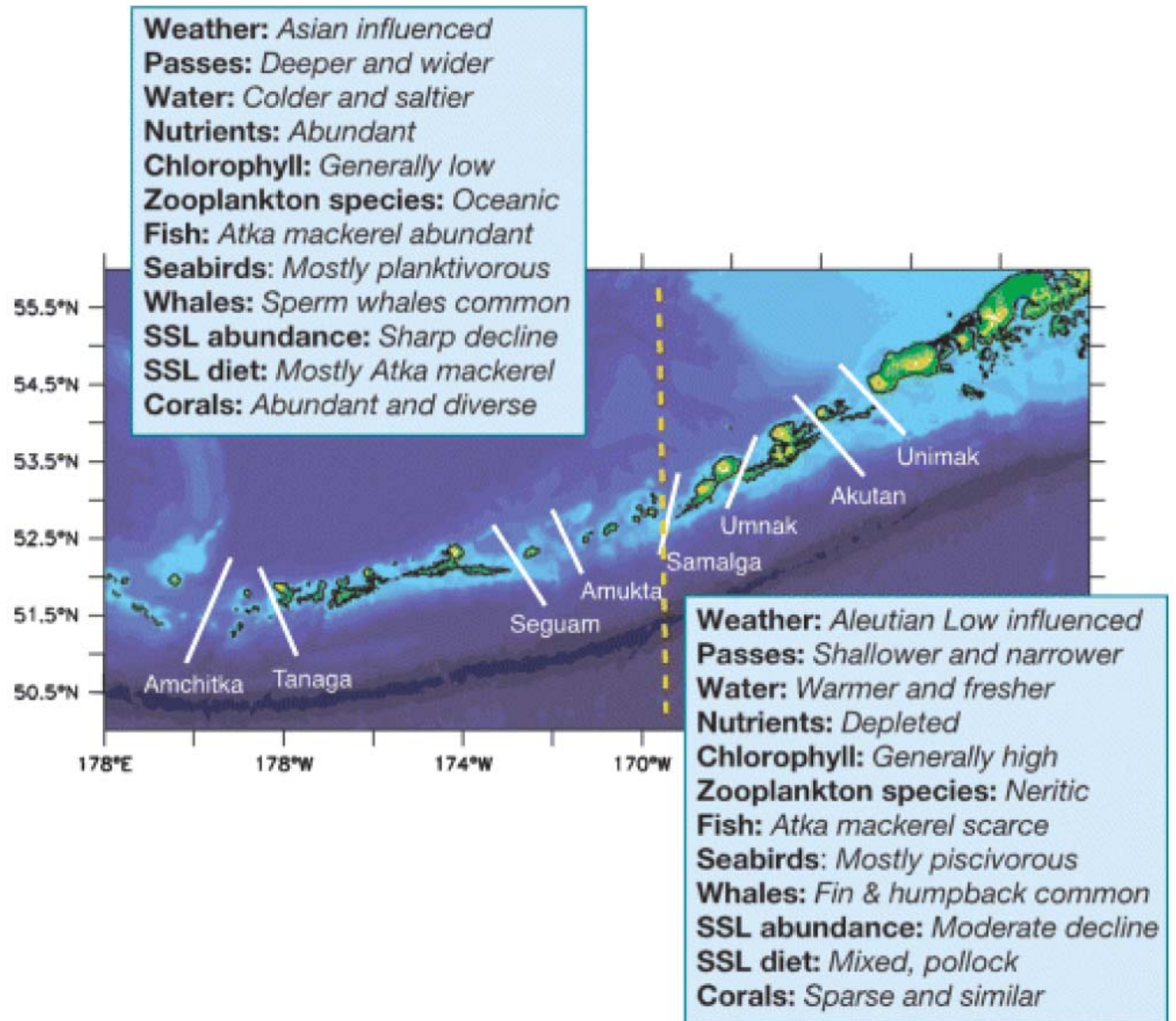


**Figure 3-6** The mean circulation along the Aleutian Arc is shown together with geographic place names, The lower panel shows the depth of the passes in the Aleutian Arc. Reprinted from Stabeno et al. 2005.

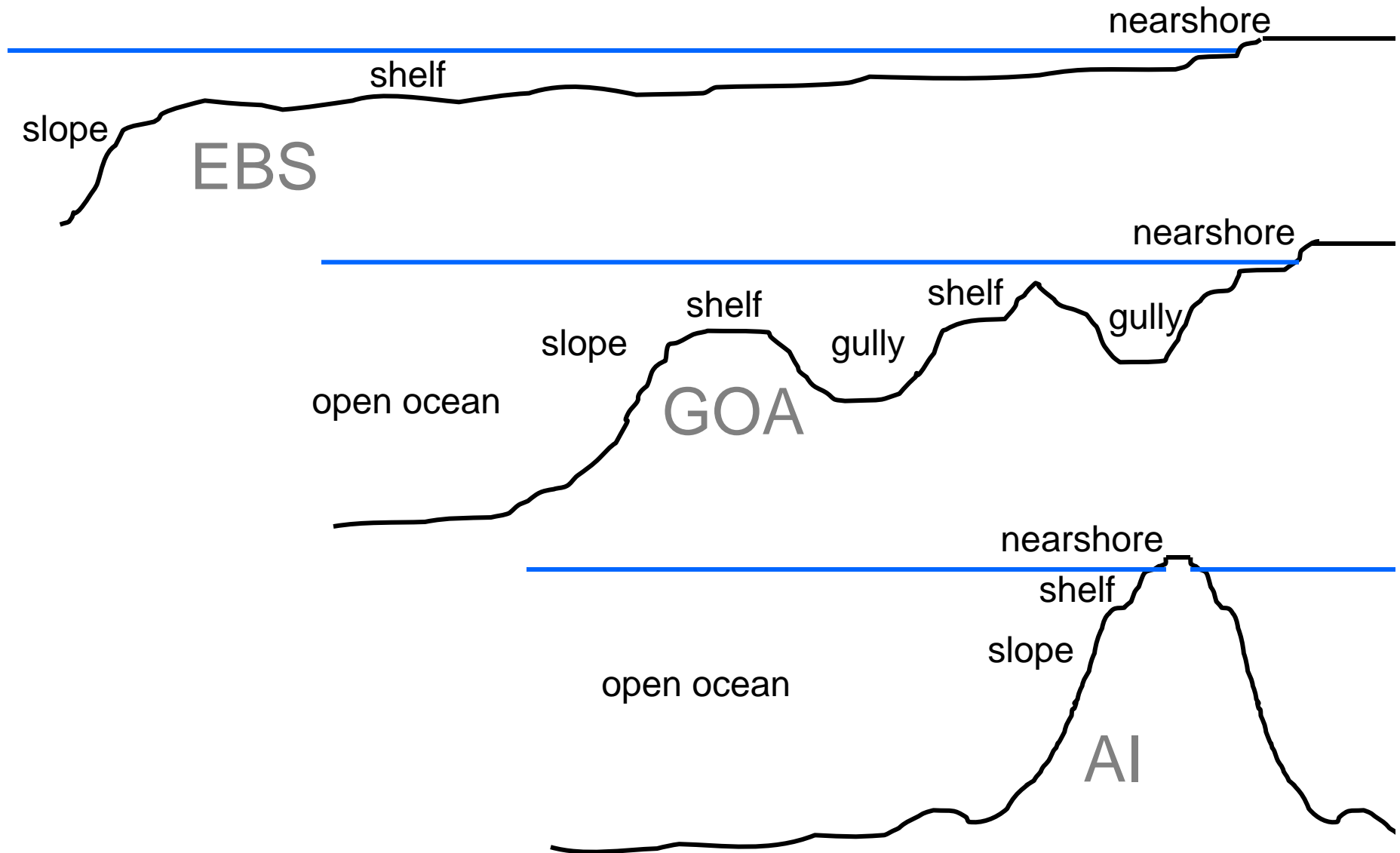
Note: ANSC = Aleutian North Slope Current, ACC = Alaska Coastal Current, BSC = Bering Sea Current.

# Aleutian Islands Physical relationships

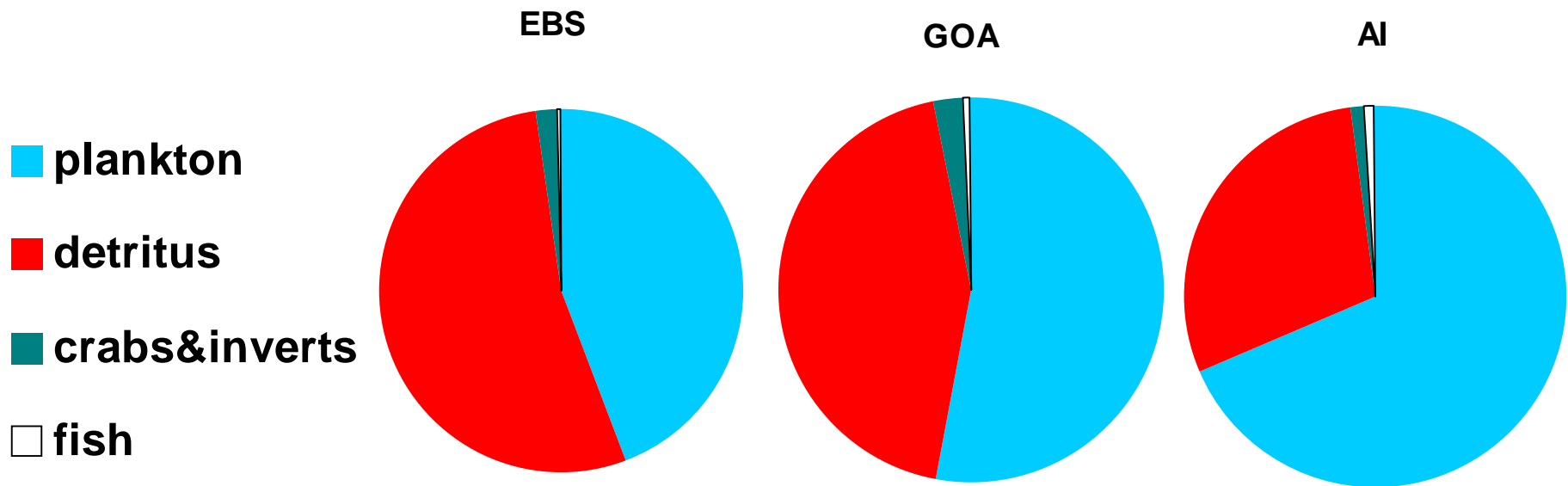
Along the chain, other physical and biological relationships continue to change through space (Ortiz 2007)



# Physical relationships affect energy flow



# Consumption in all three ecosystems

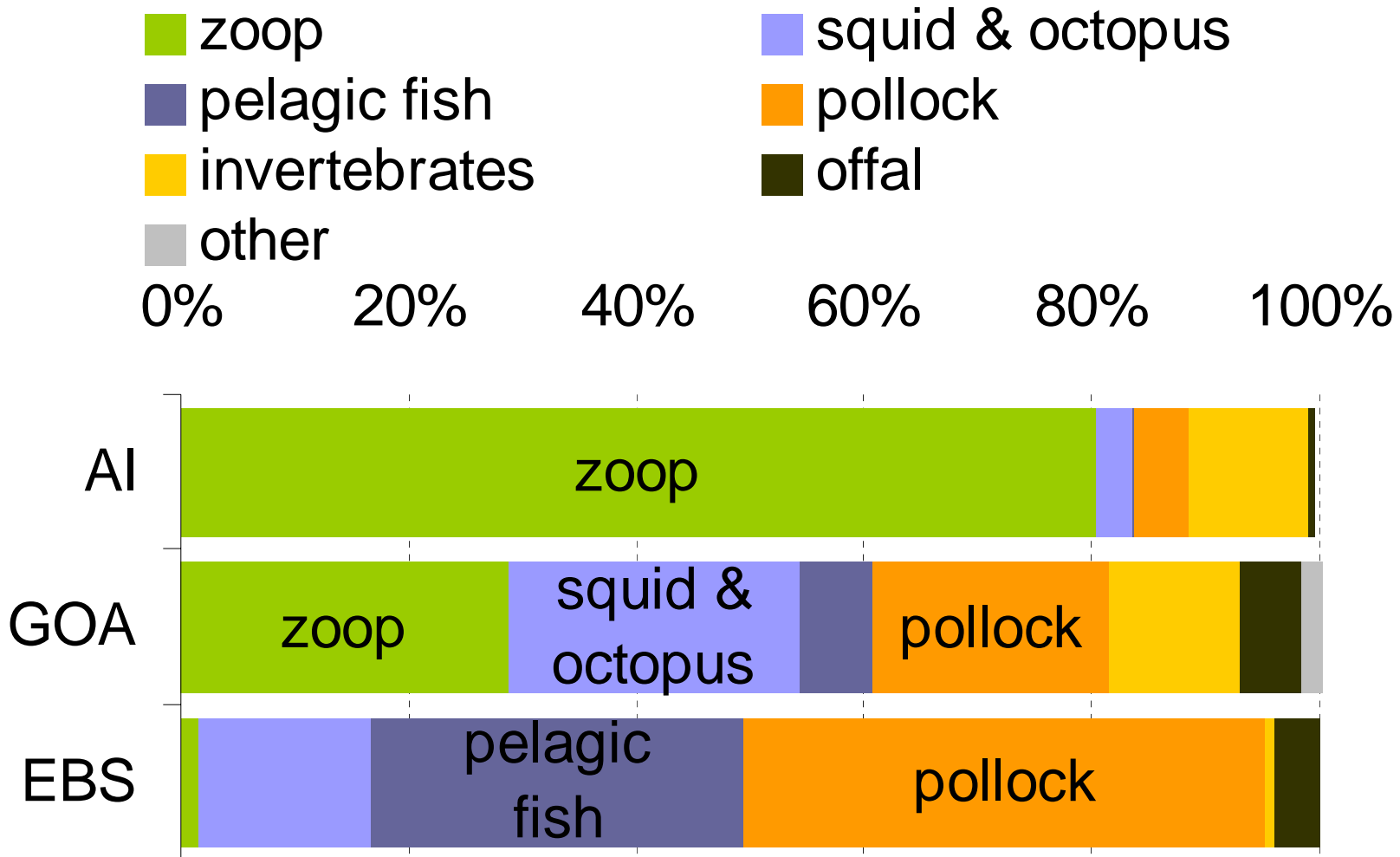


The Eastern Bering sea is **detritus / benthic** dominated

The Gulf of Alaska is intermediate

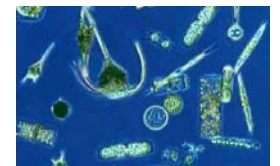
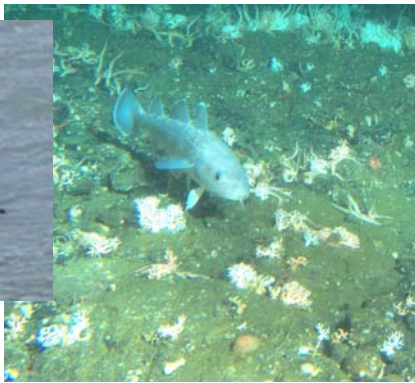
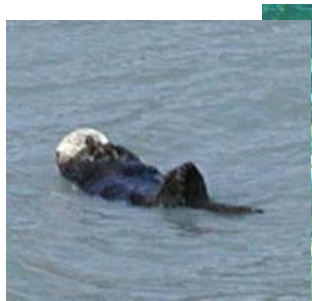
The Aleutian Islands is **plankton / pelagic** dominated

# Consumption by sablefish in all three systems

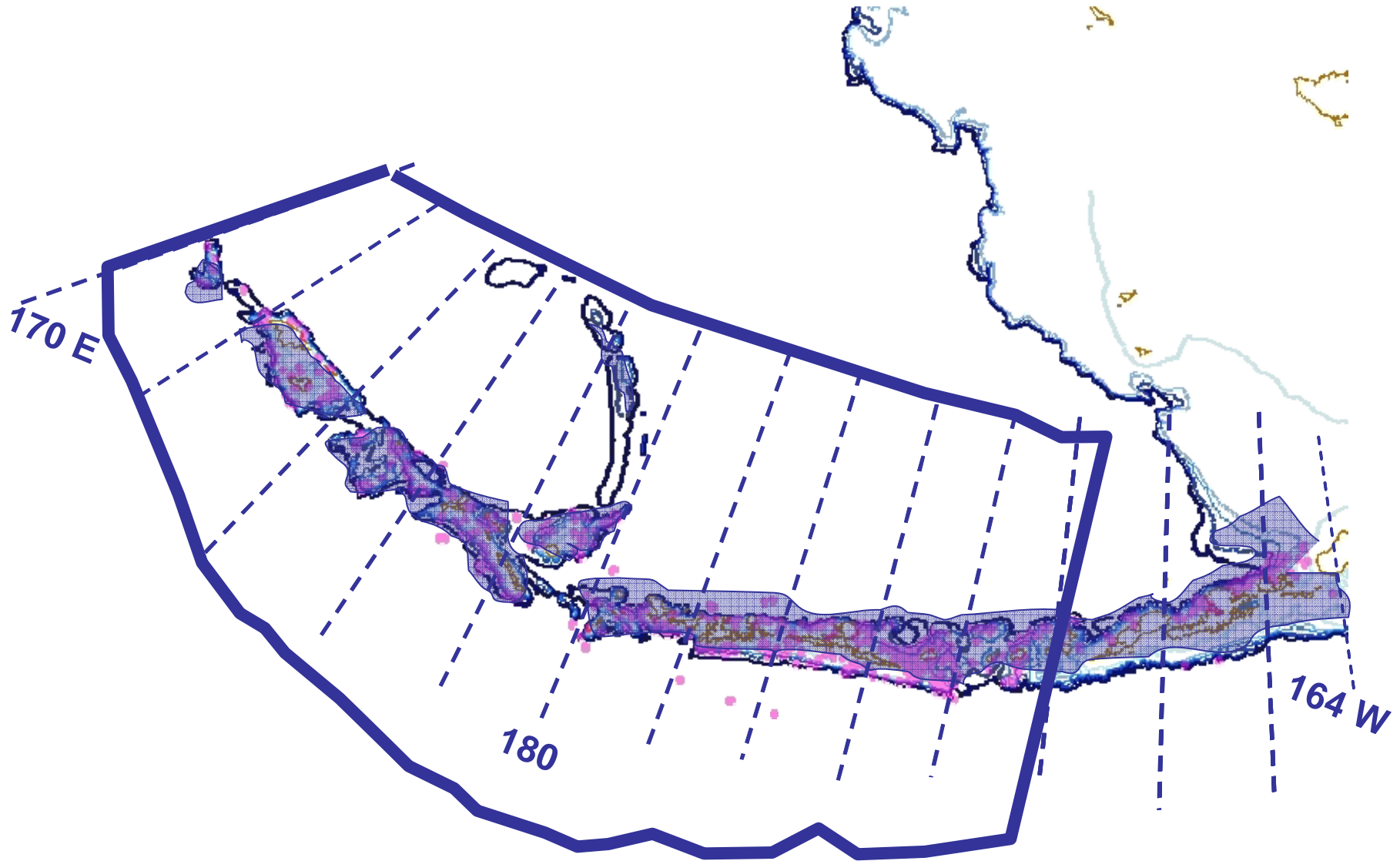


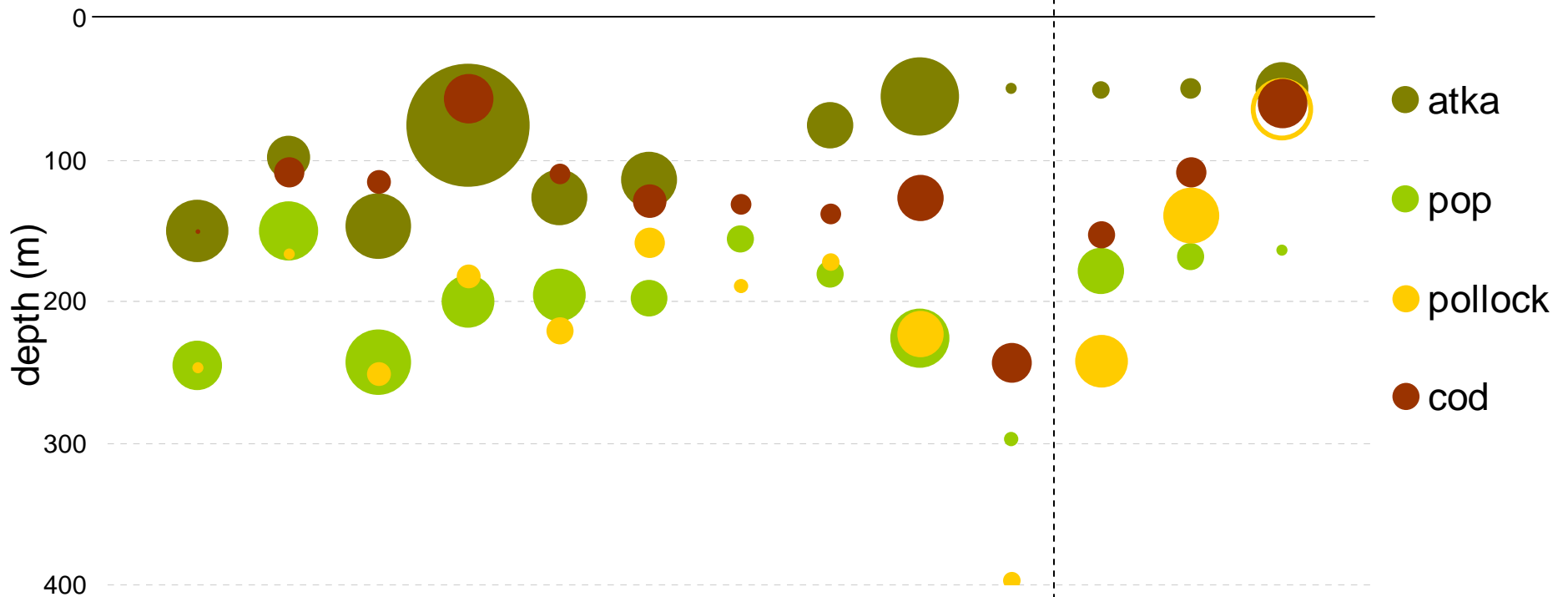
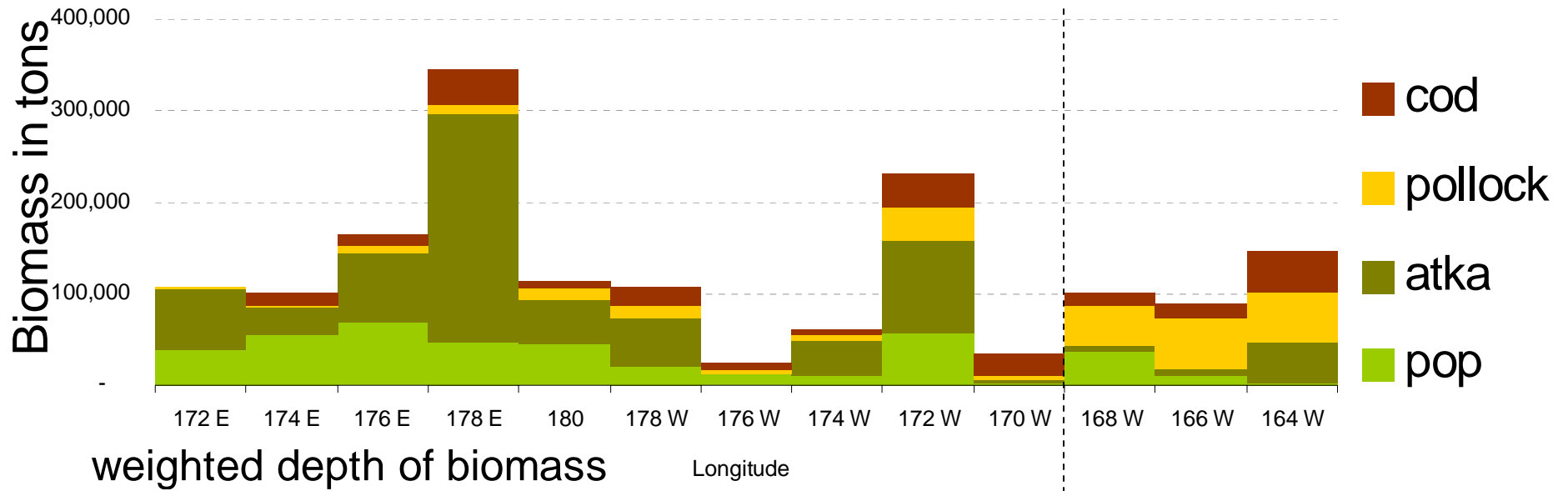


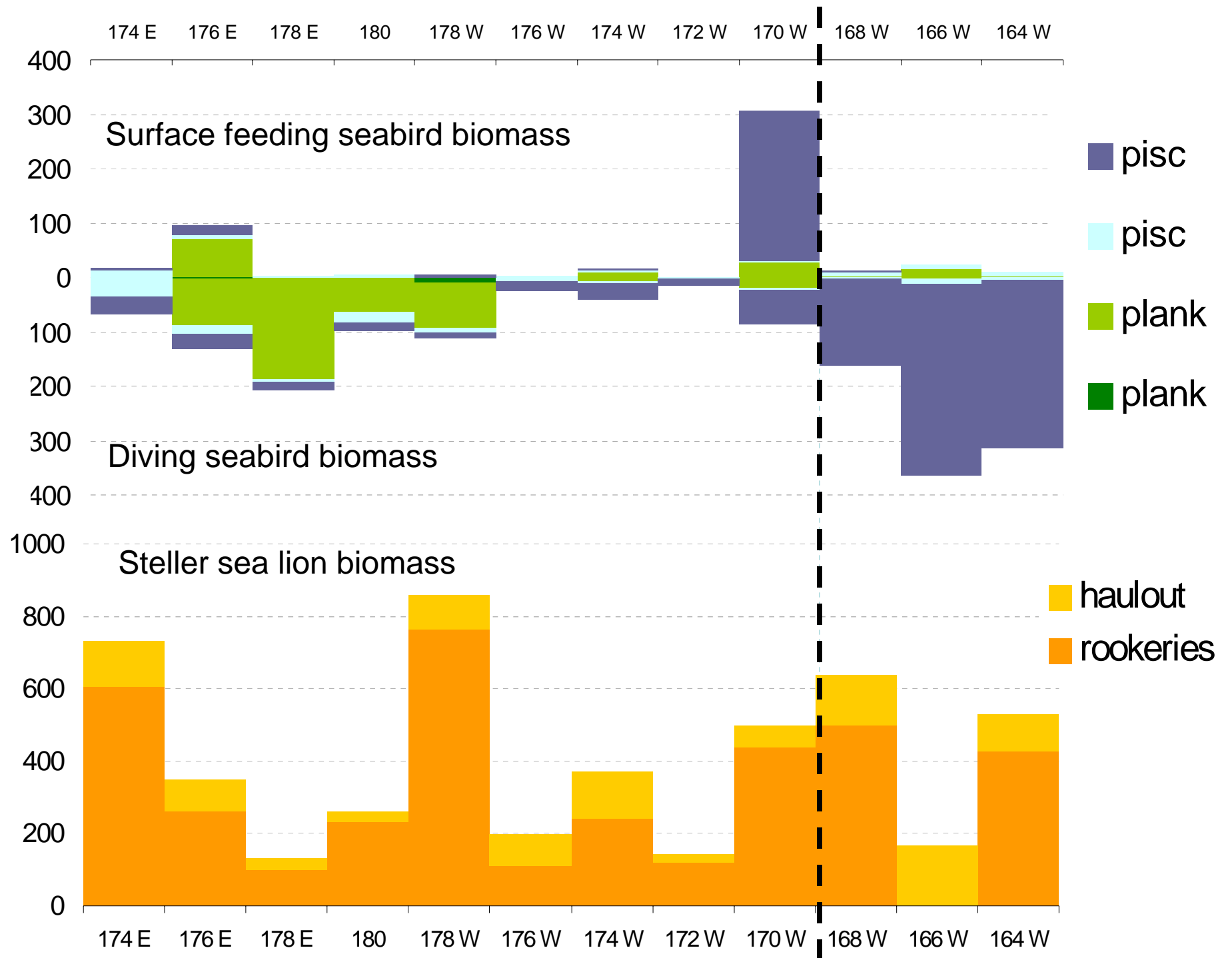
# Aleutian Islands Biological relationships



# Biological relationships: Survey data in 2 degree spatial blocks and by depth









# Building a model food web requires

Biomass (B)

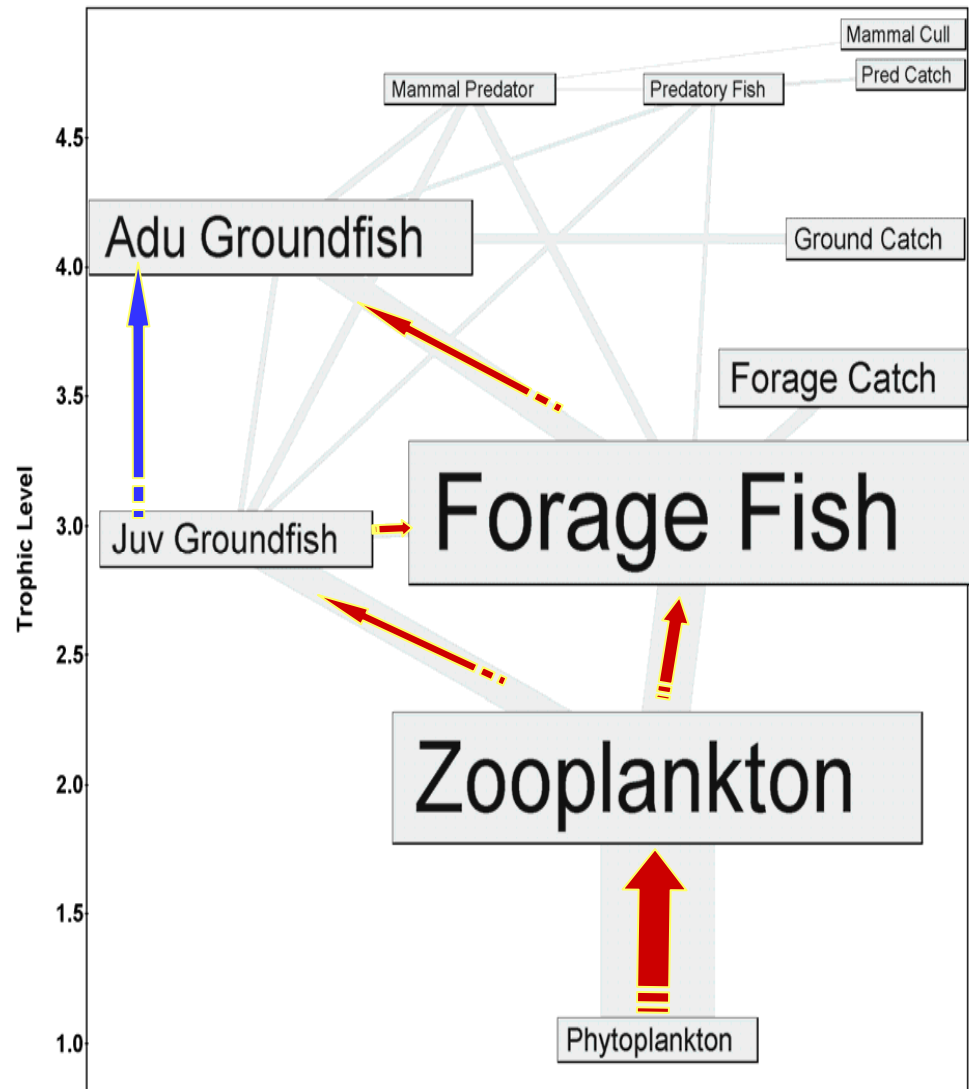
Population growth rate  
or Production (P/B)

Fishery catch (F)

Consumption (Q/B)

Diet comp (DC)

For ALL groups!!



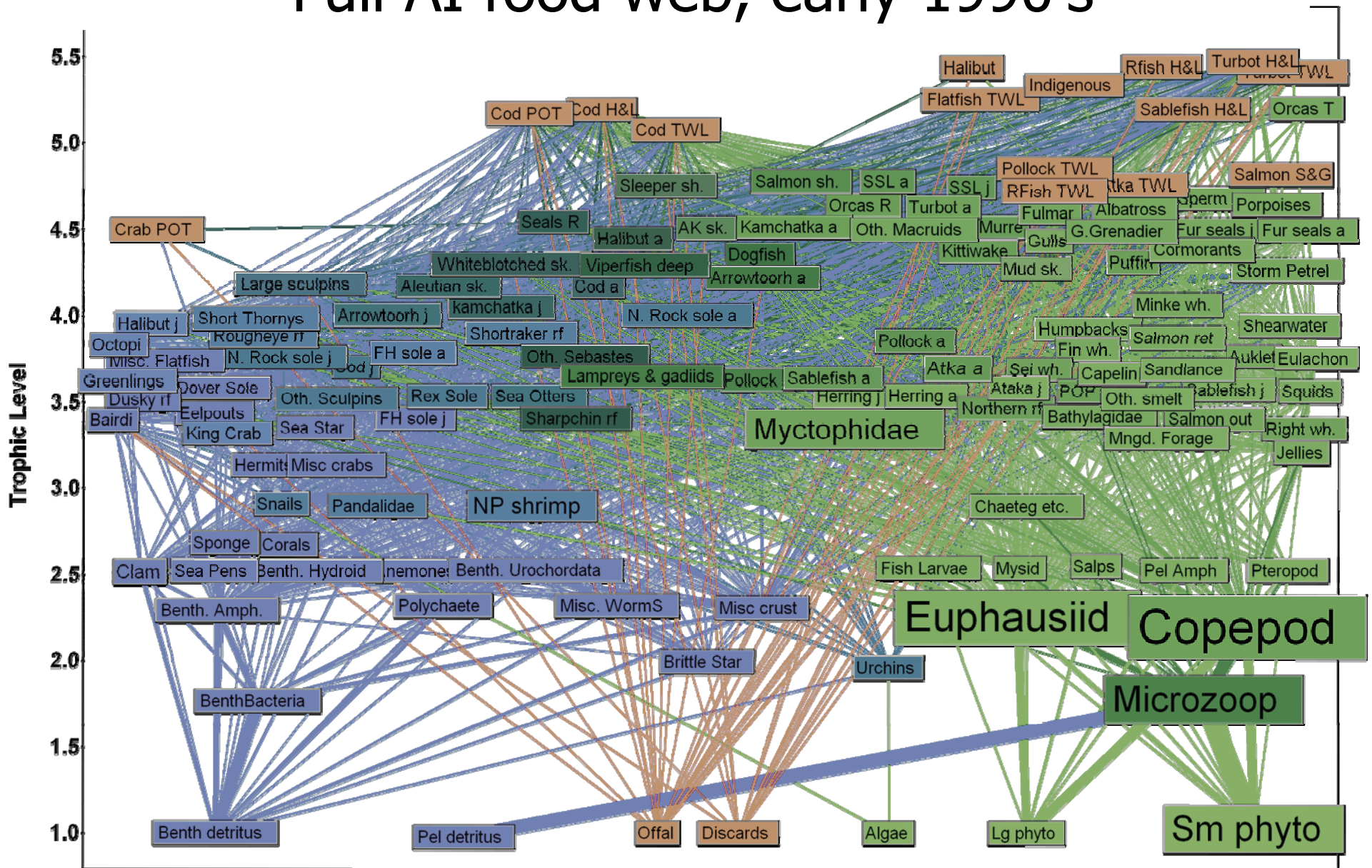


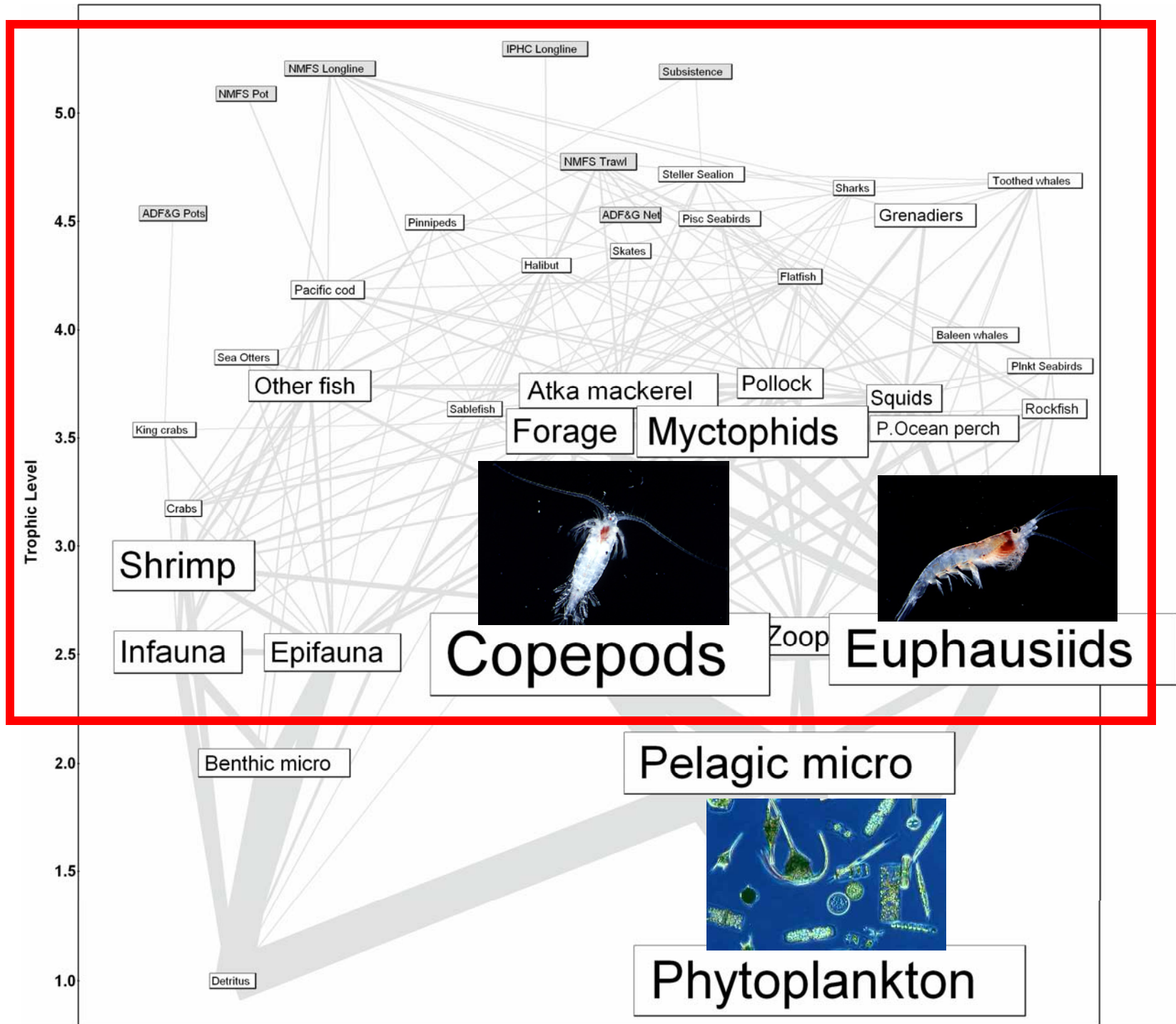
# Information sources for modeling

- ✓  Standard stock assessment data
  - Biomass or abundance index
  - Productivity information
- ✓  Fishery observation
  - Commercial catch
  - Incidental catch and discards
- ✓  Food habits collections
  - Multiple species and trophic levels
  - Multiple seasons



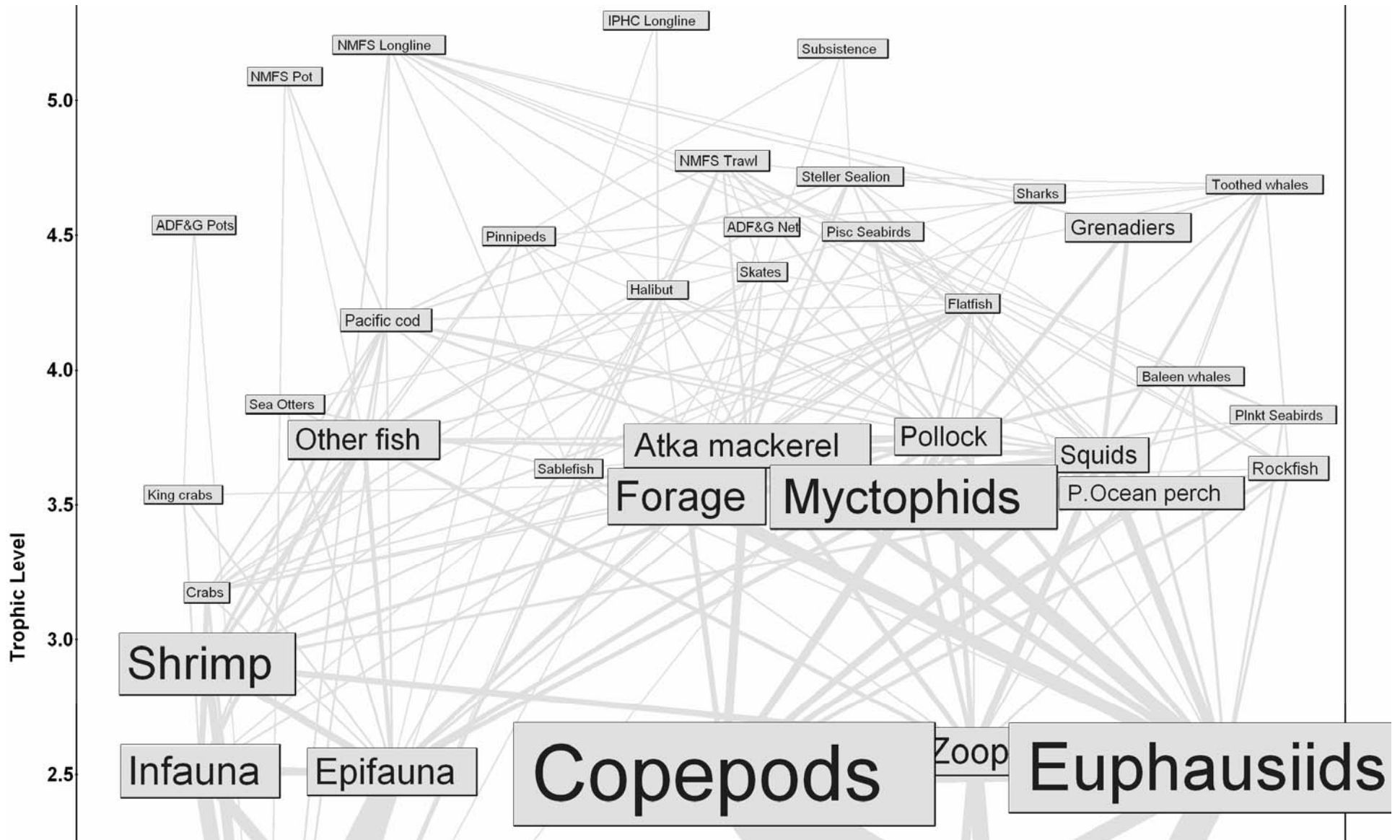
# Full AI food web, early 1990's



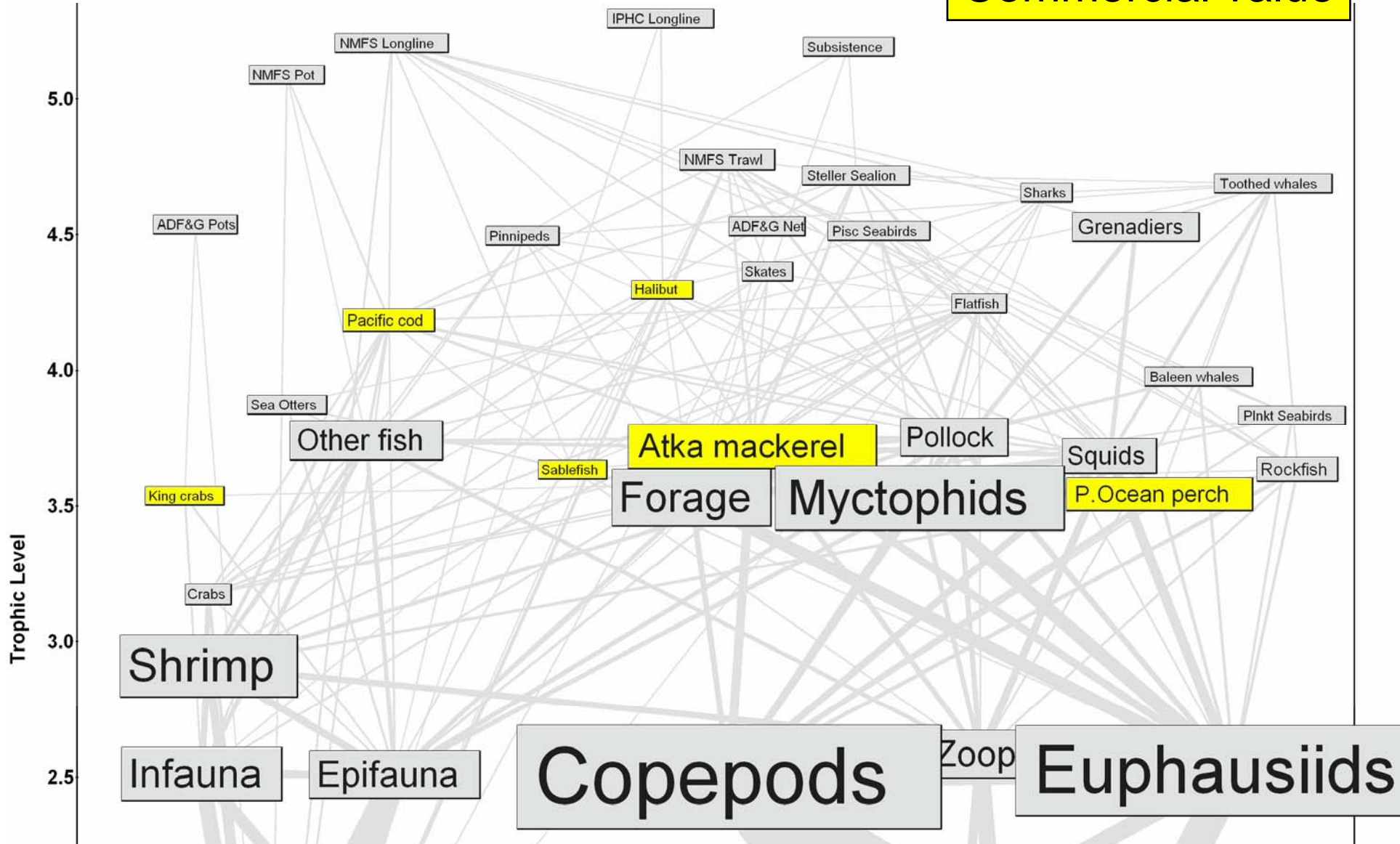




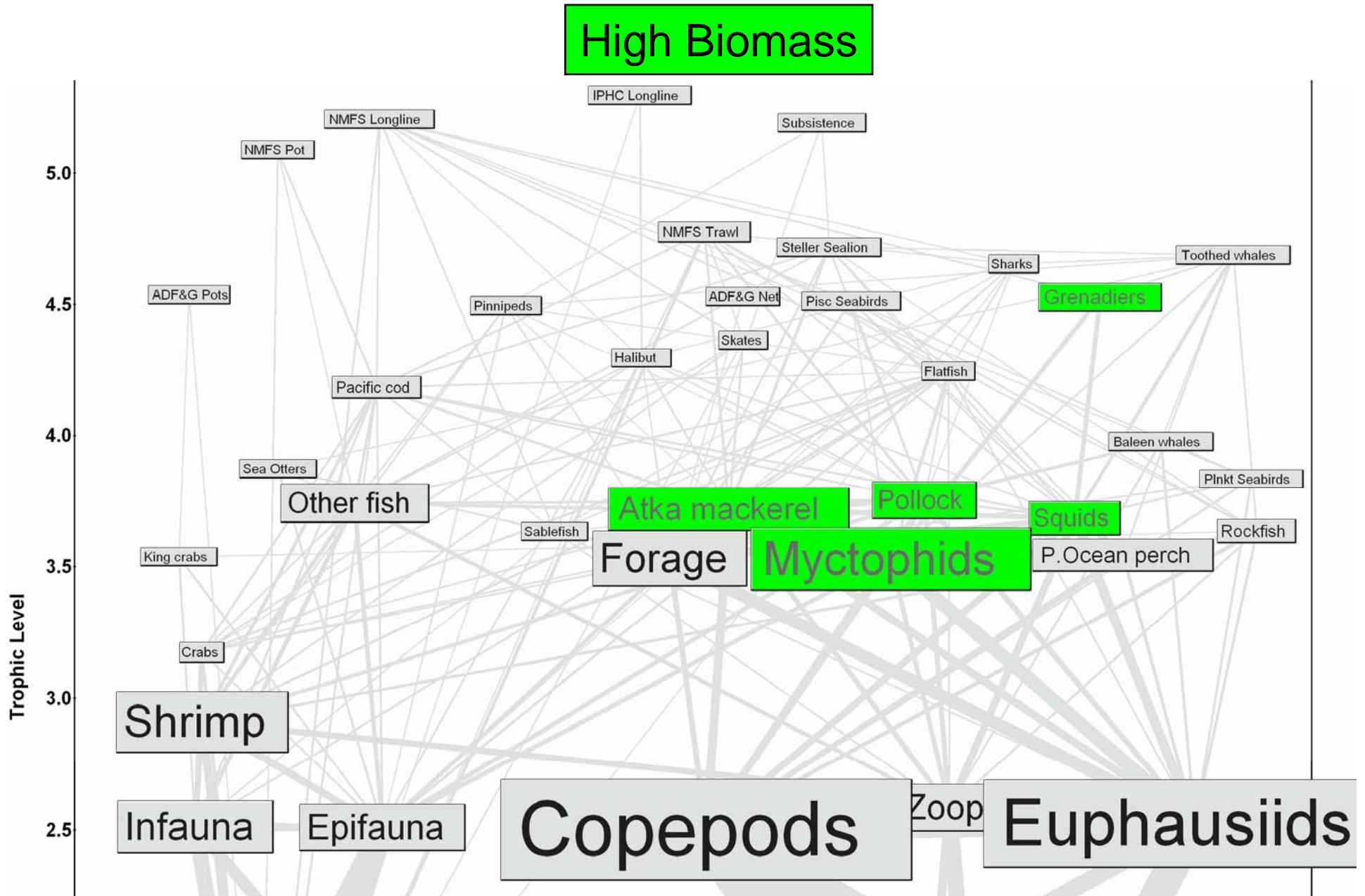
# Viewing the food web through our focus species



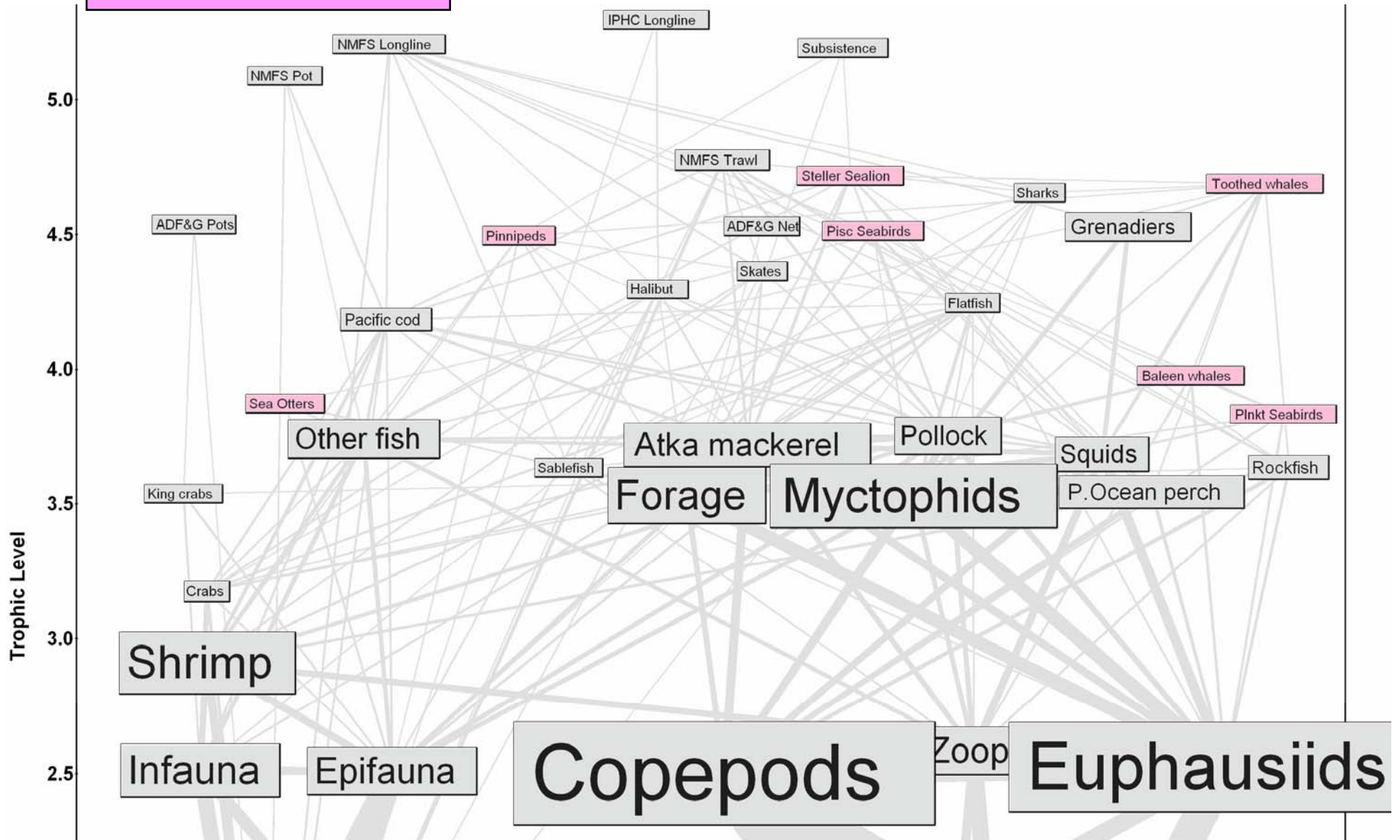
# Commercial value







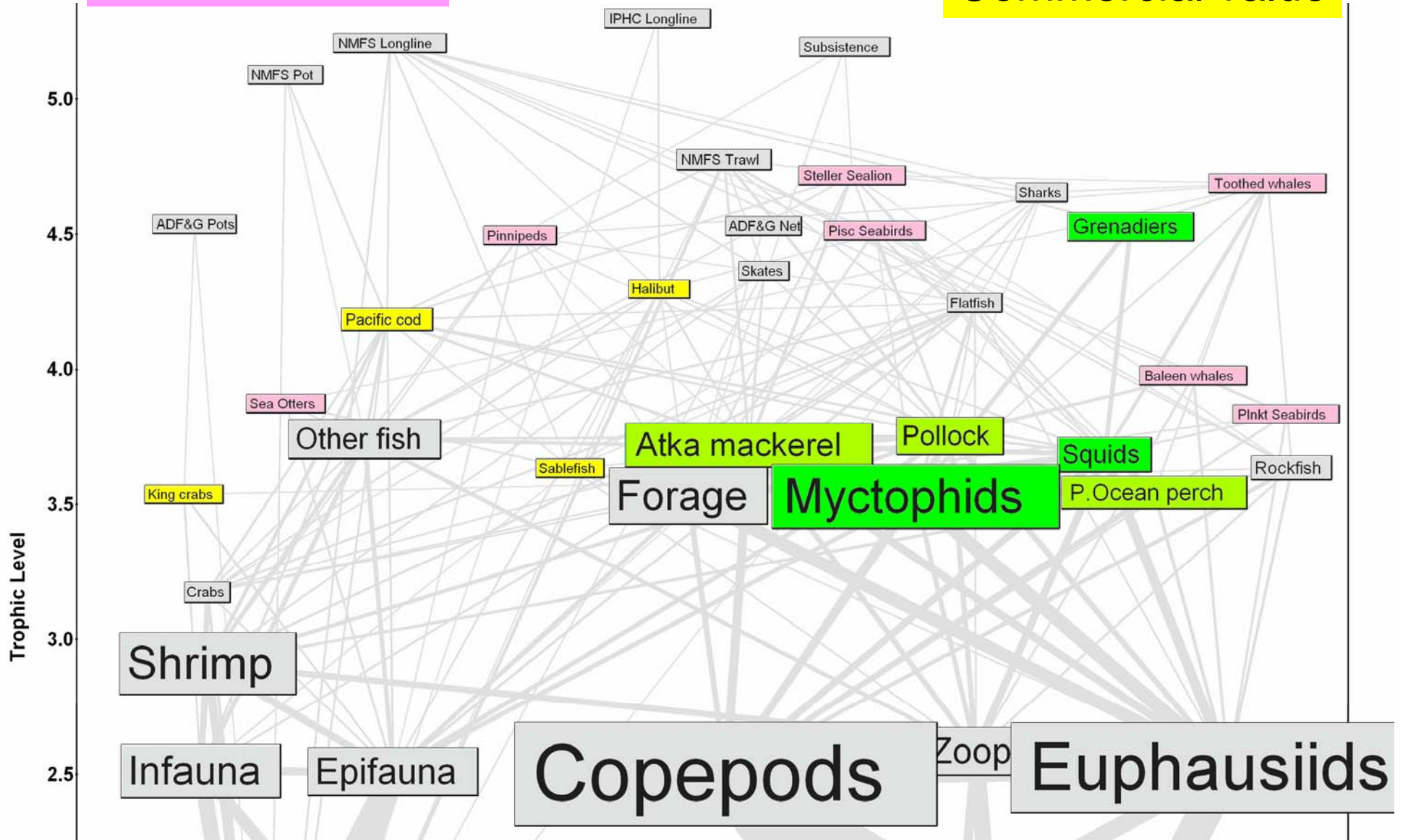
# Protected status



Protected status

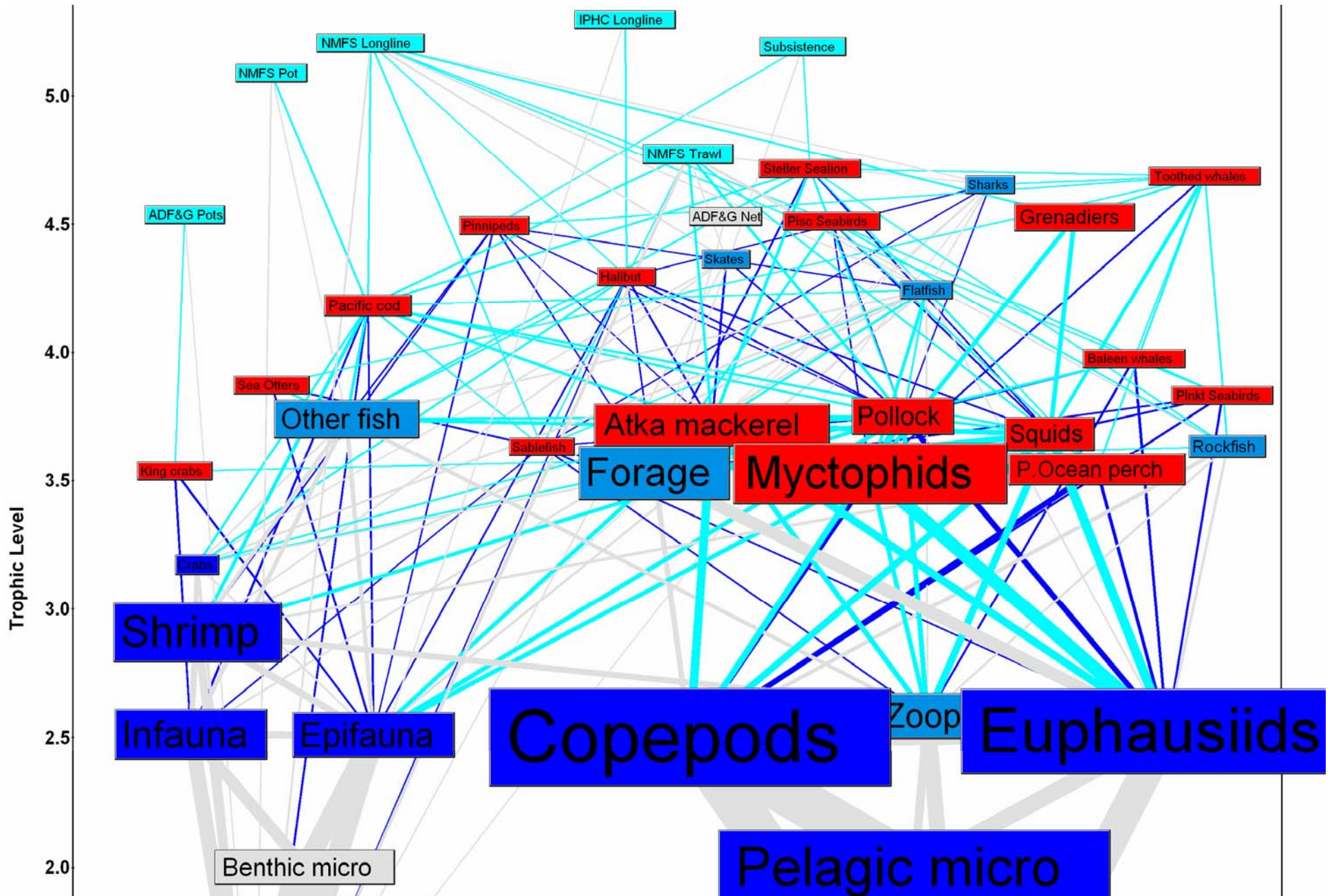
High Biomass

Commercial value



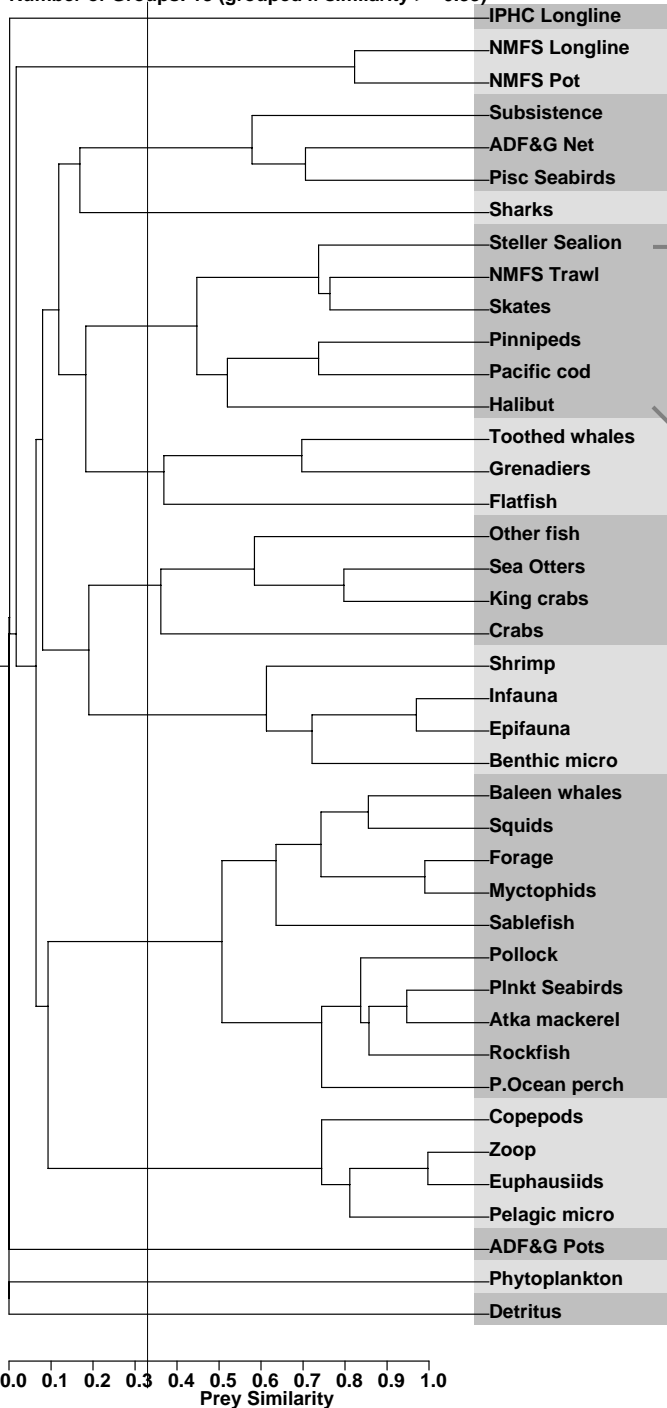


# Focus species interact with most of the food web

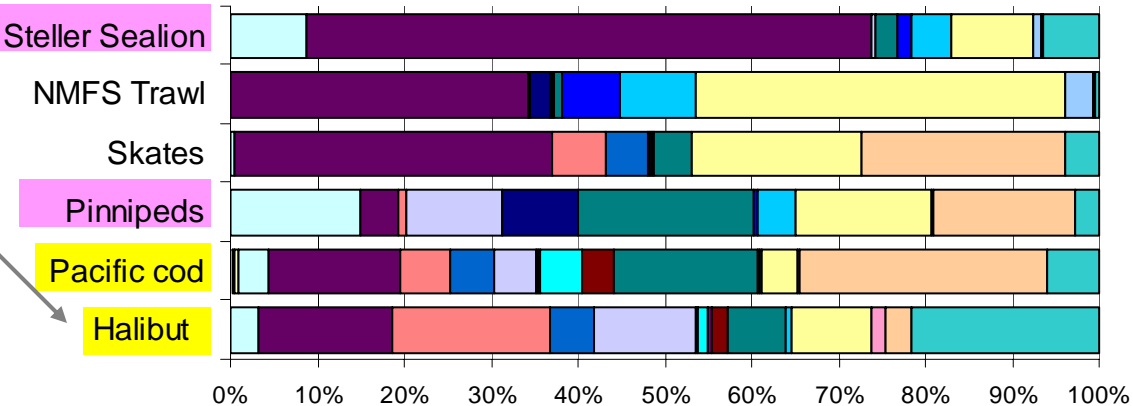


Number of Groups: 13 (grouped if similarity >= 0.33)

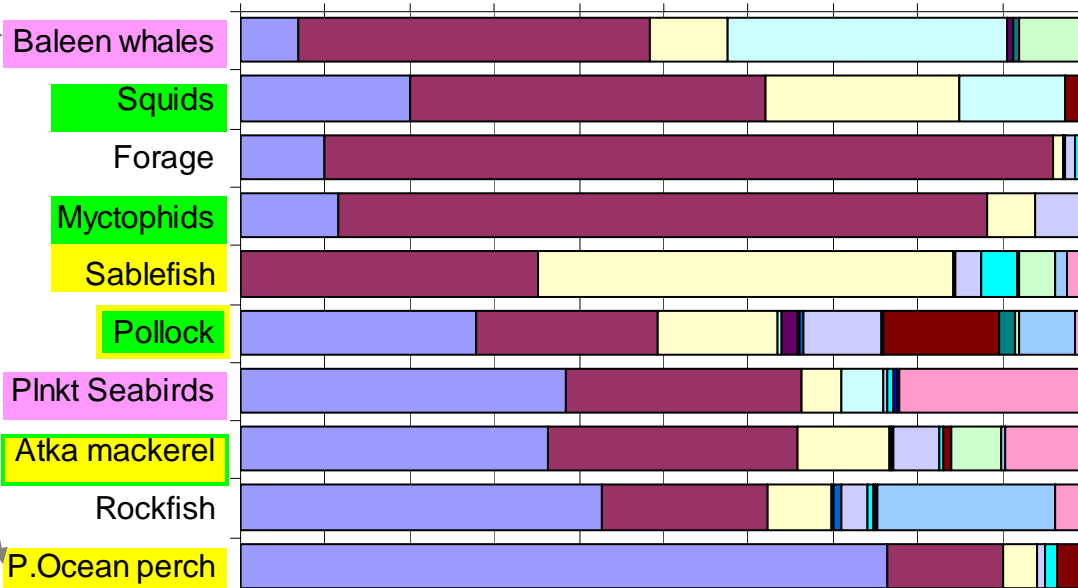
# Groups with similar diets



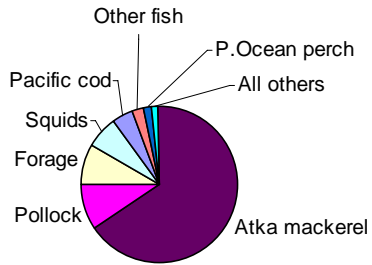
■ Forage 
 ■ Atka mackerel 
 ■ Crabs 
 ■ P.Ocean perch 
 ■ Pacific cod 
 ■ Pollock 
 ■ Shrimp 
 ■ Squids



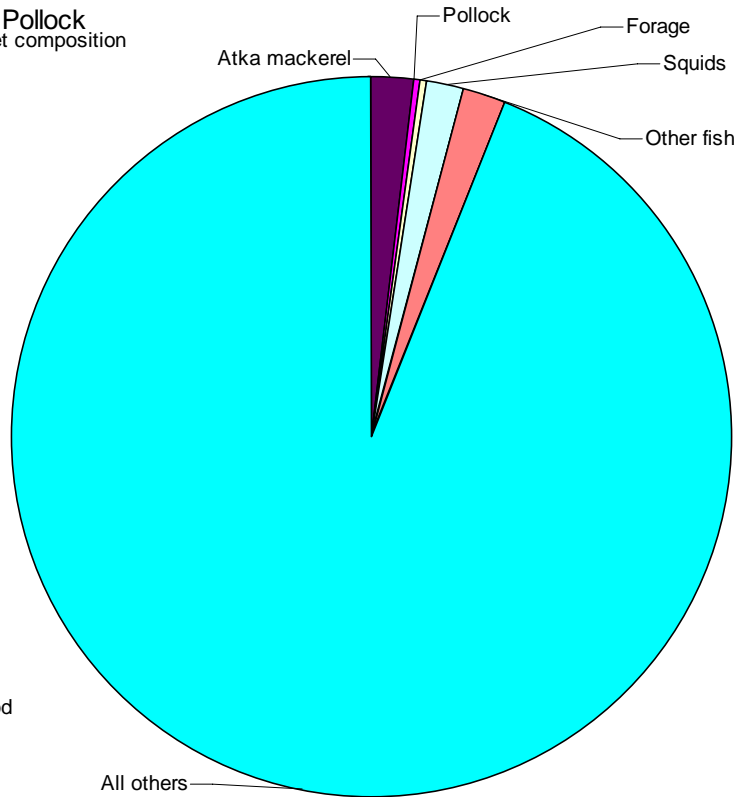
■ Copepods 
 ■ Euphausiids 
 ■ Zoop 
 ■ Forage



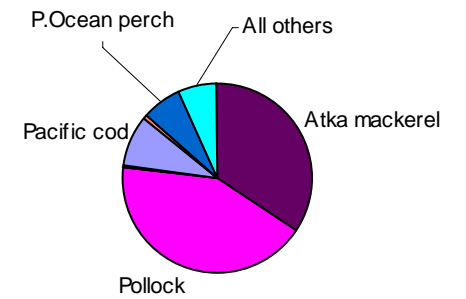
Steller Sealion diet composition



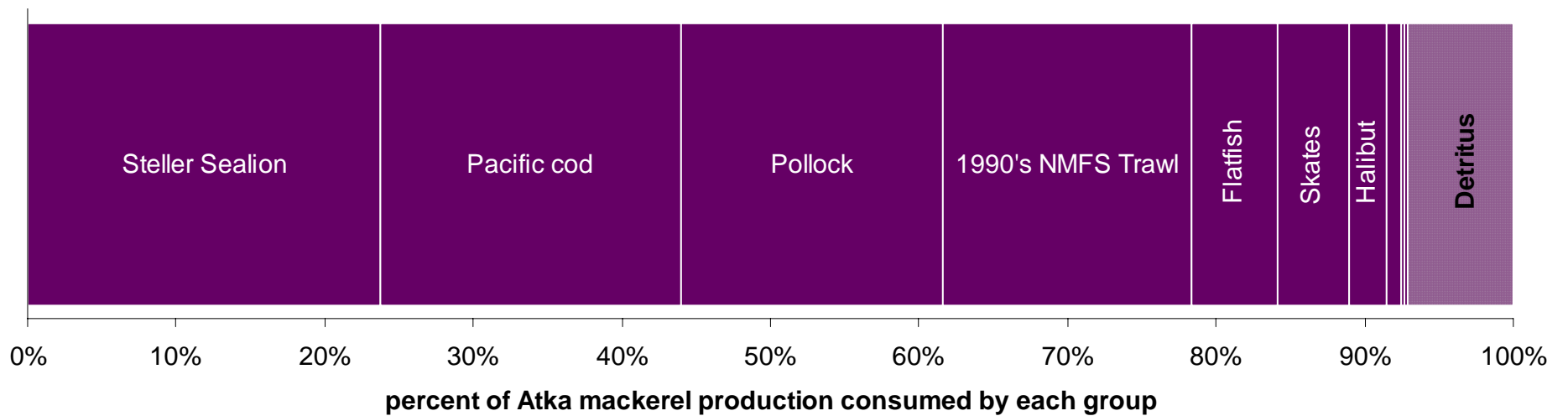
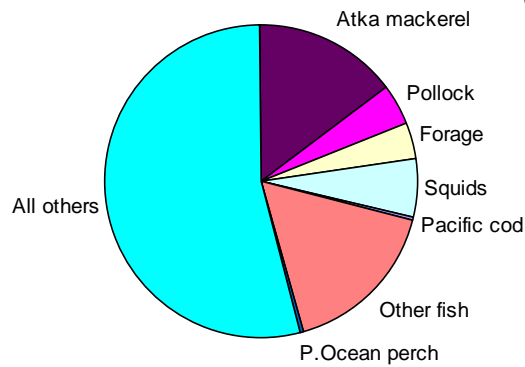
Pollock diet composition



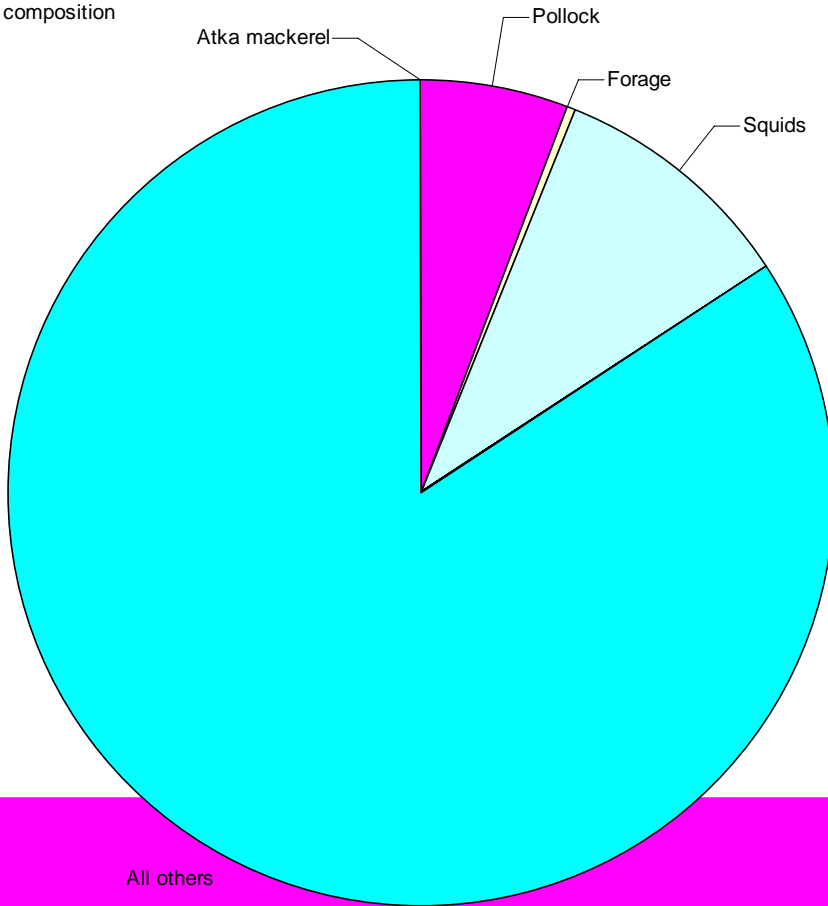
1990's NMFS Trawl catch composition



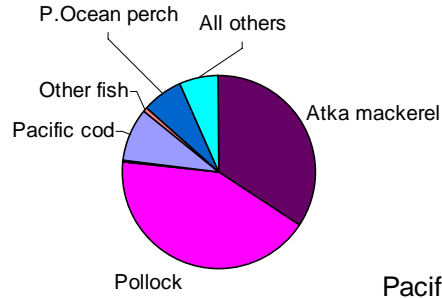
Pacific cod diet composition



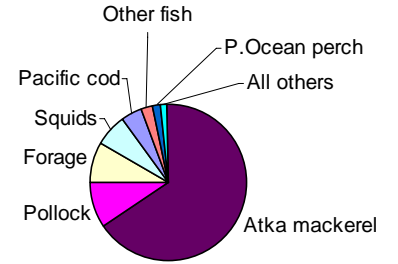
Atka mackerel diet composition



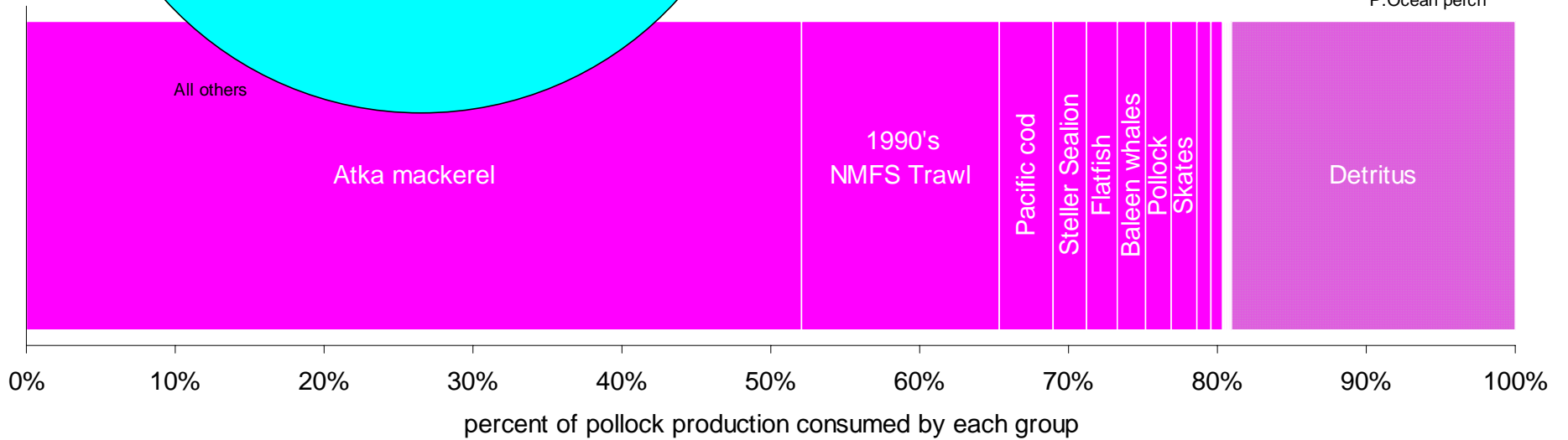
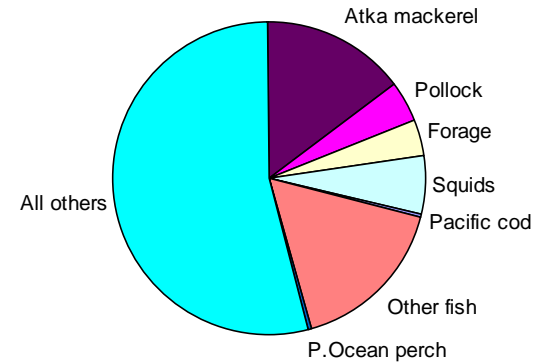
1990's NMFS Trawl catch



Steller Sealion diet composition

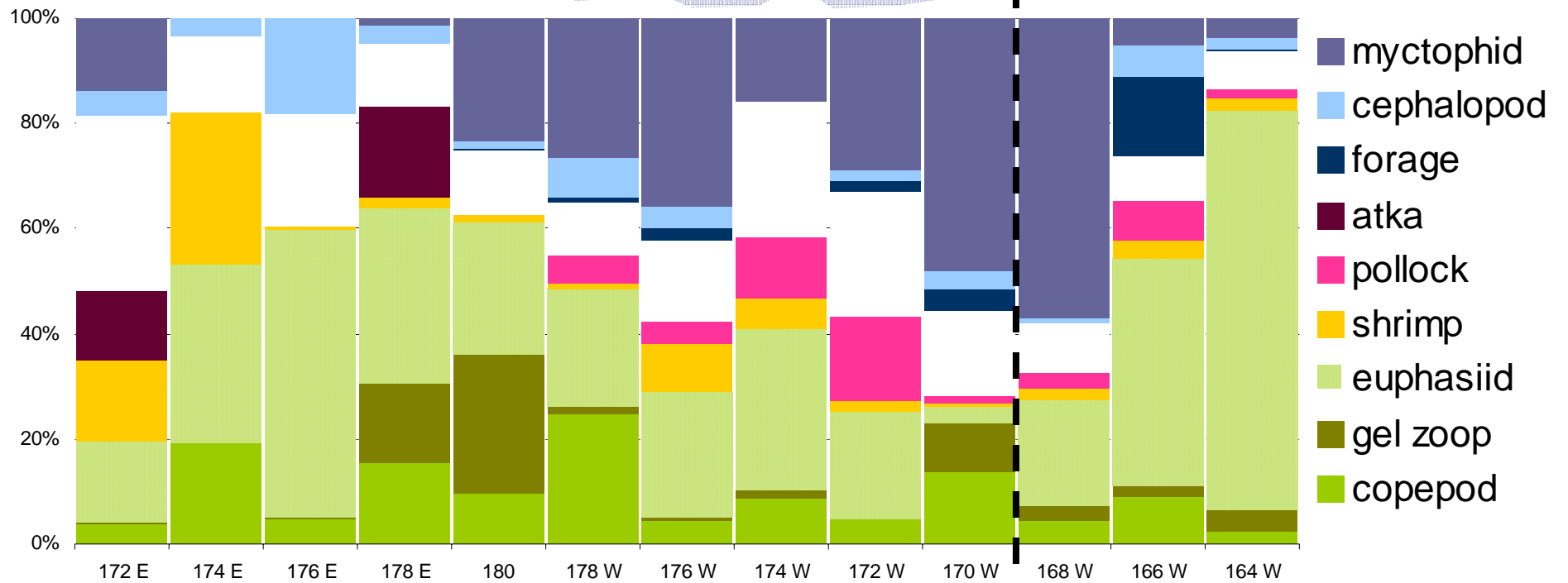
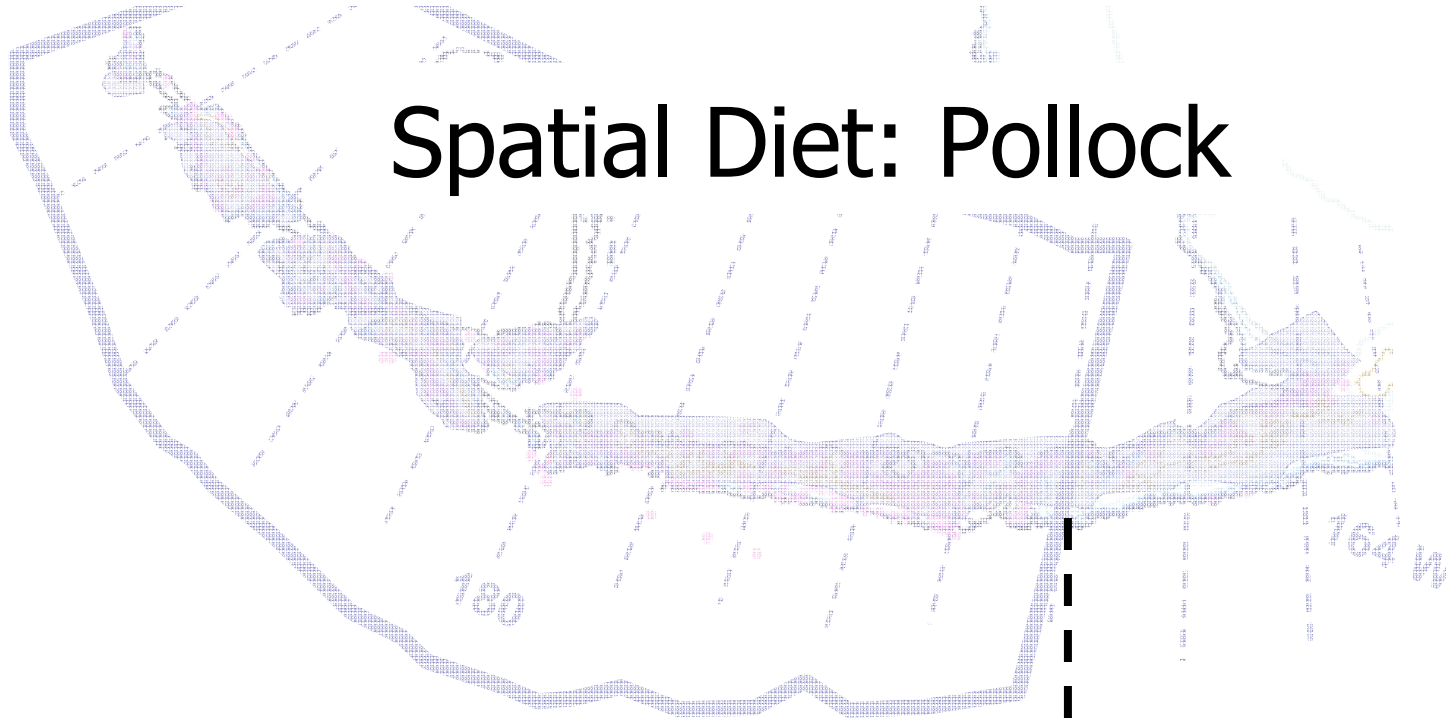


Pacific cod diet composition



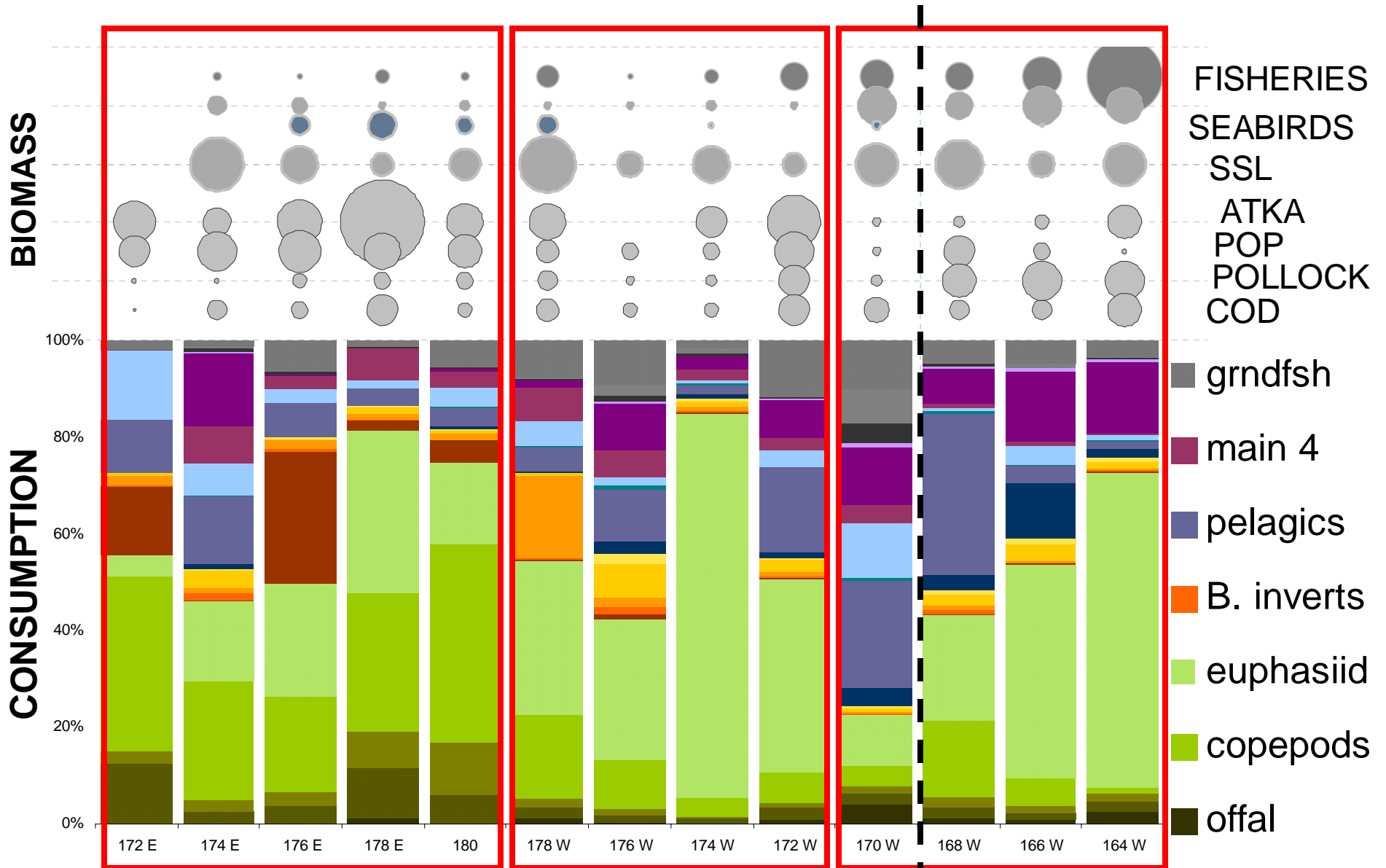


# Spatial Diet: Pollock

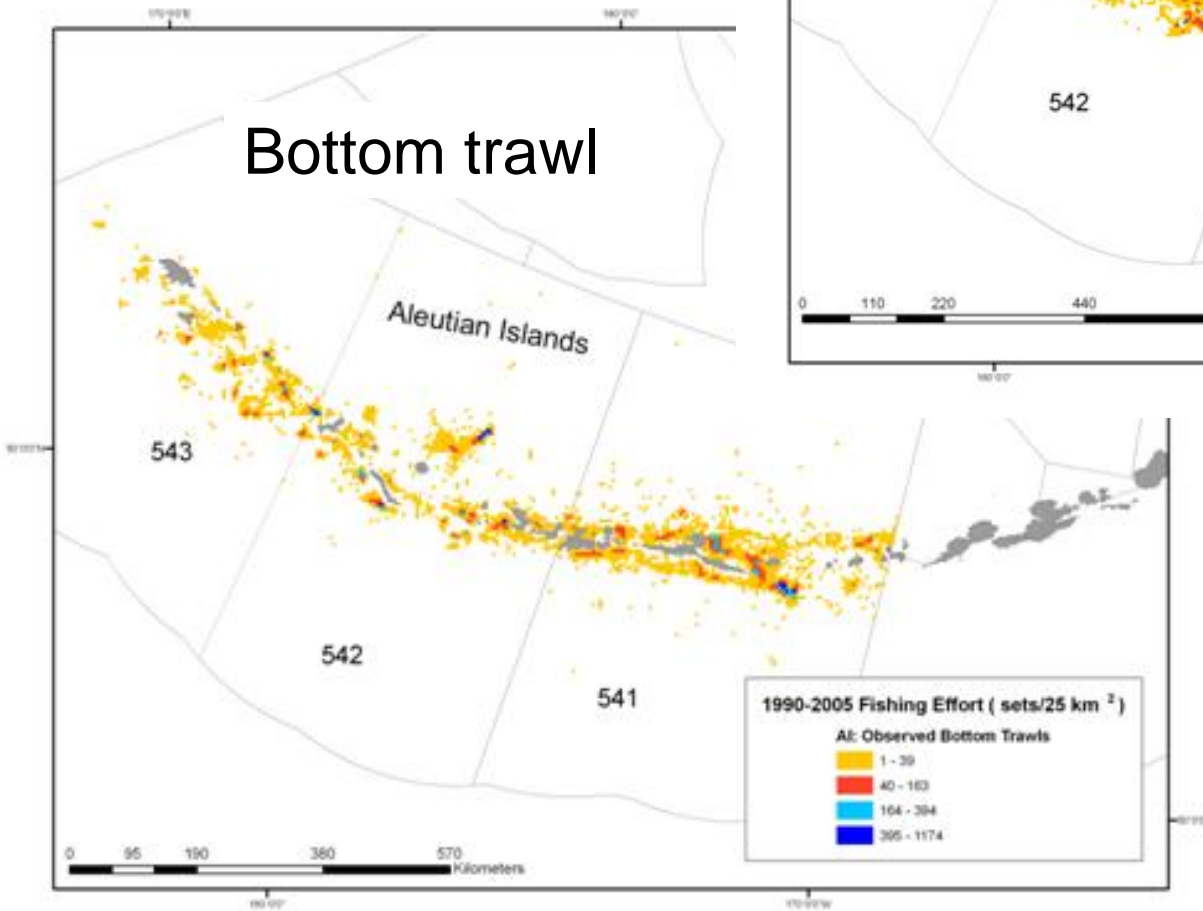
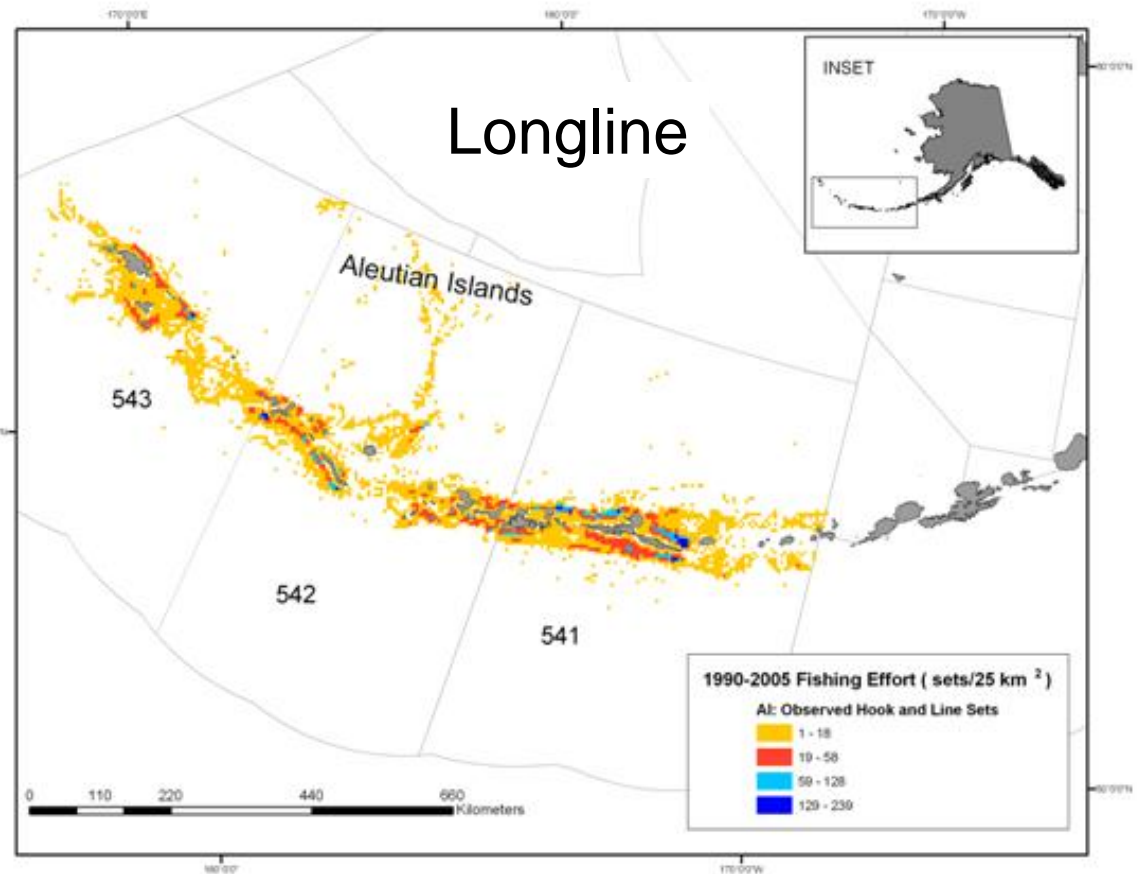




# AI Food webs: location, location, location

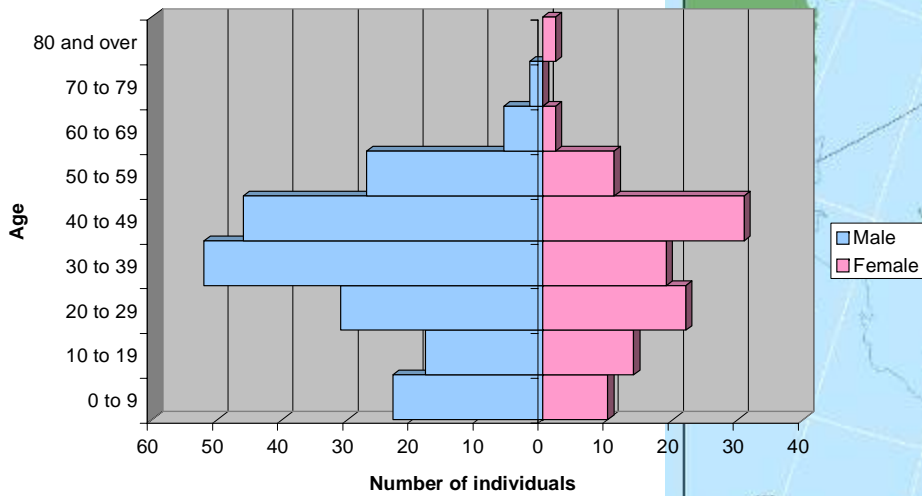


# Socioeconomic relationships: Fishing patterns 1990-2005



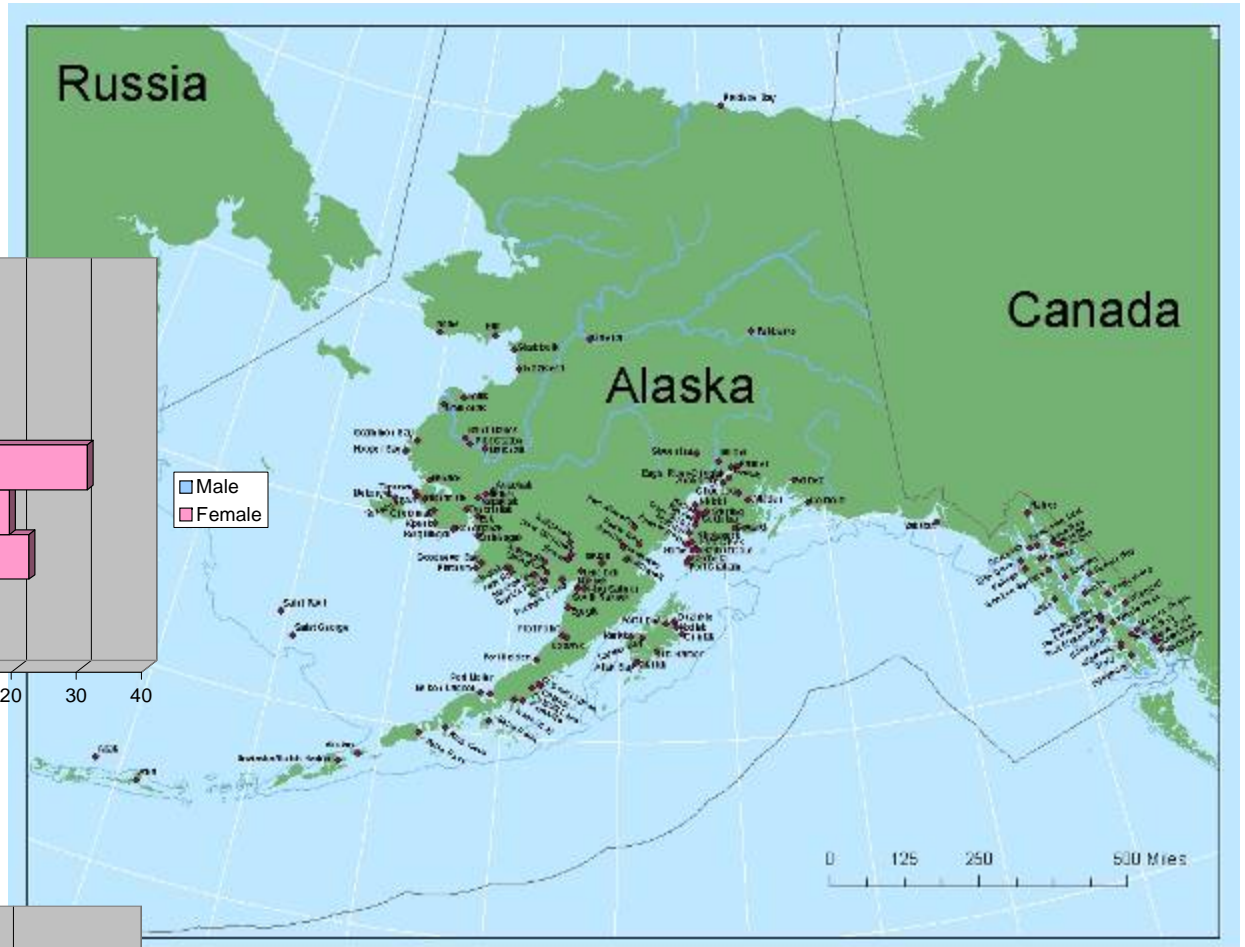
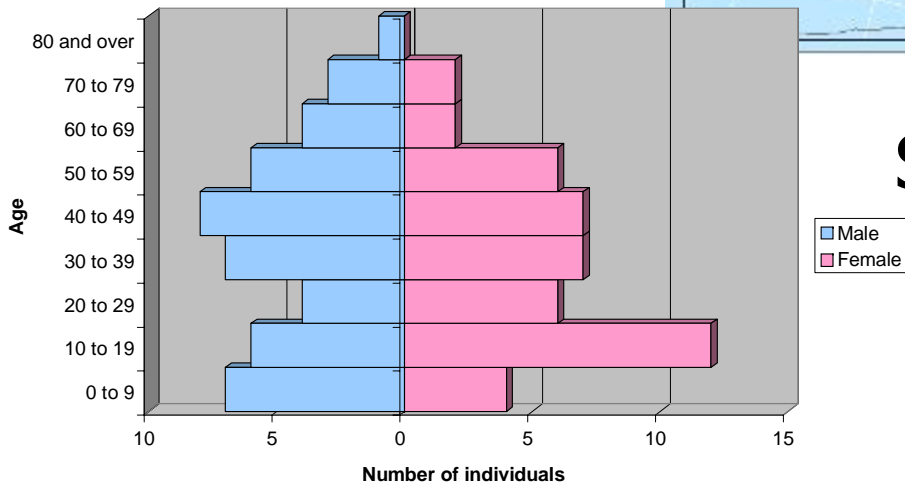
**2000 Population Structure  
Adak**

Data source: US Census



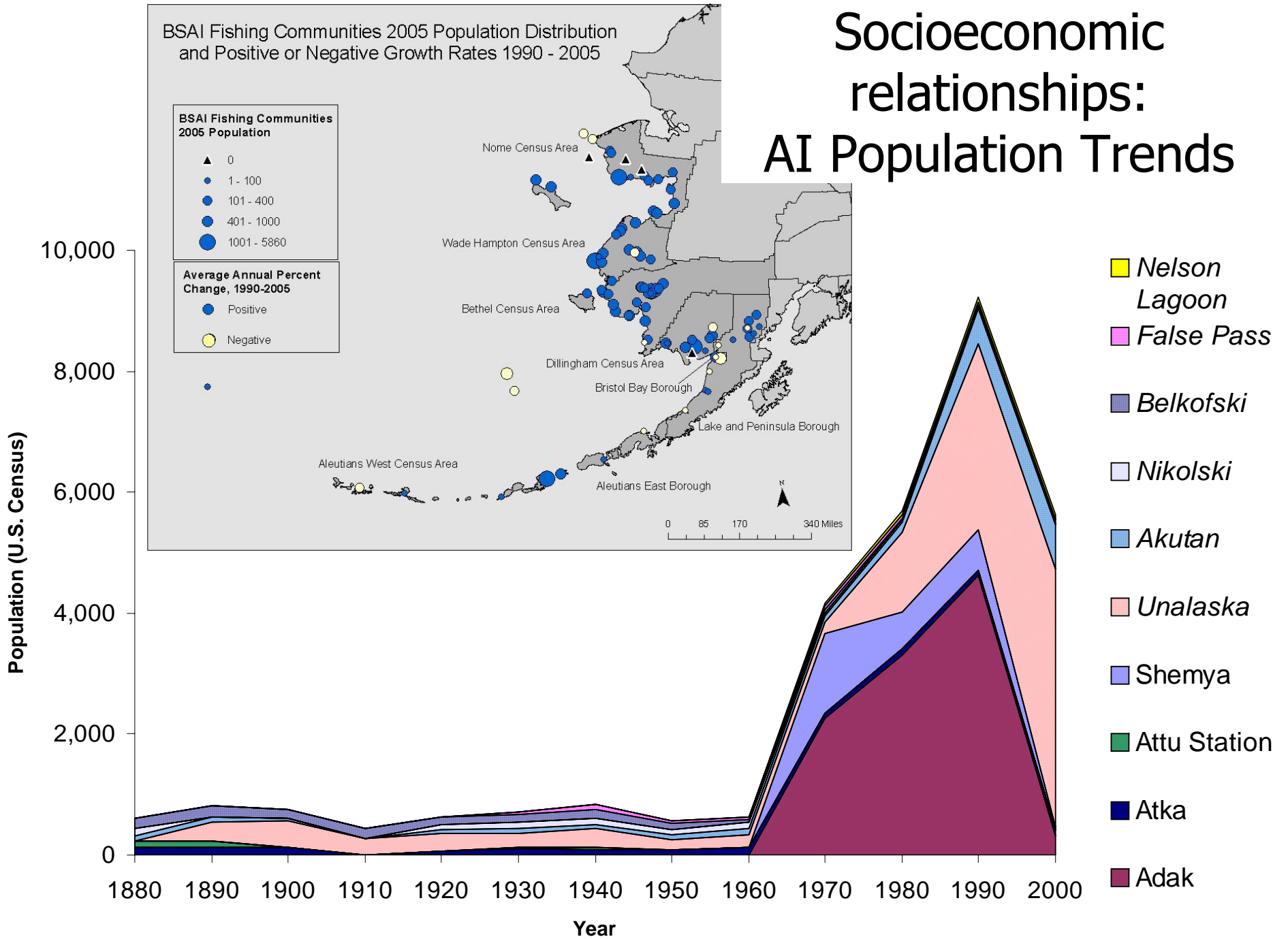
**2000 Population Structure  
Atka**

Data Source: US Census



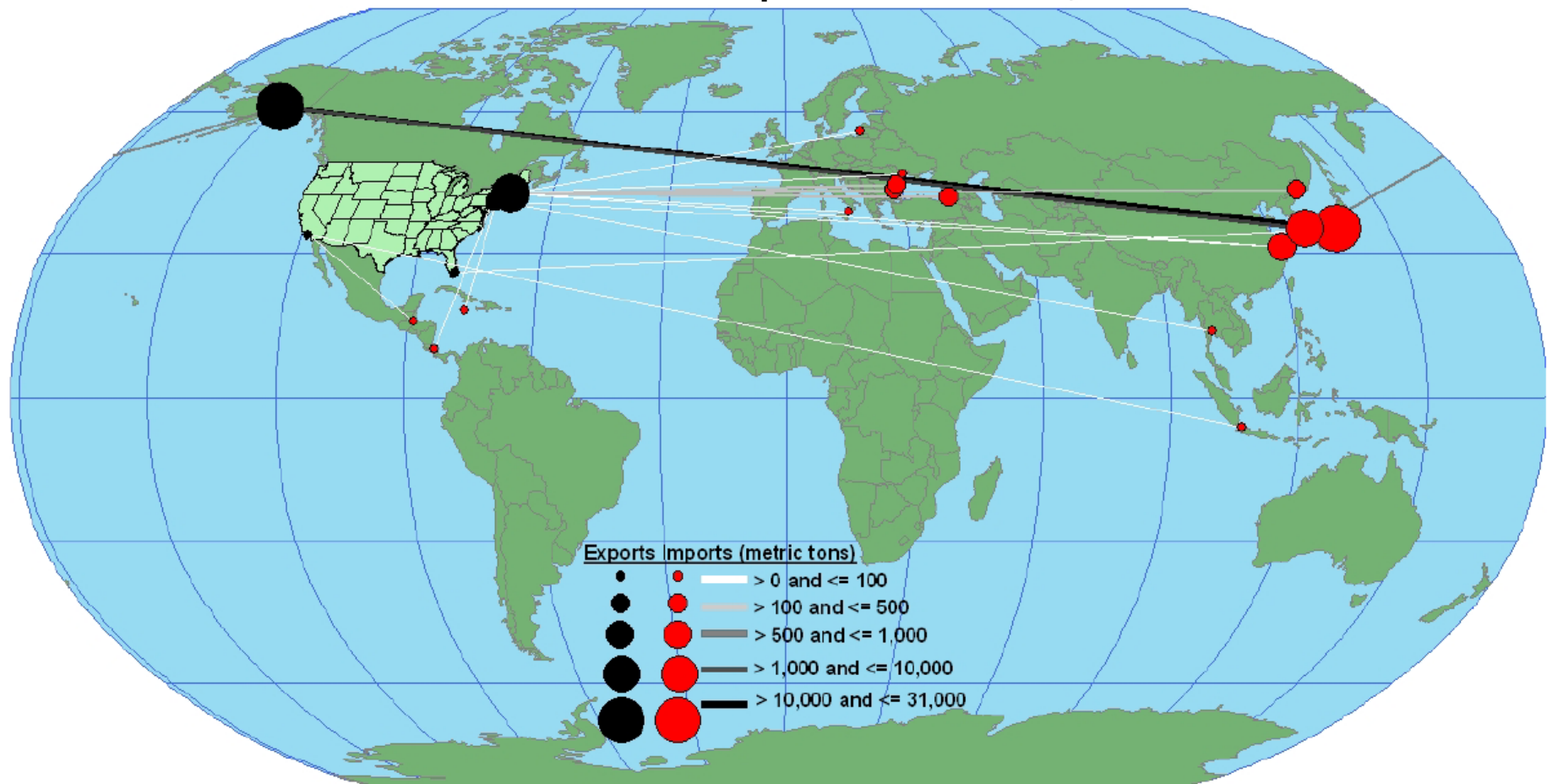
# Socioeconomic relationships: Aleutian Islands Communities

# Socioeconomic relationships: AI Population Trends





# Atka mackerel: Local fish, global market



Source: U.S. Merchandise Trade Statistics, GIS: Alaska Fisheries Science Center (michael.dalton@noaa.gov)

Figure 3-23 US Atka Mackerel Exports to the World, 2005.



# International shipping: global markets, local impacts



Source: The Economist, January 18, 2007

Estimated 3000-3500 vessel transits annually through Unimak pass  
1600 container ships, 30-40 tankers, and increasing with global trade  
Risk concentrated near Dutch Harbor, Unimak Pass, Akun Is., Near Is.

# Social and management boundaries

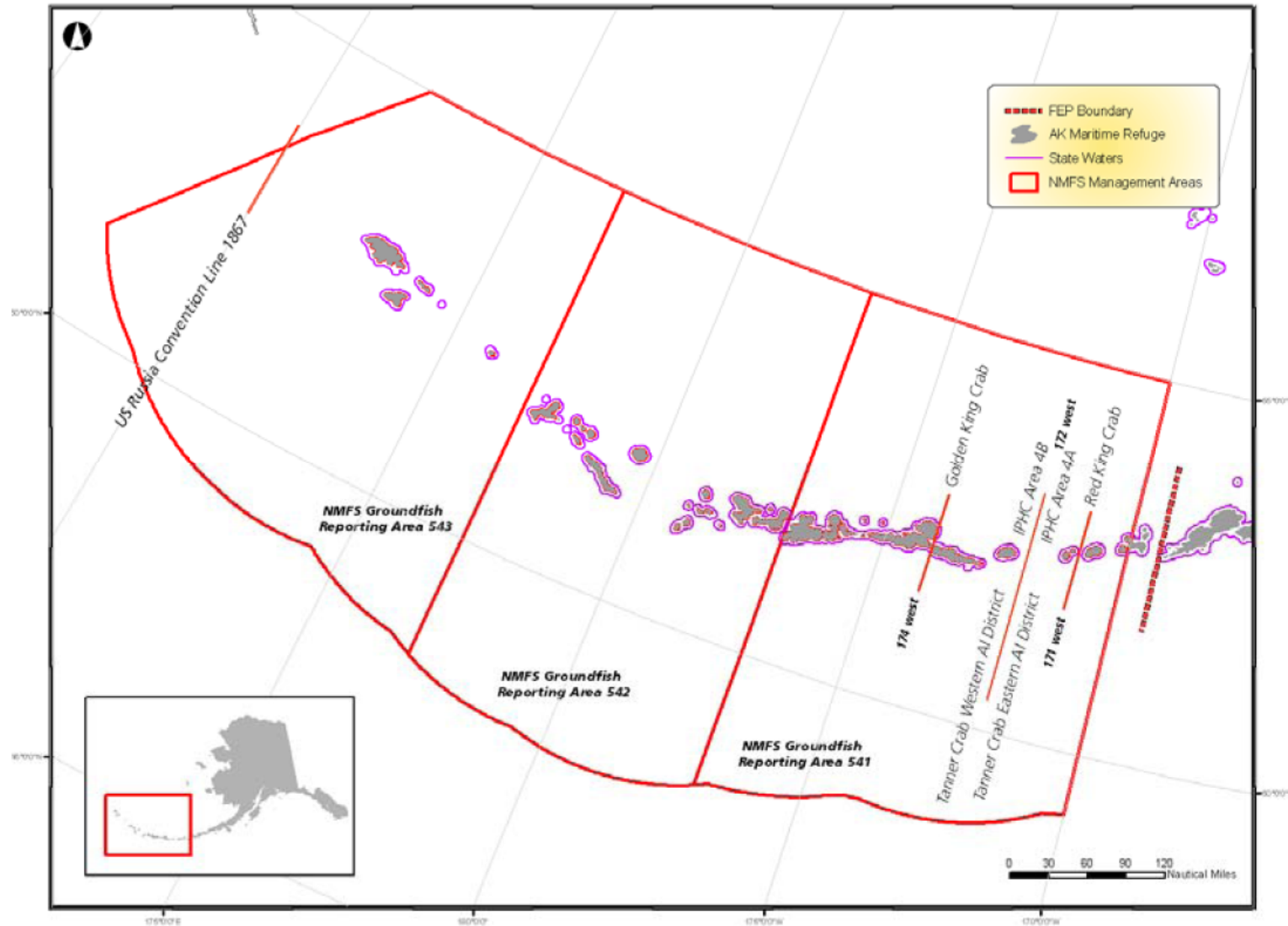


Figure 3-25 Management boundaries in the Aleutian Islands for groundfish, halibut, and crab fisheries.

# Agencies in the AI

**Table 3-3 Regulatory responsibility in Aleutian Islands**

Resource, Population	Agency	Responsibility
groundfish	NPFMC/NMFS ADFG	3-200nm; population abundance; setting harvest levels, fishery management, monitoring, and enforcement 0-3nm
halibut	IPHC NPMFC/NMFS	population abundance, setting harvest levels management of fishery
crab	NPFMC/NMFS ADFG	monitor overfishing levels, allocations harvest levels; fishery management, monitoring, enforcement
scallop	NPMFC/NMFS ADFG	monitor overfishing levels harvest levels, fishery management, monitoring, enforcement
salmon	ADFG NPFMC/NMFS	population abundance, harvest levels, fishery management retention prohibited 3-200nm
herring	ADFG	population abundance, harvest levels, fishery management
other fish	NMFS	advisory authority for habitat for all fish including fish in nearshore watersheds
marine mammals (except walrus and otters)	NMFS	population abundance, advisory authority, protection under the MMPA and ESA
walrus and otters	USFWS	population abundance, advisory authority, protection under the MMPA and ESA
birds	USFWS	population abundance, advisory authority, protection under the MBTA
citizens of Adak	City of Adak	municipal responsibility
citizens of Atka	City of Atka	municipal responsibility
land	USFWS BLM DNR DOD	protection of Alaska Maritime National Wildlife Refuge, including marine responsibility extending offshore (own some small parcels) (own some land parcels) Shemya, others?
shipping	DEC USCG	oversight of spill response ensure safety of vessels in US ports and waterways
oil and gas development	MMS DNR or DEC	3-200nm 0-3nm
military activity	Alaskan Command, Pacific Command	Shemya, floating barge
formerly used defense sites	AFCEE	cleanup
Amchitka	DOE	cleanup

**KEY:** ADFG – Alaska Department of Fish and Game; AFCEE – US Air Force Corps of Engineers; DEC – Alaska Department of Environmental Conservation; DNR – Alaska Department of Natural Resources; DOD – Department of Defense, DOE – Department of Energy, EPA – Environmental Protection Agency, MMS – Minerals Management Service, NMFS – National Marine Fisheries Service, NPFMC – North Pacific Fishery Management Council, USFWS – US Fish and Wildlife Service

# Interactions

- Climate and or physically mediated interactions
- Predator-prey (food web mediated) interactions
- Endangered Species Act (regulatory) interactions
- Fishing effects interactions
- Other socioeconomic activities interactions

Interactions between interactions are discussed within each category to the extent possible

Are the interactions clear and are we missing any?

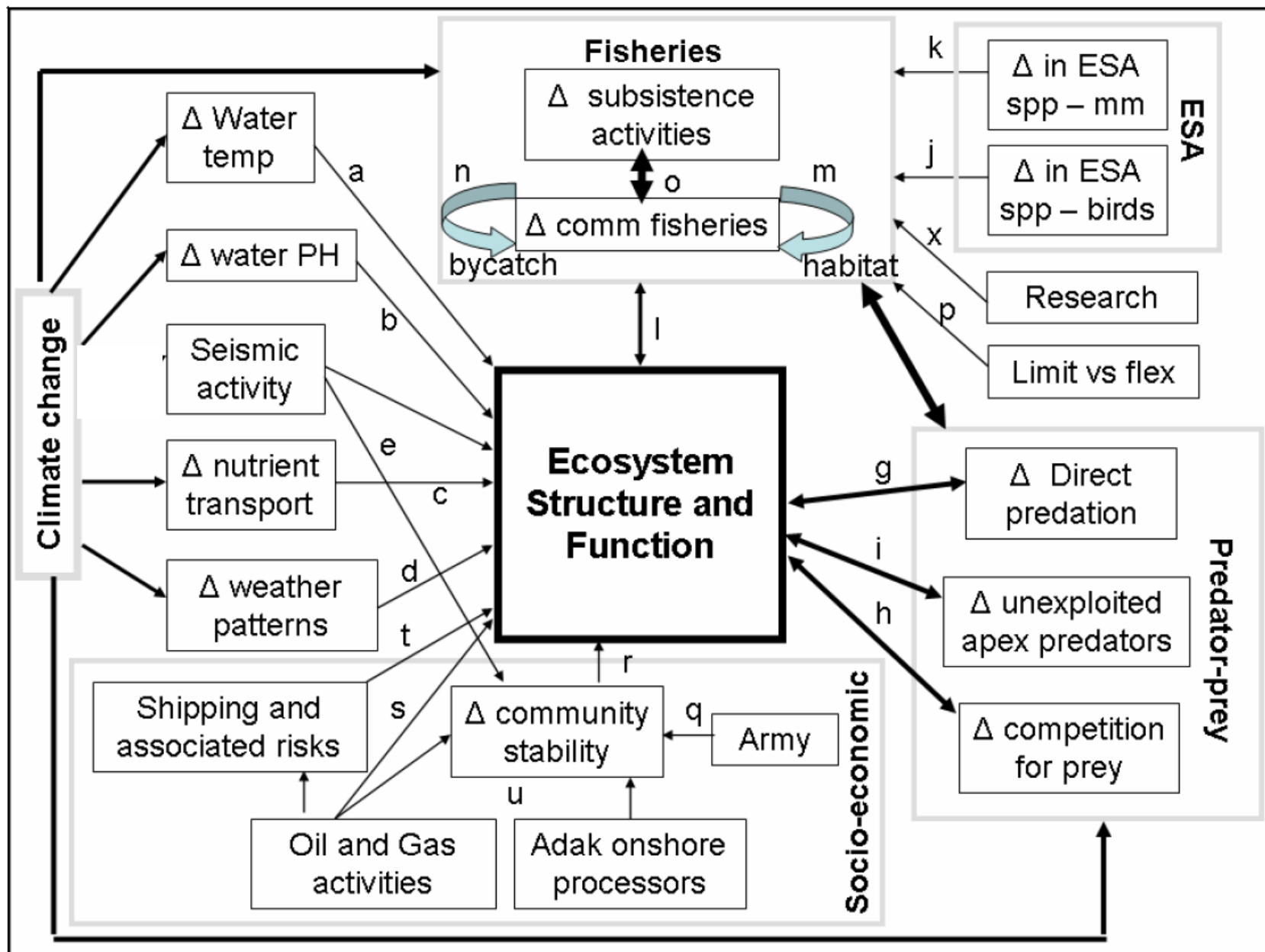
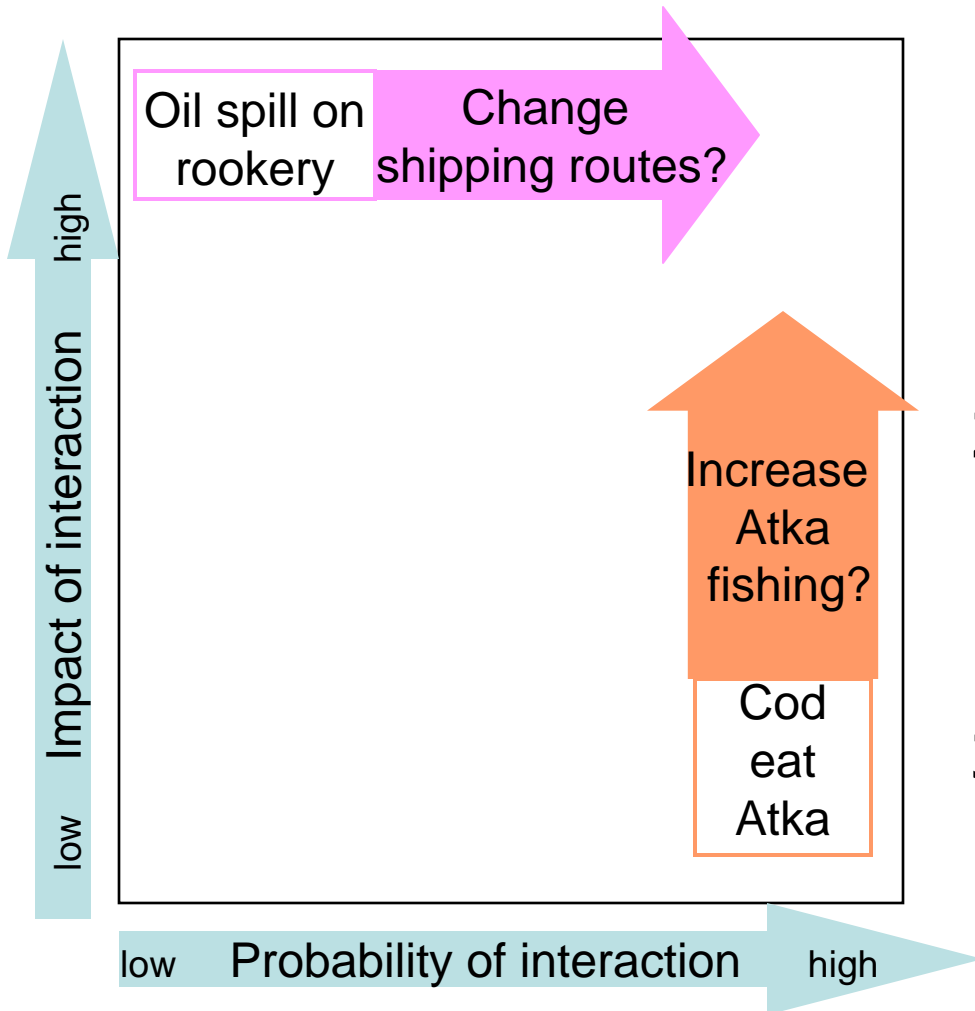


Figure 4-2 Map of ecosystem interactions

# Risk Assessment

Interactions in context...

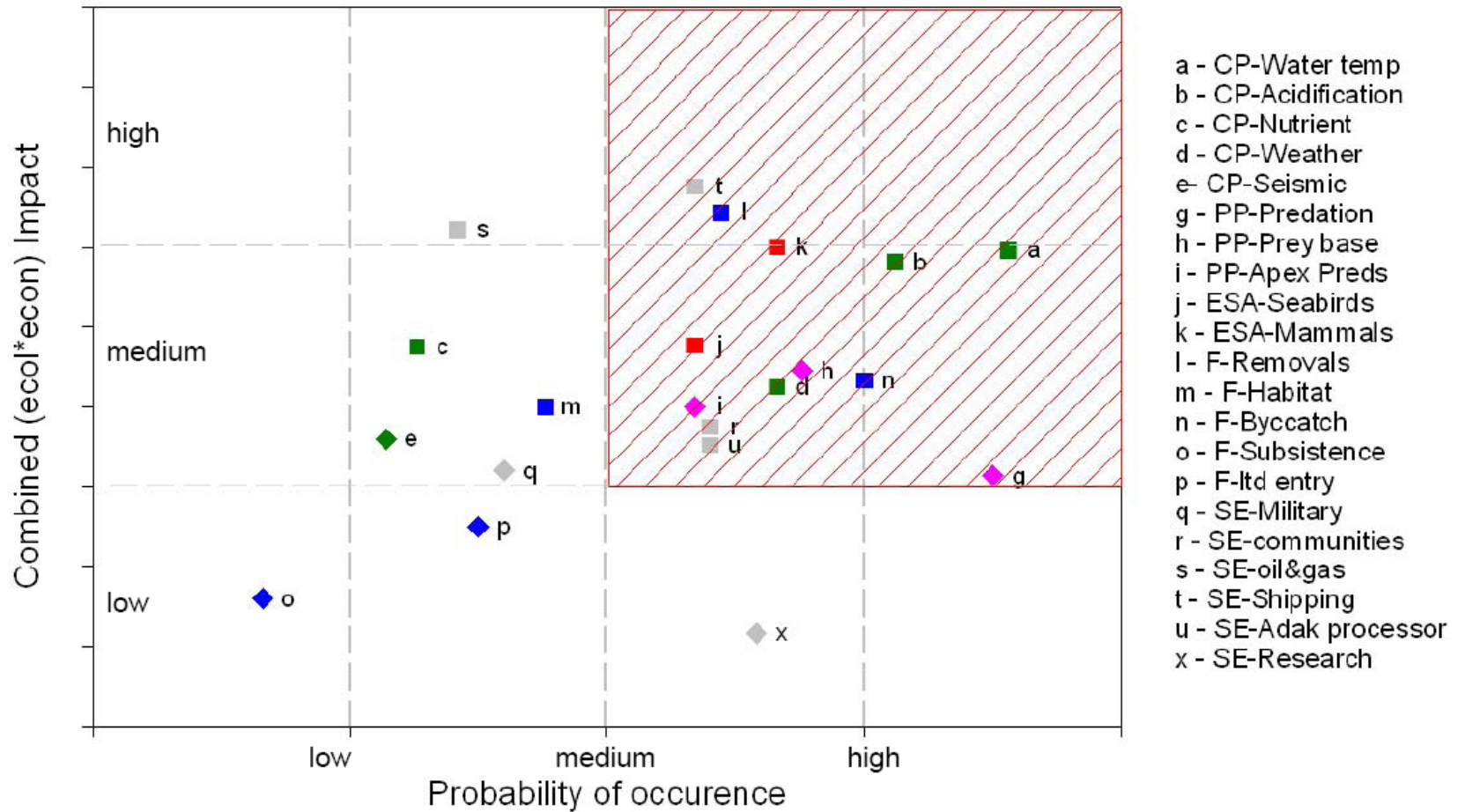


Each team member qualitatively estimated (low, medium, high)

1. The probability of each interaction happening
2. The extent of adverse impact of the interaction
  - Ecologically
  - Economically
3. And rated the length of impact (months-centuries)



# Risk Assessment



**Figure 4-4** Characterization of interactions in terms of probability of occurrence and a combined ecological multiplied by economic impact. Shaded area in upper right quadrant highlights those interactions with a medium to high probability of occurring and likely impact.