

Fishery interaction and availability of Atka mackerel prey for Steller Sea lions: Results from local abundance and movement study of Atka mackerel



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Overview

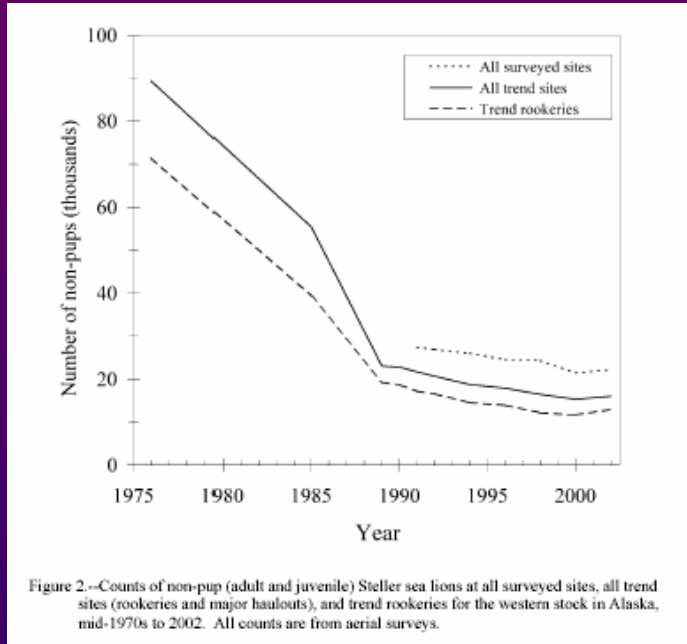
- Background
- Research goal
- Atka mackerel tagging study
- Small Scale Food web model (Libby Logerwell)
- Conclusions

Background information



- Atka mackerel (*Pleurogrammus monopterygius*) is one of the most abundant groundfish in the Aleutian Island area (2004 Biomass ~ 336, 345mt, 2003 Fishery landings ~58,585 mt)
- Important component in the ecosystem
 - Prey: Euphasiids, Copepods, Myctophids
 - Predators: Steller Sea lions, P. Cod, Halibut, Arrowtooth fl.
- Patchy distribution on large and small scales

Atka mackerel and Steller Sea lions



- ▲ **Western stock of Steller Sea lion was declared endangered in 1997**
- ▲ **Trawl exclusion zones established around rookeries, haulouts**
- ▲ **Atka mackerel prevalent in diet (78% occurrence in the Aleutians)**

Research goal



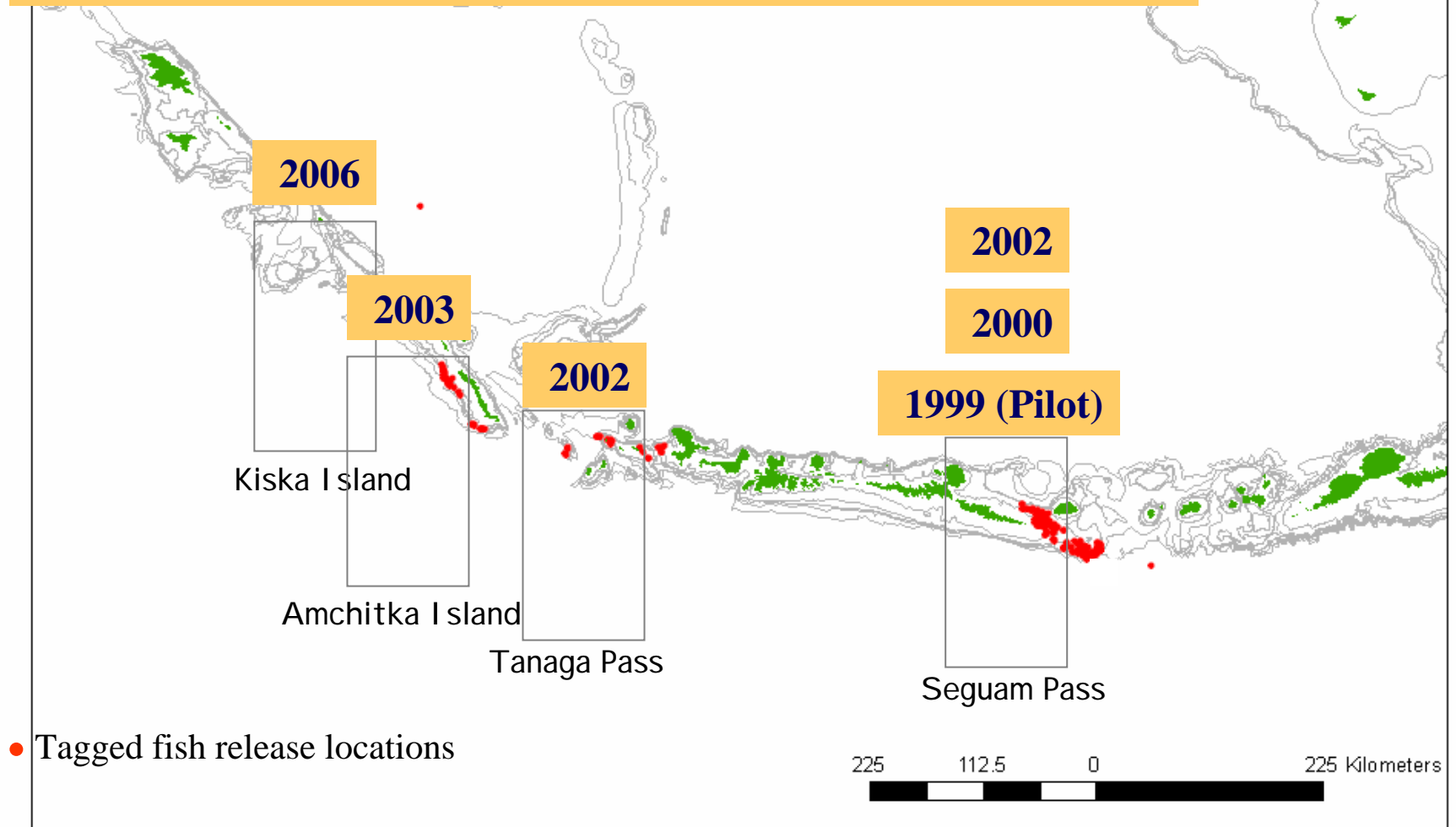
- Study efficacy of trawl exclusion zones (TEZs) in preserving prey abundance for Steller Sea lions
 - Estimate local abundance and movement in and out of the TEZs
 - Small-scale food web model

Tagging as means of abundance estimation



- Local abundance and localized movement can be estimated (patchiness not as problematic as in other survey methods)
- Tag recovery pays partly for research effort
- Fishery can be used in tag recovery (cost-effective)
- **Assumptions:**
 - Population is closed within study area (no immigration or emigration)
 - Tagged fish mix randomly with untagged fish
 - All fish have same recovery probability
 - Tag shedding, tag mortality, tag reporting rates can be estimated with auxiliary data

Project History



Methods

- 1999-2006
 - released over 75,000 tagged fish
- 2006 tag release and recovery effort cooperative funding with industry
- Model
 - Integrated tagging model using maximum likelihood (Hilborn 1990)
 - Estimates
 - N (population size)
 - p (probability of moving)
 - Tag mortality
 - Tag reporting rate
 - Tag loss

Catch...



Tag...



Release...



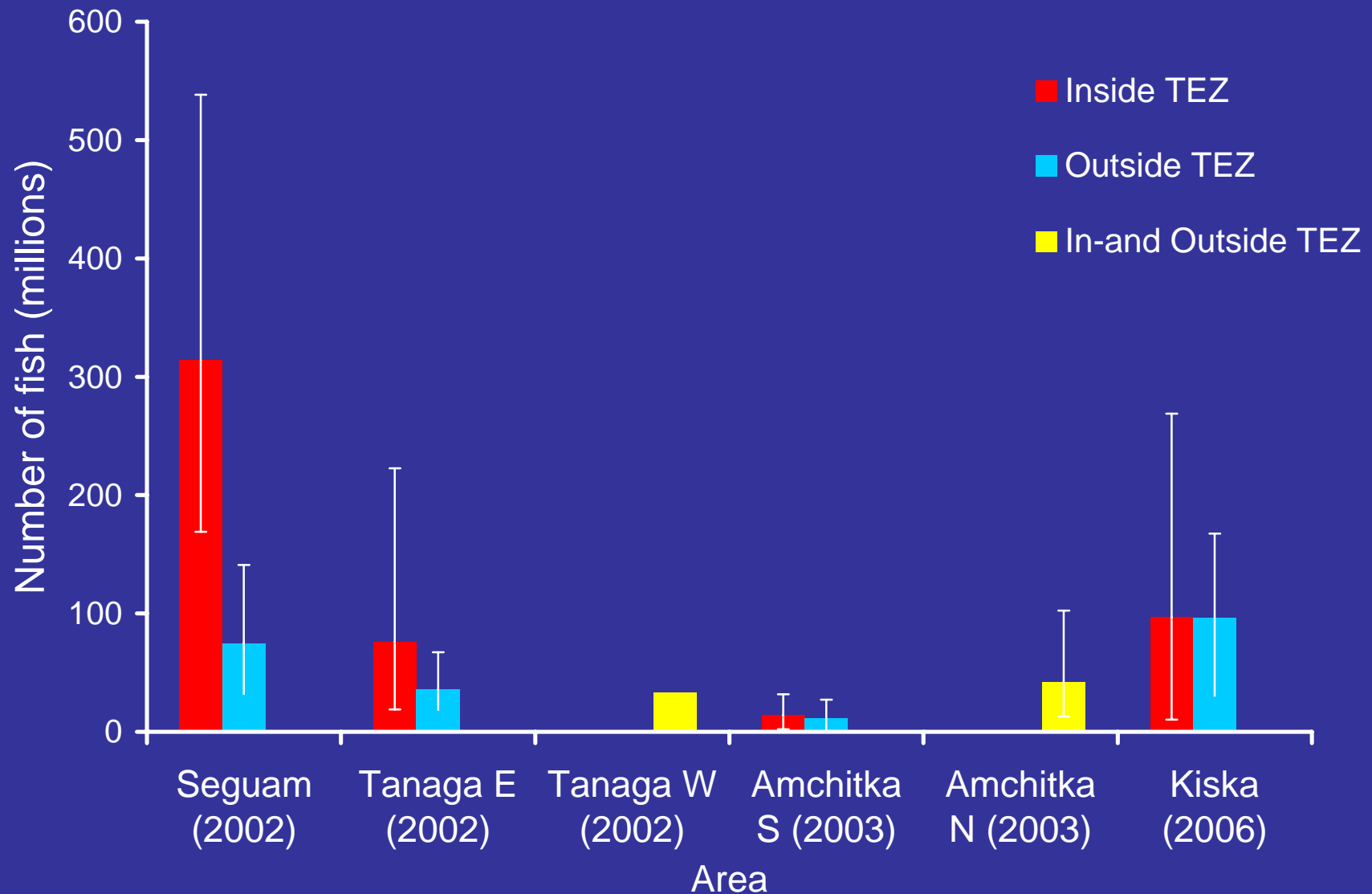
Recapture



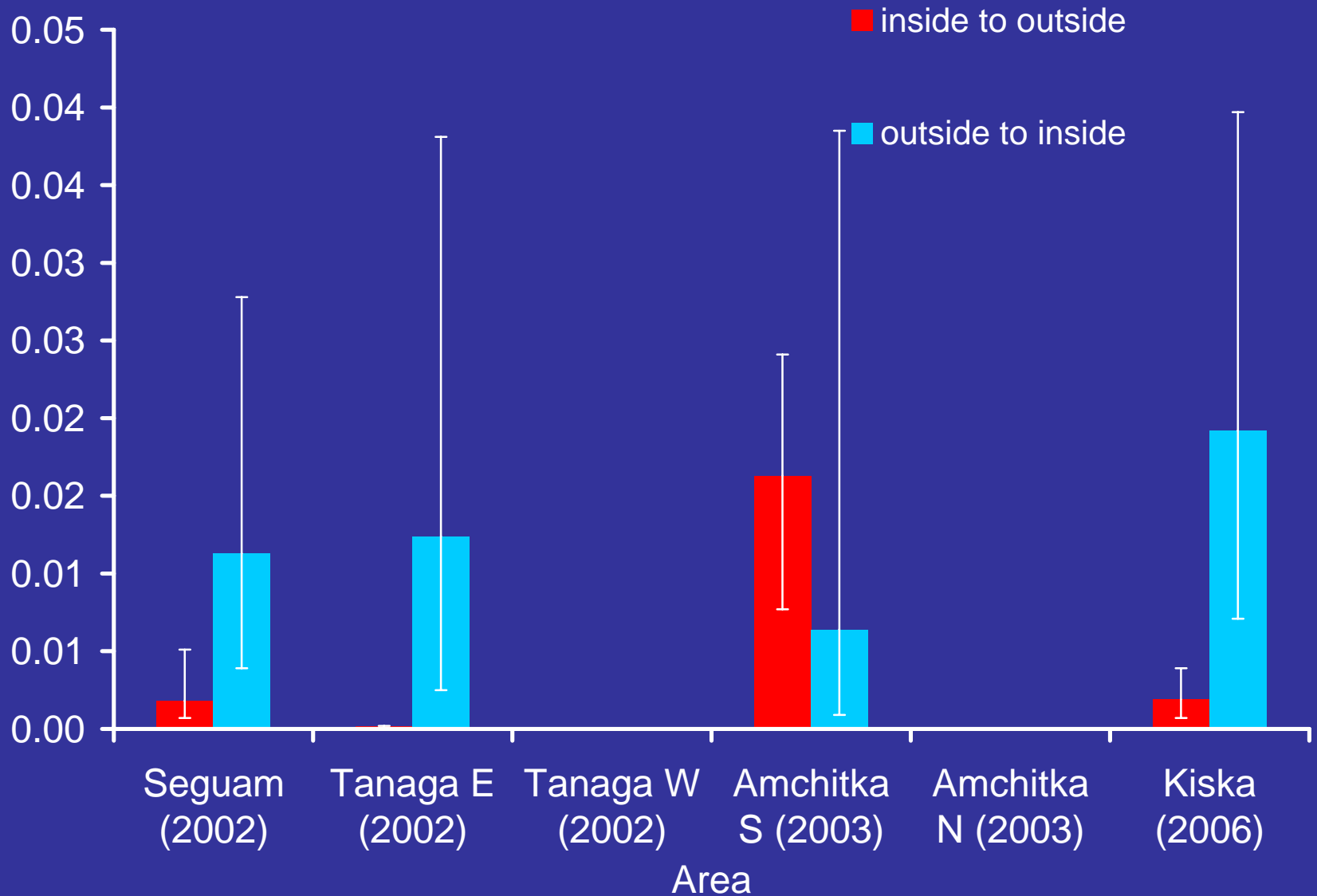
Recapture



Abundance estimates



Movement rate



Biomass in all areas combined



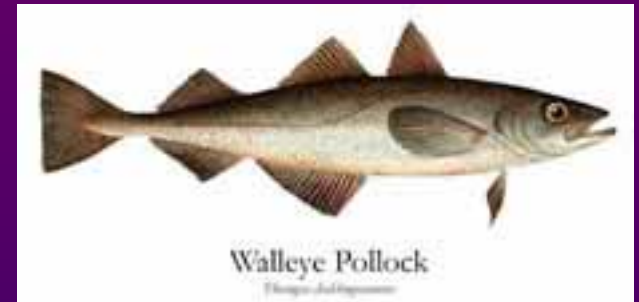
Small-scale food web model

- Is there enough Atka mackerel production inside Trawl Exclusion Zones (TEZs) to support Steller sea lions?
- Construct a food web model for each TEZ

Small-scale food web model



Steller sea lions



Fish predators:
Pollock
Halibut
Pacific cod
Arrowtooth Flounder
Skates



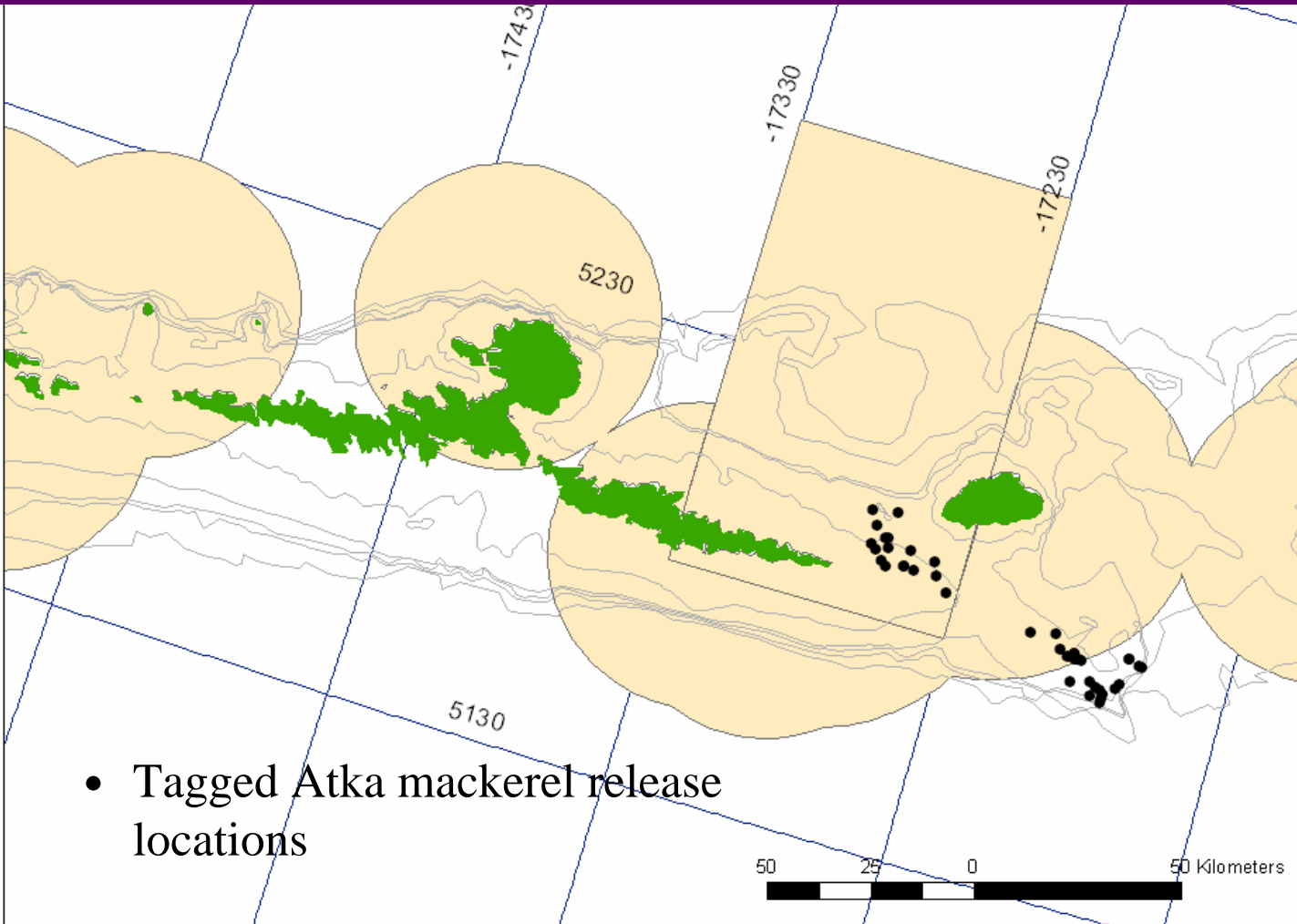
Atka mackerel
Production

Small-scale food web model

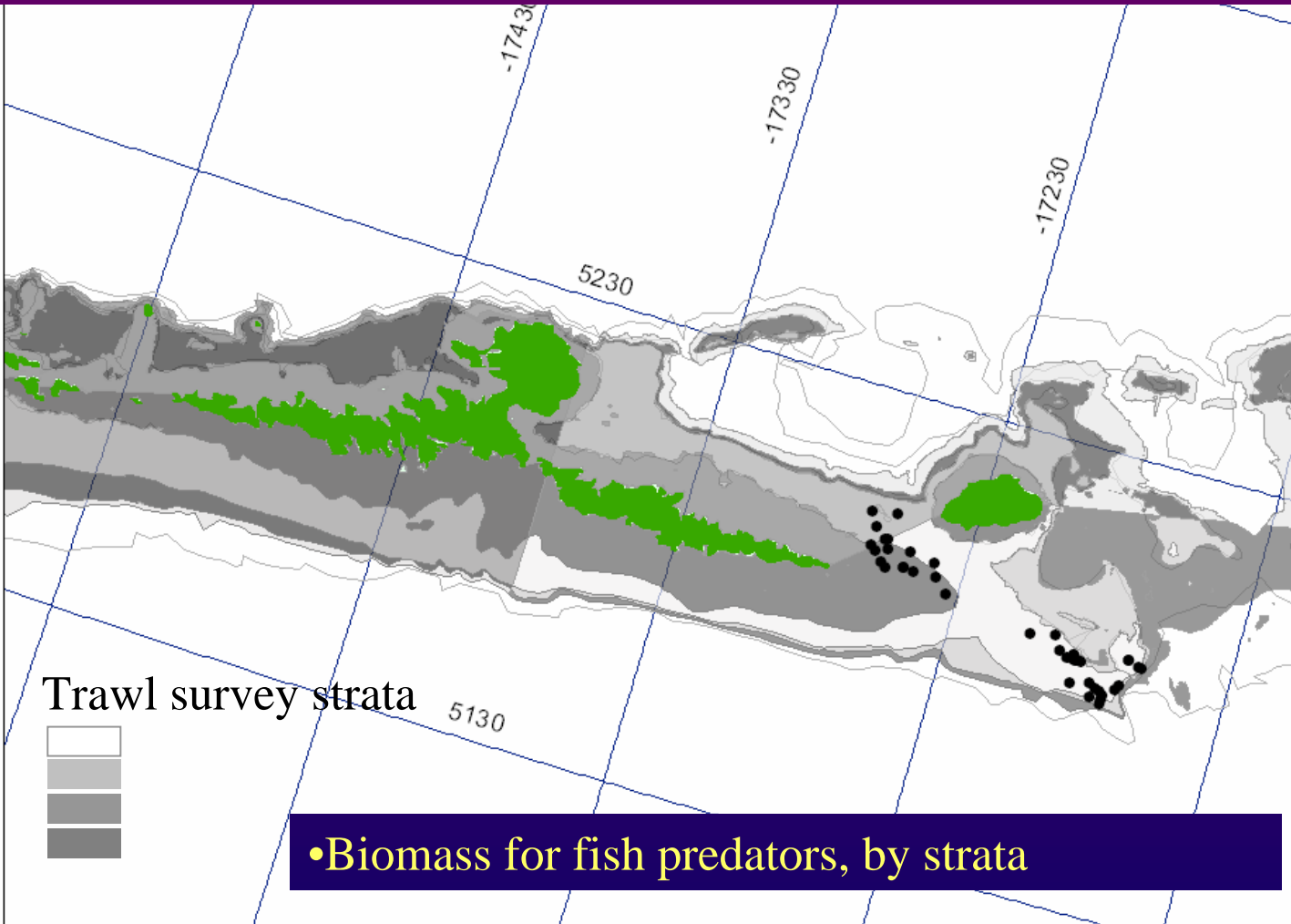
Data

- Atka mackerel
 - Biomass from tag model
 - Production rate (P/B) from Aleutian EcoPath model
- Steller sea lions
 - Biomass from derived counts, age-structure, sex ratio, pregnancy rate, and weight-at-age
 - Diet from scat collections
 - Consumption rate (Q/B) from Aleutian EcoPath model
- Fish predators
 - Biomass from trawl survey
 - Diet from trawl survey collections
 - Consumption rate (Q/B) from Aleutian EcoPath model

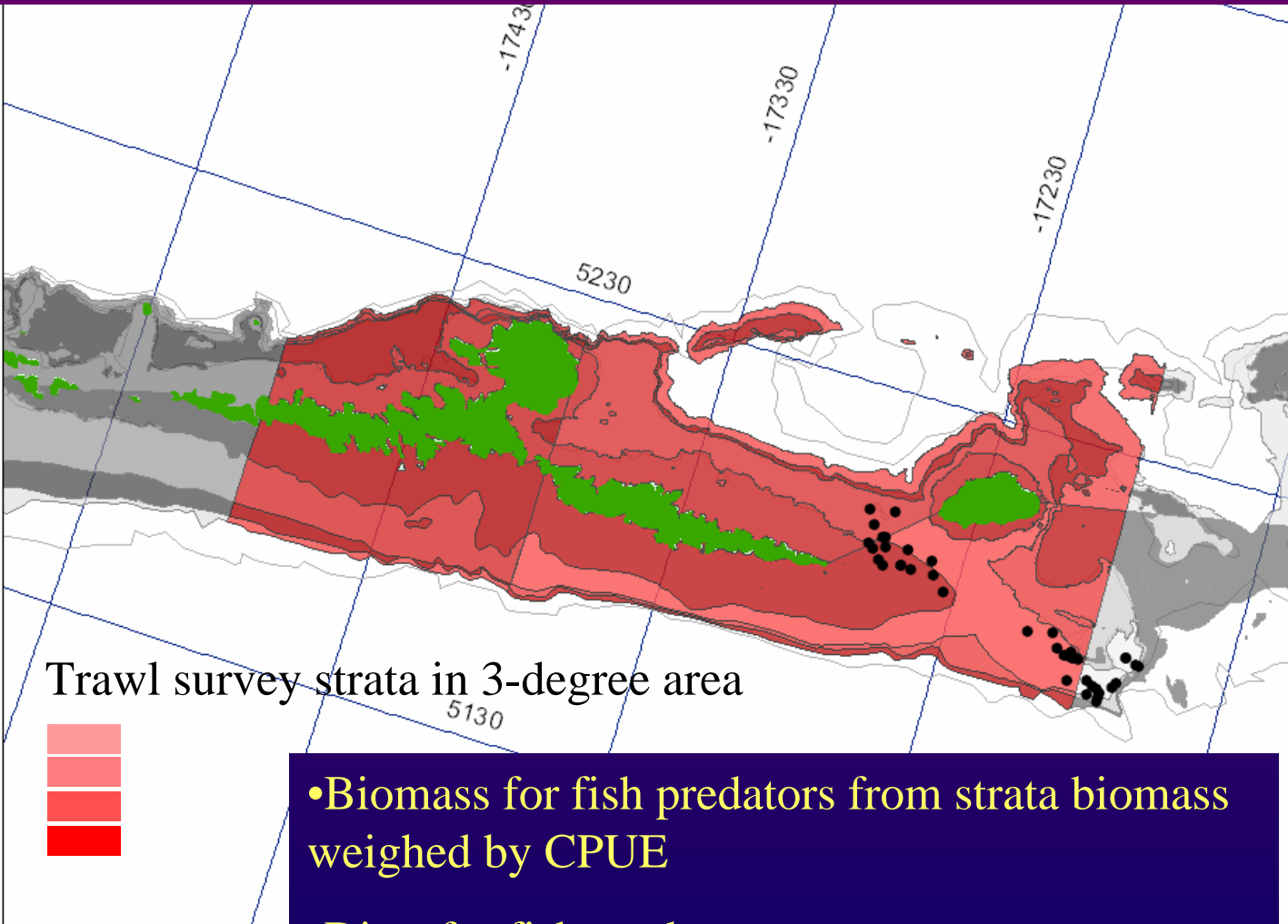
Results – Seguam Pass 2002



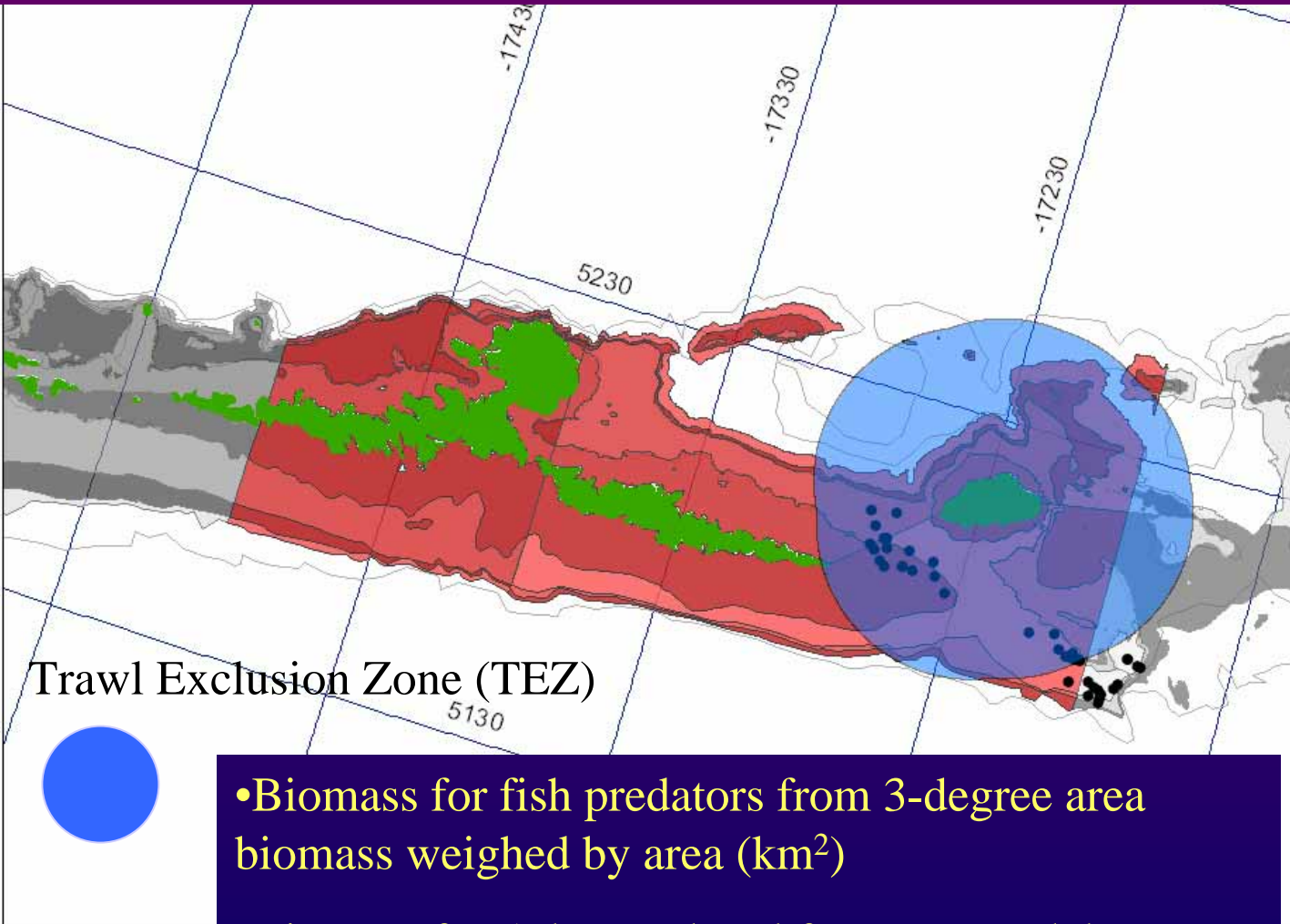
Results – Seguam Pass 2002



Results – Seguam Pass 2002



Results – Seguam Pass 2002

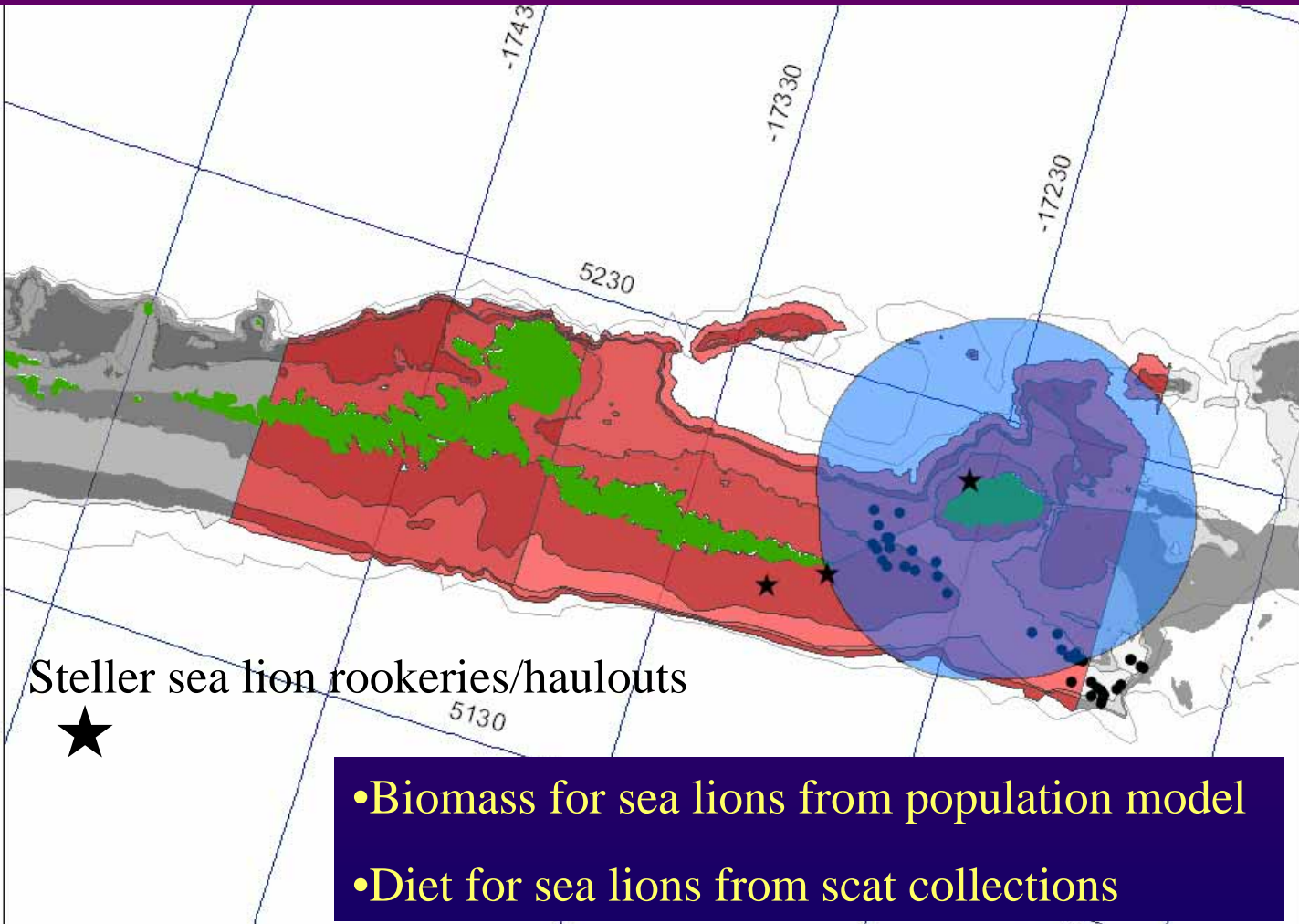


Trawl Exclusion Zone (TEZ)



- Biomass for fish predators from 3-degree area biomass weighed by area (km²)
- Biomass for Atka mackerel from tag model

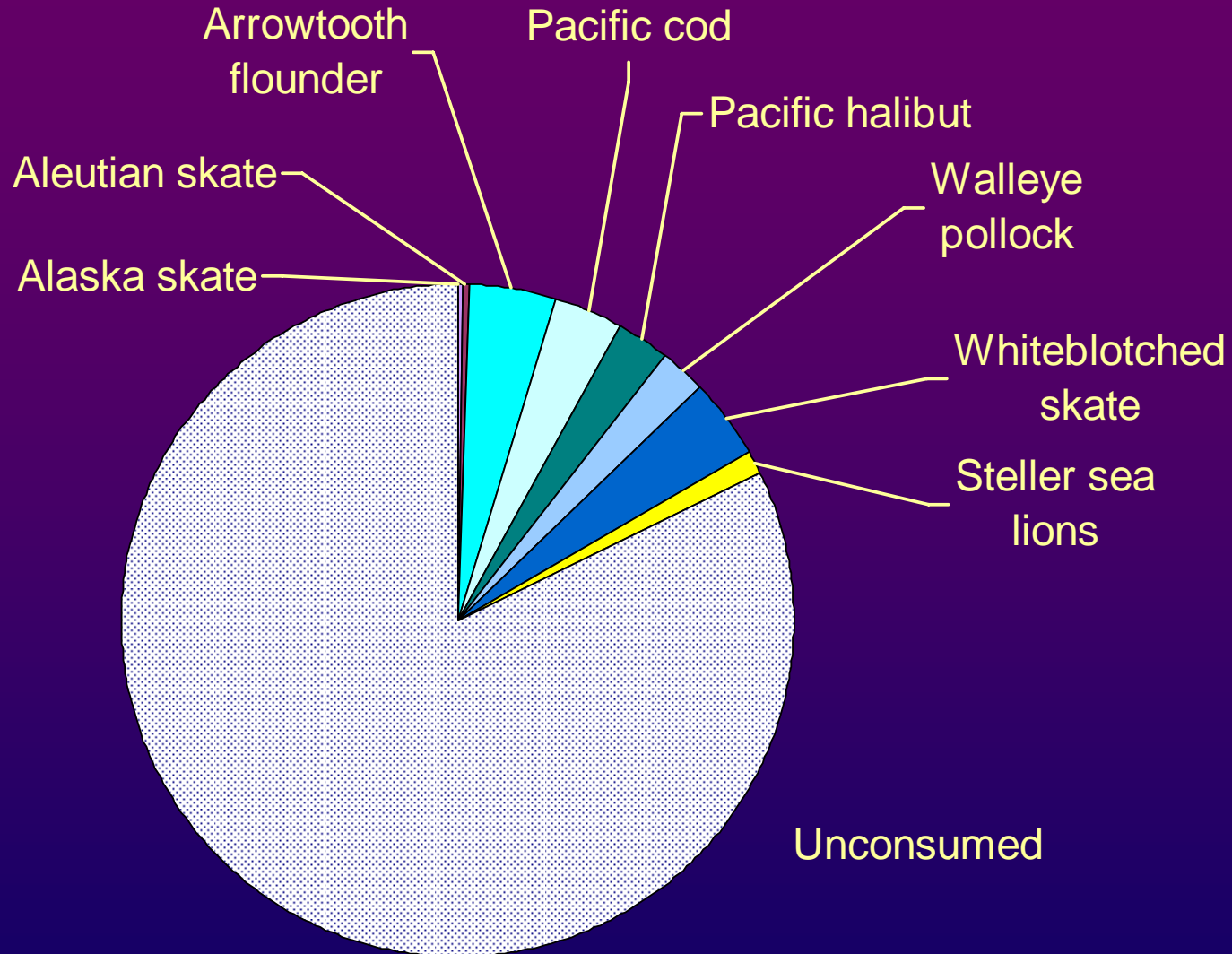
Results – Seguam Pass 2002



Data Details

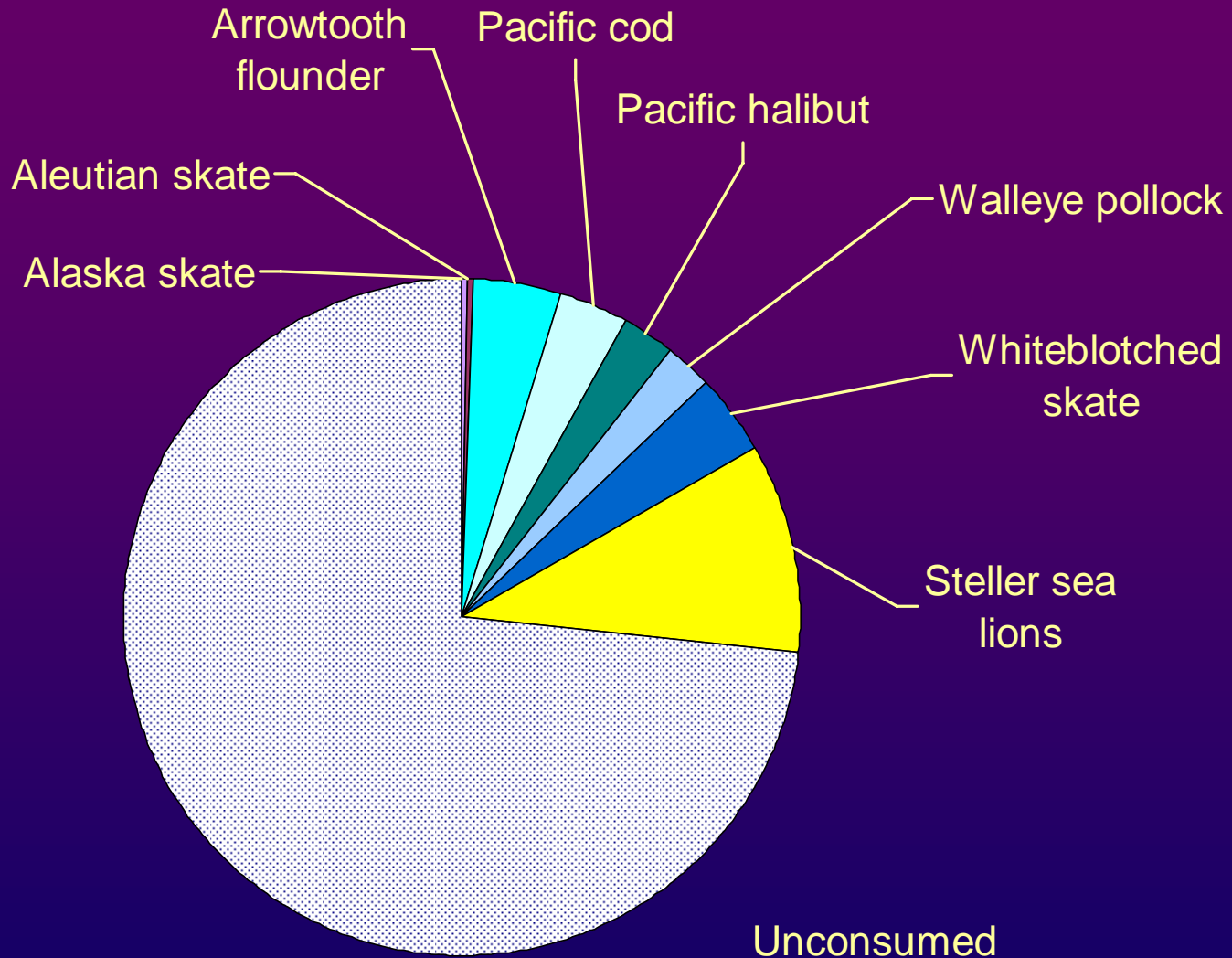
Data	Year(s)	Season(s)	Sample size	Source
Survey strata biomass	2002	Summer	119 hauls	AFSC
3-degree area CPUE	2002	Summer	72 hauls	AFSC
Fish predator diets	2000-2006	Summer	Pollock 349 stomachs Arrowtooth Flounder 391 Halibut 115 Pacific cod 317 Skates, 1997-2006 26	AFSC
Atka mackerel biomass	2002	Summer	24,999 tagged fish released 58 tagged fish recovered	McDermott
Steller sea lion biomass	1977, 2000			Fay (UW) Holmes, Fritz (NMML)
Steller sea lion diet	1990-1999	Summer (mostly)	231 scats	NMML

Results - “current” sea lion population (2002)



Proportion of Atka mackerel production consumed

Results – “recovered” sea lion population (1977)



Proportion of Atka mackerel production consumed

Conclusions

Efficacy of trawl exclusion zones at mitigating competition between sea lions and commercial fisheries varies geographically

- Do fish move from inside to outside?
 - Small movement at Seguam and Tanaga and Kiska
 - Large movement at Amchitka
- What is the abundance of fish inside?
 - Large biomass at Seguam, Tanaga, and Kiska
 - Small biomass at Amchitka
 - Food web model indicates that there is enough Atka mackerel production for sea lions at Seguam (current and “recovered”)

Acknowledgements

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 - Crew of the *Pacific Explorer*
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