Fish movement and commercial fishing impacts on Steller sea lions

Fishery Interaction Team (FIT)

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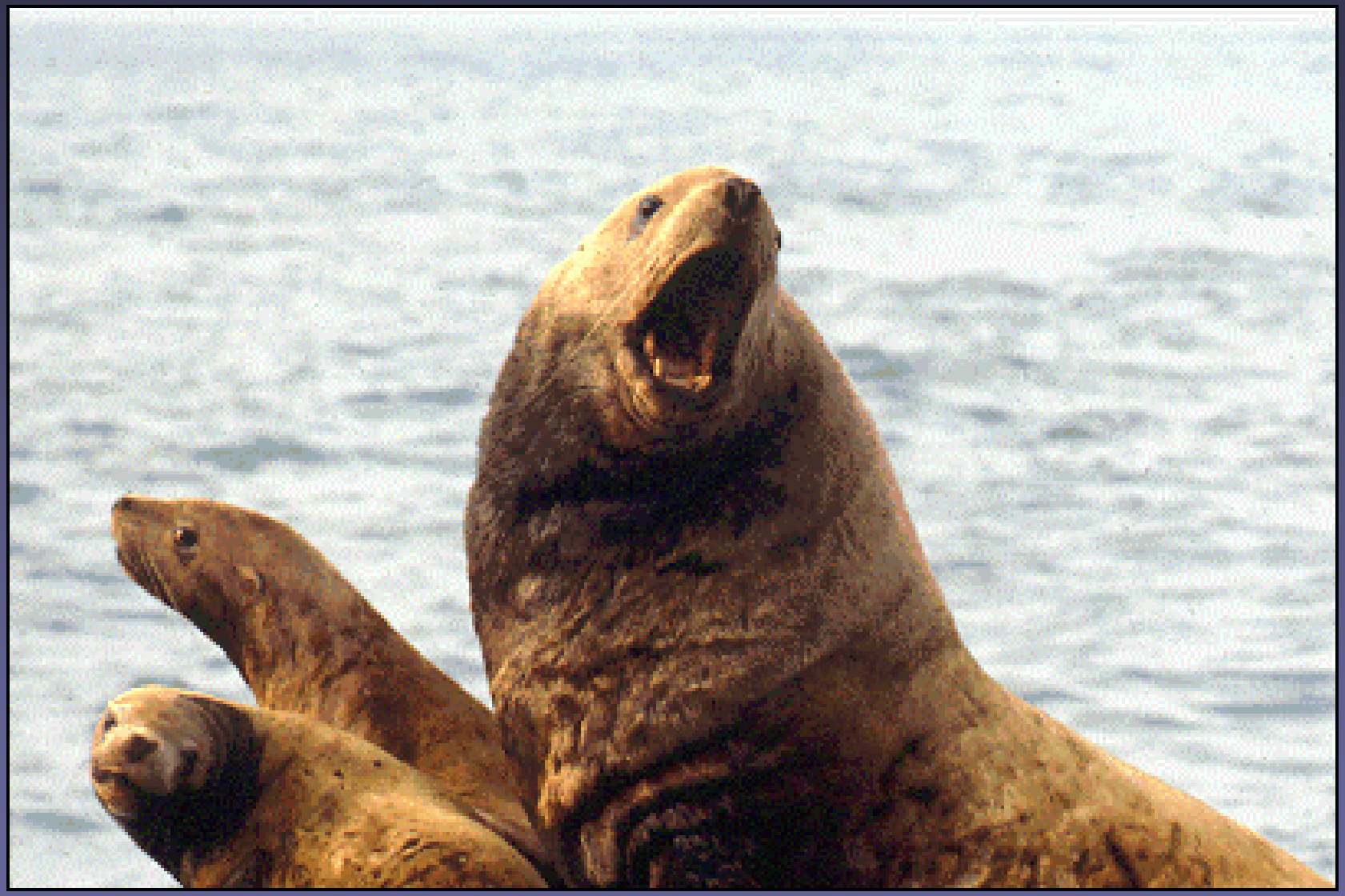
Goal – investigate the potential impact of commercial groundfish fishing

Impacts – distribution, abundance, biological characteristics, community characteristics

Purpose – provide advice re: effects of management actions on fish community, marine mammals, seabirds and etc.

Steller sea lion (*Eumetopias jubatus*)



http://nmml.afsc.noaa.gov/gallery/pinnipeds/pinniped_gallery3.htm

Decline of the western stock of sea lions

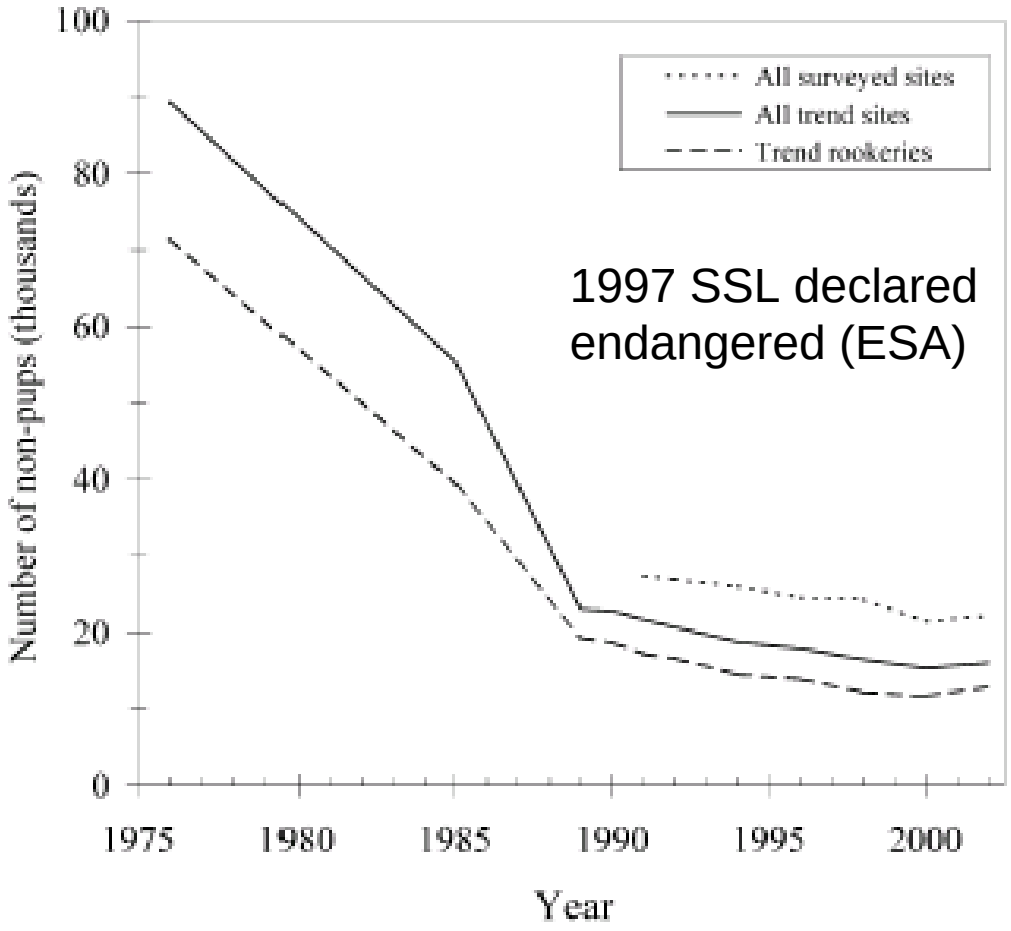
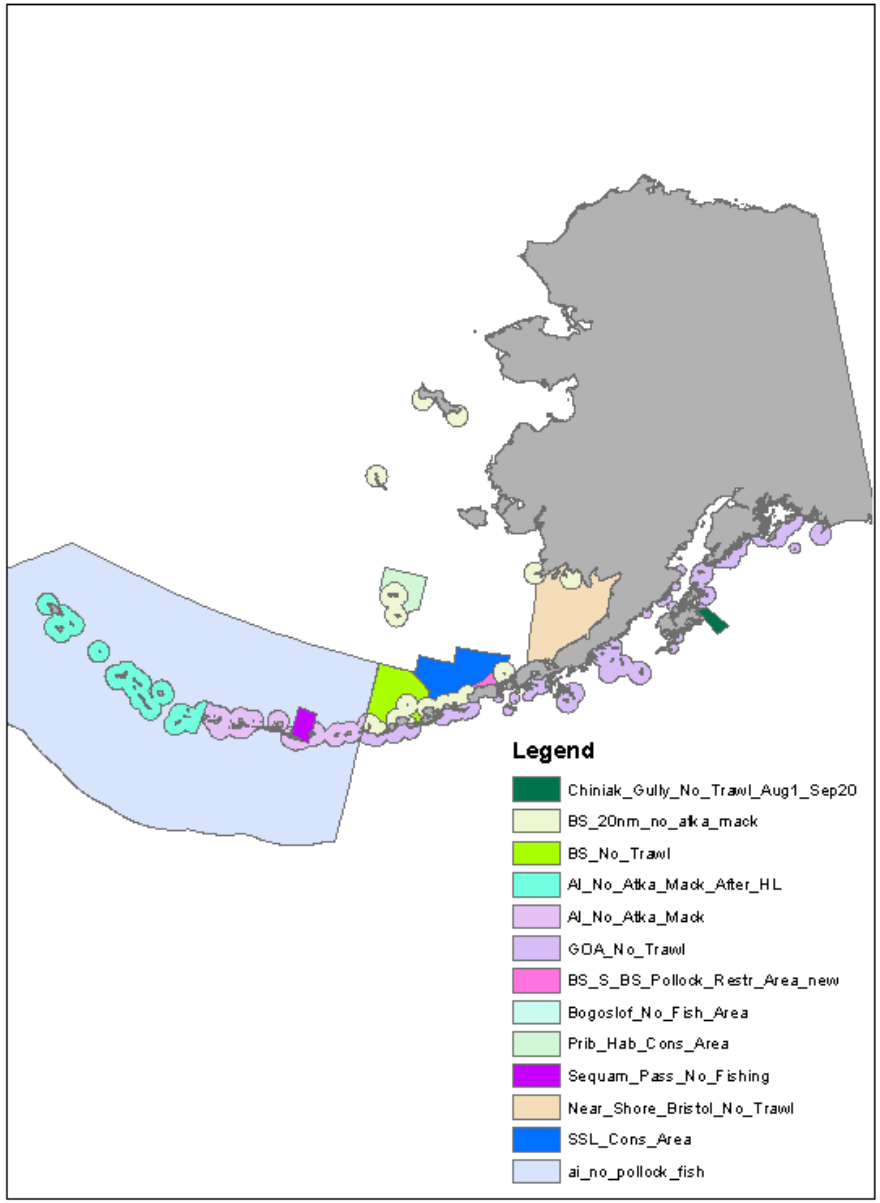


Figure 2.--Counts of non-pup (adult and juvenile) Steller sea lions at all surveyed sites, all trend sites (rookeries and major haulouts), and trend rookeries for the western stock in Alaska, mid-1970s to 2002. All counts are from aerial surveys.

Sease & Gudmundson 2002

SSL Protection Measures



FIT’s current mission

1. Do commercial fisheries result in localized depletion and/or disruption of Steller sea lion prey fields?
2. What is the efficacy of existing protection measures (trawl exclusion zones)?

Groundfish species

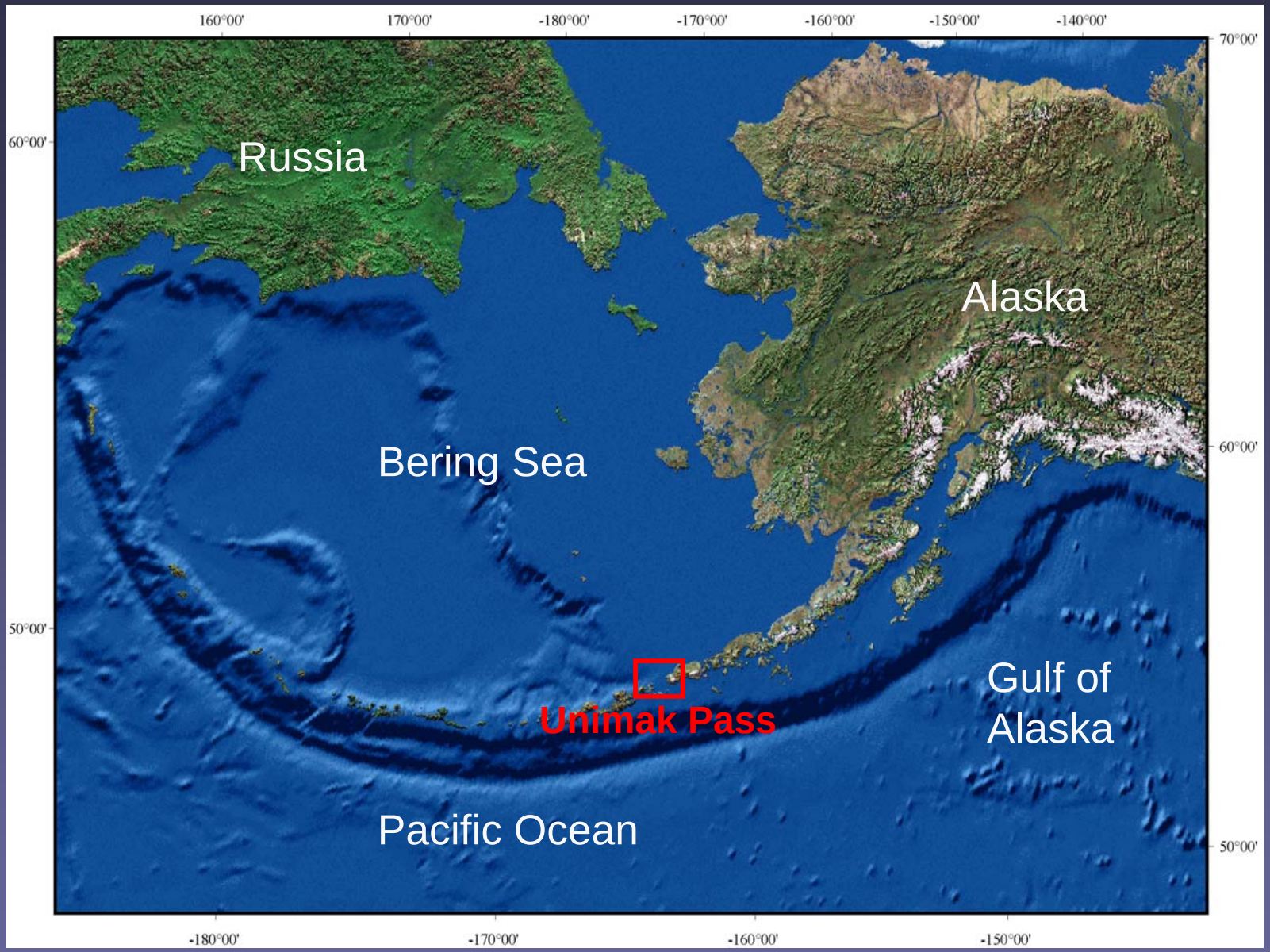
- Atka mackerel (*Pleurogrammus monopterygius*)
- Pacific cod (*Gadus macrocephalus*)

Pacific cod

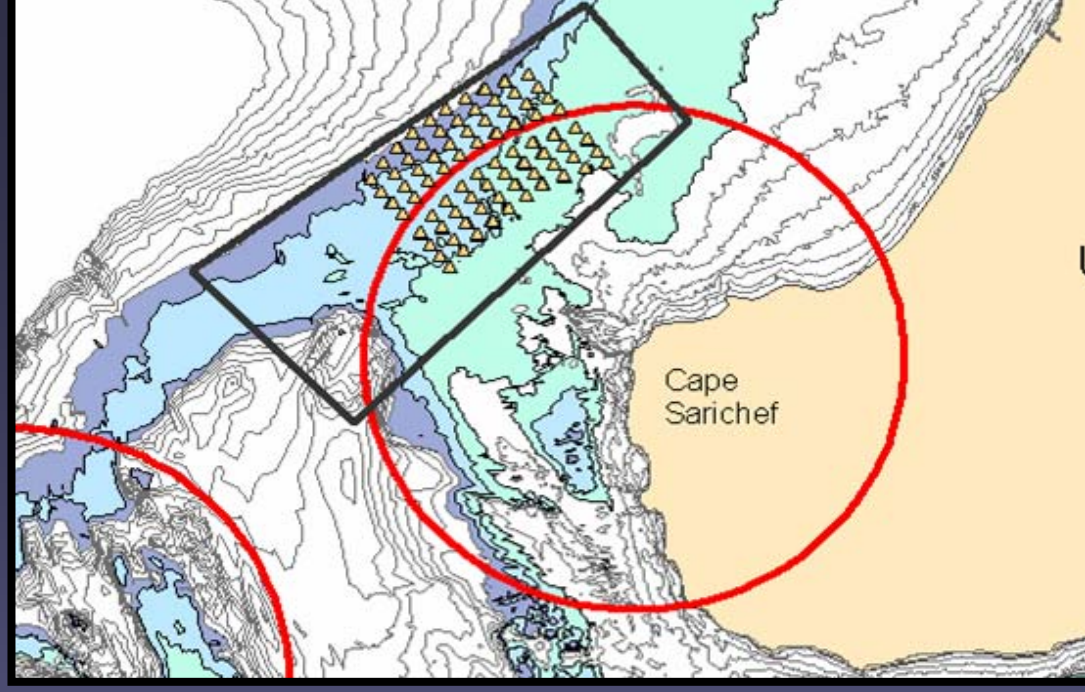
- Family Gadidae
- Spawning aggregations in Aleutian Islands and SE Bering Sea during winter
- 11% of commercial catch
- Large portion of sea lion diets in winter

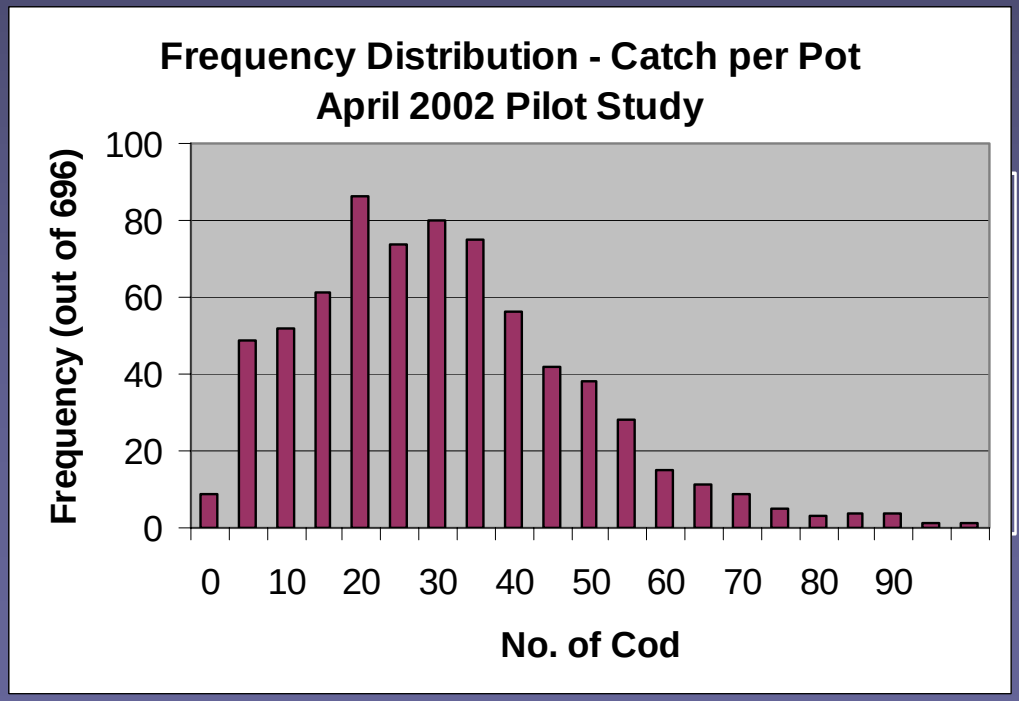
Pacific cod project overview

- Field test for localized depletion of cod due to commercial trawling
- Before-after-control-impact design


160°00'
170°00'
-180°00'
-170°00'
-160°00'
-150°00'
-140°00'
70°00'
60°00'
50°00'
Russia
Alaska
Bering Sea
Unimak Pass
Gulf of Alaska
Pacific Ocean

- Cape Sarichef no-trawl zone intersects historically trawled area, provides "Treatment" and Control"
- Surveys "Before" (Jan) and "After" (March) main trawl season
- 2004, 2005





- Pot catch used as index of local cod abundance. Pots provide good sample size and spatial precision.
- Compare change in pot catch (After/Before) between treatment and control areas.


Bridle & Floating Line
Trigger
Bait Bags
Pot Door
Tunnel
Pot Launcher
Sinking Line
Buoys

Measured Variable: Ratio of Average Catch After/Before

- X_B= Avg. catch over 3-5 pots in “Before” survey
- X_A= Avg. catch over 3-5 pots in “After” survey
- Percentage change δ

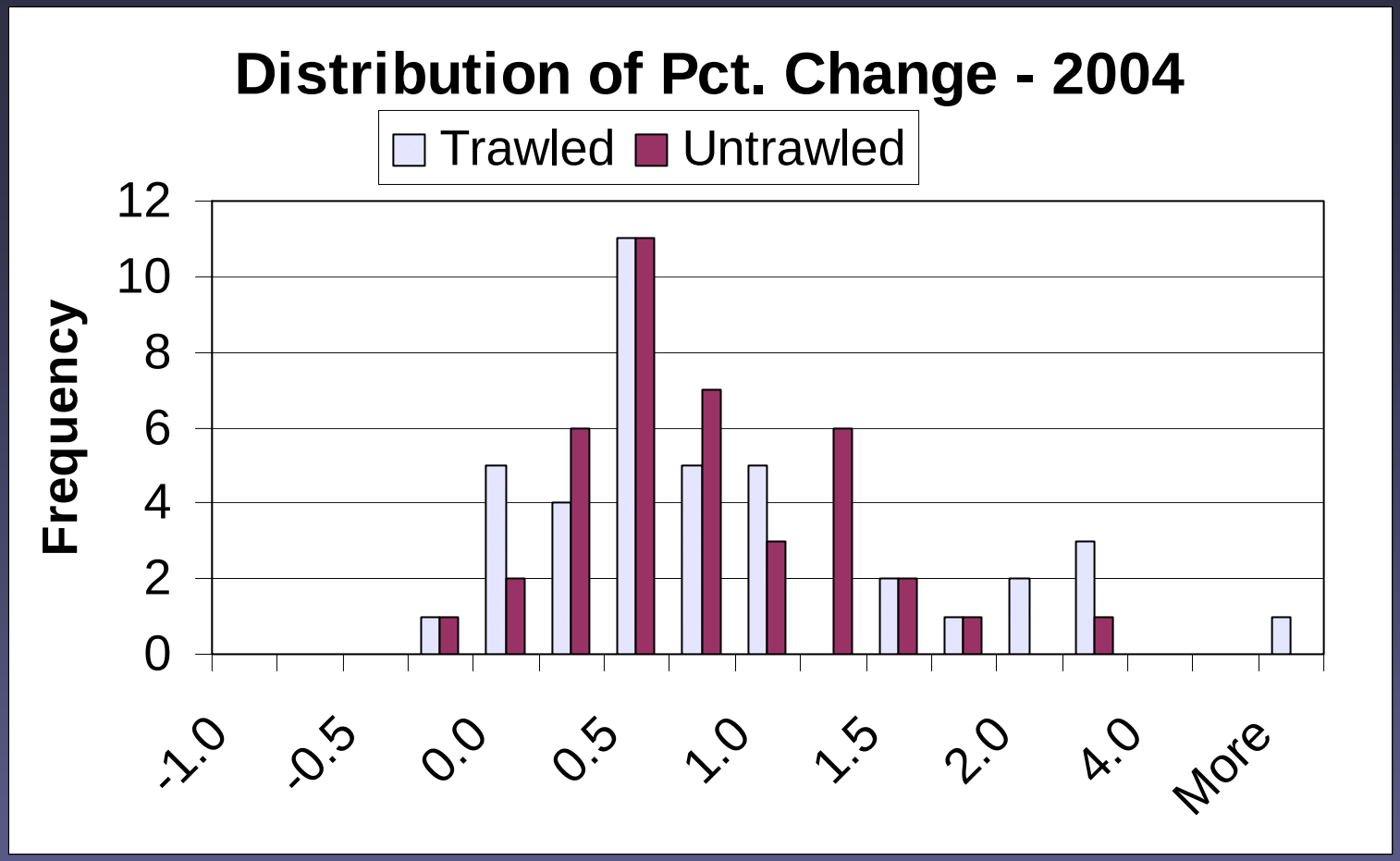
$$\delta_i = (X_A - X_B)/ X_B = X_A/X_B - 1$$

$\delta \sim 0$ No change in abundance

$\delta > 0$ Increased abundance

$\delta < 0$ Decrease abundance

- Compare δ between control and treatment



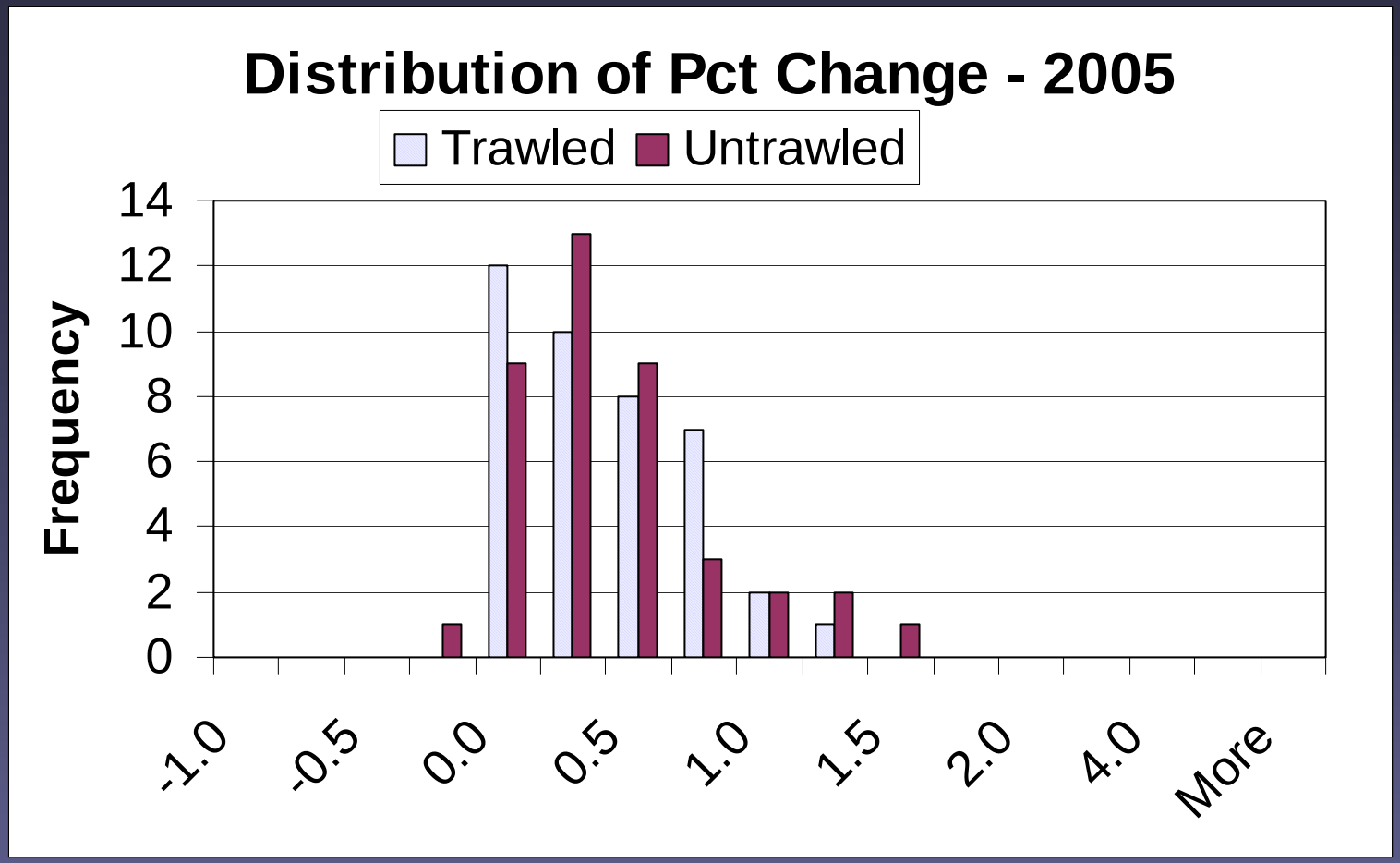
N= 40 sites trawled, 40 sites untrawled

Cod catch increased from January to March

Wilcoxin Rank-Sum Test for difference in means: p=0.981

If localized depletion, expect *less* of an increase in trawled

Power: 75-95% chance of detecting 30% reduction in catch



Wilcoxin Rank-Sum Test for difference in means: p=0.807
Power: 75-95% chance of detecting 20% reduction in catch

Possible Reasons for Observed Result:

1. Fishery removals not enough to significantly affect local abundance
2. Effect disperses in <2 weeks
3. Spatial scale of effect larger than scale of experiment
4. Directional migration of fish – spatially displaced effects

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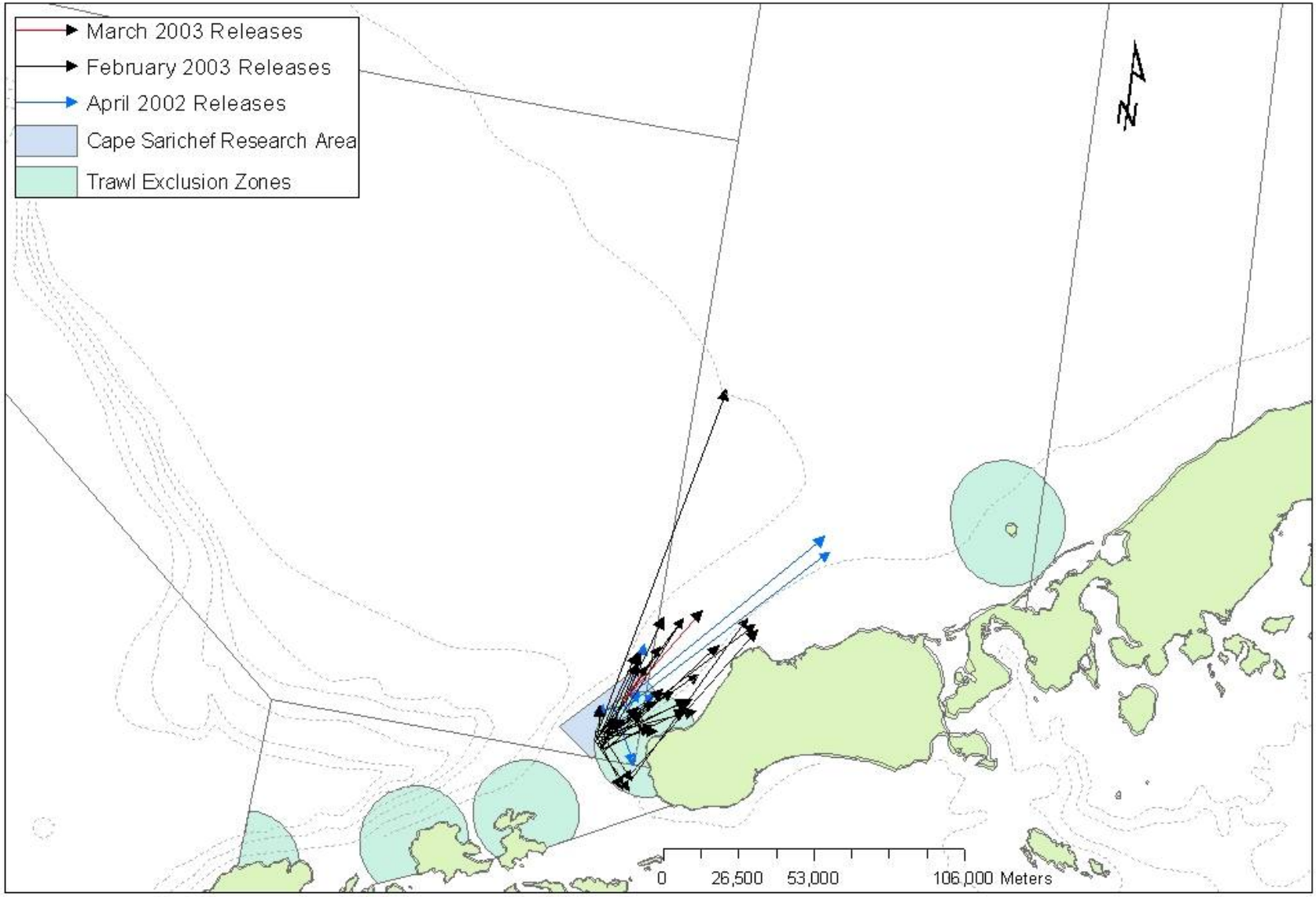
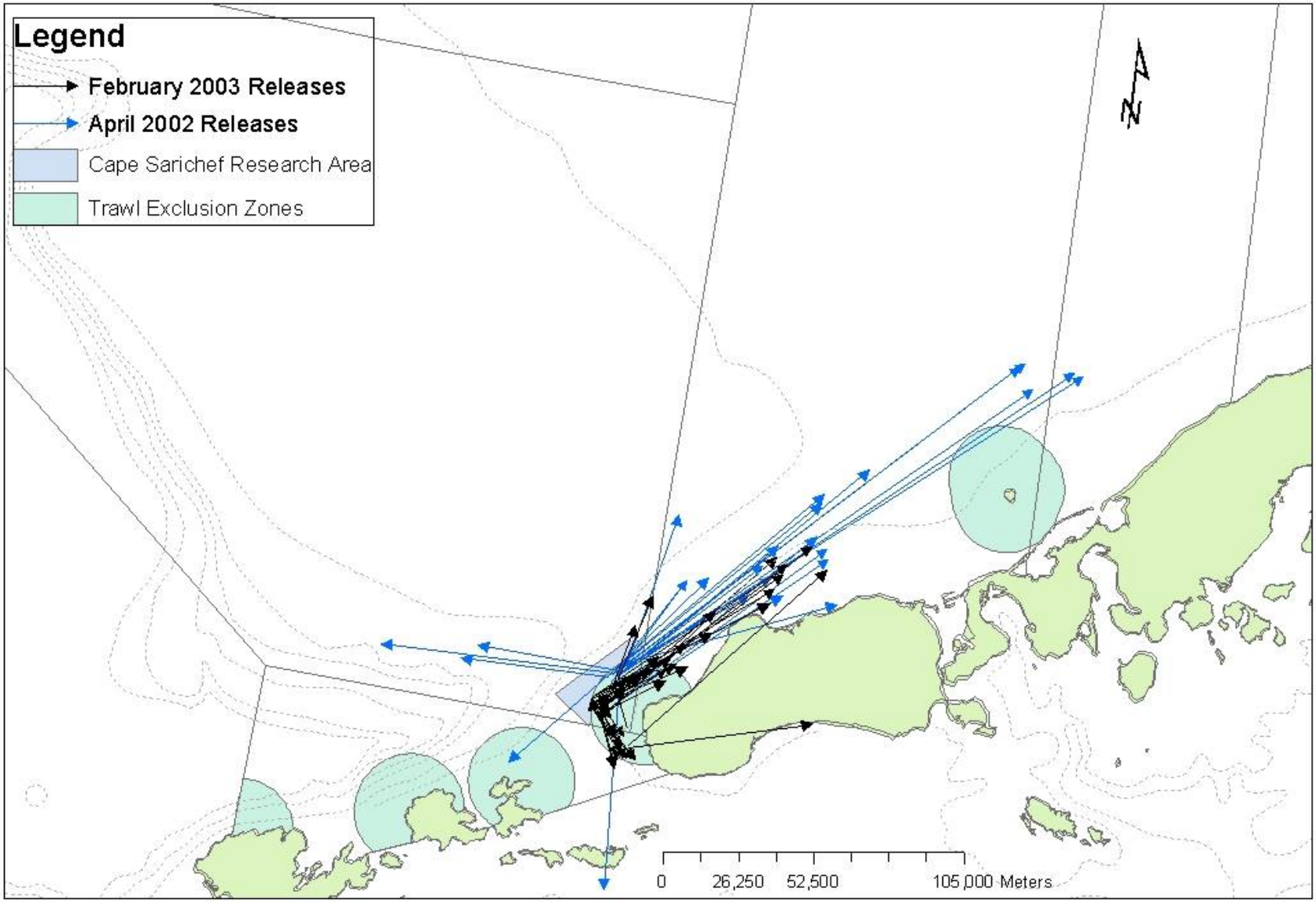
Tags released in Trawl Exclusion Zone (Control Area) at Cape Sarichef and recovered less than 8 days at liberty (n = 42).



Tags released in Trawl Exclusion Zone (Control Area) at Cape Sarichef and recovered between 7 to 14 days at liberty (n = 73).



Summary

- Pacific cod
  - Localized depletion due to commercial fishing was not observed
  - Movement through study area was great
  - Suggest that commercial fishing effect was dispersed or displaced

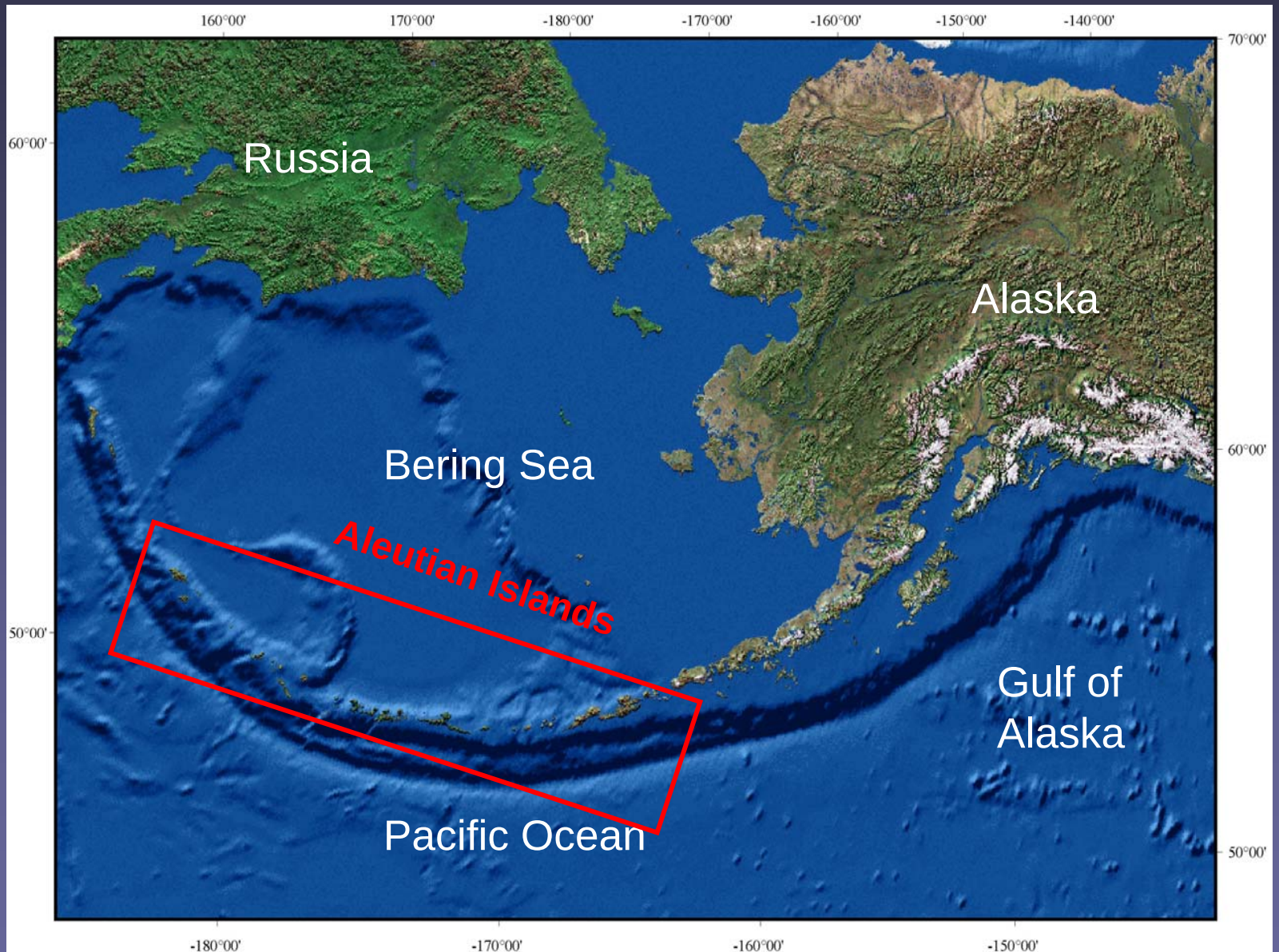
Atka mackerel

- Family Hexagrammidae
- One of the most abundant groundfish in the Aleutian Islands
- Large portion of SSL diets during summer and winter

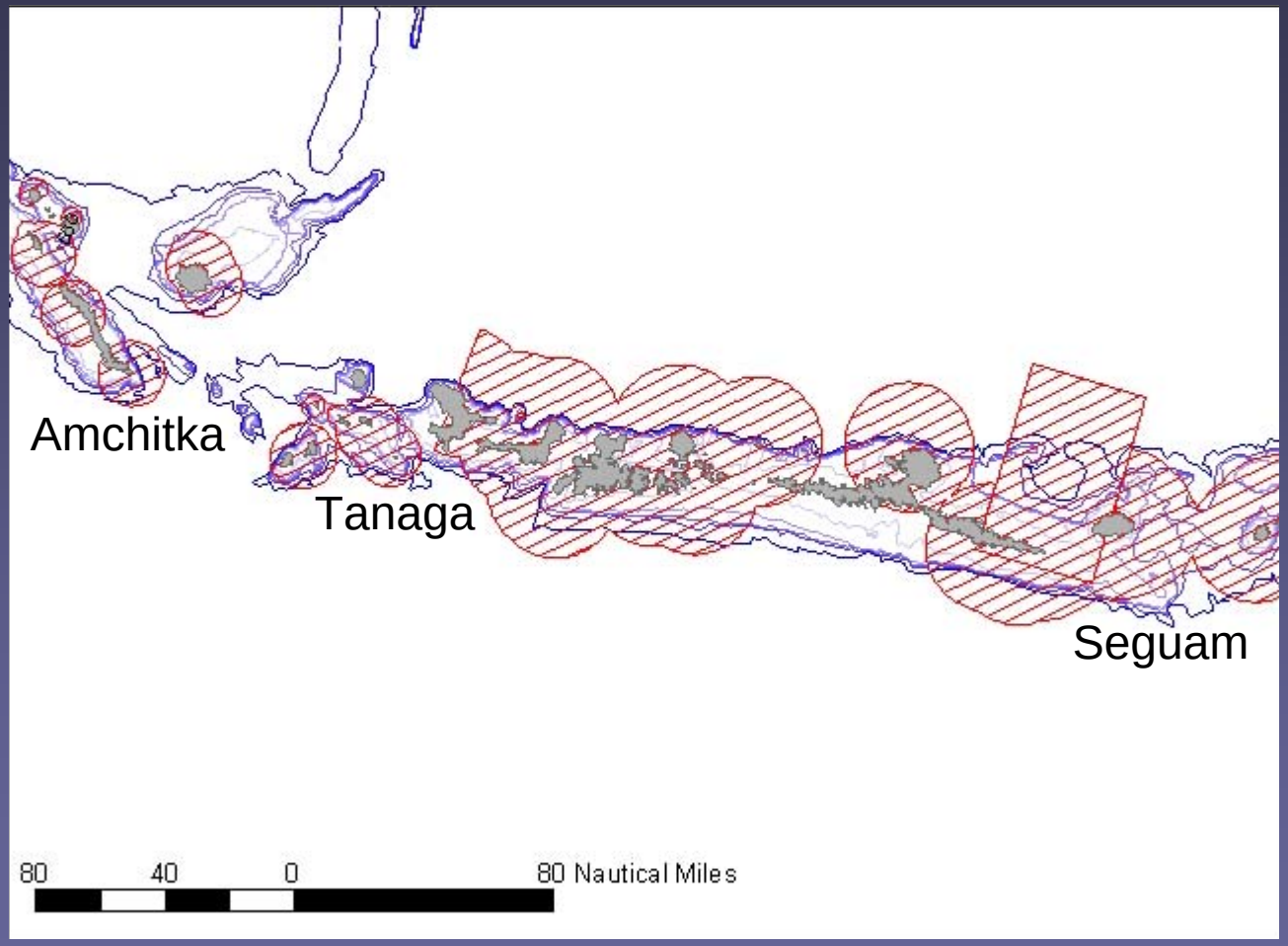
Atka mackerel project overview

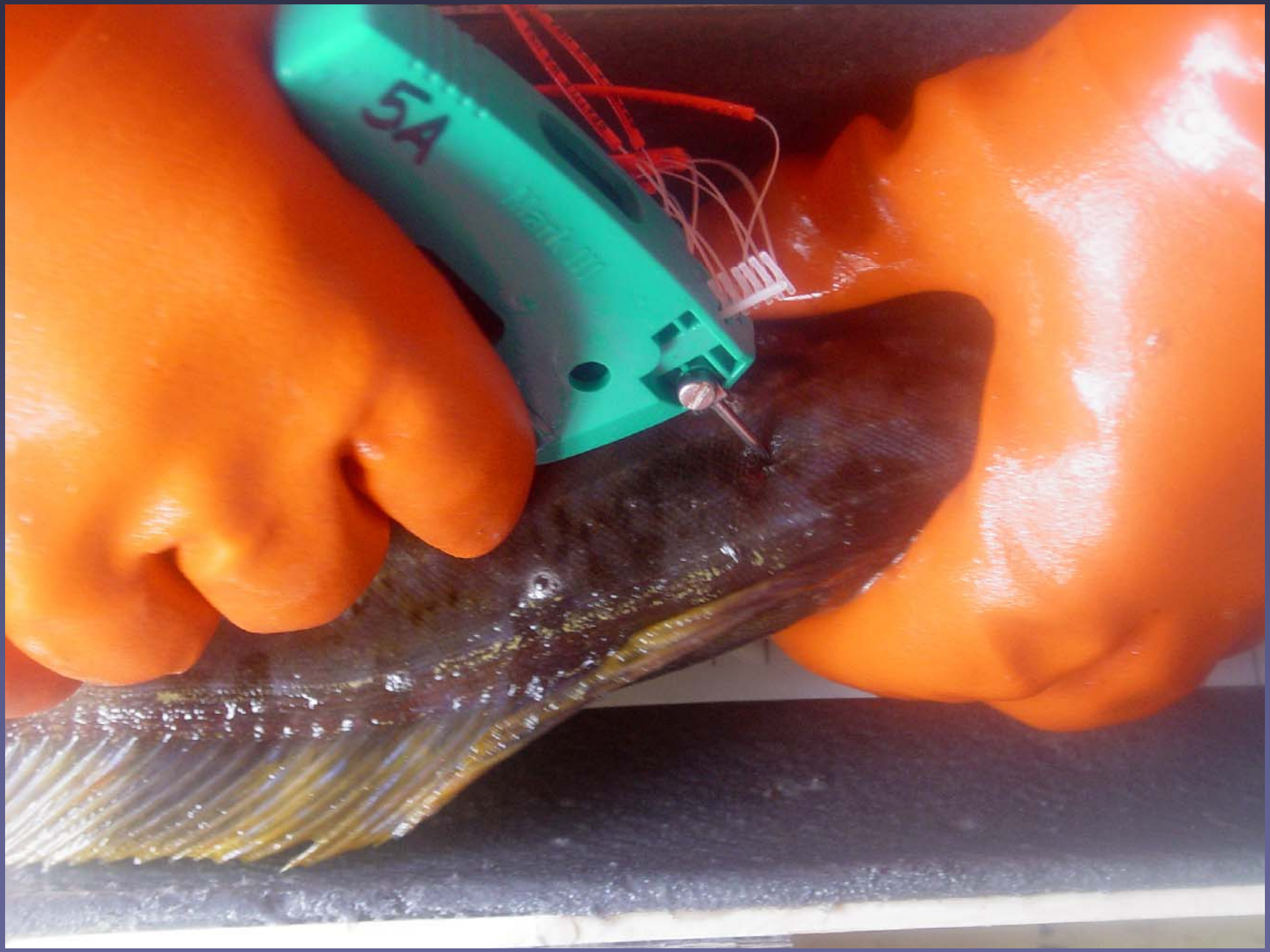
- Evaluate efficacy of trawl exclusion zones (TEZ)
  - Do fish move from inside to outside?
  - What is the abundance of fish inside?
- Tag release-recovery model
  - Local abundance
  - Movement rates

Atka mackerel – Study site

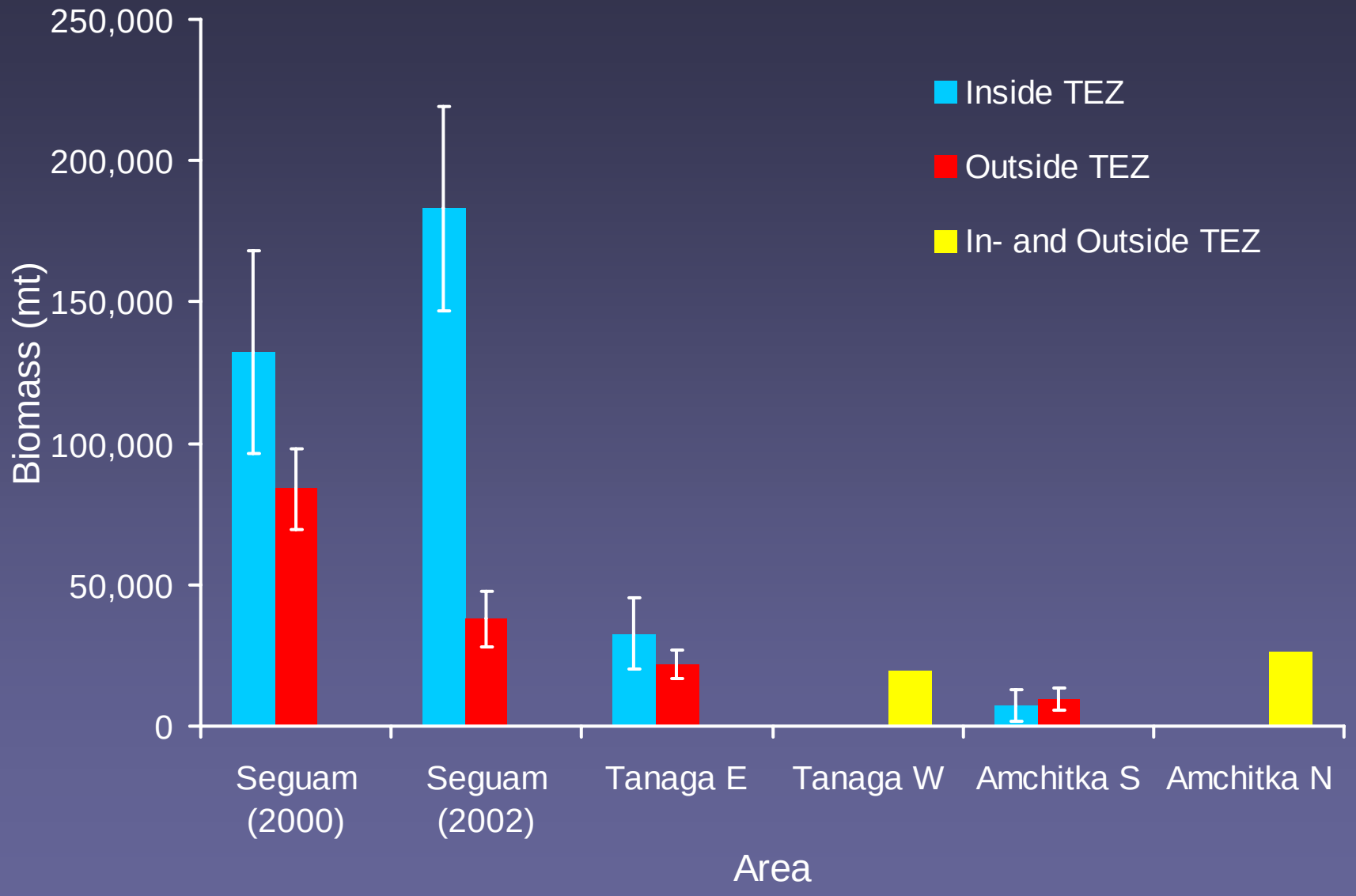


Study sites

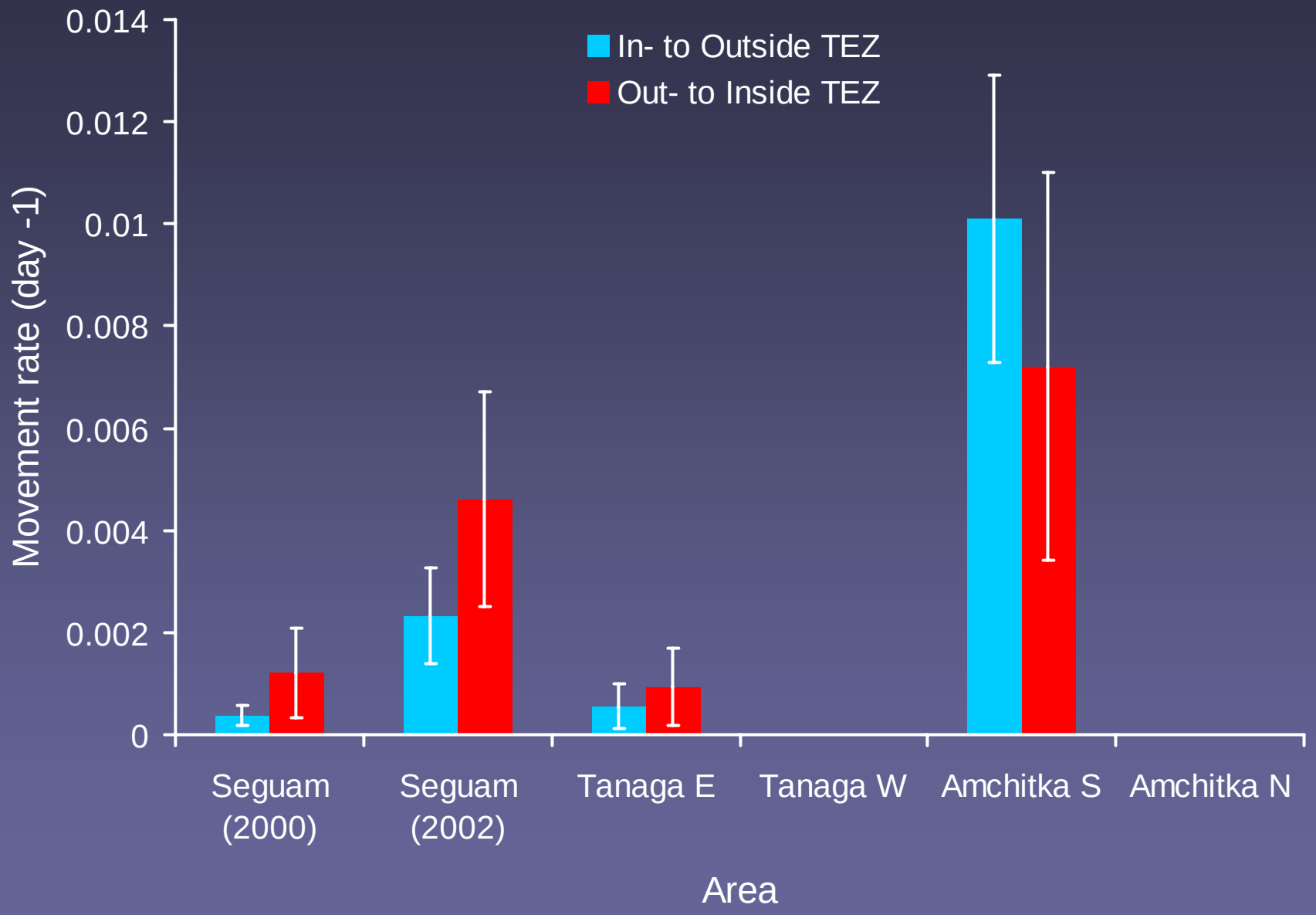



5A

Local biomass



Movement rate



Management implications?

- Efficacy of trawl exclusion zones varies geographically
  - Seguam and Tanaga
    - High biomass, low movement, more effective
  - Amchitka
    - Low biomass, high movement, less effective

Conclusions

- Pacific cod
  - Suggest that a localized commercial fishing effect was dispersed or displaced due to fish movement
  - Need to consider fish movement when designing studies of fishery effects
- Atka mackerel
  - Suggest that trawl exclusion zones at sites where movement from inside to outside is great are less effective
  - Need to consider fish movement when designing trawl exclusion zones or marine protected areas

Contact information

http://www.afsc.noaa.gov/refm/stocks/fit/FIT.htm

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