Fishery Interaction Team (FIT) Presentations to North Pacific Fishery Management Council (NPFMC)

M. E. Conners and E. Logerwell gave presentations to the Advisory Panel, Science and Statistical Committee and Council during the NPFMC's June meeting in Girdwood, Alaska. The purpose of the presentations was to provide an update on FIT research on the potential impacts of commercial fishing on Steller sea lion prey fields. Input was also sought with regard to future FIT research.

Summaries of the FIT presentations follow.

Fisheries Interaction Team
Status of Stocks and Multispecies Assessment Program
Resource Ecology and Fisheries Management Division
Alaska Fisheries Science Center

In late 2000 the Resource Ecology and Fisheries Management (REFM) division formed the Fishery Interaction Team (FIT). The primary responsibility of the team is to investigate the ecosystem effects of commercial fishing. Potential effects to be studied include: changes in fish distribution, abundance and habitat use; changes in biological characteristics such as fish size, reproduction and genetic make-up; and changes in marine community characteristics such as predator-prey relationships and species composition.

FIT is currently focused on the interactions between Alaska groundfish fisheries and endangered Steller sea lions (SSL). Members of the team conduct studies to determine whether commercial fishing operations are capable of impacting the foraging success of sea lions either through disturbance of prey schools or through direct competition for a common prey. To accomplish this objective, the team conducts field studies to examine potential commercial fishery impacts including reduction in the abundance or availability of prey at local scales and disturbance of prey fields. In addition to studies of anthropogenic factors, FIT scientists conduct process-oriented field studies of the natural factors that influence the abundance, distribution and species composition of Steller sea lion prey.

The research team aims to play an integral role in the design and evaluation of management strategies for commercial fisheries in Federal waters. FIT also anticipates that members of this research team will provide information that is directly relevant to the development of biological opinions as well as stock assessment advice.

The research activities of FIT currently focus on three commercially fished groundfish species in Alaska: Pacific cod, Atka mackerel and walleye pollock.

Contact information:
Libby Logerwell (FIT Lead)
libby.logerwell@noaa.gov
206-526-4231
http://www.afsc.noaa.gov/refm/stocks/fit/FIT.htm

Progress Report: Pacific Cod Local Depletion Study

AFSC Fisheries Interaction Team
M. Elizabeth Conners, Peter Munro, Sandi Neidetcher, Yunbing Shi

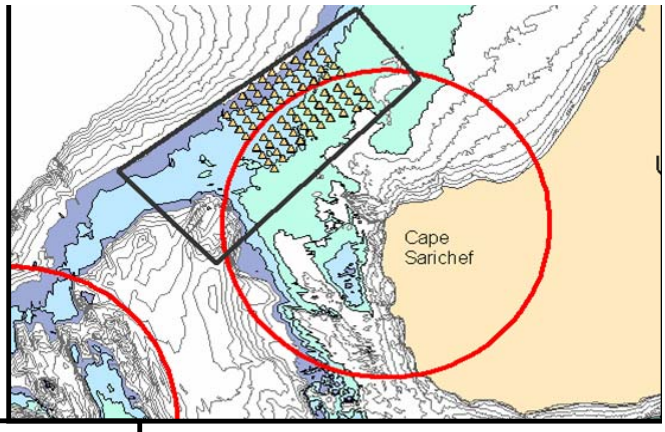
We have now completed three years of the Pacific cod local depletion experiment at Cape Sarichef. The study was designed to determine if intensive trawl fishing for cod creates a localized depletion in fish abundance that could adversely affect prey availability for Steller sea lions. The experiment uses a before-after, treatment-control type design to compare the seasonal rate of change in cod abundance within the Cape Sarichef no-trawl zone to the rate of change in the adjacent heavily-trawled area. While the cod catch rates and observed seasonal changes have been variable over the three years of the study, the result of the comparison between trawled and untrawled areas has been consistent. In each of the three years, the nonparametric statistical test has overwhelmingly indicated no difference between sites in the trawled and untrawled areas (p-values of 0.81 to 0.98). Power calculations indicate that the experiments in 2004 and 2005 would have been able to detect a reduction in the average catch of the trawled zone in the range of 20-30%. Maps of the observed catches and seasonal percentage changes show no consistent spatial pattern.

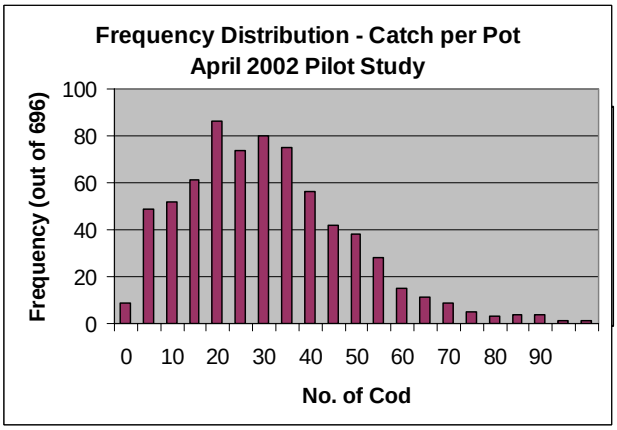
The concept of local depletion is strongly dependent on assumed spatial and temporal scale. The experiment looked for an effect based on assumptions that fishing effects would be evident within 5 nmi of the removal and persist for at least several weeks. The observed results indicate either that the relative rate of exploitation off Cape Sarichef is low or that actual fishing effects occur at different spatial and temporal scales. The results of preliminary tagging work and auxiliary biological studies suggest that the cod stocks in the study area are highly mobile over time scales shorter than two weeks.

Part of the objective of the presentation is to seek input from the Council on directions for future research stemming from this study. If the Council is strongly interested in more work on the local depletion hypothesis, we have identified possible sites where the experiment could be repeated in the western Gulf of Alaska. We have also looked at ways to redesign field studies in the Bering Sea to look for fishery effects at different temporal and spatial scales. Another option is to shift focus to following up cod tagging studies in the Bering Sea, leading to quantitative estimates of movement rates and local mortality and exploitation rates.

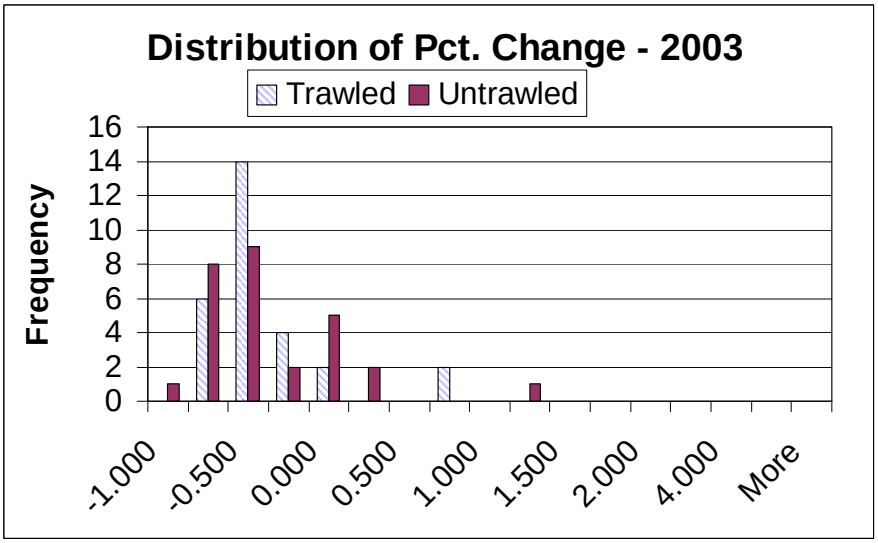
Because the results through 2005 have been so consistent and clear, and because of reduced funding, we will not be repeating the Cape Sarichef experiment in winter 2006. The special closure of the study area for March 15-31 2006 can be rescinded. There is no other action requested of the council at this time. If there is strong interest in repeating the experiment at another location, council action for a special opener/closer would be needed for the winter 2007 season.

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

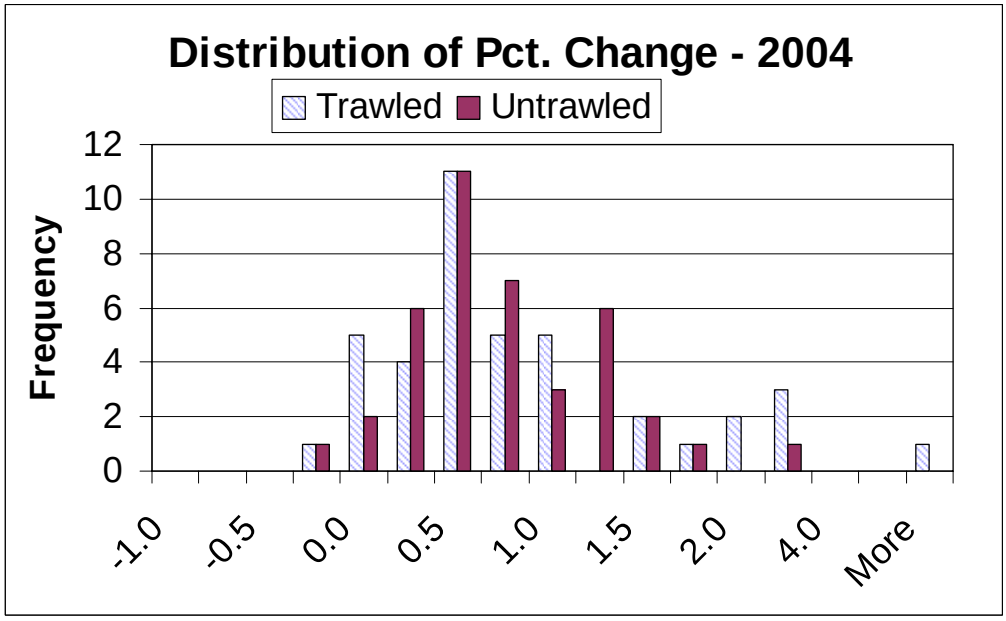




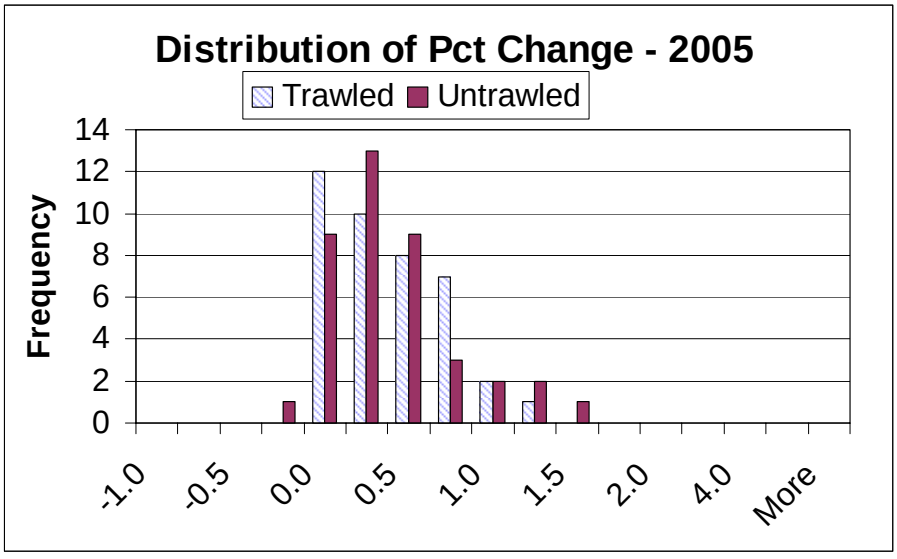
- **Pot catch used as index of local cod abundance. Pots provide good sample size and spatial precision.**
- **Compare change in pot catch (After/Before) between treatment and control areas.**



Wilcoxin Rank-Sum Test for difference in means: p =0.928
Power: poor due to low sample size

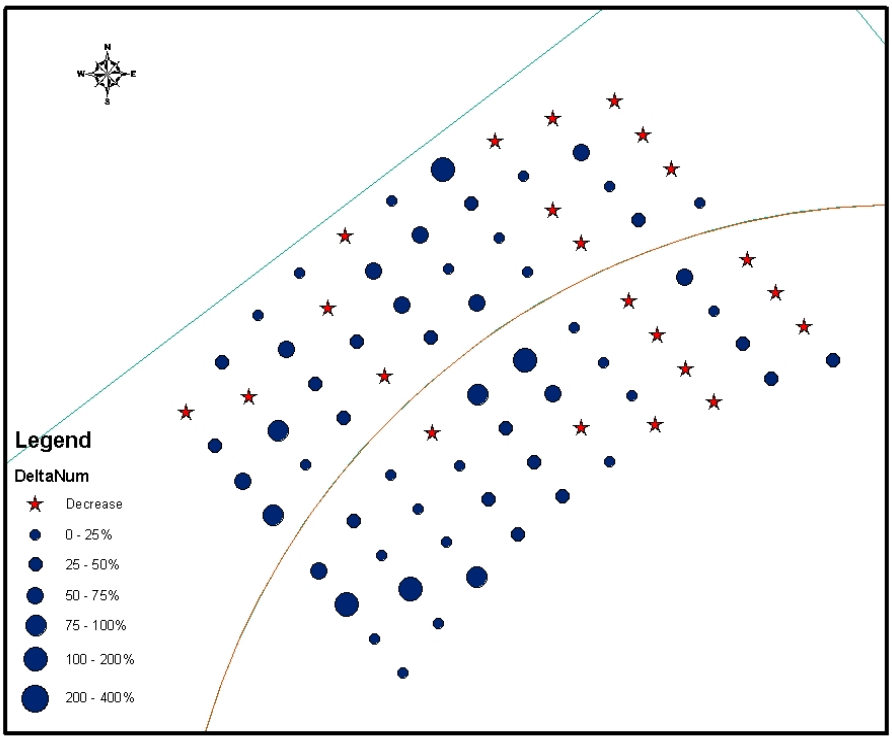


Wilcoxin Rank-Sum Test for difference in means: p=0.981
Power: 75-95% chance of detecting 30% reduction in catch



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

Results 2005 – Percent Change



Possible Reasons for Observed Result:

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

Progress Report: Short-term effects of commercial fishing on walleye pollock.

A. Hollowed, C. Wilson, L. Logerwell, and P. Walline
Fishery Interaction Team (FIT) and
Midwater Assessment and Conservation Engineering (MACE)
Alaska Fisheries Science Center

The purpose of this research is to determine whether commercial pollock fishing results in localized depletion or disturbance of Steller sea lion (SSL) prey fields. A pollock fishery interaction experiment has been conducted off Kodiak Island during four years, 2000, 2001, 2002 and 2004. The sampling design utilized control (unfished) and treatment (fished) areas. Barnabus Trough was open to fishing and thus was the treatment site. Chiniak Trough was closed to fishing and thus was the control site (Fig. 1). In 2001 and 2004, substantial (> 1500 t) amounts of adult pollock were removed from our study area during the C season. Results from the 2001 experiment show high temporal variability in adult pollock biomass in the treatment area, but not in response to fishing (Fig. 2). In contrast, results from 2004 show a statistically significant decrease in pollock biomass in the treatment area following the start of commercial fishing (Fig. 2). No concurrent decrease in adult pollock biomass in the control area was observed. Results from 2000 and 2002 are not shown because the region was closed to pollock fishing in 2000, and fishery removals were very small (roughly 300 tons) in the study area in 2002. Fishery removals in 2001 and 2004 were 2853 and 1723 tons, respectively. No differences were detected in the vertical distribution of adult pollock from before to after the start of the fishery in either year (Fig. 3). Statistical power analyses based on the 2004 data show that differences in biomass of 35% could be detected 80% of the time in the treatment area. The analyses also show that differences of 6 to 8 meters in mean distance off-bottom could be detected 80% of the time.

Input from the Council is sought on the direction of future Fishery Interaction Team pollock research. The inter-annual variability of the results suggests caution in drawing conclusions from only two years of study (2001 and 2004). Thus, repeating the Kodiak fishery interaction experiment for one or two years is one possibility for future work. Another possibility is to investigate the potential for commercial pollock fishing in the Aleutian Islands to cause localized depletion or disruption of SSL prey fields. The Council recently moved to accept an amendment to the Fishery Management Plan for the Bering Sea-Aleutian Islands (Amendment 82). This amendment allowed a fishery outside SSL critical habitat in 2005, for the first time since 1999. Before 1999, most of the Aleutian Islands pollock catch was taken from the Bering Sea side of the chain immediately west of the Bogoslof Island closure and also inside what is now SSL critical habitat (10 - 20 nautical mile trawl exclusion zones). The fishing fleet encountered difficulties in finding fish outside of critical habitat in 2005. These difficulties may stimulate interest in improving our knowledge of seasonal movement patterns of walleye pollock relative to Steller sea lion critical habitat in the eastern Aleutian Islands.

Because of lack of NOAA Vessel availability, the Kodiak fishery interaction experiment will not be conducted in 2005 or 2006. Therefore the Chiniak Gully Research Area Closure will not be necessary in those years.

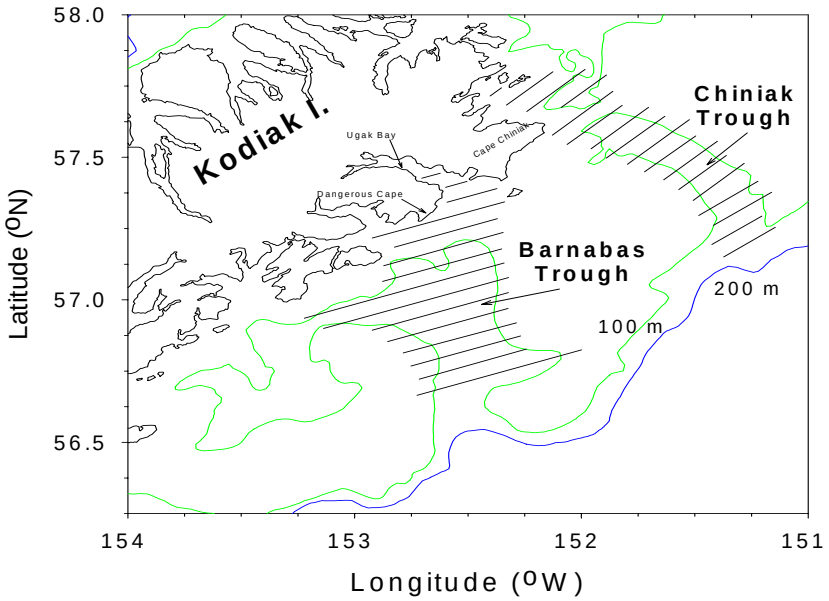


Figure 1. Study area off the east coast of Kodiak Island. Barnabus Trough was open to fishing, Chiniak Trough was closed to fishing. Lines show locations of echo integration-trawl survey transects.

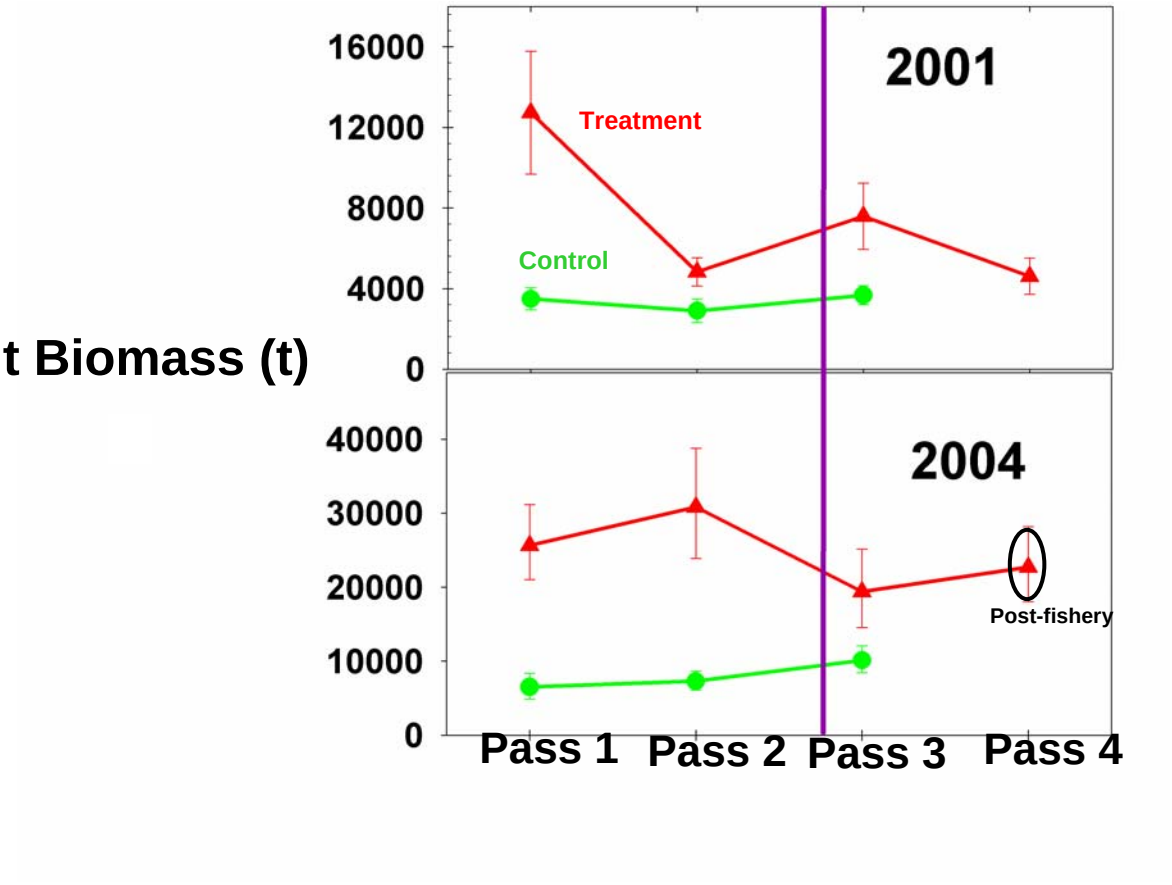


Figure 2. Adult pollock biomass (with 95% confidence intervals) in 2001 and 2004, during passes 1 and 2 (before the start of the commercial fishery) and passes 3 and 4 (after the start of the commercial fishery). Data for treatment (Barnabus Trough) and control (Chiniak Trough) are shown as red triangles and green circles, respectively.

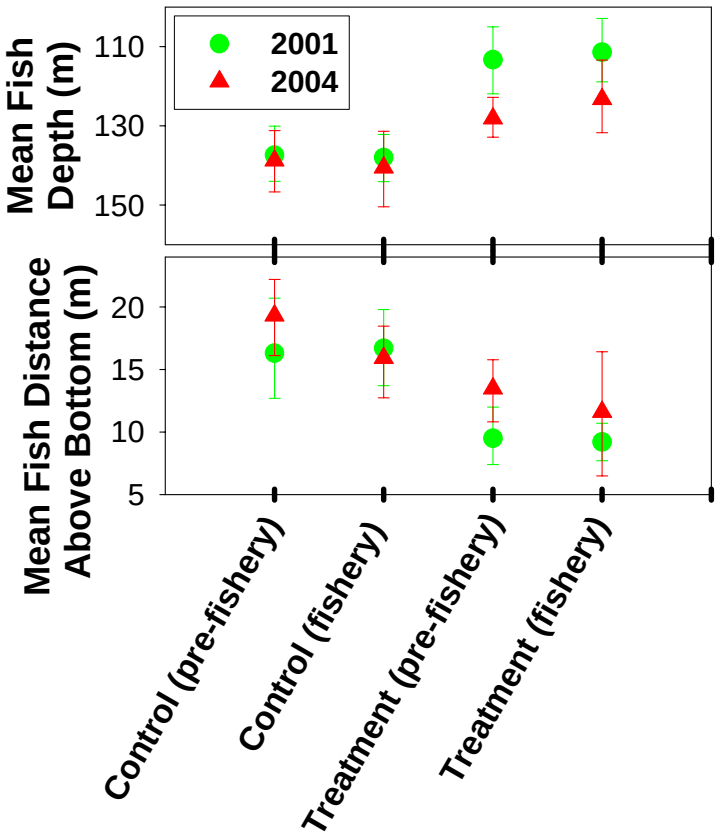


Figure 3. Mean adult pollock depth and distance off bottom (with 95% confidence intervals), in 2001 and 2004 for the control area (Chiniak Trough) and the treatment area (Barnabus trough) during a pre-fishery and a fishery passes.

Progress Report: Atka mackerel biomass and movement relative to trawl exclusion zones in the Aleutian Islands.

S.F. McDermott, E. Logerwell and J. Ianelli
Fishery Interaction Team (FIT)
Alaska Fisheries Science Center

The objective of this project is to evaluate the efficacy of trawl exclusion zones (TEZs) at maintaining sufficient quantities of Atka mackerel prey for Steller sea lions (SSL) in the Aleutian Islands. Tag release-recovery methods were used to estimate local abundance and movement rates inside and outside TEZs at several sites in the Aleutian Islands. Movement rates are of interest because fish moving from inside to outside TEZs are vulnerable to commercial fishing. From 2000-2003, Atka mackerel have been tagged, released and recovered at Seguam Pass, Tanaga Pass and Amchitka Island (Figs. 1 – 4). Biomass and movement rates were estimated with an integrated model that uses maximum likelihood to estimate all parameters simultaneously. Biomass was highest at Seguam Pass and lowest at the south end of Amchitka Island. In all areas, biomass inside the TEZs was similar to or greater than biomass outside the TEZs (Fig. 5). In all areas, movement rates from inside to outside were similar to or less than movement rates from outside to inside, with the exception of Amchitka Island where movement rates may have been greater from inside to outside. In addition, movement rates were greater overall at Amchitka Island than at any of the other study areas (Fig. 6).

The results suggest that TEZs in Seguam and Tanaga Passes, where Atka mackerel biomass is relatively high and movement is relatively low, may be effective at preserving local foraging areas for SSL. In contrast, the TEZ at the south end of Amchitka, where biomass is low compared to other areas and movement is high, may be less effective. These differences in movement relative to TEZs may be due to differences in the distribution of Atka mackerel habitat. For example, the boundaries of the TEZs at Seguam and Tanaga passes appear to coincide with natural Atka mackerel habitat boundaries (by chance). In contrast, the TEZs at Amchitka Island, appear to bisect Atka mackerel habitat. This may be why movement rates relative to TEZ boundaries at Amchitka were higher than at Seguam and Tanaga passes.

Input from the Council is sought on the direction of future Fishery Interaction Team Atka mackerel research. One objective could be to conduct tag release-recovery studies at sites in the western Aleutians in addition to Amchitka Island. SSL population declines from 2000-2002 in the western Aleutians were among the greatest, whereas SSL counts generally increased or showed little change in the central and eastern Aleutians (Fig. 7). Another objective could be to conduct a tagging study in the Unimak Pass area where Atka mackerel catch appears to have increased dramatically in recent years, possibly as a result of strong 1998 and 1999 year classes.

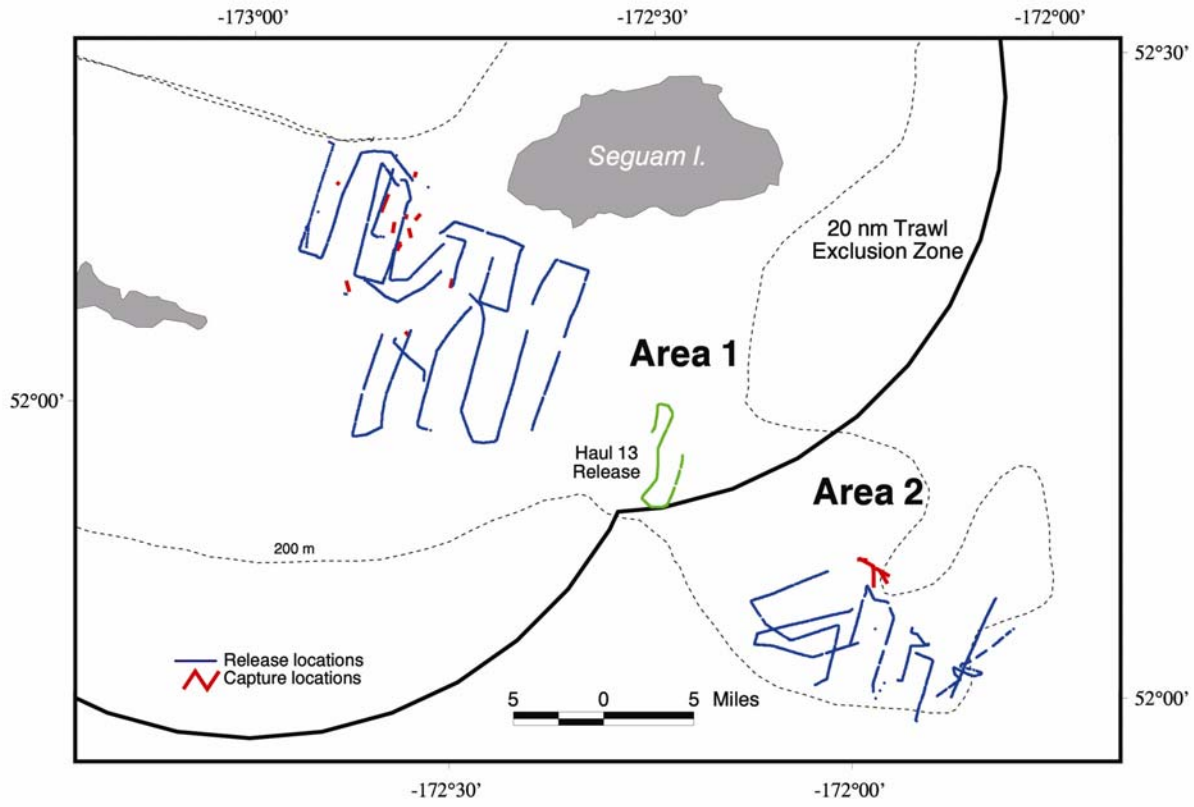


Figure 1. Capture and release locations of tagged fish in Seguam Pass in 2000. Capture locations of the fish to be tagged are in red, transects along which tagged fish were released into the water are shown as a series of blue points, except for haul 13 which is shown in green.

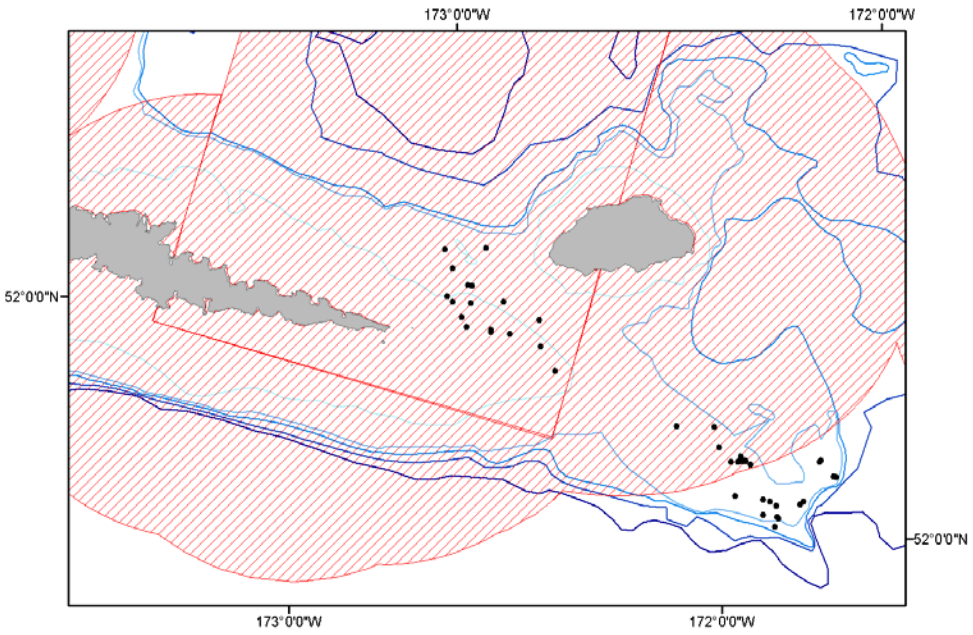


Figure 2. Capture and release locations for tagged fish in Seguam Pass in 2002. Points show mid-point of hauls. Tagged fish were released within 1 nautical mile of the capture location. Red-hatched areas indicate the 20-nautical mile trawl exclusion zones.

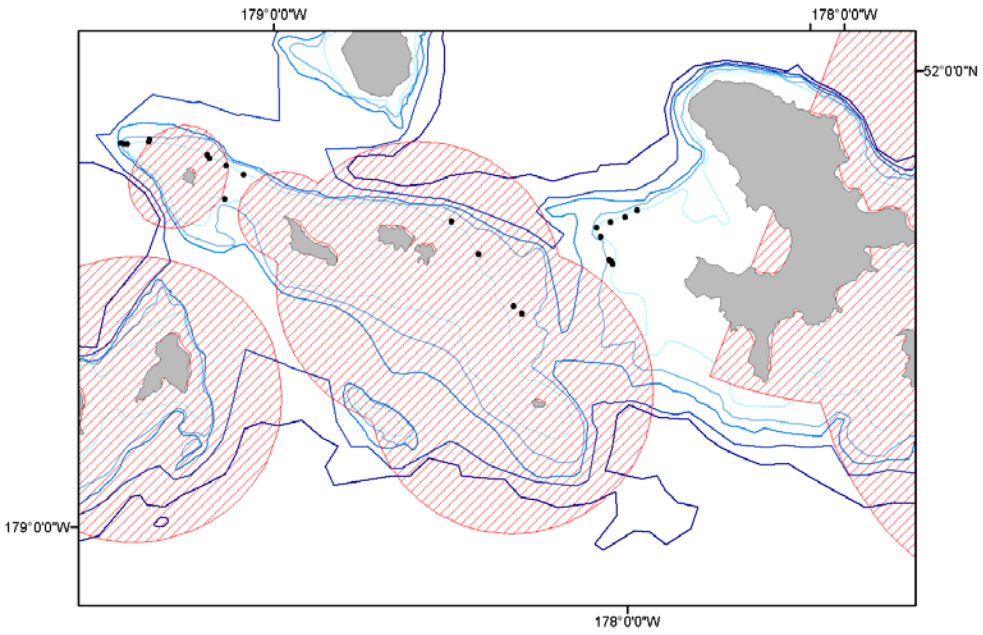


Figure 3. Capture and release locations for tagged fish in the Tanaga Pass area in 2002. Points show mid-point of hauls. Tagged fish were released within 1 nautical mile of the capture location. The release locations near Tanaga Pass (around 178° W) are referred to as "Tanaga E". The release locations west of 179° W, are referred to as "Tanaga W". Red-hatched areas indicate the 10-nautical mile trawl exclusion zones.

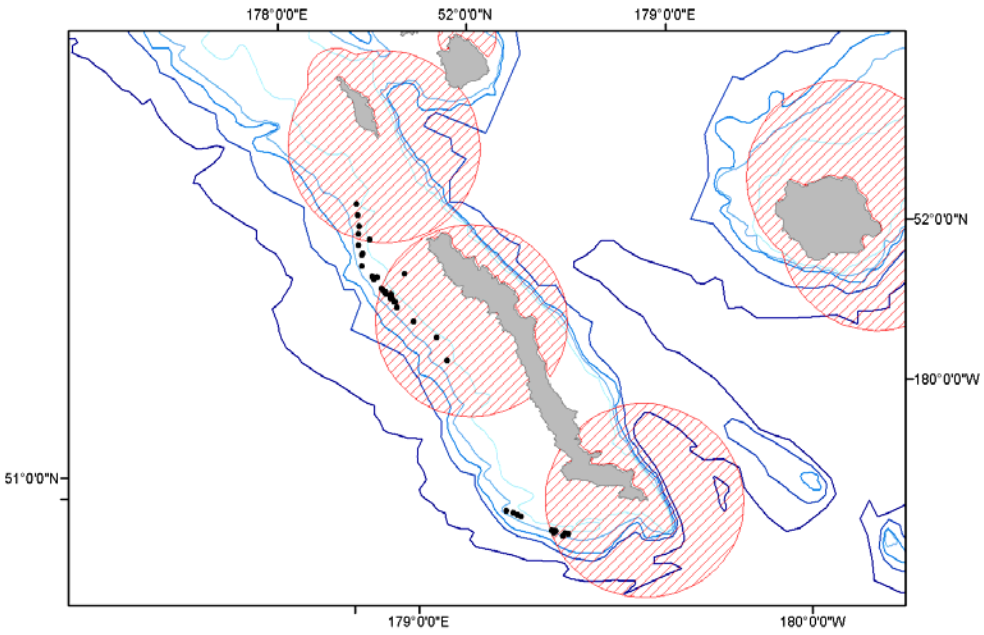


Figure 4. Capture and release locations for tagged fish in the Amchitka Island area in 2003. Points show mid-point of hauls. Tagged fish were released within 1 nautical mile of the capture location. The release locations off the southern end of the island (south of 51° N) are referred to as "Amchitka S". The release locations off the northern end of the island (around 52° N) are referred to as "Amchitka N". Red-hatched areas indicate the 10-nautical mile trawl exclusion zones.

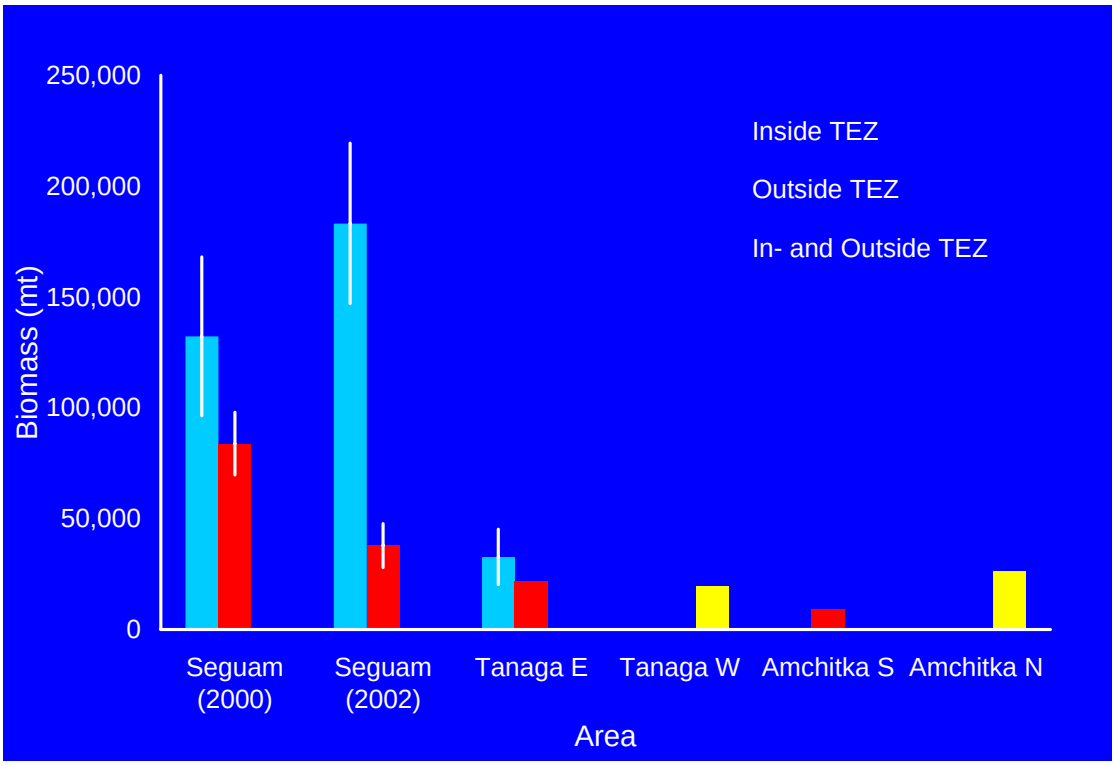


Figure 5. Tagging model estimates of Atka mackerel biomass in the three study areas. Biomass estimates for inside and outside the trawl exclusion zones (TEZ) are shown, with standard deviations. Biomass estimates for Tanaga W and Amchitka N are based on a Peterson model estimate made for inside and outside TEZ areas combined.

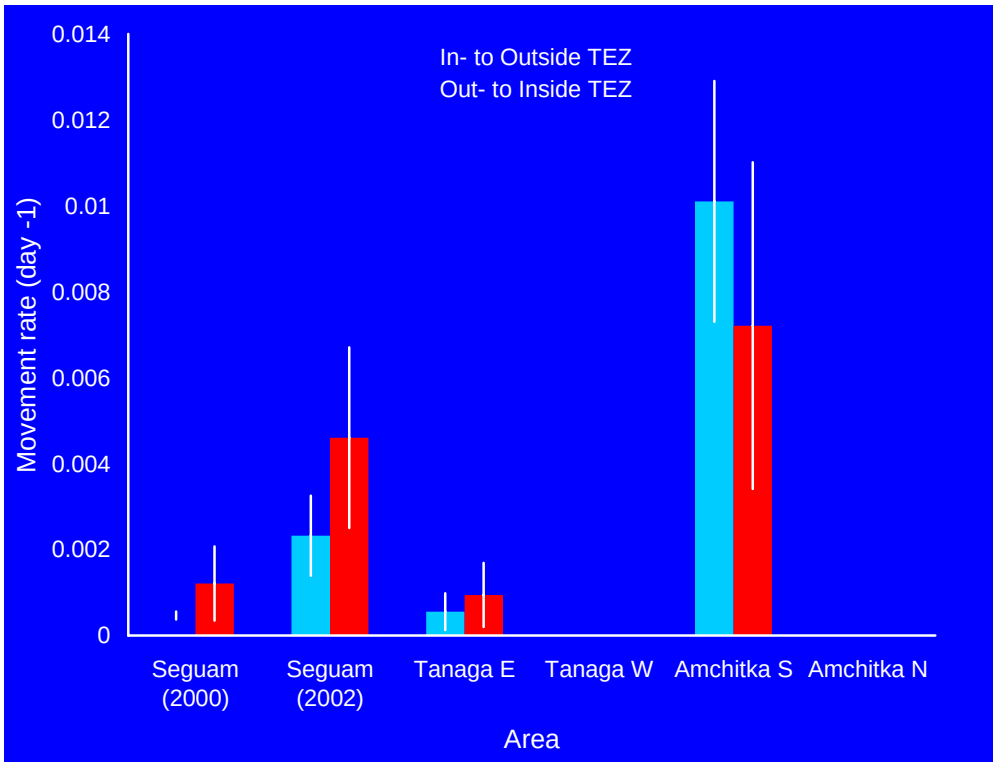


Figure 6. Tagging model estimates of Atka mackerel daily movement rate in the three study areas. Movement estimates for inside and outside the trawl exclusion zones (TEZ) are shown, with standard deviations. No movement rates were estimated for Tanaga W and Amchitka N.

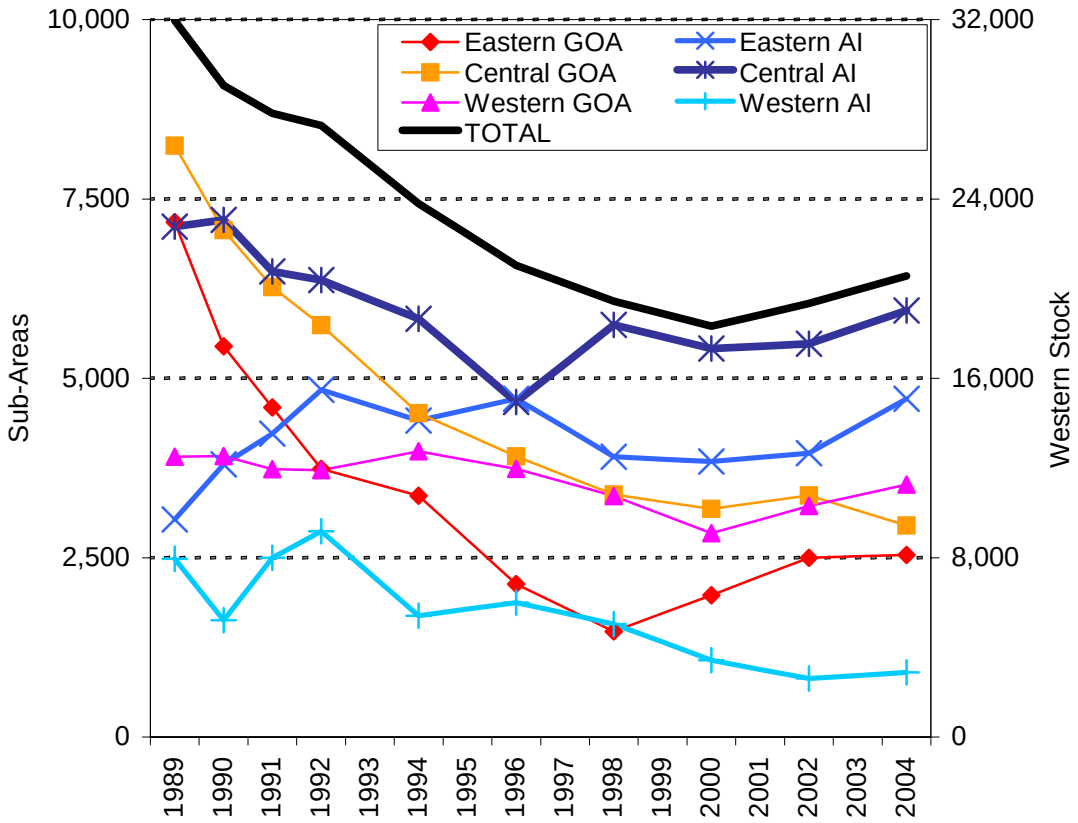


Figure 7. Counts of non-pup (adult and juvenile) Steller sea lions on rookery and haulout trend sites in the range of the western population from 1989-2004. Counts are aggregated by sub-area (left axis) in the Gulf of Alaska (GOA) and Aleutian Islands (AI) and for the entire western Alaskan population (TOTAL; right axis). Surveys in 1989-2002 used 35 mm oblique slides, while the 2004 survey used medium format vertical photographs. Counts in 2004 displayed above have been reduced 3.5% from the actual count to account for the format differences (L. Fritz, NMML, pers. com.).