Local Abundance and Movement of Atka Mackerel and Other Steller Sea Lion Prey in the Aleutian Islands

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Background

Atka mackerel are one of the most abundant groundfish in the Aleutian Islands (2015 adult age 3+ biomass 589, 000 metric tons). They are distributed in dense aggregations in areas of strong currents from Kamchatka to the Gulf of Alaska along the Aleutian Island chain.

Atka mackerel are semi-pelagic and mostly occur at a depth of 100-200m.

During the spawning season from July through October, males establish nesting sites where they actively guard the nests.

Atka mackerel and Steller sea lions

Atka mackerel are one of the main prey items of the endangered Steller sea lion in the Aleutian Islands.

In 1997, the western Stock of Steller sea lions was declared endangered. In 2000, 10-20nm trawl exclusion zones were established around rookeries and haulouts. In addition, the fishery was allocated in space and time to avoid local overfishing.

In 2011, as Steller sea lions populations were still declining in the Western and Central Aleutian Islands, the entire Western Aleutian Island subarea was closed to Atka mackerel and Pacific cod fishing and the Central Aleutian Island subarea was closed to fishing inside critical habitat (Fig. 1). However, in 2015 the Western Aleutian subarea was opened up to restricted fishing and the restrictions in the Central Aleutians Island subarea were reduced.

These mitigation measures were put in place to avoid competition between the fishery and Steller sea lions for prey and were in part influenced by the results from our previous Atka mackerel tagging studies from 2000 - 2012. Results from previous tagging effort in the Central Aleutians showed that exploitation rates were less than 10% in the areas where fishing was allowed during 2011, indicating that the mitigation efforts were working.

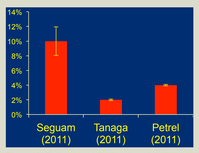


Figure 1: Estimates of the local exploitation rate of the Atka mackerel fishery in the Central Aleutian Islands based on biomass estimates form the Atka mackerel tagging study in 2011 (NPRB project 1007).

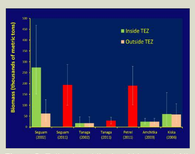


Figure 2: Estimates of the local biomass of Atka mackerel derived with the integrated tag recapture model from previous Atka mackerel tagging studies 2002-2011 (NPRB project 1007).

However, the National Marine Fisheries Service acknowledged that there was still much uncertainty as to the impact of fishing on the Steller sea lion prey field, especially in the Western Aleutian Islands, where Steller sea lion prey fields have not previously been studied around rookeries. This study was designed to fill this important data gap.

References

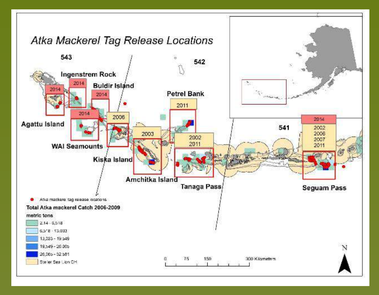
McDermott, S.F., L.W. Fritz, and V. Haist. 2005. Estimating movement and abundance of Atka mackerel (Pleurogrammus monopterygius) with tag–release–recapture data. Fish. Oceanogr. 14 (Suppl. 1):113-130.

McDermott, S.F, D. Cooper;J. Guthridge; I. Spies; M. Canino; P. Woods; N. Hillgruber. 2011. Effects of maternal growth on fecundity and egg quality of wild and captive Atka mackerel. Mar. Coast. Fish. 3:1, 324-335. .

Objective: Examine the impacts of fishing on the Steller Sea lion prey fields

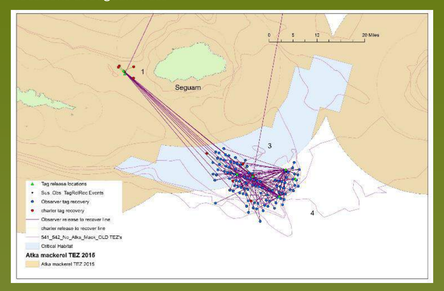
1. **Estimate Atka mackerel movement and abundance in the Western Aleutian Island subarea**
   Atka mackerel tag release study
2. **Examine biological traits of Atka mackerel and compare them between Eastern and Western Aleutian Islands**
   Atka mackerel length frequency data, Spawning vs feeding aggregations
3. **Describe oceanographic features of Atka mackerel habitat**
   CTD casts and underwater camera tows

Figure 3: Study sites 2000-2015



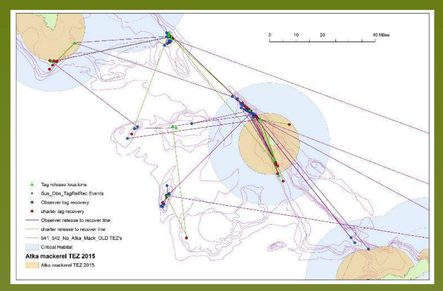
Project history outlining previous tagging study locations and years (orange) including the current study (pink).

Figure 4: Atka mackerel tag release and recovery locations at Seguam Pass



Tag release and recovery locations in the Eastern Aleutian Island subarea, Shown here are only results from the 2014 tag release event. Lines represent linear distance from tag release to tag recovery sites.

Figure 5: Atka mackerel tag release and recovery locations in the Western Aleutian Island subarea



Tag release and recovery locations in the Western Aleutian Island subarea from the 2014 study. Lines represent linear distance from tag release to tag recovery sites.

Catch

Tag

Release

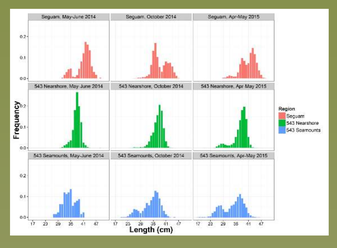
Recover

Photo: Jared Guthridge

Recapture

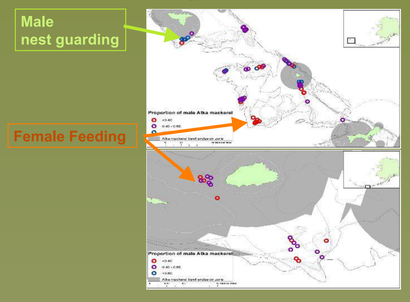
Preliminary results 2014 – 2015 study

Figure 6: Atka mackerel length frequency distribution by study area and season.



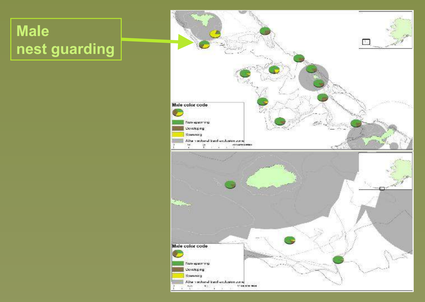
Atka mackerel exhibit larger fish in the Eastern Aleutians Island subarea. The nearshore distribution in the Western Aleutians Islands (green) does not exhibit the smaller year classes that are apparent in the Seamounts area in 543.

Figure 7: Atka mackerel sex ratio during the tag recovery charter in October 2014 during breeding season.



Atka mackerel exhibit a skewed sex ratio in many sampling stations during their breeding season . Predominantly 'female' hauls might represent feeding areas whereas predominantly male hauls might represent nest guarding areas.

Figure 8: Male color code as a proxy for nest guarding during September/October (spawning season).



Male color code was determined from random length frequency samples for each haul. Bright yellow color indicates spawning males that are guarding a territory. Most territorial males were observed in Agattu inside the Trawl exclusion zone and Wall's plateau.

Summary

Atka mackerel movement:

Atka mackerel show movement between the different population centers in the Western Aleutian Island subarea. Especially movement between Buldir, Kiska, Ingenstrem rock and Petrel bank were noted.

At Seguam pass, movement from the inside to the outside of the closed area was observed (Figs. 4 and 5).

Length frequency distributions

Atka mackerel exhibited different size and growth patterns with larger fish at Seguam pass, medium size fish in the areas at Agattu, Ingenstrem rock and Buldir, and the smallest fish at the seamounts further offshore. This indicated that movement between population centers was infrequent enough to maintain distinct size compositions, or movement was ontogenetic and small fish moved further north as they grew larger (Fig. 6).

Spawning and feeding habitat:

Atka mackerel exhibit skewed sex ratios at a local scale. Hauls with a high percentage of males in spawning coloration were used as a proxy to locate nest guarding. This was observed inside the protected area at Agattu Island. Feeding areas (female dominated hauls) were found at Tahoma reef and inside the closed area at Seguam pass. Other areas showed a mix of male and female dominated hauls, indicating mixed habitats (Figs. 7 and 8).

Methods

Atka mackerel were tagged and released on the charter vessel Pacific Explorer in May-June 2014 (Fig. 3).

Fish are tagged with Floy T-bar tags, measured and released into the water. We chose two separate study sites:

Seguam Pass: Commercial fishery present, sea lion population stable

Western Aleutian Islands: Commercial fishery present (large portion of the quota), outside critical habitat for Steller sea lions.

In September and October 2014 and in March 2015 we recovered tagged fish aboard the chartered F/V *Seafisher* (Fig. 4 and 5). Catches are sorted and sampled for species composition similar to observer sampling on commercial vessels. In addition length frequencies and biological samples were collected for every haul.

Model: We will use an integrated maximum likelihood model based on tagging and auxiliary data (ADMD) to estimate abundance.

Oceanographic habitat:

During the tag release cruise, we sampled the water column after each trawl tow with a CTD. In addition, we collected depth and temperature data during each tow.

Underwater camera tows:

During the release and recovery cruises, we conducted underwater camera transects in the locations of the trawl hauls whenever weather permitted this operation.

Our custom system enabled us to estimate fish density, species composition, and fish length. We then compared these estimates to those from spatially and temporally close trawl hauls. Fish density trends were consistent between camera and trawl methods. However, fish lengths were underestimated in our camera transects.

This camera system was developed to assess fish abundance in untrawlable areas and we are constantly Improving our methods.

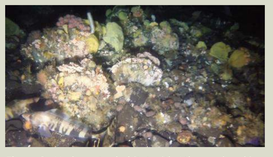


Figure 9: Underwater habitat with Atka mackerel in the Aleutian Islands from our camera system.

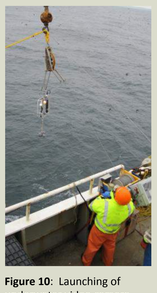


Figure 10: Launching of underwater video camera