Arrowtooth flounder *Atheresthes stomias* diet and prey consumption near Kodiak Island, AK*

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**Introduction**

Arrowtooth flounder (ATF) are large, piscivorous flatfish that feed on commercially and ecologically important fish and invertebrate prey in Alaskan waters (Yang, 1995, Yang and Nelson 2000). Their population has increased dramatically over the past 25 years and they are currently the most abundant groundfish in the Gulf of Alaska (GOA). Consequently, ATF are becoming a increasingly important component of the GOA ecosystem. Arrowtooth flounder diet and prey consumption was studied to assess the predator/prey interactions of this top-level predator near Kodiak Island (Fig. 1), an area of high ATF abundance and rich commercial fisheries.

**Methods**

**Diet analysis:**

- ATF stomachs were collected at 12 sampling stations during bottom trawl surveys conducted in May and August of 2002, 2003, and 2004 near Kodiak Island, AK.
- Intennauxal, within year, and ontogenetic diet trends were quantified from the analysis of 742 ATF stomach samples.
- In the laboratory, prey items were identified to the lowest practical taxonomic group.
- Dietary trends were investigated by comparing changes in the frequency of occurrence and percent weight contribution of the main prey groups.
- Non-parametric tests (Kruskal-Wallis and Mann-Whitney U test) were used to test for significant differences in the percent weight contribution of prey.

**Prey consumption:**

- A bioenergetics model was used to estimate ATF prey consumption over an 84 day period (May to August) in each study year.
- Model inputs describing diet composition, bottom water temperature, and the energy density of ATF and main prey were generated from field collected data.
- Necessary physiological parameters were generated from a synthesis of the literature on ATF and closely related species.
- ATF population estimates were generated using the area swept method (Alverson and Pereyra 1969) for each depth strata (0-99 m, 100-200 m, and > 200 m) in the study area.
- Multiple model simulations were conducted to examine: 1) the interannual variations in prey consumption by adult ATF ≥ 60 cm, 2) prey consumption among 10-cm ATF length classes in 2004, and 3) total prey consumption by the ATF population (≥ 20 cm) within the study area in 2004.

**Results and Discussion**

**Diet analysis:**

- The main fish prey were walleye pollock *Theragra chalcogramma*, Pacific sand lance *Ammodytes hexapterus*, and capelin *Mallotus villosus*. Euphausiids (Thysanoessa spp.) and pandalid shrimp were the key invertebrate prey.
- Walleye pollock were the main prey in the diets of ATF (≥ 40 cm) in 2002 and 2003 whereas euphausiids and *P. sand lance* sand lance were the top prey in 2004.
- In 2004, each ATF size class (20-39 cm and ≥ 40 cm) displayed significant dietary differences between May and August (Fig. 2). Most notably, the importance of euphausiids decreased significantly from May to August whereas the importance of capelin increased in most instances.
- The ATF near Kodiak Island consumed mostly pelagic and semi-pelagic prey and became more piscivorous with size which is consistent with previous findings (Yang 1995, Yang and Nelson 2000). However, the importance of *P. sand lance* sand lance in the ATF diets in Kodiak waters was found to be much greater than previous reports in the GOA which suggests they are locally important.
- Overall, the diet trends appeared to reflect changes in prey abundance, availability, and/or quality (i.e., In August, it appears the ATF were targeting mature capelin which were likely moving nearshore to spawn).

**Prey consumption:**

- Between 2002 and 2004, the prey consumption by adult ATF (≥ 60 cm) ranged from 61 to 160 metric tons (t) and was largely driven by changes in the abundance of these fish among the years.
- The nearshore ATF population was dominated by large individuals (50-69 cm) which accounted for over 70% of the prey removals among the size classes in 2004 (Fig. 3).
- From May to August 2004, the ATF population near Kodiak Island consumed an estimated 200 t of prey (mostly Pacific sand lance and euphausiids) in the shallowest depths (0-99 m) and 360 t of prey (mostly other fish, euphausiids and walleye pollock) at deeper depths (100-200 m) (Fig. 4).
- The bioenergetics model’s consumption estimates were reasonable based on the available data. The model produced daily consumption rate estimates that fell within the range of estimates from previous studies.
- The estimates were influenced by a number of factors including: 1) the age/length class structure of the ATF population, 2) temporal, spatial, and ontogenetic diet shifts and 3) inter-connected biotic and abiotic factors.

**Overall conclusion:**

- ATF are significant predators in the nearshore waters of Kodiak Island and their diet directly overlaps with other top-level predators in the area.
- Future work documenting the abundance and productivity of the species involved is needed to determine if ATF are competing with these predators for similar food resources.
- The ATF population near Kodiak Island does not rely solely on a single prey resource, rather they are able to exploit multiple resources through space and time. Their adaptable feeding behavior allows them to compensate for changes in prey abundance and composition.
- This study produced valuable baseline estimates of ATF prey consumption near Kodiak Island and enabled us to identify data gaps. The bioenergetics approach appears promising and future work developing species specific physiological parameters and better ATF growth estimates are needed to improve the model.