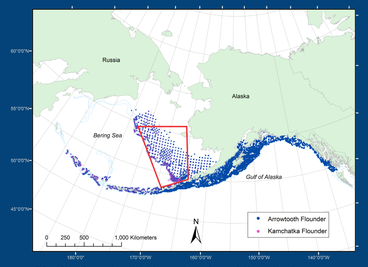
Identification and Distribution of the Early Life Stages of Arrowtooth (*Atheresthes stomias*) and Kamchatka Flounder (*A. evermanni*) in the Eastern Bering Sea

Matarese, A.C., De Forest, L.G., Duffy-Anderson, J.T., Smart, T.I. and Spies, I.B.
Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, Seattle, WA 98115 | Ann.Matarese@noaa.gov

Why study Arrowtooth Flounder?

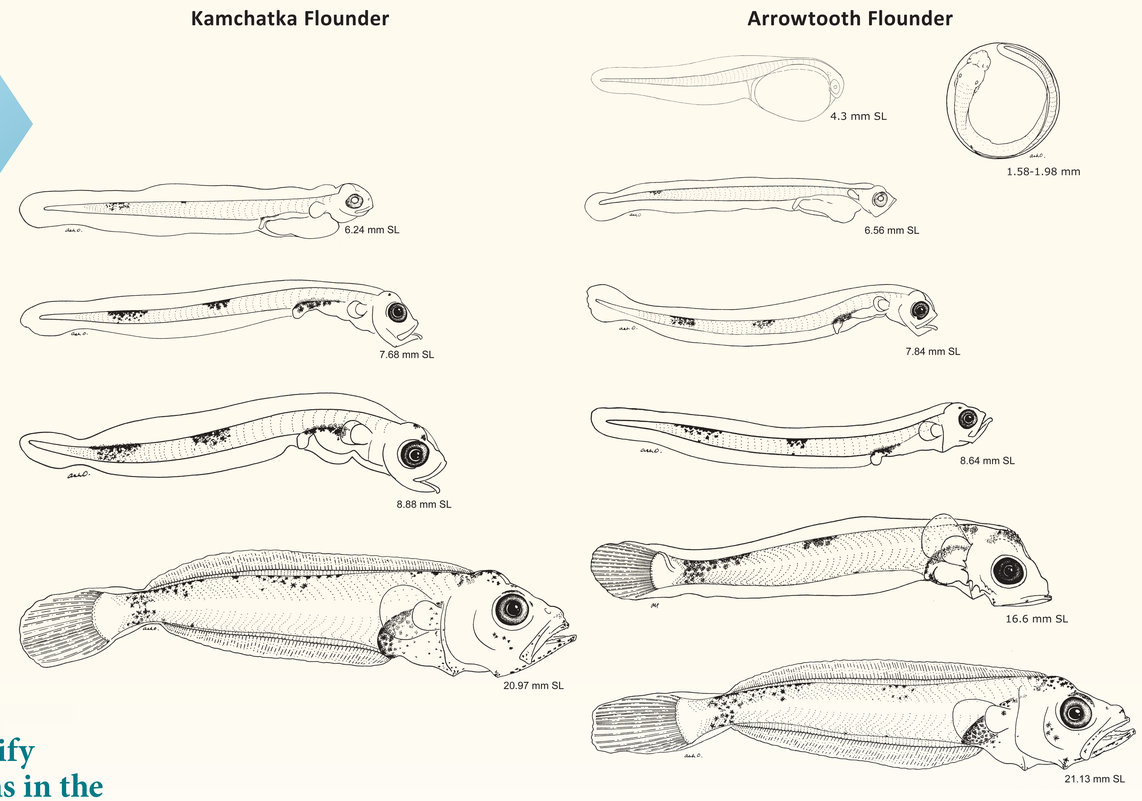
Arrowtooth Flounder (*Atheresthes stomias*: ATF) is a pleuronectid flatfish occurring from central California, north to the Bering Sea, and west to the Kamchatka Peninsula, Russia. Historically there has not been a large commercial demand for ATF; however, they are important ecologically as both predator and prey. An increase in population size from the 1980s and recent interest for directed fishing are reasons to fully understand ATF life stages. Previous research on early life stages of ATF has been focused in the Gulf of Alaska (Blood et al. 2007). Recent studies in the Bering Sea have been confounded by the presence of a congener, Kamchatka Flounder (*Atheresthes evermanni*: KF), which occurs mostly in the western Bering Sea but also in the eastern Bering Sea and Aleutian Islands. Visual identification between these two species is possible for adults, but not for larval or early juvenile stages.



Distribution of adult Arrowtooth and Kamchatka Flounder collected from AFSC adult groundfish surveys. Boxed region indicates current study area.

- ATF are ubiquitous throughout the Gulf of Alaska, Aleutian Islands, and eastern Bering Sea. The most abundant fish in the Gulf of Alaska, ATF are voracious predators of Walleye Pollock and, in turn, are themselves a significant food source for Steller Sea Lions.
- KF are found on the eastern Bering Sea shelf and slope and throughout the Aleutian Islands. They are rare in the Gulf of Alaska. Where the species co-occur, equal proportions of KF and ATF are caught by trawl vessels.

What do larvae and early juveniles look like?

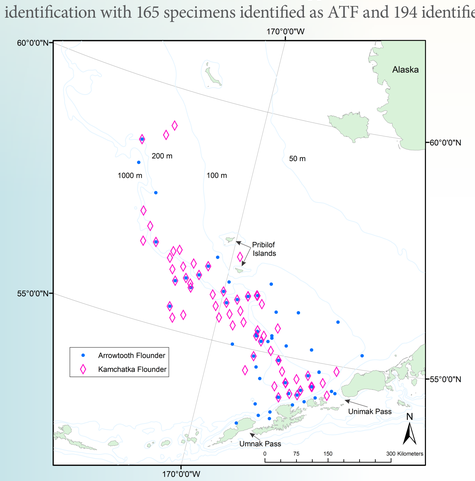


The purpose of our study

1) Use a genetic technique to identify larval and early juvenile *Atheresthes* spp. individuals collected in the eastern Bering Sea to the species level.
2) Use genetically identified individuals to determine characters that would allow visual identification of historic and future samples.
3) Describe the distribution and abundance of each species in the eastern Bering Sea.

How do we begin to identify *Atheresthes* spp. specimens in the Bering Sea?

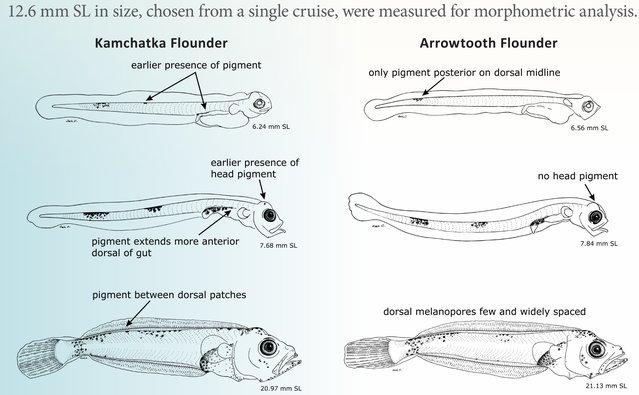
Initial identification of larvae and early juveniles collected in the eastern Bering Sea used a genetic technique that utilized the mtDNA cytochrome oxidase subunit I (COI). A total of 415 *Atheresthes* spp. specimens were used for genetic identification with 165 specimens identified as ATF and 194 identified as KF.



Results from genetic identification indicate that Arrowtooth and Kamchatka Flounder larvae and early juveniles are collected in the same locations and often in the same hauls.

How do we tell them apart?

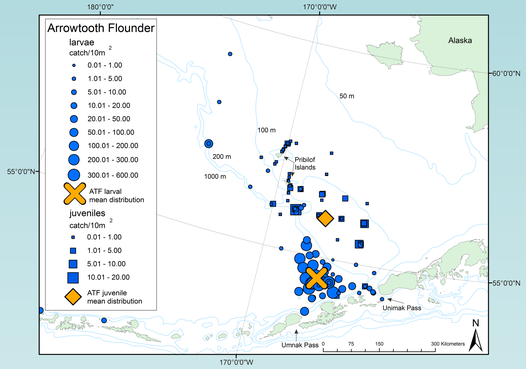
All specimens used in the genetic technique were examined with regards to morphology, pigmentation patterns, and intensity of pigment. Additionally, 20 ATF and 19 KF larvae 6.3–12.6 mm SL in size, chosen from a single cruise, were measured for morphometric analysis.



- In the Bering Sea, we can successfully identify specimens 6.0–12.0 mm SL and ≥18.0 mm SL.
  - KF larvae and early juveniles develop pigment in specific locations at smaller sizes than ATF.
  - KF larvae (6.0–12.6 mm SL) are deeper bodied (12.0% BD:SL) than ATF larvae (9.8% BD:SL) (p=0.00).
- Specimens 12.1–17.9 mm SL are still indistinguishable due to a high degree of natural variation and lack of sufficient specimens to examine.
  - ATF have been identified at these sizes from specimens collected in the Gulf of Alaska.

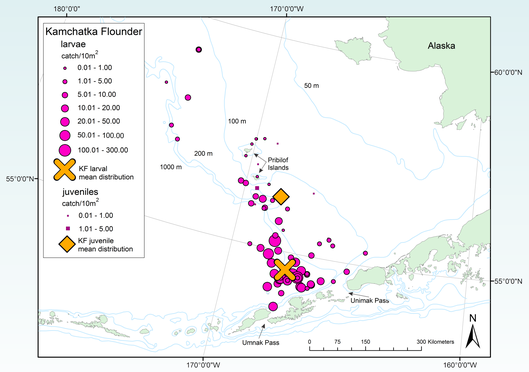
What is the new distribution of larvae and early juveniles?

A total of 2,160 formalin-preserved *Atheresthes* spp. larvae collected on AFSC cruises conducted 1994–2010 were reidentified to the species level using visual identification. All specimens were categorized as either larvae (3.0–24.9 mm SL) or juveniles (≥25.0 mm SL).



Distribution and abundance of visually identified Arrowtooth Flounder specimens (1,547 larvae, 125 juveniles).

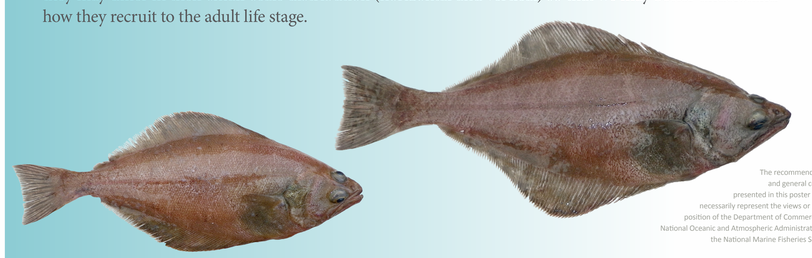
- Larval ATF and KF have very similar distributions in the eastern Bering Sea with most collected between Umnak and Unimak Pass and south of the Pribilof Islands.
- Juveniles of both species were collected north of where most larvae occur. Mean distribution of ATF juveniles is located farther east and over shallower waters than KF juveniles. However, there were far fewer KF juveniles collected than ATF juveniles.



Distribution and abundance of visually identified Kamchatka Flounder specimens (480 larvae, 8 juveniles).

Where do we go from here?

This study has provided successful methods for genetically identifying larval and early juvenile ATF and KF, and for visually identifying these two species at small (6.0–12.0 mm SL) and large sizes (≥18.0 mm SL). Focused field work in the appropriate areas and time of year will be necessary to collect *Atheresthes* spp. larvae 12.1–17.9 mm SL to aid in determining diagnostic morphological and pigmentation characters. As ATF and KF are potential sibling species that occur in the same geographic location and in the same temporal time frame, it is important to understand how these two species interact with each other and how they may differ in their small-scale distribution (horizontal and vertical) so that we may better understand how they recruit to the adult life stage.



Acknowledgements

This project was funded by the North Pacific Research Board under the Bering Sea Integrated Ecosystem Research Program. We would like to acknowledge and thank AFSC colleagues Morgan Busby and Deborah Blood for their time examining preserved *Atheresthes* spp. specimens, Melanie Paquin for genetic work in the lab, Dan Cooper for genetic work at sea, and Ashlee Overdick for illustrations of both species. We also would like to thank Dawn Roje, a former UW student, for her help during the initial phases of this project. Finally, we would like to thank everyone who picked and preserved specimens out at sea and the officers and crews of the following ships: NOAA ship Miller Freeman, NOAA ship Oscar Dyson, R/V Thomas G. Thompson, USCGC Healy, and the R/V Knorr.

Blood, D. M., A. C. Matarese, and M. S. Busby. 2007. Spawning, egg development, and early life history dynamics of Arrowtooth Flounder (*Atheresthes stomias*) in the Gulf of Alaska. NOAA Professional Paper NMFS 7, 28 p.

The recommendations and general content presented in this poster do not necessarily represent the views or official position of the Department of Commerce, the National Oceanic and Atmospheric Administration, or the National Marine Fisheries Service.