A comparative assessment of resource use by Pacific Halibut (*Hippoglossus stenolepis*) and Arrowtooth Flounder (*Atheresthes stomias*) throughout the Gulf of Alaska

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Introduction

- Pacific Halibut have supported culturallly and economically important fisheries for over a century.
- Recent decreases in spawning stock biomass and size-at-age have generated concerns among those who depend upon and manage the resource.

Hypothesis: Intensified competition with an increasing Arrowtooth Flounder population has limited growth of Pacific Halibut in the Gulf of Alaska (Fig. 1).

Research Objective: Assess spatiotemporal variation in resource partitioning (i.e., the relationship between spatial and dietary overlap) between Pacific Halibut and Arrowtooth Flounder.

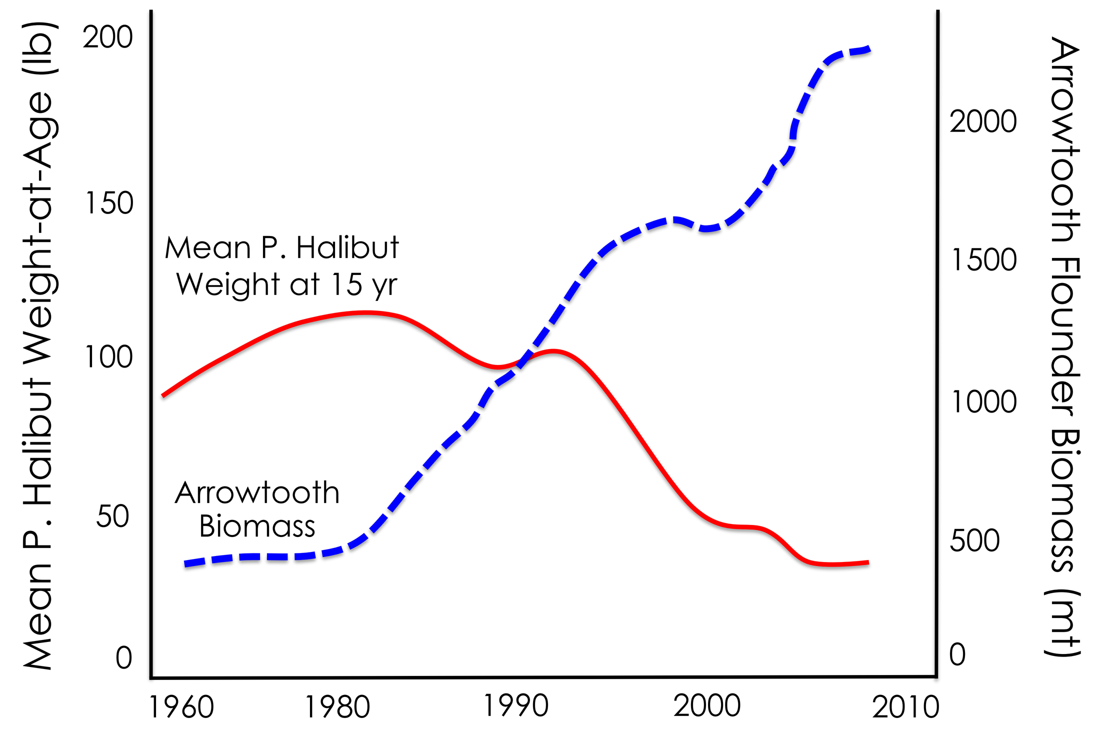


Fig. 1: Mean weight (lb) of age 15 yr Pacific Halibut (red) and estimated Arrowtooth Flounder biomass (mt; blue) from 1960 to 2010 (Hare, IPHC).

Methods

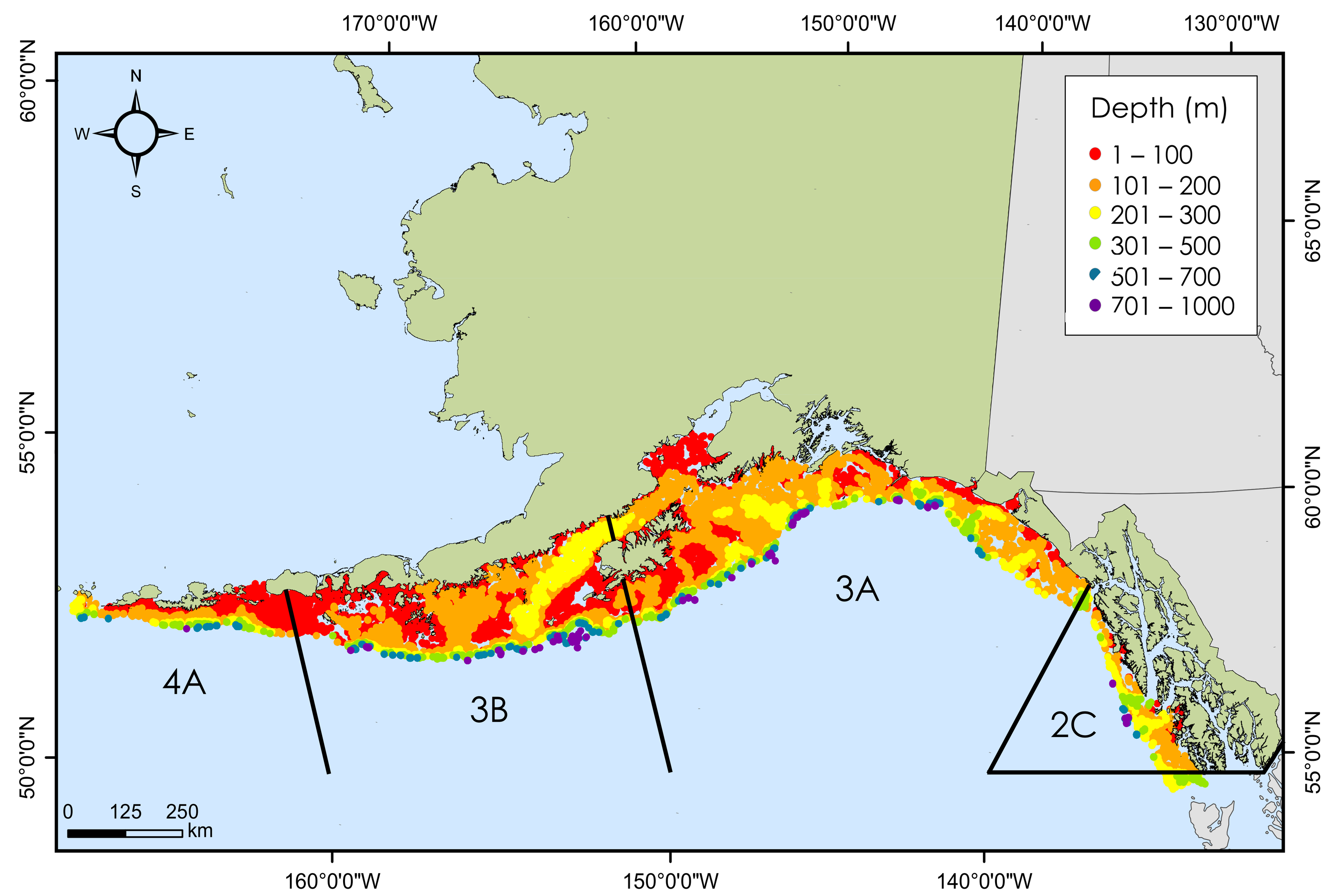
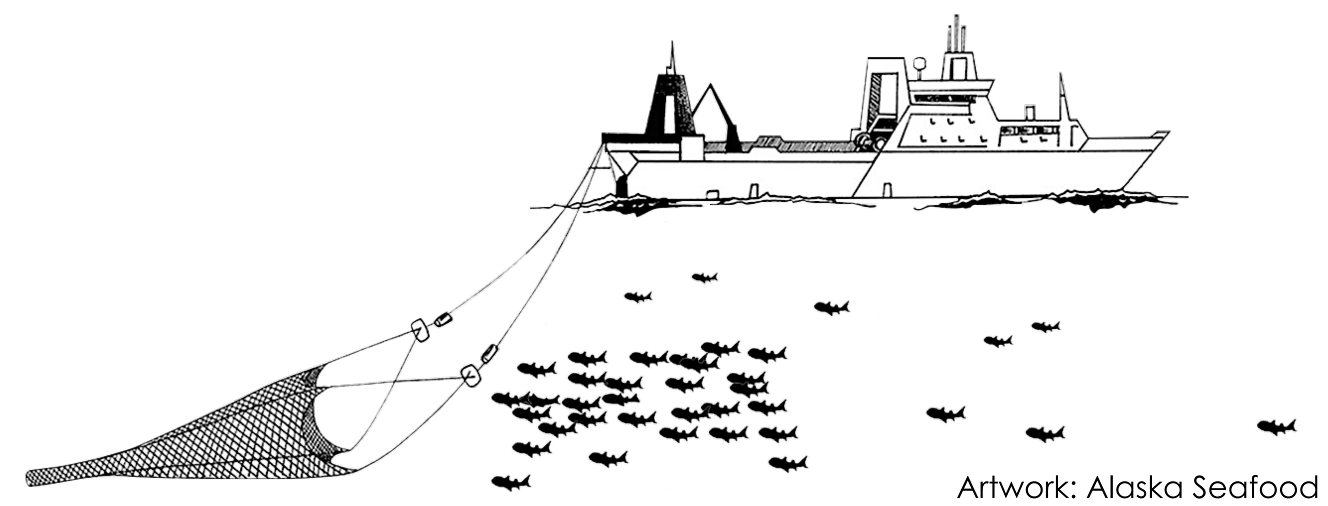


Fig. 2: Map of sampling locations, color coded by depth (m). Black lines denote International Pacific Halibut Commission regulatory areas. We expect that spatial overlap will be greatest in areas where declines in Pacific Halibut size-at-age have been most pronounced (i.e., 3A and 3B).

- Fishery-independent bottom trawl surveys were conducted by the Alaska Fisheries Science Center (AFSC) triennially from 1990 to 1999 and biennially from 2001 to 2013 (Fig. 2).
- Generalized additive models were used to separately assess the probability of occurrence (i.e., presence / absence) and relative density (log-transformed biomass-per-unit-effort [BPUE; kg per km^2]) of Pacific Halibut and Arrowtooth Flounder in relation to:
  - bottom temperature (°C) and depth (m)
  - BPUE of the potential competitor
  - BPUE of Walleye Pollock (important prey species)



Artwork: Alaska Seafood

Results

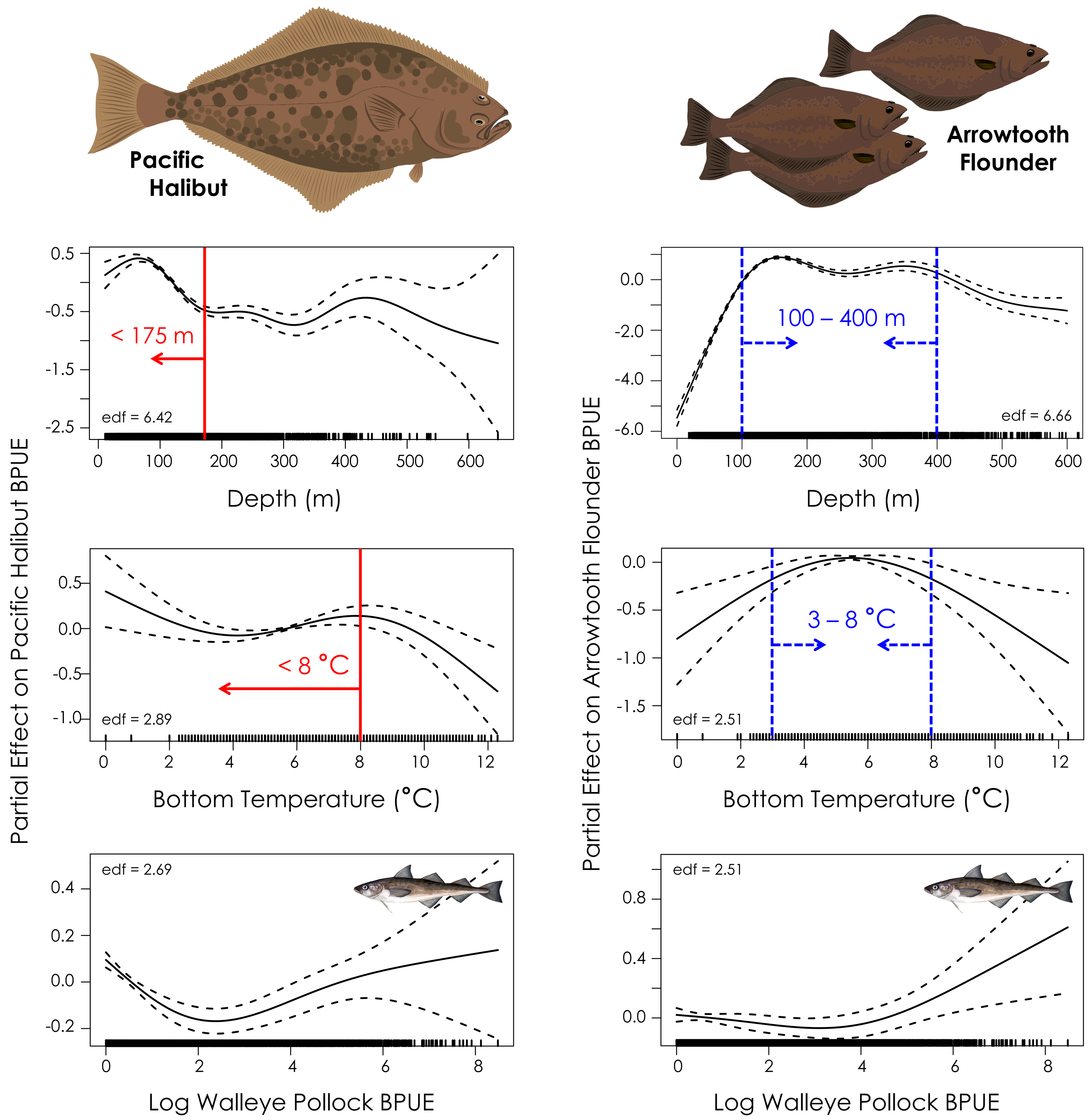


Fig. 3: Partial effects of depth (m), bottom temperature (°C), and BPUE (kg per km^2) of Walleye Pollock on relative densities of Pacific Halibut and Arrowtooth Flounder from best-fit generalized additive models (edf = equivalent degrees of freedom). Arrows (red: Pacific Halibut, blue: Arrowtooth Flounder) illustrate the greatest predictions of biomass. Dashes on x axes denote individual data points.

Future Directions

Our preliminary findings (see Fig. 3 and details below) describe the spatial distributions of Pacific Halibut (PH) and Arrowtooth Flounder (ATF) in the Gulf of Alaska, representing the first step toward quantifying spatial overlap between the two potential competitors.

Pacific Halibut

- probability of occurrence:
  - ↓ with increasing depth and temps > 8 °C
  - ↑ with increasing Arrowtooth and Pollock BPUE
- relative density:
  - ↑ < 175 m and < 8 °C
  - potential ↑ from 350 to 500 m
  - variable with Arrowtooth and Pollock BPUE

Arrowtooth Flounder

- probability of occurrence:
  - ↑ from 100 to 400 m
  - ↓ with increasing temperature
  - ↓ with increasing Pacific Halibut BPUE
  - ↑ with increasing Walleye Pollock BPUE
- relative density:
  - ↑ from 100 to 400 m and 3 to 8 °C
  - ↓ with increasing Pacific Halibut BPUE
  - ↑ with increasing Walleye Pollock BPUE

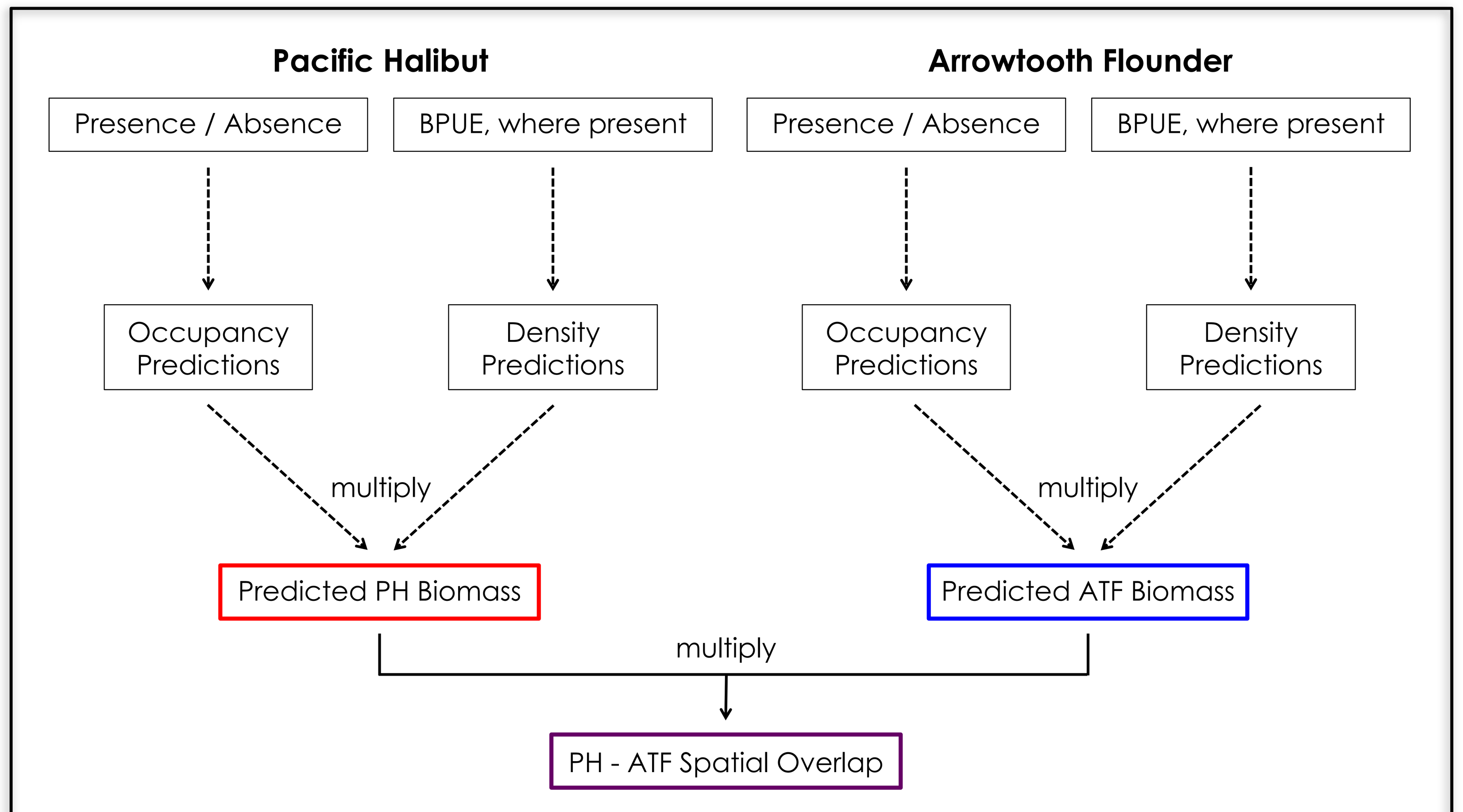


Fig. 4: Analytical framework for quantifying spatial overlap using generalized additive mixed models.

Greatest Potential for Spatial Overlap

- depths from 100 to 175 m, bottom temperatures ranging 3 to 8 °C, and areas relatively concentrated with Walleye Pollock

Next Steps: Calculate spatial overlap by predicting species-specific occupancies and densities to a uniform grid, multiplying those values to get location-based predictions of biomass, and multiplying PH and ATF biomass estimates at each location along that same grid (Fig. 4).

Acknowledgments

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