

Widespread dispersal of juvenile pink salmon from hatcheries in the GOA

Introduction – Juvenile pink salmon (*Oncorhynchus gorbuscha*) were captured opportunistically in a beach seine survey between Kodiak and Sand Point, Alaska. Pink salmon are a short lived (2-year) species whose year-class strength is determined early in their life history. Marine survival is strongly associated with juvenile size and body condition, yet the oceanic habitat for juvenile pink salmon is largely unknown.

Objectives – 1) Describe nearshore habitat for early marine life pink salmon; 2) Assess the percentage of wild- vs hatchery-origin pink salmon in beach seine catches; 3) Synthesize the dispersal of hatchery-origin pink salmon with an individual-based model (IBM) and predict the likelihood of the observed transport; and 4) Compare growth patterns and body condition between wild- and hatchery-origin juveniles.

Methods – Beach seines occurred from May to August of 2022 – 2023 in 13 bays ($n = 313$ sets). Pink salmon otoliths ($\sim 115/\text{yr}$) were randomly selected and assigned as wild-origin or hatchery-origin from thermal marks (Fig. 1).

Dispersal from the hatchery of origin was analyzed with an IBM combined with Lagrangian particle tracking. Body condition and relative growth were compared between wild-origin and hatchery-origin juvenile pink salmon.

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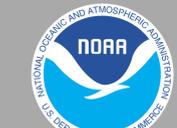
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Hatchery Facility

Wild-origin pink
Hatchery-origin pink
AFK (PWS)
CCH (PWS)
SGH (PWS)
KBH (Afognak Is.)
Hatchery unID
PGH (Cook Inlet)

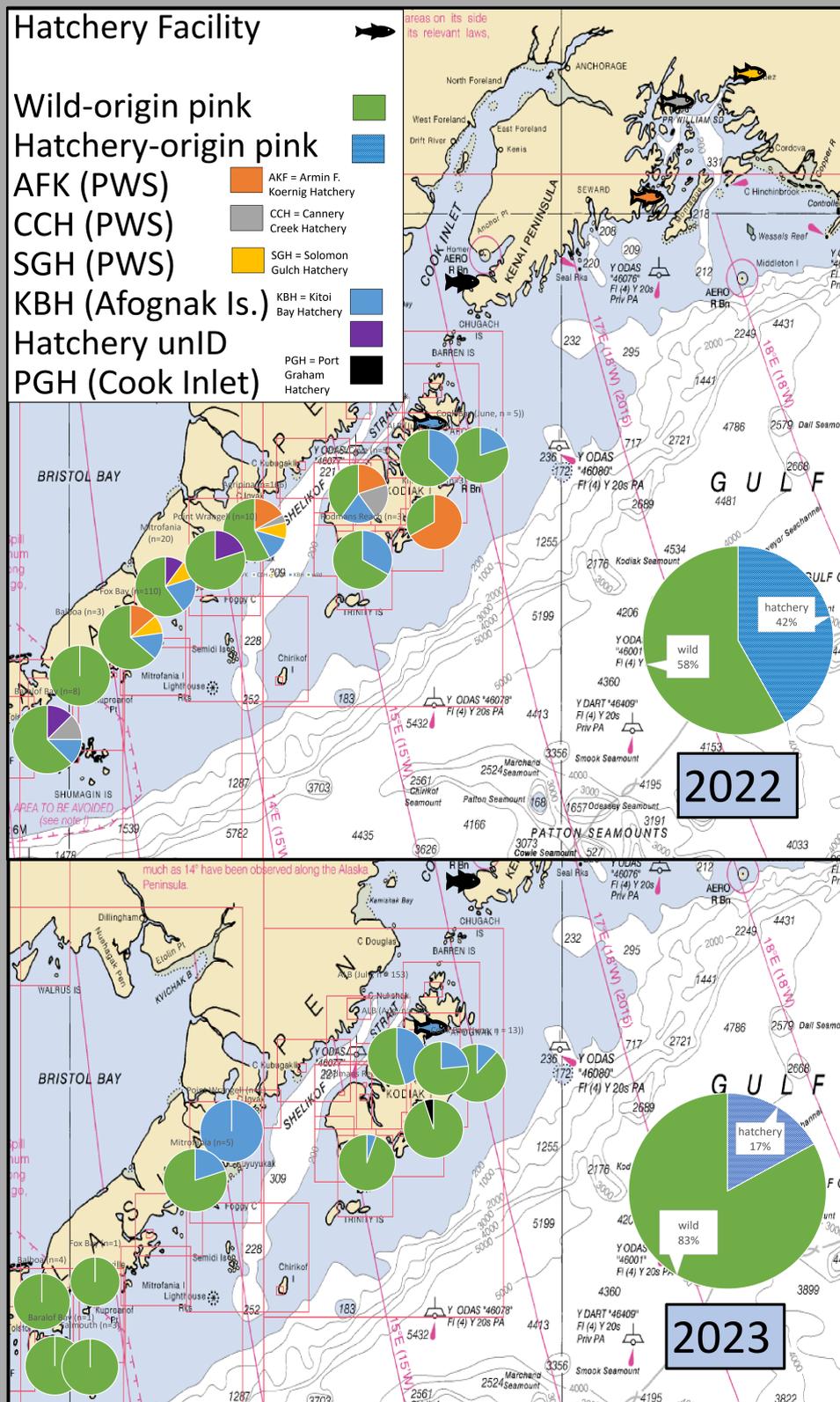


Fig. 2. Proportion of wild- and hatchery-origin juvenile pink salmon in beach seine catches by bay and year. Upper panel is 2022; lower panel is 2023. Hatcheries are denoted by color.

Conclusions

- * Unexpected nearshore habitat use during the juvenile life-stage.
- * Mixed catches (77 %) of hatchery and wild juvenile pink salmon.
- * Novel dispersal patterns > 1200 km from the hatchery release site.
- * Body condition higher for wild-origin juvenile pink salmon.

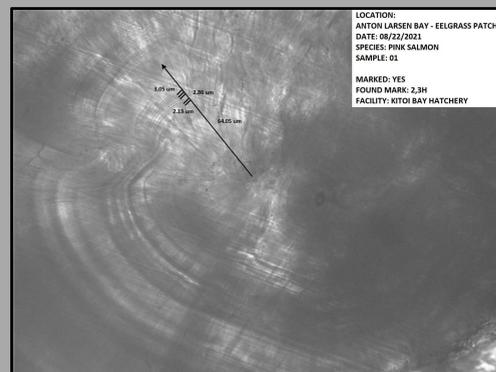


Fig. 1 A juvenile pink salmon otolith with a thermal mark (2,3H) from the Kitoi Bay Hatchery (KBH). Photo provided by M. Thomas, Kodiak Regional Aquaculture Association (KRAA).

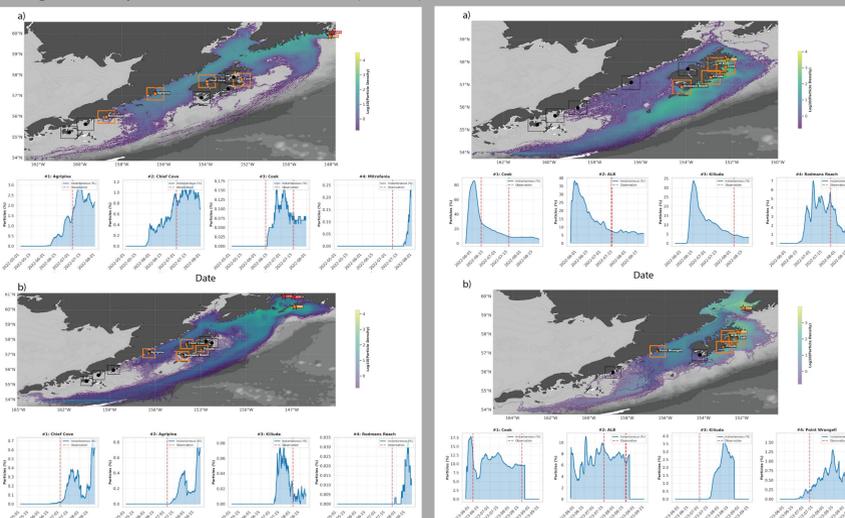


Fig. 3. IBM particle dispersal from AFK (a) and SGH and CCH (b) in 2022.

Fig. 4. IBM particle dispersal from KBH in 2022 (a) and KBH and PGH in 2023 (b).

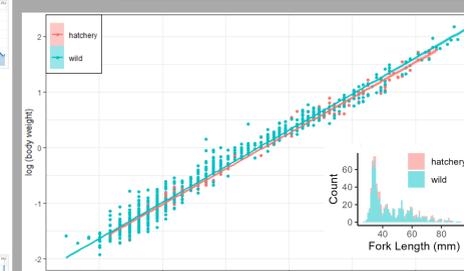


Fig. 5. Relationship between body weight (g) and fork length (FL) for known-origin juvenile pink salmon ($n = 858$). Inset: length frequency histogram by origin, both years combined.

Results

R1) Habitat - A total of 5,892 juvenile pink salmon (27 – 96 mm FL) were caught in 313 beach seine sets. Overall, pink salmon were present in 30% ($n = 94$) of beach seine sets, and occurred most frequently in May. Habitat was predominantly shallow coastline with eelgrass and macroalgae.

R2) Dispersal – Dispersal varied greatly between years (Fig. 2). In 2022 pink salmon juveniles were captured > 1200 km from the hatchery release site. In 2023 the dispersal was reduced. We presume the Alaska Coastal Current is transporting pink salmon from PWS to bays around Kodiak Island and the Alaska Peninsula (Fig. 3).

Main hypotheses for the absence of PWS juveniles in 2023 field collections:

- H1: Different oceanographic conditions (supported by IBM model; Fig. 4);
- H2: Low adult pink salmon returns to PWS in 2024 were triggered by early-life mortality in 2023, before juveniles dispersed;
- H3: Behavioral differences in migration during odd and even years.

R3) Body condition - In 77% of the bay/year combinations there were both wild-origin and hatchery-origin juvenile pink salmon cohabiting. Weight at length was higher for wild-origin juveniles (Fig. 5), and wild-origin juveniles had consistently higher body condition (Fulton's K values) than hatchery-origin juvenile pink salmon.