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Discerning population connectivity and natal origins of Pacific herring (Clupea pallasi): inferences on population structure from otolith chemistry

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Discerning connectivity and natal fidelity of Pacific herring (*Clupea pallasi*): Inferences on population structure from otolith chemistry

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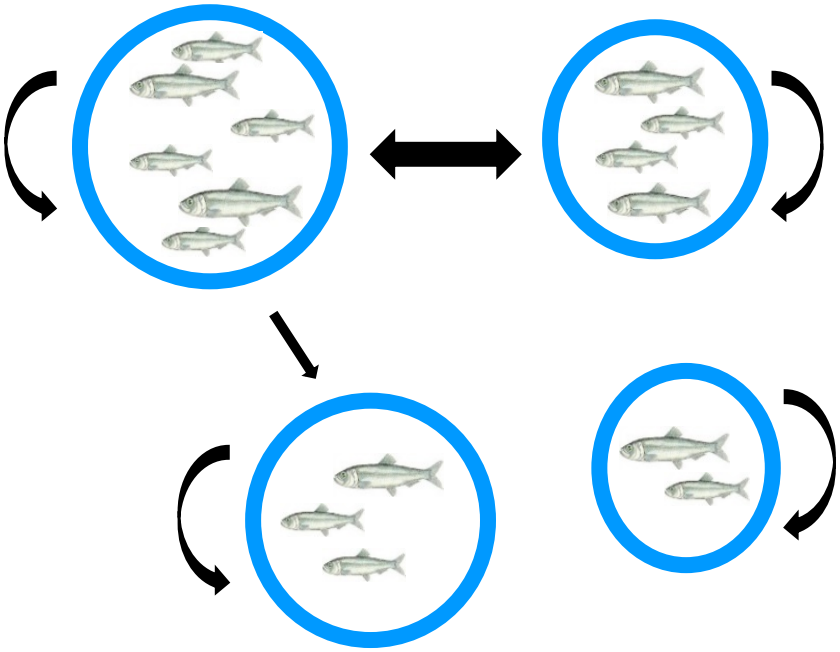

Exchange of individuals among groups critical to persistence & resilience of populations

Otoliths: Records of growth & environmental history over the lifetime individuals (daily, seasonal, annual)

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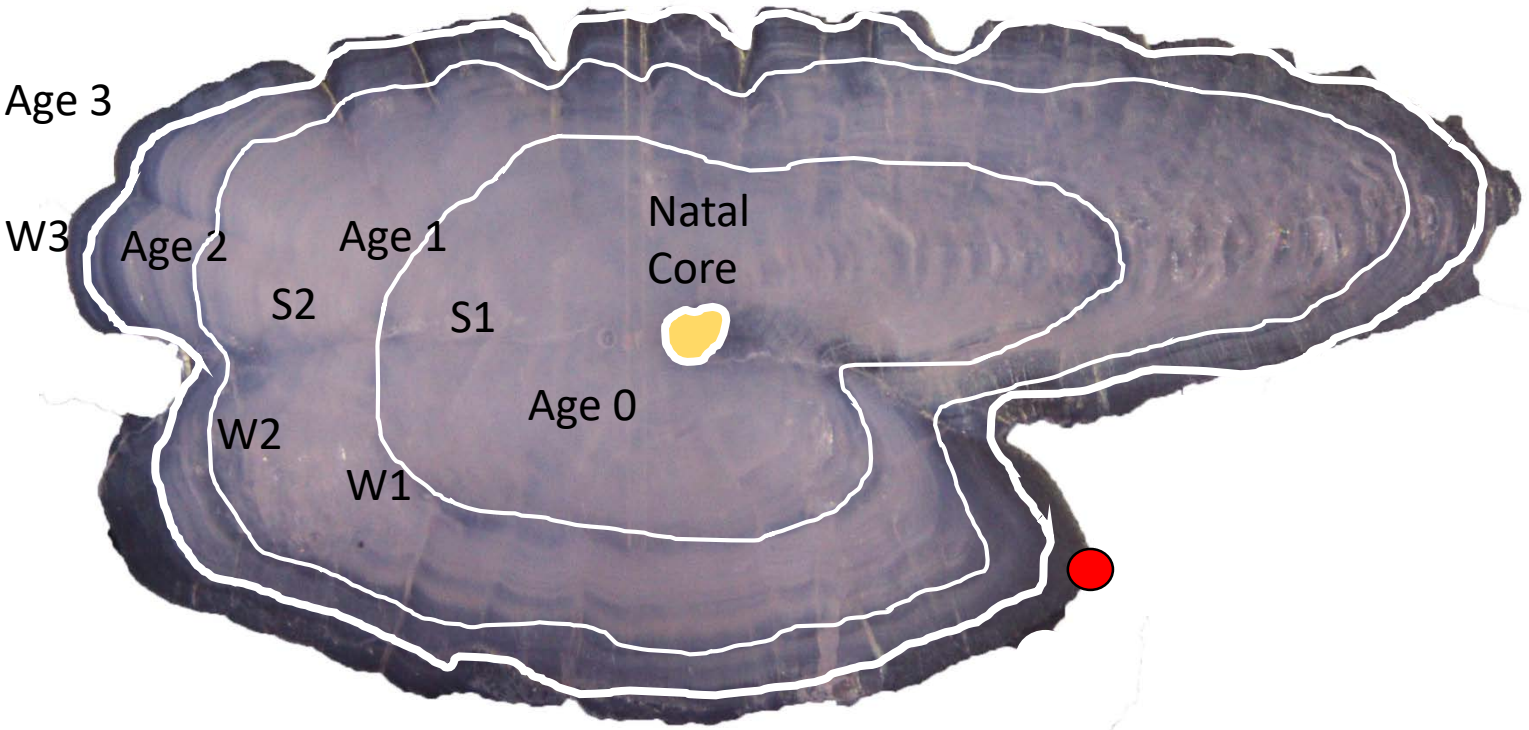
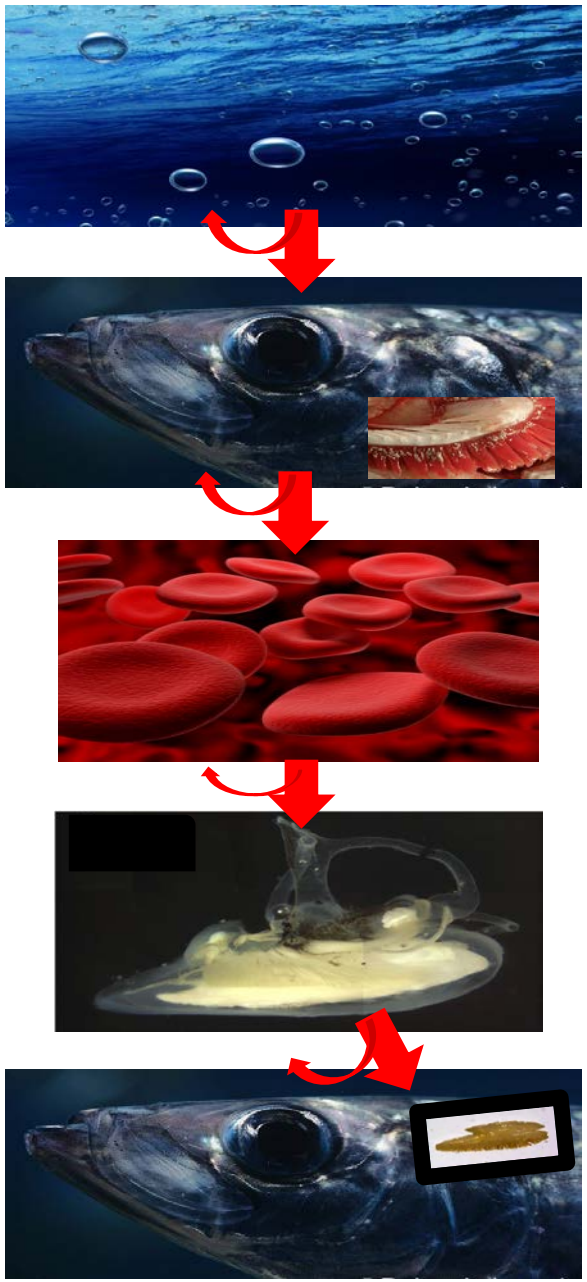


Natal core – marker of environment at birth

Edge –record of most recent environment

Elemental Incorporation

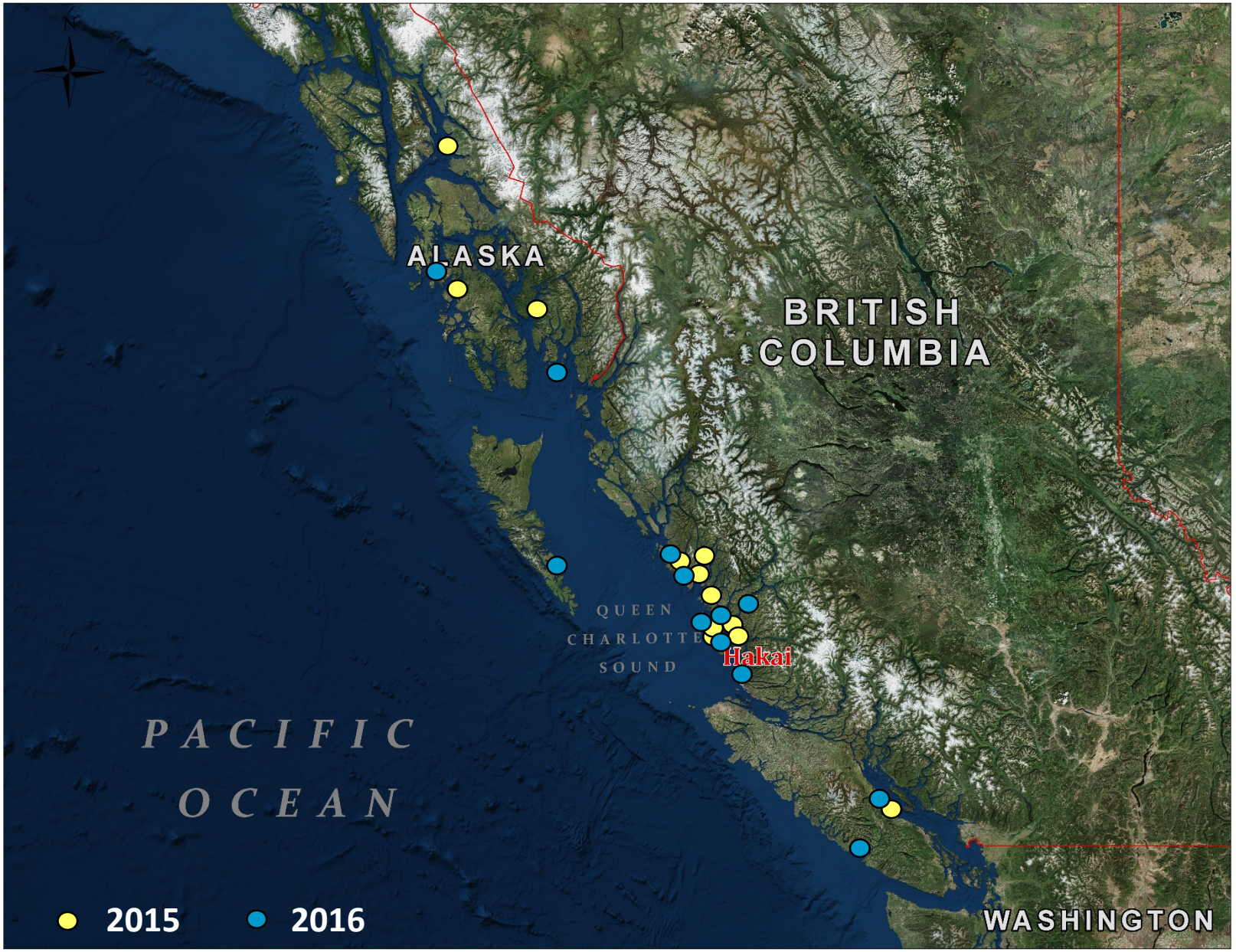


Objectives

Evaluate the extent of mixing & natal fidelity among spawning groups using intrinsic chemical “tags”

1) Evaluate baseline differences in water chemistry among spawning sites
2) Identify contributions of distinct natal sources among & within spawning groups
3) Infer extent of movement & mixing at regional & local scales

Methods: Field Sampling



Methods: Characterizing Water Chemistry

Water samples acidified & filtered

Elemental concentrations measured using Inductively Coupled Optical Emission Spectrometer:

B, Li, Mg, Ca, Cr, Mn, Rb, Sr, V, Ba, Pb

Methods: Quantifying Otolith Chemistry

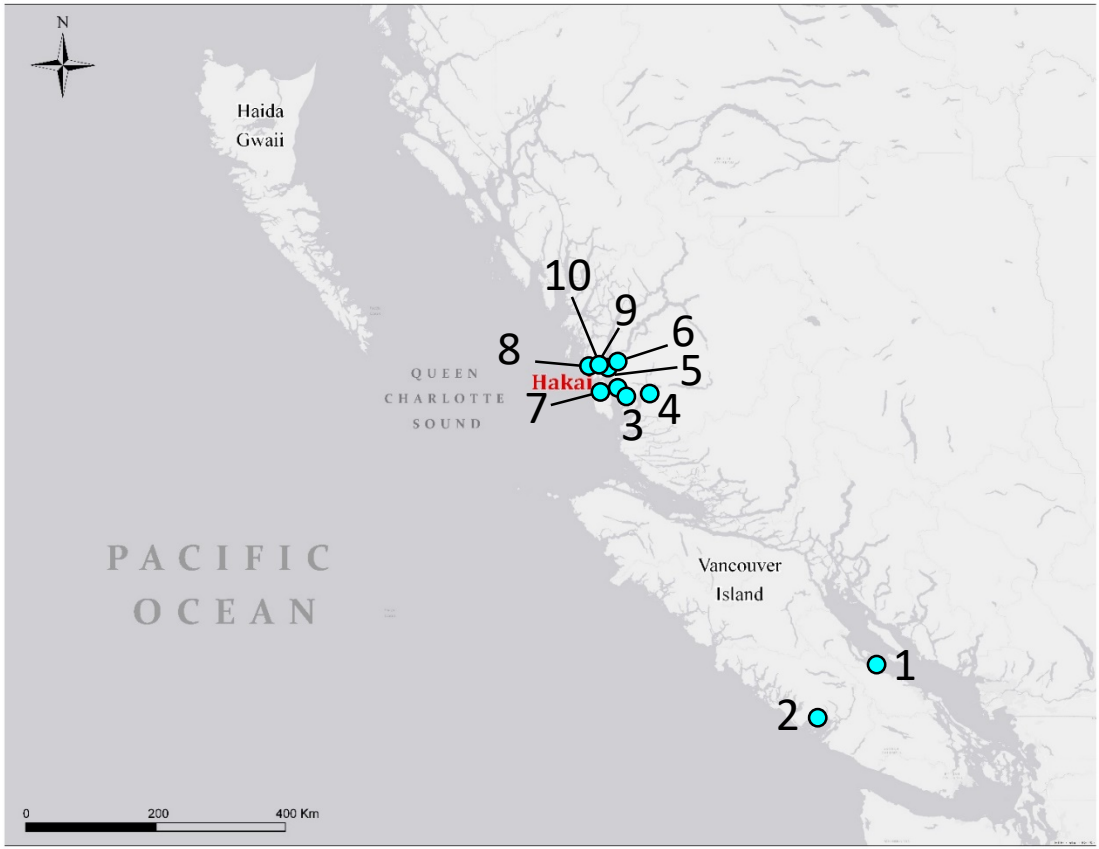
Otoliths assayed using Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS)

24 elements assayed: Li, Mg, Mn, Sr, Ba, Pb

Results: Water Chemistry

Significant variation in water chemistry among spawn sites

MANOVA (p = 0.002, Pillai's = 4.24), SIMPER



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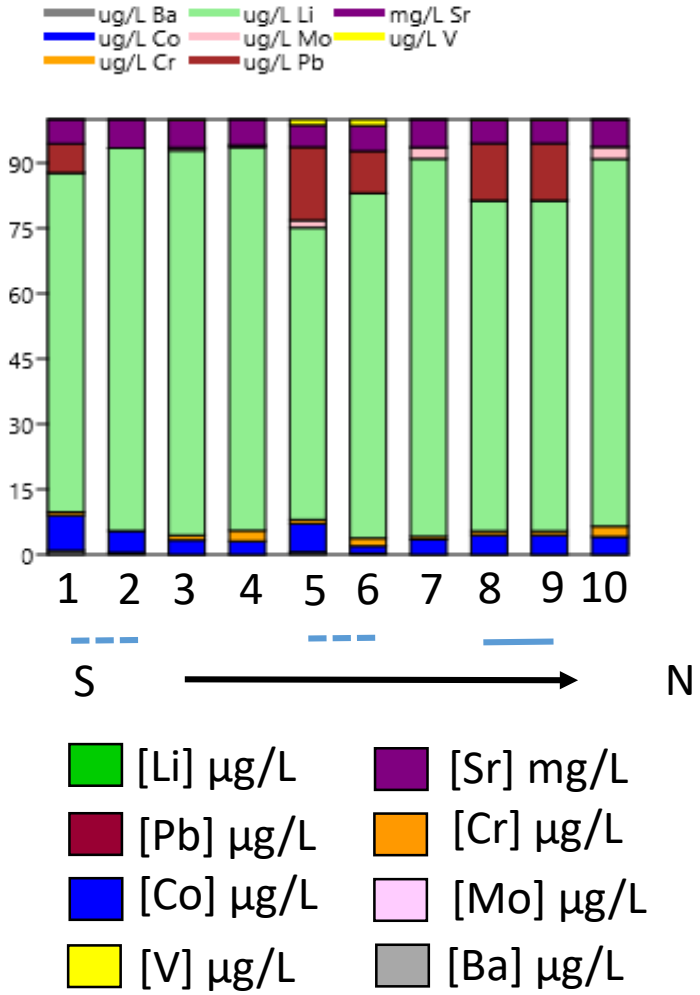
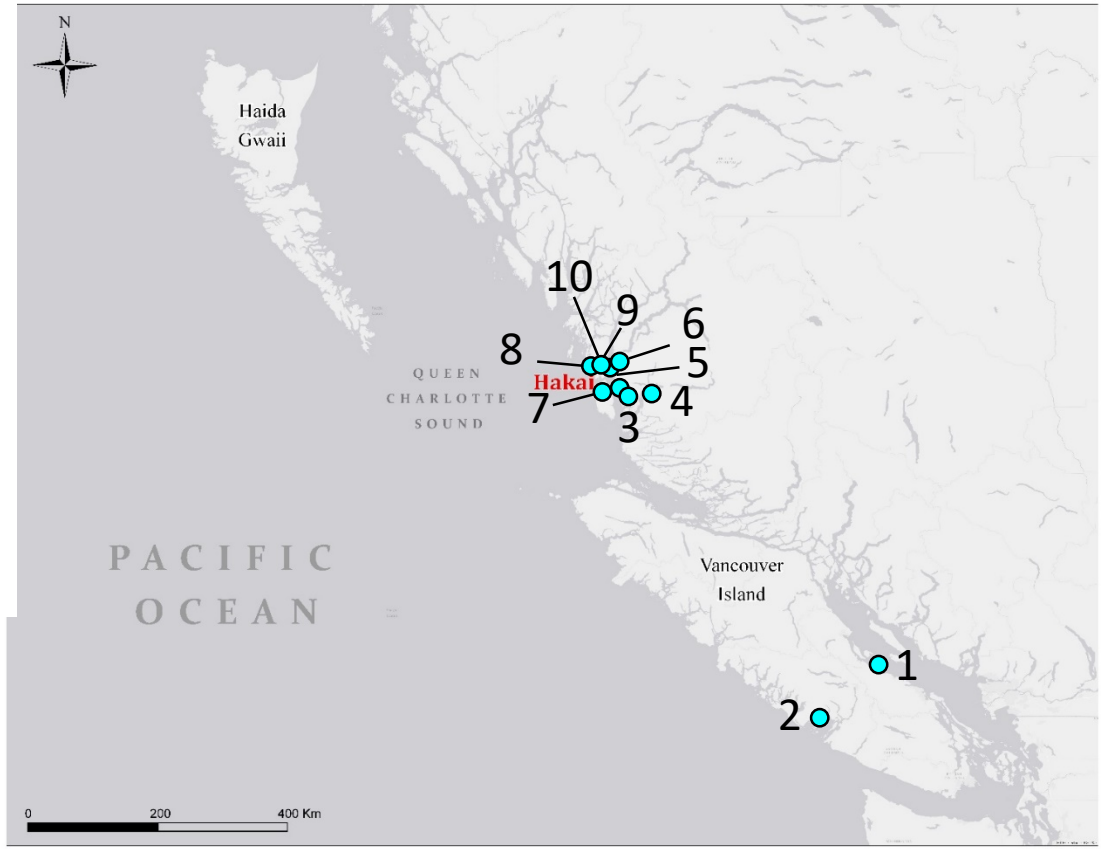
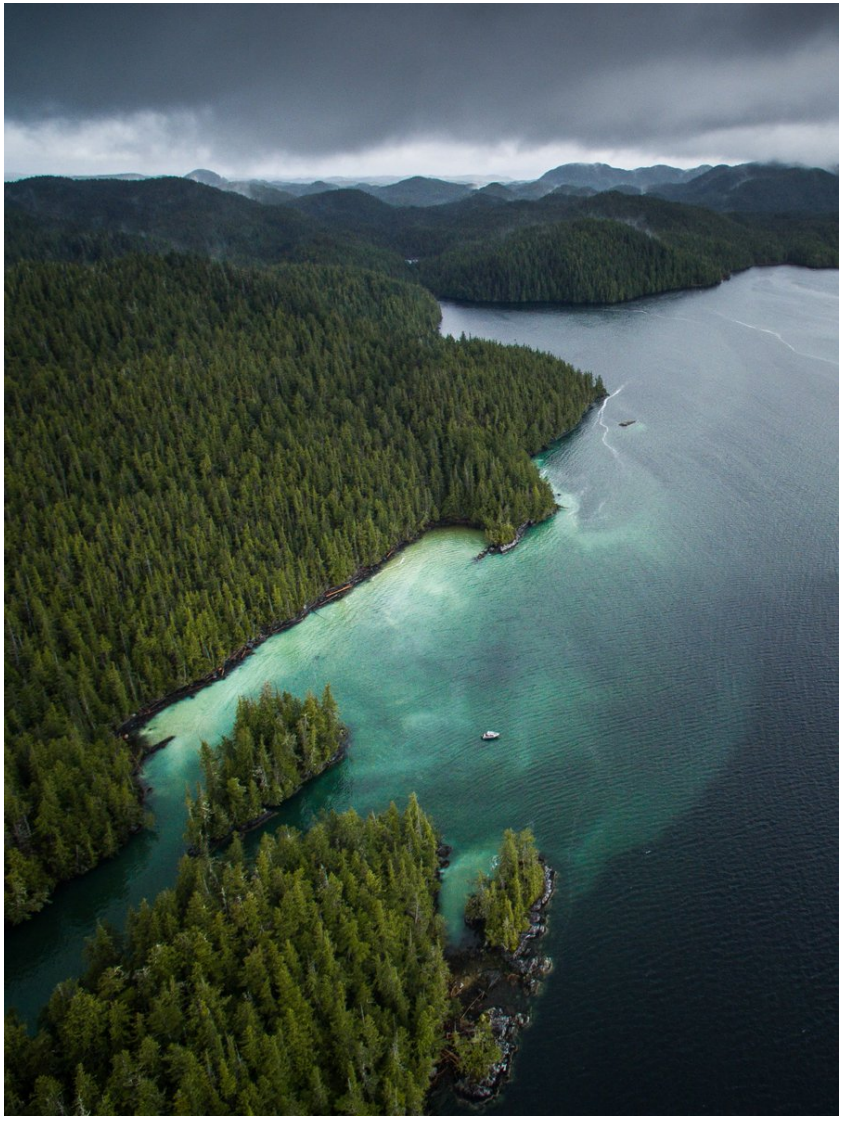




Results: Regional Variation in Natal Tags

Are natal tags distinctive among regions or sites (mixing)?

Are tags similar within sites?

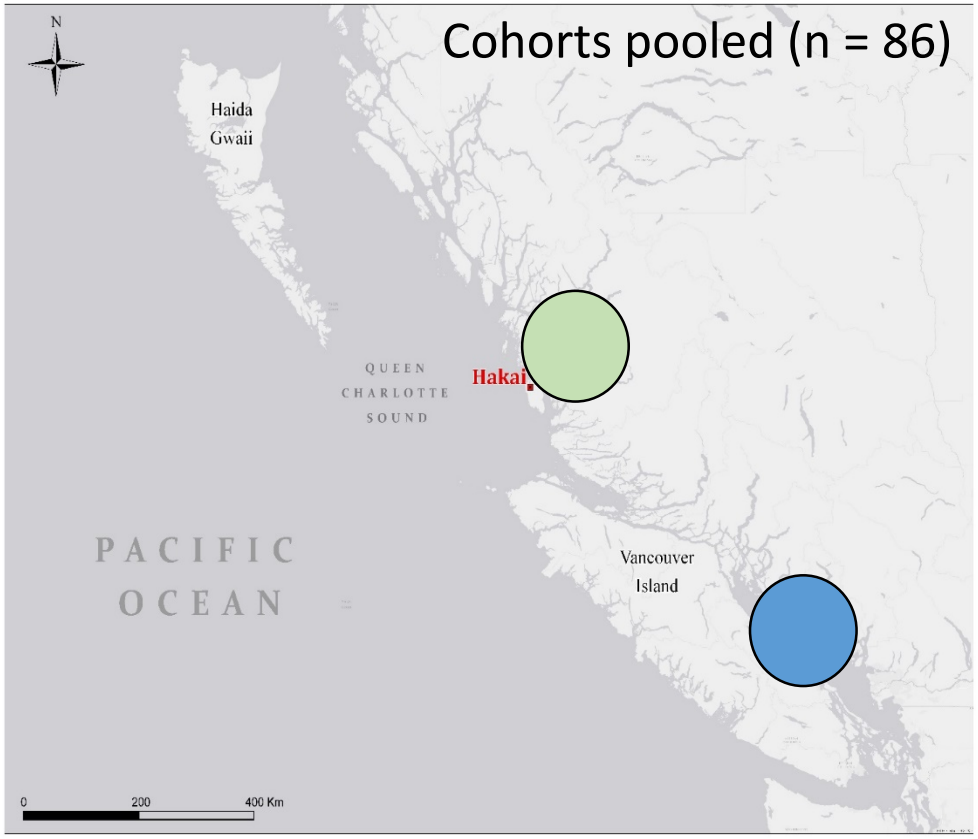


- MRPP to test HO of no difference among groups
- DFA test ability to distinguish among groups based on natal tags

Results: Regional Variation in Natal Tags

Course Scale: Natal signatures differed significantly among management regions
(MRPP, T = -26.3
Overall DFA: 94%)

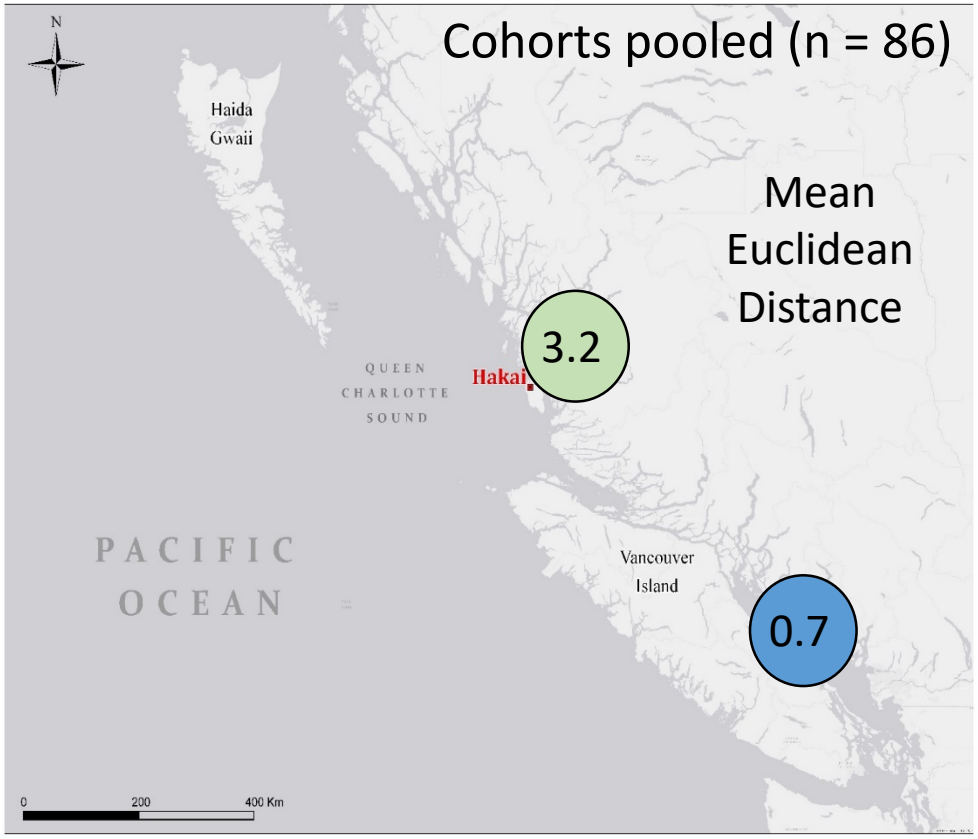
Northern Salish Sea tag useful tracer



Results: Regional Variation in Natal Tags

Course Scale: Natal signatures differed significantly among management regions
(MRPP, T = -26.3
Overall DFA: 94%)

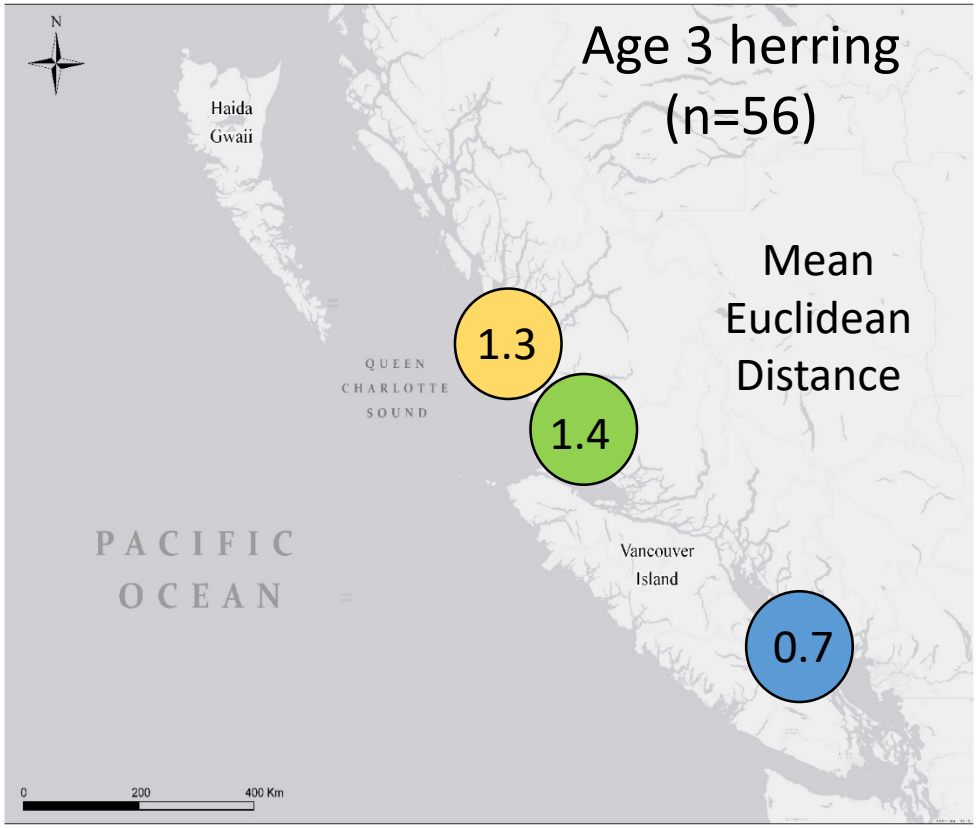
Strong variation among signatures along Central Coast



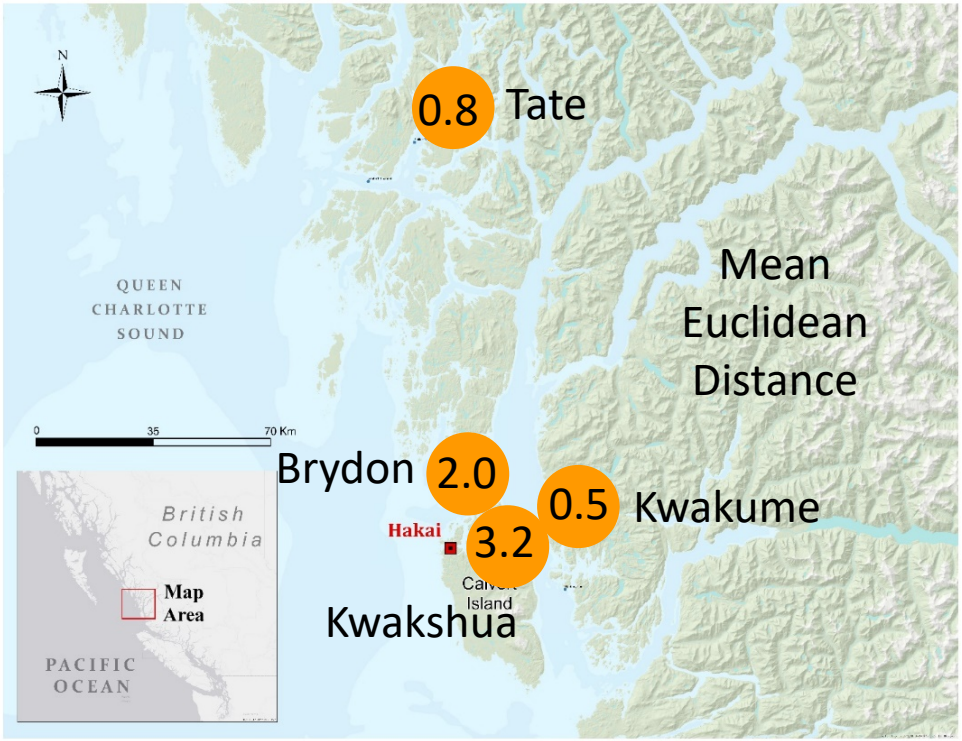
Results: Regional Variation in Natal Tags

Course Scale: Significant variation in natal source contributions *within* Central Coast unit
(MRPP, T = -16.0;
Overall DFA: 88%)

Low mixing/exchange (high fidelity) evident in some sites



Results: Local Variation in Natal Tags



Single cohort: Age 3 herring

Significant differences in natal chemical tags within & among sites
(MRPP, T = -9.46; Overall DFA 58%)

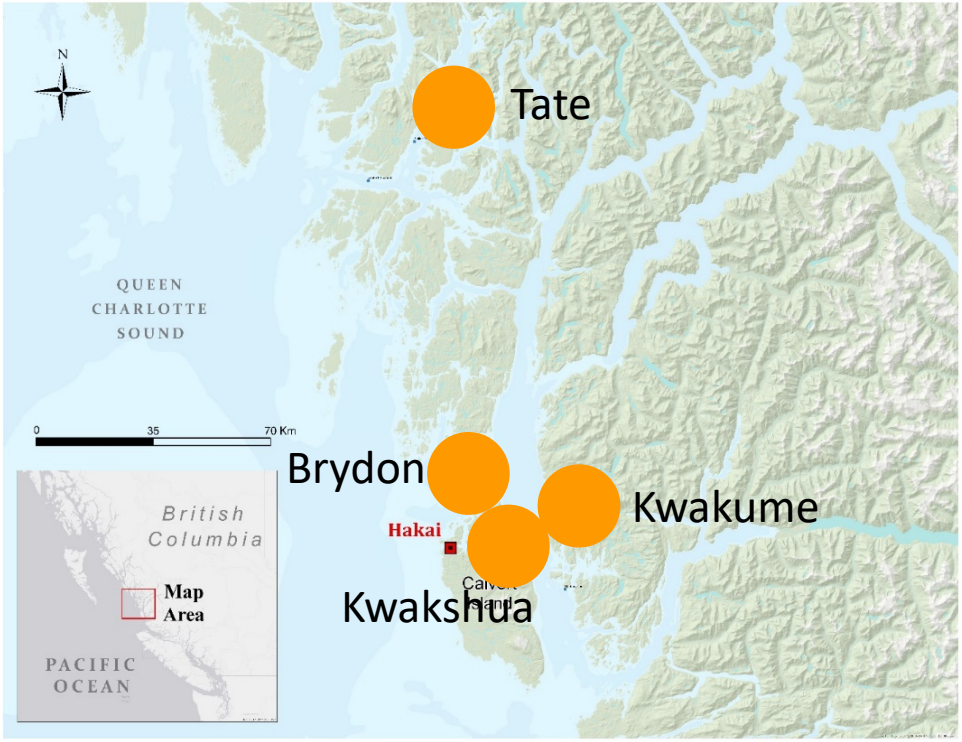
Degree of mixing (source contributions) varies among spawning sites

High group fidelity within some spawn sites

Results: Variation in the present (Edges)

Fine Scale: local variation in edge chemistry?

Test resolution based on known origins

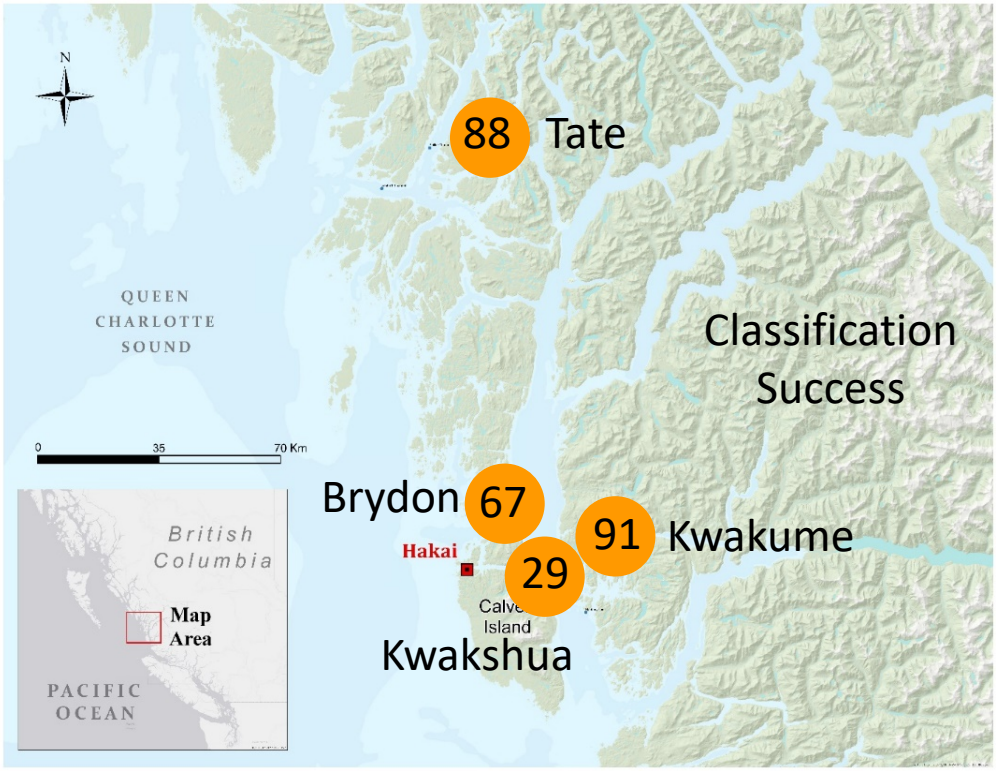


Classification to Sites: Preliminary Results (Edges)

Fine Scale: successfully assigned herring to specific spawning sites (MRPP, T = -2.9; Overall DFA 73%)

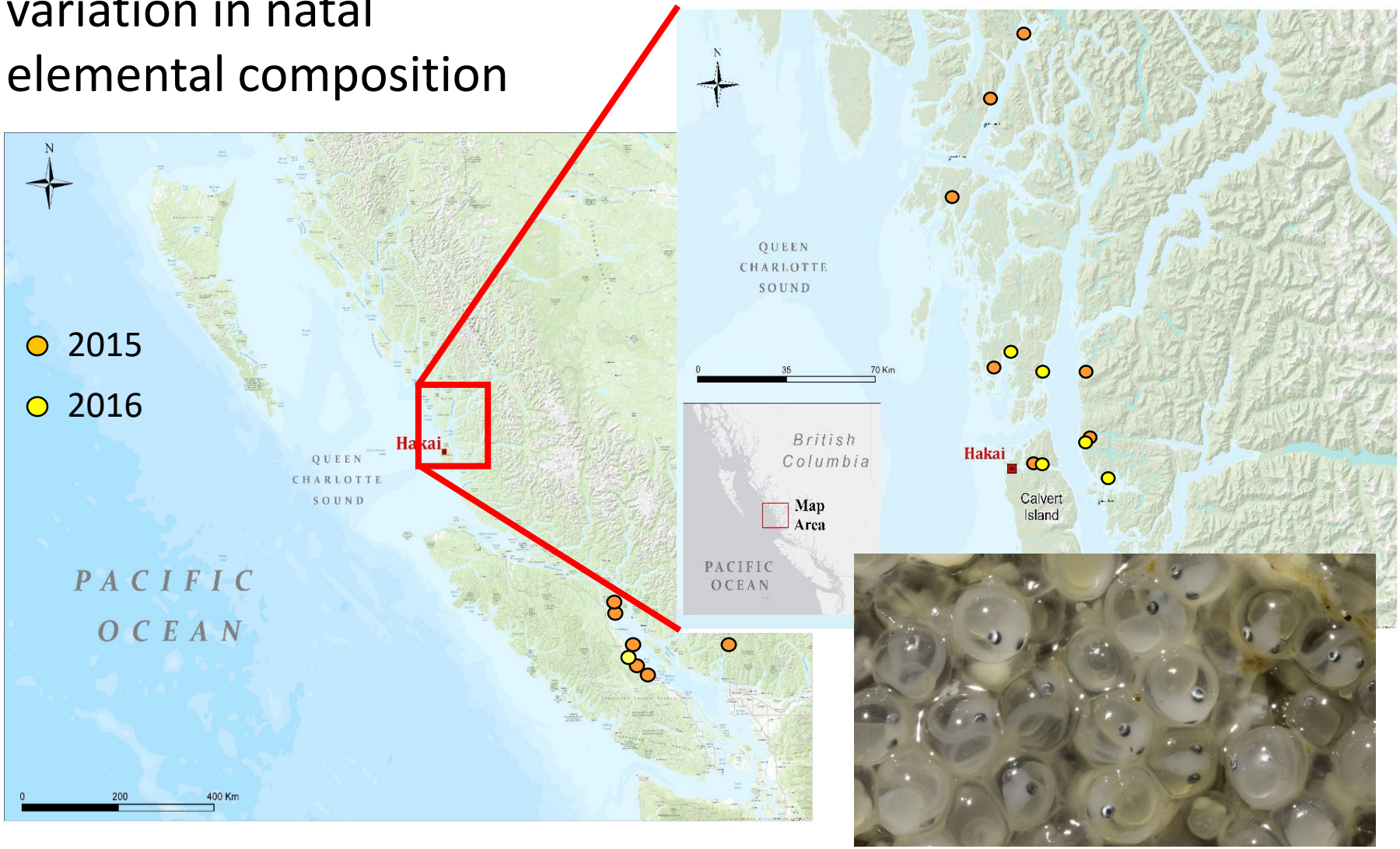
Otolith chemistry supports discrimination at local scales – 10s kms

Differential movement patterns among co-occurring fish



Ongoing: Characterizing Site-Specific Natal Signatures

Collections of late state embryos to establish baseline of variation in natal elemental composition



Conclusions

- Regional differences in natal tags provide a tool for tracing exchange/mixing among regional source populations

- Similarity in natal tags within some groups indicates high level of group fidelity

- Differences in natal & edge chemistry suggest differences in life/migration histories among co-occurring groups within management units

THANK YOU!

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