

Alaska Hatchery Research Program: Update to PWS/CR RPT



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Alaska Department of Fish and Game
PWS/CR RPT Meeting
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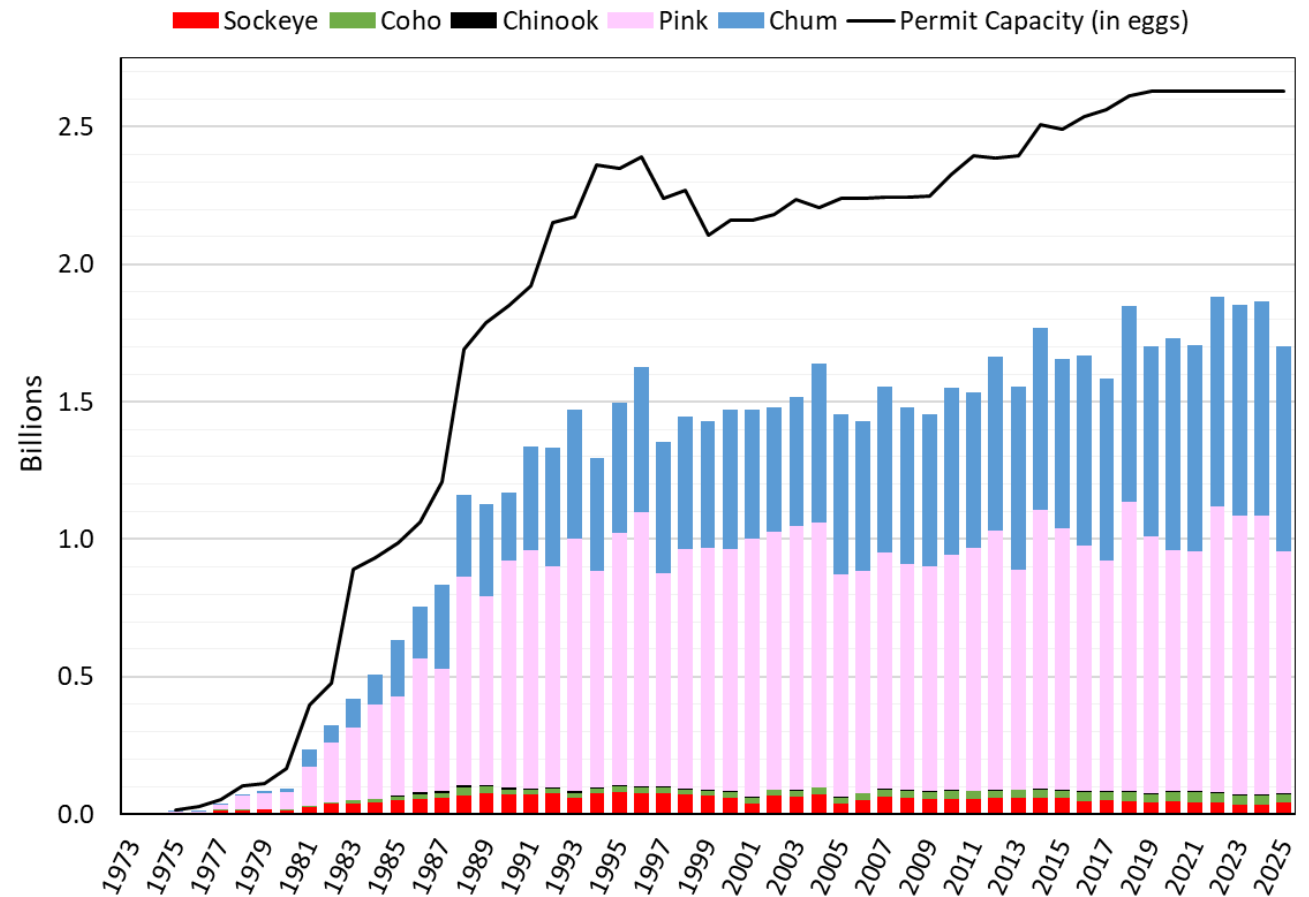
Alaska's Precautionary Approach

Large-scale salmon releases raise concerns for effect on wild stocks

Alaska policy mandates sustainable productivity of wild stocks

Do stray hatchery-origin fish affect the productivity and sustainability of wild stocks?

Alaska Statewide Hatchery Releases, 1973-2025



Alaska's Precautionary Approach

Alaska Hatchery Research Project

Plan:

PNPs proposed that ADF&G organize science panel to design/implement a research project to inform resource management decisions

Funding partnership:

State, Operators, & Industry

Purpose:

Examine potential effect of hatchery straying on fitness of wild stocks

- Pink and chum salmon PWS
- Chum salmon SEAK



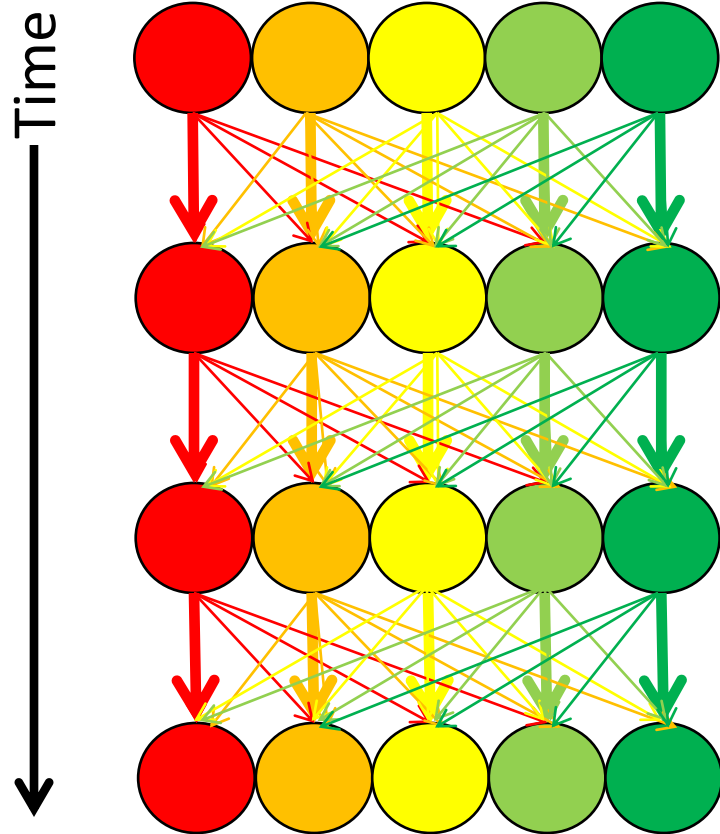
More information available at

https://www.adfg.alaska.gov/static/fishing/PDFs/hatcheries/research/background_rfp_hatchery_fish_interaction.pdf

Background: Why straying matters

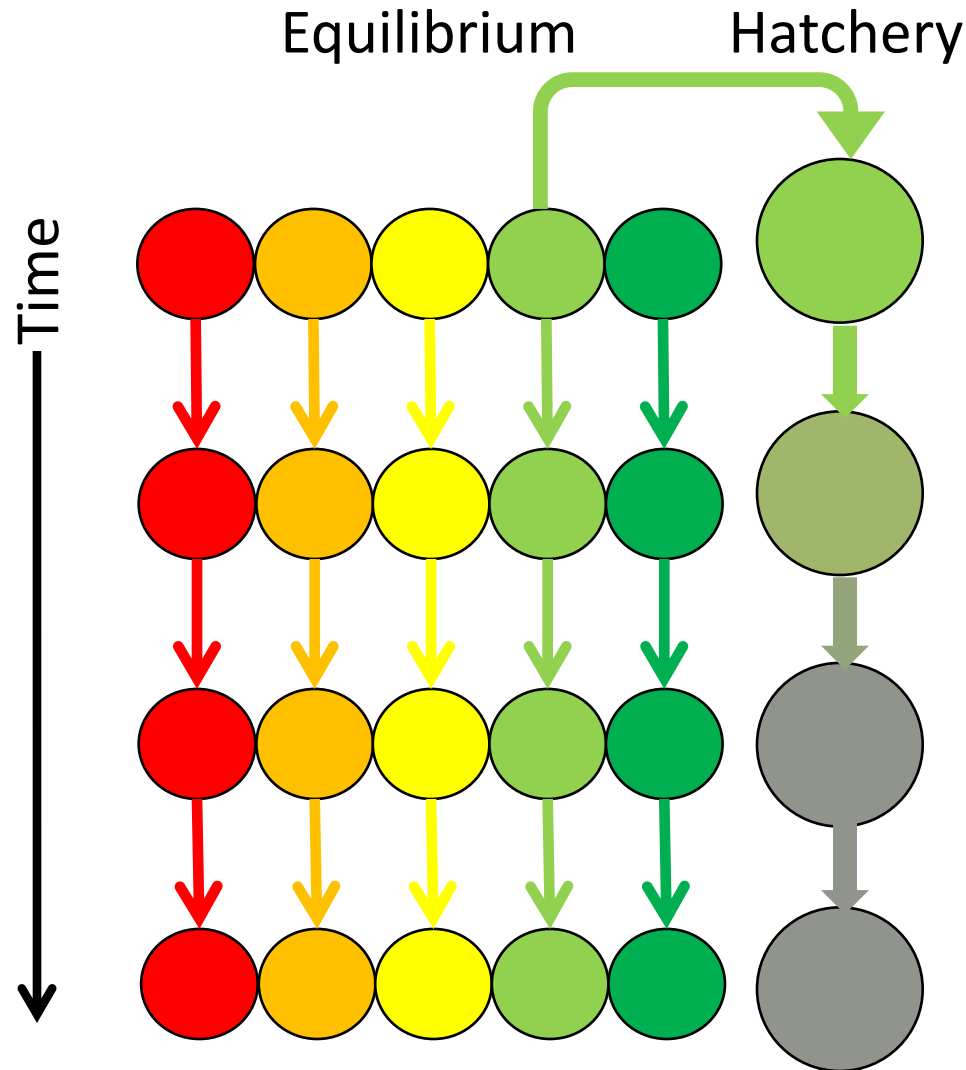
Reality natural system

Straying/drift equilibrium



Background: Why straying matters

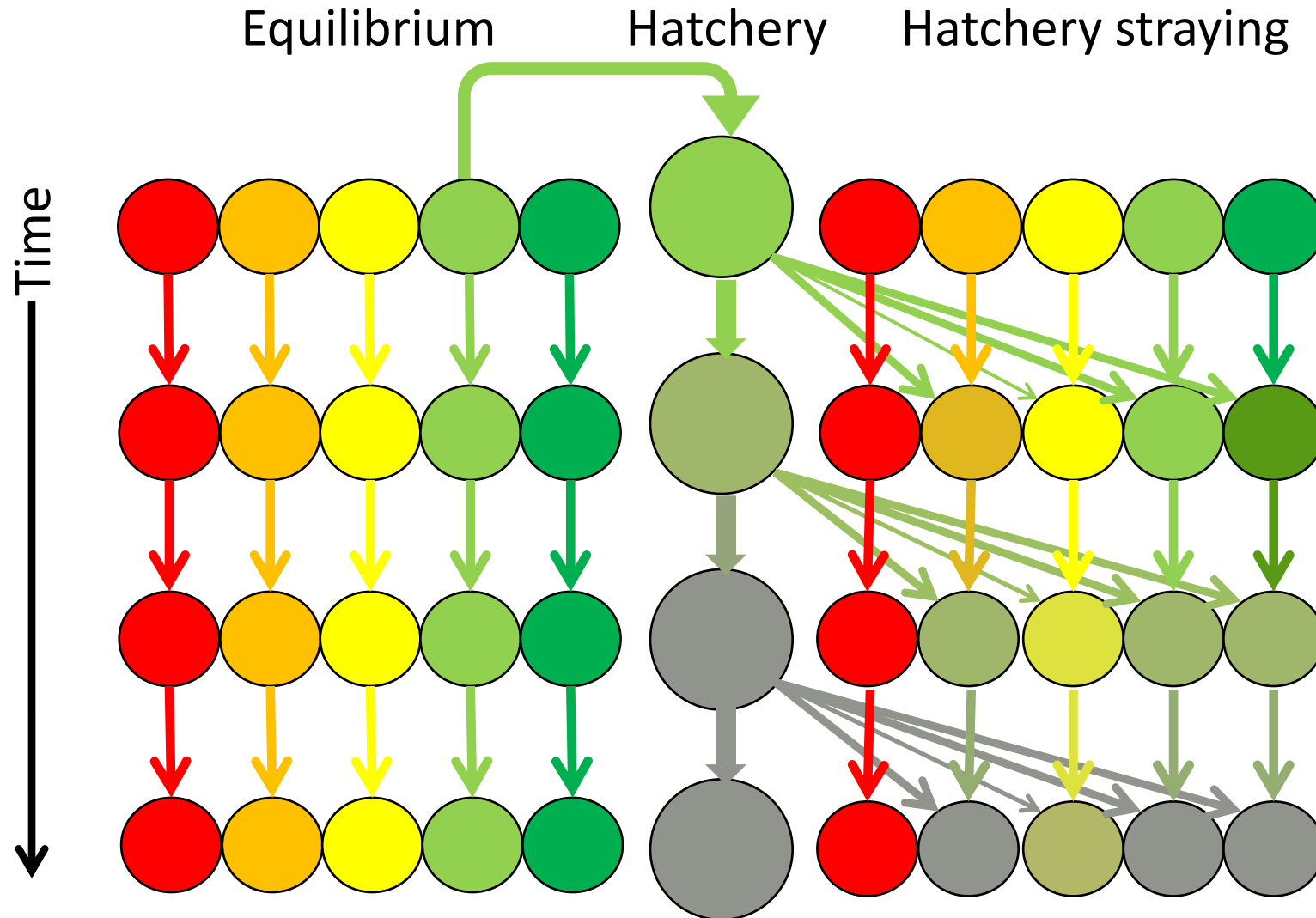
Hatchery stock domesticates through time?



- Mate selection
- Redd selection
- Parasites/disease
- Lack of predators
- Overwinter in gravel
- Freshwater feeding

Background: Why straying matters

Hatchery stock strays – homogenization and domestication?



AHRP Research Questions

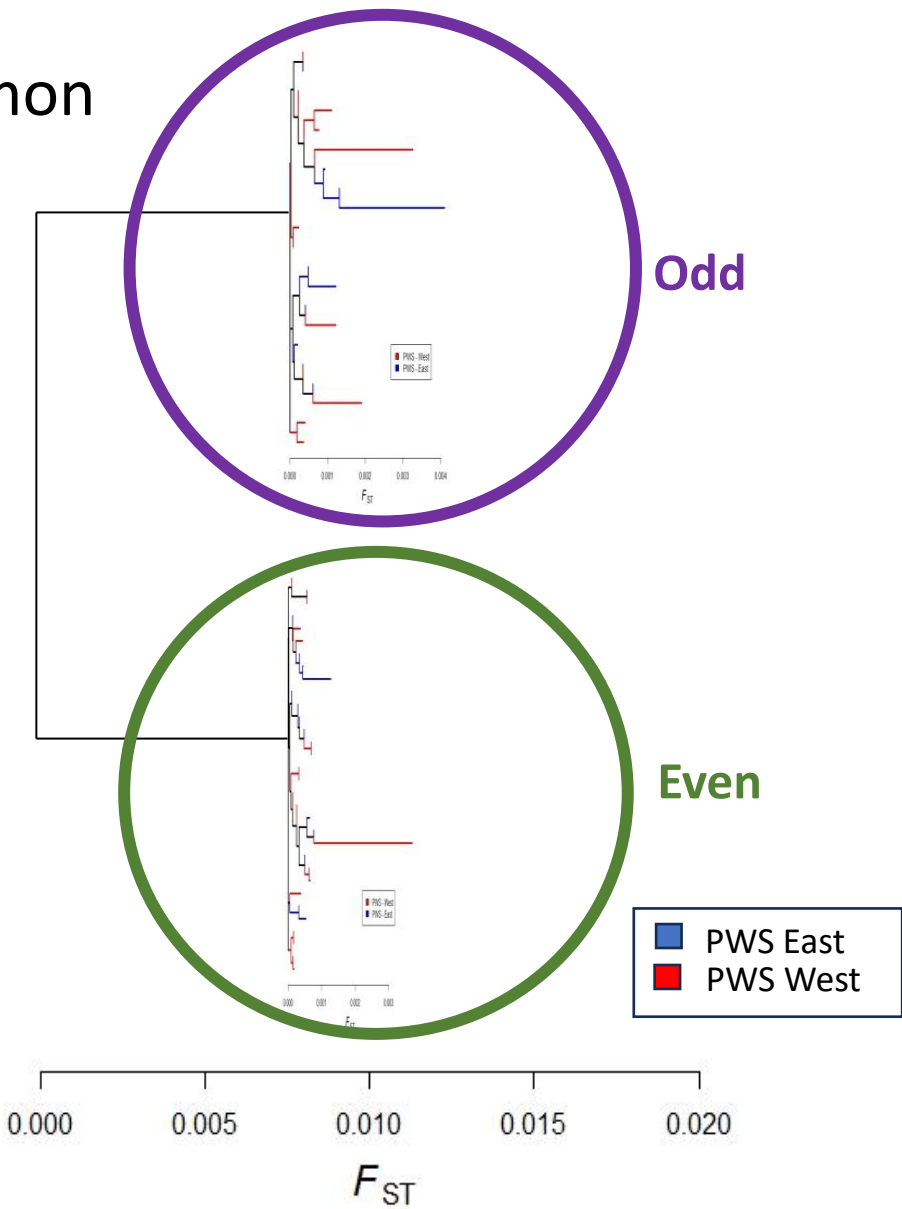
- 1) What is the genetic structure of pink and chum in PWS and SEAK?
- 2) What is the extent and annual variability of straying?
- 3) What is the impact on fitness (productivity) of natural pink and chum stocks due to straying hatchery pink and chum salmon?

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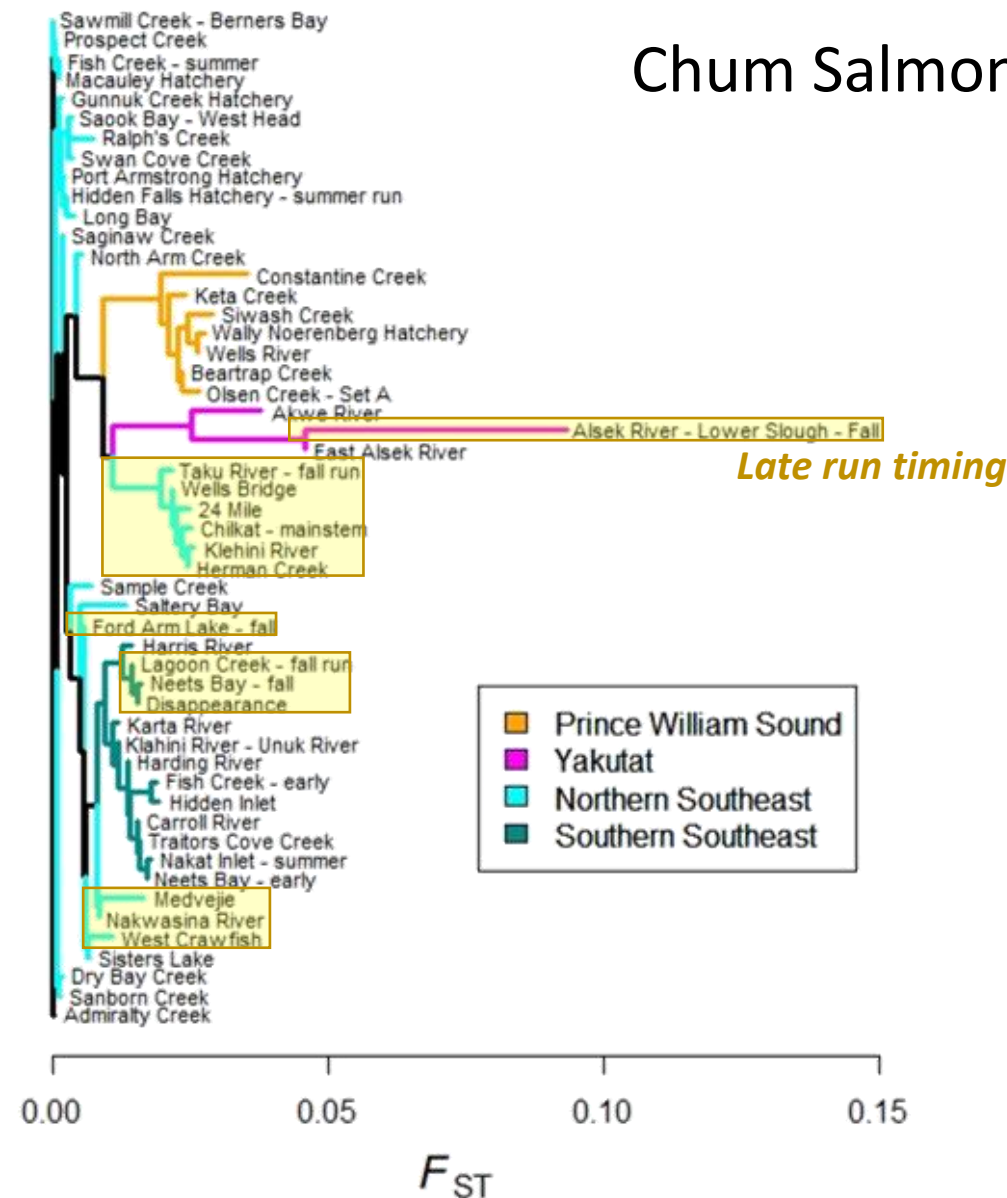
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What is the genetic structure of pink and chum?

Pink Salmon



Chum Salmon



Take-Home: 1. Genetic Structure

- Pink salmon
 - Even and odd lineages are genetically distinct
 - Neutral genetic variation among populations within lineages is small compared to other salmon species, but differences do exist
 - Structure among populations is low but may have an east/west component in the odd year and run timing component in the even year
- Chum salmon: Structure appears driven by run timing and geography

AHRP Research Questions

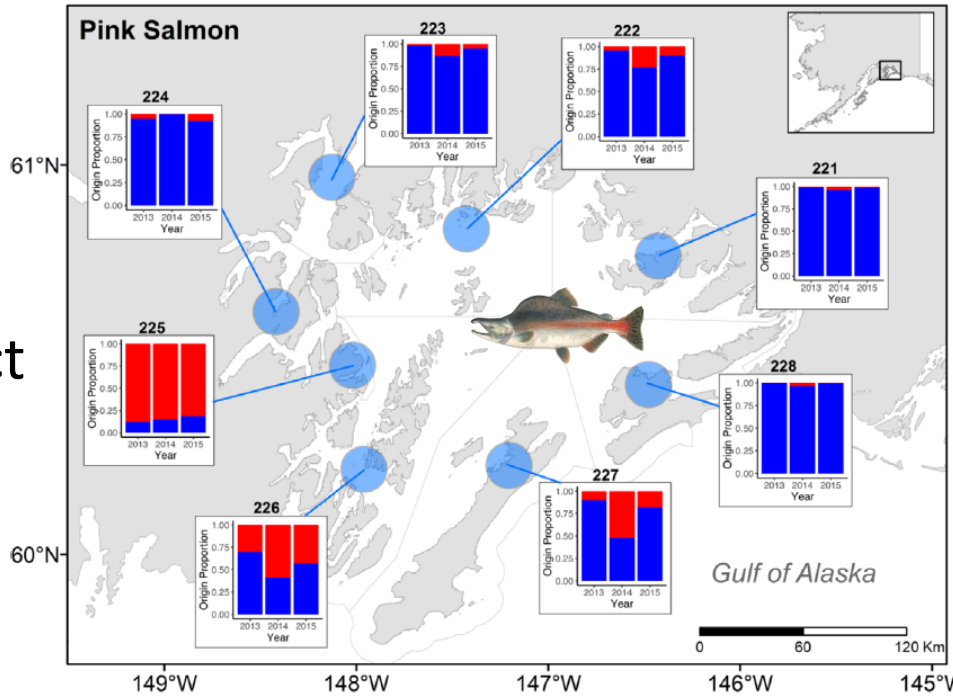
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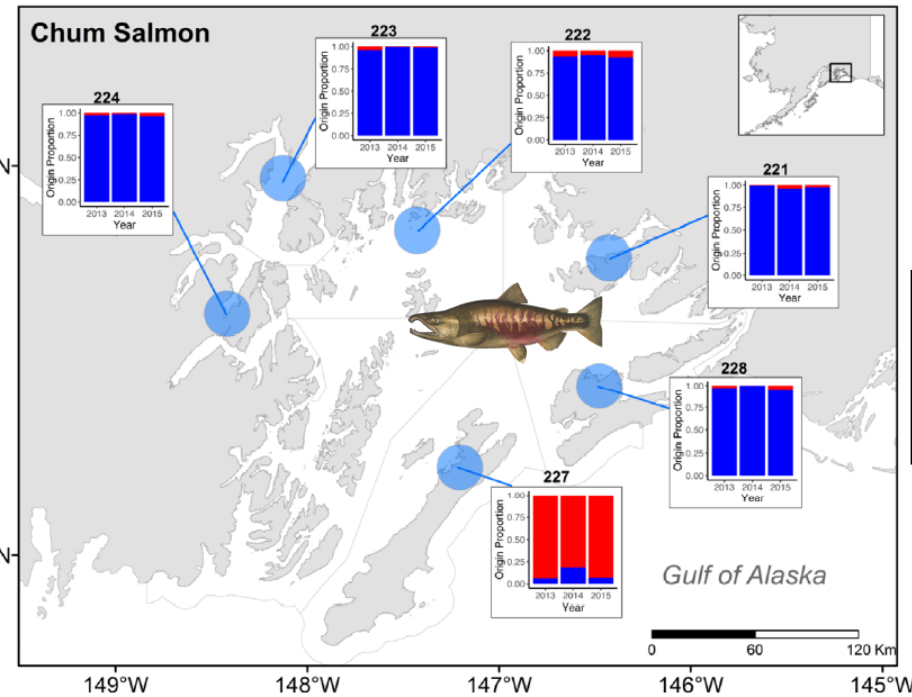
<https://www.adfg.alaska.gov/index.cfm?adfg=fishingHatcheriesResearch.meetings#infomeetings>

PWS Hatchery Proportions in Escapement

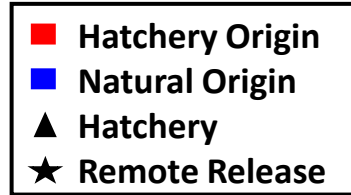
By District



Range: 0.1% - 89.9%



0.0% - 84.6%



Soundwide

Species	2013	2014	2015
Pink	4.5%	14.7%	10.5%
Chum	2.8%	3.3%	9.2%

Take-Home: 2. Straying

- Hatchery fish in PWS aggregated escapements was 5-15% for pinks and 3-9% for chum
- Highest proportions were near hatcheries, release sites, or along migratory pathways
- Higher harvest rates were on hatchery-origin (94-99%) rather than natural-origin (17-50%) fish as intended
- Due to the magnitude of hatchery returns, the proportion of hatchery production in escapements is small, but proportion of escapement they comprise can be large

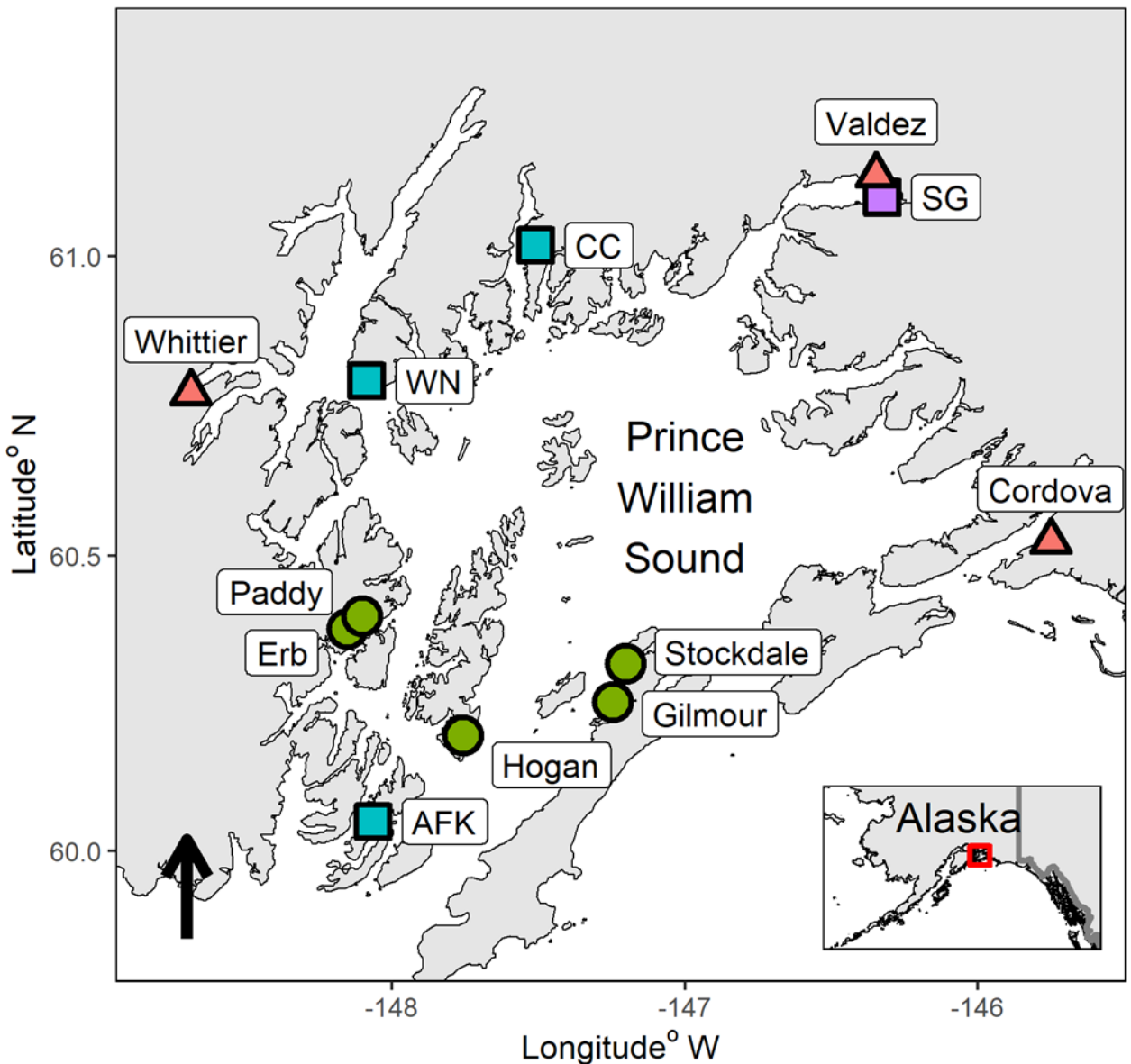
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AHRP Streams in PWS



VFDA = Valdez Fisheries Development Association
PWSAC = Prince William Sound Aquaculture Corporation



Photo credit: Brad von Wichman (PWSSC)

Measuring Reproductive Success

Reproductive success (RS):

The number of returning offspring produced by an individual (i.e., fitness)

Relative reproductive success (RRS):

Ratio of the average reproductive success of hatchery-origin fish to the average reproductive success of natural-origin fish

$$RRS = \frac{\overline{RS}_{\text{Hatchery}}}{\overline{RS}_{\text{Natural}}}$$

RRS = 1: equal success

RRS < 1: hatchery-origin less successful

RRS > 1: hatchery-origin more successful

Pink 1st-Generation RRS

RRS = 1: equal success

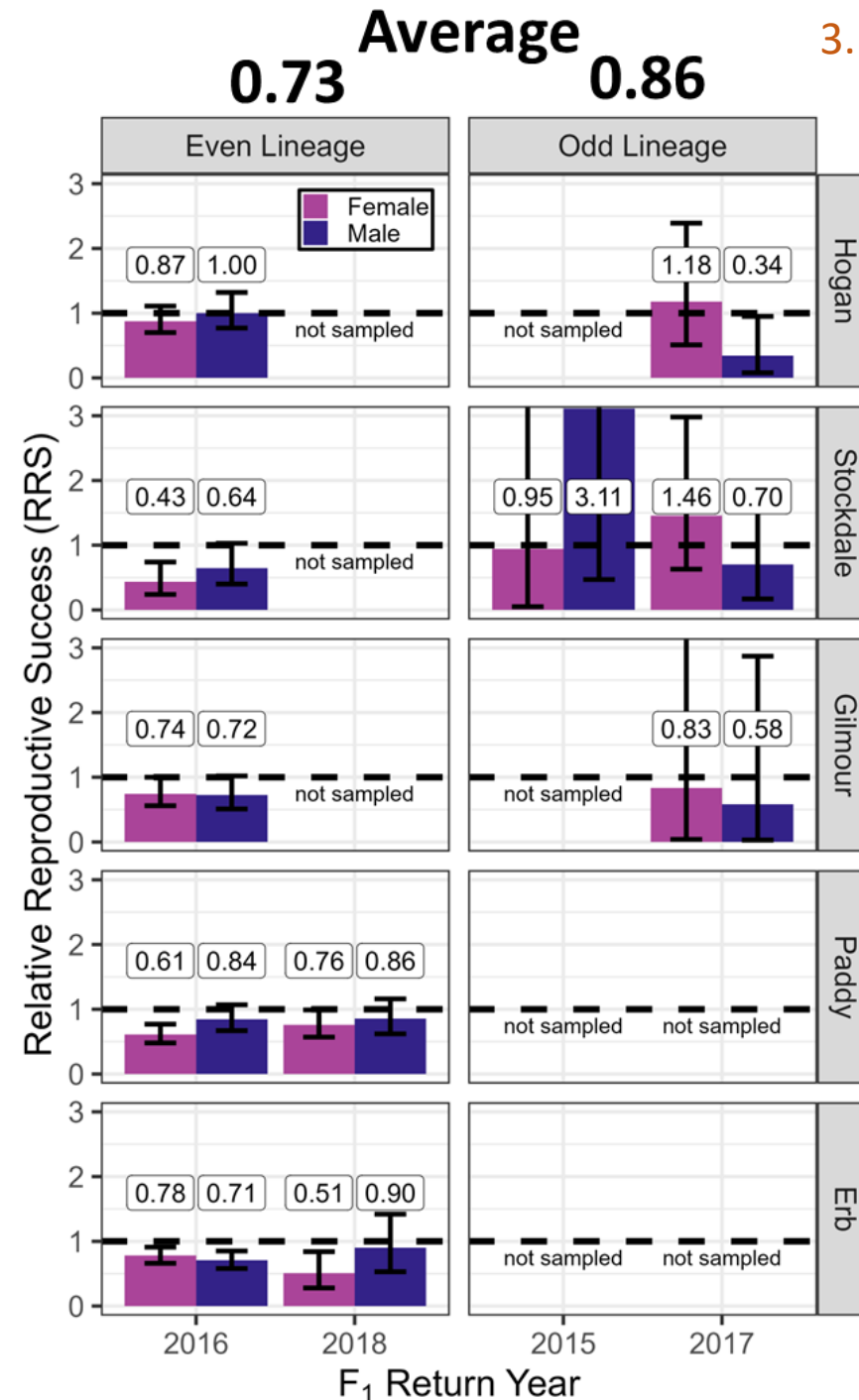
RRS < 1: hatchery-origin less successful

RRS > 1: hatchery-origin more successful



Pink 2nd-Generation RRS

- Second generation natural-origin offspring of hatchery strays have lower fitness
- Fitness reductions are less severe than in the first generation, especially in the odd-lineage



Take-home: 3. Impact on Fitness

- Pink salmon hatchery strays spawn in streams and have lower RS than wild fish
- There is variability in RRS among streams, years, and sexes
- Body size, sample date, and sample location matter, but stray hatchery-origin RRS is still < 1
- Hatchery/natural pairs typically produce fewer offspring than natural/natural pairs (even-lineage; results not shown)
- Fitness differences persist into the second generation → natural-origin offspring of hatchery strays have lower RS, but reductions are less severe than the first generation

A couple FAQs

Q: Don't wild fish stray, too?

A: Yes. We covered this earlier. One must consider the timescale, magnitude, and frequency of straying. There are thousands of locally adapted populations in PWS and four(4) recently developed large-scale hatchery populations.

Q: Are the low RRS results an artifact of skewed harvest on late-run offspring of hatchery strays?

A: No. There was virtually no commercial fishery in 2016 (one 6-hr opener in SW District), but we still saw low RRS for BY2014. Similarly, there was a limited commercial fishery in 2020 (four 12-hr openers in SW District), and we saw low RRS for BY2018.

Application of Science to Make Decisions

The interface of science and policy is where scientific knowledge is incorporated into value systems providing a bridge for decision-making

AHRP provides valuable biological information for understanding hatchery-wild interactions in pink and chum salmon

- Scientifically answerable questions
- Appropriate study design

However, more than biology must be considered when making decisions about resource use, including social, cultural, and economic values

Application of Science to Make Decisions

Q: Are hatchery pink salmon spawning in streams in Prince William Sound?

A: Yes.

Q: Which streams have spawning hatchery pink salmon and how many are there?

A: Sound-wide average recipient stray rates are 5% – 15%, depending on year, with the highest rates (up to 90%) in streams near hatcheries.

Q: Do spawning stray hatchery pink salmon affect wild pink salmon populations?

A: Yes. They spawn together, and hatchery origin and ancestry is associated with lower fitness. We don't yet know for certain the mechanism (e.g., is disjunct run timing a component?).

Q: Is the effect of hatchery-origin pink salmon spawning with wild pink salmon harmful?

A: Yes. Hatchery strays and their offspring have lower fitness, negatively affecting wild productivity (recruits/spawner), despite recent (record) high production in odd-years.

Q: Would the cost to reduce hatchery-origin pink salmon spawning in streams outweigh the benefit?

A: Maybe. What are the cost(s) and benefit(s)? Would addressing the harm cost more than it would benefit? Human valuation is required.

Acknowledgements

- Alaska Hatchery Research Program
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 - Private non-profit hatcheries
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- Pacific Salmon Commission
- Prince William Sound Science Center
- Sitka Sound Science Center
- ADF&G Mark, Tag, and Age Lab
- ADF&G Cordova Otolith Lab
- University of Washington - Seeb Lab
- University of Alaska Fairbanks
- ADF&G Gene Conservation Laboratory



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