

AHRP Research Questions

- 1) What is the genetic stock 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?



AHRP Research Questions

1) What is the genetic stock structure of pink and chum in PWS and SEAK?

- Hatchery broodstocks are all derived from stocks within their respective regions as per the Alaska Genetics Policy
- Broodstocks are necessarily large because of the scale of the program, and brood fish are spawned non-selectively from throughout the duration of the spawning run.
- As a result, broad-scale genetic variability is maintained, but the distribution of genotypes may differ from wild spawning populations which are smaller and potentially adapted to localized environmental conditions.
- Policy makers and resource managers need an improved understanding of the hierarchical genetic structure of the populations, and the degree of genetic differentiation at and within the level of harvest management resolution.

AHRP Research Questions

1) What is the genetic stock structure of pink and chum in PWS and SEAK?

Pink salmon in PWS

Ecologically important, but shallow, structure observed in even and odd years (1990s)

Re-examine structure with new samples and new markers (2013-2015)

Compare 1990s structure to present structure

Chum salmon in PWS and SEAK

Temporal and regional structuring observed within SEAK and PWS (1990s & 2013).

Collect additional samples to supplement baseline collections

Examine fine-scale structure using updated methods

AHRP Research Questions

1) What is the genetic stock structure of pink and chum in PWS and SEAK?

- Research directed by the ADF&G Gene Conservation Laboratory
- Collaborative effort with University of Alaska, NOAA Auke Bay Laboratories, University of Washington, Prince William Sound Science Center and Sitka Sound Science center
- Results to provide perspective on degree of heterogeneity across different geographic scales, insight into temporal changes associated with hatchery production, and improved capacity to track future changes.

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2) What is the extent and annual variability of Hatchery straying?

- Stray Rate (1) : Proportion of a spawning population that spawns in a stream other than its natal stream
- Stray Rate (2) : Proportion of a stream's escapement that is composed of strays from other streams (or hatcheries)
- Estimation of hatchery stray rate (2):
Proportion of spawning composed of hatchery-origin fish at the stream, management district, and region level for pink salmon and chum salmon in PWS and chum salmon in SEAK

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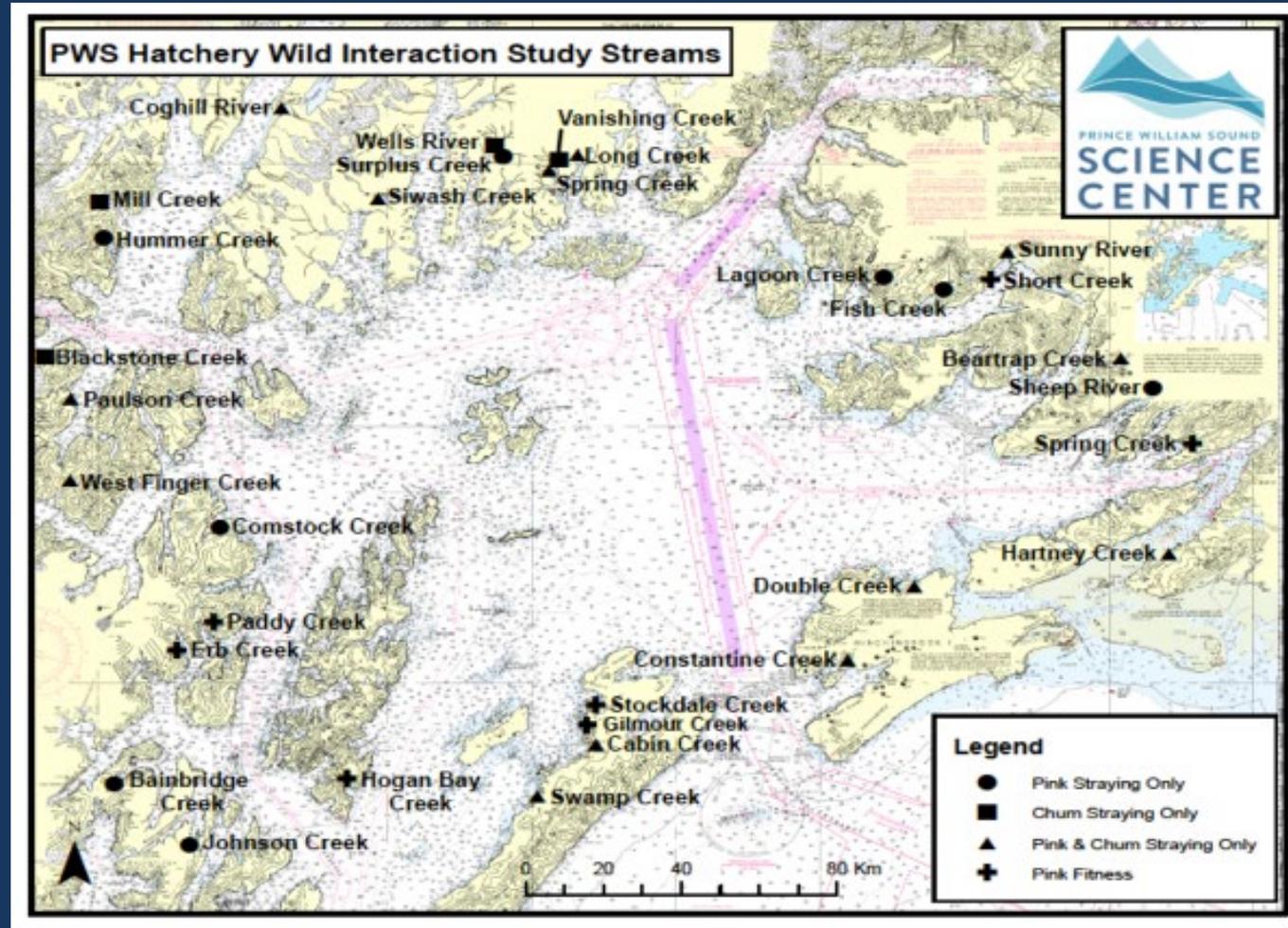
2) What is the extent and annual variability of Hatchery straying?

- Randomly select streams with selection weighted for escapement within and between management districts so that stray rates in streams can be used to accurately estimate district and regional rates
- Initial target of 384 fish per stream to estimate stray rate within 5% with 95% confidence
- Sample otoliths from carcasses throughout run, weighting samples in calculating hatchery proportion by the carcass counts at each sampling event

AHRP Research Questions

2) What is the extent and annual variability of *hatchery salmon straying*?

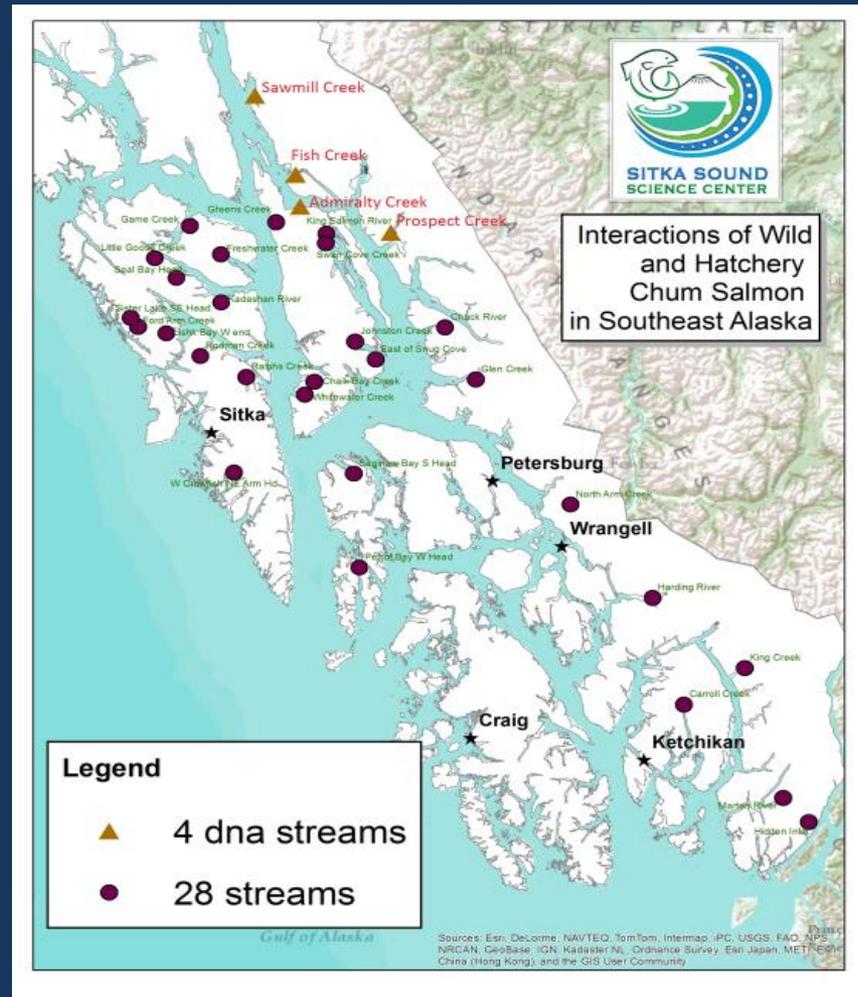
- PWS Pinks:
27 streams
8 districts
- PWS Chums:
17 streams
6 districts



AHRP Research Questions

2) What is the extent and annual variability of *hatchery salmon straying*?

- SEAK Chums:
32 streams
3 sub-regions



AHRP Research Questions

2) *What is the extent and annual variability of hatchery salmon straying?*

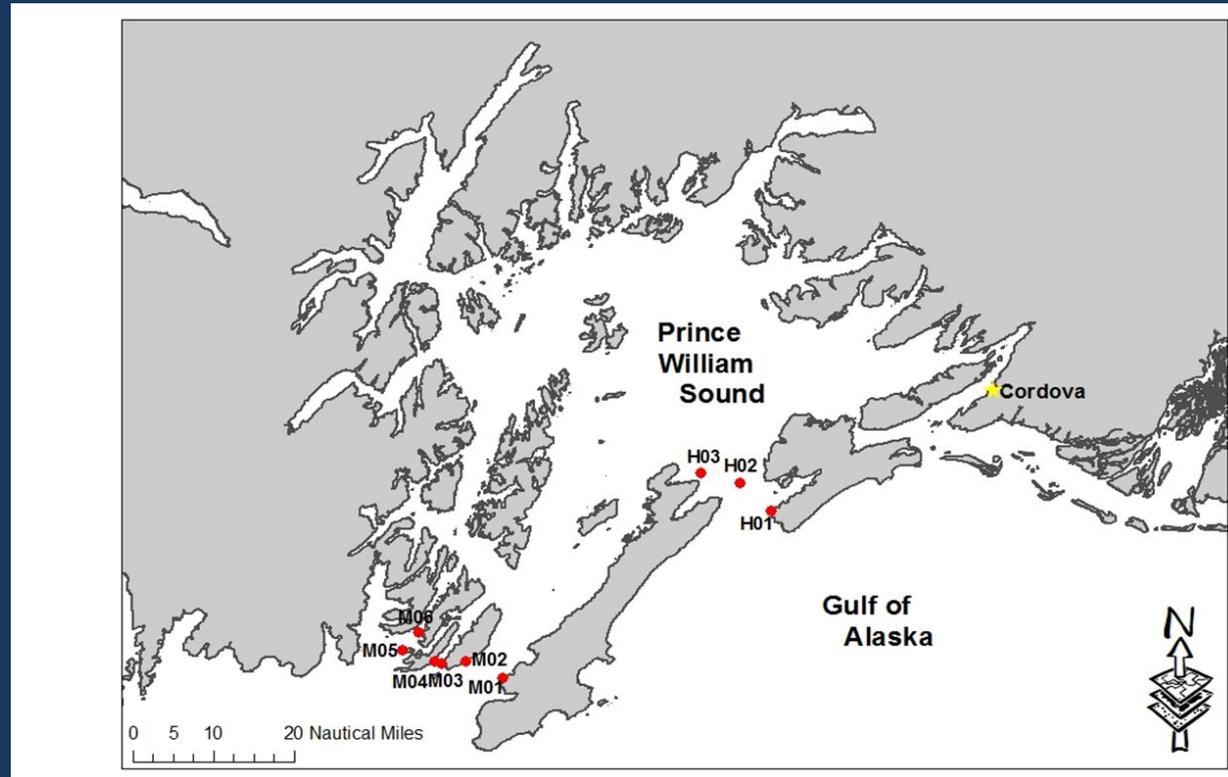
- In addition to estimation of proportion of hatchery strays in spawning escapement, the study was designed to estimate:
 - Number of wild spawners
 - Number of hatchery strays
 - Production (total run) of wild and hatchery fish
- Can be calculated from catch numbers (known), hatchery broodstock numbers (known), proportion hatchery fish in spawning escapement (estimated), and PROPORTION OF HATCHERY FISH IN TOTAL RUN
- Estimate in PWS with ocean sampling as fish enter Sound
- Estimate in SEAK from chum salmon incidental catch in pink salmon seine fishery: not feasible due to data resolution in fishery

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2) *What is the extent and annual variability of hatchery salmon straying?*

Ocean sampling 2013–2015 (PWS only)

- Fish entering PWS sampled at 9 stations
- Multi-mesh panel gillnet fished from contracted gillnet vessel
- Twice weekly sampling from mid-May until the end of August



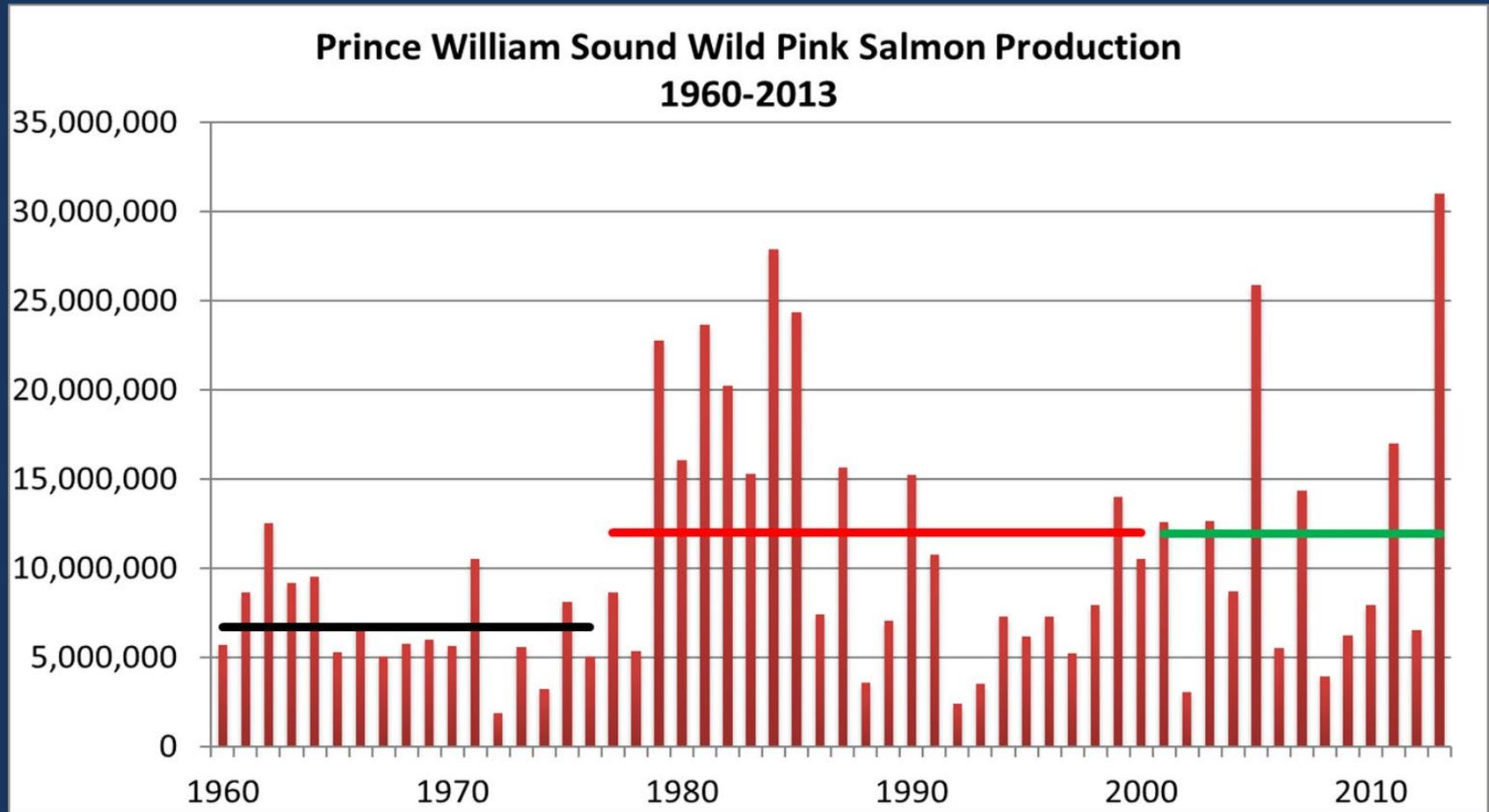
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2) *What is the extent and annual variability of hatchery salmon straying?*

- Ocean sampling allows estimates of total hatchery and wild runs, wild escapement, and number of hatchery strays in the escapement.
- Can compute the hatchery stray rate (1): proportion of hatchery run that strays into spawning streams
- Can contrast production with estimates using index counts to estimate escapement

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2) *What is the extent and annual variability of straying?*



From Gaudet (2017)

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3) What is the impact on fitness (productivity) of natural pink and chum stocks?

Fitness – the ability to survive and reproduce
[average contribution by average individual to next generation]

If hatchery fish are less fit in wild streams, then

1. Hatchery fish will produce fewer offspring

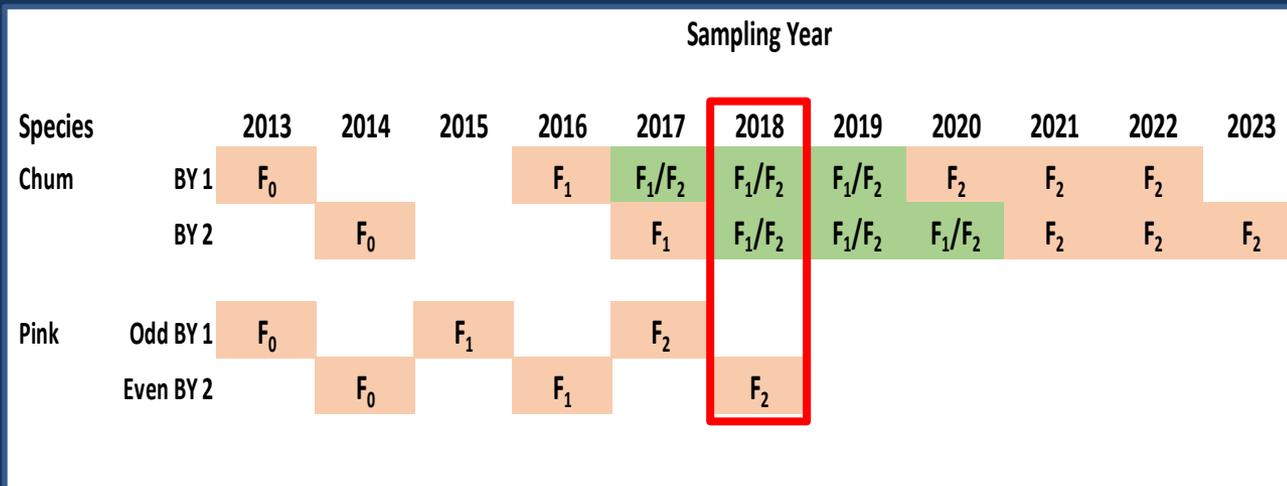
AND

2. Wild fish will produce fewer offspring due to interbreeding.

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3) What is the impact on fitness (productivity) of wild pink and chum stocks?

- Identify number of offspring produced by hatchery- and wild-origin parents
- Follow 2 brood years for 2 generations: replicate for F_1 , potential for F_2
- PWS pink salmon: 6 streams (2013-2018)
- SEAK chum salmon: 4 streams (2013-2023)
- Target streams with high (@50%) and low (@10-20%) hatchery stray rates



Otolith Mark Use 3

Are there effects of straying on fitness and productivity?

- Use otolith marks to identify hatchery vs. natural origin spawners
- Use parentage analysis to assess fitness of hatchery and wild fish
- Studies in Pacific NW on other species may not apply to AK (king, coho, steelhead)
 - ✓ Freshwater residence time
 - ✓ Life span and age structure
- Different hatchery practices
 - ✓ Local broodstock in AK
 - ✓ 10,000 + parents spawned
 - ✓ Limited holding or feeding for pinks and chums

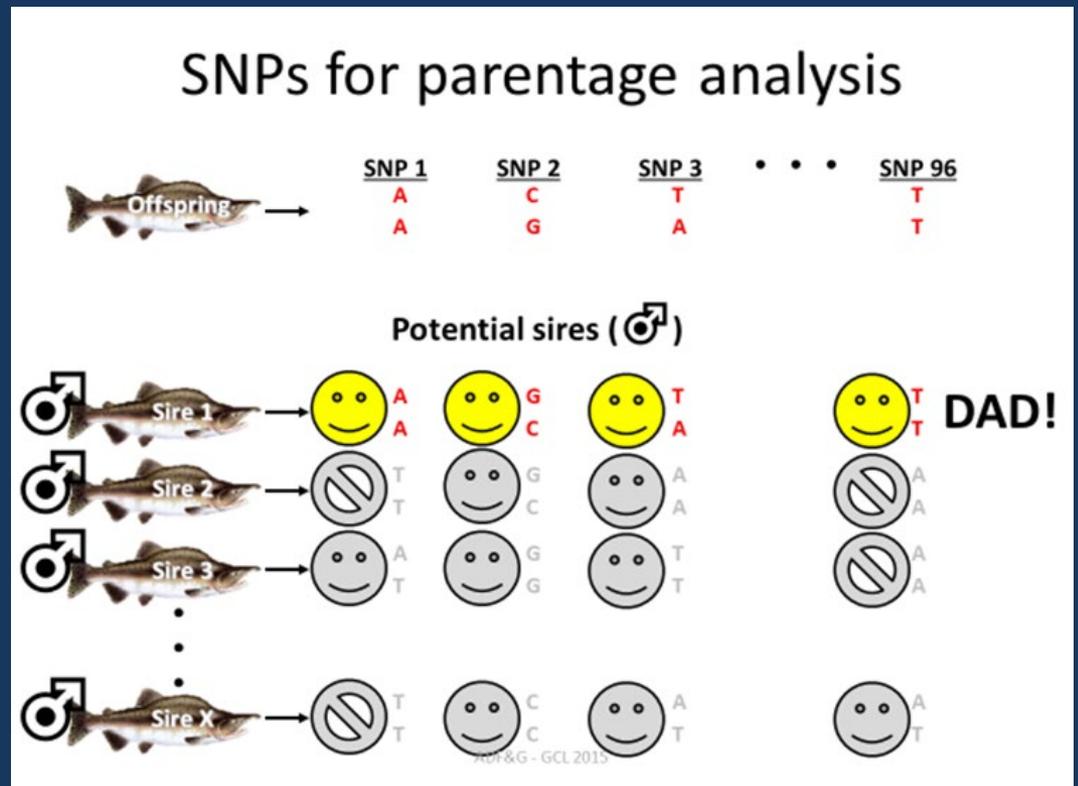


AHRP Research Questions

3) What is the impact on fitness (productivity) of natural pink and chum stocks?

Parentage analysis – use genotyping of parents (F_0) for pedigree reconstruction to identify offspring in F_1 (and F_2 if feasible) using single nucleotide polymorphisms (SNPs)

- SNPs available for chum salmon genotyping
- Extensive SNP development required for pink salmon genotyping
- Identify reproductive success (RS) of hatchery and wild parents

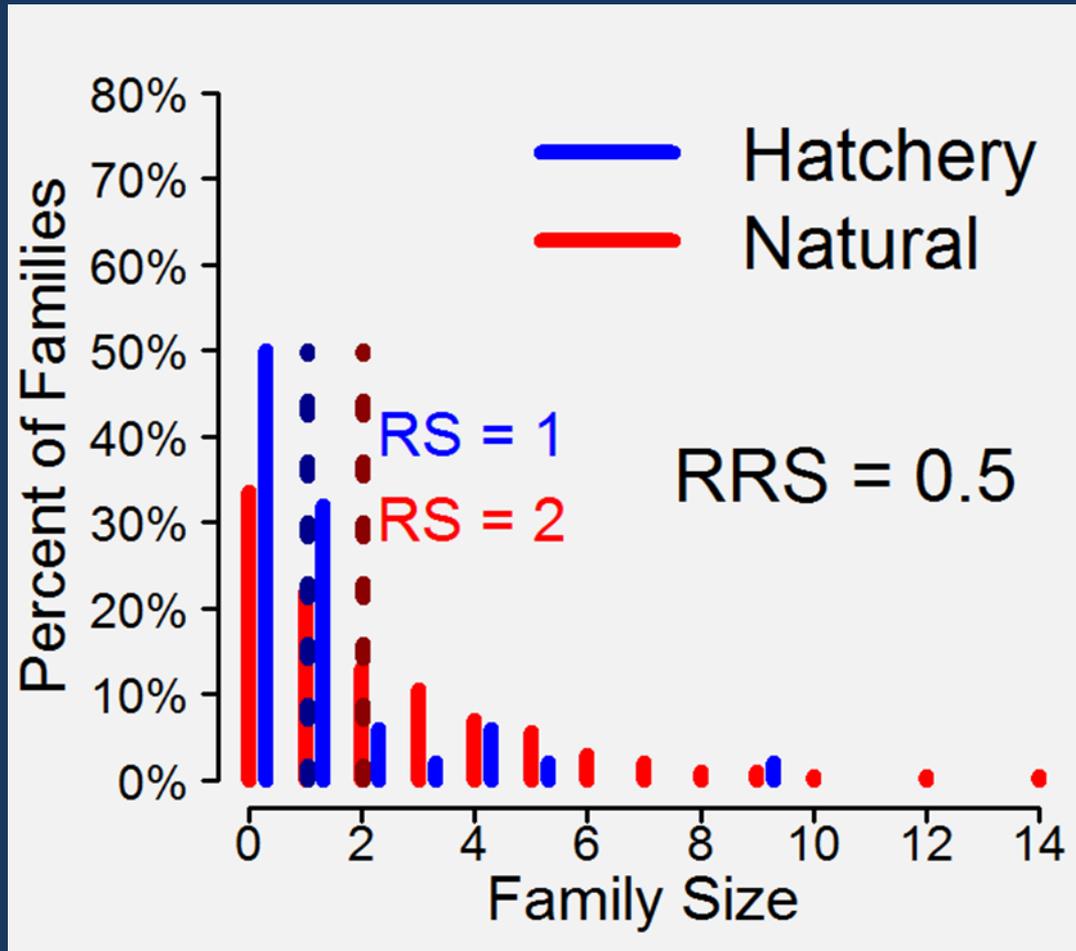


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3) *What is the impact on fitness (productivity) of natural pink and chum stocks?*

Hypothetical distribution of family size for hatchery and wild parents

- Determine RS for hatchery and wild parents for each gender in a stream.
- Calculate the ratio (RRS) = $RS(h)/RS(w)$
- Differences in fitness must be large in order to detect as statistically significant; use $RRS=0.5$ for power analysis



AHRP Research Questions

3) *What is the impact on fitness (productivity) of wild pink and chum stocks?*

Power increases with...

- In our control
 - ↑ Number families
 - Stray rate > 10%
 - ↑ Proportion offspring
- Out of our control
 - Distribution of RS
 - ↑ Mean
 - ↑ Dispersion
 - ↓ True RRS

Depends on:

- Number parents (F_0) sampled
 - Hatchery $\sim f(\text{stray})$
 - Natural
- Proportion offspring (F_1) sampled
- Distribution of RS (productivity)
 - Mean
 - Dispersion
- RRS
 - Difference between Hatchery and Wild
 - Benchmark RRS = 0.5

AHRP Research Questions

3) What is the impact on fitness (productivity) of wild pink and chum stocks?

Alevin Sampling

- Sampling alevins (post-hatch/pre-emergent larval fish) can provide insight into life-history stage of effects: freshwater versus marine
- Hydraulic pumping in spring to collect alevins that could be progeny of parents sampled after spawning the previous fall
- 250 sample sites distributed in relation to observed spawning abundance, with up to 25 alevins retained per sample site
- Limit alevin sampling to one pink stream (Stockdale) and one chum stream (Fish Creek) due to budget constraints

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3) What is the impact on fitness (productivity) of wild pink and chum stocks?

Who does the work?

- Sampling of fitness streams contracted to PWSSC for PWS pink salmon, SSSC for SEAK chum salmon
- Otolith samples processed by ADF&G in Cordova (PWS) and Juneau (SEAK)
- SNP development for pink salmon a collaboration with University of Washington and ADF&G Gene Conservation Lab
- Processing and analysis of parentage and offspring samples the responsibility of the ADF&G Gene Conservation Lab