



Spatial and Temporal Patterns in the Returns of Hatchery- and Natural-origin Pink and Chum Salmon in Prince William Sound during 2013-2015

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Alaska Hatchery Research Project

*“Because of the value of hatchery production to Alaska’s salmon harvest and its place in the international market, and the state’s mandate that hatchery production be compatible with sustainable productivity of wild stocks, Alaska Department of Fish and Game (ADF&G) and Private Nonprofit (PNP) salmon hatchery corporations have recognized the need for a research program **addressing the concerns about escapement assessment and genetic and ecological interactions between hatchery and wild salmon stocks**. In July, 2011, ADF&G convened a Science Panel composed of current and retired scientists from ADF&G, University of Alaska, PNP corporations, and the National Marine Fisheries Service. The Panel members have broad experience in enhancement, fisheries management, pathology, genetics, and biometrics pertaining to wild and hatchery salmon interactions; they designed and guided this research.”*

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The screenshot displays the Alaska Department of Fish and Game website. The header includes the department's logo and name, a search bar, and a navigation menu with categories like Home, Fishing, Hunting, Subsistence, Viewing, Education, Species, Habitat, and Regulations. Below this, there are sub-navigation links for Licenses & Permits, Commercial, Sport, Subsistence, Personal Use, Aquatic Farming, Hatcheries, and Research. The main content area is titled 'Hatcheries Research' and features an 'Overview' tab. A photograph shows a person in a cap and vest handling a large salmon. The text explains that in 1971, the state initiated a salmon fishery enhancement program to address depressed commercial fisheries. It details the program's goals, such as advancing science and increasing consumer confidence. A list of bullet points discusses the challenges of straying hatchery fish and the use of otolith thermal marks for mass-marking. A second photograph shows a large pile of salmon. The page concludes with a link to 'Additional Background Information - Excerpt from Request for Proposal (PDF 30 kB)'. The footer contains social media icons for Facebook, Vimeo, and YouTube, along with contact information and office locations.

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Overview Current Research Project Findings and Updates



In 1971, the State of Alaska initiated its modern salmon fishery enhancement program in response to severely depressed commercial salmon fisheries. Protection of wild stocks has been foremost since the inception of the program and statutes, regulations, and policies are in place to provide for this priority. Alaska's hatchery program is designed to advance the science of fisheries enhancement in Alaska as well as to increase consumer confidence in Alaskan salmon by assuring the marketplace that these products come from sustainable and responsibly managed systems. Our program guards against potential negative effects on natural production, as evidenced by over 40 years of hatchery production alongside stable or increasing natural production.

Alaska continues to approach requests for increased hatchery production by asking if an increase can be managed with consideration of potential risks to wild stocks. Alaska's modern salmon fishery enhancement program is stakeholder driven, with provisions for planning and oversight by representatives of regional user groups. Since we are not comfortable directly applying research on steelhead, and other species in the Pacific Northwest or elsewhere to the unique situation in Alaska, we are expanding our own studies of wild and hatchery interactions to better understand those relationships as they occur in Alaska. As these studies provide results, we will evaluate and decide if any modifications to the program may be warranted.

- From the beginnings of Alaska's salmon fishery enhancement program it was recognized that salmon stray and that hatchery stocks would stray; consequently, policies and regulations were adopted to mitigate concerns associated with straying.
- For the protection of wild salmon stocks, hatchery programs are required to use local stocks as the brood source and locate hatcheries away from important wild stocks. Requiring the use of only local salmon stocks means that straying hatchery fish are less likely to reduce fitness of local populations.
- In the 1980's hatchery programs in Alaska pioneered use of otolith thermal marks for mass-marking hatchery production. Now almost 100% of all hatchery salmon in most of the state are marked. Marking programs have made possible accurate detection of hatchery-bred salmon on the spawning grounds of wild salmon.
- Straying on a sub-regional level appears to be on the order of 5 to 10% for pink and chum salmon; and less for other species. However, in a few select streams it can be over 50%.

These observations have raised several important questions:

1. Are hatchery-bred salmon interbreeding with wild salmon to the extent that fitness and productivity of these stocks are being diminished?
2. Is the annual assessment of wild stocks (which is, in large part, based on visual observation) so biased by the presence of hatchery salmon that excessive harvest of wild fish is being allowed or that escapement goals are difficult to set and difficult to assess?
3. Do density interactions diminish productivity of wild salmon?



[Additional Background Information - Excerpt from Request for Proposal \(PDF 30 kB\)](#)

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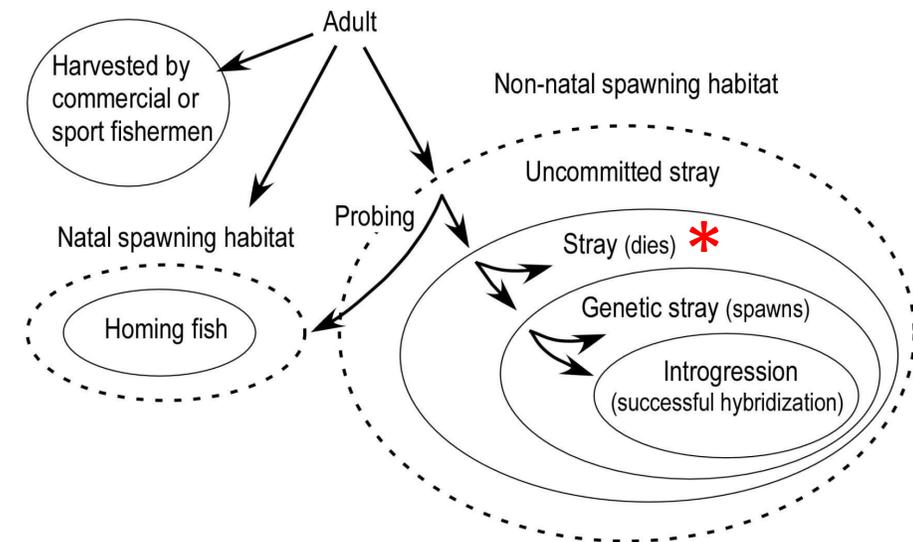
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Objectives

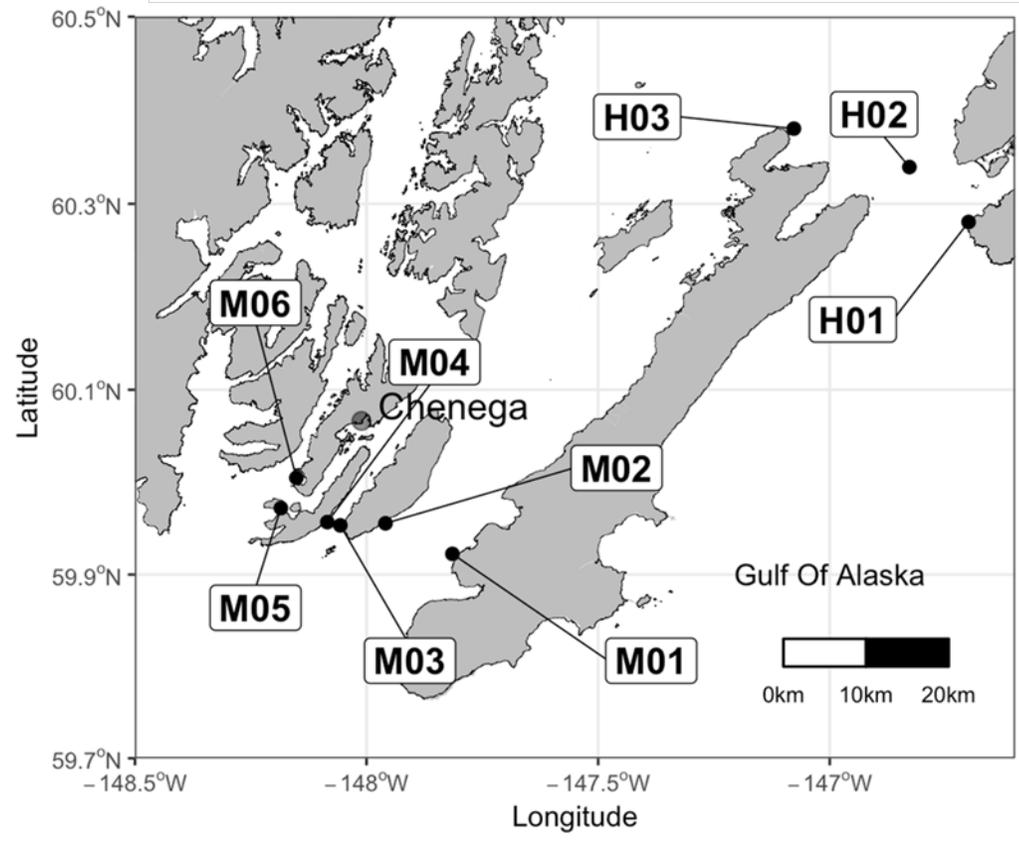
- Focus was on estimating total run size for natural- and hatchery-origin pink and chum salmon during 2013-2015 based on unbiased estimates of hatchery fractions (ocean test fishing and stream surveys).
- Explore spatial and temporal patterns in the data to describe differences in spatial distribution and timing between natural- and hatchery-origin salmon.
- Working toward first, peer-reviewed product generated from the Alaska Hatchery Research Project.

Key definitions

- *Natural-origin*: Fish originating from natural spawning parents.
- *Hatchery fraction*: Percentage of the natural spawning population that originated in a hatchery.
- *Hatchery stray rate*: Percentage of the total hatchery-origin salmon run that enter spawning streams.



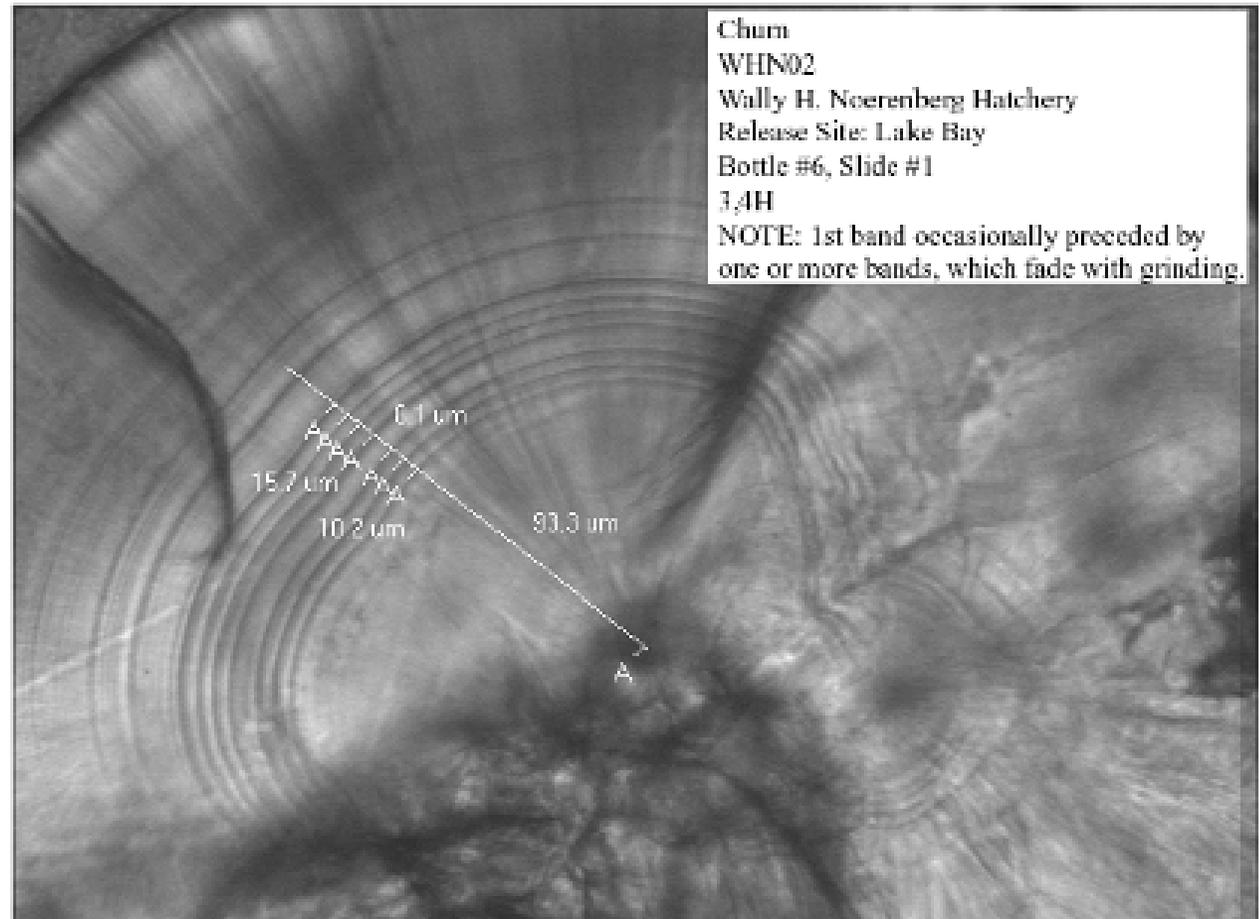
Ocean sampling



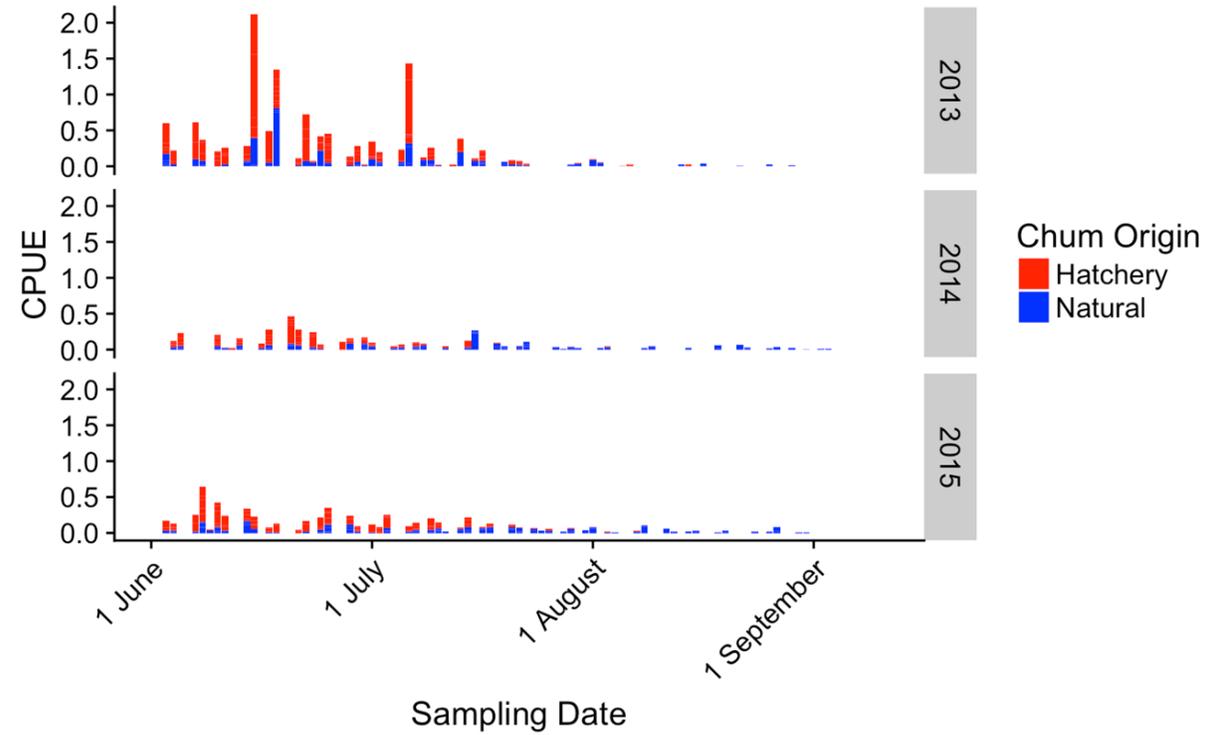
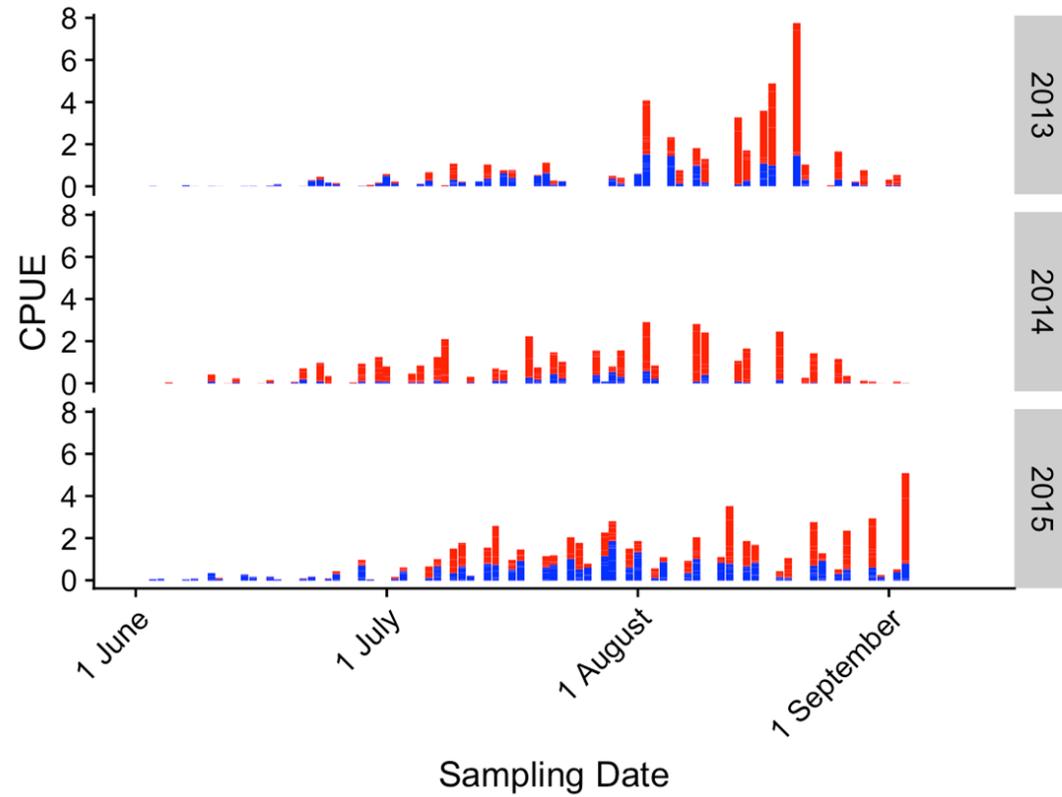
Ocean test fishing



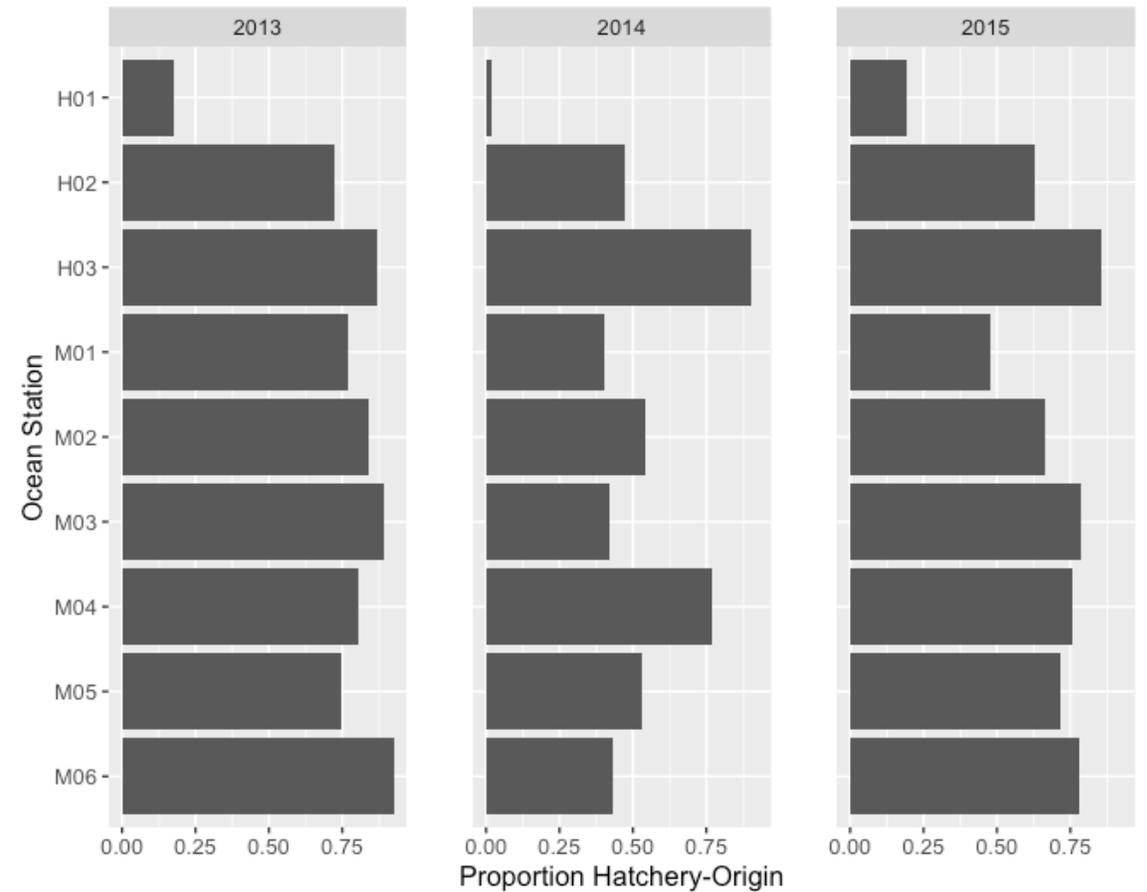
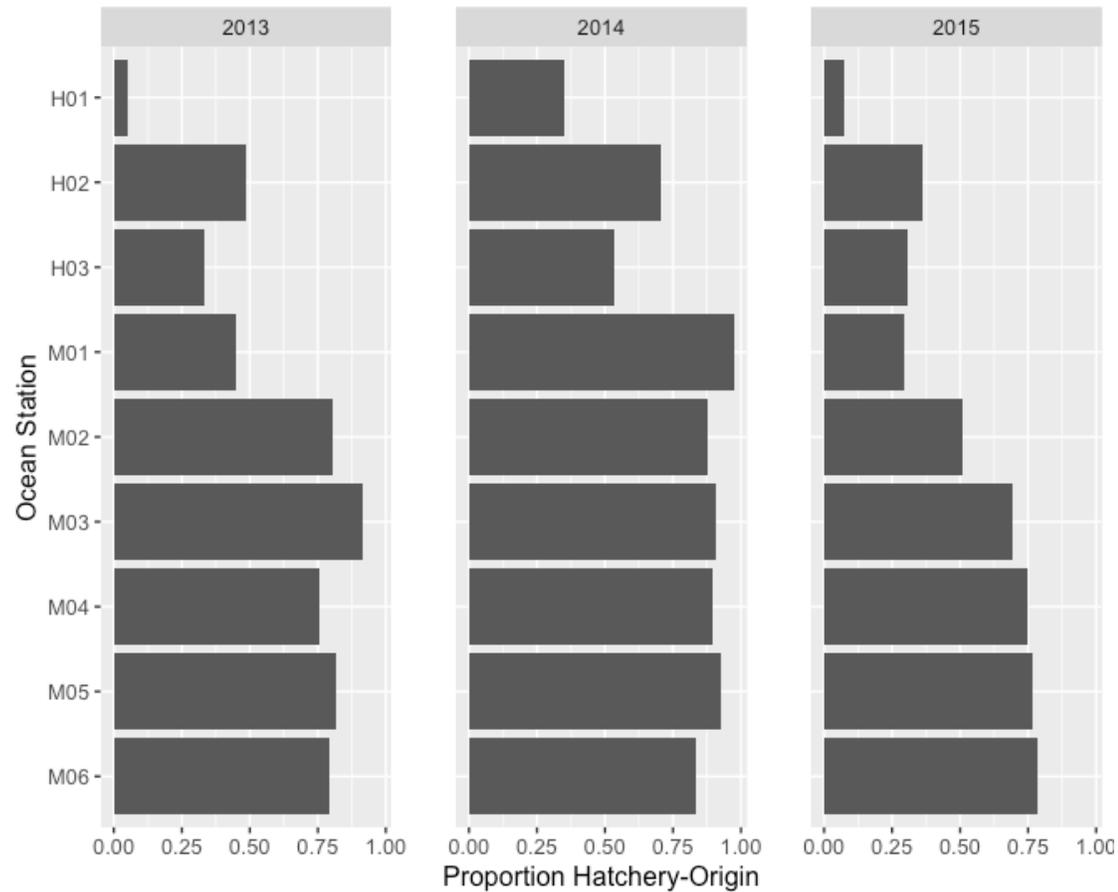
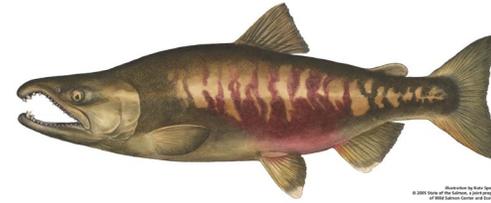
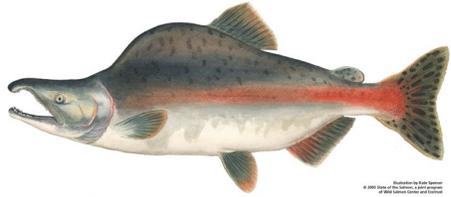
Cordova Otolith Lab, ADF&G



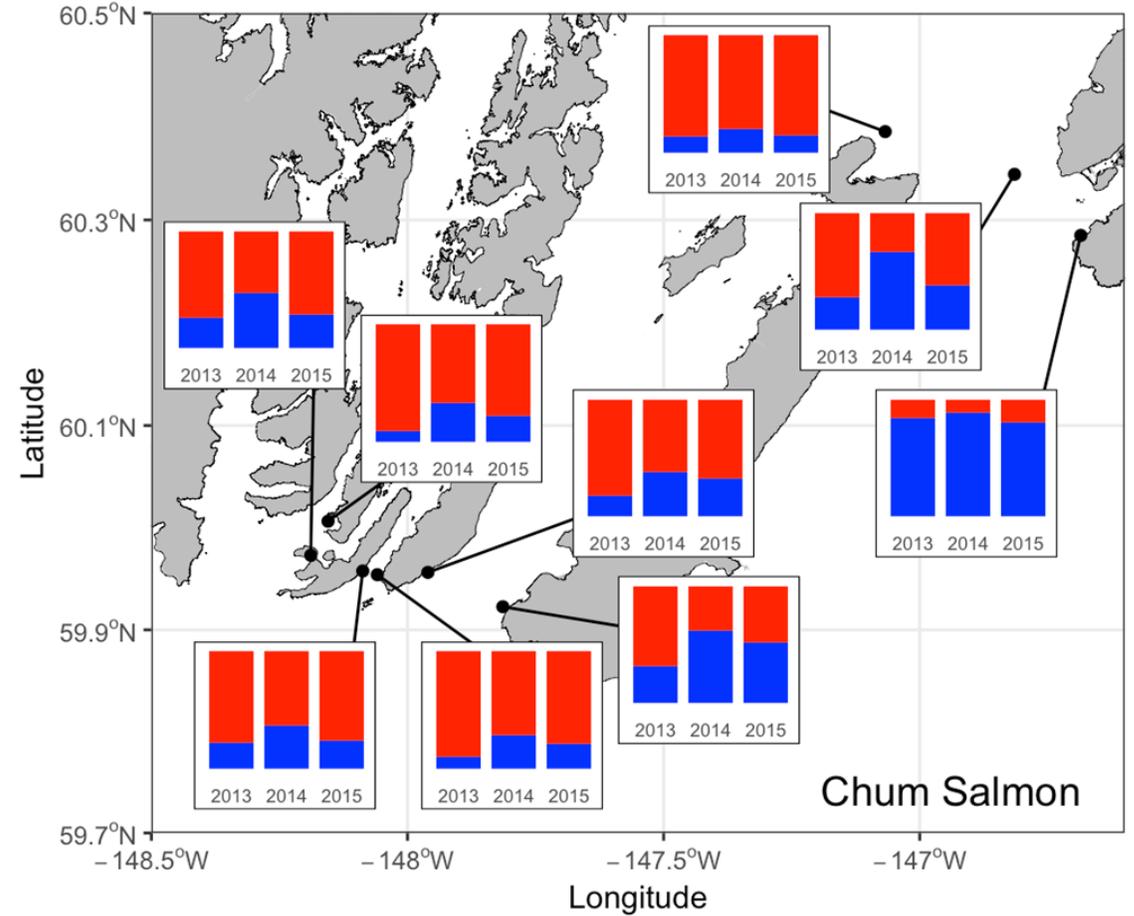
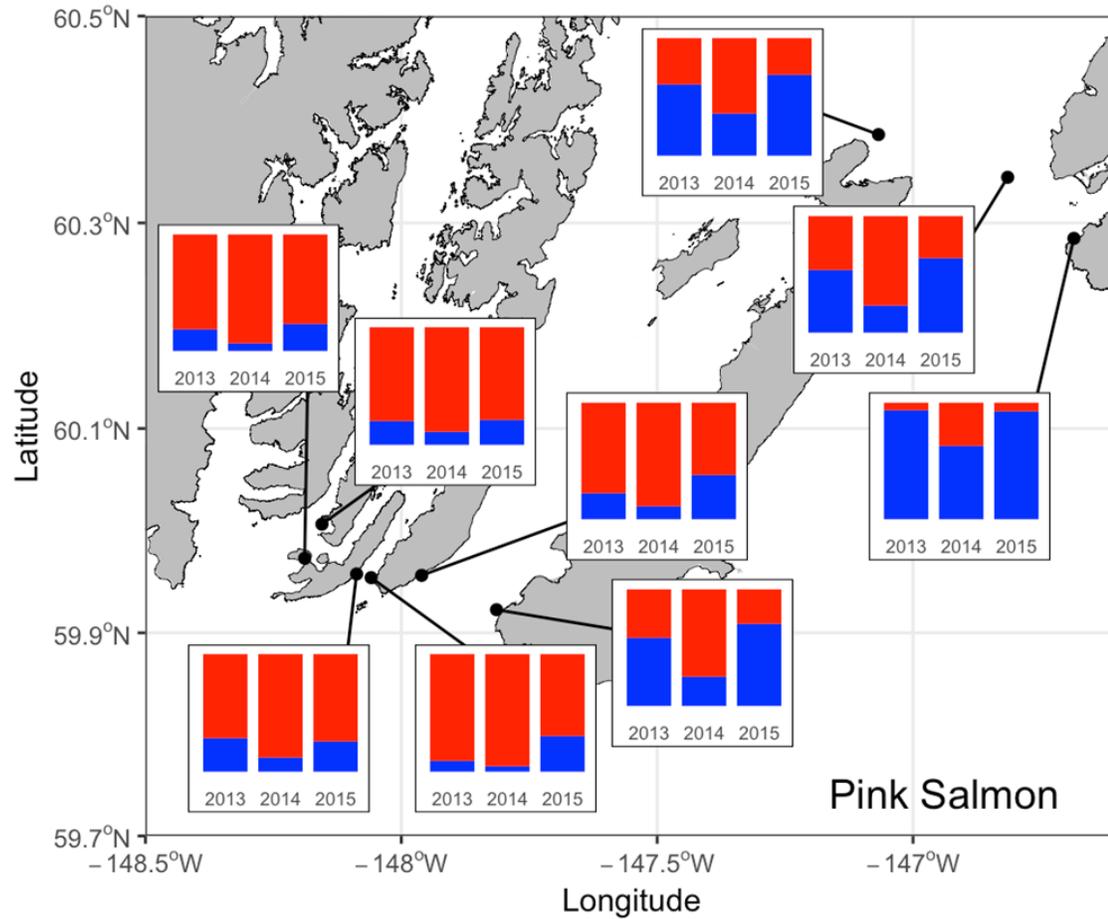
CPUE, over time at ocean stations



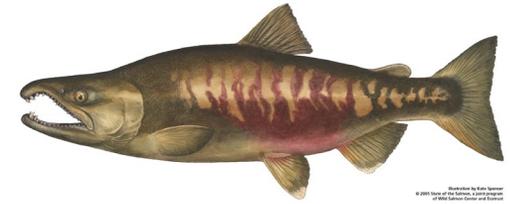
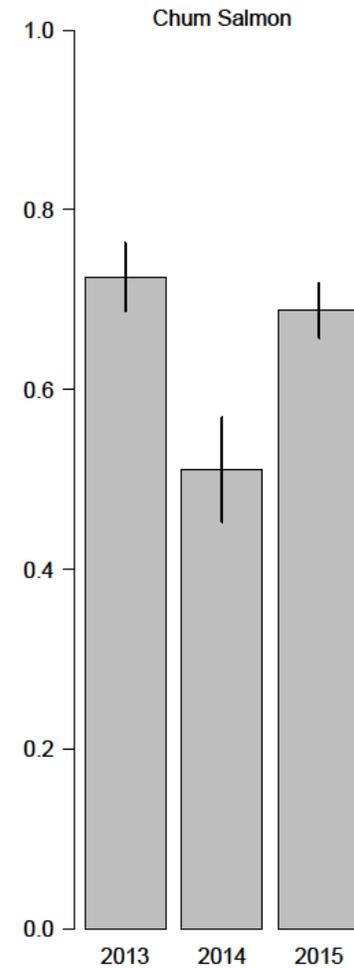
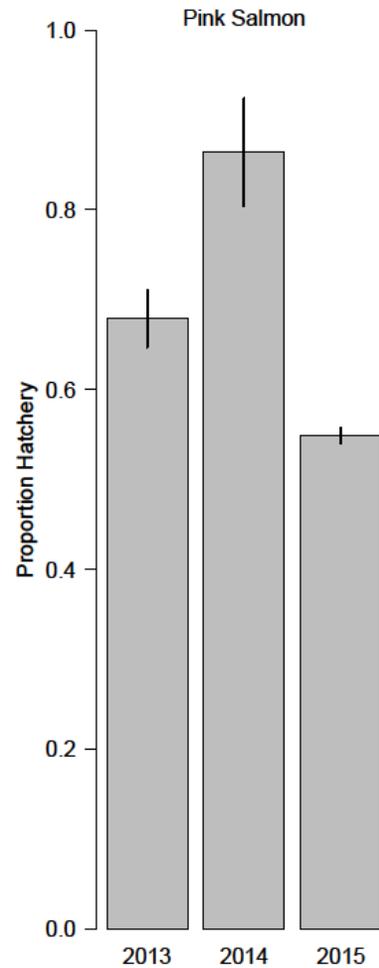
Hatchery fraction by ocean station



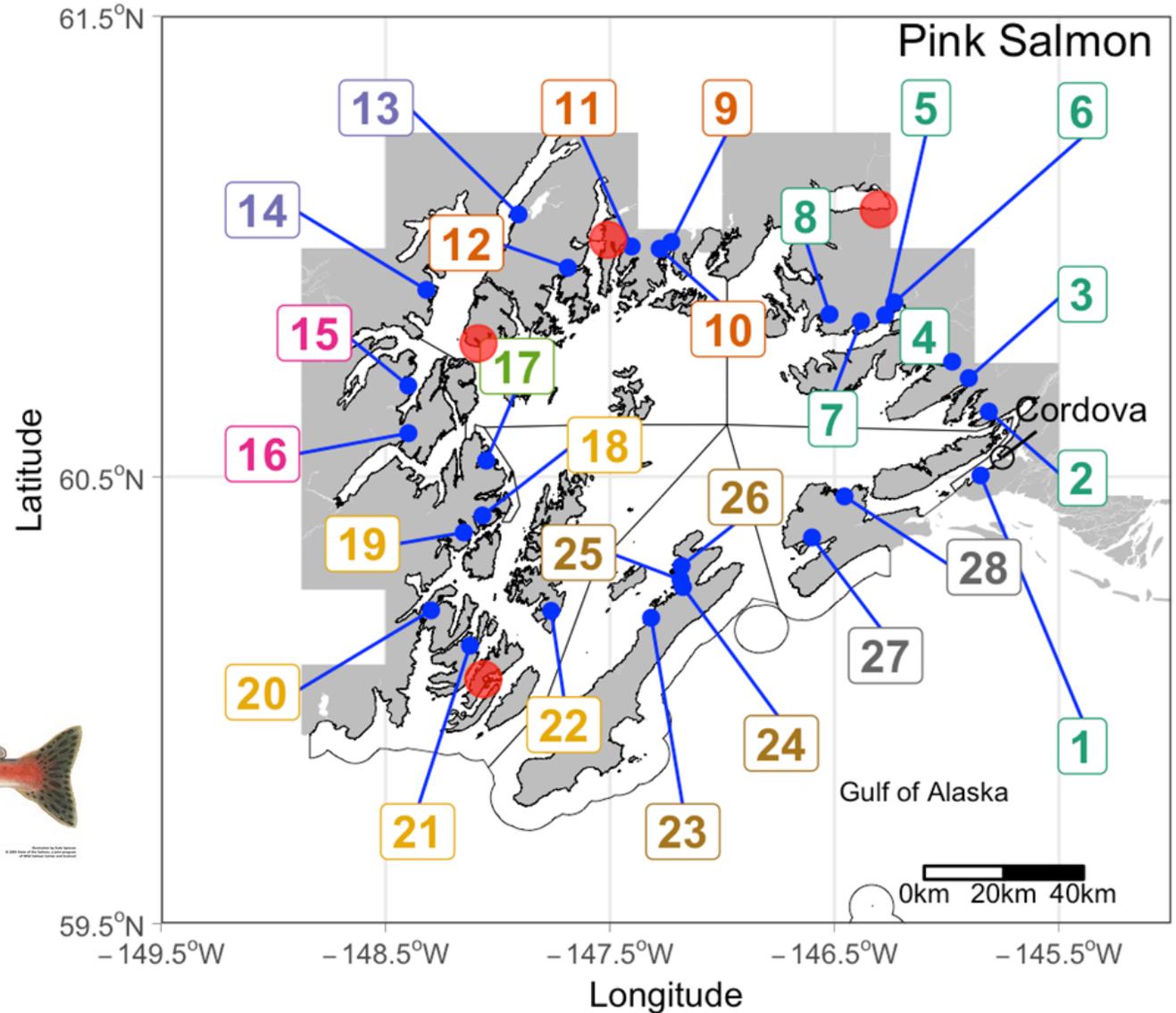
Annual summary of hatchery fractions



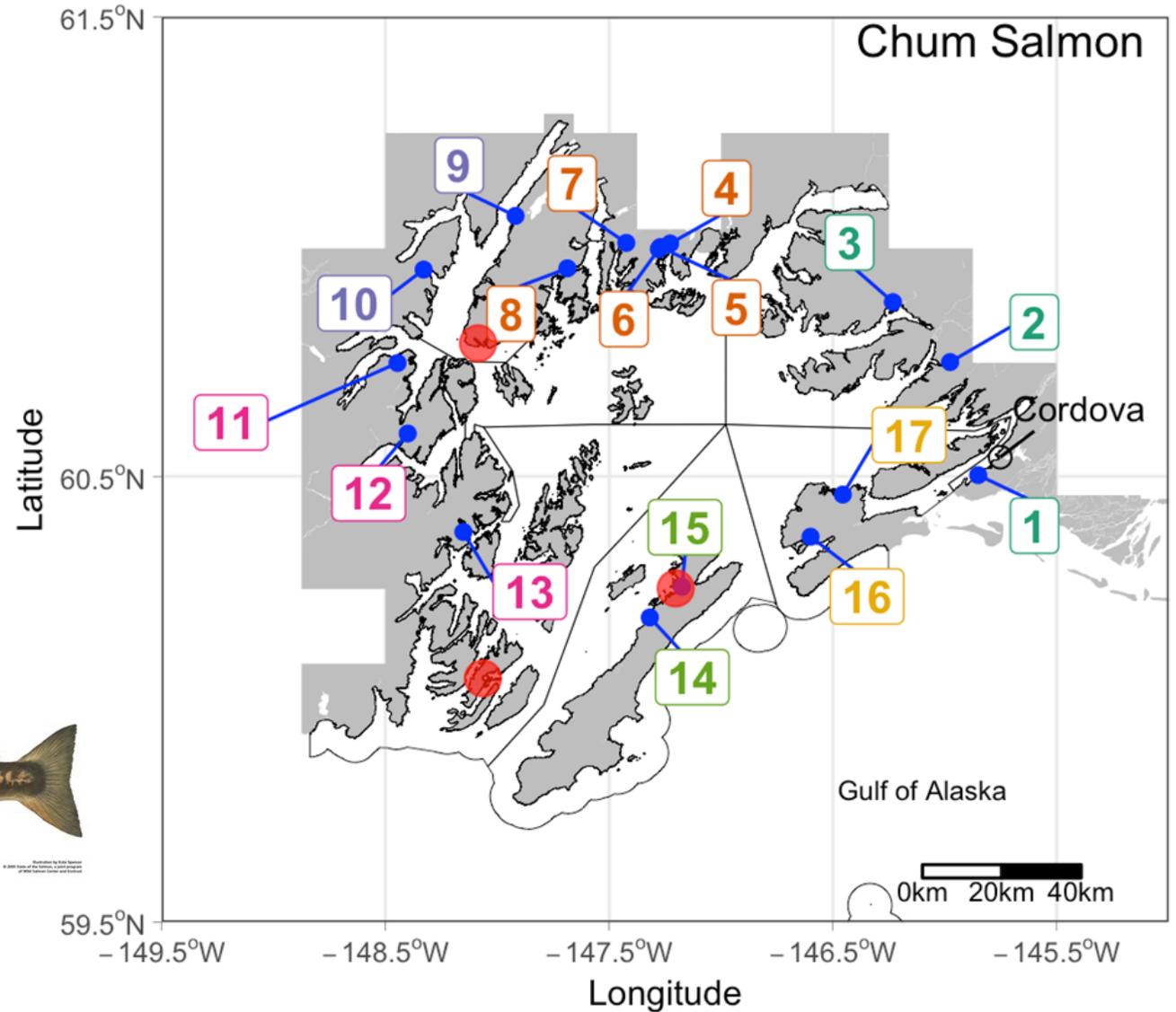
Hatchery fraction in PWS run



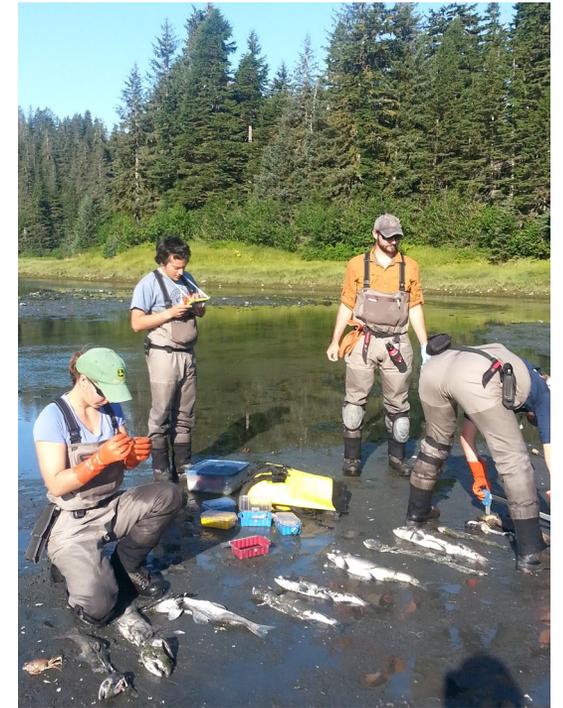
Stream sampling



Stream sampling



Stream sampling

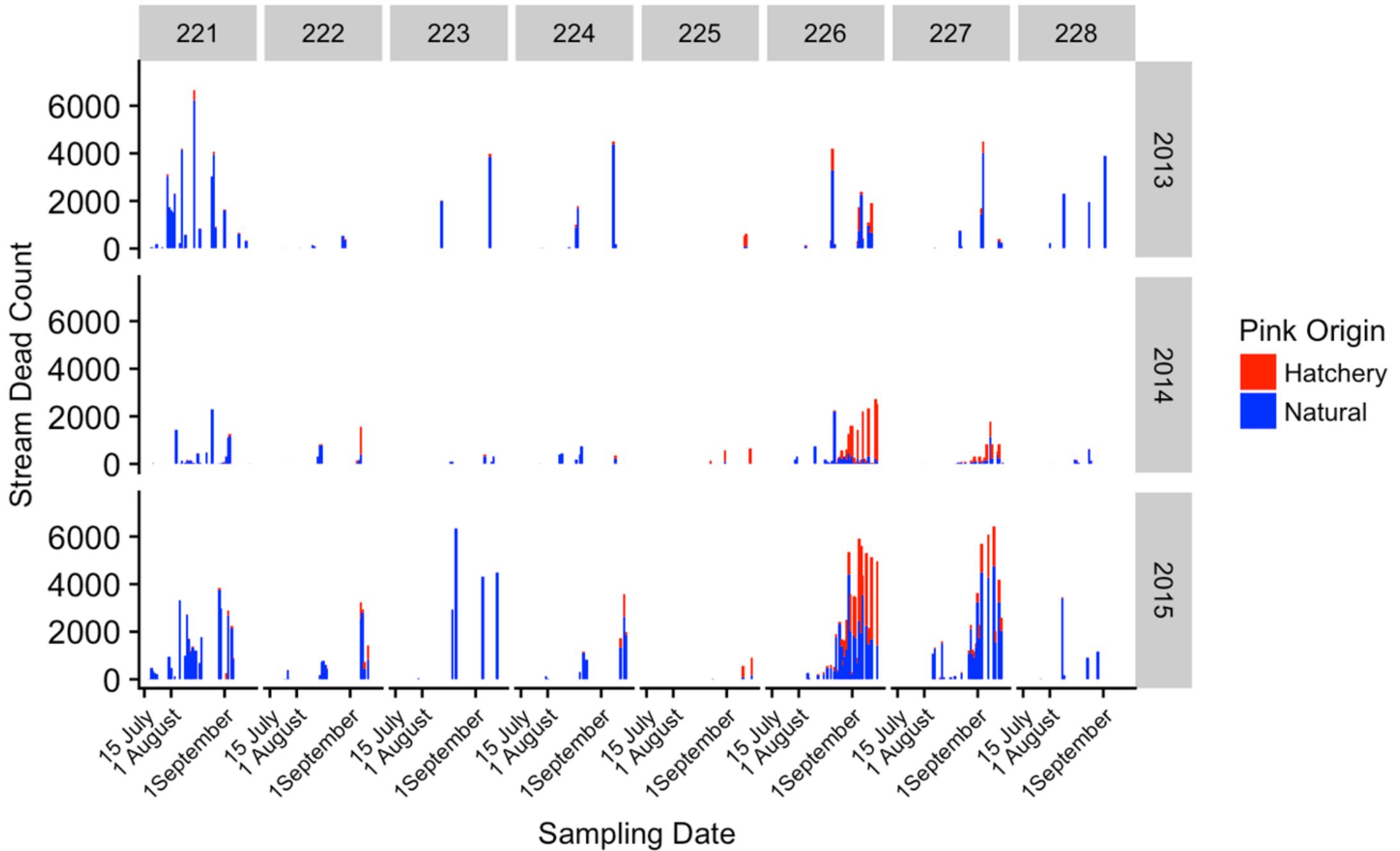


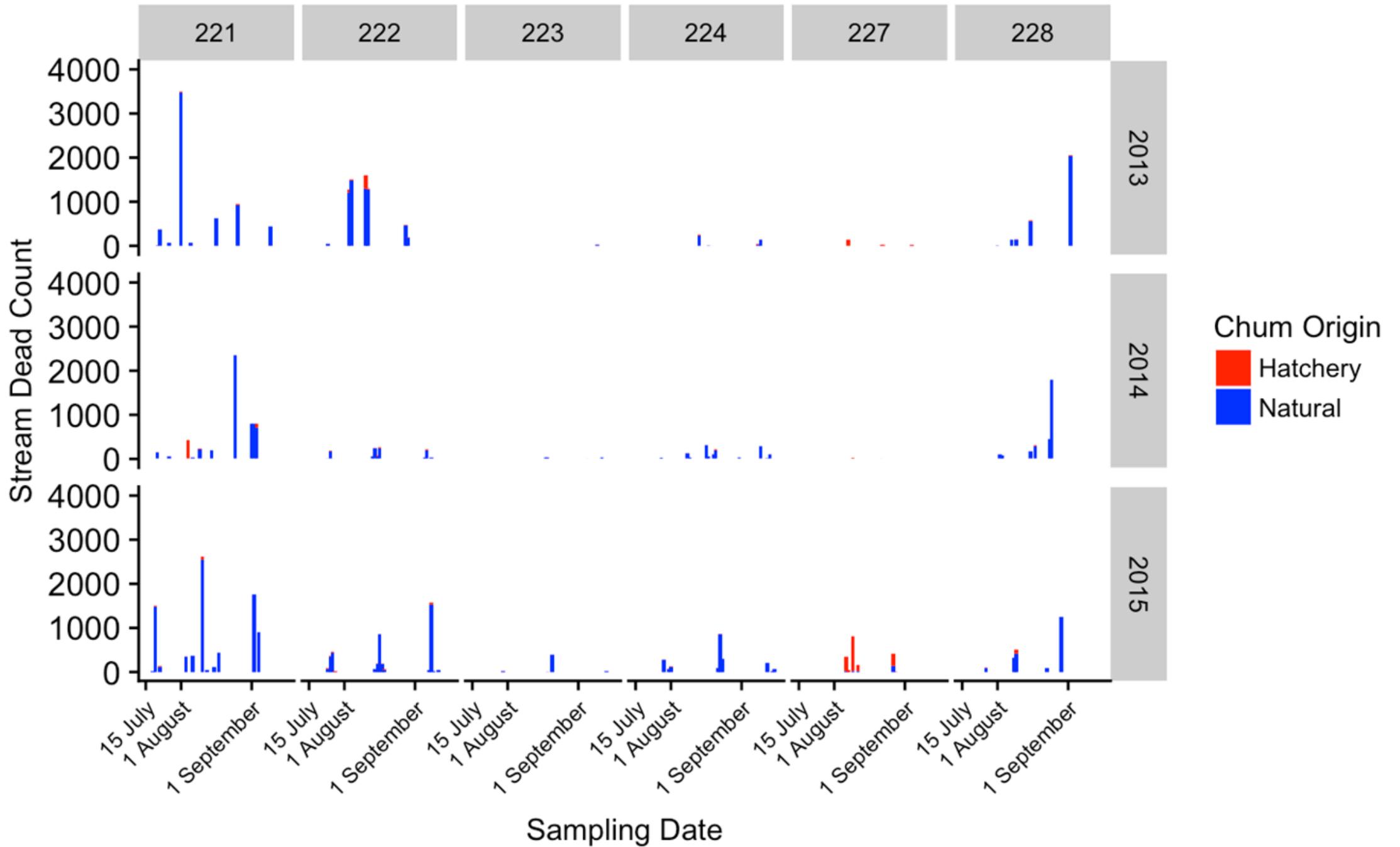
Stream sampling



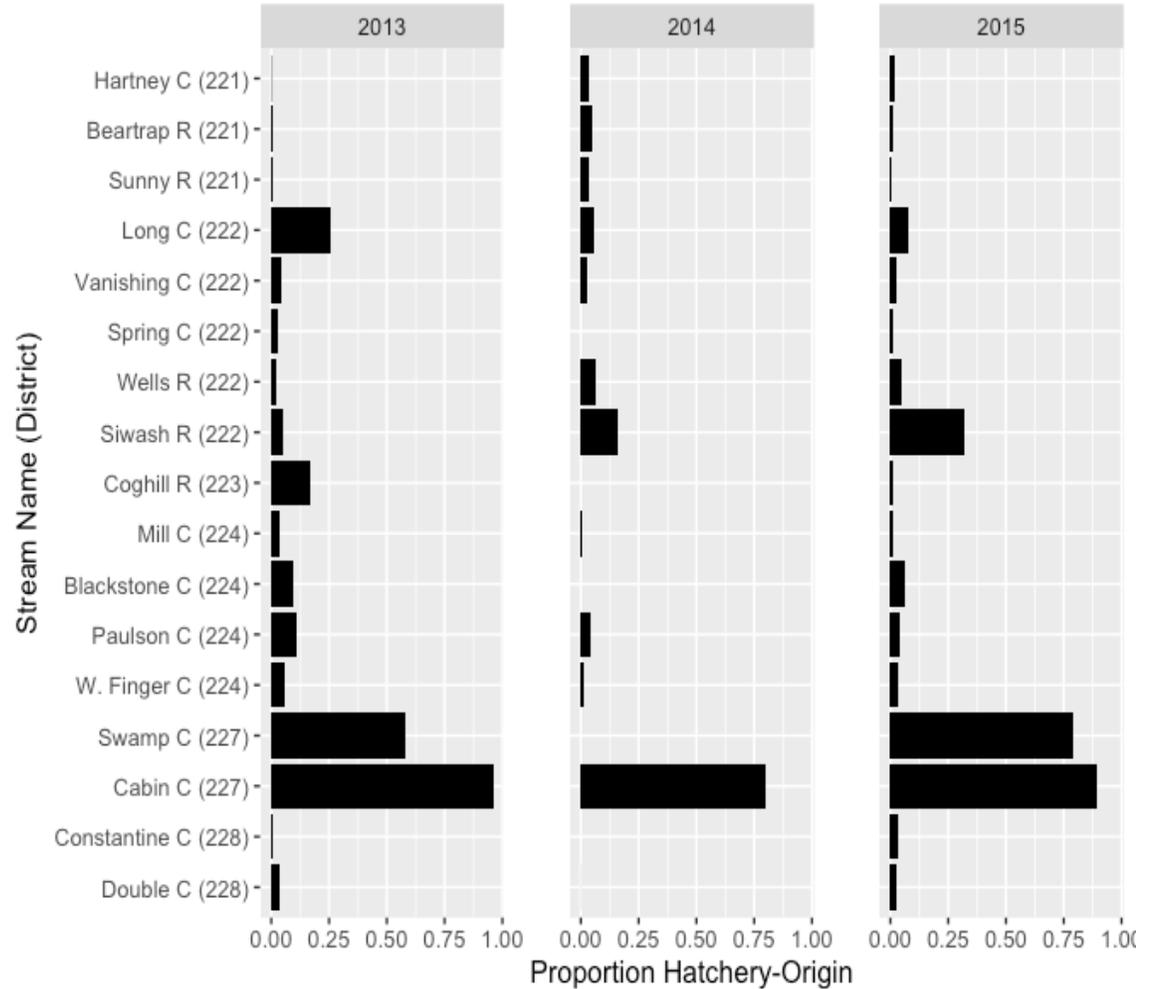
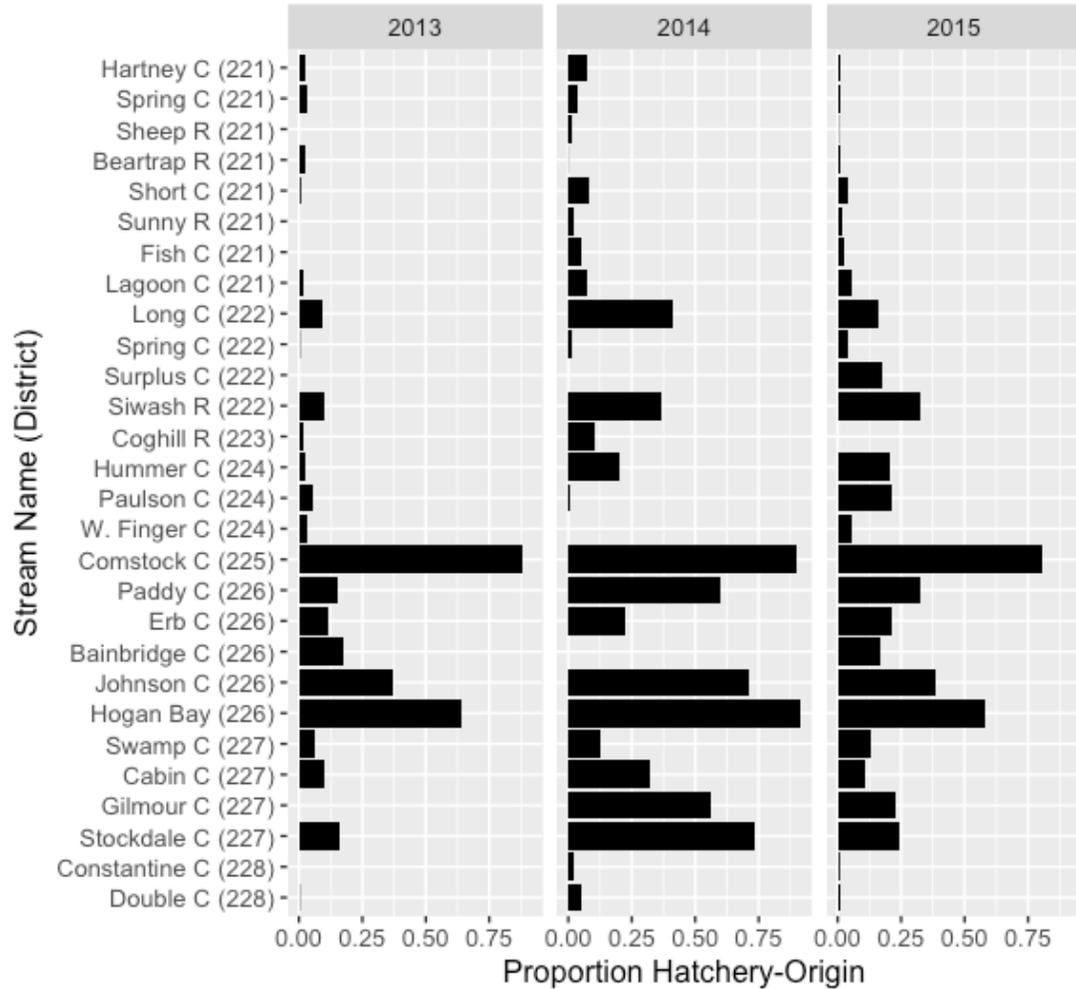
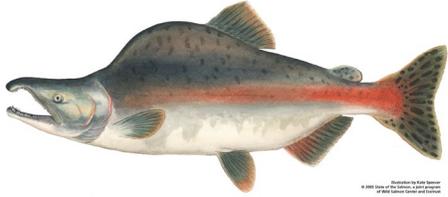
Sampling protocols



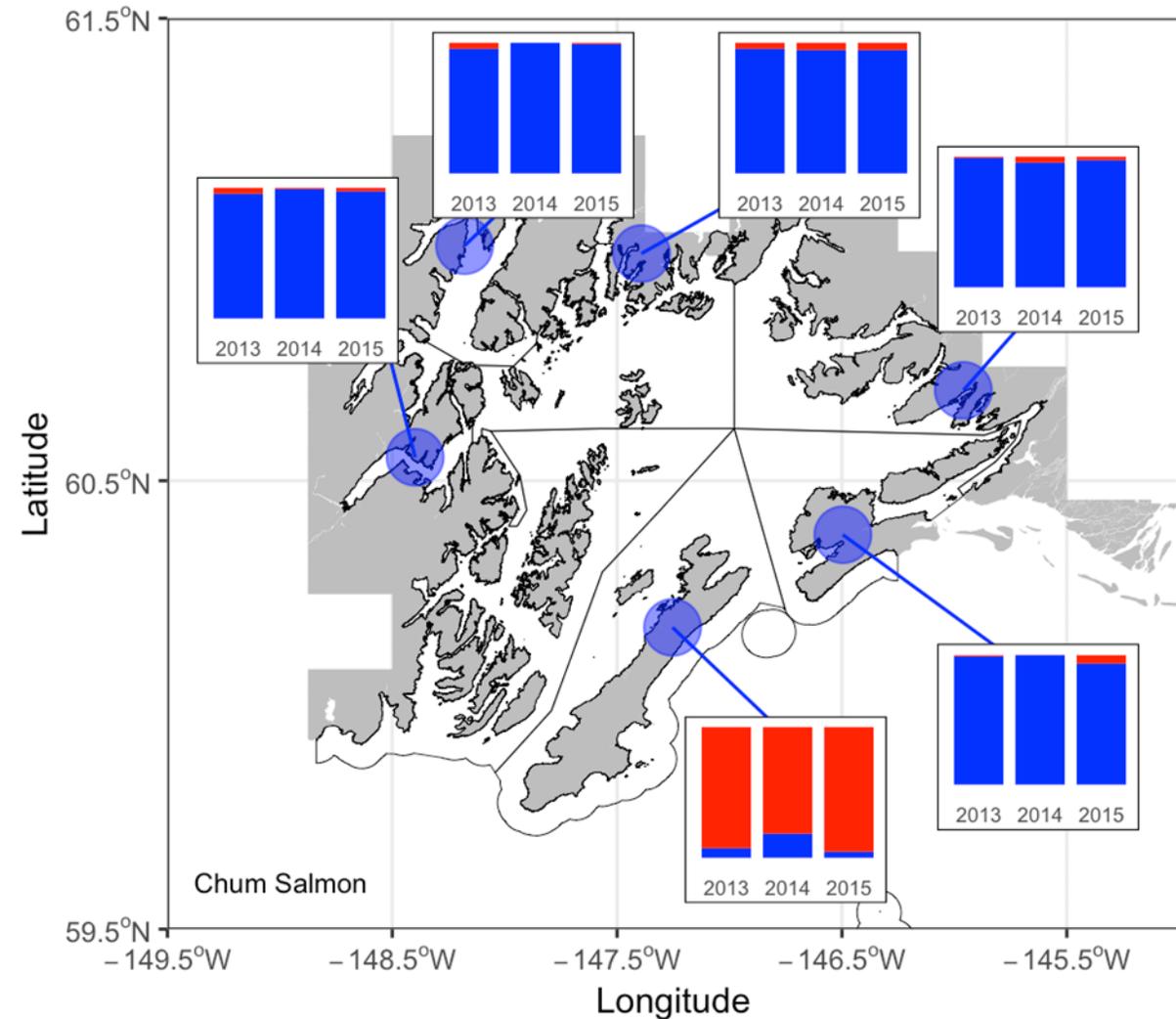
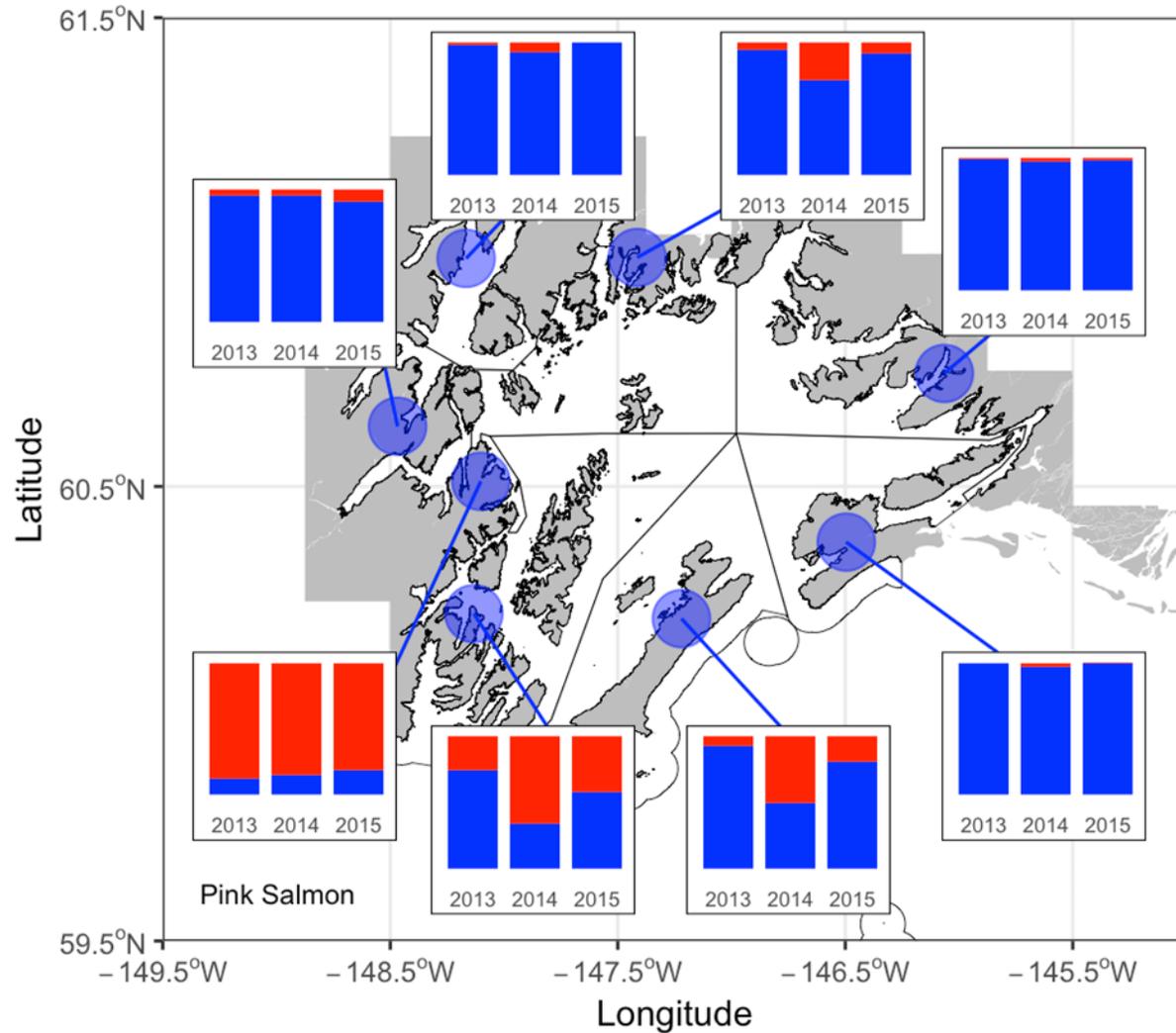




Hatchery fraction by stream



Stream results, district averages



Overall PWS hatchery fractions in spawning streams

Species	2013	2014	2015
Pink	4.4%	14.8%	9.5%
Chum	2.8%	3.2%	3.1%

Key results

- Spatial patterns:
 - Pink
 - Natural-origin fish tend to enter PWS through eastern corridors
 - Eastern district streams tended to have lower hatchery fractions
 - Chum
 - Higher hatchery fraction observed at H3 (west Hinchinbrook Entrance)
 - High hatchery fractions on Montague Island (District 227).
- Temporal patterns:
 - Natural-origin pink salmon tend to return earlier than hatchery-origin individuals
 - Natural-origin chum salmon tend to return later than hatchery-origin individuals
- Context is important!
 - Overall, hatchery fraction in streams is relatively low, but in some streams it is high.
 - Underscores need to look at the ecological implications of N and H crosses.

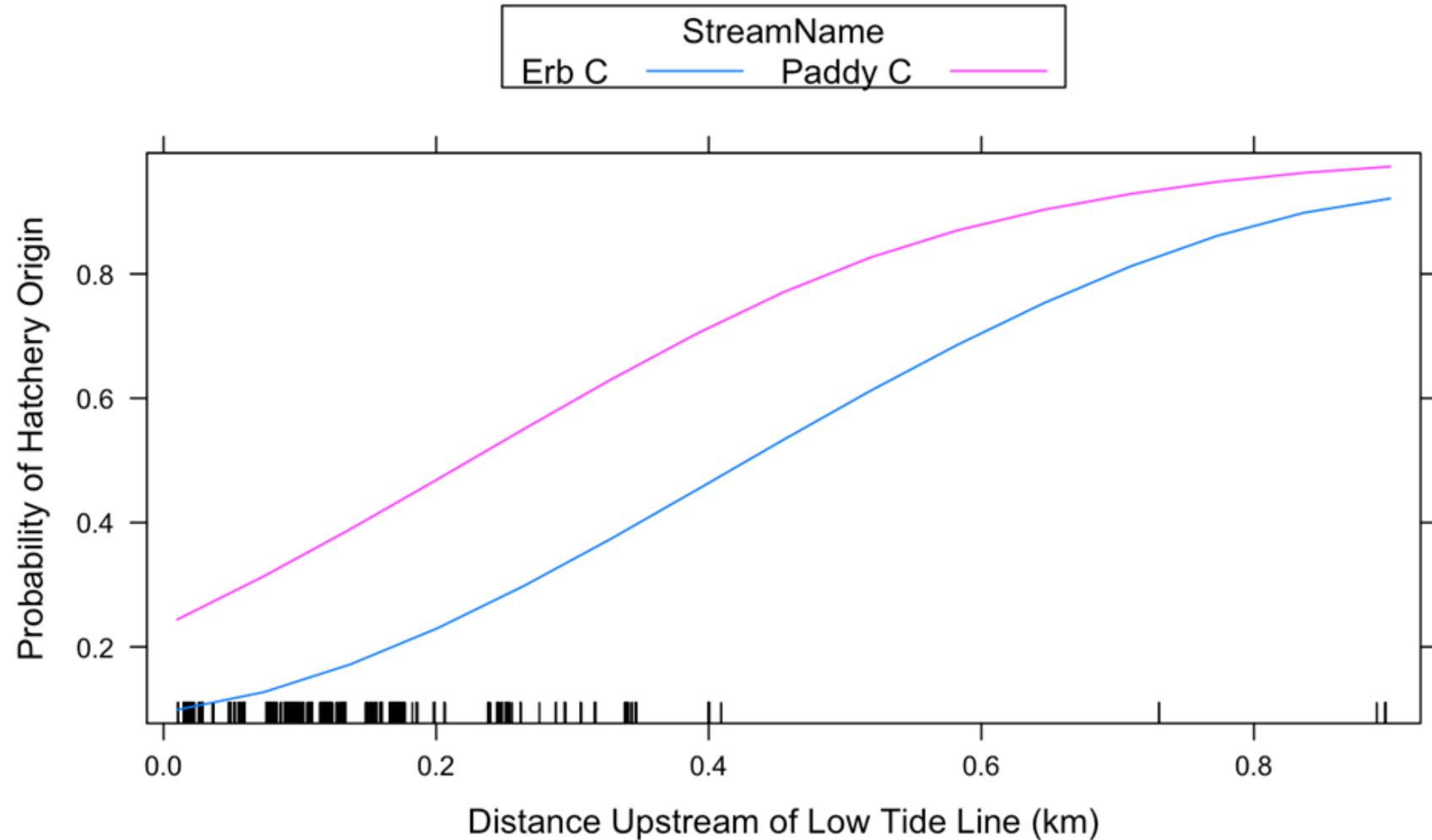
Acknowledgements

- Gratitude toward the PWSSC field crews for dutifully carrying out the field work with great attention to detail. A few in particular stand out: Julia McMahon, Megan Roberts, Neil Durco, and Garrett Dunne.
- Amazing contribution by Brad Reynolds for carrying out all three years of test fishing for this project.
- Special thanks to staff of the ADF&G Cordova Otolith Lab for otolith reading and Rick Busch at Resource Data, Inc. for managing our field data.

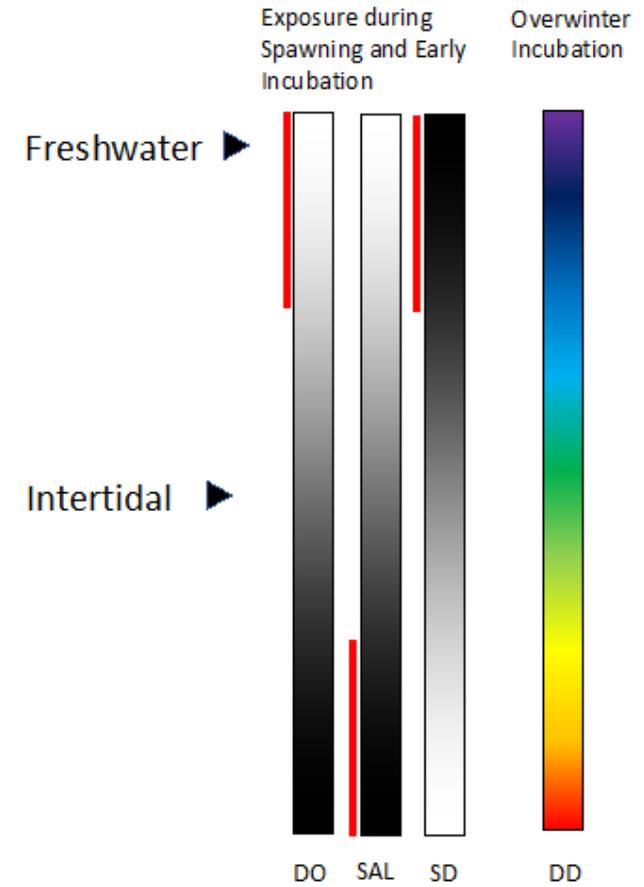
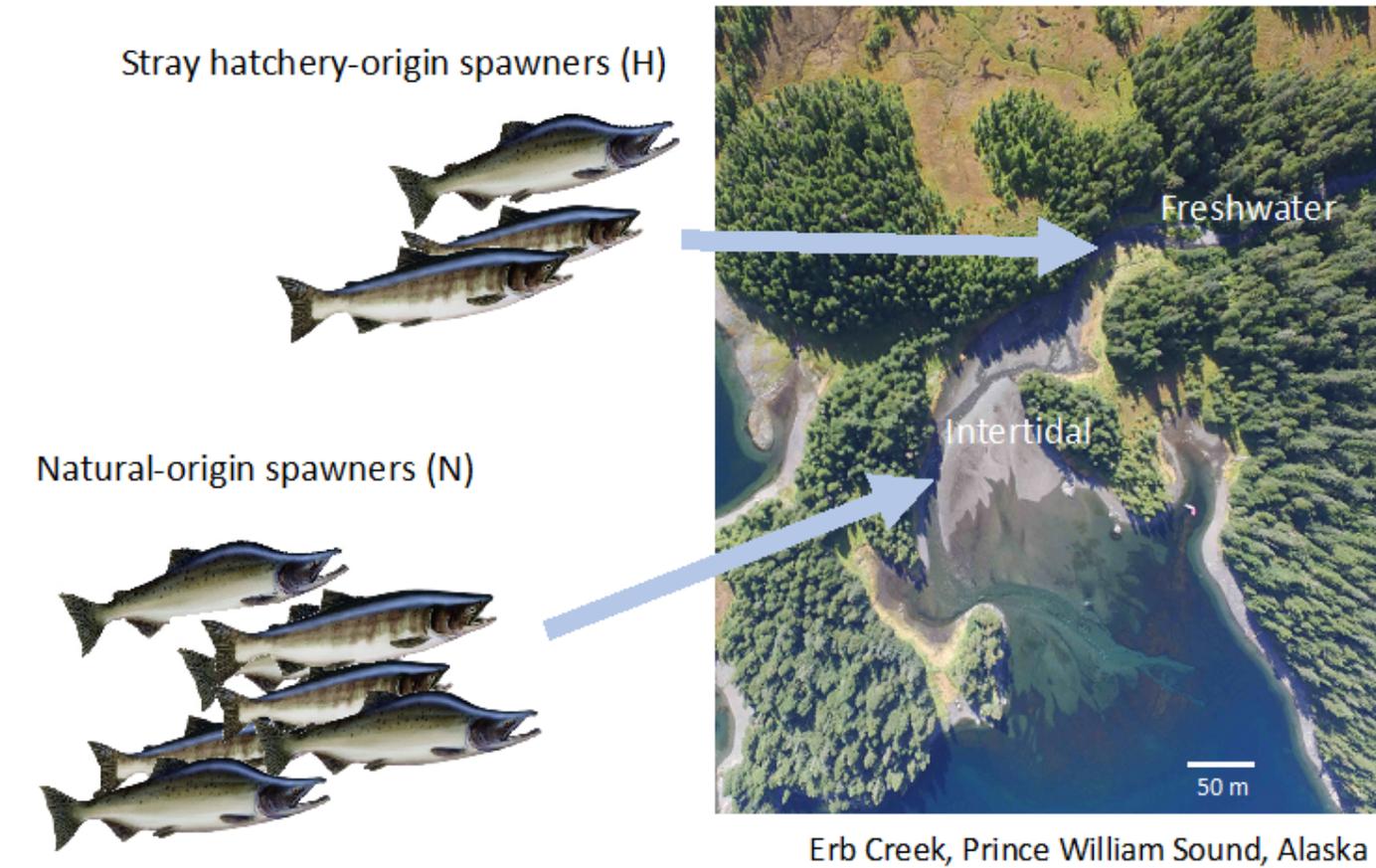
Future

- Despite significant investment in research on this topic, we still lack an understanding of basic ecological processes related to straying and interactions.
- Important themes include:
 - Examination of fitness-related traits (secondary sexual characteristics, stream life, egg retention)
 - Closer examination of freshwater and intertidal spawning, habitat selection
 - Factors affecting homing and straying
- We realize the greatest benefits by industry, management and scientists working together rather than in silos.
- Need to investigate potential changes to management to minimize risk.

Habitat Use Within Stream



Proposed ecological studies



Proposal submitted to:

