*Exxon Valdez* Oil Spill Trustee Council

Long-Term Research and Monitoring, Mariculture, Education and Outreach

Annual Project Reporting Form

**Project Number:** 24220111-I

**Project Title:** Ecological interactions between Pacific herring and Pacific salmon in Prince William Sound

**Principal Investigator(s):** Pete Rand (lead PI) and Rob Campbell (co-PI), Prince William Sound Science Center; Kristen Gorman (co-PI), University of Alaska Fairbanks; and Ron Heintz (co-PI), Sitka Sound Science Center

**Reporting Period:** February 1, 2024 – January 31, 2025

**Submission Date (Due March 1 immediately following the reporting period):** April 30, 2025

**Project Website:** https://gulfwatchalaska.org/

Please check all the boxes that apply to the current reporting period.

☒ **Project progress is on schedule.**

☐ **Project progress is delayed**

☐ **Budget reallocation request.**

☐ **Personnel changes.**

## 1. Summary of Work Performed:

*I. Review of study motivation and scientific objectives following the original proposal's Executive Summary and Project Design including updated references and study details:*

This project seeks to resolve the role pink salmon (*Oncorhynchus gorbuscha*) play in regulating Pacific herring (*Clupea pallasii*, hereafter herring) production in Prince William Sound (PWS), Alaska (Fig. 1), and develop tools for predicting pink salmon survival. In 2008, Deriso et al. (2008) hypothesized that increased production of PWS pink salmon may be constraining the production of herring and limiting recovery of the PWS herring population. Despite dramatic increases in the hatchery production of PWS pink salmon during the early 1980s that has continued since the herring collapse of the mid-1990s (Amoroso et al. 2017), Deriso's hypothesis remains unresolved (Pearson et al. 2012). Currently, PWS is home to the largest pink salmon hatchery program in the world and there is growing interest in the ecological impacts of the large number of these released fish (Brenner et al. 2012, Pearson et al. 2012, Ward et al. 2017, Knudsen et al. 2021). Recently, reports documenting the impacts of increased pink salmon releases on other salmon populations (Connors et al. 2020, Kendall et al. 2020, Oke et al. 2020, see also Rand and Ruggerone 2024) and ecosystem processes (Kaga et al. 2013, Springer and van Vliet 2014, Batten et al. 2018, Ruggerone and Irvine 2018) have motivated the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) to request information on ecological interactions between pink salmon and herring in PWS, in an effort to explain why herring populations have not recovered to pre-spill numbers.

The project described here began in 2023 and is a multi-faceted research effort that builds on past work (including EVOSTC projects), and develops new data specifically aimed at assessing Deriso's hypothesis. We also examine the countervailing effect of age-1+ (juvenile and adult) herring feeding on pink salmon fry. In addition, the project provides for the resumption of a key fisheries survey originally initiated by the Alaska Department of Fish & Game (ADF&G) on juvenile pelagic fishes including pink salmon, the extension of EVOSTC funded data series on age-0 herring body condition, and an analysis of factors affecting pink salmon survival.

Pink salmon and herring have distinct life histories that occasionally overlap in time, space, and for shared dietary resources, producing opportunities for ecological interactions. Pink salmon are semelparous with an obligate two-year life history and a conspicuous odd- and even-year return pattern by adults with larger numbers of pink salmon returning to spawn in odd years to the PWS region. Newly emerged pink salmon fry (larger abundance during even years) forage and grow in nearshore habitats in spring before becoming large enough to emigrate seaward in summer. Adults return in late summer to spawn in natal streams 12-13 months later. In contrast, herring are iteroparous and longer lived. They spawn on beaches in early spring. Herring larvae hatch a few weeks later than pink salmon and are advected into currents until they metamorphose and settle out in nearshore habitats during early summer. They rear in these nursery habitats until age-2 or 3 until sexual maturity (Hay et al. 2008). After spawning, adult herring forage over deeper waters including migrations outside PWS to the Gulf of Alaska (GOA) before shoaling in bays and fjords during winter.

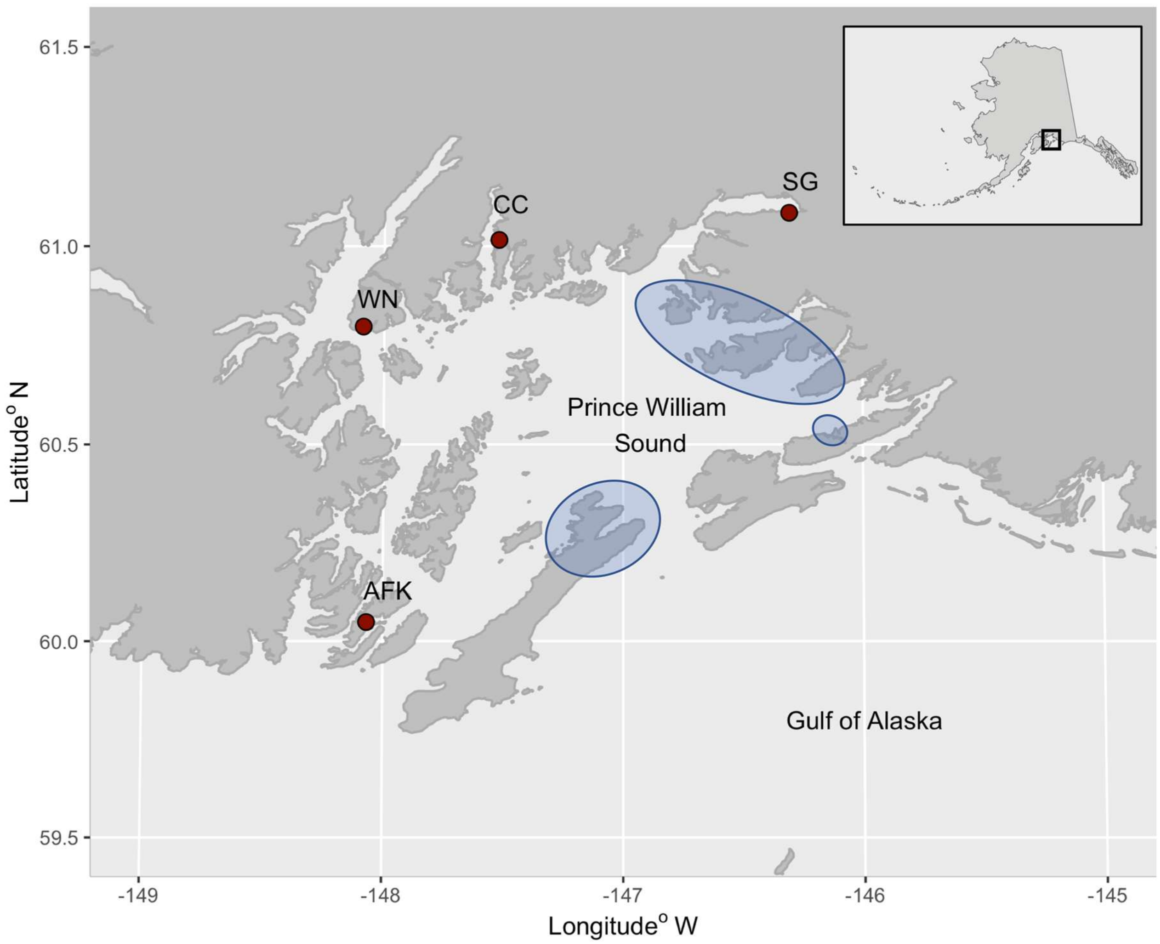


*Figure 1. The Prince William Sound, Alaska study region. The location of pink salmon hatcheries (Solomon Gulch = SG, Cannery Creek = CC, Wally Noerenberg = WN, and Armin F. Koernig = AFK) are noted by the dark red circles. Location of the dominant regions of herring spawn for 2010-2019 are noted by the blue ovals following Pegau et al. (2019).*

We hypothesize that there are three life history periods (and associated habitats) that set the stage for ecological interactions between herring and pink salmon including predation, competition, and disease transmission that may have important recruitment consequences for both species. Chronologically, the first period occurs in spring when newly emerged pink salmon fry occupy nearshore habitats and are vulnerable to predation by age-1+ and older herring. Competition for food may also be important during this period (Cooney et al. 2001). The second stage occurs one to two months later over deeper, more offshore waters, when larger, emigrating juvenile pink salmon may prey upon larval herring originating from major spawning areas (particularly in the well documented spawning area at Hell's Hole in Gravina Bay, eastern PWS, McGowan et al. 2021) and advecting in anticyclonic (i.e., counter clockwise) currents that tend to disperse larvae to the west and south-west regions of PWS (Niebauer et al. 1994). Critically, the co-occurrence of these species during the first and second time periods presents opportunities for disease transmission that can affect each species' survival. The third stage occurs during summer and early fall when age-0 herring rely on prey fields previously exploited by out-migrating juvenile pink salmon. Figure 2 represents a conceptual diagram of these potential ecological interactions.

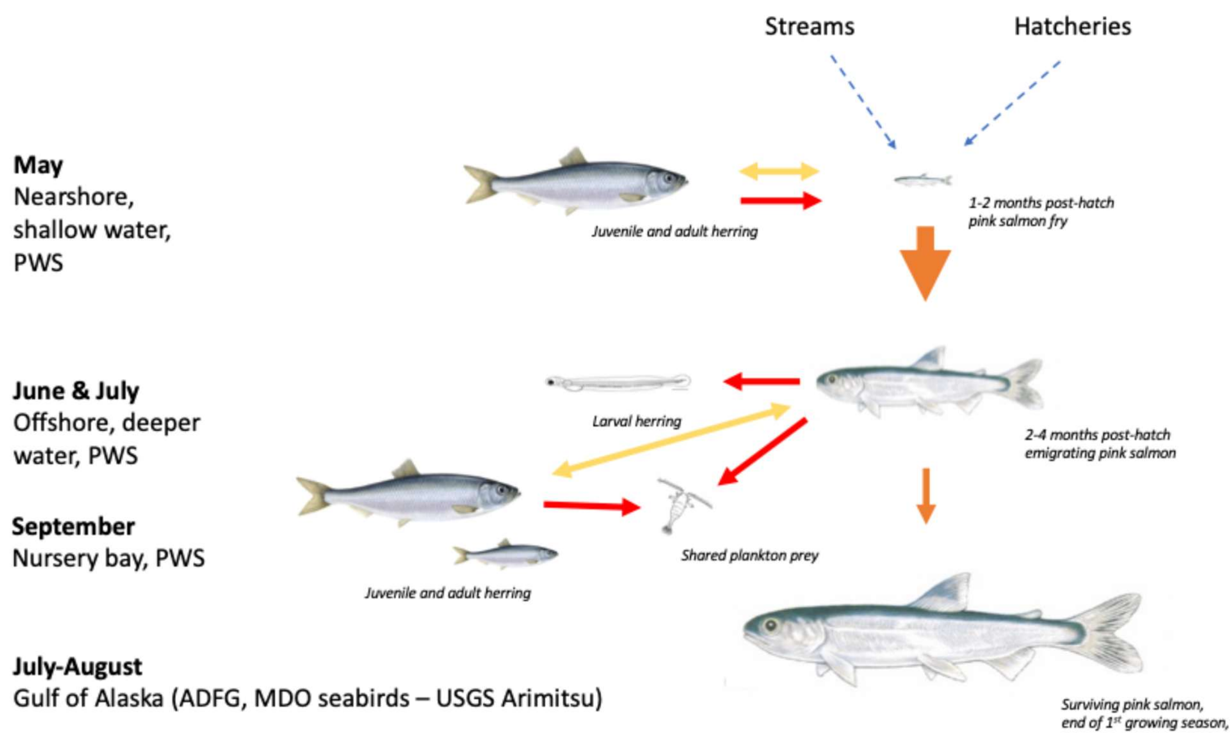


*Figure 2. Illustration of potential interactions between juvenile pink salmon and Pacific herring, highlighting habitat shifts and the survival progression during early life history of pink salmon in Prince William Sound (PWS), Alaska. Potential disease interactions are shown in yellow, predation and competitive processes are shown in red, and survival processes are shown in orange. This study is focused on carrying out field studies and data synthesis to evaluate a suite of hypotheses related to these interactions that may limit herring recruitment and physical and biotic variables controlling survival of pink salmon.*

Our approach to examining ecological interactions between herring and pink salmon combines retrospective analyses, new field and lab data collected over a six-year period, and modeling exercises. Specifically, we will (1) assess the spatial and temporal co-occurrence of both species using retrospective and newly collected data, (2) examine prey availability, (3) conduct dietary analysis using gut contents, DNA barcoding, and bulk carbon and nitrogen stable isotope analysis (SIA) and compound-specific stable isotope analysis (CSIA) techniques, (4) examine the prevalence of a key pathogen, Viral Erythrocytic Necrosis (VEN), in both species, and (5) construct bioenergetic models to estimate larval herring predation by pink salmon. New data will be collected during purse seine (May and September) and surface trawl (June and July) surveys. The surface trawl surveys will resume an existing pink salmon time series initiated by ADF&G, while the combined effort with the purse seine surveys will extend a time series of age-0 herring condition supported by prior EVOSTC programs. By conducting these surveys over multiple years, we will capture replicate odd and even year pink salmon run cycles, as well as (6) examine the influence of environmental covariates on pink salmon survival, and (7) develop a tool for forecasting future pink salmon returns. These latter two analyses will directly aid management of pink salmon populations in PWS. The early years of the study includes resumption of the surface trawl survey and a retrospective analysis of existing data on herring and pink salmon spatial and temporal dynamics aimed at informing our field efforts during later years of the study. The project supports a graduate student (MS program) at the University of Alaska Fairbanks (UAF) in years 2 and 3 (FY23-25). The bioenergetic modeling will be done in collaboration with a research associate to be funded by co-principal investigator (PI) Heintz's portion of the study. The bioenergetic modeling work will begin in FY25 now that we have some preliminary data from FY23-24.

*<u>II. Summary of work performed (FY23-24):</u>*

The focus of our study is in the southwestern region of PWS, an area important as a major migratory corridor for juvenile salmon produced throughout PWS (Willette 1996, Sturdevant et al. 1999, Sturdevant et al. 2001) and also an area thought to serve as important habitat for different life stages of herring (see Bishop and Eiler 2018, Gorman et al. 2018, Bishop and Bernard 2021). Our field work is timed with important ontogenetic stages of these two species, described in detail above (and in our original proposal). During FY24 we conducted five research cruises during May, June (two trawl cruises), July, and September 2024 (Table 1, Fig. 3).

*Table 1. Research cruises for the Salmon-Herring Interactions Project in Prince William Sound, Alaska, including vessel, gear type, month, dates, and participants. The R/V Solstice is owned and operated by Alaska Department of Fish and Game (ADF&G) and the R/V New Wave is owned and operated by Prince William Sound Science Center.*

| Vessel | Gear type | Month | Dates | Participants |
|---|---|---|---|---|
| *Solstice* | Purse seine, nearshore | May | 5/28/24 – 6/3/24 | Gorman, Borsky, ADF&G crew |
| *New Wave* | Surface trawl, offshore | June | 6/11/24 – 6/13/24 | Campbell, Rand, Barnes |
| *New Wave* | Surface trawl, offshore | June | 6/27/24 – 6/28/24 | Campbell, Borsky, Barnes |
| *New Wave* | Surface trawl, offshore | July | 7/8/24 – 7/10/24 | Campbell, Borsky, Barnes |
| *Solstice* | Cast net, nursery bays | Sept | 9/12/24 – 9/16/24 | Gorman, Russin, ADF&G crew |

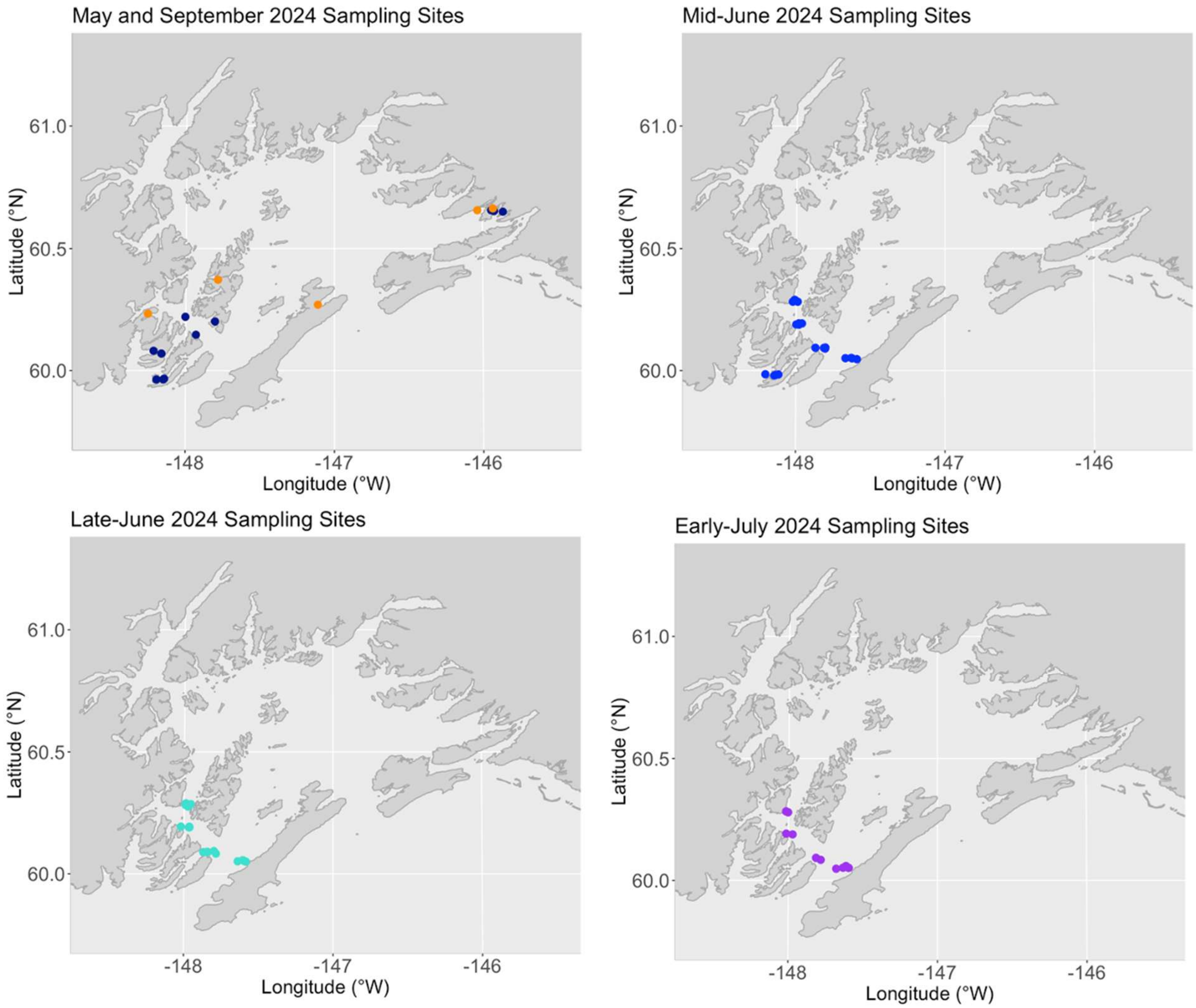


*Figure 3. Herring and salmon sampling sites in Prince William Sound, Alaska during 2024. Purse seine (nearshore, May, dark blue), cast net (nursery bay, Sept, orange), surface trawl (offshore, mid-June, blue; late-June, turquoise; early-July, purple). Trawl cruise sites are for start locations only.*

The following is a list of objectives we outlined in our original proposal with details on progress in addressing these objectives to date:

1. Conduct a retrospective analysis of historical data to examine spatio-temporal overlaps in occurrence by herring and pink salmon in PWS.

*Results.* This work is being conducted as part Alex Borsky's MS thesis program in the College of Fisheries and Ocean Sciences (CFOS, Marine Biology program), UAF under the supervision of co-PI Gorman. PI Rand and co-PI Heintz also serve on Alex's graduate committee at UAF along with Prof. Katrin Iken (EVOSTC nearshore PI). As described in our original proposal, this analysis is the primary focus of the graduate student training and research supported by the project (two years of funding during FY23-25 as part of a three-year MS program).

To provide a summary of the MS graduate student position supported by this project to date, we conducted a national-level search for a student beginning Fall semester 2022 using a position description that was distributed on the Texas A&M Job Board and to colleagues at agencies and universities in Alaska, the Pacific Northwest, and California. We received 29 US applicants and 21 international applicants. After review of all applicants, we interviewed several candidates who made our short list. We originally offered the position to an applicant during Fall 2022, but she decided to join UAF CFOS as a Tamamta Fellow working on a different, more community-focused project. We regrouped and after additional review we offered the position to a strong candidate during Spring semester 2023, but she decided to pursue a graduate project with more of a physical oceanography focus. At this point, our first field season in 2023 was beginning, and we needed to put this search on hold until the Fall semester 2023. During this time, we connected with Alex who had originally applied to our position announcement and made our short list. He was now located in Fairbanks due to his summer employment with UAF. Thus, Alex officially started his program in Marine Biology at UAF CFOS in January 2024. Therefore, it took us just over a year (FY22-23) to recruit and onboard a student for this project, which is to be expected given that students must be certain that they want to relocate to Alaska for graduate school.

Over the last three semesters, Alex has made excellent progress in his graduate program. He has completed all his core coursework (Biological Oceanography, Marine Biology, Physiology of Marine Organisms) and field course requirements, as well as some electives including Proposal Writing, Statistical Computing in R, Physiological Ecology of Fishes, Data Analysis in Community Ecology, and an independent study – Introduction to Vector-Autoregressive Spatio-Temporal (VAST) Modeling earning a top GPA. Alex produced a thesis proposal for his graduate study plan over the last year and will be publicly presenting this proposal in June 2025 followed by his comprehensive exam to advance to candidacy in the MS Marine Biology program. Notably, this semester (Spring 2025), Alex was awarded an Oil Spill Recovery Institute, Graduate Research Fellowship ($60,000 over two years), as well as a $10,000 award from UAF's Northern Gulf of Alaska Applied Research Award. These additional funds are critical to the success of Alex's MS program, which is anticipated to take three years (completion Fall 2026 or Spring 2027), especially as it was unclear for much of FY24 whether we would be receiving EVOSTC funding for Year 3 that supported Alex's second year of his program. In addition to the two years of graduate tuition and stipend support, EVOSTC funding supported Alex's attendance at Alaska Marine Science Symposium in 2024 and 2025 including a poster presentation (see Fig. 4 below), as well as Alex's participation in three of our five research cruises in FY24. Importantly, Alex led our group's data management effort in FY24 that included the development of a comprehensive Access database to organize and archive all the various data streams produced by the project. We are now up to date in submitting the FY23 and currently available FY24 data to Research Workspace based on this effort.

During this academic year, Gorman and Borsky have worked together to identify and summarize historical catch data for PWS herring and salmon, currently focusing on early life history stages. Notable datasets include those from the National Oceanic and Atmospheric Administration's (NOAA's) Nearshore Fish Atlas of Alaska for PWS pink salmon (2006, 2007, 2012, 2013, 2014), U. S. Geological Survey's (USGS's) Alaska Forage Fish Database for PWS herring (1954, 1959, 1962, 1970, 1984, 1990, 1993, 1995, 1996, 2001, 2003, 2004, 2005, 2006, 2007, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2021, 2023), ADF&G's PWS seine survey data (2002-2010) and trawl survey data (2011-2015) for herring and salmon, PWS herring aerial survey data (2010-2024), Willette EVOSTC Sound Ecosystem Assessment (SEA) data (1994-1996) for herring and salmon, and Global Ocean Systems Dynamics (GLOBEC) salmon data (1998, 2001, 2002, 2003). Other data may be available, we are still conducting a comprehensive literature review to identify additional datasets. As noted in our proposal, we have initially focused on developing preliminary maps of spatial and temporal overlap in the life history-specific distributions of herring and pink salmon based on our currently identified datasets, which was the focus of Borsky's AMSS poster (Fig. 4). We are now working to quantitatively explore distributional overlaps between herring and pink salmon in PWS using the VAST modeling package described by Thorson (2019). Alex's Northern GOA Applied Research Award funds will allow him an opportunity over the next year to attend a VAST modeling workshop or work with VAST experts in Juneau (UAF) or Seattle (NOAA). As noted in our proposal, results from our VAST modeling exercises may lead to some adjustments in our field study sampling, we anticipate the addition of any potential new sites outside the southwestern region of PWS to be included during the second half of our study (years 4-6).

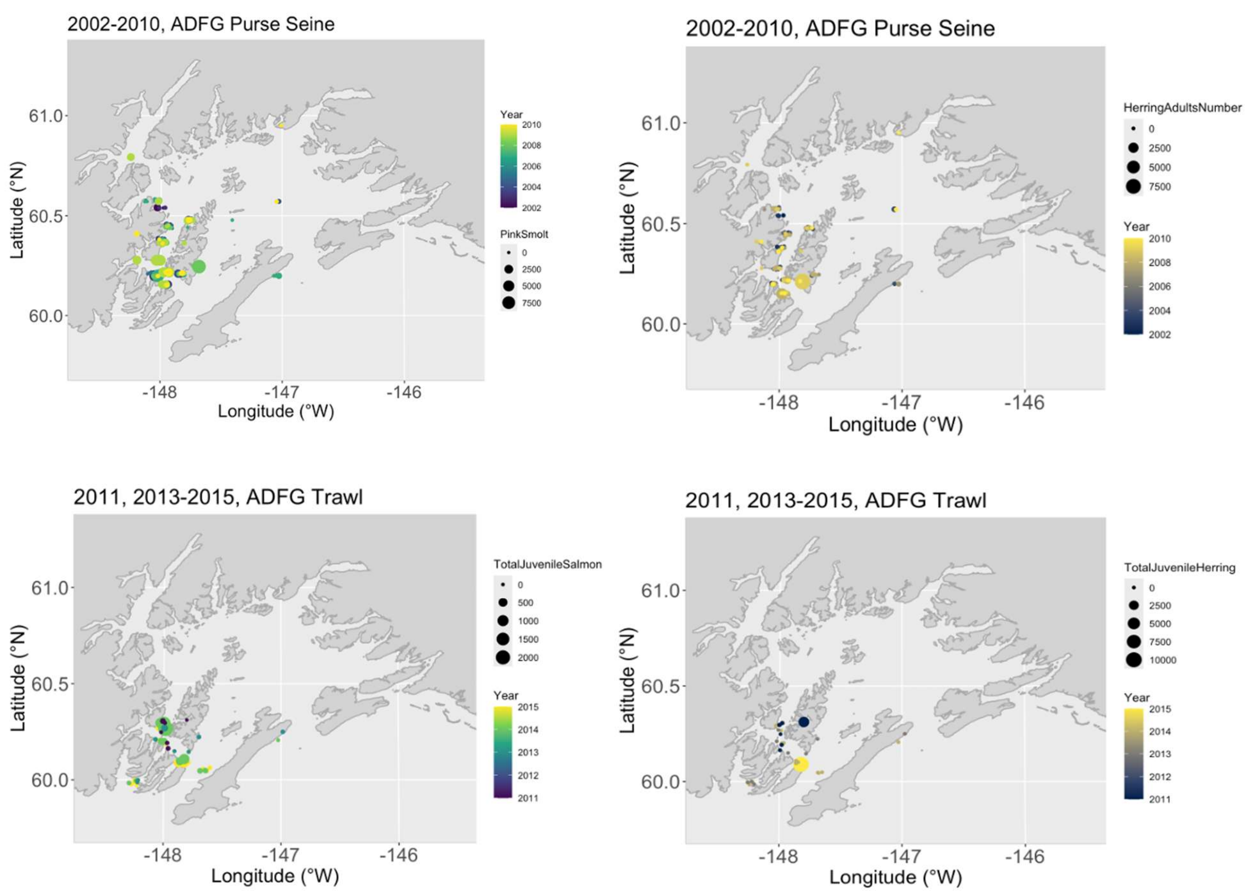


*Figure 4. Spatial and temporal variability in pink salmon (left panels) and herring (right panels) catch data from Alaska Department of Fish and Game (ADFG) purse seine surveys (upper panel, 2002-2010) and trawl surveys (lower panel, 2011-2015). Both surveys indicate distributional overlaps in pink salmon and herring sampled in the southwestern region of Prince William Sound, Alaska.*

2. Conduct field sampling to determine current probabilities of co-occurrence of herring and juvenile pink salmon in near-shore and off-shore habitats of PWS. These field data will be compared with the retrospective analysis we develop in Objective 1.

*Results.* This work is ongoing; it is expected that MS student Borsky will incorporate new field data from years 1-3 in his study prior to defending his MS thesis in Fall 2026. Below we have plotted all sets from May-July in 2023 and 2024, September data were not included as at this point in the season salmon fry have already outmigrated from the PWS region. We note catches included co-occurring herring and salmon. Our available data indicate that 44% of our sets in May – July include the co-occurrence of herring and salmon (Fig. 5). As we work to apply a spatial model to these data we will be able to determine probabilities of co-occurrence to compare with our retrospective analysis results.

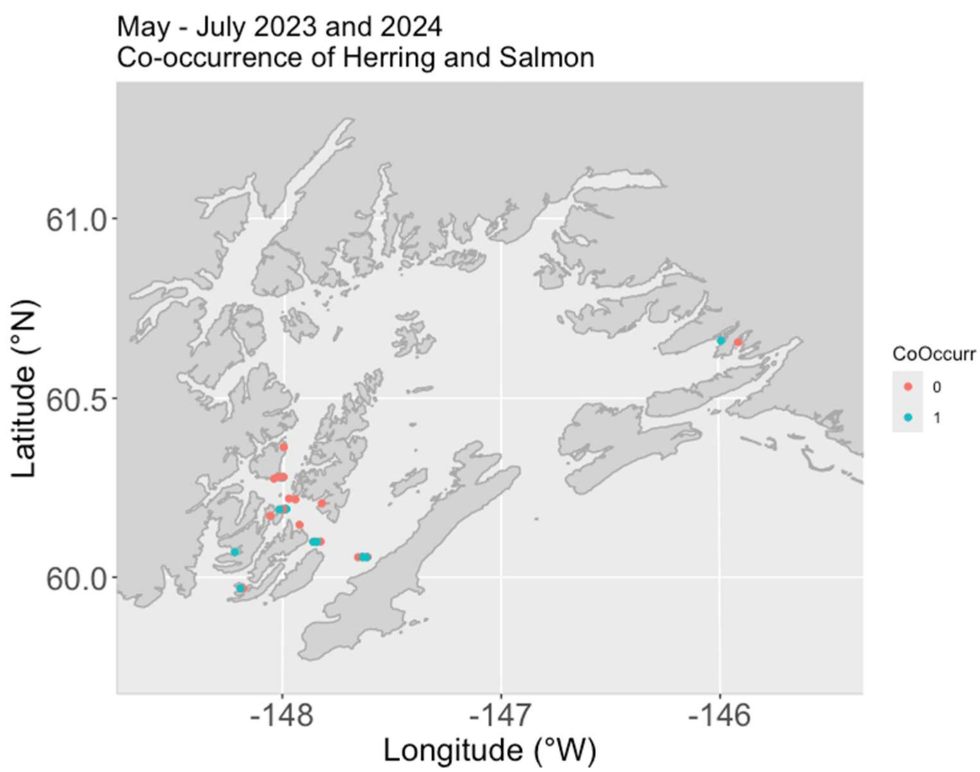


*Figure 5. Co-occurrence of herring (adults or larvae) and salmon (fry) in sets conducted May – July 2023 and 2024 in Prince William Sound, Alaska. Green locations indicate co-occurrence, pink locations are sets that did not include both species.*

3. Assess ecological interactions between herring and pink salmon that occur in both near-shore and off-shore habitats:
   a. Near-shore habitats (purse seine/cast net sampling in May and September)
      i. Determine whether herring (age-1+) consume pink salmon fry in May using stomach content analysis, DNA barcoding, and bulk SIA and CSIA. *Predation hypothesis – herring forage on pink salmon*

*Results.* We have not observed any prey fishes in the diets of herring captured during our late May cruises in 2023 (n = 72 examined stomachs) and 2024 (n = 27 examined stomachs). We are currently working on microscopically examining additional herring stomachs from 2024 to increase the sample size to be more comparable to our effort in 2023. Diets of herring have been composed mostly of copepods, euphausiids, and pteropods. DNA meta-barcoding (NOAA lab) has revealed a low prevalence of salmon DNA in herring captured in 2023 (4 out of a total of 52 individuals, or 7.7%) suggesting that there may be cases where herring are feeding on young salmon fry. We are awaiting meta-barcoding results from herring collected in 2024. SIA results suggest that adult herring and salmon fry are isotopically distinct, suggesting little reliance by adult herring on young salmon (see Fig. 6).

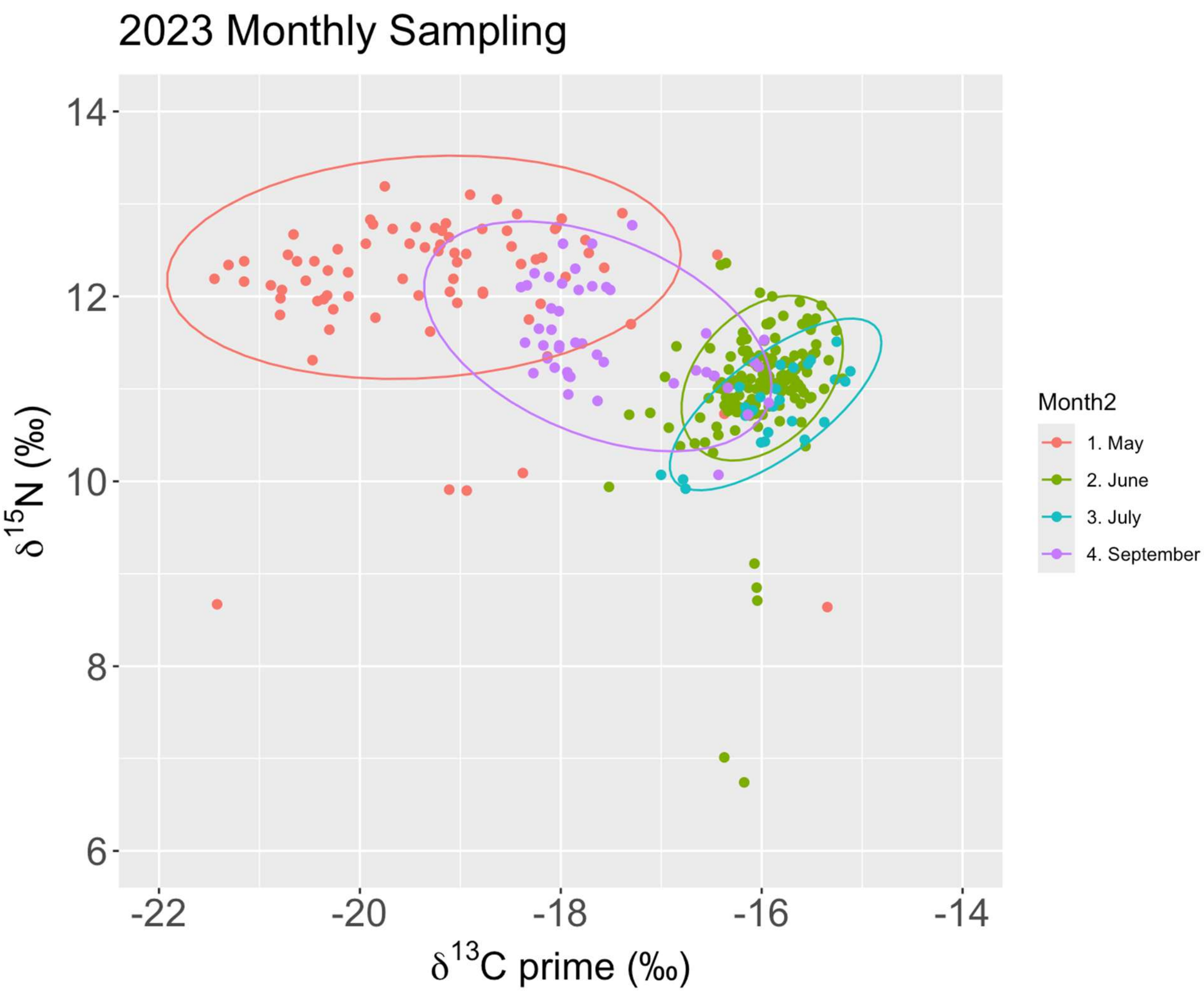


*Figure 6. Carbon and nitrogen stable isotope variability of adult herring (sampled in May 2023), outmigrating salmon fry (sampled in June and July 2023), and age-0 herring (sampled in September 2023). Ellipses represent 95% confidence levels.*

ii. Determine pink salmon fry and age-1+ herring diet composition in May using stomach content analysis, DNA barcoding, bulk SIA and CSIA, as well as determine prey availability using zooplankton nets during purse seine sampling. *Competition hypothesis*

*Results.* We did not capture any juvenile salmon in May 2023 by purse seine. We did collect juvenile salmon in eastern PWS in May 2024, but we have not yet examined their diet or isotopic composition. As noted above, diets of herring have been composed mostly of copepods, euphausiids, and pteropods. We have obtained SIA data for herring collected in May 2023 and 2024: these data are described in more detail below. We have completed counts by taxonomic group for all the plankton samples collected in May 2023 and 2024 (referred to in more detail below).

For our upcoming field season, we plan to continue purse seining our study sites in May and will augment sampling with a beach seine to allow us to sample closer to shore in shallower water. We suspect salmon fry are residing in shallow habitat in late May, and we may be able to more effectively sample them with a beach seine deployed off a skiff and pulled toward the shore. We intend to process our beach seine catches using the same protocols as we have been using in our purse seine catches.

iii. Quantify the prevalence of VEN for both species in May and age-0 herring in September. Disease hypothesis. Note: VEN analysis conducted by the disease program (project 24120111-C, PI Hershberger).

*Results.* We found 4 out of a total of 262 herring captured in May 2023 to be VEN positive (prevalence rate of 1.5%). Prevalence of VEN among juvenile herring captured in September 2023 was 7 out of a total 176 (4.4%). Prevalence rate in herring was markedly higher in May 2024 (63 out of a total of 177, or 35.6%), with particularly high rates observed at Fox Farm (50 out of 60, or 83.3%) which is located near the Armin F. Koernig (AFK) hatchery (Fig. 1), but also moderate prevalence at Hogg Bay and Simpson Bay. A total of 4 individuals were VEN positive out of a total of 186 individual juvenile herring (or 2.2%) in September 2024. VEN results were generated by the USGS Marrowstone lab (P. Hershberger, unpubl. data). The interannual and seasonal variability in VEN prevalence we have detected thus far is important to note as it suggests VEN dynamics are not static and vary across years, seasons, and locations.

iv. Determine age-0 herring diet composition and body condition in September using stomach content analysis, DNA barcoding, and bulk SIA and CSIA to determine the degree of dietary overlap with juvenile pink salmon diets measured in May, June, and July (see 3a, ii and 3b, ii). *Competition hypothesis*

*Results.* We have quantified diet composition for age-0 herring captured in September 2023 and 2024. The diets of juvenile herring in September 2023 consisted mostly of small copepods, while the diets observed in September 2024 were more diverse, with dominant prey types including small copepods, larvaceans, and pteropods. It is interesting to note that this diet variability coincides with odd (low) - even (high) year outmigration patterns by pink salmon where during 2024 diets were more diverse potentially reflecting greater competition and possible prey switching. We will compare diet results with zooplankton surveys to assess prey availability relative to herring diet to better understand the possibility of density-induced prey switching by herring. SIA data suggest that age-0 herring collected in September appear somewhat isotopically segregated between years (Fig. 7) with the 2024 age-0 herring showing more variation in carbon values perhaps reflective of their broader diet in 2024. We are in the process of producing energy estimates (bomb calorimetry and C/N ratios) for age-0 herring and will evaluate how energy density varies between years in association with outmigration abundance of salmon as past work has shown that energy and growth appear to be lower in years of high salmon outmigration in PWS (Gorman et al. 2018, Arimitsu et al. 2021). We had hoped to make more progress on this in fall and winter (24/25), but with the delay in receiving Year 3 funding from EVOSTC through NOAA we were unable to hire an additional student assistant to help with this analysis. We have someone on board now and we expect the 2023 and 2024 September age-0 herring energy data will be available by June 2025.

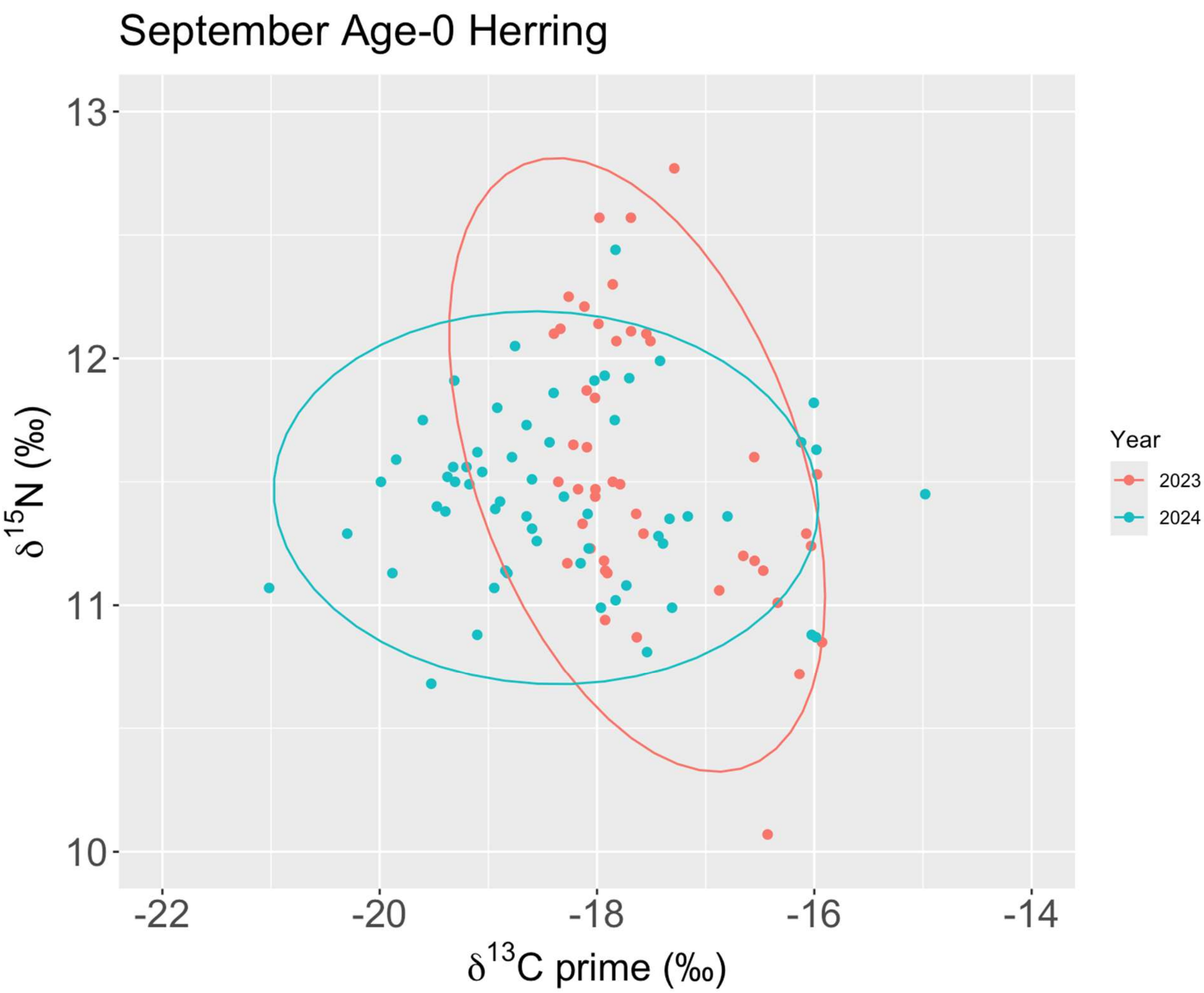


*Figure 7. Carbon and nitrogen stable isotope variability of age-0 herring sampled in September 2023 (pink) and 2024 (green). Ellipses represent 95% confidence levels.*

We are evaluating bulk and compound-specific isotopic variability between adult herring, salmon fry, and age-0 herring (Figs. 6, 7, 8). We have a complete dataset for 2023. Data suggest that adult herring are isotopically distinct from salmon fry, perhaps more support for less dietary reliance on salmon fry by adult herring in PWS (Fig. 6). Salmon fry sampled in June and July mainly overlapped in isotopic values, however sample sizes were smaller for July (Fig. 6). Some age-0 herring overlapped in isotopic values with salmon fry, while some were more isotopically distinct (Fig. 6). We will evaluate spatial variability in these isotope data. We know from past studies that age-0 herring collected from northeastern PWS have different δ$^{13}$C values than those from elsewhere in PWS (Gorman et al. 2018). CSIA data indicate that species and age classes perhaps are relying on different sources of primary productivity (Fig. 8), while juvenile herring may rely on higher trophic level prey based on non-essentially amino acids such as aspartic acid and glutamic acid (Fig. 9, note: leucine is an essential amino acid, see also Fig. 6). We recognize that the CSIA data are based on very small sample sizes at this point so results should be considered preliminary, but we will continue to explore these ideas with further analysis as justified.

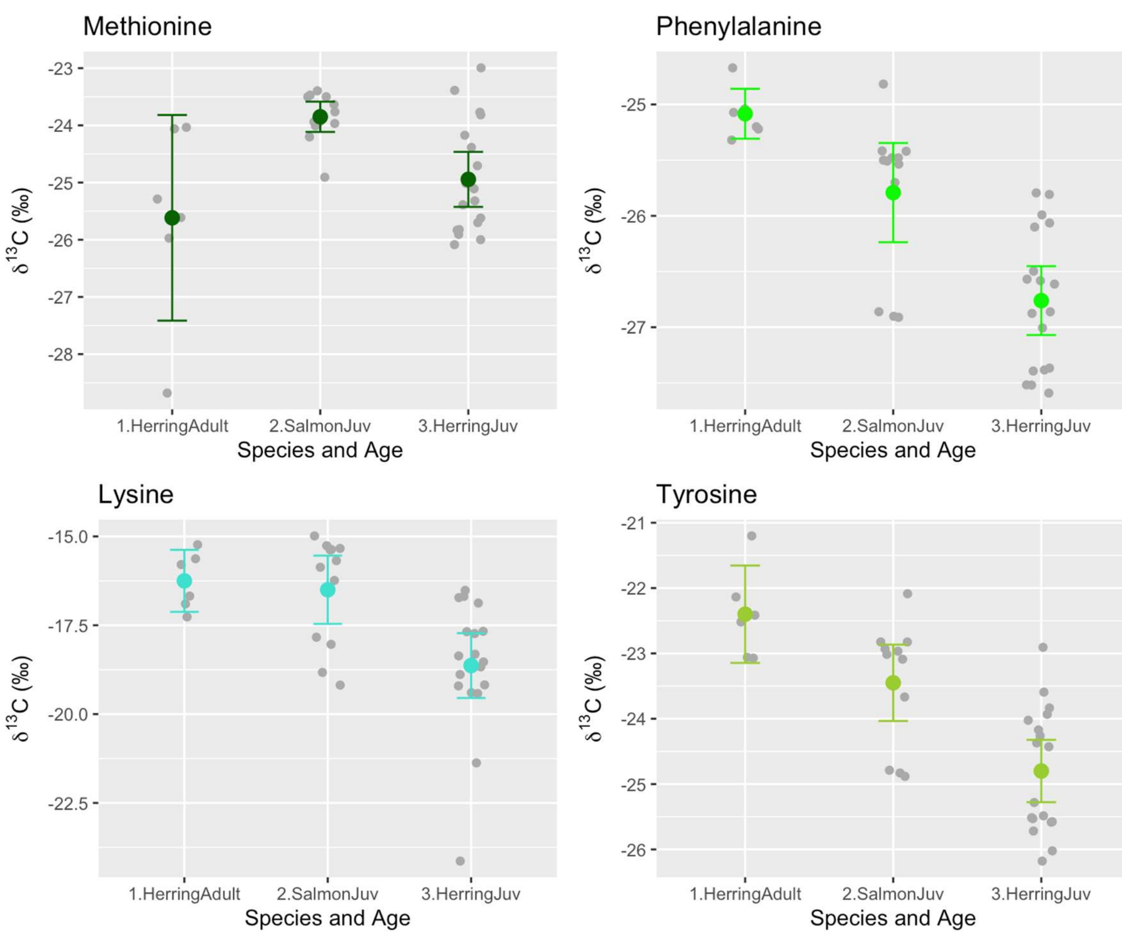


*Figure 8. Compound-specific carbon isotope variability of adult herring, outmigrating salmon fry, and age-0 herring sampled throughout the summer of 2023. All compounds suggest some discrimination among species or age classes.*

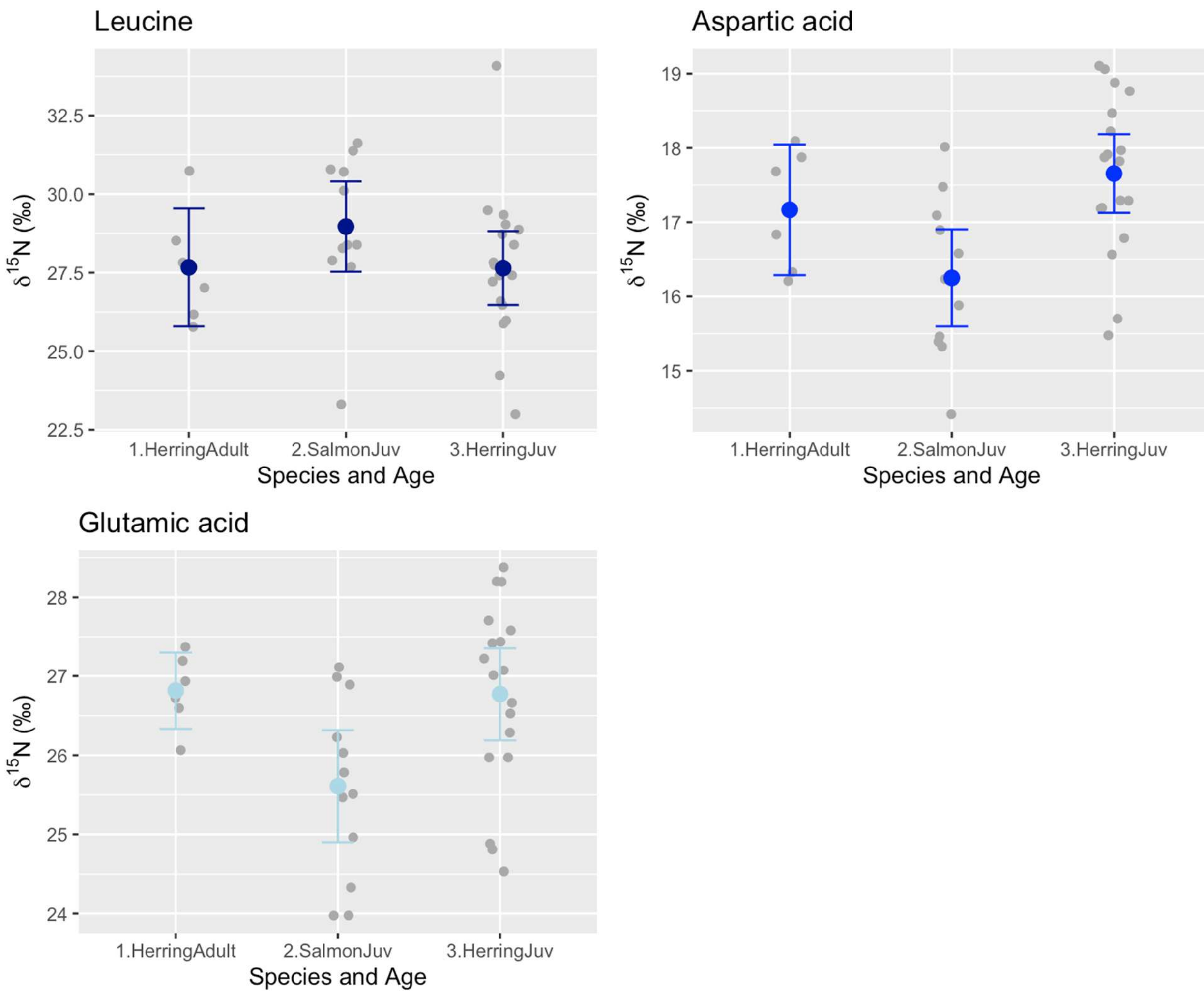


*Figure 9. Compound-specific nitrogen isotope variability of adult herring, outmigrating salmon fry, and age-0 herring sampled throughout the summer of 2023. Both aspartic acid and glutamic acid suggest juvenile herring sampled in September may be foraging at a higher trophic level than juvenile salmon sampled in June and July. Note: leucine is an essential amino acid, therefore it is not surprising that there are no differences among species or age classes.*

b. Off-shore habitats (trawl sampling in June and July)
   i. Determine whether larger, emigrating pink salmon fry feed on larval herring in June and July using stomach content analysis, DNA barcoding, and bulk SIA and CSIA. *Predation hypothesis – pink salmon forage on herring*

*Results.* We observed larval fishes in diets of juvenile salmon in early and late June surveys in 2024 but not in 2023, likely owing in part to an earlier-timed cruise in 2024 (we had a late start to surface trawl sampling in 2023, late June, due to the delayed delivery of the surface trawl to Cordova). We estimated mean number of herring larvae per pink salmon stomach from 0.2 to 1.6 in early June (up to 7 individual herring larvae observed in a single stomach, Table 2). Prevalence of herring larvae in pink salmon stomachs declined by late June and we observed no larval herring in their diet in July (Table 2). We note herring are metamorphosing by late June therefore they may become less available as prey to salmon fry later in the season when they are settling into nearshore habitats.

*Table 2. Presence of herring and other larval fishes in diets of pink salmon collected in early and late June 2024. No larval fishes were observed in diets of pink salmon during the July cruise, 2024.*

| Cruise | Trawl site | N | Mean number of herring larvae/pink salmon stomach | Mean number of unidentified fish larvae/pink salmon stomach |
|---|---|---|---|---|
| Early June | Sleepy Bay | 17 | 0.9 | 4.4 |
| | Prince of Wales | 10 | 0.6 | 2.0 |
| | Chenega Island | 9 | 1.6 | 1.2 |
| | Fox Farm | 9 | 0.2 | 0.2 |
| Late June | Sleepy Bay | 10 | 0.1 | 0.9 |
| | Prince of Wales | 10 | 0.7 | 0.6 |
| | Chenega Island | 7 | 0.0 | 0.1 |
| | Point Brazil | 10 | 0.3 | 1.5 |

DNA meta-barcoding of diet contents of juvenile salmon collected in 2023 revealed a moderate prevalence of herring DNA (7 out of 20 individuals, or 35%). However, we did not observe fish larvae in the stomachs of pink salmon we examined in 2023. We are awaiting results of DNA metabarcoding for pink salmon collected in 2024. We anticipate this DNA approach may provide a more reliable measure of the importance of herring larvae in the diets of these juvenile pink salmon due to the difficulty of identifying all larvae to species given the degraded and fragmented state of a majority of the consumed fish larvae.

Stable isotope values of wild and hatchery salmon fry suggest that wild fish are consuming perhaps a more variable diet, and that hatchery fish are likely reflecting a less variable diet they were fed while in captivity (Fig. 10).

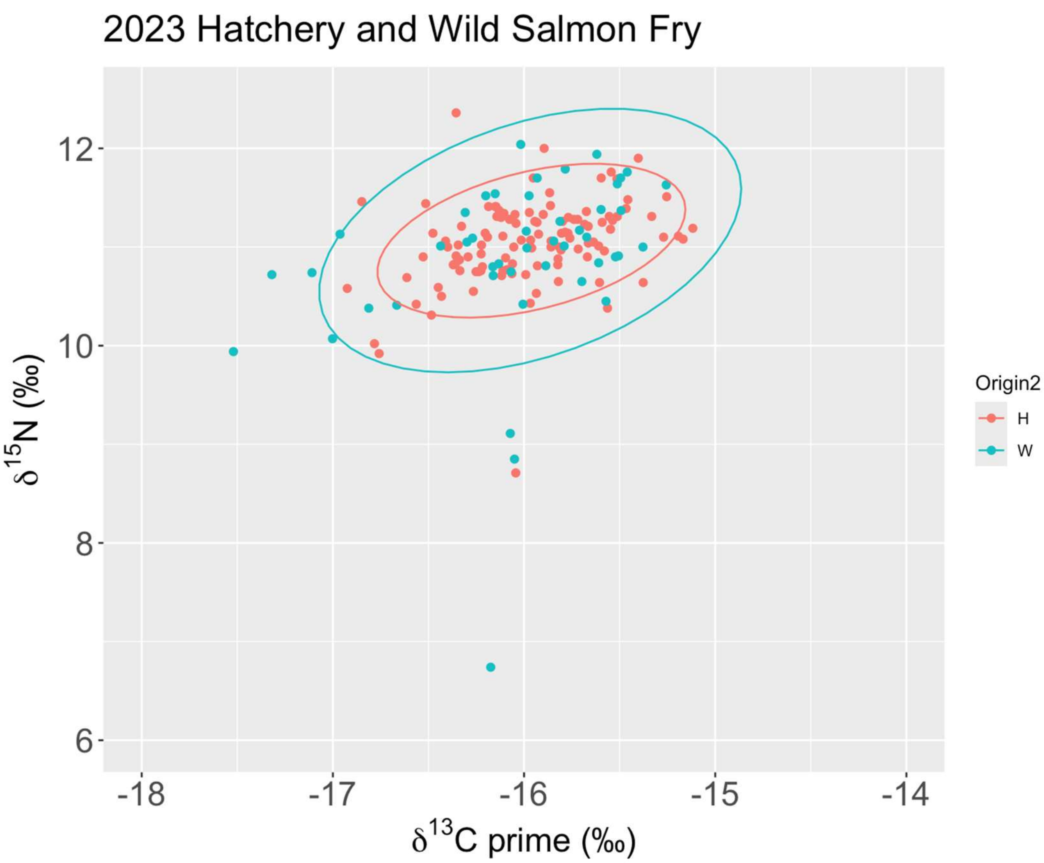


*Figure 10. Carbon and nitrogen stable isotope variability of outmigrating hatchery and wild salmon fry collected during June and July 2023. Ellipses represent 95% confidence levels.*

ii. Determine whether pink salmon fry in June and July consume similar prey as age-0 herring in September (see Objective 3a, iv) using stomach content analysis, DNA barcoding, and bulk SIA and CSIA. Also, determine prey availability using zooplankton nets during trawl sampling. *Competition hypothesis*

*Results.* We have completed counts of diet composition of juvenile pink salmon and age-0 herring collected in 2023 and 2024. The dominant prey item was small copepods for both species, but diet composition appeared to vary markedly by site. We present results for 2024 for pink salmon (Fig. 11). Although copepods were generally the most common prey item, the contribution of larger size prey items (e.g., euphausiids and larval fishes) to total mass or energy is likely to be much more important. Our bioenergetic model synthesis will be able to better quantify the relative contribution of the different prey items to the overall energy budget of the consumers in our study. We further refer to Fig. 6 above showing some overlap in stable isotope values of salmon fry and age-0 herring, which may be driven by site dynamics.

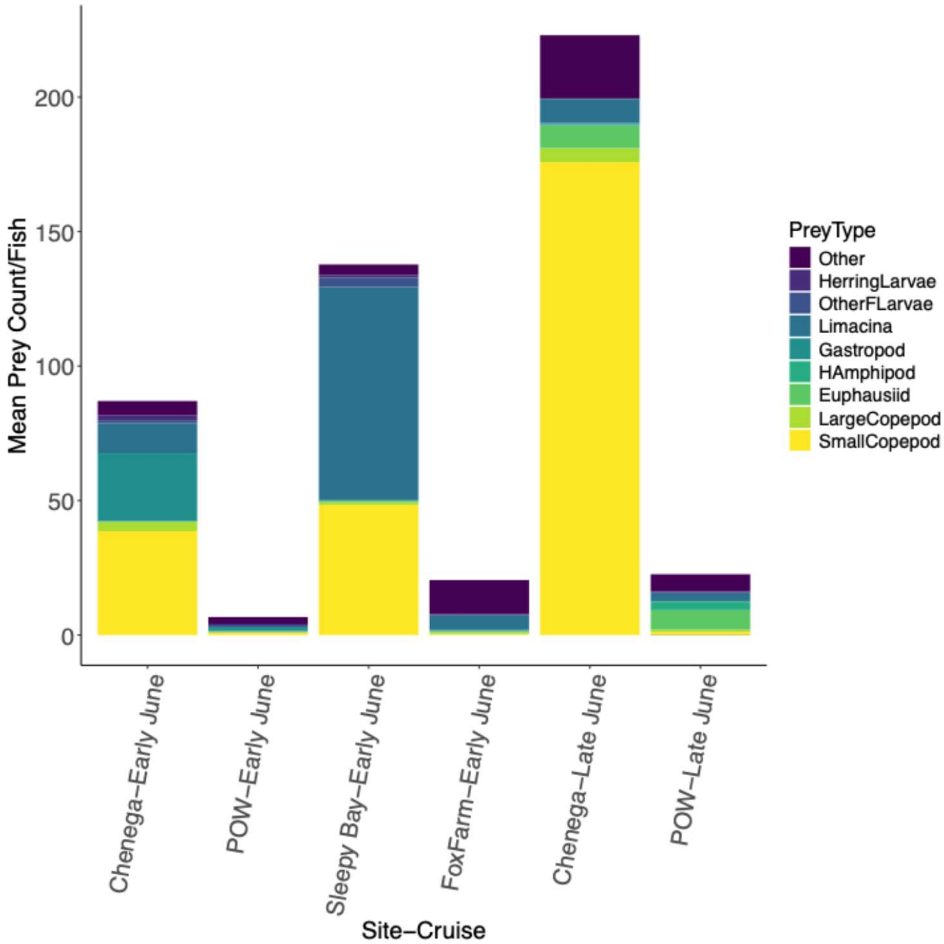


*Figure 11. Composition of prey items in diets of juvenile pink salmon captured in 2024. Prince of Wales = POW.*

We have fully worked up the plankton collections for all the cruises completed to date in 2023 and 2024. We quantified counts in 17 separate taxonomic categories. We apply the same categories that were used in earlier GLOBEC studies to allow us to make comparisons to earlier study results; however, in this study we are discriminating herring larvae from other fish larvae where possible (Fig. 12). We present here results from bongo plankton collections (in densities, log number/$m^3$ for two different mesh sizes, 333 and 500 µm) from our June and July surveys (Fig. 13). Densities of herring larvae, which will be a critical metric in our bioenergetic model simulations, ranged from 0 to >0.15 individuals per $m^3$ (Fig. 14). As with the prevalence of herring larvae in the juvenile salmon diet data reported above, the prevalence of herring larva in the water column was markedly higher in the early June survey compared to the late June survey. We observed no herring larvae in the bongo sampling in July.


May 2023, Site 9, 500 um Bongo

*Figure 12. Example of preserved herring larvae collected in May 2023 using a bongo plankton net.*

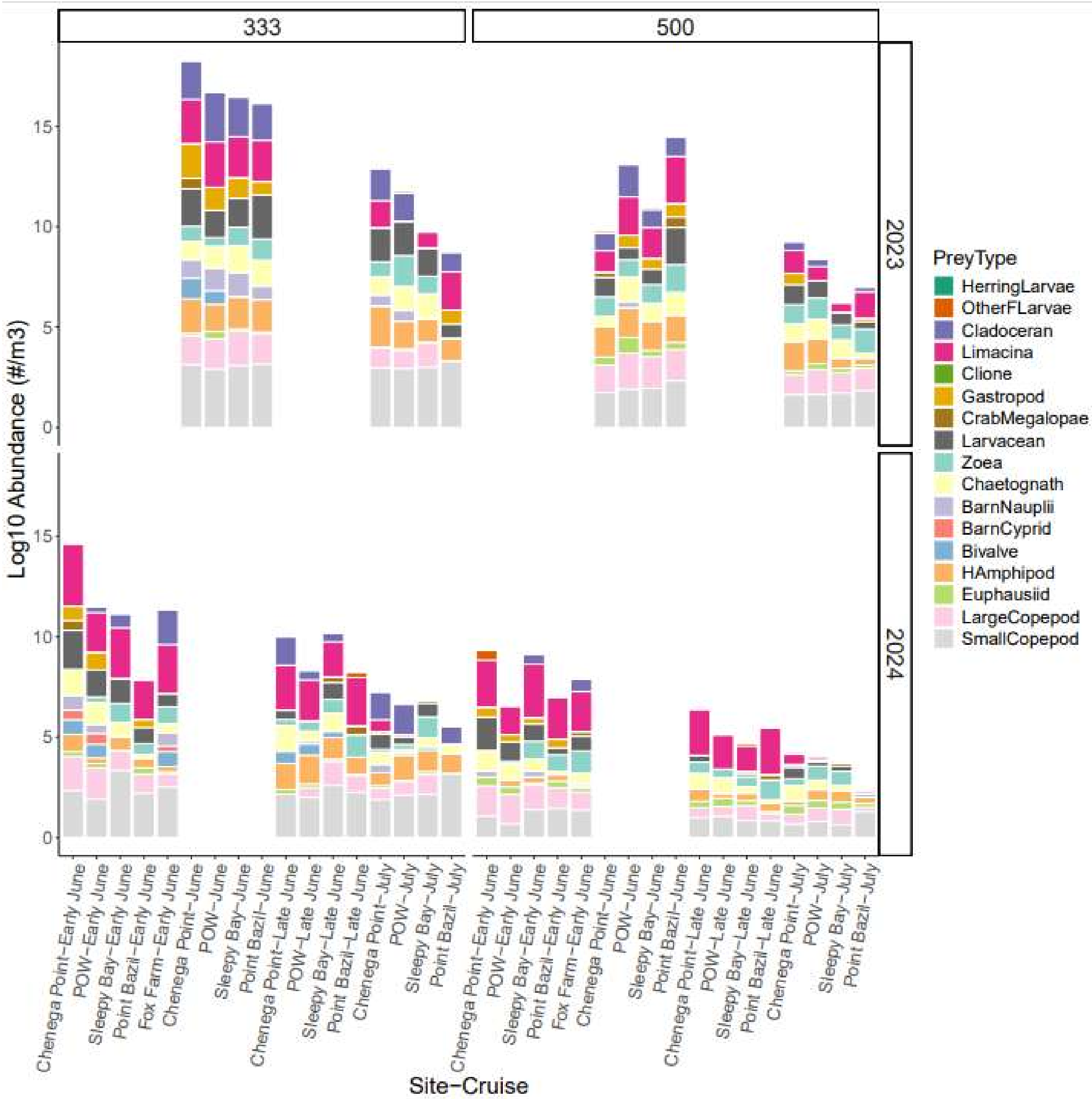


*Figure 13. Densities (number/m$^3$) derived from microscope counts of plankton and nekton collected with a bongo net at surface trawl sampling sites in June and July of 2023 and 2024. Finer mesh (333 µm) presented on the left, and coarser mesh (500 µm) presented on the right. Prince of Wales = POW.*

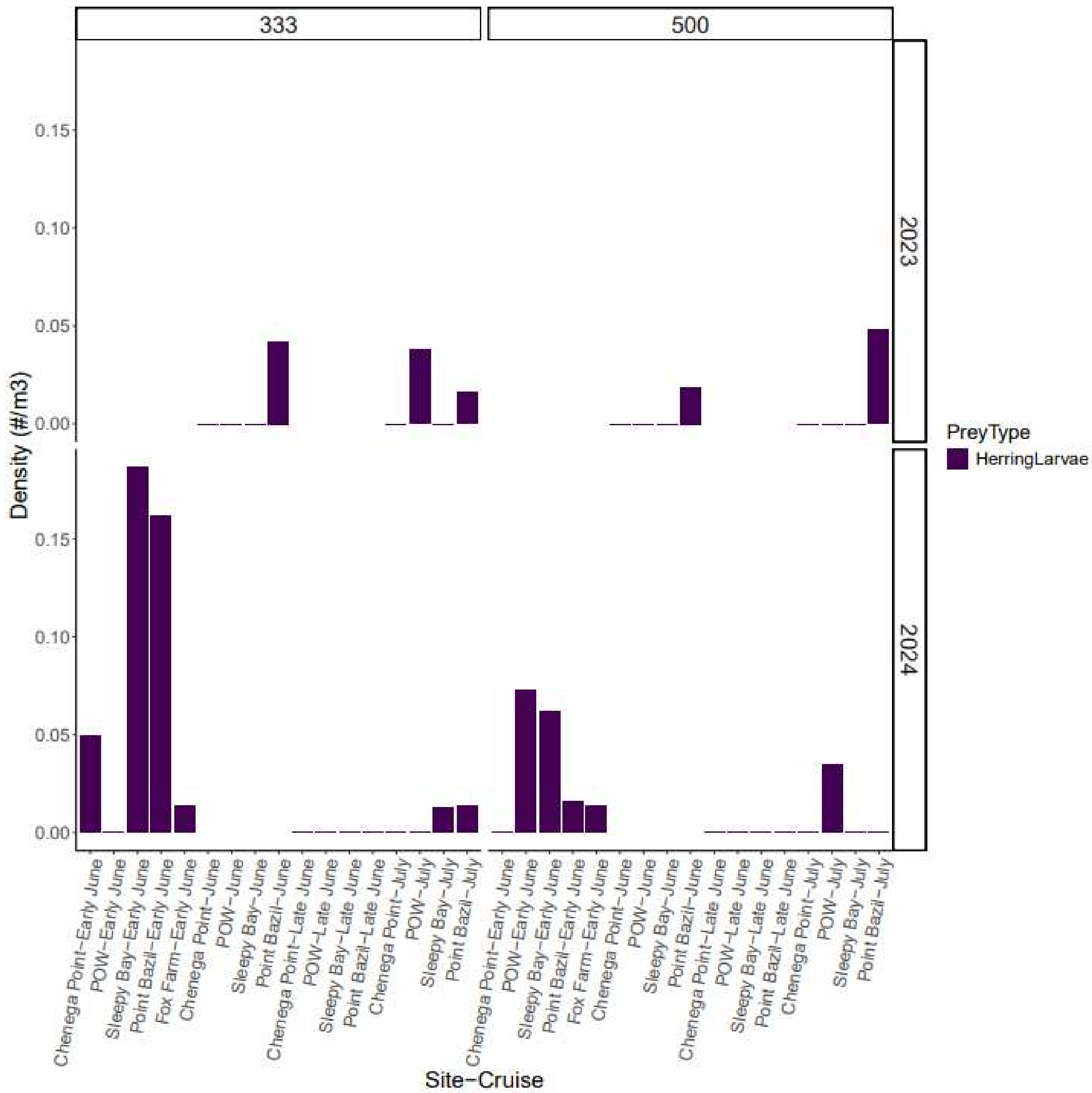


*Figure 14. Estimates of larval herring densities (#/m$^3$) in separate rings of bongo net (333 µm and 500 µm mesh) during 2023 and 2024. Finer mesh (333 µm) presented on the left, and coarser mesh (500 µm) presented on the right. Prince of Wales = POW.*

iii. Quantify the prevalence of VEN in juvenile pink salmon and age-1+ herring opportunistically caught during June and July. Disease hypothesis. Note: Disease analysis conducted by the disease program (project 24120111-C, PI Hershberger).

*Results.* No juvenile salmon have tested positive for VEN in our surveys in 2023 and 2024, and we did not capture herring in our trawl surveys in June and July of either year of our study.

iv. Produce bioenergetic model estimates of larval herring consumption by juvenile pink salmon originally planned to be led by a post-doctoral associate funded by a separate EVOSTC project (22220111-H). *Predation hypothesis – pink salmon forage on herring*

*Results.* Given the postdoc for the Herring Research and Monitoring (HRM) program was not funded, we plan to apply funds going to co-PI Heintz (Sitka Sound Science Center [SSSC]) to support a research associate beginning in 2025-26 when we have three to four complete years of data. This will represent the start of the 'synthesis phase' of our project and provide support to build a bioenergetic model to simulate growth and consumption of pink salmon and evaluate trophic dynamics (described as the predation hypothesis in our original proposal), as well as assist in the development of a forecast model.

4. Develop pink salmon models
   a. Evaluate a suite of covariates to improve our understanding of factors regulating marine survival of pink salmon, including data on trawl catch per unit effort (CPUE) and body size of PWS hatchery pink salmon captured in the NOAA GOA survey, as well as bulk SIA data produced by Objective 3b, ii noted above.
   b. Develop predictive models of pink salmon survival and evaluate their performance compared to the current model used by ADF&G to manage the PWS commercial pink salmon fishery.

*Results.* We now have two years of trawl CPUE data of pink salmon (and associated metrics, including origin, body size, energy densities, and stomach diet composition and fullness). In addition to the diet composition and disease prevalence described earlier, we have now worked up size and energy densities measures for juvenile pink salmon in 2023, and we are currently working through 2024 collections (carcasses were returned to us in September 2024 after otoliths were extracted by the ADF&G Otolith Lab). In 2023, we collected individuals from all four hatcheries (AFK, Wally Noerenberg [WNH], Cannery Creek [CCH], and Solomon Gulch

[SGH]) and wild fish, and the mean size of pink salmon smolts were ~ 90 mm total length (Fig. 15). Mean energy densities (measure through bomb calorimetry at the PWSSC lab) for each origin group were generally 19-20 MJ/kg (Fig. 16). Relatively few pink salmon originating from the AFK hatchery were collected. This is not surprising given the hatchery is located in Sawmill Bay in Chenega and is down-current from our sampling sites. For this reason, we plan to add Fox Farm as one of our trawl sampling sites in 2025, which was sampled in mid-June 2024 (Fig. 3).

We intend to evaluate relationships of CPUE to these and other covariates after we have collected three years of data. The two years of CPUE data (shown plotted by trawl station in Fig. 17) show substantial overlap, and are generally consistent with earlier years CPUE data collected by a trawl survey led by ADF&G. The exception was the year 2014, which had anomalously high CPUE indicating an abundant smolt run that year (smolt were not keyed out to species in this early survey, but presumably the majority of them were pink salmon). This strong year class was certainly reflected in the run in 2015, which was one of the biggest runs on record (Knudsen et al. 2021). It should be noted that the early ADF&G survey used a larger trawl net (264 Nordic style trawl) and thus this time series is not directly comparable to CPUE generated in this study. Ideally, we want to include several even and odd years in this analysis to fully evaluate how covariates might affect the dynamics of pink salmon in PWS.

There have been delays in the start of the Western GOA trawl survey led by ADF&G. Based on recent communication with staff at ADF&G, we expect the survey to begin in 2025. The PIs are in communication with staff at ADF&G to coordinate sharing of juvenile pink salmon collected in those surveys. We hope to report some of those results in our next annual report and describe how this survey will complement our study and contribute to our efforts at developing a fishery forecast model.

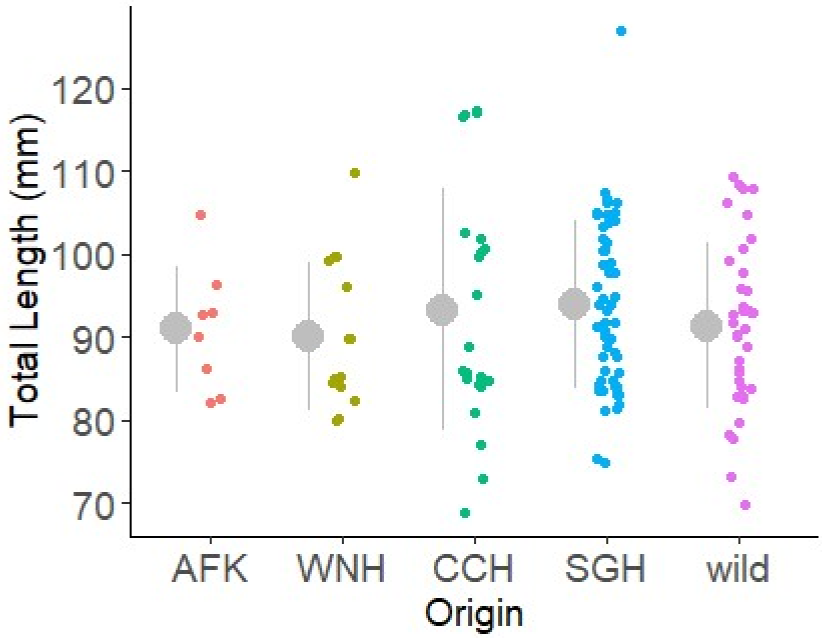


*Figure 15. Total length (mm, mean and ± 1 standard deviation) of juvenile pink salmon captured during 2023. Origins of salmon identified (AFK = Armin F. Koernig Hatchery, WNH = Wally Noerenberg Hatchery, CCH = Cannery Creek Hatchery, SGH = Salomon Gulch Hatchery, wild = naturally-produced).*

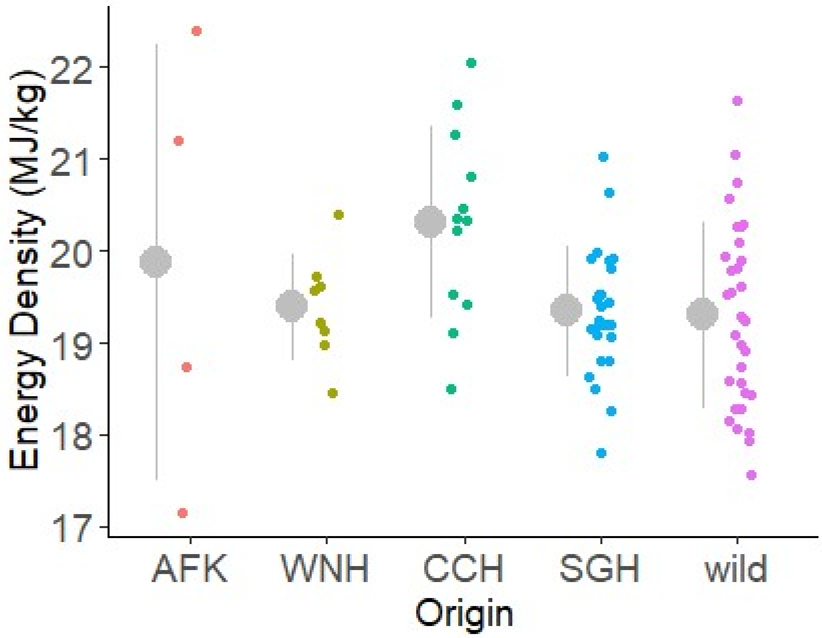


*Figure 16. Energy density (MJ/kg, mean and ± 1 standard deviation) determined through bomb calorimetry of juvenile pink salmon captured during 2023. Origins of salmon identified (AFK = Armin F. Koernig Hatchery, WNH = Wally Noerenberg Hatchery, CCH = Cannery Creek Hatchery, SGH = Salomon Gulch Hatchery, wild = naturally-produced).*

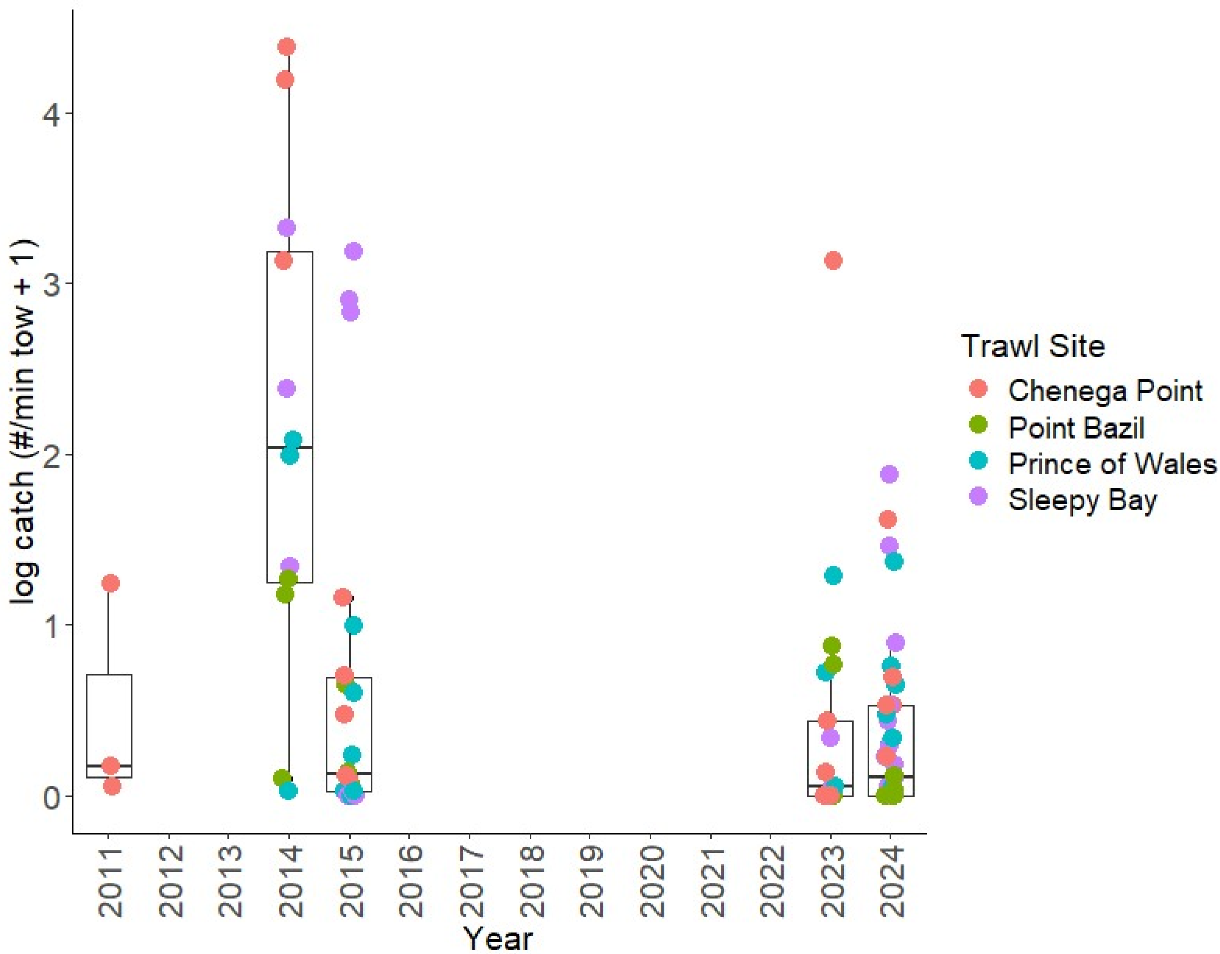


*Figure 17. Trawl catch per unit effort for juvenile salmon based on catch data from 2023 and 2024, color-coded by trawl station. Also included are early trawl data from the Alaska Department of Fish and Game at some of the same sites but using a different style and size of surface trawl.*

## *III. Brief Overall Summary:*

We have made significant progress over the past year in completing a very successful second field season and the continued processing of lab samples from 2023 and 2024. Our data suggest that adult herring do not appear to be relying heavily on outmigrating salmon fry as indicated by stomach content analysis, meta-barcoding, and stable isotope analysis. Gut content analysis reveals that outmigrating salmon fry consume herring larvae, particularly earlier in the summer during June in 2024. Stable isotope analysis suggests that wild salmon fry may have a more diverse diet than their hatchery conspecifics, and that some age-0 herring appear to isotopically overlap with salmon fry earlier in the season. Diets of juvenile herring and salmon fry both contained copepods, but these appear to vary by site and year. We need to further assess prey availability and how it relates to the diets of both herring and salmon. VEN prevalence in herring was at times very high in particular regions of PWS, and we note marked interannual and seasonal variability of VEN prevalence. The research we are developing will be an important contribution to the literature given the application of meta-barcoding information coupled with traditional gut content analysis and stable isotope data. The data we are collecting is helping us evaluate our hypotheses related to predation and competition, but continued sampling over additional odd-even run cycles of pink salmon is necessary to more fully test our hypotheses. The early data we describe in this report will be important to the modeling phases of the project – bioenergetics and pink salmon survival/forecasts.

The project has provided notable educational and training opportunities for UAF graduate (Borksy) and undergraduate (Russin) students, as well as PWSSC seasonal field and lab assistants (Shaw, Barnes, Anderson, Carter, and Becker). Of note, Maya Russin was a UAF undergraduate intern this year who assisted the project in the field in September and greatly helped with lab processing of fish samples for stable isotope analysis this year at UAF. This experience helped Maya fulfill her degree program's internship requirement and she presented a poster on her field and lab experiences at the UAF Fisheries and Marine Sciences Undergraduate Intern Symposium in December 2024. In terms of progress on addressing our primary hypotheses, Borsky's MS thesis work on spatio-temporal modeling of herring and salmon in PWS is coming along and we expect significant progress on this over the next 6 months in preparation for the Gulf Watch Alaska Long-Term Research and Monitoring (GWA-LTRM) program PI meeting in fall 2025. We will also look to conduct more public outreach on this project over the coming year now that we have more lab data available.

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## 2. Products:

*Peer-reviewed publications:*

No new contributions for this reporting period.

*Reports:*

No new contributions for this reporting period.

*Popular articles:*

Rand, P. and K. Gorman. 2024. Who's eating who in Prince William Sound? Delta Sound Connections, Prince William Sound Science Center, 2024-2025 Issue.

*Conferences and workshops:*

Rand, P. 2024. Larval Fish Identification Workshop. NOAA Auke Bay Labs, Juneau, Alaska, October.

Rand, P. 2024. Zooplankton Identification Workshop. Organized by PWSSC and UAF, Homer, Alaska, November.

*Public presentations:*

Rand, P., R. Campbell, K. Gorman, and R. Heintz. 2024. Salmon-herring interactions project. Virtual presentation to the EVOSTC Public Advisory Committee, October.

Rand, P. 2024. Overview of EVOSTC GWA salmon-herring interactions project, Presentation at the Alaska Maritime National Wildlife Refuge Visitor Center, Homer, Alaska, November.

Russin, M. 2024. Ecological interactions between Pacific salmon and Pacific herring in Prince William Sound, Alaska: Field and lab insights. UAF, Fisheries and Marine Sciences Undergraduate Internship Symposium, Fairbanks, Alaska, December.

Borsky, A., K. Gorman, P. Rand, and K. Iken. 2025. Spatio-temporal distributions of Pacific herring and pink salmon in Prince William Sound, Alaska. Poster presentation, Alaska Marine Science Symposium, Anchorage, Alaska, January.

*Data and/or information products developed during the reporting period:*

We developed a comprehensive Access database during the reporting period to manage and archive all the various data streams from the project. This database will continue to be updated as new data become available. This was a significant effort led by Borsky, Gorman, and Rand over the reporting period. This database and associated files are currently available on Research Workspace.

*Data sets and associated metadata:*

Currently, all available data for this project are archived on this project's Research Workspace shell. No data have been fully vetted and submitted with metadata to the Gulf of Alaska data portal or DataONE at this time. We plan to publicly disseminate the data for this project at the time datasets are published or at the end of the project as part of our data archiving requirement.

To date, primary datasets on Research Workspace include: Cruise headers, Catch data (date, location, gear, catch information), Ocean station (date, location for CTD and bongo deployments), Fish attributes (species, life stage, length, mass, diet content, meta-barcoding data, stable isotope values, energy content information, VEN status, and otolith hatchery or wild determination), and Plankton counts.

*Additional Products not listed above:*

None.

## 3. Coordination and Collaboration:

*The Alaska SeaLife Center or Prince William Sound Science Center*

PIs Campbell and Rand both work at PWSSC. Campbell's oceanographic research platform, R/V *New Wave*, was used by this project in June and July to conduct trawl sampling.

PIs Rand and Gorman contributed an article to PWSSC's *Delta Sound Connections* in their 2024-2025 issue ("Who is eating who in Prince William Sound").

*EVOSTC Long-Term Research and Monitoring Projects*

This project is a recently funded research project within the GWA-LTRM program HRM component. PI Rand coordinated with M. Arimitsu (GWA-LTRM Pelagic Component lead and PI of the forage fish project, 24120114-C) to share data and samples from rhinoceros auklet diets at Middleton Island, Alaska. We intend to compare data on size, origin, and energy density of juvenile pink and chum salmon in the diets of auklets to trawl-caught individuals processed as part of this project.

PIs Rand and Gorman are coordinating with Paul Hershberger (herring disease program [24120111-E] PI) to collect blood smears for disease screening for VEN.

Our project will produce key measures (e.g., rates of larval herring consumption by juvenile pink salmon) to be used in modeling herring dynamics as part of the GWA-LTRM project led by Trevor Branch (herring modeling project 24120111-C).

*EVOSTC Mariculture Projects*

None.

*EVOSTC Education and Outreach Projects*

PI Rand and his seasonal research assistant at PWSSC, Shelby Barnes, served as outreach participants at the Ocean Sciences Festival held in October, 2024, in Cordova, Alaska.

PI Rand gave a presentation as part of a public outreach effort organized by the Community Organizing, Restoration, and Learning CORaL Network in November 2024 in Homer, Alaska.

*Individual EVOSTC Projects*

Rand and Gorman met with the Data Management team (Adrienne Canino, Axiom) multiple times during the winter of 2024/25 and she confirmed we are up to date on data submission for this project (i.e., through 2023).

*Trustee or Management Agencies*

We have been in communication with Ben Gray at the ADF&G office in Anchorage to coordinate our work with their western GOA trawl survey. This GOA survey has been delayed, but we hope to obtain samples beginning in 2025 and we intend to collaborate on future analyses of trawl CPUE and other biological measures made on juvenile salmonids in both of these surveys.

Project PIs are contracting with Jenni Morella at ADF&G to process juvenile pink and chum salmon otoliths to determine origin. The project PIs are also contracting for ship time on the R/V *Solstice*, the ADF&G research vessel based in Cordova, for our cruises in May and September each year of the project.

Project PIs are contracting with Wes Larson at NOAA Auke Bay Labs to conduct DNA metabarcoding of stomach contents of juvenile pink salmon and herring.

PIs Rand and Gorman are coordinating with Paul Hershberger (herring disease program [24120111-E] PI) to collect blood smears for disease screening for VEN.

*Native and Local Communities*

We stay in communication with the Prince William Sound Aquaculture Corporation (PWSAC) to help with the timing of our surveys. We obtain data from them each spring on release number and timing of releases to help us schedule our cruises.

The development of a fishery forecast model is a high priority need identified by PWSAC. Rand has been in communication with Geoff Clark, the PWSAC general manager, on our EVOSTC GWA-LTRM project. Mr. Clark is strongly supportive of our project as it may be a useful tool to predict the magnitude of pink salmon runs in the future.

## 4. Response to EVOSTC Review, Recommendations and Comments:

*September 2024 EVOSTC Science Panel Comment:*

The FY22 and FY23 annual reports are extremely short, reflecting two delays: (1) the merging of two separate proposals into a single, integrated project, following early recommendations of the Science Panel (and after proposals were first received), and (2) a delay in the startup time by one year, made at the PI's request. Consequently, there is little in the form of tangible progress to report in FY22 and FY23. However, the SP was pleased to see frequent reference to collaboration between this project and others, although this was mainly seen in the annual reports for other concurrent projects.

*PI Response:*

The FY22 EVOSTC Annual Report submitted March 1, 2023 (review period Feb 1, 2022 – Jan 31, 2023) was short. The brevity of that report reflected the delay in the start of research activities by one year due to the delay in receiving EVOSTC funding from NOAA, which did not become available until August 2022. During FY22, we were able to complete some of the planned activities such as ordering field equipment in particular the trawl gear, participation in EVOS planning and coordination meetings, and acquiring ADGF permits and UAF Institutional Animal Care and Use Committee (IACUC) protocol approval for FY23 fieldwork.

The FY23 report provided much more detail than the FY22 report, reflecting the fact that by March 2024 we had completed our first field season (May-Sept 2023), recruited a MS graduate student to work on the retrospective analysis (began at UAF in Jan 2024), and the various lab analyses of our 2023 field collected samples were in process (1-disease - USGS, 2-gut content and 3-plankton haul analyses - PWSSC, 4-gut metabarcoding analysis - NOAA, 5-otolith extraction and readings for hatchery or wild origins -ADFG, and 6-energy and isotopic analyses - PWSSC and UAF). The various lab analyses of field collected samples is time consuming and involves multiple labs, therefore data were not completely available by the time the FY23 report was submitted. Given that the lab data we had in hand prior to March 2024 was limited, we felt it was too early to make any conclusions regarding our hypotheses. Thus, the FY23 report focused on our progress in the field and lab, and recruiting of students and seasonal assistants to the project.

*September 2024 EVOSTC Science Panel Comment:*

While the SP recognizes that this project is in the very early stages of development, it was not clear from the annual reports what the main thrust of the research was at the onset, or how the focus of the investigation might develop in future years (i.e., competition or predation, by salmon on herring, or herring on salmon or herring, between different life stages, and at different locations at different times/seasons), and between wild and hatchery salmon.

*PI Response:*

This project was designed to collect the same data annually over a 6-year period to include 3 odd-even pink salmon cycles to address each of our hypotheses regarding predation, competition, and disease interactions between herring and hatchery- and wild-origin pink salmon. The power of the study is to assess variation in mechanisms across years with differing abundances in pink salmon and environmental conditions. We have now successfully completed two field seasons (FY23, FY24), which is 1 pink salmon odd-even cycle. We are receiving some very interesting lab results that were not available when the FY23 report was submitted, and we are just at the beginning of having complete datasets to begin evaluating our hypotheses.

*September 2024 EVOSTC Science Panel Comment:*

We note, for example, that the PIs are starting to use the "vector alignment search tool (VAST)" for "analysis of past data to quantify where, when, and at what life stages pink salmon and herring might be interacting." This is sensible so the SP was puzzled by the initiation of sampling prior to the geographic VAST analysis. Perhaps the extreme brevity of the FY23 annual report failed to address some of the issues that were considered in the original proposals. Several questions were raised during our review and we look forward to clarifications on these in the FY24 annual report.

*PI Response:*

Given the time frame of the proposed work we designed the project to start field sampling ahead of the completion of our retrospective analyses using VAST. We never intended for the results of the VAST modeling exercises to replace our overall field campaign but perhaps add some additional future sampling sites pending results.

*September 2024 EVOSTC Science Panel Comment:*

1. What if the pink-herring overlaps occur primarily in regions other than where they are sampling? The sampling effort is focused on SW PWS with only one hatchery in the vicinity. The other three hatcheries are in N PWS. Most herring spawn in E and SE PWS (from Fig. 2 in Morella 111-F).

*PI Response:*

We chose to focus our purse seine and trawl sampling in the southwestern PWS region because this area is recognized as the major migratory corridor for juvenile pink salmon and it aligns with the expected trajectory of larval herring (due to the anticyclonic circulation in PWS that advects larvae from major spawning areas in the eastern PWS to western and southwestern bays that serve as nurseries). Given the high likelihood that juvenile salmon migrate through this region and the cases of cooccurrence of herring evident from ADF&G and aerial surveys, we expected this to be an area with a high likelihood of interaction. Sampling in this region also allowed us to build upon the historic sampling by ADFG salmon programs that was carried out in this region.

Our logic in selecting the trawl sites was to provide a reliable measure of wild- and hatchery-origin pink salmon abundance each year as this approach allows us to scale up our estimates of predation on larval herring if we detect it in the dietary component of our project. While the early ADF&G trawl surveys did not key out juvenile salmon species or determine origin, we will document in our FY24 annual report that we collected wild pink salmon and pink salmon produced by all the operating hatchery programs in PWS in our 2023 surveys (Morella, Rand, and Gorman, ADF&G, unpubl. data). Thus, our study will be able to examine interactions involving all possible origin groups of pink salmon, underscoring the utility of trawling in the migratory corridors of southwestern Prince William Sound.

*September 2024 EVOSTC Science Panel Comment:*

2. What is the outmigration timing of herring and wild and hatchery pinks?

*PI Response:*

Outmigration timing for juvenile pink salmon occurs in June and early July (based in part on unpublished data records of ADF&G, and R. Brenner, pers. comm.). Earlier surveys indicated that catch rates at these trawl sites fall to zero by late July and early August.

*September 2024 EVOSTC Science Panel Comment:*

3. Where are the corridors through the SW study area?

*PI Response:*

The corridors correspond to the four trawl sites described in our original proposal (see Fig. 5 in this project's original proposal).

*September 2024 EVOSTC Science Panel Comment:*

4. Do diets of either pink salmon or herring shift during the time they move from N PWS to the sampling region, perhaps because they grow or because of regional variability in prey availability?

*PI Response:*

This is currently unknown. While we did not propose to directly evaluate diet differences between northern PWS and southwestern PWS, the isotope variability could reveal that, for example, salmon fry from northern hatcheries have a different isotopic signature than those from the southwestern hatchery. Because we are evaluating the isotope signature of whole fish, the turnover rate should capture any longer-term variation in diet than simply a snap-shot gut content analysis, underscoring the importance of our suite of dietary metrics - gut content, metabarcoding, and bulk and compound specific stable isotope analysis.

*September 2024 EVOSTC Science Panel Comment:*

5. Could significant competition occur *before* they reach SW PWS?

*PI Response:*

It is possible. It is important to note that our study, however, can evaluate the "net effects" of earlier interactions. Our study involves monitoring size (a reflection of growth), energetic condition, disease prevalence, and isotopic signatures in body tissues that can provide an integrated measure of the effects of factors experienced prior to the time of sampling.

*September 2024 EVOSTC Science Panel Comment:*

6. Are there any effects of wild versus hatchery pinks on herring (e.g. timing of out-migration, diets).

*PI Response:*

We are determining origin on a robust sample of juvenile pinks collected during our sampling events, so we will be able to partition effects by each origin group (wild or hatchery). This will include effects of sample timing (May, June, and July) and we will be able to test for differences in diets between wild- and hatchery-origin pink salmon.

*September 2024 EVOSTC Science Panel Comment:*

7. Is there adequate information on the outmigration timing of herring and wild and hatchery pinks, and are the corridors through the SW study area?

*PI Response:*

There has been sampling by ADF&G and the EVOSTC SEA program (e.g., Willette 1996, Sturdevant et al. 1999, 2001) that defined the timing and corridors. Recent work by Bishop and Eiler (2018) and Bishop and Bernard (2021) based on acoustic telemetry revealed the seasonal movement patterns of adult herring in and out of the migratory corridors of Prince William Sound.

*September 2024 EVOSTC Science Panel Comment:*

As the PIs state (Page 8, FY22 annual report) *"The potential role of pink salmon on herring in PWS is palpable, as PWS is home to the largest pink salmon hatchery system in the world and the herring stock is depressed. If there is an effect of hatchery pink salmon, this is the place to look."* We agree. Further, and as stated on P 5 of the FY22 report, this proposal *"responds to a suggested area of interest in the FY22-31 Invitation for Proposals: An examination of the role of hatchery-produced pink salmon, wild pink salmon, on herring ecology in PWS and the Gulf of Alaska."* Yes, but again, it is not clear from the FY22 and FY23 annual reports that this is actually being done.

*PI Response:*

When the FY23 report was submitted, we had completed only our first field season for this project given the 1-year delay in starting due to the delay in receiving funding, and only portions of our 2023 lab data had been received by March 2024. Over the past 8 months we have conducted another very successful field season and have received more lab data for 2023 and are working to produce the 2024 lab data more quickly. We hope that the FY24 report shines a light on how the activities in this project combine to address the interaction of hatchery and wild salmon with herring.

*September 2024 EVOSTC Science Panel Comment:*

The Science Panel has some concerns about project progress, and we expect to see significant progress reported in the FY24 annual report. SP recommendations for the Trustee Council to consider rescinding funding for this project will be dependent on future progress: given the status of research subaccount, these funds may be better used elsewhere.

*PI Response:*

Based on the Science Panel questions presented here, it is clear that we need to do a better job at describing how we are meeting the study objectives. We are in a much better position to provide results from 2023 and for some datasets in 2024 in the FY24 annual report. We appreciate the opportunity to clarify our project objectives, design, and status to the Science Panel. We have worked very hard to get this project launched and we are making good progress that we look forward to reporting on in the FY24 annual report.

*2024 EVOSTC Executive Director and PAC Comments:*

None.

**5. Budget:**

The project is behind in spending because of the delay in the release of the NOAA grant in FY22, when this project began, resulting in a one-year delay in the beginning of field sampling and laboratory analysis (started in 2023 not 2022). In addition, the delay in the release of FY24

NOAA grant funds until February 2025 caused additional work delays mainly for laboratory processing of samples.

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
**PROGRAM BUDGET PROPOSAL AND REPORTING FORM**

| Budget Category: | Proposed FY 22 | Proposed FY 23 | Proposed FY 24 | Proposed FY 25 | Proposed FY 26 | 5-YR TOTAL PROPOSED | ACTUAL CUMULATIVE |
|---|---|---|---|---|---|---|---|
| Personnel | $112,299 | $201,472 | $206,654 | $185,064 | $182,478 | $887,967 | $367,173 |
| Travel | $11,223 | $15,539 | $14,459 | $11,998 | $10,764 | $63,983 | $31,811 |
| Contractual | $61,706 | $89,644 | $91,119 | $89,774 | $88,674 | $420,917 | $83,601 |
| Commodities | $16,050 | $13,250 | $13,250 | $13,250 | $12,250 | $68,050 | $20,735 |
| Equipment | $22,000 | $22,775 | $23,913 | $2,000 | $0 | $70,688 | $59,360 |
| Indirect Costs (varies by proposer) | $7,755 | $22,032 | $22,218 | $16,441 | $13,723 | $82,168 | $23,948 |
| **SUBTOTAL** | $231,033 | $364,711 | $371,613 | $318,527 | $307,888 | $1,593,773 | $586,628 |
| General Administration (9% of subtotal) | $20,793 | $32,824 | $33,445 | $28,667 | $27,710 | $143,440 | N/A |
| **PROJECT TOTAL** | $251,826 | $397,535 | $405,058 | $347,194 | $335,598 | $1,737,212 | |
| Other Resources (In-Kind Funds) | $0 | $0 | $0 | $0 | $0 | $0 | |

COMMENTS:
This is the combined budget for the individual Rand and Campbell, Gorman, and Heintz budgets that follow. Detail by year for each PI/organization can be found in the following worksheets.

The project is behind in spending because the delay in the release of NOAA grant funds in FY22 resulted in a one year delay in the beginning of spring field sampling and laboratory analysis. In addition, the delay in release of NOAA grant funds in FY24 until January 2025 caused additional work delays.

| | | |
|---|---|---|
| **FY22-26** | **Project Number: 24220111-I**<br>**Project Title: Trophic Interactions**<br>**PI(s): Rand & Campbell (PWSSC), Gorman (UAF), & Heintz (SSSC)** | **SUMMARY TABLE** |