Juvenile salmon migration report; Discovery Islands

— Hakai Institute Juvenile Salmon Program 2023 —

Aim

To provide a rapid end of season summary of juvenile salmon migration characteristics and oceanographic conditions in the Discovery Islands and northern Strait of Georgia in British Columbia, Canada.

Background

The Hakai Institute Juvenile Salmon Program was launched in the spring of 2015. For a complete background including methods see Hunt et al. 2018. The program operates in the Discovery Islands (Figure 1) and thus provides information on the health of juvenile salmon after passage through:

1) Strait of Georgia – stratified high plankton biomass zone; and
2) Discovery Islands – highly-mixed low-plankton-biomass zone, and area of, historically, high potential for wild and farmed salmon interactions.

Program Objectives

1) Determine migration timing and relative abundance;
2) Map migration habitat - oceanographic conditions along the migration route;
3) Understand the dynamics of the plankton food-webs that underpin juvenile salmon growth and health;
4) Understand parasite and pathogen infection dynamics and their impact on juvenile salmon growth and health.

Key Parameters Reported

- Catch Statistics and Migration Timing
- Lengths
- Parasite Loads
- Ocean Temperatures

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The following plots are subject to change as the underlying data are preliminary and subject to further quality assurance. The Hakai Institute embraces an "Open Science Policy"; to that end you can access the time series data used in this report at http://dx.doi.org/10.21966/1.566666.

Figure 1: Locations of seining and oceanographic stations surveyed in 2023.

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Catches and Migration Timing

Survey Date	Site ID	Site	Sockeye	Pink	Chum
2023-05-15	D09	Okisollo Channel	4	0	2
2023-05-15	D30	Chonat Bay	0	0	0
2023-05-16	D10	Hall Point	0	0	0
2023-05-16	D10	Hall Point	0	6	283
2023-05-17	D27	Granite Point	0	1526	179
2023-05-23	D10	Hall Point	0	0	0
2023-05-23	D10	Hall Point	0	0	0
2023-05-23	D35	Denham Bay	NA	NA	NA
2023-05-24	D09	Okisollo Channel	0	0	0
2023-05-24	D09	Okisollo Channel	20	684	46
2023-05-25	D27	Granite Point	NA	NA	NA
2023-05-25	D22	McMullen Point	NA	NA	NA
2023-05-29	D10	Hall Point	0	4545	46
2023-05-30	D09	Okisollo Channel	0	112	112
2023-05-31	D27	Granite Point	0	32	2
2023-06-05	D10	Hall Point	0	0	0
2023-06-05	D10	Hall Point	0	0	0
2023-06-05	D35	Denham Bay	0	1	1
2023-06-05	D35	Denham Bay	0	0	0
2023-06-06	D09	Okisollo Channel	823	341	0
2023-06-07	D27	Granite Point	0	599	729
2023-06-12	D10	Hall Point	0	0	0
2023-06-12	D10	Hall Point	7	6736	214
2023-06-13	D09	Okisollo Channel	183	36	132
2023-06-15	D27	Granite Point	16	49	227
2023-06-19	D10	Hall Point	11	276	185
2023-06-20	D09	Okisollo Channel	0	0	0
2023-06-20	D09	Okisollo Channel	0	0	0
2023-06-20	D09	Okisollo Channel	2	15	53
2023-06-21	D27	Granite Point	0	30	120
2023-06-27	D10	Hall Point	0	699	17
2023-06-28	D09	Okisollo Channel	0	0	0
2023-06-28	D09	Okisollo Channel	3	3	281
2023-06-29	D27	Granite Point	0	155	36
2023-07-03	D10	Hall Point	2	811	210
2023-07-04	D09	Okisollo Channel	1	25	68
2023-07-05	D27	Granite Point	0	5	0
2023-07-05	D27	Granite Point	0	93	135

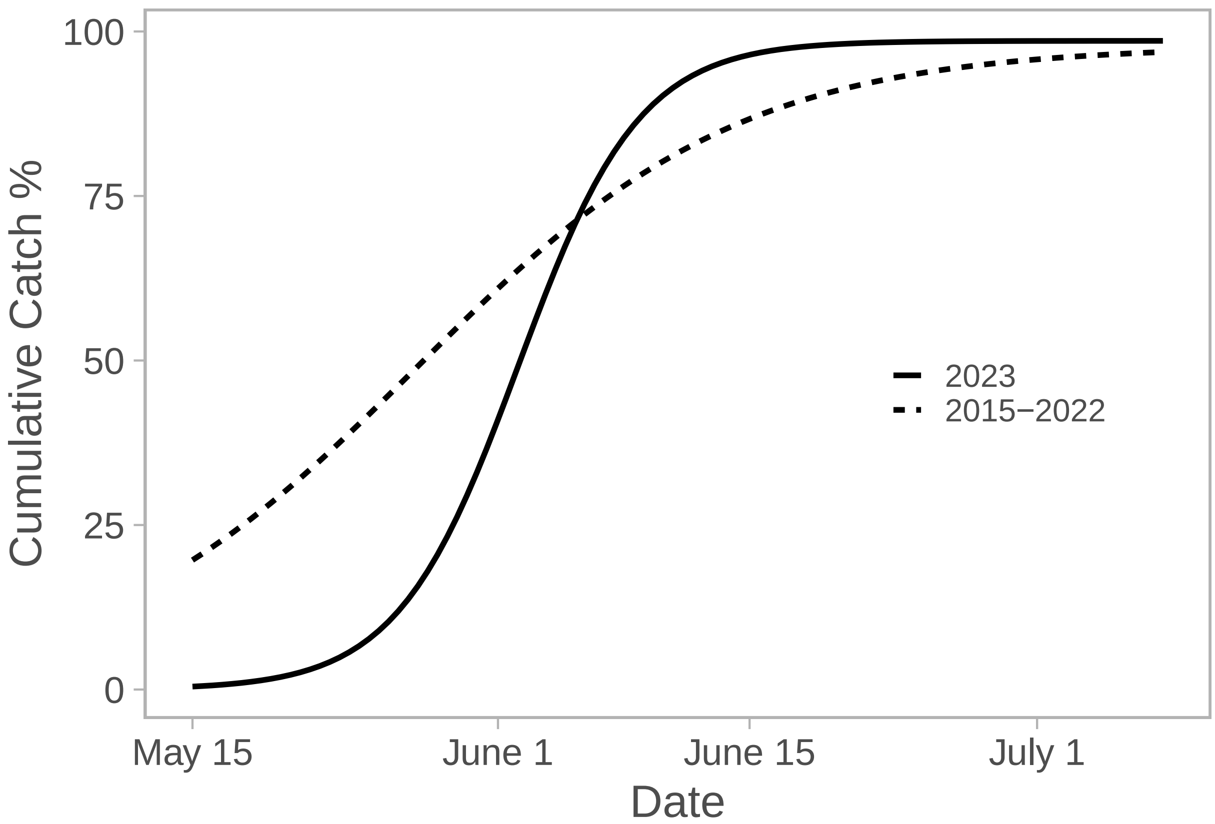

Figure 2: Migration timing of juvenile sockeye salmon in the Discovery Islands in 2023 compared to 2015-2022 modelled using a logistic growth curve fitted to cumulative catch for each period.

Catch Intensity

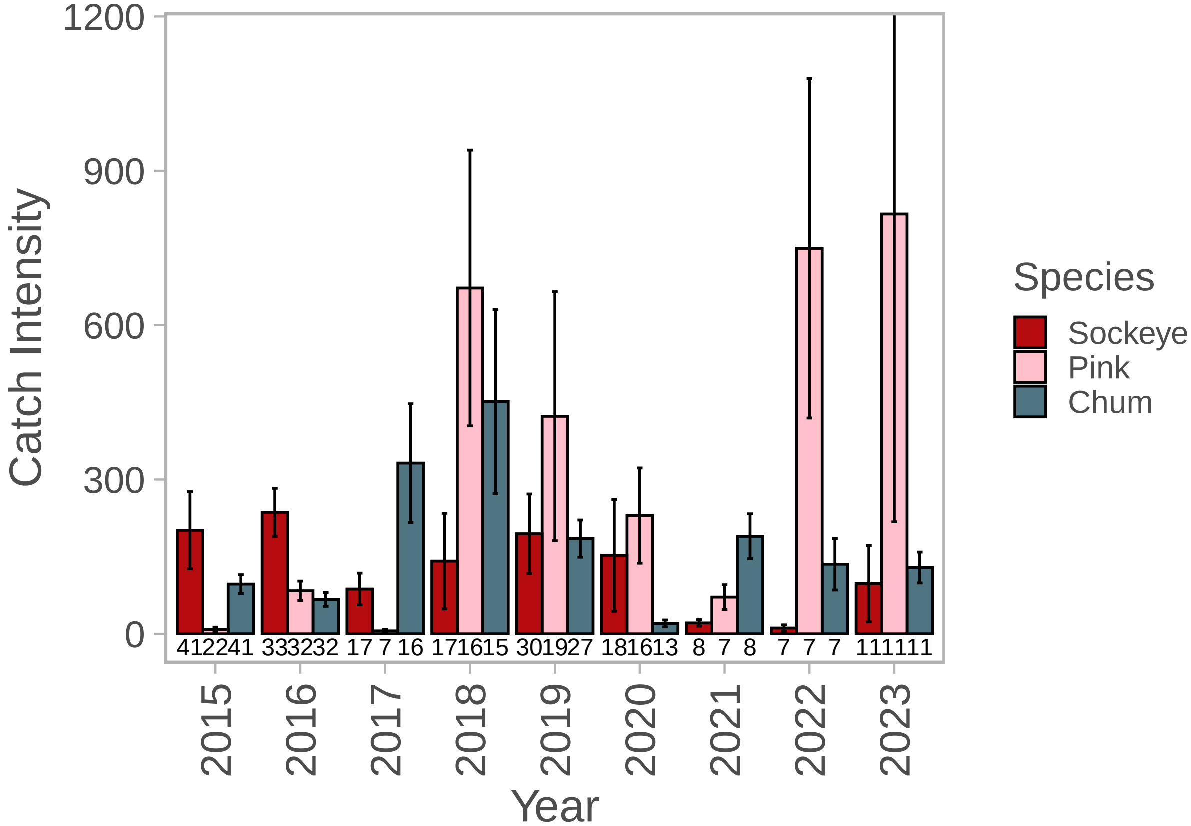

Figure 3: The catch intensity (average number of species i when i > 0 and when sockeye were also caught) of sockeye, pink, and chum salmon in the Discovery Islands. Numbers under each bar indicate the number of seines in which sockeye were caught, and error bars indicate 1 standard error.

Species Proportion

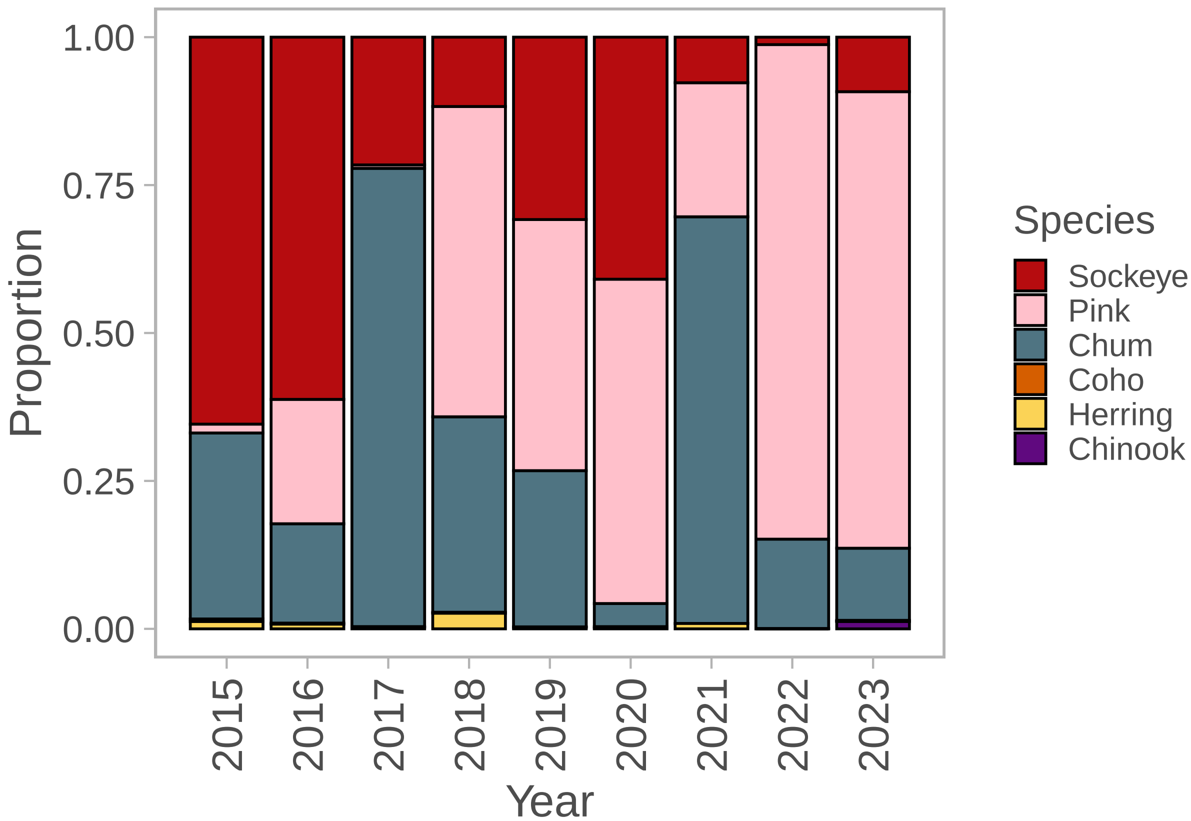

Figure 4: Proportion of juvenile salmon species and herring caught in the Discovery Islands from 2015-2023.

Fish lengths

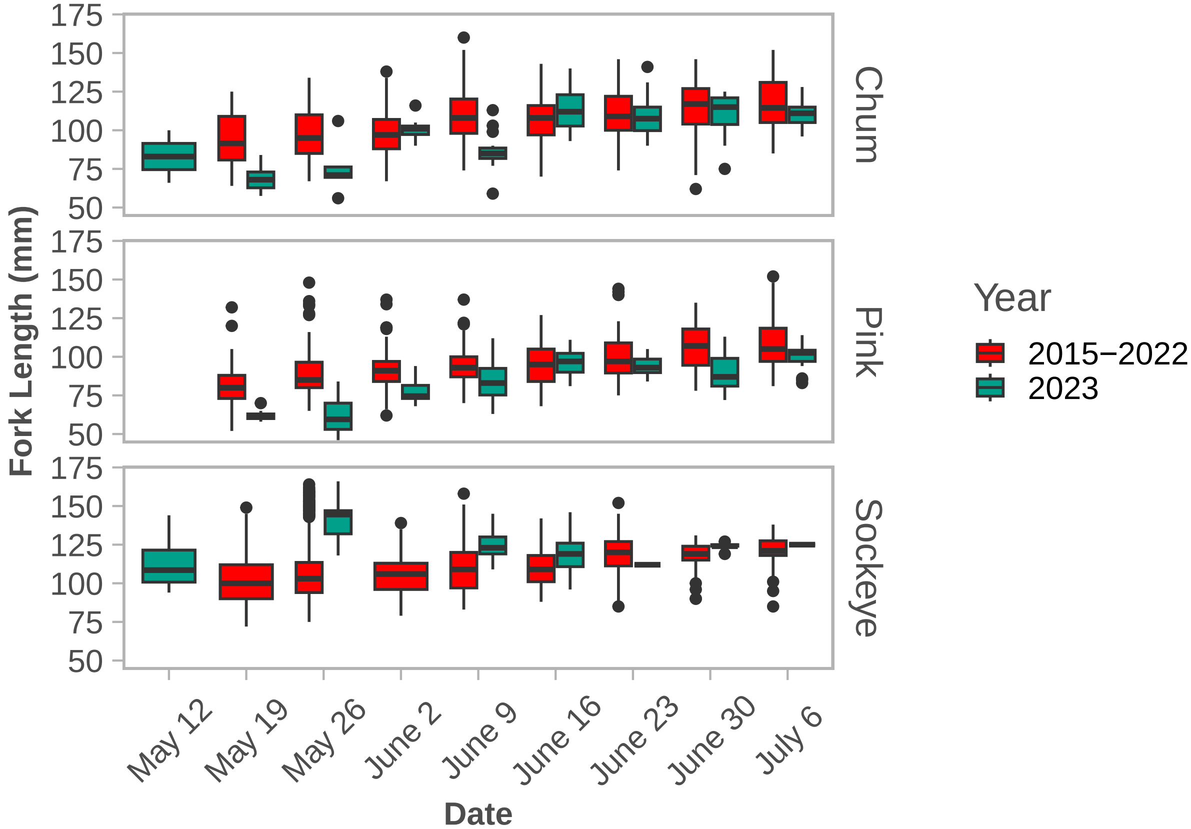

Figure 5: Fork-length boxplots of juvenile salmon in the Discovery Islands in 2023 grouped by week, and represented by the middle day of each week, compared to all lengths from 2015-2022.

Parasite Loads

In 2023 we resumed enumerating both attached and motile sea lice in the field using hand lenses (Krkosek et al. 2005) after switching in 2020 to enumerating only motile sea lice under a dissecting microscope in the lab. As a result, our time series for attached stage lice excludes some years and species of salmon. Here we present the abundance and prevalence of attached stage lice in 2015, 2017, 2018, 2019, 2022 and 2023. Our time series for parasite loads is complete for motile sealice on sockeye, pink and chum spanning 2015-2023.

Note that species identification of attached chalimus sea lice stages was not conducted in the field. Instead species proportions of chalimus staged were inferred based on the ratio of species in the copepodite and motile stages in each year.

Definitions[1]

Abundance: The total number of individuals of a particular parasite species in a sample of hosts ÷ Total number of individuals of the host species in the sample (Average number of lice per fish).

Prevalence: Number of individuals of a host species infected with a particular parasite species and louse life stage ÷ Number of hosts examined for that particular louse life stage (Proportion of fish infected with lice).

[1] Margolis, L., Esch, G.W., Holmes, J.C., Kuris, A.M. and Schad, G.A. (1982). The use of ecological terms in parasitology: report of an ad hoc committee of the American Society of Parasitologists. J. Parasitol. 68:131–133.

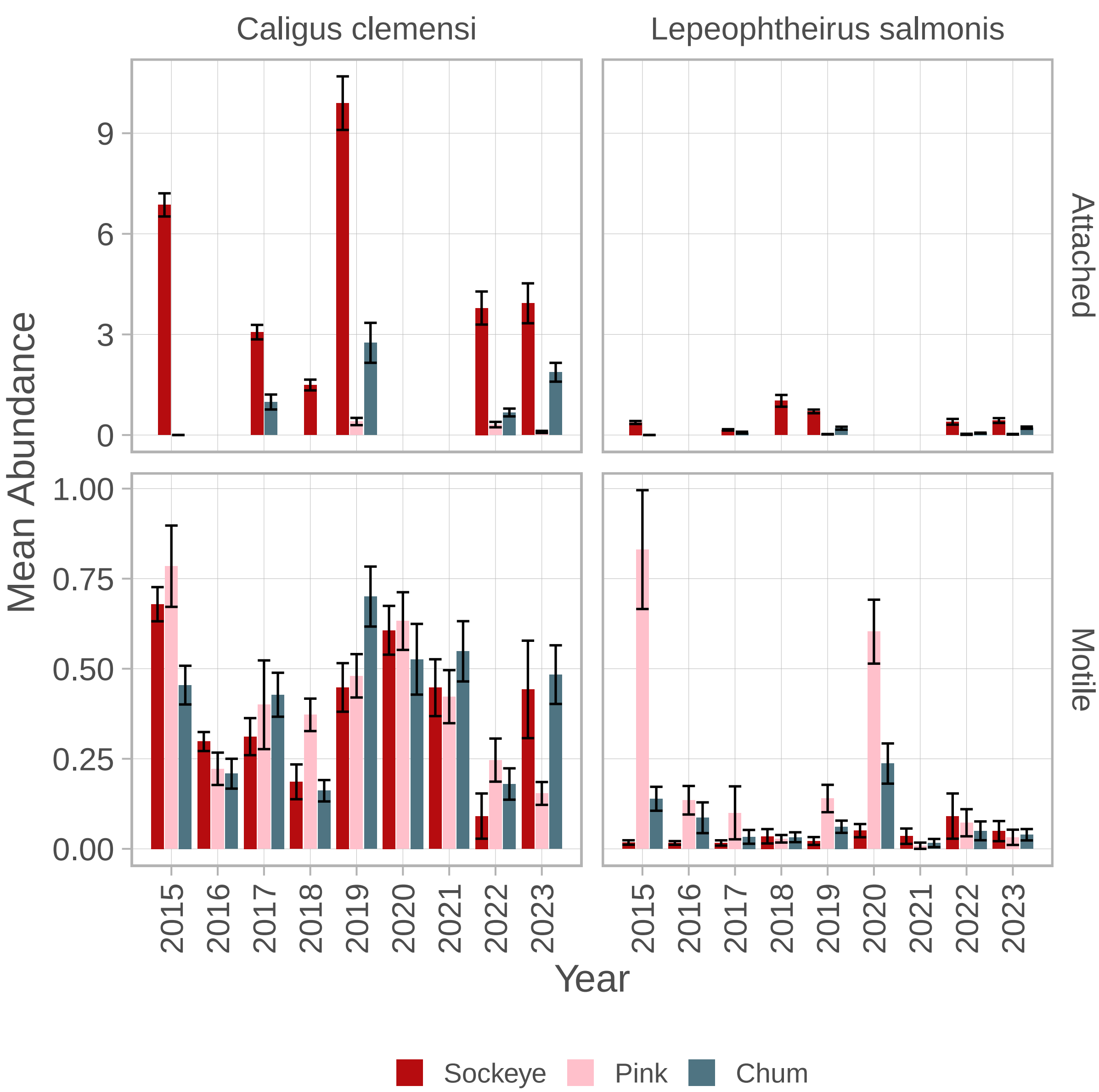

Figure 6: The mean abundance (+/- 1 SE) of sea lice in the Discovery Islands, BC.

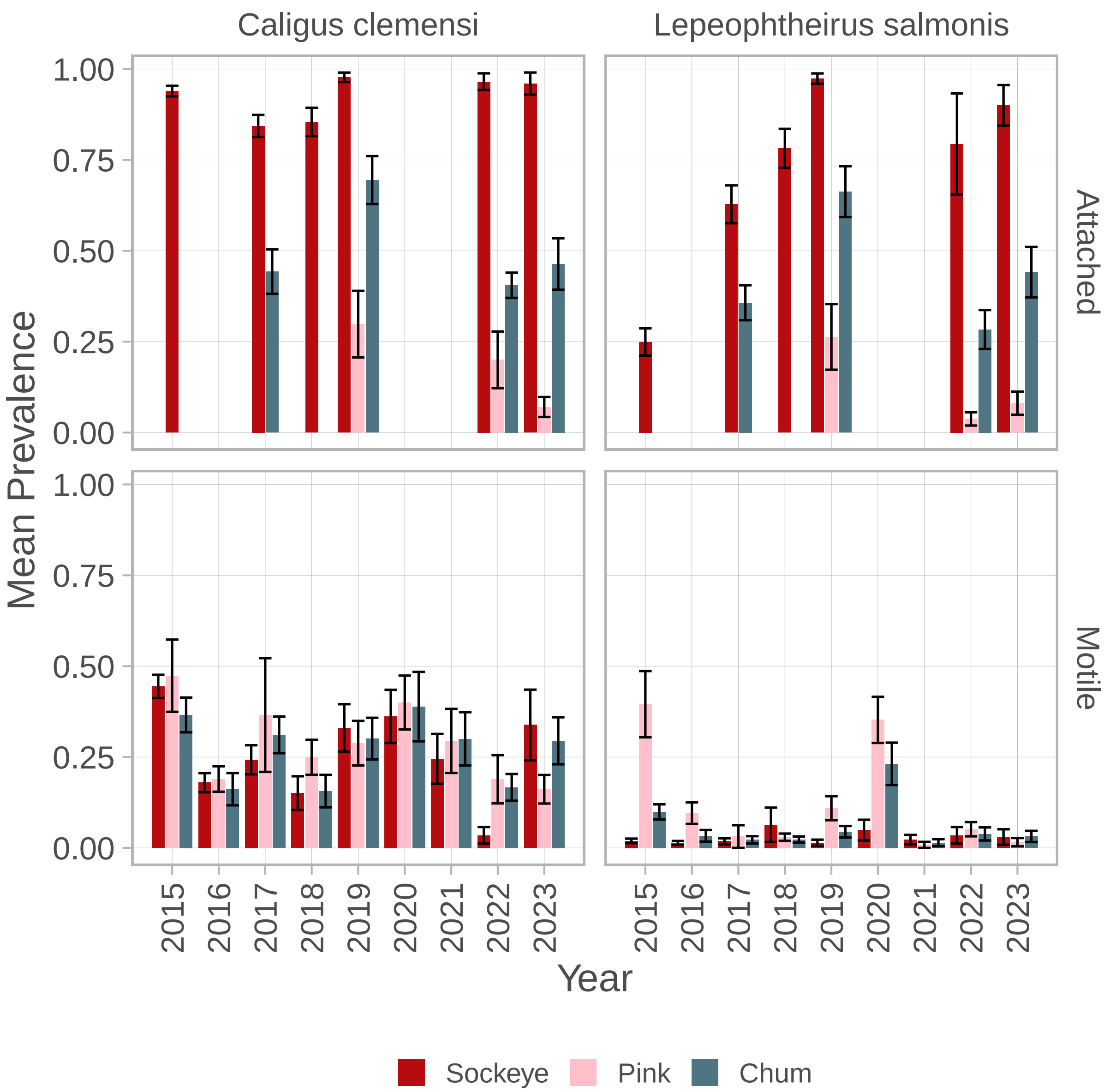

Figure 7: The mean prevalence (+/- 1 SE) of sea lice in the Discovery Islands, BC.

Ocean Temperatures

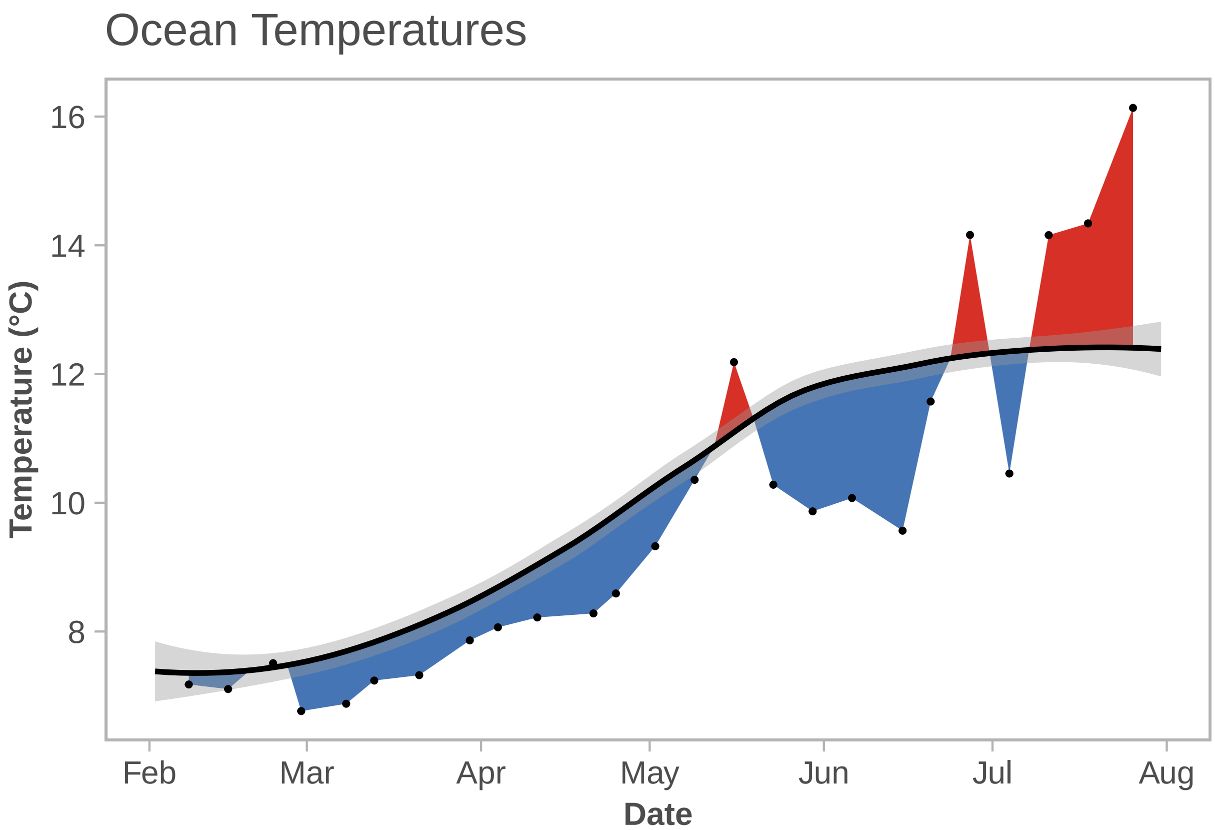

Figure 8: Ocean temperatures (top 30 m) at station QU39 in the northern Strait of Georgia between Quadra and Cortes Island. The solid black line is a LOESS regression based on temperatures from 2015-2022, representing the study period average. The shaded grey area is 1 SE of the LOESS regression. Blue areas represent temperatures from 2023 that are below average and red areas represent above-average temperatures.

References

Hunt, B.P.V., B.T. Johnson, S.C. Godwin, M. Krkosek, E.A. Pakhomov, and L. Rogers. 2018. The Hakai Institute Juvenile Salmon Program: early life history of sockeye, pink and chum salmon in British Columbia, Canada. NPAFC Doc. 1788. 14 pp. Institute for the Oceans and Fisheries and Department of Earth, Ocean and Atmospheric Sciences, University of British Columbia, Hakai Institute, Earth to Ocean Research Group, Simon Fraser University, Department of Ecology and Evolutionary Biology, University of Toronto, and Salmon Coast Field Station (Available at http://www.npafc.org).

Johnson, B., Gan, J., Godwin, S., Bachen, K., van der Stap, T., Krkosek, M., Rogers, L. A., Portner, L., Janusson, C., & Hunt, B. P. V. (2017). Hakai Institute Juvenile Salmon Program Time Series. [Dataset] https://doi.org/10.21966/1.566666

Krkošek, M., Morton, A., and Volpe, J.P. 2005b. Nonlethal assessment of juvenile pink and chum salmon for parasitic sea lice infections and fish health. Trans. Am. Fish. Soc. 134(3): 711–716. doi:10.1577/T04-133.1.