

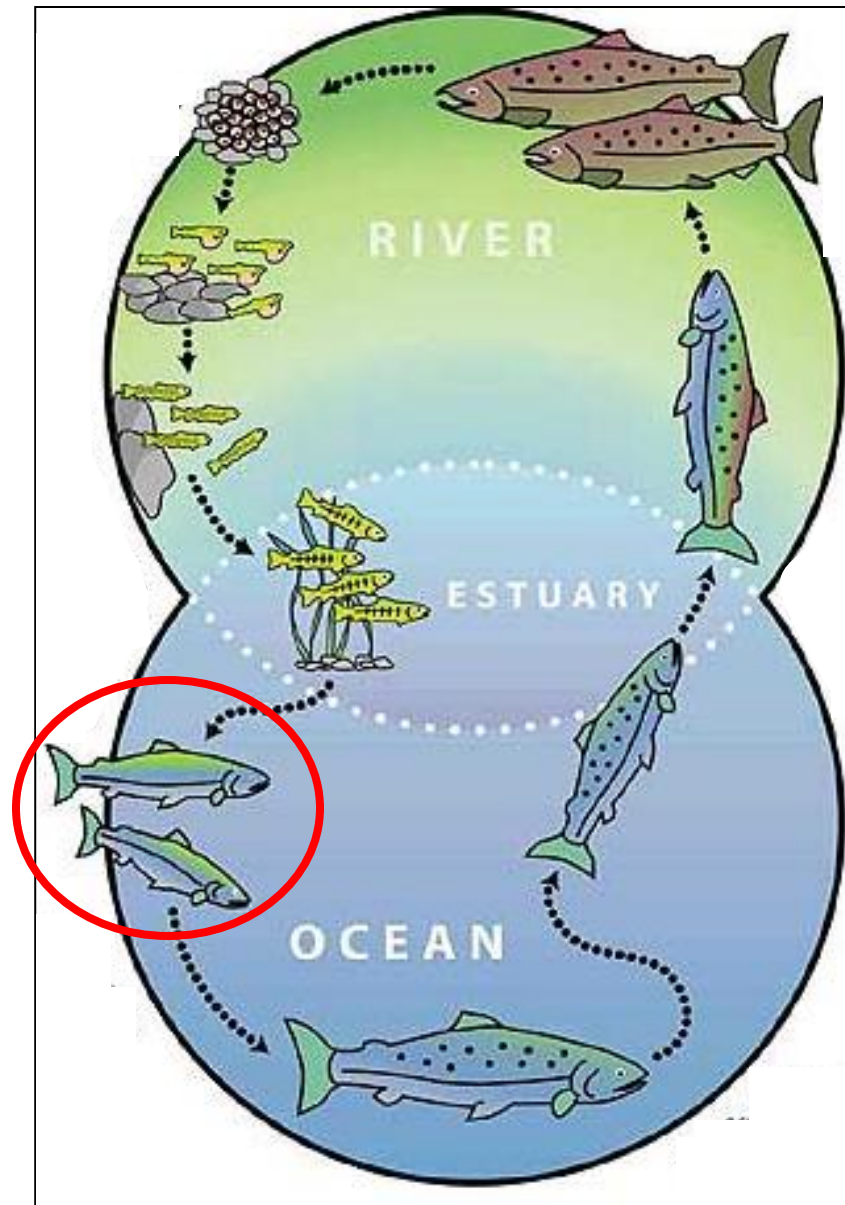
Trophically transmitted parasites as ecosystem indicators: relationships among parasite community structure, juvenile salmon diet composition and ocean conditions



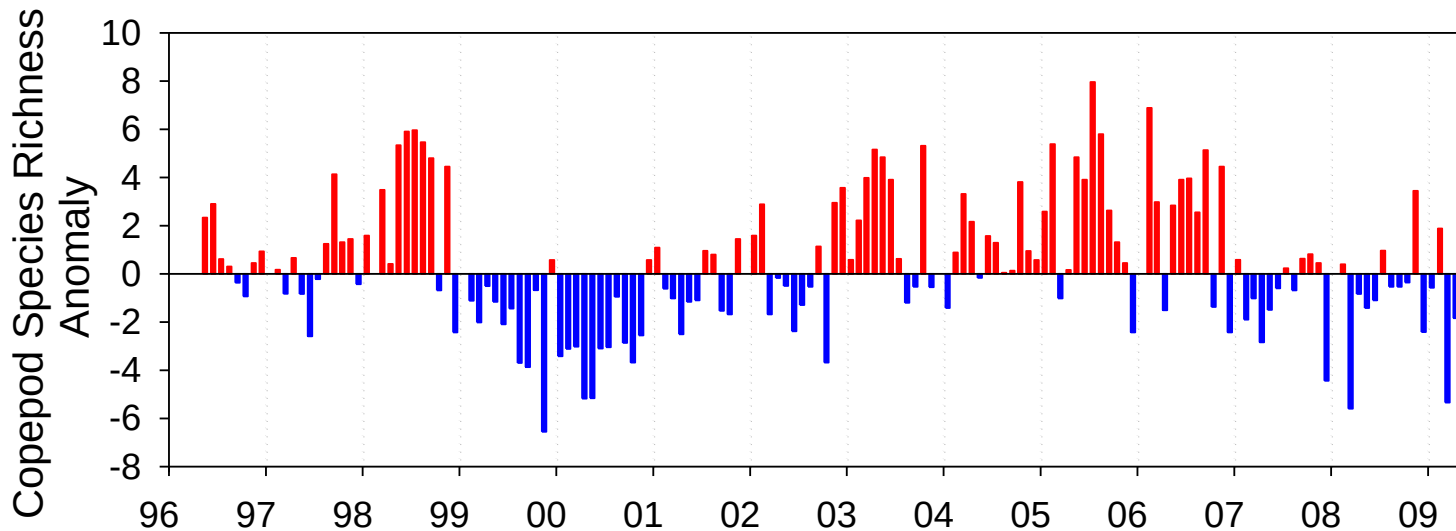
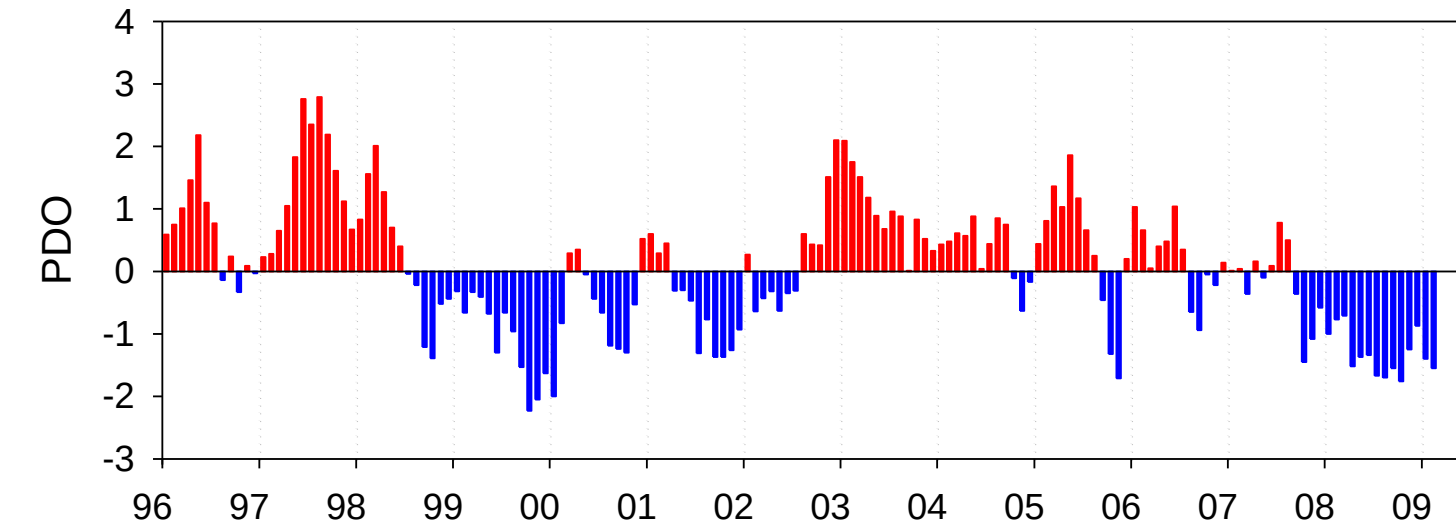
James P. Losee



Generalized Salmon Life Cycle



Pacific Decadal Oscillation (PDO)



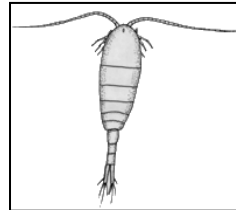
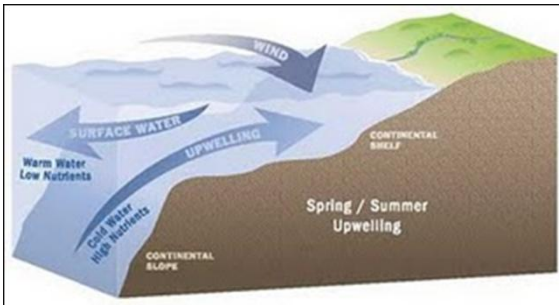
Mantua et al. 1997

YEAR

Peterson et al. 2010

Bottom-up Control

Ocean Conditions → **Plankton** ----→ **Salmon Survival**

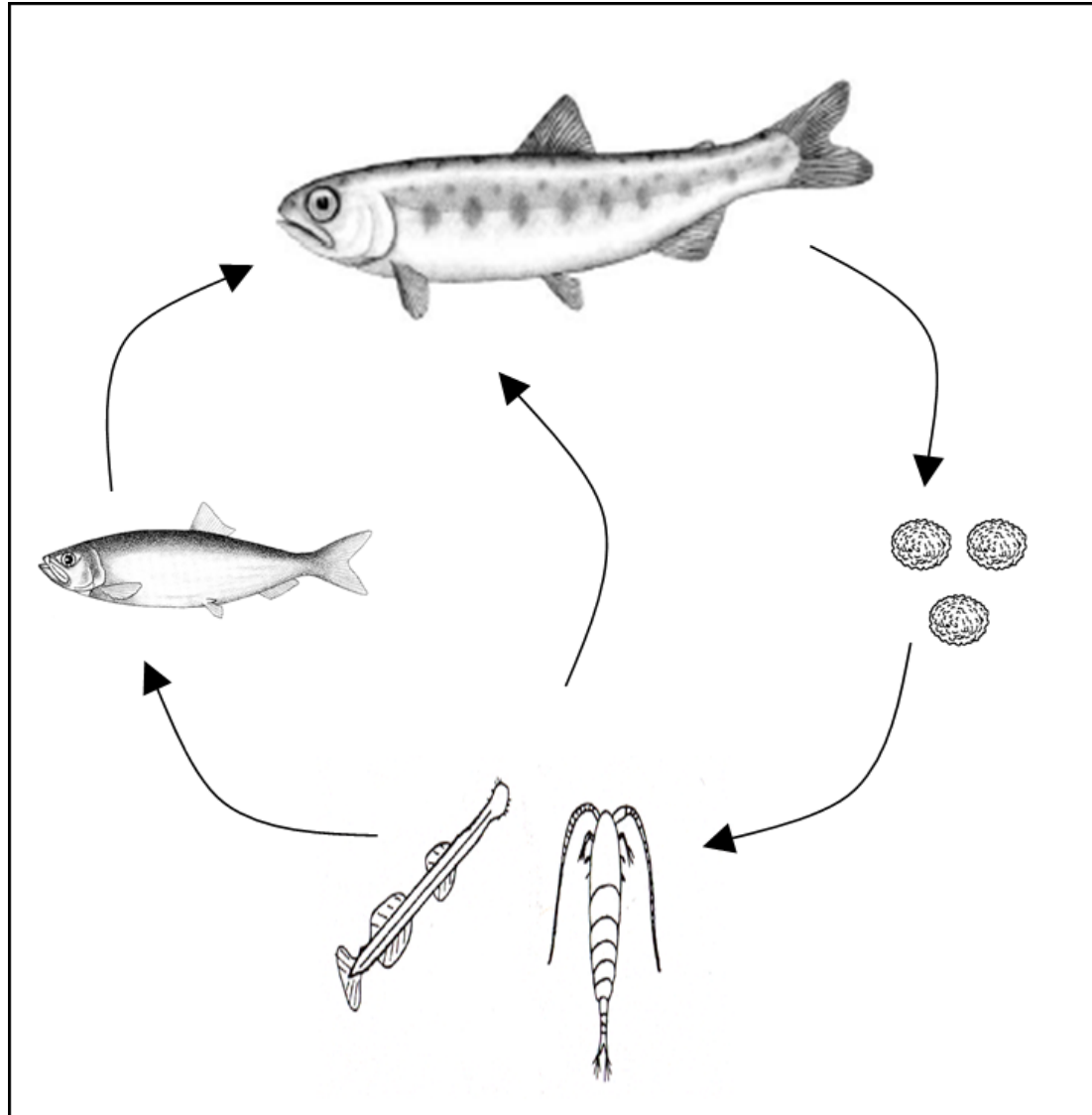


Introduction

- Focus: Trophic interactions of yearling Chinook and coho salmon captured in the Northern California Current in June, 2002-2009.
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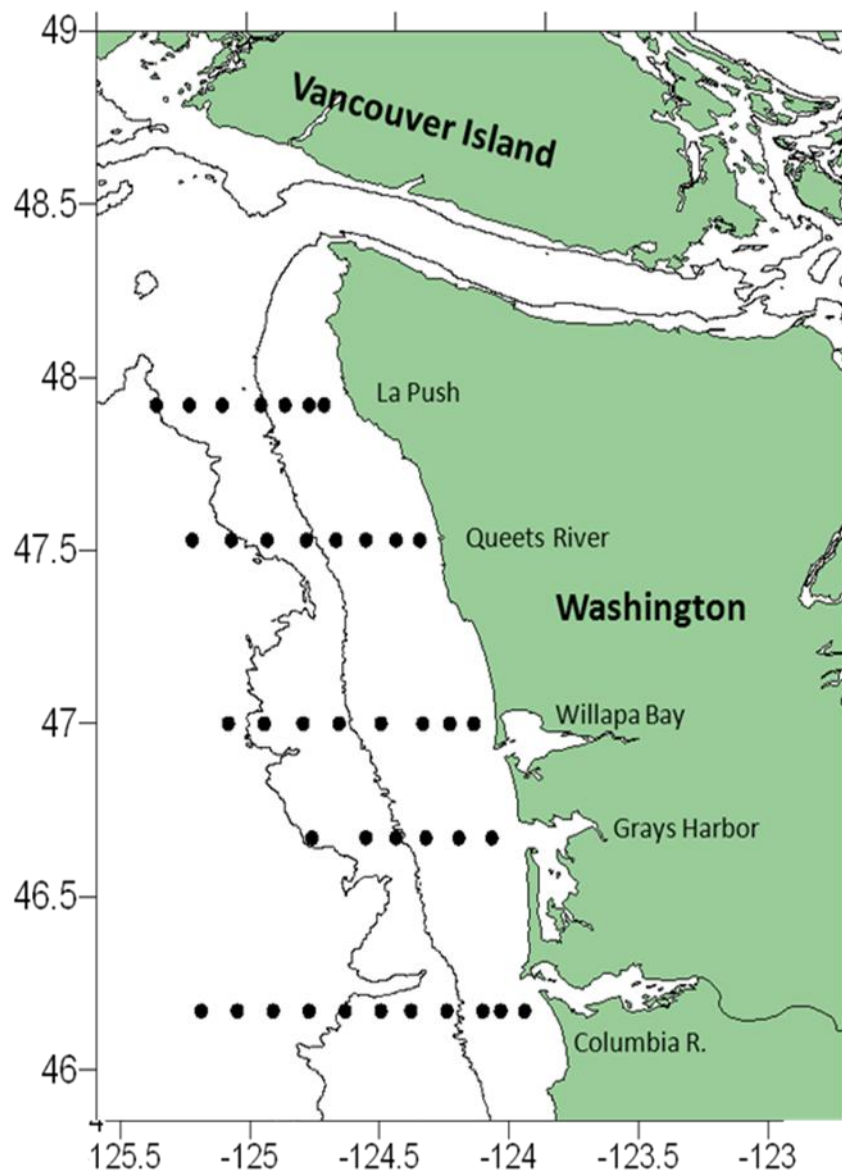
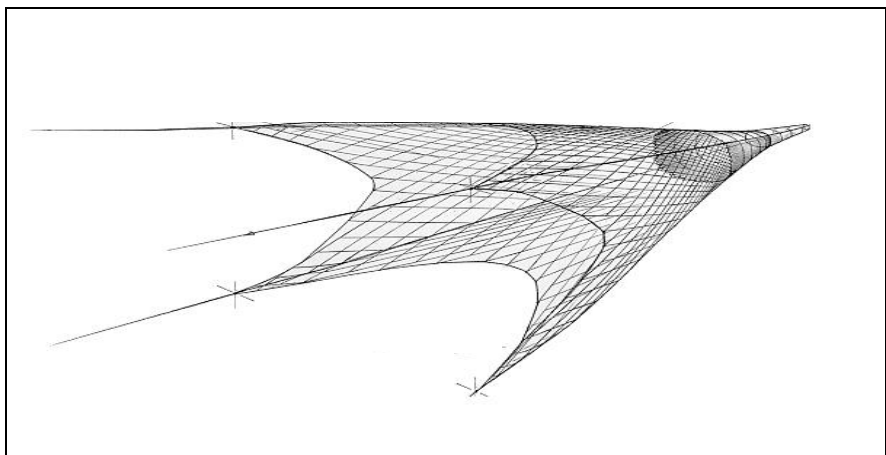


Trophically Transmitted Parasite Lifecycle

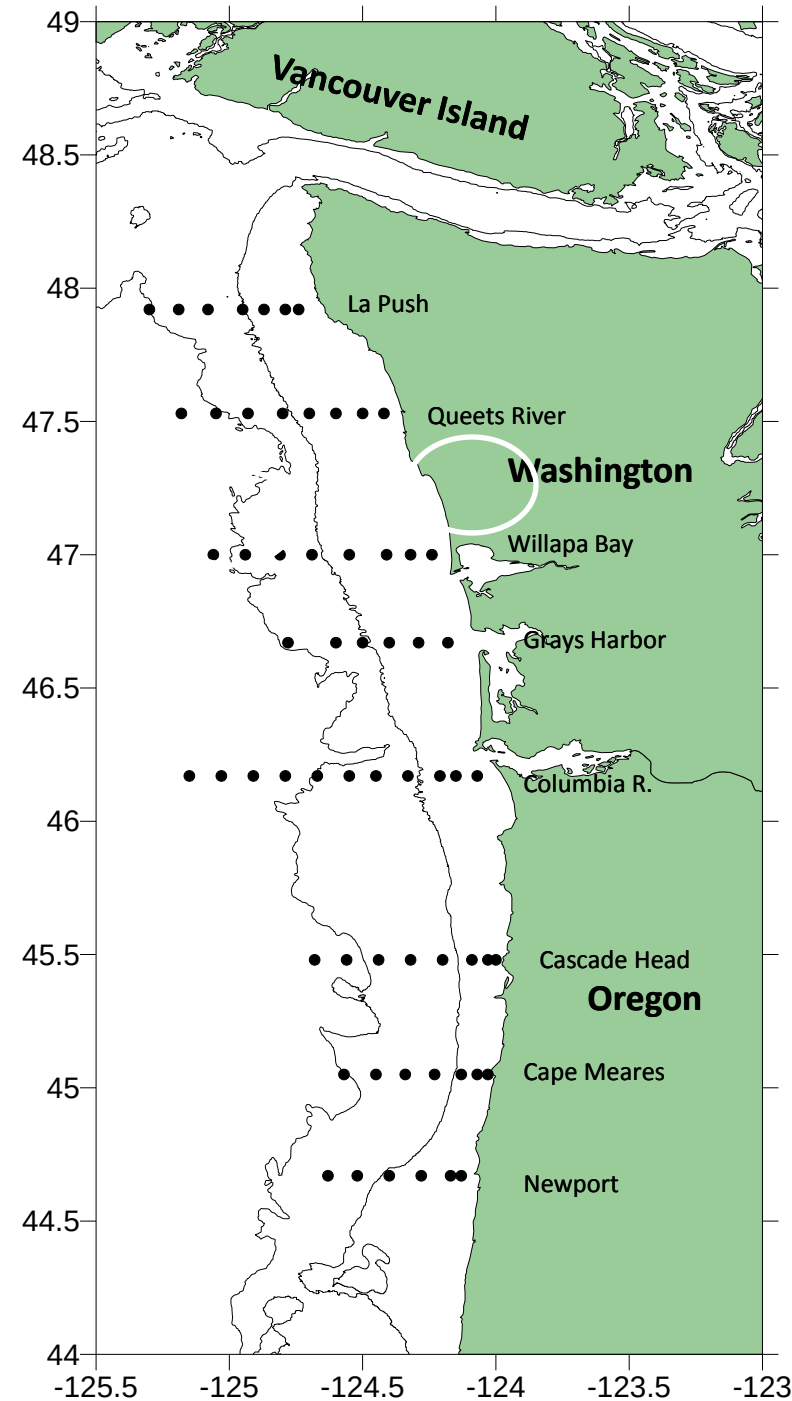


Methods-fishing

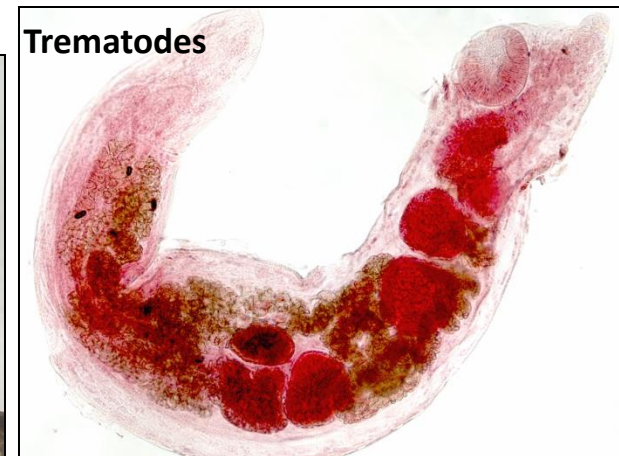
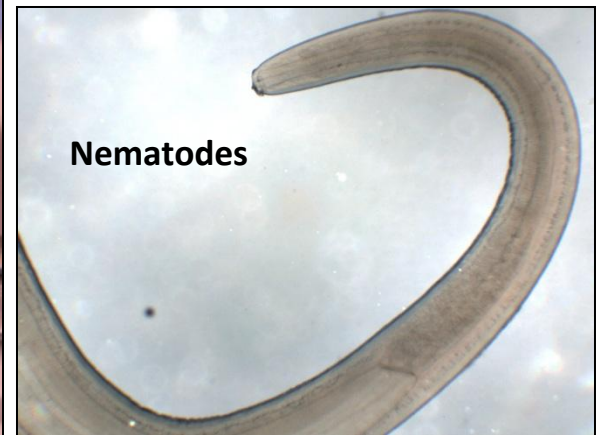
BPA Plume Study 2002-2009-June



Methods-fishing



Methods-parasitology



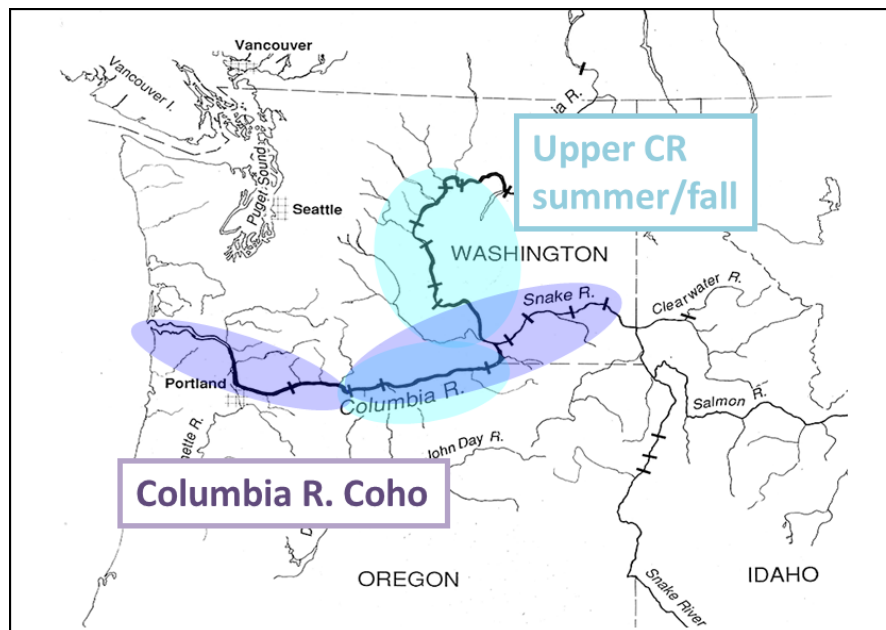
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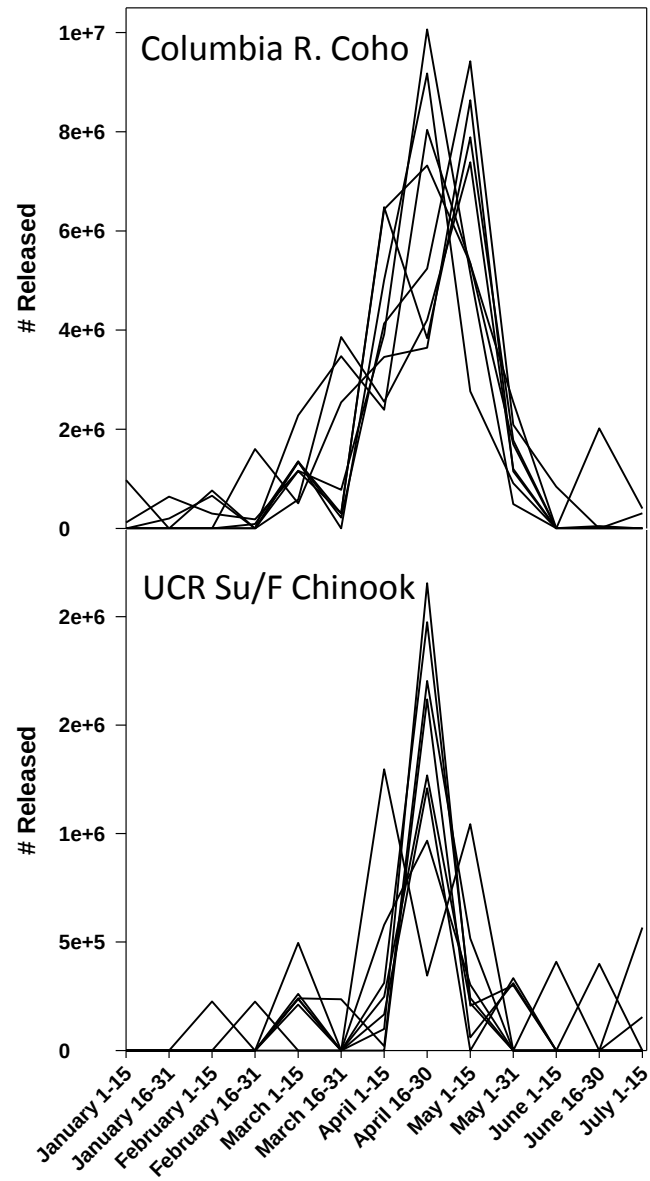
Samples Processed

	Stock	2002	2003	2004	2005	2006	2007	2008	2009	SUM
Chinook	UCR_Su/F	32	29	37	13	35	34	23	31	234
Coho	Columbia R.	68	40	44	19	47	58	48	49	373

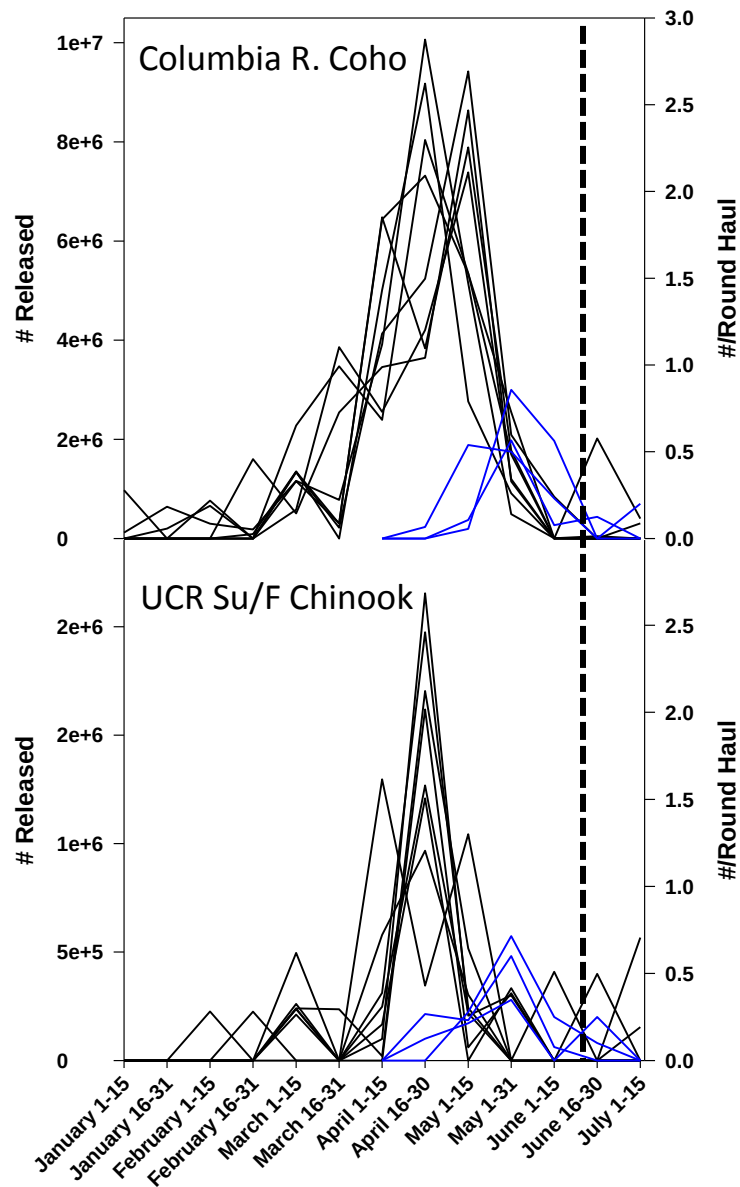


Genetic stock identification courtesy of David Teel using the GAPS coastwide microsatellite baseline

Emigration Timing

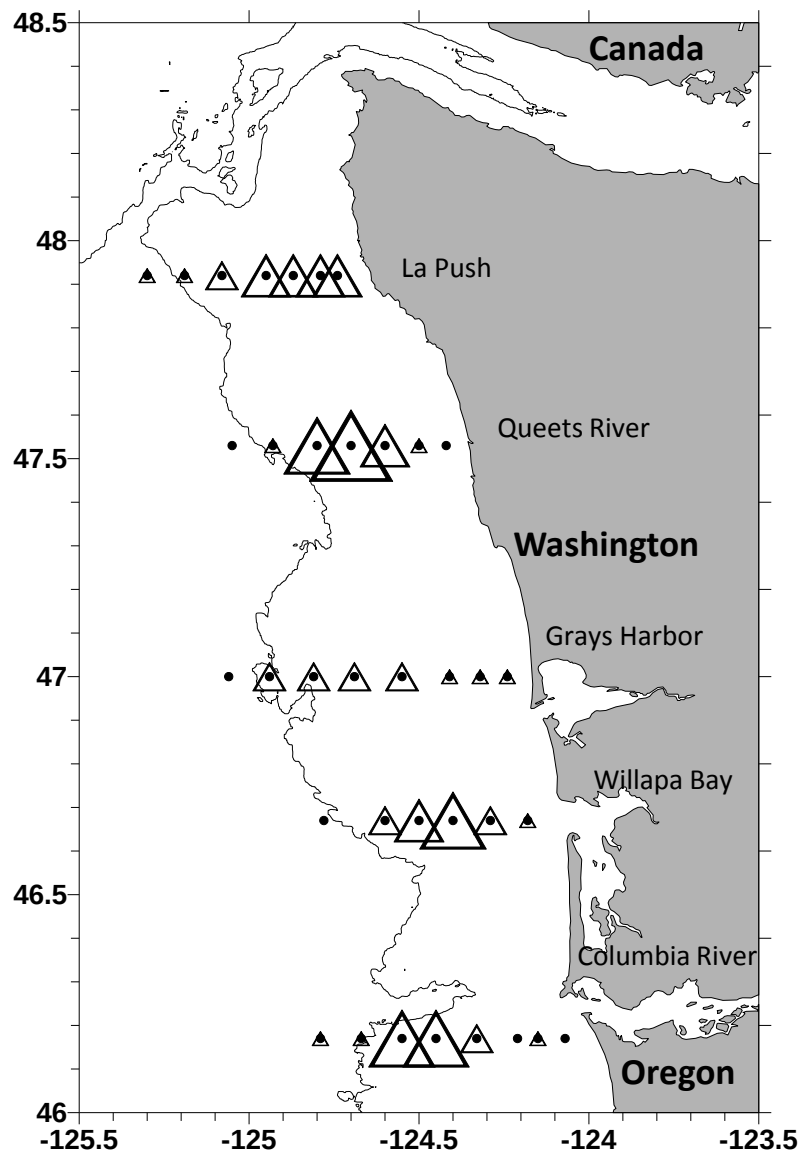


Emigration Timing

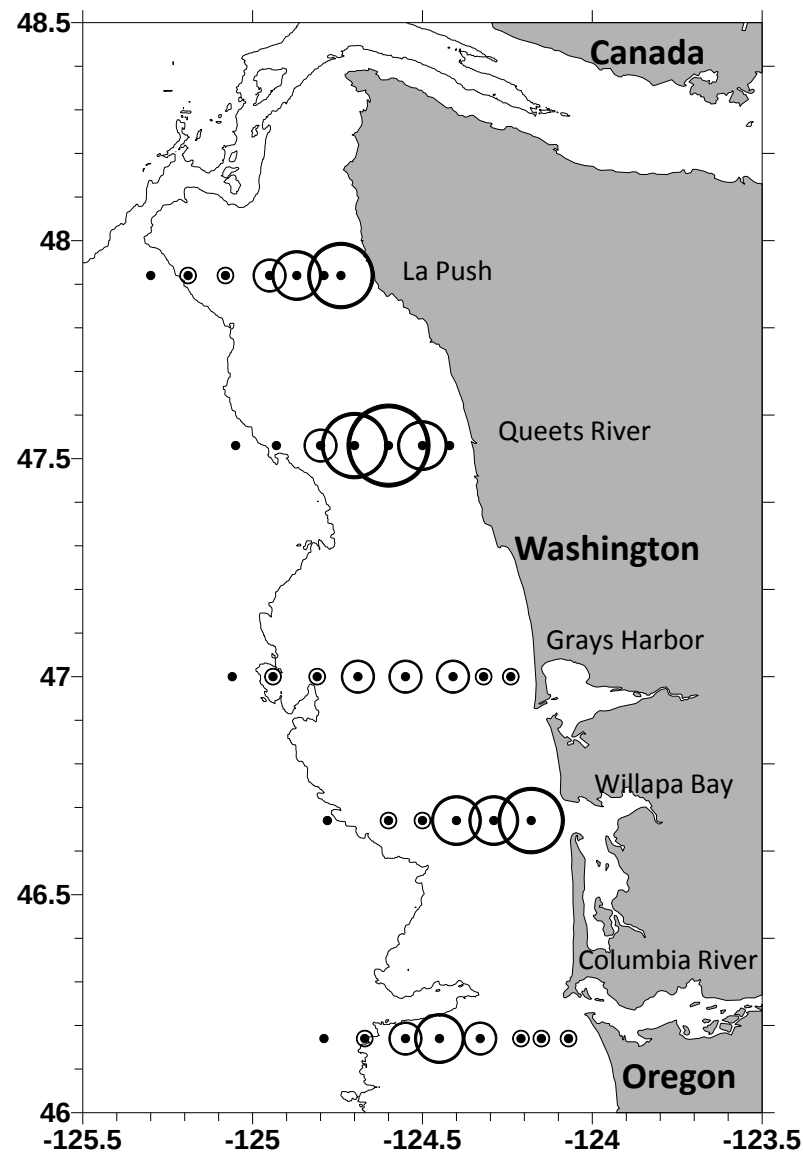


Catch Distribution 2002-2009

Coho Salmon

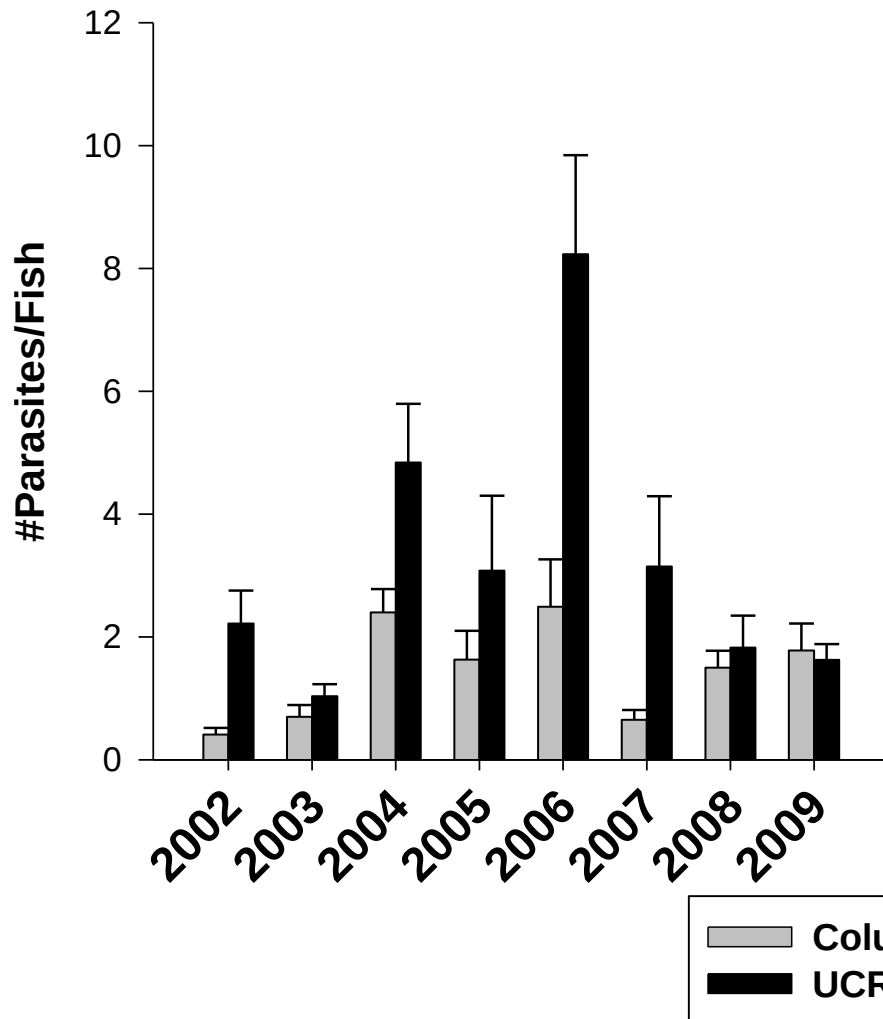


Chinook Salmon

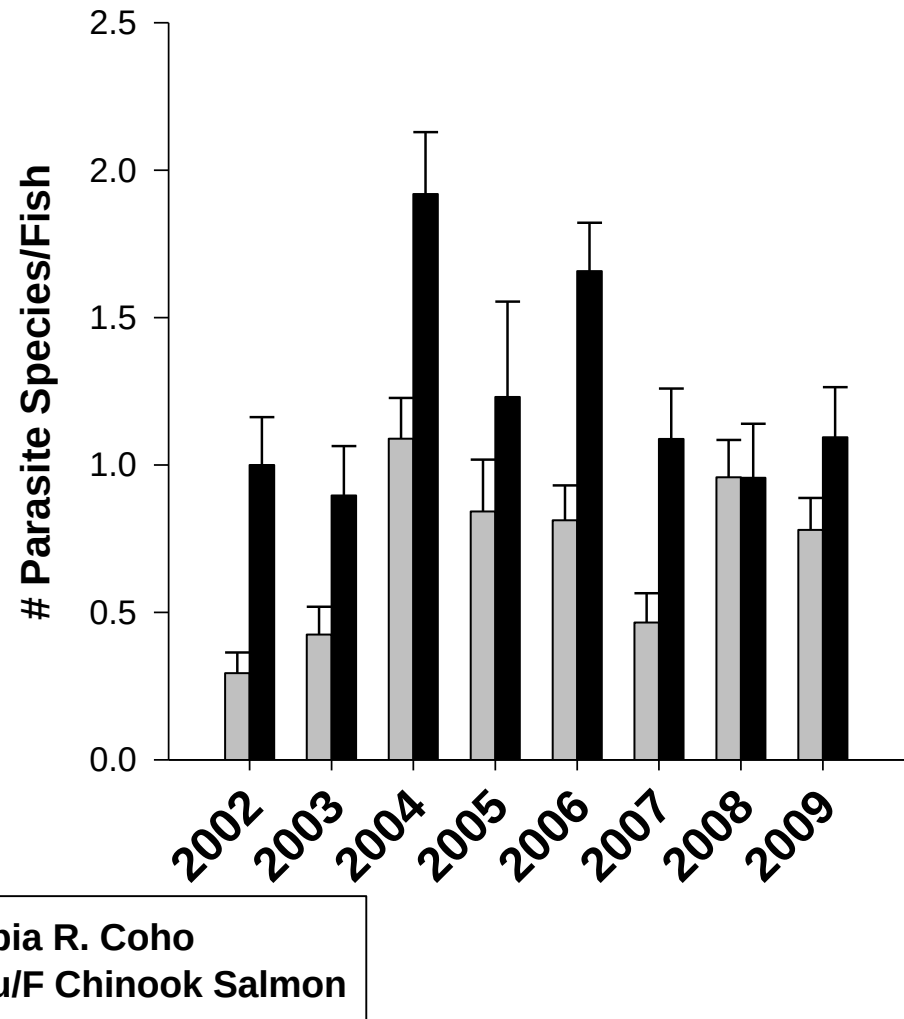


Columbia R. Coho vs. UCR Chinook Salmon

Parasite Abundance

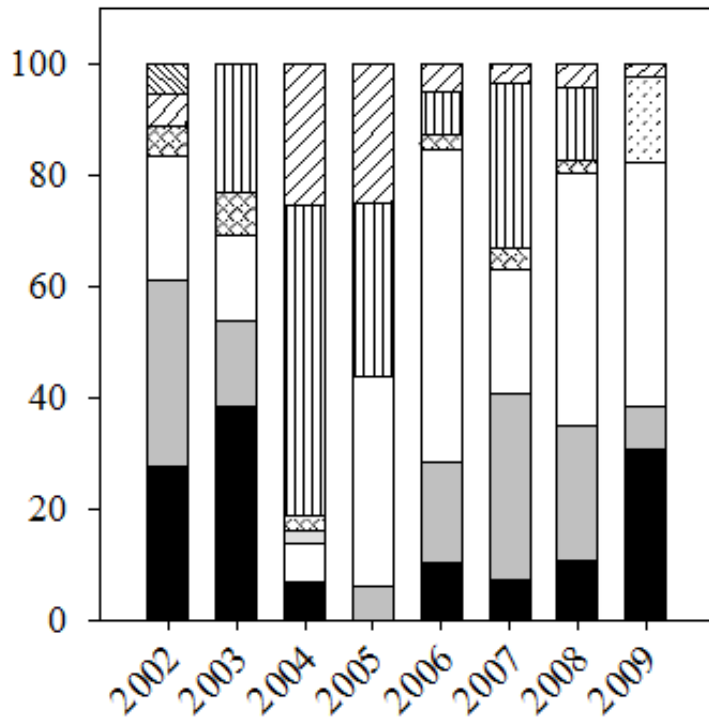


Parasite Species Richness



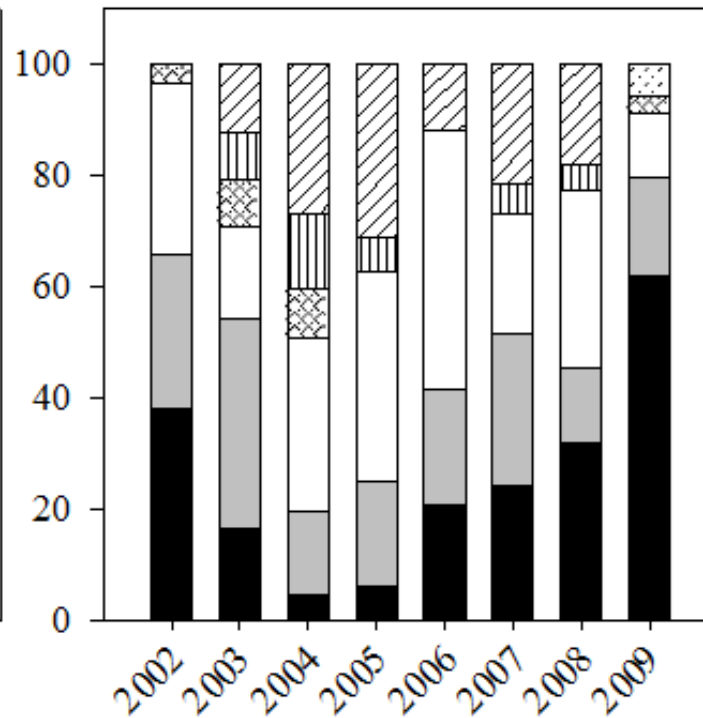
Parasite Composition

Coho Salmon



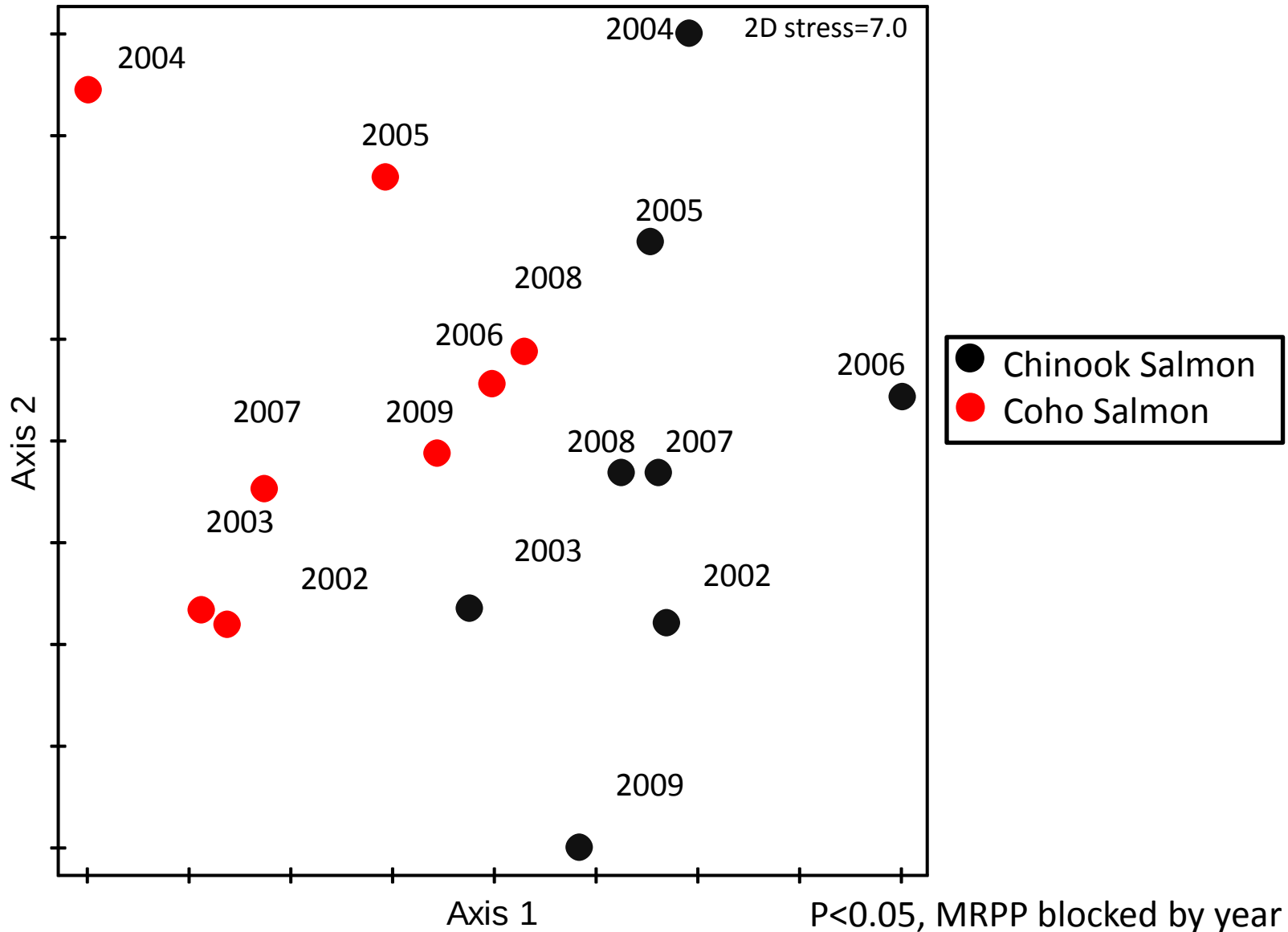
N=373

Chinook Salmon



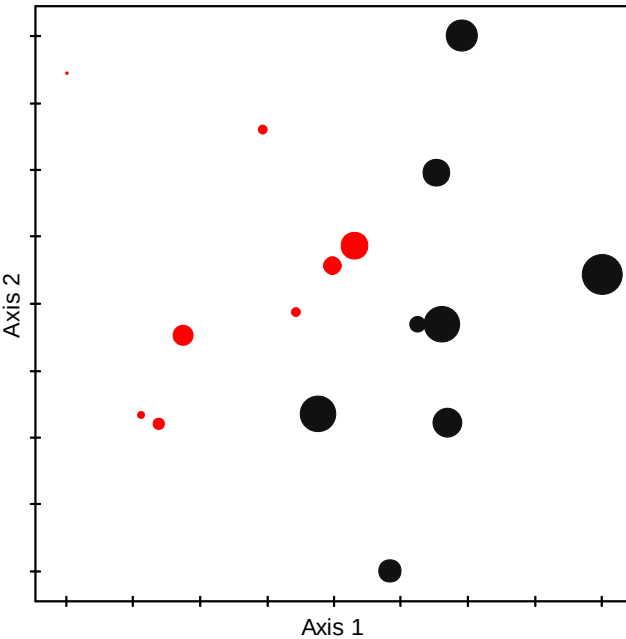
N=234

MDS-Coho and Chinook Salmon by Year

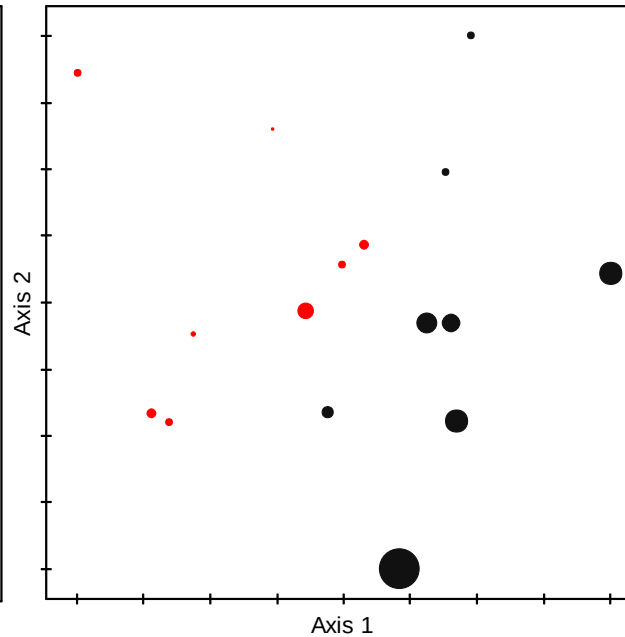


MDS-Coho and Chinook Salmon by Year

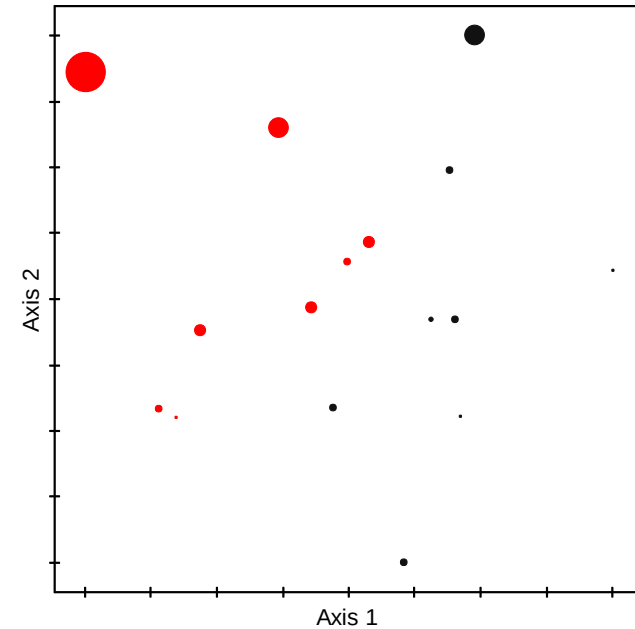
Anisakis simplex



Hysterothylacium aduncum



Rhadinorhynchus trachuri



- Chinook Salmon
- Coho Salmon

Indicator Species Analysis (ISA)

<i>Oncorhynchus</i> spp.	Indicator Species	IV	P	Likely Int. host*
Chinook Salmon	<i>A. simplex</i>	78	0.01	Fish
	<i>H. aduncum</i>	74	0.01	Amphipods
Coho salmon	<i>R. trachuri</i>	64	0.02	Euphausiids

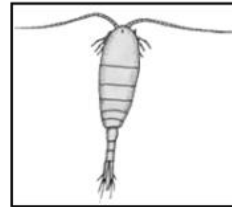
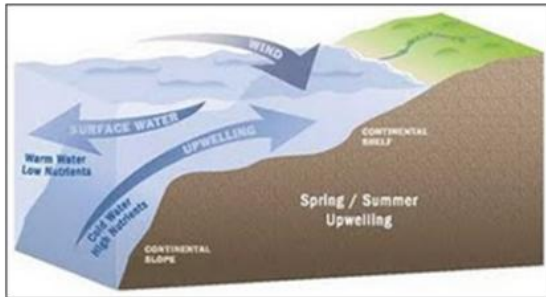
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Ho: Variability in parasite community composition is related to variability in ocean circulation patterns and copepod community.

Ocean Conditions → **Plankton** --> **Salmon Survival**



Local Scale:

- SST (April-June)
- Upwelling (Jan-June)
- Plume Volume (April-June)

Basin Scale:

- PDO (Jan-June)
- N. Pacific Gyre Oscillation (NPGO) (Jan-June)

- Southern Copepod Bio. Anomaly (April-June)
- Northern Copepod Bio. Anomaly (April-June)

Chinook Salmon:

- Counts at P. Rapids Dam (3,4&5 year lag)

Coho Salmon:

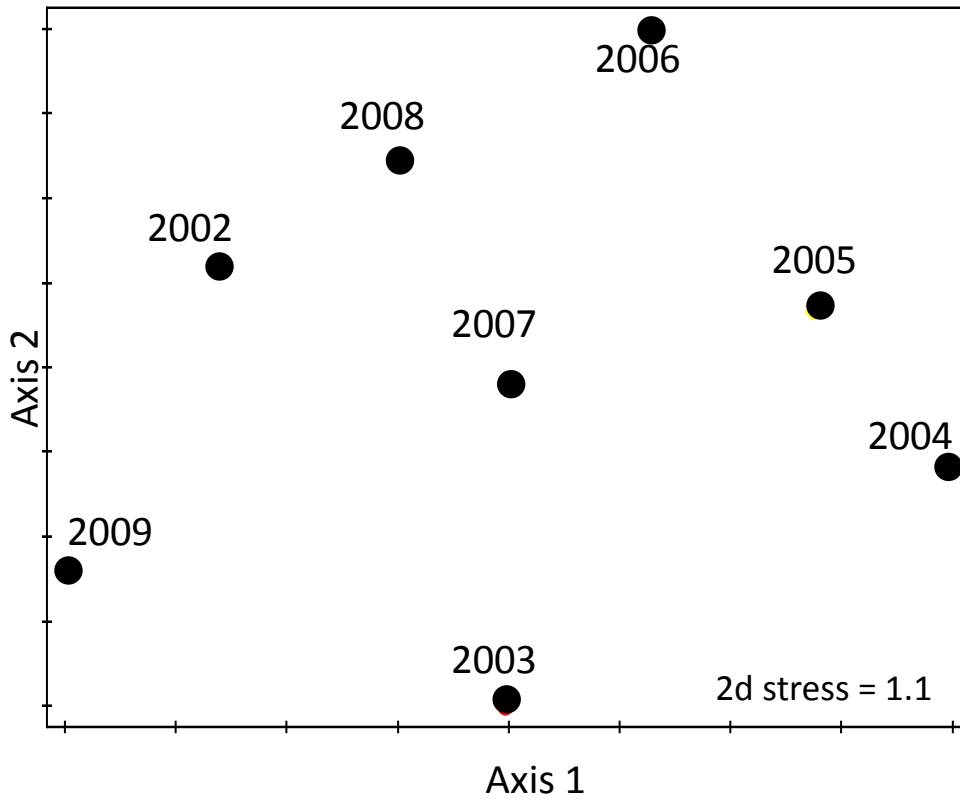
- Oregon Production Index (OPIH)

Parasite Analysis

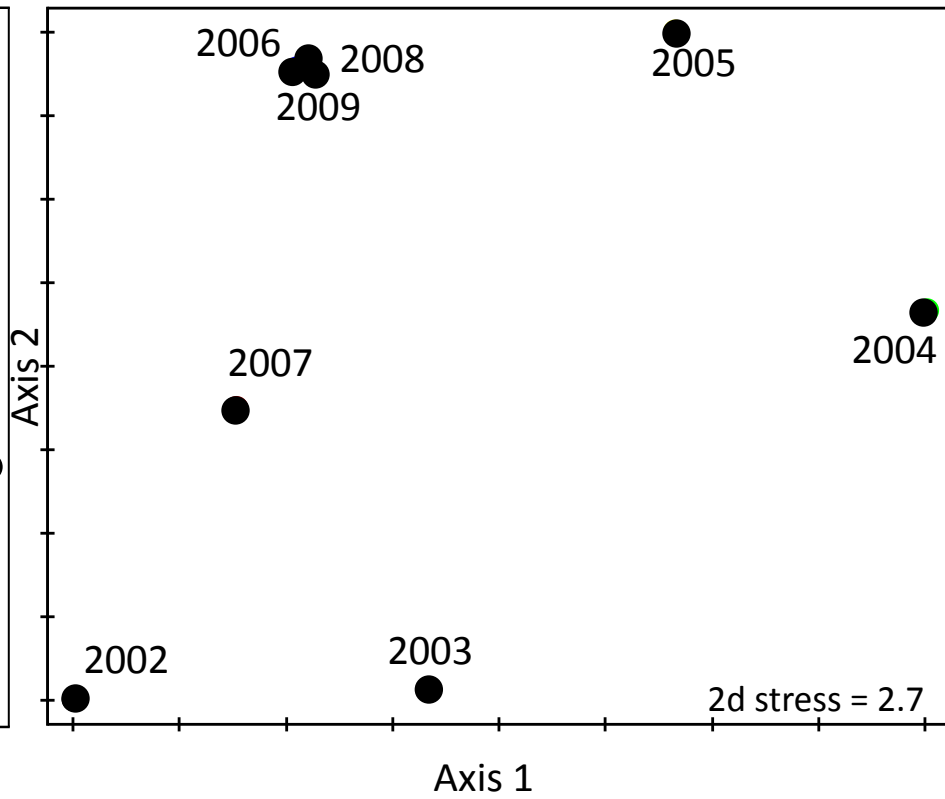
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Community Analysis

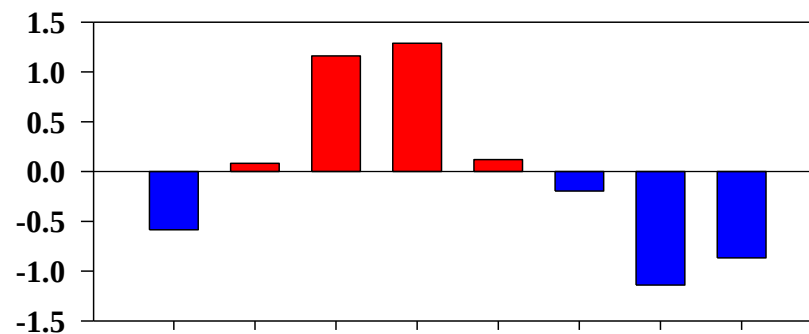
Chinook salmon



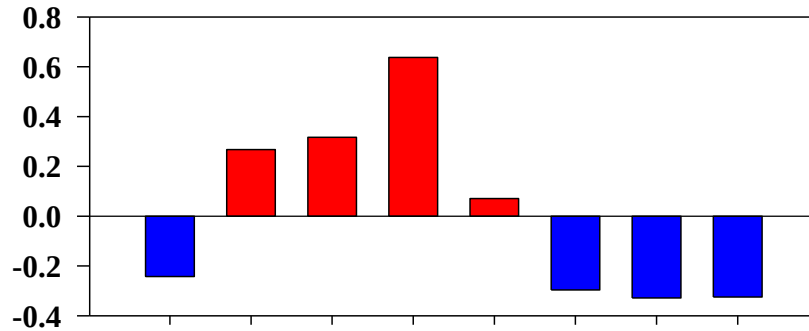
Coho salmon



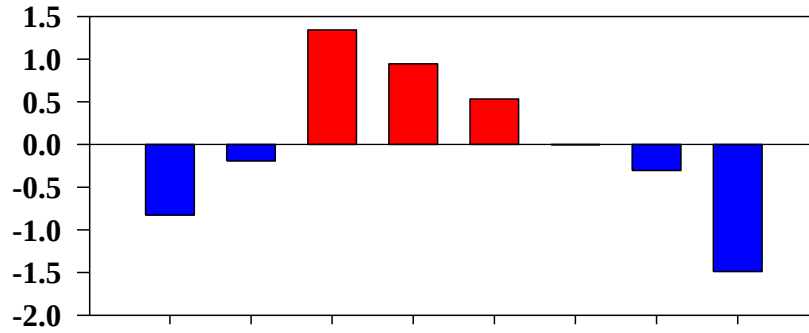
Sea-surface temperature



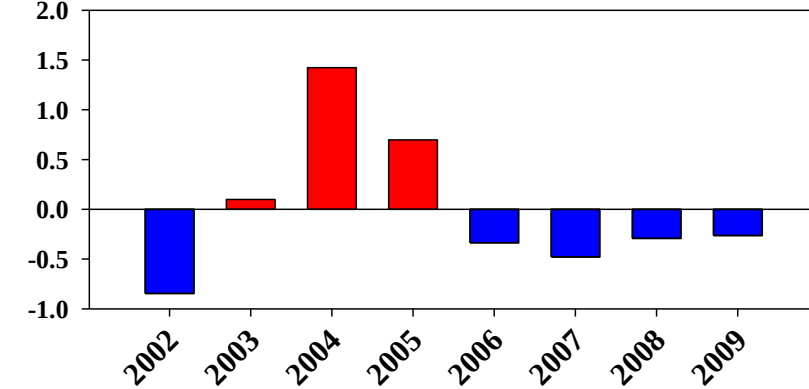
Southern Copepod
Biomass Anomaly



Chinook Salmon
Parasite Community Index



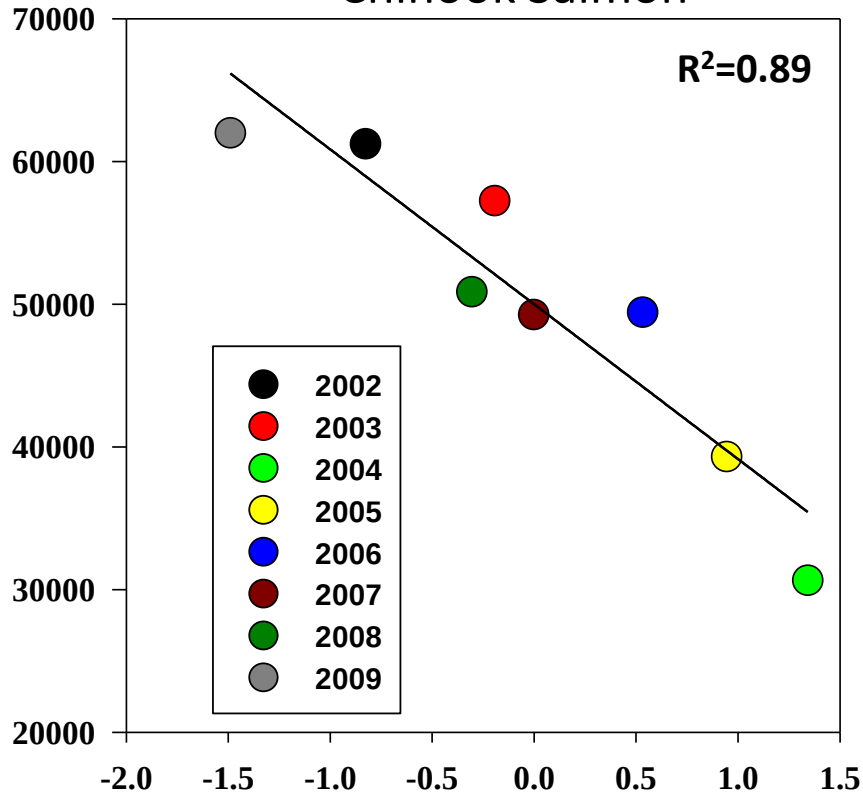
Coho Salmon
Parasite Community Index



Parasites and Salmon Survival

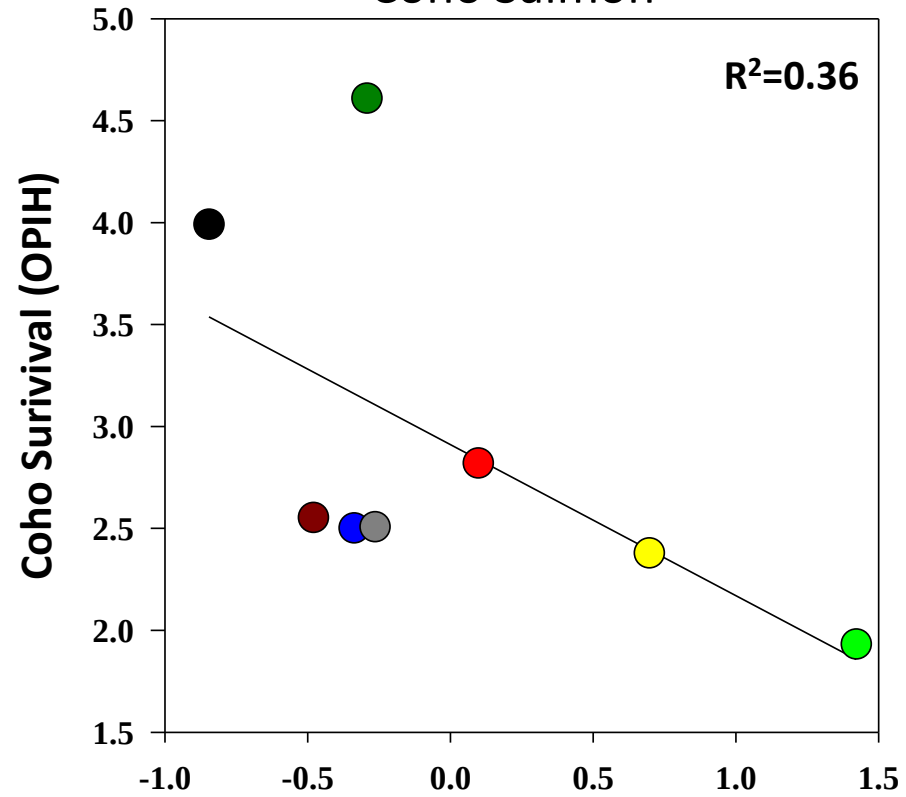
Adult Returns to Priest Rapids Dam (3 year Lag)

Chinook Salmon



Chinook Salmon Parasite Community Index

Coho Salmon

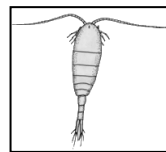
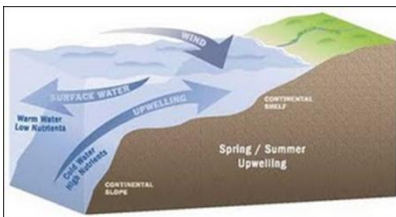


Coho Salmon Parasite Community Index

Conclusion

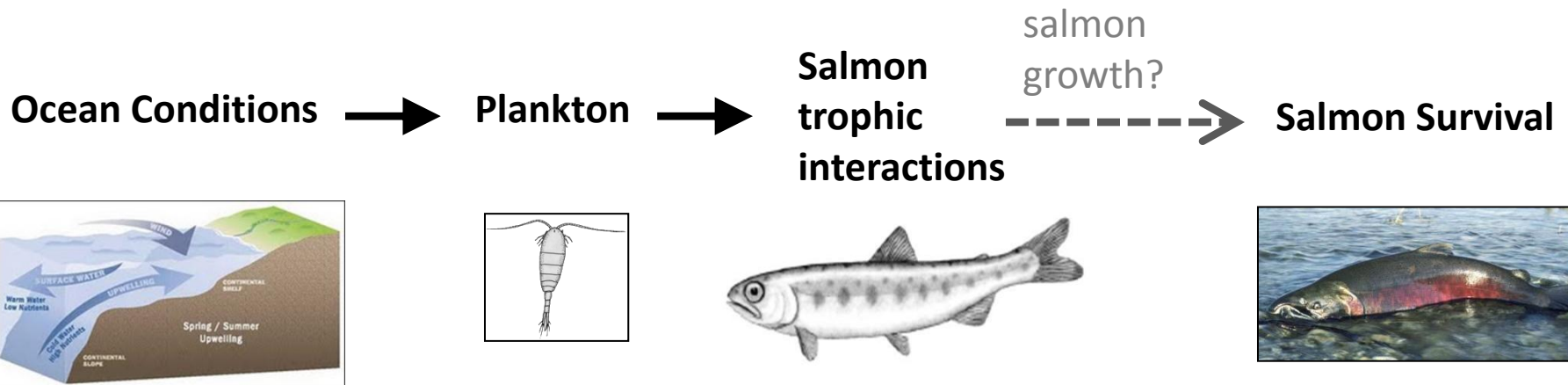
- Parasites enhanced ability to detect interspecific differences in diet and act as an ecosystem indicator for variability at lower trophic levels.
- Coho and Chinook salmon exiting the Columbia River exhibit differences in feeding behavior during early marine residency however. . .
- The trophic interactions (inferred from parasites) of both salmonid species was related to variability in ocean climate

Ocean Conditions **→** **Plankton** **---** **→** **Salmon Survival**



Conclusion

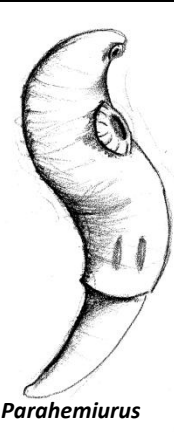
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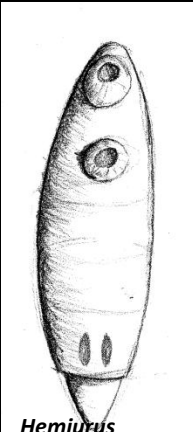
Future Directions

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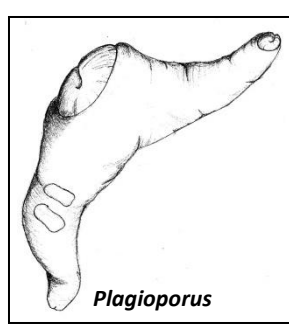




Parahemiurus



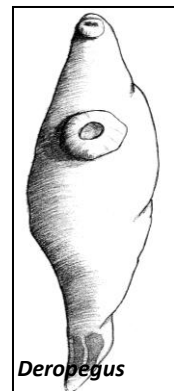
Hemiurus



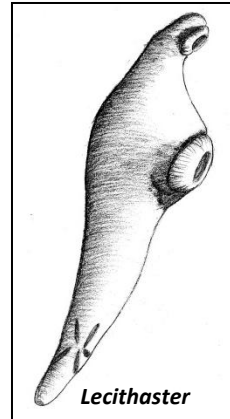
Plagioporus



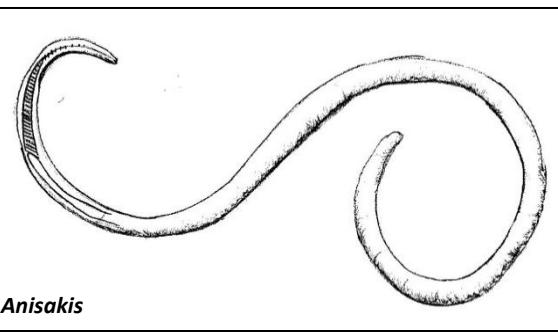
Tetraphyllid Cestode



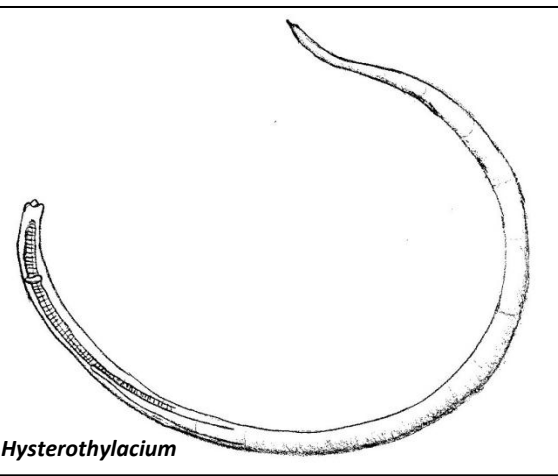
Deropogus



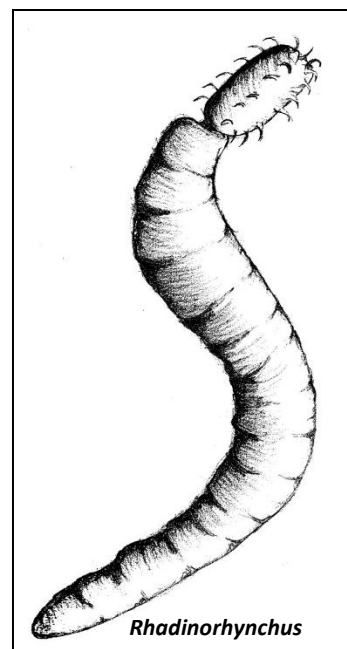
Lecithaster



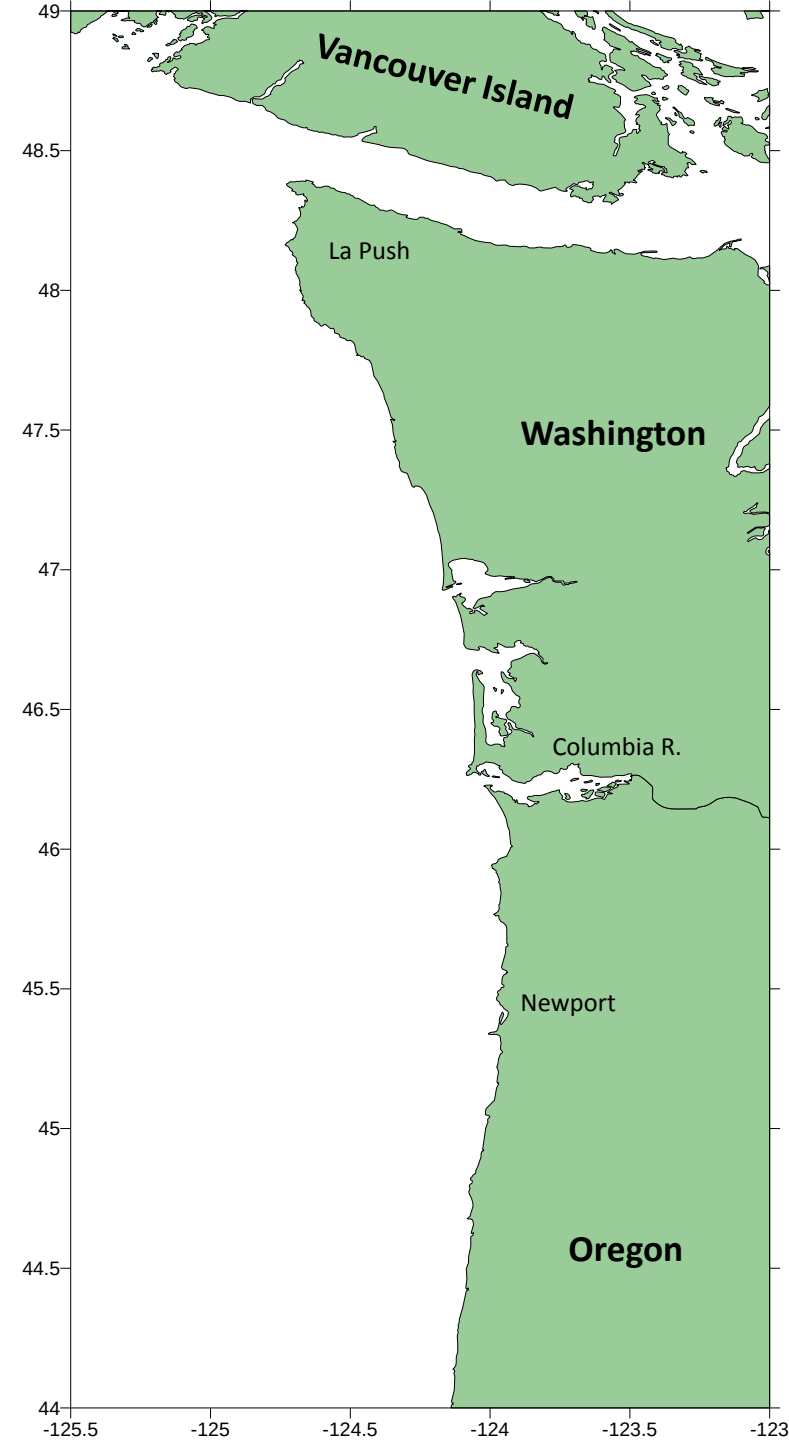
Anisakis



Hysterothylacium



Rhadinorhynchus



Acknowledgments

Graduate advisors: Kym Jacobson, Jessica Miller and Bill Peterson

Co-authors and data contributors: Antonio Baptista, Elizabeth Daly, David Teel, Laurie Weitkamp

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Family: Kate, Finnegan, Juniper

Questions?



Fork Length

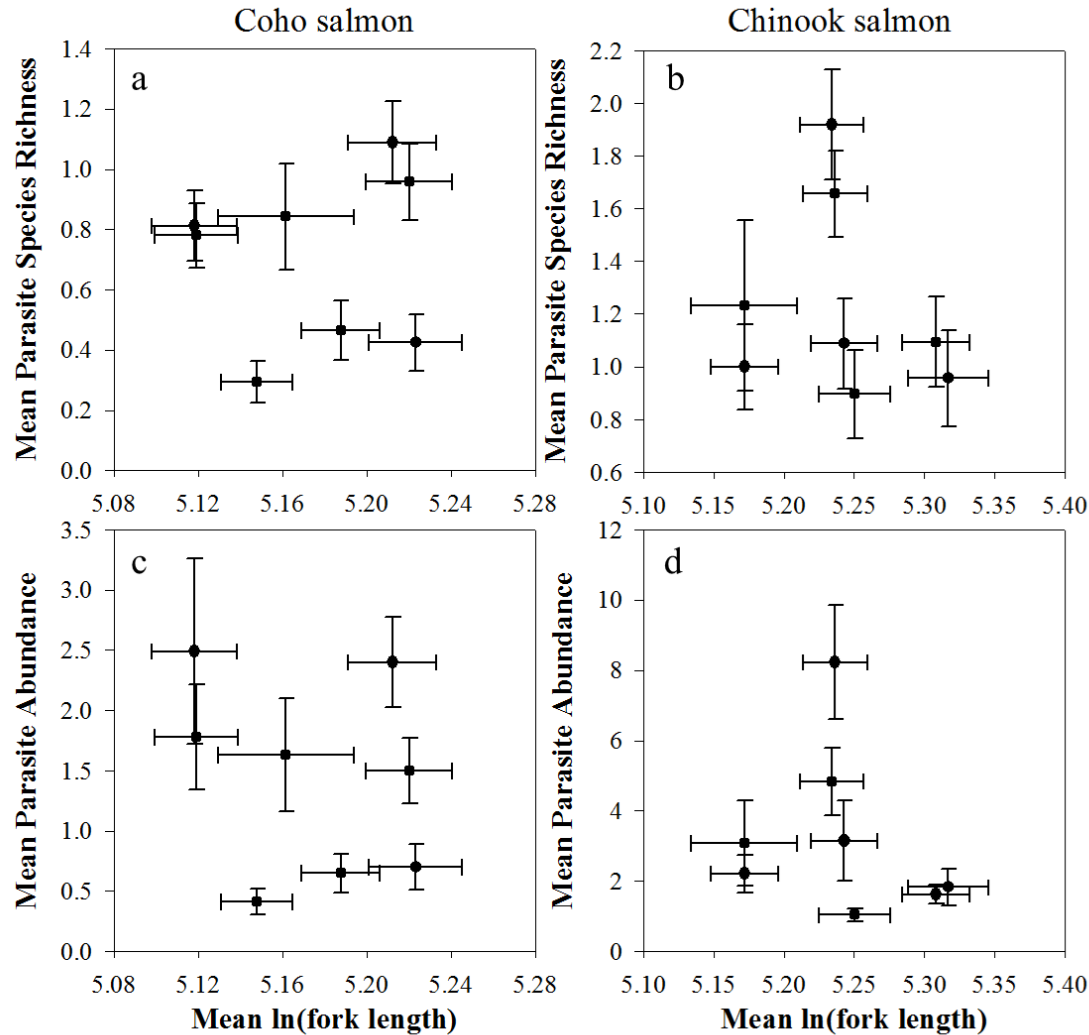
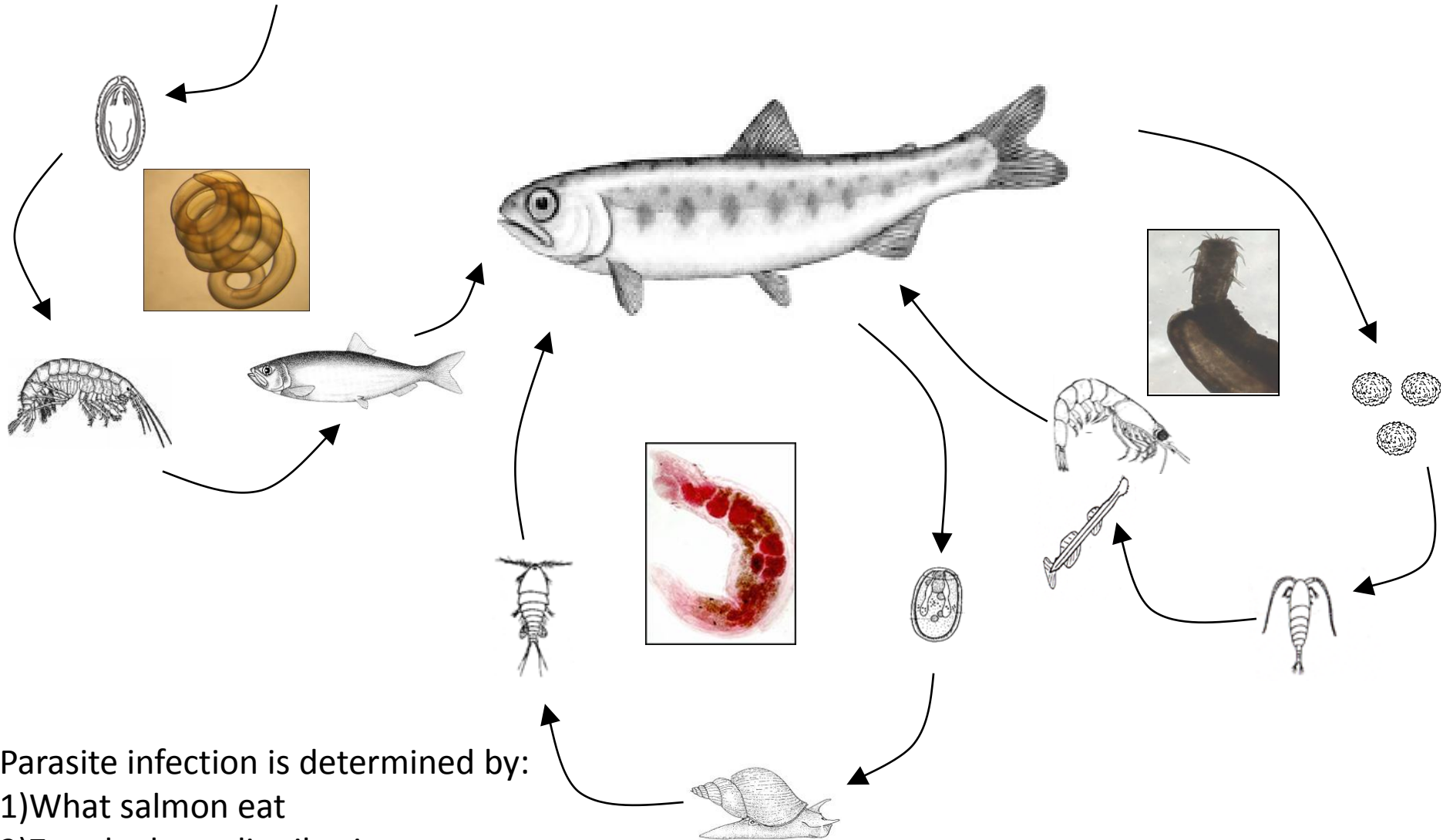


Figure 2.3. Mean natural log transformed fork length ($\pm$ SE) vs. (a&b) mean parasite species richness ($\pm$ SE) and (c&d) mean parasite abundance ($\pm$ SE) for coho and Chinook salmon collected in June of 2002-2009 off the coast of Washington, U.S.

Trophically



Parasite infection is determined by:

- 1) What salmon eat
- 2) Zooplankton distribution