



University  
of Victoria

Graduate Studies

Notice of the Final Oral Examination  
for the Degree of Doctor of Philosophy

of

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BSc (University of Victoria, 2011)

**“The Drivers and Implications of Spatial and Temporal Variation in the  
Feeding Ecology of Juvenile Chinook Salmon”**

Department of Biology

Friday, June 10, 2016

1:30 P.M.

David Turpin Building

Room A144

Supervisory Committee:

Dr. Asit Mazumder, Department of Biology, University of Victoria (Co-Supervisor)

Dr. Marc Trudel, Department of Biology, University of Victoria (Co-Supervisor)

Dr. Julia Baum, Department of Biology, UVic (Member)

Dr. Brian Starzomski, School of Environmental Studies, UVic (Outside Member)

External Examiner:

Dr. Jonathan W. Moore, Department of Biological Sciences, Simon Fraser University

Chair of Oral Examination:

Dr. Stephen Neville, Department of Electrical and Computer Engineering, UVic

## Abstract

Feeding ecology of organisms has a critical influence on ecosystem structure, function, and stability, but how feeding ecology of a single organism varies over multiple spatial and temporal scales in nature is generally unknown. Here, I characterize the factors driving and the implications of variability in feeding ecology of juvenile Chinook Salmon (*Oncorhynchus tshawytscha*) over multiple spatial and temporal scales using stable isotopes and stomach contents. Significant individual-level variation in juvenile Chinook salmon feeding ecology was found to occur off of the west coast of Vancouver Island (WCVI) (British Columbia, Canada) that is correlated with a diet shift from feeding on invertebrates to feeding on fish with increasing size. I developed a novel Bayesian stable isotope method to model this shift while taking into account the time-lag associated with isotopic turnover. I found that this model able to replicate patterns seen in a simplified coastal food web, and that resource-use estimates from this stable isotope model somewhat diverged from a compilation of stomach content data. Next, I compared the feeding ecology of Chinook Salmon in one season and year along nearly their entire North American range. I found considerable spatial variation in ontogeny and feeding ecology, with individuals from different geographic regions having different  $\delta^{13}\text{C}$ ,  $\delta^{15}\text{N}$ , and trophic levels. These differences likely corresponded to regional variability in sea surface temperature, ocean entry date and size, and growth rates. Subsequently, I quantified temporal shifts in the feeding ecology of Chinook Salmon from WCVI. I found that feeding ecology overwinter was different from feeding ecology in the fall, likely corresponding to shifts in the prey field. Finally, I found that WCVI juvenile Chinook Salmon showed significant interannual variability in feeding ecology. I found that the interannual variability in the  $\delta^{13}\text{C}$  value of juvenile salmon (indicative of primary productivity or nutrient source) predicts their smolt survival. In turn, large-scale climate variability determines the  $\delta^{13}\text{C}$  values of salmon—thus mechanistically linking climate to survival through feeding ecology. These results suggest that qualities propagated from the base of the food chain have a cascading influence that is detectable in salmon feeding ecology. I conclude that the feeding ecology of juvenile Chinook Salmon varies on individual, spatial, season and interannual scales, and that this variability has impacts on survival rates. These findings have implications for the understanding of ontogeny in natural systems in general, allowing for modelling of ontogeny in previously intractable ecological systems. Furthermore there may also be implications for Chinook Salmon management, considering that feeding ecology showed utility as a mechanistic leading indicator of survival rates.