Juvenile salmon prey consumption and bioenergetics: comparing Discovery Islands-Johnstone Strait Corridor and Rivers Inlet feeding

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Abstract

The Discovery Islands-Johnstone Strait corridor (DJC), British Columbia has previously been identified as a potential bottleneck in success of out-migrating Fraser River juvenile salmon stocks. This hypothesized critically poor feeding region has been proposed in many studies as the Trophic Gauntlet Hypothesis (TGH). Using 24-hr feeding surveys and gut evacuation experiments from the Discovery Islands (DI) from 2017 we calculated daily rations for sockeye, pink, and chum salmon and compared these *in-situ* daily rations to daily rations necessary to meet bioenergetic demands, as determined by bioenergetic modeling. As a reference site, daily rations were also calculated for sockeye and pink salmon in Rivers Inlet between 2008-2010, a biologically productive region. Contrary to the TGH, daily rations showed that juvenile salmon from both regions are feeding sufficiently to meet metabolic needs and some growth. However, they are likely not feeding quite enough to reach growth rates of 2.27% WW/day, an estimated average for Pacific Northwest juvenile salmon. DI salmon had very high gut evacuation rates and low gut fullness indices while RI salmon exhibited the opposite behaviors; this resulted in comparable daily rations between study sites. However, gut evacuation rate experiments indicated that DI salmon could be eating very high proportions of gelatinous prey, a lower energy-dense food in wet weight, which may mean that they are not receiving sufficient prey in terms of energy density. Further investigation in zooplankton caloric content in the DJC region should be explored. Conclusions on the Trophic Gauntlet Hypothesis will help better inform salmon stock management and forecasting.

Lay Summary

Juvenile salmon out-migrate from river systems to the ocean in the spring where feeding opportunities are more optimal. Many salmon stocks in British Columbia out-migrate from the Fraser River into the Strait of Georgia and head Northwest through the Discovery Islands and Johnstone Strait. Previous studies have shown juvenile salmon stocks migrating through the Johnstone Strait-Discovery Island corridor (DJC) to have poor health. Because of the unique and strong ocean mixing conditions in this corridor, a hypothesis has previously been formed, named the "Trophic Gauntlet Hypothesis", suggesting that these unique mixing conditions create a region of poor feeding for juvenile salmon. To further investigate this hypothesis, data collected on salmon stomach fullness over 24-hour surveys and consumption rates were used to calculate how much a typical juvenile salmon in this region consumes per day. Then, using modeling and literature values from previous salmon physiological experiments, we created models estimating how much a juvenile salmon should be consuming to reach metabolic and growth demands. We also did the same calculations for salmon in a reference site approximately 400 km up the coastline from Vancouver, BC, called Rivers Inlet. Our consumption calculations compared to our models did not indicate that juvenile salmon in the DJC were experiencing starvation during surveys in 2017 nor that they had notably different daily consumption rates than the Rivers Inlet salmon. However, daily consumption calculations may not show the whole picture if DJC salmon are eating poorer quality food as suspected.