Potential effects of increasing water temperature on growth and migration timing of juvenile Chinook salmon in Oregon coastal habitats: a proposal

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Juvenile Chinook salmon background

- In Oregon, majority enter brackish/ocean water as sub-yearlings during summer when they inhabit estuary, surf zone and coastal ocean
- High mortality occurs during first ocean summer potentially due to size-selective mortality
- Growth rates of juveniles during this critical period may influence future survival
- Similar sizes observed at standard collection times in surf zones and estuaries (Fig. 1) suggests juveniles of similar characteristics inhabit both environments
- Abundance and timing of arrival to surf zone is related to estuarine water temperature

Influence of temperature on fish growth

- Growth rates are constrained by sub-optimal temperatures, low prey abundances and/or poor prey quality
- Temperature is the most important factor regulating metabolic processes and growth rates
- When adequate prey resources are available, maximum juvenile salmonid growth rates occur at approximately 13°C (Fig. 2)
- If temperatures in estuaries or surf zones surpass 13°C, juvenile growth and survival rates may be substantially reduced.
- At present, water temperature in Oregon coastal estuaries during summer is approximately at optimum for growth
- In Pacific Northwest, increases in water temperature predicted to occur in near future may allow values to surpass optimum for growth in estuaries

Goals and objectives

- To determine the influence of increased water temperatures on the growth rates of juvenile Chinook salmon using a bioenergetic approach
- Objectives:
  A. Model juvenile consumption rates in two Oregon estuaries, Alsea and Coos Bays, and their adjacent sandy beach surf zones
  B. Model juvenile growth rates based on predictions of increased water temperature from International Panel of Climate Change

Modeling methods

Objective A: Model current consumption rates in estuaries and surf zones

\[ Consumption = Growth + Metabolism + Waste \]

- Wisconsin Bioenergetics Model: species parameters
- Locally obtained data: growth rates (otolith analysis), diet proportions, energetic content, temperature (2008-2010)
- Juveniles and temperature data collected in Alsea and Coos Bays and adjacent sandy beach surf zones (Fig. 3,4)
- Prey energetic content obtained by collecting prey with hyperbenthic sledge and analyzing with bomb calorimeter, and from literature

Objective B: Model future growth rates

\[ Growth = Consumption - Metabolism - Waste \]

- Estimate future estuarine and surf zone water temperature with predictive mixing model and predicted increases in water temperature (IPCC)
- Model growth rates using future temperature and present day consumption rates, and energetic content and prey proportion

Expected outcomes

- Estuarine temperatures in 2008-2010 surpassed the optimum temperature for salmonid growth (13°C, Brett 1969) during ~30% of the summer (Fig. 5)

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