Hatchery and Wild Stock Interactions of Juvenile Chum Salmon in Marine Waters of Southeastern Alaska: A Bioenergetics Approach

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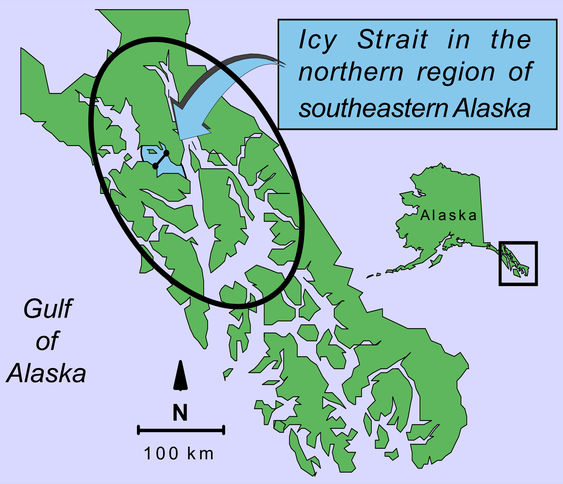
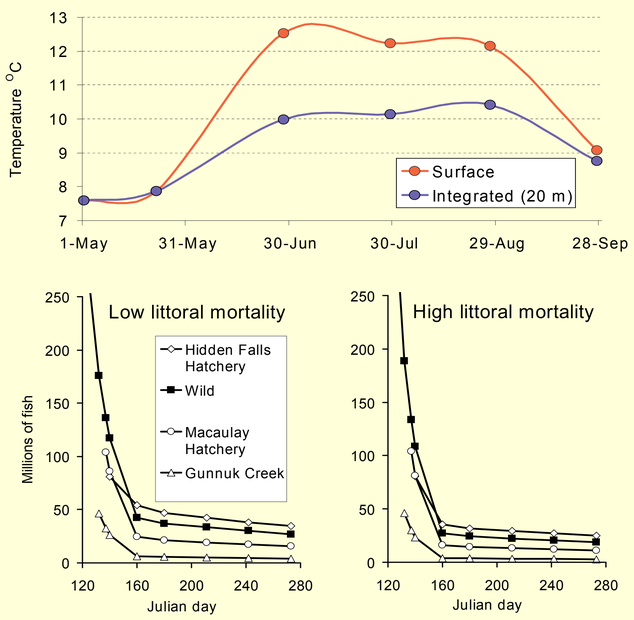


As part of the Southeast Alaska Coastal Monitoring project, the interactions of hatchery and wild stocks of juvenile chum salmon (*Oncorhynchus keta*) migrating seaward were studied in littoral (nearshore) and neritic (epipelagic offshore) marine habitats in southeastern Alaska. Bioenergetics modeling was used to estimate prey consumption by different salmon stock groups during their first five months at sea. Model runs were completed using biophysical data collected in Icy Strait, a regional salmon migration corridor, in May, June, July, August, and September of 2001.

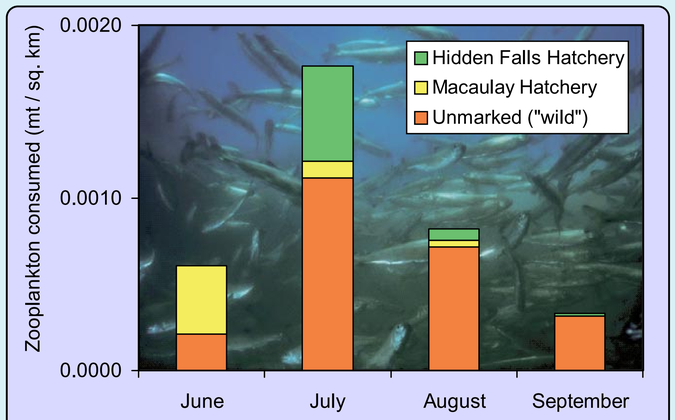
These data included temperature (1-m surface versus surface to 20-m average), zooplankton standing crop (surface to 20-m depth versus entire water column), salmon diet (percent weight of prey type consumed), and energy densities, weight, and growth of juvenile chum salmon. Literature values were used for energy densities of salmon prey items. Known numbers of hatchery releases were used in a cohort reconstruction model to estimate total abundance of hatchery and wild chum salmon in the northern region of southeastern Alaska given average survival to adults, and for two different (low and high) early marine littoral mortality assumptions.

Total prey consumption was relatively insensitive to temperature differences associated with the depths potentially utilized by juvenile chum salmon. However, the magnitude and temporal patterns of total prey consumed differed dramatically between the low and high mortality assumptions. Daily consumption rates from the bioenergetics model and juvenile salmon densities from Icy Strait were used to estimate amount and percentage of zooplankton standing crop consumed by hatchery and wild chum salmon. We estimated that only a small percentage of the available zooplankton was consumed by juvenile chum salmon, even during peak abundances of hatchery and wild fish in July.

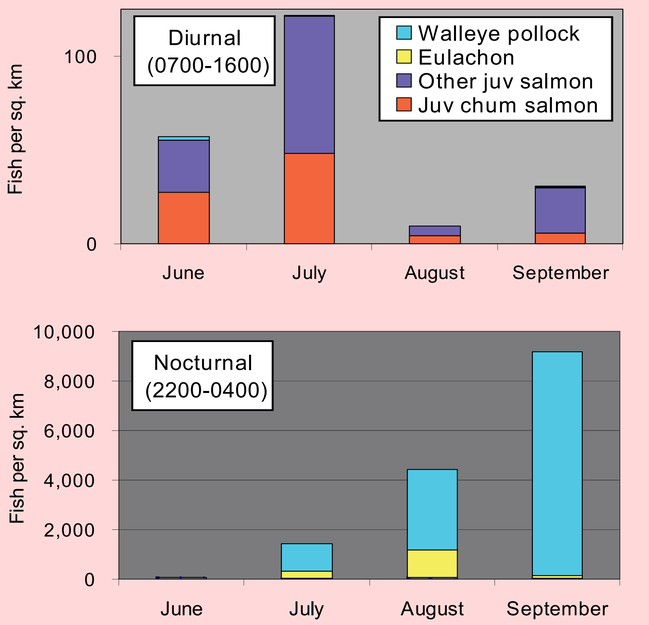
Under the modeling assumptions, these results indicate that current levels of hatchery production in southeastern Alaska do not represent a significant impact on the prey resource available to wild chum salmon stocks in neritic marine habitats represented by the Icy Strait migration corridor. As with any modeling exercise, model outputs can be misleading if input parameters and underlying assumptions are not valid; therefore, additional studies are warranted, especially to refine physiological input parameters specific to juvenile chum salmon.



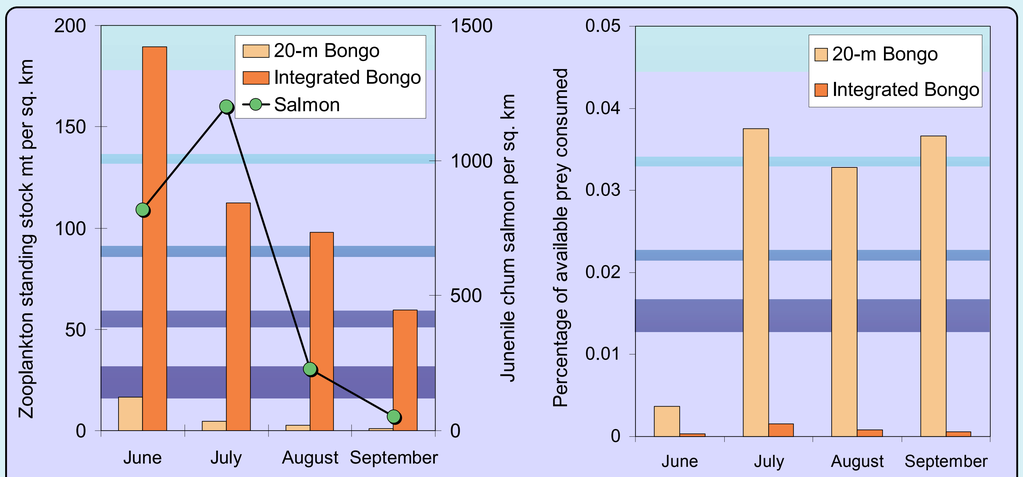
Temperature and mortality assumptions used to model zooplankton consumption by wild and hatchery juvenile chum salmon in the northern region of southeastern AK



Estimated zooplankton consumption by hatchery and unmarked stocks of juvenile chum salmon in Icy Strait

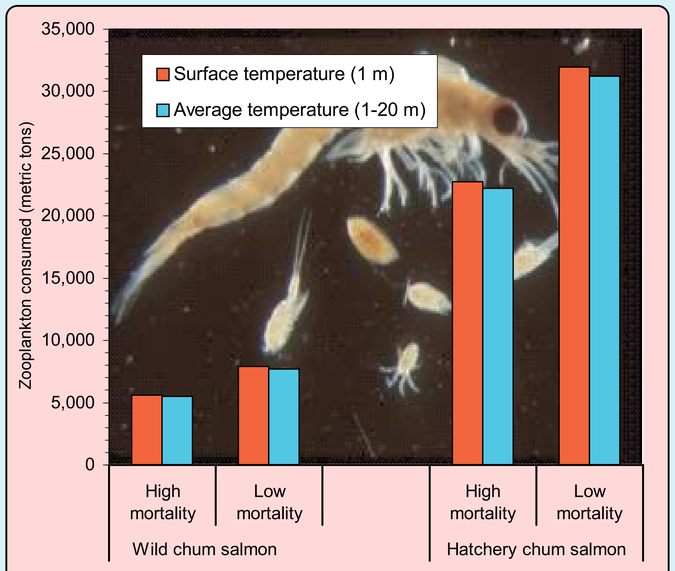


Diurnal versus nocturnal abundance of juvenile chum salmon in relation to other planktivorous fishes sampled at one station in Icy Strait

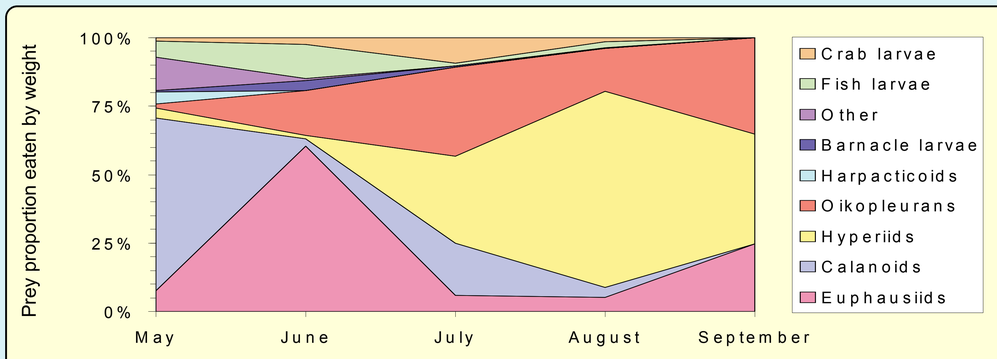


Zooplankton standing crop and juvenile chum salmon abundance in Icy Strait

Percentage of the available zooplankton consumed by juvenile chum salmon



Estimated consumption of zooplankton by wild and hatchery juvenile chum salmon in the northern region of southeastern Alaska



Seasonal diet of juvenile chum salmon in Icy Strait

Conclusions

- Maximum consumption rates of zooplankton by both hatchery and unmarked stocks of juvenile chum salmon were greatest in Icy Strait during July.
- Hatchery and unmarked chum salmon consumed a small percentage of the available standing crop of zooplankton in Icy Strait.
- Juvenile salmon relative to other planktivorous fishes are probably a minor component of the trophic demand on zooplankton.
- Further bioenergetics modeling of planktivores that co-occur with juvenile salmon is needed to quantify predation pressure on zooplankton standing crop.
- Bioenergetics is a useful approach to evaluate marine habitat quality and carrying capacity of juvenile salmon; however, further refinement of input parameters is needed to improve model accuracy.