



North Pacific Research Board *Project Synopsis*

PROJECT 327

FUNDING SUMMARY

Principal Investigators

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US Geological Survey

Year funded

2003

Research period

May 2003–January 2007

Budget

\$624,025

Estuarine ecology of chum salmon in Kuskokwim Bay, western Alaska

LIFE AT THE MOUTH OF A RIVER

Chum salmon (*Oncorhynchus keta*) face lifelong challenges, but an especially critical period occurs when they reach estuaries—mouths of rivers—and begin to make their way out into the ocean, where they will spend several years before returning to their home streams to spawn. Many chum die during this period, as they physiologically adapt to marine water and adjust to a new environment with unfamiliar predators and prey.

WHY WE DID IT

We wanted to learn more about patterns of estuarine distribution, diet, condition, and growth of juvenile chum in Kuskokwim Bay, and to model the growth potential of outmigrating juveniles. Knowing more about patterns in environmental conditions, food availability and use, length of residence, and growth of juveniles will allow us to develop and evaluate stronger hypotheses of population regulation in western Alaska chum salmon, particularly in light of observed changing climatic conditions in the Bering Sea.

HOW WE DID IT

In 2003 and 2004, we collected hydrographic data, zooplankton prey, and juvenile chum throughout the bay. We identified zooplankton prey, examined salmon diets, analyzed energy density, and assessed post-emergence age and estuarine residence. We then used these data as variables in a model that allowed us to assess the growth potential of outmigrating cohorts of juvenile chum salmon in the different habitats of Kuskokwim Bay.

WHAT WE DISCOVERED

The timing of outmigration and spatial distribution of juvenile chum salmon appear to be critically important to their feeding conditions and feeding

(Continued)



Sampling platform for 2004, F/V Namorada (Nicola Hillgruber)

The Big Picture

On their journey from freshwater to marine habitats, juvenile chum salmon encounter dramatic changes in environmental conditions that affect their potential survival. Our research revealed that the lowest growth potential for juvenile chum occurred in inshore habitats where salinity is relatively low. Juveniles spent less than 30 days in these areas, which could mean that inshore areas in Kuskokwim Bay do not provide optimal nursery habitat.

NPRB Research Interest

We addressed NPRB's mission to improve our understanding of the Bering Sea ecosystem and its fisheries by focusing on a critical early marine life stage of chum salmon. Knowing more about what affects juvenile survival will improve our understanding of this important fisheries resource.



RESEARCH THEME

Fish and Invertebrates

success, energy density (calories per gram of body weight), and growth. Models showed that the lowest growth potential for juvenile chum salmon occurred in inshore habitat.

Environmental conditions changed remarkably during our observation of juveniles' estuarine residence from mid-May until late July: sea surface temperature more than doubled from 7°C in May to 16°C in June. At the same time, the fish lost energy density with size and season, with fish of similar size exhibiting a lower condition in June than in May. We also observed many empty fish stomachs, likely a result of highly variable feeding successes.

Finally, we learned that juvenile chum salmon in Kuskokwim Bay spend less than 30 days in areas characterized by salinities of less than 24, possibly supporting the indication that these areas do not provide optimal nursery habitat.

WHAT'S NEXT?

We continue to need to fill in gaps in our understanding of this critical period in the early lives of salmonids in western Alaska, in particular:

- ⊙ effects of different environmental conditions on salmon distribution, growth and survival probability
- ⊙ patterns of estuarine distribution of different salmon species and the potential for competition and predation between them
- ⊙ species-specific seasonal patterns of energy allocation during estuarine outmigration

OUTREACH

Scientific publications

- ⊙ Burril SE (2007). Feeding ecology and energy density of juvenile chum salmon, *Oncorhynchus keta*, from Kuskokwim Bay, western Alaska. M.S. thesis, University of Alaska Fairbanks, Fairbanks, AK.

Conference presentations

- ⊙ 2006 and 2007 Alaska Marine Science Symposia: Presentation by Hillgruber.
- ⊙ 2006: 5th Int'l. Conference on Stickleback Behavior and Evolution: poster by Zimmerman
- ⊙ 2005: 135th Annual Meeting, American Fisheries Society. Presentation by Hillgruber.
- ⊙ 2005: 29th Annual Larval Fish Conference. Presentation by Hillgruber.
- ⊙ 2004, 2006: Meetings of the American Fisheries Society (Alaska chapter). 2004: Presentation by Burril. 2006: Presentation by Hillgruber; poster by Peterson.

Workshops and Meetings

- ⊙ Burril SE, Hillgruber N, Zimmerman CE (2006). Estuarine ecology of juvenile chum salmon (*Oncorhynchus keta*) in Kuskokwim Bay, Alaska. Proceedings of the 22nd Northeast Pacific Pink and Chum Salmon Workshop, Ketchikan, AK, pp 91-97.
- ⊙ 2005: Kuskokwim Interagency Planning Meeting. Presentation by Zimmerman.
- ⊙ 2004: Kuskokwim Fishery Recourses Coalition. Discussion with Zimmerman.

Press

- ⊙ 2003: Article in *The Tundra Drums* by Baldwin.

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MISSION OF THE NPRB

Building a clear understanding of the

North Pacific, Bering Sea and Arctic

Ocean ecosystems that enables

effective management and sustainable

use of marine resources



Satellite data-derived image of the mouth of the Kuskokwim River. (Used with permission from: Dr. William A. Bowen, California Geographical Survey, <http://geogdata.csun.edu>)



Juvenile chum salmon. (Sean E. Burril)

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