

## NEP-CCS Progress Report 2004

### GLOBEC TROPHIC RELATIONSHIPS OF JUVENILE SALMON IN COASTAL WATERS OFF OREGON AND CALIFORNIA: TOP-DOWN OR BOTTOM UP CONTROL?

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## PROJECT SUMMARY

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We are studying the upper-level (zooplankton, fish, birds, mammals) trophic structure and dynamics of the California Current System (CCS) pelagic zone, with a focus on the production and survival of key species such as salmonids. General effects of climate variation on biological processes in the CCS are well-documented, but few studies have focused on the processes linking physical changes with changes in the population dynamics of species in the upper trophic levels (tertiary production and above). To effectively study these linkages, empirical data and models describing the trophic structure and seasonal/interannual changes in that structure are needed. We are characterizing the temporal and spatial nature of the trophic relationships within the pelagic fish community during the spring-summer transition (peak salmonid migration period) and relating these dynamics to salmonid survival. A primary focus is identification of the strength of trophic linkages between forage and fish predator species, and the influence of these relationships on predation rates on juvenile salmon. Comparisons are made between prey availability, diet, and food consumption for the same salmon species along a latitudinal gradient. In coastal environments, the importance of mesoscale features, such as riverine plumes, eddies, and coastal jets relative to the coastal ocean as a whole will be assessed. This requires detailed comparisons of juvenile salmon, their predators, and prey between these locations and at reference sites.

We are also developing a formal, empirically-based description of food-web structure in the CCS and estimating trophic dynamics for seasons/years with adequate data. We are

developing a multi-species population model of the CCS and applying the model in testing hypothesized linkages with lower trophic and physical processes. In particular, the model will be used to identify the relative importance of marine food-web processes (food supply, predation, competition) in controlling salmonid population dynamics, with particular focus on defining the magnitude of potential predation rates by piscine, avian, and mammalian predators. This project interacts with several existing GLOBEC projects, as well as other research projects in the CCS area.

### **1) Key major objectives to our proposed study (from proposal):**

- (1) conduct a broad-scale analysis of the diets of all juvenile salmon, their predators, and competitors, from inshore-offshore transects off the coast of Oregon and northern California to examine spatial, temporal, and ontogenetic variations in diet and food consumption,
- (2) conduct a spatially-intensive process study of the food environment and predator field related to juvenile coho and chinook salmon populations focusing on two contrasting areas of strong oceanographic features (frontal region or plume) to examine smaller scale biophysical correlates of feeding by juvenile salmon and predation upon them,
- (3) undertake detailed quantitative comparisons of the prey type and size consumed by juvenile salmon relative to what is available in the water column (neuston and plankton) at the time of collection,
- (4) analyze parasite fauna (species composition and abundance) of juvenile salmon, their competitors, and their predators to determine trophic linkages not easily identified through gut content analysis,
- (5) develop empirically-based descriptions of food-web structure in the CCS, estimate trophic dynamics for seasons/years with adequate data, and develop a multi-species population model of the CCS,
- (6) apply the model in testing hypothesized linkages with lower trophic and physical processes and the effects of changing oceanographic conditions on salmonid populations.

### **2) Papers or presentations that discuss the above hypotheses (in parentheses):**

#### **Presentations:**

Miller, T.W., R.D. Brodeur and R.L. Emmett. 2000. "Distribution and diet of the Pacific sardine (*Sardinops sagax*) off of Oregon and Washington". California Cooperative Oceanic Fisheries Investigations Annual Conference, 1-3 November (published abstract). **(1)**

Wainwright, T.C. "Time Scales of Top-Down and Bottom-Up Processes in a Coastal Upwelling System". PICES 10th Annual Meeting, Victoria, BC, October 2001. **(6)**

Brown, C.A., T. C. Wainwright, and W. T. Peterson. "Simulating temporal variations in nutrients, phytoplankton, and zooplankton on the inner Oregon Shelf". ASLO Meeting, Victoria, 2002 (published abstract). **(6)**

Miller, T. and R. Brodeur. "Trophic relationships of juvenile Pacific salmon and associated

forage fish in coastal waters off Oregon and Washington". GLOBEC NEP SI Meeting, Seattle, WA, November 2001. Poster presentation. **(1)**

Baldwin, R.E. and K.C. Jacobson. "The Northeast Pacific Program of U.S. GLOBEC: Integrating Parasitology with Oceanography in studies of the California Current. The 76th Annual Meeting of the American Society of Parasitologists. 2001. Albuquerque, NM. Poster presentation. **(4)**

Baldwin, R.E. and K.C. Jacobson. "Juvenile Salmonids in the Northern California Current: Differences in Parasites Obtained Through Trophic Interactions." GLOBEC NEP SI Meeting, Seattle, WA, November 2001. Poster presentation. **(1,4)**

Jacobson, K.C., Baldwin, R.E. and D. Teel. "Trophic interactions and migrations of juvenile salmon in the California Current ecosystem. Parasites and fish population genetics". The 10th International Congress of Parasitology, Vancouver BC. August 2002. Poster Presentation. **(4)**

R. E. Baldwin. "Comparing Macroparasites and Host Diet in Juvenile Chinook (*Oncorhynchus tshawytscha*) and Coho (*O. kisutch*) Salmon Collected off the Coast of Oregon." American Society of Parasitologists (ASP), Halifax, Nova Scotia, Canada, August 2003. **(1,4)**

V. V. Gertseva. "A model for describing survival of juvenile salmon in the Northeast Pacific Ocean." GLOBEC West Coast Biological Modelers meeting, Seattle, WA, August 2003. **(5)**

V. V. Gerseva and T. C. Wainwright. Modeling survival of juvenile salmon in coastal waters off Oregon." AGU Ocean Sciences Meeting, Portland, OR. Jan. 2004. **(5)**

V. V. Gertseva, T. C. Wainwright, and V. V. Gertsev. "Mathematical model of juvenile salmon survival in coastal waters off Oregon." ASLO Ocean Research Conference, Honolulu, HI. Feb. 2004. **(5,6)**

V. V. Gertseva and T. C. Wainwright. "Juvenile salmon survival in coastal waters of the Northeast Pacific Ocean: top-down or bottom-up control?" Ecological Society of America, Portland, OR. Aug. 2004. **(6)**

T. C. Wainwright and T. W. Miller. "Pelagic Food Web Structure in The California Current System." GLOBEC NEP PI/SI Meeting, Corvallis, OR, November 2002. **(5)**

T. C. Wainwright. "Trophic mediation of salmonid response to environmental variation." Salmon Ocean Ecology Meeting, Newport, OR, February 2003. **(5)**

T. C. Wainwright. "A Comparison of Two Lower Trophic Models for the California Current System." PICES Annual Science Meeting, Seoul, Korea, October 2003. **(5)**

Wainwright, T. C., L. R. Feinberg, R. C. Hooff, and W. T. Peterson. 2004a. A comparison of two lower trophic models for the California Current System. EOS Trans. AGU, 84(46), Suppl., Abstract OS21B-18. **(5)**

Wainwright, T. C., R. C. Hooff, and W. T. Peterson. 2004b. Seasonal dynamics of plankton in the northern California Current ecosystem: A model-data comparison. PICES 13<sup>th</sup> Annual Meeting, October 2004, Honolulu. Abstract W2-2045 ([http://www.pices.int/publications/book\\_of\\_abstracts/](http://www.pices.int/publications/book_of_abstracts/)). (5)

Suchman, C.L., R.D. Brodeur, and W.T. Peterson. "Abundance, distribution, and feeding ecology of large medusae in the California Current upwelling system." ASLO Aquatic Sciences Meeting. February 2003, Salt Lake City, UT (1)

Suchman, C.L., E. Daly, W.T. Peterson, and R.D. Brodeur. "Trophic ecology of the scyphomedusa *Chrysaora fuscescens* in the Northern California Current" AGU Ocean Sciences, January 2004, Portland OR. (1)

Suchman, C.L., Daly, E., Keister, J.E., Peterson, W.T., and Brodeur, R.D. Predation by the scyphomedusa *Chrysaora fuscescens* in the northern California Current. PICES annual meeting, October 2004, Honolulu, HI. (1)

Miller, T.W., R.D. Brodeur, and K.L. Bosley. "Trophic dynamics of marine nekton from the California Current: Insights from diet and stable isotope analyses" AGU Ocean Sciences, January 2004, Portland OR. (1,2)

Baldwin, R.E. T.W. Miller, R.D. Brodeur, K.C. Jacobson. "Using macroparasites to understand predator-prey interactions of juvenile salmon collected off the coasts of Oregon and northern California". AGU Ocean Sciences, January 2004, Portland OR. (1,4)

Suchman, C.L., E. Daly, J. Keister, W. Peterson, R. Brodeur. "Predation by the Scyphomedusa *Chrysaora fuscescens* in the Northern California Current". PICES Annual Meeting, October 2004, Honolulu, HI. (1)

### **Publications:**

V.V.Gertseva, T.C. Wainwright, and V.I. Gertsev (In review). Toward an understanding of the mechanisms controlling juvenile salmon survival in the Northeast Pacific Ocean. *Fisheries Research* (submitted). (5,6)

Reese, D.C., T.W. Miller, and R.D. Brodeur. 2005. Community structure of near-surface zooplankton in the northern California Current in relation to oceanographic conditions. *Deep-Sea Research II*. Accepted for publication and will be published in January 2005. (3)

Wainwright, T., L. Feinberg, R. Hoof, and W. Peterson. (In review). A comparison of two lower trophic models for the California Current System. *Ecological Modeling* special issue. (5)

### **3) Online status of data and model products.**

No data sets are yet available online. Laboratory analysis of the 2002 samples is nearing

completion, as is data entry and quality control in our internal databases. By the end of 2005, all diet and parasite data will be published on the GLOBEC dataserver. As models are completed, model code and documentation will be made available on a local webserver, with links from the GLOBEC servers.

#### **4) Papers and products to emerge by the Fall of 2005.**

Baldwin, R., T.W. Miller, R.D. Brodeur, and K.C. Jacobson. In prep. Using macroparasites and diet to understand predator-prey interactions of juvenile salmon collected off the coasts of Oregon and Northern California. Target Submittal Date: Winter 2005, Journal: *Can. J. Fish. Aquat. Sci.* **(1,2,3)**

Baldwin, R., K.C. Jacobson, and R.L. Emmett. In prep. Parasite communities of pelagic fishes describe trophic interactions in the Northern California Current. Target Submittal Date: Summer 2005, Journal: *Environ. Biol. Fishes.* **(2,4)**

Miller, T.W., R.D. Brodeur, and G. Rau. In prep. Description of trophic guilds based on size- and species-specific feeding patterns and stable isotopes. Target Submittal Date: Spring 2005, Journal: *Mar. Ecol. Prog. Ser.* **(1,2)**

Suchman, C.L., E. Daly, J. Keister, W. Peterson, R. Brodeur. In prep. Predation by the Scyphomedusa *Chrysaora fuscescens* in the Northern California Current. Target Submittal Date: March 2005, Journal: *J. Plank. Res.* **(1)**

Emmett, R.L., R.D. Brodeur, S. Pool, T.W. Miller, P. Bentley, and G. Krutzikowski. In prep. Sardines in the ecosystem of the Pacific Northwest. Target Submittal Date: December 2004, Journal: *CalCOFI Reports.* **(1)**

Miller, T.W. and R.D. Brodeur. In prep. Shelf and slope community dependence on upwelling based on stable isotopes. Target Submittal Date: Spring 2005, Journal: *Limnol. Oceanogr.* **(2)**

Gertseva V., T. Wainwright, and V. Gertsev. In prep. Juvenile salmon survival in coastal waters of the Northeast Pacific: top-down or bottom-up control. Target Submittal Date: Dec. 2004, *Prog. Oceanogr.* (PICES Special Volume). **(5)**

Gertseva, V., T. Wainwright, and R. Emmett. In prep. Analysis of spatial distribution of habitat quality based on a juvenile salmon production model. Target Submittal Date: March 2005, Journal: *Ecol. Modeling* **(5, 6)**

Wainwright, T., T. Miller, R. Brodeur, R. Baldwin, K. Jacobson, and R. Emmett. In prep. Description of the trophic structure of the Northern California Current pelagic zone. Target Submittal Date: Fall 2005, Journal: *Mar. Ecol. Prog. Ser.* **(5, 6)**