Final Report for 2006

Submitted by Rick Routledge
November 27, 2006

Summary

We have now completed field work for the 2006 field season, and have achieved the following main objectives:

- We obtained observations on inlet conditions in the lead-up to the juvenile sockeye salmon migration.
- We have made a preliminary assessment of the recently received results from the laboratory analyses of nutrient and plankton samples.
- We have begun the hydrodynamic modeling.
- We have assembled equipment for monitoring surface water flow in Rivers Inlet.

In addition, we have received acceptance for one paper associated with Phase I of this project, have submitted a second, and are nearing completion of a third. Following are more detailed comments.

Sampling: We took plankton samples, depth profiles, and water samples in Rivers Inlet every two weeks from early March to late June. We also found opportunities for three sampling trips to Smith Inlet, and were able to fit in one further sampling trip to Rivers Inlet in October. Observations to date include:

- We found remarkably low early-spring runoff.
- We observed a main phytoplankton bloom in late March, with a lesser bloom in early May.
- We found phytoplankton to be most abundant near the halocline.
- We observed anomalous peaks in some near-surface Hydrolab readings whose cause is being investigated.

Weather observations: We set up two weather stations.

- The Ethel Island station was very successful.
- The station at Stone Point proved to be too prone to wind eddying around the point. Hence, we moved it to a point at the southwest corner of Kilbella Bay. Limited observations to date suggest that this will be a more valuable site.

Laboratory Work: Results from analyses of zooplankton and nutrient samples have recently been received. Here is a summary of our most significant findings to date:

- There were abundant nutrients in early March, followed by the main phytoplankton bloom in late March.
- We observed a concommitant peak in abundance of barnacle nauplii (the first life stages of immature barnacles).
- There was an immediate increase in abundance of oikopleura (a small, herbivorous chordate), and the beginning of a sustained increase in *Metridia pacifica* (a common calanoid copepod which feeds on phytoplankton in its earliest life stages and becomes more carnivorous as it matures).
- A late-May peak in barnacle cypris (the final planktonic stage and a common prey item for juvenile sockeye salmon in the inlet) and in *Metridia pacifica*.

Thus we have found direct evidence supporting the importance of inlet conditions in early spring to the marine survival of juvenile sockeye salmon migrating down the inlet in late spring. A strong phytoplankton bloom appears to set the wheels in motion for good food production for the late-spring juvenile sockeye salmon migration.

Horizontal Plankton Tows: We also experimented with horizontal plankton tows near the shore, and found substantial differences in species composition between the vertical hauls and the horizontal tows.

Field Support: We received good logistical support from Oweekeno Fisheries and Dawson's Landing. For this, we offer special thanks to John, Darryl, and Bruce in Oweekeno Fisheries, and to Rob and Nola Bachen at Dawson's Landing.

Smith Inlet: We found it difficult to access Smith Inlet, and especially Wyclees Lagoon. In light of these difficulties and unavoidable increases in transportation costs in general, we are reassessing the feasibility of this component to the project.

Modelling: Maureen Yeremy, who has previously developed a two-dimensional, integrated, partial differential equation model of Knight Inlet, has begun this month to build a similar model for Rivers inlet. To provide essential data associated with this task, we have also begun preparations for collecting data on inlet currents and precise tide levels as follows:

Drifters: We have constructed 12 drifters equipped with GPS loggers for recording their movements and VHF radio transmitters for retrieval. Our goal is to use them to obtain direct observations on surface water movement in the inlet both for the direct value of this information and for assessing and tuning the model. We are investigating the feasibility of sharing the cost with another project.

Tide Gauges: We have purchased two tide gauges for initial deployment near each end of the inlet. Their purpose is to obtain more precise and accurate data on tidal forcing in the hydrodynamic model than is available from existing records.

Publications:

- One sediment coring paper, on general methodology, has recently been published: Brahney, Janice, Darren G. Bos, Marlow G. Pellatt, Thomas W. D. Edwards, and Richard Routledge (2006). The influence of nitrogen limitation on $\delta^{15}N$ and carbon: nitrogen ratios in sediments from sockeye salmon nursery lakes in British Columbia, Canada. *Limnology and Oceanography*, **51(5)**: 2333–2340.
- A second one, specific to Long Lake, has been submitted to *Can. Journal of Fisheries and Aquatic Sciences.* We are currently developing quantitative estimates of past spawning abundances. Early indications are that they were large compared to historic records. Such a conclusion could have major implications for future management of Long Lake sockeye salmon.
- Seana Buchanan's thesis has been circulated to her supervisory committee and external examiner. Her defence date is set for December 1, 2006.
- Conversion of the thesis to a shorter manuscript for submission to scientific journal is to begin immediately thereafter.

Integrated Ecosystem Study:

At a recent scientific workshop, plans were made for a major, integrated ecosystem study that will extend this project to encompass the entire watershed from the headwater snowfields and glaciers to the inlet mouth.

Figures: We conclude with two sample figures generated from data from the 2006 season.

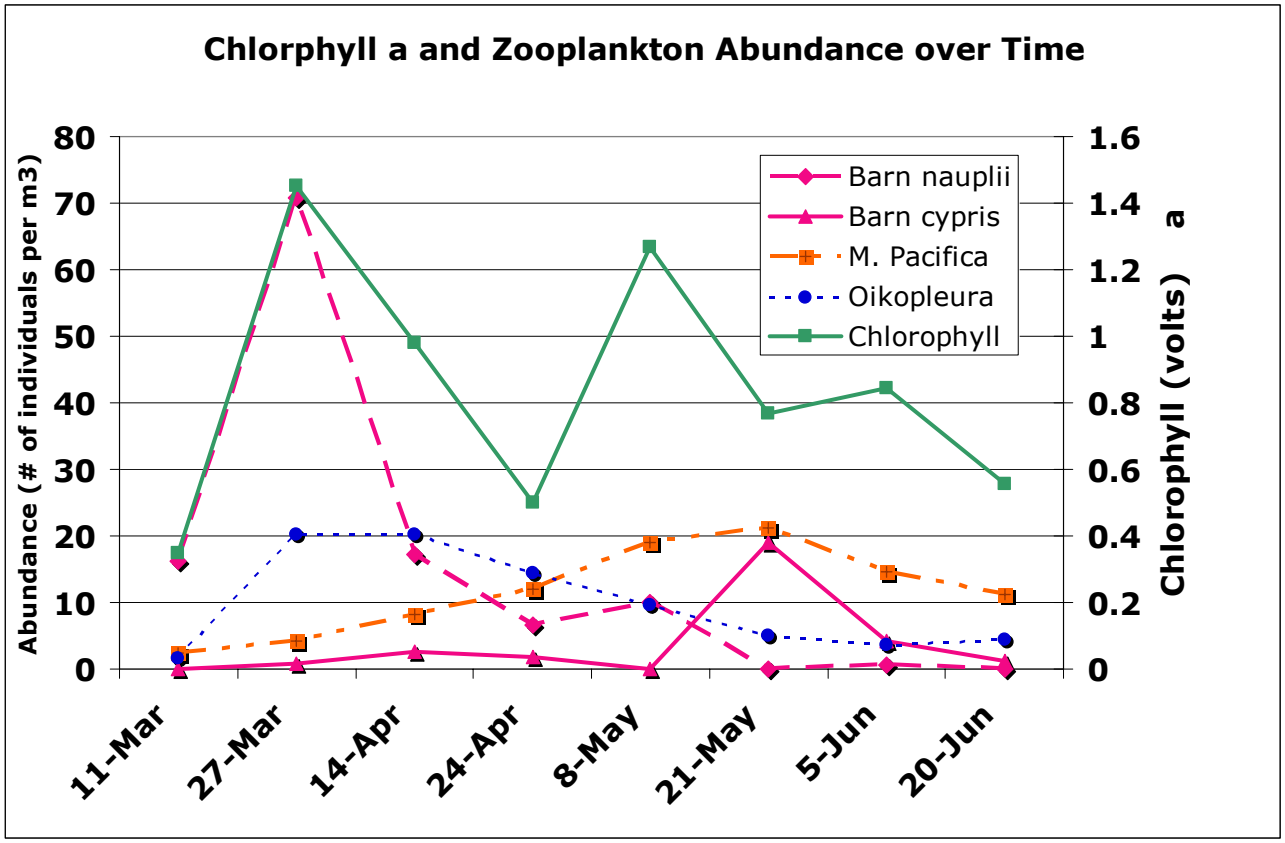

Figure 1. Abundances of key plankton components in Rivers Inlet in the spring of 2006. The first phytoplankton bloom (as gauged by the abundance of chlorophyll) in late March was accompanied by an immediate peak in barnacle nauplii. Barnacle cypris (the last planktonic stage of barnacles) peaked in late May. Barnacle cypris are common prey items for juvenile sockeye salmon in Rivers Inlet. Hence, it appears that an early-spring phytoplankton bloom can set the food chain in motion for plentiful food for juvenile sockeye salmon in their late-spring migration down the inlet.

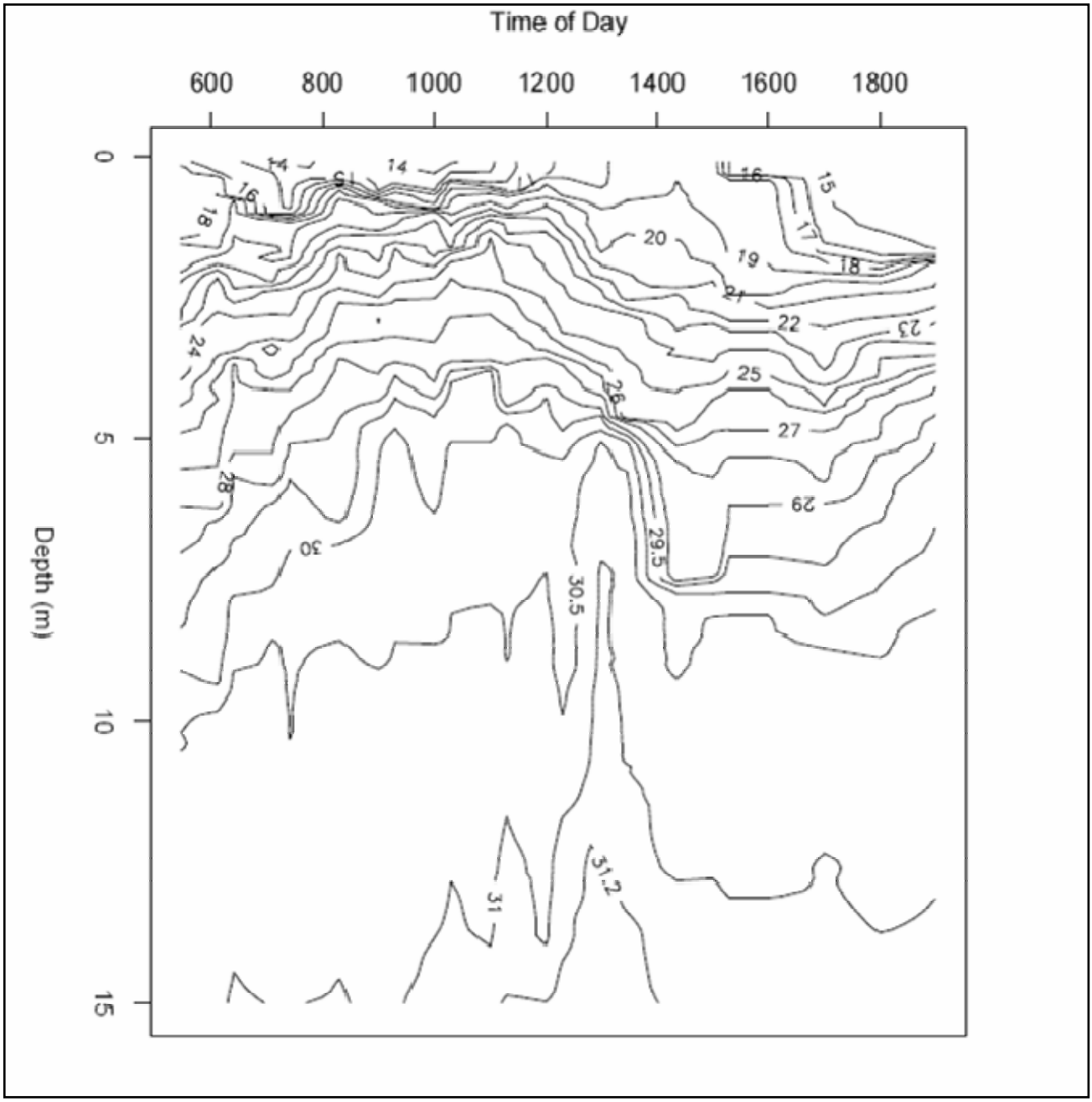

Figure 2. A contour plot of salinity vs. depth over a half-day tide cycle at a site near Edna Matthews Island. Note the intrusion of salt water near low-tide in the early afternoon. We had anticipated such intrusions to be associated with incoming tides. The anomalous behaviour appears to be caused by a reverse tidal flow back up Darby Channel at low tide, caused in turn by the constriction at Pendleton Island further down Darby Channel. This surprise anomaly demonstrates the need for direct observations in developing an accurate hydrodynamic model.