Pollock Conservation Cooperative Research Center Annual Report 2008 -09

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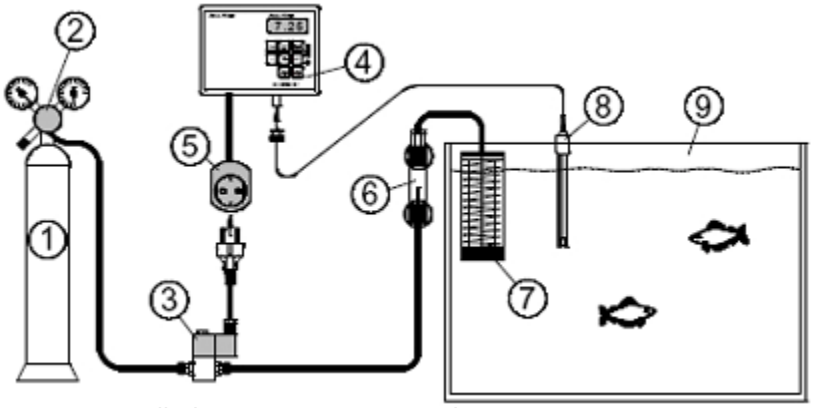
Project: Present and Future Impacts of Ocean Acidification on Juvenile Walleye Pollock Metabolic Processes and Growth Rates

Project Objectives and Accomplishments

The overall objectives of this project are to (i) determine if ocean acidification has a significant effect on the metabolism, growth rate and mortality of larval and juvenile Pollock, (ii) determine which metabolic enzymes (PK, LDH, and CS) ocean acidification significantly effects, and how, and (iii) determine the current and future state of ocean acidification in the Gulf of Alaska and in the Bering Sea, particularly in areas of Pollock recruitment? Our hypotheses for this study were; (i) there will be a significant increase in the standard metabolic rate of larval Pollock, and a moderate increase in juvenile Pollock when exposed to lower pH, (ii) there will be a significant upregulation of metabolic enzymes as the environmental pH decreases, and (iii) it is likely that the pH in the northern Gulf of Alaska and Bering Sea have decreased over the past several decades.

The most challenging part of the project to date was finding a fisheries lab capable of both hatching and rearing Pollock. Fortunately, Dr. Tom Hurst at the Hatfield Alaska Fisheries Science Center in Newport Oregon agreed to work with UAF on the project. Dr. Hurst is an expert at fish rearing and behavioral observations and his commitment to the project has changed the scope of the potential results.

Once the fisheries lab was located, Mathis designed and built a CO2 delivery system (Figure 1, Figure 2A) capable of controlling the pH in the fish tanks. In August, Mathis traveled to Newport and installed the control system.



1. CO2 Cylinder 2. Pressure regulator 3. Solenoid Valve
4. pH Computer 5. Flow regulator 6. Bubble counter
7. Membrane Contactor 8. pH probe 8. Aquarium

Figure 1 – Schematic of pH control system.

In September, Dr. Hurst and graduate student Elena Fernandez set up the rearing tanks in the lab. The experiment will be run with sixteen fish tanks in sets of four (Figure 2B). Each set of four will be controlled at a different pH level; set 1 (ambient) – pH 8.15, set 2 – pH 8.0, set 3 – pH 7.8, set 4 – pH 7.6.

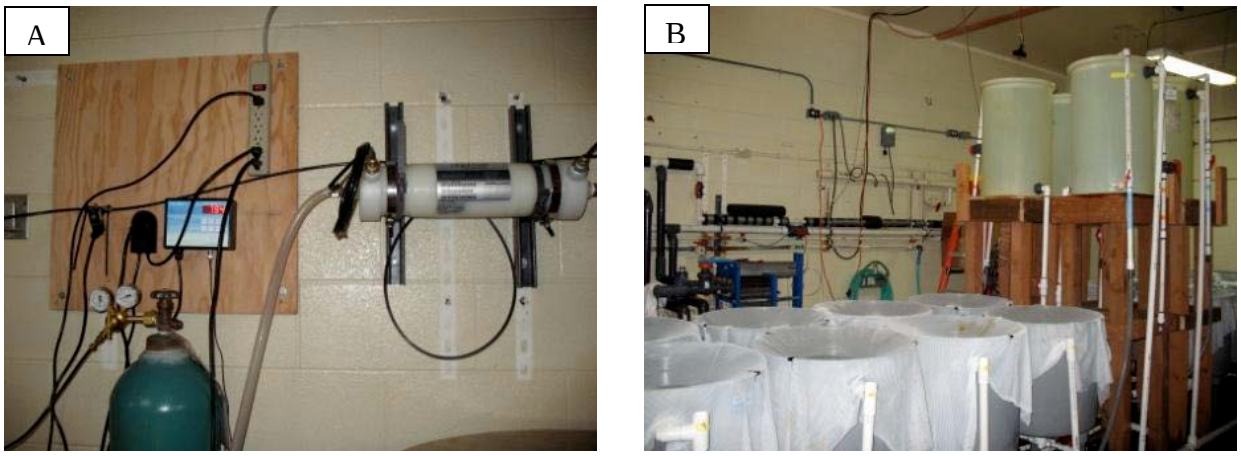


Figure 2 - Photos of lab setup. A) CO2 control system B) Pollock tanks

Because Pollock spawning does not occur until mid to late December the first experiment is currently underway on juvenile (age 1+) fish. Do to size constraints three fish were placed in each tank (12 total fish for each pH treatment) and are currently being allowed to acclimate to the tank conditions. On November 1st, 2009 pH treatments will begin on these fish and they will remain in the treated environment for six weeks. At the end of this time, the fish will be harvested and dissected for physiological analysis.

By January 1st, 2010 fertilized eggs will be placed in each treated tank set and will be allowed to hatch and grow to six weeks old. During this time, the behavior of the larval fish will be monitored. At the end of the incubation, the fish will be harvested and pH treated fish will be compared with those kept at ambient conditions. In May, juvenile (year 1) Pollock will again be placed in the treatment tanks and will be kept there for three months. These results will be compared with the initial study results to see if the Pollock are capable of acclimating to different pH conditions over time.

Meanwhile, Mathis continues to analyze water samples collected in the northern Gulf of Alaska and eastern Bering Sea to determine the current state of ocean acidification in those regions. This data will be coupled with results from the laboratory experiments to determine the potential impacts to Pollock stocks in the wild.

Overall, the project is on schedule and great progress has been made in the first six months (award was made in April, 2009). By August of 2010, all laboratory experiments should be complete.

Student Progress

Elena Fernandez, a SOFS Oceanography student is working on the project for her Master's thesis. Elena is in her second year and will spend most of her time in Newport at the fisheries lab. She completed most of her coursework during her first year in residency in Fairbanks and will spend year three in Fairbanks writing and publishing the results from the project. Her anticipated graduation data is May of 2011.

Timeline

October 1st, 2009 – Tanks setup complete and pH control system in place.
November 1st, 2009 – pH treatment begins on juvenile fish.
December 15th, 2009 – Juvenile fish are harvested and physiology analysis begins. Fertilized Pollock eggs transfer to pH control tanks.
February 1st, 2010 – Larval Pollock are collected from tanks and analyzed.
March 1st, 2010 – Laboratory analysis completed for first two experiments.
May 1st, 2010 – Second batch of juvenile Pollock are placed in pH control tanks.
August 1st, 2010 – Juvenile fish are harvested and analyzed.
September 1st, 2010 – Fernandez returns to Fairbanks full time for final year.
January, 2011 – Final results are presented at Alaska Marine Science Symposium and manuscript(s) are submitted for publication.
March, 2011 - Fernandez thesis defense.
May, 2011 – Fernandez graduation.