

King Crab Aquaculture and Enhancement in Alaska

Project Performance Report

NA08OAR4170766

6/1/08 to 11/30/08

Accomplishments:

Large scale king crab culture is being conducted at the Alutiiq Pride Shellfish Hatchery, in Seward, Alaska, which aims is to develop technology to mass rear juvenile king crab for stock enhancement purposes.

Specific milestones reached with this research include: 1) successfully acquiring and holding red and blue king crab broodstock; 2) evaluating effects of larval diet, culturing equipment and techniques on survival of larval red and blue king crab; 3) evaluating effects of larval stocking density of red and blue king crab in a hatchery setting; 4) evaluating suitable substrate for settlement of red and blue king crab post-larvae and juveniles, 5) evaluating optimal stocking densities and diets for early red and blue king crab juveniles, and; 6) conducting preliminary field studies to assess critical habitat for early juvenile red king crab and make observations of sites to be considered for pilot out-planting.

Milestone 1: Broodstock acquisition and holding technology

Red king crab broodstock were acquired from Bristol Bay, Alaska in fall 2007 and 2008 and blue king crab broodstock were acquired from Little Diomed Island, Alaska in spring 2008. Broodstock were successfully held until larval hatching began for both species. Husbandry techniques were developed to maintain healthy broodstock for long term holding (several months).

Milestones 2&3: Evaluating effects of diet and stocking density on larval rearing

Larvae were used in hatchery-scale experiments that investigated effects of stocking density, diet and water temperature on growth and survival. Successful larval rearing yielded 35,000 red king crab juveniles and 7,000 blue king crab juveniles in 2008. Specific stocking densities, diets, and temperatures were developed to optimize survival. Enrichment media proved to be essential in the larval diet to produce healthy post-larvae and juveniles. Stocking densities of approximately 50 larvae L⁻¹ is optimal. Water temperature from 8-10°C optimizes larval development by decreasing intermolt duration and prevents excess bacteria build-up.

Milestone 4: Evaluating suitable substrate for post-larvae and juveniles

It has been shown that settling glaucothoe prefer complex substrate. We investigated settling behavior of red and blue king crab glaucothoe using a variety of artificial

substrates in large-scale production tanks. Once larvae molted from Z4 to glaucothoe, artificial seaweed, strips of burlap, gillnet, and biofilter medium were added to rearing tanks. In all cases, considerably more glaucothoe were found on the seaweed. The straight structure of the seaweed fronds may promote better attachment than the structure of burlap, biofilter, and gillnet. The seaweed is also easier to use in a hatchery setting because it is easy to clean and neutrally buoyant.

Milestone 5: Evaluating optimal stocking densities and diets for early juveniles

Juvenile red king crab and blue king crab obtained from 2008 larval experiments were used in mass rearing experiments to understand effects of diet, stocking density, and substrate on survival and growth. Data acquired from experiments suggest best practices for rearing larval and juvenile red and blue king crab in a large-scale hatchery setting such as the presence of artificial substrate to decrease cannibalism, lower stocking densities, and a mixed diet supplemented with calcium.

Milestone 6: Assessing critical habitat for early juveniles and making observations of sites to be considered for pilot out-planting.

Laboratory studies in Juneau, AK and Newport, OR are conducting ongoing projects that are investigating predation processes and the functional importance of habitats. These studies will illustrate the importance of releasing hatchery reared crabs in suitable habitats that provide the best possible defense against losses to predators.

Products:

Hatchery raised juvenile red king crabs have been sent to Al Stoner (NOAA Newport) and Ginny Eckert (UAF Juneau) for growth, survival, and habitat selection experiments. These studies will help understand how hatchery raised crabs may perform in the wild.

A method was developed to help predict timing of larval release. Based on embryo eye spot (length, width) and yolk length measurements we are able to predict hatch date within several weeks. Simple methods to predict larval release of red king crab may be useful as a managing tool for researchers and hatchery managers. Predicting hatch timing would allow for cost effective preparations as larval food production and infrastructure can be costly to maintain.

Impacts:

Developing technology for successful king crab hatchery rearing is important to Alaska's long-term economic development and sustainability. The first step in establishing a successful enhancement effort is perfecting strategies for hatching and rearing king crab to a stage where they can be released into the wild and contribute to reversing low wild stock abundance in Alaska. Acquiring this knowledge base will aid policymakers in making informed decisions about whether to one day pursue active rehabilitation of depressed wild king crab stocks through hatchery enhancement.

After a second year of research, successful large scale cultivation of king crab juveniles was achieved. With large scale cultivation as possibility, policymakers can now decide if active rehabilitation of depressed crab stocks through hatchery enhancement should be further implemented. The preliminary success and early establishment of hatchery technology may inspire investors to contribute to a crab enhancement effort in Alaska.

Publications:

Leroux, Celeste (2008) Nutrition and technique for large scale larval culture of the red king crab (*Paralithodes camtschaticus*) and blue king crab (*Paralithodes platypus*). MSc Thesis. University of Alaska Fairbanks, Fairbanks, Alaska

Daly B, Swingle J, Eckert G (in preparation) Effects of diet, stocking density, and substrate on survival and growth of hatchery-cultured red king crab (*Paralithodes camtschaticus*) juveniles in Alaska, USA. Aquaculture.

Daly B and Swingle J (in preparation) Embryo monitoring as a method to predict larval release of *Paralithodes camtschaticus* for aquaculture purposes. Aquaculture.

Presentations:

Alaska King Crab Industry Meeting, October 2008, Ginny Eckert

Contributed Talk: Introduction to the AKCRRAB program.

Interagency Crab Meeting, Anchorage, AK, December 2008, Ginny Eckert

Contributed Talk: Recent developments in the AKCRRAB program

Interagency Crab Meeting, Anchorage, AK, December 2008, Ben Daly

Poster: Effects of diet, stocking density, and substrate on survival and growth of hatchery-cultured red king crab (*Paralithodes camtschaticus*) juveniles in Alaska, USA

Students Supported:

Celeste Leroux, masters student, expected graduation: Dec 2008.

Leroux, Celeste (2008) Nutrition and technique for large scale larval culture of the red king crab (*Paralithodes camtschaticus*) and blue king crab (*Paralithodes platypus*). MSc Thesis. University of Alaska Fairbanks, Fairbanks, Alaska

Benjamin Daly, PhD student, expected graduation: May 2012

Daly, Benjamin (2012) Large scale cultivation of red king crab (*Paralithodes camtschaticus*) for stock enhancement purposes in Alaska, USA. PhD Thesis. University of Alaska Fairbanks, Fairbanks, Alaska.