The effect of temperature on broodstock conditioning of the Spiny scallops (*Chlamys hastata*)

491 Research Project Proposal

Submitted to Dr. Helen Gurney-Smith

Written by Keith Halper

November 6th, 2009

Submitted in partial fulfillment of the requirements for the Bachelor of Science degree at

Vancouver Island University, Nanaimo, British Columbia

November, 2009.

Approved by:

Research Advisor: Helen Gurney-Smith, CSR, Vancouver Island University

Proposal

Introduction

When conditioning a bivalve species in the laboratory, many environmental factors play important roles in culture success and one of the most important variables is temperature (Liu et al., 2008). Temperature has a direct effect on the rate of development of juveniles and if the range of temperature is not at suitable levels for each particular species, adults or larvae, the animals could become stressed, sick or even die (Pilditch and Grant, 1999). Trials of varying rearing temperatures of bivalves can be used to determine suitable and optimal conditions, which provide the best results in growth and survival of the animals.

Wild scallop fisheries is very limited in British Columbia compared to oysters or clams, producing less than half of a tonne of seafood to the shellfish industry every year; oyster fisheries in BC produces 7 – 8 tonnes of seafood to market each year. On the commercial side of shellfish in BC, cultured scallops only produce 0.02 tonnes of meat to market every year; 25 times less than commercial fisheries provide (BCSGA, 2008). With only one scallop seed producer on Vancouver Island that cultures a hybrid of the Weathervane (*Patinopecten caurinus*) and Japanese scallops (*Pecten yessoensis)*, there is a monopoly on scallop production and the seed supply is limited. It is also not possible to produce offspring of these hybrids outside of the licensed hatchery. Therefore research into other scallop species, such as the native species the Spiny scallop (*Chlamys hastata*), may provide other directions for scallop aquaculture in British Columbia. Preliminary research may provide positive results and data that could enable future experimental trials.

The Spiny scallop (*C. hastata*) is a sporadically dispersed species in small dense populations, found along the Pacific coast of North America from the Gulf of Alaska to California. These scallops can be found attached to hard rocks or gravel in areas with fast moving currents via their byssal threads. The Spiny scallops can easily detach from their rocky substrates and swim to a new location if threatened and then re-attach. These scallops are dispersed anywhere from 5 – 150 meters in depth along the BC coast and recorded to be found in temperatures from 0^{o}C to 23^{o}C (Bourne, 1969). The adductor muscle is generally the desired consumable portion of any scallop. Past research on Pink and spiny scallops occurred nearly 20 years ago and was looking at potential for scallop culture on the Pacific coast but was soon after declared not economically viable since the grow out period was too long (4-5 for both) and the final product's size was lesser than expected, although it was determined that Spiny scallops reach a larger maximum size than pinks (Parsons and Shumway, 2006). Since then hatchery techniques and bivalve culture have evolved to include other technology and practices that could now be applied to these species. We aim to concentrate on the effect of environmental temperatures on the growth and broodstock conditioning for potential spawning of the Spiny scallops (*C. hastata*).

Materials and Methods

For the proposed experiment, examining the effects of temperature on adult and juvenile scallops, broodstock wild adult Spiny scallops (*Chlamys hastata*) will be collected in November 2009 using a commercial dive team. Since the scallops are being collected by divers we can assume that they will be found in shallower areas and

therefore will likely be accustomed to warmer ocean temperatures. The average ocean temperatures in BC at the surface are found to be between 6 and 16^{o}C on the Pacific coast, meaning that shallower scallops are tolerate are warmer ocean temperatures (DFO, 2008). The proposed fishing area is located ……. Once the animals are brought up to the surface, they will be gently cleaned to remove any sediment and placed in filtered and aerated seawater until they are successfully transferred into tanks in the Centre for Shellfish Research (CSR) in Nanaimo, BC.

Following a period of temperature acclimation, the experiment will consist of nine oval shaped tanks, three of each on a different temperature regime, with a flow-through, filtered sea water system. The flow rate that will be sent through the tanks will be at 1.5 LPM (litres per minute) based on suitable flow conditions as used in previous trials (Liu et al, 2008). The scallops will all be acclimated to the same temperature to begin with (most likely the median regime) and then the two higher and lower regimes will be separated after that. The temperatures that will be used are 8^{o}C, 12^{o}C and 16^{o}C to observe any difference in conditioning of the scallops over a set period of time. These temperatures fall within the suitable environmental conditions recorded upon collection of the adult scallops in the past (Bernard, 1983). Since 23^{o}C is the upper limit of the temperature range we feel that 16 ^{o}C will be suitable enough as our upper limit to represent the remaining upper range. The scallops will be fed daily a mixture of algae (one diatom and one flagellate) at a 1:1 flagellate to diatom ratio based on algal cell size, using Tahitian Isochrysis (T-iso) as the best proposed flagellate (Utting and Millican, 1998) combined with a diatom such as *Chaetocerous muelleri* (Cm). A suitable ration for the broodstock is 6% of the dry meat weight being cultured at 20-22^{o}C, 3% dry meat

weight is used for bivalves that prefer lower temperatures (Utting and Millican, 1997). Full sets of measurements, such as animal size, wet weight, dry weight, gonad weight, somatic weight for condition indices reporting, along with histology samples (wet weights of gonads and gonadal development examination), will be taken over a four month period (November to February) to determine how conditioning is affected by temperature. Histology samples will likely only be taken at time zero (first collection), half way through the experiment and at the end. During sampling, visual inspection of gonad development will also be documented. Therefore as dry meat weights are a fatal means of testing, sufficient animals will be needed to enable sampling of dry meat weights every 3-4 weeks based on best results in previous trials several scientists in the past (Solon, 1984). Since dry weights will be taken, extra animals will be required to be able to sacrifice them and weigh the meat. The total number of animals desired would be roughly 270 animals to suffice the experiment, combining the sampling of 27 animals (3 from each of the 9 tanks) every sample period (Solon, 1984). 9 scallops from each different temperature regime would be sampled each time interval and it is desired to have roughly 30 animals remaining (10 from each environmental condition) at the end for spawning trials. Some extra scallops would also be needed as for possible mortalities may occur from the transfer from the boat to the CSR or general stress in captivity. Stress could be a strong influence during both the acclimation period from the wild to captivity as well as acclimation to the 3 different temperature regimes. To minimize stress, temperatures in captivity will only be adjusted at $1^{o}C$ per day until the desired temperatures have been reached.

References

Bourne, N. (1969). Scallop resources of British Columbia. *Fish. Res. Board Can. Tech. Rep.* **104**. 60 pp.

Liu, W. Alabi, A.O., and Pearce, C.M. (2008). Broodstock Conditioning in the Basket Cockle, *Clinocardium nuttallii*. *J. Shell. Res.* **27** (2): 399-404.

Pilditch, C.A. and Grant, J. (1999). Effect of temperature fluctuations and food supply on the growth and metabolism of juvenile sea scallops (*Placopecten magellanicus*). *J. Mar. Bio.* **134** (2): 235-248.

Solon, M. (1984). Hatchery Development of Marine Bivalve Molluscs. *Final Report Oregon State University School of Oceanography.* 54 pp.

Utting S.D. and Millican, P.F. (1998). The role of diet in hatchery conditioning of *Pecten maximus.* Centre for Environment, Fisheries and Aquaculture Science, UK.

Ocean and Marine Fisheries. Ministry of Environment. Statistics Canada. 2007 BC Seafood Industry – Year in Review. September 2008. Victoria, BC.

Parsons, G.J. and Shumway, S.E. (2006) Scallops: biology, ecology and aquaculture. Developments in Aquaculture and Fisheries Science. Volume 35. Oxford, UK.

Bernard, F.R. (1983). Catalogue of the living Bivalvia of the Eastern Pacific Ocean: Bering Strait to Cape Horn. Canada. Spec. Publ. Fish. Aquat. Sci. 61:102p.

Department of Fisheries and Oceans – Pacific Region. 2009. http://www.pac.dfo-mpo.gc.ca/sci/osap/data/Searchtools/Searchlighthouse_e.htm Canada.