PERSPECTIVES OF REPRODUCTION AND CULTIVATION OF RED KING CRAB *PARALITHODES CAMTSCHATICUS* IN THE BARENTS SEA (RUSSIA AND NORWAY)

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Significant decline in the red king crab abundance together with sharp fall of the Barents Sea catches (3–4 times), and the expected poor recruitment of the stocks necessitate search for additional measures aimed at conserving this valuable commercial species stocks and reproduction, including techniques of artificial reproduction.

There is no doubt that eventually, we shall have to restore this species stocks in the northern basin. This is obvious from the red king crab exploitation experience in the Far Eastern seas where these fisheries have been long in a depressive state. The stock depletion is apparently caused not only by over fishing but also by low efficiency of natural reproduction. The last made scientists to develop techniques of artificial reproduction and rearing of this species. For many years, Laboratory of crustacean reproduction and cultivation (VNIRO) has been carrying research studies of this problem, both in closed systems with artificial seawater, and in flow-type systems on the coast of the Barents Sea (Kovatcheva et al., 2005; Kovatcheva et al., 2006; Kovatcheva, 2006; Kovatcheva, 2008).

Reproduction and cultivation of red king crab in the coast of the Barents Sea (Russia)

With the aim of optimizing maintenance of the red king crab artificial reproduction, in 2009 the VNIRO specialists developed a design specification for the crab module construction on the Barents Sea coast (Dal'nye Zelentsy Ltd.). This project took account of biological and technological requirements for the red king crab cultivation systems.

The set of basins consists of eight various basins for keeping gravid females, larvae (zoea and glaucothoe), as well as young red king crabs. Two basins designed for gravid females and spawning are made of nontransparent plastic, while six basins for rearing larvae, glaucothoe and juvenile crabs are made of transparent polycarbonate which allows for visual control of the hydrobionts state. The overall area of the basins (bottom) is 8.4 m^2.

The module includes a section for live food (nauplii *Artemia* sp.) production. Thermostatted incubators make adequate daily provision of nauplii for the specified feeding regime.

Basins have a flow water supply system with the overall volume of 4.7 m^3; the seawater intake varies from 0.25 to 5.0 m^3/h. This system provides optimal environment in basins as it has a controlled water intake with mechanical filtration and UV-sterilizer, as well as a separate circuit for the water recirculation with thermostatting to keep the water temperature at the required level. Besides, the module includes a separate water supply system for particular basins to maintain different temperature regimes in them. Thus, the module provides for control of the physiological rhythms of adult and young crabs, as well as larvae through changing of the water temperature.

In March, 2010, after setting up the water supply system and establishment of the experimental module, we started experiments on adaptation and optimization of the artificial reproduction technique in the coast rearing module with the aim to release young crabs into the sea.

Under controlled conditions in March, the module produced 600,000 larvae (zoea I).

During the entire larval period (zoea I – IV) our experiments with zoea were connected with elaboration of some bio technology elements of the red king crab reproduction in natural seawater under constant temperature of 7^o C. Duration of the larvae period was 39 days or 273 degree -days.

At the postlarval stage (glaucothoe), we introduced substrates into the basins for settlement of the hydrobionts and increased the water temperature up to 8^o C. The post larval stage took 19 days or 152 degree -days.

The glaucothoe molt took 10 – 12 days. Mean survival rate of zoea I till the glaucothoe molt ranged from 30 – 60% in various basins and directly depended on the introduced substrates.

On the 9th of June 2010, we released 200,000 juvenile crabs into the sea in presence of officers from the Murmansk state veterinary service, the Murmansk department of Rosselkhoznadzor, the Barents Sea-

White Sea territorial department of the Russian Federal Agency of Fisheries, personnel of Dal'nye Zelentsy Ltd., and the VNIRO specialists.

First results of experiments in the coast module for crab rearing (the Dal'nye Zelentsy Ltd. property), which were supported by the VNIRO specialists, showed good opportunities for successful artificial reproduction of the red king crab under controlled conditions with subsequent release of juveniles into the sea.

For investigation of early stages of the red king crab juveniles cultivated under artificial conditions of the coast rearing complex experiments continue.

In 2010 – 2014, we are planning to conduct the following studies:

1/ Develop a technique for production of the red king crab larvae and juveniles with further rearing under controlled conditions;

2/ Develop a technique for releasing of the red king crab juveniles into the sea (restocking);

3/ Investigate biology and physiology of red king crab at the early life stages.

Proceeding of the red king crab artificial reproduction in the Barents Sea could become a good example of efficient partnership between private and state institutions in addressing of such grand-scale issues as conservation of aquatic biological resources of the Russian Federation. Moreover, the results of these studies will be used to construct the crab rearing complexes with the aim of restocking and maintaining natural populations of red king crab in the Barents Sea and the Far Eastern seas.

Cultivation of the red king crab on the coast of the Barents Sea (Norway)

Red king crab is a valuable fishery resource both for Russia and Norway. Russia has accumulated long traditions of commercial utilization of red king crab. While in Norway, studies and exploitation of this species only started a decade ago in mid-1990s, when natural stocks of this acclimatized species increased in the Barents Sea.

With the object of rational commercial utilization of the red king crab resources came into existence elaborated of technology of the species keeping and cultivation in the Norway region. Therefore, by the end of 2007, the project in this sphere began under the joint Russian-Norwegian project – VNIRO (Moscow, Russia) and Norway King Crab Production AS (Bugøynes, Norway).

***The main goal of the project**:*

1. Establishment of an experimental coast facility for keeping and rearing of red king crab;

2. Optimization of bio technology for prolonged keeping and rearing of red king crab in the basin complex;

3. Improvement of techniques of the long-distance transportation of live red king crab;

4. Development of techniques to control physiological state of red king crab under cultivation conditions.

Studies began with development of the technical design specification for the crab complex construction on the coast of the Barents Sea (Bugøynes, Norway). The project is based on the scientific research outcomes which account of all stages of keeping and artificial rearing of crab under controlled conditions, including a whole range of technical decision.

The complex site is the Barents Sea coast (Bugøynes, Norway).

Since 2008, there are experiments with red king crab in respect of identifying optimal parameters of cultivation and long-distance transportation of live red king crab.

Main activities in the complex under continuous water quality control are as follows:

1. Investigation of feed rations and feed types;

2. Examination of stocking density;

3. Studies of the crab legs filling with muscles;

4. Optimization of the crab rearing during the premolt and molt period under artificial conditions;

5. Studies of physiological state of red king crab under various conditions of keeping and transporting.

Development of techniques of the long-distance transportation of live red king crab is the principal goal of the experiments carried out in the complex.

Live red king crab is the most valuable delicacy. Since 2004, when the Barents Sea fisheries for the acclimatized red king crab started, the demand for live red king crab has been continuously growing.

Since 2005, the VNIRO specialists have been conducting studies of the red king crab transportation. In 2008–2009, when we started our joint work with the Norway King Crab, our studies attained a new level. The Bugøynes complex of basins allows advancing the known techniques of the crab transportation without water.

Development of scientifically founded methods and techniques of artificial reproduction of red king crab in Russia and identification of optimal parameters of its keeping, rearing and long-distance transportation of alive commercial crab in Norway are promising bases for rational commercial use of the red king crab resources both in Norway, and in Russia.

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A METHOD FOR DERIVING HYDROLYSATES FROM FRESHWATER FISHES (RUFF, SMELT, BLEAK) OF POTENTIAL RESOURCE VALUE IN KARELIA

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One of the ways to get unique biologically active substances from aquatic organisms is recycling of wastes from processing of valuable commercial fish and marine invertebrates, as well as of low-value species that constitute a high proportion in the catches. Quite a number of papers devoted to the issue mainly focus on marine species, whereas studies where the raw material is freshwater aquatic organisms are few. The fact however is that in just one commercial fishery lake of Karelia (Syamozero) these fish species (ruff, bleak, smelt, etc.) contribute up to 70% of the catch. Furthermore, the wastes of processing of more valuable fish species (whitefish, vendace, pike-perch, bream, etc.) are hardly used at all, although they may be utilized in the biotechnology of producing various biologically active substances. Depending on the purpose of deriving a certain hydrolysate, one applies different methods of hydrolysis, but the most promising and convenient one is enzymatic hydrolysis performed using preparations with nuclease and proteinase. In this study, we used the preparation derived from the digestive gland of the king crab, which contains oligonucleotides with a molecular weight of 6–68 kDa and is easily soluble, which makes it more readily available for further utilization, and broadens the range of its applications (Mukhin and Novikov, 2001).

Protein preparations in this study were produced from fish species "of potential resource value" from Republic of Karelia waters: smelt – *Osmerus eperlanus eperlanus* (L.), ruff – *Acerina cernia* (L.), bleak – *Alburnus alburnus* (L.).

Minced tissues and organs of the fishes under study were obtained by homogenizing them in the 1:3 ratio in the chosen extraction medium (distilled water) in Potter-Elvehjem homogenizer (1.200 rpm x 3 min). After the homogenate had been refrigerated for 3 hours, filtered through several layers of gauze, and centrifuged (10.000 g x 30 min, K-24), the activity of proteolytic enzymes was determined in the supernatant fluid (Alekseenko, 1968). The activity of the enzymes was expressed in units of optical density of the solutions containing substrate hydrolysis products. The optical density of the solutions was measured spectrophotometrically at 240 – 320 nm.