The Australian red-clawed crayfish (*Cherax quadicarinatus* Von Martens 1868) is a promising aquaculture object for the south of the Russian Federation

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Abstract. The paper presents information about a promising aquaculture object for the south of the Russian Federation - the Australian red-clawed crayfish *Cherax quadicarinatus* Von Martens 1868. A brief description of its biological characteristics, which are the main factor in the development of specific biotechnologies for its commercial cultivation, is given. The main limiting factor in the artificial cultivation of this species is water temperature. The article indicates that for Russian conditions, three possible directions for growing Australian crayfish can be distinguished: in ponds in the southern regions of Russia in natural climatic conditions (summer); in ponds, cages and pools on warm waters of energy facilities in the summer; in closed water supply installations – year-round. A technology has been proposed for combined cultivation of crayfish, in which the production of juveniles is carried out in controlled basin conditions, and the cultivation of commercial products in earthen ponds in warm seasons, when the water temperature corresponds to the biological needs of the species.

1 Introduction

Over the past 20-30 years, world aquaculture has been actively developing, steadily increasing its share in the total production of aquatic organisms. Today, more than 48% of consumed fish products are grown in aquaculture conditions. In the area of consumption, the range of delicious species of aquatic organisms (including crustaceans) is expanding. Crustacean meat is a source of complete protein, fat, as well as a whole range of microelements and vitamins necessary for the human body.
Crustaceans are a group of aquatic organisms, technologies for the production of which in artificial conditions are at the development stage, and the range of crustacean species in aquaculture is constantly expanding.

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The Australian red-clawed crayfish *Cherax quadricarinatus* Von Martens 1868 is a species of freshwater decapod crayfish from the family Parastacidae Huxley, 1879. It is characterized by a relatively large body size and high fecundity compared to other crayfish of this genus [1]. The native range of the species is the fresh waters of the tropical and subtropical zone of north-eastern Queensland, northern and eastern parts of the Northern Territory of Australia and southern New Guinea [2] (figure 1). This species has now been introduced to many countries [3-6].

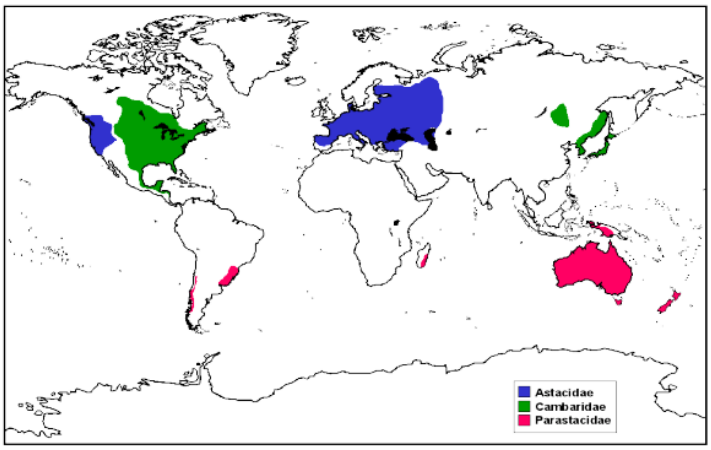

Fig. 1. Range of crayfish from the family Parastacidae Huxley, 1879 [7]

Work on its development as an aquaculture object in the world began in the 1980s. This species of crayfish is an important object of warm-water aquaculture in a number of countries. A number of biological features of the Australian crayfish make it a promising object for cultivation in aquaculture [8], but today only one enterprise for the commercial cultivation of *Cherax quadricarinatus* is successfully operating in the southern part of Russia. In this regard, the purpose of the study is to analyze and summarize the available information on the biological characteristics of the red claw crayfish to assess the prospects of using this species as an aquaculture object and to propose a scheme for the biotechnology of its cultivation.

2 Biological characteristics

The Australian red-clawed crayfish *Cherax quadricarinatus* is a large species, the maximum body size of which can reach up to 25 cm, body weight up to 600 grams [9]. The life cycle of *Cherax quadricarinatus* is simplified in the same way as that of other crayfish species; larval stages are absent. The loss of planktonic larvae is typical for most species of aquatic organisms that have transitioned to life in freshwater bodies. Significant embryonic development is accompanied by an increase in the size of eggs and, as a consequence, a decrease in their number. Fecundity in *Cherax quadricarinatus* ranges from 100 to 1000 eggs (average 300 to 800 eggs) per female and depends on the size of the individual.
Cherax quadicarinatus is an omnivore with small differences in diet depending on sex and size, both temporally and spatially [10].
The body consists of the cephalothorax (cephalothorax) and abdomen (abdomen). The cephalothorax is covered from the back and sides by a powerful carapace (carapace), the

lateral parts (brachiostegites) of which, covering the gills, form the gill chambers. The anterior part of the carapace is elongated into a long wedge-shaped rostrum. The abdomen is formed by six movably connected segments and a telson. The abdomen easily bends under the cephalothorax. It has an attractive appearance, which is why it is widely used in ornamental aquaculture.

The native climatic conditions determined the temperature range of existence of *Cherax quadricarinatus*. Preferred temperature ranges are from 23 to 31°C. Temperatures below 10°C and above 36°C are lethal. For this species to reproduce, the water temperature must be above 23°C.

2.1 Taxonomic position

The species was described with the name «*Astacus Quadicarinatus*» by the German scientist Carl Eduard von Mortens in 1868 while processing material collected during a Prussian expedition to the Far East. The species was later renamed «*Cherax Quadicarinatus*» by Clark (1936) [11]. Today the species has the following systematic position:

Domain: Eukaryotes
Kingdom: Animals
Type: Arthropods
Subtype: Crustaceans
Class: Higher crayfish
Order: Decapod crustaceans
Family: Parastacidae
Genus: *Cherax*
Species: *Cherax quadricarinatus*

2.2 External appearance

The color of the integument of the Australian crayfish varies from blue to green, including yellow, pink, orange and red inclusions (speckles) [11]. Males have a bright orange spot on the outer side of the claw (figure 2).

Fig. 2. Appearance of the male of the Australian red-clawed crayfish *Cherax quadricarinatus* (photo by the author).

3 Aquaculture biotechnology

One of the main advantages of the Australian red claw crayfish is its high growth rate. Crayfish can reach market size (approximately 50–100 g) in 5–6 months. An undeniable positive biological feature of the species is tolerance to low concentrations of oxygen dissolved in water [12].

Growing Australian red claw crayfish is possible using several technologies: in pond conditions [13-14], in industrial aquaculture [15] (figure 3).

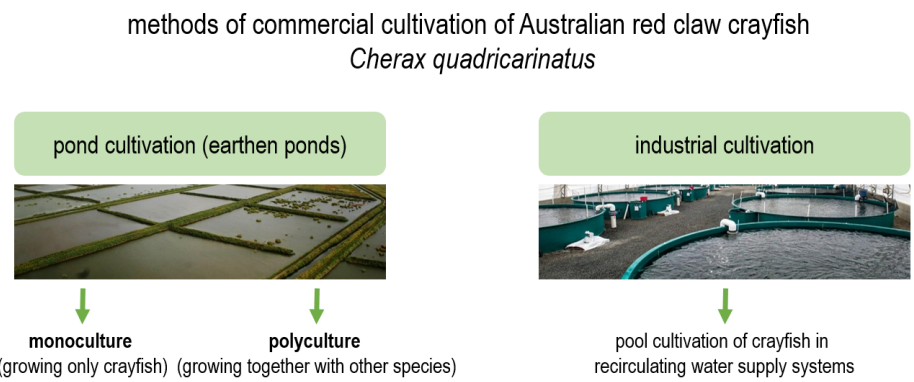

Fig. 3. Methods for commercial cultivation of the Australian red-clawed crayfish *Cherax quadricarinatus*

For the conditions of our country, three possible directions for growing Australian crayfish can be distinguished:

- in ponds in the southern regions of Russia in natural climatic conditions (summer);
- in ponds, cages and pools on warm waters of energy facilities in the summer;
- in closed water supply installations – year-round.

In the climatic conditions of the Russian Federation, taking into account the presence of cold winters, when the water temperature drops significantly below 10°C even in the southern territories, the use of combined cultivation technology is promising.

In industrial conditions (in swimming pools), controlled production of juveniles (planting material for Australian crayfish) is required. After which the juveniles are grown in pools to the required size (the size of juvenile crayfish before release into the pond depends on the required marketable weight of the final product).

After the juveniles have been raised, they are transferred to pond conditions when the water temperature in the ponds reaches 23°C. First, it is necessary to create a sufficient level of natural food supply in the ponds, on which the success of the pond stage of cultivation will depend.

Due to the fact that males spend more energy on somatic growth than females, a promising direction is the same-sex rearing of crayfish after sorting large juveniles. In this case, it is promising to release males into the pond for rearing, which will ultimately make it possible to obtain marketable products in the form of males with an attractive appearance and large body size.

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