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Study on the effect of still water environment on the growth of Australian freshwater lobster

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Abstract: Regression analysis of Australian freshwater crayfish (Cherax quadricarinatus) revealed power function relationships between body length (L) and weight (W) across age groups: W = 1.2995L^0.986 (R^2 = 0.9538) for 1-month-old, W = 0.3468L^1.3747 (R^2 = 0.9242) for 2-month-old, W = 2.852L^0.4004 (R^2 = 0.9704) for 3-month-old, and W = 2.5846L^0.4238 (R^2 = 0.9404) for 4-month-old individuals, while daily feed intake (F) correlated with weight as F = 0.013W^1.014 (1-month), F = 0.047W^0.7274 (2-month), F = 0.0012W^2.4975 (3-month), and F = 0.0018W^2.3598 (4-month), demonstrating peak growth at 2 months with significant deceleration by 4 months, suggesting optimized farming practices—increased feeding, water exchange, or aeration during the second month and harvest after 4 months.

1. Introduction

Australian freshwater lobster (Cherax quadricarinatus), also known as Australian lobster, red crayfish, blue lobster, native to northern Australia, named after the appearance of sea lobster, is one of the world 's most valuable freshwater economic shrimp species [1].

Australian freshwater lobster has a strong adaptability to the environment, and likes to live in muddy waters with lush water plants, or a large number of shelters and humus. The survival temperature of Australian freshwater lobster is 5 ~ 35 ℃, the best growth temperature is 22 ~ 30 ℃, and the suitable water pH is 7.5 ~ 8.2. Australian freshwater lobsters don 't like light, like to live in caves, into the cave during the day and out of the cave at night, each cave is usually androgynous. When the sex ratio is imbalanced and the food is insufficient, mutual killing will occur between Australian freshwater lobsters [2]. Australian freshwater lobster has a wide range of food habits. In the natural environment, it mainly feeds on filamentous algae, organic debris, the roots, leaves and debris of aquatic plants. It likes to eat juicy and tender green plants such as water hyacinth, water hyacinth, Potamogeton malaianus, green duckweed and bitter grass. Animal foods include earthworms, snails, clams, fish, earthworms, and eggs and pupae of aquatic insects [3].

In 1988, Australia initially carried out commercial aquaculture of Australian freshwater lobster. The main areas of aquaculture were Queensland in northern Australia and New South Wales in southern Australia. The aquaculture method was mainly pond aquaculture, in addition to reservoir aquaculture and lake aquaculture. For the development of Australian freshwater lobster farming

industry, the United States is more inclined to pond farming mode.[4] The trial culture of Australian freshwater lobster in China began in 1992 [5].At present, Guangdong, Zhejiang, Hubei, Anhui and other provinces have formed a certain scale of culture, which has great potential for development. At present, there are mainly two breeding modes: pond intensive culture and paddy field culture [6]. In recent years, the scale of Australian lobster farming in China has increased rapidly, the output has increased significantly, and the market size has become larger and larger. As consumers ' demand for Australian freshwater lobster continues to rise, it has directly stimulated the investment scale of Australian freshwater lobster farming. Many local governments have vigorously supported Australian freshwater lobster farming as a poverty alleviation industrial project. .[7]

As a precious freshwater aquaculture species, Australian freshwater lobster has high economic value and nutritional value. Because of the relationship between body length and body weight, it has been widely used in fishery and population space-time assessment. It is not only an important breeding management index, but also an important economic performance index. However, the related research on Australian freshwater lobster focuses on water quality, disease, breeding mode and breeding density, and the relationship between body length and body weight has not been reported.

In this experiment, the static water environment is used for aquaculture. Because the nutrients in the static water environment are more concentrated, it is easier for shrimp seedlings to obtain sufficient food resources, and it is not necessary to establish a complex water flow system, which can reduce the cost of equipment investment and maintenance. Therefore, by studying the relationship between body length and body weight of Australian freshwater lobster and the relationship between feeding amount and body weight in hydrostatic environment, it provides theoretical basis and reference for the management of artificial pond culture of Australian freshwater lobster.

2. Materials and methods

2.1 Aquaculture pond construction

The primary work of breeding Australian freshwater lobster is to build a shrimp pond. A stainless steel frame with a height of 1.2 m, a width of 2 m and a length of 6 m was built in the experiment, and then the corresponding size of impervious canvas was inserted, and the canvas was fixed on the stainless steel frame with a tie. Add water to the canvas pool, and the water depth is controlled at about 0.25 m. Plant Elodea nuttallii and Potamogeton crispus in the tank of the canvas pool, and then sprinkle the red duckweed on the water surface, which can provide a rest place and avoid light for Australian freshwater lobster. The pH of the water in the canvas pool was adjusted to 7.5 ~ 8, and then the Australian freshwater lobster seedlings were put into the culture pool.

Breeding management: all materials need to be soaked and disinfected with lime water, and washed with water before entering the pond. Ensure that parasites and other pathogens are not introduced. Feeding was carried out twice a day, 25 % in the morning and 75 % in the afternoon. Record the feeding situation, adjust the amount of feed in time according to the weather and feeding situation, ensure that the feed is fed enough and not too much surplus, and the high temperature weather (≥ 35 °C) can be less or not. Daily monitoring of breeding pools should include the systematic removal of accumulated feed residues and organic debris from canvas enclosures to uphold hygienic conditions and

Regularly change water, add water when the water rushed to the canvas culture pool wall, can play a role in increasing dissolved oxygen. Real-time monitoring of water quality, once found that the water quality is acidic, immediately sprinkled with lime water adjustment, to ensure that the water quality meets the growth needs of Australian freshwater lobster.

2.2 Materials and reagents

PH precision test paper (5.5-9.0): Hangzhou Shisan Technology Co., Ltd.; raw lime: Sichuan Jinghetai Agricultural Technology Co., Ltd.; potassium ferrate: Shandong Wuchuang Yufeng Biological Co., Ltd.; yeast mud: Guizhou Duyun Jianjiang Wine Development Co., Ltd.; elodea nuttallii, Potamogeton crispus and duckweed were collected from Jianjiang River in Duyun City, Guizhou Province. Australian freshwater lobster fry: Buy from Huazhong Agricultural University, randomly fished 20 Australian freshwater lobsters every month, repeated three times, measured and recorded their body length and weight.

2.3 Instruments and equipment

High pressure steam sterilization pot GR110DR: Zhiwei (Xiamen) Instrument Co., Ltd.; electronic Balance YP5002: Shanghai Youke Instrumentation Co., Ltd.; vacuum filter SHB-IIIS: Zhengzhou Great Wall Technology Industry & Trade Co., Ltd.; vernier caliper O-150mm: Shanghai Shen Hanzuo Co., Ltd.; pump DLXPH6594: Hangzhou Delixi Group Co., Ltd.; drying oven Model: Shanghai Boxun Industrial Co., Ltd. Medical Equipment Factory; thermometer E300: Zhengzhou Boyang Instrument Co., Ltd.

2.4 Measurement method

After sucking the water off the body surface of Australian freshwater lobster with absorbent paper, routine biological measurements were performed on Australian freshwater lobster, including body length and body weight. The measurement of morphological parameters is defined as follows: body length refers to the straight line length (cm) from the base of the eyestalk to the end of the caudal segment [8]; body weight refers to the wet weight (g) after absorbing water from the body surface. Body length was measured with a vernier caliper, and body weight was measured with an electronic balance[9] .

2.5 Statistical analysis of data

The relationship between body length and body weight was calculated by the formula W = aLb [10]. W is body weight (g), L is body length (cm), a and b are constants. The measured data of body length and weight of Australian freshwater lobster were input into the Excel table, and the scatter diagram was drawn to obtain the curve regression equation of body length and weight. SPSS 23.0 statistical software was used for variance analysis.

3. Results and analysis

3.1 The relationship between growth time and body length, body weight of Australian freshwater lobster

3.1.1 Relationship between growth time and body length of Australian freshwater lobster

Each month, 20 tails were randomly selected to measure their body length, and the average body length of each month was calculated respectively. The average body length was used as the ordinate, and the growth time was the abscissa, and the line chart was drawn. It can be seen that there is a positive correlation between body length and growth time. (See Figure 1)

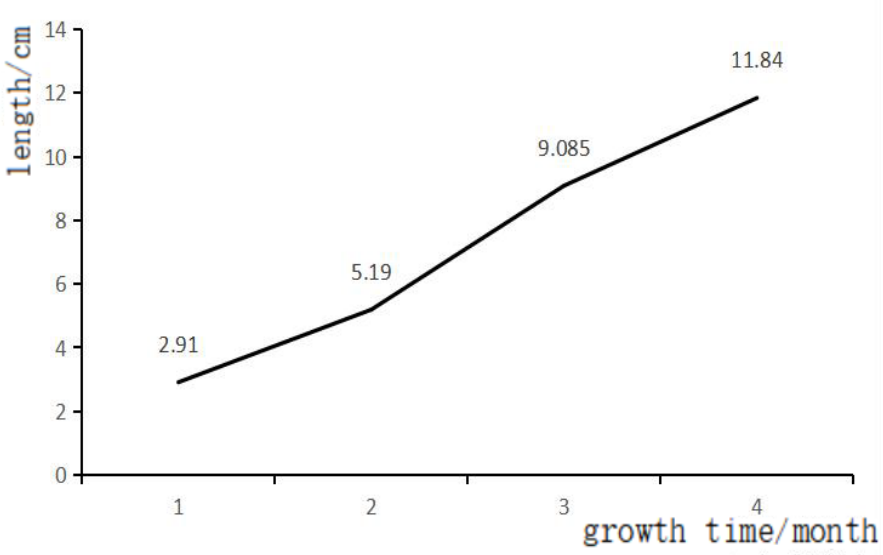

Figure 1. Herax quadricarinatus relationship between growth time and body length

3.1.2 Relationship between growth time and body weight of Australian freshwater lobster

Each month, 20 tails were randomly selected to measure their body weight. The average body weight was used as the ordinate, the growth time was used as the abscissa, and the line chart was drawn. It can be seen that there is a positive correlation between body weight and growth time. (See Figure 2)

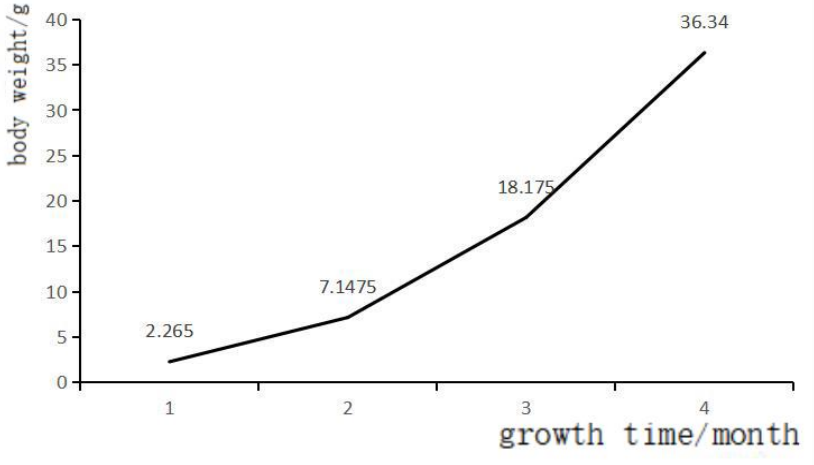

Figure 2. Herax quadricarinatus relationship between growth time and weight

3.2 The relationship between body length and body weight of Australian freshwater lobster

Taking the body weight of Australian freshwater lobster as the abscissa and the body length as the ordinate, the scatter diagram is drawn, and then the power function trend line is fitted. This is almost the same as the relationship between the body weight and body length of Li Ruiyu [11] and Li Gang [12]. It can be concluded that the Australian freshwater lobster is cultured in the hydrostatic environment for 4 months, and the curve regression equation of body weight and body length of each month is as follows:

One month: W1 = 1.2995L0.986 (R2 = 0.9538) (see Fig.3).

2 months breeding: W2 = 0.3468L1.3747 (R2 = 0.9242) (see figure 4)

Aquaculture for 3 months: W3 = 2.852L0.4004 (R2 = 0.9704) (see figure 5).
Aquaculture for 4 months: W4 = 2.5846L0.4238 (R2 = 0.9404) (see figure 6)

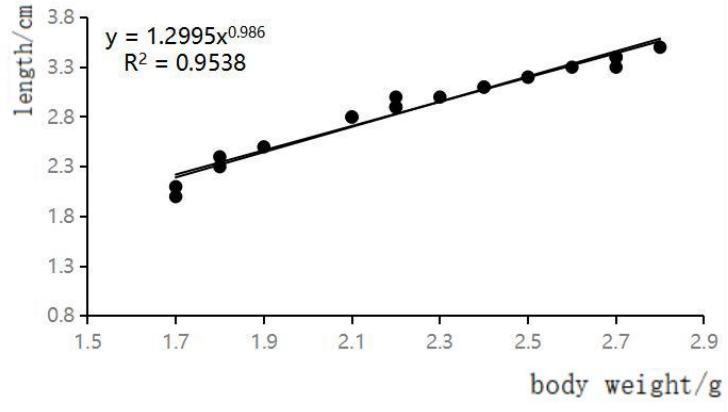

Figure 3. Regression curve of body weight to body length of Herax quadricarinatus cultured for 1 month

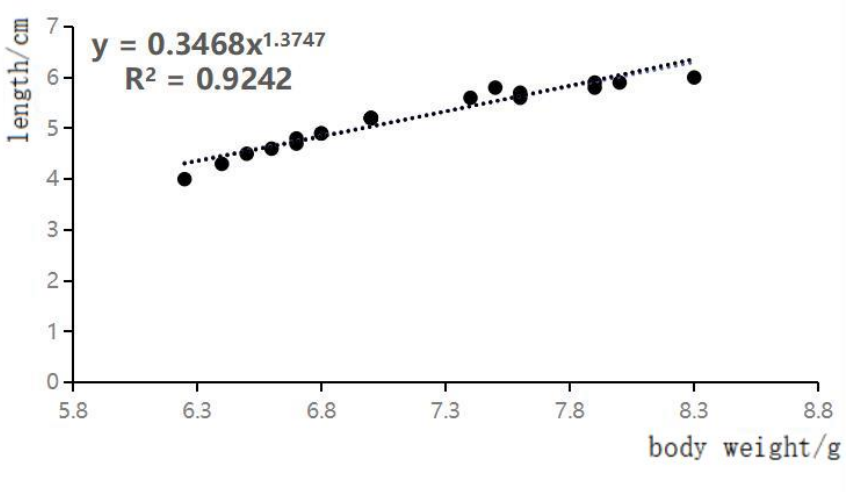

Figure 4. Regression curve of body weight to body length of Herax quadricarinatus cultured for 2 month

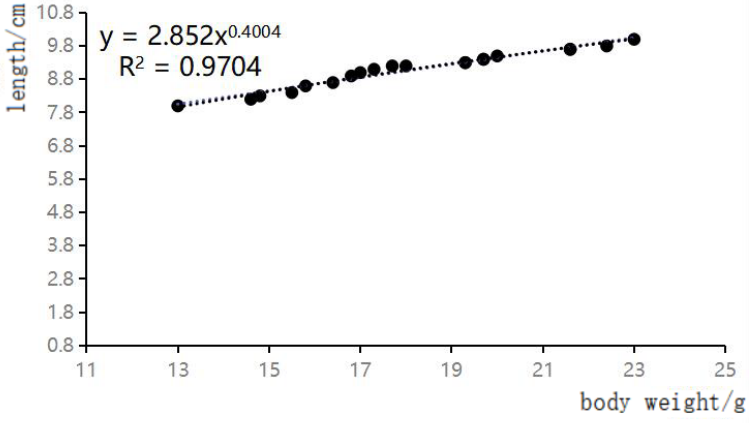

Figure 5. Regression curve of body weight to body length of Herax quadricarinatus cultured for 3 month

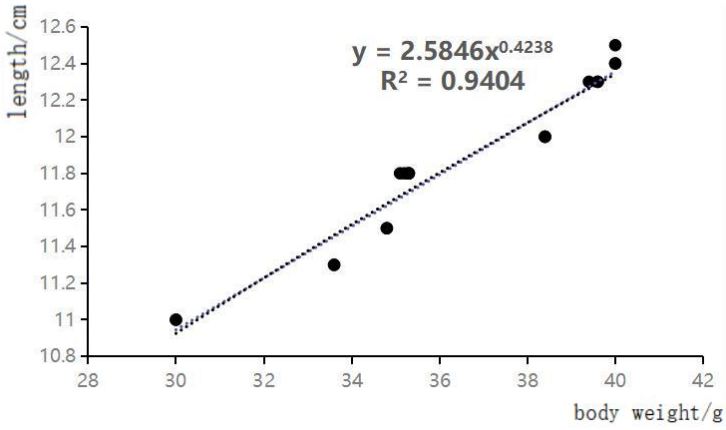

Figure 6. Regression curve of body weight to body length of Herax quadricarinatus cultured for 4 month

The significance analysis of body length and weight in different months was carried out by SPSS 23.0 statistical software. Through the t test, it is known that the monthly growth of body length and body weight has reached the extremely significant difference level of P = 0.01, and the standard error is small, indicating that the gap between the sample mean and the overall mean will be smaller, so that the sample data is representative and can be statistically analyzed [13] [14].

3.3 The relationship between daily feed intake and body weight

According to literature [15], the empirical relationship between daily feeding amount and body length of Australian freshwater lobster is a power function. In this study, the fitting equation was obtained based on the measurement data of body weight and body length: breeding for 1 month

W = 1.2995L0.986, culture for 2 months W = 0.3468L1.3747, culture for 3 months

W = 2.852L0.4004, cultured for 4 months W = 2.5846L0.4238). The correlation analysis between the body weight of Australian freshwater lobster and the feeding amount was carried out. Finally, the fitting equations of daily feeding amount and body weight of shrimp larvae at different stages were as follows: cultured for 1 month F = 0.013W1.014, cultured for 2 months.

F = 0.047W0.7274, F = 0.0012W2.4975 for 3 months, F = 0.0018W2.3598 for 4 months.

4. Results and discussion

4.1 The relationship between feeding time and body length, body weight of Australian freshwater lobster

The results showed that there was a positive correlation between body length and growth time, body weight and growth time in 4 months of culture.

4.2 The relationship between body length and body weight of Australian freshwater lobster

Through the statistical analysis of the body length and body weight data of Australian freshwater lobster, the curve regression equation of body length and body weight and the R2 in the equation are 0.9538, 0.9242, 0.9704 and 0.9404 respectively. The closer the value of R2 is to 1, the better the fitting effect of the equation is [8]. Therefore, the curve regression equation can be used as the growth prediction formula of Australian freshwater lobster at different feeding stages.

The relationship between body length and body weight of Australian freshwater lobster conforms

to the power function curve equation W = aLb. The power exponent b is a characteristic index reflecting the growth of shrimp in different environments. The b value is generally in the range of 0.25 ~ 4.00. When the growth rate is constant, b = 3 or similar to 3 [16], and allometric growth, b < 3 or not close to 3 [17]. The b values obtained in this analysis are 0.986 and 1.3747 respectively.0.4004 and 0.4238, which are smaller than 3. It can be seen that the growth of Australian freshwater lobster in hydrostatic environment is allometric, which is consistent with the view that the body length and weight of aquatic animals in Huang Cheng [17] are allometric. This study only studied the functional equation of body length and body weight of cultured Australian freshwater lobster in the still water environment of artificial ponds, which may be slightly different from that of flow culture and paddy field culture [18].

4.3 The relationship between daily feeding amount and body weight

By analyzing the relationship between daily feeding amount and body weight of Australian freshwater lobster at different stages, it can be seen that the growth rate of Australian freshwater lobster is the fastest in the second month of breeding Australian freshwater lobster, and the growth rate of Australian freshwater lobster is relatively slow in the fourth month, and the feed cost required to increase the unit weight is greatly increased. Therefore, it is recommended to increase the feeding amount in the second month of culture, increase water exchange and oxygenation, so as to make full use of the physiological time of rapid growth of Australian freshwater lobster. It is recommended that Australian freshwater lobsters be sold after four months of culture, as Australian freshwater lobsters enter the slow growth stage.

5. Conclusion

The culture experiment showed that there was a positive correlation between the growth time of Australian freshwater lobster and body length and body weight, and there was a power function relationship between body length and body weight, and the growth rate of Australian freshwater lobster at different growth times was different. The second month of age is the physiological period for the rapid growth of Australian freshwater lobsters. When entering the fourth month of age, the growth rate of Australian freshwater lobsters slows down significantly, and the cost of feed required to increase the unit weight increases greatly. It is recommended that farmers increase the feeding amount in the second month of breeding Australian freshwater lobsters, and increase water exchange or oxygenation to make Australian freshwater lobsters grow rapidly. It is recommended to sell Australian freshwater lobsters at the age of four months.

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