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Research Article

Effects of Different Habitat Space on Growth Performance and Nutritional Composition of Swimming Crabs (*Portunus trituberculatus*)

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Habitat space is crucial for animals. This experiment explored the effect of four different farming acreages (0.5 m^2, 1 m^2, 10 m^2, and 100 m^2) on survival rate, growth performance, and muscle nutrition composition of swimming crabs (*Portunus trituberculatus*) at the farming density of 2 ind/m^2. The results showed that the survival rate of the crabs that live in the 10 m^2 group and live in 0.5 m^2 alone had the highest survival rate of 20.50% and 20%, better than the 1 m^2 group and the 100 m^2 group with the lowest of 12.00% and 13% ($P < 0.05$). There was no significant difference between final body weight and final carapace width among the 4 groups ($P > 0.05$). The crude lipid content was the highest in 1 m^2, which was significantly higher than in 0.5 m^2 ($P < 0.05$). The crude protein content in the 1 m^2 and 10 m^2 groups was significantly higher than that in the 0.5 m^2 and 100 m^2 groups ($P < 0.05$). The results of the three conventional nutrients showed that there was no positive correlation between the muscle conventional nutrients and the farming area. The polyunsaturated fatty acid part of the 100 m^2 and 10 m^2 group was significantly different from the 1 m^2 and 0.5 m^2 groups ($P < 0.05$). The results show that farming crab alone is not better than together, and a small aquaculture acreage helps to improve the muscle nutrition composition of the swimming crabs, while a large aquaculture acreage is more conducive to balance the development of nutrition. Overall, 10 m^2 of habitat space was more economically feasible in practice.

1. Introduction

The swimming crab (*Portunus trituberculatus*) taxonomically belongs to *Crustacea*, *Decapoda*, *Portunidae*, and *Portunus*, which is widely distributed on the East Asian coasts. It is popular among consumers in China because of its fast growth rate, tasty meat, and high nutritional value. It is also an important farmed economic crab in China, which has been widely farmed from the north to the south of China coast ponds [1], with a farmed production of 113,810 tons in 2019 [2]. At present, the primary farm model of the crab is pond farm, and the advantages of using purse seine to farm crabs include improving the efficiency of crab harvesting, reducing the manual labor intensity, and preventing aquatic enemies from preying on crabs and increasing production [3]. It can also easily feed and reduce the risk of deterioration of pond water quality due to overfeeding [4]. In addition, the farm mode can effectively reduce the occurrence of diseases during the farming process [5, 6]. The survival rate can reach 11.30% [7]. Crabs have a fighting phenomenon, this is a large effect leading to the rise in mortality rates, and the habitat space of the purse seine plays a crucial role in the farm [8]. Small habitat space can stress the swimming crabs and reduce their feeding rate [9]; these stresses can be confirmed from the protective enzyme classes [10]; moreover, stressed swimming crabs will provide more energy to resist the physiological effects of stress [11].

Several studies have demonstrated that different sizes of experimental enclosures have impacts on the behavior of aquatic animals [12, 13]. For example, it has been found that different container sizes can influence the growth performance of fish. Restricting fish in a tank that was too small can negatively affect their normal growth [14–16]. The minimum scale ought to be higher than 0.3 m^3; otherwise, it can negatively affect the growth rate of *Dicentrarchus labrax* [17]. Similarly, many research studies have been conducted using the pond farm techniques for swimming crabs, including stocking density [18], monosex and mixed-sex culture modes [19–21], disease control [22], and water conditions [23]. We also found that the space size affected the growth performance of swimming crabs in a single crab basket culture system, and the rearing space for the crab should be set at two time-length spaces [9]. However, this single crab basket culture system is not suitable for large-scale farming of swimming crabs in ponds. Nowadays, aquatic farmers often select the farming area based on their personal experience, and it may cause problems such as inconsistency and arbitrariness, which leads to the instability of the farming output of crabs.

It is worth noting that little study has focused on the effect of habitat space, different farming acreages on swimming pond farms. This study combines practical experience, aiming to explore the impact of different aquaculture acreages on the livability, growth performance, and nutritional composition of swimming crabs and determining the feasible purse seine area in a pond. This study will provide a reliable reference range of purse seine area for farmers and enhance the farming efficiency of swimming crabs in aquaculture applications.

2. Materials and Methods

2.1. Experimental Animals and Sampling. In this experiment, healthy juvenile swimming crabs were selected from Guangyuan Crab Seedling Rearing Nursery, Jiangsu Province. The initial data of the swimming crab for the farming test are shown below. Full carapace width is 6.80 ± 0.41 cm, carapace length is 3.31 ± 0.29 cm, and body weight is 18.82 ± 3.23 g. The materials for the test mesh include mesh, rope, steel ring, and large bottom drop. Make four kinds of cylindrical nets with bottom area of 0.5 m^2, 1 m^2, 10 m^2, and 100 m^2. The purse seine is 40 cm above the water surface, and the bottom of the seine was inserted into the sludge for 10 cm above the water surface of the pond to ensure the reliability of the seine. Among them, there were fifty 0.5 m^2 groups (1 m × 0.5 m, length × height), fifty 1 m^2 groups(1 m × 1 m), ten 10 m^2 groups (4 m × 2.5 m), and one 100 m^2 (10 m × 10 m) for farming. The feed in the farming experiment is a small-sized clam, *Potamocorbula laevis*.

2.2. Experimental Design and Daily Management. This experiment were divided into four area test groups (0.5 m^2, 1 m^2, 10 m^2, and 100 m^2), and there were 50 groups of 0.5 m^2, 50 groups of 1 m^2, 10 groups of 10 m^2, and 1 group of 100 m^2. The culture density of each seine was 2 ind/m^2, and it means that put 1 crab in each 0.5 m^2 group, put 2 crabs in each 1 m^2 group, put 20 crabs in each 10 m^2 group, and put 200 crabs in 100 m^2 group. The specifications of the swimming crabs selected in the four test groups were uniform.

The experiment lasted for 105 days. It started on July 9 and ended on October 20. The swimming crabs were fed daily at 6 p.m. with fresh bivalve. The deceased individuals were salvaged and recorded daily, and the amount of bait would be timely adjusted to ensure sufficient food for swimming crabs (the daily feeding limited was 6–8% of the crab's body weight). Throughout the farming experiment, the average water quality parameters in the pond were as follows: dissolved oxygen >4 mg/L, salinity 20–30, total ammonia nitrogen <0.015 mg/L, and *pH* 7.0–9.0. We ensured adequate dissolved oxygen by turning on aerators for the duration of high temperatures and used sediment conditioners (persulfides) to improve the quality of water and sediment in ponds. In the middle and late stages of farming, drugs with improved substrate and water quality should be regularly used. The application frequency is every ten days on the sunny morning. The dosage was used according to the drug instructions. The drugs used include potassium persulfate, base change preparation, yeast, and organic acids.

2.3. Data and Sample Collection. Growth data were collected on the 9th July, 20th August, 20th September, and 20th October. The time interval between the initial data measurement and the second data measurement was added to reduce the effect of the previous measurement operation on the survival of the swimming crabs. For each data measurement, 10 crabs were raomly sampled from each group to measure the growth indicators at night to minimize adverse effects.

We used electronic scales to measure the body weight (BW) of swimming crabs (accurate to 0.01 g) and digital calipers to measure the carapace width (CW) of swimming crabs (accurate to 0.01 mm). The data were used for calculating the weight growth rate (Rw), the carapace gain rate (Rc), the weight-specific growth rate (SRw), and the carapace-specific growth rate (SRc).

The calculation formula for each growth parameter is as follows:

$$\begin{aligned}
\text{Survival rate}\,(\%) &= 100\%\frac{N_X}{N_0},\\
Rw\,(\%) &= 100\%\frac{\left(W_a - W_{a-1}\right)}{W_{a-1}},\\
Rc\,(\%) &= 100\%\frac{\left(C_a - C_{a-1}\right)}{C_{a-1}},\\
\text{SRw}\left(\frac{\%}{d}\right) &= 100\%\frac{\left(lnW_a - lnW_{a-1}\right)}{\text{DSRc}\,(\%/d)}\\
&= 100\%\frac{\left(lnC_a - lnC_{a-1}\right)}{D},
\end{aligned} \tag{1}$$

where N_0 is the initial number of swimming crabs in each purse seine area, and N_X is the number of crabs alive in each group in the end (20th October 2019). W_a and W_{a-1} are the mean body weight of swimming crabs at a month and $a-1$ month (unit: g), respectively. C_a and C_{a-1} are the mean carapace width of swimming crabs at a month and $a-1$ month (unit: cm), respectively. The D represents each sampling interval time (unit: day).

After the experiment, six crabs were randomly collected from each group, with a total of 24 crabs being used for muscle sample collection. After binding the swimming crabs back to the laboratory, when sampling, cut from the back end of the crab and separate the shell from the crab body with disinfected anatomical scissors. Collect muscular tissue from the connection between the swimming foot and the body. Wrap the muscle tissue with the tin foil, put it in the self-sealing bag and mark it, and put it in the −80°C refrigerator for future use.

2.4. Biochemical Analysis. The determination of proximate composition in muscle of the samples was followed with the procedures of Association of Official Analytical Chemists procedures [24]. Moisture content was determined by drying the muscle samples to a constant weight in an oven at 105°C, and the ash content was obtained by placing the samples in a muffle furnace set at 550°C and running it for 8 hours. The crude protein content of the samples was determined by the Kjeldahl method and acid digestion with FOSS Kjeltec TM8400. Using petroleum ether as a solvent, the crude lipid was extracted by Randall's modified method in FOSS, Soxtec, and fat analyzer.

The amino acid content of the crabs was analyzed following the methods described by Blackburn [25]. The determination of methionine (Met) and cysteine (Cys) was determined according to the method of oxidation with performic acid : hydrolysis (1 : 9) solution [26]. The amino acid analyzer (Hitachi, Ltd., Tokyo, Japan) detected 17 amino acids in each sample, respectively. The fatty acid extraction method followed the methods of Folch et al. [27], and chloroform-methanol (2 : 1 v/v) was used to extract total lipids in the muscle of crabs. After that, the percentage of each fatty acid in the total fatty acid was determined by the area normalization method. Total lipids were esterified with boron trifluoride methanol solution, and fatty acid methyl esters were extracted by isooctane [28], and fatty acids were determined using a gas chromatograph (GCEM-QP2010 SE).

2.5. Statistical Analysis. SPSS 23.0 software (Kaysville, UT, USA) was used for data analysis and comparison. The factor analysis of variance (ANOVA) was used to analyze differences in survival. Homogeneity of variance was tested of Levene's. ANOVA was used to analyze the experimental results, and Duncan's method was used for multiple comparisons. The level of significance was regarded as $P < 0.05$ for all statistical tests. All data are presented as mean ± standard error (mean ± SEM).

3. Results

3.1. Crab Survival Rate. The survival of the crab in the 10 m^2 group was the highest among the four various cultivation acreages, and the 1 m^2 crabs was the lowest. The survival of crabs in the 0.5 m^2 and 100 m^2 was 20.00% and 13.00%, respectively. In the 0.5 m^2 group, crabs live alone, and it is different from other groups with crabs living together. So, we compare the other three groups separately. After comparing the survival of the different groups by the Chi-square test, there was a statistically significant difference between 10 m^2 group with 1 m^2 group ($P < 0.05$) and different between 10 m^2 with 100 m^2 ($P < 0.05$) (Table 1).

3.2. Growth Performance. The BW and CW of swimming crabs under different groups were measured in three culture stages for Rw, Rc, SRw, and SRc calculation. Among the four groups, the crabs in the 1 m^2 and the 10 m^2 showed better performance in Rw, SRw, Rc, and SRc than the other two groups, but there was no significant difference in FW, FCW, Rw, SRw, Rc, and SRc among all groups in the whole culture period ($P > 0.05$) (Table 2).

The BW and CW of the four groups increased with the extension of farming time. In the BW and CW of the 100 m^2 crabs were the highest among the four experiment areas in the early and middle stages of culture (the third sampling). The BW and CW of the 100 m^2 crabs became the lowest, and the 1 m^2 crabs had the prime growth performance in the later stage (the fourth sampling); however, the difference was not significant ($P > 0.05$) (Figure 1).

In the early stage of culture (the second sampling), the BW and CW of the four grouped crabs increased rapidly, of which the order was 100 m^2 > 10 m^2 > 1 m^2 > 0.5 m^2, while in the middle stage of culture, the SRw of the 0.5 m^2 crabs was significantly exceed than it of the 10 m^2 crabs ($P < 0.05$) (Figure 2) and 100 m^2 group. In the later stage of the culture ($P < 0.05$), the ANOVA analysis showed that the SRw of the 1 m^2 crabs and the 10 m^2 crabs were exceed than the SRw of the 100 m^2 crabs.

Table 1: Survival of *P. trituberculatus* in the four habitat space.

Parameter	Different habitat space			
	$0.5\,m^2$	$1\ m^2$	$10\,m^2$	$100\,m^2$
Survival (%)	20.00 ± 0.21^{ab}	12.00 ± 0.15^{b}	20.50 ± 0.34^{a}	13.00 ± 0.27^{b}

Note. Values in the same row with same lowercase letters are not significant at $P > 0.05$.

Table 2: Changes of body weight and carapace width of crabs in different habitat space.

Parameter	Different habitat space			
	$0.5\,m^2$	$1\,m^2$	$10\,m^2$	$100\,m^2$
IBW (g)	19.25 ± 0.88	19.71 ± 0.92	19.07 ± 0.96	18.70 ± 0.76
FBW (g)	199.40 ± 16.51	218.75 ± 23.31	201.21 ± 8.77	189.25 ± 9.3
Rw (%)	935.85 ± 81.37	1009.83 ± 118.27	955.11 ± 44.74	912.03 ± 49.74
SRw (%/d)	2.24 ± 0.08	2.29 ± 0.10	2.28 ± 0.04	2.24 ± 0.05
ICW (cm)	5.73 ± 0.11	5.76 ± 0.12	5.72 ± 0.10	5.67 ± 0.08
FCW (cm)	11.91 ± 0.38	12.27 ± 0.45	12.02 ± 0.18	11.79 ± 0.22
Rc (%)	107.77 ± 6.27	112.93 ± 7.85	110.09 ± 3.07	107.85 ± 3.83
SRc (%/d)	0.71 ± 0.03	0.73 ± 0.03	0.72 ± 0.01	0.71 ± 0.02

No superscripts values in the same row represents that there was no significant difference ($P > 0.05$). [a]IBW means initial body weight; [b]FBW means final body weight; [c]Rw means weight gain rate; [d]SRw means weight-specific growth rate; [e]ICW means initial carapace width; [f]FCW means final carapace width; [g]Rc means carapace width gain rate; [h]SRc means carapace width-specific growth rate.

In the meanwhile, the result also showed no significant difference in the SRc among four different aquaculture acreages ($P > 0.05$) (Figure 3).

3.3. Proximate Composition in the Muscle of P. trituberculatus. The nutritional composition analysis of swimming crab demonstrated that the crude protein content of the $0.5\,m^2$ group and $100\,m^2$ group were significantly lower than that of the $1\,m^2$ group and $10\,m^2$ group ($P < 0.05$). The swimming crabs in the $1\,m^2$ group had the significantly higher ash content than that of the $0.5\,m^2$ group ($P < 0.05$). Compared with the crabs in $10\,m^2$ and $100\,m^2$, the crabs in $0.5\,m^2$ and $1\,m^2$ had lower ash content in the muscle ($P < 0.05$) (Table 3).

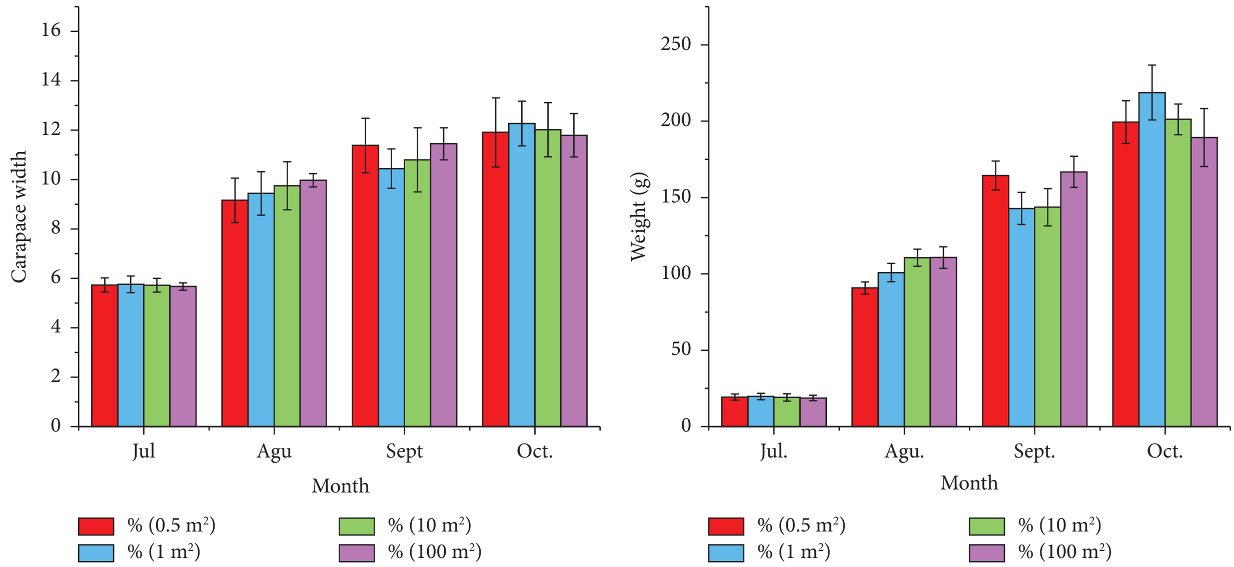
3.4. Amino Acid Profile in the Muscle of Four Groups. The amino acid composition in the muscle of swimming crab under four different various cultivation acreages is determined with the results demonstrated in Table 4. Fifteen species of amino acids were detected, including eight kinds of essential amino acids (EAA) and seven kinds of nonessential amino acids (NEAA). As shown in the table, the proline content of the $100\,m^2$ crabs was significantly lower than that of the $0.5\,m^2$ crabs ($P < 0.05$). Similar amino acid compositions were observed among the four culture areas. There was no significant difference observed in the EAA, NEAA, and TAA among the crabs under four different various cultivation acreages. However, compared with the crabs in the $100\,m^2$ group, the crabs in the $1\,m^2$ group had a higher EAA/NEAA ratio and EAA/TAA ratio in the muscle ($P < 0.05$) (Table 4).

3.5. Fatty Acid Profile in the Muscle of P. trituberculatus. Figure 4 presents the composition and proportion of fatty acids detected in the muscle of crabs under various cultivation acreages.

Regarding the monounsaturated fatty acid (MUFA), the content of C16 : 1 $n-7$ in the $0.5\,m^2$ group crabs and the $1\,m^2$ crabs was significantly lower than that in the $10\,m^2$ and $100\,m^2$ crabs ($P < 0.05$). As for the polyunsaturated fatty acid (ΣPUFA), the content of C18 : 2 $n-6$ in the $1\,m^2$ crabs was significantly higher than that of crabs in the other three groups ($P < 0.05$) (Table 5). The content of C20 : 5 $n-3$(EPA) in the $100\,m^2$ crabs was significantly higher than that in the $0.5\,m^2$ crabs and $1\,m^2$ crabs ($P < 0.05$). No significant difference between the other fatty acids ($P > 0.05$).

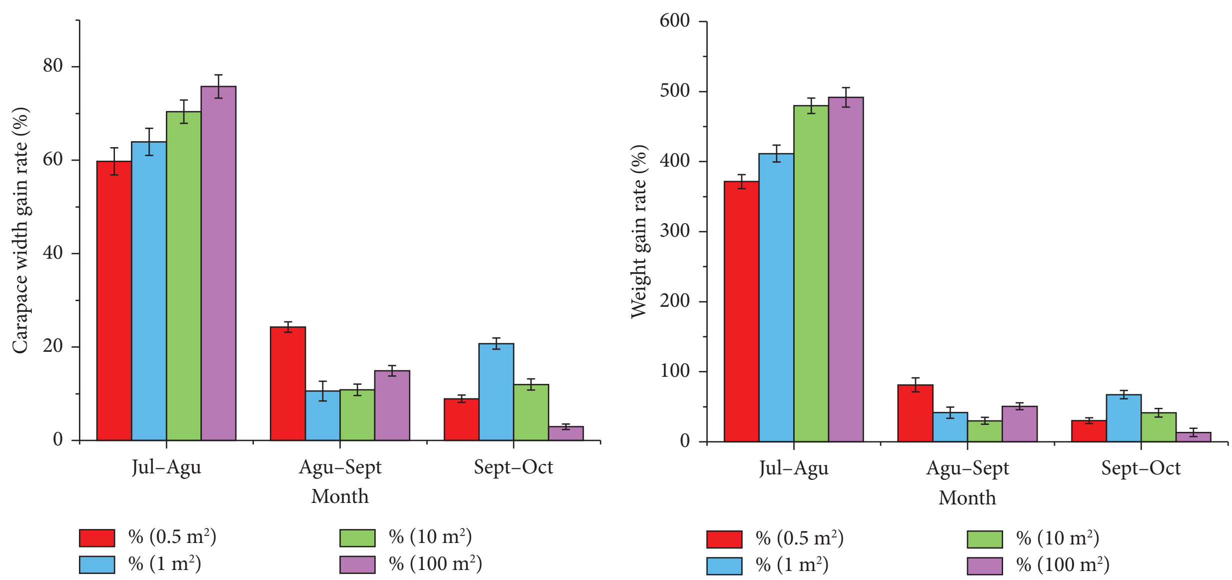
4. Discussion

4.1. Effect of Different Habitat Space on Surviving. The crabs in the $0.5\,m^2$ group and in $10\,m^2$ have a better livability. From the experimental results, the discussions will have two aspects. First, there are no significant differences between crabs living alone or together. Crabs live alone in a $0.5\,m^2$ group and live in other groups, there are at least two crabs living together. It is a significant factor in death, because swimming crabs have a fighting phenomenon [8]. However, even though the livability of the $0.5\,m^2$ group was 20%, and the rate was higher than the $1\,m^2$ group by 12% and $100\,m^2$ group by 13%. There was no significant difference among them. From the data analysis, this may be because the number of samples is too small, and the surviving rate of crabs was too low. Furthermore, swimming crabs can sense multiple chemical signals, and the pheromones released by swimming crabs can spread with the flowing of water, which might result in disturbing behavior in crabs [29, 30]. Under the stimulation of pheromone, the anxiety of the crabs will increase, and it would prompt crabs to search for a movable exit, which may cause damage to the crab and even death. The small range of activities could be an essential reason for the low survival rate of the $0.5\,m^2$ and $1\,m^2$ crabs.



(a) (b)

Figure 1: Changes of carapace width (a) and body weight (b) of *P. trituberculatus* in different habitat space.



(a) (b)

Figure 2: Changes of the gain rate of carapace width (a) and weight (b) of *P. trituberculatus* under different habitat space. Note: values within the same group with different letters mean significant difference ($P < 0.05$).

Second, if we discuss the crabs that live in a group of at least two, there are significant differences between the 1 m^2 group and 10 m^2 group. In narrow, "unstable" environments, crabs have a longer duration of fighting behavior, leading to increased mortality rates [31]. The survival rate between the 10 m^2 group and 100 m^2 group is also significantly different. Considering the aggressive nature of swimming crabs, cannibalism occurring during competition, molting, and mating, and the stocking density of the swimming crabs was 2/m^2, There are 20 crabs in each 10 m^2 group, and there are 200 crabs in each 10 m^2 group. Think of the factor of the fighting phenomenon, the crabs live in 100 m^2 are more likely to cause fights because of competition for the food and social order system [32]. The 100 m^2 was the largest, and it cultured the most swimming crabs. The swimming crabs cultivated in the 100 m^2 group had a larger range of activity and forage. Intriguingly, the fighting behavior between individuals due to food or spouse competition was also higher than in other groups, which may be the main reason for the high mortality rate [33].

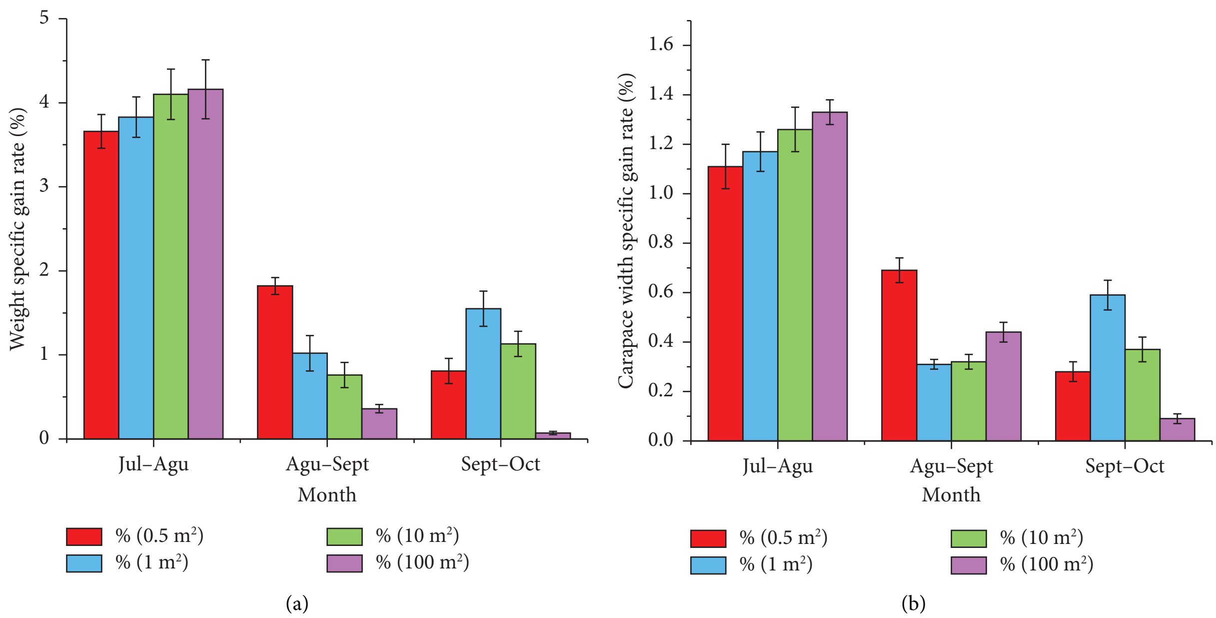


Figure 3: Changes of the specific growth rate of body weight (a) and carapace width (b) of *P. trituberculatus* under different habitat space.

Table 3: Proximate composition of muscle of *P. trituberculatus* (dry matter; $n = 3$).

Parameter	Different habitat space			
	$0.5\ m^2$	$1\ m^2$	$10\ m^2$	$100\ m^2$
Moisture (%)	79.79 ± 0.84	78.73 ± 2.35	78.58 ± 2.17	79.42 ± 1.07
Crude protein (%)	16.77 ± 0.31^{b}	17.93 ± 0.11^{a}	17.85 ± 0.25^{a}	17.11 ± 0.19^{b}
Crude lipid (%)	0.40 ± 0.01^{b}	0.48 ± 0.04^{a}	0.41 ± 0.01^{ab}	0.44 ± 0.01^{ab}
Crude ash (%)	1.93 ± 0.02^{a}	1.96 ± 0.02^{a}	1.88 ± 0.01^{b}	1.89 ± 0.03^{b}

Note: values within the same row with different letters mean significant difference ($P < 0.05$).

Table 4: Amino acid compositions (%) of *P. trituberculatus* (dry matter; $n = 3$).

Amino acid	Different habitat space			
	$0.5\ m^2$	$1\ m^2$	$10\ m^2$	$100\ m^2$
Aspartic acid#	5.97 ± 0.26	5.18 ± 0.58	5.63 ± 0.16	5.17 ± 0.31
Threonine*	2.65 ± 0.12	2.36 ± 0.23	2.59 ± 0.05	2.39 ± 0.16
Serine	2.32 ± 0.10	2.13 ± 0.20	2.29 ± 0.05	2.10 ± 0.13
Glutamic acid#	8.68 ± 0.34	7.35 ± 0.84	8.02 ± 0.19	7.37 ± 0.45
Glycine#	4.71 ± 0.19	3.93 ± 0.38	4.28 ± 0.06	3.91 ± 0.26
Alanine#	3.98 ± 0.17	3.44 ± 0.33	3.74 ± 0.08	3.53 ± 0.25
Cysteine*	3.59 ± 0.20	3.32 ± 0.30	3.49 ± 0.06	3.22 ± 0.25
Valine*	3.02 ± 0.15	2.73 ± 0.28	2.99 ± 0.06	2.70 ± 0.19
Methionine*	3.49 ± 0.21	2.99 ± 0.31	3.28 ± 0.06	2.99 ± 0.26
Isoleucine*	2.81 ± 0.13	2.43 ± 0.28	2.69 ± 0.05	2.45 ± 0.17
Leucine*	5.05 ± 0.21	4.48 ± 0.47	4.88 ± 0.05	4.38 ± 0.31
Phenylalanine*#	0.42 ± 0.02	0.37 ± 0.06	0.43 ± 0.11	0.24 ± 0.04
Lysine*	5.01 ± 0.23	4.43 ± 0.43	4.80 ± 0.10	4.34 ± 0.30
Arginine	6.13 ± 0.28	5.82 ± 0.60	6.22 ± 0.18	5.55 ± 0.35
Proline	4.18 ± 0.15^{a}	3.44 ± 0.30^{ab}	4.04 ± 0.09^{ab}	3.20 ± 0.22^{b}
EAA	26.04 ± 1.22	25.62 ± 2.65	25.15 ± 0.37	22.71 ± 1.66
NEAA	35.96 ± 1.83	31.31 ± 3.94	34.23 ± 0.82	30.82 ± 2.41
TAA	64.23 ± 3.35	56.20 ± 7.03	61.66 ± 1.39	55.87 ± 4.80
DAA	23.75 ± 0.95	20.29 ± 2.18	22.11 ± 0.48	20.22 ± 1.30
EAAs/NEAAs	0.72 ± 0.01^{b}	0.82 ± 0.00^{a}	0.74 ± 0.01^{b}	0.74 ± 0.01^{b}
EAAs/TAAs	0.41 ± 0.00^{b}	0.46 ± 0.00^{a}	0.41 ± 0.00^{b}	0.41 ± 0.00^{b}

Note: *Essential amino acids; #Umami amino acids; EAAs means total essential amino acids; NEAAs means total nonessential amino acids; TAA means total amino acids; DAAs means total delicious amino acids.

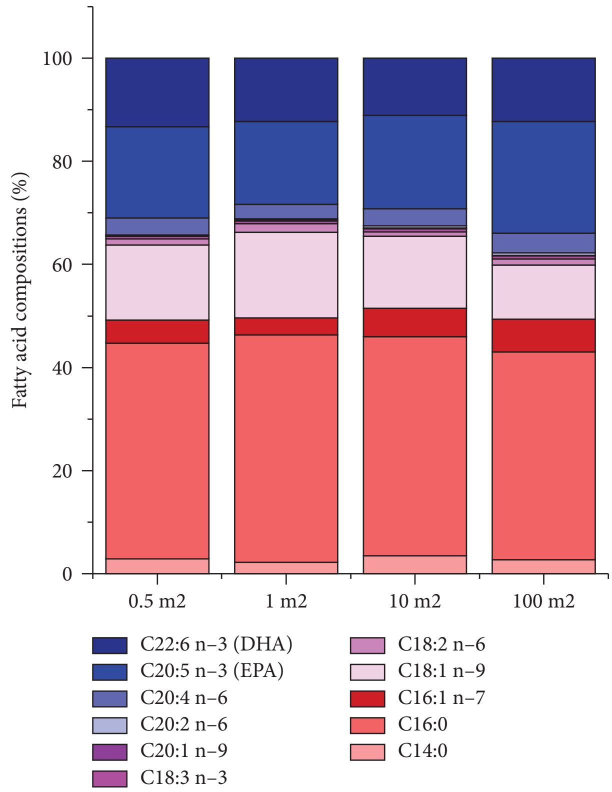


FIGURE 4: Fatty acid compositions (%) of *P. trituberculatus* under different habitat space.

TABLE 5: Fatty acid compositions (%) of *P. trituberculatus* (dry matter; $n = 3$).

Fatty acid	Different habitat space			
	$0.5\ m^2$	$1\ m^2$	$10\ m^2$	$100\ m^2$
C14 : 0	2.90 ± 0.37	2.20 ± 0.26	3.43 ± 0.85	2.68 ± 0.73
C16 : 0	41.8 ± 0.69	44.15 ± 0.87	42.52 ± 0.66	40.33 ± 2.1
C16 : 1 $n-7$	4.47 ± 0.26^b	3.24 ± 0.17^b	5.56 ± 0.65^a	6.33 ± 0.65^a
C18 : 1 $n-9$	14.56 ± 1.93	16.59 ± 2.13	13.91 ± 0.91	10.57 ± 0.28
C18 : 2 $n-6$	1.22 ± 0.12^b	1.74 ± 0.16^a	0.92 ± 0.05^b	1.13 ± 0.16^b
C18 : 3 $n-3$	0.49 ± 0.02	0.46 ± 0.06	0.53 ± 0.03	0.61 ± 0.05
C20 : 1 $n-9$	0.08 ± 0.04	0.19 ± 0.10	0.22 ± 0.14	0.08 ± 0.08
C20 : 2 $n-6$	0.19 ± 0.12	0.28 ± 0.09	0.39 ± 0.08	0.52 ± 0.21
C20 : 4 $n-6$	3.29 ± 0.32	2.81 ± 0.18	3.35 ± 0.21	3.84 ± 0.76
C20 : 5 $n-3$ (EPA)	17.73 ± 0.68^b	16.03 ± 0.83^b	18.07 ± 1.41^{ab}	21.68 ± 1.1^a
C22 : 6 $n-3$ (DHA)	13.27 ± 0.95	12.32 ± 0.29	11.11 ± 0.47	12.21 ± 0.35
ΣSFA	44.7 ± 0.34	46.36 ± 0.87	45.95 ± 0.27	43.01 ± 2.20
ΣMUFA	19.11 ± 2.05	20.02 ± 2.07	19.7 ± 1.62	16.99 ± 0.43
ΣPUFA	35.56 ± 1.45	33.62 ± 1.56	34.35 ± 1.71	40.00 ± 2.50

Note: ΣSFA means total saturated fatty acid; ΣMUFA means total monounsaturated fatty acid; ΣPUFA means total polyunsaturated fatty acid.

4.2. Effect of Different Habitat Spaces on Growth. Previous studies have shown that the farming scale can affect the behavior and growth performance of aquatic animals [9, 16, 17]. To date, studies have reported that the order of growth rate of the four various cultivation acreages in the early stage was $100\ m^2 > 10\ m^2 > 1\ m^2 > 0.5\ m^2$. It was speculated that a larger living spaces can help swimming crabs adapt to the environment more quickly. In this research, crabs in all groups demonstrated the highest SRw and SRc in the early stage, which was consistent with the earlier findings of Che et al. [34]. The reason for this result is that the growth rate of swimming crabs was affected by the growth stage and water temperature. The growth of swimming crabs requires periodic molting, and water temperature is one of the important factors affecting the molting cycle of crustaceans. In addition to this, several studies have explored that higher temperatures in August led to an increase in the frequency of molting of swimming crabs. As a result, the CW and BW achieved a high growth rate [35, 36]. In this experiment, the average water temperature in the early stage of farming was the highest in the whole process, which confirmed that statement. In the middle and later stages, the growth performance of the 0.5 m^2 crabs and 1 m^2 crabs was better than that of the other groups (10 m^2 and 100 m^2). The reason for the phenomenon may be the swimming crabs in the 0.5 m^2 and 1 m^2 showed compensatory growth after a period of adaptation [37]. A similar conclusion was reached by Cai, who compared the growth characteristics of *Litopenaeus vannamei* in different of high-level intensive culture ponds [38].

4.3. Effects of Various Cultivation Acreages on Nutrition. Many factors affecting the nutritional quality of aquatic animals include season, growth, environment, bait, feed, and farming variety [39–42]. In this study, the nutritional differences of muscles of swimming crabs in various cultivation acreages were compared. The results demonstrated that there were significant differences in the crude protein content, crude lipid content, and ash content in the muscles of the swimming crabs cultured under the four groups. It is worth noting that the content of proximate composition in the muscles of swimming crabs did not show a specific trend as the farming area increased or decreased. It is speculated that there were differences in the size of individual crabs randomly selected from each group, and prior research showed that the proximate composition of muscle could be influenced by different sizes, even aquatic animals in the same farming conditions [43–45].

The amino acid and fatty acid composition in the muscle of swimming crabs from various cultivation acreages demonstrated no significant differences among the EAA, NEAA, TAA, DAA, ΣSFA, ΣMUFA, and ΣPUFA contents. Only a few amino acid indicators (EAAs/NEAAs ratio and EAAs/TAAs ratio) and fatty acid indicators (C16 : 1 $n-7$, C18 : 2 $n-6$, EPA) were significantly different in the muscle of the crabs among the four areas. Our research showed that EAAs/TAAs ratios in the muscle of crabs cultured from the four groups were all above 40%, and the EAAs/NEAAs ratios were all above 60%, which was higher than the ideal protein content proposed by FAO/WHO. It means that crabs cultured in the four various cultivations acreages were the source of high-quality protein. The results of recent studies are also clear and consistent, and under the same or similar condition of the farming environment, there was no significant difference in the total content of conventional nutrients, free amino acids, and fatty acids in the muscle of the crabs, and significant differences were only found on a few indicators [42].

Previous studies showed that there were few differences on the nutritional quality indicators (MUFA and PUFA) between *Eriocheir sinensis* cultured in the sea with purse sines and raised in ponds [46]. The total content of EPA and DHA in the muscle of swimming crabs in each group accounted for more than two-thirds of PUFA. The order of fatty acid content in the muscle of experimental crabs was ΣSFA > ΣPUFA > ΣMUFA. However, this finding was incompatible with the previous study, of which the result turned to be ΣPUFA > ΣSFA > ΣMUFA [47]. Previous studies have shown that the difference in the fatty acid and amino acid content in the muscle of swimming crabs may be caused by various factors such as different food nutrition, production environment, water temperature, and growth stage [48, 49]. The fatty acid content of the swimming crabs in this experiment was different from Xu's previous study, and the main reason may be the variety of bait fed in this experiment was too simple.

5. Conclusions

In this experiment, we proved that *P. trituberculatus* differs in livability, growth performance, and nutritional composition under various cultivation acreages. All swimming crabs in the experiment were sources of high-quality protein. The crabs in 1 m^2 performed better in crude protein. The difference in the survival of 0.5 m^2 and 10 m^2 was small. It may tell us that the factor of crab fighting had a significant impact. But, it should be noted that the custom cost of a single 0.5 m^2 purse seine was close to that of 10 m^2, and 10 m^2 was more convenient for daily maintenance and management in actual aquaculture production. After careful consideration of economic benefits, labor consumption, management, convenience, and daily maintenance, we believe that 10 m^2 is the appropriate purse seine area for cultivating swimming crab in ponds. It may open up a new farming model to increase the production of the swimming crab and obtain higher benefits for the marine fishery.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Ethical Approval

The collection and sampling of the experimental animals utilized in this study were approved by the Animal Care and Use Committee of Jiangsu Ocean University. All handling of animals was performed in accordance with the guidelines for the care and use of laboratory animals at Jiangsu Ocean University.

Conflicts of Interest

The authors declare that they have no conflicts of interest with this work.

Authors' Contributions

Z.D. conceived and designed the project and revised and finalized the manuscript. S.Y. and S. M. wrote the manuscript. S. M., Z. C., Y.C., H. D., G. R., X. L., H. G., and M. L. together collected the data and conducted the study. All authors read, reviewed, and approved the manuscript.

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