

# Stocking density significantly affects culture performance and economic profits of female Chinese mitten crab reared in earth ponds during the adult crab culture period

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## Introduction

- A high stocking density could substantially increase the harvest, whereas overstocked animals can lead to crowding stress, which may depress growth performance, increase feed conversion ratio and decrease size uniformity, or an increment of cannibalism, resulting in greater production costs and poor yield. Nevertheless, understocking would indicate that the production systems have not reached their full potential, and not allow the net income to be maximized.
- Monosex culture is another alternative approach to improve yields and profitability, which has proven as a preferred aquaculture model in some fish and crustacean species.
- Therefore, the present research was undertaken to evaluate the effects of four levels of stocking densities (1.3, 1.8, 2.5 and 3.8 inds./m<sup>2</sup>) of all female crabs reared in grow-out ponds. The parameters including growth, gonad development, culture performance and economic profits will be estimated to determine the optimal stocking density for all-female culture in earth ponds.



## Materials & methods

### 1. Experimental setup

- The culture experiment was conducted in earth ponds at the research station of Jintan Fisheries Technology Extension Center, Jiangsu Province between March and November 2020.
- In later-March, female juveniles (initial average weight: 10.87-11.16 g) were selected from the research station and stocked into outdoor earth ponds (length × width × depth = 23 m × 23 m × 1.5 m) and then were assigned to four treatments, each treatment corresponding to a stocking density of 1.3, 1.9, 2.5 and 3.8 inds./m<sup>2</sup> (hereinafter referred to as D1.3, D1.9, D2.5 and D3.8 respectively).

### 2. Flow chart

Time: March-November 2020

Experimental ponds (13): 4 treatments \* 3-4 replicates

	Sampling time
Growth	Apr.-15; Jun.-15; Aug.-15; Oct.-15
Puberty molting	Jul.-20; Aug.-10; Aug.-30; Sep.-20
Dissection: female	Sep.-10; Oct.-10; Nov.-10

Growth performance:

a. Weight, WGR, SGR

Culture performance and gonadal development

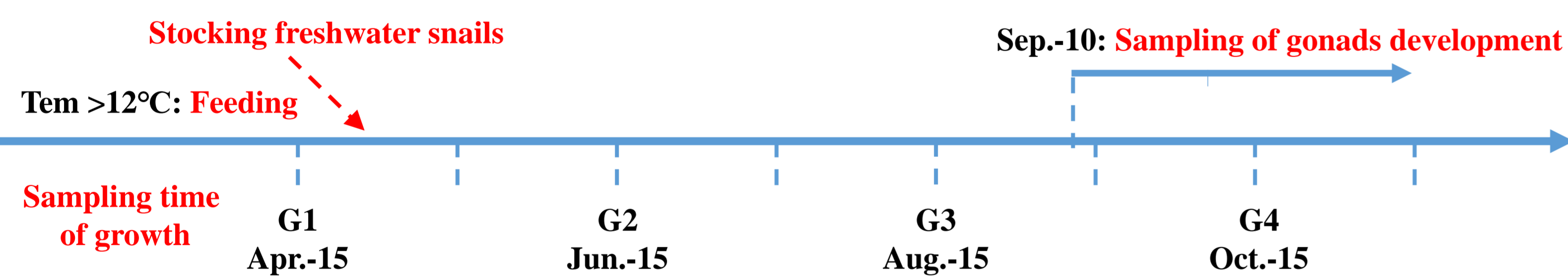
a. Survive rate, FCR, yield, autotomy rate

b. Gonads and hepatopancreas (GSI, HSI)

Economic performance:

a. Size distribute

b. Total income, inputs, net profit

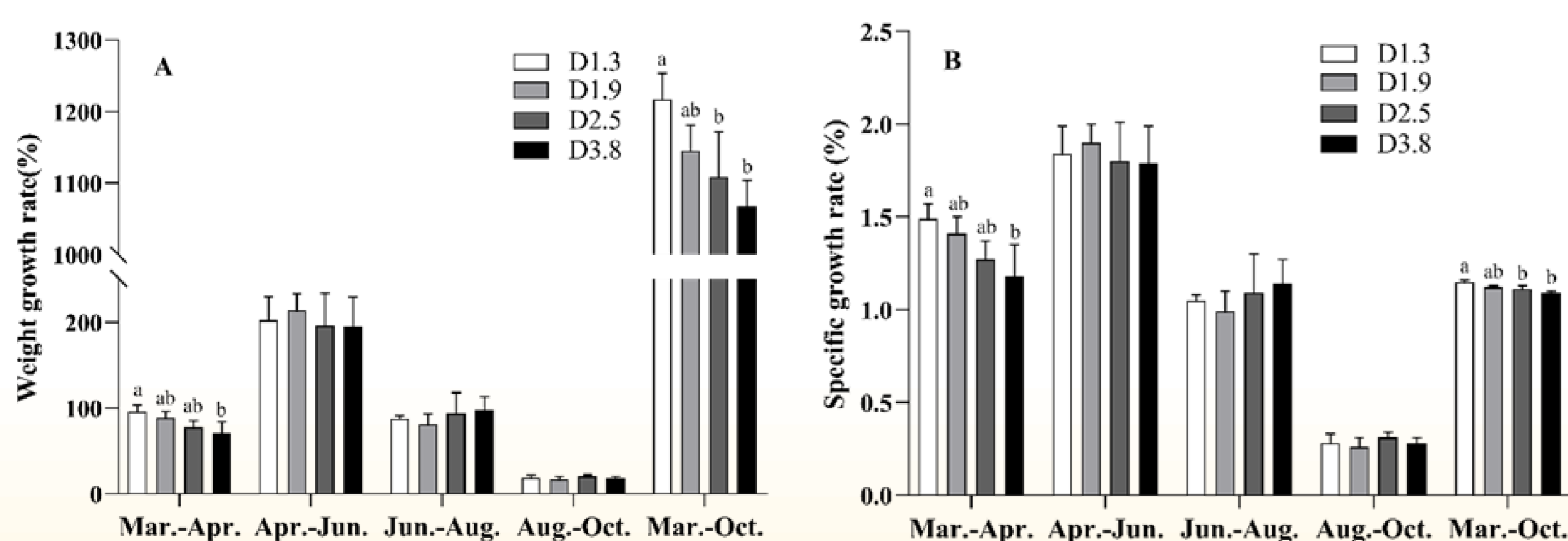


## Results

### 1. Growth performance

**Tab. 1** The effects of stocking densities on body weight of mono-female culture during the second year culture of *Eriocheir sinensis* in earth ponds.

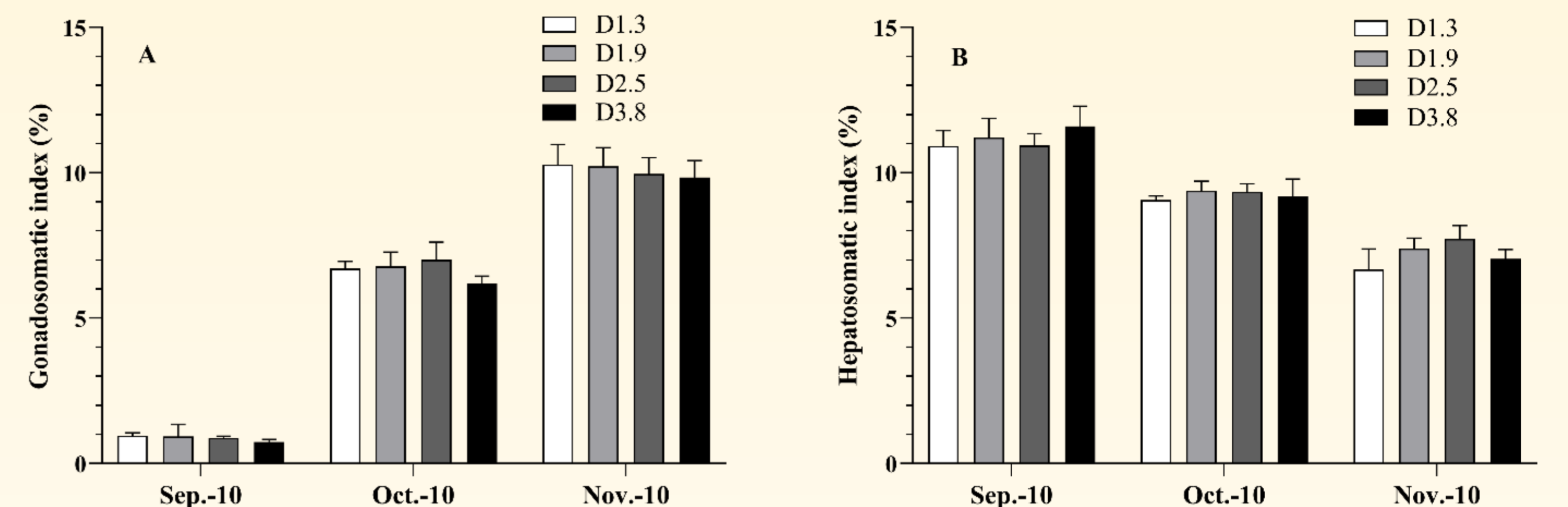
Time	Weight (g)			
	D1.3	D1.9	D2.5	D3.8
Mar.-5	10.87 ± 1.21	10.93 ± 1.02	11.16 ± 1.22	10.94 ± 1.38
Apr.-15	21.30 ± 0.81 <sup>a</sup>	20.59 ± 0.85 <sup>ab</sup>	19.80 ± 0.90 <sup>ab</sup>	18.67 ± 1.46 <sup>b</sup>
Jun.-15	64.30 ± 3.35 <sup>a</sup>	64.48 ± 2.86 <sup>a</sup>	58.38 ± 5.76 <sup>ab</sup>	54.68 ± 2.49 <sup>b</sup>
Aug.-15	120.66 ± 7.68	116.50 ± 3.15	112.10 ± 7.61	108.16 ± 5.26
Oct.-15	143.20 ± 3.96 <sup>a</sup>	136.07 ± 3.95 <sup>ab</sup>	134.82 ± 7.11 <sup>ab</sup>	127.73 ± 3.99 <sup>b</sup>



**Fig. 1** The effects of different stocking densities on weight gain rate (WGR, Figure 1A) and specific growth rate (SGR, Figure 1B) of mono-female culture during the second-year culture of *E. sinensis* in earth ponds.

## Results

### 2. The percentage of puberty molting and gonadal development



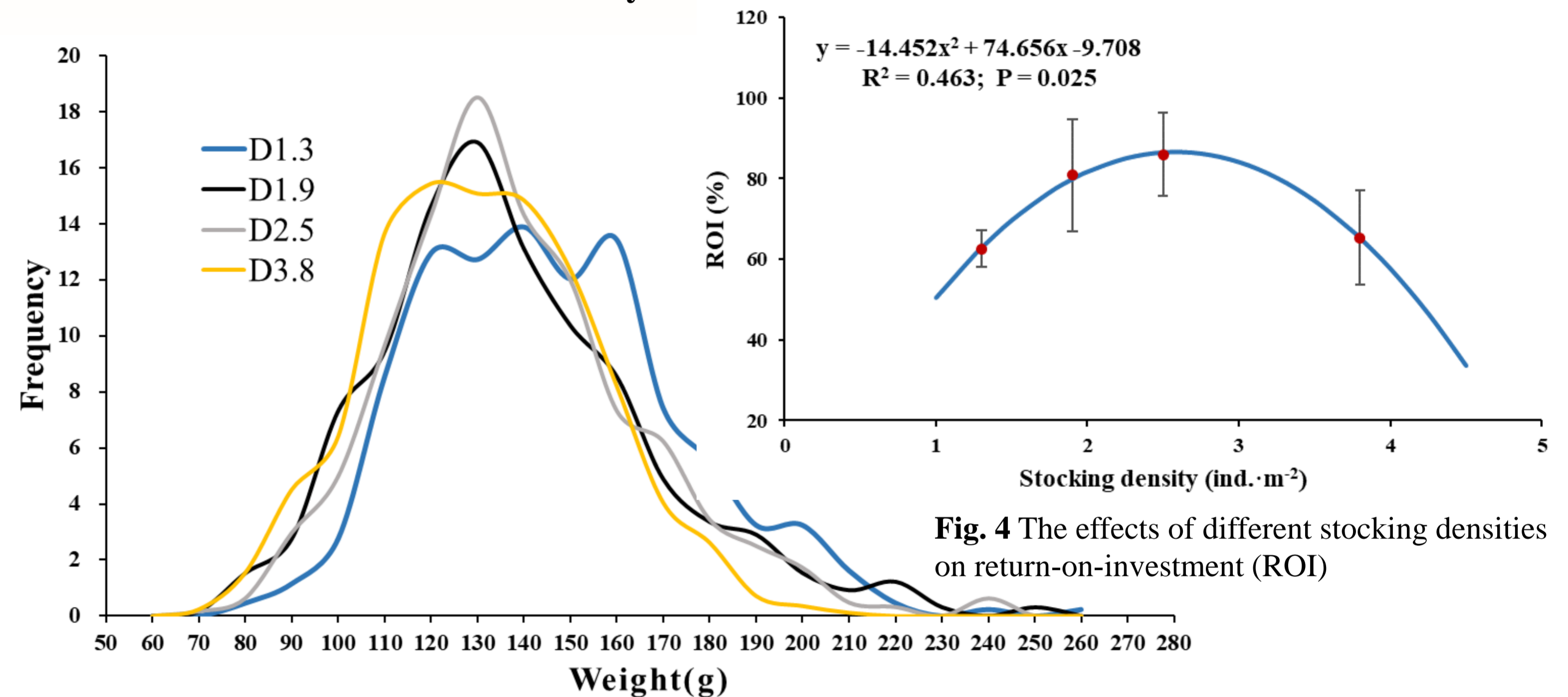
**Fig. 2** The effects of different stocking densities on the gonadosomatic index (GSI, A) and hepatosomatic index (HSI, B).

### 3. Survival, production, and FCR

**Tab. 2** The effects of different stocking densities on final culture performance.

Parameters	Stocking density			
	D1.3	D1.9	D2.5	D3.8
Body weight (g)	140.08 ± 3.30 <sup>a</sup>	132.71 ± 4.79 <sup>ab</sup>	132.62 ± 3.68 <sup>ab</sup>	127.94 ± 2.21 <sup>b</sup>
Survival (%)	72.01 ± 6.48 <sup>a</sup>	65.77 ± 7.02 <sup>ab</sup>	54.42 ± 4.35 <sup>ab</sup>	48.22 ± 3.68 <sup>b</sup>
Yield (g/m <sup>2</sup> )	125.83 ± 8.27 <sup>c</sup>	163.06 ± 12.83 <sup>bc</sup>	180.77 ± 10.75 <sup>1b</sup>	230.95 ± 14.19 <sup>a</sup>
FCR	2.32 ± 0.24 <sup>b</sup>	2.60 ± 0.12 <sup>ab</sup>	2.74 ± 0.29 <sup>ab</sup>	3.02 ± 0.07 <sup>a</sup>
Limb injury rate (%)	0.97 ± 0.44 <sup>b</sup>	0.99 ± 0.35 <sup>b</sup>	0.75 ± 0.24 <sup>b</sup>	2.39 ± 0.51 <sup>a</sup>

### 4. Size distribution and economic analysis



**Fig. 3** The effects of different stocking densities on harvest size distribution of different body weight.

**Tab. 3** Economic comparison of mono-female culture under the four stocking densities

Items	D1.3	D1.9	D2.5	D3.8
	(×10 <sup>3</sup> RMB/ha)	(×10 <sup>3</sup> RMB/ha)	(×10 <sup>3</sup> RMB/ha)	(×10 <sup>3</sup> RMB/ha)
<b>Cost</b>				
Land rental	22.5	22.5	22.5	22.5
Crab seed	10.88	16.40	22.34	32.82
Feed	23.39 ± 1.87 <sup>c</sup>	33.93 ± 3.27 <sup>b</sup>	39.64 ± 5.00 <sup>b</sup>	55.82 ± 4.20 <sup>a</sup>
Freshwater snail	7.50	7.50	7.50	7.50
Aquatic plant	1.5	4.69	5.63	9.38
Electric charge	7.5	7.5	7.5	7.5
Fertilizer and Drug <sup>1</sup>	10.31	11.25	11.81	13.88
Labor	15.00	15.00	15.00	15.00
Pond maintenance and the others <sup>2</sup>	9.00	9.00	9.00	9.00
Subtotal cost	109.45 ± 1.87	129.64 ± 3.27	142.79 ± 5.00	175.27 ± 4.20
Interest on capital	3.44 ± 0.06	4.09 ± 0.10	4.51 ± 0.16	5.55 ± 0.13
Total cost	111.01 ± 1.93 <sup>d</sup>	131.85 ± 3.38 <sup>c</sup>	145.53 ± 5.16 <sup>b</sup>	178.94 ± 4.34 <sup>a</sup>
<b>Total return</b>	181.19 ± 4.04 <sup>c</sup>	241.10 ± 20.39 <sup>b</sup>	277.86 ± 11.82 <sup>ab</sup>	298.33 ± 28.01 <sup>a</sup>
<b>Net profit</b>	71.22 ± 4.71 <sup>b</sup>	109.25 ± 19.01 <sup>a</sup>	129.68 ± 13.79 <sup>a</sup>	119.39 ± 23.72 <sup>a</sup>
<b>Return-on-investment (ROI, %)</b>	64.80 ± 4.67	82.81 ± 14.05	87.65 ± 10.47	66.53 ± 11.81

## Conclusion

- High stocking density had the negative effects on growth performance, survival and feed utilization efficiency of crabs.
- Stocking density was not significantly affected the puberty molting and gonadal development of pond-reared female *E. sinensis*.
- With the consideration of culture performance, net profits and ROI, the appropriate stocking density was recommended to be 1.8 - 2.5 inds./m<sup>2</sup> for all-female culture of *E. sinensis* during the adult crab culture period