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Comparative Analysis of Growth and Reproductive Performance in Domesticated Mud Crab (*Scylla paramamosain*) Across Generations in Grow-out Ponds Versus Wild Broodstock

Vutthichai Oniam[1,*], Wasana Arkronrat[1], Jitima Suwanmala[2], Chonlada Leearam[1], Rungtiwa Konsantad[1]

[1]Klongwan Fisheries Research Station, Faculty of Fisheries, Kasetsart University, Prachuap Khiri Khan, Thailand.
[2]Department of Agricultural and Fishery Science, Faculty of Science and Technology, Prince of Songkla University, Pattani, Thailand.

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Corresponding Author
E-mail: ffisvco@ku.ac.th

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Abstract

Domestication of mud crab (*Scylla paramamosain*) is an important endeavor to support research and reduce the reliance on wild crab fisheries. Present study was conducted to evaluate growth and reproductive performance of domesticated mud crabs in the 1st (G1), 2nd (G2), and 3rd (G3) generations compared to those of wild crab (W) reared in grow-out ponds for 6 months. Results showed that there were significant differences in growth patterns between W and domesticated crabs, especially in G2-G3. The final carapace width and body weight of W were not significantly different from those of G1 but were significantly greater than those of G2 and G3. Furthermore, weight gain and specific growth rate of crabs significantly decreased in G2-G3 generations. W and G1 female brooders differed in reproductive performance only in hatching rate and total number of zoea I (Z1) produced, with W being higher than G1. G2 female brooders had lower to those from W regarding fecundity, hatching rate, total number of Z1 produced, and survival of Z1 at 1-day post-hatch. In addition, G2 had significantly lower values than G1 for total number of Z1 produced and the survivability of Z1 ($P<0.05$). The G3 female brooders were unsuccessful in breeding and larval hatching. These findings recommend selective breeding to improve reproductive success in G2 and G3 for sustainable mud crab aquaculture.

Introduction

Mud crabs of the genus *Scylla* are an important commercial marine resource, comprising four species: *S. serrata*, *S. paramamosain*, *S. olivacea*, and *S. tranquebarica*. These species are distributed along the coasts of Southeast Asia, the Indian Ocean, and the tropical western Pacific (Lovatelli et al., 2025). Due to their high nutritional value and excellent flavor, they became a vital resource in fisheries and aquaculture (Syafaat et al., 2021; Liew et al., 2024). In aquaculture, an important obstacle to the cultivation of mud crabs of the genus *Scylla* is their low survival rates and productivity levels, which may result from several factors, including cannibalism (Sanda et al., 2021), unsuitable nutritional quality of feed (Azra & Ikhwanuddin, 2016; Zheng et al., 2020), and poor water quality (Baylon, 2013; Oniam et al., 2022), as well as habitat, stress, and disease. (Yu et al., 2022; Zhang et al., 2022; Liew et al., 2024). However, among *Scylla* species, *S. paramamosain* is favored in aquaculture due to its abundance, rapid growth, and high market value (Syafaat et al., 2021; Lovatelli et al., 2025).

In Thailand, the farming of *S. paramamosain* significantly expanded in recent years. Despite this growth, the production levels remained insufficient to satisfy the rising market demand (Koolkalya et al., 2017; Thaiburi et al., 2020). Additionally, most studies to date have indicated that the rearing of this species relied heavily on wild broodstock, raising concerns about

sustainability and resource depletion (Oniam et al., 2022). A long-term solution for crab aquaculture production is to develop domesticated broodstock to reduce the reliance on wild, berried female crabs. Therefore, there is a need to enhance the aquaculture and farming techniques for *S. paramamosain*. It is widely recognized that utilizing domesticated aquatic animals offers benefits due to their adaptation to captive environments. Consequently, successful aquaculture can benefit from domesticated broodstock, as domestication enhances reproductive and growth performance (Suresh, 2015).

Domestication in aquaculture refers to the process of breeding and rearing aquatic species under controlled conditions, typically for commercial purposes, where this process involves using selective breeding programs to focus on the desirable traits in the species, such as faster growth, disease resistance, and adaptability to captive conditions (Brooker et al., 2020; Teletchea, 2021; Podgorniak et al., 2022). The primary method in domestication involves repeated selection to produce the best generations under culture conditions, a strategy that has been successfully employed with other commercially important crustaceans such as the black tiger shrimp, *Penaeus monodon* (Maheswarudu et al., 2016), the white shrimp, *Penaeus indicus* (Vijayan, 2019), and the giant freshwater prawn, *Macrobrachium rosenbergii* (Pillai et al., 2020). The successful domestication of crabs usually requires a combination of scientific knowledge, technological innovation, and careful husbandry practices. Research institutions and aquaculture companies have invested in such endeavors to develop sustainable aquaculture practices for crabs, such as in the domestication of the coconut crab, *Birgus latro* (Sulistiono et al., 2007), the mud crab, *S. serrata* (Quinitio et al., 2011), the Chinese mitten crab, *Eriocheir sinensis* (Wang et al., 2018), and the blue swimming crab, *Portunus pelagicus* (Fujaya et al., 2019), where the focus has been on research, with initial results showing potential for captive broodstock production. A successful outcome could potentially reduce pressure on wild populations and provide a consistent supply for markets (Wu et al., 2010; Oniam, et al., 2021; Oniam & Arkronrat, 2022). In addition, utilizing a domesticated stock resource proved beneficial in reducing operational costs and ensuring year-round availability with minimal seasonal variation (Wu et al., 2010). Despite reports on the domestication of *S. paramamosain* (Gao et al., 2023; Qin et al., 2023), empirical data are lacking on the growth and reproductive performance of the domesticated crabs that have been reared in grow-out ponds. We hypothesized that domestication improves growth but may compromise reproduction over generations. Therefore, this study assessed domestication's impact on growth patterns and reproductive performance of mud crab across the 1st, 2nd, and 3rd generations in grow-out ponds compared to broodstock, aiming to enhance domesticated production and advance its aquaculture.

Materials and Methods

Wild Crab Sourcing and Breeding

The study was conducted at the Klongwan Fisheries Research Station (KFRS), Prachuap Khiri Khan province, Thailand, during March 2021 to September 2023. Wild (W) female mud crab brooders with a carapace width (CW) of 12.5±1.8 cm, and body weight (BW) of 358.4±155.4 g were caught by local fishers using collapsible crab traps in the mangrove area of Pak Nam Chumphon, Chumphon province, Thailand (10º43´–10º44´ N, 99º23´–99º24´ E) during March and April 2021. The W female crab brooders (n = 30) were transferred to the KFRS hatchery and then female crabs were selected based on a U-shaped abdomen with darkened color and ovarian development in the maturing (stage V) stage, following the classification of Islam et al. (2010). A flashlight was used to observe the external characteristics of the ovarian developmental stages, through the underside of the crab's shell, based on stage V being about 10-20 mm thick and occupying >75% of the shell cavity (Islam et al., 2010). In this paper, the ovarian developmental stage V is referred to as the eggs stage V.

Female *S. paramamosain* with eggs stage V were individually reared in 200 L fiberglass tanks (maturation tank) using low light condition. A sand substrate, approximately 10 cm thick, was provided at the bottom of the tank to allow the female crabs to bury themselves and to support the attachment of eggs to their abdomens during ovarian maturation. During the rearing period at 30 days for the female crabs in the maturation tank, all crabs were fed daily at about 5:00 p.m. with trash fish (mainly *Amblygaster* sp., *Selaroides* sp., and *Gazza* spp.) alternated with fresh squid (*Loligo* spp.) and green mussel (*Perna viridis*), at 5% of body weight per day. Newly berried female crabs were individually placed in 500 L fiberglass tanks (hatching tank) to allow them to release eggs, as described by Oniam et al. (2022). To maintain good water quality, including temperature, oxygen, and pH in the maturation and hatching tanks, approximately one-half of the water was replaced in each tank every 3 days.

Nursing and Rearing Methods to Domesticate Mud Crabs

The newly hatched *S. paramamosain* larvae from the W female brooders at 1-day post-hatch (dph) were reared in indoor concrete tanks (2.0 m × 1.5 m × 1.2 m, water height: 1.0 m) at a density of 100 crabs/L. Crab larvae at the zoea I (Z1) stage were fed rotifers (*Brachionus* sp.) at about 10 rotifers/mL. From the Z2 stage onward, they were provided *Artemia* nauplii until they metamorphosed into the first crab (C1) stage. At the C1 stage, the crabs were fed shrimp feed No. 1 (CPF®, pellet size approximately 0.40-0.42 mm, 38% protein). Define C3-C4 stages (about 40-45 dph) were

then transferred from the concrete nursing tanks to grow-out ponds.

The crabs were reared in three 1,600 m^2 grow-out ponds at a density of 800 crabs/pond (0.5 crabs/m^2). The basic design of the grow-out ponds used for crab rearing is the same as that used to rear marine shrimp but with added netting around the pond to prevent the crabs from leaving the pond. Crabs were fed daily with trash fish (mixed species of marine fish) at 5% of body weight/day (once a day at about 5:00 p.m. for 6 months). Crabs were reared until they reached sexual maturity based on ovarian development, which took about 6 months (Oniam et al., 2022). Then, the W female crab brooders with their eggs stage V in the grow-out ponds were used for breeding, as mentioned earlier for the 1st generation (G1) crab production.

The G1 crabs were reared until they reached sexual maturity, which took approximately 6 months. Female crabs (eggs stage V) from the G1 generation were then used as broodstock to produce the 2nd generation (G2) crabs. This process of breeding, nursing, and rearing was repeated, resulting in the production of the 3rd generation (G3) crabs in 2023, with female crabs (eggs stage V) from the G2 generation used as broodstock. The domesticated crab population in each generation was established from at least 10 female crab brooders.

Experimental Design and Set-up

The experiment was designed using four treatments, i.e., W, G1, G2, and G3, to investigate the impact of domestication on the growth and reproductive performance of *S. paramamosain* cultivation in grow-out ponds. The crabs were reared in 1,600 m^2 earthen ponds at a density of 0.5 crab/m^2 (800 crabs/pond). The crabs were fed daily at 17:00 p.m. with trash fish (mixed species of marine fish) at about 5% of body weight. Rearing was undertaken for 6 months. To maintain optimal water quality, approximately half of the water in each grow-out pond was replaced once a week.

Water quality parameters were monitored twice a week. Salinity was measured with a refractometer (Master-S10 alpha; Atago, Japan), and pH was assessed using a portable pH meter (pH Testr30; Eutech; Singapore). Dissolved oxygen concentration (DO) and water temperature were recorded with an oxygen probe (Pro20i; YSI; USA). Total ammonia, nitrite, and alkalinity were determined using the indophenol blue method, colorimetric method, and titration method, respectively (APHA, AWWA & WEF, 2023). Additionally, during the crab rearing, bottom soil quality was analyzed monthly by collecting samples from three locations in the grow-out ponds (inlet, center, and outlet) using a 5-cm-diameter clear plastic core liner tube (Wildlife Supply Company; Buffalo, NY, USA). The top 5 cm of each core was removed, and three core segments from each pond were combined to provide a composite sample for analysis. Tests were undertaken for organic matter concentration using the ignition loss method. Soil pH and the total ammonia concentration were determined using the method described by Munsiri et al. (1995) and Thunjai et al. (2001).

Growth Measurement

During the crab rearing, once a month, a random sample of crabs (n = 30) from each population in the grow-out ponds was collected using a crab trap and the collected crabs were evaluated for their growth. The crabs were individually measured for CW (in centimeters) and BW (in grams). The CW was measured between the tips of the epibranchial spines using a set of vernier calipers. The BW was measured using a digital weighing scale with an accuracy of 0.01 g. At the end of the cultivation period, each crab population was measured to assess growth pattern, final CW, and BW. The weight gain (WG) and specific growth rate (SGR) were calculated using the following formulas (Brown, 1957):

$$WG\ (g) = \text{final BW} - \text{initial BW} \quad (1)$$

$$SGR\ (\%/\text{day}) = 100 \times [\ln(\text{final BW}) - \ln(\text{initial BW})] / \text{rearing period (day)} \quad (2)$$

In addition, the reproductive performance was investigated based on a random sample of female crabs (each 250-300 g BW) with eggs stage V (n = 5) from each population in the grow-out ponds at about 6 months into the rearing period. Maturation time (days) from the eggs stage V to the newly berried, yellowish orange eggs (cleavage-blastula stages) of W, G1, G2, and G3 female crabs were checked and recorded. Then, their dates of spawning in the hatching tank were recorded for the newly berried to hatched larvae. Following hatching, the total number of newly hatched Z1 larvae and the total number of unhatched eggs were estimated from three 100 mL aliquot water samples collected from the hatching tank. The fecundity (F), hatching rate (HR), and survival of Z1 at 1 dph were calculated, using equations 3–5, respectively according to (Oniam et al, 2021):

$$F\ (\text{eggs/crab}) = \text{number of newly hatched Z1} + \text{total number of unhatched eggs} \quad (3)$$

$$HR\ (\%) = \text{number of newly hatched Z1} \times 100 / F \quad (4)$$

$$\text{Survival of Z1 at 1 dph}\ (\%) = \text{number of Z1 at 1 dph} \times 100 / \text{number of newly hatched Z1} \quad (5)$$

Statistical Analysis

Descriptive statistics of all measurements were calculated. The experimental data, including growth and reproductive performance parameters, were analyzed using one-way ANOVA, with differences between means assessed using Duncan's multiple range test at a 95%

confidence level. All analyses were performed with IBM SPSS Statistics for Windows software (version 21.0; IBM Corp.; Armonk, NY. USA), and results were presented as mean±standard deviation.

Results

Growth Pattern

The mean initial sizes of the experimental *S. paramamosain* reared in the grow-out ponds from each population ranged from for CW of 1.9±0.1 - 1.9±0.3 cm and for BW of 0.6±0.3 - 0.6±0.5 g (about 40-45 dph), (P>0.05). At 6 months, the results of the growth of the domesticated crabs compared to the W crabs showed that the final CW and BW of the W crabs (10.7±0.9 cm and 245.1±43.8 g, respectively) were not significantly different from the G1 crabs (10.5±0.5 cm and 226.5±64.8 g, respectively); however, the growth of the W crabs was significantly greater than for the G2 crabs (10.0±0.7 cm CW; 189.7±51.6 g BW) and G3 crabs (9.6±1.4 cm CW; 180.4±52.7 g BW). Comparisons among the domesticated groups showed that the G1 crabs had a significantly higher final CW than the G3 crabs and significantly higher final BW than both the G2 and G3 crabs (P<0.05). The final CW and BW of the G2 and G3 crabs were not significantly different (P>0.05) (Figure 1).

The growth in terms of WG and SGR of the domesticated crabs showed a decreasing trend with increasing generation number. The WG and SGR of W crabs (242.9±19.9 g and 2.85±0.04 %/day, respectively) and G1 crabs (229.2±33.3 g and 2.83±0.06 %/day, respectively) were not significantly different, while both parameters were significantly higher than for the G2 crabs (182.8±17.1 g WG; 2.68±0.04 %/day SGR) and G3 crabs (173.9±13.5 g WG; 2.66±0.06 %/day SGR), as shown in Figure 2.

Reproductive Performance

The *S. paramamosain* of female W crabs (11.5±1.1 cm CW; 267.1±14.1 g BW) and domesticated female crabs for the G1-G2 stage (11.3±0.7-11.4±0.7 cm CW; 264.6±12.0-270.2±29.4 g BW) were not significantly different maturation and spawning times (P>0.05). However, there were significant differences for F, HR, total number of Z1 produced, and survival of Z1 at 1 dph between the W and G1-G2 crabs. The G2 crabs had a reproductive performance that was significantly decreased for each of these parameters compared to the W crabs and had significantly lower values for the total number of Z1 produced and for the survival of Z1

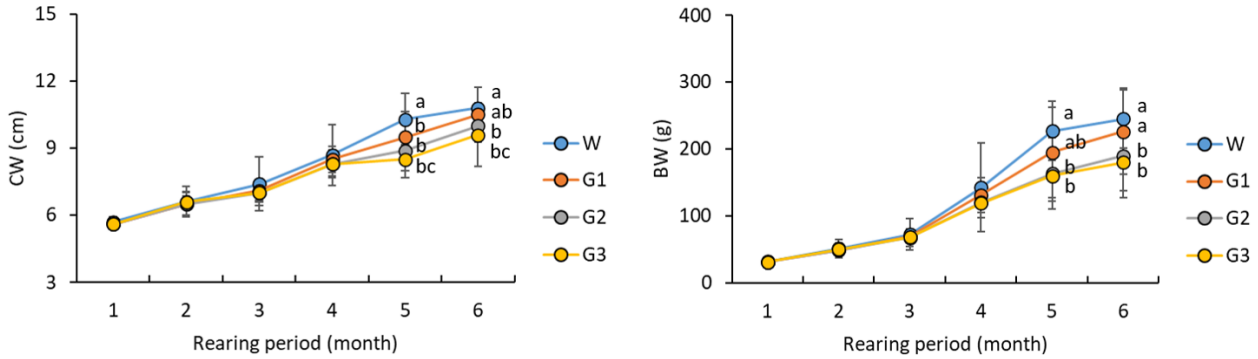

Figure 1. Carapace width (CW) and body weight (BW) of wild (W) and domesticated mud crabs *Scylla paramamosain* for 1st (G1), 2nd (G2), and 3rd (G3) generations reared in grow-out ponds. Error bars represent the mean±SD, and different lowercase letters at the symbols indicate significant differences among treatments (P<0.05).

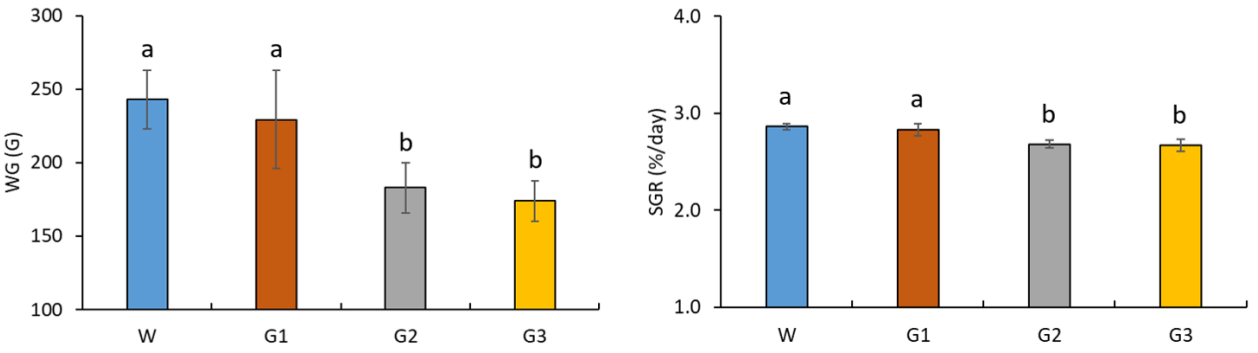

Figure 2. Weight gain (WG) and specific growth rate (SGR) of wild (W) and domesticated mud crabs (*S. paramamosain*) for G1-G3 generations reared in grow-out ponds for 6 months. Error bars represent the mean±SD, and different lowercase letters above the columns indicate significant differences (P<0.05).

Table 1. Reproductive performance parameters (mean±SD) of female broodstock of wild (W) and domesticated mud crab (*S. paramamosain*) in G1-G3 generations reared in grow-out ponds for 6 months.

Trait	Female *S. paramamosain* broodstock			
	W	G1	G2	G3
Carapace width (cm)	11.5±1.1[a]	11.4±0.7[a]	11.3±0.7[a]	11.4±0.8[a]
Body weight (g)	267.1±14.1[a]	270.2±29.4[a]	264.6±12.0[a]	258.7±5.0[a]
Maturation time (days)	49.4±7.8[a]	47.8±8.5[a]	43.0±9.5[a]	nd
Spawning time (days)	10.2±1.3[a]	10.6±1.1[a]	10.8±1.3[a]	nd
Fecundity (eggs/crab)	1,769,032±280,873[a]	1,483,986±343,816[ab]	1,255,314±102,805[b]	nd
Hatching rate (%)	65.0±16.0[a]	41.6±17.0[b]	37.9±10.4[b]	nd
Total number of Z1 produced (crabs)	1,134,451 ±255,538[a]	700,991±224,409[b]	475,762±136,520[c]	nd
Survival of Z1 at 1 dph (%)	89.4±6.5[a]	84.3±12.6[a]	68.9±6.1[b]	nd

Note: Means within row with different superscripts are significantly (P<0.05) different; W=wild crab; G1, G2, and G3=domesticated crabs in generations 1, 2, and 3, respectively; Z1=zoea 1; 1 dph=1-day post-hatch; nd=no data, because of unsuccessful breeding and larval nursing.

Table 2. Bottom soil quality parameters during the experiment involving wild (W) and domesticated mud crabs (*S. paramamosain*) across G1-G3 generations reared in grow-out ponds for 6 months (mean±SD).

Parameter	Treatment				p-value
	W	G1	G2	G3	
Soil pH	6.9±0.2	6.8±0.4	6.6±0.3	6.5±0.4	0.487
Organic matter (%)	7.3±4.2	7.0±3.1	5.2±3.2	5.7±1.2	0.815
Ammonia (mg/kg)	4.6±3.8	5.7±4.3	4.2±2.8	3.8±1.5	0.903

Table 3. Water quality parameters during the experiment involving wild (W) and domesticated mud crabs (*S. paramamosain*) across G1-G3 generations reared in grow-out ponds for 6 months (mean±SD).

Parameter	Treatment				p-value
	W	G1	G2	G3	
Salinity (ppt)	30.1±0.7[a]	31.5±1.0[ab]	32.7±1.2[b]	31.5±0.6[ab]	0.048
Temperature (°C)	30.3±0.7[b]	29.2±0.9[ab]	28.5±0.5[a]	28.1±0.8[a]	0.029
Dissolved oxygen (mg/L)	4.9±0.9[ab]	4.3±0.4[a]	6.8±1.8[b]	5.2±0.8[ab]	0.099
pH	8.0±0.7[a]	7.8±0.6[a]	8.4±0.5[a]	8.2±0.9[a]	0.744
Total ammonia (mg-N/L)	0.08±0.02[a]	0.02±0.11[a]	0.32±0.11[b]	0.09±0.12[a]	0.014
Nitrite (mg-N/L)	0.11±0.04[b]	0.00±0.00[a]	0.17±0.05[b]	0.00±0.00[a]	0.000
Alkalinity (mg/L as $CaCO_3$)	105.8±9.5[a]	128.2±12.1[b]	110.9±9.1[ab]	128.0±8.2[b]	0.047

Note: Means within row with different superscripts are significantly (P<0.05) different.

at 1 dph than in the G1 generation. Attempts to breed and larval hatching from any of the female crabs in the G3 sample population (11.4±0.8 cm CW; 258.7±5.0 g BW) were unsuccessful in this investigation. These results might have resulted from the reproductive deficit seen in the G3 generation of domesticated *S. paramamosain* (Table 1).

Rearing Ponds Conditions

The mean soil pH, organic matter, and ammonia concentrations in the bottom soil of the ponds used in the experiment are shown in Table 2. These parameters did not differ significantly among the treatments (P>0.05). Meanwhile, the mean water quality values during most crab cultures showed statistical differences (P<0.05). However, these water quality levels remained within a range that did not affect the crab culture (Table 3).

Discussion

The domestication of aquatic animals, such as fish, crustacean, and aquatic mammals, is influenced by several conditions that differ from those affecting terrestrial animals. Some key factors include controlling and manipulating offspring that grow quickly and reach maturity early would be more likely to result in successful outcomes for domesticated captivity (Quinitio et al., 2011; Brooker et al., 2020; Teletchea, 2021; Podgorniak et al., 2022). In the present study, the water conditions in the grow-out ponds of the W and domesticated mud crabs in the G1, G2, and G3 generations were maintained within suitable ranges, and parameter values within these ranges have been reported not to affect the rearing of mud crabs of the genus *Scylla*, including *S. paramamosain* (Quinitio et al., 2011; Baylon, 2013; Hasanuzzaman et al., 2014; Syafaat et al., 2021; Oniam et al., 2022; Zhang et al., 2022; Qin et al., 2023; Liew et al., 2024). Although there have been

no published reports on the properties of pond bottom soil for *S. paramamosain* cultivation, the present results appeared to not affect the rearing of this crab species, based on the reported properties of pond bottom soil from rearing other marine crab species such as the blue swimming crab, *Portunus pelagicus* (Oniam et al., 2016; 2018). Thus, our experiments showed that in the grow-out ponds there were significant differences in the growth rates of W and domesticated *S. paramamosain* in each generation. However, there were significant differences in the growth rates between the W and domesticated crabs with decreasing values for final CW, final BW, WG, and SGR of domesticated *S. paramamosain*, especially in the G2-G3 populations. These results showed that differences in the growth variability between the populations need to be managed in the domesticated *S. paramamosain* in each generation in the grow-out ponds based on genetic principles, such as a selective breeding program (Quinitio et al., 2011; Trijuno et al., 2015; Sharif et al., 2016; Wang et al., 2018; Wu et al., 2018), to improve the commercial income from domesticated crabs of this species.

The reproductive behavior of aquatic animals can impact domestication efforts, with species having complex reproductive behavior or specific environmental requirements for breeding being more challenging to breed in captivity (Wu et al., 2018; Brooker et al., 2020; Teletchea, 2021; Podgorniak et al., 2022). Based on the present results, the reproductive performance of the domesticated *S. paramamosain* groups was inferior to the W brooders, especially the G2 brooders. Furthermore, the G3 female brooders were unsuccessful in breeding and larval hatching. In general, domestication can improve the reproductive performance of the domesticated stock, as has been shown for other crustaceans (Quinitio et al., 2011; Maheswarudu et al., 2016; Wang et al., 2018; Wu et al., 2018; Vijayan, 2019; Pillai et al., 2020; Oniam et al., 2021). However, the reproductive performance of the domesticated *S. paramamosain* in the present study was inconsistent with these other results, perhaps because of some factors affecting the domesticated crabs such as optimum diet and genetics. In the present study, the domesticated *S. paramamosain* in the G1-G3 generations were fed only with trash fish for extended periods, which can have both positive and negative effects on the domestication of this crab species. The trash fish can be used as a cheap and abundant source of food for aquatic animals being domesticated, such as fish, shrimp, or crabs. This can help reduce the cost of feeding these livestock during the domestication process. In addition, some trash fish species may contain nutrients that are beneficial for the growth and development of aquatic animals, potentially leading to improved growth rates in the domesticated population (Chor et al., 2020; Nugraha & Rozi, 2020). On the other hand, there may be negative impacts on the growth and health of the domesticated population if any of the trash fish caught from the wild introduce diseases or parasites to the domesticated population, increasing the risk of disease outbreaks in the aquatic livestock being reared (Nugraha & Rozi, 2020). Therefore, proper management of trash fish populations is essential to minimize any negative impacts on the domestication process. Alternatively, optimum artificial feed can be provided instead of trash fish for the production of domesticated *S. paramamosain* populations. Artificial feeds have been formulated to meet the nutritional needs of aquatic animals, including supporting growth, reproduction, and overall health, which play crucial roles in the success and sustainability of aquacultural operations, with the species being fed optimum diets more likely to be successfully domesticated (Brooker et al., 2020; Chor et al., 2020).

Genetic factors can influence the domestication process. Some species may have genetic traits that make them more suitable for captivity and selective breeding. In other crab species, such as the mud crab, *S. serrata* (Quinitio et al., 2011), the mangrove crab, *S. tranquebarica* (Sharif et al., 2016), the blue swimming crab, *Portunus pelagicus* (Trijuno et al., 2015), the swimming crab, *P. trituberculatus* (Wu et al., 2018), and the Chinese mitten crab, *Eriocheir sinensis* (Wang et al., 2018), a selective breeding program from domesticated stock resources can improve the productivity of these crabs. This would be an interesting topic for future study to enhance the development of genetic improvement strategies that could lead to the way for establishing a selective breeding program to produce the first genetically improved strain of *S. paramamosain* with desirable traits, such as rapid growth. However, it remains unclear whether the differences observed in other traits, such as the effects of inbreeding, are due to the short domestication period (only three generations) in the current study, compared to the over five generations of broodstock examined in the study by Pullin et al. (1998), where the domesticated populations were reported to be susceptible to inbreeding, with potential negative impacts on growth and reproductive performance and other traits important for aquaculture. However, effective crab-rearing management practices must be consistently applied, with a focus on using a large number of broodstock to minimize the risk of genetic variation loss and prevent inbreeding (Podgorniak et al., 2022).

Overall, the domestication of *S. paramamosain* is a complex process that may be influenced by a variety of species-related factors, including the natural habitat, cannibalism behavior, diet, and genetics. Successful domestication of *S. paramamosain* requires careful consideration of these factors and the development of specialized techniques for rearing this crab in grow-out ponds. Thus, further innovations, such as a selective breeding program and satisfying the nutritional requirements of the crabs in grow-out ponds, are needed to fulfil the potential of the domesticated *S. paramamosain* production sector.

Conclusion

In the present study, there were significant differences in the growth and reproductive performance between the W and domesticated mud crabs (*Scylla paramamosain*), especially up to the G2 and G3 generations. The growth in terms of WG and SGR of the domesticated crabs tended to decrease with an increase in the generation of domesticated breeding. In addition, the G2 crabs had a negative reproductive performance compared to the W crabs, with the total number of Z1 produced and the survivability of Z1 lower than for the G1 crabs. Furthermore, the G3 crabs were unsuccessful in breeding and larval hatching. However, we hope that in the near future, the present results will lead to the establishment of a selective breeding program that produces the first genetically improved strain of *S. paramamosain*, possessing desired traits such as faster growth and higher reproductive performance compared to the W population.

Ethical Statement

Animal care and all experimental procedures were approved by the National Research Council of Thailand (Animal Use License no. U1-02075-2558).

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Author Contribution

VO: Project administration, Methodology, Data curation, Writing-original draft, and Editing; WA, JS: Investigation, Formal analysis, and Review; CL, RK: Conducted data collection, analysis, and synthesis.

Conflict of Interest

The authors declare that there are no conflicts of interest.

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