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Differences Between Breeding and Weaning Khmer Channa Striata and Vietnamese Channa Striata at Freshwater Aquaculture Research and Development Center, Cambodia

By

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Abstract

This study aimed to analyze the eating practices of Channa striata species, examine breeding, hatching, yield, and post-mortem survival rates, and measure the growth and feeding of Channa striata. The investigation was divided into two main stages. In the first stage, only male fish were injected with the hormone HCG during incubation. In the second stage, both male and female fish received the hormone concurrently. One PG was added to the initial injection at a dose of 500 IU/kg. The second dose was administered at a rate of 300 IU/kg, while the female fish received a dosage of 1000 IU/kg. After three days of consuming their food reserves, the young fish (powder or hatchlings) are fed. Moina is fed to them four times a day for ten days during this phase. When the fingerlings are 45 to 60 days old, the third step in the weaning process involves feeding them a mixture of Moina and trash fish four times a day. This continues until the fish are old enough to consume their own food, at which point they can begin to be raised for meat. The entire Completely Randomized Design (CRD) procedure was used to design the experiment, with one restriction: only the Khmer and Vietnamese Channa Striata species were included. The average fertilization rate for Khmer Channa Striata fish was 67.50%, with an average hatching rate of 62.86%. In comparison, the Vietnamese Channa Striata fish had an average fertilization rate of 47.25% and an average hatching rate of 87.13%. Vietnamese Channa Striata fish also had a higher average survival rate (88.50%) compared to Khmer Channa Striata fish (92.29%). After harvest, Vietnamese Channa Striata fish had an average weight of 334.0 g/head and an average length of 27.63 cm, exceeding the Cambodian carp's average weight of 214.9 g/head and average length of only 23.42 cm. For Khmer Channa Striata fish, the average monthly death rate decreased from 2.06% to 0.022%. Vietnamese Channa Striata fish saw a similar decrease, with their average monthly death rate going from 2.46% to 0.022%. While Vietnamese Channa Striata fish consumed an average of 333 g/head to 1269 g/head of feed, Khmer Channa Striata fish received between 298 g/head and 1013 g/head of feed. This study discovered that while there remain some issues with the growth chain and feeding habits, the benefits of Khmer Channa Striata fish, such as their higher fertility rate and survival rate after three days of reserve, were greater than those of Vietnamese Channa Striata fish. Researchers should focus on ongoing studies to address the issues raised by these findings, particularly in research facilities that are still seeking collaborators to support deeper research into fish species and identify superior-quality fish for cultivation by farmers.

Keywords

Khmer Channa striata, Vietnamese Channa striata, survival rate, total length, total weight, weaning

1. INTRODUCTION

The aquaculture sector plays an important role in providing food sources and increasing daily income, especially for Cambodian fish farmers who live far from fishing grounds (fishing lots, rivers, lakes, streams, and natural water areas) (Moun, 2016). This helps reduce their reliance on buying food from the market.To meet this critical need, the Fisheries Administration works with government and non-governmental organizations to continue promoting aquaculture across the country. They provide technical training, hatching techniques, and fish farming techniques in needy areas.Fish farming in some provinces of the Kingdom of Cambodia contributes to poverty reduction by helping solve food insecurity issues, which aligns with the Royal Government's current Rectangular Strategy (Touch et al., 2016).The Royal Government's Statement on National Fisheries Policy states, "Encourage the development of all types of aquacultures, both freshwater and marine, in accordance with local hydrological operations teams" (Fia et al., 2011).

Fish is a popular and important source of protein for millions in Cambodia. It is low in bones and fat, making it a good option for those who avoid meat or are on a restricted diet. There is no evidence to suggest that fish causes cancer in humans (So, 2016).Wild carp are omnivores, not carnivores. They feed at all water levels and consume a variety of food sources, including small fish, aquatic animals, plankton, and detritus (Pheng, 2014).When there are few aquatic animals, they may resort to cannibalism. Newly hatched fish initially feed on their yolk sac reserves. Once depleted, they start seeking external food sources like small insects, larvae, and zooplankton (Pheng, 2014).Males have a clear black patch under the chin and are thinner than females. Females have a bulging abdomen, enlarged genitals, and pinkish-red fins (Pheng, 2014).At around 5 grams, female carp stop guarding their fry and leave them to find food independently. A single female weighing 1 kg can produce 2,000-5,000 fry typically in December (Touch, 2016).

A study by Touch & Moun (2016) investigated fish hatching using fish collected from natural sources like the Tonle Sap Lake and the Mekong River.The Tonle Sap and Mekong Rivers showed average fertility rates of 67.70% to 82.25%, incubation rates of 32.75% to 47.80%, and survival rates after 3 days of food reserve depletion ranging from 93.37% to 95.50%.Research by Pheng et al. (2014), Chheng &Yeak (2017), and Thai & Chhin (2020) found that 60-day-old carp fry have an average weight of 8.50 g/head to 10.67 g/head and a body length of about 6.15 cm/head to 10.67 cm/head.

A fish's growth depends on its environment and access to food. Suitable living conditions with abundant nutrients will promote faster growth. Conversely, a poor environment with limited food will hinder growth (Touch, 2016).The growth of fish also varies seasonally, with redfish experiencing the strongest growth in April, June, September, and October (Khana, 1990, cited by Chean, 2009).

The aim of this study was to compare breeding rates, hatching rates, survival rates, growth rates, feed quality, and fish yields from both sources.

2. METHODOLOGY

2.1. Location of study

The research process was conducted at the Freshwater Aquaculture Research and Development Center, located in Bati Village, Peam Ro Commune, Peam Ro District, Prey Veng Province. The experimental site is approximately 8 kilometers from Neak Leung Bridge and 70 kilometers from Phnom Penh.

This study focused on two main stages: the incubation stage and the aquaculture stage. The incubation stage examined the incubation rate, hatching rate, survival rate after 3 days of consuming

reserve food, and the feeding of juvenile fish up to 60 days old. The aquaculture stage involved weighing juvenile fish, measuring their average length at rearing time, weighing the feed, monitoring fish length, recording the monthly mortality rate, calculating the post-harvest survival rate, and monitoring water quality on a weekly basis.

2.2. Materials and experimental design

The research experiment utilized the following materials: floating hapa ponds (sizes: 1m x 1m x 1m and 1.5m x 2m x 1.5m), water, serum, salt, lime, and a book, pen, and calculator. The following equipment was used: hormones (HCG), syringes, a water quality measuring device, finished feed, a fish grinder, a bait motor, a water pump, a length gauge, an electronic scale, an automatic scale, and PVC-21mm hoses. This study compared fish bred from two sources: Khmer fish and Vietnamese fish. Mineral feed, Phytase powder, and vitamin supplements were provided for the fish.

Funding for this research activity was provided by the Fisheries Administration, with the support and coordination of the center director. Notably, the director also directly supported the acquisition of Khmer fish and other materials. All juvenile fish were reared in nine hapas measuring 1.5m x 2m x 1.5m. Hapa placement was randomized using a completely randomized design (CRD) with two replicates and three treatments. For feeding juvenile fish, separate experimental hapas were constructed with mesh walls. Each hapa has a surface area of 4.5 square meters (1.5m x 3m) and a height of 1.5 meters.

2.3. Feed preparation and feeding

The breeding experiment used a plant-based seed feed and maintained the same breeding conditions for 60 days. This allowed the offspring to reach a size suitable for rearing. A total of 2,025 fry were hatched, with an average weight of 11.16 grams per fish and an average length of 9.32 centimeters per fish. (Note: "hat" is likely a typo for "fish" when referring to weight and length). The fish rearing experiment lasted for 185 days. Data on fish feed was collected daily. Other data, including fish weight and body length, were collected every 15 days throughout the experiment. Water quality data was recorded twice a week. This note can be rephrased as: "Note: The experiment involved raising both Khmer fish and Vietnamese fish in hapas measuring 1.5 meters x 3 meters x 1.5 meters."

2.4. Water parameter

The table below summarizes the water parameters monitored during the fish rearing experiment for both fish sources.

Table 1. Water parameter

Water parameter in average	**Session**	**Temperature**	**pH**	**NH_3NH_4**	**NO_2**
Experimental model of fish pond	Morning	30.08	7.90	0.1	0.0
	Evening	32.59	8.26	0.5	0.0

According to Table 1, the average water temperature in the morning is 30.08 °C, and the average evening temperature is 32.59 °C. The average pH level is 7.90 in the morning and 8.26 in the evening. Ammonia (NH_3) levels average 0.1 mg/l in the morning and 0.5 mg/l in the evening. Nitrite (NO_{2-}) levels were 0.0 mg/l in both mornings and evenings.

2.5. Data collection and analysis

The primary data collected will include: fertilization rate, hatching rate, survival rate, fish weight at each stage (weighed at each sampling point), amount of feed provided at each stage, and amount of leftover feed at each stage (until the final sampling).Secondary data will include measurements of water quality parameters: temperature, pH (potential of hydrogen), Ammonia (NH_3) levels, and Nitrite (NO_2) levels.

To analyze data, all data will be entered into Microsoft Excel (2010) to compare the two fish sources, a two-sample t-test will be performed in Minitab version 20 to identify statistically significant differences in Mean growth rate and Mean feed rate.This will determine which fish source exhibits superior growth and feed efficiency.

3. RESULTS AND DISCUSSION

3.1 Incubation status of Khmer and Vietnamese Channa striata

After cross-breeding Khmer and Vietnamese Channa striata fish, the results showed that Khmer Channa striata had a higher average birth rate exceeding 67.57% and a hatching rate of 62.86% compared to Vietnamese Channa striata. However, Vietnamese Channa striata exhibited a higher hatching rate of 87.13% and a birth rate of 46.25%. Khmer Channa striata displayed a superior average survival rate (92.29%) compared to Vietnamese Channa striata (88.50%). Regarding the three-day reserve food period, Khmer Channa striata experienced a lower mortality rate (only 7.71%) compared to Vietnamese Channa striata (11.50%).

Table 2. Data afterincubation of Khmer Channa striata and Vietnamese Channa striata

Incubation status of Channa striata	Khmer Channa striata	Vietnamese Channa striata
Birth rate (%)	67.57	46.25
Hatching rate (%)	62.86	87.13
Survival rate after three days of no feed (%)	92.29	88.50
Mortalityrate after three days of no feed (%)	7.71	11.50

Picture 1. *Photos of Khmer Channa striata*

Picture 2. *Photos of Vietnamese Channa striata*

3.2 Weight of fingerlingsin stock (g/head)

The results showed that the weight of fingerlings while raising Khmer and Vietnamese Channa striata was not significantly different ($p>0.05$), as shown in Figure 1. The average weight of the fingerlings of both Khmer and Vietnamese Channa striata was 11.16 grams. This compares to the research of Pheng et al. (2014); Chhin & Thai (2020) found that the fingerlings aged 55 to 60 days weighed an average of 11.16 to 11.28 grams.

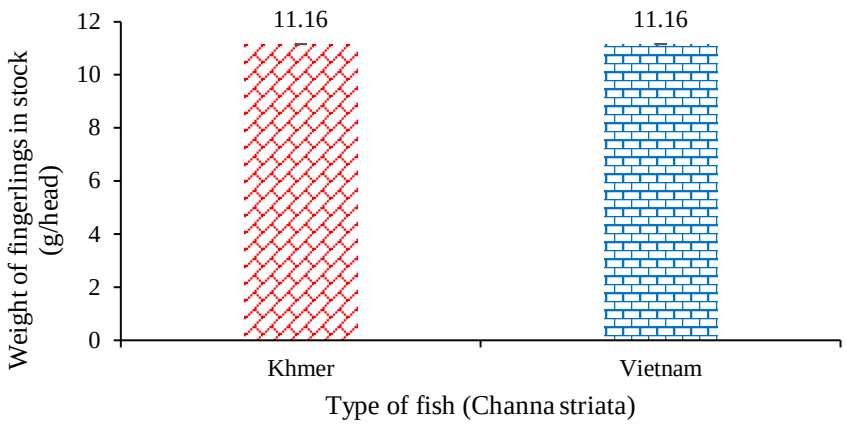

Fig. 1. Weight of fingerlings in stock (g/head)

3.3 Length of fingerlingsin stock (cm/head)

There was no statistically significant difference ($p > 0.05$) in the length of fingerlings of Khmer Channa striata and Vietnamese Channa striata, as shown in Figure 2. The average length for both Channa striatas was 9.37 cm. This finding differs from the research by Pheng et al. (2014) and Chhin & Thai (2020), who reported an average length of 6.15 to 9.37 cm for 55- to 60-day-old fingerlings.

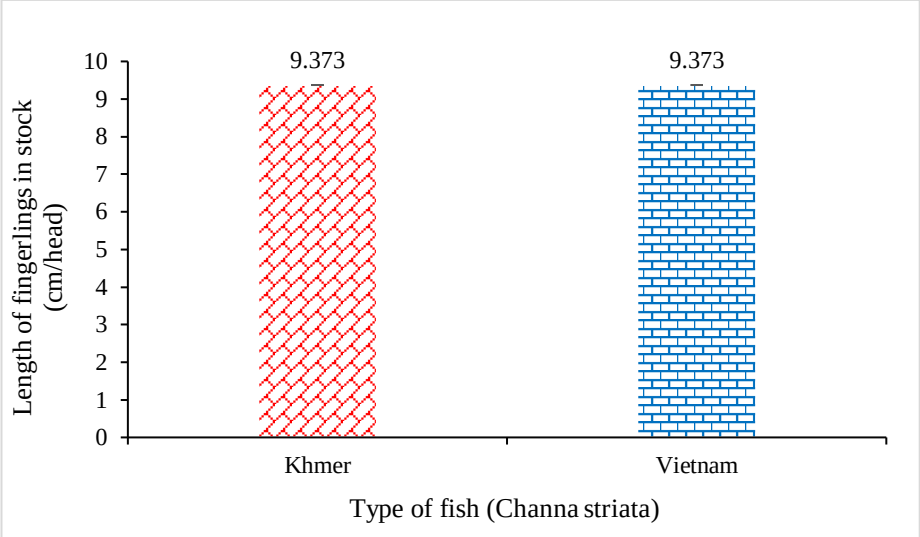

Fig. 2. Length of fingerlings in stock (cm/head)

3.4 Average weight of Channa striata fingerlingsin May (g/head)

The results showed that the average weight of Khmer and Vietnamese Channa striata fingerlings in Maywere significantly different ($p<0.01$), as shown in Figure 3. The average weight of Khmer Channa striata fingerlings in May was 40.4 g/head, while the Vietnamese Channa striata fingerlings weighed an average of 47.0 g/head. This compares to the research of Pheng et al. (2014), Touch (2016), and Chheng (2017), who found that 90-day-old Channa striata fingerlings weigh an average of 38.5 to 40.3 g/head.

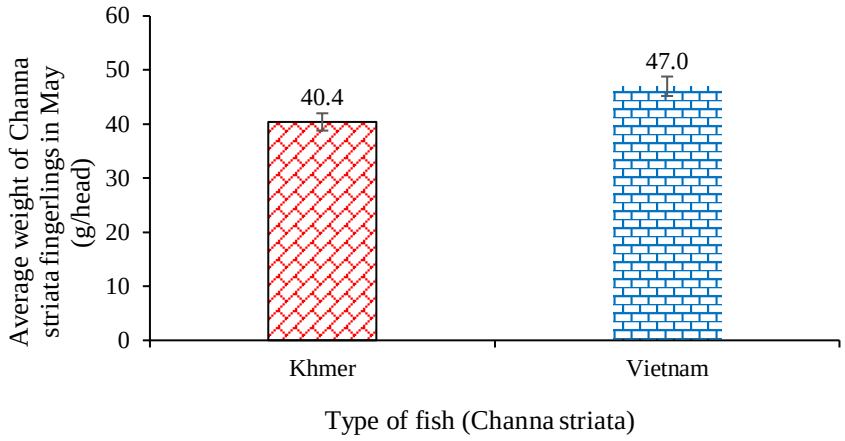

Fig. 3. Average weight of Channa striata fingerlings in May (g/head)

3.5 Length of Channa striata fingerlings in May (cm/head)

The results showed that the lengths of Khmer and Vietnamese Channa striata fingerlings in Maywere significantly difference ($p<0.05$) asshown in Figure 4. The average length of Khmer Channa striata in May was only 13.78 cm/head, while the Vietnamese Channa striata averaged 14.40 cm/head. This compares to the research of Pheng et al. (2014),Chheng (2017) found that 90-day-old Channa striata have an average length of 6.15 to 9.37 cm/head.

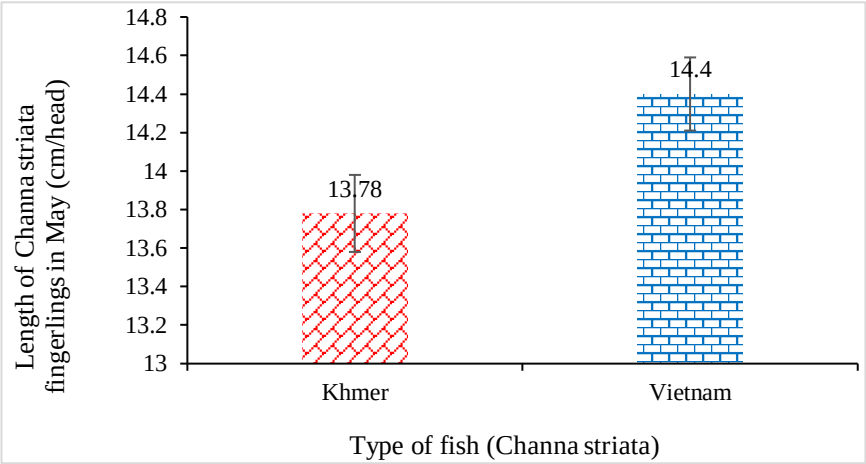

Fig. 4. Length of Channa striata fingerlings in May (cm/head)

3.6 Weight of Channa striata in June (g/head)

The results showed that the weight of Khmer and Vietnamese Channa striata in June were significantly different ($p<0.01$) as shown in Figure 5. The weight of Khmer Channa striata averaged 72.4 g/head in June, while Vietnamese Channa striata averaged 98.0 g/head. This compares to the

research of Pheng et al. (2014), Touch (2016), and Chheng (2017) found that 120-day-old Channa striata weigh an average of 68.5 to 73.3 g/head.

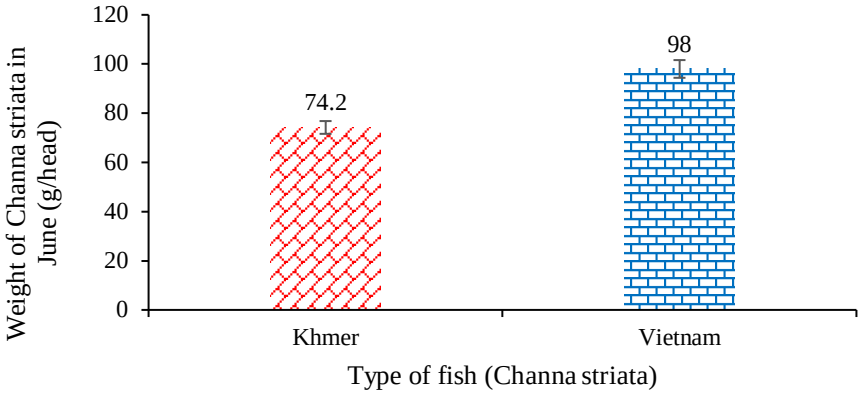

Fig. 5. Weight of Channa striata in June (g/head)

3.7 Length of Channa striata in June (cm/head)

The results showed that the lengths of Khmer and Vietnamese Channa striata in June were significantly difference ($p<0.01$) as shown in Figure 6. The average length of Khmer Channa striata in June was only 16.63 cm/head, while the Vietnamese Channa striata averaged 18.02 cm/head. This compares to the research of Pheng et al. (2014), Touch (2016), and Chheng (2017) found that 120-day-old Channa striata have an average length of 14.15 to 16.37 cm/head.

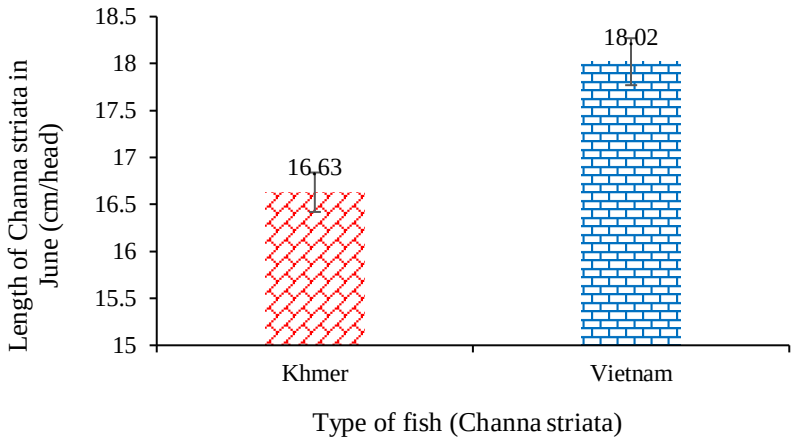

Fig. 6. Length of Channa striata fingerlings in June (cm/head)

3.8 Weight of Channa striata in July (g/head)

The results showed that the weight of Khmer and Vietnamese Channa striata in July were significantly different ($p<0.01$) as shown in Figure 7. The weight of Khmer Channa striata averaged 121.4 g/head in July, while Vietnamese Channa striata averaged 155.3 g/head. This compares to the research of Pheng et al. (2014), Chheng (2017), and Sim (2019) found that 150-day-old Channa striata weigh an average of 120.5 to 122 g/head.

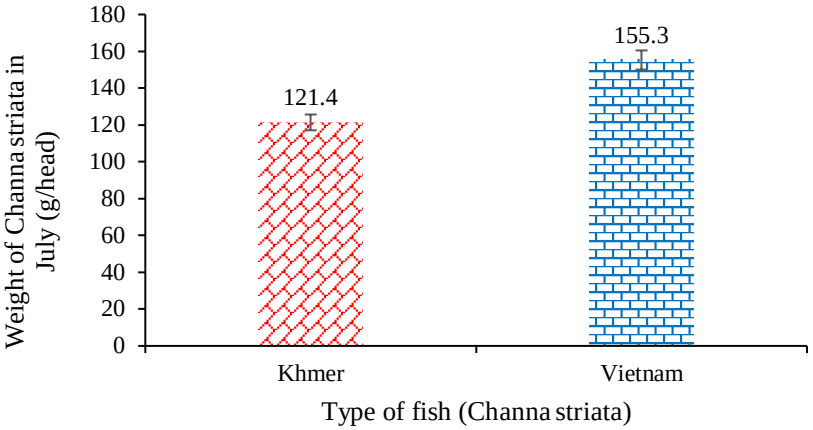

Fig. 7. Weight of Channa striata in July (g/head)

3.9 Length of Channa striata in July (cm/head)

The results showed that the lengths of Khmer and Vietnamese Channa striata in July were significantly difference ($p<0.01$) as shown in Figure 8. The average length of Khmer Channa striata in July was only 19.61 cm/head, while the Vietnamese Channa striata averaged 21.33 cm/head. This compares to the research of Pheng et al. (2014), Chheng (2017), and Sim (2019) found that 150-day-old Channa striata have an average length of 16.80 to 18.50 cm/head.

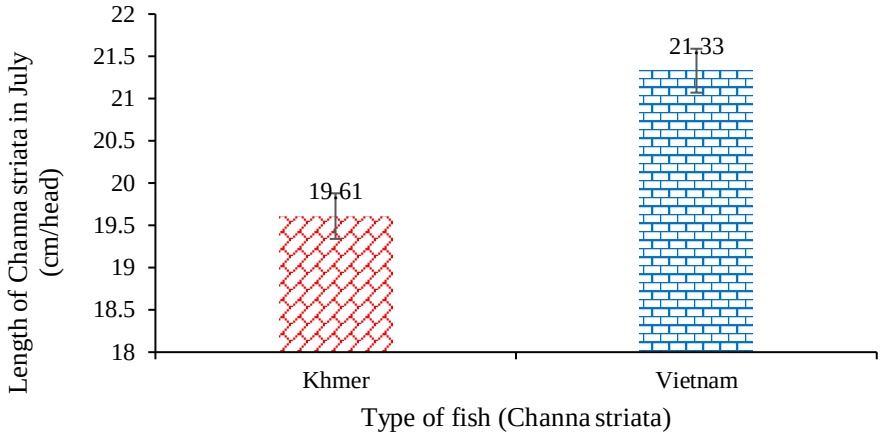

Fig. 8. Length of Channa striata fingerlings in July (cm/head)

3.10 Weight of Channa striata in August (g/head)

The results showed that the weight of Khmer and Vietnamese Channa striata in August were significantly different ($p<0.01$) as shown in Figure 9. The weight of Khmer Channa striata averaged 167.9 g/head in August, while Vietnamese Channa striata averaged 253.6 g/head. This compares to the research of Pheng et al. (2014), Chheng (2017), and Sim (2019) found that 180-day-old Channa striata weigh an average of 165.5 to 170.8 g/head.

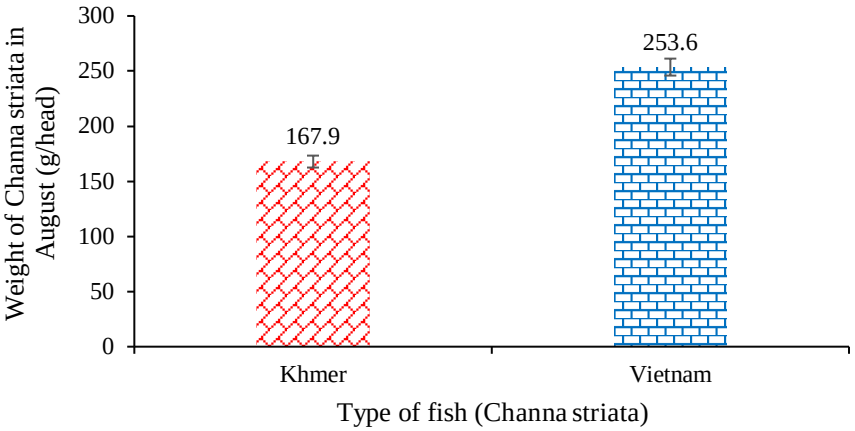

Fig. 9. Weight of Channa striata in August (g/head)

3.11 Length of Channa striata in August (cm/head)

The results showed that the lengths of Khmer and Vietnamese Channa striata in August were significantly difference ($p<0.01$) as shown in Figure 10. The average length of Khmer Channa striata in August was only 21.93 cm/head, while the Vietnamese Channa striata averaged 25.36 cm/head. This compares to the research of Pheng et al. (2014), Chheng (2017), and Sim (2019) found that 180-day-old Channa striata have an average length of 17.65 to 20.50 cm/head.

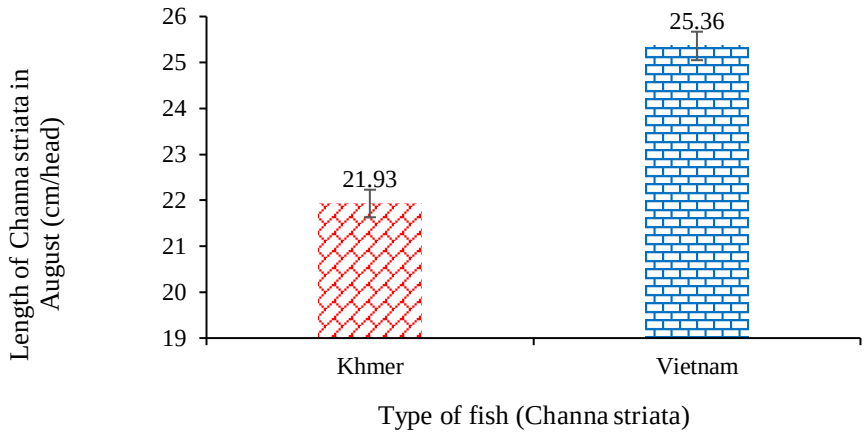

Fig. 10. Length of Channa striata fingerlings in August (cm/head)

3.12 Weight of Channa striata in September (g/head)

The results showed that the weight of Khmer and Vietnamese Channa striata in September were significantly different ($p<0.01$) as shown in Figure 11. The weight of Khmer Channa striata averaged 214.9 g/head in September, while Vietnamese Channa striata averaged 334 g/head. This compares to the research of Pheng et al. (2014), Chheng (2017), and Sim (2019) found that 210-day-old Channa striata weigh an average of 185.4 to 205.8 g/head.

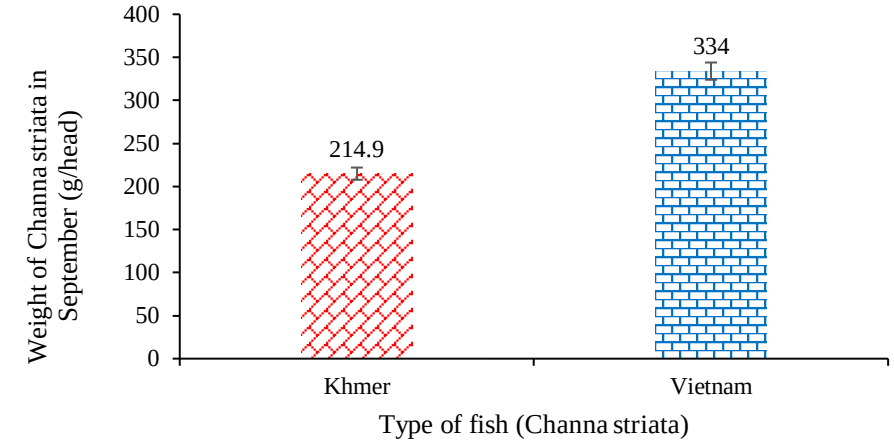

Fig. 11. Weight of Channa striata in September (g/head)

3.13 Length of Channa striata in September (cm/head)

The results showed that the lengths of Khmer and Vietnamese Channa striata in September were significantly difference ($p<0.01$) as shown in Figure 12. The average length of Khmer Channa striata in September was only 23.42 cm/head, while the Vietnamese Channa striata averaged 27.63 cm/head. This compares to the research of Pheng et al. (2014), Chheng (2017), and Sim (2019) found that 210-day-old Channa striata have an average length of 19.7 to 22.4 cm/head.

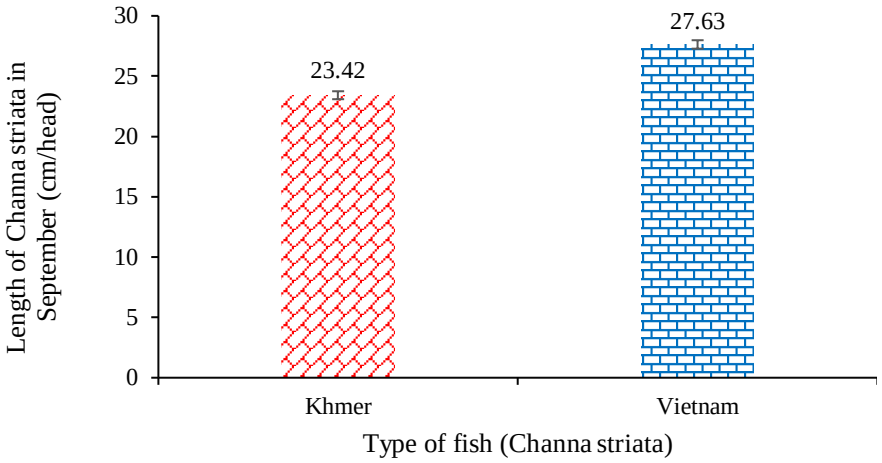

Fig. 12. Length of Channa striata fingerlings in September (cm/head)

3.14 Monthly mortality rate (%)

The results showed that the mortality rates of Khmer and Vietnamese Channa striata were not significantly different ($p>0.05$) as shown in Figure 13. The average mortality rate of Khmer and Vietnamese Channa striata from May to June was only from 2.06% to 0.211%, while the mortality rate of Vietnamese Channa striata was from 2.46% to 0.46%. The average mortality rate of Khmer Channa striata from July to August was only 0.1% to 0.022%, while Vietnamese Channa striata mortality rate was 0.089% to 0.022%. The results of monthly mortality rate of both Channa striataspecies were not significantly different.

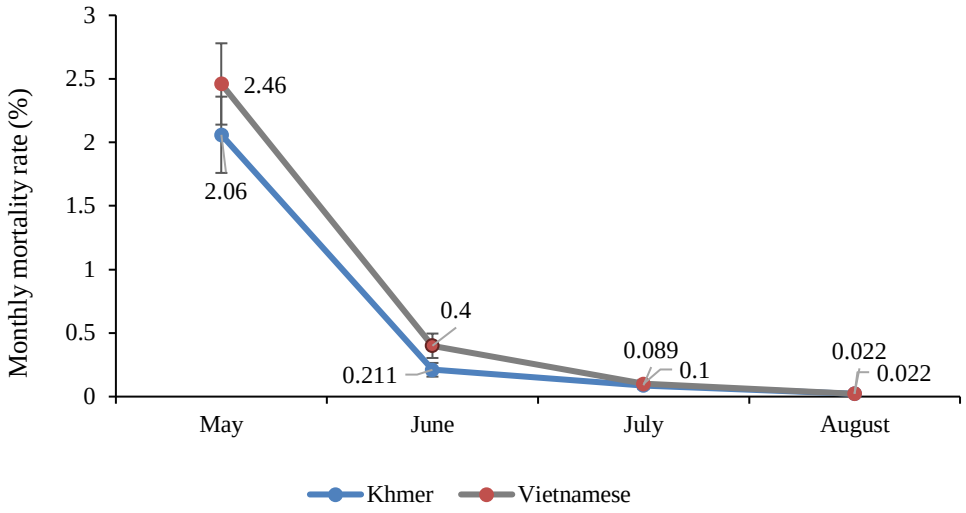

Fig. 13. Monthly mortality rate (%)

3.15 Monthly Channa striata feeding data (g/head)

The results showed no significant difference ($p>0.05$) in the effect of feed on the breeding of Khmer and Vietnamese Channa striata (Figure 14). On average, from May to June, Channa striata consumed only 298 to 589 g/head, while Vietnamese Channa striata consumed 333 to 621 g/head. The average consumption for Khmer Channa striata from July to August was only 596 to 894 gr/head, while Vietnamese Channa striata consumed up to 770 to 1287 g/head. Similarly, in September, the average consumption of Khmer Channa striata was only 1013 g/head, while Vietnamese Channa striata consumed up to 1,269 g/head.

Based on the research results, the chain feed system appears to be the most effective for breeding both Khmer and Vietnamese Channa striata species. However, the source of the Vietnamese fish's superior performance remains unclear.Previous research by Pheng et al. (2014), Touch (2016), Chheng (2017), and Sim (2019) found that Channa striata reared for harvest at 210 days old consumed an average of 1,560 to 2,038 g/head. The current research shows reduced growth in Channa striata with less feeding, leading to improved results compared to previous studies.

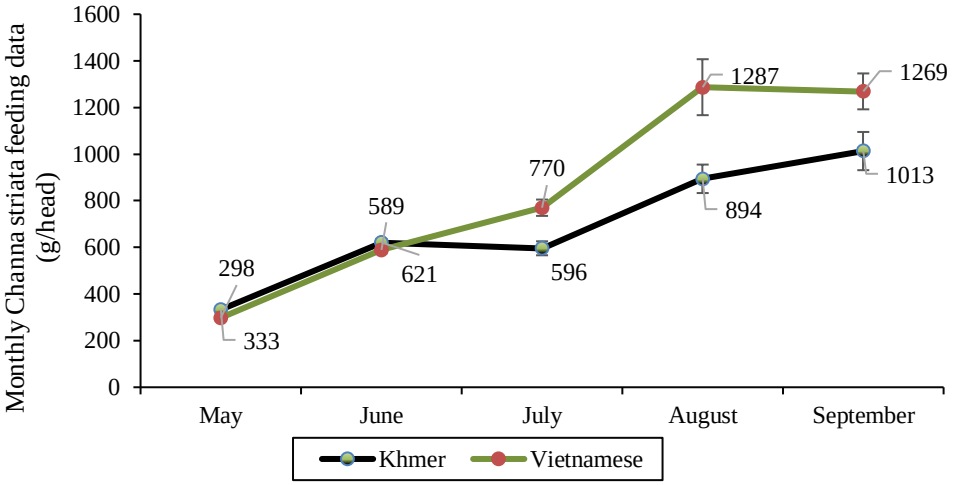

Fig. 14. Monthly Channa striata feeding data (g/head)

4. CONCLUSION

Based on research on breeding and weaning of both Khmer and Vietnamese Channa striata species, the results show significant differences in birth rate, hatching rate, survival rate, and average growth rate. For birth rate, Khmer Channa striata received an average of 67.57%, while Vietnamese Channa striata received only 47.25%. The hatching rate was higher for Vietnamese Channa striata (87.13%) compared to Khmer Channa striata (62.86%). Similarly, the survival rate after three days of food supply was higher for Khmer Channa striata (92.29%), with a mortality rate of 7.71%. The Vietnamese Channa striata had a survival rate of 88.50% and a mortality rate of 11.50%. In terms of growth, the Vietnamese Channa striata source outperformed the Khmer Channa striata source. Vietnamese Channa striata showed an average weight gain of 334 g/head, a length increase of 27.63 cm, and a mortality rate of 0.742% per feeding. They consumed an average of 1,269 grams of feed per head. In comparison, Khmer Channa striata gained a weight of 214.9 g/head, grew 23.42 cm in length, had a mortality rate of 0.598% per feeding, and consumed only 1,013 grams of feed per head.

5. RECOMMENDATIONS

This study identified advantages of Khmer Channa striata, such as higher birth rate and survival rate after three days of food supply. Additionally, the post-harvest survival rate of Khmer Channa striata was higher than that of Vietnamese Channa striata. However, challenges were also identified, including a slower growth rate and lower nutritional value compared to Vietnamese Channa striata.To address these challenges identified in the research, the following recommendations are made for stakeholders to pay close attention to:

For relevant ministries and institutions:

- The Freshwater Aquaculture Research and Development Center can play a crucial role in identifying high-quality fish species for aquaculture by focusing research activities on breeding, hatching, and rearing techniques.
- The Ministry of Agriculture, Forestry and Fisheries (MAFF), along with the Fisheries Administration, can significantly contribute to the development of freshwater aquaculture by prioritizing support for research activities. This should focus on incubating new, commercially viable freshwater fish species preferred by consumers and offered at competitive market prices. This initiative has the potential to create employment opportunities for fish farmers and reduce reliance on imported fingerlings from neighboring countries.

For farmers:

- Farmers can benefit from exploring the aquaculture potential of Khmer fish species. Given their adaptation to local resources and potential resilience to climate change, these species offer a sustainable option for future generations. Continued experimentation with raising Khmer fish is encouraged.
- To further enhance the viability of Khmer trout aquaculture, public and private entities are encouraged to continue research on this species. The focus should be on developing varieties with improved growth rates, efficient artificial feeding strategies, and overall quality.

For researchers:

- Research efforts should be intensified on developing new generations of Khmer fish species. This includes exploring the use of effective hormones to improve fertilization rate, hatching rate, survival rate, and growth. Additionally, continuous efforts to strengthen researcher skills in fish breeding, rearing, healthcare, and finished feed production are crucial for successful aquaculture development.
- This research program should prioritize involving students and professional officers from the Freshwater Aquaculture Research and Development Center (FARDC) under the Fisheries Administration. Their participation can contribute valuable knowledge and manpower to the project.

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