Length-Weight relationship on Monoculture and polyculture of Shrimp in demonstration farm of U-To village, Chaungtha Township, Ayeyarwady Region

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Abstract

Length –weight relationship (LWRSs) is one of the yield authentic biological information and is of great importance in fishery assessment. The investigation of length-weight relationship and some growth parameters of the tiger shrimp (Penaeus monodon) based on the shrimp culture in demonstration farm of Myanmar Sustainable Aquaculture Programme (MYSAP) was conducted from December 2018 to June 2019 in U-To Village, Chaungtha Township, Ayeyarwady Region. Six earthen ponds (pond 1, 3 and 6 of monoculture ponds and pond 2, 4 and 5 of polyculture ponds) were prepared for culture. Feeding for monoculture ponds was managed by natural feed without supplementary feed and floating pellet were used as feed for polyculture ponds. During the studied period, the length and weight of prawn were regularly measured to estimate the relation of length–weight of studied species according to King, 1996. By analyzing the data, the 'b' values of the studied species were 1.789, 2.730 and 1.685 in pond 1, pond 3 and pond 6 of monoculture ponds and the 'b' values in polyculture ponds were 1.746, 1.170 and 1.360 in pond 2, pond 4 and pond 5 respectively.

Key words: shrimp culture, demonstration farm, Length-weight relationship

1. Introduction

Marine shrimp farming is an aquaculture business for the cultivation of marine shrimp or prawns for human consumption. In global shrimp production, farming culture has gradually risen which was increased from 6% to 26% in 1970s and 1990s [1]. Aquaculture increases its contribution to global seafood production in every year. The sector generated 110.2 million tonnes in 2016 [2]. The shrimp *P. monodon* is generally considered for farming because of its large size and high price and it has also been seen that these species are suitable for farming. Fisheries management is comprised among the economic, social and biological factors affecting fish stock in order to adopt a strategy that fulfills the feeding requirements of societies without exploiting fish stocks [3].

In fisheries biology, length - weight relationships are important tools for growth patterns and the general condition of the fish that can be used in population structure analysis [4]. Fish farmers commonly use fish weight gain to evaluate profit gain and scientists usually adopt length measurements to assess fish growth performance in the field. LWRs is a useful measure for body condition in selected species and to compare morphological differences between populations in different regions [5].

The growth process can differ in the same species dwelling diverse locations and its influenced by numerous biotic and abiotic factors[6]. The relationship of length and weight are expressed as a formula (LWRs), which allows the estimation of the fish weight (W) using a particular length (L) [7].

Keystone tool of LWRs had been used for investigation and management included the biometric studies that deliver information on fish species for an estimated assessment of their biomass [8]. In biometric studies is imperative to determine the growth characteristics related to the weight and length of the species [9].

At the present experiment, two types of aquaculture farming techniques: a monoculture of tiger shrimp *P. monodon* and a polyculture of tiger shrimp *P. monodon* with sea bass (*Lates calcarifer*) in a cage were performed in shrimp culture. The aim of the present study was to know the Length-weight relationship of studied species and to compare the growth rate between two types of culture ponds. The objective of this work was to management the shrimp culture and conservation and to get the economically success of shrimp culture for culture farmers in future.

2. Materials and Methods

2.1. Study area and study sites

The culture experiment was conducted in a demonstration farm of MYSAP in U-To village, Chaungtha Township, Ayeyarwady Region. It is the one of the delta region in Myanmar and located at Lat 16°57′08.9″ N, Long 94°28′05.5″E. The experiment lasted 212 days from December 2018 to June 2019.

2.2. Experiment Set-Up

Six earthen ponds were utilized for mono and polyculture farm. The size of each pond was 50x21x0.7m or 0.25 acre (0.10 ha). Three earthen ponds (pond 2, pond 4 and pond 5) were utilized as polyculture ponds which were rearing sea bass *(L.calcarifer*) and tiger shrimp (*P. monodon*) and pond 1, pond 3 and pond 6 were used for only tiger shrimp (*P. monodon*) in monoculture system. Each pond had been provided with two PVC standpipe gates (12 cm

diameter) installed at the opposite ends of the pond serving as water inlet and outlet. All water outlets were provided with Nylon nets to prevent the entrance of undesirable species and the escape of stock. Small bamboo bridges were also installed in each pond to take the sampling data. The size of the cage for sea bass culture was 3 x 2 m in polyculture ponds.

2.3. Experimental Design

2.3.1. Stocking density of post- larvae (PL) shrimp and fingerling of sea bass

Fingerlings of *Penaeus monodon* were selected as seed for the culture and the stocking density of seeded shrimps was 5000 post larvae (PL) in each pond (0.1ha) or 5pL/m^2 in each pond. The size of the post larvae shrimps was 1cm at the beginning of the culture. 70 numbers sea bass (*Lates calcarifer*) fingerlings was stocked in each polyculture pond. The size of the fingerling was 1.7 cm (about 2 g) which was added about one month after the beginning of the shrimp culture. Post-larvae (PL) of shrimp and fingerling of sea bass were collected from the Yuzana Fisheries farm, Ngwe Saung. Ayeyarwady Region.

2.3.2. Feeding

The shrimp of monoculture ponds have relied the natural food such as phyto and zooplanktons. In polyculture ponds, fishes were fed with flooding pellet (1.2 and 1.5 diameter) and the feeding was carried out about 6 hour interval and 45 g of food was supplied to fish with three times per day (135g per day). Feeding was carried out 10% body weight of fish in every month .Remaining and sinking feed was intended to serve as feed for the shrimp outsides the cages of polyculture ponds.

2.3.3. Sources of water and water quality management

Salt water was irrigated from the Chaungtha creek which is connected with the sea. Water was allowed to enter the ponds by inlet canal during the high tide and it was irrigated by pump in every 20 days during ebb tide. Water exchange was regularly carried out not only to maintain the water quality but also to stimulate molting of the shrimp. The depth of water always maintained about 0.8m (80cm) and water parameters such as water pH, alkalinity, salinity, temperature, dissolved oxygen and water transparency were also measured in every weekend at 07:00 to 09:00 AM. Pond water . was maintained the optimum level to control the water quality.

2.4. Data collection and analyzing

Total length (TL in cm) and weight (gram in g) of shrimp species were regularly measured every weekend during the study periods. The natural food such as phytoplankton and zooplankton in monoculture and polyculture ponds were also identified.

2.4.1. Length-weight relationship

The length-weight relationship (LWRs) parameters are important and useful tools in fish biology, fisheries assessment, stock conditions and other components of fish population dynamics. The LWR is also used to convert growth-in-length equations for prediction of weight-at-age and in stock assessment models. The length-weight relationship was calculated using the least squares regression on log-transformation of the equation, $W= a*L^b$ (FAO, 1992) and all weights (g) and total lengths (cm) were fitted to these equation.

Where, L= body length of the specimen
W= body weight of the specimen
'a' and 'b' are the intercept and slope (-exponent) of the length-weight curve, [10].

3. Results

3.1. Monthly mean length of shrimps in monoculture and polyculture ponds

During the study period, monthly mean length of shrimp in pond 1, pond 3 and pond 6 of the monoculture ponds were regularly recorded during the study period. The maximum mean length of shrimp in pond 1 and pond 6 was showed 12.1±1.6 cm and 8.2±0.6 cm in May and June. In pond 3, the maximum mean length was 14.3±0.75 cm in June. Monthly mean length of shrimp in polyculture ponds was regularly recorded. The maximum mean length of pond 2, pond 4 and pond 5 were 10.4±1.0 cm in April, 7.9±0.9 cm in May and 8.3±1.2 cm in April. The minimum mean length of pond 2, pond 4 and pond 5 were 3.4±0.4 cm, 3.3±0.2 cm and 5.1±0.8 cm in December (Table 1 and 3).

3.2. Monthly mean weight of shrimps in monoculture and polyculture ponds

During the study period, the highest mean weights in pond 1 and pond 6 of monoculture ponds were 16.3±7.7 g and 6.2±0.8 g in May. The lowest mean weight in pond 1 and pond 6 were 1.3±0.5 g and 2.5±1.7 g in December. In pond 3, the highest mean weight was observed at 30±8.66 g in June and lowest mean weight 1.5±0.5 g occurred in December (Table 2). The highest mean weight in pond 2 and pond 5 of polyculture ponds were 12.0±3.3 g and 6.4±3.2 g in April. The lowest mean weight in pond 2 and pond 5 were 1.1± 0.25 g and 2.3±0.7 g in December. The highest mean weight was observed at 6.1±4.1 g in March and lowest mean weight 1.0±0 g occurred in December in pond 4 (Table 4).

Table 1. Monthly mean length (cm) and standard deviation of shrimps in monoculture ponds

Sr No	Monoculture ponds	Monthly Mean Length ± SD (cm)						
		December	January	February	March	April	May	June
1	Pond 1	3.5±0.7	5.8±0.9	6.5±0.9	9.6±1.1	10.2±0.9	12.1±1.6	10.3±0.7
2	Pond 3	3.6±0.7	5.7±0.28	7.1±0.25	10.1±0.68	10.1±2.71	14.2±1.24	14.3±0.75
3	Pond 6	5.3±1.3	6.4±0.4	6.9±0.6	7.4±1.5	7.5±0.7	8.2±0.6	7.9±0.1

Table 2. Monthly mean length (cm) and standard deviation of shrimps in polyculture ponds

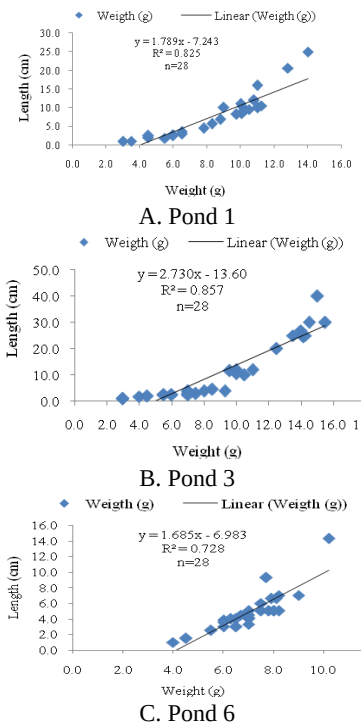
Sr No	Polyculture ponds	Monthly Mean Length ± SD (cm)						
		December	January	February	March	April	May	June
1	Pond 2	3.4±0.4	5.5±1.0	6.3±0.2	8.0±1.5	10.4±1.0	10.2±0.9	10.1±10.1
2	Pond 4	3.3±0.2	4.5±0.7	6.7±0.9	8.5±2.0	7.4±1.3	7.9±0.9	7.8±0.2
3	Pond 5	5.1±0.8	6.5±0.7	6.9±1.0	7.2±0.6	8.3±1.2	8.1±0.3	8.2±0.2

Table 3. Monthly mean weight (g) and standard deviation of shrimps in monoculture ponds

Sr No	Monoculture ponds	Monthly Mean Weight ± SD (cm)						
		December	January	February	March	April	May	June
1	Pond 1	1.3±0.5	2.9±0.4	2.9±1.14	8.4±2.0	12.3±2.6	16.3±7.7	9.1±1.2
2	Pond 3	1.5±0.5	2.6±0.15	3.1±0.63	9.9±3.41	11.5±10.74	26.1±4.83	30±8.66
3	Pond 6	2.5±1.7	3.7±0.4	5.4±2.6	6.1±4.5	5.4±1.8	6.2±0.8	5±0

Table 4. Monthly mean weight (g) and standard deviation of shrimps in polyculture ponds

Sr No	Monoculture ponds	Monthly Mean Weight ± SD (cm)						
		December	January	February	March	April	May	June
1	Pond 2	1.1±0.25	2.5±0.8	2.1±0.6	4.5±3.1	12.0±3.3	11.8±2.2	11.6±11.6
2	Pond 4	1.0±0	1.8±0.5	3.8±0.9	6.1±4.1	4.9±2.7	5.1±1.2	5.7±0.8
3	Pond 5	2.3±0.7	4.2±0.7	4.2±2.3	5.3±1.3	6.4±3.2	6.3±0.6	5.7±0.5

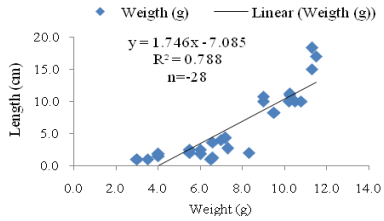


A. Pond 1

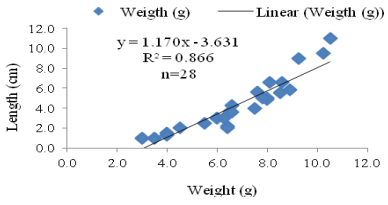
B. Pond 3

C. Pond 6

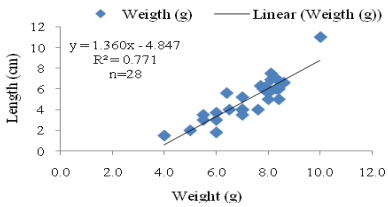
Figure 4. Length-weight relationship of studied species in monoculture ponds.



A. Pond 2



B. Pond 4



C. Pond 5

Figure 5. Length-weight relationship of studied species in polyculture ponds

3.3. Length-Weight relationship of prawn in studied ponds

According to statistically analysis, the 'b' values of the studied species were 1.789, 2.730 and 1.685 in pond 1, pond 3 and pond 6 of monoculture ponds. In polyculture ponds, the 'b' values of the studied species were also showed 1.746, 1.170 and 1.360 in pond 2, pond 4 and pond 5 (Fig. 4 and 5).

4. Discussion

In the present experiment, shrimp (*Penaeus monodon*) and fish (*Lates calcarifer*) were cultured by using two different types of feeding. The monoculture ponds were only stocked with shrimp and all monoculture ponds relied on natural food such as planktons. Polyculture ponds used a combination of shrimp culture and fish that were supplied with feed.

Growth of shrimp in polyculture ponds have similar growth rates to monoculture ponds (where feed rations were determined by feed consumption conditions in individual ponds) [11].According to present result, the mean length and weight of shrimps was regularly increasing in monoculture pond especially in pond 3. However, decreased mean length and weight were found in pond 1 and pond 6 of monoculture ponds at the end of the culture period in June. Also the length and weight of shrimps in pond 2, pond 4 and pond 5 of polyculture ponds were normally increased the first couple of month when the cultured started. However, the length and weight decreased at the end of cultured in June.

The parameters of 'b' generally do not vary significantly throughout the study period [12]. Unlike parameter 'a' which may vary according to the seasonally, monthly and between habits. Based on the above results, 'b' values range from 1.685 – 2.730 in monoculture ponds and 1.170-1.746 in polycutlure ponds. It was indicated that the negative allometric growth ($b<3$) in all culture ponds except in pond 3.

In the present study, the result of b value showed that the growth rate of shrimps in pond 1 and 6 of monoculture ponds and pond 2, 4 and 5 of polyculture ponds have not similar growth rate of shrimp. It is not agree with the previous authors.

However, the shrimp in pond 3 of monoculture pond was maintained their growth rate of the body shape as they grow.

5. Conclusion

The present study provided on LWRs for *Penaeus monodon* which was cultured on U-To village, Caungtha Township, Ayeyarwady Region. In the present finding, almost all LWRs of studied species had showed the negative allometric expect in pond 3. However, the b value in monoculture pond was nearly closed to 3 than the polyculture ponds. It was concluded that the monoculture ponds with natural feed was a little benefic than the poluculture ponds with supplementary feed. It might be attributed to environmental conditions or linked to morphological characteristics specific to each species. According to the results, it should be maintained to increase the growth rate for marine shrimp species to avoid economical loss.

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