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A Comparative Study on Survival and Growth of Larvivorous Fish, *Rasbora daniconius*, *Puntius ticto*, and *Puntius Conchonius*

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***Abstract*—**Experiments were carried out on the survival and growth of *Rasbora daniconius*, *Puntius ticto* and *Puntius conchonius*. The motivation of the study was to obtain information for growing the fish on a commercial scale for their use as biological control agents against mosquito larvae. The effects of temperature, total hardness, DO, pH and feed on the growth of fish were also investigated. Excessive value of total hardness was found because very rich calcium ion is present in Chitrakoot area. There was significant increases in growth rates of fish as temperature was increased from 28^0C to 30^0C. Further increases in temperature up to 32^0C, did not further affect growth. The positive and highly significant correlations 0.991488, 0.9581 and 0.9935 were found between length and weight of *P. ticto*, *P. conchonius* and *R. daniconius* respectively. The regression was significant at 5% level of probability.

***Keywords*—**Indigenous fish, DO, larvae, mosquito, pH, Temperature, total hardness.

I. Introduction

MOSQUITO-BORNE diseases are big problem for human health especially in the rural areas due to increased risk of disease transmission, lack of facilities and adequate knowledge, long distance for medical help and poor economic conditions. They are responsible for more than 3 million deaths per year [6]. The chemical control of mosquitoes has a number of drawbacks including being costly, causing environmental pollution and resistance development in mosquitoes [20]. A well known alternative to chemicals in the fight against mosquitoes is using fish, which not only prey on mosquito larvae, but also have been found to repel ovipositon [14].

Native fish should be used for biological control of mosquitoes as opposed to introducing exotic species [15]. Once the suitable fish for biological control, breed successfully under controlled conditions, further investigations are to be needed to provide information for maximizing growth rates of the fish. The low-cost and efficient fish-culture programs are essential, especially in developing countries where tropical diseases are one of the main obstacles for development [9]. Thus, the suitability of P. *ticto, P. conchonius* and *R. daniconius* as biological control agents against mosquitoes was further investigated by determining the effects of feed and environmental factors on the growth of the fish. Stocking density is an important indicator that determines the economic viability of the production system [2]. Knowing the best densities for a species is a critical factor for good husbandry practices and creating efficient culture systems.

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II. Material and Methods

Initially *P. ticto, P. conchonius* and *R. daniconius* were collected from river Paiswani and transferred in to the laboratory. All fish were acclimatized under laboratory and field conditions over a week before the experiments. Initial size of fish at the time of introduction was 1.5 to 2.0 cm and body weight 0.8 to 1.5g per fish. For the feed trial experiment three cemented tanks (1m x 1m x 1/2m) were selected for a period of six months starting from September to February 2010-2011. The experimental feed (Tokyu fish feed (5g) with 1000 *Culex* mosquito larvae) was applied twice a week at a rate of 5% (5g) of the body weight over a six month trails. The density of each species was maintained 50 fingerlings in the tank. Ten fish were randomly selected from each tank; the weight (g) was taken by a digital balance (Citizen CTG 302) and the standard length (cm) from the tip of the snout to the tip of the caudal peduncle by placing the fish in a Petri dish on a normal scale.

The field culture methods of fish were adopted [1], [7], [8]. The fish were harvested from tanks and their final length and weight were measured. The survival rate was estimated as follows:

$$\text{Survival rate (SR \%)} = \frac{\text{(No. of fish harvested)}}{\text{Initial no. of fish}} \times 100$$

The physico-chemical parameters such as water temperature, dissolved oxygen (DO), pH and total hardness (calcium and magnesium) were monitored weekly throughout the experimental period. Water quality parameters were analyzed using standard methods [4]. The pH was taken by pH meter (ESICO MADEIN 1010) and temperature by Mercury thermometer (accuracy 0.5). The variation in length gain (cm) and weight gain (g) of the fish under treatments over a six month were tested using bivariate analysis. Significant results

(P = 0.05) were further tested. Statistical analysis of raw data was calculated using SAS-JMP (USA) Software 9.03 version.

III. Results

The highest length and weight were recorded in *R. daniconius* whereas the lowest of *P. ticto*. The weight and length increases during study period in all observed fish (Table I). The minimum survival was observed in *P. conchonius* and the maximum was in *R. daniconius* (Table II). The value of all observed physicochemical parameters like average temperature ranges from 18.24^{0}C to 27.97^{0}C, pH 7.38 to 7.57, DO 4.52 to 7.18 and total hardness 338 to 365 (Table III).

A. Fish Growth

1. Temperature

The significant differences were found in average weight of *P. ticto* 1.7031, *P. conchonius* 2.0523 and *R. daniconius* 2.9351 respectively. The growth of fish was stopped below 18.24^{0}C where as unchanged at 32^{0}C. *P. ticto, P. conchonius* and *R. daniconius* has gained higher body weight 13.94g, 15.04g and 20.65g under average temperature ranges from 18.24^{0}C to 27.97^{0}C respectively (Table II). The comparison of means of body weight in different water temperatures (Tables II, III) indicated that the water temperature ranges, significantly affected the average body weight gain of the fish.

TABLE I
Observational Revelation of Fish Recording to Length and Weight in Experimental Conditions (Cement Tanks) N = 10

Month	*P. ticto*		*P. conchonius*		*R. daniconius*	
2010-2011	**Length (cm)**	**Weight (g)**	**Length (cm)**	**Weight (g)**	**Length (cm)**	**Weight (g)**
Stocking	1.88	0.71	1.85	0.75	1.92	0.80
September	2.27	1.30	2.49	1.69	2.60	1.98
October	2.65	2.29	3.65	2.10	2.89	2.33
November	3.30	2.32	4.58	2.15	4.68	3.04
December	4.05	2.36	5.10	2.65	5.20	4.10
January	4.85	3.00	5.66	3.20	5.81	4.68
February	5.49	3.38	5.82	4.00	6.38	5.32

2. Total Hardness

The fish were found to be well adapted to extreme conditions of the water. The growth of all fish was significantly increased at total hardness 338 to 365. The comparison of means of body weight in different water hardness (Tables II, III) indicated that the water hardness significantly affected the average body weight gain of the fish.

TABLE II
Growth Performance of Larvivorous Fish

Parameters	*P. ticto*	*P. conchonius*	*R. daniconius*
Mean initial weight (g)	0.71	0.75	0.80
Final weight (g)	14.65	15.79	21.45
Weight gain (g)	13.94	15.04	20.65
Survival rate (%)	94.11	82.35	100

3. pH

The impact of pH on the survival of fish depends on ecological and climatic factors which play an important role in the process of eating of mosquito larvae. The growth of all fish was significant increases on pH 7.38 to 7.57. The comparison of means of body weight in different pH value (Tables II, III) indicated that the pH ranges significantly affected the average body weight gain of the fish.

4. Dissolve Oxygen

All fingerlings were successfully grown in the tanks environment at DO 4.52 to 7.18. The survival rate of *P. ticto* was 94.11, *P. conchonius* 82.35 and *R. daniconius* 100 % at optimal DO level. The comparison of means of body weight in different DO level (Tables II, III) indicated that DO ranges significantly affected the average body weight gain of the fish.

TABLE III
Physicochemical Parameters during the Culture Period in Tank Ecosystem

Year 2010 - 2011/ Month	Temperature	pH	DO*	Total hardness*
September	27.970C	7.57	4.52	365
October	27.21^{0}C	7.50	6.23	352.68
November	24.26^{0}C	7.46	6.12	342.68
December	21.15^{0}C	7.42	7.18	338.64
January	18.24^{0}C	7.38	6.18	340.62
February	24.28^{0}C	7.44	7.14	352.72
APHA (1998)	28 – 30	6.5 - 9.0	5 – 8	300

(* = Milli gram per liter)

Bivariate Analysis of Length and Weight

The bivariate analysis between weight and length of the fish was statistically investigated in field. The parametric model is given in Table IV.

TABLE IV
Bivariate Analysis of Length and Weight of *P. ticto*, *P. conchonius* and *R. daniconius*

	Field		
	P. ticto	*P. conchonius*	*R. danconius*
SE	0.071247	0.173557	0.084476
t	15.23	6.69	17.49
Correlation	0.991488	0.9581	0.9935
R- square	0.983049	0.917991	0.987089

P. ticto - Weight = -2.38602 + 1.0851447* Length
P. conchonius - Weight = -3.212624 + 1.161346* Length
R. daniconius - Weight = -3.967631+1.4772715* Length

Relationship between Length and Weight of Fish in Field Condition

The statistical analysis has revealed that there are positive and highly significant correlations (0.9914), (0.9581) and (0.9935) between length and weight of *P. ticto*, *P. conchonius* and *R. daniconius* respectively. The regression was significant at 5% level of probability. If the length of *P. ticto* is increased by 1 cm. the weight of fish is enhanced by 1.08g i.e., the increase of 8.51 per cent, in case of *P. conchonius* 1.17gms i.e., increase of 16.13 per cent and in *R. daniconius* 1.48gms i.e., increase of 47.72 per cent respectively. Further this model shoulders 98 per cent of the variation in weight due to length.

Thus, it is concluded that as the length increases, the weight of *P. ticto*, *P. conchonius* and *R. daniconius* also increases respectively.

The distribution of length pattern was observed Q_1 = 2.555 (25%), Q_2 =3.675 (50%) and Q_3 = 5.01 (75%) in the tanks. The mean and the range were observed 3.7668 and 2.4468-5.0898 respectively. The coefficient variation was 33.41 per cent.

The distribution of weight pattern for this fish was observed Q_1 = 0.20425 (25%), Q_2 =1.74 (50%) and Q_3 = 3.095 (75%) in the cemented tanks. The mean and the range were observed 1.7031 and 0.2568-3.1495 respectively. The coefficient variation was 80.91 per cent.

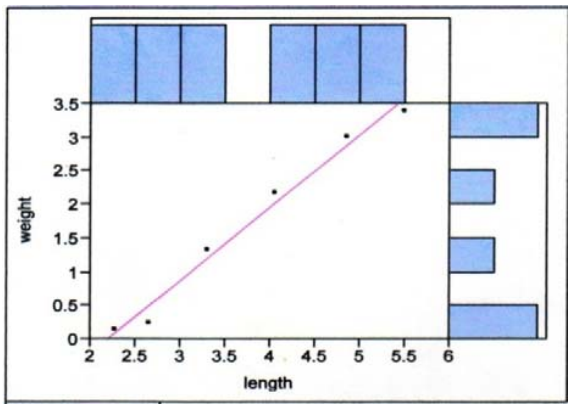

Fig. 1 Growth pattern of *P. ticto* fingerlings

The distribution of length pattern was observed Q_1 = 3.36 (25%), Q_2 =4.84 (50%) and Q_3 = 5.33 (75%) in the tanks. The mean and the range were 4.45 and 3.2102-5.6897 respectively. The coefficient variation was 26.54 per cent. The distribution of weight pattern for this fish was observed Q_1 = 0.1885 (25%), Q_2 =2.375 (50%) and Q_3 = 3.4 (75%) in the tanks. The mean and the range were observed 2.0523 and 0.3952-3.7094. The coefficient variation was 76.93 per cent.

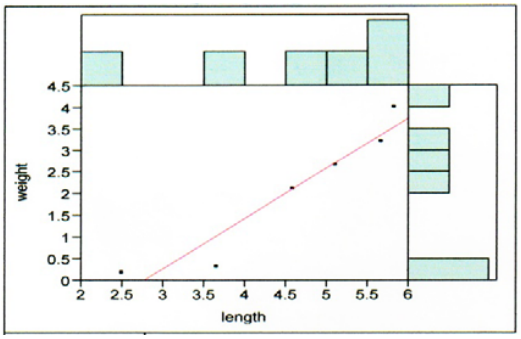

Fig. 2 Length and weight performance of *P. conchonius*

The distribution of length pattern was observed Q_1 = 2.8175 (25%), Q_2 =4.94 (50%) and Q_3 = 5.9525 (75%) in the tanks. The mean and the range were observed 4.5933 and 2.9727 to 6.2138 respectively. The coefficient variation was 33.61 per cent. The distribution of weight pattern for this fish was observed Q_1 = 0.2242 (25%), Q_2 = 3.57 (50%) and Q_3 = 4.85 (75%) in the tanks. The mean was 2.9351 and the range was 0.5845-5.2858. The coefficient variation was 76.31 per cent.

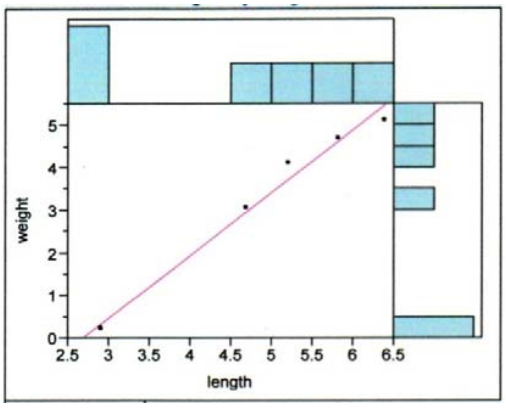

Fig. 3 Length and weight performance of *R. daniconius*

IV. Discussion

The growth bar of this study demonstrated a gradual phase of growth in all the treatments. However, at points where the treatment growth bars space could be due to recorded low speed growth. For instance, growth of fish in treatments decline in the month October and November and assumed a gradual increasing growth till the experiment was terminated. Growth of fish is normally found to be exponential over periods of six month or less [17], as was found for fry elevate in this study

Intra specific variation in fish can be expressed in their morphological, physiological or biochemical characteristics [12] as well as in the growth rate [10], [11]. As the age of the fish fingerling increased, the variation in size of the group increased. In addition, the size frequency distribution of the fingerling was found to be twisted to the left. The best performance in respect of growth and survival, exhibited by fingerlings in this study, when reared exclusively on natural live prey substantiates [18]. The different homemade feed like whole-wheat bread, vegetable peelings and alternative live feeds like water fleas, Tubifex or sludge worm, mosquito larvae and chopped earthworm were useful for fish culture [8], [16], [19]. The best result in growth and survival of *Cyprinus carpio* larvae was found with cultured live prey organisms [5]. The living Tubifex was the best feed for guppy for increasing the growth and colouration and utilized the living organisms more efficiently than the artificial diet [13]. The increasing rearing density in fry *O. niloticus* resulted in heterogeneous growth rates and reported that feed conversion ratios, specific growth and survival rates were not affected by different stocking densities [3].

References

[1] T. Adak, C.P. Batra, C.R. Pillai. Raising mother stocks and maintenance of larvivorous fish hatcheries in Delhi. In: V.P. Sharma, A. Ghosh editors. Larvivorous fishes of inland ecosystems. Proceedings of the MRC-CICFRI workshop, New Delhi: Malaria Research Centre (ICMR). pp.141-146. 1994.

[2] H. E. Ako, K., Shimizu, L. de Lemos, C. Tamaru. Behavioral limitations of high density fish grow-out. World Aquaculture, vol. 36, no. 3, pp.25-29. 2005.
[3] E. H. Alhassan, E. D. Abarike, C. L. Ayisi. Effects of stocking density on the growth and survival of Oreochromis niloticus cultured in hapas in a concrete tank. African J. Agricultural Research, vol. 7, no 15, pp. 2405-2411. 2012.
[4] APHA-AWWA-WPCF. Standard methods for the examination of water and waste water, 20th edition, Washington, DC- 2005, pp. 2605. 1998.
[5] P. Bambroo. On the diet substitution and adaptation weight in carp Cyprinus carpio larvae. Indian J. Science. Res, vol.3, no. 1, pp.133-136. 2012.
[6] J. Fang. A world without mosquitoes. Nature. 466, pp. 432-434. 2010.
[7] A.K. Ghosh, A. Ghosh, M.K. Das. Perspectives of larvivorous fish culture in integrated fish farming. In: V.P. Sharma A. Ghosh, editors. Larvivorous fishes of inland ecosystems. Proceedings of the MRC-CICFRI workshop, New Delhi: Malaria Research Centre (ICMR). pp. 205-212. 1994.
[8] A. Ghosh, B.K. Mahapatra, N.C. Datta. Ornamental fish farming – successful small scale aqua business in India. Aquaculture Asia, vol. 8, no. 3, pp. 14-16. 2003.
[9] T. Guiguemde, R.F. Dao, V. Curtis, A. Traore, B. Sondro, J. Testa, J.B. Ouedrago. Household expenditure on malaria expenditure and treatment for families in the town of Bobo-Dioulasso, Burkina Faso. Trans. R. Soc. Trop. Med. Hyg. Vol. 88, pp.285–287. 1994.
[10] B. Hepher. Nutrition of Pond Fishes. Cambridge Univ. Press, Cambridge, pp. 388. 1988.
[11] M. Huet. Textbook of Fish Culture. Breeding and Cultivation of Fish, 2nd edn. Fishing News Books, 1986.
[12] V.S. Kirpichnikov. Genetic Bases of Fish Selection. Springer, Berlin, pp. 410. 1981.
[13] B. Mandal, A. Mukherjee, S. Banerjee. Growth and pigmentation development efficiencies in fantail guppy, Poecilia reticulata fed with commercially available feeds. Agriculture and biology J. North America, vol. 1 no.6, pp. 1264-1267. 2010.
[14] S.A. Ritchie, C. Laidlawbell. Do fish repel oviposition of Aedes taeniorhynchus. J. Am. Mosq. Control Assoc. pp.103. 1994.
[15] H.R. Rupp. Adverse assessments of Gambusia affinis: an alternate view for mosquito control practitioners. J. Am. Mosq. Control Assoc, vol. 12, no. 2, pp. 155–166. 1996.
[16] C.B. Santiago, J.B. Pantastico, S.F. Baldia, O.S. Reyes. Milkfish (Chanos chanos) fingerling production in freshwater ponds with the use of natural and artificial feeds. Aquaculture, vol. 77, pp. 307-318. 1989.
[17] C.B. Schreck, P.B. Moyle. Methods for Fish Biology. American Fisheries Society, Bethesda, MD, pp. 684, 1990.
[18] J.G. Sharma, R. Chakrabarty. Larval rearing of common carp (Cyprinus carpio): A comparison between natural and artificial diets under three stoking densities. J. World Aquaculture. Soc. Vol. 3, pp. 490-495. 1999.
[19] K. F. Shim. By-product utilization in live food culture for tropical aquarium fish. In: Finfish Nutrition Research in Asia. De Silva, S. S. editors. Proceedings of the Second Asian Fish Nutrition Network Meeting. Asian Fisheries Society, Manila, Philippines. pp.42–47. 1986.
[20] M.S. Zaman. Malaria *control through fish. Pak. J. Sci. vol.32, pp.163–168. 1980.*