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Issue Date	2014

Crowding Effect on the Survival Rate of Ornamental Fish (Swordtail)

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Abstract

Survival rate and growth play an important role in rearing of fish. The experiment was conducted from July to December of 2010. The present study was carried out to find the efficiency of different stocking density in *Xiphophorus helleri*, Swordtail provided with the same live food (*Tubifex*). A total of 90 healthy fingerlings were selected and used. They were divided into three groups of 5, 10, 15 per group and bred in glass aquaria of 50 liter capacity. Three replicate tanks were made for each stocking density. During experiment the total weight of each group was taken on monthly. Mortality and survival rate were checked in each tank every day. Stocking density had a significant effect on growth and survival. But in present study there is no mortality rate in three different stocking densities. The optimum stocking density for good growth of *Xiphophorus helleri* fingerlings is 5 fingerling/50 liters feeding at the rate of 5% of total body weight.

Key words: Ornamental fish, same live food (*Tubifex*), survival rate

Introduction

Establishing on ornamental fish culture industry has long been felt to be one means to diversity the aquaculture sector in Hawaii. Since 1992, this effort has been supported by the Center for Tropical and Subtropical Aquaculture (CTSA), the University of Hawaii Sea Grant Extension Service (SGEs), and the State of Hawaii Department of Agriculture Aquaculture Development Program (ADP). Over the years, the producers of ornamental fishes have requested detailed yet user-friendly information in the areas of controlled reproduction, nutrition, diseases, hatchery management, growout techniques and economics. In response, CTSA, SGEs and ADP have pooled their resources, for the publication of a series of "How to" manuals covering commercial production of a variety of ornamental fish species. In 2001 December, published of the manual on the commercial production of the swordtail, *Xiphophorus helleri* is the latest series. This manual is directed to the culture of the swordtail *X helleri*, the methods could be applied to other livebearing fishes (Tamaru *et al.*, 2001).

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Fish can be grouped in a number of different ways. One major division is that between egg-laying species and live-bearing species. Among them, the most common types of livebearers are cultured in numerous color and finnage varieties and belong to two genera, *Poecilia* and *Xiphophorus* (Hill, 2002).

Environmental factors that exert their effect on the growth of fish are population size (density), nutrition, season, temperature, precipitation and genetic background etc.

Unlike other vertebrates fish show indeterminate type of growth in which they grow continuously if the food is available (Lagler *et al*., 1962).

Correct selection of a fish tank is the first step in successful aquarium keeping. In aquaculture, the price of fish is determined by the market demand of supply which includes size and production. Two primary goals of aquaculture are to maximize production efficiency and to produce animals of more or less uniform size. The production is a summation of individual weights of all reared fish, or a cross-product of the number of surviving fish and their mean weight. It is very important to control the survival and growth rates and individual size difference of fish in a commercial production system (Huang *et al*., 2002).

To understand the effect of each factor, for example density (crowding) in the present work, variation in the population of growth the ornamental fish concerned is made while other factors kept almost constant. This can be achieved by keeping all the groups of different population size in the same room under similar environmental conditions. The experimental works absolute growth and absolute growth rates are most commonly employed as indicated by Ricker (1979).

The density of a fish population plays a predominant role in influencing the growth of the fish (Smith et al., 1978 cited by Huang, 2002) and changes of population densities of fishes may lead to changes in growth and survival rate (Miao, 1992 cited by Huang, 2002).

When the population density is above a certain level (threshold), a lack of sufficient space act as an independent stress that reduces growth (Woiwode and Adelman, 1989 cited by Huang, 2002).

In the present work fingerling *Xiphophorus helleri* (Swordtail) were used when they of approximately from 3.1cm to 4.3cm and 0.2g to 0.29g in weight. Monthly changes in the body weights were employed as indexes to

indicate growth. The fingerlings of swordtails from the same ponds and same food were used to investigate what affect population density has on the growth.

The aim and objective of the present work is to understand the optimum population size for an optimum volume of culture medium (water here) and to examine the effects of various stocking densities on growth and survival rate of swordtails within aquariums.

Materials and Methods

Collection of specimens

One hundred and fifty fingerlings of *Xiphophorus helleri*, swordtails were obtained from Nickel Pet Shop. The fingerlings were brought to the laboratory and kept in small brick culture tank 60cm x 120cm x 60cm with ample supply of water until they become acclimatized to their new surroundings. During this period, they were fed with live food (*Tubifex*) and commercial small pellets.

Selection for specimens to study

When the fingerlings were approximately from 0.2g to 0.29g in weight and 3.1cm to 4.3cm in standard length, a total of 90 healthy looking fingerlings were selected and used throughout the course of the experiment.

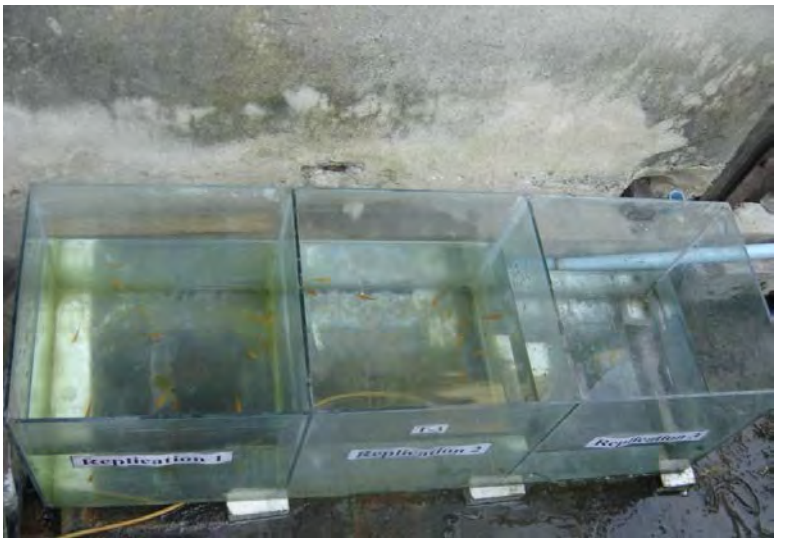
Feeding

The fingerlings were fed with live food (*Tubifex*) at least 5days per week and supplemented with commercial small pellets in other days. Feeding was made twice a day, one in the morning 7:00am and another in the evening 5:00pm. The food was provided to the 5% of the total body weight.

Procedure of the experiment

The fingerlings were divided into three groups of 5, 10 and 15 per group and each group kept in a glass aquarium (Plate 1). Each aquarium was filled with 50Liter of water.

Plate 1. *Xiphophorus helleri* fingerlings were kept in same size of glass aquarium.



Each aquarium of 50L capacity was covered with the size of 90cm x 30cm mosquito net to prevent the fish jumping out of water. All aquaria were kept in the same room so as to alleviate the effects environmental variable. About half of water with faeces and uneaten food were siphoned off and refilled with tap water in three days per week. Three replicate tanks were made for each stocking density.

Data collection

The total weight of each group was taken on a monthly basis. The mean body weights for each group were then calculated. A daily check was made of the general conditions of each fish of each group. Number of fishes in each tank was checked every day to know the mortality and survival rate.

Statistical analysis

Differences of means among months, monthly mean body weight were compared statistically student's "t" test of SPSS software version 11.5.

Comparison of mean body weight of three groups and differences of body weight among the different months of each group were analyzed by the ‘t’ test.

The effective volume medium available for an individual is calculated according to Gromko *et al.* (1973). The total volume refers to the whole volume of water made available for all the fish. The effective volume is calculated as

$$\text{The effective volume} = \frac{\text{The volume in liter}}{\text{Number of fish}}$$

Calculation of growth

In this work, absolute growth and its rate were calculated following Ricker (1979) as

$$\text{Absolute Growth (AG)} = Y_2 - Y_1$$

$$\text{Absolute Growth Rate (AGR)} = (Y_2 - Y_1)\ (t_2 - t_1)$$

Where, Y_1 and t_1 are initial weight and initial time respectively. The absolute growth rate (AGR) is expressed as percentage.

Result

Allocation of fish to three different groups is given in Table 1, and the monthly means of body weight in Table 2.

Table 1. Allocation of fish in different groups.

Group number	Number of fish	Total volume	Effective volume
I	5	50	10.00
II	10	50	5.00
III	15	50	3.33

Food was provided at the rate of total weight of 5%. Rearing medium was 50 liter of water; faeces and uneaten food were siphoned off.

Table 2. Monthly mean body weight of *Xiphophorus helleri* under three different population density in July to December 2010. Group I consists of 5, II of 10, III of 15 individuals.

Months	Body weight (g)		
	Group I	Group II	Group III
July	0.23	0.25	0.21
August	0.50	0.31	0.22
September	0.57	0.31	0.24
October	0.79	0.34	0.30
November	0.81	0.40	0.36
December	0.84	0.41	0.40
Mean ± SD	0.62 ± 0.24	0.34 ± 0.06	0.29 ± 0.08

No mortality was observed in all density groups to end of experiment. The mean body weight increases were 0.62, 0.34 and 0.29g from Group I to III. Absolute growth showed highest in Group I individuals, followed in descending order by Group II to III (Table 3, Fig 4).

Table 3. Absolute growth and absolute growth rate of fingerling *Xiphophorus helleri* under different population density from July to December 2010.

Month	Group I			Group II			Group III		
	BW	AG	AGR	BW	AG	AGR	BW	AG	AGR
July	0.23			0.25			0.21		
August	0.50	0.27	0.09	0.31	0.06	0.20	0.22	0.01	0.03
September	0.57	0.07	0.23	0.32	0.01	0.03	0.24	0.02	0.07
October	0.79	0.22	0.73	0.34	0.02	0.07	0.30	0.06	0.20
November	0.81	0.02	0.07	0.40	0.06	0.20	0.36	0.06	0.20
December	0.84	0.03	0.10	0.43	0.03	0.10	0.38	0.02	0.07
Mean ±SD	0.62 ±0.24	0.12 ±0.12	0.41 ±0.28	0.34 ±0.06	0.04 ±0.02	0.12 ±0.08	0.29 ±0.08	0.03 ±0.02	0.11 ±0.08

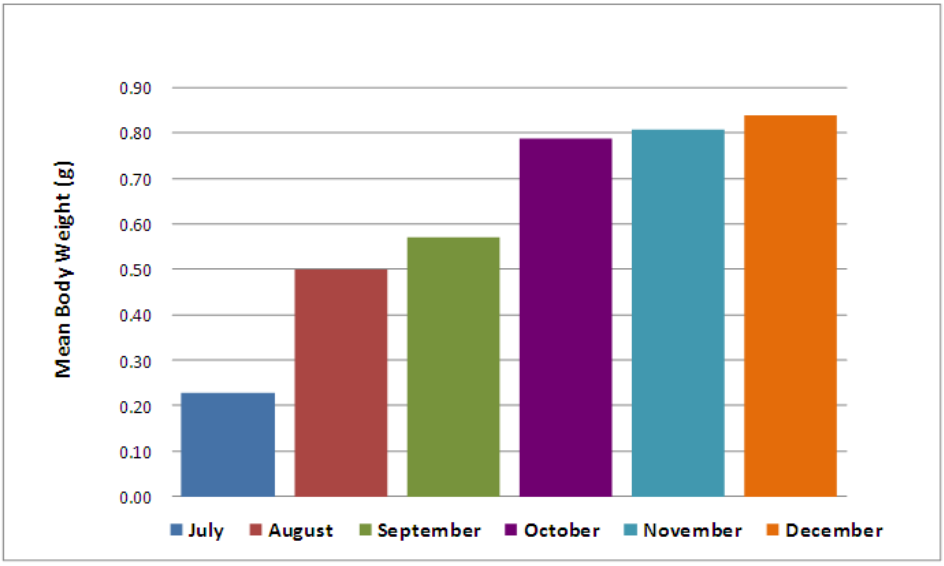


Figure 1. Comparison of mean body weight of Group I from July- December

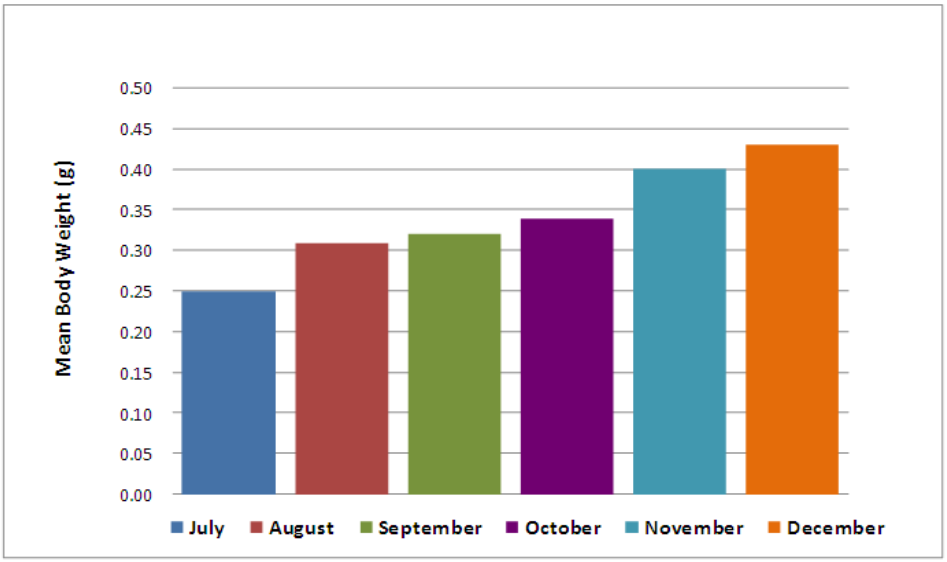


Figure 2. Comparison of mean body weight of Group II from July-December

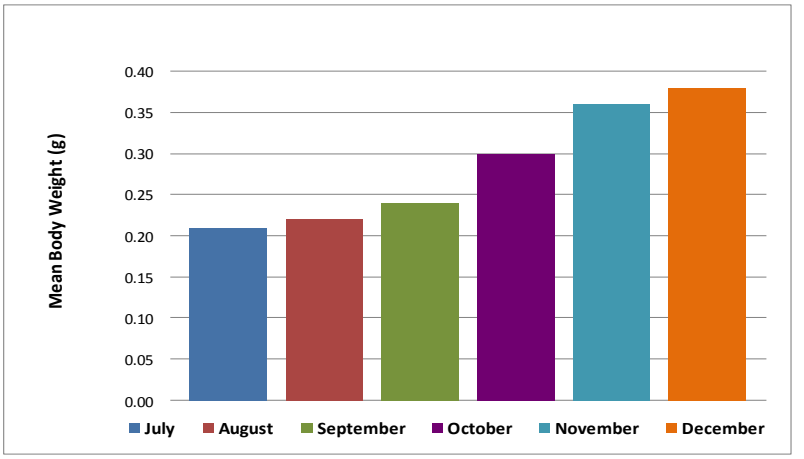


Figure 3. Comparison of mean body weight of Group III from July – December

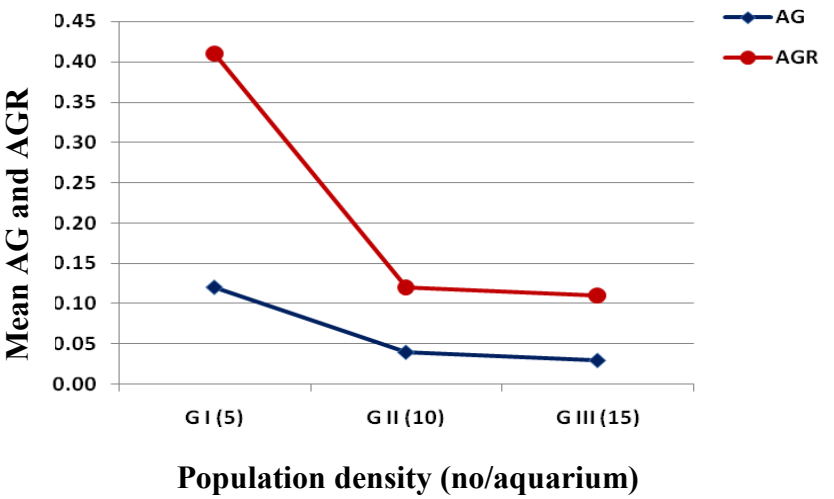


Figure 4. Monthly mean absolute growth and absolute growth rates in weight of fingerling *Xiphophorus helleri* for G I, G II and G III.

Discussions

Discussion is made on the basis of increase in body weight taken for six months by different density on *Xiphophorus helleri*. The present work takes six months from July to December 2010.

Survival of all individuals in three different density groups indicated that all the fingerling reflected their healthy and fit condition. Therefore, the survival rates of entire experiment were 100% for all groups. Fifty liters of diffusible volume of water which works to be 3.3 (50/15) liters for each in Group III of 15 fingerlings did not seem to have any detrimental effect on the health of fish but did have on the growth rate. The careful handling of each in taking monthly measures of weight and covering of the containers with a mosquito net pieces to prevent jumping out could also have contributed to such a good survival rate.

The mean absolute growth rates in weight for three density groups of 5, 10, 15 were 0.41g, 0.12g and 0.11g respectively (Table 3). Comparison of the monthly weight gained between the density Group I and II showed a difference of 0.29% and Group I and III of 0.30% in favour of the former.

Absolute growth in weight of three different density groups revealed a line graph (Fig. 4).

Absolute growth rate declined imperceptibly from Group I to II and II to III, it declined drastically (Table. 3, Fig. 4). This was the result of decrease in absolute growth which, when calculated on per month based on the mean value for six months. The same trend has been noted by Kay Thi Myint (2002), where treatment group of three fries increased drastically, but the remaining groups of 6, 9, 12 and 15 the growth were less spectacular.

This decline in weight with increase in population size in a similar volume of water is due to density factor Khin Ma Ma (1995) did not report mortality in fingerling *Labeo rohita* under different densities. The crowding effect on the growth and development of *Bufo melanostictus* tadpoles under different population densities have been observed by Tin Hlaing (1988). In this work lower growth rates and higher mortality were observed among high population densities. In the present work, no mortality occurred in any group throughout the study period, but growth rates were different among three groups of unequal population sizes.

Shubha and Reddy (2011) express that they observed 100% survivability in lowest stocking density and the rate steadily decreased with

increased in stocking density at three other aquariums. They also recorded; daily growth of fish is increase in lowest stocking density.

Huang et al. (2002) reported that the highest size variation does not occur in the high stocking densities of the common carp fry and at a high stocking densities the growth and survival of that fish is low in the experiment of randomly selected and stocked in six aquariums at densities of 6, 12, 24, 48, 96, 192 fry per water volume 30 liter tank. He also suggested that the growth and survival of the fish is reasonable in the median stocking densities, though the size variation is high and the potential for limiting growth is greater when stocking density is higher and vice versa.

Conclusion

In the present experiment, there is no mortality rate in three different densities and the growth rate is decrease when the stocking density is increase in Group I, II, and III respectively.

In the present work, it could be concluded that crowding factor or variation in population size has exerted on the growth fingerling *Xiphophorus helle*ri (swordtail).

Acknowledgement

The authors are grateful to the Dr. Tin Maung Hla (Rector), Mandalay University of Distance Education.

References

Gromko, M. H, F. S (1973). Analysis of Crowding Effect in *Rana pipien* tadpoles. J. Mason and S. J. Smith-Gill Exp. Zoo. 186 (1) 63-72.

Hill, J. E. and R. P. E. Yanong (2002). Freshwater Ornamental Fish Commonly Culture in Florida. Circular 54, Department of Fisheries and Aquatic Sciences, University of Florida.

Huang, W. B., Y. C. Lin and T. S. Chiu (2002) Effects of Stocking Density on Growth, Survival, Production, and Size Variation of the Common Carp *Cyprinus carpio* Linnaeus (1758) fry within Aquariums. J. Fish. Soc. Taiwan, 30 (1): pp 29-41.

Kay Thi Myint (2002). Effects of Density Factor on the Growth of *Labeo rohita* fingerling. M. Res. Thesis. University of Mandalay.

Khin Ma Ma (1995). Crowding Effect on the Survival and Growth in the larval *Tilapia mossambica*. M. Sc. Thesis. University of Mandalay.

Lagler, K. F., J. E. Bardach and R. R. Miller (1962) Ichthyology. John Wiley & Sons Publication, Inc, New York, USA. 545pp.

Ricker, W. E (1979). Growth Rates and Models. In W. S. Hoar, J. D. Randall, and J. R.Bretts (Eds). Fish Physiology. Vol. III. Academic Press. New York. pp 677-743.

Shubha, M. and S. R. Reddy (2011) Effect of stocking density on growth, maturity, fecundity, reproductive behaviour and fry production in the mouth brooding cichlid *Oreochromis mossambicus* (Peters). African Journal of Biotechnology Vol. 10(48), pp.9922-9930.

Tamaru, C. S., B. Cole, R. Bailey and C. Brown. (2001). A Manual for Commercial Production of the Swordtail *Xiphophorus helleri*. Center for Tropical and Subtropical Aquaculture. 38pp.

Tin Hlaing (1988). Crowding Effect on the Development of *Bufo melanostictus* tadpoles. M. Sc. Thesis. University of Mandalay.