

MATING BEHAVIOUR, GROWTH AND DEVELOPMENT OF MULTIPLE VISUAL PIGMENTS UNDER DIFFERENT PREDATOR LEVELS IN GUPPIES (*Poecilia reticulata*)

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Abstract: Ability to change colour is used by fish for many kinds of signals in many different social and environmental settings. Change in colouration patterns themselves have been subject to both natural and sexual selection. Guppies (*Poecilia reticulata*) have been an important fish system for examining the anti-predatory behaviour. Guppies are popular ornamental fishes all over the world due to its bright colours and cheap maintenance cost in aquarium. Under predation effect colouration of guppies were affected. To study huddles coming due to predation effect for the development of colours and growth in guppies following experiment was carried out under which three sets of conditions were maintained. Absence of predation, mild predation and high predation effects were maintained during experiment to check the mating behaviour, growth and colour development in new born guppies. The results indicated that the predation was found to have a profound effect on mating behaviour, colour development and growth.

Keywords: Predation, Colour development, Growth rate, Brightness, Guppy.

I. INTRODUCTION

In ecology, predation describes a biological interaction where a predator (an organism that is hunting) feeds on its prey (the organism that is attacked). Predators may or may not kill their prey prior to feeding on them, but the act of predation always results in the death of its prey and the eventual absorption of the prey's tissue through consumption. Thus predation is a power selective force, contributing significantly to mortality in many ecological systems i.e., individuals, populations and communities. Anti-predator defences have been shown to have a strong genetic basis across a wide range of taxa. When predation risk varies temporally or spatially it may be adaptive for prey organisms to phenotypically respond to changes in the environment to avoid incurring such costs where unnecessary. Guppies have been widely used to examine in relating to predation effect because this species exhibits great polymorphism in colour among geographically isolated populations. Earlier studies have been focused on experiments in which the tanks were divided in two equal or unequal parts. In one part of tank predator was kept and in other half of tank guppies were kept to study the foraging posture of prey, schooling behaviour, and inspection behaviour of prey for 10 to 20 minutes (Magurran and Seghers 1994). Few studies have also been carried out to check the predation effect for natural population of guppies at places with relatively innocuous predators to places where a large proportion of the predator's diet is guppies. These guppies reduce number of colour spots, change in their mating pattern. Long term effect of predation on mating behaviour, growth and colour patter of guppies has not been studied till now. This is the first direct experiment under which courting behaviour, colour pattern and growth of guppy fishes were observed with effect of variation in degree of predation.

II. MATERIAL AND METHODS

Wild guppies were collected from Mumbai region and allowed to breed under laboratory conditions in a glass aquaria (24×12×15) having water temperature at 26°C-28°C ± 1°C and pH at 7.5. Newly born guppies were reared in mixed aquarium till colour developed on male's body and females was distinguished from males. Male and female guppies were transferred in the ratio of 2: 1 in tank I, II and IV and predator fish in tank III for acclimatization. All the tanks were kept together without keeping any space between them. Tank I were no predation effect was given act as a control level, tank II were predation tank was at its one side and on other side guppy tank was kept i.e., mild predation tank and tank III were predator tank was on one side and aerial predator was hanging on its surface i.e., under high predation. In tank III (predator's tank) were sharks and carps was kept. Following observations was observed under the predation affect: courting strategy was observed daily in morning and evening hours for 10 minutes, colour pattern was checked after every month till they stop developing colour spots. Growth rate was checked for male and female after every twenty days.

III. RESULTS

Courting behaviour, colour pattern and growth of guppy fishes were observed as moving from tank I, II and IV i.e., no predation to high predation.

Courting strategy under no predation, low predation and high predation effect in guppies:

Courting strategy always altered with the presence of predation. All the tanks were observed individually for 10 minutes daily in morning and evening hours. It was calculated that how many time males make mating attempt towards female in 10 minutes during morning and evening hours. Mean for mating attempts was taken to plot the graph as shown in figure 1.

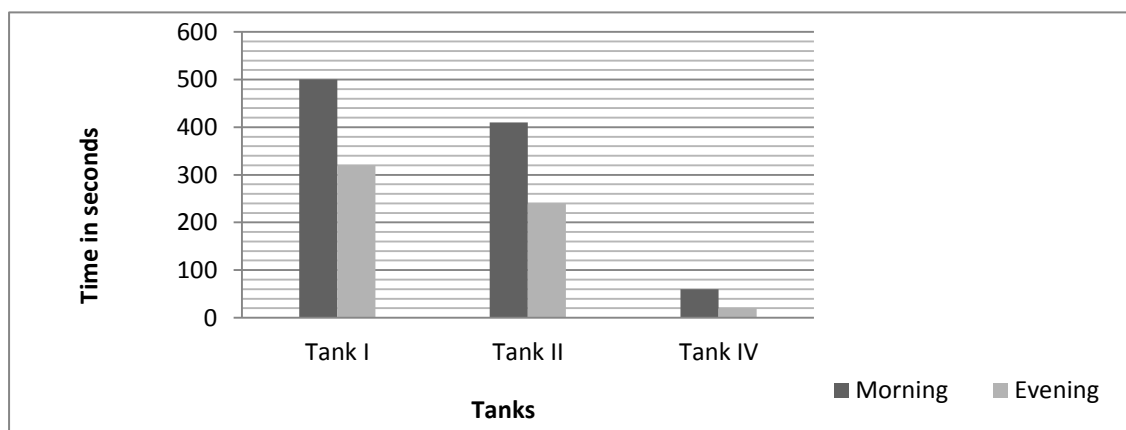


Figure 1 represents the time spends by males of three tanks in courting the females in morning and evening hours.

During evening hours there was reduction in courtship displays. Tank I faces no predation threat and male's courting behaviour was not altered. Most of the time males remain busy in courting the females by performing sigmoidal display. In 10 minutes of observation males mostly do sigmoid displays but sometimes perform forced copulation 2 to 3 times i.e., "sneaky copulation". In tank II where there was predation effect at a distance, males courting behaviour was little bit altered as compared to tank I. Males spend less time in courting the female. In tank IV, males hardly spend time in courting the females and it was negligible in evening hours.

Body Colour Pattern:

Males and females body colour pattern were varying among all the three tanks. Orange colour was most dominating colour among all colours present on male's body. Initially all the males were olive grey black in colour with one small orange spot and one small black spot on their body and the females were dark olive-grey black in colour. Colour pattern of female guppies were not varying to some extent in all the three tanks. Tank I fishes were devoid of predator effect, body colour pattern of fishes vary greatly with increase in number of colour spots on males body along on its tail. With course of time these colour spots increases in number and in area wise also. Some males show fully orange tail or orange colour spot or yellow black spot or orange with black spots or orange with iridescent colours. Orange colour constituted

more than 60 % among all colours, other colour were yellow, black and some mixed iridescent colours violet and blue. 1 or 2 yellow spots and 4 to 6 black spots were present on male's body. After four month size of these spots were found to increase but numbers of these spots remain constant as in figure 2.

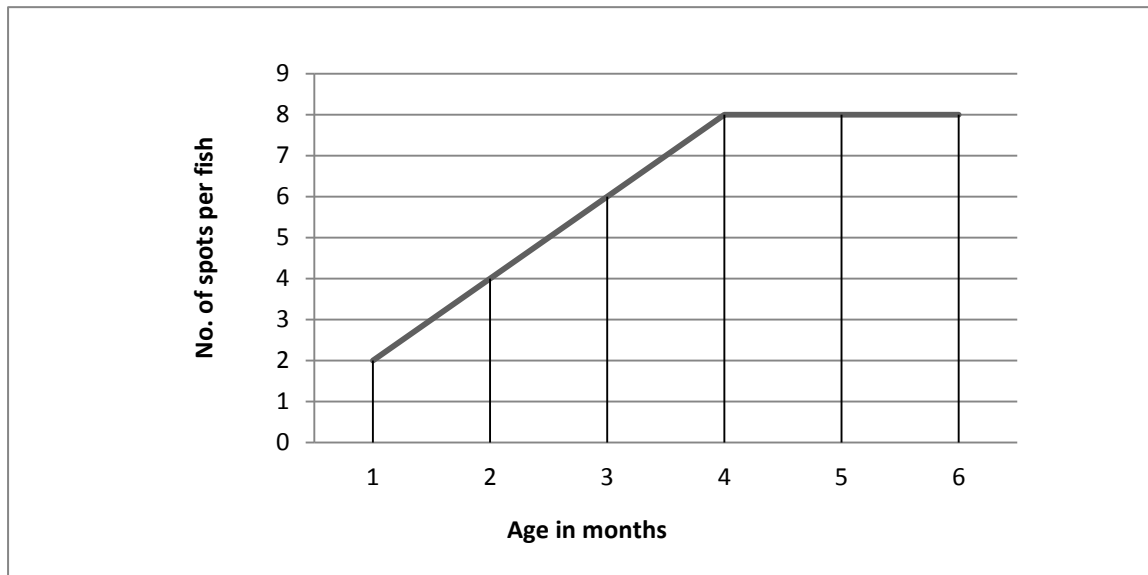


Figure 2 represents development of colour spots increases in tank I males with respect to time in months.

Tank II colour pattern of males varied from other tanks of males with respect to colour intensity and number of spots due to the presence of predation at a distance. Orange colour constitutes less than 40% of total surface area of male's body. 2 to 4 black spots were present, some show presence of single yellow spot, iridescent colour appears as tinge and total numbers of spots were show in figure 3.

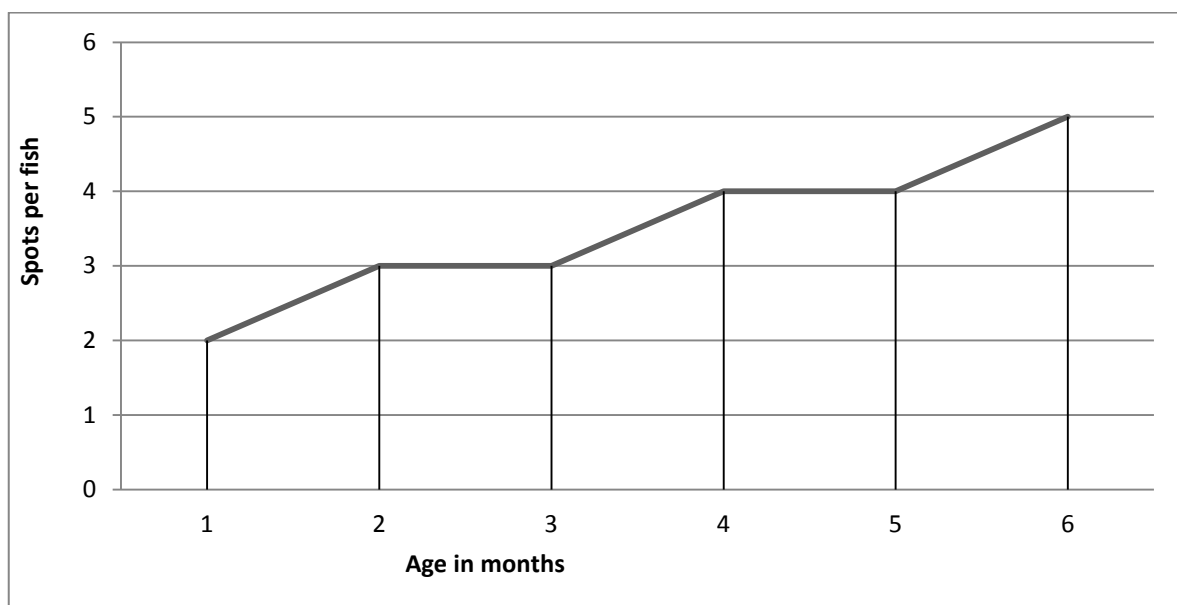


Figure 3 represents males colour development in tank II with respect to time in months.

Brightness of colours on male's body was also less intense as compared to tank I male's body colour. Movement of fishes were bit restricted as predation tank was at distance. Tank IV fishes showed greater variation in colour pattern with very much restricted in their movements. Colour intensity was greatly reduced. One small less intense orange spot with light black spot was present. Males were olive off grey in colour, due to presence of two predation regimes. Number of colour spots was less as shown in figure 4.

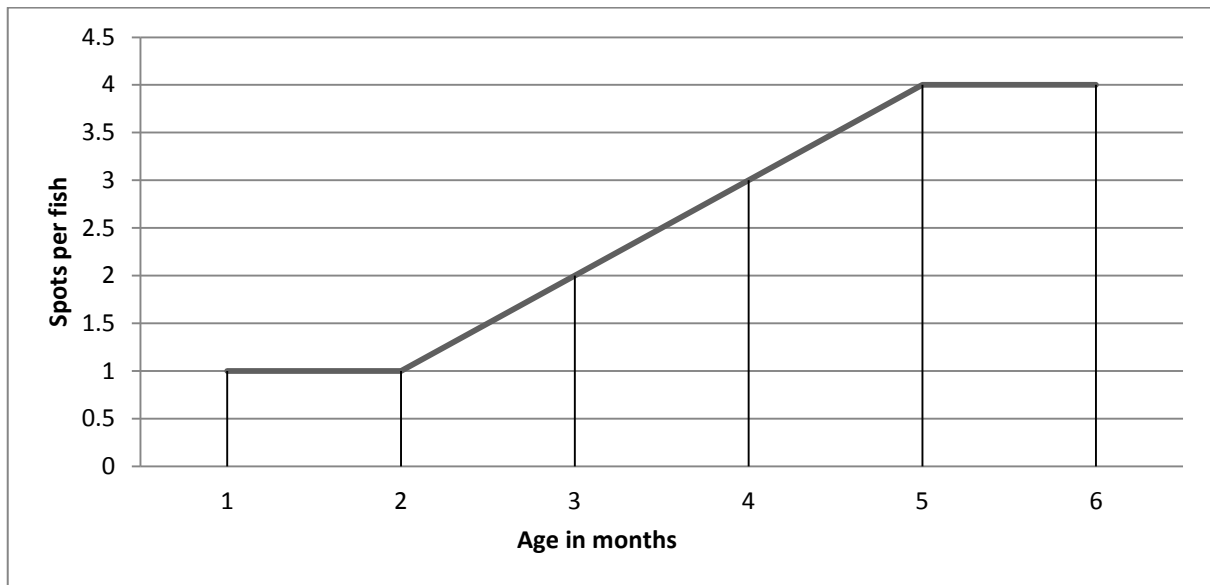


Figure 4 shows development of colours in males of tank IV with respect to time in months.

Growth Rate:

Growth rate was observed by measuring the length of guppies in centimetre. Growth was varying as the effect of predation was varying, growth rate was found to be inversely proportional to predation i.e., growth rate was increasing as effect of predation was decreasing. Growths of newly born fishes were measured under three sets of above said conditions after every 15 days. Figure 5 shows the maximum measurement of growth of male and female guppies present in tank I. Length attained by females after 120 days was 3.4 cm in length where as in male's length attained after 120 days was 2.9 cm.

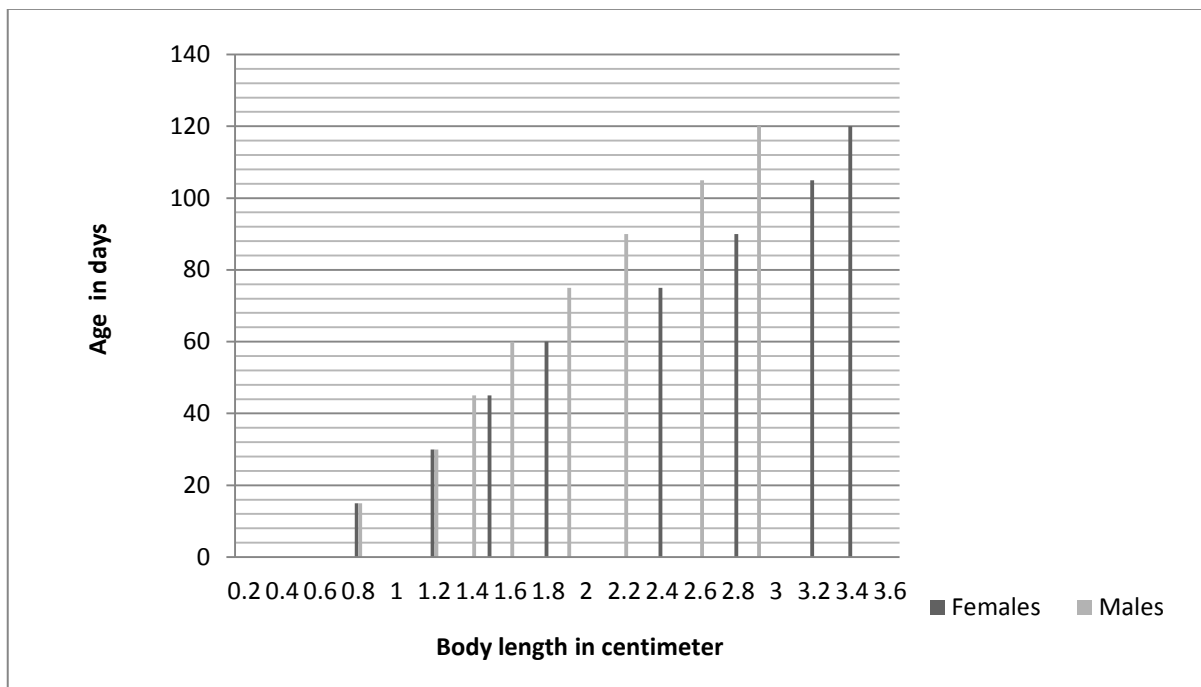


Figure 5 represents body length attained by females and males in tank I with respect to time in days.

Double growth rate of fishes were observed after every 15 days 0.2 to 0.4cm. Tank II (figure 6) shows decrease in body length than tank I guppies, as female's attained maximum length 2.7 cm and males attain 2.1 cm after 120 days and growth rate varied from 0.2 to 0.3cm. Retarded growth was observed in tank IV fishes (figure 7) as females attain maximum length of 2.2 cm and males attain 2cm after 120 days and fish's growth was 0.1 to 0.2cm in length.

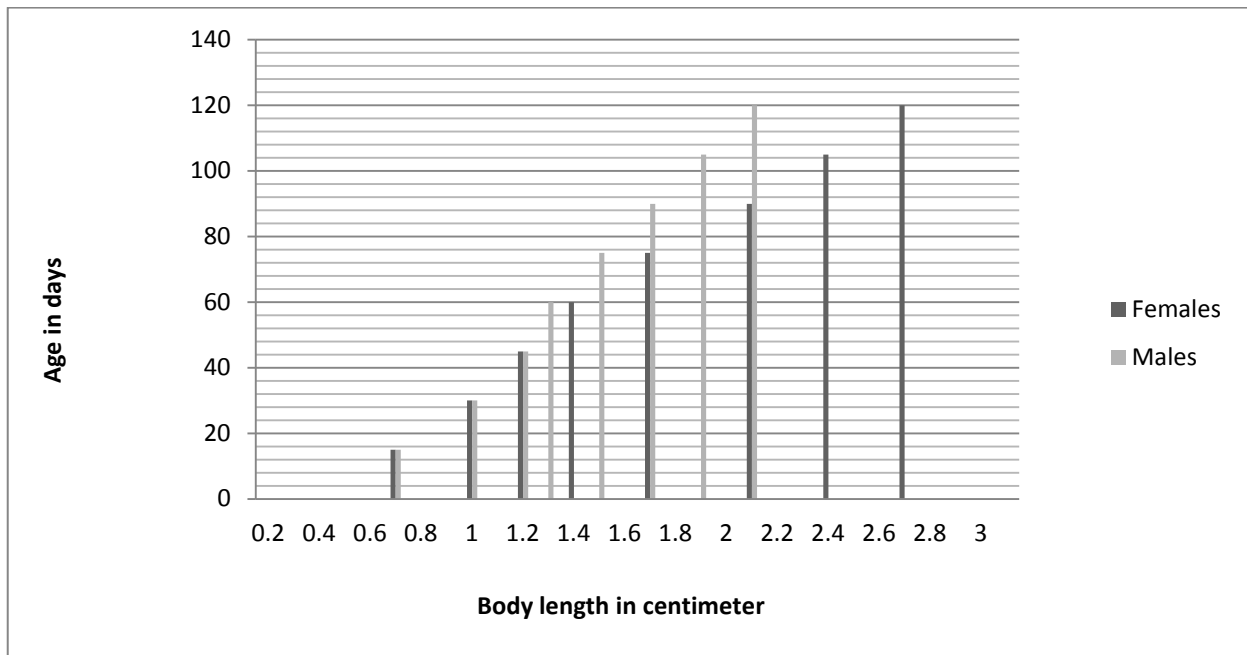


Figure 6 shows body length attained by females and males in tank II with respect time in days.

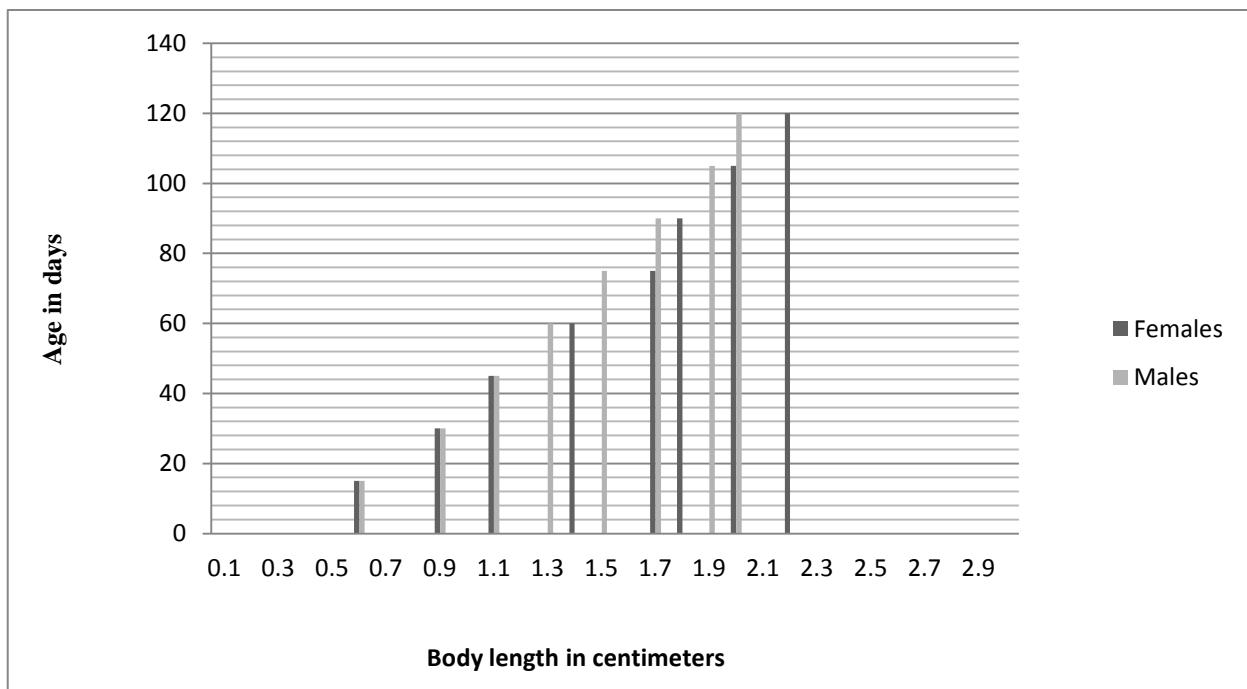


Figure 7 represents body length attained by females and males in tank IV with respect to time in days.

IV. DISCUSSION

Guppies respond strongly to a predator effect and used different behavioural response. Guppy male change their mating tact's in response to environmental factors such as predation risk, parasite load, operational sex ratio, population density, male age, male body size, female receptive and light intensity. Courtship activity peaks at dawn and dusk when light is relatively rich in short and long wave length in all the three tanks, similar results were observed by Farr, (1975). Male's frequency for sigmoid display was decreasing as predation effect was increasing i.e., from tank I (no predation) to tank IV (high predation). Dill et al, (1999) demonstrated that mating activity was depressed by exposure to a predator and showed a lower frequency of courting and mating behaviours (sigmoid displays and thrusts) after predation exposure. Templeton

and Shriner (2003), observed fish from the high-risk streams spend more time inspecting the potential predator than did fish from the low-risk stream.

Coloured spots and spot size is reduced with increasing predation effect because a small spot will not be as visible to predator, as a large spot at the same distance, especially if the spots are near the limit of the predator visual acuity. Bright colourations in male guppies thus appear to be an honest indicator trait of their quality, and female guppies generally tend to prefer to mate with brightly coloured males than with drabber one. Reznick (1982) guppies produce relatively large offspring as predator ate predominantly small guppies and guppies mature early under predation threat. Reznick and Endler (1982) concluded that the growth of fishes was reduced under high-predation Rivers. Similar type of result was observed by (Endler 1978), where growth is reduced with increasing predation. Based on the available literature and the results of this experiment it is clear that the mating behaviour, colour pattern and growth of guppies were affected in presence of predation. It is advisable that not to keep guppies along with the other fishes like shark, carp and also near by the tanks which will decrease the ornamentation of guppies.

REFERENCES

- [1] L. M. Dill, , A. V. Hedrick and Fraser, A, "Male matting strategies under predation risk: do females call the shots," Behav Ecol, vol 10 no 4, pp 452-461, 1999.
- [2] J.A. Endler, "A predators view of animal colour patterns", Evol Biol, vol 11, pp 319-364, 1978.
- [3] J. A. Farr, "The role of predation in the evolution of social behaviour of natural populations of the guppy *Poecilia reticulata*", Evolution, vol 29, pp 151-158, 1975.
- [4] E Houde, Sex, colour, and mate choice in guppies. Princeton University Press, 1997.
- [5] Magurran and B. H. Seghers, "Sexual conflicts as a consequence of ecology: evidence from guppy, *Poecilia reticulata*, populations in Trinidad", Behaviour, vol 118, pp 214-234. 1994.
- [6] D, Reznick and J. A. Endler, "The impact of predation on the life history evolution in Trinidadian guppies (*Poecilia reticulata*)", Evolution, vol 36, pp 160-177, 1982.
- [7] N. Templeton and W. M. Shriner, "Multiple selection pressure influence Trinidadian guppy (*Poecilia reticulata*) antipredator behaviour", Bahav Eco, vol 1, no 4, pp 673-678, 2003.