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Research Article

Effect of Isolation Period in the Aggressive Behavior of *Trichogaster lalius* (Hamilton)

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Abstract: Aggression is a key component of the behavioral repertoire of animals that impacts on their Darwinian fitness. Anabantid fishes are excellent model for comparative ethological studies for several physiological and behavioral reasons. We tested the effect of isolation period on the aggressiveness of an anabantid fish *Trichogaster lalius*. A pair of male fishes were placed in an aquarium (12″x 9″x 9″), isolated by a removable opaque partition. The fishes were of comparable size and weight (varying not more than 10 % in weight). Chemical conditions of all aquaria were similar (temperature 30-32^{o}C; pH 6.8-7.1; dissolved oxygen content 5.5-6.2 ppm). After 5, 10, 15 and 20 days the opaque partition was removed and the fishes were left to interact for 30 minutes. The aggressive drive was analyzed by different agonistic display. Total duration, latency of orientation and mouth biting increased with the increased period of isolation. But lateral spread, circling, chasing and air gulping decreased with the increased period of isolation. This study showed that long-term social isolation though increased total duration of aggressiveness but except mouth biting all other aggressive motor patterns decreased in *Trichogaster lalius*.
Keywords: Aggressive behavior, *Trichogaster lalius*, agonistic display, anabantid fish

INTRODUCTION

Within group living or colonial animals, to be successful individuals need to know specific details about their environment and their status relative to other individuals. Animals gain such information either directly through interactions, or indirectly through observation [1].

Aggressive interactions are part of the social behavior of animals and are a route to successful competition for limited resources. Aggression is defined as threats or harmful actions directed toward another individual. In animals, aggressive behaviors are a means of communication. Animals use aggressive displays, threats and attacks to resolve competitive disputes over resources (territory, food) or to increase their reproductive potential. Aggression serves various adaptive functions, such as the establishment of dominance relationships and hierarchis and the competition for key resources such as food, shelter, or mates and territories [2], and therefore plays a major role in Darwinian fitness. Development of a stable and peaceful dominance hierarchy benefits everyone because fighting is energetically costly, potentially injurious and therefore not to be done on a regular basis. However, it goes without saying that the low-ranking subordinates are not necessarily living the happiest existence. Their access to food is limited, so their growth rate is slower than that of dominants [3-5]. Several variables can affect aggressive drive in fishes, such as prior residence [6], dominance or subordination experience [7], levels of androgens [8] and social isolation [9]. With regard to the latter factor, there are diverse effects depending on the species, isolation period and other social organization-related factors.

Fishes are very excellent model to study ethology because of their well visible constructive behavior, simple and few highly stereotype motor patterns and can easily be maintained in the laboratory. Ethological studies of fish behavior are limited to only a few groups, namely on Gasterosteus (Sticklebacks), cichlids, catfish, siamese fighting fish, zebrafish, centrarchid, cyprinodontidae, salmonids [10-15]. But there are few studies on the ethology of anabantid fishes. Anabantid fishes are excellent model for comparative ethological studies for several physiological and behavioral reasons. The 16 known genera contain about 50 species distributed throughout most of the southern Asia, India and Central Africa. Pal and Southwick [16] studied the reproductive behavior of the Indian spike-tailed paradise fish, *Macropodus cupanus*, an anabantid fish. Pal and Pal [17-18] studied the aggressive and reproductive behavior of climbing perch, *Anabas testudineus*, also an anabantid fish. Mandal & Nandi [19] studied the effect of isolation period in the aggressive behavior of *Trichogaster fasciata*.

Trichogaster lalius is commonly called "Lal Kholisa", attained a maximum length of about 2 inches. The fishes inhibits slow moving streams, rivulets and lakes with plenty of vegetation. It showed sexual dimorphism. Males are more brilliantly coloured than females-vertically banded with scarlet and light blue, half of each scale being of either colour. The aim of our present study was to see whether the increase period of isolation increase the aggressive behavior of *Trichogaster lalius* or follow the same aggressive behavior as observed by Mandal & Nandi [19] in *Trichogaster fasciata*.

MATERIALS AND METHODS

Trichogaster lalius were collected from the local water bodies of Malda district of West Bengal and transferred to the laboratory, where they were acclimatized prior to our study. Only male fishes were used in the experiment to avoid variability in social interactions due to sexual bias. After acclimatization a pair of fishes were placed in an aquarium (12″x 9″x 9″), isolated by a removable opaque partition. The fishes were of comparable size and weight (varying not more than 10 % in weight). Chemical conditions of all aquaria were similar (temperature 30-32^{o}c; pH 6.7-7.2; dissolved oxygen content 5.6-6.2 ppm and the photoperiod was 12 L : 12 D). After 5, 10, 15 and 20 days the opaque partition was removed and the fishes were left to interact for 30 minutes, a duration that exceeded the necessary time to determine a clean winner of the contest. After each interaction, the fish were separated again by placing back the partition. The following agonistic display was observed according to the ethogram presented in Table 1, in our present work. We have presented frontal display in the form of latency of orientation. It is the time taken by the fishes to perform frontal display after removal of the partition. The experiment was repeated five times and data were analyzed by ANOVA at $\leq$0.01 for statistical significance test.

Table 1: Ethogram of aggressive behavior of *Trichogaster lalius* during dyadic interaction

Behavioral Pattern	Description
Frontal Displays	After removal of the partition the fishes oriented and moved forward towards each other with erects dorsal and anal fins and flares its body flank toward the opponent. During that the colour of the fishes becomes darker. Generally both the fishes touched each other with their filiform pelvic fins. In our experiment latency to orientation was observe. It is the time taken for frontal display after removal of partition.
Circling	Two fish approach one another in opposite directions and with erected fins, and in an antiparallel position circle each other usually ascending in the water column. It can last from a few seconds to minutes.
Lateral Spread	In lateral spread both the fish oriented side by side with their all fins in stretched condition, mouth may remain open or close. The fish undulated their tail vigorously (tail beating), moved forward and surpassed each other. Generally in most of the time fish engaged in tail beating in anti parallel orientation i.e. with their heads in opposite direction. Occasionally they fought in parallel orientation i.e. with their heads in the same direction.
Mouth Bite	Fish opens and closes its mouth in contact with the body surface of its opponent, usually near the more ventral or posterior parts of the body.
Chase	The fish swims rapidly toward the opponent from a distance with an intention of attack but failed to touch the body of the opponent. During the straight forward thrust the fins (dorsal and anal) remained closed which were stretched on coming closure to its opponent. Mouth remained opened or closed.
Air gulping	It is very common non-aggressive motor pattern. During fighting fishes took 0_2 from the air.

RESULTS AND DISCUSSION

Total duration of fight increased significantly with increasing period of isolation, but the time to latency of orientation increased significantly with increased period of isolation (Table 2). Parallel and anti parallel tail beating decreased significantly with increased period of isolation (Table 2). Circling, chasing and air gulping increase up to 10 days and then decreased between 10 to 15 and 15 to 20 days isolated groups (Table 2). The mean mouth beating scores in different isolate groups increased with increased periods of isolation (Table 2).

Table 2: Effects of isolation period on aggressive behavior of *Trichogaster lalius*. Values are means with SE of 5 experiments.

		D	A	Y	S
		5	10	15	20
	Total Duration (Min.)	6.26± 0.86	8.54±1.48	11.22±1.24	14.62±1.28
	Latency of Orientation(Min.)	1.64±0.46	2.56±0.67	3.62±0.49	4.86±0.58
Lateral Spread	Parallel/minute	1.12±0.14	0.91±0.10	0.76±0.14	0.48±0.09
	Anti Parallel/minute	7.18±1.12	5.94±0.58	4.12±0.23	2.740±0.28
	Circling/minute	0.56±0.16	0.78±0.11	0.48±0.06	0.42±0.05
	Mouth Biting/minute	1.67±0.36	1.90±0.24	2.15±0.36	2.48±0.36
	Chase/minute	0.85±0.12	0.97±0.18	0.72±0.11	0.66±0.10
	Air gulping/minute	1.32±0.26	1.48±0.22	0.94±0.16	0.62±0.08

The effect of increasing period of isolation increased total duration of aggressive behavior. But increased isolation time has a negative effect on the initiation of aggressive motor pattern. As a result latency of orientation increased with the increased of isolation period. Among the different aggressive motor patterns, only mouth biting increased with the increased period of isolation. Other aggressive and non aggressive motor patterns like tail beating, circling, chasing and air gulping increased up to 10 days and then decreased.

Pal [20] reported increased aggressive activities with increased period of isolation in *Macropodus cupanus.* Frank and Wilhelmi [21] found an increase in the duration of fighting and modification of the agonistic profile in *Xiphophorus helleri* after 14 days of isolation. However, after longer isolation (4 weeks), Frank *et al.* [22] recorded a reduction in the aggressive motivation in the same species. Hinkel and Maier [23] found increased aggressiveness in *Betta splendens* only after 72 hrs. of social deprivation. They also found a reduction of the latency for attacks and an increase in the time spent on attacks against the fishes mirror image. Cichilid fishes can also display varied responses. In *Haplochromis burtoni,* for example, social isolation increases aggressiveness over short periods, but these effects diminished over longer periods [24]. Moreover, the angelfish, *Pterophylum scalare,* does not alter its aggressiveness when isolated for short periods [25]. This theme was revised by Gomez-Laplaza and Morgan [9] for teleost fishes. Mandal & Nandi [19] observed that increase period of isolation, increase aggressive motor patterns in *Trichogaster fasciata* up to 10 days of isolation and then decrease. Thus *Trichogaster lalius* showed similar pattern of aggressive behavior as showed by *Trichogaster fasciata.*

Lorenz's theory of 'Specific Action Potentials' states that isolation would have a tendency to lower the threshold for the Stimuli effective in releasing a particular activity and would serve to accentuate the activity. Thus in this study one might expect that with longer period of isolation the aggressive behavior would increase and the threshold to different aggressive activities would decrease. Result of our study showed that one aggressive motor pattern i.e. mouth biting increased with increases period of isolation, but no decrease in the latency to aggressive motor patterns is seen in *Trichogaster lalius.*

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