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Predatory effect of Cat fish (*Clarias batrachus)* on small carp species

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ABSTRACT

The present work deals with the effect of predatory behaviour of *Clarias batrachus* (Linnaeus, 1758) on small carp species (*Labeo rohita*, *Cirrhinus mrigala*, *Catla catla*, *Hypophthalmichthys molitrix* etc.). Three experiments were conducted in the laboratory condition and two aquariums were used for each experiment. To observe the predatory effect of *C. batrachus* on small carp species each experiment were set with treatment-I and treatment-II. The supplementary feed was provided for the treatment-I and supplementary feed was not provided for treatment-II. Different size of *C. batrachus* such as fingerling, adult size and large size are used as predators in the experiment-1, experiment-2 and experiment-3 respectively and different stages of carp species fry such as hatchling, early fry, fry, advanced fry and fingerling are used as preys in each experiment. At the end of the study the result was found to be varied among the experiments. In experiment-1, the highest predation rate of fingerling of *C. batrachus* on hatchling and early fry were 95 and 92.5% respectively during treatment-II. The lowest predation rate was on fry (10, 20%), advanced fry (0, 0%) and fingerling (0, 0%) of carp species in both treatment-I and II respectively. The highest rate of predation by adult size of *C. batrachus* on hatchling, early fry and fry were 92.50, 97.50 and 80% respectively in treatment-II during experiment-2. The lowest predation rate was found on advanced fry (5, 10%) and fingerling (0, 0%) both treatment-I and II during experiment-2. In experiment-3, predation rate of large size of *C. batrachus* on hatching, early fry and fry were 85, 90 and 95% respectively in treatment-II, which were not provided supplementary feed whereas in case of providing supplementary feed 67.5, 60 and 65% predation rate were found. The lowest predation rate of large *C. batrachus* on fingerling of carp species was nil both treatment-I and II. In case of the study we observed that the supplied feed can justly keep down of predation rate of *C. batrachus*.

Introduction

In Bangladesh the fisheries sector employs over 2 million people. Total fishermen 1280000 of which 770,000 are of inland fishermen and 510,000 of marine fishermen. Moreover 12 million people are engaged in part time fishing profession to supplement their income (DoF, 2008).

Culture of swamps, ditches, depression, sewage fed canals can most easily be done with the freshwater catfishes. Catfish species like *Clarias batrachus* can well thrive in foul water with low dissolved oxygen content, high ammonia and hydrogen sulfide levels (Jhingran, 1983). *Clarias batrachus* is a commercially important air breathing catfish which is done of the high ranking valuable fishes of Bangladesh. Bangladesh has vast lands of swampy area. So, this species has a good prospect of culturing in our country.

The total catch of catfish in Bangladesh in 35981 MT per year, which in 8.34% of the total catch (DoF, 2007) The catfishes of the families Clariidae can also live in buckets on pots with minimum water due to their air breathing habit for this reason people buy this fish in a larger quantity keep at home in live condition and consume daily. People believe that *Clarias batrachus* have medicinal value for this reason people considered by many as excellent food for the table.

Clarias batrachus us a voracious predator native to south eastern Asia has been introduced in to many places for fish farming walking Catfish as it is commonly known is an opportunistic feeder and can go for month without food. During a drought large numbers of walking catfish may congregate in isolated pools and consume other species. They are known to have invaded as a benthic, nocturnal, lacteal omnivore that consumes detritus and opportunistically for forages on large aquatic insects, tadpoles and fish. This species occurs in fresh, brackish as well as marshy, muddy waters over its native range (Sen, 1985). Inhabits swamps, ponds ditches, rice paddies and pools left in low spots after rivers have been in flood. Usually confined to stagnant, muddy water. Found in medium to large-sized rivers, flooded fields and stagnant water bodies including flowing canal. At present these catfishes are cultured in kitchen ponds and other small water bodies with supplemental feeds. Now in our country they are also widely used as a tropical aquarium fish. So, there is a great chance to contribute a handsome amount of money in our country economy increasing the production of catfish. And catfish like *C. batrachus* an important food fish that is marketed live, fresh and frozen. In the present study the *C.*

batrachus is cultured in aquaria under supplied different carp species fry, for investigation of predatory effect on small carp species, in laboratory condition.

Materials and methods

Investigation of predatory effect of indigenous magur (*Clarias batrachus*) on fry of carp species (*Labeo rohita*, *Cirrhinus mrigala*, *Catla catla*, *Hypophthalmichthys molitrix*) was carried out during June to August 2008.

Experiments

There experiments were carried out to observe the predation of different size of magur on small carp species (Table 1). Experiment 1 was carried out to observe the predatory behavior of fingerlings (9.5 cm weighing 5.8gm) of indigenous magur (*Clarias batrachus*) on small carp species. In experiment-2, the predation of medium size (total length 15 cm weighing 40g) of *Clarias batrachus* was observed on small fry of carp species and in experiment-3, the predation of large size (total length 22 cm weighing 120g) of *Clarias batrachus* was observed on small carp species.

Preparation of aquarium

Two rectangular aquariums (62cm×31cm×31cm) were used for each experiment. The aquarium was set in the laboratory having no mud on the bottom.

A one foot long plastic pipe having two inches radius was also set on the bottom of aquarium for the shelter of the fish. Finally the aquarium was filled with tap water depth 25cm containing 20 liter of water. There is used an aerator supply oxygen in the aquarium.

Collection of specimen

The fry of small carp species that were collected from Rajshahi Govt. hatchery and were used as preys.

Table 1. The fry size weight and age that were used as preys.

Species	Type	Age of fry (days)	Size of fry (mm)	Weight of fry (g)	No. of fry
Carp species (*L. rohita*, *C. catla*, *C. mrigala*, *H. molitrix* etc.)	Hatching	3-5	5-10	0.05 (±0.01)	40
	Early fry	5-10	15-25	0.15 (±0.02)	40
	Fry	15-22	30-40	1.00 (±0.20)	40
	Advanced fry	25-30	41-60	2.50 (±0.50)	40
	Fingerling	35-40	81-100	7.00 (±1.00)	40

Preparation of feed

For the experiment a common feed was selected by the mixture of four food items in a particular ratio (Mustard oilcake 20%, Wheat bran 40%, Flesh of mollusks 20% and Earthworm 20%). The feed was supplied in the aquarium at the rate of 5% of the body weight of fish once a day at 9.30 a.m. for treatment I and in the rest aquarium no feed was provided for treatment II. As the feed was prepared by the author himself, so, there was no scope to calculate the food value. So, FCR was avoided in calculation and analysis.

Treatments

Aquaria were divided into two treatments (Treatment I and Treatment II) having two replications in treatment. Earth worm, flesh of molluscs and supplemental feed were provided as feed for the treatment I and feed was not supplied in treatment II.

Stocking of fishes

The number of predator and preys in each aquarium were 1 and 40 respectively. The initial length and weight of all fishes were recorded individually in centimeter (cm) and gram (g) respectively before releasing them in the aquaria with the help of measuring scale, pan balance and electric balance. Dead fish was replaced by live ones.

Maintenance

The aquaria were supplied with deep tube well water and were monitored daily to observe. The amount of preys consumed by the predator fish. The water quality of the aquaria was also observed. The feeds were supplied as balls in specific corner of the aquaria for treatment I. water was changed at a regular interval to avoid pollution and the aquaria were cleaned and water with wastes was removed by siphoning method at 9 a.m. every day. The aerator was used in both aquaria for better oxygenation.

Collection of data

Total number of predator and prey were recorded in each aquarium. The total weight and total length of the predator fish was recorded. The age, weight and size of the preys were recorded. Initial number of preys and number of preys consumed were recorded. Water quality parameters were also recoded throughout the experimental period and the percent predation was calculated.

Water quality parameters

The water quality parameters like temperature, dissolved oxygen (DO), pH were recorded throughout the experimental period at 10.30 a.m. at 7 days interval.

Result and discussion

Water quality parameters

Water temperature did not vary much rather remained almost similar 30.50 (±1.50)°C throughout the period of experiment in treatment 1 and treatment 2. The dissolve oxygen content of aquarium water did not show much fluctuation and the average value was 6.50 (±0.50) mg/L. The average pH of water of the experimental aquaria was 7.6 (±0.35) which was slightly alkaline (Table-2).

Predatory performance of the fingerling of *Clarias batrachus:*

Earth worm, flesh of Molluscs and supplemental feed were provided as feed for treatment I with preys and there was no feed was provided with preys in the treatment II of all experiments.

In case of experiment- 1, the initial length and weight of predator were 9.5 cm and 5.7 g respectively in treatment–I. Again for treatment-II, the initial length and weight of predator were 9.7 cm and 5.9 g. So, average length and weight of predator were 9.6 cm and 5.8 g for Experiment-1 same type of preys are used in treatment-I and treatment-II. In the treatment-I the consumption no of Hatchling, early fry, fry, advanced fry and fingerling were 27, 24, 30, 5 and 0 respectively. The predation rate on Hatchling, early fry, fry, advance fry and fingerling were 67.5, 60, 65, 12.5 and 0% respectively. The predation rate of fingerling of *C. batrachus* on hatchling was highest 75% and lowest predation rate on fingerling and advance fry both were provided with supplemental feed, flesh of mollusk, earth worm etc. The predation rate of fingerling on carp species during treatment-I is shown in the Table 3.

In case of experiment 2, the adult size/medium size of *Clarias batrachus* are used as a predator and different Carp species fry same as experiment-I are used as preys. The information of predator for experiment 2 is shown in the Table 3. The experiment-2 also separated in two treatments which are treatment-I and treatment-II. Experiment w was continued for a period of 30 days from 1st July to 30th July 2008 in two aquaria in order to observe the predation of Adult size / medium size of *Clarias batrachus* on small carp species such as Hatchling, early fry, fry, Advanced fry and Fingerling of carp species like *Labeo rohita*, *H. molitrix*, *C. mrigala*, *C. catla* etc (Table 1).

Table-2. Water quality parameters of the experimental aquaria during the study period (data with average±SD).

Experiments	Treatment	Temperature (°C)	DO (mg/L)	pH
Experiment-1	I	31.50 (±0.50)	5.25 (±0.25)	7.75(±0.25)
	II	30.50 (±1.50)	6.50 (±0.50)	7.60(±0.35)
Experiment-2	I	32.15 (±0.85)	5.00 (±0.50)	7.80(±0.15)
	II	31.00 (±0.15)	5.50 (±0.50)	8.05(±0.25)
Experiment-3	I	29.85 (±0.15)	5.75 (±0.25)	7.75(±0.25)
	II	27.25 (±0.25)	7.00 (±0.50)	8.25(±0.25)

Table 3. Information about predator for the experiments.

Experiments	Treatment	Type of predator	Total length (cm)	Average total length (cm)	Total weight (g)	Average total weight (g)	No. of predator
Experiment-1	I	Fingerling of *C. batrachus*	9.5	9.6	5.7	5.8	1
	II		9.7		5.9		1
Experiment-2	I	Adult size of *C. batrachus*	16	15	42.5	42	1
	II		14		41.5		1
Experiment-3	I	Large size of *C. batrachus*	21.8	22	119	120	1
	II		22.2		121		1

In the experiment-3, the average length and weight of predator were 22 cm and 120 g for experiment 3 same types of preys were used in treatment-I and treatment-II. The predation rate on various carp species fry at different treatment from 0 to 75%. The predation rate of large size of *C. batrachus* on fry was highest in treatment-I 75% and predation rate was the lowest on the fingerling in the treatment-I

0% which was provided with supplementary feed. The predation rate of large size of *C. batrachus* on various stage carp species fry during treatment-I in shown in the (Table 3).

Comparative predatory behavior of *C. batrchus*

At the end of the experiment-1, carefully done of comparative study of predation rate between treatment-I and treatment-II. Generally predation rate in treatment-II is higher than treatment I, because there is no supplied feed for predator in the treatment-II. So, the predation rates have been increased by hungry predator. The predator used preys as food. The highest rate of predation by fingerling of *C. batrachus* on Hatchling was 95% in treatment-II and lowest predation rate was 0% both on advanced fry and fingerling during both treatment-I and II. Comparative study of predation rate between treatment I and treatment II are shown in Table 4.

Table 4. Comparative study of predation rate between treatment I and II of 3 experiments.

Predator	Type of preys	Predation rate (%)	
		Treatment-I	Treatment-II
Experiment-1	Hatchling	75	95
	Early fry	70	92.5
	Fry	10	20
	Advanced fry	0	0
	Fingerling	0	0
Experiment-2	Hatchling	70	92.50
	Early fry	80	97.50
	Fry	55	80
	Advanced fry	05	10
	Fingerling	0	0
Experiment 3	Hatchling	67.5	85
	Early fry	60	90
	Fry	65	95
	Advanced fry	12.5	45
	Fingerling	0	0

At the end of the experiment-2 carefully was done comparative study of predation rate between treatment I and treatment-II. Generally predation rate is higher in treatment-II then treatment-I (Table 4). There was significant difference in the predation rate of indigenous magur (*C. batrachus*) as obtained from treatment-I (T-I) and the treatment-II (T-II) where they were feed with supplied feed earth warm and no feed respectively.

In experiment 3, the highest rate of predation by large size magur on fry of carp species in the treatment II was 95% which was not provided with supplement feed, on the other hand the lowest rate of predation by large size of *C. batrachus* on fingerling of carp species in T-II was 0% where finger ling size was main factor for not consuming by predators.

The highest rate of predation by adult size of *C. batrachus* on early fry was 97.5% in treatment-II. Lowest rate of predation by predator on fingerling both were 0% in treatment-I and II.

Comparative study of predatory behavior of *C. batrachus* on different stage of carps

Different predatory behaviors were observed in different experimental period by predator. In the experiment-1 during treatment-II the highest predation rate of fingerling of *C. batrachus* on Hatchling was 95% than all other experiment. Average size of fingerling of *C. batrachus* was 9.5 cm on the other hand size of Hatchling of carp species was 5-10mm. The lowest predation rate of large size of *C. batrachus* on Hatchling of carp species was 67.5% during Experiment-3 in treatment-I. Adult size of *C. batrachus* predation rate on Hatchling in the experiment-2 during treatment-I and treatment-II were 70 and 92.5% respectively (Fig. 1).

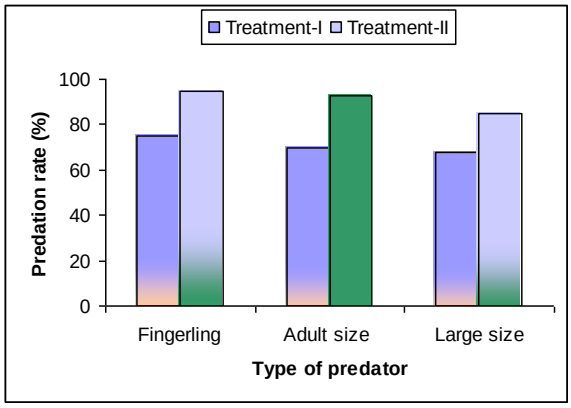

Fig. 1. Comparative study on predation rate of adult size *C. batrachus* on hatchling fry of carp species.

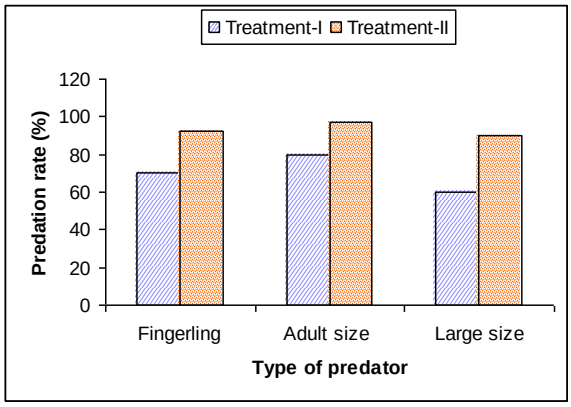

Fig. 2. Comparative study on predation rate of *C. batrachus* on early fry of carp species in three different experiments.

Different predation rate were observed in different experiment by predator. In the experiment 2 during treatment II the highest predation rate of Adult size of *C. batrachus* on early fry was 97.5% most of all experiment. Average size of Adult size of *C. batrachus* was 15 cm and early fry of carp species size was 15-25mm. The lowest predation rake of large size of *C. batrachus* on early fry of carp species was 60% which provided with supplemental feed during exp. 3 in treatment-I. Fingerling of *C. batrachus* predation rate on early fry during experiment-1 in treatment-I and II were 70% and 92.5% respectively (Fig. 2).

During study period different size of *C. batrachus* show different kind of predatory behavior on fry of carp species. The highest predation rate on fry was 95% by large size of Magur (*C. batrachus*) in the experiment 3 during treatment-II. The lowest predation rate on fry was 10% of fingerling of *C. batrachus* in the experiment-1 during treatment-I which was provided with feed. Average TL of large size of *C. batrachus* was 22 cm and fry was 30-40 mm. The predation rate of adult size of *C. batrachus* on fry during experiment-2 in the treatment I and II were 55% and 80% respectively (Fig. 2).

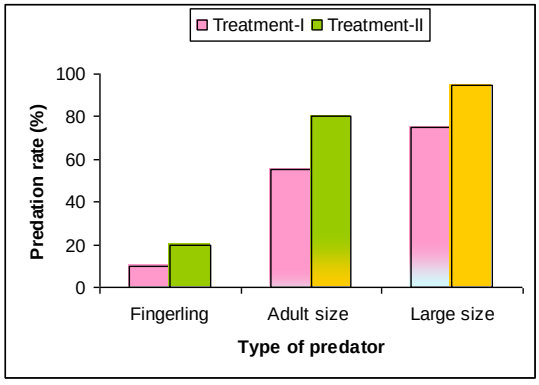

Fig. 3. Comparative study on predation rate of *C. batrachus* on fry of carp species in three different experiments.

During study period different type of *C. batrachus* have shown different kind of predatory behavior on advanced fry of carp species. The highest predation rate on advanced fry was 45% by large size *C. batrachus* in the experiment-3 during treatment-II. The lowest predation rate on advance fry by fingerling of *C. batrachus* was 0% during experiment-1 in both treatment-I and II (Fig. 3).

During study period different type of *C. batrachus* have shown different kind of predatory behavior on advanced fry of carp species. The highest predation rate on advanced fry was 45% by large size *C. batrachus* in the experiment-3 during treatment-II. The lowest predation rate on advance fry by fingerling of *C. batrachus* was 0% during experiment-1 in both treatment-I and II (Fig. 4).

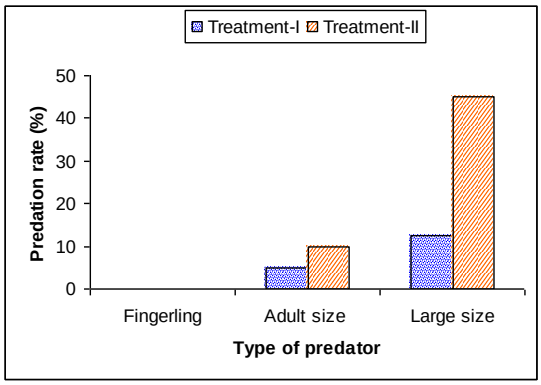

Fig. 4.Comparative study on predation rate of *C. batrachus* on advanced fry of carp species in three different experiments.

However, in case of carp fingerling the predation rate of different type of predator was same (0%) fingerling of carp species size 81-100 mm. The predator (*C. batrachus*) cannot consume any fingerling of carp species, but occurrence of some injury in the fingerling body by predator during study period.

Experiment 1

Predation rate was the highest in treatment II mostly due to lack of supplementary or available feed. The starved fish found no other alternative rather than preying on small carp species. Hecht and Appelbaum (1988) found that sibling cannibalism was negatively correlated to food availability. Ware (1972) stated that the rate of predation could be simulated by increasing predators hunger. Predation rate was higher in treatment II than in treatment–I. Probably the fish fed with live feed, lost their affinity for preys. The lowest predation rate was 0% both on advanced fry and fingerling during both treatment–I and treatment–II. Mollah and Hossain (1997) found the highest survival rate of African catfish larvae in the treatment which was provided with tubificid worms. Fingerling (9.6cm) of *C. batrachus* was preferred as feed hatchling (5-10mm) and early fry (15-25mm) of carp species. The highest rate of predation by fingerling was 95% on Hatchling of Carp species. Sometimes preys are injured by predator attack. In this case hampered preys life. Native centrachids and catfishes appear to be the most affected (Courtney, 1975). This species has been reported to kill large bass without subsequent eating them (Courtney, 1975).

Experiment–2

The highest rate of predation by Adult Magur (*Clarias batrachus*) on early fry of carp species in the treatment–II, was 97.5% which was not provided with supplemental feed. On the after hand the predation fingerling of carp species in the treatment–I was nil. It also observed the lowest predation rate of adult fish (C*. batrachus*) on fry, advance fry and fingerling, which was not provided with supplemental feed. Predation rate on advanced fry by adult size of predator was only 4% in

treatment-I and 10% in treatment-II. It can be said that the predation rate depend on the preys size and available supply feed. Hence it can be also said that Magur (*C. batrachus*) is passive predator which shown its predatory action when there is no alternative way. The *Clarias batrachus* is a carnivorous. It is also omnivorous too. Ghosh and Saigal (1981) studied the digestive enzymes of *Clarias batrachus* in relation to its food Habits and found that it was predacious. In its native habitat it is a scavenger and will eat smaller fish and are opportunist feeders and so will eat just anything. It also observed that the predation rate of adult fish (*C. batrachus*) on hatchling in treatment–II was 92.5%. The less predation was shown by adult *C. batrachus* on advanced fry and fingerling of carp species both treatment-I and treatment-II. When supplied feed or not. So, it can be said that the advanced fry and fingerling will be stock with adult *Clarias batrachus* for mixed culture in the water bodies.

Experiment–3

At the end of the experiment–3, carefully was observed that the highest rate of predation by large size of *C. batrachus* on fry (30-40mm) of carp species was 95%, which was not provided supplemental feed. The large size (22cm) of *C. batrachus* was preferred as feed to hatchling, early fry and fry. The lowest predation rate of large size of *C. batrachus* on fingerling of carp species was nil in both treatment-I and treatment-II. In case of the study we observed that the supplied feed can justly keep down of predation rate.

It is a voracious mollusks and other invertebrates as well as detritus and aquatic weeds. It is a voracious eater which consumes food rapidly and this habit makes it a particularly harmful invasive species. Walking cat fish (*C. batrchnus*) are voracious, opportunistic feeders. They are mainly active at night. Courtenay (1975) reported that major preys items include attached periphyton for the young, insect larvae, insects, fish larvae, attached fish eggs, fish and occasionally they may take plant material.

The present study clearly indicates that predation rate of *C. batrachus* effect on small carp species influenced by the type of feeds. It was also observed that the advance fry of carp species is suitable for stocking with large size *Clarias batrachus* with provided supplemental feed because the rate of predation on advance fry was only 12.5%. It also suitable for mixed stock fingerling with *Clarias batrachus*.

CONCLUSION AND RECOMMENDATION

Clarias batrachus a voracious predator native to south eastern Asia has been introduced in to many places for fish farming. Walking catfish, as it is commonly known is a voracious, opportunistic feeder and can go for month without food. *C. batrachus* has been described as a benthic, nocturnal, omnivore that consumes detritus and opportunistically forages on larges aquatic insects, tadpoles and fish. This species occurs in fresh, brackish as well as marshy muddy waters over its native range.

In order to study the predatory effect of *C. batrachus* on different stage of carp species fry 3 (three) consecutive investigation were conducted in 6 aquaria. In experiment-1, fingerling of *C. batrachus* and different stage of carp fry were treated as predators and preys respectively. In experiment–2, adult fish of *C. batrachus* and different stage of carp fry were treated as predator and prey respectively. Again in experiment–3, large size of *C. batrachus* and different stage of carp fry as predator and preys, respectively. Stocking ratio of the predator and prey was 1:40 each treatment.

Each experiment was conducted with 2 treatments. Supplemental feed are provided as feed for treatment–I and no feed was provided in treatment–II.

The present work deals with the effect of predatory behavior of *C. batrachus* on small carp species. It was observed from the study that the predatory effect on hatchling (5-10mm) and early fry (15-20mm) of carp species by *C. batrachus* fingerling average (9.6cm), adult fish (15cm) and large size (22cm) of *C. batrachus* was so high. It should not be stock hatchling and early fry of carp species with *C. batrachus* in the water body for ploysculture.
Again the predation effect on fry (30-40mm) of carp species was very high by adult and large *C. batrachus* which was not provided any supplemental feed. In other observation it was also found that the predatory behavior of fingerling (9.6cm) of *C. batrachus* on fry of carp species was negligible (10%) and predation rate on advanced fry was nil (0%) which were provided supplied feed.

Predatory effect of adult and large size of *C. batrachus* on advanced fry (41-60mm) of carp species were negligible also where was provided supplemental feed.

It was also observed that the predation rate of all stage *C. batrachus* on fingerling (81-100mm) of Carp species was nil (0%). So, It can be said that fingerling of carp species will be mixed culture with *C. batrachus* for better production without any effect.

Fry and advanced fry of carp species can be stock with fingerling of *C. batrachus* for mixed culture without any predation effect. Sometimes *C. batrachus* hamper on carp species habitat and life cycle and also occurred injury and will be secondary infection finally cause disease. Sometime *C. batrachus* competition with other stocks for food and habitat.

C. batrachus is a predatory fish, but from the present observation it can be concluded that they are passive predator. Predatory effect of small carp species was significant when they were not provided with any other supplemental feed but they

showed little or no predation provided with supplemental feed. Thus it is suggested that *C. batrachus* is suitable for carp poly culture where supplementary feed is provided at satiation level and must be stocking which have no predation effect on carp species with proper size of fish. It is rather difficult to arrive to a conclusion on the basis of this investigation and more studies with variable size of predators and preys for a longer period are essential to a definite conclusion.

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