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A STUDY ON AQUATIC BIODIVERSITY OF SHUTHI-SHAIDULI RIVER OF BANGLADESH

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Abstract: A total number of 88 species (78 fishes, 4 prawns, 1 crab, 1 snail and 4 reptiles) were identified from the Shuthi-Shaiduli River and its flood plains. About 10 types of operative fishing gear and craft were found in the river. Increasing rates of using current jaal (23.00-30.10%) and Kapuri jaal (17.60-20.90%) were identified as detrimental gear used to kill the different species during four years. A common increasing trend of using current jaal, Kapuri jaal (seine net) and FAD (fish aggregating device) were identified as detrimental gear killing different species between 2016 and 2019. The fish productivity decreased dramatically from 139.32±7.77 to 114.00±3.88 mt within four years and the total production percentage (%) also sharply decreased from 7.97% to 18.17% over the same period. As a result, commercially important 5 aquatic species namely nandina (*Labeo nandina*), olive barb (*Puntius sarana*), gazar (*Channa marulius*) and reptiles (*Lissemys punctata* and *Kachuga tecta*) were extinct, 17 commercially important aquatic species were at the edge of extinction (critically endangered, CR), 6 species endangered (EN), 25 species vulnerable status (VU), three species were identified as at lower risk (LR) and only two species of the river were not threatened (NT) in position between 2016 and 2019 in the river.

Keywords: Aquatic fauna, Biodiversity, Extinct, Endangered, Illegal fishing.

INTRODUCTION

River ecosystems encompass ecological, social and economic processes that interconnect organisms including humans and helpful in maintaining the biodiversity. The biodiversity has different levels and values (Verma, 2016). The biodiversity helps in maintaining the ecological balance. There is a necessity of ecological balance for widespread biodiversity (Ashok, 2017a) and the ecological balance is an indispensable need for human survival (Verma, 2018). The biodiversity conservation and environmental ethics both are required for sustainable development and survival of plants and animals because biodiversity is the foundation of human life (Ashok, 2019; Verma and Prakash, 2020).

The study of biodiversity has become a major concern to the fishing biologists against the backdrop of rapid decline in the natural population of fish and aquatic biota across all the continents of the world. Biodiversity encompasses genetic species, assemblage, ecosystem and land cape levels of biological organization with structural, compositional and functional components (Noss, 1983; Crains and Lackey, 1992). The genetic diversity acts as a buffer for biodiversity (Ashok, 2017b). Though loss of aquatic species has been

occurring rapidly, the aquatic organisms have received comparatively little attention from conservation biologists (Allendorf, 1988). A rich diversity of fish species is critical to the ecology and sustainable productivity of the flood plains (Praksh and Verma, 2019; Prakash *et al.,* 2020). The resource of aquatic fauna in Bangladesh are under severe threat due to over-exploitation and environmental degradation, which includes human interventions through construction of flood control embankments, drainage structures and sluice gates, conversion of inundated land to cropland thereby reducing water area and indiscriminate use of pesticides. Pollution from domestic, industrial and agrochemicals wastes and run off have resulted in extinction of a considerable amount of aquatic biota in same stretches of the open water system (Disaster, 1990).

The upper region of the Shuti-Shaiduli River is connected with Kangshow river. In its 21-23 km long course, the river flows across the Atpara, Kendua and Modon Upazilla of Netrokona district from northern to southern Tharail and Itna Upazilla of Kishorgong District, before joining the Surma River. The water flow is continuous in the river. During monsoon, the water flow comes down from the upper region of Kangshow River and water flow does not confine within the banks. As a result, it causes floods in some area of Kendua and Modan Upazilla in every year.

Once, this river had abundance of native wild aquatic different fish species, crabs, snail and reptiles. But this river and its floodplains are under great stress and its existence is under danger because of over-exploitation and changing aquatic ecosystem. The downstream of the river system is silted which reduces the rate of water flow and causes habitat degradation. The feeding and breeding grounds of fishes in and around the river has been reducing drastically due to anthropogenic activity.

The river basin works as a natural reservoir as it plays a key role in the basin water resources by regulating water flows from the upper region. There are two flood phases in the Shuti-Shaiduli River. One is the early flood phase and another is the deep flood phase. The early flood phase is relatively shorter than deep flood phase. A well planned and systematic study was required to assess the present status of the river with a view to take on appropriate actions to preserve and manage the aquatic lives. The present study focuses on the abundance, species combination, catch statistics and related aspects of the river.

MATERIALS AND METHODS

1. Location and area of the river

The Shuthi-Shaiduli River comprises an average area of 21-23 km long course with an average depth 2.83±0.02 m. The river is surrounded by Kamargaon, Jurail, Kunapara, Jalapur, Gogbazar and Nowpara villages of Kendua Upazilla under the district of Netrokona (Fig. 1).

2. Experimental procedures

Survey of the Koijani-Shingua and its flood plains was conducted during 2016 to 2019 with particular emphasis on soil and water quality, biological productivity and status of fishery exploitation.

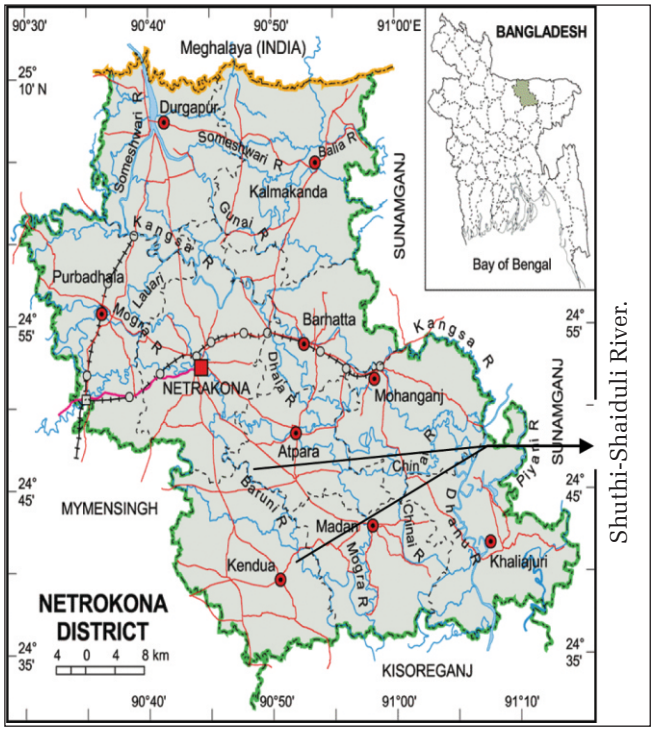

Fig. 1. Map of Bangladesh and Netrokona district showing the location of Shuthi-Shaiduli River.

The Shuthi-Shaiduli river was divided into upper (Kamargaon to Gogbazar) and lower (Gugbazar to Jalalpur, Kandiura union) regions based on soil structure, water quality, biological productivity, fishing activities and river course.

The research was based on both primary and secondary data, comprehensive literature review and extracts of local knowledge and information. Collection of primary data was made by field observation and other different methods: fishing in the river, survey of different fishing methods, survey of fish markets adjacent to river, monitoring of hydrological, meteorological, physico-chemical and biological characteristics of river and fishers' perception as well as secondary data were collected from the fishers and Department of Fisheries (DoF).

3. Study of Meteorological, physico-chemical parameters and plankton

A bamboo made meter scale was used to measure water depth. Water temperature was measured using a Celsius thermometer and transparency was recorded by using a Secchi disc of 20 cm diameter. Dissolved oxygen and pH were calculated directly using a digital electronic oxygen meter (YSI Model 58) and an electronic pH meter (Jenway Model 3020). Alkalinity was recorded by titrimetric method (Clesceri *et al.*, 1989).

4. Data collection

The Shuthi-Shaiduli river was sampled during winter (mid November to mid February), pre monsoon (mid February to April), monsoon (May to August) and post monsoon (September to mid November) for assessment of aquatic lives abundance and availability. The present study, being a rapid survey, gives only a broad picture of a stock of fishes, crustaceans, crabs, snail and reptiles that was recorded through fish landing center and different market survey, collection of different species directly from fishers' catch, khata fishing (shelter created by branches of trees) and interaction with fishers' in the river. The global conservation was determined following the database of IUCN 2000.

5. Analysis of experimental data

The data were analyzed through one way ANOVA using MSTAT followed by Duncan's Multiple Range Test to find out whether any significant difference existed among different means (Duncan, 1955; Zar, 1984). Standard deviation in each parameter was calculated and expressed as mean ±S.D.

RESULTS

1. Morphometry and hydrodynamics of experimental river

Generally, there are three main sources of water input into the river ecosystem *viz.* overspill from the higher river channel, surface flow and regeneration. Water flows were determined by both rainfall and flooded water from the Meghaloya's hilly range, India. In upper rigion, this river is connected with Khongsa River. Flooding of the river originated from the Kangshow River. Surface run-off and increased in river height due to inflow of rainwater from the upper stretch, cause inundation of floodplains. The more water gain or exchange of water took place during southwest monsoon when floodplains were flooded. The early flood phase (April to early June) occurred in the early monsoon when the water level in basin was relatively low. The deep flood phase (June to September) began when the water level in the river, causing deep flooding in the four unions of Kendua Upazilla. Floodwater in flood plains started receding in the post-monsoon season (October to December). The water loss by various means caused shrinkage of the effective water area and lowering of depth in the river which is very similar to the study of Chakraborty and Mirza (2007).

2. Physical characteristics of river

Soil texture of Shuthi-Shaduli river bed varied from loam sand to sandy.

Table 1: Physical features (sediment) of the Shuthi-Shaiduli River.

Location	Soil texture of the bed of beel (%)		
	Sandy	Loam sand	Clay
Deeper bed	19.4 ± 2.24^{b}	63.5 ± 6.62^{a}	17.1 ± 3.18^{c}
Wet land bed	12.5 ± 0.66^{c}	27.4 ± 3.84^{b}	60.1 ± 5.28^{a}

Figures with different superscripts in the same row varied significantly ($P>0.05$).

Soil texture of river bed was 19.4±2.24% sandy, 63.5±6.62% loam sand and 17.1±3.18% clay, in which highest percentage of loam sand was recorded (Table 1). On the other hand, highest percentage of clay in the wet land bed of the river (60.1±5.28%) was identified.

Water depth of the Shuti-shaiduli River varied from 3.85±0.65 to 3.80±0.42 m during the 2016 to 2019, respectively. The highest depth of the river was recorded in the year 2016 and lowest depth was found in the year 2019. There was a tendency to decrease the depth of the river bed shallow to shallower between 2016 and 2019 (Fig. 2) due to siltation and sedimentation.

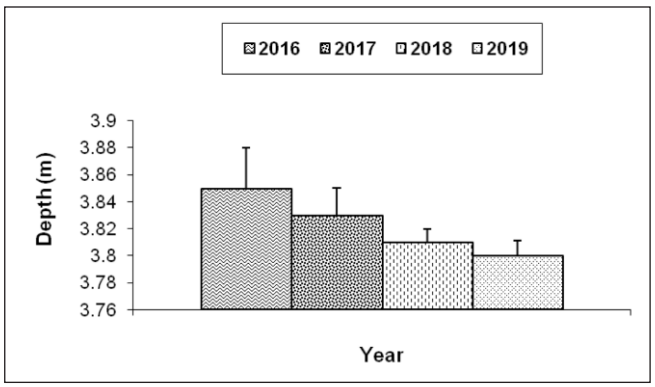

Fig. 2: Water depth of the Shuthi-Shaiduli River between the year 2016 and 2019.

The results of the physico-chemical parameters of the river water are given in Table 2. The temperature, transparency, pH, dissolve oxygen and alkalinity of water were found to be more or less in a normal range. The mean water temperatures of the river environments was not statistically significant (P>0.05). Water temperature of the river showed increasing trend in monsoon and post monsoon and decreasing trend in winter which is supported by Mathew (1975). Mean Secchi disk transparency differed significantly (P<0.05), during the year 2016-2019. Higher values occurred during post monsoon and summer months due to reduced flow and relatively stable conditions of water.

The pH of the experimental river did not differ significantly (*P*>0.05). Transparency was consistently higher in upper region, possibly due to running water of the river and higher in deeper portion of the river, possibly due to huge volume of water. A significant rise in pH during pre-monsoon followed by a drop in winter was noted in the experimental river. The mean dissolved oxygen (DO) of the experimental river was not also differed significantly (*P*>0.05). The pH and oxygen values of the river agreed more or less similar with the findings of Boyd (1982). Total alkalinity of the experimental river was differed significantly (*P*<0.05). Lowest value of alkalinity was recorded in the in the winter during 2018. Alkalinity levels of the river were recorded medium to high (Clesceri *et al.*, 1989).

3. Uses of fishing Craft and gears

Generally, fishers use boat for transport of nets and related materials. According to season and availability of different species of fishes, they used seine net or bar jaal, komor jaal, thela jaal, bua jaal, lift net, cast net, current jaal and various

Table 2: Physico-chemical parameters of Shuthi-Shaiduli River.

Parameters	Study years			
	2016	2017	2018	2019
Temperature (°C)	26.78±6.81 (14.35-32.55)	26.08±7.01 (13.62-32.57)	26.42±6.88 (14.28-32.62)	26.38±7.26 (13.08-32.85)
Transparency (cm)	36.36 ± 6.28^{c} (27.22-48.80)	40.11 ± 5.22^{d} (30.11-49.33)	33.77 ± 5.87^{b} (26.38-47.41)	30.01 ± 6.44^{a} (28.11-46.7)
pH	7.10± 1.86 (6.34-8.38)	7.12±2.04 (6.21-8.17)	7.25± 2.34 (6.51-8.22)	7.18±2.28 (6.55-8.17)
Dissolve oxygen ($mg.L^{-1}$)	4.84±1.64 (3.18-7.82)	4.77±1.62 (3.52-7.04)	5.10±1.42 (4.01-7.58)	5.04±1.44 (3.82-7.05)
Alkalinity ($mg.L^{-1}$)	124.55 ± 8.84^{b} (98.41-136.33)	136.11 ± 10.11^{a} (94.28-130.22)	108.44 ± 10.11^{d} (90.23-131.15)	118.02 ± 9.17^{c} (101.03-130.28)

Figures with different superscripts in the same row varied significantly (P>0.05). Figures in the parenthesis indicate the range.

type fish traps, hook and lines; and dewatering FAD (Fish aggregating device) for fishing. During monsoon and post monsoon, fishers used lift net, current jaal, cast net, traps, hook and lines to catch fishes. Fisher's also operated kata fishing by seine net (Bar jaal and Komor jaal) in the season of winter and spring. There are so many fish trap (vair, dugair, ghuni and pholo etc.) and hook and line (barshi, fulkuichi, Jhupi aikra etc.) were used to capture different groups of aquatic lives.

Craft and gears used in the Shuthi-Shaiduli River:
The percentage of catch statistics by using illegal (net) current jaal, bar jaal (kaperi jaal) and FAD were 23.0%, 25.40%, 27.8 % and 30.10%; 17.60%, 19.0%, 20.7% and 20.9%; 10.0%, 10.10%, 10.8% and 11.00% in the year 2016, 2017, 2018 and 2019, respectively (Fig. 3) and using of current jaal, bar jaal (kaperi jaal) and FAD differed significantly ($P<0.05$). Catch statistics by using of Komor jaal were 14.70%, 13.80%, 13.10% and 12.80% in the year 2016, 2017,2018 and 2019, respectively but use of Komor jaal was also differed significantly ($P<0.05$) in different year. But according to Haroon *et al.* (2002), eighteen types of fishing gears was recorded from the Sylhet sub-basin and thirteen types from Mymensingh sub-basin which are very similar to this study. The catch statistics by use of thela jaal, dharma jaal, bua jaal, lift net, cast net, fish trap, and hook and line was decreased and differed significantly ($P<0.05$) in the year 2016, 2017, 2018 and 2019. As a result, a significant reduction in fish abundance was noted in the river every year.

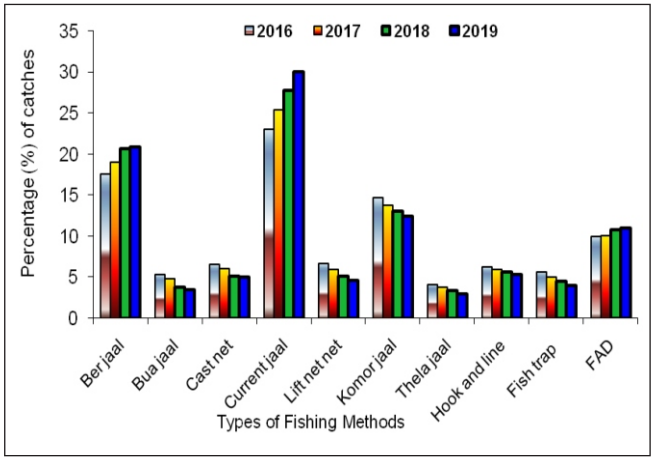

Fig. 3: Percent of catch composition by different types of fishing gear between 2016 and 2019 in Shuthi-Shaiduli River.

Cast net (Jaki jaal) was used whole year and it is a very popular fishing method and used in all over the Bangladesh (Ahmed, 1962). The fishing effort with various types of fishing gear such as seine net (especially kaperi jaal), gill net (current jaal) and FAD had been increasing between the year 2004 and 2006 but use of current jaaal was increased rapidly during same period. As a result, aquatic lives of the river and its flood plains were declined. These finding were correlated with the findings of Chakraborty *et al*. (2013) and Sugunan and Bhattacharjya (2000).

4. Catch and composition of the river
An organized sampling programme was run for a long time to get an actual picture of the catch and composition of Shuthi-Shaiduli River. The present investigation was given a wide picture of a stock of aquatic lives that obtained through landing center, market survey and interaction with fishers' in the river. Present status and position of the investigated river is shown in the Table 05. In the present study, eighty eight aquatic wild species (78 species of wild fishes, 4 species of prawn, 1 species of crabs, 1 species of snail and 4 species of turtles) were identified. These 88 species are belonging to 54 genera and 23 families.

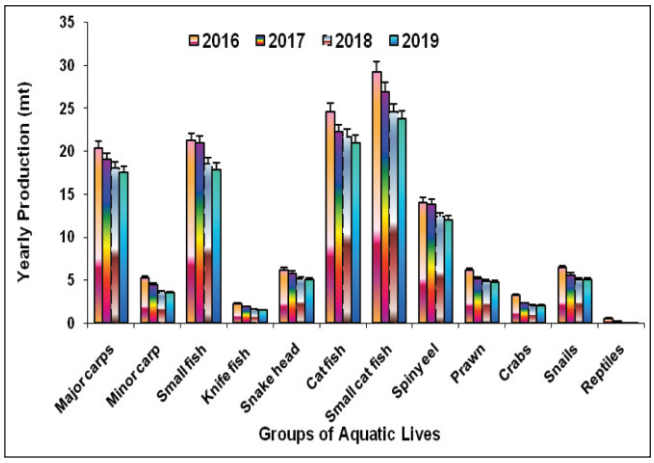

Fig. 4: The production of different groups of aquatic wild lives in the Shuthi-Shaiduli River during the year 2016-2019.

Yearly catch assessment of the experimental river was around 139.32±6.58; 128.30±5.55; 117.37±5.02 and 114.00±4.88 mt in the year 2016, 2017, 2018 and 2019, respectively consisting of 10 groups (Fig. 4) *viz.,* major carp, minor carp, small fish, knife fish, snake head, cat fish, small cat fish, spiny eels, prawn, crabs, snails and reptiles. From the catch statistics it was found that the magnitude of fishing pressure had been increasing from the year 2016 to 2019. As a

result, the total abundance of aquatic lives was found to decrease the production level at 7.97%, 15.76% and 18.17% in the year 2016-17, 2017-18 and 2018-19 and same tendency was recorded in all the twelve groups of wild lives of the river (Fig. 5). The catch statistics indicate that fishing pressure of the river was increased in the year 2016 to 2019. As a result, a decreasing trend in production percentage of river was clearly pronounced within four years which was very similar report of Chakraborty and Mirza (2010) and Moyle and Leidy (1992). It is found that the production tendency of major carp, minor carp, small fish, knife fish, snake head, cat fish, small cat fish, spiny eel, prawn, crabs, snails and reptiles of the river was decreased but the production of reptiles decreased rapidly in the study period. Small cat fish and cat fish was the dominant group of the river between the year 2016 and 2019 and second highest production was recorded in group of small fish. The catches of all the groups of fishes, crabs, snails and reptiles were higher in 2016 but in 2019, gradually lower catches was recorded between the year 2017and 2019, respectively.

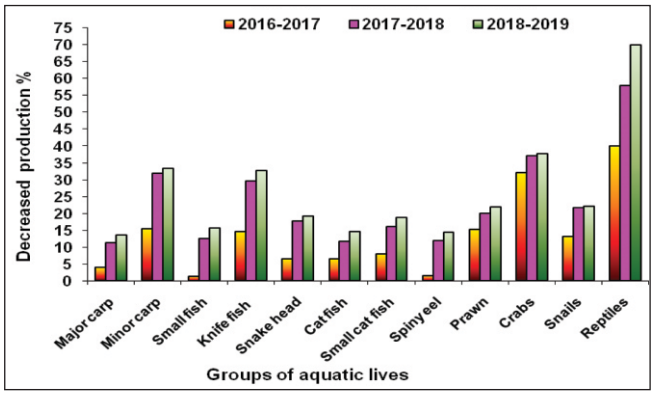

Fig. 5: The status of production percentage of aquatic wild lives was decreasing from 2016 to 2019 in the Shuthi-Shaiduli River.

Total catch statistics of aquatic lives in the river indicated that percentage of different group of aquatic lives has been sharply decreasing within three years which are very similar to the observation of Chakraborty and Mirza (2007); Chakraborty (2009); Chakraborty *et al.* (2019). As a result, commercially important five aquatic lives of river were extinct during experimental period.

The status of the 88 aquatic wild lives of the river was ranked as EX-05 (5%), CR-17 (19%), EN-36 (40%), VU-25 (27%), LR-03 (7%) and NT-02 (2%), respectively (Fig. 6).

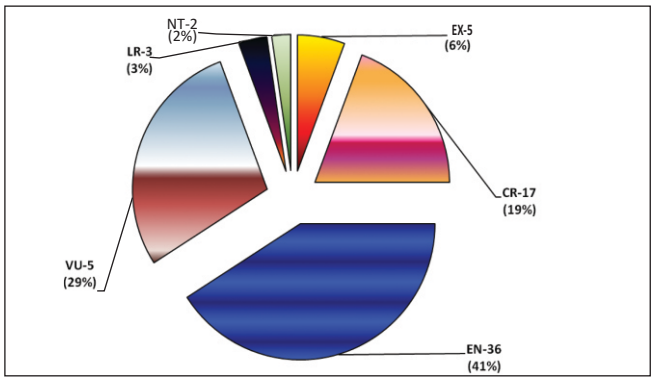

Fig. 6. Status of different species of aquatic lives in the Shuthi-Shaiduli River during 2016-19.

Commercial important major carp nandina (*Labeo nandina*) was extinct. Local sarpunti (*Puntius sarana*), Gajar (*Channa marulius*) and Reptiles (*Kachuga tecta* and *Morenia petersi*) were rarely found in the year of 2016 but these species were extinct (EX) between 2017 and 2019. Sixteen commercial importance aquatic species was facing as extremely higher risk of extinction (Critically endangered, CR) day-by-day.

Thirty six major commercially important aquatic wild species of the river were facing extremely high risk of extinction (endangered, EN), 25 species were vulnerable under status (VU), six species were identified as at lower risk (LR) and only two species not threatened (NT) position in the river, respectively (Table 3). According to IUCN 1998, in Bangladesh, about 56 freshwater fish species are critically or somewhat endangered. Due to over-exploitation and various ecological changes in natural aquatic ecosystem of river and its flood plains, commercially important aquatic lives are in the verge of extinction which is agreed with the findings of Sarker (1993).

During winter season, turtles (*Morenia petersi* and *Kachuga tecta*) were caught in the river and its flood plains. Khan (1982) reported that *K. tecta* are mainly distributed between the stretches of the Ganges River and the Brahmaputra River. Bengal Eyed turtle, *Morenia petersi* was found in the rivers and its flood plains wetland. Das (1991) mentioned its occurrence in Assam of India. Turtles of the Shuthi-Shaiduli River and its flood plains have been declining because of dewaterization of its habitat. The river water is used for irrigation and consequently destruction of its habitat *viz.* breeding ground and nesting sites. Over exploitation for local consumption

and foreign trade indiscriminately are creating a threat to all species of turtles as well. The population of bivalve, *Lamellidens marginalis* as found in the river and its flood plain wetland has also been decreasing which is considing with the observation of Ali (1991) and Chakraborty (2009).

Table 3: Status of aquatic lives in the Shuthi-Shaiduli River

Sl. No.	Status	Name of the species
1.	EX	Nandina (*Labeo nandina*), Olive barb (*Puntius sarana*), Gajar (*Channa marulius*), Reptiles (*Kachuga tecta* and *Morenia petersi*) = 5
2.	CR	Bata (*Labeo bata*), Laubuca (*Chela laubuca*), Bhagna (*Cirrhinus reba*), Dhela (Rohtee *cotio*), Batasi (*Pseudeutropius atherinoides*), Chola punti (*Puntius chola*), Baghair (*Bagarius yarrellii*), Gulsa (*Mystus cavasius*), Gang tengra (*Gagata nangra*) Modhu pabda (*Ompok pabda*), Pabda, (*Ompok pabo*) Napit (*Badis badis*), Ghura chela (*Securicola gora*), Vul (*Barilius bola*), Korsula (*Rhinomugil corsula*) and Along (*Bengala elanga*) = 17
3.	EN	Khoksa (*Barilius vagra*) Calbaus (*Labeo calbasu*), Ghonia (*Labeo gonius*), kalo bata (*Crossocheilus latius*) Jili punti (*Puntius gelius*), Mola (*Amblypharyngodon mola*), Phutani punti (*Puntius phutunio*), Jat punti (*Puntius sophore*), Fulchela (*Salmostoma phulo*), Khalisha (*Colisa fasciata*), Lal khailsha (*Colisa lalia*), Chuna Khalisha (*Colisa sota*), Kanpona (*Oryzias melastigma*), Mini (*Nundas nandus*), Rani/Botya (*Botia dario*), Rani (*Botia dayi*), Kakila (*Xenentodon cancila*), Potka (*Tetrodon cutcutia*), Chitol (*Notopterus chitala*), Shol (*Channa striatus*), Koi (*Anabas testudineus*), Neftani (*Ctenops nobiilis*), Ayre (*Aorichthys aor*), Guzia (*Aorichthys seenghala*), Rita (*Rita rita*), Kani papda (*Ompok bimaculatus*), Kajuli (*Ailia coila*), Bacha (*Eutropiichthys vacha*), Gharua (*Clupisoma garua*), Magur (*Clarius batrachus*), Baim (*Mastacembalus armatus*) Kuicha (*Monopterus cuchia*), Tara Baim (*Macrognathus aral*), Galda (*Machrobrachium rosenbergii*), Reptile (*Chiitra indica* and *Lissemys punctata*) = 36
4.	VU	Catla (*Catla catla*), Rui (*Labeo rohita*), Mrigal (*Cirrhinus cirrhosus*), Taka punti (*Puntius conchonius*), Tit punti (*Puntius ticto*), Teri punti (*Puntius terio*), Darkina (*Esomus danricus*), Chapila (*Gadusia chapra*), Nama chanda (*Chanda nama*), Kata chanda (*Pseudambasis bacuculis*), Kachi (*Corica soborna*), Ranga chanda (*Pseudambasis ranga*), Bala (*Glossogobus giuris*), Gachua (*Channa gachua*), Taki (*Channa punctatus*), Boal (*Wallago attu*), Tengra (*Mystus vitttus*), Bujuri (*Mystus tengra*), Singi (*Heteropneustes fossilis*), Guchi baim (*Macrognathus pancalus*), Gura chingri (*Machrobrachium birmanicum*), Kakra (*Sartoriana spinigera*), Shotka chingri (*Machrobrachium malcolmsnii*), Kakra *(Acanthopotamon martensi)* and Snail (*Lamellidens marginalis*) = 25
5.	LR	Common carp (*Cyprinus carpio*), Gutum (*Lepidocephalus gontea*) and Foli (*Notopterus Notopterus*) = 3
6.	NT	Gkatakia chingri (*Machrobrachium villosimanus*) and Thai sarpunti (*Puntius gonionotus*) = 2

(Status code: EX - Extinct, CR - Critically Endangered, EN - Endangered, VU - Vulnerable, LR - Lower risk, NT - Not threatened; followed as per IUCN, 2000).

During investigation periods, fresh water pearl bearing mussels (Bivalve, *Lamellidens marginalis*) were identified in the river. Shells of bivalve were utilized by rural people for production of lime which was utilized in aquaculture and agriculture land, and consumed with betel leaves and nuts.

The wildlife comprises amphibians (*Bufo melanostictus, Rana tigerina, Rana limnocharis*, *Rana cyanophyctis* and *Salamandra salamandra*) aves (whistling duck, great crested grebe, great cormorant, red crested pochard, water cock, swamphen, great black headed gull, gray-headed fish eagle, curlew, spotted redshank) and mammals (musk shrew, fishing cat, small Indian jackal, flying fox) were recorded.

The study clearly indicated that the aquatic lives of the river were subjected to over fishing resulting in gradual decline in aquatic population. The stock of aquatic populations was reduced due to pollution and destructive fishing practices (Mazid and Hussain, 1995; Chakraborty, 2011; Chakraborty *et al.*, 2019). Indiscriminate killing of fish occured due to the use of pesticides in improper doses (Prakash and Verma, 2014 & 2020; Verma and Prakash, 2018; Kaur and Mishra, 2019), use of forbidden chemicals, and aerial spray of chemicals as used in paddy field which was very much similar to the observation of Chakraborty (2008) and Mazid (2002). Intervention to control floods, adoption of new agricultural technologies and construction of road networks altered the ecology of rivers and its flood plains significantly which was supported the views of Khan (1993) and Ali (1991). Stock of the wildlife brood fishes in their breeding ground was also suffered significant damages resulting in a reduction of biodiversity as noted by Nishat (1993) and Zaman (1993).

CONCLUSION

For better management to save the stock of aquatic species in the river, a team of local management comittee like Hilsa fisheries management is needed to develope a working frame-work. The deep area of the river must be declared as sanctuaries to protect the aquatic lives in all season, stricked enforcement of fish Act-1950 in the river, ensured unplanned construction of flood control, embankments, drainage system and sluice gates, conversion of inundated land to cropland (reducing water area); and controlling use of pesticides and agrochemicals in the floodplains area of the river; can save and change the ecosystem and the production level of the river; and can ensure food security of the people of Bangladesh.

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