ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Microhabitat Use by the Herpetofauna in Mixed-evergreen and Deciduous Forests of Bangladesh.

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ABSTRACT

Microhabitats of 35 herpetofaunal species were studied by following visual encounter surveys and night searches with headlamps and flashlights. During the study period 3 nationally rare amphibian species were found: *Xenophrys parva* found in Dhopachari Reserve Forest, Chittagong beside a rocky Hill stream, *Rhacophoruns htunwini* found in Satchari National Park of Habiganj District in the undergrowth of mixed-evergreen forestand *Kalophrynus interlineatus* found in deciduous forest of Madhupur, in the slope of hillock. Among the amphibian species, most of the toads used the forest floor, the roots of trees, human settlement and slopes of the hillock as their microhabitat. The frogs used grasslands**,** forest floor with fallen leaves, water bodies and hill streams. Reptiles usually prefer to live in the bushy areas and also in trees, shrubs, rocks, under the fallen leaves, besides hill streams, under stones etc. Among the lizards Common Garden Lizard *calotes versicolor* was the most abundant in number and most of them used the undergrowth of the forest and bushy areas. The skinks used moist areas near hill streams and forest floor. The microhabitat is very specific for a species but many of the herpetofaunal species shared their microhabitat and also showed habitat preference.
Keywords: Herpetofauna, microhabitat, deciduous, mixed-evergreen, forest, Bangladesh

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ISSN: 0975-8585

INTRODUCTION

Bangladesh is one of the most biodiversity rich countries in the world. Different kinds of flora and fauna are easily found here in Bangladesh including herpetofaunal species. The diverse assembly of amphibians and reptiles is collectively called herpetofauna [1]. This diversity richness is the result of suitable environmental condition of Bangladesh.

Amphibians are cold-blooded vertebrates with rough or smooth skin [2, 3]. Water is essential for at least one part of their life cycle [3]. Three ordersof amphibians exist today. The frogs and toads belong to the Order-Anura, the salamanders in the Order-Caudata or Urodela and the caecilians under the Order-Gymnophiona [4]. In Bangladesh only the anuran members are found. There are about 5,800 species of amphibians in the world of which a total of 53 species is expected to occur in Bangladesh (Khan, 2008) [3]. The amphibians are terrestrial, arboreal and aquatic in the community [5]. They are beautifully adapted to life in their particular environment. Most amphibians are live in and around wetlands, but many species have adapted themselves to terrestrial and arboreal habitats of both plain and hill tract regions. The amphibians feed mainly on insects like invertebrates [6]. They also feed on any animal, including others of their kind, which they can overcome.

Reptiles are cold-blooded vertebrates of the class Reptilia, which holds a position in the animal kingdom intermediate between the amphibians and the birds, comprising the turtles and tortoises, lizards, worm lizards, snakes, crocodilians and the tuatara; primarily tetra pod (4-legged), but the legs lost in snakes and in some lizards [3,7]. Reptiles are a well-represented and diverse group of animals in Bangladesh. The total number of species in Bangladesh is 126 (109 inland and 17 marine species). Of the 109 inland reptiles 2 are crocodilians, 21 turtles and tortoises, 18 lizards, and 67 snakes; marine species comprising 12 snakes and 5 turtles [3].

Amphibians and reptiles are found in a great variety of ecosystems from tropical rainforests to barren deserts (Stebbins and Cohen 1997) [8]. In Bangladesh herpetofauna are widely distributed throughout the country including both central moist Deciduous forest and northeast and southeast Mixed-evergreen forest [9]. There they use different kinds of microhabitat. Microhabitats are very small, specialized habitats located within larger habitats which are specific for particular types of species for live. Like all others species the herpetofaunal species also have particular habitat types which is very important for their survival and existence.

The herpetofaunal diversity of Bangladesh is decreasing day by day. Habitat destruction, alteration and fragmentation are probably the most serious causes of current and future herpetofauna population declines and species extinctions (Dodd and Smith 2003) [10].Habitat destruction is defined as the complete elimination of a localized or regional ecosystem leading to the total loss of its former biological function (Dodd and Smith 2003) [10]. Clear cutting alters habitats drastically and can have devastating effects on species richness and abundance. Faunal diversity also decreasing because of the increasing human pollution and ignorance of the people about the beneficial role of herpetofauna.

Study area

The forests of Bangladesh are mainly divided into three categories viz. mangrove forest, mixed-evergreen forest and moist deciduous forest [9]. During this study the microhabitat of herpetofauna studied only in mixed-evergreen and deciduous forest. The study area was divided into three categories on the basis of location of the forest. Location of the forest is shown in the (Fig. 1, Table 1).

ISSN: 0975-8585

Table1: Location of the study area

Sl. No	Location in Bangladesh	Name of area	Forest types	District	Area(ha)
1.	Northeast	Satchari National Park	Mixed-evergreen forest in hills	Habiganj	243
		Rema-Kalenga Wildlife Sanctuary	Mixed-evergreen forest in hills	Habiganj	1,795
2.	Central	Madhupur National Park	Deciduous forest in hillocks	Tangail and Mymensing	8,436
		Bhawal National Park	Deciduous forest in hillocks	Gazipur	5,022
3.	Southeast	Chunati Wildlife Sanctuary	Dwarf bamboo and other vegetation in hills	Chittagong and Cox's Bazar	7,764
		Kaptai National Park	Mixed-evergreen forest in hills	Rangamati	5,464
		Teknaf Game Reserve	Mixed-evergreen forest in hills	Cox'Bazar	11,615
		Dhopachari Reserve Forest	Mixed-evergreen forest in hills	Chittagong	_

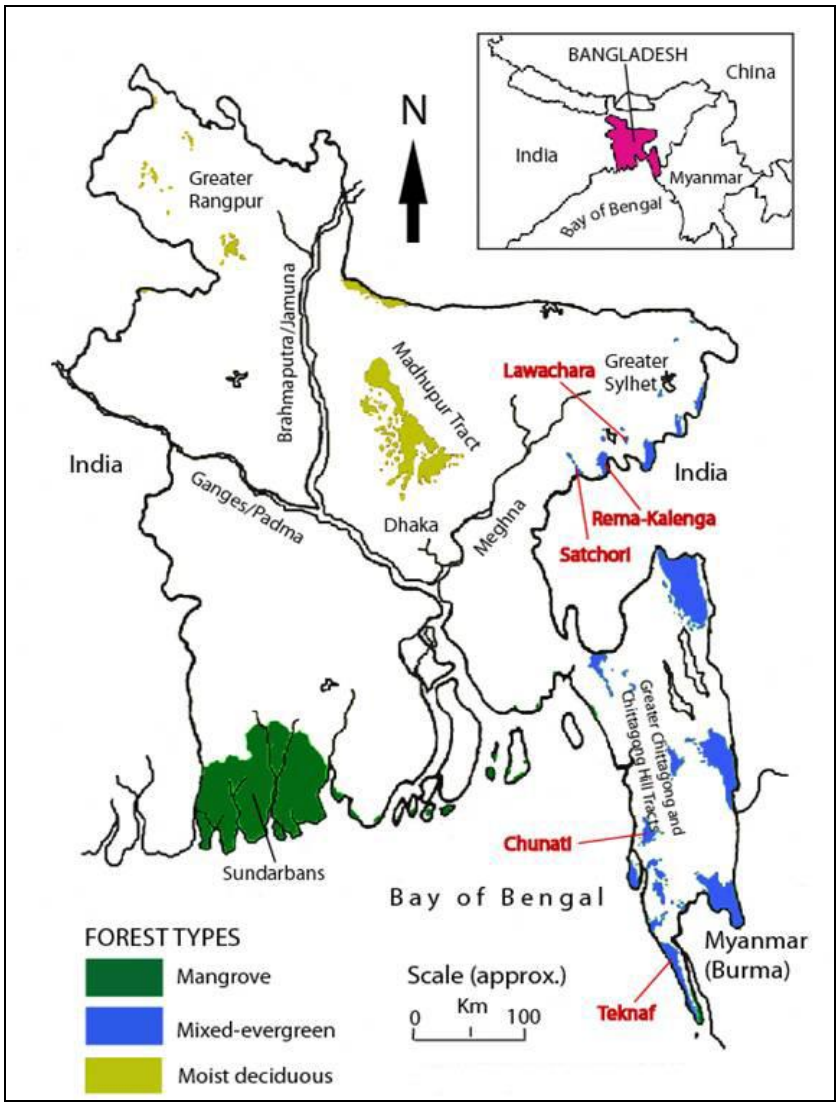

Figure 1: Protected area of Bangladesh showing the Mangrove, Moist deciduous and Mixed-evergreen forest types

MATERIAL AND METHODS

The survey was conducted between early April '15, 2008 and late March '16, 2009. A variety of methods were employed to collect and identify the herpetofauna. The following two methods were used for the observation and collection of herpetofauna in the different study areas-

Visual encounter survey: Visual encounter surveys were conducted mainly for reptile's fauna over a wider area. These surveys generally comprised walking through various habitats, such as bushy areas, along hill streams, agricultural areas or swamps, looking for active reptiles, and disturbing logs, rocks and others ground debris to check for sheltering animals.

Night searches: Night searches with headlamps and flashlights along existing trails of the forest, conducted by two or more persons for frog and reptiles. These searches were mostly targeted at, or near, aquatic environments such as streams, swamps and vegetation, leaf litter, ground debris (logs, rocks) but nocturnal searches, specially targeting geckos and snakes, were also conducted in bushy habitats and caves. Stream transects were established at few sites in the study area for standardized censuses of the relative abundance of frog species. The specimens were collected by these two methods from 9 A.M to 1 P.M and 4 P.M to 9 P.M. In some cases, a longer period than the above mentioned was surveyed.

After data collection process following measures had been taken to identify the species: Tympanum and its size in relation to eye, eye diameter, snout vent length, tibio-tarsal articulation, distinctive colorations/markings, toe/finger webbing, orientation(horizontal/vertical) of pupil, presence of distinctive tubercles. Microhabitat were also studied on the basis of following data: Digital photos, location of caught, sighting time, weather, habitat type, rain condition, description of immediate location (i.e. under leaf litter, on tree branch at x), height from ground or water, miscellaneous notes.

Following types of equipment were used for the present survey: Two types of nets were used to collect the specimens-a) sweep net, b) fish net, we also used hand gloves, GPS unit, headlight, torchlight, plastic jar, slide calipers, scale, small fine smash net, dissecting box, snake hook and tong, cotton, camera, note book, data sheet, pen, pencil etc.

Ethical approval: This study was partly supported by the Nishorgo Program which was actually a biodiversity conservation and management program of Bangladesh forest department. All of the data were collected during the study period by the proper approval of Bangladesh forest department. During this study no animals were harmed or injured intentionally or unintentionally and we followed all of the code, conduct and legislation for the care and use of animal for scientific purposes.

RESULTS AND DISCUSSION

The microhabitats of 35 herpetofaunal species (17 amphibians and 18 reptiles) were studied during the study periods. All of the founded frogs and toads belong to the families-Bufonidae, Dicroglossidae, Megophryidae, Microhylidae, Ranidae and Rhacophoridae. Of the 17 amphibian species 3 nationally rare species were found: Myanmar pelobatid toad *Xenophrys parva* of the family Megophryidae (found in Dhopachari reserve forest, Chittagong beside a rocky hill stream), Htun win's tree frog *Rhacophoruns htunwini*of the family Rhacophoridae (found in Satchari national park of habiganj district in the undergrowth of the mixed-evergreen forest) and sticky frog *Kalophrynus interlineatus* (found in deciduous forest of Madhupur, in the slope of hillock). Most of the toads used the forest floor, the roots of trees, human settlement and slopes of the hillock. The frogs used grasslands, forest floor with fallen leaves, water bodies and hill streams. Among the reptile lot of lizards, skinks and snakes were also seen during the study period belong to the family Agamidae, Gekkonidae, Varanidae, Scincidae, Lacertidae, Typhlopidae, Colubridae and Elapidae. Reptiles usually prefer to live in the bushy areas and also in trees, shrubs, rocks, under the fallen leaves, besides hill streams, under stones etc. Among the lizardcommon garden lizard *calotes versicolor* was most abundant in number and most of them used the undergrowth of the forest and bushy areas. The skinks used moist areas near hill streams and forest floor. The microhabitat is very specific for a species but this can be change due to adverse environmental condition or for seasonal variation.

ISSN: 0975-8585

Microhabitat use by the amphibianfauna

Total six families of amphibians were found combindly in the deciduous and mixed-evergreen forest, of them Dicroglossidae and Microhylidae were highest in number and Bufonidae and Megophryidae were lowest in number. No representative species under the family Megophryidae and Ranidae were found in deciduous and mixed-evergreen forest respectively. The total numbers of amphibian species and their proportion of occurrence under different family are listed below respectively (Table 2 & Table 3).

Table 2: Number of amphibian species found in different forest types

Family	Total No. of Species	No. of species in D.F	No. of species in M.E.F
Bufonidae	1	1	1
Microhylidae	5	4	4
Dicroglossidae	5	5	4
Megophryidae	1	0	1
Ranidae	2	2	0
Rhacophoridae	3	2	3
Total	17	14	13

Table 3: Proportion (%) of occurrence of amphibian fauna in the study areas

Sl. No.	Family name	Proportion (%) of occurrence in		
		In both forest	Deciduous forest	Mixed-evergreen forest
1.	Bufonidae	5.9%	7.1%	7.7%
2.	Microhylidae	29.4%	28.6%	30.8%
3.	Dicroglossidae	29.4%	35.7%	30.8%
4.	Megophryidae	5.9%	0.00%	7.7%
5.	Ranidae	11.8%	14.3%	0.00%
6.	Rhacophoridae	17.6%	4.3%	23.1%

Duttaphrynus melonostictus: Very common toad (snout vent length: 14.5 cm) under the family Bufonidae.

Microhabitat: Widely distributed all over the country including both mixed-evergreen and deciduous forest. Live besides human habitation under bricks and furniture, slope of hillocks, fallen leaves of forest floor, dike of canals and base of tree hole.

Habitat preference: Among the found 23 number of *Duttaphrynus melonostictus,* 43% used human habitat, 22% slope of hill, 4% fallen leaves, 17% dike of canals and 13% base of tree as their microhabitat (figure 2).

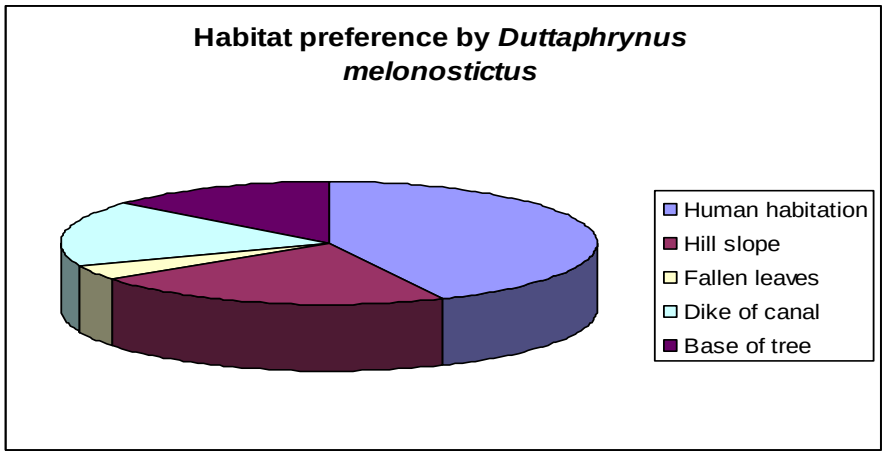

Figure 2: Habitat preferences by *Duttaphrynus melanostictus*

***Microhyla ornata*:** Commonly known asOrnate microhylid frog (snout vent length: 2.3 cm) under the family Microhylidae

ISSN: 0975-8585

Microhabitat: They are usually nocturnal but can be active during day time. Very common species found both deciduous and mixed-evergreen forest. They remain in the shady forest floor covered by fallen leaves, slope of hillocks and bushy areas of the forest. They are also found slopes of the forest rest house.

Habitat preference: During this study period 20 number of ornate microhylid frog was found. Of them 70% used the fallen leaves, 20% used the slope of hillocks, 10% used bushy areas as their microhabitat (Figure 3).

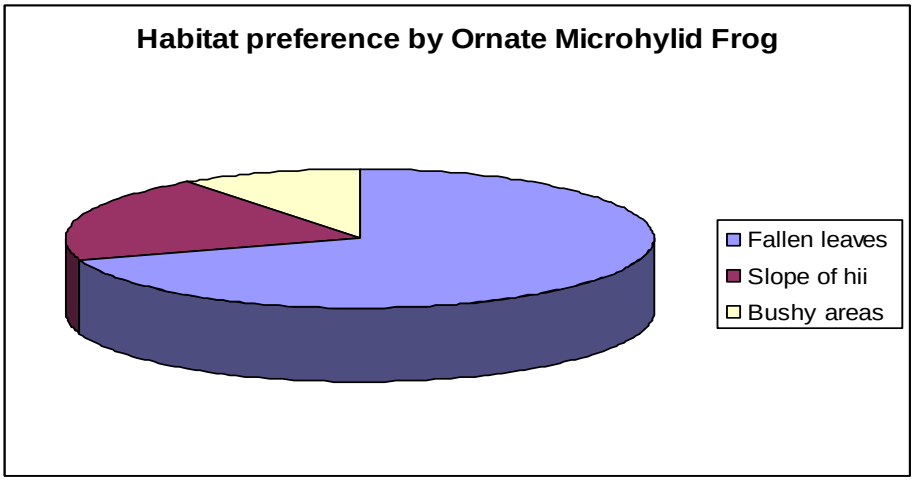

Figure 3: Habitat preferences by *Microhyla ornate*

Microhyla rubra: English name Red microhylid frog (snout vent length: 2.5 cm) under the family Microhylidae

Microhabitat: They are also active at night. Found in both deciduous and mixed-evergreen forest. They live or found in and upon fallen leaves of the forest floor and bushy hill streams side. At night they feed ants and other small insects which are available under fallen leaves.

Habitat preference: Total 10 number of *Microhyla rubra* are found of them 80% use the fallen leaves and 20% use the bushy hill stream side as their microhabitat (Figure 4).

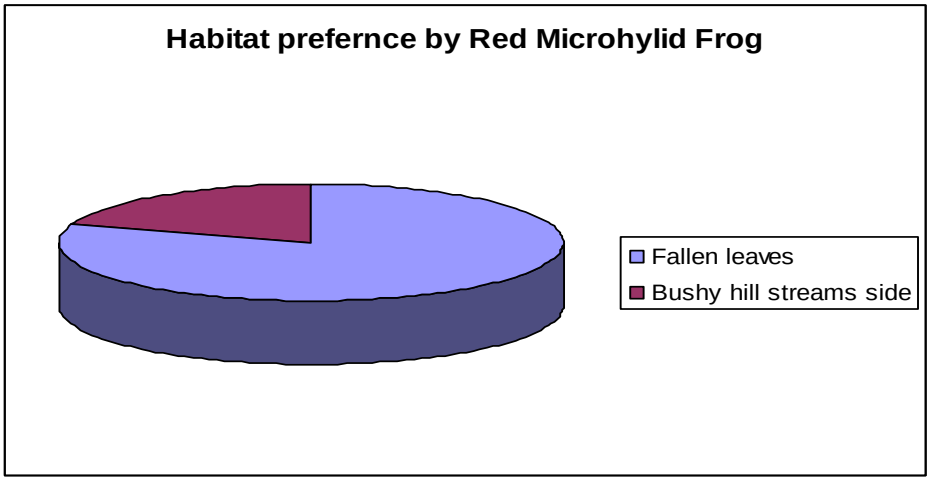

Figure 4: Habitat preferences by *Microhyla rubra*

Microhyla berdmoeri: Berdmore's microhylid frog (snout vent length: 4.4 cm) under the family Microhylidae.

Microhabitat: They are nocturnal but also found during afternoon. Occurs both mixed-evergreen and deciduous forest of Bangladesh. Lives the near moist part of the forest where grasses and bushes are easily available.

Kalophrynus interlineatus: Popularly known asSticky frog (snout vent length: 4.4 cm) under the family Microhylidae (Figure 5)**.**

Figure 5: Sticky frog (*Kalophrynus interlineatus*)

Microhabitat: Regarded as nationally rare species and they are nocturnal. They occur in the central deciduous forest of Bangladesh (Madhupur and Bhawal national park). They prefer to live slopes of the hillocks and bushy area of the forest. Only one number of this species was found during study period.

Kaloula pulchara:Commonly known as Asian painted frog (snout vent length: 6.8 cm) under the family Microhylidae.

Microhabitat: Largest microhylid frogs of Bangladesh. They are nocturnal and occur in the mixed-evergreen forest of northeast and southeast. Prefer to live in the tree holes where some deposited rain water is available. During day time they are found under the debris.

Euphlyctis cyanophlyctis: Commonly known as skipper frog (snout vent length: 6.0 cm) under the family Dicroglossidae**.**

Microhabitat: They arefound both mixed-evergreen and deciduous forest. They can be diurnal or nocturnal. Found in land near water, water bodies like ponds, lakes, paddy fields, small depressions of lands filled with water. Most of the time they remain floating condition on water.

Euphlyctis hexadactylus: Popularly known as green frog (snout vent length: 13.0 cm) under the family Dicroglossidae.

Microhabitat: They use the microhabitat like green aquatic vegetation, land near water bodies. They roost in bushes and water transition. With their green color they can camouflage easily with their habitat.

Fejervarya *limnocharis:* English nameCricket frog (snout vent length: 5.3 cm) under the family Dicroglossidae.

ISSN: 0975-8585

Microhabitat: They are nocturnal and diurnal. Widely distributed in different habitat types both mixed-evergreen and deciduous forest. Found microhabitat like moist grass land of forest floor, paddy field, besides hill strems.

Habitat preference: Total 22 number of *Fejervarya limnocharis* are found of them 36.37% use moist paddy field, 22.72% edge of water, 22.72% grassland and 18.19% use hill streams side as their microhabitat (Figure 6).

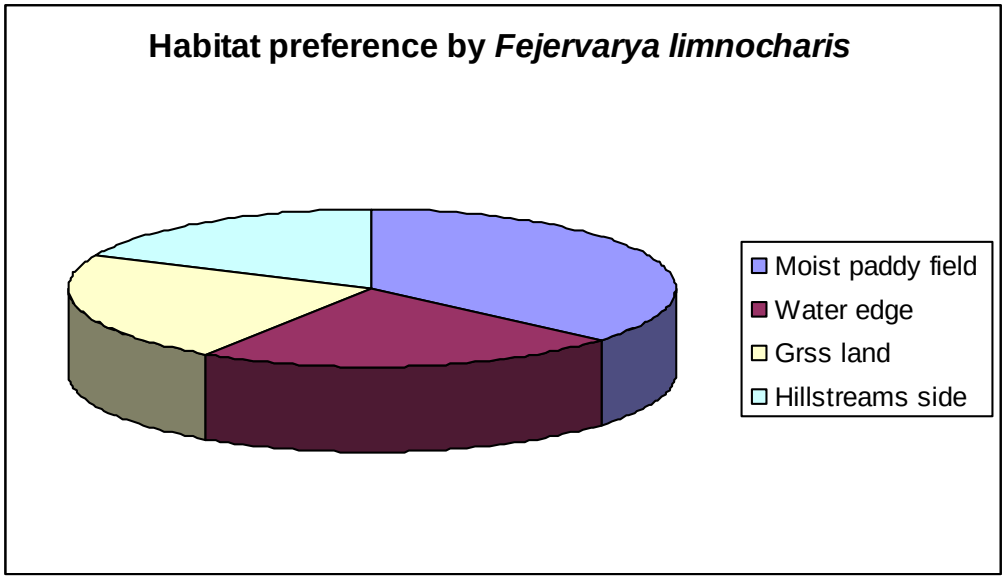

Figure 6: Habitat preferences by *Fejervarya limnocharis*

Hoplobatrachus Crassus: Common name Jerdon's bull frog (snout vent length: male 9.0 cm and female 11.2 cm) under the family Dicroglossidae.

Microhabitat: They are not aquatic like Green frog. Though widely distributed but mainly found in the deciduous forest of the central Bangladesh. They use microhabitat like bushy slopes of hill streams, forest floor, dry paddy field and sides of canals.

Hoplobatrachus tigerinus: Commonly known as Indian bull frog (snout vent length: 12.5 cm) under the family Dicroglossidae.

Microhabitat: They are nocturnal and diurnal widely distributed all over the deciduous and mixed-evergreen forest of Bangladesh. Commonly live near the hill streams, near the side of ponds and sides of small depressions of land filled with water and paddy field.

Xenophrys parva: Popularly known as Myanmar pelobtid toad (snout vent length: 6.2 cm) under the family Megophryidae (figure 7).

Microhabitat: Very rare type toad of Bangladesh. Found in the southeast mixed-evergreen forest of Chittagong hill tracts. They prefer to live moist place of the forest mainly besides rocky hill streams.

Sylvirana leptoglossa: English name Cope's assam frog (snout vent length: 5.7 cm) under the family Ranidae.

Microhabitat: Nocturnal, but becomes active from dusks. They occur both in the deciduous and mixed-evergreen forest. Use the microhabitat like forest floor and bushy areas of the hillocks.

Sylvirana taipehensis: Two-striped grass frog (snout vent length: 5.5 cm) under the family Ranidae.

ISSN: 0975-8585

Figure 7: Myanmar pelobtid toad *(Xenophrys parva)*

Microhabitat: Diurnal and nocturnal species occur mainly in the deciduous forest of Madhupur and Bhawal national park. Use microhabitat like Shady areas of the hillocks and moisture bushy areas. Also occurs on broad leaf low vegetation of the forest.

Polypedates leucomystax: Commonly known as Asian brown tree frog (snout vent length: male 4.8 cm, female 6.8 cm) under the family Rhacophoridae.

Microhabitat: This tree frog is nocturnal. They are widely distributed over all types of forest of northeast, southeast and central. They live on low vegetation of the forest, banana leaves upon hill streams etc. Often returns to same place for diurnal roosting.

Polypadates maculates: Popularly known asIndian tree frog (snout-vent length: male 5.0 cm, female 7.9 cm) under the family Rhacophoridae.

Microhabitat: They are nocturnal in nature and widely distributed in various habitat types of deciduous and mixed-evergreen forest. Live on the branch of low vegetation. During breeding season produce foam nest above water bodies and live there.

Rhacophoruns htunwini:They are commonly known as Htun win's tree frog(snout-vent length: 4.2 cm) under the family Rhacophoridae (Figure 8).

Microhabitat: Very rare species of tree frog.They are nocturnal in nature occurs in the mixed-evergreen forest of northeast and southeast. They use low vegetation or undergrowth trees of the forest as their microhabitat besides small land depressions. They remain inactive during day times and roost in the hidden place of the trees.

Comparison between the proportion (%) of occurrences of amphibian fauna in the deciduous and mixed-evergreen forests has shown in the figure9.

Microhabitat use by the reptilian fauna

Total 18 species of reptilian fauna under 8 families were found during study period in deciduous and mixed-evergreen forest of Bangladesh. The total numbers of reptilian species and their proportion of occurrence under different family are listed below respectively (Table 4& Table 5). Like amphibian fauna some of the reptilian fauna sometimes also showed their habitat preferences.

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Figure 8: Htun win's tree frog*(Rhacophorus htunwini)*

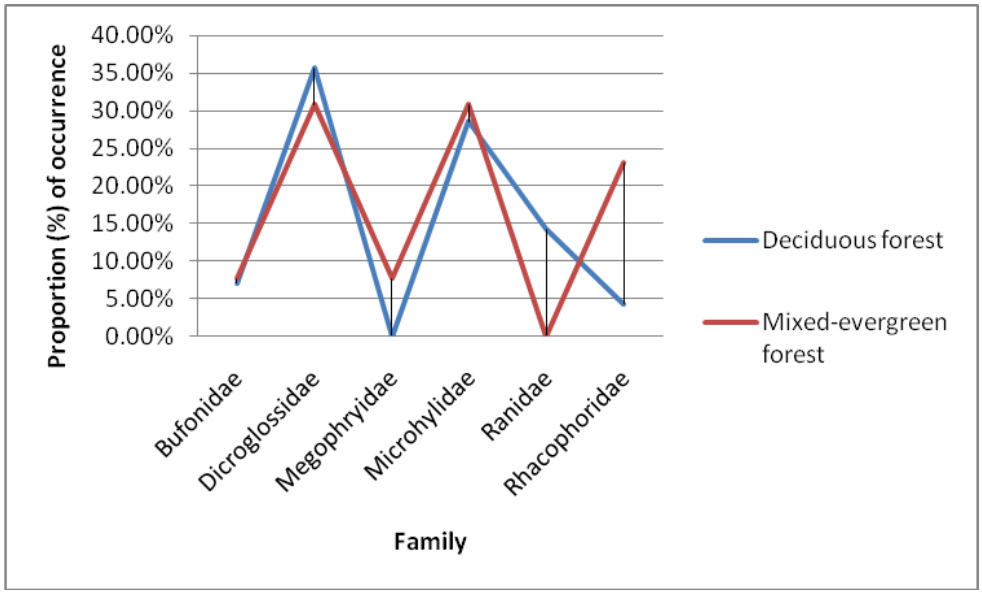

Figure 9: Comparison of occurrence of amphibian fauna in the study area

Table 4: Number of reptilian species found in different forest types

Family	Total No. of Species	No. of species in D.F	No. of species in M.E.F
Agamidae	2	1	2
Gekkonidae	3	3	3
Lacertidae	1	0	1
Scincidae	4	2	4
Varanidae	2	1	2
Typhlopidae	1	1	1
Colubridae	4	2	4
Elapidae	1	1	0
Total No. of species	18	11	17

ISSN: 0975-8585

Table 5: Proportion (%) of occurrence of reptilian fauna in the study areas

Sl. No.	Family name	Proportion (%) of occurrence in		
		Both forest	Deciduous forest	Mixed-evergreen forest
1.	Agamidae	11.1%	9.1%	11.8%
2.	Gekkonidae	16.7%	27.3%	17.7%
3.	Lacertidae	5.5%	0.00%	5.9%
4.	Scincidae	22.2%	18.2%	23.5%
5.	Varanidae	11.1%	9.1%	11.8%
6.	Typhlopidae	5.5%	9.1%	5.9%
7.	Colubridae	22.2%	18.2%	23.5%
8.	Elapidae	5.5%	9.1%	0.00%

Calotes versicolor: Commonly known asCommon garden lizard (total length: 49 cm, snout-vent length: 14 cm) under the family Agamidae.

Microhabitat: They are common in different habitat types generally active during mid of the day. Bushy trees, under growth tree branch of the forest or garden, forest floor upon fallen leaves and tree trunk are considered as their microhabitat.

Habitat preference: Total 15 number of *Calotes versicolor*species found of them 40% use small tree branch, 33.33% use bushy area, 13.33% use tree trunk, 13.33% use forest as their microhabitat (Figure 10).

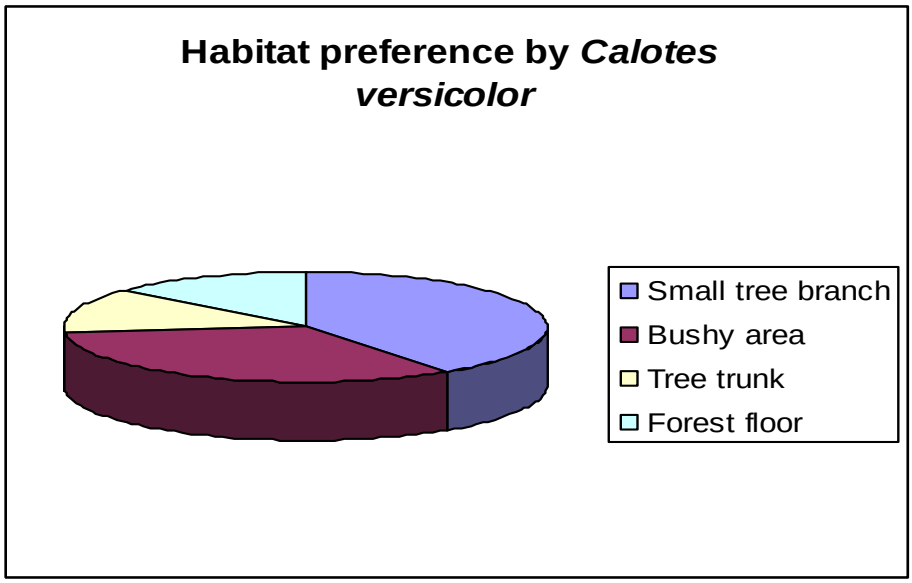

Figure 10: Habitat preferences by *Calotes versicolor*

Calotes emma: They are also known asEmma gray's forest lizard (total length: 41 cm, snout-vent length: 12 cm) under the family Agamidae.

Microhabitat: They are common lizard in the mixed-evergreen forest of northeast and southeast. Active during sunny day and use the bushy areas, besides hill streams small trees, forest under growth trees and garden as their microhabitat.

Hemidactylus brookii: English common name isBrook's house gecko (total length: 13.0 cm, snout-vent length: 6.2 cm) under the familyGekkonidae.

Microhabitat: Widely distributed, occurs both deciduous and mixed-evergreen forest. They Lives in the variety of habitats, on trees, rocks, under stones and buildings of the forest rest house. Their loud *chuk chuk chuk* call is heard after dusk from the bushes, trees etc.

Hemidactylus frenatus: Popularly known as Common house gecko (total length: 13.0 cm, snout-vent length: 6.0 cm) under the familyGekkonidae.

Microhabitat: Very common widely distributed in different microhabitat types of deciduous and mixed-evergreen forest. Mainly occurs in human habitations and nearby trees of the associated forest.

Gekko gecko: Tokay gecko (total length: 34.0 cm, snout-vent length: 17.0 cm) under the familyGekkonidae.

Microhabitat: Very common widely distributed in and around the both types of forest. Generally, they are nocturnal and their loud call heard both day and night. Typically tree holes and secluded place in human house of the adjacent forests are considered as their microhabitat.

Takydromus khasiensis: Commonly known as Khasi hills long-tailed lizard (total length: 17.0 cm, Snout-vent Length: 5.0 cm) under the family Lacertidae (Figure 11).

Figure 11: Khasi hills long-tailed lizard (*Takydromus khasiensis*)

Microhabitat: Uncommon types of lizard occur mainly in the mixed-evergreen forests in the northeast. They use tea garden and bushy undergrowth of the forest as their microhabitat. They also occur in the bushy areas besides the hill streams.

Mabuya carinata: English common name Keeled grass skink (total length: 26.3 cm, snout-vent length: 11.9 cm) under the family Scincidae.

Microhabitat: Widely distributed in different habitat types of deciduous and mixed-evergreen forest. They areprimarily a ground dweller. Found in the bushy areas besides the hill streams, under fallen logs. Actively searches through the ground litter for prey. This species was found hidden under leaf litter.

Mabuya macularia: Commonly known as Bronze grass skink (total length: 15.5 cm, snout-vent length: 7.3 cm) under the family Scincidae.

Microhabitat: Widely distributed in hills and highlands of the mixed-evergreen forest also in deciduous forest. Use bushes, fallen leaves under stone and besides Hill streams between two high hills.

Sphenomorphus maculates: English common name is Spotted litter skink (snout-vent length: 56 mm) under the family Scincidae.

Microhabitat: *Sphenomorphus maculates* is a forest floor species. They occur in hilly areas in mixed-evergreen forest and active usually during sunny midday. Bushy area, forests floor and leaf litter considered as their microhabitat.

Scincella reevesi: Commonly known as Reeve's Ground skink under the family Scincidae.

Microhabitat: Uncommon species distributed in the mixed-evergreen forest of northeast and south east Bangladesh. Dry leaf litter, rotten logs and leaves deposited in the side of the hill streams are their microhabitat.

Varanus bengalensis: Most popularly known asBengal monitor lizard (total length: 275.0 cm, snout-vent length: 175.0 cm) under the family Varanidae.

Microhabitat: Very common species widely distributed in all habitat types. They live in the cracks and crevices in the ground of the forest. They are diurnal species and move all over the forest floor. Often enters burrows in search of food or for laying eggs.

Varanus salvator: Commonly known as Water monitor lizard (snout-vent length: 250.0 cm) under the family Varanidae.

Microhabitat: Common salt water monitor found mainly in the coastal region of Bangladesh. The hole of the edge of water and the water are their microhabitat.

Typhlops jerdoni: Popularly known as Jerdon's blind snake (snout-vent length: 28.0 cm) under the family Typhlopidae.

Microhabitat: Common blind snake of Bangladesh widely distributed over the deciduous and mixed-evergreen forest. Fallen leaves, rotten logs besides hill streams and moist forest floor are their microhabitat.

Ahaetulla nasuta: English common name Common vine snake (total length: 273.0 cm, snout-vent length: 200.0 cm) under the family Colubridae.

Microhabitat: Uncommon but widely distributed species both in deciduous and mixed-evergreen forest of Bangladesh. They used bushes and scrub, tall grasses as microhabitat.

Amphiesma stolatum: Commonly known as Striped keelback (total length: 99.0 cm, snout-vent length: 80.0 cm) under the family Colubridae.

Microhabitat: Very common species in all the forest types of Bangladesh. They are diurnal and active mainly in morning and evening. Fallen leaves and forest floor and besides hill streams.

Enhydris enhydris: Popularly known as Common smooth water Snake (total length: 96.0 cm, snout-vent length: 81.0 cm) under the family Colubridae.

Microhabitat: Common species of snakes found both deciduous and mixed-evergreen forest of Bangladesh. They mainly found besides canals and hill streams of the forest.

***Xenochrophis piscator*:** Commonly known as Checkered keelback (Total length: 111.5 cm, snout-vent length: 82.4 cm) under the family Colubridae.
Microhabitat: Commonest snake of Bangladesh. They are widely distributed in different habitat types of deciduous and mixed-evergreen forest mainly Occurs in canals, paddy fields, pools and rivers. In mixed-evergreen forest they are found besides hill streams.

Naja naja: English common name Spectacled Cobra (snout-vent length: 220.0 cm) under the family Elapidae.

Microhabitat: Common venomous species of snake. Widely distributed in different habitat types of mixed-evergreen and deciduous forest of Bangladesh. Base of the large size tree, under stone are their microhabitat.

Comparison between the proportion (%) of occurrences of reptilian fauna in the deciduous and mixed-evergreen forests has shown in the figure 12.

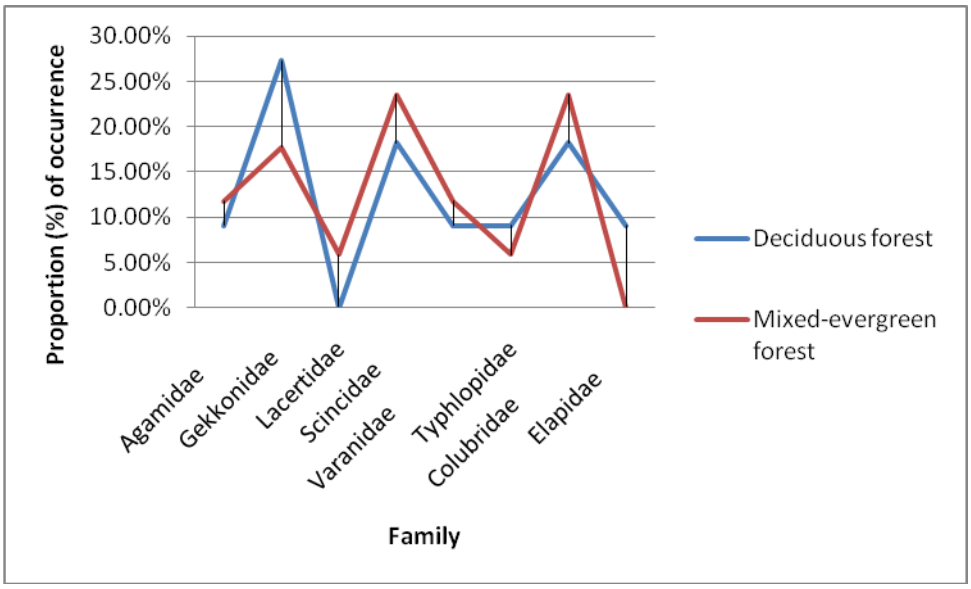

Figure 12: Comparison of occurrence of reptilian fauna in the study area

In the mixed-evergreen and deciduous forests the herpetofauna of different species used different types of microhabitat. Some species are habitat specialists and found exclusively in a particular habitat types of a region [3, 9]. Others are widely distributed throughout the country and different types of microhabitat they use. As Bangladesh is a small country, most of the herpetofauna occurs in the same habitat types. Though microhabitat is exclusively specific for a particular species but sometimes same microhabitat is used by different species at a time. Again the age specific habitat preference occurs in case of some species as for example, the frog and toad species the habitat and microhabitat of tadpole is quite different from to that of the adult of same species [11]. This type of habitat preference occurs because of their complex life cycle.

During the survey period the six families of amphibian fauna are found which includes both frogs and toads. The families are the Bufonidae, Dicroglossidae, Megophryidae, Microhylidae, Ranidae and Rhacophoridae. Previously Khan (2004) found only four families [12]. The species *Xenophrys parva* under the family Megophryidae in the Dhopachari reserve forest, Chittagong and *Rhacophoruns htunwini* under the family Rhacophroidae in the Satchari national park is the newly recorded species for Bangladesh. In the moist deciduous forest of central Bangladesh the species under the family dicroglossidae are highest in number and species under Bufonidae family are lowest in number. In mixed-evergreen forest of the northeast and southeast the occurrence of the species under the family Dicroglossidae and Microhylidae are highest and Bufonidae and Megophryidae are lowest in number. No representative species of the family Megophryidae in the deciduous forest habitat and Ranidae in the mixed-evergreen forest habitat occurs. This is due to the species *Xenophrys parva* prefer to live besides rocky hill streams which is completely absents in the central deciduous forest.

The most common toad of Bangladesh *Duttaphrynus melonostictus* are widely distributed [13] all over the country including both types of forest habitat. But their occurrence in the deep forest is not so rich. They are found most abundantly besides human settlements associated with forest and also in and around forest rest house. This is probably due to they prefer to live drier place in the human habitat than the moist place of the forest inside habitat. Of the members of the family Dicroglossidae the species *Euphlyctis cyanophlyctis* is of most common occurrence in the water bodies in and around the forest. They are highly aquatic and littoral frog. It remains permanently in different types of habitats, with pooled water, in the plain and submountain parts. The frog either floats or remains squatting in the vegetation along marginal water. The Green frog

Euphlyctis hexadactylus use green vegetation near moist place as their microhabitat during study period. But Peter Janzen 2005 mentioned that they are fully aquatic. They are also found in ponds with dense aquatic vegetation (Daniel 1983) [5]. They prefer to live in green vegetation probably due to their green color which helps them to easily camouflage with green vegetation to protect themselves from predator.

Cricket Frog *Fejervarya limnocharis* use Grass land, forest floor and hill stream side as their microhabitat.

They are semi-aquatic species; prefer mostly wetlands (Khan, M.M.H. 2008) [3]. Jerdon's Bull Frog *Hoplobatrachus crassus* use paddy field and bushy slopes of hill streams as their microhabitat. They are seen in temporary rainwater pools and near tanks (Daniel 2002) [14]. Indian Bull Frog *Hoplobatrachus tigerinus* mainly found in the bank of the water body, canals, besides paddy field and besides hill strems slope. Now an endangered species partly due to the fact that the frog was a case study from the high school level and due to indiscriminate use in dissections their Number went down.

Myanmar Pelobtid Toad *Xenophrys parva* under the family Megophryidae are found besides rocky hill stream of Chittagong hill tracts. Their rocky brownish color helps them to camouflage to the rock.

Most of the species under the family Microhylidae used grasses, bushes, forest floor covered by fallen leaves and hill stream side's bushy vegetation as their microhabitat. They also may be occurred under the stones. The species under this family are more commonly seen in the rainy season. The sticky frog *Kalophrynus interlineatus* was occurred in the slope of hillocks in the deciduous forest of Madhupur National Park, Mymensingh. But they are also found close to a termite hill in the same forest by AHM Ali Reza (Jun 11, 2006). The species *Microhyla berdmoeri, Microhyla ornata* and *Microhyla rubra* use generally the same microhabitat types and they use mostly fallen leaves because they prefer insects like ants as their diet which are available under fallen leaves. Juvenile of *Microhyla ornate* used temporary rainwater pools for a short time as their resident (Daniel 2002) [14]. *Microhyla rubra* are also found near sandy river beds (Daniel 2002). But *Kaloula pulchara* show little difference and use tree hole and fallen leaves deposited near water bodies as their microhabitat.

Two species *Sylvirana leptoglossa* and *Sylvirana taipehensis* under the family Ranidae are found only in the central deciduous forest but no representative are not found in the mixed-evergreen forest during study period. *Sylvirana leptoglossa* are found on forest floor upon fallen leaves and bushy slope of the forest during my study period. They are also occurs under logs and small hollows (Khan 2008) [3]. *Sylvirana taipehensis* used shady areas of the hillocks and moisture bushy land as their microhabitat in the deciduous forest of the central Bangladesh during study period. But they also occurs on ground and on low vegetation in wetlands (Khan 2008) [3].

Three species under the familyRhacophoridae were found in the study area, of them *Rhacophoruns htunwini* are newly recorded tree frog for Bangladesh found on the under growth tree branch of the forest besides land depressions of the Satchari national park. It was first reported to science, from Myanmar, in 2005 (Khan 2008) [3]. *Polypedates leucomystax* live on under growth trees of the forest near the canals and on the low vegetation and small trees upon hill streams. They are widely distributed both of the forest types. *Polypadates maculates* another common type of tree frog of Bangladesh live on the branch of low vegetation. During breeding season produce foam nest above bodies of water and live there [15].

In the study area total 18 species of reptiles including lizards, skinks and snakes were found under the family Agamidae, Gekkonidae, Varanidae, Scincidae, Lacertidae, Typhlopidae, Colubridae and Elapidae. Of them the species under the family scincidae and colubridae are highest in number and the species under the family Lacertidae and Elapidae are lowest in number jointly in the deciduous and mixed-evergreen forest.

Common Garden Lizard *Calotes versicolor* are found on the garden, tree trunk, bushy under growth tree, beside hill streams. They prefer shrubs and undergrowth of the forest (Daniel 2002) [14]. They are occurs most abundantly during sunny day at the time of rain and after rain they are not visible. Emma Gray's Forest Lizard *Calotes emma* used bushy areas, besides hill streams, Forest under growth trees and garden as their microhabitat. They are occurs on this types of habitat because insects are available there.Brook's House Gecko

Hemidactylus brookii and Common House Gecko *Hemidactylus frenatus* are nocturnal and found in the trees, building besides the forest, Rocks and under stone. This types of habitat preference occurs probably due to they don't tolerate the heavy sunlight. Tokay Gecko *Gekko gecko* are active during dusk and night they are not easily visible because they remain hide in the tree hole [16]. Most of the time their presence recorded by hearing their loud sound *tuck too-tuck too-tuck too* both day and night. The uncommon species of lizard, *Takydromus khasiensis* use mainly bushy under growth of the Mixed-evergreen forest as their microhabitat. They prefer lower vegetation than ground (Khan 2008) [3].

Most of the skinks are ground-dwellers; they preferred sandy ground and litter on the forest floor [19]. Kelled Grass Skink *Mabuya carinata* use the fallen leaves of forest floor and bushy areas in the deciduous forest and bushy area side of the hill streams and rotten logs in the mixed-evergreen forest as their microhabitat. They are more visible at the sunny days. Bronze Grass Skink *Mabuya macularia* also occurred besides Bushes, leaf litter, under stone and besides Hill streams at clear sunny day. Spotted Litter Skink *Sphenomorphus maculates* use bushy area and forests floor as their microhabitat in the mixed-evergreen forest and are not recorded in deciduous forest. It is not known why they are not found in the deciduous forest. Reeve's Ground Skink *Scincella reevesi* are found near decomposed vegetation deposited on the sands of hill streams and rotten logs during the study period. Many of the forest-dwelling forms of skinks are semi-arboreal (Shrestha 1998) [17].

Bengal Monitor *Varanus bengalensis* are found in the Hillocks, paddy fields and slopes of hills during study periods. It is reported to live in cracks and crevices in the ground (Smith 1935) [18]. Normally they are burrow dwellers, often going head first into its bolt holes and remaining in that position till its needs to come out again (Daniel 2002) [14, 20]. Water Monitor *Varanus salvator*s are found near on the edge of water during study periods. They generally occur on coast and lay eggs in tree holes or holes in banks of water (Khan 2008) [3].

Jerdon's Blind Snake *Typhlops jerdoni* are found under fallen leaves, rotten logs and besides hill streams during study periods. They are solitary and its highly polished scales help its passage through the soil (Daniel 2002) [14]. They are generally active at day in shady places; possibly also active at night (Khan 2008) [3, 20].

Common Vine Snake *Ahaetulla nasuta* during study periods found bushy and under growth trees in the forest only in the mixed-evergreen forest. They are also reported in tall grasses in and around forest (Khan 2008) [3]. Striped Keelback *Amphiesma stolatum* occurs fallen leaves and forest floor in the deciduous forest and in the mixed-evergreen forest besides hill streams with rotten logs during study periods. They are common in fields, grassy and cultivated areas of open country during the rains, its choice of habitat being related to its food: frogs and toads (Daniel 2002) [14]. Common Smooth Water Snake *Enhydris enhydris* during study periods they are occurred in and around the water in the mixed-evergreen forest. They are also occurs frequently in the rivers, estuaries, lakes, marshes and perhaps wet fields (Daniel 2002) [14]. Checkered Kewlback *Xenochrophis piscator* they used canals, paddy field and other water bodies in the forest as their microhabitat during study periods. They are quite aggressive, sleep and bask on ground (Khan 2008) [3]. Spectacled Cobra *Naja naja* venomous snakes found besides base of the large size tree holes during study periods. But their actual microhabitats are white ant nests, holes in the ground or the tangle of roots at the base of trees (Daniel 2002) [14].

CONCLUSIONS

The herpetofauna all over the world including Bangladesh are facing continuous threat. The major threats are responsible for their decline includes- habitat destruction, habitat alteration, habitat fragmentation, poaching, excessive use of insecticides and fertilizers. Dramatic declines in herpetofaunal populations, including population crashes and mass localized extinction, have been noted in the past two decades from locations all over the world, and amphibian and reptilian declines are thus perceived as one of the most critical threats to global biodiversity. To protect the herpetofaunal population from the continuous threats we should prevent its habitat destruction, alteration and fragmentation by habitat management practice. Management practices commonly used to manipulate the structure and composition of vegetation within restorations can exert immediate, short-term, and long term effects on herpetofaunal assemblages. If

we protect the total forest from habitat destruction, alteration and fragmentation the microhabitat of herpetofaunal population will be saved automatically.

ABBREVIATIONS: D.F: Deciduous forest, M.E.F: Mixed-evergreen forest

AUTHORS' CONTRIBUTIONS

This research work was carried out in collaboration among all authors. Author KMMR designed the final research study, fieldwork, data processing, taken care of formatting and provided final change to this manuscript. Author MMHK and IIR helped to make the experimental design, identification of the species and interpretation of data. All authors read and approved the final manuscript and they have no competing interests.

ACKNOWLEDGMENTS

This research work was supported in part by Nishorgo Program, Bangladesh forest Department.

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