

## ECOLOGY OF SPOTTED FLAPSHELL TURTLE, *Lissemys punctata* (LACEPEDE, 1788) IN BANGLADESH

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### ABSTRACT

Spotted flapshell turtle, *Lissemys punctata* was found in all types of habitats of Bangladesh. Of the 9 categories of habitats studied, the highest number (17.42%) of the turtle species was found in marshland followed by puddles (17.26%), agriculture fields (17.12%), streams (12.1%), canals (10.54%), tanks (10.39%), derelict ponds (9.18%) and domestic ponds (6.08%). Most of the time the turtle was found in burrowing condition (55.83%), rarely it was observed in feeding (7.2%) condition. The turtle seem to have a considerably higher tolerant in all types of environment, so it may be possible to set-up turtle farm commercially in Bangladesh.

**Key words:** Spotted flapshell turtle, ecology, habitat preference, behavioral patterns.

### INTRODUCTION

The wetlands of Bangladesh are very rich in Chelonian fauna maintaining ecological balance and controlling water quality. This turtle plays an important role in the aquatic ecosystem by feeding different slow moving aquatic animals like crabs, snails, insects, dead animals and their fragments, thus reduces the water pollution (Hossain and Sarker 1993). Freshwater turtles perform a valuable service as scavengers in the tanks, rivers and stagnant water and thus keep the aquatic systems free from pollution (Rao 1986).

Turtles are consumed by a group of people as a source of protein and for its delicacy (Rao 1987). Huge quantities of turtles would be exported from

Bangladesh as estimated 3164.24 tons from FY 1980 to 2002. By annual average earning from turtles and turtle products was over 7.8 million Taka (1 US \$ = 68 Tk) (Export Promotion Bureau of Bangladesh 1980–2002). Countless turtle species will be lost over the next few decades (Beebe 2001). The declination rate is a serious indication as some species have rapidly declined in the past decade, may face extinction in the wild (Sandra and Daniela 2000). Although Bangladesh is a signatory of the CITES, the turtles and tortoises are still indiscriminately being killed. Unsustainable exploitation of turtle is a great threat of extinction in near future (Sarker and Hossain 1995). The freshwater turtle population is declining due to over exploitation and habitat

destruction (Rao 1986) and very rare turtle species are also collected for food (Zhao and Adler 1993).

Some information are available about different aspects of turtle and tortoises in the following books written by Boulenger (1890), Hans (1964), Chen (1976), Gregory (1982), Daniel (1983), Khan (1987), Barbour and Ernst (1989), Milan and Melvin (1997). Some research works have also been carried out on the ecology, habitat status and the trend of trade of freshwater turtles and tortoises in Bangladesh and other countries by Mertens (1966), Bennett *et al.* (1970), Talukder (1979), Yadava and Prashad (1982), Auffenberg (1981), Fugler (1984), Das (1989), Bhupathy and Vijayan (1989; 1994), Das (1990), Rashid and Swingland (1990), Nicolas (1995), Shrestha (1995; 1997), Sarker and Hossain (1997), Hossain (2000), Sandra and Daniela (2000). The present study is an attempt to collect and add information on behavioural pattern, micro and macro habitat, feeding habit, browsing, burrowing, basking habit, etc. to the existing knowledge of ecology of spotted flapshell turtle *L. punctata*. This study also explores the commercial potentiality of turtle farming.

## MATERIALS AND METHODS

The study was conducted in Matlab and Haziganj upazilas under Chandpur district; Sonargaon and Naraynganj sadar upazilas under Naraynganj district; Gopinathpur upazila under Manikganj district; Gopalganj and Madaripur sadar districts between January 1997 and December 2000.

**Ecological study in captivity:** An artificial culture conditions were created in the Zoological garden, Department of Zoology, University of Dhaka; Dhaka. A cemented tank (4 m × 4.5 m) was in the Zoological garden where there was an adequate space within the boundary of the tank which was used by the turtles as petrol area as well as feeding

and breeding ground. Two mini ponds of 168 m<sup>3</sup>, each (8 m × 7 m × 3 m) was used to rear and to observe the ethology of turtles.

The corners of the enclosure, in the zoological garden, were slightly elevated and middle was slightly sloped inserted with 6 earthen jars (100 cm<sup>2</sup>) with ideal habitat, the device to facilitate the turtle species to get out and get in easily to the jars. Some plants (arum) were grown up inside the enclosure that provided shade for the turtle. Twelve aquaria were placed in the open space to rear the turtles. There were some breeding grounds made in the corner of the enclosure with different types of soil to estimate the ecological niche and nesting preferences. A turtle hatchery was also made at Arua Union, Gopinathpur upazila, Manikganj district.

**Ecological study in nature:** Habitat preferences were calculated by observing the frequency of occurrence of *L. punctata* in the study areas. The macro and micro habitats of the turtle species were differentiated in nature by extensive field visits. The ideal habitats were differentiated on the basis of abundance of the turtle species.

Habitats were also studied by accompanying the turtle collectors. This also facilitated to gather information on the methods of turtle collection from different habitat throughout the year. Burrowing habitats of the turtle species were located by the presence of a breathing hole and from grass beds and other habitats with their trails. Habitat classification was based on the plant cover and moisture contents in the soil. Habitats utilization and preferences were tested by one and two way ANOVA. The means were differentiated by arc sign transformation and habitat preferences were calculated by Duncan's New Multiple Range Test (DMRT). Chi-square ( $\chi^2$ ) test was done to compare different habitats in different seasons. SPSS (version 10.0) program was used for data analysis.

## RESULTS AND DISCUSSION

**Aquatic Habitat:** Spotted flapshell turtle preferred aquatic (13.4%), terrestrial (66.8%) and perennial waterbodies (19.8%). The study areas were low-lying with diverse ecosystem having a number of stagnant and seasonal inundated waterbodies, i.e., ponds, ditches, pools, puddles, lakes, canals and marshlands. with diverse plant species. It was observed that the species preferred aquatic systems with diverse aquatic vegetations. The notable species were *Eichhornia crassipes* (Kachoripana), *Hydrilla verticillata* (Jhajipata), *Vallisneria spiralis* (Pataseola), *Spirodela polyrhiza*, *Lemna* spp. (Khudipana), *Wolffia arrhiza*, *W. microscopia*, *Najas graminea*, *Limnocharis flava*, *Tenagocharis latifolia*, *Ottelia alismoides*, *Hydrocharis dubia*, *Blyxa auberti*, *Ipomoea aquatica*, *Enhydra* sp. (Helencha), *Aponogeton* spp., *Trapa* spp., *Ludwigia adscendens* and *Nymphaea* spp. Yadava and Prashad (1982) stated that *L. punctata* occurs in all tributaries of rivers. Fugler (1984), Khan (1987), Daniel (1983) mentioned that the turtle is entirely aquatic.

**Macro Habitat:** In nature, spotted flapshell turtle inhabited all types of terrestrial habitat i.e. garden, agriculture fields, grasslands, roadsides, etc. and, lotic and lentic water including domestic ponds, derelict ponds, puddles, tanks, dighees, lakes, temporarily created water standing places, marshlands, wetlands, inundated agriculture fields, beel, jheel, irrigation canals, tributaries and distributaries of the Meghna, Dhonaghoda and the Dhakatia. Boulenger (1890) stated that the turtle is distributed in Ganges plains in rivers and canals and wide spread in Bhahmaputra drainage (Das 1990, Talukder 1979), distributed across the country (Khan 1982) and Rashid and Swingland (1997).

In the four years study, the maximum number of *L. punctata* was found to prefer the marshlands and agriculture lands than other habitats (Table 1

and Fig. 1). The highest abundance (19.4%) of *L. punctata* was observed in the marshlands in 1999 and the lowest (16.1%) in 2000. In winter, most of the aquatic habitats were dried up due to agriculture practices, fishing, and irrigation purposes when the turtle inhabited the moist soil and bushy places. The highest abundance of *L. punctata* (21.2%) was in 2000 and the lowest (12.4%) in 1998 in agriculture fields (Fig. 1).

There was a significant difference in habitat preferences ( $F = 14.767$ ,  $df = 8/24$  and  $p < 0.01$ ) that means the highest preferred habitats were marshlands followed by agriculture fields, canals, tanks, derelict ponds, streams, lakes, puddles, domestic ponds, and no significant difference among the study period, 1997-2000, ( $F = 2.979$ ,  $df = 3/24$  and  $p < 0.05$ ) (Table 2).

**Micro Habitat:** The spotted flapshell turtle was found under aquatic weeds like water hyacinth ( $n = 28$ , 35%), water cabbage ( $n = 17$ , 21%), *Enhydra* and *Ipomoea* ( $n = 13$ , 16%) and other floating and semi-submerged vegetations ( $n = 23$ , 28%). In dry season, the turtle was found in burrowing condition in moist dry soil and moist vegetation with straw of agriculture fields ( $n = 45$ , 48%), soil of vegetable ( $n = 14$ , 15%), pineapple garden ( $n = 5$ , 6%), and betel leaf garden ( $n = 29$ , 31%). The turtle occasionally left burrows and moved towards waterbodies at rains in search of food and returned to burrows condition. This turtle had the ability to adapt habitats of different environmental conditions like puddle, drainage, and polluted water retaining areas. Shrestha (1997) mentioned that weedy places, slow running rivers, oxbows lakes and reservoirs with muddy bottom were their preferable habitats. This turtle preferred water with mud or sand bottoms but it was often forced to aestivate in the mud during dry period. The turtle was found under mud just with the head above the water ( $n = 15$ ), paddy fields with stagnant water ( $n = 11$ ).

**Table 1. Habitat preferences of *L. punctata* in nature from 1997–2000 (figures in parenthesis show percentage of occurrence).**

Habitat type	Study period and percentage of occurrence				Mean ± SD*
	1997	1998	1999	2000	
Domestic ponds	9.7 ± 5.0 (6.33)	8.2 ± 5.1 (5.93)	8.8 ± 3.9 (5.39)	7.8 ± 4.1 (6.70)	34.4 ± 0.8 <sup>d</sup> (6.08) <sup>c</sup>
Derelict ponds	12.0 ± 5.2 (7.91)	15.2 ± 5.8 (11.01)	11.8 ± 5.3 (7.22)	12.3 ± 5.2 (10.58)	51.3 ± 1.6 <sup>c</sup> (9.18) <sup>c</sup>
Tanks	13.6 ± 2.0 (8.90)	16.3 ± 4.9 (11.80)	15.7 ± 6.9 (9.56)	13.1 ± 5.5 (11.30)	58.6 ± 1.6 <sup>b</sup> (10.39) <sup>b</sup>
Lakes	10.4 ± 3.4 (6.82)	14.3 ± 8.5 (10.47)	7.8 ± 4.4 (4.78)	10.2 ± 3.6 (8.78)	42.8 ± 2.7 <sup>c</sup> (7.56) <sup>c</sup>
Puddles	11.9 ± 3.5 (7.75)	5.1 ± 4.3 (10.95)	4.1 ± 1.9 (2.49)	9.1 ± 3.6 (7.84)	30.1 ± 3.6 <sup>c</sup> (7.26) <sup>a</sup>
Marsh lands	29.6 ± 7.1 (19.38)	25.8 ± 9.1 (18.75)	25.3 ± 11 (15.41)	18.7 ± 8.3 (16.13)	99.3 ± 4.5 <sup>a</sup> (17.42) <sup>a</sup>
Agriculture fields	30.3 ± 10.0 (19.81)	17.9 ± 9.5 (12.95)	24.0 ± 11.9 (15.20)	23.8 ± 6.4 (20.52)	96.7 ± 5.1 <sup>a</sup> (17.12) <sup>a</sup>
Canals	20.4 ± 11.7 (13.37)	15.2 ± 8.7 (11.01)	14.0 ± 4.9 (8.04)	11.2 ± 1.7 (9.72)	61.2 ± 3.8 <sup>b</sup> (10.54) <sup>b</sup>
Streams	14.9 ± 5.7 (9.72)	9.9 ± 6.5 (7.14)	13.27 ± 5.1 (23.09)	9.7 ± 7.2 (8.42)	47.6 ± 2.5 <sup>c</sup> (12.09) <sup>b</sup>

\* Mean ± SD followed by the same letter in column do not differ significantly at p = 0.05 according to DMRT.

**Table 2. ANOVA for different habitat used by *L. punctata* in different years.**

Source of variation	Sum of squares	df	Mean sum of square	F (Calculated)	F (Tabulated)
Between the groups (Years)	85.131	3	28.377	2.979*	3.01
Between sum of squares (Habitats)	1125.131	8	140.641	14.767**	3.36
Residual	219.057	24	9.529		

\*\* = Significant at p = 0.01, \* = Insignificant at p = 0.05.

In 1999, about 800 *L. punctata* were captured from airport and kept in Mirpur Zoo, Dhaka. The enclosure was watered and turtles were released, they were burrowed under the silt clay soil. At droughts almost all the turtles were died due to

dryness and adhesive characteristics of the clay soil. Those turtles failed to release themselves from the sticky nature of the soil. During the present study it was observed that the turtle species avoided clay soil as their burrowing habitat, it

seems that when clay soil dried up, the eyelids and skin of the turtles become tightened with the clay soil.

**Terrestrial Habitat:** Spotted flapshell turtle used the terrestrial habitats like, grasslands (n = 42, 32%), alongside the bushes (n = 25, 19%), dry and semi-dried weeds (n = 22, 17%), vegetable garden (n = 23, 18%), straw and dry soil of agriculture fields and other vegetation cover (n = 18, 14%), as hibernating or aestivating place. Besides, it crossed roads, agriculture lands in search of suitable habitats. Turtle were also found to use bank of ponds, tanks, canals and other waterbodies for burrowing, basking and nesting purposes. Twenty three turtles were collected from cultivated lands under vegetations in winter months. Moreover, paddy fields, jute, sugarcane cultivated lands, reed beds and long grass growing areas were used for their habitats. It seems these habitats had sufficient moisture and cover, which saved the turtles from desiccation. The turtle seem to have a considerably higher temperature tolerance in the wild. Bhupathy and Vijayan (1994) mentioned that it has the highest temperature tolerance. Auffenberg (1981) reported that it has the well adaptation both morphologically and behaviorally to drought conditions. During daytime, captive *L. punctata* were observed to take shelter under loose soil and at night they frequently moved around the mini ponds and cemented tank in the enclosure. Their movement was higher in the morning and evening than noon. Bennett *et al.* (1970) stated that the turtle travel overland during summer in search of suitable aestivation sites when water bodies were dried.

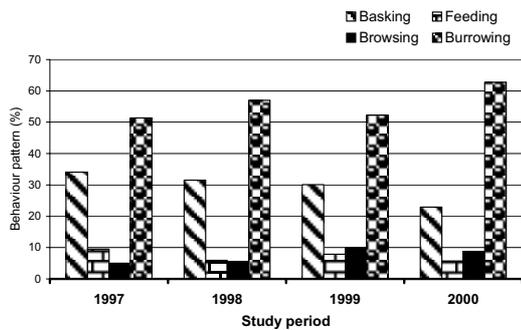
**Basking Habitat:** Spotted flapshell turtles were found to spend a considerable time for basking in the sunny day on floating materials (n = 37), emergent objects (n = 26), sand bars and on the bank of waterbodies (n = 20). During the study period, *L. punctata* was found basking on long

floating logs at the middle of a ditch (n = 3), and a canal at the village Bhasnakhal; Twelve *L. punctata* were also found on the bank of canals (n=5), ditch and ponds at village Koladhy and Dingabanga of Chandpur district. Three specimens were observed basking at the bank of mini pond in the village Zitka, Arua Union, Manikganj.

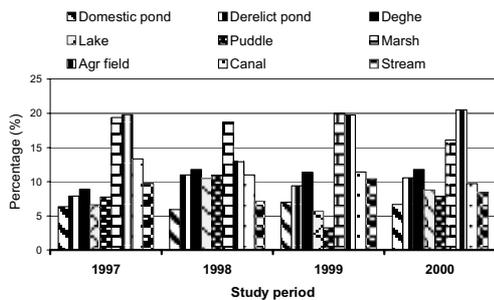
In captive condition, the turtle was found to bask on the driftwood (n = 14), and the elevated portion in the middle of the cemented tank at daytime (n = 33). Sometimes it was found basking on the bank of mini ponds. They were ready to drop into water by a little disturbance. The basking habit of the turtle was common in winter and parts of summer. The turtle extended its neck and raised head with spreading limbs while basking. Chen (1976) and Barbour and Ernst (1989) reported that the turtle inhabits shallow waterbodies often climb to water edge to get the warmth of the sun.

**Feeding Habitat:** In captive condition it was found that the turtle fed them from the bottom of waterbodies (mini ponds, aquaria, cemented tanks). The limbs were used for swim swiftly and extended its neck to catch the food. The captured foods were consumed by tearing with the help of forelimbs and the sharp shield like teeth. They preyed garden snails, earthworms and also terrestrial insects i.e. beetle, grasshopper, field cricket, etc. by extending the protrude neck and by sharp claws. They were active to feed in the shallow waterbodies and marshlands at rains in captivity.

**Browsing Habitat:** The turtle was found browsing in the bottom layer of the shallow ditches, marshlands by extending its neck in search of prey. Moreover, in rainy day it moved frequently in and around the mini ponds and cemented tank. Rarely, it was observed browsing on the surface of the water but used the edge of waterbodies as browsing habitat. The turtle was observed to respire at times after few minutes (7–20 minutes).



**Fig. 1. Habitats used by *Lissemys punctata* from 1997-2000.**



**Fig 2. Behaviour patterns of *L. punctata* in nature from 1997-2000.**

**Burrowing Habitat:** The turtle species was found in burrowing condition in the betel leaf garden (n = 41), turmeric and pineapple garden (n = 16), homestead forest (n = 13), bamboo clusters (n = 04), lechi orchard (n = 5), vegetable garden (n = 5, 6%), (n = 18), paddy field (n = 17), farmlands (n = 08), bush along the roadsides (n = 06), irrigation canals(n = 12), fallow lands (n = 15) under dry weeds and rotten materials (n = 19), etc. They remained buried under mud or loose soil along the banks of ponds, canals, ditches, drains near water edge covered by herbaceous plants and bushes (n=13).

The turtle made burrow quickly within 16 to 25 minutes (mean  $20.4 \pm 3.0$  min, n = 17) by the claws of fore and hind limb and neck. They

completely buried themselves under soil of 5 – 10 cm (mean  $7.14 \pm 1.6$  cm) (n = 19) and keeping narrow passages between air and nostrils for respiration. It is thought that the turtle covered themselves to prevent from dryness and predation. Gregory (1982) reported that *L. punctata* burrowed and remained dormant until rain occurs. Bhupathy and Vijayan (1989) stated that the turtle remains in the aestivation site until normal condition return till the monsoon. Nicolas (1995) cited that the turtle always solitary appeared to be aestivating predominantly in east facing crevices. Hans (1964) stated that the turtle spends part of the year either in hibernation or aestivation, with much reduced activity; this finding provides a good support to the present findings. Sarker and Hossain (1997) revealed that the turtle burrowed its body completely within 10-20 minutes in the ground, made air hole for respiration. Bhupathy and Vijayan (1989) stated that the more stable habitats were bushes, adjacent to the drying marsh, the habitat has sufficient moisture and cover.

**Comparison of Habitats:** In the four years study, the highest number of *L. punctata* of all ages was found as burrowing and the lowest browsing (Table 3). Of the total turtles observed in the field, the mean highest percentage was found as burrowing (55.48%) followed by basking (30.08%), feeding (7.37%) and browsing (7.07%) in 1997-2000 (Fig. 2). There was a significant difference among the behaviour patterns of *L. punctata* in different years (F = 89.014, df = 3/12 and p < 0.01) (Table 4).

The present investigation shows that this species can acclimatize all types of habitat and maintain the ecological balance. The study reveals that it is possible to establish turtle farming commercially to mitigate the gradual demand of protein for the ethnic groups in the country and for export to foreign countries.

**Table 3. Behaviour patterns of *L. punctata* in nature (1997–2000) (figures in parenthesis show percentage of occurrence).**

Behaviour patterns	1997	1998	1999	2000	Mean $\pm$ SD* DMRT	Percentage
Basking	52.1 $\pm$ 7.2 (34.12)	43.5 $\pm$ 9.1 (31.58)	37.8 $\pm$ 8.2 (30.03)	26.5 $\pm$ 6.3 (22.89)	(29.66) <sup>b</sup>	
Feeding	14.5 $\pm$ 9.4 (9.5)	8.2 $\pm$ 6.9 (5.93)	9.8 $\pm$ 7.0 (7.80)	6.6 $\pm$ 5.7 (5.58)	9.8 $\pm$ 3.0 <sup>c</sup> (7.2) <sup>c</sup>	7.37
Browsing	7.7 $\pm$ 6.1 (5.02)	7.6 $\pm$ 5.2 (5.51)	12.5 $\pm$ 6.4 (9.92)	10.0 $\pm$ 4.6 (8.71)	9.4 $\pm$ 2.0 <sup>c</sup> (7.29) <sup>c</sup>	7.07
Burrowing	78.4 $\pm$ 22 (51.36)	78.5 $\pm$ 35.1 (56.98)	65.8 $\pm$ 26.2 (52.25)	72.6 $\pm$ 23.9 (62.71)	73.8 $\pm$ 5.2 <sup>a</sup> (55.83) <sup>a</sup>	55.48

\* Means  $\pm$  SD followed by the same letter in column do not differ significantly at  $p = 0.05$  according to DMRT.

**Table 4. ANOVA for behaviour patterns of *L. punctata* in different habitats.**

Source of variation	Sum of squares	df	Mean sum of square	F (Calculated)	F (Tabulated)
Between the groups (Behaviour patterns)	1618331	3	539443.8	89.014 **	5.95
Residual	72722.5	12	6060.208		

\*\* = Significant at  $p = 0.01$

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