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Diversity and Distribution of Turtles in Central valley of Manipur, India

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Abstract

Turtles or Testudines are one of the most threatened groups of animals. The turtles in Manipur had received little attention in terms of scientific surveys and conservation initiatives at this time. Poor idea of species occurrence, local distribution, and threat assessment amidst the apparent threat to existence has created information gaps. During the present study 5 species (Cuora amboinensis, Cyclemys dentata, Melanochelys trijuga, Amyda cartilaginea and Nilssonia hurum) from 2 families (Geoemydidae and Trionychidae) were physically recorded from the central valley of Manipur. New localities along with their coordinates were presented. We also present a checklist containing 7 species based on cumulative records. The turtles are facing threat from habitat destruction and anthropogenic pressure. More survey to other areas coupled with conservation and management effort in behalf of this fauna is urgently needed.

Keywords: Turtles, Chelonians, Testudines, Checklist, Manipur, Central valley, Wetland, Conservation.

Introduction

Turtles are animals that belong to order Chelonii or Testudines under class reptilia. They are distinguished by the presence of bony or cartilaginous shell developed from their ribs. Turtles are included amongst the most endangered fauna in the planet with nearly half of their existing species facing the threat of extinction[1]. Indian subcontinent harbouring 33 chelonia species is one of the region in the world having the highest turtle diversity[2] of which 23species are found in Northeast India[3]. The northeast India covering almost 7.6% of India's geographical area is highly biologically diverse. The region falls under Indo-Myanmar biodiversity hotspot[4] and supports varied physiognomic and habitat features ranging from tropical to alpine[5] and is considered a significant place having highest turtle diversity [6]. The region has also been recently acclaimed as a tortoise and freshwater turtle priority conservation area[7].

The hilly Indian state of Manipur is situated in eastern border of northeast India and is located between Myanmar in the east, Mizoram in the south, Assam in the west and Nagaland in the north. Ninety percent of the state is covered by hills which surrounds an oval shaped central valley that accounts for almost 10% of the state area. The central valley of Manipur is an intermontane basin that lie at an average elevation of 760m ranging from 93°42' to 94°11' E and 24°41' to 25°06' N stretching 70 km length north-south and 30-35 km length east-west. It consists of four administrative districts namely Imphal East, Imphal West, Thoubal and Bishnupur. The central valley is home to many marshes, lakes and small rivers flowing down from surrounding hills.

The valley is drained by Manipur river system which comprises of Imphal river (or Manipur river) and its tributaries like Thoubal, Iril, Khuga and Chakpi. Imphal river is also called by the name Manipur river at its lower course. These varied microhabitats provide a perfect place to support rich variety of turtles. Routine survey to document the diversity and distribution of turtles is essential, so as to understand their status of existence, which in turn may help in timely implementation of a scientific based conservation strategy for this dwindling fauna population. But there are few scientific surveys and conservation initiatives in respect to turtles of central valley Manipur at this time. In this paper we report the diversity and distribution of turtle species found in the central valley of Manipur.

Materials and Methods

A study to determine the diversity and distribution of turtle species in central valley Manipur was performed during 2011 to 2013. The study consists of an initial Interview and questionnaire (I&Q) survey with minimum 15 sampling size on some selected locations to locate potential turtle habitats, followed by field survey upon the areas located through I&Q survey. Field survey in terrestrial ecosystem was done using visual encounter surveys[8]. In aquatic ecosystems fishing and trapping gears were used for turtle capturing. Deployed were regularly checked to prevent accidental drowning. Incidental or accidental catch by local fisherman were also recorded. The gears used were: a. Box trap (Taijep), b. Cast net (Nupa-een), c. Throw net (Nupa-een), d. Lift net (Nupi-een), e. Tubular-trap (Lu), f. Spindle-shaped tubular trap (Taothum-lu).

Coordinates were recorded using Garmin E-Trex H. Specimens obtained from sources other than our field assistants were also assigned coordinates by identifying the encountered site. All photographs in the paper were taken by the author. Body lengths were measured using simple measuring tape and vernier calipers. Body weight was taken using spring balance (±50 grams). Species were identified [6,9]. Subsequently the specimens after study were released into their respective habitats.

Results and Discussion

During the present study 3 species from Geoemydidae family, 2 species from Trionychidae family with a total number of 33 individuals from 5 species were physically recorded from the central valley of Manipur.

Figure-1
Cuora amboinensis

Figure-4
Nilssonia hurum

Figure-2
Floating vegetation mass locally called Phumdis of varying size is abundant in Loktak lake

Figure-5
Amyda cartilaginea

Figure-3
Cyclemys dentata

Figure-6
Melanochelys trijuga

Table-1
Distribution of different turtle species in the central valley of Manipur recorded during the present study

Site	Coordinates	Elev (msl)	Dist	Sex	SCL	BW	Site significance
	Cuora amboinensis						
Canchipur	24°44'33.76"N 93°56'40.13"E	779	IE	M	12	350	IMR bank
Urup	24°43'13.87"N 93°58'11.99"E	788		F	15.5	800	IR
Hitangthang	24°43'10.31"N 93°54'02.95"E	776	IW	F	17.1	900	NR
Phoubackchao	24°32'51.74"N 93°51'24.62"E	769		F	18.2	1100	LL
	24°32'35.38"N 93°51'30.76"E	769		M	11.9	400	LL
Laphupat tera	24°27'39.09"N 93°51'18.93" E	769		F	17	1000	LL outlet drainage
	24°28'11.64"N 93°51'47.31"E	769		F	13.5	500	LL
Phubala	24°32'06.97"N 93°45'55.03"E	769	BPR	M	11.1	300	LL
	24°32'13.91"N 93°45'47.05"E	769		Ju	8.9	100	LL
Ningthoukhong	24°34'44.03"N 93°45'55.67"E	769		F	17	800	LL
[a]Khoijuman Khullen	24°35'39.01"N 93°47'08.79"E	769		M	12	400	LL
[a]Thanga	24°29'56.86"N 93°45'55.67"E	769		F	13.2	600	LL
[a]Toubul	24°37'09.67"N 93°48'14.16"E			M	11.9	400	Paddy field
Keibul heiga	24°29'47.11"N 93°49'46.44"E	769		F	12	400	KNLP
	24°29'43.12"N 93°49'45.64"E	769		Ju	7.4	100	KNLP
	24°29'12.43"N 93°49'29.36"E	769		M	18	1300	KNLP
Lilong	24°42'13.55"N 93°55'11.57"E	779	TBL	F	16.4	800	IMR
	24°42'14.00"N 93°54'52.85"E	779		F	16	740	IMR
Irong Ichil	24°38'22.60"N 93°55'09.37"E	780		M	11	320	IMR bank
Arong Nongmaikhong	24°26'45.14"N 93°53'50.46"E	770		M	17	800	PL
	24°26'33.00"N 93°53'53.43"E	771		F	13.5	500	PL
Tokpaching	24°25'48.24"N 93°52'59.99"E	771		Ju	9.8	200	PL
	24°25'50.33"N 93°52'59.18"E	771		Ju	8.3	150	PL
Nungpakthabi	24°25'30.81"N 93°53'22.07"E	776		M	11.5	400	PL
	Melanochelys trijuga						
Keibul Heiga	24°29'47.11"N 93°49'46.44"E	770	BPR	M	19	1350	KNLP
	Cyclemys dentata						
Urup	24°43'47.72"N 93°58'39.71"E	785	IE	F	24	2050	IR bank
[a]Sadu koireng	25°01'39.59"N 94°01'37.63"E	809	IE	F	20.5	1300	Near IR
Laphupat Tera	24°27'37.67"N 93°51'37.58"E	773	IW	F	19.5	1000	IMR
[a]Toupokpi	24°15' 23.29"N 93°53'26.10"E	778	TBL	M	23	2000	CR
[a]Wangoo Tera	24°22'40.68"N 93°51'03.07"E	774	BPR	M	22	1800	MR bank
	Nilssonia hurum						
Irong Ichil	24°38'24.10"N 93°55'09.22"E	780	TBL	F	32.8	5100	IMR
Laphupat Tera	24°28'14.28"N 93°51'50.37"E	772	IW	F	23.6	3750	LL outlet drainage
	Amyda cartilaginea						
[a]Tangjeng Khunou	24°19'31.80"N 93°51'22.54"E	768	BPR	M	23.1	3850	MR bank

[a]Specimen from other sources. Elev(msl): Elevation from mean sea level; IE: Imphal east district; IW: Imphal West District; TBL: Thoubal district; BPR: Bishnupur district; J: Juvenile; IMR: Imphal river; IR: Iril river; MR: Manipur river; NR: Nambul river; CR: Chakpi river; LL: Loktak lake; PL: Pumlen lake; KNLP: Keibul Lamjao National Park; SCL: Straight carapace length (in centimetres); BW: Body weight (± 50grams). Imphal river is also known by the name Manipur river at its lower course.

The three species under family Geoemydidae are *Cuora amboinensis, Cyclemys dentata* and *Melanochelys trijuga*. Geoemydidae is characterised by webbed toes, flexibility in joining of pelvic girdles to plastron, vertically withdrawn neck, and 12 scutes at dorsal carapace. The two species under family Trionychidae are *Amyda cartilaginea* and *Nilssonia hurum.* Trionychidae is characterised by lack of horny scutes in carapace, presence of leathery skin, webbed toes and three claws. Species *C. amboinensis* and *C. dentata* were however observed in wild in Imphal East and Imphal West districts in 2011[10]. The most abundant among them was *C. amboinensis,* found in all 4 districts in the central valley of Manipur. Various localities, coordinates, Straight carapace length (SCL) and Body weight (BW) were represented in Table-1.

***Cuora amboinensis* (Malayan Box Turtle):** *C. amboinensis* is found in the freshwater bodies of northeast India, Bangladesh, East and Southeast Asia[11]. The species is characterised by domed shaped and olive brown to blackish brown shell along with a V shaped yellow strip at the side of the head. The ecology and RAPD based diversity of the species in Manipur specially around Loktak region has been described[12].

During the present study *C.amboinensis* (Figure-1) was found in most of the wetlands of central valley. 25 out of total 34 turtle individuals encountered from central valley of Manipur turned out to be the *C. amboinensis.* The biggest, a female (SCL 18.2cm; BW 1100±50g) was found in Loktak lake above a phumdi at Phoubackchao, a village at the eastern side of the lake. Phumdis are floating vegetation mass abundant in Loktak lake (Figure-2). Phumdis are rich in aquatic biodiversity and is composed of heterogeneous mass of organic matter at different stages of decomposition. The heaviest, a male (BW1300±50g) was also found above a Phumdi at Keibul Heiga village, Keibul Lamjao National Park. The smallest juvenile (SCL 7.4 cm; BW 100±50 g) was also found nearby the same area. Keibul Lamjao National Park, a southern extension of Loktak lake mainly consists of floating Phumdis making it the only floating national park in the world. Three individuals were encountered from Keibul Heiga, a village at Keibul Lamjao National Park periphery. It has been stated that there had been a mass death of the species during 1990's when the park was burnt out. The species had also reportedly been found at nearby Toya Ching (Toya hill) and Pabot ching (Pabot hill) inside the park, although we have not surveyed there. A specimen was also found by a farmer from paddy field of Toubul near Loktak lake. Maximum encounter during the study took place in Loktak lake (93°46' to 93°55' E and 24°25' to 24°42'N), the largest freshwater wetland in Manipur, a Ramsar site. Within Loktak, the species was encountered mostly from the western shore in

Bishnupur district and eastern shore at Phoubackchao area in Imphal west district. Three individuals were also found from Pumlen lake. Loktak and Pumlen, the two biggest lakes with an area of 288 Km² and 32.26 Km² respectively cover nearly 32,694 hectares (75 per cent) wetlands area within the Central Valley[13].

Six individuals were also located from different drainage of the central valley. The species is found at various points of Imphal river. Interestingly one *C.amboinensis* individual was found from one of the most polluted rivers of the state, the Nambul River at Hiyangthang. The distribution of *C. amboinensis* across various wetlands and streams including the polluted river shows its high adaptability to various habitats. A total of 9 males, 11 females and 4 juvenile were recorded during the study. Male do possess slightly concave plastron, thicker tails while females do have almost flat plastron and shorter tail. Maximum encounter took place during monsoon in Loktak Lake.

***Cyclemys dentata* (Asian Leaf Turtle):** *C. dentata* is found in almost all East and Southeast Asian countries ranging from north-eastern India, Bangladesh, Myanmar, Thailand, Cambodia, Laos, Vietnam, China, Philippines, Malaysia and Indonesia. The subtle species normally inhabit the clear freshwater stream or rivers flowing in the lowlands or hills. *C dentata* is found in Philippines[14], Beris Valley, Kedah, Malaysia[15], Palawan Island Group, Philippines[16] and probably in Nepal[17].

Locally, five individuals of *C. dentata*, 2 males and 3 females were encountered from the valley during the present study. It has a prominent vertebral keel and fine lines radiating from centre of each plastral scute. Males possess concave plastron while the female have almost flat plastron. The biggest specimen, a female (Figure-3) having SCL 24 cm, BW 2050±50 g was found from the Iril river at Urup village, Imphal east. The species was also found from Imphal river at Laphupat Tera, Chakpi River at Toupokpi village, Manipur river at Wangoo Tera Khokmakhong. Another specimen was found by trespassers nearby Iril river in a small tree covered area at Sadu Koireng, a village at an elevation of 809 msl at foothill of forested Senapati district hills. Loktak Lake outlet drainage passes at Laphupat Tera. Chakpi river flowing from southern hilly Chandel district is a tributary of Imphal river (Manipur river) joining Imphal river at southern valley. Imphal river at its lower course in southern valley is also known by the name Manipur river.

***Nilssonia hurum* (Peacock Soft-shelled Turtle):** *N. hurum* inhabits rivers and reservoirs[18]. The species is distributed across Bangladesh, eastern Pakistan, north, central and east part of India and southern part of Nepal[18]. During the present survey 2 female adult *N. hurum* were found in different locations of the valley. A female (SCL 32.8cm; BW 5100±50 g) was found from Imphal river at Irong Ichil, Thoubal district. Another female (Figure-4) having SCL 23.6 cm, BW 3750±50 g was also found near the drainage of Laphupat Tera.

***Amyda cartilaginea* (Asiatic softshell turtle):** *A. cartilaginea* normally inhabit a wide variety of wetlands including rivers, hill

streams and swamps. The species is distributed across southeast Asia ranging from India, Bangladesh Myanmar, Thailand, Vietnam, Cambodia, Laos, Malaysia, Brunei Darussalam, Indonesia and some parts of china[19].

During the present study a male adult *A. cartilaginea* (Figure-5) having SCL 23.1cm, BW 3850±50 g was found by villagers from the Imphal River, at Tangjeng Khunou village, Bishnupur district. Chakpi River meets Manipur River upstream of this site. During the current survey some villagers have reported the encounter of softshell turtle inside the Keibul Lamjao National Park. According to their description the species may be either *A. cartilaginea* or *N. hurum*. Due to lack of minute observations by fisherman they could not recall the differences between the species from the identification book. But during our study we have not been able to physically locate any softshell turtle inside Keibul Lamjao National Park.

***Melanochelys trijuga* (Indian Black Turtle):** *M. trijuga* ranges from North-eastern India to peninsular India, Bangladesh, Nepal, Sri Lanka, Myanmar, Thailand, and perhaps Pakistan[20]. The species inhabits a wide range of freshwater habitats and is mainly active at night, dawn or dusk while burrowing during daytime[21]. During the present survey one male adult *M. trijuga* (Figure 6) having SCL 19cm, BW-1350±50g was encountered above a phumdi near a water stream at Keibul Heiga village at the periphery of Keibul Lamjao national park.The species is fond of shady places and active at night[22].

Most effective trapping was for all species was found to be box traps locally called 'Taichep' placed in narrow channels connecting two water bodies (Figure 7). It was not submerged completely to prevent trapped specimen from drowning. All the individuals of different species after examination were released back into its habitat (Figure 8). Among different habitats Manipur river system supports 4 turtle species (*C.amboinensis*, *C.dentata, A.cartilaginea* and *N.hurum*). Manipur river system draining across hills and valley provides a good habitat for freshwater turtles residing both hilly and valley streams. Loktak lake support 2 species (*C.amboinensis* and *N.hurum*). Keibul Lamjao National Park supports 2 species (*C.amboinensis* and *M.trijuga*). As Loktak lake and Keibul Lamjao National Park are interconnected, the joint water body can be said to supports 3 turtle species (*C.amboinensis, M.trijuga* and *N.hurum*). Pumlen lake supports *C.amboinensis*. Loktak Lake and Pumlen lake has open water area and has rich aquatic flora and fauna making it a favourite habitat for freshwater turtles.

Keibul Lamjao National Park, the last home to endangered *Cerves eldi eldi,* has also rich aquatic floral and faunal diversity making it a favourite habitat for freshwater turtles. Nambul river support *C.amboinensis.* The presence of *C.amboinensis* in polluted Nambul river displays its greater adaptability to different environments. During the present study females outnumber males. Maximum encounter of turtles took place during species *C.amboinensis , C.dentata, A.cartilaginea and M.trijuga.* Thoubal district got 3 species *C. amboinensis, C dentata* and *N.hurum*. Imphal West got 3 species *C.amboinensis, C.dentata*, and *N.hurum*. Imphal East got *C.amboinensis* and *C.dentata*. Park, the last home to endangered *Cerves eldi eldi,* has also rich aquatic floral and faunal diversity making it a favourite habitat for freshwater turtles. Nambul river support *C.amboinensis.* The presence of *C.amboinensis* in polluted Nambul river displays its greater adaptability to different environments. During the present study females outnumber males. Maximum encounter of turtles took place during southwest monsoon season. Bishnupur district got 4 turtle species *C.amboinensis, C.dentata, A.cartilaginea and M.trijuga.* Thoubal district got 3 species *C. amboinensis, C dentata* and *N.hurum*. Imphal West got 3 species *C.amboinensis, C.dentata*, and *N.hurum*. Imphal East got *C.amboinensis* and *C.dentata*.

Figure-7
Turtles after study were released back into habitat. (Photograph by N. Somorjit).

Figure-8
Box trap placed partially submerged in narrow passage connecting two water bodies. (Photograph by Habibullah Qaiser)

The oval shaped central valley surrounded by hills on all its sides is characterised by streams and rivers flowing down from surrounding hills. It has plenty of wetlands as 99% of the wetlands area of the state lies in the valley[13]. Wetlands are spread in all corners, but mostly in southern part of the valley where Loktak Lake, Pumlen lake and Keibul Lamjao National park is located. Bishnupur districts have ample of water bodies like Loktak Lake, Keibul Lamjao National Park, Nambol River, Imphal River and Khuga river. Thoubal district has Manipur river system, Pumlen lake, Ikop Lake, Kharung lake etc. Imphal east has Manipur River system and some pocket of wetlands. Imphal west has Imphal river, Loktak Lake and other pockets of wetlands. *C. amboinensis* got distributed in all districts and water bodies ranging from standing big freshwater lake to polluted river. *C. dentata* was found in Manipur river system draining different districts of the valley. *M.trijuga* was found in phumdi covered wetland of Keibul Lamjao National Park. *N. hurum* was found both in standing freshwater Loktak lake and Manipur river system. *A. cartilaginea* was found in Manipur river system.

Besides the species *Morenia petersi* and *Pangshura tentoria*[23] could not be observed during the present study. The habitation of these species in the area need further study. Considering the secondary sources, the valley is home to 7 turtle species belonging to 2 families, Geoemydidae and Trionychidae. A cumulative list of turtle fauna so far recorded from central valley of Manipur based on the current survey and other literatures is presented in Table-2. During the present study only freshwater turtles and no terrestrial turtles (Family Testudinidae) were physically encountered in the valley.

Freshwater turtles inhabit river, ponds, marshes and lake performing various roles in the ecosystem. They too comprise a main biomass of aquatic ecosystem performing substantial role in the energy flow[24]. Turtles owing to its high sensitivity to their environmental and habitat changes lead to turtle family disappearances[25]. Almost all the turtle species are threatened due to habitat destruction and uncontrolled exploitation by man [26]. Their population is waning worldwide due to illegal harvest, habitat loss and fragmentation, unintentional trapping in fishing gears, pet trade, predation by other higher animals[27].

The region with rich turtle diversity has a dark side too. The small stretch of valley is filled with sprawling human settlements and some river get polluted as they pass through urban areas. The wetlands of the region which are the primary habitats of the freshwater turtles are also being threatened. The two main lakes, the Loktak lake and Pumlen lake is shrinking, while some other smaller ones got dried up and some are near to extinction [13]. Much of the areas under the lakes were transformed into agricultural lands, fish farms, settlements and other infrastructure owing to increased population pressure in the areas. In many cases the wetlands are fragmented due to construction of roads through it. Many small rivers from surrounding hills are drained into Loktak and most significant among them is highly polluted Nambul river which carries urban waste from Imphal urban area. The unchecked deforestation in catchment areas increases soil erosion and siltation making Loktak lake shallower. Agricultural runoff from surrounding fields, organic and inorganic pollutants from the rivers especially Nambul river are also drained into the lake causing eutrophication, and pollution. As fishing is one of the main activities of the people around the lake, lot of fishing traps meant to catch fish are placed completely submerged in water and so any accidental trapping of turtle led to drowning. But there is little consumption of turtles as meat in the valley region. Therefore the threat facing the fauna in the valley is not from consumption as meat but mainly from habitat destruction and anthropogenic disturbances. Three among the five species recorded during the present survey are listed[28] as Vulnerable species.

Table-2
Turtle fauna so far recorded from central valley of Manipur based on the current survey and other literatures.

Turtle species	Common name	Localities/Places from where turtles were encountered	IUCN status
	Family Geomydidae		
Cuora amboinensis	Malayan Box Turtle	LL, PL, KLNP, MRS, NR	.VU
Cyclemys dentata	Asian Leaf Turtle	MRS	LR/NT
Melanochelys trijuga	Indian Black Turtle	KNLP	LR/NT
Pangshura tentoria[23]	Indian Tent Turtle	Lamphelpat, IW	LR/LC
Morenia petersi[23]	Indian Eyed Turtle	Chingmeirong, IE	VU
	Family Trionychidae		
Amyda cartilaginea	Asiatic softshell turtle	MRS	VU
Nilssonia hurum	Peacock Soft-shelled Turtle	LL, MRS	VU

LL: Loktak lake; PL: Pumlen lake; KLNP: Keibul Lamjao National Park; MRS: Manipur river system; NR: Nambul river; IE: Imphal East district; IW: Imphal West district; VU: Vulnerable; LR/NT: Lower Risk/Near Threatened; LR/LC = Lower Risk/Least Concern.

Devoid of focussed strategic conservation effort, a sizeable portion of chelonian diversity might be lost over the next century[7]. Therefore a scientific based regional management and conservation effort to save the species is urgently needed. The hilly region which surrounds the valley accounts for around 90% of the geographical area of the state also needed to be studied. More survey is essential to identify new species and localities in both hill and valley. More inventories of different species are expected from the region.

Conclusion

During the present study a total of 33 turtles from 5 species (*Cuora amboinensis, Cyclemys dentata, Melanochelys trijuga, Amyda cartilaginea and Nilssonia hurum*) from 2 families (Geoemydidae and Trionychidae) were physically recorded from the central valley of Manipur. Considering earlier literatures a total of 7 species (*C. amboinensis, C. dentata, M. trijuga, A. cartilaginea, N. hurum M. petersi* and *P. tentoria*) have been reported from the valley till date. Most of the natural encounter takes place during monsoon. The fragmentation and diminishing wetlands due to increased anthropogenic pressure is making its toll on the existence of the turtle species in the region. A broad based scientific based systematic management and conservation effort is urgently needed to save the species. Further survey and threat assessment is essential especially on the hilly regions of Manipur. More diversity, new localities of different species is expected from the region.

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References

1. Alacs E.A. (2007). Genetic Issues in Freshwater Turtle and Tortoise Conservation. *Defining Turtle Chelonian Research Monographs,*4, 107-123.

2. Bhupathy S. (2009). Status, distribution and ecology of Indain Flagship turtle, Lissemys Punctata. K. Vasudevan (Ed.), Freshw, Turtles Tortoises India, Envis Bull. Wildl. Prot. Areas., Wildlife Institute of India, Dehradun, India, 91-95.

3. Baruah C. and Sharma D.K. (2009). Checklist of turtle fauna so far recorded from northeast India. *Environmental Education*. 1(1), 10-13.

4. Mittermeier R.A., Turner W.R., Larsen F.W., Brooks T.M. and Gascon C. (2011). Global Biodiversity Conservation: The Critical Role of Hotspots. E.F. Zachos, C.J. Habel (Eds.), Biodivers. Hotspots, Springer Berlin Heidelberg, Berlin, Heidelberg, pp, 3-22.

5. Champion H. and Seth S.K. (1968). A Revised Survey of the Forest Types of India. The Manager of Publications, Government of India, New Delhi, 404.

6. Das I. (1995). Turtle and tortoises of India. World Wide Fund for Nature- India and Oxford University Press, Bombay, 176.

7. Buhlmann K.A., Akre T.S.B., Iverson J.B., Karapatakis D., Mittermeier R.A. and Georges A. et al. (2009). A Global Analysis of Tortoise and Freshwater Turtle Distributions with Identification of Priority Conservation Areas. *Chelonian Conservation and Biology*, 8(2), 116-149.

8. Heyer W.R., Donnelly M.A., McDiarmid R.W., Hayek L.C. and Foster M.S. (1994). Measuring and monitoring biological diversity: standard methods for amphibians. Smithsonian Institution Press, Washington.

9. Ahmed M.F., Das A. and Dutta S.K. (2009). Amphibians and Reptiles of Northeast India- A Photographic Guide. Aaranyak, Guwahat, 168.

10. Qaiser H. and Sharma D.K. (2012). Diversity and distribution of turtle fauna in Imphal East and Imphal West districts of Manipur, India. Global Publishing house, Vishakhapatnam, India, 200-213, ISBN978-93-81563-15-1.

11. Schoppe S. and Das I. (2011). Cuora amboinensis (Riche in Daudin 1801) - Southeast Asian Box Turtle. *Chelonian Research Monographs*., 5(1991), 053, 1- 053, 13.

12. Linthoi N. and Sharma D.K. (2013). Diversity of turtle fauna of Manipur with special reference to the ecology of Cuora amboinensis Daudin in Loktak lake Manipur. Doctorate Thesis, Gauhati University, India, 1-185.

13. Singh A.L. and Moirangleima K. (2009). Shrinking Water Area in the Wetlands of the Central Valley of Manipur. *The Open Renewable Energy Journal*., 2(1), 1-5.

14. Gaulke M. (1995). On the distribution of Emydid turtles and the Anuran genus Microhyla in the Philippines. *Asiatic Herpetological Research*., 6, 49-52.

15. Shahriza S., Ibrahim J., Nurul Dalila A.R. and Muin M.A. (2011). An Annotated Checklist of the Herpetofauna of Beris Valley, Kkedah, Malaysia. *Tropical Life Sciences Research*, 22(1), 13-24.

16. Fidenci P. and Castillo R. (2009). Some data on the distribution, conservation status and protection of freshwater turtles in the Palawan Island Group, Philippines. *Testudo*, 7(2), 76-87.

17. Aryal P.C., Dhamala M.K., Bhurtel B.P., Suwal M.K. and Rijal B. (2010). Species Accounts and Distribution of Turtles with Notes on Exploitation and Trade in Tarai , Nepal. First Natl. Youth Conf. Environ., Katmandu, 29-38.

18. Das I., Basu D. and Singh S. (2010). Nilssonia hurum (Gray 1830) - Indian Peacock Softshell Turtle. *Chelonian Research Monographs*. 5 (1980), 048.1- 048.6.

19. Auliya M., Van Dijk P.P., Moll E.O. and Meylan P.A. (2016). Amyda cartilaginea (Boddaert, 1770), Asiatic Softshell Turtle. *Chelonian Research Monographs*, 5(9), 092, 1-17.

20. Das I. and Bhupathy S. (2009). Melanochelys trijuga (Schweigger 1812) - Indian black turtle. *Chelonian Research Monographs*. 5, 038.1-038.9.

21. Karunarathna D.M.S.S. and Amarasinghe A.A.T. (2011). rescue actions of the "black turtle" melanochelys trijuga thermalis (reptilia: bataguridae) from sri lanka. *Herpetotropicos*., 7(1-2), 17-19.

22. Premkishore G. and Chandran M.R. (1996). Nesting studies of two freshwater turtles (Lissemys punctata punctata and Melanochelys trijuga trijuga) of Tamil Nadu, India, in the context of their conservation. *Annales Des Sciences Naturelles-Zoologie Et Biologie Animale*., 17, 99-104.

23. Linthoi N. and Sharma D.K. (2009). Turtles and Tortoises of Manipur. K. Vasudevan (Ed.), Freshw. Turtles Tortoises India, Envis Bull. Wildl. Prot. Areas., Wildlife Institute of India, Dehradun, India, 49-52.

24. Congdon J.D., Whitfield G.J. and Greene J.L. (1986). Biomass of Freshwater Turtles. *American Midland Naturalist,* 115(1), 165-173.

25. Bour R. (2008). Global diversity of turtles (Chelonii; Reptilia) in freshwater. *Hydrobiologia*., 595 (1), 593-598.

26. Burke R.L., Ford L.S., Lehr E., Mockford S., Pritchard P.C.H. and Rosado J.P.O. et al. (2007). Non-standard sources in a standardized world: responsible practice and ethics of acquiring turtle specimens for scientific use. *Chelonian Research Monographs*., 4, 142-146.

27. Rhodin A.G., Walde A., Horne B., van Dijk P.P., Blanck T. and Hudson R. (2011). Turtles in Trouble: The World's 25+ Most Endangered Tortoises and Freshwater Turtles—2011. Lunenberg, MA, USA., 1-58

28. IUCN (2016). The IUCN Red List of Threatened Species. Version 2015-4. (www.iucnredlist.org). 02/06/2016(Accessed: 02 Feb 2016).