Chapter 6
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Five freshwater turtle species (*Cuora amboinensis*, *Cyclemys dentata*, *Melanochelys trijuga*, *Amyda cartilaginea*, *Nilssonia hurum*) belonging to family Geoemydidae and Trionychidae was recorded from the central valley consisting of 4 districts namely Imphal east, Imphal west, Thoubal and Bishnupur during the present study. The turtle species *Cuora amboinensis* was located from wetlands of central valley only. The hilly Churachandpur district got at least 7 species (*Cyclemys dentata*, *Melanochelys trijuga*, *Cuora mouhotii*, *Nilssonia hurum*, *Amyda cartilaginea*, *Indotestudo elongata* and *Manouria emys*) from family Geoemydidae, Trionychidae and Testudinidae. Four species; *C. dentata*, *M. trijuga*, *A. cartilaginea* and *N. hurum* were common to both central valley and hilly district of Churachandpur. The turtles from the family Testudinidae were found from hilly district of Churachandpur only. Another turtle species *Cuora mouhotii* from Geoemydidae was also located from Churachandpur district only. Overall 8 turtle species *Cuora amboinensis*, *Cyclemys dentata*, *Melanochelys trijuga*, *Cuora mouhotii*, *Nilssonia hurum*, *Amyda cartilaginea*, *Indotestudo elongata* and *Manouria emys* were recorded from present study in Central valley and Churachandpur belonging to family Geoemydidae, Trionychidae and Testudinidae.

The availability of 5 freshwater turtle species from central valley Manipur may be due to the presence of abundant wetlands in the area. The reported presence of *M. petersi* and *P. tentoria* in central valley could not be recorded in this study.
Churachandpur harbours highest diversity (H= 1.92, D= 0.13) owing to its varied microhabitats and microclimate with different forest types and hilly streams.

Habitat parameters analysis of freshwater turtle habitats reveals that water temperature ranged from 16-27 °C. The pH ranged from 6.5 to 7.66 and was observed slightly acidic during cold seasons. Conductivity ranges from 108 to 409.67 μS/cm and was seen higher during monsoon. Loktak Lake showed higher transparency while Nambul showed lower transparency. Dissolve oxygen (DO) ranges from 3.39 to 8.09 with Loktak Lake and Imphal River having higher Dissolve oxygen (DO) and got higher values during winter while Nambul presents lower DO during winter. FCO₂ ranges from 5.30 to 27.43 with higher values during monsoon except Nambul. Nitrate ranges from 0.17 to 0.51 with value higher during wet seasons. Calcium ranges from 10.67 to 22.05 with values higher during warm and wet seasons. The freshwater turtle habitats Loktak Lake and Imphal River showed physico chemical parameters values well within permissible limits, while Nambul River DO (3.39) was below permissible limit prescribed by WHO. The occurrence of *Cuora amboinensis* at that low DO value of 3.39 mg/l in Nambul River signifies adaptability of the species at a low DO of 3.39mg/l.

The morphometric measurements of different species recorded during the present study is comparable to measurements provided by other workers from various regions of east and Southeast Asia. It signifies that there is very little size variation within same species across the region. It may be due to the similarity in climate and vegetation type between Manipur and East Asia. In the present study sexual dimorphism is evident in some adult turtle species in some features like plastron concavity and tail
features but no statistical significant variation is seen between males and females in morphometric measurements using Man Whitney U test. Better results are expected from larger sampling.

Genetic variation studies of *Manouria emys* from Churachandpur district, Manipur using cytochrome b displays genetic distinctness of *M. emys phayrei* and *M. emys emys* subspecies of Manipur. Nucleotide position differences were observed between *M. emys phayrei* and *M. emys emys* subspecies of Manipur. Evolutionary relationship using Maximum likelihood, Maximum parsimony and Neighbor–joining method showed separate clades for the two subspecies from Manipur. COI study of *M. emys* from Manipur reveals no nucleotide variations within the local specimens studied. But nucleotide position differences were observed between Manipur samples and sister population outside the state. Within the local samples no p-distance were observed irrespective of their subspecies, but showed p-distance distance of 0.027 from samples outside of state. The genetic variation studies based on R35gene intron reveal extremely low genetic polymorphism within the population. No nucleotide variation was observed within local samples. Evolutionary relationship based on cyt b, COI and R35 intron using Maximum likelihood, Maximum parsimony and Neighbor–joining method shows genetic distinctness of Manipur samples from their counterparts outside of Manipur by forming a separate clade. The specimen from Manipur also showed genetic distinction from their counterparts from other parts of Northeast India and East India. The predicted mRNA structures carry low free energy.
The predicted protein show non polar nature and displays high quality as observed from Ramachandran plot and ERRAT.

*Manouria emys* is classified as an endangered tortoise (IUCN, 2016) and is protected under Schedule IV of Wildlife (protection) Act, 1972. The population of this species faces number of threats mainly from anthropogenic source. The perception and practices of local people are important to make insight in to the conservation scenario prevailing in the area. The forest officials, NGO and conservationist must work together with the village chief to resolve the issue. Formal, non formal and informal education on conservation issues would also be an effective means of spreading conservation effort. Unfortunately the population bears very low genetic diversity. The long-term survival of this population, as with other similar populations being left behind will ultimately depend on the sincere conservation efforts, reintroduction of gene flow, either through range expansion along the Hill ranges across Mizoram, Assam, Myanmar or through the regular translocation of *Manouria emys*. The present investigation on genetic diversity of *Manouria emys* might be a beginning and might provide some inputs in resolving many of the conservation related issues.