

## Diversity and Distribution of Tortoises and Turtles in the Phibsoo Wildlife Sanctuary and Adjoining Areas in Southern Bhutan

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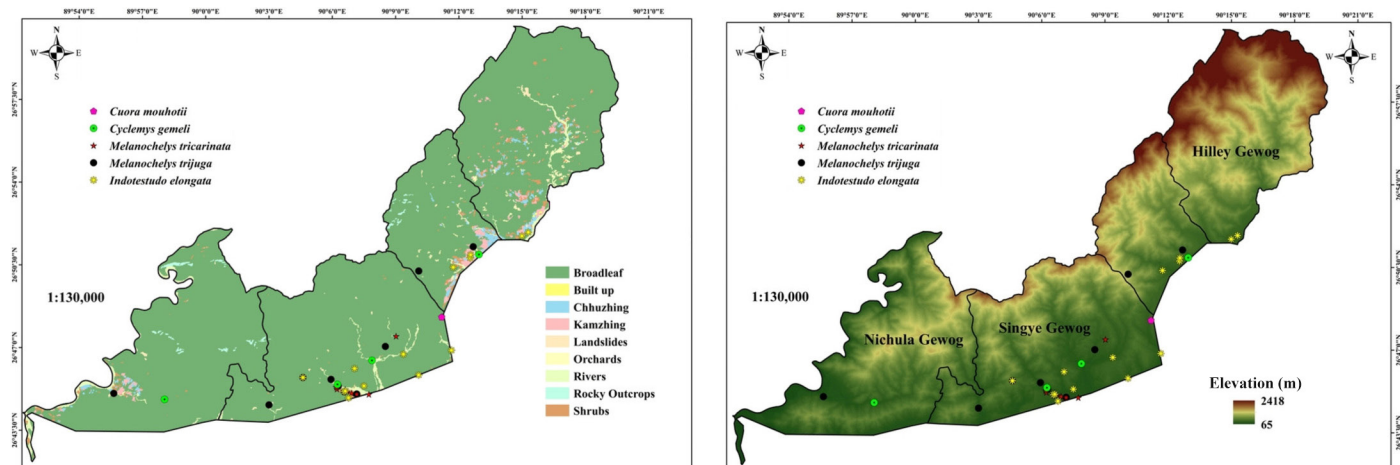
Turtles and tortoises (chelonians) are significant components of terrestrial and aquatic ecosystems around the world. Roles may range from seed dispersal to mineral cycling and carbon storage (Lovich et al. 2018). Chelonians are among the most threatened of the major groups of vertebrates (Turtle Taxonomy Working Group 2021; Rhodin et al. 2018), and populations have been in steep decline for many years (van Dijk et al. 2000; Rhodin et al. 2018). Globally, as of 2021, turtles and tortoises comprise 357 recognized species and, as of the current IUCN 2021 Red List, 357 (47.9%) recognized modern species are regarded as globally threatened (Turtle Taxonomy Working Group 2021).

The chelonian fauna of Bhutan is relatively understudied. The earliest scientific record of turtles and tortoises within the political boundaries of Bhutan started in the late 2000s with sporadic documentation in which Wangyal et al. (2012) reported the presence of *Cuora amboinensis*, *Cuora mouhotii*, *Cyclemys gemeli*, *Melanochelys tricarinata*, and *Indotestudo elongata* from the southern and central regions of Bhutan. Subsequently, Wangyal (2013) reported *Melanochelys trijuga*

from Kanamukra in the Sarpang District. The elevational record for *I. elongata* was reported from Tsirang Dzongkhag at 1,910 m (Drukpa et al. 2020). Most recently, *Pangshura sylhetensis* was recorded by Wangyal et al. (2020) from Chukha District. However, a substantial proportion of prior chelonian studies in Bhutan exclude vital baseline data on habitat and abundance, which are invaluable for developing conservation plans (Wangyal et al. 2012; Wangyal 2013; Drukpa et al. 2020; Wangyal et al. 2020).

Baseline distribution mapping of a species suffering range contraction and subsequent population decline is often the first step in the development of sound conservation initiatives (Scott et al. 1993; Smith et al. 1999; Quinn and Keough 2002). In this study, we provide distribution and habitat information on the species we observed.

The Phibsoo Wildlife Sanctuary (PWS) is the smallest Protected Area in Bhutan with an area of 286.83 km<sup>2</sup>. The PWS covers two districts of the country, Sarpang to the east and Dagana to the west. The northern part of the wildlife sanctuary shares the Beteni gewog (administrative



**Fig. 1.** Map of the Phibsoo Wildlife Sanctuary, Bhutan., showing the distribution of turtles and tortoises based on habitat types (marked by different symbols) (left) and at various elevations (right).

district) boundary in Tsirang District between 26.86418°N, 90.02024°E to 26.84964°N, 90.13098°E with a Biological Corridor (BC) connecting the wildlife sanctuary on the north-eastern side. The eastern part of the sanctuary falls in Singye gewog in Sarpang District between 26.85001°N, 90.14551°E to 26.77288°N, 90.19306°E. Its southern boundary follows the Indo-Bhutan international border with Ripu-Chirang Reserve Forest and Raimona National Park of the neighboring state of India. The PWS parallels the foothills and is representative of the subtropical landscape in the country.

The PWS experiences hot summers and cold winters. Elevations range from 65–2,418 m asl (Fig. 1), with the lowest recorded elevation in Bhutan at Nichula gewog in Dagana Dzongkhag. Climatic conditions of PWS are characterized by incessant summer rainfall with high humidity, whereas winter is often dry and sunny (PWS 2022).

The geophysical features and biogeographic elements within the PWS and adjoining landscapes are forged mainly by several perennial and seasonal rivers (Singyechhu, Longa chhu, Pinkhawachhu, and Nichulachhu) that originate within the sanctuary. The Sunkos River, which enters from the mountainous terrain of the adjoining District of Tsirang, flows through the sanctuary before entering the Indian state of Assam. PWS straddles the Indo-Malayan biogeographic realm and is in the Subtropical zone of Bhutan (75–2,000 m asl) characterized by subtropical (at elevations of 75–2,000 m asl) and warm broadleaf forests. Alluvial grasslands occur adjacent to the Longa, Phibsoo, Pinkhawa, and Punatsangchhu Rivers. These grasslands, along with adjoining forests, serve as important habitat for a large spectrum of wildlife species including the globally threatened chelonian fauna of the country.

We surveyed rivers, wetlands, streams, ponds, agricultural lands, riverine vegetation, and forested areas along

line transects 1 km in length and 50 m apart for turtles and tortoises throughout the lowland areas of the sanctuary. These were supplemented by actively searching the undergrowth using a visual encounter survey method (Litzgus and Mousseau 2004). All chelonian fauna encountered during the study were identified to species using descriptions in Smith (1931), Tikader and Sharma (1985), Das (1985, 2008, 2009; 2015), Ahmed and Das (2010), and Wangyal et al. (2012). We recorded a total of 36 sightings of five species in four genera and two families; individuals were captured, photographed, measured, and released at the site of capture.

### TESTUDINIDAE

**YELLOW TORTOISE** *Indotestudo elongata* (Blyth 1853)  
Critically Endangered (Fig. 2)

We recorded 14 individuals from the outskirts of Sarpang Town (26.8619°N, 90.24948°E; elev. 286–307 m), Phibsoo, Themba, Pankay Dara, and Singye (26.74786°E, 90.11258°N; elev. 230–306 m). Habitats included open deciduous forest patches, including natural Sal forest (*Shorea robusta*), evergreen forest, open grasslands, and human-dominated landscapes with few remaining trees adjacent to farmland.

### GEOEMYDIDAE

**INDIAN BLACK TURTLE** *Melanochelys trijuga* (Schweigger 1812) Least Concern (Fig. 3)

We recorded nine individuals (juveniles and adults) from Singye, Themba, and Phibsoo, Sarpang District (26.83729°N, 90.16805°E; elev. 283–290 m), Nichula, Dagana District (26.75101°E, 89.92754°E; elev. 200 m). Habitats included natural ponds and forest streams and adjacent grasslands, natural Sal forest, and subtropical deciduous broadleaf forest.



**Fig. 2.** *Indotestudo elongata*: dorsal (left) and ventral (right) views. Photographs by Tashi Phuntsho.



Fig. 3. *Melanocheyls trijuga*: dorsal (left) and ventral (right) views. Photographs by Tashi Phuntsho.



Fig. 4. *Melanocheyls tricarinata*: dorsal (left) and ventral (right) views. Photographs by Tashi Phuntsho.

TRICARINATE HILL TURTLE *Melanocheyls tricarinata* (Blyth 1856) Endangered (Fig. 4)

We recorded nine individuals (one juvenile, four sub-adults, and four adults) from Phibsoo, Sarpang District (26.75211°N, 90.10915°E; elev. 196–234 m). Habitats included alluvial grasslands adjacent to the Phibsoo and Longa Rivers, flood plains, streams, and various wetlands, most with surrounding vegetation of natural Sal forest.

ASSAM LEAF TURTLE *Cyclemys gemeli* (Fritz 2008) Near Threatened (Fig. 5)

We recorded four individuals (two juveniles and two adults) from Garbu Stream, Phibsoo (26.77426°N, 90.13109°E; elev. 298 m) and near Nichula Stream, Dagana District (26.75101°N, 89.92754°E; elev. 298 m). Habitats included a forest stream in Sal forest, small bodies of water and swamps with adjoining sub-tropical deciduous and evergreen forest.

THE KEELED BOX TURTLE *Cuora mouhotii* (Gray 1862) Endangered (Fig. 6)

We recorded one juvenile from Phibsoo in thick leaf litter in subtropical broadleaf forests, largely dominated by Sal trees, in close proximity to the Singye River, Sarpang District, bordering Assam State, India (26.80053° N, 90.18907°E; elev. 329 m).

Turtles and tortoises in PWS were concentrated at lower elevations, particularly between 196–329 m asl where habitat types are represented by open grassland, natural Sal forest, evergreen forests, and a network of ponds, swamp, and small forest streams to large river systems. Das (2009) noted that park management procedures in Indian Wildlife reserves involving fires in grasslands and deciduous forests are likely detrimental to surface-dwelling turtles, and uncontrolled surface fires have been used as a management tool to control invasive grasses and rehabilitate habitats for wild herbivores in Bhutan. We suggest revising existing habitat management strategy in the sanctuary to seasonal prescribed burning. Also, although six of seven recorded species of turtles and tortoises in Bhutan are globally threatened, the country has yet to give special conservation priority to chelonian fauna through



**Fig. 5.** *Cyclemys gemeli*: dorsal (left) and ventral (right) views. Photographs by Tashi Phuntsho.



**Fig. 6.** *Cuora mouhotii*: dorsal (left) and ventral (right) views. Photographs by Tshering Wangdi.

legal protection by including it on the Protected Species List (Schedule-I) of Forests and Nature Conservation Rule (DoFPS 2017) and Forest and Nature Conservation Act of Bhutan (DoF 1995). Legal protection of specific species is a cornerstone of conservation, and tortoises and freshwater turtles are among the species in need of urgent prioritization for protection under legislation.

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