

Review Article

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Testudines of India: A Review on Diversity, Threats and Conservation Initiatives

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Abstract

The present review is a collection of the available literature resources related to Testudines of India. Different aspects of diversity studies pertaining to turtles in India is presented in this review along with threats and conservation initiatives in different parts of India in different timeline.

Key-Words: Testudines, India, Conservation

Introduction

Turtles are reptiles placed in the order Chelonii or Testudines of Class Reptilia. Turtles are characterised by a special bony or cartilaginous shell developed from their ribs which acts as a shield¹. Turtles are the only reptiles that have a shell and no teeth and are found in both temperate and tropical climates². Turtles occur in different kinds of habitat, marine, freshwater and land. Land turtles can swim, while marine and freshwater turtles breathe air and lay their eggs on land². Reptiles are traditionally classified based on single key character, the pattern of fenestration in the temporal region of the skull. Turtles are placed in the subclass Anapsida as they lack fenestration. Other reptiles such as snakes, lizards, crocodiles and dinosaurs are placed in subclass Diapsida because of the presence of two fossae in the temporal region of the skull. The controversy of placing turtles in Subclass Diapsida considering lack of fenestration as a secondary condition is far from settled^{3&4}. Fossil evidence shows that giant tortoises once existed on every continent of earth except Antarctica and Australia⁵. Turtles have existed-colonised on earth ever since the rise of dinosaurs. The earliest known fossil of turtles reported are, *Proganochelys*, from the late Triassic of Germany^{6,7&8} and *Odontochelys semitestacea* from the Triassic of China around 220 million years old^{9&10}.

This makes turtles as the oldest group of reptiles than lizards, snakes or crocodiles¹¹. Currently there are 322 species and 119 additional subspecies or 441 total taxa of living turtles and tortoises. Among them 7 species are marine turtles and 315 species and 434 total taxa are of modern living freshwater and terrestrial turtles¹². A detailed review of different aspects of diversity studies pertaining to turtles in India is presented in the present review under different sub-heads. All information has been presented in a chronological sequence.

Diversity of Turtles in India

The presence of 29 species of tortoises and freshwater turtles and 6 species of marine turtles makes India as one of the most diverse chelonian faunas in the world^{13, 14&15} and is considered to be one of the top five Asian countries in terms of its importance for turtle conservation because 40% of its total chelonian fauna is threatened¹⁶. There are seven marine turtle species in the world, but some consider there are total of 8 marine species including the Black turtle. The controversy on the taxonomy of the black turtle, which is considered as the eighth, is still not settled¹⁷. Of the reported seven sea turtle species, five are known to nest in the Indian coastal waters, Olive Ridley's sea turtle (*Lepidochelys olivacea*), Hawksbill sea turtle (*Eretmochelys imbricata*), Green sea turtle (*Chelonia mydas*), Loggerhead sea turtle (*Caretta caretta*) and Leatherback sea turtle (*Dermochelys coriacea*)¹⁸ and the sixth sea turtle known to nest in Indian coastal water, is the Flat back sea turtle (*Natator depressus*)¹⁵. It is believed that the Gahirmatha rookery in Orissa is the largest reported nesting ground for olive ridley sea

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turtles in the world after it was discovered by H.R.Bustard in 1974¹⁹. As claimed by the Wildlife Wing of Government of Orissa, Olive ridleys visiting Gahirmatha represent about 50% of the total world population and about 90% of the Indian population of Olive Ridley sea turtle. Worldwide attention is naturally focused on the rookeries at Gahirmatha for conservation of this species²⁰.

India's freshwater turtle's fauna was not known clearly until a country wide survey was conducted during late 1980's²¹. Occupancy of different species of freshwater turtles in various Biogeographic zones and in different states of India has been reported²². Turtle and Tortoise diversity is highest in northeast region of India where in 23 of 29 species are found in this region^{23, 24, 25&26}. Twenty three turtle species of 3 families from Northeast region of India, which include 15 species of family Geoemydidae; 6 species of family Trionychidae and 2 species of family Testudinidae has been reported²⁷. The Ganges and Brahmaputra of North-eastern region of India have been identified as the areas where more than 11 turtle species are likely to co-occur²⁸. Few studies conducted on Indian fresh water turtles have mainly dealt with taxonomy and their broad distributional ranges^{29, 30, 33, 32&21}. Indian star tortoise (*Geochelone elegans*) to be the most common

tortoise compared to other three species, (*Indotestudo elongate*, *I. forestenii* and *Manouria emys*) in India³³. Significant knowledge on the ecological relationships among few turtles in the Chambal River and in the Ganga River has been contributed by different authors^{34, 35&36}. Other significant studies in India include morphometric characters of two populations of main land star tortoise³⁷. Fecal coliform bacteria from the Diamond back terrapin³⁸. Distribution and status of the star tortoise (*G. elegans*) in Gujarat³⁹. Phylogeography of olive ridley turtles (*L. olivacea*) on the east coast of India⁴². Role of freshwater turtle *Kachuga tentoria* in water purification and their biology, ecology, population dynamics near Panchnada⁴¹. The natural and anthropogenic threats to Olive ridley sea turtle at the rushikulya rookery of Orissa Coast⁴². The exploitation and trade of freshwater turtles *Melanochelys trijugacoronata* and *Lissemys punctata punctata* in Punnamada, Kerala has been studied⁴⁵. Survey was conducted to identify the population of Soft shell Turtles in the states of Karnataka and Andhra Pradesh⁴⁴.

The list of species reported in India are enlisted chronologically along with their Conservation status of IUCN and CITES in Table 1.

Table 1: Conservation status of Indian Testudines

Scientific Name	Common Name	IUCN Red List	CITES
Family Bataguridae			
<i>Batagur baska</i> (Gray, 1830)	Northern River terrapin	CR A1cd	AI
<i>Cuora boinensis</i> (Daudin, 1802)	Southeast Asian box turtle	VU A1d+2d	AII
<i>Cyclemys oldhami</i> (Gray, 1863)	Oldham's leaf-turtle	NE	AII
<i>Cyclemys dentata</i> (Gray, 1831)	Asian leaf-turtle	LR/nt	AII
<i>Geoclemys hamiltonii</i> (Gray, 1831)	Spotted pond turtle	VU A1d+2d	AI
<i>Vijayachelys silvatica</i> (Henderson, 1912)	Cochin forest cane turtle	EN B1+2c	AII
<i>Hardella thurjii</i> (Gray, 1831)	Crowned river turtle	VU A1cd+2cd	AII
<i>Batagur dhongoka</i> (Gray, 1832)	Three-striped roofed turtle	EN A1cd+2cd	AII
<i>Batagur kachuga</i> (Gray, 1831)	Red - crowned roofed turtle	CR A1cd	AII
<i>Melanochelys tricarinata</i> (Blyth, 1856)	Tricarinate hill turtle	VU B1+2c	AI
<i>Melanochelys trijuga</i> (Schweigger, 1812)	Indian black turtle	LR/nt	AII
<i>Morenia petersi</i> (Anderson, 1879)	Indian eyed turtle	VU A1cd+2d	AII
<i>Pangshura smithii</i> Gray, 1863	Brown roofed turtle	LR/nt	AII
<i>Pangshura sylhetensis</i> Jerdon, 1870	Assam roofed turtle	EN B1+2c	AII
<i>Pangshura tecta</i> Gray, 1830	Indian roofed turtle	LR/nt	AI
<i>Pangshura tentoria</i> Gray, 1834	Indian tent turtle	LR/nt	AII
<i>Cuora mouhotii</i> (Gray, 1862)	Keeled box turtle	EN A1d+2d	AII
Family Cheloniidae			
<i>Caretta caretta</i> (Linnaeus, 1758)	Loggerhead sea turtle	EN A1abd	-
<i>Chelonia mydas</i> (Linnaeus, 1758)	Green sea turtle	EN A2bd	-
<i>Eretmochelys imbricate</i> (Linnaeus, 1766)	Hawksbill sea turtle	CR A2bd	-
<i>Lepidochelys olivacea</i> (Eschscholtz, 1829)	Olive ridley sea turtle	VU A2bd	-

<i>Natator depressus</i> (Garman, 1880) Family Dermochelyidae	Flatback sea turtle	DD ver 2.3	-
<i>Dermochelys coriacea</i> (Vandelli, 1761) Family Testudinidae	Leatherback sea turtle	CR A1abd	-
<i>Geochelone elegans</i> (Schoepff, 1795)	Indian star tortoise	LR/nt	-
<i>Indotestudo elongate</i> (Blyth, 1853)	Elongated tortoise	EN A1cd+2cd	-
<i>Indotestudo travancorica</i> (Boulenger, 1907)	Travancore tortoise	VU A1cd	-
<i>Manouria emys</i> (Schlegel & Muller, 1840) Family Trionychidae	Asian Giant tortoise	EN A1cd+2cd	-
<i>Amyda cartilaginea</i> (Boddaert, 1770)	Asiatic softshell turtle	VU A1cd+2cd	AII
<i>Nilssonina gangetica</i> (Cuvier, 1825)	Indian softshell turtle	VU A1d+2d	AI
<i>Nilssonina hurum</i> (Gray, 1830)	Indian peacock softshell turtle	VU A1cd+2d	AI
<i>Nilssonina leithii</i> (Gray, 1872)	Leith's softshell turtle	VU A1c	AII
<i>Nilssonina nigricans</i> (Anderson, 1875)	Black softshell turtle	EW	AI
<i>Chitra indica</i> (Gray, 1830)	Indian Narrow-headed softshell turtle	EN A1cd+2cd	AII
<i>Lissemys punctata</i> (Bonnaterre, 1789)	Indian flapshell turtle	LR/nt	AII
<i>Pelochelys cantorii</i> Gray, 1864	Asian giant softshell turtle	EN A1cd+2cd	AII

Source: Murthy, 2010; www.ftp.fao.org/docrep/fao/007/y5750e/Y5750E02.pdf;

www.cites.org/eng/app/appendices.php; www.envfor.nic.in/legis/wildlife/wildlife1.html

Legends: IUCN [International Union for Conservation of Nature and Natural Resources (World Conservation Union)] Threats Categories: EX = Extinct; EW = Extinct in the Wild; CR = Critically Endangered; EN = Endangered; VU = Vulnerable; LR/nt = Lower Risk/Near Threatened; DD = Data Deficient; NE = Not Evaluated; CITES [Convention on International Trade in Endangered Species of Wild Fauna and Flora] Threats Categories: AI = Appendices I and AII = Appendices II.

Threats

The primary causes for sharp declines in many turtle species is exploitation and unregulated trade. Habitat loss and degradation are also being major factors in widespread declines^{45,46&47}. Many sea turtle populations have been critically affected by human-related activities, both past and present⁴⁸. Removing even small fractions of adults from a population can cause declines or delay a population recovery^{49&50} because many turtle and tortoise species depend on high adult survival to offset high egg and juvenile mortality in the wild⁵¹.

Most of the published papers and reports in India indicate gill-nets and bottom trawl nets responsible for the death of turtles by drowning^{52, 53, 54, 55, 56&18}. Small shrimp trawler operated in continental shelf causes incidental catch and subsequent mortality of turtles⁵⁷. Gear used by traditional non-mechanized craft causes entanglement⁵². Turtle mortality due to implication of monofilament nets in greater concentration in a particular area⁵⁵. But however, no special studies have been undertaken so far to determine the specifications of the gill-nets such as mesh composition, size of the mesh, net length, depth, area of application etc. that are actually responsible for turtle mortality⁵⁸.

Many reports from India identified various kinds of threats to the chelonian fauna. Thousands of Olive ridleys shipped to market each year in 1970's in Orissa and West Bengal⁵⁹. Nine species of chelonians harvested on commercial scale in India⁶². Turtles are also exploited for medicine, jewellery and pet trades other than for food which results in removal many eggs, juveniles and adults from populations^{61&64}. Northern river terrapin (*Batagur baska*) have been heavily exploited for its flesh and for its large eggs^{63&64}. The major factors for population decline of turtles is due to loss of turtle eggs due to predation by man, domestic and wild animals and other abiotic factors^{34&35}. Trade of turtle in Northern India has been reported^{64&65}. The incidental catch is the major cause of mortality of turtle in the Indian Ocean^{66&67}. Fishery related mortality is the major cause threatening Olive ridley sea turtle^{54&67}. Lakshadweep Archipelago turtles are killed for the oil which is used to treat wooden boats, bait and for making stuffed curios⁶⁸. Beach erosion at major nesting site like Rushikulya rookery or Gahirmatha beach may cause heavy loss of the post ovipositional eggs⁶⁹. Indiscriminate harvesting is the severe cause to decline of Leith's softshell turtle in Bharatapuzha Kerala, an endemic species to peninsular India⁷⁰. In Karnataka, the pressures of habitat destruction due to unsustainable fishing practices in

combination with the collection of turtle eggs by humans and nest depredation by feral animals is leading to a potential loss of sea turtles⁷¹. A survey was undertaken to observe the exploitation and trade of turtle in Punnamada, Kerala and eight hundred and forty three individual turtles belonging to two species i.e. *Melanochelys trijugacoronata* and *L. p. punctuata* were observed to be exploited and traded⁴³. The nesting habitat of *Nilssonia leithii* may be under threat in certain areas of peninsular India due to change in river morphology from hydrological projects⁴⁴. In India, incidental catch in fisheries has been reported from many parts of the country, namely, West Bengal⁷², Andaman and Nicobar Islands⁷³, Gujarat⁷⁴, Karnataka⁷⁵, Kerala⁷⁶, Tamil Nadu⁷⁷, Maharashtra⁷⁸ and Andhra Pradesh⁷⁹. Threats to marine turtle in costal habitat has been categorised into 4 main groups, i.e. On the beach (Sand mining, Beach armouring, Artificial illumination, Highways and marine drives, Exotic plantations, Ports, harbours and jetties); In the offshore water (Pollution, Fisheries); Aquaculture and Tourism⁶⁹.

Conservation initiatives

Turtles are much more at risk of approaching extinction than birds, mammals, amphibians and paralleled among the larger vertebrate groups only by the primates^{11&80}. The steady decline in populations of different species of freshwater turtles in different river systems in India has prompted research and conservation programmes on freshwater turtles in different parts of India^{21, 34&60}. Northeast India has been recognized as major conservation area for tortoise and freshwater turtle⁸¹. It is also regarded as one of the major centre of turtle diversity⁸².

Turtles play an important role in the ecosystem, control of insect and snail populations, seed dispersal and vegetation management, keeping water clean and populations healthy by scavenging on dead animals and preying on weak and sick individuals⁸⁴ this encourages the conservation of Testudines. Consolidating, captive breeding centre and village ponds into a common captive breeding centre, may be the effective way of conservation^{64&83}. The best approach for conservation of river terrapins will depend on result of survey and if any viable population persists then a combination of *ex-situ* technique combined with protected area to maintain the wild population and its habitat is the preferred approach⁸⁵. Rise of awareness on Indian wildlife Protection laws and also on the biological and also socio-economic impacts of turtle exploitation and trade should be brought among Local fishers, turtle collectors etc. to protect the highly exploited species

like *L. p. punctuata* in Punnamada and elsewhere in Kerala⁴⁴. *B. baska* and *B. kachuga* included in the World's 25 Most Endangered Tortoises and Freshwater Turtles list. *Chitra indica* has been included in World's Most Endangered Tortoises and Freshwater Turtles at Very High Risk of Extinction list. *M. emys*, *Nilssonia nigricans* and *Pelochelys cantorii* has been included in World's Most Endangered Tortoises and Freshwater Turtles at High Risk of Extinction List⁸⁶. In IUCN Red list, 2013, *Nilssonia nigricans* is in 'Extinct in Wild' category⁸¹ but presence of wild populations has been reported in 2009 by Ahmed and Das from Kaziranga National Park⁸⁷. In India, chelonians are given protection through National as well as International legislation^{88&61}. Turtles are considered as endangered and categorized in Schedules of the Indian Wildlife (Protection) Act, 1972⁸⁹. Since the declaration and strict enforcement of Wildlife Protection Act has brought down the practice of turtle fishing in India⁵⁶. The following species are categorized in Schedule I of the Indian Wildlife (Protection) Act, 1972. Audithia turtle (*Pelochelys bibroni*); Terrapin (*B. basika*); Eastern Hill terrapin (*Melanochelystri carinata*); Ganges Soft-shelled turtle (*Trionyx gangeticus*); Green Sea turtle (*Chelonia mydas*); Hawksbill turtle (*Eretmochelys imbricate inlscata*); Indian Soft-shelled turtle (*L. p. punctata*); Kerala Forest terrapin (*Hoesemys sylratica*); Leathery turtle (*Dermochelys coriacea*); Logger Head turtle (*Caretta caretta*); Olive Back Logger Head turtle (*Lepidochelys olivacea*); Peacock-marked Soft-shelled turtle (*Triony xhurum*) and Three-keeled turtle (*Geoemydastris carinata*) in Schedule IV⁸⁹. Turtles are also protected by religious beliefs occupying an honoured place in many mythologies. In Hindu mythology the world is supported by four elephants that stand upon the shell of a turtle⁹⁰. Akupara is a tortoise in Hindu legends who carries the world on his back upholding the earth and sea⁹¹. One avatar of Vishnu is said to be the giant turtle Kurma, The Sri Kurmam Temple in Andhra Pradesh, India, is dedicated to the Kurma avatar⁹². In conclusion considering their eco-aesthetic values these vulnerable organisms needs to be protected and conserved.

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