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Nilssonia gangetica (Cuvier 1825) –
Indian Softshell Turtle, Ganges Softshell Turtle

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Nilssonia gangetica (Cuvier 1825) – Indian Softshell Turtle, Ganges Softshell Turtle

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SUMMARY. – The Indian (or Ganges) Softshell Turtle, *Nilssonia gangetica* (family Trionychidae), is a monotypic species that occurs in northern India and neighboring countries of South Asia. Females are usually larger than males, with average female size ca. 70 cm straight-line carapace length (SCL) (maximum size up to 94.0 cm SCL) and average male size is only ca. 28 cm SCL, but can reach up to 77.0 cm SCL. The species is primarily carnivorous. The ecology of *N. gangetica* has been relatively well studied in the National Chambal Sanctuary in northern India. The species basks on sand banks, riverside rocks, and mid-riverine islands. Nesting occurs during the fall and early winter (August–October). The average clutch size is 13.7 eggs (range 6–39) and the species apparently lays one to two or more clutches per season. The eggs are spherical in shape, with a mean diameter of 29.5 mm. The eggs hatch after an average incubation period of 250–275 days, following a period of diapause. Major rehabilitation programs for conservation of the species are present in the Ganges (Ganga) River basin; wild-laid eggs were collected from the Chambal River and incubated in captive facilities and juveniles were released near Varanasi in the Ganges River. Research studies on distribution, behavior, habitat use, genetics, reproduction, exploitation, and conservation of *N. gangetica* have been carried out rangewide. The species was formerly common in several northern Indian rivers, but its populations are declining in many of its habitats. There has been a large illegal trade of live animals in north and northeast India, and the species is heavily exploited for commercial use. Nationwide surveys have indicated that fairly good populations are present in many protected areas. The species receives protection under respective National legislation in different countries and international listings through the IUCN Red List as Endangered and CITES Appendix I.

DISTRIBUTION. – Afghanistan, Bangladesh, India, Nepal, Pakistan. In India, it is present in the major river basins of the Indus, Ganges (Ganga), Narmada, Tapi, Mahanadi, Brahmaputra, and their tributaries. Its distribution range extends from Mahanadi River basin in the southeast to the base of the Nepal foothills in the north. Similarly, its range extends from the floodplains of Brahmaputra River in Assam, India, in the northeast to the Indus Basin in eastern Afghanistan in the northwest.

SYNONYMY. – *Trionyx gangeticus* Cuvier 1825, *Aspidonectes gangeticus*, *Tyrse gangetica*, *Isola gangetica*, *Aspideretes gangeticus*, *Amyda gangetica*, *Nilssonia gangetica*, *Nilssonia gangetica gangetica*, *Trionyx javanicus* Gray 1830 (partim, junior homonym), *Tyrse javanica*, *Gymnopus duvaucelii* Duméril and Bibron 1835 (partim, *nomen novum*), *Trionyx gangeticus mahanaddicus* Annandale 1912, *Nilssonia gangetica mahanaddica*, *Trionyx gangeticus mahanadicus* Das, Dattagupta, and Gayen 1998 (*nomen invalidum*).

SUBSPECIES. – None currently recognized.

STATUS. – IUCN 2026 Red List: Endangered (EN A2d+4d; assessed 2021); CITES: Appendix I (1975); US ESA: Endangered (1976); India: Schedule I, Wildlife (Protection) Act (1972).

Taxonomy. — *Nilssonia gangetica*, the Indian (or Ganges) Softshell Turtle, is a monotypic species that was originally described as *Trionyx gangeticus* by Cuvier (1825) based on four specimens in the Paris Museum (MNHN 4148, 9387, 1887-838, and A5226; Bour et al. 1995; TTWG 2011; Iverson 2022). The type locality “du Gange” clearly refers to the Ganges (Ganga) River. No

subspecies are currently recognized, although Annandale (1912) described *Trionyx gangeticus mahanaddicus* based on a specimen in the collection of the Zoological Survey of India (ZSI 17014) from “Sambalpur and Cuttack, Orissa” (Das et al. 1998; Kundu et al. 2018; Iverson 2022). The type locality of *mahanaddicus* was restricted to “Cuttack, Orissa” (Smith 1931; TTWG



Figure 1. Adult female Indian (or Ganges) Softshell Turtle, *Nilssonia gangetica*, from the Ganges River, India. Photo by Sourabh Gawan.

2025), and Smith (1931) synonymized *mahanaddicus* with *gangeticus*. Das et al. (1998) erroneously amended the synonymized subspecies name to *mahanadicus*. Smith (1931) reviewed the species as *Trionyx gangeticus*, as did Das (1985, 1991), but Meylan (1987) assigned this species to the genus *Aspideretes* based on extensive morphological analysis. Engstrom et al. (2004) analyzed mitochondrial DNA and found that the species of *Aspideretes* were most closely related to the single species of *Nilssonia*, and Praschag et al. (2007) subsequently provided an expanded phylogenetic analysis of *Aspideretes* and *Nilssonia* species based on mitochondrial DNA and argued for an expanded concept of *Nilssonia* to include all the species of *Aspideretes*, and reassigned the Indian Softshell to *Nilssonia*. This taxonomic concept

has been globally accepted since then (Fritz and Havas 2007; TTWG 2011, 2021, 2025).

At present, the genus *Nilssonia* contains five extant species (*N. formosa*, *N. gangetica*, *N. hurum*, *N. leithii*, and *N. nigricans*), which are distributed across India and adjacent South Asian countries, including Pakistan, Nepal, Bangladesh, and Myanmar. According to Liebing et al. (2012) each major river basin (Brahmaputra, Indus, Ganges, and Mahanadi basins) harbors a genetically distinct population of *N. gangetica*. The genetic differentiation among different river basins represents intraspecific lineage variation within *N. gangetica* and there is no evidence that cryptic species are involved. Since *N. gangetica* is an endangered species (Ahmed et al. 2021), the genetic distinctiveness of the populations in different river basins must be taken into account when conservation strategies are designed (Liebing et al. 2012).

According to Thomson et al. (2021) *N. gangetica* is sister to the clade including *N. leithii* and *N. hurum*, but they did not sample *N. nigricans*. Rajpoot et al. (2019) conducted a molecular study of globally threatened turtle species, including *N. gangetica*, and observed that most of the turtle species from the northern and northeastern parts of India have geographical genetic signatures. The geographical signatures of turtles can play vital roles in wildlife forensics in tracking the origin of poached turtles to support law enforcement. Kundu et. al. (2018) stated that mitogenomes are used to understand the evolutionary relationships of Testudines within amniotes. They have sequenced and characterized the complete mitogenome of *N. nigricans* and compared it with that of some other



Figure 2. Adult female *Nilssonia gangetica* from Assam, India. Photo by Mohammad Firoz Ahmed.



Figure 3. Adult female *Nilssonia gangetica* from Assam, India. Photo by Mohammad Firoz Ahmed.

softshell turtles (family Trionychidae) to confirm the unique genetic features and evolutionary relationships.

These studies should also be conducted on *N. gangetica* for better understanding of the phylogenetic and evolutionary relationships among Testudines. Yadav et al. (2021) reported species-specific variations among turtle species, including *N. gangetica*, based on the mitochondrial cytochrome b gene (1,140 bp) and the nuclear Cmos gene (602 bp). This genetic information will help augment the molecular database to identify Gangetic turtle species and lineages effectively, and help in formulating *in-situ* and *ex-situ* conservation and management plans to improve rescue and rehabilitation strategies.

Since serum protein analysis serves as a foundational biochemical tool in turtle taxonomy to clarify evolutionary relationships, Gayasuddin and Rao (1980) studied the serum proteins of *N. gangetica* and compared them with the serum protein fractions of humans. Rohilla and Tiwari (2008) used the mitochondrial cytochrome-b (Cyt-b) gene sequences for precise identification of the Ganges Softshell Turtle. Genetic characterization of *N. gangetica* has primarily focused on molecular taxonomy and phylogenetic analysis. The phylogenetic and restric-

tion fragment length polymorphism (RFLP) analyses rely on the partial sequences of the mitochondrial Cyt-b gene to effectively discriminate between *N. gangetica* and *Lissemys punctata*, and three other vulnerable or legally protected Indian freshwater geoemydid species.

There are no studies on chromosomes of *N. gangetica*; however, Gorman (1973) reported chromosomes of reptiles including *N. leithii*, which has a diploid chromosome number of $2n = 52$ to 54 . There is a need for further genetic studies on all species of *Nilssonia*, including *N. gangetica*.

Description. — *Nilssonia gangetica* is a very large turtle with an oval-shaped shell. Females are usually larger than males, reaching ca. 70.0 cm in average straight-line carapace length (SCL) (sexually mature females typically range from 30.0 to 70.0 cm SCL) with body weights of 40 to 46 kg, whereas sexually mature males are usually smaller in size, typically ranging from 20.0–59.9 cm SCL with body weights of 30 to 35 kg (A. Panda and S. Singh, pers. comm.). Maximum recorded carapace lengths are 77.0 cm for males and 94.0 cm for females (Rashid and Swingland 1997; Pritchard 2001; Baruah et al. 2012; TTWG 2025).

The carapace and plastron are covered by a continuous layer of soft skin instead of scutes, and the peripheral bones are absent; thus, the sides and rear part of the carapace are quite flexible. The scalation of the limbs is almost completely absent except for a few transversely enlarged scales on the forelimbs. The species has a large and broad head with dorso-laterally situated eyes. The snout is elongated into a distinctive narrow breathing snout, the neck is long and retractile, and the lips are fleshy. The limbs are broadly webbed and paddle-like in appearance with three claws each. The oval carapace of adults is dull olive to green in color with fine black reticulations.

The plastron is much shorter than the carapace and is ivory in color. The plastron and carapace are united by fibrous ligamentous tissue. The skull is broad and the blunt bony snout is short and broad (shorter than the



Figure 4. Adult female *Nilssonia gangetica* from Chambal River, India. Photo by B.C. Choudhury.



Figure 5. Hatchling *Nilssonia gangetica* from Hayagriva Madhab Temple, Hajo, Assam, India. Photo by Jayaditya Purkayastha.



Figure 6. Carapacial bony disc (top) and skull (bottom) of *Nilssonia gangetica* from Tighra Reservoir, Gwalior, Madhya Pradesh, India. Photos by R.J. Rao.

diameter of the eye) and slightly downturned (Gorman 1973). The snout is as long as the diameter of the orbit, the post-orbital arch is one and half to one-third the diameter of the orbit, and the alveolar surfaces of the upper jaw are flat, with a well-defined median groove between them (Smith 1931).

Sexual dimorphism is seen in the size and length of the tail. Males possess a long and thick tail that contains the penis in its base, and the cloaca extends beyond the edge of the shell (Rao and Shaad 1985). The tail in females is much shorter, and the cloaca lies within the perimeter of the carapace. Males are easily differentiated from females.

The head is greenish with black lines which may be broken up or indistinct in old individuals. Hatchlings are greenish with ocelli on the carapace with an average SCL of 42.6 mm and weight of 11.4 g. (Rao 1990).

Nilssonia gangetica is readily distinguished from *N. leithii* and *N. hurum* by the presence of black lines on the forehead, which may be indistinct or entirely lost in old individuals.

Distribution.—*Nilssonia gangetica* is allopatric with its congener *N. leithii* from southern India, but sympatric with *N. hurum* and *N. nigricans* (TTWG 2025). The species occurs in India, Bangladesh, Nepal, Pakistan, and far eastern Afghanistan (Murray 1886, Minton 1966; Rao 1982; Moll 1984; Tikader and Sharma 1985; Iverson 1992; Rashid and Khan 2000; Baig et al. 2008, Ahmed and Das 2010; Aryal et al. 2010; Kayani et al. 2015a,b; Ahmed et al. 2021; Khan 2021; TTWG 2021, 2025; Safi et al. 2024b, 2025).

It is found throughout the Indus, Ganges, and Brahmaputra floodplains and associated river systems, canals and marshes of the northern parts of South Asia (Safi et al. 2025). In India, it is present in the Indus, Ganges, Brahmaputra, and Mahanadi rivers and their tributaries (Smith 1931) as well as in the rivers flowing in the states of Uttarakhand, Uttar Pradesh, Haryana, Bihar, Jharkhand, Assam, West Bengal, Madhya Pradesh, Maharashtra, Gujarat, and Rajasthan (Vyas 1989a; Rao 2001; Ahmed and Das 2010; Delu et al. 2024; Baruah and Sharma 2024). Its range extends north to the base of the Nepal foothills (Pun et al. 2023). This species is also reported from the Banas, Sabarmati, Mahi, Vishwamtri-Dhadhar, Narmada, and Tapi rivers of Gujarat State of western India (Vyas 1989b, 2015; Vyas and Patel 1990). In Assam, particularly in the Brahmaputra and Barak river floodplains, *N. gangetica* is found sympatric with a number of other softshell turtles, e.g., *N. nigricans*, *N. hurum*, *Chitra indica*, and *Lissemys punctata* across the Kaziranga-Orang Riverine Landscape (KORL) (Ahmed and Das 2010). In southern Assam, the species is recorded from Katkhal, Sonal, and Krati Rivers of the Barak River floodplains of southern Assam (Das and Gupta 2011).

In Pakistan, *N. gangetica* occurs in deep rivers and lakes of the Indus watershed drainage (Noureen et al. 2012; Kayani et al. 2015a; Khan 2015; Khan et al. 2016, 2021; Safi and Khan 2014; Safi et al. 2025). The species also occurs in Nepal, as noted by Bhatt (2019), Aryal et al. (2010), Khadka and Lamichhane (2020), and Pun et al. (2023), who studied the status, distribution, habitat preferences and threats to freshwater turtles, including *N. gangetica*, in the southern Terai lowlands.

It is also known from the Indus drainage system in extreme eastern Afghanistan (Habibi 1982), the westernmost distribution range of the species; however, there are no recent records of this species still occurring there.

The species is also found in sacred temple ponds in many states (Rao 2025) in India. Annandale and Sastri (1914) reported *N. gangetica* in temple ponds of Odisha. Giri et al. (2022), Das (2014), and Ahmed and Das (2010) reported the distribution and protection of many turtle species, including *N. gangetica*, in sacred places

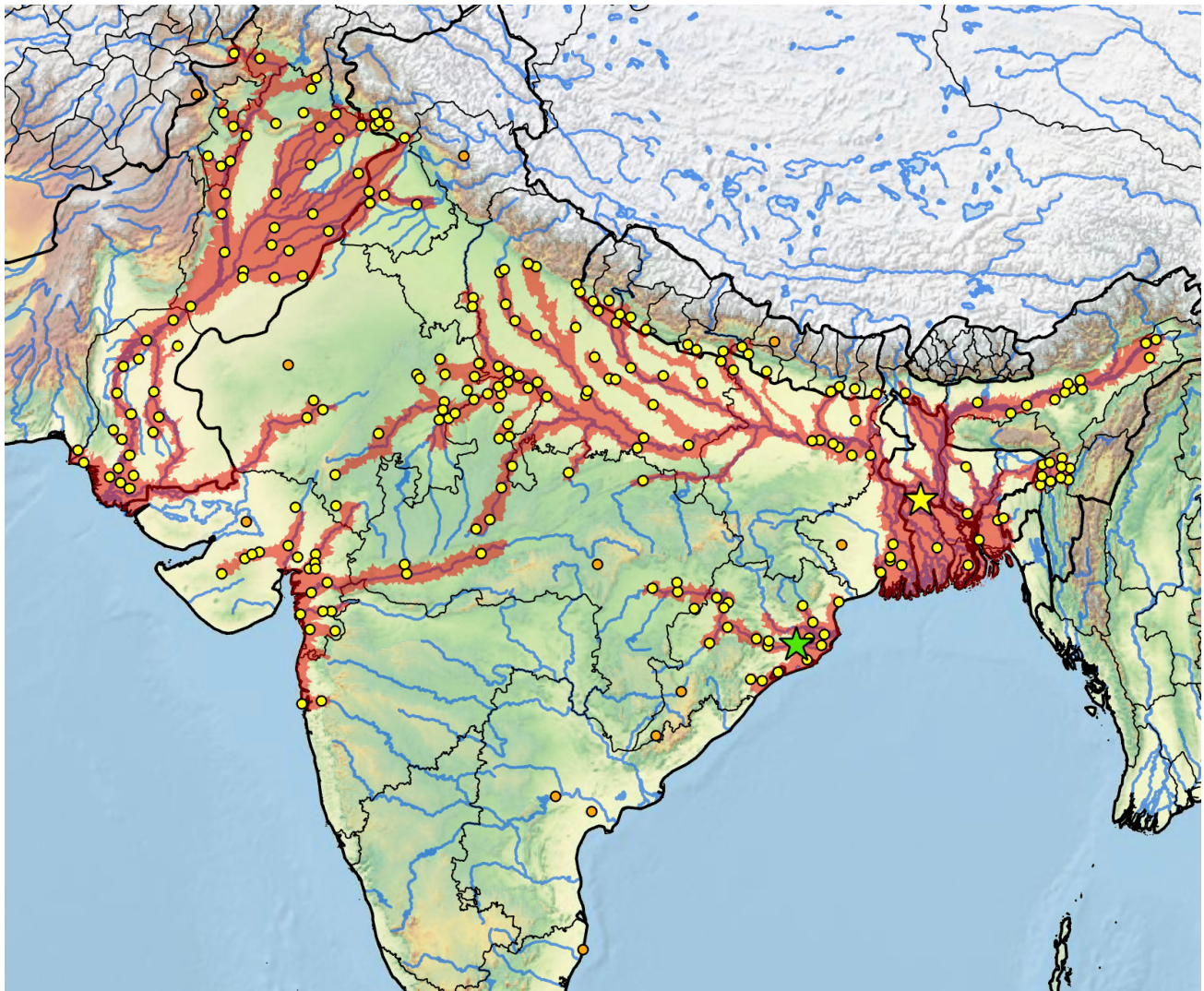


Figure 7. Estimated historical indigenous distribution of *Nilssonia gangetica* in South Asia (Afghanistan, Bangladesh, India, Nepal, and Pakistan). Yellow dots = museum and current and historical occurrence records of presumed native populations based on literature and online records (TTWG 2025); orange dots = presumed trade-related or other translocated non-native records; yellow star = estimated type locality for *Nilssonia gangetica* (Cuvier 1825; TTWG 2025); green star = restricted type locality for *Trionyx gangeticus mahanaddicus* Annandale 1912. Colored shading = estimated historical indigenous range. Distribution is based on fine-scaled GIS-defined level 12 HUCs (hydrologic unit compartments) constructed around localities and then adding HUCs that connect point localities in the same watershed or physiographic region, and similar habitats and elevations as verified HUCs, based on TTWG (2021, 2025) and adjusted based on data from the authors. Map by Chelonian Research Foundation.

of Odisha and northeastern Indian states. The species has been found in an Islamic shrine tank at Lanktadarga near Sonamura, Jagannathbari Dight (Tank) of Agartala, and Loknath temple pond of Pratapgarh near Agartala and is protected by religious faith (Datta et al. 2004). It has also been reported from Nagshankar Temple and Sarupeta Satra Pond in Assam (Ahmed and Das 2010). The species is found in various temple ponds of Assam (Barhadiya et al. 2020), Tripura, and West Bengal.

Habitat and Ecology. — *Nilssonia gangetica* is found in a wide range of permanent aquatic habitats. The species inhabits both stagnant and running water sources, including large rivers, streams, irrigation canals, lakes, ponds, and artificial water tanks. Throughout its distribution range, this species occupies a climate with

hot, dry summers and cool winters with moderate to high (above 2,000 mm) annual rainfall. It lives in lakes, ponds, and small to large rivers with varied flow (Rao 1984). Ecological studies carried out on the Chambal River have shown this species to prefer stretches with sand peninsulas and sandbanks (Rao 1987a). Sarkar et al. (2019) reported that *N. gangetica* occurred in village community ponds and temple ponds, primarily along the Ganga River in Uttar Pradesh. According to them, connectivity between rivers and community or temple ponds at that time played an important role in the exchange of individuals between wetlands, thus maintaining viable, healthy populations.

Basking. — This species is active throughout the year; even in winter, and it actively basks on sandbanks, sand

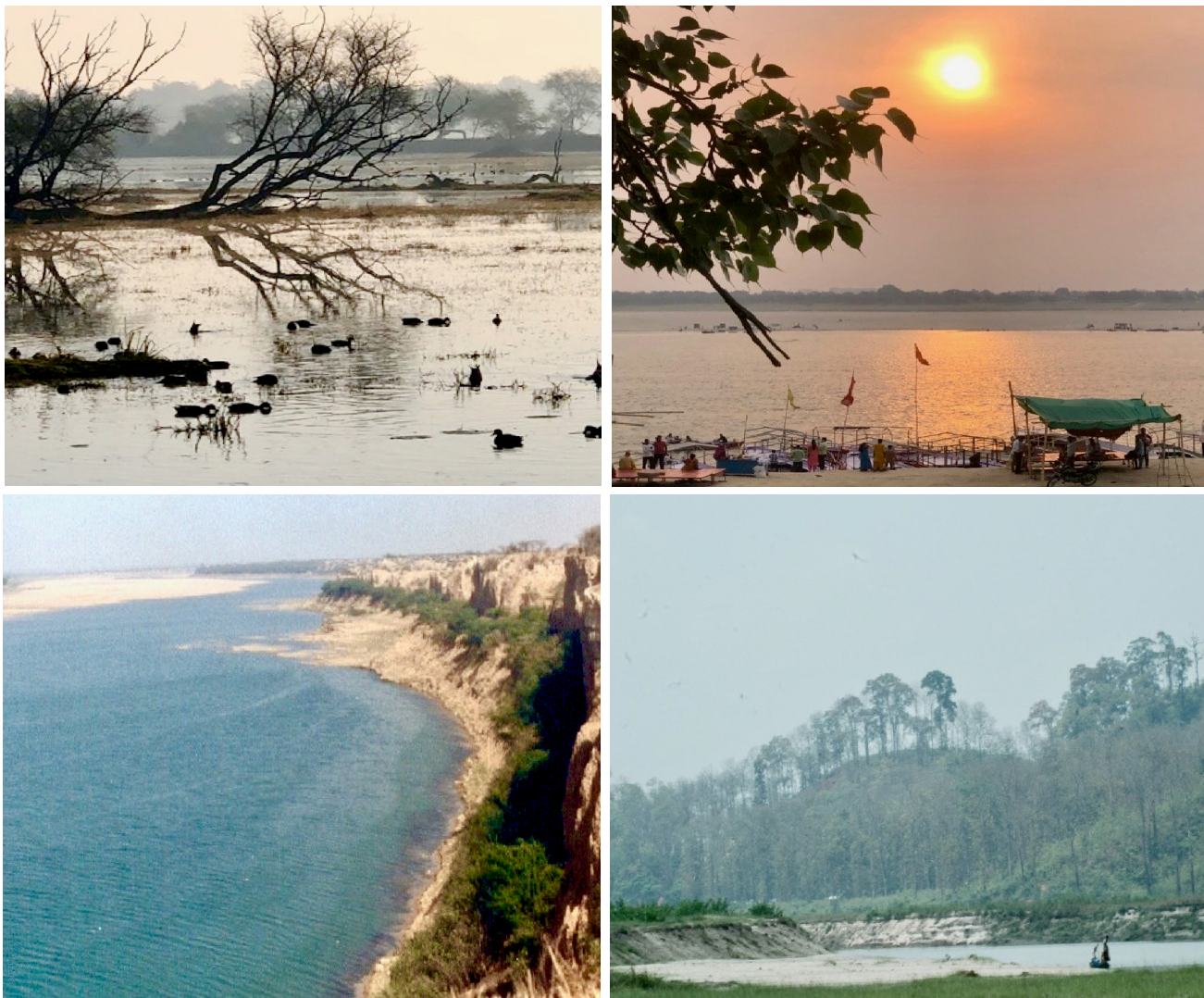


Figure 8. Typical habitats of *Nilssonia gangetica* in India. *Top left:* Bharatpur Wetland. Photo by R.J. Rao. *Top right:* Ganges River, Varanasi. Photo by R.J. Rao. *Bottom left:* Chambal River. Photo by R.J. Rao. *Bottom right:* Brahmaputra River. Photo by Mohammad Firoz Ahmed.

bars and rocky outcrops to regulate its body temperature (Rao 1990, 1987a). It inhabits areas with air temperatures ranging from 7.3°C in the winter to 42°C in the summer, and basks long hours during the winter, but much less during the summer. During basking it raises its head with extended neck and limbs and usually basks close to water. The neck and limbs are fully extended to allow maximum sun light on soft body parts. Basking turtles are easily startled when approached as they are highly alert for predators. Individual turtles often use the same preferred sites every day. Solitary basking appears to be the rule for large *N. gangetica*.

Diet. — *Nilssonia gangetica* is primarily carnivorous, but also feeds on aquatic plants, roots, and seeds among plant food, and animal matter such as prawn, fish, water birds and carrion, including human flesh (Rao 1990). The species was observed feeding on the Flapshell Turtle, *Lissemys punctata*, during summer when the water level was low (Bhupathy 1990). Individuals at Nagshankar

Temple in Assam, India, were observed with bite injuries as the pond was crowded with large softshell turtles, indicating severe competition for food and space (Ahmed, pers. obs.). Captive hatchlings feed on mosquito larvae, termites, earthworms and fish; in temple ponds turtles feed on puffed rice and other human food. Cannibalism is also observed in captive animals (Rao 1986d). In view of its voracious feeding on carrion, the government of India started a program of releasing captive *N. gangetica* in the Ganges River to control pollution caused by dead bodies of animals and humans (Basu 1987; Mishra 1987; Rao et al. 1996; 2000).

Reproduction. — *Nilssonia gangetica* is a seasonal breeder. Studies conducted by Rao (1981, 1985a,b; 1986a,b,c) on seasonal changes in the reproductive system of male and female *N. gangetica* revealed that it has a long breeding season with multiple clutches (Rao and Shaad 1983; Rao 1986a,b). Vyas and Patel (1992) observed mating of the species in captivity during April and May. Field



Figure 9. Adult *Nilssonia gangetica* basking along the Ganges River, India. Photo by Sourabh Gawan.

studies conducted in the Chambal River in central India revealed that nesting occurs during fall and early winter (August–October) (Rao 1987b, 1990; Vasudevan 1996).

Nesting females leave the main river and move into the smaller canals and tributaries sometimes up to 1 km from the main river and select a high nesting site up to 3 m above the water level to dig a nest pit and lay eggs. The average diameter of a nest is 12.2 cm with an average depth of 16.7 cm (Rao 1990). The eggs in the nest are loosely arranged without any soil between them, and the nest chamber is quite moist as a result of moisture contributed by the eggs. When egg laying is finished, the nest is covered and compacted with soil. The soil above the nest becomes hard after a month and remains so throughout the incubation period.

The average clutch size is 13.7 eggs (range 6–39), and the species apparently often lays more than two clutches per season (Rao 1986a), although in the northern parts of India only one clutch is laid per season (S. Singh, unpubl. data). The brittle-shelled eggs are spherical in shape with a mean egg diameter of 29.5 mm and weight of 14.8 g (Rao 1990). Egg mass is related to egg length and egg width (Iverson et al. 2024). Relative clutch mass (clutch mass/gravid female body mass) ranges from 1.6–4.0% (Iverson et al. 2025), among the lowest values among turtles (Iverson and Greene 2022).

In *N. gangetica*, as in other turtles reported by Cagle (1950), parental investment includes excess yolk material, more than needed to produce a complete hatchling, which will be absorbed by the hatchling after it emerges from the egg. The eggs have yolk enclosed within a vitelline membrane, and are surrounded by albumen and enclosed within a shell membrane and shell. The yolk, albumen, and shell and shell membrane of *N. gangetica* eggs constitute 51.5%, 33.5%, and 14.6% of the weight of the eggs (Rao 1990).

Eggs hatch after an average incubation period of 250 days following a period of diapause (Rao 1990; Whitaker 2000, 2006); incubation in northern India can take up

to 275 days (S. Singh, unpubl. data). A report by Khan (2015) that suggested an incubation period of 25–35 days is clearly erroneous, and more likely a typographic error for 250–350.

Female *N. gangetica* nest from August to October, prior to the cold winter season. The initially low ambient temperatures cause the embryos to enter a state of dormancy and arrests their development (diapause) until a consistent rise in temperature is reached by the end of winter. This ensures that all eggs hatch simultaneously during a warm period followed by rains when flood waters increase, and hatchlings enter the water immediately after emerging. Around 75 eggs laid in 4 clutches in the months of September and October hatched during June and July the following year, after an incubation period of 264 to 294 days (Rao 1990).

The first showers of the wet summer season (June) soften the soil above the nest that helps the hatchlings to emerge from the nest. The hatchling uses its caruncle to rupture the eggshell and then uses its front legs and claws to tear the eggshell completely open in order to emerge. The egg caruncle is shed 3 days after hatching. Hatchlings measure 39.0–47.0 mm SCL and weigh 8–16 g, and subsequent growth is rapid (Rao 1990). The species presumably exhibits genetic sex determination, rather than temperature-dependent sex determination, as in all other Trionychidae species that have been studied (Krueger and Janzen 2022).

Sexual Maturity and Longevity. — Information is unavailable on the exact age of sexual maturity or longevity for *N. gangetica*, although Flower (1925) reported longevity in captivity of 14.1 years and Slavens and Slavens (2000) listed 12.4 years, no doubt highly underestimated for wild individuals. Ahmed et al. (2021) estimated generation length as at least 25 years, which would correlate with an age of female sexual maturity of about 10–12 years (Iverson 2024). In the captive breeding center at Kukrail, a few hatchlings from the Ganga Action Plan Project matured in about 10 years and nested at the center (S.P. Singh and S. Singh, pers. comm.). Based on an age of maturity of 10–12 years, longevity would be predicted to be ca. 60–70 years (Iverson 2024).

Predation. — Predators such as domesticated and feral dogs, jackals, and monitor lizards depredate the eggs of turtles, including *N. gangetica* (Rao 1990). Predation of *N. gangetica* in the wetlands of Ranthambore National Park, Rajasthan, India, by a Royal Bengal Tiger was reported by Ranganathan et al. (2020). Unidentified softshell turtles were observed being hunted by both tiger and water monitor lizards (*Varanus salvator*) in the Diffolu River in Kaziranga National Park, Assam (Ahmed, unpubl. data).

Diseases and Parasites. — Not many data are available on the diseases and parasites of this species. According to Rathnam et al. (2024), pinworm infestation is the most common parasitic infection in reptiles especially

those which are in held in close captivity. Kundu et al. (2020) studied turtles in the trade in the northeast India and reported the presence of helminth parasites (nematodes and trematodes) in *N. gangetica*, *N. nigricans*, and *Chitra indica*. Both *N. gangetica* and *N. nigricans* are the first host records of the trematode, *Astiotrema reniferum*. Johnson et al. (1998) suggested the intramuscular or oral introduction of Praziquantel as an effective treatment for infected turtles. Kundu et al. (2020) suggested that records of infected turtles in the markets should be collected and proper treatment should be given to avoid spread of helminth parasites into the native turtle populations in northeast India.

Population Status. — *Nilssononia gangetica* is a widely distributed species in northern South Asia. It is usually found in low population densities, although no precise population estimates have been published (Choudhury et al. 2000; Ahmed et al. 2021). The species was once very common in the Ganga and Brahmaputra river systems and its tributaries; however, due to overexploitation these populations have since become depleted (Rao 1985c, 1991; Ahmed and Das 2010; Ahmed et al. 2021).

Nationwide status surveys have indicated that fairly good populations existed several decades ago in some protected areas, such as the Chambal River in India (Moll 1984). Historically, the species was encountered in 17 of 35 surveyed markets before 1983 (Moll 1983), but was only encountered in three of 61 markets surveyed in 1991–1993 (Choudhury and Bhupathy 1993; Choudhury et al. 2000; Ahmed et al. 2021).

Participants at the 2005 Red List Workshop in Lucknow considered that the species remained fairly widespread and common in northeastern India and Bangladesh, but had declined severely elsewhere over the previous 12 years and in places was nearly gone. At the 2011 Red List Workshop in Singapore, updated survey and trade data available indicated that a drastic reduction in numbers, and decreasing size of marketed animals had occurred, with an estimate made that the species' overall wild population had likely more than halved (Ahmed et al. 2021).

Nilssononia gangetica remains widespread and stable in shrine and temple ponds; these sacred spaces hold some populations of the species across India and Bangladesh. Small populations of this species also occur in the water bodies present in different National Parks, such as Keoladeo National Park and Ranthambore Tiger Reserve (Rao, pers. obs.). Populations also occur in the Son, Ken, Yamuna, Mahanadi, Gandak, Ramganga, and other rivers, which are also protected.

Threats to Survival. — Depletion of *N. gangetica* populations in its major habitats is largely attributed to habitat loss due to pollution, and heavy commercial exploitation during the 1970s and 1980s, when large numbers were shipped to Howrah in West Bengal, and other northeastern markets in India (Rao 1991; Mandal et al. 2024).

This species has been and remains one of the most frequently observed turtles for sale in consumption markets (Choudhury and Bhupathy 1993; Ahmed and Das 2010; Ahmed et al. 2021; Khalid et al. 2025). It faces continued illegal and widespread exploitation for meat and eggs and cartilaginous carapacial rim (calipee) for medicinal purposes (Roopa et al. 2024). People travel widely to collect and poach the turtles from many rivers. The usual mode of capture seems to be with fish hooks using bait of meat or animal intestines. Although turtles are protected in South Asia under the Wildlife Protection/conservation Acts, current protective legislation is only weakly enforced across its range and *N. gangetica* is still under severe illegal exploitation.

Habitat destruction is another significant factor threatening the survival of *N. gangetica*. The wetlands it inhabits are facing various threats that have led to declining turtle populations (Vyas 2015). Anthropogenic activities such as agriculture, sand mining, cattle grazing, encroachment, fishery activities, and harvesting of riverside vegetation have adverse impacts on the ecosystems of this species (Rao 1987a; Tripathi et al. 2016). In addition, predators such as domesticated and feral dogs, jackals, and monitor lizards depredate the eggs of turtles, including *N. gangetica* (Rao 1990).

Human activities such as utilizing water resources and discharging effluents into wetlands and rivers also harm *N. gangetica* severely. Ahmed and Das (2010) observed that increased human populations and their livelihood activities across the riverbanks and wetlands in Assam is a significant disturbance to the turtle's basking needs and has led to its severe decline in areas outside of the protected areas in the region. This may be the case throughout its range states.

In Pakistan, turtles face threats of habitat destruction, poaching for meat by locals as well as by hunters from neighboring countries, particularly from China (Shafi and Khan 2014). In addition, weak law enforcement, illegal trade, lack of awareness, fishing activities, and environmental pollution are responsible for severe population declines (Noureen et al. 2012; Ali et al. 2018; Safi et al. 2024a,b).

In Nepal, *N. gangetica* and other turtles are threatened by habitat loss, hunting, predators, and forest fires (Pun et al. 2023). Rashid and Khan (2000) reported turtle trade in Bangladesh as a serious threat to populations of *N. gangetica* and other turtles.

Conservation Measures Taken. — *Nilssononia gangetica* is legally protected in India, Bangladesh, Nepal, and Pakistan, and the species is also kept captive as deities in shrine and temple ponds, where devotees feed the turtles (Pritchard 1979; Vyas 2015; Sarkar et al. 2019).

The species has been recorded from a number of protected areas. It is found in wetlands in Madhav National Park (Mohit 2011), Tighra Reservoir, Gwalior,

(Gurjwar 2026); Gobind Sagar, Lalitpur, Madhya Pradesh, Ranthambore National Park, Rajasthan, India, and also in wetlands in Keoladeo National Park, Rajasthan (Rao, pers. obs.). A healthy population occurs in the National Chambal Sanctuary (Rao 1990, 2006). In central Assam, this and other sympatric species received a significant conservation boost when a series of protected areas were recently declared along and across the Brahmaputra River, extending from east of Kaziranga National Park to west of Orang National Park and now called the Kaziranga-Orang Riverine Landscape (KORL), a nearly 200 km stretch of the Brahmaputra. This conservation action, to protect this landscape, was originally recommended in 2009 (Ahmed et al. 2009) and eventually completed in 2024. It is an example of a riverine conservation area model that not only protects habitats and populations of large mammals, but also many other species of aquatic and terrestrial ecosystems, including turtles.

Nilssonina gangetica is listed as Schedule I by Indian National legislation prohibiting collection, export, or killing of turtles and other endangered species, and is also protected by inclusion in Schedule I of the Indian Wildlife (Protection) Act, 1972. However, as noted above, these regulations are only weakly enforced. It is also listed in the IUCN Red List as Endangered (Ahmed et al. 2021). *Nilssonina gangetica* has also been listed in Appendix I of the Convention on International Trade in Endangered Species of Fauna and Flora (CITES) since 1975 (Choudhury et al. 1994).

The Government of India initiated a project in 1987 to repatriate this species into the Ganga River. Wild-laid eggs (around 10,000 eggs per year) were collected from the Chambal River, a tributary of the Ganga River, for captive hatching (Mishra 1986, 1987; Vasudevan 1996). The hatchlings were then head-started for some years before releasing them into the Ganga River at Saranath (Varanasi) and Lucknow in Uttar Pradesh. Captive-reared *N. gangetica* and other freshwater turtle species were still being released fairly recently in a stretch of the Ganga River in Uttar Pradesh, declared as a Turtle Sanctuary (but now delisted), under the ‘Namami Ganga’ project sponsored by the Ministry of Environment, Forests and Climate Change and Ministry of Jal Shakti, Government of India (Talukdar et al. 2019, Panda et al. 2024). Kukrail Gharial Centre in Lucknow recently initiated a conservation breeding colony of 25 adults turtles, and the Government of Uttar Pradesh recently developed a new turtle sanctuary near Prayagraj on the Ganges (S. Singh, pers. comm.).

In recent years there has been a growing awareness of the need for positive conservation action for Indian turtles (Vyas 2015; Sarkar et al. 2019; Barhadiya and Singh 2020; Kundu et al. 2020; Kar et al. 2024; Khanduri et al. 2025, Thathi and Singh 2025). Unfortunately, there are still considerable gaps in our knowledge of relevant ecology

and life history of Indian turtles (Pandit 1997; Rao 2016, Ahmed et al. 2021). The national and state governments, at least in India, are putting efforts into conserving endangered species of turtles through state legislation and also in declaring habitats as protected areas; local people and religious leaders are also contributing to the protection of freshwater turtles and tortoises in religious reserves, sanctuaries, and temples (Das 2014; Rao 2025).

Conservation Measures Proposed. — Since there are moderate to large populations of *N. gangetica* in some areas, the local and global population status of the species needs to be studied more thoroughly to determine whether it might be a candidate for potential proposed down-listing from Appendix I of CITES and on Schedules of Indian Wildlife (Protection) Act, 1972. Understanding the global population status and trends of this species is essential to effective conservation action. Steps must be taken to further study the species' populations and ecology. The current understanding of the global population of the species is based on availability in illegal markets and limited observations in the wild in some selected protected areas. An interdepartmental combined approach is recommended for the overall improvement and restoration of *N. gangetica* habitats in different states.

Monitoring the species for ecological information and human interactions is needed in protected areas, as well as in human-dominated areas to better understand population dynamics, breeding, egg laying and anthropogenic disturbances, so as to prescribe improved conservation and management measures.

Community-based conservation efforts to secure and protect key segments of rivers and wetlands should be promoted so that the species' habitats and refugia are protected by direct involvement of communities.

While temple ponds and belief systems may protect turtles from extinction, excessive numbers in temple ponds usually leads to harmful effects on global populations of the species. In recent years, even invasive species such as the Red-eared Slider (*Trachemys scripta elegans*) are also being released in the ponds and rivers due to devotees' ignorance about turtles in general. Furthermore, the supply network of turtles for such faith-based practices is also linked to the illegal wildlife trade. The conservation and management of habitats must be implemented to protect turtle populations that are connected through rivers and wetland systems to ensure that systems within the landscape are managed and secured by multiple stakeholders, importantly including local communities.

Captive Husbandry. — *Nilssonina gangetica* is present in captivity in many zoos and captive animal facilities, and has bred at the Madras Crocodile Bank (Whitaker 2006), the Sayaji Baug Zoo, Vadodara (Vyas and Patel 1992) and the Kukrail Reptile Rehabilitation Centre, Lucknow (S. Singh, pers. comm.). It prefers an

animal diet, and needs deep pools and smooth soil for nesting purposes. It is very aggressive when handled and attempts to bite.

Current Research. — Turtle ecology study in the Chambal River, India, is the longest continued effort in India. The research has focused on the formulation of a comprehensive conservation strategy and future management programs for conservation of turtles, including *N. gangetica*. As recommended by Praschag et al. (2007), research on genetic variation of turtles including *N. gangetica* is being conducted in Wildlife Institute of India, Zoological Survey of India, and in several universities. Biological studies of captive turtles are conducted at Kukrail Reptile Rehabilitation Centre, Uttar Pradesh, India (S. Singh, pers. comm.). Research studies on habitat characteristics of *N. gangetica* are in progress in the Tighra Reservoir, Gwalior, India. Studies on status, distribution, and conservation of freshwater turtles including *N. gangetica* in Pakistan are under progress (A. Safi, pers. comm.). Research on egg incubation, and monitoring of populations is being carried out in view of the large-scale reintroduction program in India under the Ganga cleaning project (A. Panda, pers. comm.). Studies are being continued in captivity on diet, feeding behavior, egg incubation and hatching, and rearing of hatchlings and juveniles in the rehabilitation centre in Madhya Pradesh and Saranath Turtle Rescue centre, Uttar Pradesh (A. Panda, pers. comm.). The first effort to deploy a satellite tag on a *N. gangetica* in India has been successfully completed in KORL, Assam, in May 2026 (A. Das, pers. comm.).

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Literature Cited

- AHMED, M.F. AND DAS, A. 2010. Tortoises and turtles of northeast India: saving them from extinction! Survey, assessment of present status and conservation of tortoises and freshwater turtles in northeast India. Guwahati, India: Technical Report, Aaranyak, HRCI: 01/2010.
- AHMED, M.F., BORAH, J., AND SARMA, P.K. 2009. Assessing the potential of the Brahmaputra River islands to support dispersing tigers within the Central Assam, North East India. Technical Report. Aaranyak, TRCI 02: 38 pp.
- AHMED, M.F., CHOUDHURY, B.C., DAS, I., AND SINGH, S. 2021. *Nilssonia gangetica*. The IUCN Red List of Threatened Species 2021: e.T39618A2930943.
- ALI, W., JAVID, A., HUSSAIN, A., AND BUKHARI, S.M. 2018. Diversity and conservation of freshwater turtles in Pakistan: a review. *Biodiversity* 19(1–2):62–71.
- ANNANDALE, N. 1912. The Indian mud-turtles (Trionychidae). *Records of the Indian Museum* 7:151–179.
- ANNANDALE, N. AND SHASTRI, M.H. 1914. Relics of the worship of mud-turtles (Trionychidae) in India and Burma. *Journal of the Asiatic Society of Bengal* 1:131–138.
- ARYAL, P.C., DHAMALA, M.K., BHURTEL, B.P., SUWAL, M.K., AND RIJAL, B. 2010. Turtles of Nepal: A Field Guide for Species Accounts and Distribution. Kathmandu, Nepal: Environmental Graduates in Himalaya, Resources Himalaya Foundation and Companions for Amphibians and Reptiles of Nepal (CARON).
- BAIG, K.J., MASROOR, R., AND ARSHAD, M. 2008. Biodiversity and ecology of the herpetofauna of Cholistan Desert, Pakistan. *Russian Journal of Herpetology* 15:193–205.
- BARHADIYA, G. AND SINGH, S. 2020. Cultural use of turtle shells, an underrated threat in turtle conservation: a case study in Assam, India. *IRCF Reptiles and Amphibians* 27:213–215.
- BARHADIYA, G., SINGH, S., GHOSH, C., BASUMATARY, R., AND PURKAYASTHA, J. 2020. Diversity and conservation potential of captive chelonian colonies at temple ponds in north-east India. *Herpetological Bulletin* 154:12–17.
- BARUAH, C. AND SHARMA, D.K. 2024. Diversity of turtles in the Eastern Himalaya. In: Pullaiah, T. (Ed.). *Biodiversity Hotspot of the Himalaya*. Apple Academic Press, doi.org/10.1201/9781003455202, 26 pp.
- BARUAH, C., CHETIA, P., BHUYAIN, S.K., AND SHARMA, D.K. 2012. Diversity of freshwater turtles and their possible conservation in and around the Orang National Park, Assam, India. *Tigerpaper* 39:24–30.
- BASU, D. 1987. Project for rehabilitation of freshwater turtles in India. *Hamadryad* 12:13–14.
- BHAT, O. 2019. Diversity, distribution and conservation challenges of turtles in Shuklaphanta National Park, Nepal. Ph.D. Thesis, Tribhuvan University, Nepal.
- BHUPATHY, S. 1990. Observations on the food of the Ganges softshell turtle, *Trionyx gangeticus* in Keoladeo National Park, Bharatpur. *Journal of the Bombay Natural History Society* 87:460–461.
- BOUR, R., DUBOIS, A., AND WEBB, R.G. 1995. Types of recent trionychid turtles in the Museum national d'Histoire naturelle, Paris. *Dumerilia* 2:73–92.
- CAGLE, F.R. 1950. The life history of the Slider Turtle, *Pseudemys scripta troostii*. *Ecological Monographs* 20(1):31–54.
- CHOUDHURY, B.C. AND BHUPATHY, S. 1993. *Turtle Trade in India: A Study of Tortoises and Freshwater Turtles*. New Delhi. TRAFFIC and WWF-India.
- CHOUDHURY, B.C., BHUPATHY, S., AND HANFEE, F. 2000. Status information on the tortoises and freshwater turtles of India. In: van Dijk, P.P., Stuart, B.L., and Rhodin, A.G.J. (Eds.). *Asian Turtle Trade: Proceedings of a Workshop on Conservation and Trade of Freshwater Turtles and Tortoises in Asia*. Chelonian Research Monographs No. 2, pp. 86–94.
- CHOUDHURY, B.C., BHUPATHY, S., AND MOLL, E.O. 1994. Conservation and management of freshwater turtles and land tortoises of India. Final report: Turtle and Tortoise Conservation Project, a joint Indo-U.S. collaborative project of the Wildlife Institute of India and U.S. Fish and Wildlife Service. Dehra Dun, India: Wildlife Institute of India, 108 pp.
- CUVIER, G.L.C.F.D. 1825. *Recherches sur les ossements fossiles de*

- quadrupèdes, où l'on rétablit les caractères de plusieurs espèces d'animaux que les révolutions du globe paroissent avoir détruites. Paris: Dufour et d'Ocagne. Ed. 3, 5 vols.
- DAS, I. 1985. Indian Turtles – A Field Guide. Calcutta: World Wildlife Fund, 119 pp.
- DAS, I. 1991. Colour Guide to the Turtles and Tortoises of the Indian Subcontinent. Portishead: R & A Publishing, 133 pp.
- DAS, I., DATTA GUPTA, B., AND GAYEN, N.C. 1998. History and catalogue of reptile types in the collection of the Zoological Survey of India. *Journal of the South Asian Natural History* 3:121–172.
- DAS, K.C. 2014. One decade study report on diversity status of turtle fauna and their conservation initiative in Northeast India. In: Gupta, A.K. (Ed.). North-East Biodiversity and Sustainable Economic Development: Issues and Challenges. Concept Publishing Company Pvt. Ltd., pp. 309–336.
- DAS, K.C. AND GUPTA, A. 2011. Site records of softshell turtles (Chelonina: Trionychidae) from Barak Valley, Assam, northeastern India. *Journal of Threatened Taxa* 3:1722–1726.
- DATTA, M.K., NANDEESHA, M.C., RAO, R.J., AND CHAKABARTI, S. 2004. Status and conservation of freshwater turtles and tortoises in Tripura, northeastern India. *Proceedings of Seminar on Biodiversity*, pp. 40–48.
- DELU, V., KARWASRA, V., AND PANDA, A.K. 2024. Conservation of two freshwater turtle species in the Guru Gorakhnath Community Reserve in western Haryana, India. *Reptiles and Amphibians* 31: e 20609, 4 pp.
- ENGSTROM, T.N., SHAFFER, H.B., AND MCCORD, W.P. 2004. Multiple data sets, high homoplasy, and the phylogeny of softshell turtles (Testudines: Trionychidae). *Systematic Biology* 53:693–710.
- FLOWER, S.S. 1925. Contributions to our knowledge of the duration of life in Vertebrate animals – III. Reptiles. *Proceedings of the Zoological Society of London* 95(3):911–981.
- GAYASUDDIN, M. AND RAO, R.J. 1980. Electrophoretic studies on serum proteins of a soft shelled turtle *Trionyx gangeticus*. *Indian Journal of Zoology* 8(1):37–39.
- GEMEL, R. AND PRASCHAG, P. 2003. On the nomenclature and vernacular names of recent *Aspideretes* species (Reptilia, Testudines, Trionychidae). *Zoologische Abhandlungen, Staatliches Museum für Tierkunde Dresden* 53:93–105.
- GIRI, K.C., NAYAK, S., AND BEHERA, S. 2022. Status survey of freshwater turtles in sacred places of Odisha, India. *Testudo* 9(4):1–13.
- GORMAN, G.C. 1973. The chromosomes of the Reptilia, a cytotaxonomic interpretation. In: Chiarella, A.B. and Capanna, E. (Eds.). *Cytotaxonomy and Vertebrate Evolution*. London and New York: Academic Press, pp. 349–424.
- GRAY, J.E. 1830. Illustrations of Indian Zoology, chiefly selected from the collection of Major-General Hardwicke. Vol. I, Part 4, pls. 75, 78. London: Treuttel, Wurtz, Treuttel, Jun. and Richter.
- GURJWAR, R.K. 2026. Herpetofauna of Tighra Reservoir. In: Rao, R.J. (Ed.). *Tighra Reservoir*. Technical Publication CEF – 01, pp. 84–92.
- HABIBI, K. 1982. Afghanistan III. Fauna, Encyclopaedia Iranica, Online Edition, <http://www.iranicaonline.org/articles/afghanistan-iii-fauna>.
- IVERSON, J.B. 1992. A Revised Checklist with Distribution Maps of the Turtles of the World. Richmond, IN: Privately printed, 363 pp.
- IVERSON, J.B. 2022. A review of chelonian type specimens (Order Testudines). *Megataxa* 7(1):001–085.
- IVERSON, J.B. 2024 [“2023”]. Estimating generation time in freshwater and terrestrial turtles. *Herpetological Review* 54(4):546–549.
- IVERSON, J.B. AND GREENE, D.U. 2022. Elevated reproductive output in pelomedusid turtles. *Herpetological Review* 53:400–404.
- IVERSON, J.B., EWERT, M.A., AND MOLL, E.O. 2024. Egg size versus mass relationships in turtles. *Chelonian Conservation and Biology* 23:128–129.
- IVERSON, J.B., ENNEN, J., AND LOVICH, J.E. 2025. Life-history and ecology data for the turtles of the world. *Chelonian Conservation and Biology* 24:136–141.
- JOHNSON, C.A., GRIFFITH, J.W., TENORIO, P., HYTREK, S., AND LANG, C.M. 1998. Fatal trematodiasis in research turtles. *Lancet Animal Science* 48:340–343.
- KAR, S., PEGU, K., BASISTHA, M., AND SINGH, S. 2024. Diversity, abundance and habitat assessment for aquatic reptiles along the lower Brahmaputra in Assam. Technical Report by TSA Foundation India, submitted to Assam Forest Department, 26 pp.
- KAYANI, S.B., ANWAR, M., AND ASHFAQ, M. 2015a. Molecular characterization of *Nilssonina gangetica* on the basis of rflp. *International Journal of Biosciences* 6(10):64–72.
- KAYANI, S.B., ANWAR, M., ASHFAQ, M., HUSSAIN, I., AND MAHMOOD, T. 2015b. Morphometric studies of the freshwater turtles from Rawalpindi Islamabad Region of Pakistan. *Journal of Biodiversity and Environmental Sciences* 6(5):228–233.
- KHADKA, B.B. AND LAMICHHANE, S. 2020. First distribution records of *Pangshura tentoria*, *Chitra indica*, and *Nilssonina gangetica* in the major rivers of Chitwan National Park, Nepal. *Herpetology Notes* 13:157–159.
- KHALID, M.A., DUTTA, S., PAREEK, P.S., AND SINGH, S. 2025. Imperiled chelonians: issues and conservation challenges. In: Khalid, M.A., Kumar, S., Yadav, E., Pankaj, P.P., and Kharwar, R.K. (Eds.). *Vanishing Biodiversity: Global Threats to Flora and Fauna*, pp. 325–336.
- KHAN, M.Q., YASEEN, Z.H., NUMAN, M., SILVA VAZ, I., AND ALI, A. 2021. Ecology and genetic identification of freshwater turtles in Pakistan. *Acta Scientiae Veterinariae* 49:1–17.
- KHAN, M.S. 2015. Status and distribution of freshwater turtles in Pakistan. *Bulletin of the Chicago Herpetological Society* 50(4):51–53.
- KHAN, M.S. 2021. *Herpetology of Pakistan. Part II. Turtles and Crocodilia*. Lahore: Zoological Society of Pakistan, University of the Punjab, 214 pp.
- KHAN, M.Z., SAFI, A., GHALIB, S.A., AND KANWAL, R. 2016. Population status, distribution and conservation of freshwater turtles of Peshawar valley, Khyber Pakhtunkhwa, Pakistan. *Canadian Journal of Pure and Applied Sciences* 10:3732–3750.
- KHANDURI, M., HÖLKER, F., SAH, R., HUSSAIN, S.A., BADOLA, R., AND CANDOLIN, U. 2025. Guiding aquatic reptile (chelonian and crocodylian) conservation in the face of growing light pollution: lessons from experience. *Wiley Interdisciplinary Reviews: Water* 12(1), <https://wires.onlinelibrary.wiley.com/doi/epdf/10.1002/wat2.70003>.
- KRUEGER, C.J. AND JANZEN, F.J. 2022. ROSIE, a database of reptilian offspring sex ratios and sex-determining mechanisms, beginning with Testudines. *Science Data* 9:22, <https://doi.org/10.1038/s41597-021-01108-1>.
- KUNDU, S., KUMAR, V., TYAGI, K., CHAKRABORTY, R., SINGHA, D., RAHAMAN, I., PRAKRASHI A., AND CHANDRA, K. 2018. Complete mitochondrial genome of Black Soft-shell Turtle (*Nissonina nigricans*) and comparative analysis with other Trionychidae. *Scientific Reports* 8:17378, pp. 1–11.
- KUNDU, S., MAITY, P., RIZVI, A.N., TYAGI, K., CHANDRA, K., AND KUMAR, V. 2020. Detection of helminth parasites in commercialized turtles: threats to native Testudines in northeast India. *Records of the Zoological Survey of India* 120(2):99–103.
- LIEBING, N., PRASCHAG, P., GOSH, R., VASUDEVAN, K., RASHID,

- S.M.A., RAO, D., STUCKAS, H., AND FRITZ, U. 2012. Molecular phylogeny of the softshell turtle genus *Nilssonina* revisited, with first records of *N. formosa* for China and wild-living *N. nigricans* for Bangladesh. *Vertebrate Zoology* 62(2):261–272.
- MANDAL, P., JAANA, P.K., MALLICK, P.H., SINGH, S., AND BHATTACHARYA, T. 2024. Traditional harvesting practices employed for freshwater turtles by the indigenous communities along Shilabati River, West Bengal, India. *Journal of Threatened Taxa* 19(5):25147–25156.
- MEYLAN, P.A. 1987. The phylogenetic relationships of soft-shelled turtles (family Trionychidae). *Bulletin of the American Museum of Natural History* 186(1):1–101.
- MINTON, S.A. 1966. A contribution to the herpetology of West Pakistan. *Bulletin of the American Museum of Natural History* 134:27–184.
- MISHRA, S.B. 1986. Observations on the nesting of two softshell turtles in Chambal River, Uttar Pradesh. *Hamadryad* 11:15–16.
- MISHRA, S.B. 1987. Freshwater turtle egg collection in Uttar Pradesh. *Hamadryad* 12(2):16.
- MOHIT, A. 2011. Studies on biodiversity, habitat utilisation and trophic relationships of aquatic vertebrates in the Madhya National Park, Madhya Pradesh. Ph.D. Thesis, Jiwaji University, Gwalior, India.
- MOLL, E.O. 1984. Freshwater turtles in India. Their status, conservation and management. *Hamadryad* 9(3):9–17.
- MURRAY, J.A. 1886. The reptiles of Sind; a systematic account, with descriptions of all the species inhabiting the province, and a table of their geographical distribution in Persia, Beloochistan, Afghanistan, Punjab, North-West provinces, and the peninsula of India generally. London: Richardson and Co., 92 pp.
- NOUREEN, U., KHAN, A., AND ARSHAD, M. 2012. Exploring illegal trade in freshwater turtles of Pakistan. *Records of the Zoological Survey, Pakistan* 21:19–24.
- PANDA, A.K., VERMA, V., SRIVASTAV, A., BADOLA, R., AND HUSSAIN, S.A. 2024. Digital image processing: a new tool for morphological measurements of freshwater turtles under rehabilitation. *PLoS ONE* 19(3):e0300253.
- PANDIT, R.K. 1997. Studies on distribution pattern of turtles in the Ganga River between Rishikesh and Kanpur. Ph.D. Thesis, Jiwaji University, Gwalior, India.
- PRASCHAG, P., HUNSDÖRFER, A.K., REZA, A.H.M.A., AND FRITZ, U. 2007. Genetic evidence for wild-living *Aspideretes nigricans* and a molecular phylogeny of South Asian softshell turtles (Reptilia: Trionychidae: *Aspideretes*, *Nilssonina*). *Zoologica Scripta* 36:301–310.
- PRITCHARD, P.C.H. 1979. *Encyclopedia of Turtles*. Neptune City, New Jersey: T.F.H. Publications, 895 pp.
- PRITCHARD, P.C.H. 2001. Observations on body size, sympatry, and niche divergence in softshell turtles (Trionychidae). *Chelonian Conservation and Biology* 4:5–27.
- PUN, S.K., STANFORD, C.B., AND KHADKA, B.B. 2023. Distribution records and conservation status of turtles in Chitwan, Nepal. *Journal of International Science and Technology* 28(1):25–30.
- RAJPOOT A., BAHUGUNA, A., AND KUMAR, V.P. 2019. Molecular study of globally threatened turtle species (families Trionychidae and Geoemydidae) of Uttarakhand and their relationship with other Indian populations: a wildlife forensic and conservation genetic approach. *Forensic Science International: Reports* 1:100039, 1–7.
- RANGANATHAN, M.S., MITAL, A., AND DHARWADKAR, S. 2020. *Nilssonina gangetica* (Ganges Softshell Turtle). *Herpetological Review* 51(3):580.
- RAO, R.J. 1981. Morphological observations on the male reproductive system of an Indian softshelled turtle *Trionyx gangeticus*. *Indian Journal of Zoology* 9(2):81–85.
- RAO, R.J. 1982. Studies on neuroanatomy, cytology and histochemistry of the reproductive system of the freshwater turtle, *Trionyx gangeticus* (Cuvier) with special reference to seasonal cyclicity. Ph.D. Thesis, Bhopal University, Bhopal, India.
- RAO, R.J. 1984. Turtles in Chambal River. *Hamadryad* 9(2):9–10.
- RAO, R.J. 1985a. Sexual cycle of the male freshwater turtle *Trionyx gangeticus* (Cuvier). *Herpetologica* 41(4):433–437.
- RAO, R.J. 1985b. Unusual egg-laying in a captive soft-shelled turtle *Trionyx gangeticus* (Cuvier). *Journal of the Bombay Natural History Society* 82(3):897.
- RAO, R.J. 1985c. Freshwater turtle trade in Madhya Pradesh. *Hamadryad* 10:17–18.
- RAO, R.J. 1986a. Notes on the sexual cycle of female *Trionyx gangeticus* in central India. *Journal of Herpetology* 20:451–453.
- RAO, R.J. 1986b. The intrinsic innervation of the male reproductive system of a freshwater turtle *Trionyx gangeticus* (Cuvier). A breeding cycle study. *Herpetological Journal* 1:102–106.
- RAO, R.J. 1986c. Surface patterns of oviductal mucosa of the freshwater turtle *Trionyx gangeticus*. *Zoologische Anzeiger* 5/6:399–401.
- RAO, R.J. 1986d. A note on cannibalism in freshwater softshelled turtle *Trionyx gangeticus* (Cuvier). *Journal of the Bombay Natural History Society* 83(1):224.
- RAO, R.J. 1986e. Shell injury in a freshwater turtle *Trionyx gangeticus* (Cuvier). *Journal of the Bombay Natural History Society* 83(2):449.
- RAO, R.J. 1987a. Ecological studies of Indian turtles. *Tigerpaper* 14(3):21–25.
- RAO, R.J. 1987b. Influence of climate on spermatogenesis cycles of freshwater turtle, *Trionyx gangeticus* (Cuvier) in central India. *Comparative Physiological Ecology* 12(4):177–179.
- RAO, R.J. 1990. Ecological relationships among freshwater turtles in the National Chambal Sanctuary. Study Report, Wildlife Institute of India, 212 pp.
- RAO, R.J. 1991. Conservation management of freshwater turtles in the National Chambal Sanctuary. *Journal of the Ecological Society* 4:43–53.
- RAO, R.J. 2001. Biological resources of the Ganga River, India. *Hydrobiologia* 458:159–168.
- RAO, R.J. 2006. Species diversity, habitat features and conservation of freshwater turtles in the Chambal River, Madhya Pradesh, India. *Chelonii* 4:23–27.
- RAO, R.J. 2016. Conservation strategies of Indian freshwater turtles. *Bionature* 36(2):71–79.
- RAO, R.J. 2025. Case studies on religious commitments towards protection of freshwater turtles and tortoises in India. *Journal of Environmental Science and Agricultural Research* 3(3):1–4.
- RAO, R.J. AND SHAAD, F.U. 1983. The intrinsic innervation of the reproductive tract of the female freshwater turtle *Trionyx gangeticus*. *Indian Journal of Zoology* 11(2):51–55.
- RAO, R.J. AND SHAAD, F.U. 1985. Sexual cycle of the male freshwater turtle *Trionyx gangeticus* (Cuvier). *Herpetologica* 41:433–437.
- RAO, R.J., BEHERA, S.K., AND PANDIT, R.K. 1996. Status and conservation of turtles in the Upper Ganga River, India. In: Devaux, B. (Ed.). *Proceedings of the International Congress of Chelonian Conservation*. Gonfaron, France: SOPTOM, pp. 38–41.
- RAO, R.J., SAHU, B.K., BEHERA, S.K., AND PANDIT, R.K. 2000. Biomonitoring of pollution in the Ganga River, Uttar Pradesh. In: Trivedy, R.K. (Ed.). *Pollution and Biomonitoring of India Rivers*. ABO Publishers, pp. 187–193.
- RASHID, S.M.A. AND KHAN, S.M.H. 2000. Trade and conservation status of freshwater turtles and tortoises in Bangladesh. In: van

- Dijk, P.P., Stuart, B.L., and Rhodin, A.G.J. (Eds.). Asian Turtle Trade: Proceedings of a Workshop on Conservation and Trade of Freshwater Turtles and Tortoises in Asia. Chelonian Research Monographs No. 2, pp. 77–85.
- RASHID, S.M.A. AND SWINGLAND, I.R. 1997. On the ecology of some freshwater turtles in Bangladesh. In: Van Abbema, J. (Ed.). Proceedings: Conservation, Restoration, and Management of Tortoises and Turtles – An International Conference. New York: New York Turtle and Tortoise Society, pp. 225–242.
- RATHNAM, B.A., KUMAR, K.S., AND BAI, D. 2024. A report on *Tachyonetria* infestation in a turtle and its management. International Journal of Veterinary Sciences and Animal Husbandry 9(3):145–146.
- ROHILLA, M.S. AND TIWARI, P.K. 2008. Restriction fragment length polymorphism of mitochondrial DNA and phylogenetic relationships among five species of Indian freshwater turtles. Journal of Applied Genetics 49:167–182.
- ROOPA, R.S., CHAUDHURI, A., DEY, S., AND MENDIRATTA, U. 2024. Calipee trade: a pervasive yet under-recognized threat to softshell turtles in South Asia. Chelonian Conservation and Biology 23(2):153–160.
- SAFI, A. AND KHAN, M.Z. 2014. Distribution and current population of freshwater turtles of District Charsadda of Khyber Pakhtunkhwa, Pakistan. Journal of Zoology Studies 1(4):31–38.
- SAFI, A., HASHMI, M.U.A., YOUSUFZAI, S., AND KARL, H.V. 2024a. A review analysis of the poaching and illegal trade of tortoises and freshwater turtles (TFTs) in Pakistan. SPC Journal of Environmental Sciences 6(1):13–18.
- SAFI, A., KARL, H.V., AND TICHY, G. 2024b. A review of the biogeography, diversity, and current conservation status of turtles and tortoises of the Indian subcontinent. Sustainability and Biodiversity Conservation 3(2):66–85.
- SAFI, A., KANWAR, R., HASHMI, M.U.A., KARL, H.V., TRICHY, G., AND RAO, R.J. 2025. Soft-shelled turtles of the family Trionychidae in South Asia: a review of studies on their biogeography, diversity, and conservation. Nepalese Journal of Zoology 9(1):45–54.
- SARKAR, D., MITAL, A., MANDAL, R., KUMAR, R.S., AND TALUKDAR, G. 2019. Community ponds: a tool for conservation. A case study of *Nilssonia gangetica* (Cuvier, 1825) in Kashipur village, Uttar Pradesh, India. Herpetology Notes 12:631–636.
- SMITH, M.A. 1931. The Fauna of British India, including Ceylon and Burma. Vol. I. Loricata, Testudines. London: Taylor and Francis, 185 pp.
- SLAVENS, F. AND SLAVENS, K. 2000. Reptiles and Amphibians in Captivity. Breeding – Longevity and Inventory, Current January 1, 1999. Slaveware, 400 pp.
- TALUKDAR, A., SENGUPTA, D., MALLAPUR, G., HUSSAIN, S.A., MALIK, P.K., AND NIGAM, P. 2019. Amelioration of the freshwater turtle breeding and rehabilitation station in Varanasi, India. IRCF Reptiles and Amphibians 26(2):170–173.
- THATHI, P.R. AND SINGH, S.K. 2025. A review on conservation-based research on Trionychidae (order: Testudines) in the Indian subcontinent. Journal of Entomology and Zoology Studies 13(3):324–333.
- THOMSON, R.C., SPINKS, P.Q., AND SHAFFER, H.B. 2021. A global phylogeny of turtles reveals a burst of climate-associated diversification on continental margins. Proceedings of the National Academy of Sciences (PNAS) 118:7, e2012215118, 10 pp.
- TIKADER, B.K. AND SHARMA, R.C. 1985. Handbook: Indian Testudines. Calcutta: Zoological Survey of India, 156 pp.
- TRIPATHI, A., BHATT, D., AND DADWAI, N. 2016. Anthropogenic threats to freshwater turtles in upper Ganges River with special reference to Indian Narrow Headed Softshell Turtle (*Chitra indica*). Journal of Environment and Bioscience 30(1):101–107.
- TTWG [TURTLE TAXONOMY WORKING GROUP: VAN DIJK, P.P., IVERSON, J.B., SHAFFER, H.B. BOUR, R., AND RHODIN, A.G.J. 2011. Turtles of the World. 2011 update: annotated checklist of taxonomy, synonymy, distribution, and conservation status. Chelonian Research Monographs 5:000.165–242.
- TTWG [TURTLE TAXONOMY WORKING GROUP: RHODIN, A.G.J., IVERSON, J.B., BOUR, R., FRITZ, U., GEORGES, A., SHAFFER, H.B., AND VAN DIJK, P.P.] 2021. Turtles of the World: Annotated Checklist and Atlas of Taxonomy, Synonymy, Distribution and Conservation Status (9th Ed.). In: Rhodin, A.G.J., Iverson, J.B., van Dijk, P.P., Stanford, C.B., Goode, E.V., Buhlmann, K.A. and Mittermeier, R.A. (Eds). Conservation Biology of Freshwater Turtles and Tortoises: A Compilation Project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group. Chelonian Research Monographs 8:1–472.
- TTWG [TURTLE TAXONOMY WORKING GROUP: RHODIN, A.G.J., IVERSON, J.B., FRITZ, U., GALLEGU-GARCÍA, N., GEORGES, A., SHAFFER, H.B., AND VAN DIJK, P.P.] 2025. Turtles of the World: Annotated Checklist and Atlas of Taxonomy, Synonymy, Distribution, and Conservation Status (10th Ed.). In: Rhodin, A.G.J., Iverson, J.B., van Dijk, P.P., Stanford, C.B., Goode, E.V., Buhlmann, K.A. and Mittermeier, R.A. (Eds). Conservation Biology of Freshwater Turtles and Tortoises: A Compilation Project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group. Chelonian Research Monographs 10:1–575.
- VASUDEVAN, K. 1996. Reproductive ecology of *Aspideretes gangeticus* (Cuvier) in north India. In: Devaux, B. (Ed.). Proceedings of the International Congress on Chelonian Conservation. Gonfaron, France: SOPTOM, pp. 21–28.
- VYAS, R. 1989a. The Ganges soft-shell turtle (*Trionyx gangeticus* Cuvier) from the Vadodara city. Journal of the Bombay Natural History Society 85(1):107–108.
- VYAS, R. 1989b. Distribution of the Ganges soft-shell turtle (*Trionyx gangeticus* Cuvier) in Gujarat. Herpeton 2(1):112.
- VYAS, R. 1995. Notes on growth and maturity in the Indian softshell turtle (*Aspideretes gangeticus*). Hamadryad 20:30–34.
- VYAS, R. 2015. Status of Ganges soft-shell turtle *Nilssonia gangetica* amidst deplorable scenarios in urban wetlands of central Gujarat State, India. Reptile Rap 17:3–12.
- VYAS, R. AND PATEL, B.H. 1990. A survey of freshwater turtles of Gujarat. Journal of the Bombay Natural History Society 87:152–155.
- VYAS, R. AND PATEL, B.H. 1992. Studies on the reproduction of the Indian softshell turtle (*Aspideretes gangeticus*). Hamadryad 17:32–34.
- WHITAKER, N. 2000. Incubation of *Aspideretes gangeticus* eggs and long term sperm storage in females. Hamadryad 25(2):198–200.
- WHITAKER, N. 2006. Immaculate conception, incubation protocols, and egg characteristics of the Ganges softshell turtle (*Aspideretes gangeticus*). Contemporary Herpetology 1:1–6.

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