Sustainability and Biodiversity Conservation

A review of turtles' diversity, distribution, conservation, and threats in Pakistan

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Abstract

This review study is based on the compilation of available information on turtles in Pakistan, including their diversity, distribution, threats, and conservation initiatives across the country. Pakistan has many ecosystems and landscapes that support biodiversity and is home to 15 species of testudines (Tortoises and turtles) belonging to 13 genera and 5 families. The authors conducted a comprehensive review of available records and archives, incorporating field data collected between 2014 and 2024, to document the distribution, threats, and conservation status of chelonians in Pakistan. Therefore, the present study represents an up-to-date, evidence-based report containing information on the occurrence of all turtle and tortoise species in the country.
Keywords: Turtles, Diversity, Distribution, Conservation, Threat, Pakistan

Introduction

The distribution and diversity of reptilian fauna are closely related to the climatic conditions and the geographical location of an area (Karl, 1997; Safi and Karl, 2024). Reptilia is a diverse class of vertebrates that live in all natural environments of the world except Antarctica (Hashmi and Safi, 2025). Turtles are among the most threatened groups of all vertebrates (Stanford et al., 2020; Safi et al., 2024a). Turtles have a nearly global distribution, except in the polar regions. However, the fossil evidence shows that giant tortoises once inhabited every continent except Antarctica and

Australia (Ahmed et al., 2024; Safi et al., 2025a, 2025b). Giant turtles are the oldest group of reptiles to have colonized the world since the advent of dinosaurs. According to reports, the oldest known turtle fossils are those of *Proganochelys* from the Late Triassic period in Germany, approximately 220 million years ago, and *Odontochelys semitestacea* from the Triassic period in China (Karl et al., 2025). A total of 357 species and 14 recognized families of turtles, which also include sea turtles, are recorded in various habitats worldwide (Safi & Khan, 2014; TTWG, 2021; Safi et al., 2025a &b). The order Chelonidae includes 13 families (Khan et al. 2016a). Turtles, unlike other animals, have horny beaks instead of teeth and have a shell consisting of a fleshy trunk attached to the carapace. They are characterized by specialized bones or cartilages, consisting of ribs, shoulder blades, and specialized dermal bones (Reisz and Head, 2008; TTWG, 2017; Dubois, 2010; Karl et al., 2019). All testudines breathe through lungs and lay their eggs on land. They are found in temperate, subtropical, and tropical climates, as well as in various habitats, including marine, freshwater, and terrestrial environments (Hutchinson, 1996; Ramakrishna et al., 2014; Safi and Khan, 2014). Turtles are an extremely adaptable species that contribute to the well-being of terrestrial, freshwater, and marine ecosystems. Today, more than half of the species are threatened with extinction, placing turtles at the peak of the critical extinction risks of all large vertebrates. Turtle populations are declining rapidly due to habitat loss, human consumption of traditional food and medicine, and harvesting for the global pet trade, their population declines and extirpation are being driven by illegal and legal trade, habitat destruction and degradation, emerging infectious diseases, and climate change (Stanford et al., 2020; Safi et al., 2024; Ahmed et al., 2024). There are currently 364 recognized species and 493 taxa of modern non-fossil turtles and tortoises. Among them, there are 7 sea turtles, 315 species, and 434 taxa of turtles and tortoises (TTWG, 2021; TCC, 2025; Hashmi et al., 2024). Turtles are among the most endangered vertebrate groups globally, surpassing birds, mammals, fish, and amphibians (Khan et al., 2015). According to the IUCN Red List analysis, 85% of South Asian turtle species are threatened, categorized as vulnerable (VU), critically endangered (CR), or endangered (EN), while the remaining 15% are at low risk, classified as least concern (LC) or near threatened (NT). With approximately 55% of all extant species being threatened, turtles and tortoises (chelonians) are one of the most imperiled vertebrate groups, and only primates have a higher percentage of threatened species (TTWG, 2021; Stanford et al., 2020; Safi et al., 2024a; Aidek et al., 2024). Turtle diversity is highest in Asia, followed by North America (Buhlmann et al., 2008; Safi et al.,

2020). There is no doubt that Pakistan has a diverse reptilian fauna, as it is situated at the intersection of three realms of the world, the Palearctic, Ethiopian, and Oriental regions (Safi et al., 2021). Pakistan has 15 ecological zones based on soil, vegetation, and climate: 1. Alpine deserts, dry and cold, 2. Himalayan dry coniferous forests, 3. Himalayan moist temperate forests 4. Tropical Dry Deciduous Forests 5. Baluchistan higher ranges, 6. Baluchistan hill ranges, 7. Tropical dry mixed deciduous forests 8. Dry temperate semi-evergreen shrub forest and subtropical pine forest, 9. Riverine tracts, 10. Temporary inundation zones, seepage areas, 11. tropical thorn forests, 12. Lakes and swamps, 13. Hills and natural dunes of sand in the Thar, Thal, and Cholistan deserts 14. Inter-tidal and Littoral zone 15. Offshore islands (Ali et al., 2018). There are 19 Ramsar sites along the Indus River system and their distributors (Table 1; Figure 1), and some salt lakes in the upper and lower Indus basins. The Indus Delta region's mangrove swamps and inter-tidal mud flats contain vegetation and floating plants and provide habitat for Pakistan's biodiversity related to swamps and inter-tidal zones (Khan 2015; Ali et al., 2018) (Figures 1–5). Pakistan is a political division in the northwest and northeast of the Indo-Pak subcontinent rather than a geological entity (Mufti et al., 1997; Khan et al., 2015; Khan, 2015; Ali et al., 2018). The Indus River system in Pakistan is by far the most significant contributor to the country's freshwater resources, serving as a Himalayan drainage basin. The bulk of the wetlands operate as localities where various birds, fish, and aquatic vegetation make a living through native or migratory processes (Table 1; Figures 1 & 2). Turtles are represented by 5 families, 13 genera, and 15 species in Pakistan (Khan, 2006). Based solely on the faunal composition at generic and specific levels, the freshwater turtle fauna of Pakistan is purely Oriental type (Khan et al., 2015) (Table 3). Only one species, Kemp's ridley turtle is exclusively found in the Gulf of Mexico (Gulf of America), while the other six marine turtle species are cir-cum-globally, these are hawks-bill, flat back, olive ridley, leatherback, loggerhead, and green turtles, have potential nesting sites in the Indian Ocean and especially in Southeast Asian region (IOSEA) except flat back which occur on the Australian continental shelf (Manzoor et al., 2023). Most sea turtles are migratory species that use Pakistani coastal areas as their breeding ground, and all these marine species have been documented in Pakistan except for Flat back and Kemp’s ridley (Asrar, 1999; Groombridge, 1987a, 1987b; Firdous, 2009, 2015; Firdous et al., 2010; Groombridge and Luxmoore, 1989). The coast of Pakistan is divided into two parts: the great Baluchistan coast (800 kilometers) and the smaller Sindh coast (250 kilometers), including the main coast of Karachi. Green turtle nesting (Figure 23)

and Olive ridley nesting (Figure 19) are recorded at Hawkes Bay & Sands Pit, Karachi, Ormara, and Jiwani (Daran) coast of Pakistan (Manzoor et al., 2023) (Table 3). Only two species of tortoises are found in Pakistan: The Afghan tortoise (*Testudo horsfieldii*), which is found in southwestern KPK and north and western Baluchistan, and the Sindh Star tortoise (*Geochelone elegans*), which is only recorded in some areas of Sind and Punjab, especially in south and eastern parts (Safi and Khan, 2014) (Table 3). In the current paper, we illustrate a comprehensive analysis of different variables encompassing systematic, diversity, distribution, threats, and conservation status related to turtles and tortoises in Pakistan. The present article is the first of its kind to compile data collectively on sea turtles, freshwater turtles, and land turtles (tortoises) in Pakistan. Accordingly, in this study, we compile all the records of Pakistani turtle fauna from earlier published literature, museum records, citizen science data, and our published as well as unpublished findings. We aim to compile and update existing information in much detail in the future on the zoo-geography, ecology, natural history, and threats to turtle species in Pakistan.

Materials and Methods

We conducted a comprehensive review survey of the published records regarding chelonian fauna in Pakistan to gather occurrence data and analyze their geographic distribution. Additionally, fieldwork undertaken by the Pakistani authors during 2014-2024 contributed new data. The organization of species, along with their scientific and English names, as well as information regarding type localities and type specimens, was sourced from the 9th edition of the "Turtles of the World Checklist" by the Turtle Taxonomy Working Group (TTWG 2021) and Iverson (2022). The international conservation status of each species is provided according to the International Union for Conservation of Nature (IUCN, https://www.iucnredlist.org/, accessed September 22, 2024). It has been revised where applicable based on regional or sub-specific assessments from the Turtle Taxonomy Working Group (TTWG 2021) and, for *Caretta caretta,* the IUCN-SSC Marine Turtle Specialist Group (https://www.iucn-mtsg.org/statuses, accessed April 30, 2025).

Study Area

Pakistan is located in South Asia and ranks as the fifth-most populous country globally. The country boasts a diverse range of landscapes. Riverine forests flourish along the Indus River system, while mangrove forests are found in the Indus Delta in the south of Sindh and along the coastline; coral reefs have been identified off the Baluchistan coast. Mountain ranges extend along the western border with Afghanistan and the northern border with China, and sandy deserts stretch

along the eastern border with India and the southwestern border with Iran. The vegetation in Pakistan is predominantly dry, with over 90% classified as dry and sub-humid lands, as defined by the CBD. This includes xerophytic lands, grasslands, temperate deciduous land, and steppe. The varied topography and climate contribute to Pakistan's rich biodiversity, featuring numerous ecosystems, habitats, and species of global significance. Despite its arid conditions, Pakistan sustains over 780,000 hectares of wetlands, which account for 9.7% of the total land area of the country, with 225 nationally significant wetlands, of which 19 have been recognized as Ramsar sites of global significance (Chaudhry, 2010; Khan and Arshad, 2014) (Figure 1) (Table 1). Despite the widespread presence of arid and semi-arid regions in eastern, southern, and southwestern Pakistan, the country boasts significant diversity in turtle species, thanks to its forests, steppes, and rivers. Pakistan is characterized by several major rivers, including the Indus River, which flows entirely from north to south within its borders. The River Kabul, Afghanistan's largest river, is another key waterway that intersects with Pakistan, merging with the Indus River at Khairabad in Nawshehra District, KPK. Some other important rivers like the Kurram, Tochi, Gomal, and Zhob rivers meet the Indus River from the western side, while four other significant rivers from the eastern side, Jhelum, Chenab, Ravi, and Sutlej, join the Indus River at the point of Head Panjnad, Punjab (Figures 1 & 2). Pakistan also features four major wetland complexes: The North-Western Alpine Wetlands Complex (NAWC), the Salt Range Wetlands Complex (SRWC), the Central Indus Wetlands Complex (CIWC), and the Makran Coastal Wetlands Complex (MCWC) (Khan & Arshad, 2014). The Indus River, often referred to as the Sindhu River, is the largest river in South Asia and ranks as the seventh biggest in the world, extending approximately 2,000 miles (3,200 KM). Gar Tsangpo, also called the Gartang River, is a headwater of the Indus River in the Ngari Prefecture, Tibet, China, which meets the “Lake Manasarovar”, as it traverses northwestern India, Ladakh, the territory of the Indian side of Kashmir, and flows through some of the highest mountains for about 450 kilometers to enter the Pakistani territory. Much of its water is from melting glaciers and snow in the mountains. Upon exiting the mountain ranges, the Indus descends into the plains of Pakistan in the Kala Bagh area. In the Punjab and KPK provinces, several other rivers merge into the Indus, significantly broadening its width (Figures 1 & 2). The river continues through Sindh, passing near the thriving city of Karachi. Ultimately, it reaches its endpoint at Kharo Chan in Keti Bandar, District Thatta, where it elegantly meets the Arabian Sea (Fig. 3). In contrast, a few others, relatively smaller and some seasonal rivers in Baluchistan, such as Dasht,

Hingol, and Hub, are also found in Baluchistan. The riverine forest is also a significant wetland type found in the lowland rivers, growing over the banks and in the floodplains of the Indus and Baluchistan rivers (Chaudhry, 2010).

Figure 1. Important tributary rivers of the Indus River

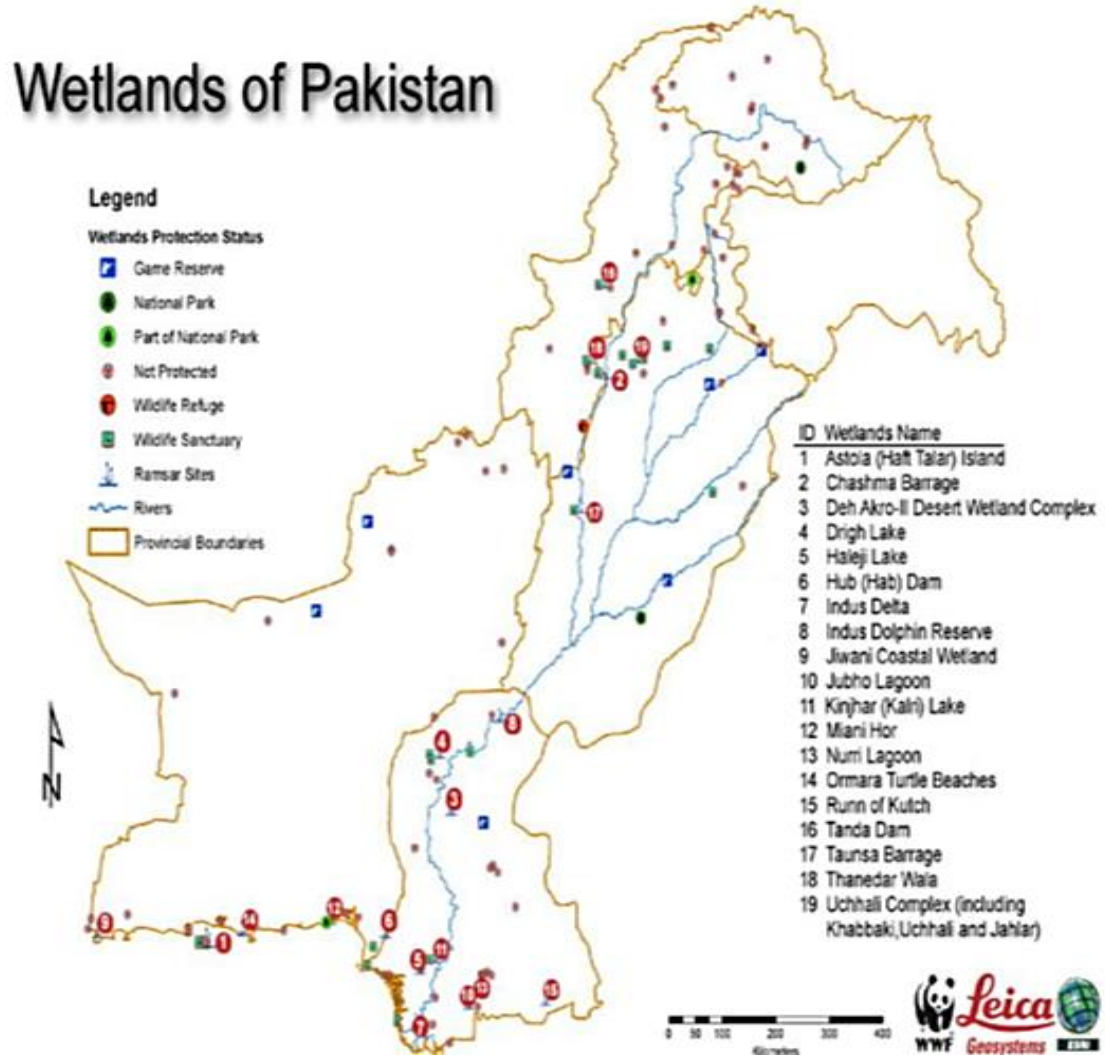

Figure 2. Important Ramsar sites and riverine tracts in Pakistan (Courtesy of WWF-Pakistan)

Table 1. The Ramsar list of wetlands of international importance in Pakistan

S. No.	Name	Province
1.	Astola (Haft Talar) Island	Baluchistan
2.	Chashma Barrage	Punjab
3.	Deh Akro-II Desert Wetland Complex	Sindh
4.	Drigh Lake	Sindh
5.	Haleji Lake	Sindh
6.	Hub Dam	Sindh and Baluchistan
7.	Indus Delta	Sindh
8.	Indus Dolphin Reserve	Sindh
9.	Jiwani Coastal Wetland	Baluchistan
10.	Jubho Lagoon	Sindh
11.	Kinjhar (Kalri) Lake	Sindh
12.	Miami Hor	Baluchistan
13.	Nurri Lagoon	Sindh
14.	Ormara Turtle Beaches	Baluchistan
15.	Rann of Kutch	Sindh
16.	Tanda Dam	KPK
17.	Taunsa Barrage	Punjab
18.	Thanedar Wala	KPK
19.	Uchhali Complex	Punjab

Figure 3: Image of the Indus Delta (Courtesy: The Times)

Figure 4. Freshwater turtle habitats **(A)** Kabul River in Charsadda, KPK **(B)** River Swat in Charsadda, KPK **(C)** Haleji Lake, Sindh **(D)** Keenjhar Lake, Sindh (Photos by Amtyaz Safi)

Figure 5. Ideal habitats for freshwater turtles in different wetlands of Pakistan **(A)** Hisara stream in Mardan, KPK **(B)** Turbela Dam in Haripur, KPK **(C)** Langh Lake in Larkana, Sindh **(D)** Hub Dam, Lasbela, Baluchistan (Photos by Amtyaz Safi)

Diversity and Distribution of Turtles and Tortoises in Pakistan

Pakistan is home to 8 species of freshwater turtles, 2 species of tortoises, and 5 species of marine turtles, making it one of the countries with a diverse chelonian fauna in the region and is considered to be one of the best South Asian countries in terms of its importance for turtle conservation because 85% of its total chelonian fauna is threatened (Fig. 6). There are seven marine turtle species in the world, but some consider there are a total of 8 marine species including the Black turtle. The controversy on the taxonomy of the black turtle, which is considered the eighth, is still not settled. Of the reported seven sea turtle species, five are recorded in the Pakistani coastal waters: Olive Ridley's sea turtle (*Lepidochelys olivacea*), Hawksbill sea turtle (*Eretmochelys*

imbricata), Green sea turtle (*Chelonia mydas*), the Loggerhead sea turtle (*Caretta caretta*), and Leatherback sea turtle (*Dermochelys coriacea*). On the other hand, the freshwater turtles of Pakistan belong to two families: Trionychidae and Geoemydidae, each with four species. The Indus River system of Pakistan and its tributaries and branches have been identified as hotspots for the occurrence of all eight species of freshwater turtles. The Indian star tortoise (*Geochelon elegans*) and the Afghan tortoise (*Testudo horsfieldii*) are the only two species of tortoises found in Pakistan. Many authors have contributed important information regarding the relationship between these turtles in the Indus River and its tributaries (Safi et al., 2021, 2024a, 2024b; Khan et al., 2015, 2016a, 2016b). Safi et al. (2024a) and Khan (2016) studied the exploitation and trade of turtles in Pakistan. The list of species reported in Pakistan is presented chronologically, along with their IUCN and CITES conservation status, in Tables 2 & 3. Pakistan, despite being the second-largest country in South Asia, is not very rich in turtles due to its habitat and climate. All eight species of freshwater turtles are found in the Indus River system. Two species, the Russian tortoise (*Testudo horsfieldii*), are found in northern and western Baluchistan, the southwestern part of KPK, and in Afghanistan. The Indian star tortoise (*Geochelone elegans*) is found in Sindh and Punjab (Safi & Khan, 2014; Khan, 2015; Khan et al., 2015, 2016; Safi et al., 2015, 2021, 2022, 2024a, 2024b).

Table 2. The IUCN Red List classifies species into nine groups (Salleh et al., 2022; Safi et al., 2024)

Classification	Description
NE (Not evaluated)	The IUCN has not yet evaluated these species.
DD (Data deficiency)	The information provided is not sufficient to make a reasonable assessment of protection.
LC (Least concern)	It isn't going to become extinct soon.
NT (Near Threatened)	A greater risk of extinction will soon emerge.
VU (Vulnerable)	It is thought to be at risk of negative (anthropogenic) extinction without further human intervention.
EN (Endangered)	There is a high risk of extinction in the wild.
CR(Critically Endangered)	Points in a particular and extremely critical state.
EW (Extinct in the wild)	Surveys have shown that species only live in zoos, farms, and places outside of their native range.
EX (Extinct)	There is no doubt that the species no longer exists.

Table 3. Testudines of Pakistan and their status as per the IUCN Red List and CITES Appendices

S. No.	Family	Habitat	Scientific name	Common name	IUCN Status	CITES Appendix	
						I	II
1.	Testudinidae	Terrestrial	*Testudo horsfieldii*	Afghan tortoise	VU		+
2.	Testudinidae	Terrestrial	*Geochelone elegans*	Indian star tortoise	VU		+
3.	Geoemydidae	Freshwater	*Geoclemys hamiltoni*	Black pond turtle	EN	+	
4.	Geoemydidae	Freshwater	*Hardella thurjii*	Brahman river turtle	EN		+
5.	Geoemydidae	Freshwater	*Pangshura smithii*	Brown roofed turtle	NT		+
6.	Geoemydidae	Freshwater	*Pangshura tectum*	Indian roofed turtle	VU	+	
7.	Trionychidae	Freshwater	*Chitra indica*	Indian narrow-headed soft-shell turtle	EN		+
8.	Trionychidae	Freshwater	*Nilssonia gangetica*	Indian softshell turtle	EN	+	
9.	Trionychidae	Freshwater	*Nilssonia hurum*	Indian peacock softshell turtle	EN	+	
10.	Trionychidae	Freshwater	*Lissemys punctata*	Indian flap shell turtle	VU		+
11.	Cheloniidae	Marine	*Caretta caretta*	Loggerhead sea Turtle e	VU	+	
12.	Cheloniidae	Marine	*Chelonia mydas*	Green Turtle	EN	+	
13.	Cheloniidae	Marine	*Eretmochelys imbricata*	Hawksbill sea turtle	CR	+	
14.	Cheloniidae	Marine	*Lepidochelys olivacea*	Olive Ridley sea turtle	VU	+	
15.	Dermochelyidae	Marine	*Dermochelys coriacea*	Leatherback sea turtle	VU	+	

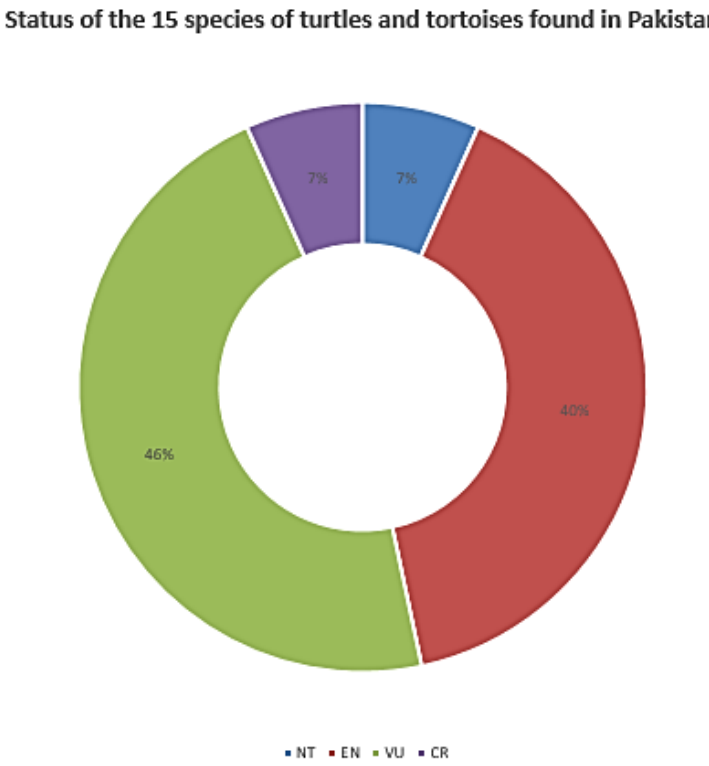

Figure 6. IUCN Status (September 2024); (CR: Critically Endangered, EN: Endangered, VU: Vulnerable, NT: Near Threatened, LC: Least Concern) of the 15 species of turtles and land tortoises found in Pakistan

Systematics, Diversity, and Conservation Status of Turtles and Tortoises of Pakistan

Freshwater Turtles

Soft-shell turtles lack hard, rigid scales or scutes; instead, they possess a leathery and pliable carapace. Therefore, they are flatter and less domed than the best-selling turtles, making it easier for them to burrow into mud or silty substrates and remain undetected. Their long necks and noses allow them to stay out of the water and breathe (Hutchinson, 1996; Ramakrishna et al., 2014; Safi and Khan, 2014).

Diversity of Freshwater Turtles in Pakistan (Table 3):

Pakistan is the second-largest country in South Asia. All eight species of freshwater turtles are found in the Indus River system (Safi & Khan, 2014; Khan, 2015; Khan et al., 2015, 2016a, 2016b; Safi et al., 2015, 2021, 2022, 2024a, 2024b).

Biogeography, Systematics, Diversity, and Conservation Status of Soft-shelled Turtles of Family Trionychidae in Pakistan

***Lissemys punctata andersonii* (Bonnaterre, 1789) (Fig. 7)**

Common Name(s) (English): Indian flap-shell terrapin, Indus flap-shelled terrapin, spotted flap-shell terrapin, and Indus-mud turtle.

Synonym(s): *Emyda granosa,* Schoepff 1801; *Testudo granulosa,* Suckow 1798; *Testudo punctata,* Lacépède 1788; *Testudo punctata,* Bonnaterre 1789; *Testudo sonnerati,* Meyer 1790; *Testudo granulata,* Daudin 1801; *Trionyx coromandelicus,* Geoffroy Saint-Hilaire 1809; *Emyda dura,* Anderson 1876 (Bhupathy et al., 2014).

Distribution: This terrapin species is found in India, Bangladesh, Myanmar, Nepal, Afghanistan, and Pakistan.

Subspecies: Currently, three subspecies are recognized:

1) *Lissemys punctata punctata* Bonnaterre, 1789 (Southern Indian Flap-shell terrapin, distributed in the Southern Indian Peninsula (Kerala, Tamil Nadu).

2) *Lissemys punctata andersoni* Webb 1980 (Distributed in Bangladesh, Northern India, Myanmar, Nepal, Afghanistan, and Pakistan).

3) *Lissemys punctata vittata* Peters 1854 (Synonymy: *Emyda vittata* Peters 1854) (Distributed in Central India) (TFTSG, 2007; Bhupathy et al., 2014).

Threats: Trading for meat and pets.

Conservation Status: This species is mentioned in Appendix II of CITES, and the status is vulnerable (VU) in the "IUCN Red List threatened species".

Figure 7. *Lissemys punctata* (Photo by Amtyaz Safi)

***Nilssonia gangetica* (Cuvier, 1825) (Fig. 8)**

Common Name(s) (English): Indian soft-shell terrapin, Ganges soft-shell terrapin.

Synonym(s): *Aspideretes gangeticus* Cuvier, 1825; *Trionyx gangeticus* Cuvier, 1825; *Nilssonia gangetica* Cuvier, 1825; *Aspideretes gangeticus* Ernst, 1989*; Aspilus gataghol* Gray, 1872; *Isola gangeticus* Baur, 1893; *Nilssonia gangetica* Praschag, 2007.

Distribution: This species is found in India, Bangladesh, Nepal, Afghanistan, and Pakistan. It is found throughout the Indus, Ganges, and Brahmaputra flood plains and associated canals and marshes of South Asia (Fig. 8; Das, 1991; Das, 1996).

Subspecies: No subspecies are recognized.

Threats: Meat & egg trade.

Conservation Status: This species is included in Appendix I of CITES, while its status is Endangered (EN) in the "IUCN Red List threatened species".

Figure 8. *Nilssonia gangetica* (Photo by Amtyaz Safi)

***Nilssonia hurum* (Gray, 1831) (Fig. 9)**

Common Name(s) (English): Indian Peacock Soft-shell terrapin.

Synonymy(s): *Trionyx occellatus* Gray 1830a, *Trionyx ocellatus, Gymnopus ocellatus, Trionyx hurum* Gray 1830b, *Gymnopus duvaucelii* Duméril and Bibron 1835, *Trionyx sewaare* Gray 1872, *Trionyx bellii* Gray 1872, *Trionyx buchanani* Theobald 1874, *Isola hurum, Aspideretes hurum, Tyrse hurum, Amyda hurum* (IUCN, TFTS, 2007; Das et al., 2010).

Distribution: Bangladesh, India, Nepal, and Pakistan (Fig. 10; Das, 1991; Das, 1996).

Subspecies: No subspecies are recognized.

Threats: Meat trade.

Conservation Status: This species is included in Appendix I of CITES, while its status is Endangered (EN) in the "IUCN Red List threatened species" (Khan et al., 2016a).

Figure 9: *Nilssonia hurum* (Photo by Ayush Maharjan)

***Chitra indica* (Gray, 1830) (Fig. 10)**

Common Name (English): Narrow-headed Soft-shell terrapin.

Synonym(s): *Trionyx indicus* Gray, 1830; *Gymnopus lineatus,* Dumeril & Bibron, 1835.

Distribution: Occurs in the Indus, Ganges, and Brahmaputra flood plains to western Malaysia (Das, 1991; Das, 1996).

Subspecies: No subspecies are recognized.

Threats: Meat and egg trade.

Conservation Status: This species is included in CITES Appendix II, while the status of this species is Endangered in the "IUCN Red List of Threatened Species".

Figure 10. *Chitra indica* (Photo by Amtyaz Safi)

Asian Hard-Shell Turtles (Geoemydidae): This is a very diverse family of turtles with 70 species worldwide (Salleh et al., 2022), 10 genera, and 19 species of which are recorded in South Asia (Purkayastha et al., 2015; Safi et al., 2024b). These are aquatic or semi-freshwater turtles, although some live in cool, wet forests. In recent years, DNA sequencing has revealed hidden diversity in this group; for example, *Cyclemys dentata* (Asian leaf terrapin) is now treated as a separate species from *Cyclemys oldhamii* (Oldham's leaf turtle) (Salleh et al., 2022).

***Pangshura smithii* (Gray, 1863) (Fig 11)**

Common Name (English): Indian Brown Roofed Turtle)

Synonym(s): *Batagur smithii* Gray, 1863; *Kachuga smithii* (Gray, 1863)

Distribution: This species is found along South Asia's tributaries of the Indus-Ganges-Brahmaputra River systems. In Pakistan, along the streams connected to the River Indus and associated wetlands (Safi et al., 2020).

Threats: Pet trade.

Conservation Status: This species is included in CITES Appendix I, while the IUCN recorded it as of Lower risk.

Figure 11: *Pangshura smithii* (Photo by Amtyaz Safi).

***Pangshura tectum (Gray, 1831)* (Fig. 12)**

Common Name (English): (Indian Roofed Turtle)

Synonym(s): *Emys tectum* (Gray, 1830); *Kachuga tecta* (Gray, 1830); *Pangshura tecta* (Gray, 1830); *Batagur tecta* (Le et al., 2007).

Distribution: This species is found along South Asia's tributaries of the Indus-Ganges-Brahmaputra River systems. In Pakistan, along the streams connected to the River Indus and associated wetlands (Safi et al., 2020).

Threats: The pet trade, seldom exploited for meat.

Conservation Status: This species is included in CITES Appendix I, while its status is lower risk in the "IUCN Red List of threatened species".

Figure 12: *Pangshura tectum* (Photo by Amtyaz Safi)

Geoclemys hamiltonii (Gray, 1830) **(Fig. 13)**

Common Name (English): Spotted Pond Turtle)

Synonym(s): *Emys guttata* Gray, 1831; *Emys picquotii* Lesson, 1831; *Melanochelys pictus* Murray, 1884; *Clemmys palaeindica* Lydekker, 1885; *Geoclemys sivalensis* Tewari & Badam, 1969.

Distribution: This species is found along South Asia's tributaries of the Indus-Ganges-Brahmaputra River systems (Safi et al., 2021; Safi et al., 2024).

Threats: Local pet trade; Exported illegally to China and Thailand.

Conservation Status: This species is mentioned in CITES Appendix I, while the IUCN reports it as Vulnerable.

Figure 13: *Geoclemys hamiltonii* (Photo by Amtyaz Safi)

***Hardella thurjii (Gray, 1831)* (Fig. 14)**

Common Name (English): Crowned River Turtle

Synonymy: *Emys thurjii* Gray, 1831; *Emys flavonigra* Lesson, 1831; *Clemmys thurgii* Fitzinger, 1835; *Kachuga oldhami* Gray, 1869; *Hardella indi* Gray, 1870.

Distribution: This species is found along South Asia's tributaries of the Indus-Ganges-Brahmaputra River systems. In Pakistan, along the streams connected to the River Indus and associated wetlands (Das, 1991; Das, 1996).

Threats: Threatened by over-exploitation of adults and eggs as food and by habitat destruction.

Conservation Status: This species is included in CITES Appendix II, while the IUCN reports it as Vulnerable.

Figure 14: *Hardella thurjii* (Photo by Amtyaz Safi)

Land Tortoises(TESTUDINIDAE)

There are 60 species of tortoises recognized worldwide, mostly found in open areas such as arid, semi-arid, desert, and grassland (Salleh et al. 2022). Four genera and five species of tortoises are found in South Asia, and they are adapted to different habitats, including forest habitats and cooler areas in lowland forests (Purkayastha et al., 2015). Only two species of tortoises are found in Pakistan.

Testudo horsfieldii (Gray, 1844) **(Fig. 15)**

Common Names (English): Russian tortoise, Afghan tortoise, Central Asian tortoise, the four-clawed tortoise, the four-toed tortoise, Horsfield's tortoise, the Russian steppe tortoise, the Soviet Tortoise, and the steppe tortoise (Karl et al., 2021).

Distribution: This species is endemic to Central Asia from the Caspian Sea south through Iran, Pakistan, Afghanistan, and east across Kazakhstan to Xinjiang, China (Karl et al., 2021).

Synonyms: *Testudo horsfieldii horsfieldii,* Gray, 1844; *Homopus burnesii,* Blyth, 1854; *Testudinella horsfieldii,* Gray, 1870; *Homopus horsfieldii,* Theobald, 1876; *Testudo baluchiorum,* Annandale, 1906; *Medaestia horsfieldi,* Wussow, 1916; *Agrionemys horsfieldii horsfieldii,* Welch, 1994; *Agrionemys baluchiorum,* Vetter, 2002; *Agrionemys kazachstanica*, Perälä, 2002; *Testudo horsfieldi kazachstanica,* Ferri, 2002; *Agrionemys horsfieldi rustamovi*, Chkhikvadze, Amiranashvili & Ataev, 1990; *Agrionemys rustamovi,* Perälä, 2002.

Subspecies: The Turtle Taxonomy Working Group and the Reptile Database list five subspecies of the Russian tortoise.

- *T. h. bogdanovi* Chkhikvadze, 2008 – Southern Kyrgyzstan, Tajikistan, Uzbekistan, Turkmenistan
- *T. h. horsfieldii* (Gray, 1844) – Afghanistan/Pakistan and southern Central Asia
- *T. h. kazachstanica* Chkhikvadze, 1988 – Kazakhstan
- *T. h. kuznetzovi* Chkhikvadze, Ataev, Shammakov & Zatoka, 2009 – Northern Turkmenistan, southern Uzbekistan
- *T. h. rustamovi* Chkhikvadze, Amiranschwili & Atajew, 1990 – Southwestern Turkmenistan.

In September 1968, two Russian tortoises flew to the Moon, circled it, and returned safely to Earth on the Soviet Zond 5 mission. Accompanied by mealworms, plants, and other lifeforms, they were the first Earth creatures to travel to the Moon (Karl et al., 2021).

Threats: Human activities in its native habitat contribute to its threatened status.

Conservation Status: This species is included in CITES Appendix II, while IUCN reports it as Vulnerable.

Figure 15. Afghan tortoise (*Testudo horsfieldii*) (Photo by Shaikh Najam Aman)

Geochelone elegans **(**Schoepff, 1795) **(Fig. 16)**

Common Names (English): The Indian Star Tortoise, Sindh Star Tortoise.

Distribution: This is a threatened tortoise species native to parts of western and southeastern India, the island of Sri Lanka, and southeastern Pakistan.

Synonyms: *Testudo elegans* Schoepff, 1795; *Testudo stellata* Schweigger, 1812; *Chersine elegans* Merrem, 1820; *Testudo actinoides* Bell, 1828; *Geochelone (Geochelone) stellata* Fitzinger, 1835; *Testudo megalopus* Blyth, 1853; *Peltastes stellatus* Gray, 1870; *Geochelone elegans* Loveridge & Williams, 1957; *Geochelone elegans elegans* Obst, 1985.

Threats: Indian star tortoises are the most trafficked and illegally sold tortoise.

Conservation Status: This species is included in CITES Appendix I and is listed as Vulnerable on the IUCN Red List.

Figure 16: Indian star tortoise (*Geochelone elegans*) (Photo by Fahad Malik)

Marine Turtles

There are seven species of sea turtles: Leatherback (*Dermochelys coriacea*), Kemp's ridley (*Lepidochelys Kempii*), olive ridley (*Lepidochelys olivacea*), hawksbill (*Eretmochelys imbricata*), green (*Chelonia mydas*), loggerhead (*Caretta caretta*), and flatback (*Natator depressus*). The International Union for Conservation of Nature's Red List of Threatened Species includes six of the seven sea turtle species in the 'threatened' category, and the deleterious effect of marine pollutants is included among the top 20 research topics for sea turtle conservation. The list is classified as vulnerable (*L. olivacea), endangered (C. caretta, C. mydas*), and critically endangered (*D. coriacea, L. kempii, E. imbri cata*) (Table 3) (Arienzo, 2023). Five species of marine turtles are reported to visit the Pakistani coast, including the leatherback, Loggerhead, hawksbill, olive ridley, and green turtles, in Sandspit and Hawksbay in Sindh, and Ormara, Astola Island, and Jiwani in Balochistan. According to the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, three species of sea turtles, namely the Olive Ridley, Loggerhead, and Leatherback are classified as Vulnerable (VU), while the Green and Hawksbill turtles are classified and are listed as Endangered (EN) and Critically Endangered (CR) respectively, which requires immediate conservation action for these magnificent reptiles. To conserve these majestic animals, the Sindh government has established two sea turtle hatcheries at Sandspit and Hawkesbay (Karachi), while WWF-Pakistan has established a similar facility at Daran in Jiwani, Balochistan. Green turtles nest on sandy beaches along the coasts of Sindh and Baluchistan. The important turtle nesting sites in Sindh are Sandspit, Hawke's Bay, and Paradise Point, along with the Baluchistan coast, Sonmiani, Taq in Ormara, Astola Island, and Daran in Jiwani, where sea

turtles come to lay their eggs every year. Five species of sea turtles have been reported in Pakistan. Of these, the green turtle (*Chelonia mydas*) is the most dominant. Another important sea turtle species is the olive ridley (*Lepidochelys olivacea*), which nests along the coast of Baluchistan, Pakistan. Three other species, including the loggerhead (*Caretta caretta*), hawksbill (*Eretmochelys imbricata*), and leatherback (*Dermochelys coriacea*), have been recorded in Pakistan by WWF-Pakistan. A study conducted by WWF-Pakistan has provided credible evidence of the presence of leatherback, loggerhead, and hawksbill turtles in Pakistan. WWF-Pakistan has also begun research on the interaction of sea turtles with fishing activities, which has shown that large numbers of turtles become entangled in various fishing gear, especially when tuna is caught with gill nets. The organization has trained fishermen to rescue entangled sea turtles and safely release them back into the water, and as a result, these fishermen now safely release thousands of sea turtles each year. In addition, WWF-Pakistan has been promoting the use of gill nets since 2016, which has reduced sea turtle entanglement in tuna gill nets by more than 95 percent. However, there is evidence that the green turtle population in Pakistan has increased since 2012.

Dermochelys coriacea **(**Vandelli, 1761**) (Fig. 17)**

Common Names (English): The leatherback sea turtle is sometimes called the lute turtle, leathery turtle, or simply the leatherback.

Synonyms: *Testudo coriacea* Vandellius, 1761; *Testudo arcuata* Catesby, 1771; *Testudo lyra* Lacépède, 1788; *Testudo marina* Wilhelm, 1794; *Testudo tuberculata* Pennant, 1801; *Chelone coriacea* Brongniart, 1805; *Chelonia coriacea* Oppel, 1811; *Testudo lutaria* Rafinesque, 1814; *Dermochelys coriacea* Blainville, 1816; *Sphargis mercurialis* Merrem, 1820; *Coriudo coriacea* Fleming, 1822; *Scytina coriacea* Wagler, 1828; *Dermochelis atlantica* LeSueur, 1829 (nomen nudum); *Sphargis coriacea* Gray, 1829; *Sphargis tuberculata* Gravenhorst, 1829; *Chelyra coriacca* Rafinesque, 1832 (ex errore); *Dermatochelys porcata* Wagler, 1833; *Testudo coriacea marina* Ranzano, 1834; *Dermochelys atlantica* Duméril & Bibron, 1835; *Dermatochelys atlantica* Fitzinger, 1835; *Dermochelydis tuberculata* Alessandrini, 1838; *Sphargis coriacea* var. schlegelii Garman, 1884; *Sphargis angusta* Philippi, 1899; *Dermochelys schlegelii* Stejneger, 1907; *Dermatochelys angusta* Quijada, 1916; *Dermochelys coriacea coriacea* Gruvel, 1926; *Dendrochelys (Sphargis) coriacea* Pierantoni, 1934; *Dermochelys coriacea schlegeli* Mertens, Müller & Rust, 1934 (ex errore); *Chelyra coriacea* Bourret, 1941; *Seytina coriacea* Bourret, 1941; *Sphargis schlegelii* Bourret, 1941; D*ermochelys schlegeli* Barker, 1964.

Distribution:

The leatherback turtle is a species with a circumglobal range. Of all the extant sea turtle species, *D. coriacea* has the widest distribution, reaching as far north as Alaska and Norway and as far south as Cape Agulhas in Africa and the southernmost tip of New Zealand and the Arctic Circle.

Threats: Human activities in their native nest habitat, illegal hunting, and accidental entanglement in fishing gear.

Conservation Status: This species is included in CITES Appendix I, while the IUCN reported it as Vulnerable (VU).

Figure 17: Leatherback sea turtle, *Dermochelys coriacea,* caught by fishermen (Courtesy: WWF-Pakistan)

***Eretmochelys imbricate* (Linnaeus, 1766) (Fig. 18)**

Common Name (English): Hawksbill sea turtle

- Synonyms: *Testudo imbricata* Linnaeus, 1766
- *E. imbricata squamata* junior synonym

Distribution: Hawksbill sea turtles have a wide range, predominantly in tropical reefs of the Indian, Pacific, and Atlantic Oceans. Of all the sea turtle species, *E. imbricata* is the one most associated with warm tropical waters. Two significant subpopulations are known in the Atlantic and Indo-Pacific.

Threats: Human activities in their native nest habitat, illegal hunting, and accidental entanglement in fishing gear.

Conservation Status: This species is included in CITES Appendix I, while the IUCN reported it as Critically Endangered (CR).

Figure 18. Hawksbill turtle (*Eretmochelys Imbricata*) in Ormara, Balochistan (Courtesy: WWF-Pakistan)

Chelonia mydas (Linnaeus, 1758) **(Fig. 19)**

Common Names (English): The green sea turtle (*Chelonia mydas*), also known as the green turtle, black (sea) turtle, or Pacific green turtle.

Threats: Human activities in their native nest habitat, illegal hunting, and accidental entanglement in fishing gear.

Conservation Status: This species is included in CITES Appendix I, while IUCN reports it as Endangered (EN).

Figure 19. Green turtle, *Chelonia mydas,* returning to sea from eggs laid in Manora, Karachi (Photo by Amtyaz Safi)

Lepidochelys olivacea (Eschscholtz, 1829) **(Fig. 20)**

Common Names (English): The Olive ridley Sea turtle (*Lepidochelys olivacea*), also known commonly as the Pacific ridley sea turtle

Synonyms: *Testudo mydas*, Suckow, 1758; *Chelonia multiscutata*, Kuhl, 1820; *Chelonia olivacea* Eschscholtz, 1829; *Chelonia caretta var. olivacea* — Gray, 1831; *Chelonia dussumierii*, Duméril & Bibron, 1835; *Caretta olivacea*,— Rüppell, 1835; *Thalassochelys (Lepidochelys) olivacea*— Fitzinger, 1843; *Caouana olivacea* — Gray, 1844; *Caouana ruppellii* Gray, 1844; *Chelonia subcarinata* Rüppell, 1844; *Caouana dessumierii,* A. Smith, 1849; *Chelonia dussumieri* Agassiz, 1857; *Chelonia polyaspis* Bleeker, 1857; *Lepidochelys dussumieri* — Girard, 1858; *Lepidochelys olivacea* — Girard, 1858; *Chelonia dubia* Bleeker, 1864; *Cephalochelys oceanica,* Gray, 1873; *Cephalochelys oceanica,* Gray, 1873; *Thalassiochelys tarapacona* Philippi, 1887; *Chelonia olivaccea* Velasco, 1892; *Thalassochelys controversa* Philippi, 1899; *Caretta remivaga* Hay, 1908; *Caretta caretta var. olivacea* — Deraniyagala, 1930; L*epidochelys olivacea olivacea* — Deraniyagala, 1943; *Caretta olivacea olivacea*— Mertens, 1952; *Lepidochelys olivacea remivaga* — Schmidt, 1953; *Caouana rueppellii* Wermuth & Mertens, 1961; *Lepidochelis olivacea* — Tamayo, 1962; *Lepidochelys olivaceas* Kesteven, 1969; *Chelonia multicustata* Márquez, 1990.

Distribution: The most abundant of all sea turtles found in the world. *L. olivacea* is found in warm and tropical waters, primarily in the Pacific and Indian Oceans, but also in the warm waters of the Atlantic Ocean.

The olive ridley turtle has a circum-tropical distribution, living in tropical and warm waters of the Pacific and Indian Oceans from India, Arabia, Japan, and Micronesia, south to southern Africa, Australia, and New Zealand. It has been observed off the western coast of Africa and the coasts of northern Brazil, Suriname, Guyana, French Guiana, and Venezuela. Additionally, the olive ridley has been recorded in the Caribbean Sea as far north as Puerto Rico.

Threats: Human activities in their native nest habitat, illegal hunting, and accidentally getting caught in fishing gear. Known predators of olive ridley eggs include feral dogs and ghost crabs. Other major threats include mortality associated with boat collisions and incidental takes in fisheries. Trawling, gill nets, ghost nets, longline fishing, and pot fishing have significantly affected olive ridley populations, as well as other species of marine turtles.

Conservation Status: This species is included in CITES Appendix I, while the IUCN reported it as Vulnerable (VU).

Figure 20. Olive ridley turtle, *Lepidochelys olivacea* (Courtesy: IOSEA)

Caretta caretta (Linnaeus, 1758) **(Fig. 21)**

Common Name (English): The loggerhead sea turtle.

Synonyms: *Testudo caretta* Linnaeus, 1758; *Testudo cephalo* Schneider, 1783; *Testudo nasicornis* Lacépède, 1788; *Testudo caouana* Lacépède, 1788; *Chelone caretta* — Brongniart, 1805; *Chelonia caouanna* Schweigger, 1812; *Caretta nasuta* Rafinesque, 1814; *Chelonia cavanna* Oken, 1816; *Caretta atra*

Merrem, 1820; *Caretta cephalo* — Merrem, 1820; *Caretta nasicornis* — Merrem, 1820; *Chelonia caretta*— Bory de Saint-Vincent, 1828; *Testudo corianna* Gray, 1831; *Chelonia pelasgorum*

Valenciennes *in* Bory de Saint-Vincent, 1833; *Chelonia cephalo* — Gray, 1829; *Chelonia* (*Caretta*) *cephalo* — Lesson *in* Bélanger, 1834; *Chelonia caouanna* — A.M.C. Duméril & Bibron, 1835; *Chelonia* (*Thalassochelys*) *caouana* — Fitzinger, 1836; *Chelonia* (*Thalassochelys*) *atra* — Fitzinger, 1836; *Thalassochelys caretta* — Bonaparte, 1838; *Chelonia* (*Caouanna*) *cephalo* — Cocteau *in* Cocteau & Bibron *in* de la Sagra, 1838 *Halichelys atra* — Fitzinger, 1843; *Caounana caretta*— Gray, 1844; *Caouana elongate* Gray, 1844; *Thalassochelys caouana*— Agassiz, 1857; *Thalassochelys corticata* Girard, 1858; *Chelonia corticata* — Strauch, 1862; *Thalassochelys elongate* Strauch, 1862; *Thalassochelys caouana* Nardo, 1864; *Eremonia elongate* — Gray, 1873; *Caretta caretta*— Stejneger, 1873; *Thalassochelys cephalo* — Barbour & Cole, 1906; *Caretta caretta caretta*— Mertens & L. Müller, 1928; *Caretta gigas* Deraniyagala, 1933; *Caretta caretta gigas*— Deraniyagala, 1939; *Caretta caretta tarapacana* Caldwell, 1962; *Chelonia cahuano* — Tamayo, 1962; *Caretta careta* Tamayo, 1962.

Distribution: The loggerhead sea turtle has a cosmopolitan distribution, nesting over the broadest geographical range of any sea turtle. It inhabits the Atlantic, Indian, and Pacific Oceans and the Mediterranean Sea (Spotila and James, 2004).

Threats: Loggerheads have numerous predators, especially early in their lives. Egg and nestling predators include ghost crabs, oligochaete worms, some beetles, flesh fly larvae, some ants, flesh flies, snakes, gulls, corvids, rats, canids, foxes, Jackals, feral dogs, feral cats, and humans.

Conservation Status: This species is included in CITES Appendix I, while the IUCN reported it as Vulnerable (VU).

Figure 21 Loggerhead turtle, *Caretta caretta,* near Karachi Coast, caught by Hasnat Khan (Observer) (Courtesy: WWF-Pakistan)

Current Conservation Status and Threats

The Status of the IUCN Red List

In 2007, the Wildlife Protection Act 1975 was amended by the KPK, and the Wildlife Department listed all freshwater turtle species in the area under Schedule III, thereby providing protection. Later, the Punjab Wildlife and Parks Department amended the Protection Act in 1974, and turtles were included in Schedule III. However, strict enforcement is still required against illegal turtle hunting and trade. The Sindh Wildlife Protection Ordinance 1972 has not made any amendments. The IUCN Red List categorizes species into nine groups based on information on population size, rate of decline, geographical distribution, isolation, and population hierarchy (Table 2) and emphasizes the importance of taking all precautions without significant information, including future surprises and potential threats. "Only what can be adequately supported is possible. Threatened categories include Critically Endangered, Endangered, and Vulnerable species on the Red List. Table 3 shows that Pakistan is home to 15 species of 13 genera and 5 families of turtles, all of which are endangered (Source: IUCN Red List, October 2024). Tables 2-3 and Figure 5. Only one species, *P. smithii,* is nearly threatened, while all other 14 species are threatened species, either Critically Endangered (CR), Endangered (EN), or declared Vulnerable (VU) according to the IUCN status of the Red List (Tables 2-3). Pakistan became a signatory to CITES in July 1976. An analysis of Table 3 reveals that CITES has classified all five species of sea turtles, all two species of genus *Nilssonia* among soft-shelled turtles, and *G. hamiltonii* and *P. tectum* among hard-shelled turtles are classified in Appendix I. The remaining 6 species are included in Appendix II. International trade in endangered species is regulated by CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). In this dismal phase of history, for this ancient and long-lived group of vertebrates, urgent action is needed to halt their decline. However, identification and knowledge of their biology are key components, especially in establishing appropriate conservation policies and stopping illegal trade. (Figures 5 & 21; Tables 2 & 3).

Threats to Turtles and Tortoises (Figures 22, 23 & 26)

Pakistan is the 5th most populous country in the world. Most of the people of this country are poor, and poverty is one of the main reasons for the trade in these turtles, but in short, many other factors also cause the threats:

- Turtle populations in Pakistan are in steep decline due to widespread illegal trade, harmful fishing practices and misunderstandings, water shortages, mismanagement, pollution, and ongoing habitat loss.
- Although turtles are not commercially harvested for food in Pakistan, eggs and hatchlings are still illegally removed from nests by poachers and sold in aquariums and pet stores. Exotic pet shop owners and independent sellers sell endangered species on different social media sites and websites.
- Freshwater turtles face serious threats, including illegal poaching, habitat destruction, water shortage, fragmentation of rivers and canals, and fishing activities.
- Sea turtles along the coast of Pakistan face a range of human-induced threats, including habitat destruction, plastic pollution, and entanglement in fishing gear. As a result of the construction of huts along the beaches of Karachi, Sindh's Sands Pit, and Hawks Bay, the Taq and Ormara in Baluchistan's major sea turtle nesting sites have been negatively impacted by plastic waste, with collapsed huts and debris posing a serious threat to nesting sites for women and young people.
- Pollution is another major threat to sea turtle populations in Pakistani waters. Popular beaches are littered with litter, much of it single-use items and microplastics. WWF-Pakistan also reported on the impact of diesel and petrol on turtle populations, stating that exposure to these fuels causes the deformation of hatchling turtles, posing a serious threat to their survival.
- Habitat loss and degradation are also major factors in the widespread decline. Many turtle populations have been severely impacted by human activities. Many turtle and tortoise species rely on high adult survival rates to compensate for high egg and fry mortality in the wild, so removing even a small portion of adults from a population can reduce or delay population recovery.
- Environmental and climate change, as well as natural disasters, are also important to the survival of these turtles. Pollution from diseases, industrial, agricultural, or domestic waste, pesticides, fertilizers, global warming, and water pollution control turtle survival (Figure 23).
- Evacuations, property damage, and disasters also contribute to this decline. Urban development, construction, infrastructure, dams, and road construction also contribute to

population decline (Khan et al., 2016). On the other hand, flooding due to coastal vegetation removal, sand mining, and fishing are some of the biggest problems caused by sea turtles (Salleh et al., 2022).

- Incidental capture is another major cause of turtle mortality. Most published articles and reports from Pakistan point to gill nets and bottom trawl nets as being responsible for turtle drownings. Small shrimp trawlers operating on the continental shelf are responsible for turtle mortality due to accidental capture. Equipment used on traditional non-powered vessels causes entanglement. Turtle mortality occurs due to the use of monofilament nets at higher concentrations in certain areas. However, to date, no specific studies have been conducted to determine the characteristics of gill nets, such as mesh composition, mesh size, mesh length, depth, and area covered, that affect turtle mortality.
- Beach construction at key nesting sites, such as Turtle Beaches in Hawke's Bay and Sands Pit in Karachi, may result in significant post-spawn egg loss.
- *Nilssonia* nesting habitats may be threatened in parts of Pakistan due to changes in riverine morphology resulting from hydrological projects.
- Sea turtles face both natural and man-made threats. Threats accumulate over long periods and can occur anywhere within the population range. Because sea turtles are highly mobile, local declines are often the result of a combination of internal and external factors. As long as nesting beaches continue to disappear, marine habitats deteriorate, and sea turtle harvesting (and bycatch) occur at unsustainable rates, population recovery will be difficult to achieve.
- Sea turtles must return to land to lay eggs, and many of the current threats are related to physical development on or near nesting beaches. For example, artificial lighting confuses and disorients both adult and juvenile females, driving them away from the ocean and making them more vulnerable to predation, dehydration, exhaustion, and early death.
- In addition to lighting, coastal development often creates an unnatural cycle of beach erosion, reducing potential nesting habitats through shoreline hardening, construction of permanent beach structures, and removal of native vegetation. Beach restoration and feeding are sometimes carried out to prevent erosion. However, beach feeding can bring external sediment onto the beach, compacting the sand surface, disturbing or burying hatchlings, and potentially disrupting the sex ratio of hatchlings by changing the

composition and temperature of the sand (the sex of hatchlings is largely determined by temperature, where eggs hatch: higher temperatures favor females, lower temperatures favor males).

- Obstructions left on the beach can prevent sea turtles from finding suitable nesting sites and can be fatal for hatchlings later in their journey to the ocean. Beach traffic and mechanical beach cleaning can break hatchling eggs, and tire ruts can trap hatchling eggs as they crawl along the beach toward the ocean. Beach sand mining scars the landscape, accelerates erosion, and degrades or destroys stable beach vegetation through mining or seawater inundation. The loss of sandy beaches due to mining not only reduces the breeding success of sea turtles but also threatens coastal property and has serious economic consequences for local essential industries such as fisheries and coastal tourism.
- Beach debris can entangle and trap hatchlings, preventing them from reaching the ocean. The smell of debris attracts non-native predators, such as dogs, rats, cats, and mongooses, which eat eggs and chicks.
- The ocean contains a large amount of marine debris. Plastic can clog stomachs and impede buoyancy and breathing, and sea turtles can mistake plastic bags for jellyfish and die from eating them. Dredging, indiscriminate anchoring, blasting, and chemical fishing also contribute to sea turtle mortality.
- Pollutants from industrial, residential, and agricultural activities, as well as the direct discharge of untreated or improperly treated wastewater into the ocean, harm sea turtles and their habitats. Adding organic pollutants, nutrients, and sediments promotes algae growth while negatively impacting seagrass beds and coral reefs, which are critical habitats for endangered sea turtles. Oil spills can be fatal to sea turtles (crude oil has serious effects on skin, blood chemistry and composition, respiration, and some aspects of salt gland function).
- A variety of diseases and parasites affect the health of sea turtles. Fibropapillomatosis, some types of sea acorns, flukes, and roundworms can harm sea turtles. Sometimes, fungi and bacteria invade nests, reducing the chances of eggs hatching.
- Fishermen catch turtles while fishing with nets and poles. Some turtles are accidentally caught in the nets and die, while others are considered enemies of the fish and kill the turtles caught to save the fish.

- There is a lack of awareness of the role turtles play in maintaining the ecosystem.

Figure 22. Images of some common threats to turtles: (A) Hunting of freshwater turtles, (B) Poaching, (C) Road mortality, (D) Mortality due to toxicity/Pollution (Photos by Amtyaz Safi)

Figure 23. Some threats to sea turtles. Source: Sea Turtle Posters Infographics. Available online: https://rollingharbour.com/marine-life-2/sea-turtles/sea-turtle-info-posters/

Conservation Initiatives in Pakistan (Figs. 24 & 25)

- Tortoises are at a much higher risk of extinction than birds, mammals, and amphibians, and among the larger vertebrate groups are only comparable to primates. The continued decline in the population of various species of tortoises in various habitats in Pakistan has prompted research and conservation programs in several parts of Pakistan, which have been recognized as key conservation areas for tortoises and turtles. They are also considered one of the major centers of tortoise diversity. Various government and nongovernmental organizations have made significant efforts to conserve tortoises in Pakistan. IUCN Pakistan, WWF Pakistan, Sindh Wildlife Department, Zoological Survey of Pakistan, and Department of Zoology, University of Karachi are actively involved in and contributing to research on the conservation and conservation of tortoises in Pakistan. The Society of Science and Culture of Pakistan (SCSP) has provided capacity development through

training workshops on turtle conservation and management for university students. The IUCN Commission on Ecosystem Management (CEM) in West Asia has also conducted several training programs on conservation and ecosystem management at the University of Karachi.

- WWF-Pakistan has started a crew-based monitoring program on tuna gillnet vessels. These observers record incidents of bycatch of large animals, including sea turtles. They are also trained to safely release entangled turtles and other bycatch. This is the primary source of sea turtle data presented in this paper (Khan and Nawaz 2019).
- In Pakistan, turtles are protected under national and international laws. Turtles are considered critically endangered and are listed under the schedule of the Wildlife Protection Act, 1976, Pakistan. The declaration and strict implementation of the Wildlife Protection Act have brought an end to the practice of turtle hunting in Pakistan. In conclusion, considering their ecological and aesthetic values, these vulnerable organisms should be protected and conserved.
- "World Sea Turtle Day" has been observed annually on 16 June since 2000 to raise awareness about the decline in sea turtle populations and habitat loss. In Pakistan, sea turtles are known to nest on several beaches, including Sandspit, Hawke's Bay, and Cape Montz along the Sindh coast and Tak (Ormara), Astola Island, Gwadar Point, and Daran along the Baluchistan coast. Thousands of female turtles visit these beaches to nest and lay eggs.
- According to WWF-Pakistan, entanglement in fishing nets is the most serious threat to sea turtles. To collect data on turtle entanglement, WWF-Pakistan started a study in 2012, which found that 30,000 sea turtles are caught in tuna gill nets in Pakistan every year. This included approximately 25,500 olive ridley turtles and 4,500 green turtles living in the coastal waters of Pakistan. It is estimated that around 3% of entangled turtles die from drowning or being mishandled on fishing vessels. To protect sea turtles, WWF-Pakistan trained a total of 100 skippers and crews on how to safely release sea turtles and developed modified gillnet operation methods that reduced sea turtle entanglement by up to 85%. This is a significant achievement for the conservation of sea turtles along the Pakistani coast.
- Relevant government agencies have taken several measures to protect sea turtles along the Pakistani coast. Thanks to the efforts of WWF-Pakistan, the fisheries laws of the two

coastal areas have been amended to protect marine and freshwater turtles. The declaration of Astola Island as a Marine Protected Area (MPA), the actions taken by the wildlife departments of Sindh and Baluchistan, the efforts of WWF-Pakistan, and awareness programs initiated by some NGOs have led to a collective increase in turtle populations along the Pakistani coast, he said. However, he added that there is a need to declare all turtle beaches along the coasts of Sindh and Balochistan as Marine Protected Areas (MPAs). "This is essential for the conservation of marine turtles in Pakistan," he said.

- ❖ Both marine and freshwater turtles are killed as bycatch in fishing nets. Turtle exclusion devices (TEDs) have been successfully implemented in some coastal fisheries.
- ❖ During field collections, surveys, and experimentation on animals, the researchers must follow the 4 "Rs" (Reduction, Refinement, Replacement, and Responsibility) (Safi & Karl, 2025).

A Summary of Recommended Future Priorities and Actions

- ➢ Habitat destruction and harmful and unsustainable fishing practices can be avoided.
- ➢ The law banning the turtle trade must be implemented in its true letter and spirit.
- ➢ The Ministry of Wildlife and the Ministry of Fisheries must control turtle poaching and mortality in fishing nets.
- ➢ Breeding practices for turtles must be initiated to reduce hunting pressure.
- ➢ Local public awareness must be raised about the importance and conservation of biodiversity, including turtles.
- ➢ Use turtle exclusion devices (TEDs) to prevent sea turtles from becoming entangled.
- ➢ Research is needed to understand the reasons for recent population declines or non-breeding behavior in some sea turtle species in areas where they were previously recorded.
- ➢ The exploitation of eggs should be stopped in strict compliance with national and international laws.
- ➢ Training workshops on turtle management should be organized regularly to improve the skills of fishermen.
- ➢ Great care should be taken when organizing recreational activities in nesting areas.
- ➢ Signs, signs, and directions should be placed in coastal areas to guide the public and tourists, and mass awareness programs on sea turtle safety and fishing activities should be organized regularly by various educational institutions.

- Academic and research work on turtle and tortoise conservation should be provided regularly to governments, relevant NGOs, and academia.
- A comprehensive network should be established among countries in the region to share research results, experiences, workshops, and training sessions.
- Consider future risks and manage them in decision-making processes such as horizontal planning. GIS should provide new insights into patterns and can be a great aid in understanding the impacts of risk and terrain sufficiency.

Figure 24. Images of some conservative measures; **(A) A**ddressing in an international conference about conservation of turtles, **(B & C)** Educating locals about turtles, (D) Visit to Sands pit turtles beach, Karachi, along with WWF team and students of Wildlife, University of Karachi (Photos by Amtyaz Safi)

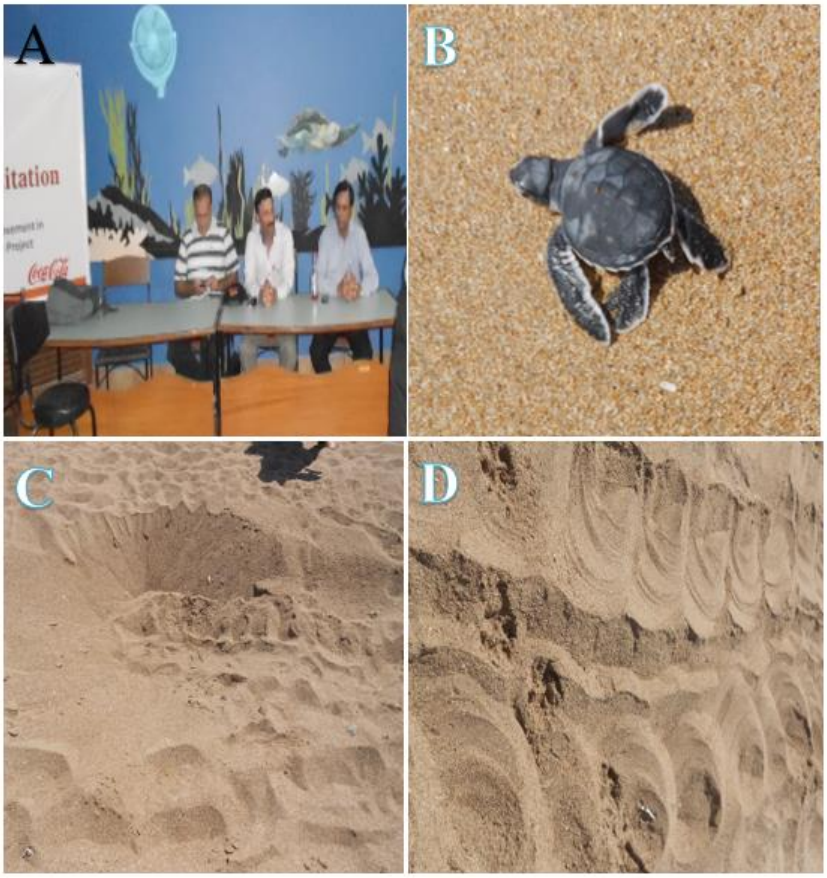

Figure 25. Images about marine turtle conservation **(A)** A workshop on turtles **(B)** A juvenile green turtle moving from nest toward Sea **(C)** A nest of green turtles in Sandspit, Karachi **(D)** A track of green turtle toward sea from nest in Hawks Bay, Karachi (Photos by Amtyaz Safi)

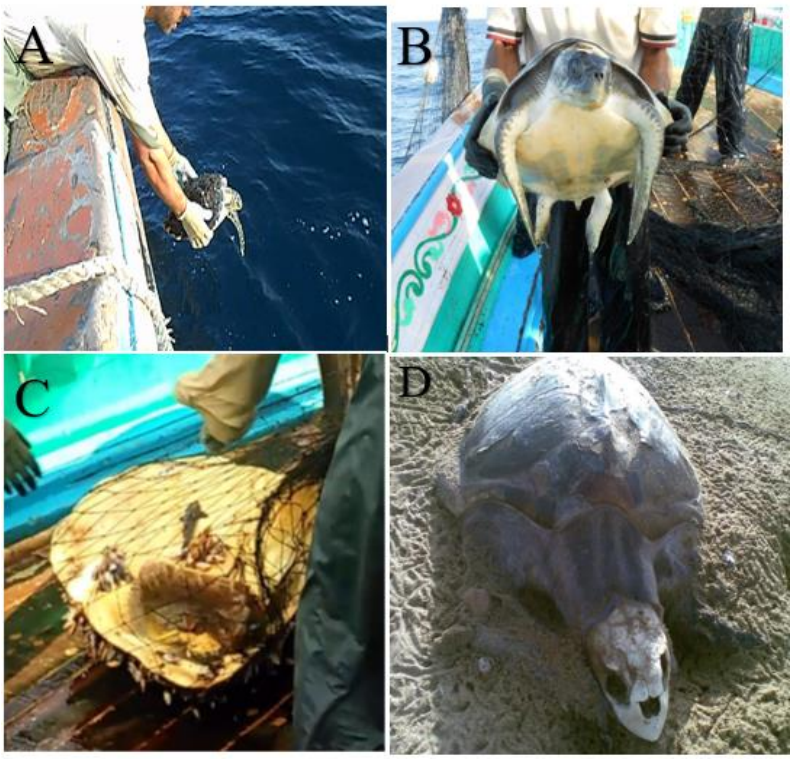

Figure 26. Images related to threats and conservation of sea turtles
(A) The Hawksbill sea turtle caught by a tuna gillnet in the offshore waters near Ormara on the Balochistan coast, and then released in the sea (Photo by WWF-Pakistan)
(B) A green sea turtle caught and then released by a fisherman in Karachi
(C) Loggerhead caught by Khaista Rehman (Observer) in a tuna gill net vessel and safely released near Karachi (ventral view)
(D) A green sea turtle found dead on Golden Beach – Hingol National Park, Baluchistan (Photo by Naeem Javid Muhammad Hassani, Deputy Conservator of Hingol National Park)

Conclusion

We are facing serious problems with many species of turtles and tortoises, and if we do not intervene, many of these precious animals will disappear shortly. We must review all information and ensure that threatened species are protected and preserved. Conservation status is usually based on IUCN and CITES assessments and includes factors such as population, diversity, and availability of information. Many countries, including those in South Asia, have restrictions on the poaching of turtles and tortoises. Our research could help determine which government projects and activities should be managed by government and non-governmental organizations. The importance of this work is to help researchers and students identify the understudied areas, inform conservation decision-makers, and provide humanitarian and financial assistance for at-risk animals. Understanding disease health and the relationship between animals and their habitats is

important for many reasons. It will be important to determine what factors influence the health of these organisms to develop new methods to assess biomarkers of endocrine disruption and to investigate whether pollution, called “persistent pesticides” (PPs), which includes inorganic and chemical substances, is persistent. A better understanding of the impact of PP on the health of endangered species will help inform future conservation efforts and allow us to protect these beautiful species. Governments and regulators must work together to ensure that laws and regulations are enforced against terrorism and other forms of violence against humans. It is also important to support short- and medium-term research into ecological and molecular systems and conditions that can be monitored and controlled. We need to bring together experts from many backgrounds, such as taxonomists, ecologists, and molecular biologists, to produce scientific results and raise public awareness of the sustainability and conservation of turtles' biodiversity. Some of the future research outlined in this review could help scientists work together to save these turtles that we care about so much. This article helps readers understand turtles' risks and threats, set goals, and prepare for the future with new ideas and conservation strategies. It is concluded that due to habitat destruction, eutrophication, some other anthropogenic activities, and climate change, the population of turtles and tortoises is on the decline. This group is an important part of our ecosystems and needs attention for its conservation and management, including control over trading activities. Further studies are needed to gather more information to develop conservation and management strategies for turtles in Pakistan. Public awareness needs to be raised to increase public participation to increase public awareness about conservation activities, particularly those directed toward turtles and their habitats. Although the threats to turtles are severe for extinction, many species may soon disappear in the wild without human intervention. Human population growth, increasing ambient temperatures, and associated habitat loss are increasing risks for these species. Immediate concerted action is thus required in the coming decades to control the chelonian decline and a substantial loss to ecosystem function. This article highlights the various threats that turtles and tortoises face and presents the steps needed to reduce and reverse these threats. The goal of all conservationists is to increase the long-term survival of species in healthy ecosystems. Among the most important pieces of information in the world is that turtles and tortoises need urgent protection to prevent serious harm in the future. But human activities are increasingly threatening many species of sea turtles and tortoises while driving others to extinction. We are the problem, but we must be the solution. The conservation strategy proposed

here is an important new step in our current efforts to work together to protect and manage the world's turtles and to develop, support, and implement a turtle conservation plan. Without this collective protection, most of the world's turtles and tortoises will become extinct in the future, and the world will lose these precious animals forever.

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