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Diversity, Distribution, and Conservation Status of Turtles of Türkiye with a Review of Fossil Tortoises from the Miocene

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SUMMARY

This article is based on compiling available information on testudines in Türkiye, their diversity, distribution, threats, and conservation status. Türkiye has different ecosystems and landscapes that support a variety of biodiversity, including Chelonian diversity, which is represented by six families, nine genera, and ten species of testudines, i.e., *Caretta*, *Chelonia*, *Dermochelys*, *Emys*, *Trionyx*, and *Rafetus* (one species of each genus), while *Mauremys* and *Testudo* have two species in each genus. The Nearctic species *Trachemys scripta* is an exotic species introduced into the country as a pet and has since established a wild population. The authors comprehensively reviewed available records and archives to document the diversity, distribution, threats, and conservation status of turtles in Türkiye. Therefore, the current article presents a newly updated list of turtle and tortoise species found in Türkiye. This study is the most comprehensive and up-to-date evidence-based report in Türkiye. It will be helpful for future studies and research in the fields of taxonomy, ecology, planning, and conservation of Turkish chelonian fauna.

Keywords: Conservation, Distribution, Diversity, Turtles, Türkiye

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INTRODUCTION

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). Reptiles are in decline worldwide and are more feared than birds, with threat rates numerically similar to mammals (Gibbons et al., 2000; Hashmi and Safi, 2025). Turtles are among the most endangered vertebrate groups globally, surpassing birds, mammals, fish, and amphibians (Khan et al., 2015). Historically, an important characteristic of reptiles has been their categorization based on the fenestration design of the skull's temporal region. Testudines are systematically categorized in the subclass Anapsida, which possesses no fenestration. Additional reptiles that belong to the subclass Diapsida possess two fossae in the temporal region of the skull, including snakes, lizards, crocodiles, and dinosaurs. Giant turtles represent the earliest group of reptiles that have inhabited the Earth since

the emergence of dinosaurs. According to reports, the oldest known turtle fossils are those of *Proganochelys* from the Late Triassic in Germany, approximately 220 million years ago, and *Odontochelys semitestacea* from the Triassic period in China (Karl et al., 2025a, b, and c).

In addition to the occurrence of large explosions, especially in Africa and Asia, significant climate changes caused by heat and cold have also led to drastic faunal turnovers and acted as a major driver of biological extinction (Karl et al., 2021, 2024). In the class Testudinata, the 13 families are one of the primary clades of extant and extinct amniotes, having 441 taxa of turtles and tortoises, which includes 322 species and 119 subspecies. They include 7 of the 8 sea turtles, and the remaining 315 species and 434 taxa of freshwater turtles and tortoises (TTWG, 2021; Khan et al., 2016a; Karl et al., 2025a; Safi et al., 2025). Unlike other animals, turtles possess horny beaks instead of teeth and a shell, which is a fleshy trunk bonded to the carapace. They are characterized by specialized ribs, shoulders, and dermal bones (Reisz and Head, 2008; TTWG, 2021; Dubois, 2010). All turtle species respire using lungs by taking in air directly from the atmosphere and are oviparous, laying eggs on dry land. They occupy diverse habitats, including marine, freshwater, and terrestrial regions in temperate, subtropical, and tropical climates (Hutchinson, 1996; Ramakrishna et al., 2014; Safi and Khan, 2014).

Karl et al. (2021a) studied fossil remains of testudines from the Lower to Upper Miocene age in western Turkey. They described the systematic position and revised the systematic paleontology, phylogeny, and paleoclimatic conditions of the two Neogene tortoises: *Protestudo bessarabica*, and *Titanochelon kayadibiensis* from the region. The fossilized turtles of Turkey include *Trionyx triunguis*, *Protestudo bessarabica*, *Testudo marmorum*, *Titanochelon kayadibiensis* and *Mauremys aristotelica*. In Greece, turtle fossils represent at least 14 different species belonging to a single pleurodiran clade and four cryptodiran clades: Trionychidae, Emydidae, Geoemydidae, and Testudinidae (Vlachos, 2021).

The diversity, abundance, and distribution of species are dependent on climatic conditions and the geographical position of any region (Safi and Karl, 2024). Turtles represent some of the most prevalent and well-preserved fossilized vertebrates, serving as valuable paleo-biogeographical indicators since their exoskeletons contain shell components that are resilient and suitable for fossilization, enabling straightforward deductions regarding their close phylogenetic ties to other species (Karl et al., 2025b). Turtles are a highly flexible group that plays a vital role in the health of land, freshwater, and ocean ecosystems. Currently, over fifty percent of the species and subspecies face the threat of extinction, making turtles among the most critically endangered large vertebrates. Turtle populations are swiftly decreasing because of habitat destruction, human use for traditional foods and medicine, and collection for the worldwide pet market (Stanford et al., 2020; Safi et al., 2024b; Ahmed et al., 2024).

Turtles are among the most endangered vertebrate groups globally, more than birds, mammals, cartilaginous and bony fishes, and amphibians (Khan et al., 2015; Safi et al., 2024a). According to the IUCN Red List analysis, 85% of South Asian turtle species are threatened: vulnerable (VU), critically endangered (CR), and endangered (EN), while the remaining 15% are at low risk: 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).

Biodiversity is being disturbed at an accelerated rate nowadays due to numerous anthropogenic activities and fragmentation (Butchart et al., 2010). For the successful conservation and management of biological diversity, knowledge about diversity and population patterns, as well as the identification of hotspot areas, is essential (Sillero et al., 2014; Margules and Pressey, 2000; Myers et al., 2000; Yasar et al., 2021). The Mediterranean, the Caucasus and the Irano-Anatolian, are the three hotspots for biodiversity, and Turkey is present at the connection of these three (Mittermeier et al., 2005). Turkey has a variety of climatic conditions, ecoregions, and habitat patterns due to its distinctive tectonic location and history between the subtropical and temperate zones (Şekercioğlu et al., 2011). The Asian part of Turkey (Anatolia) is a barrier as well as a bridge between Asia and Europe due to its unique geography, climate, habitats, and ecosystems (Sindaco et al., 2000). Türkiye is home to 5 species of freshwater turtles (Three soft-shelled and two hard-shelled terrapins), 2 species of tortoises, and 3 species of marine turtles (2 hard-shelled and 1 soft-shelled turtle), making it one of the countries with good chelonian fauna in the region.

The first research (Werner 1902; Bodenheimer 1944) on the herpetofauna of Turkey began in the early 19th century (Clark and Clark, 1973). This is the cause of the collected documents are along foremost road paths (Yasar et al., 2021). Fourteen ecoregions and 14 Ramsar sites, which are wetlands protected under the Ramsar Convention, an intergovernmental treaty, are located in Türkiye (Figure 1; Table 1) (Yasar et al., 2021). Karl et al. (2021a) presented an article that attempts to identify the Neogene fossils of Testudindae of Türkiye.

Table 1. The Ramsar List of Wetlands of International Importance in Türkiye.

Sr.	Est. Date	Ramsar site	Province
1	1994-07-13	Göksu Delta	Mersin
2	1994-07-13	Lake Burdur	Burdur
3	1994-07-13	Lake Seyfe	Kırşehir
4	1994-07-13	Lake Kuş	Balıkesir
5	1994-07-13	Sultan Marshes	Kayseri
6	1998-04-15	Kızılırmak Delta	Samsun
7	1998-04-15	Akyatan Lagoon	Adana
8	1998-04-15	Lake Uluabat	Bursa
9	1998-04-15	Gediz Delta	Izmir
10	2005-06-21	Lake Meke	Konya
11	2005-06-21	Yumurtalık Lagoon	Adana
12	2006-05-02	Kızören Obrouk	Konya
13	2009-04-02	Lake Kuyucuk	Kars
14	2013-04-17	Nemrut Caldera	Bitlis

The current paper provides a comprehensive analysis of various factors related to turtles and tortoises in Türkiye, including systematics, diversity, distribution, threats, and conservation status. The information is presented in chronological order. This article is the first of its kind to compile data collectively on sea turtles, freshwater turtles, and land turtles (tortoises) in Türkiye. In this study, we gather all available records of Turkish turtle fauna from previously published literature and citizen science data, while also updating existing information on zoogeography, ecology, natural history, and the threats faced by turtles and tortoises in Türkiye.

MATERIALS AND METHODS

We performed a comprehensive review survey of published records regarding chelonian fauna in Türkiye to gather occurrence data and analyze their geographic distribution. 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).

STUDY AREA

Turkey is located at the crossroads of Eurasia, spanning latitudes i.e. 36° to 42° N and longitudes i.e. 25° to 45° E. It covers an area of approximately 783,562 km², with 55,688 km² in Asia and 23,764km² in Europe. The country experiences an average annual temperature of 13.2°C and receives about 622.8mm of precipitation, characterized by a temperate climate (WWF 2020). Türkiye is home to fourteen recorded ecoregions (Figure 1, Olson et al., 2001).

COMPILATION AND DATA PROCESSING

The data on Turkish herpetofauna were collected from books, journal articles, museum collections, and websites. Google Earth Pro version 7.1.5 was used to obtain the locality information about localities, and the records were primarily created and stored in 2007 MS Access database. The suspicious records in the database have been rechecked for quality, and the records with layers were linked to the coordinate system of WGS-84.

Mapping

Figure 1a, the recently known distribution of fossil turtles in Turkey according to Karl et al., (2021a): IK = İstanbul-Küçükçekmece; CA = Ankara-Kalecik-Çandir-faunal group, MN 6, (lower) Astaracian /7 (highest) Burdigalian to Langhian, Lower to Central Miocene; SaG = Afyon-Sandikli-Garkin, Garkin-faunal group, MN 11, (middle) Turolian II (highest) Tortonian to (deeper) Messinian, Upper Miocene. MC

= Muğla-Yerkesik-Çatakbağyaka, Yeni Eskihisar or Sofça-faunal group, MN 7+8, (higher) Astaracian /7 Serravallian to (lower) Tortonian, Middle Miocene to Upper Miocene. KB = KBS = KD = Konya-Hatunsaray-Kayadibi, Kayadibi-Frauengruppe, MN 11, (deeper) Turolian 7/ (middle) Tortonian, Upper Miocene. The points were recorded and transformed into a grid (Sillero et al., 2000; 2014). The current maps of distribution and localities were visualized via ArcGIS and recorded to the UTM grid system at a spatial resolution of 2,500 km2 (50 x 50 km2) (Figures 1b and 2) (Yasar et al., 2021).

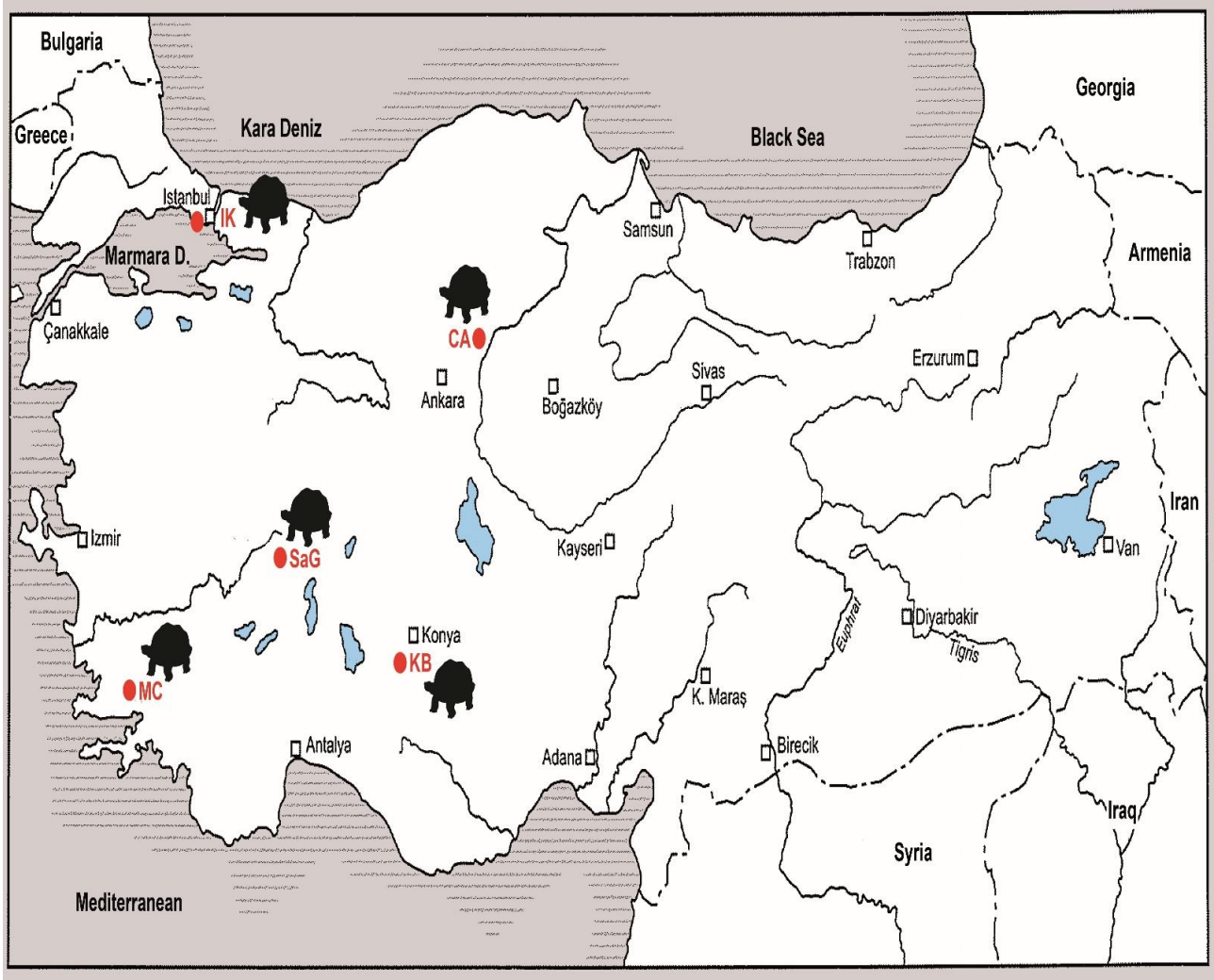

Figure 1a: Geographical position and Map of the Neogene tortoises of western Turkey. CA- Ankara-Kabecik-Eandir-faunal assemblage, IK- İstanbül-Küçük-Çekmece, MN 6, (lower) Astaracian /7 (upper) Burdigalian to Langhian, Lower to Central Miocene. SaG- Afyon-Sandikli-Garkin. MC- Muğla-Yerkesik-Çatakbağyaka. KB - KBS = KD - Konya-Hatunsaray-Kayadibi. Additionally, the location where *Protestudo bessarabica* was discovered. (Map obtained from Staesche et al., 2007; Karl et al., 2021).

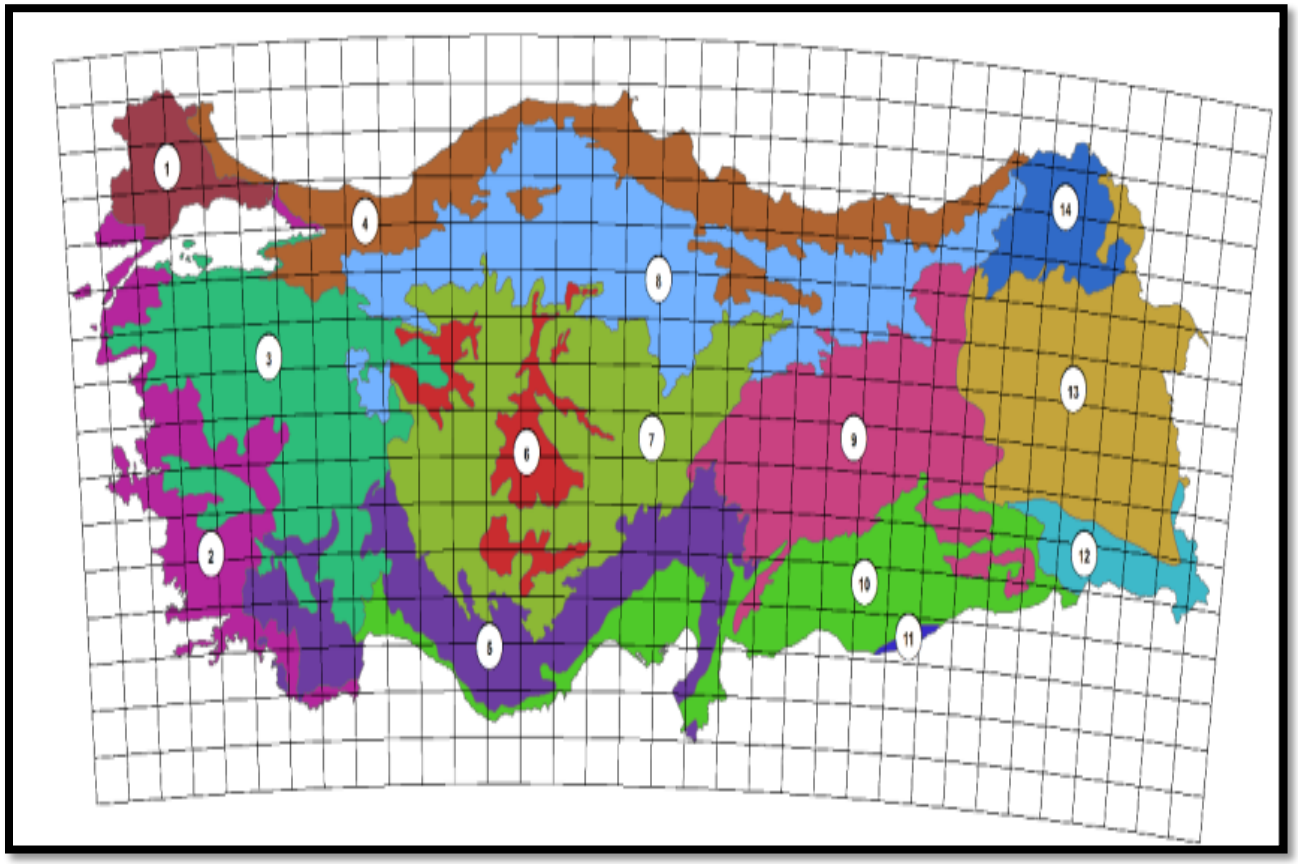

Figure 1b: Map of grid codes and ecoregions of Türkiye. Note: 1. Balkan Forests, 2. Aegean and Western Turkey, 3. Anatolian Forests, 4. Broadleaf Forests, 5. Southern Anatolian Forests, 6. Steppe of Central Anatolia, 7. Steppe and Woodlands of Central Anatolia, 8. Northern Anatolian Forests, 9. Eastern Anatolian Forests, 10. Eastern Mediterranean Forests, 11. Steppe of the Middle East, 12. Steppe and forest of the Zagros Mountains, 13. Montane Steppe of Eastern Anatolia, 14. Mixed Forests of Caucasus (Courtesy: Yasar et al., 2021).

DIVERSITY, DISTRIBUTION, AND CONSERVATION STATUS OF RECENT TURTLES AND TORTOISES OF TÜRKIYE

Study represented by 6 families, 9 genera, and 10 species of Testudines, i.e, *Caretta*, *Chelonia*, *Dermochelys*, *Emys*, *Trionyx*, and *Rafetus* (1 species of each genus), while *Mauremys* and *Testudo* have 2 species in each genus. The Nearctic species *Trachemys scripta* is an exotic species brought into the country as a pet and has gained a wild population now (Figure 2; Tables 2 and 3). 80% of its total chelonian fauna is threatened, and 20% are either least concern or near threatened (Figure 3).

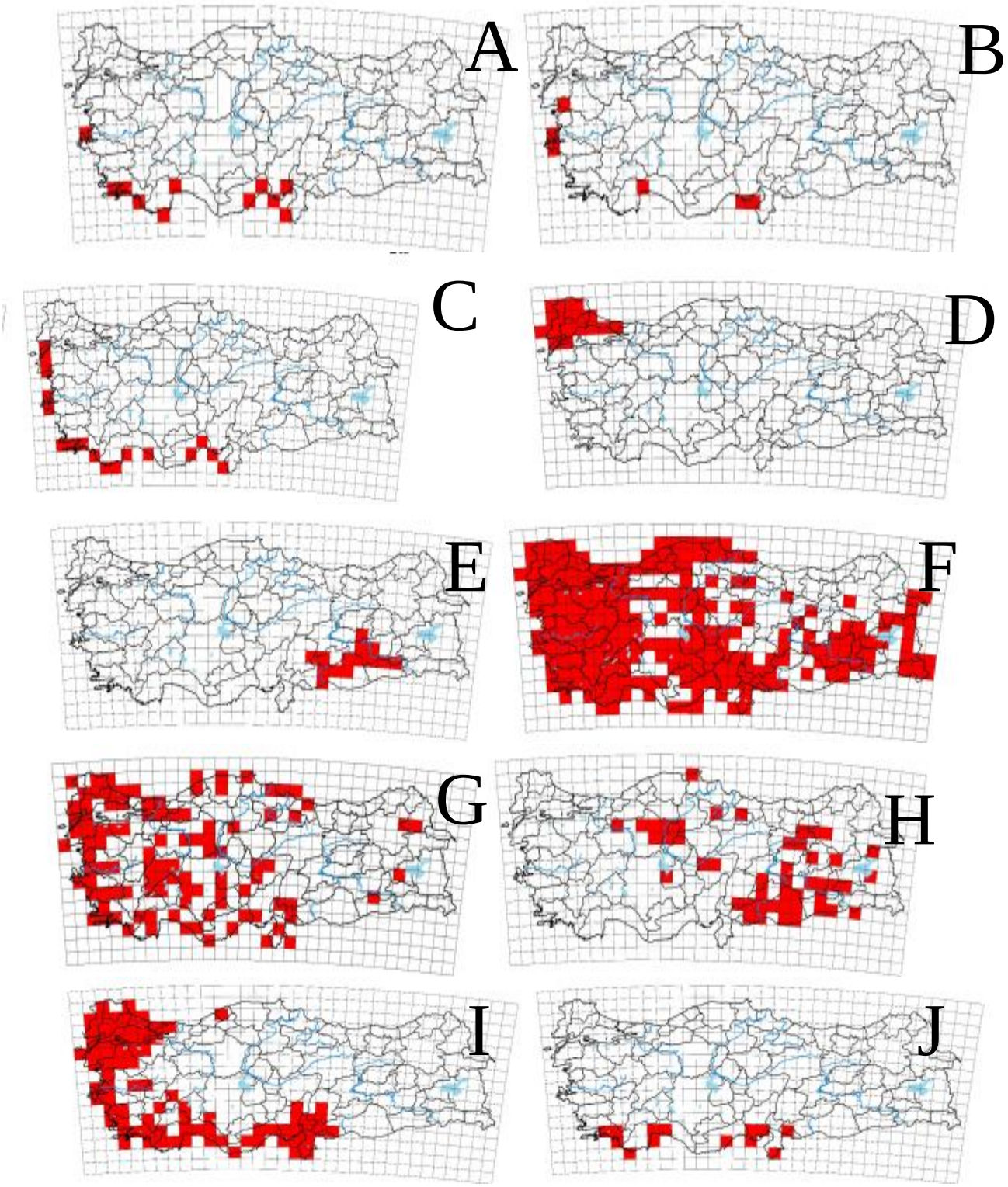

Figure 2: Distribution map of Tstudines in Türkiye: (A) *Chelonia mydas* (Linnaeus, 1758) (B) *Dermochelys coriacea* (Vandelli, 1761) (C) *Caretta caretta* (Linnaeus, 1758) (D) *Testudo hermanni* Gmelin, 1789 (E) *Rafetus euphraticus* (Daudin, 1802) (F) *Testudo graeca* Linnaeus, 1758 (G) *Emys orbicularis* (Linnaeus, 1758) (H) *Mauremys caspica* (Gmelin, 1774) (I) *Mauremys rivulata* (Valenciennes, 1833) (J) *Trionyx triunguis* (Forskål, 1775) (Courtesy: Yasar et al., 2021).

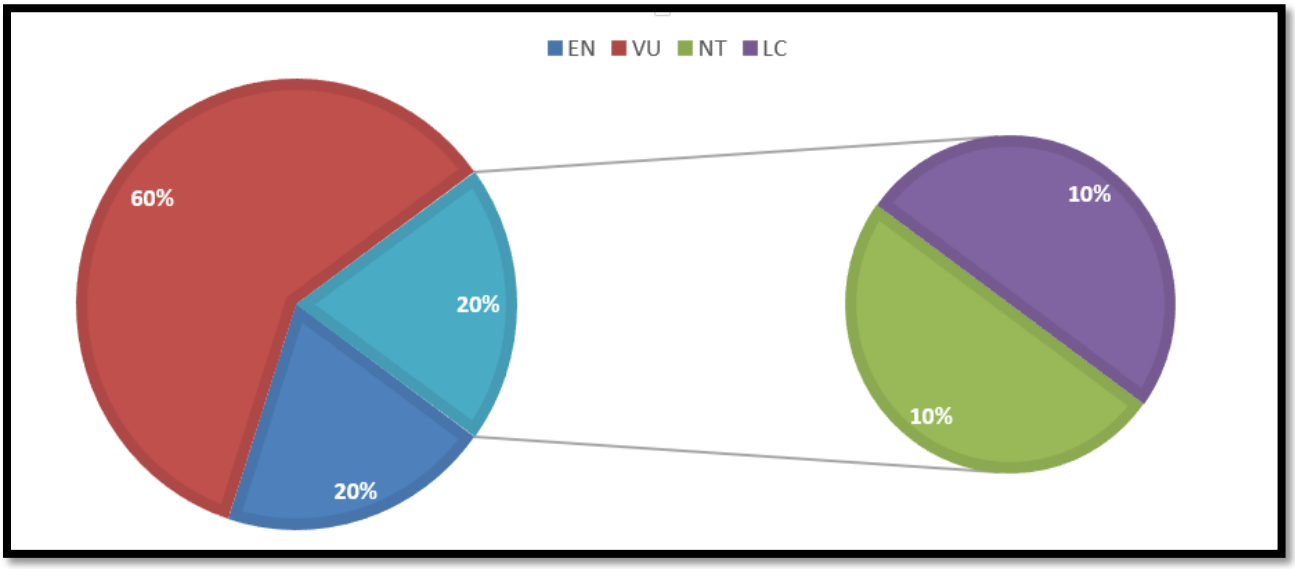

Figure 3: IUCN Status (November 2024); (EN: Endangered, VU: Vulnerable, NT: Near Threatened, LC: Least Concern) of the 10 species of turtles and land tortoises found in Türkiye.

Freshwater Turtles (Terrapins) of Turkiye

Freshwater turtles, or terrapins, feature either soft or hard shells and inhabit freshwater bodies. These popular terrapins excel at digging into mud or silty bottoms, allowing them to stay hidden effectively. Their extended necks and snouts enable them to keep their heads above the water and respire (Hutchinson, 1996; Ramakrishna et al., 2014; Safi and Khan, 2014; Khan et. al., 2015; 2016a, b), Safi et al., (2015; 2021; 2022 & 2024a & b). The freshwater turtles in Türkiye are classified into three families: Trionychidae (two species), Geoemydidae (two species) and Emydidae (one species).

Family Emydidae: *Emys orbicularis* which is also known as the European pond turtle commonly is the only local species of this family, but there is another exotic species known as *Testudo scripta* (Thunberg and Schoepf, 1792), the species was placed under *Emys*, *Chrysemys*, and *Pseudemys* previously, but now, has been known under *Trachemys scripta* (Schwartz and Henderson, 991; Çiçek and Ayaz 2015).

Family Geoemydidae: Fritz & Wischuf (1997) described *Mauremys rivulata* and authenticated the subspecies status as a new species, *M. caspica*

Family Trionychidae: Two soft-shell terrapins from this family are found here, which are *Trionyx triungius* and *T. euphraticus.* The second species has been reassigned to the genus *Rafetus* now by Gray, 1864; Ernst and Barbour (1989), and is now known as *Rafetus euphraticus.*

Land Tortoises (Testudinidae)

There are 60 species of tortoises recognized worldwide, Tortoises are primarily found in open areas such as arid, semi-arid, desert, and grassland regions (Salleh et al.,

2022). In South Asia, there are four genera and five species of tortoises, adapted to various habitats, including forested areas and cooler lowland forests (Purkayastha et al., 2015). Türkiye is home to two species of land tortoises: the Greek tortoise (*Testudo graeca*) and Hermann's tortoise (*Testudo hermanni*). Two subspecies are recognized: the eastern Hermann's tortoise (*T. h. boettgeri*) and the western Hermann's tortoise (*T. h. hermanni*) (Fritz and Havas, 2007; Karl et al., 2021b).

The genus *Testudo* is polyphyletic and has undergone significant divergence, but the European species have retained the original classification as *Testudo*. Karl (2007) and Fritz and Bininda-Emonds (2007) supported the continued use of the name as; *Testudo* for whole tortoise species of western, considering it a monophyletic genus (Karl et al., 2021b). Occasionally, these subspecies have been elevated to species status (Bour, 1989). Researchers (Bour, 2004; Perälä, 2004) advocated for the classification of the three subspecies of *hermanni* as distinct species. We align with the perspectives of Parham et al. (2006), Fritz et al. (2007), and Türkozan et al. (2010) in recognizing these two subspecies of *T. hermanni* and *Testudo graeca*. Additionally, several dubious subspecies are found in Turkey, which have sometimes been classified as separate species, such as *perses, terrestris anamurensis,* and *antakyensis* (Perälä 1996, 2002a, b; Bonin et al., 2006).

Marine turtles

Marine turtles come in seven species, including the leather, Kemp, olive, hawksbill, green, loggerhead, and flatback species (*Lepidochelys kempii, Dermochelys coriacea, Lepidochelys olivacea, Natator depressus, Eretmochelys imbricata* and *Caretta caretta*). Six of the seven marine turtles are listed in the IUCN Red List of Threatened Species as threatened, and the harmful impact of marine contaminants is one of the twenty highest-priority research areas regarding the conservation of marine turtles (Table 3) (Arienzo, 2023).

Of a total of five sea turtle taxa known from the Mediterranean ecosystem, three are encountered in Türkiye. Three species of marine turtles are reported in Turkish coastal areas, which include leatherback, loggerhead, hawksbill, and green turtles. Presently, there are 25 major sea turtle nesting locations spanning approximately 300 km of the Turkish coastline, extending from Samandağ in the east to Ekincik Bay in the west (Sönmez, 2016). During the last decade, the nesting sites of loggerhead sea turtles *Caretta caretta* (Linnaeus, 1758) in particular expanded toward the northern Aegean coasts of Türkiye. (Guclusoy and Onmus, 2024).

A decade after the last tetrapod checklist was prepared by Güçlüsoy et al. (2014), the marine representatives of the class Reptilia in Turkish seas remain confined to three sea turtle species: *Caretta caretta* (Linnaeus, 1758), *Chelonia mydas* (Linnaeus, 1758) (Figure 4), and *Dermochelys coriacea* (Vandelli, 1761). *Dermochelys coriacea* does not typically nest in the Mediterranean, and the infrequently encountered individuals are likely of Atlantic origin (Casale et al., 2018).

Figure 4: Green turtle, *Chelonia mydas,* returning to sea from laying eggs (Photo by Amtyaz Safi).

During the last decade, no major change was observed in the distribution and nesting sites of sea turtles. All three sea turtle species are found along the Levantine and Aegean coasts of Türkiye. *C. caretta* and *C. mydas* primarily rely on nesting sites along the northern Levantine shores (Sonmez, 2016; Kaska et al., 2023). The presence of *C. mydas* was also confirmed in the Sea of Marmara (Tonay and Oruç, 2016; Özdilek et al., 2018). *C. mydas* had already been confirmed from the Black Sea in the previous checklist (Güçlüsoy et al., 2014). *C. caretta* and *C. mydas* are categorized as least concern (LC) and near threatened (NT), respectively, in the Mediterranean region by the IUCN Red List, and the vagrant *D. coriacea* is categorized as vulnerable (VU) globally. All three sea turtle species and their nesting sites are protected by national legislation. They are also listed as protected species by both the Barcelona Convention and the Bern Convention. Because sea turtles exhibit natal homing behavior, it's possible that their nesting beaches or localities have distinct genetic makeups. This could be a single beach or a group of beaches under management. Numerous tiny pocket beaches and other inaccessible, isolated sandy beaches can be found along Turkey's Mediterranean coast (Kaska and Sozbilan, 2024). Of the seven known species of sea turtles, eight are marine, including the Black turtle. Loggerhead Sea Turtle (*Caretta caretta*), Leatherback Sea Turtle (*Dermochelys coriacea*) and Green Sea Turtle (*Chelonia mydas*), are the three species found in Turkish coastal waters.

Based on IUCN Red List of Threatened Species (Table 2), three sea turtle species, viz. Olive Ridley, Loggerhead, and Leatherback are listed as Vulnerable (VU), whereas Green and Hawksbill turtles are listed and classified as Endangered (EN) and Critically Endangered (CR), respectively, which necessitate urgency in conservation efforts for these marvelous reptiles.

FOSSIL TESTUDINES FROM THE MIOCENE EPOCH OF TÜRKIYE

The mass screen-washing method of paleontological examination is used to study fossil turtles (Karl et al., 2025d). Fossil evidences of testudines were recorded in different sites from the Lower to Upper Miocene in western Turkey. Karl et al, 2021, revised and described the systematic paleontology, distribution, phylogeny, and palaeo-climatic conditions of the two Neogene turtles *Protestudo bessarabica* and *Titanochelon kayadibiensis* (Testudinidae) of Turkey, and described an updated list of fossil turtles of Turkey, *Mauremys aristotelica*, *Trionyx triunguis*, *Protestudo bessarabica*, *Testudo marmorum* and *Titanochelon kayadibiensis*, re-evaluated and outlined the systematic paleontology, distribution, phylogeny, and paleo-climatic conditions of two Neogene turtle species, *Protestudo bessarabica* and *Titanochelon kayadibiensis* (Testudinidae) from Western Turkey, while providing an updated catalogue of Turkish fossil turtles, including *Mauremys aristotelica* and *Trionyx triunguis*, Vlachos et al., 2019, *Titanochelon kayadibiensis, Protestudo bessarabica* and *Testudo marmorum.*

Table 2: The IUCN Red List classifications and descriptions (Salleh et al., 2022; Safi et al., 2024b).

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 doesn't look like it will 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) impacts.
EN (Endangered)	There is a high risk of extinction in the wild habitats.
CR (Critically Endangered)	In an 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 Türkiye and their status as per the IUCN Red List and CITES Appendices.

Sr.	Family	Habitat	Scientific name	Common name	IUCN Status	CITES Appendix	
						I	II
1.	Testudinidae	Terrestrial	*Testudo graeca*	Greek tortoise	VU		+
2.	Testudinidae	Terrestrial	*Testudo hermanni*	Hermann's tortoise	VU		+
3.	Trionychidae	Freshwater	*Trionyx triunguis*	African softshell turtle	VU		+
4.	Trionychidae	Freshwater	*Rafetus euphraticus*	Euphrates softshell turtle	EN		+
5.	Geoemydidae	Freshwater	*Mauremys rivulata*	Balkan terrapin	LC		+
6.	Geoemydidae	Freshwater	*Mauremys caspica*	Caspian turtle	VU		+
7.	Emydidae	Freshwater	*Emys orbicularis*	European pond turtle	NT		+
8.	Cheloniidae	Marine	*Caretta caretta*	Loggerhead Sea Turtle	VU	+	
9.	Cheloniidae	Marine	*Chelonia mydas*	Green Turtle	EN	+	
10.	Dermochelyidae	Marine	*Dermochelys coriacea*	Leatherback Sea turtle	VU	+	

THREATS TO TURTLES AND TORTOISES IN TÜRKIYE

Many factors cause the threats (Figure 5):

- The population of testudines in Türkiye is in steep decline due to widespread poaching, excessive fishing practices, pollution, and ongoing habitat degradation.
- Although turtles are not commercially harvested for food in Türkiye, 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 various social media sites and websites.
- Dalyan in Turkey is one of the very few places where the Nile and loggerhead turtles can both be found nesting. Dalyan is a protected area; however, individual species aren't protected. Some predators, such as the foxes (*Vulpes vulpes*), are moving and predating on the eggs of both turtle species.
- Turtle mortality is increasing due to the increase in gill nets and ghost fishing gear.
- Freshwater turtles face serious threats, including habitat destruction, fragmentation of rivers and canals, and fishing activities.
- Sea turtles along the coast of Türkiye 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, major sea turtle nesting sites have been negatively impacted by plastic waste, with collapsed huts and debris posing a significant threat to nesting sites for female turtles and their young. Popular beaches are littered with litter, much of it single-use items and microplastics.
- Turtles are endangered due to anthropogenic activities such as nest destruction, unplanned development, and climate change.
- Habitat loss and degradation are also major factors in the widespread decline.
- Environmental and climate change, as well as natural disasters, are also important to the survival of these turtles. Pollution from industrial, agricultural, and domestic waste, as well as pesticides and fertilizers, affects turtle survival, particularly about global warming and water pollution (Figure 5).
- Unplanned 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 a major cause of turtle mortality. Gill nets and bottom trawl nets are 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.
- Beach construction at key nesting sites may result in significant post-spawn egg loss.
- Sea turtles must return to nesting sites to lay eggs, and many threats are related to nesting beaches. For example, artificial lighting confuses and disorients both adult and juvenile females, driving them away from the ocean, vulnerable to predation, dehydration, and death.
- 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).
- Beach sand mining scars the landscape, accelerates erosion, and degrades stable beach vegetation. The loss of sandy beaches due to mining not only reduces the breeding success of sea turtles but also has serious economic consequences for local essential industries such as fisheries and coastal tourism.
- 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, and indiscriminate anchoring also contributes to sea turtle mortality.
- Pollution from industrial, municipal, and agricultural pollutants, as well as the direct discharge of untreated or improperly treated wastewater into the ocean, harms sea turtles and their habitats. 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 sea turtles. Fungi, bacteria, and some types of sea acorns, flukes, and worms can harm sea turtles.
- Freshwater turtle nests are not protected, and wild animals eat the eggs, and even small children break the eggs.
- Bring some objectivity to responsible interactions with turtles and other general wildlife interactions (Safi and Karl, 2025).

RECOMMENDED FUTURE PRIORITIES AND ACTIONS

- Habitat destruction can be avoided.
- Pet owners have long been fascinated by turtles and tortoises, and many species are collected worldwide for the pet trade. This practice should be banned as populations are under serious threat from the pet trade in Asia, where increasing wealth fuels the appetite for turtles as pets, and rare species are sold at high prices.
- Use turtle exclusion devices (TEDs) to prevent sea turtles from becoming entangled.

- Research projects are 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.
- Small, simple structures should be erected in riverine areas to minimize nesting disturbance.
- 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.
- 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.
- Community-level awareness should be utilized.
- Integrating captive enclosures and community ponds into communal captive enclosures can be an effective conservation measure. The best approach to conserving river turtles will vary depending on the findings, and where viable populations remain, a combination of ex-situ methods combined with protected areas to conserve wild populations and their habitats will likely be the preferred approach.
- Developing modern management strategies using SMART (Specific, Measurable, Attainable, Realistic, and time-based) goals that assess, modify, and promote evidence-based conservation is critical to determining current and future business board performance.
- 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.
- The carrying capacity of a territory is a critical factor in reclaiming living space. Although much more research is needed, several researchers have attempted to explain the general or transmissivity capabilities of specific ecological systems.
- Optimizing field methods for turtle eDNA classification, further testing primer specificity by testing assays that include DNA from multiple species, and designing primers that target different turtle networks could significantly improve recognition rates for rare species.
- Using meta-barcoding, harmful microorganisms such as viruses, bacteria, parasites, and fungi that have not yet been tested in turtles may be able to spread between or among hosts. Future studies could also investigate the influence of dominant phyla (*Proteobacteria*) and genera (*Cetobacterium*).
- There are several ways to understand the spatial biology of turtles and to calculate natural biomarkers, such as genetic traits and stable isotopes.

- Identify and monitor the key habitats of turtles to obtain baseline data. Mesocosm experiments are being integrated with other scientific studies.
- Develop strategies to identify and measure the microplastics, associated toxins, and bioaccumulation.

Figure 5: Some threats to sea turtles. (Source: Marine turtle Posters Infographics): (https://rollingharbour.com/marine-life-2/sea-turtles/sea-turtle-info-posters/) .

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