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Rafetus euphraticus (Daudin 1801) – Euphrates Softshell Turtle

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Summary. – The Euphrates Softshell Turtle, *Rafetus euphraticus* (Family Trionychidae), is a medium-sized (maximum recorded carapace length 680 mm), freshwater turtle thought to be most closely related to the eastern Asian species *Rafetus swinhoei*. The species inhabits diverse habitats, including rivers, streams, ponds, lakes, reservoirs, marshlands, and artificial canals. It is found only in the Euphrates and Tigris rivers and their tributaries in Turkey, Syria, Iraq, and southwestern Iran. It occurs in relatively shallow, calm waters, typically adjacent to deeper, fast-flowing water. The home range size averages 47.5 ha (minimum convex polygon) with a mean 95% kernel density of 21.8 ha. Knowledge of the species' distribution in the Tigris system lacks detail, due in part to political disturbance. Populations of the species are threatened by ongoing habitat fragmentation, alteration, and destruction throughout its range. Construction of several large dams has drastically changed the habitat of this turtle, especially in the Turkish part of the Euphrates watershed. This serious threat endangers the future of this species. No conservation measures are being taken in southeastern Anatolia (Turkey), Syria or Iraq. A participatory conservation project is underway in Khuzestan Province, Iran. Population studies, strengthened national and international protection, and regional cooperation will be required for the long-term survival of *Rafetus euphraticus*.

Distribution. – Iran, Iraq, Syria, Turkey. Restricted to the Euphrates and Tigris River basins.

Synonymy. – *Testudo euphratica* Daudin 1801, *Trionyx euphraticus, Gymnopus euphraticus, Rafetus euphraticus, Pelodiscus euphraticus, Amyda euphratica, Tyrse euphratica, Testudo rafcht* Olivier 1807, *Testudo rascht* Gray 1830 (*nomen novum*), *Tyrse rafeht* Gray 1844 (*nomen novum*), *Trionyx rafeht*.

Subspecies. – None recognized.

Status. – IUCN 2015 Red List: Endangered (EN A1ac+2c; assessed 1996); TFTSG Draft Red List: Endangered (EN, assessed 2011); CITES: Appendix II, as *Rafetus* spp.

Taxonomy. — The Euphrates Softshell Turtle was described by Daudin (1801) as *Testudo euphratica*, based on a description provided by G.A. Olivier of a specimen from the Euphrates River, which was cited as the type locality. Olivier (1807) later applied the name *Testudo rafcht* to a specimen of this species from the Tigris. Geoffroy Saint-Hilaire (1809a,b), after establishing the generic name *Trionyx*, coined the new combination *Trionyx euphraticus*. Noting distinctive characteristics of the alveolar surface, Gray (1844) named a new genus and species, *Tyrse rafeht*. Later, Gray (1856) renamed this form *Trionyx rafeht*. Still later, Gray (1864, 1869, 1870, 1873a,b) claimed that the species was intermediate between *Trionyx* and *Potamochelys,* both in palatal features and in having just two plastral callosities, and he proposed a new genus, *Rafetus*.

Boulenger (1889) reverted to Geoffroy Saint-Hilaire's (1809b) *Trionyx euphraticus,* which remained in common use until the work of Meylan (1987). Taking into consideration distinctive skull and shell features (especially the reduced eighth pleural bones and the presence of only two plastral callosities), Meylan recommended the use of *Rafetus* Gray (1864) for this species and *Rafetus swinhoei,* considered by Boulenger (1889), Siebenrock (1913), Loveridge and Williams (1957), Obst (1985), Meylan (1987), and Meylan and Webb (1988) to be its closest relative. Meylan (1987) suggested that *Rafetus* was the sister group of *Apalone,* which includes three North American species, *A. ferox*, *A. mutica,* and *A. spinifera*. He also considered that *Rafetus* plus *Apalone*, in turn, comprised the sister group of *Trionyx triunguis*. Engstrom et al. (2004) proposed the new clade name *Amydona* as sister to the *Apolonina* clade that evolved from the common ancestor of *Rafetus euphraticus* and *Apalone ferox*. Ihlow et al. (2014) sequenced two mitochondrial genes, cytb and ND4, from 31 *R. euphraticus* from 12 localities

Figure 1. *Rafetus euphraticus* in Balarood River, Khuzestan Province, Iran. Photo by Hanyeh Ghaffari.

in Turkey, Iran, and Iraq, but did not detect significant phylogeographic variation.

Description. — The adult is flattened and dorsally compressed (Fig. 1). Maximum total carapace length (leathery shell) given in the literature ranges from 420 mm (Basoglu and Baran 1972) to 535 mm (Dumeril and Bibron 1835). A specimen from the Tigris in the Zoology Department of Ege University (ZDEU 67/1990-4) has a straight carapace length of 680 mm (Taskavak 1992). The maximum bony carapace length was given as 282 mm by Siebenrock (1913) and Meylan (1987), but the largest specimen in the Pritchard collection (PCHP) measures 292 mm, and the maximum bony disc length has been recorded to reach 351 mm (ZDEU 67/1990-4). Straight total carapace length of hatchlings has been given as 43.3 mm (Gramentz 1991), 55.0 mm (Hennipman et al. 1961; Eiselt and Spitzenberger 1967), and as a range from 39.3 to 43.5 mm (Ghaffari et al. 2013). In specimens from the Euphrates, Tigris and their tributaries, there are no discernible differences in absolute or relative body measurements between males and females.

The carapace is smooth, without tubercles; anteriorly it is thick and fleshy (Figs. 2, 3). The outline and sutures of the bony disc are easily discernible from above. In some specimens (usually large adults) a slight vertebral depression is present. The ground color of the carapace is uniformly olive-green, occasionally with indistinct scattered dark blotches, with some irregular cream-colored spots, especially on the lateral margins. Larger and more abundant spots are visible on the head. Occasionally, the ground coloration of the entire dorsum is uniformly dark brown and rarely black (Fig. 3) instead of the usual olive-green. The snout is proportionally shorter and thicker than that of *Trionyx triunguis* or *Pelodiscus sinensis* (Fig. 4). The lateral septal ridges (or septal papillae) have small longitudinal troughs with sharp edges.

The anterior edge of the plastron extends anterior to the anterior edge of the carapace. The total carapace width approximately equals the plastron length. The bony elements of the plastron are reduced, with very weak callosities present only on the hyo- and hypoplastra (Fig. 2). These

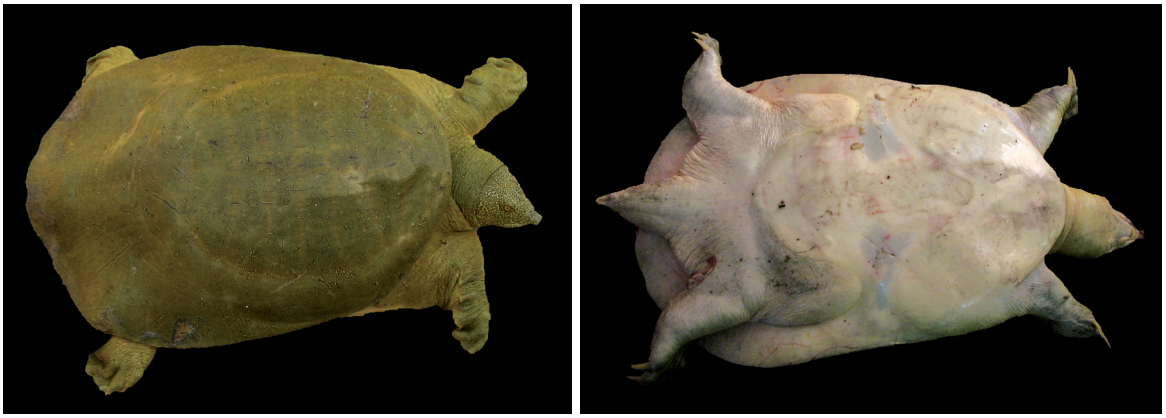

Figure 2. *Rafetus euphraticus* from Karkheh Lake Dam, Khuzestan Province, Iran. Photos by Hanyeh Ghaffari.

Figure 3. Top: *Rafetus euphraticus* from Dukan Lake, Sulaimani, Iraq. Photo by Hanyeh Ghaffari. **Bottom**: *Rafetus euphraticus* from Saray-Birecik, Sanliurfa, Turkey. Photo by Mehmet Atatür.

areas, although somewhat roughened, do not exhibit the vermiculate sculpturing seen on the bony carapace elements. The entoplastron is generally acute-angled, usually between 68 and 80°. The bridge, formed by the hyo- and hypoplastron on each side, is quite narrow.

In hatchlings, the carapace is oval with tubercles arranged in longitudinal rows. Tubercles do not extend to the posterior margin of the carapace, and they gradually disappear as the carapace becomes smooth with age. The carapace ground color is olive gray with scattered light spots and black blotches (Fig. 5). Light blotches on the lateral parts of the head extend onto the neck and are distinctly larger than the blotches on the dorsal part of the head and carapace. The hatchling plastron color (Fig. 5) is sandy gray to yellowish (Ghaffari et al. 2013).

The characteristic sculpturing of the bony carapace is very fine-grained and shallow, and the dorsal sutures become irregular and jagged with age. Generally, the 8th pleurals share a common suture medially (Boulenger 1889). In many specimens, the 7th pleurals also share a common suture (Meylan 1984, 1987). The lateral (suprascapular) fontanelles of the bony carapace may disappear with age in mature specimens (Meylan 1984, 1987), but Taskavak (1992) has found these fontanelles to persist in all the Turkish specimens examined, and they are prominent even in PCHP 4062, a very large and old Iranian specimen.

Rafetus euphraticus has a robust, obtuse skull (Eiselt 1976; Atatür and Üçüncü 1986). Its widest point usually lies between the ventral processes of the squamosals, just posterior to the tympanic cavities. The squamosals are roughly parallel to each other at a level anterodorsal to the tympanic cavities. The posterior border of the intermaxillary foramen is formed by the emarginate anterior edge of the vomer. In some skulls, the maxillae share a common medial suture ventral to the vomer; in others, the vomer separates the maxillae (Atatür and Üçüncü 1986; Meylan 1987). In the largest specimen from the Tigris (ZDEU-67/990-4) the vomer is in contact both with the pterygoids and the basisphenoid. Anterior to

Figure 4. Adult *Rafetus euphraticus* from Khuzestan Province, Iran. Photo by Hanyeh Ghaffari.

Figure 5. Hatchling *Rafetus euphraticus* from Dez River, Khuzestan Province, Iran. Photos by Barbod Safaei-Mahroo.

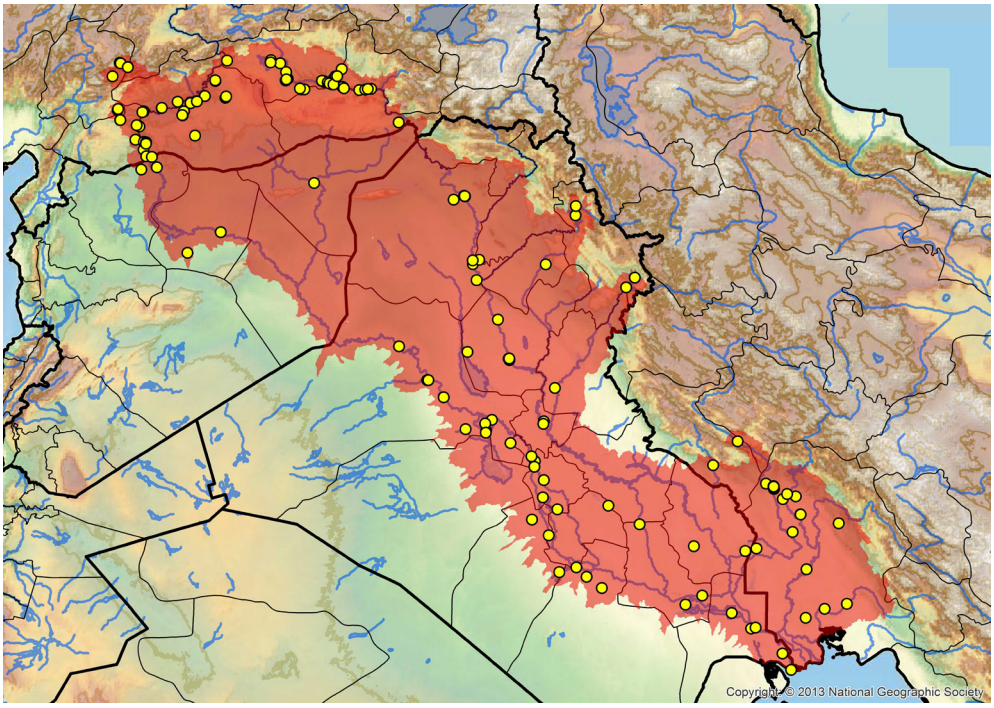

Figure 6. Distribution of *Rafetus euphraticus* in the Middle East. Yellow dots = museum and literature occurrence records of native populations based on Iverson (1992), plus more recent and authors' data. Red shading = projected historic distribution of *R. euphraticus*. Distribution based on GIS-defined level 10 HUCs (hydrologic unit compartments) constructed around verified localities and then adding HUCs that connect known point localities in the same watershed or physiographic region, and similar habitats and elevations as verified HUCs (Buhlmann et al. 2009; TTWG 2014), and adjusted based on authors' subsequent data.

the basisphenoid, the pterygoids may share a common medial suture, or not (roughly 50-50 in Turkish material).

In material from Turkey, the ratio of the intermaxillary foramen length to primary palate length does not exceed 0.64 (ca. 0.60; Meylan 1987). The postorbital bar is between 0.32–0.51 times the orbital diameter (ca. 0.33; Meylan 1987) which is 1.4–2.3 times the interorbital distance. The width of the alveolar surface of the maxillae gradually increases from anterior to posterior. A slight symphysial ridge is almost always present in the lower jaw (Gray 1873a; Atatür and Üçüncü 1986). Ahranjani et al. (2016) stated that *R. euphraticus* carpal and tarsal bones are similar to those of *Apalone spinifera*.

Distribution. — The distribution of the Euphrates Softshell Turtle extends from southeastern Turkey (Anatolia) to the northwestern extent of the Persian Gulf, encompassing the Euphrates and Tigris rivers and their tributaries, and adjacent lakes, ponds, and marshlands in Syria, Iraq, and southwestern Iran. The northeastern limit of the species' range has previously been given as Zengibar or Negreos creek, a tributary of the Euphrates (Ainsworth 1842). The correct name is Zengecur Creek, which joins Geldik Stream, then flows through a deep valley before joining the Euphrates near Kazo village. This locality is not between Samsat and Halfeti as reported by Kinzelbach (1986), but north of Samsat. Observations in Turkey suggest that the northern limits of this turtle in the Euphrates is the junction of a small stream coming from the general area of Cermik/Diyarbakir, which lies 50–60 km north of Zengecur Creek (Taskavak and Atatür 1996, 1998). In the Tigris system, the northern limit is a small stream 4–5 km east of Devegecidi Dam Lake (Taskavak and Atatür 1996, 1998).

Other locality records from southeastern Anatolia are: on the Tigris from the vicinity of Diyarbakir and from a small tributary between Diyarbakir and Ergani (Hennipman et al. 1961; Eiselt and Spitzenberger 1967; Basoglu and Baran 1977), on the Euphrates from Birecik and the vicinity of Halfeti (Ainsworth 1842; Lortet 1883; Griehl 1981; Atatür and Üçüncü 1986; Gramentz 1991). Besides these records from the Euphrates itself, we have records from tributaries of the Euphrates including Goksu, Karasu, Bozatli, Camdere, Geldik, and Zengecur creeks. There is also a record from Tigris in the vicinity of Göksu (Taskavak and Atatür 1998). Another record is from Gullap Creek a few km southeast of Sanliurfa, which joins the Euphrates in Syria (Basoglu and Baran 1972).

Data on the distribution of this species in Syria consists mainly of Siebenrock's (1913) records from Hsitch, from Habur Creek, which connects with the Euphrates, and from Rakka. Kinzelbach (1986) also mentioned the presence of *R. euphraticus* in Ar Raqqah (Rakka).

Although the most comprehensive treatment of reptiles of Iraq (Khalaf 1959) does not mention any localities for

Figure 7. *Rafetus euphraticus* habitats in northern Khuzestan, Iran. Photos by Barbod Safaei-Mahroo.

this species, Siebenrock (1913) reported *R. euphraticus* from Babylon, Mosul (al Mawsil), and Kalat Schirkat. Salih (1965a,b,c) listed a record from Samarra. There are also specimens from Fao, Baghdad, Basrah, Goosba, and Shul al-Arab (BMNH collection, C. McCarthy, pers. comm.), and from Habbaniya Lake (MCZ collection; Iverson 1986). Other *R. euphraticus* locality records from throughout southern, central, western, and northern Iraq are based on extensive surveys conducted by Nature Iraq (2016) from 2005 to 2012; they include: Dukan and Darbandikhan lakes in Sulaimani Province; Jabal Makhool, Mahzam, Al-Alam, Tharthar Lake, Al-Dhebaeji Fields, and Samara Wetlands in Salah Ad-Din Province; Qadissiya Lake, Haditha Wetlands, and Baghdadi in Anbar Province; Musayab, Hindiya Barrage, and North Ibn Najm in Babel Province; Ibn Najm in Babel and Najaf Provinces; Dalmaj in Al-Qadissiya and Wasit Provinces; Gharraf River in Wasit Province, and Thi-Qar; Sawa Lake and Area in Muthanna Province; Auda Marsh and Hawizeh in Missan and Basrah Province; Central Marshes and West Hammar in Thi-Qar Province; and East Hammar in Basrah Province.

The southeastern limit of the species' range is in Iran. Blanford (1876) claimed the probable occurrence of the turtle in Karun River, Khuzestan Province. Tuck (1971, 1973) also cited records from this river. In the past, fishermen frequently reported the presence of *R. euphraticus* from the Karun River; however, because of various pollutants discharged into this river, it is no longer suitable habitat (Ghaffari, pers. obs.). Anderson (1963, 1974, 1979) and Mertens (1957) gave the locality of Jarrahi River, Shadegan County. Haji Gholi Kami from Gorgan University (1991, pers. comm.) caught a specimen in the Karkheh River, Shush County, Iran, in August 1990. Various specimens were also observed and caught in Dez, Looreh, Balarood, Shahoor, Gargar and Sabzab Rivers, Hawizeh Marsh, Karkheh regulatory dam lake, and in most other rivers, lakes, and marshlands of Khuzestan Province. Other localities from Iran includes Rofaye on the border of Iran and Iraq, Zavieh Mashali, Siah-Mansoor, Hamidieh, Bone-Hajat, Bonvar-Hosein, Dezful, Shush, Shushtar, and Mollasani. Safaei-Mahroo et al. (2015) mentioned the existence of *R. euphraticus* from Kashkan River in Cham-mehr, 28 km west of Pol-e Dokhtar, Lorestan Province. Another specimen was found in Ilam Province in 2015 (Ghaffari, unpubl. data).

There is some confusion concerning the possible occurrence of this species in Israel, although no direct evidence of its presence there exists. Following his observations in Tiberiade Lake (Tiberias, Kinnaret, Sea of Galilea), Lortet (1887) claimed that the species at this locality was *Trionyx triunguis*. However, Siebenrock (1913) considered that it was *Trionyx euphraticus*. Flower (1933) maintained that the softshells living in Tiberiade Lake differed from those observed in the eastern Mediterranean (i.e., from *Trionyx triunguis*). Haas (1951) tried to clarify this controversy by stating that it was unwise to accept Siebenrock's (1913) report, in that Siebenrock had been unaware of the presence of *T. triunguis* in the Palestinian coastal area. Adding to the confusion, Wermuth and Mertens (1961), Anderson (1979), and Obst (1985) included Israel in statements of the distribution of *R. euphraticus* without giving any locality details. There is no mention of *R. euphraticus* in Hoofien's (1967, 1972) checklists of Israeli reptiles, and Frankenberg and Werner (pers. comm.) are of the opinion that *R. euphraticus* is not present in Israel, and probably never was. On the other hand, during their observations on the Orontes of Israel (Nahr al-Asi) River in the Ghab valley, Kasparek and Kinzelbach (1992) twice observed a small softshell in a ditch near Ain Taga. They could not clearly identify the species, and stated that it could be *R. euphraticus*. However, *T. triunguis* is known to inhabit the Asi River (Orontes). Lambert (1981) mistakenly listed *Trionyx euphraticus* from Mediterranean coastal regions of Syria and Lebanon. Giebel's (1866) report of *R. euphraticus* from Bangha Island, northeast of Celebes Island in Indonesia, is certainly an error.

Figure 8. Fishing activity with nets in *Rafetus euphraticus* habitat, Siah-Mansoor River, Iran. Photo by Barbod Safaei-Mahroo.

We are of the opinion that softshells observed in the eastern Mediterranean, or in associated lagoons or estuaries, are almost certainly *T. triunguis*. The two species in question cannot be instantly differentiated in the field, although examination of specimens in hand, live or dead, may be adequate to distinguish the two using the persistent scapular fontanelles and the reduced eighth pleural bones of *euphraticus*. In addition, the adult/maximum size of the two species is very different, with adults of *T. triunguis* sometimes approaching 900 mm in total disc length.

Habitat and Ecology. — Little is known about habitat requirements and ecology of this cryptic softshell turtle. *Rafetus euphraticus* inhabits diverse freshwater habitats, including rivers, streams, ponds, lakes, reservoirs, marshlands, and even artificial canals in the vicinity of cities (Fig. 7). It occurs in relatively shallow, calm waters, typically adjacent to deeper, fast-flowing water. The basins of the Euphrates and Tigris are both extensive in area, and differ from each other in seasonal water content. Waterside vegetation of these rivers consists mainly of *Robinia*, *Salix,* and *Populus*. Aquatic vegetation includes various species of *Ranunculus*, *Typha*, *Juncus*, *Arum,* and *Bolboschenus* (Taskavak and Atatür 1996). Some *Nympha* species were also observed in Araban district of Gaziantep (Taskavak and Atatür 1998). Substrates of both rivers are generally blackish oily mud, but in some localities sandy, pebbly, rocky, muddy, or muddy-sandy substrates are present. In the Euphrates, where the currents are stronger, the softshells are rarely seen in the main channel; they prefer the relatively sluggish side-branches, shallow backwaters, or junctions with various tributaries. They can survive in small, temporary pools formed after spring floods. In the portion of the Tigris from Devegecidi Dam Lake to Cinar County of Diyarbakir, main channel currents are relatively much slower and the water temperature higher, so the turtles are more abundant in the main channel (Taskavak and Atatür 1996, 1998). However, juveniles prefer shallower (and thus warmer) portions of the system. Basking has been reported close to the water's edge, often on the muddy shores and also on grass and stone (Griehl 1981; Gramentz 1991). Ghaffari et al. (2014) noted the species prefers more hidden locations and mostly basks along vegetated shorelines, on top of *Phragmites australis* and on floating logs.

The species is primarily diurnal, although almost 30% of the Turkish specimens were caught during the night (Taskavak and Atatür 1996). While it has been stated that the species is more abundant (i.e., presumably more conspicuous or mobile) in autumn than in spring (Lortet 1883, 1887; Bodenheimer 1944; Basoglu and Baran 1977), in Turkey, apparent abundance was similar in the spring, summer, and autumn months. Local residents and fishermen claim that the turtle is not seen during the winter months (Taskavak and Atatür 1998). The inactivity of *R. euphraticus* in winter is understandable, taking into consideration the low mean ambient temperature of the season (average, 3–4°C in southeastern Anatolia and -8 to -10°C in eastern Anatolia in 2010–2014).

Home Range. — Ghaffari et al. (2014) conducted a radiotelemetry study of *R. euphraticus* at Karkheh in northwestern Khuzestan Province, Iran. The study in the meandering dam lake indicated that the mean linear home range size of the species was 2.54 ± 0.83 km, the mean minimum convex polygon size was 47.49 ± 23.36 ha, and the mean 95% kernel density estimator was 21.75 ± 9.44 ha, with a core area of 5.74 ± 2.87 ha.

Diet. — There is some controversy about the feeding habits of *R. euphraticus* in its natural habitat, with earlier literature indicating a more carnivorous diet. Ainsworth (1888) observed two or three Euphrates softshells feeding on the carcass of an antelope. In 1989 we observed a similar scenario with a horse carcass floating in the Euphrates. It is quite easy to attract Euphrates softshells by lowering porous nylon bags filled with fresh lamb blood into the water. Gramentz (1991) reported the presence of pigeon (*Columba livia*) fragments in the stomach of one individual. We were unable to identify any animal matter, excepting the bait meat, in gut contents of two individuals; but we observed barely recognizable plant material. However, two specimens were caught by using watermelon rinds as bait and another individual defecated a large amount of partly digested, but recognizable tomato skins and seeds (Taskavak 1992). Farmers cultivating fields along the Tigris 4–5 km north of Diyarbakir claim that their crops are continuously eaten and damaged by Euphrates softshells.

A feeding ecology study of *R. euphr*aticus in Iran using fecal analysis of 30 individuals from Looreh, Shahoor, Balarood, and Sabzab rivers and also Karkheh lake dam (Ghaffari et al. 2015) showed that food items included crabs, insects, birds, fish, plants, river-bed material, and

debris, but predominantly invertebrates (mainly crabs) and plants. Based on these results we concluded that *R. euphraticus* is an opportunistic omnivore that feeds on or near the river-bed. However, fishermen in Dezful County complain that Euphrates softshell turtles frequently take fish from their nets.

Nesting. — Reproductive biology and nesting behavior of *R. euphraticus* is poorly known (Biricik and Turğa 2011; Ghaffari et al. 2013). The work of Taskavak (1992) indicated that the northern limit of nesting by the species in Anatolia occurs at the northern sand banks at the Camdere-Euphrates junction in Gecitagzi of Hilvan county. In the same locality, broken shells of 17 eggs were found in May 1989. After the beginning of water retention by the Atatürk Dam (January 1989), the water level began to rise, forming a new lake and submerging previously utilized nesting sites. Similar suitable nesting sites at Kantar, Gecitbasi, and Igdeli were approximately 17 km northwest of Bozova. The sand banks at these localities were lost to the Atatürk Dam lake. It is still possible to observe nests and hatchlings south of the Atatürk Dam at Kirkiz and Nizip (Gramentz 1991). Further suitable nesting sites are at Saray, 2 km north of Birecik; Habes, at the junction of Karasu Creek and the Euphrates; and Belkiz banks and Kirkiz, 6 km north of Birecik (Gramentz 1991).

The nesting season usually extends from late April to early June (Lortet 1883; Basoglu and Baran 1977; Griehl 1981; Gramentz 1991; Ghaffari et al. 2013). Ghaffari et al. (2008) observed oviposition on 2 June 2005 in Iran. Ghaffari et al. (2013) stated that *R. euphraticus* hatchlings can emerge from their nest in early July in Iran. Biricik and Turğa (2011) described a single nest from the Tigris River in southeastern Anatolia discovered on 17 June 2009; the clutch consisted of 32 eggs with egg diameters of 29.47 ± 0.29 mm. The nesting season may extend into the second half of September in southern Turkey and females may lay more than one clutch in a season. The dominant vegetation in nest site areas in Iran includes *Typha domingensis, Populus euphratica, Tamarix* sp., *Ziziphus spinachriti,* and *Vitex pseudonegundo,* with a nest situated under *Tamarix* sp. and *Z. spinachriti* (Ghaffari et al. 2013). A reported nest from the Tigris River in southeastern Anatolia showed nest site vegetation to be predominantly *Tamarix* sp. and herbs growing on the alluvial sediments and a few trees of *Populus euphratica* and *Salix* sp. (Biricik and Turğa 2011).

Numerous claw and bite marks made by other turtles are frequently observed on the lateral and caudal margins of the soft carapace of both subadult and adult turtles, clear indication of the aggressive character of the species (Taskavak and Atatür 1998).

We know of no data on the internal or external parasites of the species or its natural predators. Possible egg and hatchling predators include jackals, wolves, foxes and dogs. Local farmers and fishermen are probably more harmful to the turtles than any wildlife.

Population Status. — No data are currently available on the population status of this species in Syria, Iraq, or Iran. The only data we have on population status are from investigations carried out in southeastern Anatolia in Turkey (Taskavak 1992).

The largest populations of *R. euphraticus* in the Euphrates system are not in the main stream channel, but rather in the more sluggish, shallow oxbows and tributaries. In such habitats 18 individuals were caught and a further 73 observed in a 6-day period during July 1989. In Kantar District, 11 specimens were observed in one hour on 25 July 1989.

Our observations in the Tigris system are mainly limited to an area about 50 km north to 140 km south of Diyarbakir, owing to the political instability in the region. Within this segment, the main river-bed of the Tigris is much narrower and the rate of flow much less than that of the Euphrates and the majority of our sightings are from the main channel. In a 4-day period, during July 1990, 4 specimens were caught and 26 observed in the Carikli Fabrika district (Taskavak and Atatür 1996, 1998).

The Euphrates River becomes progressively wider, but reduced in volume of flow, from north to south. It also has larger sand banks and large, sandy islets in its more southern regions, including the Syrian and Iraqi segments. These sites would appear to be excellent *R. euphraticus* nesting sites but we do not have any records from these regions. The Euphrates and Tigris Rivers coalesce and discharge into the Persian Gulf at Arvand Rud (Shatt al-Arab), a flat sandy to marshy region. Unfortunately, there are no records of *R. euphraticus* from the Arvand Rud itself. On the other hand, there are specimens in the BMNH from Basrah, Goosba, and Shul al-Arab (C. McCarthy, pers. comm.), and another specimen from the Karun River, which empties into the Arvand Rud (Tuck 1971, 1973). These records would suggest the possible presence of *R. euphraticus* in Arvand Rud. The records from Jarrahi River, Shadegan County, Iran (Mertens 1957; Anderson 1963, 1974, 1979), suggest that the species may be present in other rivers or streams emptying into the northern Persian Gulf.

Threats to Survival. — Anthropogenic fragmentation, alteration, and destruction of suitable habitat throughout its range are the main threats to *R. euphraticus*. In the northern part of its range, the Euphrates River is now dammed by the Atatürk and Karakaya dams. With the closure of the dam gates in 1989, Atatürk Dam Lake began to enlarge and progressively submerge sites suitable for nesting. During the summer of 1989, former nesting grounds were lost in Bozova and Hilvan Districts. After completion of the Atatürk Dam, two more dams, Birecik and Karkamis, were completed on the Euphrates. As a result, three dam reservoirs with surface areas of 817, 56, and 28 km^2, respectively, now occur on

the main Euphrates, creating three subpopulations of *R. euphraticus* that are isolated from each other. These dam reservoirs reach almost all the way up to the dam gates of the previous upstream dam. The new reservoir banks consist mainly of hard, rocky terrain, and suitable nesting areas for the turtles are very limited in size and almost impossible to use. Even if suitable substrates were to be found, the weekly, and even daily, fluctuations in the reservoir water level are likely to make survivorship of nests extremely low. Furthermore, the great volume of reservoir water will maintain a low temperature (the upper Euphrates system is fed by melting snows in spring). Thus, water released from the dam may significantly cool the river waters in more southern regions. In the summer of 1991, water temperature of the main Euphrates at Birecik was around 12°C (D. Gramentz, pers. comm.) while during the summer of 1988, before the reservoir lake formed, water temperature in the same locality was approximately 24–27°C (Taskavak 1992). All these conditions are endangering the survival and reproductive potential of *R. euphraticus* in these areas.

During the construction of the Atatürk dam, sand mining near the river lowered the sand levels in Samsat, Kantar and Gecitbasi districts so that these areas filled with water between 1989–1992. South of the dam area, in Saray District, close to Birecik, sand mining continues. In the vicinity of Girlavik Village, near the Turkish-Syrian border, filling of both banks of the river with gravel by contractors greatly disrupted the natural sandy banks, and some softshells were trapped in the resulting small ponds.

For the present, owing to a lack of industrial activities in the vicinity of the Euphrates, no discernible pollution is present in the Anatolian part of the river. Fishing is pursued by simple means such as line fishing or small nets. In the last decade, some freshwater fish farms were developed along the Euphrates River. The number of fishermen in the general area is small; inhabitants of southeastern Anatolia do not eat turtle meat, although it is favored by a small populace of Armenians in Diyarbakir (Taskavak 1992).

On the other hand, pollution is evident in portions of the Tigris studied, especially in Diyarbakir-Kale Alti District. It is caused mainly by domestic sewage, but the alcohol factory at Carikli Fabrika also releases its wastes directly into the river from time to time. In both localities adult softshells have frequently been observed, swimming and feeding among dead fish that have apparently been killed by these wastes (Taskavak 1992). No data are available on how the softshells may be affected.

In numerous tributaries of both the Euphrates and Tigris (Camdere, Zengecur Creek, Geldik Stream, Karasu, Bozatli Creek, Gullap Creek, etc.), water levels drop so low during the dry summer months, mainly due to high demand for water for irrigation of agricultural fields, that they dry out completely. Softshells entrapped in small pools at such localities are completely at the mercy of local people and of collapsing ecological conditions.

There is an extensive barbed wire barrier on the Euphrates at the Turkish-Syrian border, designed to prevent unauthorized passage of people. This barrier probably continues underwater. If so, it may prevent the free movement of adult Euphrates softshells between Turkey and Syria.

In Iran, six large dams (Dez and Karkheh dams in Andimeshk County, Masjed Soleyman and Shahid Abbaspour II dams in Masjed Soleiman County, Maroon dam in Behbahan, and Karoun III dam in Izeh County) and 41 smaller dams, have been constructed to generate hydroelectric power, provide flood control and supply irrigation water along the rivers of Khuzestan Province. This proliferation of dams has significantly fragmented *Rafetus* habitat. Furthermore, riverine habitats in Iran are severely affected by various water pollutants: fertilizers, oil leakage, and domestic and industrial waste products (Ghaffari et al. 2008). Another serious threat to *Rafetus* throughout its range in Iran is fishing, done by throw nets (Fig. 8), trawl nets, hooks, and illegal electro-fishing (Ghaffari et al. 2014).

Recently, the Chinese softshell, *Pelodiscus sinensis,* has been imported into Iran illegally and has the potential to become a competitor for *R. euphraticus* (Ghaffari et al. 2008). Fortunately, softshell turtles are not consumed by local people in Iran, but it is reported that Chinese employees of the National Iranian Oil Company consume turtles in the Hawr-al-Azim wetlands along the border of Iraq (Ghaffari et al. 2014).

In Iraq, various wars and political conflicts, drought, dam construction, unsustainable fishing methods, especially electro-fishing, the use of poisons and explosive materials are the main concerns for *Rafetus* survival. Furthermore, oil development, especially in southern Iraq and gravel mining in northern rivers threatens *R. euphraticus* populations (Nature Iraq 2016).

No information is available on threats to *R. euphraticus* in Syria, where it occupies territories under severe political unrest and turmoil.

Conservation Measures Taken. — *Rafetus euphraticus* was assessed as Endangered by the IUCN Red List of Threatened Species in 1996 (IUCN 2015). The IUCN/SSC Tortoise and Freshwater Turtle Specialist Group has categorized the species as Endangered based on a 2011 draft assessment (TTWG 2014). Throughout its distribution in Iran, the killing or capture of *Rafetus* is legally prohibited. Currently, Supreme Council for the Environment of Iran has legislated 50 million Rial (equal to US$ 1400) as a penalty for catching, capturing, or killing *R. euphraticus*. There is no evidence yet of international trade in the species but it was recently (October 2016) listed on CITES II (as *Rafetus* spp.) in conjunction with the CITES II listing of all African softshells (*Cyclanorbis* spp., *Cycloderma* spp.,

and *Trionyx* spp.) that are being increasingly impacted by unsustainable consumption and unregulated domestic and growing international trade.

The species occurs in the following protected areas in Iran: Dez National Park and Protected Area, Karkheh National Park and Protected Area, Hawr-Al-Azim Protected Area, and Shadegan Wildlife Refuge. In Turkey, the species occurs in Sanliurfa Birecik Euphrates Wildlife Enhancement Area. In Iraq, the species apparently occurs in the Central Marshes National Park, Sawa Lake, Hammar Marsh, Central Marshes and Hawizeh Marsh Ramsar Sites, and several Nature Reserves, such as Tharthar Lake.

Conservation Measures Proposed. —The monitoring of population size and trends of this species in each country and throughout its entire distribution should be a high priority. Since suitable habitat has been drastically decreased and fragmented, regional efforts will be required to conserve remaining populations where they still survive. Relevant governments should develop or modify their national laws for endangered species and *R. euphraticus* as per their listings on the IUCN Red List. The countries that have completed national legislation need to develop action plans for conservation of the Euphrates soft-shelled turtle without delay.

More precise and up-to-date data on distribution, population status, and breeding/nesting grounds are needed, especially in Syria, Iraq, and Iran. Field surveys in Syria are needed (when feasible and safe) to more precisely map the distribution of *R. euphraticus*. Participatory conservation projects for *R. euphraticus* such as the one undertaken in Khuzestan Province, Iran (Ghaffari et al. 2014), should be extended to other parts of the species' overall distribution.

The three isolated populations inhabiting the dam reservoirs of Atatürk, Birecik, and Karkamis need evaluation and possible management of their nesting sites. Possible suitable nesting grounds on the shores of these reservoirs (if any) need to be found and put under strict protection. If natural nesting grounds are absent, then some artificial means needs to be developed to help guarantee the future survival of these populations. Some practical means should also be found to minimize the periodic fluctuations of the water levels.

In southeastern Anatolia, where human populations are not dense, industry is also sparse. This strengthens the survival chances of the species in the region. However, the widespread habit of discharging every waste product, including domestic sewage, directly into the rivers is likely to lead to future problems. Even today, pollution levels are quite high in some slow-flowing segments of the Tigris. Effective public education programs are also needed to neutralize the enmity of the local people, especially fishermen, towards this turtle species.

Captive Husbandry. — Some of our adult specimens caught during the 1987–1990 period were kept in captivity in small tiled pools for 30–35 day periods and were fed with raw frog (*Rana*) meat, chopped beef and beef liver, watermelon, cucumbers and tomatoes (Taskavak 1992). A few captive juveniles and a subadult maintained in captivity by D. Gramentz (pers. comm.) were kept in different sized aquaria, with continuous filtration and a complete change of water every 3–4 weeks. Water temperature was regulated day and night at 24–25ºC and 27–29ºC, respectively. The juveniles were decidedly carnivorous and were fed meats of different *Salmo* species, earthworms, snails, tenebrionid larvae, various beetles, grasshoppers, butterfly larvae, chicken and turkey hearts, and beef. The only plant material they consumed were small pieces of orange and bananas.

Current Research. — The most recent research on *R. euphraticus* has included studies on genetic structure, habitat suitability, nesting, home range, habitat selection and anatomy (Biricik and Turğa 2011; Ghaffari et al. 2013, 2014; Ihlow et al. 2014; Ahranjani et al. 2016). A participatory conservation program in Dezful County, Khuzestan Province of Iran was initiated by Pars Herpetologists Institute NGO and sponsored by the Rufford Small Grants Foundation and the Global Environment Facility Small Grants Programme (SGP-Iran) of United Nations Development Programme. The project focused on local communities' education and public awareness regarding *R. euphraticus*; the first phase successfully finished in 2012 (Ihlow et al. 2014). The second phase of the project (Enhancing Community Participation in Euphrates Softshell Turtle Conservation) has extended to Shavoor and Shoosh counties, Khuzestan Province. The Department of Wildlife Management of Turkey Ministry is planning to start a public awareness project on Euphrates Softshell Turtle Conservation in Turkey (Burak Tatar, pers. comm.).

This account is based partly on the Ph.D. thesis of Ertan Taskavak (Ege University, Science Faculty, Dept. of Zoology, Izmir, Turkey), who continues his work on Anatolian populations of *R. euphraticus*. Hanyeh Ghaffari from Pars Herpetologists Institute, in collaboration with Amir Rostami from Faculty of Veterinary Medicine, University of Tehran, is currently performing feeding ecology studies with support of The Rufford Foundation and a study of internal parasites of *R. euphraticus* in Khuzestan, Iran. We are not aware of any current work in Syria or Iraq.

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