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Research Article

Observation and studying the morphometerical characteristics in Euphrates turtle

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Abstract

The Euphrates turtle, *Rafetus euphraticus*, is one of the least known aquatic species inhabited in northwest of Persian Gulf and Khuzestan province waters. To evaluate the morpho-meterical and biological characteristics of this species, 32 samples were captured from nearby populations of Khuzestan province through Balarood, Sakhiri, Dez, Gargar and Shatit rivers and the lagoons of Shadegan and Hoor-al-Azim of which 14 samples were used for morpho-meterical tests. The measured characteristics were sex determination, carapace curved length and width, plastron length and width, the length of cloaca, the length of tail, total weight, the ratio of plastron length/width, carapace length/width, plastron length/carapace length and cloaca length/plastron length. The maximum weight of the collected specimens was up to 20 kg and the sex ratio (males to females) was 1:0.7. Highly significant correlation was found between sex and some morphometerical characteristics such the ratio of carapace length/width which would be considered as an index in the situation that cloaca observation is impossible. More morphological and ecological studies are needed for better understanding about the species in Iran.

Keywords: Biological aspects, Morphometric, Euphrates turtle, Persian Gulf, River

Introduction

The southern border of distribution of Euphrates turtle, Rafetus euphraticus (Daudin 1801), is restricted to Khuzestan province in Iran. Tuck (1971,1973)reported the observation of this species in Karoon River, Jarrahi River (Anderson 1963, 1974, 1979). The species also might be found in other rivers in the north edge of the Persian Gulf (Metens 1957, Basoglu and Baran 1972, Anderson 1974, 1979). In addition, Karami *et al.* (2005) observed this species in the Karkheh River. Generally the main habitats of *R. euphraticus* are reported as Euphrates and Tigris basins, Hoor-al-Azim, Shadegan lagoons, Karoon, Karkheh, Dez and Jarrahi rivers and their branches. Biricik and Turga (2001) described the nest of this species along Tigris river in southeastern Anatolia region. Ghaffari *et al.* (2008) described habitat situation of the species in Khuzestan Province and reported that habitat destruction, pollution, and conflict with fisheries as the main threats to the survival of this species in Iran. Binh *et al.* (2010) studied the morphology and DNA analysis of other Rafetus species, *R. swinhoei*, R. *vietnamensis* and *R. euphraticus* living in northern Vietnam along the Song Hong, Song Ma and Song Da rivers. According to their

findings, skull characteristics were different among the studied species but phylogenetic analysis showed that the specimens form a unique group close to each other. In a recent study, the movement pattern and habitat selection of Euphrates turtle were studied in Karkheh Regulating Dam Lake in southwestern Iran (Ghaffari *et al.* 2014). The study showed that the turtle inhabits generally calm and shallow rivers, preferring tributaries and the shallow backwaters of main river channels and seasonal ponds and wetland. Habitat selection differs between adults and juveniles. Juveniles prefer puddles with higher water temperatures and abundant potential prays (Asadi Ahranjani *et al*. 2016). There is a lack of sufficient data from systematic studies on dead or living specimens. The main objective of this study was to assess morphometric and biological aspects of Euphrates turtle in the northwest of Persian Gulf (Khuzestan province waters) as the unique habitat for the species in Iran.

Materials and Methods

Sampling regions in Khuzestan province consisted of Balarood, Sakhiri, Dez, Gargar and Shatit rivers, and the lagoons of Shadegan and Hoor-al-Azim. Different fishing methods were applied such as net, electro-shocker and hooks. It was arranged with some active local fishermen to collect and deliver any observed turtles. A total of 32 specimens were collected and after carrying out all measurements, they were released to their natural habitats. The biological and morpho-meterical measurements consisted of sex determination by observing cloacae, carapace curved length (CL, cm) and curved width (CW, cm), plastron length (PL, cm), plastron width (PW, mm), cloaca length (TL1, mm), tail length (TL2, mm) and total weight (g). For better understanding the differences among the sampling points, the ratio of length/width of plastron, length/width of carapace, carapace length/plastron length, cloaca length/plastron length were calculated.

Feeding habit, oviposition nests and general behavioral habits of the species were observed and one autopsy case was conducted to find the detailed feeding habit. In case of finding any nest full of eggs, the mean diameter of eggs were measured.

According to the previous studies, the main measured data were used for statistical analysis (Jolicoeur and Mosimann 1960). All the collected data was analyzed using SPSS software version 22.0. Kolmogorov-Smirnov test was conducted to assess the normality of the measured data. As the samples were at different ages and weights, GLM analysis was conducted to estimate the relationships among measured variables in the format of the ratio of some characteristics such as plastron length/width, carapace length/width, carapace/plastron length and cloaca/plastron length based on weight for all the individuals at 95% confidence level. Correlation between different characteristics and sex was estimated by Pearson test for 14 individuals which the sex identification was possible.

Results and Discussion

General observations

The head of the Euphrates turtle were roughly wide and their short and thick beak-like snout were covered by fleshy lobes. The neck was long and elastic. All fingers of the front and back feet were covered by curtains except three inner fingers; with all feet posing claws. The carapace was circular or oval with yellow, cream or white spots. However, carapace in more mature animals lacked any specific mark, had few black spots, and felt leathery, soft, and delicate. In certain individuals, minor holes could be found in the vertebra of the spinal cords.

Sex determination

There were not any distinct characters between males and females for sex determination. Cloacae examination was employed as a mechanism to identify the sex by puffing the finger into the cloacae. Males were identified if a sexual organ or penis was detected; otherwise

the species was classified as female. In the juvenile Euphrates turtles, no apparent specifications could be found as an indication of sex which left no mechanism for identification in autopsy. The sex ratio was calculated M:F= 1.0: 0.7.

Feeding

As an endangered and protected species (IUCN 2017), there was any permission to do autopsies to analyze stomach contents for *R. euphraticus*. In one case, a dead turtle was found by the local fishermen. Fish pieces and plant materials such as watermelon rinds were found inside the stomach. As the Euphraes turtles were very shy and fearful, the feeding behavior could be rarely observed. Through the visit to Shadegan lagoon, one Euphrates turtle was seen carrying corpse of a chicken into the water.

Reproduction

Euphrates turtle oviposit in May under sands close to rivers. Number of eggs and fertility ratio were usually dependent on its size. Studying several random turtle nests at the banks of the Euphrates turtle and their empty egg shells showed that the turtle spawned over 4-5 eggs in each phase. The eggs were white circular with delicate and soft skin. The mean diameter of 12 eggs in different nests was calculated as 28.95 mm ± 2.73 mm.

Behavior

The Euphrates turtle was a very timid mammal that jumped into water to escape as the animal felt any closure within 30-40 cm. This species came out of water just for sunbathing and making nest in its reproduction season. During observation, the Euphrates turtle never strayed far from the river for safety against any danger or predators. The highest abundance of turtles was found around Gargar River (one of the minor branches of the Karoon River). Field observations indicated that there was no hibernation behavior for this species, as they were found year-round in the studied area.

Morpho-metrical analysis

A total of 32 specimens were collected during the survey. The largest specimen had 65cm length, 20kg weight, and found in Balaroud region around Dezfool city. The smallest specimen was found in Dez River (12.0cm and 225g) which would be a bony.

Table 1. Biometric measurements of different characteristics in Euphrate turtle in different sampling points of the studying area inside the Iranian borders. Animals weighed more than 5 kilograms were selected for mean estimation. All presented data are Mean ± SE mean.

river	Weight (kg)	Carapace Length (cm)	Carapace Width (cm)	Plastron Length (cm)	Plastron width (cm)	Tail (cm)	Cloak (cm)
Balarood	6.50	43.00	35.00	31.00	26.00	16.00	10.00
	20.00	65.00	47.00	44.00	40.00	30.00	25.50
Sakhiri	14.80	58.00	40.00	40.00	28.00	27.00	21.00
	10.00	50.00	38.00	36.00	24.00	22.00	16.00
	6.70	42.00	30.00	33.00	26.50	15.00	10.00
Gargar	7.50	43.50	33.00	33.00	30.00	19.00	17.00
	8.50	44.00	33.00	32.00	31.00	16.00	14.00
	6.00	35.00	28.00	25.50	26.50	13.50	12.50
	10.40	51.00	37.50	37.50	25.00	16.00	12.00
	14.40	57.00	41.00	42.00	27.00	22.00	17.00
	8.80	48.00	33.50	35.00	20.00	24.00	20.00
Dez	5.20	35.50	30.00	29.00	26.00	13.00	12.00
	10.10	52.00	36.00	36.00	34.50	24.00	21.00
	5.60	36.50	27.00	27.00	25.00	14.00	11.00

As measuring the morphological features were so difficult and would harm the bonies, so the morphological measurement were done on the specimens weighed more than 5 kg. Therefore only 14 individuals were used for morphometric analysis and the lightest individual in this group weighed 5.20 kg from Dez river and the heaviest individual weighed 20 kg from Balarood river. Data belonging to turtles weighed more than 5 kilograms were tabulated in Table 1 regarding different sampling points. As it can be seen most of the samples (6 samples of 14) were found in Gargar river which were at the similar weight.

Kolmogorov-Smirnov test results showed there was no significant differences among the collected data so the data distribution was considered as normal. General linear model (GLM) analysis based on weight, sex and sampling region showed significant relation between sex and the ratio of carapace length to width (F= 5.401, Sig.= 0.034, Table 2).

Table 2. The effective parameters on diversity of characters in Euphrate turtle. GLM analysis of different characteristics based on weight and sex.

Sources of variation	**Traits**	**F**	**Sig.**
Effect of Sex	Plastron L./W.	0.042	0.840
	Carapace L./W.	**5.401**	**0.034***
	Carapace L./Plastron L.	0.237	0.807
	Cloak L./ Plastron L.	0.738	0.633
	Cloak Length	3.091	0.098
Effect of Weight	Plastron L./W.	4.894	0.108
	Carapace L./W.	1.974	0.319
	Carapace L./Plastron L.	3.580	0.160
	Cloak L./ Plastron L.	1.184	0.519
	Cloak Length	25.62	0.011*
Effect of Region	Plastron L./W.	0.667	0.621
	Carapace L./W.	1.931	0.135
	Carapace L./Plastron L.	1.239	0.319
	Cloak L./ Plastron L.	1.554	0.215
	Cloak Length	**9.235**	**0.000****

This ratio could likely be suggested for sex determination. Cloaca length showed highly significant correlation to the sampling points, but as there was no significant difference in mean comparison test, explaining the obtained correlation needed more sampling animals.To determine the effect of sex on the ratio of carapace length to its width, Pearson correlation test was carried out and the results (Pearson correlation= -0.487, Sig= 0.035, Table 3) confirmed GLM model analysis. Also, the negative index showed that in female turtles, the carapace ratio could be less than males.

Discussion

The distribution pattern of the Euphrates turtle is not restricted to main rivers, their branches, minor rivers, or lagoons as they are even found in agricultural drainages. Some turtle specimens were found during mating season with fresh scars on their bodies, which could be the result of mating. In one of the observations, a male was mating on the back of a female and kept the female sessile by use of his tows and therefore it caused the scars on female carapace.

The Euphrates turtle is not found during the winter in Turkey region due to hibernation (Taskavak 1992, 1995, 1998). But this species was found in all seasons and suggesting no hibernation behavior in Iran.

The distribution pattern of this species in Iran is restricted to the Khouzestan Province as subtropical region and warmer area compared to Turkey Rivers. Biricik and Turga (2001) reported mean egg diameter as 29.47±0.9 mm and egg clutches with maximum 32 eggs along Tirgin river in Turkey. The species belongs to the family of Trionychidae. As species in this family are carnivorous (Palot and Radhakrishnan 2004). Taskavak and Atatur (1998) reported the feeding of R. euphraticus on horse corpses and also other food contents consisted of insects' larva, crustaceans, mollusks, amphibian and fish were found

amongst the stomach contents with few observations of herbs. The observation of pigeon particles form stomach contents of this species were reported by Gramentz (1991).

Taskavak (1992) observed two Euphrates turtle eating the water melon, and tomato was observed in their feces. Based on Taskavak (1995) the agricultural products and agricultural lands around Euphrates River in Diayarbakyr area were damaged due to Euphrates turtle. This species would feed on fish, chicken liver, invertebrates, young frogs, rats, meat and even some herbs such as water lemon, cucumber, tomato, banana and orange during captivity condition. In this study the feeding of turtle from chicken corpses was observed.

Amongst five specimens reported before (Ghaffari 2005), the maximum carapace length was 52 cm found from Dez River. This characteristic was measured 42.0-53.5 cm in Turkey region (Basoglu and Baran 1972). The sex ratio was calculated M:F= 1.0: 0.7; and there were no significant differences among measured parameters. Similar result was reported by Taskavak (1998). Also, the results showed that the spatial distribution didn't have any significant effect on the measured characteristics. But sex determination could be done by the ratio of carapace length to its width in all animals even the juveniles. Bigger animals weighed more than five kilograms showed highly significant correlation with the length of the carapace to its width. So this characteristic can be suggested for sex determination. Meanwhile, there is a need to present a mathematical model for sex determination by carapace length/width ratio which can be carried out in further studies by more morpho-meterical data.

Table 3. Correlation between different characteristics and parameters to obtain an index for sex determination. Data analysis was done for all the collected and observed animals even the juveniles.

	Plastron L./ Width.	Carapace L./ Width	sex	Carapace L./ Plastron L.	Cloak L./ Plastron L.	Cloak Length	Weight
Plastron L./ Width.	1	-0.037	-0.008	0.081	0.228	0.234	0.038
Carapace L./ Width.	-0.037	1	-0.487*	0.253	0.123	0.612**	0.714**
Sex	-0.008	**-0.487***	1	-0.121	-0.161	-0.330	-0.203
Carapace L./ Plastron L.	0.081	0.253	-0.121	1	0.110	0.505**	0.619**
Cloak L./ Plastron L.	0.228	0.123	-.161	0.110	1	0.583**	0.170
Cloak Length	0.234	0.612**	-0.330	0.505**	0.583**	1	0.776**
Weight	0.038	0.714**	-0.203	0.619**	0.170	0.776**	1

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