

## Population estimation of the Euphrates softshell turtle *Rafetus Euphraticus* in the Central Marshes (UNESCO site)

Samer Ammar Taher\*  , Hind Suhail Abdulhay  

Department of Biology, College of Science, University of Baghdad, Baghdad, Iraq.

\*Corresponding Author.

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### Abstract

The Euphrates softshell turtle *Rafetus euphraticus* was classified as Endangered species on the IUCN Red List and is thought to have undergone large, recent population declines. Species information in Iraq is limited to a few rapid surveys with little detailed information on breeding and distribution. The study aimed to estimate the population of *R. euphraticus* in the Central Marshes using simple extrapolation of the count. Quadrature methodology 5 km<sup>2</sup> size each was used to record the distribution of Euphrates softshell turtles within the study site and ten surveys were carried out from October 2021 to September 2022 except for the hibernation season (December, January and February). Turtles were recorded inside the water by setting nets in certain areas in the Central Marshes. Simple extrapolation of our counts to the entire Central Marshes suggested a maximum population size of 2526.55 individuals/ total area (219,700 ha). The Central Marshes is an important site for *R. euphraticus* as a total of 46 individuals were recorded.

**Keywords:** Central Marshes, Euphrates softshell turtle, Estimate the population, population, *Rafetus euphraticus*.

### Introduction



**Figure 1.** The olive-green leathery skin that covers the carapace distinguishes the species.

*Rafetus euphraticus* (Daudin, 1801) known as the Euphrates softshell turtle is a species of the Trionychidae family Fig. 1, is an enigmatic and highly aquatic trionychid distributed in Euphrates and Tigris rivers and their tributaries in Iraq, Syria, Turkey, and Iran<sup>1-3</sup>. The Euphrates softshell turtle *R. euphraticus* is listed on the IUCN Red as Endangered species and is thought to have undergone a large, recent population decline in Iraq<sup>4</sup>. Although Iraq is expected to hold the biggest number of appropriate places for the Euphrates softshell turtle because it has suitable habitats for living and thriving<sup>5</sup>, there is a gap in information inside Iraq on this species<sup>6</sup>. The first published observations in Iraq (after anecdotal records in the 1960s) were in 1992 from the Euphrates River<sup>7</sup>. The species was subsequently recorded in Iraq from 2005 onwards during KBA (Key Biodiversity Area) surveys in nineteen sites all over Iraq; Two in Kurdistan area and Mosel<sup>6</sup>; eight in the central portion of Iraq and nine in the south<sup>5</sup>.

However, these surveys were rapid and more intensive surveys at finer spatial scales are needed to obtain a more accurate understanding of the species, distribution and conservation status<sup>8</sup>. The Central Marsh in southern Iraq is the focus of our research because it's been recognized as a potential stronghold for the species because of its ecological suitability<sup>5</sup>. As a result of the Tigris-Euphrates river complex, the Central Marsh is one of the three main wetlands in Iraq. The Central Marsh formerly covered around 300,000 hectares but was almost totally drained

following the 1991 uprisings in Iraq and has since been reflooded in 2003 – 2004<sup>9</sup>. While the Central Marsh is Iraq's first national park officially recognized as Mesopotamian National Park in July 2013<sup>10</sup>. The biggest dangers to the turtle's existence, according to studies from Iran and Turkey, are habitat alteration, water pollution, and persecution by fishermen. This may also be true in the Central Marshes<sup>11,4</sup>. Also, because thorough studies have not yet been conducted in the region, it is unknown whether the softshell turtle confronts comparable concerns in the Central Marshes. The ecology of the turtle's reproduction and conservation in the Central Marshes is also little understood. For example, the research site is expected to see a rise in human activity due to the adjacent Chibayish city's growing population, while animals might suffer due to the Euphrates River's water shortage. Knowing how the turtle is distributed with respect to risks and if its nesting grounds are exposed to such threats might aid in the conservation of the species and the development of a population that is able to withstand such challenges in the future<sup>8</sup>.

The Central Marshes in southern Iraq seem to be ecologically and climatically important for *R. euphraticus*; yet is little known about its population. Therefore, this study was conducted to add further knowledge to the biodiversity of the southern Iraqi marshes in a special case. This study aimed to Estimate the population of *R. euphraticus* in the Central Marshes using simple extrapolation of count.

## Materials and Methods

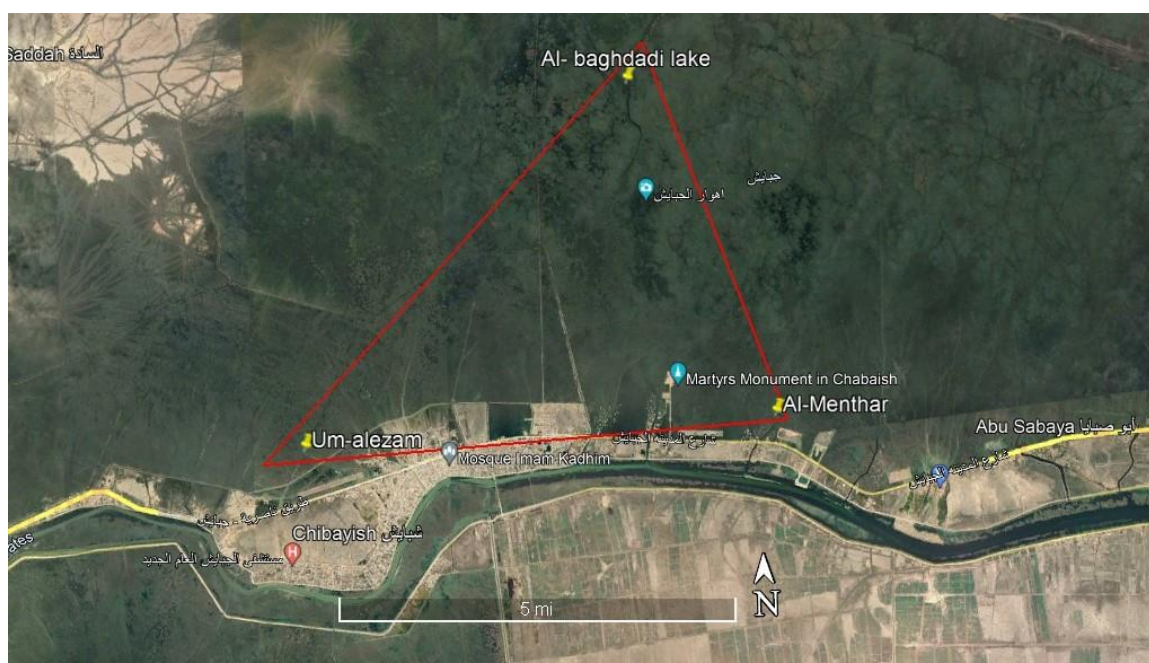
### The study area:

Central Marsh is one of the most important wetlands/ecosystems in the south of Iraq. The Central Marshes is an Important Birds Area (IBA), Key Biodiversity Area (KBA), and the first national park in Iraq<sup>12</sup>. is a vast complex of permanent freshwater wetlands, semi-desert arid lands, and scrublands of the Central Marshes encompasses the geographical zone (31°11'N 46°59'E) that extends between Thi-Qar (Nassiriyah) and Mayssan (Emara) provinces<sup>13</sup>. The total area size of the Central Marshes is 219,700 ha (2197km<sup>2</sup>)<sup>14</sup>. The surveying plot's 4000 ha (40 km<sup>2</sup>) research area is located inside

the Central Marshes. With an elevation of fewer than 6 meters, the Central Marshes are located in the Tigris-Euphrates Alluvial Salt Marsh Ecoregion. The Tigris and Euphrates rivers provide water for Central Marshes, and these rivers' tributaries create huge wetlands with open freshwater lakes that are mostly covered with *Typha* species and common reed *P. australis* vegetation. One of the biggest marshes in the province of Thi-Qar is called Al-Chibayish (Central Marshes), and it is located south of the Tigris River which continues to pass through the Mayssan governorate. The Al-Bitera, Al-Majer Al-Kabeer Rivers and Al-Areedh, these branches are

located on the right side of Tigris River. Euphrates River is situated between Sook Al-Sheyukh and Al-Qurna marshes on the southern side of the Central Marshes. During flood seasons, the Central Marshes' wet area is around 3000 km<sup>2</sup>. The Central Marshes are connected to the Euphrates River by 12 outlets acting as culverts (Al-Soora, Al-Jala'a, Kahala, Al-Badreea, Al-Sana'a, Abu gedaea'a, Alkhenzeeri, Al-Sabagheea, Hadsa, Abu Juelana, Abu Al-Narsee, Abu Sobaat). When the Euphrates River has a greater water level than the southern portion of the marshes,

these outflows also serve as feeders for the marshes<sup>15</sup>. The complicated feeding system of the Al-Chibayish marshes results from the fact that many outlets in the southern part occasionally serve as feeders from the Euphrates River to the marshes. Additionally, Abu-Ziriq marsh plays a significant role in the marshes' feeding system, so its outlets are also thought of as feeders of the Al-Chibayish marshes. The three sites were chosen in this study Fig. 2.



**Figure 2. Sampling sites in Al-Chibayish marshes, including 3 sites: Abo-Sobat, Al-Baghdadi, and Um-Alezam. google earth pro (2022).**

#### The first site:

Located in the south of the Central Marshes in an area called the Al-Menthar, it is characterized by a narrow water passage, and it has some big patches of water it's used by the local marsh dwellers for fishing. The resident plants are *Cyperus* sp., *Typha domingensis* and *P. australis*. There is a fishing activity in this area. The water level is 210 cm, and this site is located at a longitude of 47° 2'57.64"E and a latitude 30°58'17.51"N.

#### The second site:

Located in the middle of the Central Marshes in an area called the AL-Baghdadi Lake, it is characterized

by an open and shallow water area, existing growth of submerged aquatic plants such as *Ceratophyllum demersum*, *Potamogeton pectinates*, *Vallisneria spiralis*. Also, there are prominent plants such as *Cyperus longus* and *Typha domingensis*. There is a fishing activity with a small flock of buffaloes. Since this point is located in the middle of the Central Marshes, this area is affected by water quality coming from Tigris and Euphrates rivers. The water level is 130 cm, this site is located on longitude 47° 2'5.65"E and latitude 31° 2'0.60"N.

#### The third site:

Located in the west of the Central Marshes in an area called the Um-Aleizam, it is characterized by a

narrow water passage and this site is fairly close to an Al-Chibayish city, it is considered the first site affected by the quality of water coming from the Euphrates River in the case of high discharge. The resident plants the *Cyperus* sp., *T. domingensis* and *P. australis*. There is a fishing activity in this area. Since this point is located in the west of the Central Marshes, this area is affected by water quality coming from Euphrates rivers. The water level is 130 cm and some portions of this area reach more than 400 cm. This site is located at a longitude of 47° 2'48.79"E and latitude of 31° 2'6.03"N.

### Euphrates softshell turtle sampling:

#### Netting:

This technique (below) is recommended for sampling aquatic reptiles. It can provide an accurate indicator of the presence or absence of species at the most fundamental level and can contribute to estimations of relative abundance and absolute density<sup>16</sup>. The Euphrates softshell turtles (*Rafetus euphraticus*) were captured from the Central Marshes by a 200 x 2m seine net of mesh size 10 cm<sup>2</sup> and a fishing net with the same size<sup>16</sup>. Capturing samples was conducted for 2 to 3 days from each month from October 14, 2021, to September 17, 2022, except for the hibernation season (December, and January, and February). For all studied sites, the net was installed at about 5 A.M and collecting the net at approximately 5 P.M. Fishing nets were used instead of submerged traps because this equipment it's not available and the fishing nets provide good efficiency in our survey. In addition, recorded some observations of turtles during the study but the distance or angle of observation was not recorded. Ironic ruler tape was used to know the ages of the turtles. Animals that were sexually immature and had a carapace length of less than 250 mm were classified as subadults, while those with a carapace length of less than 110 mm were classified as juveniles<sup>11</sup>.

#### Quadrats:

It is used for counting species that are relatively stationary. Primarily to determine the relative abundance of different species present in an area, but with multiple repetitions of the method, it can also be used to determine the absolute density of species. More suitable for baseline surveys, but also

applicable for long-term monitoring<sup>14</sup>. During the 2021-2022 field quadrats survey conducted to detect Euphrates softshell turtles in the Central Marshes. The quadrats are taken fixed across the Central Marshes. The quadrats were conducted in three random sites every month to provide a representative sample of the Central Marshes. A total of three distanced quadrats (5 km<sup>2</sup> size each) were identified and driven by motorboat (Marsh Arab canoe) covering 40,000 ha survey plot in the study area within the Central Marshes. Quadrat I (Q1): Al-Menthar (30°58'17.8"N 47°02'58.7"E) located in the east part of the Central Marshes. Quadrat 2 (Q2): AL-Baghdadi Lake (31° 0'12.90"N 47° 0'19.25"E) located in the middle part Of the Central Marshes. Quadrat 3 (Q3): Um-Alezam (30°57'53.1"N 46°58'01.5"E) located in the western part of the Central Marshes.

#### Data analysis:

Extrapolation is a general term used throughout this manual referring to the concept that if you are able to sample part of a population specifically, you can assume that this information can be extended to cover the rest of the population. Samples will often take many different forms, but in the end, the data will usually be extrapolated to estimate the population for a much greater area<sup>16</sup>. The calculation we need to do to extrapolate is usually one to determine density per unit area. Once we have surveyed a number of sample locations across the study area, the study can determine the relative density at each of the sample locations. This is done with the following simple<sup>16</sup>, Eq. 1: Density= $n_i/A_i$ .....1

$n_i$  : The number of individuals observed at the sample location.  $A_i$  : The area of the sample location. To determine the population of the entire study area, the study worked under the assumption that the density of the entire study area is an average of the densities of all the sample locations. The recent study should first determine the average density using the following Eq. 2<sup>16</sup> : Average Density =  $\sum n_i / \sum A_i$ .....2

$\sum n_i$  : The total number of individuals observed at all the sample locations.  $\sum A_i$  : The total area of all the sample locations. To determine the number of

individuals in the total area, we use the following Eq. 3<sup>16</sup>,

$$n_T = A_T * \sum n_i / \sum A_i \dots \dots \dots 3$$

$n_T$ : The total number of individuals in the entire study area.  $A_T$ : The total area of the entire study area.

## Results and Discussion

### The presence of *Rafetus euphraticus*:

During the field surveys, 46 turtles were observed (Table 1). Sexes were not determined because there wasn't sexual dimorphism in size existing in the family Trionychidae<sup>11</sup>. 41 were captured alive and 5 were found dead. Records of the Euphrates softshell turtle *Rafetus euphraticus* varied between the 12 months surveyed Turtles outside and inside the water were recorded in only 10 of the 12 surveys. Most records came from May, June, July, August, and September surveys as the following: Four adult turtles were found in October, one adult in site 1, two adults in site 2 and one adult in site 3. Two adults, one of them dead, were found during November in sites 1 and 2 but no turtles were found from December to February. One adult was recorded in March in site 1. One adult in site 2 during April 2022. Four adults in May were found in site 3 but one was dead. In June the survey conducted one dead adult, two subadults and one juvenile was found at site 2, and one adult at site 3. Three adults were seen in site 3; one of them was found dead, while one subadult and two juveniles (one of them was dead) were in July. Sixteen adults and one subadult were recorded in site 3 during August. Six adults were recorded in site 3 during September. All records gave us 41 alive and 5 dead turtles. The current study showed that the highest number of turtles was recorded in August 2022 which was 17 in site 3. This may be due to the

scarcity of water in other sites, which encourages the turtle to leave their place and search for new habitats. Also, Water and air temperature are the important factors that affect turtles in terms of the life cycle, activities, and hibernation. The summer season has the greatest temperature, and the winter season has the lowest<sup>17</sup>. That was supported by several studies, noting water temperature followed by air temperature<sup>18</sup>. Decreasing temperature leads the turtle to winter hibernation by burying themselves in mud to maintain their body temperature. When the temperature rises, the turtle becomes active and returns to their activities<sup>19</sup>. Hibernation begins in November at the beginning of winter and ends with spring in March. At the beginning of the survey we observed and captured the turtles in site 1 and site 2 from October 2021 to April 2022 (except during hibernation season) than in site 3, which may be due to these sites having a good condition (water quality, abundance of water, richness of food) to live and thrived more than site 3 (Table 1) but, most specimens were observed and captured in site 3 from May 2022 to September 2022, demonstrating the good condition of this habitat in this period in comparison with other habitats in the Central Marshes. The other two sites were affected by water scarcity, which lead to a change in water quality and subsequently a decrease in food abundance, these conditions led the turtle to leave their sites and move to another site<sup>20</sup> (Table 1).

**Table 1. Number of *Rafetus euphraticus* in the Central Marshes (October 2021 -September 2022).**

The number of <i>Rafetus euphraticus</i>			
Months	Site 1	Site 2	Site 3
October	1	2	1
November	1	1	0
February	0	0	0
March	1	0	0
April	0	1	0
May	0	0	4
June	0	4	1
July	0	3	3
August	0	0	17
September	0	0	6
<b>Total number of <i>Rafetus euphraticus</i> for each site</b>	<b>3</b>	<b>11</b>	<b>32</b>
<b>Total number of <i>Rafetus euphraticus</i></b>	<b>46</b>		

### Population estimation of the recorded *Rafetus euphraticus* in the Central Marshes:

Previous work in Iraq recorded *R. euphraticus* in 28 sites along the Tigris and Euphrates rivers and their branches and tributaries. Between 2005 and 2010, *R. euphraticus* was discovered at 19 key biological areas (KBA) sites in Iraq, covering a total of

1,231,444 ha <sup>5</sup>, and there have been 55 individual records of the *R. euphraticus* in the Euphrates river from Faloja to Hammar Marsh (about 400 km) in 1992 <sup>7</sup>. Further survey in the Central Marshes recorded the *R. euphraticus* in four transects between 2014 – 2015 (an area of 219,700 ha), with the maximum estimated population size of 212-283 individual records <sup>8</sup>.

**Table 2. Species densities and estimated population size of *Rafetus euphraticus* recorded in the Central Marshes (2021-2022).**

<b>The density of <i>Rafetus euphraticus</i></b>			
<b>Months</b>	<b>Site 1</b>	<b>Site 2</b>	<b>Site 3</b>
<b>October</b>	0.002	0.004	0.002
<b>November</b>	0.002	0.002	-
<b>February</b>	-	-	-
<b>March</b>	0.002	-	-
<b>April</b>	-	0.002	-
<b>May</b>	-	-	0.008
<b>June</b>	-	0.008	0.002
<b>July</b>	-	0.006	0.006
<b>August</b>	-	-	0.034
<b>September</b>	-	-	0.0012
<b>Total density of <i>Rafetus euphraticus</i> for each site</b>	0.006	0.022	0.064
<b>Total density of <i>Rafetus euphraticus</i> for whole study area.</b>	0.0115 (individual/ha)		
<b>Estimated population of <i>Rafetus euphraticus</i> for the Central Marshes.</b>	2526.55 (individuals/ total area)		

This study was designed to be the first to estimate the total number of *R. euphraticus* inside and outside of water in the Central Marshes and suggests that the Central Marshes could be an important site for the softshell turtle in Iraq. The maximum estimated population size was 2526.55 individuals/total area and 0.0115 individuals /ha based on 46 observations for 10 months (Table 2). Given this result, prioritizing the Central Marshes for future conservation of soft-shelled turtle in Iraq is recommended. (Table 2) shows the turtles density in our study fluctuated across monthly surveys and seasons: the maximum density was observed during May, June, July, August, and September (the end of spring to the beginning of autumn), while there were no data during the winter hibernation season. The maximum population size (based on simple extrapolation) likely to be sustained by the Central Marshes is 2526.55 individuals/total area. The

survey in site 3 contained the largest density of turtles (Table 2). This area is characterized by open water with dominant vegetation including *Typha domingensis* and *Phragmites australis*, with frequent records of the invasive fish species *Tilapia zilli* <sup>5</sup>.

There are some differences between the previous and current study that was conducted in the Central Marshes. The previous study included the turtle outside of water while the current study included turtles inside and outside the water and was conducted using nets for longer periods than the previous study to estimate the number of turtles in the Central Marshes, may be the reason for differences between the studies in the population size as the current study record 2526.55 individual/total area, while the previous study reported that 212-283 individual/total area)<sup>8</sup>.

## Conclusion

With an estimated population size of 2526.55 individuals/total area and 0.0115 individuals/ha based on 46 observations over a 10-month period, the Central Marshes is a significant location for *R.*

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## Authors' Declaration

- Conflicts of Interest: None.
- We hereby confirm that all the Figures and Tables in the manuscript are ours. Furthermore, any Figures and images, that are not ours, have been

## Authors' Contribution Statement

S.A. contributed to the design, analysis, interpretation, drafting, and writing of the

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*euphraticus*. Given this result, the Central Marshes will get priority for future soft-shelled turtle conservation in Iraq.

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- included with the necessary permission for re-publication, which is attached to the manuscript.
- Ethical Clearance: The project was approved by the local ethical committee in University of Baghdad.

manuscript. H.S. contributed to the revision and proofreading the manuscript (supervisor).

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## تقدير اعداد المجاميع السكانية لترسة الفرات ملساء الصدفة *Rafetus euphraticus* في الاهوار الوسطى ( موقع تراث عالمي)

سامر عمار طاهر، هند سهيل عبدالحى

قسم علوم الحياة، كلية العلوم، جامعة بغداد، بغداد، العراق.

### الخلاصة

تم تصنيف ترسة الفرات ملساء الصدفة *Rafetus euphraticus* على أنها مهددة بخطر الانقراض ضمن القائمة الحمراء للاتحاد الدولي لحفظ الطبيعة، ويُعتقد أنها تعرضت لانخفاض كبير في أعدادها مؤخرًا. تقتصر معلومات الأنواع في العراق على عدد قليل من المسوحات السريعة مع القليل من المعلومات التفصيلية عن التربيعة والتوزيع. هدفت الدراسة الى تقدير اعداد سلاحف الفرات ملساء الصدفة في الأهوار الوسطى باستخدام استقراء بسيط للعدد. تم استخدام طريقة المربع (بحجم 5 كم<sup>2</sup> لكل منهما) لتسجيل توزيع سلاحفة الفرات ملساء الصدفة داخل موقع الدراسة وتم إجراء عشرة مسوحات ابتداءً من شهر تشرين الاول 2021 إلى ايلول 2022 باستثناء موسم السبات (كانون الاول وكانون الثانيو شباط). تم تسجيلها داخل المياه عن طريق وضع الشباك في مناطق معينة بالأهوار الوسطى. اقترح الاستقراء البسيط لتعداداتنا لكامل الأهوار الوسطى أن يبلغ الحد الأقصى لحجم المجاميع السكانية 2526.55 فردًا /المساحة الكلية ( 219.700 هكتار). تعتبر الأهوار الوسطى موقعًا مهمًا لـ *R. euphraticus* حيث تم تسجيل إجمالي 46 فردًا.

**الكلمات المفتاحية:** الاهوار الوسطى، سلاحفة الفرات ملساء الصدفة، تقدير عدد السكان، عدد السكان، *Rafetus euphraticus*.