Migration pattern and wintering population of the Eurasian marsh harrier (*Circus aeruginosus*) in the Central Marshes, a wetland of international importance in southern Iraq

Charakter migrácie a zimujúca populácia kane močiarnej (*Circus aeruginosus*) v Centrálnych močiaroch, mokradi medzinárodného významu v južnom Iraku

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**Abstract:** There is scarce information on the migration patterns and population size of the Eurasian marsh harrier (*Circus aeruginosus*) in Iraq in general and in the southern Mesopotamian wetlands in particular. From February 2018–April 2019, a total of 11 field expeditions were conducted in the Central Marshes (219,700 ha), one of the major Mesopotamian wetlands and Iraq’s National Park, a Ramsar and UNESCO site. Two of the field survey objectives were to determine the spatial and temporal distribution and estimate the population size of the migratory/wintering Eurasian marsh harrier in the Central Marshes. Distance sampling on three line-transects covering a study plot of 40,000 ha was conducted. Among other wintering *Circus* harriers, the Eurasian marsh harrier was the most abundant species with a total of 93 individuals recorded. The estimated species densities were 0.0042–0.035 individuals/ha, and the estimated size of the Eurasian marsh harrier migratory population in the Central Marshes was 922.7–7689.5 individuals. Moreover, the migration phenology and breeding status of the Eurasian marsh harrier in the Central Marshes were investigated. Our efforts did not confirm the breeding of this species during recent years, or since the inundation of the Mesopotamian wetlands in 2003. Furthermore, hunting and trapping were identified as major threats affecting the species which need urgent conservation action.

**Abstrakt:** O charaktere migrácie a veľkosti populácie kane močiarnej (*Circus aeruginosus*) všeobecne v Iraku a obzvlášť v mokradiach južnej Mezopotámie je málo informácií. Od februára 2018 do apríla 2019 sa v Centrálnych močiaroch (219 700 ha), jednej z najvýznamnejších mokradi Mezopotámie, Ramsarskej lokalite a lokalite Svetového dedičstva UNESCO, uskutočnilo 11 expedícií. Jedným z cieľov terénneho prieskumu bolo určiť priestorovú a časovú distribúciu a veľkosť populácie migrujúcej/zimujúcej kane močiarnej v Centrálnych močiaroch. Distančné vzorkovanie sa uskutočnilo na troch transektoch pokrývajúcich plochu 40 000 ha. Kaňa močiarna s 93 zaznamenanými jedincami bola najpočetnejšou zo zimujúcich kaní (*Circus*). Hustota druhu bola odhadnutá na 0,0042 – 0,035 jedincov/ha a veľkosť migrujúcej populácie kane močiarnej v Centrálnych močiaroch bola odhadnutá na 922,7 – 7689,5 jedincov. V príspevku tiež diskutujeme migráciu a hniezdenie kane močiarnej na študovanom území. Nás výskum nepotvrdil súčasné hniezdnenie tohto druhu na území a ani od zaplavenia mezopotámských mokradi v roku 2003. Ako najváčšie hrozby pre druh tu boli identifikované lov a chytanie do pascí, čo vyžaduje neodkladné ochranárske opatrenia.

**Key words:** avifauna, Mesopotamian wetlands, population, protected areas, raptor, density.

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**Introduction**
The Eurasian marsh harrier (*Circus aeruginosus*) is a long-distance migrant raptor, moving on a broad front and using a leap-frog migration pattern (Bildstein 2006, Panuccio et al. 2013a, Polakowski et al. 2014). Its zoogeographical range extends from western Europe...
(Fennoscandia south to the Iberian Peninsula), east to Central Asia (Baikal), Asia Minor and Mongolia, and into northern Africa. It winters in southern Europe, sub-Saharan Africa (few cross the equator), and in the Indian subcontinent (GRIN 2019).

In the western Palearctic there are two main known routes for migratory raptors (Bildstein & Zalles 2005, Bildstein 2006). These are the Western European-West African (Atlantic) flyway, where raptors migrate from Scandinavia through western Europe to Spain, and the West African and Eurasian-East African (western Black Sea) flyway, which leads from north-eastern Europe and western Siberia, passes through the Middle East and ends in sub-Saharan Africa (Shirihai & Christie 1992, Shirihai et al. 2000, Bildstein 2006, Meyburg et al. 2017, Fülöp et al. 2018). However, Marsh harriers originating from north-eastern European populations and migrating south-west along the southern Baltic Sea coastline are assumed to make a strong contribution to the Western European-West African flyway (Panuccio et al. 2013b, Polakowski et al. 2014).

During autumn and spring, large numbers of migratory raptors pass along the major flyways, avoiding large water bodies or high mountain chains, and become concentrated at just a few bottleneck sites around the Mediterranean Sea, Black Sea and Red Sea (Verhelst et al. 2011). The main bottleneck sites on the Western European-West African flyway are situated in Sweden, Spain, and Italy (Porter & Beaman 1985, Kjellén 1992, Kjellén & Roos 2000, Bildstein 2006, Polakowski et al. 2014), while those on the Eurasian-East African flyway are in Romania, Bulgaria, Greece, Georgia, Turkey, and Israel (Porter and Beaman 1985, Shirihai & Christie 1992, Shirihai et al. 2000, Bildstein 2006, Ullman & Ullman 2010, Michev et al. 2011, Panuccio et al. 2011, Verhelst et al. 2011, Fülöp et al. 2018, Panuccio et al. 2018).

In autumn, raptors originating from the eastern part of the western Palearctic arrive in the Middle East via two major routes. The first follows both sides of the Black Sea and northern Caspian Sea area, bypassing the eastern Mediterranean Sea and the northern Red Sea, and move through Levant/Israel using the North Negev and Dead Sea-Kfar Kasem-Eliat-Suez route towards Sinai (Porter & Beaman 1985, Shirihai & Christie 1992, Shirihai et al. 2000, Verhelst et al. 2011, Fülöp et al. 2018). The second major route involves mostly the eastern and some western populations following the south-eastern side of the Caspian Sea and crossing the north-eastern Arabian Peninsula, the Arabian Gulf via the Hormuz Straits, and the southern Red Sea via the Bab-el-Mandeb Straits between Yemen and Djibouti (Shirihai & Christie 1992, Shirihai et al. 2000, Ullman & Ullman 2010, Panuccio et al. 2018).

The Mesopotamian marshes (Ahwar) are large open freshwater wetlands occupying the Tigris and Euphrates river basin. The estimated total area of the Iraqi marshes is 900,000–2,000,000 ha covering the alluvial plain of the Arabian Gulf delta in southern Iraq (Haba et al. 2017). The Mesopotamian marshes consist of three major core wetlands, which are the Central Marshes, Hammar Marsh (Haur Al-Hammam), and Hawizreh Marsh (Haur Al-Hawizheh) (Al-Mansori 2008). In the 1990s the Mesopotamian wetlands of southern Iraq faced massive habitat destruction after they were almost drained following the uprisings in Iraq in 1991, although they were subsequently re-flooded in 2003–2004 (Richardson et al. 2005, Al-Sheikhly & Nader 2013).

One of the major Mesopotamian wetlands is the Central Marshes, a vast complex of permanent freshwater wetlands extending along the geographical zone (30°50' N–31°30' N and 46°45' E–47°25' E) between ThiQar (Nassiriyah), Mayssan (Emara), and Basra provinces, and covering a total area of 219,700 ha (Evans 1994, RSIS 2019). The Abu Zirig marshes (Haur Abu Zirig) form the north-western part of the Central Marshes, the Al-Chebaeish (Al-Chabaish, Al-Chibaish) marshes make up the central part, while Lake Zichri occupies the eastern part. The Central Marshes have been identified as an Important Bird Area (IBA038), a wetland of International Importance, and as a Key Biodiversity Area (KBA) site (Carp 1980, Evans 1994, Nature Iraq 2017). Due to their ecological significance, the Central Marshes were declared Iraq’s first National Park (Mesopotamian National Park MNP), a RAMSAR site, and a United Nations Educational, Scientific and Cultural Organization (UNESCO) site (IMOE 2014, Pearce 2014, UNESCO 2016, RSIS 2019).

Iraq is one of the range countries for many migratory raptors en route to their wintering grounds in Arabia and Africa, however, raptor migration in the Mesopotamian wetlands of southern Iraq has not been fully investigated (Al-Sheikhly et al. 2017). Besides other hen (C. cyan-eus), pallid (C. macrourus), and Montagu’s (C. pygar-gus) harriers wintering in the Mesopotamian wetlands, the Eurasian marsh harrier is the most abundant and predominant raptor species (Scott 1995, Abed 2007, Fazaa et al. 2017). It is a Least Concern species (Birdlife International 2019) which has been regarded as a local breeding resident in the southern marshes and possibly...
in the wetlands of central Iraq as well, it is also a passage migrant and winter visitor (Salim et al. 2012). In the past, it was abundant in the Euphrates marshes, at Hammr Lake, and in the marshes near Basra, where it bred (Ticehurst et al. 1922). It was common to the Suweicha marsh in Kut and in the plains between Suweida and Chabbab on the north bank of the Tigris River (Al­louse 1960, Moor & Boswell 1965). It was the most abundant raptor in Haur Al­Hammar and adjacent areas and at Haur Uwainah and along the Nasiriya-Kut road, where a total of 286 harriers were observed during a mid-winter survey in 1979 (Scott & Carp 1982). The Eurasian marsh harrier has been recorded at many sites around the geographical zone of the Mesopotamian marshes. A total of 73 marsh harriers were recorded during very incomplete surveys in January 1968, December 1972 and January 1979 (Scott 1995). However, information on the breeding and wintering populations of the Eurasian marsh harrier in the Mesopotamian wetlands was particularly scarce after the marshes were inundated in 2003. It was listed among the avifauna of the southern Iraqi marshes recorded from 2005 to 2008 (Salim et al. 2009). The Eurasian marsh harrier was the most abundant raptor species recorded in three restored Mesopotamian wetlands in southern Iraq during May 2004–May 2005 (Abed 2007). Moreover, it was recently recorded in the Central Marshes where a total of 28 marsh harriers were observed during October 2013–June 2014 (Fazaa et al. 2017). Given the lack of information concerning their current spatial and temporal distribution, migration patterns and estimated population size of migratory (wintering/passage migrant) Eurasian marsh harriers in the Central Marshes, this study was conducted to fill this gap.

Materials and methods

Study area

The study area (study plot) is situated within the Central Marshes geographical zone (Fig. 1). This is a vast complex of permanent freshwater wetlands, semi-desert aridlands and scrublands which encompasses an area of 40,000 ha (400 km²) and occupies the Tigris-­Euphrates Alluvial Salt Marsh (PA0906) Ecoregion with altitudes of less than 6 m. The study area is fed with water from the Tigris and Euphrates rivers and their tributaries. The general landscape is dominated by freshwater open lakes lined with dense common reed (Phragmites australis) beds and Typha sp. vegetation.

Field techniques

A line-transect survey with a distance sampling field method was performed (Sutherland 2006, Hardey et al. 2013). A total of three distanced longitudinal water tran-

Fig. 1. The Central Marshes area in Southern Iraq, showing the boundaries of the study area, Key Biodiversity Area (KBA), and National Park boundaries.

Obr. 1. Územie Centrálnych močiarov v južnom Iraku, zobrazené sú hranice študovaného územia, Klúčové územie biodiverzity (KBA) a hranice národného parku. Study area = skúmané územie, KBA boundaries = hranice Klúčového územia biodiverzity, National Park boundaries = hranice národného parku, Marshlands = močiare, Transect line = transekt, Provincial boundaries = hranice provincie.
sects (length 10 km each) covering a study plot of 40,000 ha were randomly identified and followed by motor canoe. Transect (T1) started from the first channel in Al-Hamrawia (Al Moajed Village) and covered the western part of the Central Marshes; (T2) started from the Abo Sobat Channel in Al-Chebaeish district and covered the central part of the Central Marshes; (T3) started from Kinziri Village towards Zichri Lake and covered the eastern part of the Central Marshes. Transects were carefully surveyed at a slow-moving rate (20–30 km/hour) in order to increase detection probability and accurate identification of species, and reduce the possibility of double counting. Transects were randomly followed from south to north and north to south alternately, and flying/perching raptors within a fixed observation/detection distance (500 m) were counted. Stopping points were applied at fixed intervals (15–20 minutes) along each surveying transect; a 30 to 40-

**Fig. 2.** Age classes of the Eurasian marsh harrier (*Circus aeruginosus*) in the Central Marshes, Southern Iraq. A & B: Juvenile (1st y), overall dark-brown body, fresh flying feathers, dark underside of primaries with pale crescent at base, underwing coverts and tail lack rufous tint, head with pale yellowish crown and dark eyes. C: Sub-adult/Immature (3rd y) male, streaked upper-breast, pale secondaries with dark subterminal band, dark rufous underwing coverts, and brown eyes. D: Adult male, body retains younger plumage, whitish underwing coverts with light rufous wash, and yellow eyes. E: Adult female, creamy patches on upperwing coverts contrasting with darker secondaries, rufous cast on tail and uppertail coverts, and yellowish eyes. F: Older juveniles/immature (circa 2nd y) probably a young male, fresh flight feathers retain juvenile plumage, streaked upperbreast, clear facial disk, and pale tail feathers.

**Obr. 2.** Vekové triedy kaní močianych (*Circus aeruginosus*) z Centrálnych močiarov, južný Irak. A a B: juvenil (1. rok), celkovo tmavohnedé sfarbenie, nové letky, tmavý spodok ručných letiek so svetlým "polmesiacom" na báze, spodným laktívym krovkám a chvostu chýba červenoohnedý nádych, hlava so svetloňutým temenom a tmavými očami. C: subadultný (3. rok) samec, prúžkovaná horná časť hrude, svetlé laktívne letky, s tmavým pásom na okrají, tmavé červenoohnedé spodné laktívne krovky, hnedé oči. D: Dospelý samec, telo si zachováva perie mladšieho vtáka, beľavé spodné krovky s ťažkým červenoohnedým nádychom, žlté oči. E: Dospelá samica, krémové Škrvní na horných laktívnych krovkách kontrastujúce s tmavšími laktívymi letkami, červenoohnedý nádych na chvoste a horných chvostových krovkách, žlté oči. F: Starší juvenilný/nedospelý jedinec (asi 2. rok), pravdepodobne mladý samec, nové letky si zachovávajú juvenilný charakter, prúžkovaná horná časť hrude, svetlá tvárová časť a bledé chvostové perá.
minute time period was spent at each stop. Counting of raptors stopped at the end of each survey transect, and raptors observed on the way back were ignored.

A total of 11 field surveys were conducted in the Central Marshes from February 2018 to April 2019. Three days were spent in the study area during each survey period (one day/transect), and six to eight hours per day were spent moving along each transect. The field observations were made using a ‘double-observer’ approach by three field observers (primary observer, secondary observer, and recorder). The starting time of the field surveys varied. A Canon EOS/SLR 7D Canon camera body attached to 100×400 mm and Canon image stabilizer zoom lens and 8×42 mm Swarovski binocular were used to observe/document species/habitats. A Garmin GPS device was used to digitally position the three transect way-points on the map.

The age state of the observed harriers was classified into two classes: (i) juvenile/immature (year y1–2) and (ii) adult (≥y3) birds (Fig. 2). Their breeding was assessed using the British Trust for Ornithology (BTO) breeding evidence (BTO 2019) and interviews with Marsh Arabs (indigenous inhabitants of the Mesopotamian Marshes) were performed when possible. The species field identification remarks followed (Clark 1999).

Data analysis

The species density was interpreted as the number of individuals recorded in one hectare of the study area. The species density was calculated in each survey using distance sampling (Sutherland 2006). The estimated species density (D) was calculated in each survey using the formula: 

\[ D = n \sqrt{\frac{2n}{\pi \sum x_i^2}} / (2L) \]

where 

- \( n \) = total number of birds detected,
- \( L \) = length of transect, and
- \( x_i \) = perpendicular distance from the transect line of the ith bird detected.

Perpendicular distance \( x_i \) was calculated using the formula \( x_i = Z \sin \Theta \), where \( Z = \) distance from observer to the bird in meters (m), and \( \Theta = \) measured observation angle. The \( Z \) distance was estimated using the mean of three observers’ estimations. The observation angle was measured using a measuring protractor. The species migratory/wintering population size in the Central Marshes was estimated by extrapolating the species density to the total area size of the Central Marshes (219,700 ha) (Fazaa et al. 2015). In order to determine significant differences between age/sex classes, the chi-square \((\chi^2)\) test of goodness-of-fit was performed (McDonald 2014). Our null hypothesis suggests no differential migration between age/sex classes (\( H_0 = P_{\text{juvenile/immature}} = P_{\text{adult male}} = P_{\text{adult female}} \)).

Results

Population size

During the 2018–2019 field surveys, a total of 93 marsh harriers were recorded in the Central Marshes. The species was observed in all surveyed transects and periods, except May and June 2018 and April 2019. The recorded age classes were 53 juveniles/immature, 16 adult males and 24 adult females (Tab. 1).

In February 2018 a total of five harriers (two juveniles; one adult male; two adult females) were carefully observed at an estimated 30–300 m distance range with 22–42° observation angles. The estimated density for this species in the study area was 0.013 individual/ha, and the estimated population migrating across the Central Marshes was 2856.1 individuals.

In March 2018 a total of three harriers (two adult females and one juvenile) were carefully observed at an estimated 50–200 m distance range with 30–45° observation angles. The estimated species density was 0.0055 individual/ha, and the estimated migratory population was 1208.35 individuals.

In April 2018 two adult males were carefully observed at estimated 70 m and 90 m distances with 30° and 22° observation angles. The estimated species density was 0.0077 individual/ha, and the estimated migratory population was 1691.69 individuals.

In September 2018 a total of eight harriers (seven juveniles; one adult male) were carefully observed at an estimated 20–400 m distance range with 25–70° observation angles. The estimated species density was 0.0066 individual/ha, and the estimated migratory population was 1450.02 individuals.

In November 2018 a total of 15 harriers (11 juveniles; 3 adult females; 1 adult male) were carefully observed at an estimated 50–300 m distance range with 30–75° observation angles. The estimated species density was 0.019 individual/ha, and the estimated migratory population was 4174.3 individuals.

In December 2018 four harriers (one juvenile; two adult females; one adult male) were carefully observed at an estimated 100–200 m distance range with 40–70° observation angles. The estimated species density was 0.0042 individual/ha, and the migratory population was 922.74 individuals, which represents the lowest estimated value.
The highest count of Eurasian marsh harriers was made in January 2019, when a total of 35 harriers (21 juveniles; eight adult females; six adult males) were carefully observed at an estimated 20–400 m distance range with 10–70° observation angles. The estimated species density in this case was 0.035 individual/ha, and the estimated migratory population was 7689.5 individuals.

In March 2019 a total of 21 harriers (10 juveniles; seven adult females; four adult males) were carefully observed at an estimated 60–400 m distance range with 20–70° observation angles. The estimated species density was 0.02 individual/ha, and the estimated migratory population in the Central Marshes was 4394 individuals (Table 1).

**Migration**

Our field surveys focused on the period when large numbers of passage migrant and wintering Eurasian marsh harriers can be observed, mainly during autumn (September–November), winter (December–January), and spring (February–April) each year. The Eurasian marsh harrier migration in the Central Marshes starts in September, when migrant individuals emerge and are followed by a noticeable increase in numbers of migrants in November–January. The peak of the Eurasian marsh harrier winter migration is in January, when a total of 35 migratory/wintering individuals were counted. The winter count possibly represents the actual migratory/wintering populations of Eurasian marsh harrier in the Central Marshes; this assumption however needs further investigation. Afterwards the numbers of migrant individuals fade during the subsequent months (March–April) (Tab. 1).

**Breeding**

Furthermore, summer surveys (May–July) which focused on observing late migrant and/or breeding pairs in the Central Marshes were conducted. Despite our intensive field surveys, no harriers were detected. Moreover, large proportions of the study area which appear to be suitable breeding habitats (dense reed beds) for the Eurasian marsh harrier were surveyed. Breeding evidence such as adult harriers in pairs or in courtship/display, occupied breeding territories or nesting sites were not detected during the survey period, and the area seems to be abandoned (Tab. 1).
Discussion
The Eurasian marsh harrier is a common raptor widely spread over the Mesopotamian wetlands. It has been regularly recorded since the 1920s, but its wintering population trends were enigmatic. Besides the migration pattern, this study represents an initial attempt to quantify the Eurasian marsh harrier population size in the Central Marshes, a wetland of international importance in southern Iraq. Knowing population trends of migratory species might be useful to predict ecological changes in the Mesopotamian wetlands in the future.

Historically, the species was abundant in the Mesopotamian wetlands prior to the 1990s, when extensive hydrological drainage was carried out (Scott 1995, Hussain 2014). Large numbers of marsh harriers (286 individuals) wintered here in 1979 (Scott & Carp 1982). The drainage of the Mesopotamian wetlands had an adverse effect on the populations of about 40 avian species occurring in the marshes in internationally significant numbers, and it might have caused a major decline (>10%) in Eurasian marsh harrier regional populations (Evans 1994, Scott 1995). However, the species continues to visit the Mesopotamian marshes, but in lower numbers (Abed 2007, Fazaa et al. 2017).

When estimating the current population size of the migratory Eurasian marsh harrier in the Central Marshes, we reduced bias probabilities through standardized field methodologies and arithmetical estimations, even so, a number of caveats should be taken in consideration. The scarcity of available data related to habitat classification in the Central Marshes made the identification of the surveying sites and suitable applied methodologies rather difficult. We assumed the species made use of the whole geographical zone of the Central Marshes, and also that the habitat classification within the study area was homogenous, of course this is a simplification. The detection distances were estimated rather than being measured using digital range-finders, such devices are prohibited due to the security situation in Iraq. Fazaa et al. (2017) indicated that the numbers of migratory Eurasian marsh harriers in the Central Marshes increased during December 2013. However, our low count in December (n = 4) is explained by low detection probability due to very brief (one day) survey efforts influenced by security and logistical circumstances. Current results suggest that the migratory/wintering population of the Eurasian marsh harrier in the Central Marshes is estimated at between 923–7690 individuals (mean ± SD = 2216.9 ± 2392.3), however, cumulative results from subsequent years suggest the need for further estimations.

There is a scarcity of information concerning raptor migration in Iraq and the Middle East generally (Shirihai & Christie 1992, Shirihai et al. 2000, Al-Sheikhly et al. 2017). Our results suggest that the autumn migration of the Eurasian marsh harrier in the Central Marshes starts in early September, when increasing numbers of migrants emerge, similar to those migrating from western and eastern Europe across sub-Saharan Africa (Strandberg et al. 2008, Agostini and Panuccio 2010, Agostini et al. 2017). The pre-migration movement strategies adopted by the genus Circus are used to reduce intraindividual competition, ensuring sufficient resources for moulting or recovering from breeding efforts, and for preparing for migration (Limñana et al. 2008, Triewieler et al. 2008). The timing of Eurasian marsh harrier differential migration in the Central Marshes has not been fully explored. Juvenile/immature marsh harriers (n = 53, 57%) dominated the migratory population in the Central Marshes, followed by adult females (n = 24, 26%) and then by adult males (n = 16, 17%), with significant differences between age classes (χ²(2) = 25.452, P < 0.05). Our results are in agreement with those for marsh harriers migrating across the Falsterbo Peninsula in Sweden (western Europe) in autumn, where juveniles (n = 1594, 78%) outnumbered adult females (n = 273, 13%) and adult males (n = 216, 9%) (Kjellén 1992). In contrast, adult marsh harriers were observed in greater numbers than juveniles along the Central Mediterranean flyway (Agostini et al. 2017). Furthermore, our observations suggest that migrating juveniles arrive in the Central Marshes earlier than adults, as their numbers gradually increased from September-January (7–21) respectively. Juveniles tend to migrate over shorter distances, and their migration speed is lower than for adults (Strandberg et al. 2008). Adults may be less inclined to follow major flyways during migration, however, the differential timing between juveniles and adult females (p < 0.05) and that between adult females and males (p < 0.001) migrating over the Falsterbo Peninsula is significant (Kjellén 1992). Conversely, marsh harriers from western and eastern Europe need to refuel at several stopover sites before crossing the Mediterranean Sea in a long-distance energy consuming migration (Agostini et al. 2017). Ring recoveries show that adult marsh harriers tend to engage in autumn migration slightly earlier than juveniles (Strandberg et al. 2008), similarly to those crossing on the Central Mediterranean.
The autumn movement of satellite-tagged marsh harriers from western Europe towards their wintering grounds in western Africa showed that adult females arrived earlier (early October) than adult males, which arrived in mid-October (Strandberg et al. 2008). However, the timing of autumn migration of adult marsh harriers in the Central Marshes is rather different from that of harriers from western Europe. Our results show that adult males seem to arrive earlier (mid-September) than adult females (mid-November), but in lower numbers. This is in accordance with the “body size hypothesis” about smaller and lighter males migrating over longer distances (Agostini et al. 2003). The males’ tendency towards long-distance movements has been attributed to the higher proportion of males’ flapping flight (Spaar & Bruderer 1997), or their avoidance of intraspecific sex competition with larger females, which are capable of capturing larger prey, tolerating cold climates, and enduring starvation (Agostini et al. 2017). However, our conclusion was based on a single observation of an adult male in September with no further records in October, which is rather scarce data to support our claim and requires further investigation.

In the Middle East, several resident breeding populations of Eurasian marsh harriers exist in the northern Mediterranean Sea, southern Black Sea, southern Caspian Sea, and northern Arabian Gulf (Porter & Aspinall 2010). Based on our results, the Central Marshes seems important as a wintering/stopover site for migratory marsh harriers, as 7690 individuals were estimated (Tab. 1), however, their origin is still unknown. Birds originating from eastern Europe and the central Asian breeding populations probably reach the Central Marshes via the eastern Black Sea and southern Caspian Sea routes (see: Shirihai & Christie 1992, Fülöp et al. 2018), however, this claim requires further verification. On the eastern Black Sea route, at the Batumi bottleneck in south-west Georgia, a total of 4234 marsh harriers were recorded between August and October in 2008–2009 (Verhelst et al. 2011), a few of which may have drifted away on route to the Central Marshes. On the southern Caspian Sea route, at the Alborz Mountains in north-eastern Iran, a total of 101 marsh harriers were recorded during autumn migration in October 2017 (Panuccio et al. 2018). This route crosses the northern Arabian Gulf region on the way to eastern Africa, and seems to make a significant contribution to the Eurasian marsh harrier migratory/wintering population in the Central Marshes. Moreover, in autumn, marsh harriers (especially juveniles) originating from the Caspian Sea and northern Arabian Gulf breeding populations might arrive in the Central Marshes earlier than those from eastern Europe and Central Asia. This may be attributed to a short-distance movement (e.g. Strandberg et al. 2008) or adapting leap-frog and flapping flight migration strategies (e.g. Spaar & Bruderer 1997). Besides wintering populations, the fate of marsh harriers migrating through the Central Marshes in autumn is unclear. They might migrate across the northern Arabian Peninsula, bypassing the Al-Fao Peninsula in southern Iraq/northern Kuwait to reach eastern Africa via the Bab-el-Mandeb straits, or move through western Iraq towards Sinai via the North Negev and Dead Sea-Kfar Kasem-Eilat route (see: Shirihai & Christie 1992).

Data on raptor migration through the Middle East in spring are deficient, however, the bulk of the spring movement of raptors appears to follow the northern route, bypassing the eastern Mediterranean and northern Red Sea (Shirihai and Christie 1992). In spring, immature marsh harriers were extremely abundant in the marshy areas of southern Iraq up to mid-April, but less so thereafter (Moor & Boswell 1956). This corresponds with our current field observations, as numbers of marsh harriers are notably decreased during April–May.

The current breeding status of the Eurasian marsh harrier in the Central Marshes and adjacent marshy regions is unknown. Previously, their breeding in the Mesopotamian wetlands started in late March-late May, and nests with eggs/young were found in early June (Ticehurst et al. 1922). Breeding records outside the Mesopotamian wetlands geographical zone were lacking for June-July, which was attributed to the impact of extreme heat on bird-watchers (Moor and Boswell 1956). The most recent surveys, especially those preformed after the Mesopotamian wetlands inundation in 2004, did not confirm the breeding of this species (Abed 2007). In addition, marsh harriers left the Central Marshes in April and June 2014 and breeding was not detected (Fazaa et al. 2017). Besides our field observations, extensive interviews with Marsh Arabs have ruled out the breeding of this species in the Central Marshes during recent years. In our study we did not detect any adults with coition attempts, breeding territories or nest-
ing sites, which suggests that marsh harriers are former breeders in the Central Marshes, further field observations may yet modulate this claim.

In Europe, the Eurasian marsh harrier breeding population faces dramatic decline due to shooting, poisoning by pesticides, and habitat destruction and fragmentation especially in south-eastern Europe between 1990 and 2000 (Clarke 1995, Coleiro et al. 1996, Agostini & Pannucci 2010, BirdLife International 2019). The proliferation of wind farms has been identified as a major threat to the species in southern Italy (Panuccio et al. 2007, Panuccio 2011). Further studies on migration routes have been proposed to identify any threats, such as shooting or trapping of migrant raptors, which could lead to conservation measures being set up in the future (Porter & Beaman 1985). Hunting and trapping have been highlighted as major threats to migratory raptors in Iraq (Al-Sheikhy et al. 2017). During our surveys, species persecution has been observed as a serious threat to migratory raptors in the Central Marshes. Several migratory raptors including the Eurasian marsh harrier are persecuted whenever and wherever possible by local hunters/trappers without known motivations. Live trapped harriers are presented in the local animal markets to be sold as domesticated pets or mummified as trophies in hunters’ residences or hunting shops. The Iraqi legislation on the protection wild animals (law no. 17 issued on February 15, 2010) bans illegal hunting practices in Iraq affecting 34 avian species, unfortunately, the Eurasian marsh harrier is not included. The absence of full enforcement of existing legislation might cause regional declines in certain raptor species (Al-Sheikhy 2011). Moreover, the weak enforcement of the hunting legislation encourages the illegal persecution of many raptor species in Iraq. Indeed, the conservation of the indigenous biota of the Mesopotamian wetlands is an environmental responsibility which urgently needs to be actively acknowledged by the Iraqi authorities.

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