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Ornis Hungarica 2019. 27(2): 67–76.
DOI: 10.2478/orhu-2019-0016

Biometric data of North African Blackbird *Turdus merula*: are there many subspecies?

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Received: April 08, 2019 – Revised: October 16, 2019 – Accepted: November 01, 2019

Djemadi, I., Bakhouche, B., Draidi, K. & Bouslama, Z. 1019. Biometric data of North African Blackbird *Turdus merula* spp.: reconsidering of multiple subspecies. – Ornis Hungarica 27(2): 67–76. DOI: 10.2478/orhu-2019-0016

Abstract During the past two centuries, few studies have been conducted on biometrics of North African Blackbirds. Several of these studies were carried out during the latter part of the 19th and in the early 20th centuries. As a result, two subspecies were recognized namely *Turdus merula algira* inhabiting northern regions of North Africa and some localities in southwestern continental Europe and *T. m. mauritanicus* inhabiting central western Morocco and southern Algeria and Tunisia (to the end of arid climatic regions). In this study we provide morphological data from the northeastern Algerian population of Blackbird. Results reveal no differences between sexes in any of the measurements (small sample size). Comparison of morphological data of specimens collected in the northern region of North Africa and from the southern region of Maghreb countries (Algeria, Tunisia and Morocco) show morphometric differences only in wing length. These results are consistent with the existence of multiple subspecies in North African populations of Blackbird. Our findings support the assumptions of previous researchers in considering *T. m. algira* as typical of northern areas of Maghreb countries and *T. m. mauritanicus* typical of southern areas of the region.

Keywords: North African Blackbird, morphological characteristics, subspecies, *Turdus merula mauritanicus*, *Turdus merula algira*

Összefoglalás Az elmúlt két évszázadban csak kevés tanulmány foglalkozott az észak-afrikai fekete rigók biometriájával. Ezen vizsgálatok többsége a 19. század második felében, valamint a 20. század elején készült. Két alfajt különböztettek meg: a *Turdus merula algira* Észak-Afrika legészakibb területeit, és Európa délnyugati részét, valamint a *T. m. mauritanicus* közép-nyugat Marokkó, Algéria és Tunézia deli részét (a sivatagi klímazónáig) népesíti be. Ebben a tanulmányban a fekete rigó északkelet-algériai populációjának morfológiai vizsgálatát közöljük. A jelen tanulmányban is rögzített testméretek, eredmények alapján nem lehet jelentős különbséget tenni a nemek között. Az Észak-Afrika északi részéről, valamint a Maghreb államok (Algéria, Tunézia, Marokkó) déli régióiból származó adatok összehasonlításakor is csak a szárnyhosszban mutatkozik eltérés. Azonban ezek az eredmények megerősítik a leírt alfajok elkülönítését az észak-afrikai fekete rigó populációkban, miszerint korábban a Maghreb államok északi területeiről leírt *T. m. algira* és a deli régiókban megtalálható *T. m. mauritanicus* valóban különálló alfajoknak tekintendőek.

Kulcsszavak: alfajok, észak-afrikai feketerigó, morfológiai tulajdonságok, *Turdus merula mauritanicus*, *Turdus merula algira*

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Introduction

The morphological characters of birds are one of the factors reflecting their physiological processes, life history traits, behavior and ecological functions (Dunning 1993, Gaston *et al.* 2001). Biometric data are of great interest in the study of biogeography and the evolution of species (Guillaumet *et al*. 2005, Svensson 2015).

In the 19th and early 20th centuries, the interest was focused on the description of new species (Hounsome 1993). Several studies had demonstrated that biometrics was one of the most important characteristics, which facilitates the detection of a subspecific or population-level differences, which were later often confirmed by phylogenetic technics. In the occidental Palearctic (especially Maghreb countries), these studies were represented by the identification of: Atlas Pied Flycatcher *Ficedula speculigera* described as morphologically different subspecies (Svensson 1992, Sætre *et al*. 2001a) and identified later as a species (Sætre *et al*. 2001b); Streaked Scrub Warbler *Scotocerca inquieta* (Bergier *et al.* 2013); two major lineages were genetically identified within Crested Larks *Galerida cristata* (Guillaumet *et al*. 2008) to describe a new endemic species to North Africa, namely Maghreb Crested Lark *Galerida macrorhyncha* (Sangster *et al*. 2016) and finally, the *Saxicola* complex which is still under revision concerning the two species occurring in North Africa, the European Stonechat *S. rubicola* and African Stonechat *S. torquatus* (Zink *et al*. 2009, Gill & Donsker 2018).

The Blackbird *Turdus merula* is one of the most common birds in the Palearctic region (Isenmann 2002, Collar 2005) including the southernmost areas where the species is present in various habitats from coastal to semi-arid conditions (Isenmann & Moali 2000). It is one of the most successful species judged by its ability to adapt to a wide range of environments including woodland, farmland and urban habitats (Mac Arthur & Mac Arthur 1961, Ludvig *et al*. 1994, Isenman 2002). Møller (2008) and Ciach and Fröhlich (2017) have related the response of some bird species (including Blackbird), which become very abundant in urban areas, to increasing food availability and night lighting in these ecosystems. One of the oldest colonizers of urban areas, the North African Blackbird *T. merula* constitutes the only breeding thrush species in urban ecosystems in northeastern Algeria (pers. unpub. data).

The seven actually recognized subspecies of Blackbird are distributed over the Palearctic region (Gill & Donsker 2018). Despite the consideration of two subspecies of North African Blackbird in the 19th and early 20th century (Hartert 1902, Madarász 1903), only *T. m. mauritanicus* have been retained for North Africa in the updated list of Gill & Donsker (2018). In the case of the Tibetan Blackbird *T. m. maximus*, for example, an investigation into the phylogenetic and biogeographic status of the subspecies led researchers to classify it as a separate species *T. maximus* (Collar 2005).

Previously, using morphological differentiation, Witherby (1905) have distinguished two races for North African Blackbird namely: Algerian Blackbird *T. m. algira* (Madarász 1903) and Moroccan Blackbird *T. m. mauritanicus* (Hartert 1902). These subspecies were evidently distinguishable by wing length, and based on the measurements, it has been concluded that the smaller Algerian Blackbird inhabited the northern areas of Great Maghreb (Aïn Mokra, Annaba; Hammem Meskoutine, Guelma; Akbou, Béjaïa), while the other one was

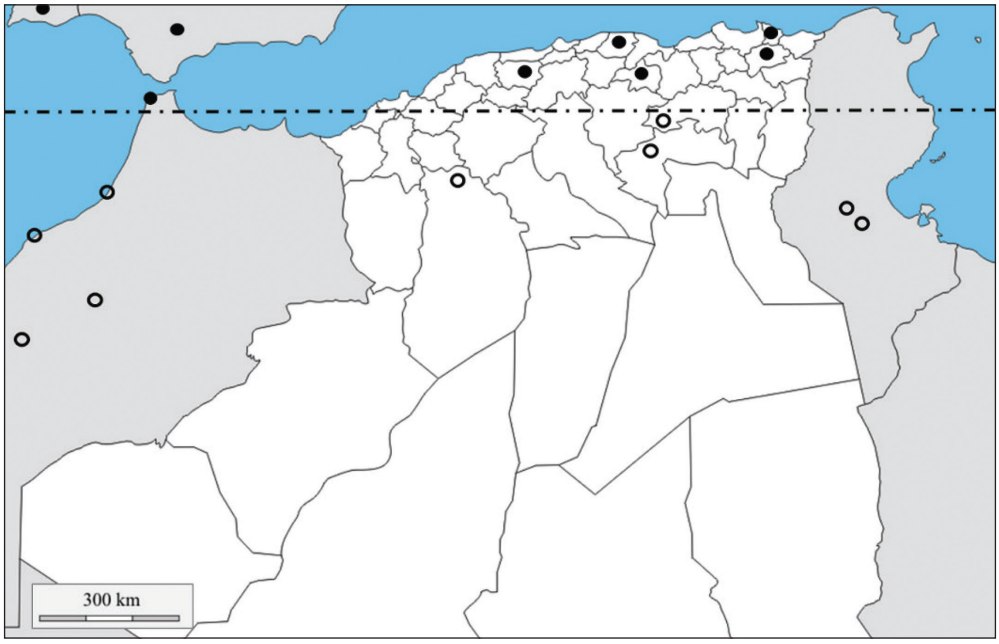

Figure 1. Supposed distribution of North African subspecies *T. m. algira* and *T. m. mauritanicus* across Maghreb and south Europe (● *T. m. algira*, ○ *T. m. mauritanicus*, overlapping area)
1. ábra A *T. m. algira* és a *T. m. mauritanicus* alfajok vizsgálatainak földrajzi elhelyezkedése a Maghreb régióban és Dél-Európában (jelölések: ● *T. m. algira*, ○ *T. m. mauritanicus*, átfedő területek határa)

Table 1. Geographic localities of Blackbird specimens presented in *Figure 1*.
1. táblázat Az összehasonlításra felhasznált fekete rigó egyedek földrajzi eredete (lásd 1. ábra)

Locality	Source
Aïn Defla	Jordans 1950
Casa Blanca	Cottrell *et al*. 1964
Djbel Mekter	Rothschild *et al*. 1914
Monchique	Ticehurst & Whistler 1933
Tilatou	Ménégaux 1914
Tiffrit	Rothschild & Hartert 1912
Berrahel	Rothschild *et al*. 1911
El Kantara	
Hammem Meskoutine	
Azrou	Rothschild *et al*. 1923
Rabat	
Rif	
Rhamna	
Safi	
Tanger	
Tazoult	

present in the arid region of the Maghreb countries (El-Kantara, Biskra; Tazoult, Batna; Djebel Mekter, El Bayadh) (Rothschild *et al*. 1911, Ménégaux 1920) *(Figure 1)*. The same biogeographical differentiation of the two subspecies was noted in Morocco, where *T. m. algira* was observed in Tanger (Rif) and *T. m. mauritanicus* was identified in the central-west of the country in Mazagan, Casablanca (Rothschild *et al*. 1923) *(Table 1, Figure 1)*. Other observations were recorded in southern Portugal

(Monchique) and in South and Central Spain, where the subspecies was described as belonging to the Algerian Blackbird *T. m. algira* (Stenhouse 1921, Ticehurst & Whistler 1933). In addition, it was found that a continental Palearctic population fraction (extreme northwestern Africa and extreme southwestern Europe) of Blackbirds presented three divergent lineages of haplotypes (Rodrigues *et al*. 2016). This implies that the northern Mediterranean population of Blackbird would belong to North African subspecies.

According to Wysocki (2002), defining the differentiation among populations is possible using morphological parameters. Over a century, knowledge on the Blackbird populations inhabiting the northern regions of North Africa was insufficient and the question of differentiation has been seldomly studied. Consequently, only two studies had reported superficially morphological data of North African Blackbird (Cramp 1988, Selmi 2004). Although the Blackbird *T. merula* has thoroughly been studied, the subspecific variation of the North African populations is still not completely known. In our study, we aim to present morphometric parameters of a North African Blackbird *Turdus merula* population. We compare these traits with other studies (notably certain from North Africa). Using comparison, we will discuss a previously described existence of intra-species variability (morphological traits) that is still unconfirmed.

Materials and methods

This study was conducted throughout the breeding season of 2015 on a resident urban population of North Africa (*Turdus merula* spp.), in the Christian cemetery of Bône (Algeria). The study site is a 6 ha large, old downtown cemetery belonging to the historic, colonial district of the city (36° 54’41’’N/ 7° 45’24’’E) *(Figure 2)*. The cemetery comprises an area of evergreen and deciduous vegetation, with low undergrowth managed once a year. The built parts (vaults and chapels) and pedestrian ways divide the site to different patches covering the most important surface of the cemetery.

We captured adult Blackbirds using mist nets during the breeding season (February to early July). We measured the biometrics of individuals according to Svensson (1992): weight (g), tarsus, bill, tail and wing lengths (mm). A 0.02 mm precision caliper was used to measure the tarsus length of captured birds. For weight measurement, we used a digital scale to the nearest 0.01 g. Wing parameters were measured with a metal ruler, also with 0.02 mm nearest precision. Colored and numbered metal rings were attached to the legs of all captured individuals before release. Additional specimens were captured from Algiers province exactly in “Bebezzouar university campus”.

Adult wing length of Balckbirds *Turdus merula merula* collected from Denmark, Poland, France and Hungary (Møller 1995, Wysocki 2002, Grégoire 2003, Csörgő *et al.* 2017) were used for comparison with North African ones (Rotschild 1921, Vaurie 1955, Selmi 2002, present study). Furthermore, we compared Blackbirds (museums data *Table 1*, *Figure 1*) from Maghreb countries to support the differentiation between subspecies using morphometric parameters of individuals. Including present study data, we used older specimens (Hartert, collected from northeastern Algeria) and another recent one from southern Tunisia

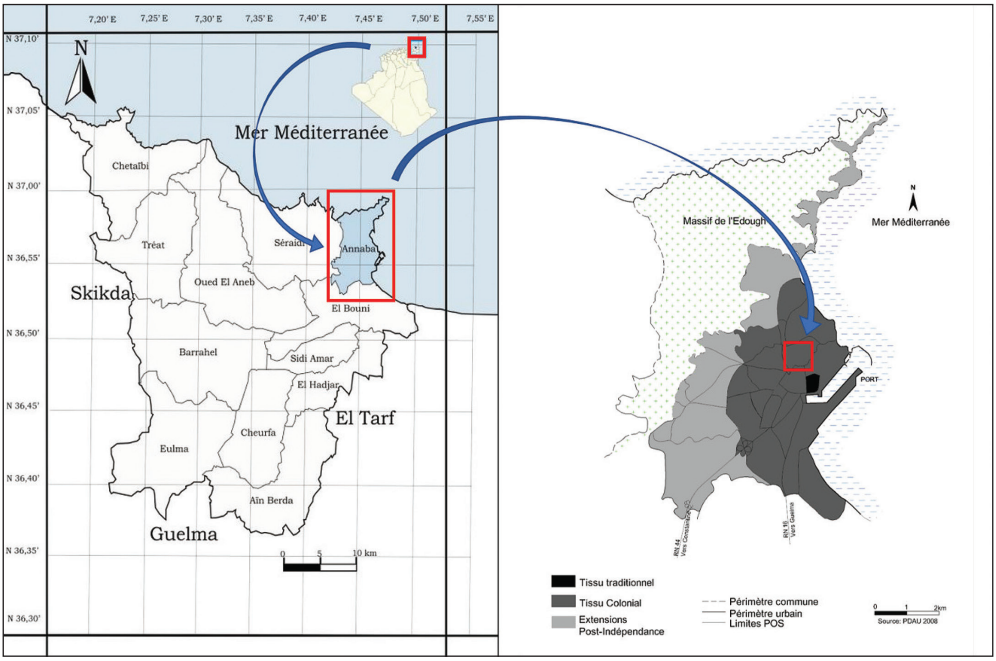

Figure 2. Study area (Traditional tissue: built before 1830; Colonial tissue: built during the colonial epoch 1830–1962 and post-independence extension: after 1962)

2. ábra A vizsgálati terület elhelyezkedése (eredeti terület: 1830 előtt építve; gyarmati időszak: 1830 és 1962 között építve; a felszabadulás utáni terület: 1962 után)

(Op. cit) to assure North African population analyses. These data represent the most southern range of the species.

First, we compared North African Blackbirds (without specified subspecies) and then revealed the difference within North African supposed subspecies. Welch's T test for two independent samples and an ellipses principal component analyses (PCA) were used to highlight morphologic variation and overlapping geographic distribution of North African subspecies. In the last comparison, only specimens of known locality were used. Analyses were carried out in R 3.4.0 (R Core Team 2017).

Results

For this study 26 adult individuals were captured (17 males and 9 females). No difference between males and females was found for any biometric measurement because of the small sample size ($p < 0.05$), *(Table 2)*. Although, marginally significant difference in wing and tail ($p = 0.06$ and 0.07, respectively) would reflect probable changes if the sample size will be enlarged.

First, we compared wing length of European Blackbirds *T. m. merula* (125.8 ± 5.22 mm, ranged 113–132 mm, n = 15) with North African *T. m. mauritanicus* (121.83 ± 5.86 mm, 112–135 mm, n = 104), which measurements significantly differed (t = –2.70, df = 19.46,

Table 2. Morphological characteristics of North African Blackbird *Turdus merula* spp. from Annaba city
2. táblázat Annaba város fekete rigóinak (*Turdus merula* spp.) morfológiai jellegei

Measurements	Range	Sex	Mean ± SD	t	*p*
Wing (mm)	114.4 – 124.8	Males	120.82 ± 3.63	2.058	0.0603
	111.8 – 124	Females	117.28 ± 4.29		
Tail (mm)	100.9 – 112.9	Males	105.54 ± 4.83	1.940	0.0707
	96.7 – 109.1	Females	103.11 ± 4.55		
Tarsus (mm)	34.6 – 42.7	Males	38.94 ± 1.63	0.744	0.4651
	36.3 – 40.1	Females	38.49 ± 1.23		
Bill (mm)	29.2 – 31.9	Males	30.76 ± 0.85	1.317	0.2132
	28.2 – 31.7	Females	30.07 ± 1.33		
Weight (g)	73 – 95.9	Males	83.76 ± 11.04	0.795	0.437
	58.7 – 95.5	Females	80.17 ± 9.83		

$p < 0.05$). This result was based on the current subspecies inhabiting North Africa in which formerly described separation was pooled. Repeating the comparison without the data of the supposed *T. m. algira* as part of *T. m. mauritanicus*, the wing length did not reveal any evident difference ($t = 0.43$, $df = 19.39$, $p = 0.67$). Of 68 North African Blackbird measured,

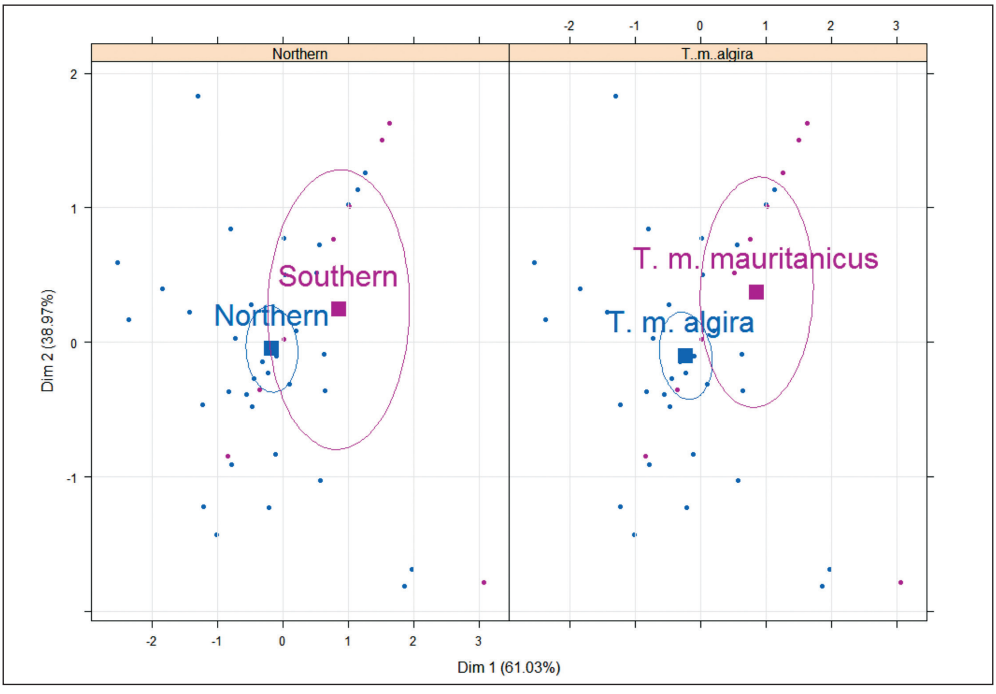

Figure 3. Ellipses PCA of subspecies traits (Wing and Tail) distributed in North Africa and Southern Europe
3. ábra Az alfajok jellemzőinek (szárny és farok) főkomponens elemzése Észak-Afrikában és Dél-Európában

wing length was 120.83 ± 4.79 mm (range 112–135 mm). This trait revealed a significant difference ($t = –5.38$, $df = 40.47$, $p < 0.05$) when data were separated according to old trinomial nomination *T. m. algira* (119.19 ± 4.24 mm, n = 48 (present study data included) and *T. m. mauritanicus* (124.75 ± 3.71 mm, n = 20).

According to wing and tail lengths PCA, despite weak sample size of *T. m. mauritanicus*, the supposed smaller *T. m. algira* was associated to *T. m. mauritanicus* traits. The latter, sometimes collected outside its "described" distribution area, has a larger wing length (126.8 ± 6.51 mm, range 115–135 mm, n = 10) contrary to *T. m. algira* (120.35 ± 4.90 mm, range 112–131 mm, n = 39). *T. m. mauritanicus* is mostly present in positive side of the Dim 1. According to the presence of *T. m. algira* individuals in the positive and negative sides of both axes, subspecies traits would overlap because of the presence of some long-winged specimens of this subspecies. However, distribution of the two subspecies overlaps contrary to traits *(Figure 3)* because some authors attributed *T. m. mauritanicus* to several long-winged specimens.

Discussion

We had marked an unbalanced sex ratio (captured individuals) which follows general tendencies within the species as the number of captured adult males was mostly important compared with this of females (Cresswell 1999, Wysocki 2002, Selmi 2004, Scheifler *et al*. 2006). It was showed that capture probabilities were male-biased in birds (Donald 2011) and precisely within Blackbirds (Lovász *et al.* 2018). Within studied population (sampled during breeding season), these results could reflect behavioral response to predation risk (Ibáñez-Álamo & Soler 2012, 2017) where females spend more time in nest and males guard the territory. There was a single exception from the population of central France (Dijon) where females were more likely to be captured than males (Faivre *et al*. 2001).

Contrary to our results, in northern populations of Blackbird, weight presented significant variation (Cresswell 1999, Macleod *et al*. 2005). As well as weight, wing, tarsus and tail lengths are the most used characters showing dimorphism in Blackbirds (Cramp 1988, Selmi 2004). These differences were not observed within our population which would reflect an absence of sexual dimorphism in morphological terms *(Table 2)*. However, marginal difference detected in wing and tail lengths would explain a hidden difference if the sample size was increased.

Parallel to the fact that some populations/subspecies of the Blackbird is short-distance migrant (Isenmann 2002) and, the probability of the occurrence of the species in a given habitat is strongly linked to its presence in the nearest neighboring habitat (Selmi 2003), we could confirm the observation of the North African subspecies in southern Europe (Portugal, South and Central Spain (Stenhouse 1921, Ticehurst & Whistler 1933)). In addition, our results state the absence of difference (at least in wing length) between *T. m. merula* and *T. m. mauritanicus* (only southern described area in *Figure 1*), which supports the geographic belonging of the supposed *T. m. algira*. Rothschild *et al*. (1911) did not give an average of wing length of both supposed subspecies but he presented ranges of this character. He had confirmed that *T. m. algira* was smaller (118–120 mm) than *T. m. mauritanicus* (118–128,

mostly above 120 mm) following geographical division of subspecies. Later in 1955, Vaurie reported that wing length of *algira* ranged between 119 and 131 mm for thirteen specimens whereas *mauritanicus* measured 122–135 mm with an average of 128 mm.

Tarsus length in South Tunisia revealed a clear sexual dimorphism (Selmi 2004). Our individuals may present a longer tarsus compared to southern Tunisian (supposed *T. m. mauritanicus*) and European populations *T. m. merula* (Wysocki 2002, Selmi 2004). Although we do not know what was the length of the tarsus of *mauritanica*, our Blackbirds would be *algira* with longer tarsus. This supports the hypothesis of presence of another subspecies of North African Blackbirds mentioned in the last century as *algira*. It seems that a longer tarsus would be a morphological character which has not been reported before.

Within Forest Thrush *Turdus lherminieri* populations (Guadeloupe), a strong micro-geographic differentiation was found for a body-size descriptor (Arnoux *et al.* 2013). Because of the strong endemism related to Mediterranean basin species and insular environments all around notably Balearic Islands, the same body-size descriptor may explain the presence of differentiation within North African Blackbird. Beside Africa, other specimens (according to authors belong to *algira*) were captured in other continental localities, notably Portugal. Captured specimens' wings measured 115 and 117 mm, respectively for females and a male which were different of north Portugal specimen (from Vizeu) with 124 mm wing length (Ticehurst & Whistler 1933). In addition, Vaurie (1955) had reported that several authors had referred the populations of the Balearic Islands, southern Portugal, and central and southern Spain to *algira* (he did not mention authors see "Bird notes from southern Spain, 1921") following genetic facts presented from Azores islands (Rodrigues 2016).

Morphological characters of Blackbirds do not differ only in size but also in colorations (feathers and bill), which reflect, according to different authors, immunity, health and reproductive performance of individuals (Faivre *et al*. 2003a, b, Préault *et al*. 2005, Tomiałojć & Bursell 2006).

We confirmed the presence of a morphological differences at least in wing lengths of North African Blackbirds (Hartert 1902, Rotschild 1911, 1912, 1914, 1923, Ménégeaux 1914, Ticehurst & Whistler 1933). In fact, we would consider that Blackbirds collected during our study are smaller than southern Tunisian ones (Selmi 2004), and also European ones (Op. cit). This agreement follows results combined from those found during the 19th and 20th centuries. Although, Gill and Donsker (2018), described *T. m. mauritanicus* as a unique subspecies geographically belonging to northwestern Africa (from Morocco to Tunisia). Considering subspecific level of North African Blackbirds described previously and confirmed by morphological data in the present paper we would class current study collected specimens as *T. m. algira* until the genetic confirmation.

Acknowledgements

Authors would like to thank Juan Diego Ibáñez-Álamo who revised an early draft of the paper as well as Jenő Nagy for helpful comments which improved the final version of the text. We are grateful for Zoltán Németh for his detailed review.

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