White-throated Dipper subspecies in Iberia: a review

Strömstarens underarter på Iberiska halvön

Koskikaran alalajit Iberian niemimaalla

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ABSTRACT
Currently, two Dipper (*Cinclus cinclus*) subspecies breed in Iberia: *C. c. cinclus*, with a dark-brown breast which occupies N and W Iberia, and *C. c. aquaticus*, with a brownish-red breast, in S and E Iberia. However, a recent analysis has demonstrated that, except in S Iberia, both *C. c. cinclus* and *C. c. aquaticus* can share the same hydrographic basin, river and that a subspecies that changes its breast colour with age has been found. In S Iberia, only the *C. c. aquaticus* form is observed. A zoological subspecies, or geographic race, is a recognizable population, or group of populations, that occupies a geographic area different from other populations. Therefore, the actual status of *C. c. cinclus* and *C. c. aquaticus* in Iberia must be reconsidered. Probably, Dippers from N Iberia and the Central and Iberian mountain ranges belong to *C. c. cinclus* or to a subspecies that differs from that to which south-Iberian Dippers would belong. Biometric data and genetic studies support such a hypothesis.

Introduction

The White-throated Dipper (*Cinclus cinclus*), hereafter Dipper, is a polytypic Palaearctic passerine breeding from W Europe to E Asia (Cramp 1988). In the W Palaearctic it is present between Fennoscandia and S Europe, reaching also the main mountain ranges of N Africa (Cramp 1988). Dippers are normally associated to well-oxygenated waters in rivers with stone beds (Cramp 1988). As a highly mountainous region extending over an area of nearly 583 000 km^2 in SW Europe, Iberia offers good breeding rivers for the Dipper (Tellería et al. 1999). Normally, they occupy mountain rivers with pronounced slopes and non-acid waters (Peris et al. 1991). Overall, four main breeding quarters can be recognised in Iberia (López et al. 2003): northern Iberia, with the Pyrenees and the Cantabrian mountain ranges (north and south face) and all the northern rivers that go to the bay of Biscay; the Central and Iberian Systems (from Candelario and Sierra de Gredos to mountain ranges from east Iberia); and southeastern Iberia (Sierra Nevada and the surrounding mountain ranges) (Fig. 1). A minimum of 3,310 pairs breed in Spain, with most being found in northern Iberia (López et al. 2003).

Within Iberia, the species has been suggested to be sedentary, performing only some post-breeding or post-juvenile movements, normally from high- to lowlands after breeding (Tellería et al. 1999). This suggests that the most isolated breeding nuclei could experience their own evolutionary histories at the end of which they could become into well differentiated subspecies. Currently, two subspecies are known to breed in Iberia: *C. c. cinclus* in Central and N Iberia, and *C. c. aquaticus* in S and E Iberia (Ormerod & Tyler 2005). The identification of Dipper subspecies is based on breast colour geographic variations (Cramp 1988). Thus, *C. c.*

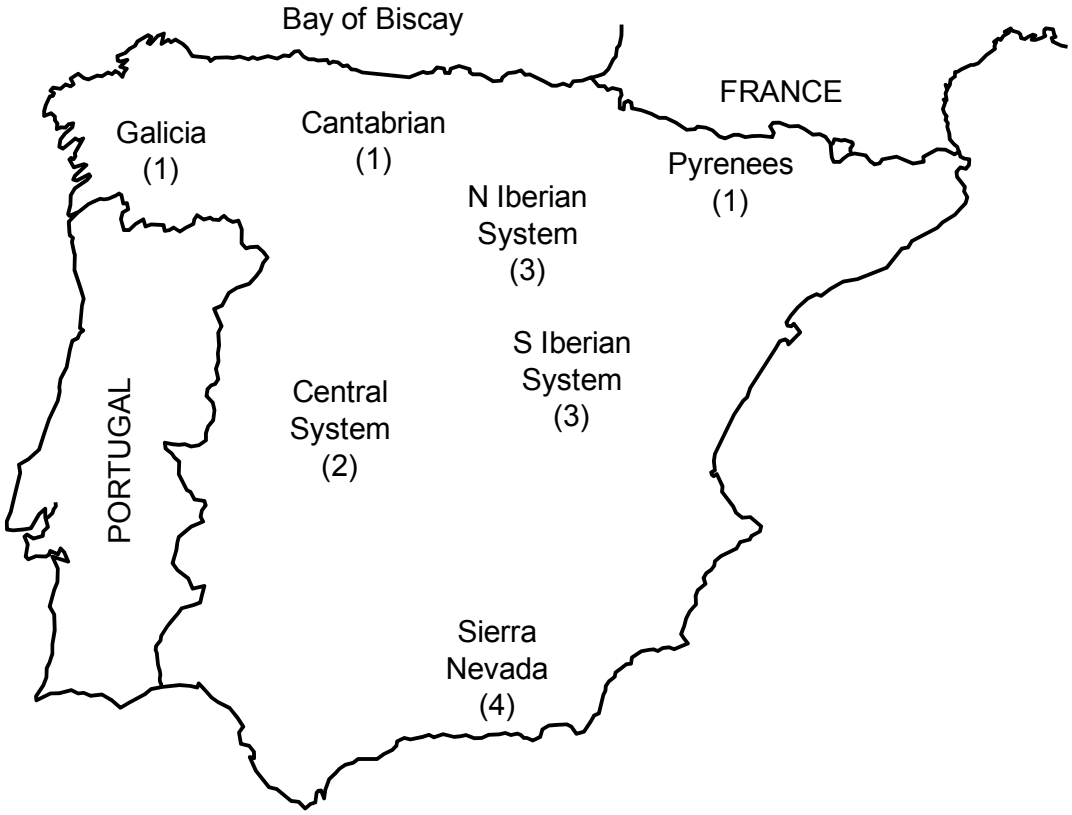

FIGURE 1. MAIN MOUNTAIN RANGES AND AREAS WHERE DIPPERS BREED IN SPAIN. MAIN BREEDING NUCLEI: (1) NORTHERN POPULATION, THAT INCLUDES THE CANTABRIAN AND PYRENEES MOUNTAIN RANGES, GALICIA AND ALL THE RIVERS THAT GO TO THE BAY OF BISCAY; (2) CENTRAL SYSTEM; (3) IBERIAN SYSTEM, AND (4) SOUTHERN MOUNTAIN RANGES (SIERRA NEVADA AND THE SURROUNDING MOUNTAIN RANGES). / *KOSKIKARAN PÄÄASIALLISET PESIMÄALUEET / STRÖMSTARENS HÄCKNINGSOMRÅDEN*

cinclus shows dark brown breast, and *C. c. aquaticus* brownish-red.

Some recent studies have strongly questioned these subspecies as historically determined, highlighting the necessity of a deep review and further field studies (Campos *et al.* 2005, Campos *et al.* 2010). The goal of this work is to review the coloration and morphology of a number of Dipper populations from several regions of Iberia in light of the two subspecies-associated morphotypes presumed to occur.

Recent studies and current knowledge

Until now, the study about the distribution of Dipper subspecies throughout Iberia is based on the analysis of (1) breast colour, and (2) biometric variation among different populations (Campos *et al.* 2005, Arizaga *et al.* 2009, Campos *et al.* 2010).

A recent analysis of breast colour variation among different Iberian populations has demonstrated that *C. c. cinclus* and *C. c. aquaticus*-associated forms are found (1) everywhere, except in southern Iberia (Table 1) and, (2) even within a same given river (Campos et al. 2010). Furthermore, in a sample of 10 Dippers recaptured after performing at least a complete moult after being first captured, two birds were found to change their breast colour from *C. c. cinclus* to *C. c. aquaticus*-like morphotype and one bird from *C. c. aquaticus* to *C. c. cinclus* (Campos et al. 2010).

Studies on biometrics of Iberian Dippers showed that populations from Spain lump into two main clusters: one in the southern Iberian mountain ranges and the other one comprising the rest of Iberia (Fig. 2). Such a result was obtained even when controlling for several

environmental factors that explained much of the morphological variation among different populations (Arizaga et al. 2009). Thus, southern Iberian Dippers showed proportionally longer wings than those from the rest of Iberia, revealing population-specific allometric patterns between southern and the rest of Iberia (Arizaga et al. 2009). These allometric variations have been attributed to a different feeding behaviour: birds inhabiting areas with rivers with a high degree of seasonality featured by periods without or with few water may take advantage of having proportionally longer wings, since this would allow them to feed more successfully on aerial insects (Moreno-Rueda & Rivas 2007). Such a differentiation and the geographic isolation of southern Iberian populations would support the hypothesis that the Dipper population breeding in southern Iberia is a subspecies different from that to which belong the rest of Iberian populations.

The biometrics of northern Iberian Dippers did not differ when birds were classified as *C. c. cinclus* or *C. c. aquaticus* according to their breast colour (Table 2; see also for further details Campos et al. 2005), hence supporting the lack of morphological differences among "subspecies" occurring in a same breeding area. Dippers from northern Iberia were smaller than those from further north regions in Europe, whilst Dippers from southern Iberia were larger than the rest of European populations (Table 2). Such a result does not contradict the Bergmann's rule, since Dippers from southern Iberia live at a very high altitude and this is equivalent to living at high latitude (Arizaga et al. 2009).

There is also a brief phylogeographic study on European Dipper subspecies that includes data from a Pyrenean population in France (Lauga et al. 2005). Although such a work did not consider Iberia and the sample sizes were small,

TABLE 1. PROPORTION OF DIPPER "SUBSPECIES" IN SEVERAL REGIONS OF IBERIA, CLASSIFIED ACCORDING TO BREAST COLOUR. OBTAINED FROM CAMPOS ET AL. (2010). / *ERI "ROTUJEN" (RINNAN VÄRITYKSEN MUKAAN) OSUUS ERI ALUEILLA / ANDELEN OLIKA "RASER" (ENL. BRÖSTFÄRGEN) INOM OLIKA OMRÅDEN.*

Mountain system/ Region	Location in Iberia	Sample size	*C. c. cinclus*-type	*C. c. aquaticus*-type
Galicia	NW	21	28.6 %	71.4 %
Cantabrian	N	44	75.0 %	25.0 %
Pyrenees	N	47	53.2 %	46.8 %
Iberian	NE	13	53.8 %	46.2 %
Central	Central	88	81.8 %	18.2 %
Southern	S	88	-	100 %

TABLE 2. WING LENGTH (MEAN ± SE, SAMPLE SIZE) OF DIFFERENT POPULATIONS BELONGING TO SUBSPECIES (AS HISTORICALLY DETERMINED) *C. C. CINCLUS* AND *C. C. AQUATICUS*. AGE CATEGORIES (YOUNG/ADULT BIRDS) POOLED / *SIIVEN PITUUS (KESKIARVO ± STANDARDIPOIKKEAMA, NÄYTTEEN KOKO) ERI POPULAATIOISSA / VINGLÄNGD (MEDELVÄRDE ± STANDARDAVVIKELSE, URVALSSTORLEK) I OLIKA POPULATIONER*.

Population	Male ♂	Female ♀	Source
C. c. cinclus			
Northern Iberia	93.0 ± 0.5 (n=22)	85.3 ± 0.4 (n=13)	(Campos et al. 2005)
Fennoscandia	97.8 ± 0.6 (n=13)	88.9 ± 0.6 (n=7)	(Cramp 1988)
C. c. aquaticus			
Northern Iberia	91.2 ± 1.3 (n=9)	86.0 ± 0.8 (n=10)	(Campos et al. 2005)
Southern Iberia	96.2 ± 0.5 (n=18)	88.8 ± 0.4 (n=22)	(Campos et al. 2005)
West-East Germany	95.1 ± 0.4 (n=16)	86.5 ± 0.7 (n=8)	(Cramp 1988)
Mainland Italy	94.7 ± 0.4 (n=6)	88.1 ± 0.7 (n=7)	(Cramp 1988)
Southeastern Europe	94.1 ± 0.4 (n=20)	86.1 ± 0.8 (n=8)	(Cramp 1988)
Hungary	93.2 (n=89)	85.6 (n=107)	(Róbert 1992)

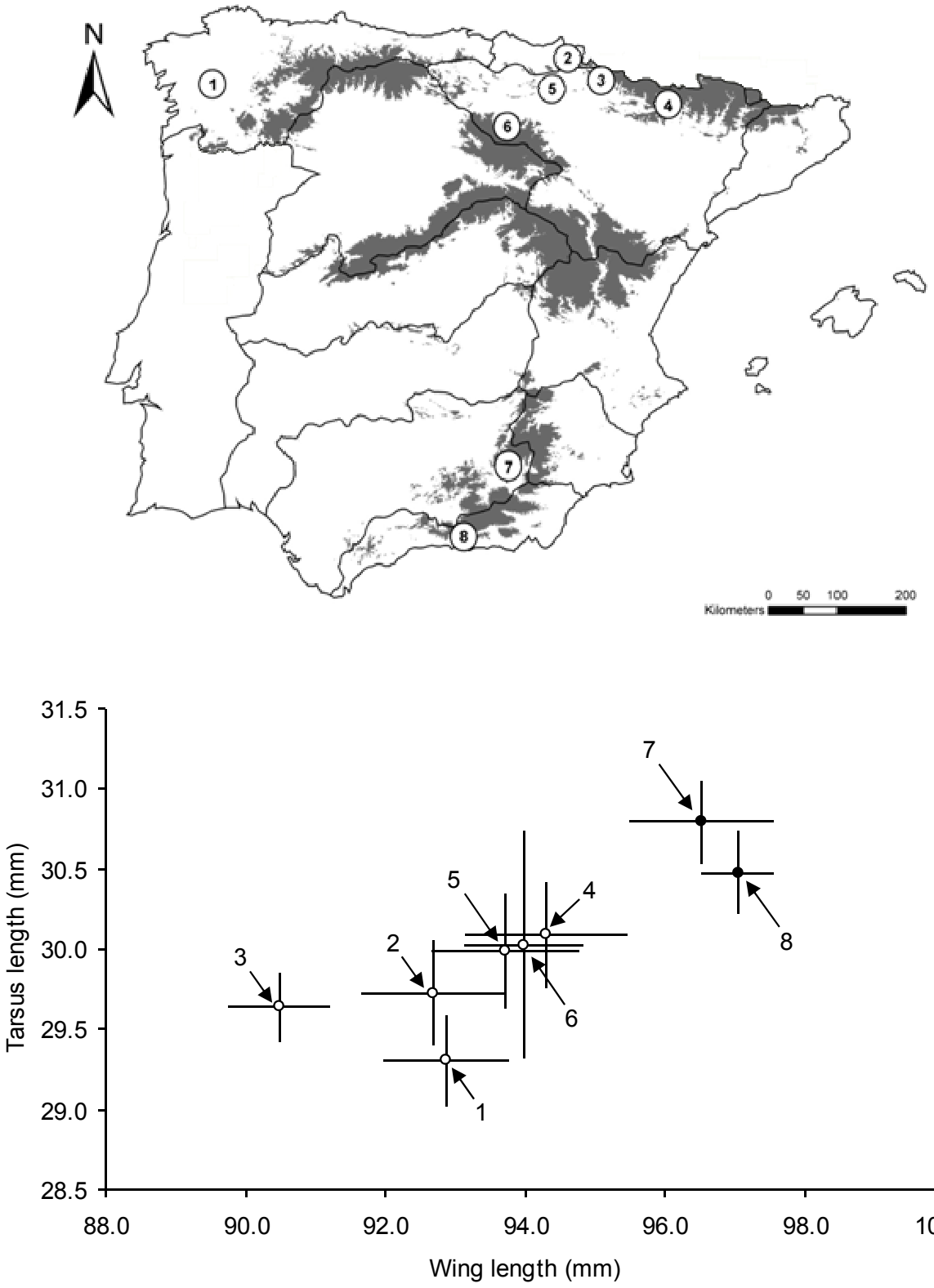

FIGURE 2. BIPLOT OF MEAN WING LENGTH VERSUS TARSUS LENGTH (± SE) OF DIPPER POPULATIONS FROM SOUTHERN (BLACK) AND THE REST (WHITE) OF SPAIN. 1: GALICIA; 2-4: PYRENEES; 5: URBASA (A MOUNTAIN RANGE TO THE SOUTH AND CLOSE TO WEST PYRENEES); 6: IBERIAN SYSTEM; 7-8 (CAZORLA AND SIERRA NEVADA, RESPECTIVELY, IN SOUTHERN IBERIA).
MAP: SHADOWED AREA IS 1,000 M ABOVE SEA LEVEL; SOLID LINES SEPARATE HYDROGRAPHIC BASINS. TAKEN FROM ARIZAGA ET AL. (2009). / *SIIVEN PITUUDEN KESKIARVO SUHTEESSA NILKAN PITUUTEEN ERI ALUEILLA / MEDELVÄRDE AV VINGLÄNGDEN I FÖRHÅLLANDE TILL TARSLÄNGDEN INOM OLIKA OMRÅDEN.*

the authors did not find strong data supporting the current two subspecies *C. c. cinclus* and *C. c. aquaticus.* This agrees with our findings.

Conclusions

A zoological subspecies, or geographic race, is a recognizably different population, or group of populations, that occupies a geographic area different from other populations. Accordingly, the breast colour cannot be used as a characteristic useful in distinguishing the subspecies *C. c. cinclus* and *C. c. aquaticus* previously accepted as breeding in Central and N Iberia and S and E Iberia, respectively, since both types are found within the same area or even within the same individual depending on its age. Thus, their existence might, or should be questioned at least as classically understood. However, Dippers from southern Iberia only show the *C. c. aquaticus*-like colour and are well morphologically differentiated from Dippers from the rest of Iberia. Such results would support that Dippers breeding in southern Iberia (mainly in Sierra Nevada and the surrounding mountains) could be given the label of subspecies.

Future research

Future research should focus on these questions using genetic tools: (1) To what extent Iberian populations are isolated among each other? (2) How big the genetic flow among all these populations is? (3) Are southern Iberian populations genetically well differentiated from the rest of Iberia? (4) If isolated, when did this isolation begin?

Questions to be also addressed would be those associated to climate change effects on the isolation and genetic flow among all these Iberian populations, and to how this climate warming could influence the distribution of genetically well differentiated populations.

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Nykytietämyksen mukaan Iberian niemimaalla pesii kaksi koskikaran rotua: C. c. cinclus (eli sama kuin Fennoskandian rotu), jolla musta rinta, pohjois- ja länsiosissa ja C. c. aquaticus, jolla ruskea rintavyö, etelä- ja itäosissa. Viimeaikaiset tutkimukset ovat kuitenkin osoittaneet, että alueen eteläosia lukuun ottamatta, C. c. cinclus ja C. c. aquaticus voivat elää samalla alueella, jopa samalla joella, ja molempien rotujen näköisiä muotoja on tavattu jopa samalta yksilöltä, joiden rinnan väritys muuttuu iän myötä. Kaksi rengastettua ja myöhemmin kontrolloitua lintua muutti rinnan värityksen C. c. cinclus-tyypisestä C. c. aquaticus-tyyppiseen ja yksi lintu päinvastoin. Alueen eteläosassa on tavattu ainoastaan C. c. aquaticus-rodun näköisiä yksilöitä. Tästä syystä koskikaran rodut pitäisi tukia uudelleen! Todennäköisesti pohjois- ja keskiosien koskikarat kuuluvat rotuun C. c. cinclus tai johonkin muuhun rotuun, joka eroaa siitä rodusta, johon eteläosien (lähinnä Sierra Nevada) koskikarat kuuluvat. Biometria ja geneettiset tutkimukset tukevat hypoteesia.

Baserat på nuvarande kunskap finns det två häckande strömstareraser på den Iberiska halvön: C. c. cinclus (samma som den nordiska rasen), med svart bröst, i de norra och västra delarna samt C. c. aquaticus, med brunt bröstbälte, i söder och öster. Nyare studier har emellertid visat att C. c. cinclus och C. c. aquaticus, med undantag av de södra delarna av regionen, kan leva i samma region, även vid samma flod, och former som liknar de båda raserna har påträffats till och med hos samma individ, vars bröstfärg ändras med åldern. Två ringmärkta fåglar, och senare kontrollerade, ändrade bröstfärgen från C. c. cinclus-typ till C. c. aquaticus-typ och en fågel vice versa. I den södra delen av Iberia har man endast hittat fåglar med C. c. aquaticus-utseende. Av den anledningen borde strömstareraserna definieras på nytt! Förmodligen tillhör strömstararna i de norra och centrala delarna rasen C. c. cinclus eller någon annan ras, som avviker från rasen i de södra delarna (främst Sierra Nevada). Biometri och genetiska studier stöder hypotesen.