

DIFFERENTIAL MIGRATION IN A WINTERING POPULATION OF COMMON GUILLEMOTS *URIA AALGE* AFFECTED BY THE *PRESTIGE* OIL SPILL

MIGRACIÓN DIFERENCIAL EN UNA POBLACIÓN INVERNANTE DE ARAO COMÚN *URIA AALGE* AFECTADA POR LA MAREA NEGRA DEL *PRESTIGE*

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In some species or populations of migrant birds, the distances travelled and subsequent wintering areas may vary between categories of sex or age. This phenomenon is usually called «differential migration» (Ketterson & Nolan, 1983) and can be explained as a trade-off between the benefits and the costs of moving less of further from breeding places. Those birds that pass the winter close to the nesting places gain the benefits of shorter return journeys and better chances of obtaining a good breeding territory, but they must bear a harder winter climate.

The differences in migration patterns between adult and immature birds are common in a great part of the migrant birds (see Cristol *et al.*, 1999). Usually, juvenile birds migrate early and further away than adults. The differential migration of sexes has been studied in some species of ducks and other dimorphic species of birds (Broyer & Fournier, 1995; Méndez *et al.*, 1997). In sexually monomorphic species the study of the differential migration between sexes is very difficult due to the impossibility of determining the sex of the birds in the field (Nettleship & Birkhead, 1995). The catastrophic mortalities produced by oil spills allow the study of big samples of seabirds, very difficult to obtain in normal circumstances (Anker-Nilssen *et al.*, 1988). Moreover, the oil presumably affects in the same way at all the birds, independently of their sex or age (Nevins & Carter, 2003; Wiese *et al.*, 2004), and this fact allows to take an unbiased sample of birds.

The aim of this study is to determine the sex ratio and age composition of the wintering po-

pulation Common Guillemot *Uria aalge* in the north of Spain and to study the possible existence of sex and/or age differential migration patterns in these species.

On 19 November 2002, the *Prestige* oil tanker wrecked at about 130 nautical miles WSW off Cape Finisterre (Galicia, NW Spain; 42°15' N 12°08' W), with a cargo of 77,000 tonnes of heavy fuel oil. This caused the spill of 60,000 Tm of fuel during the following months, affecting some 1,000 km of the Iberian Peninsula and French coast. The total number of dead seabirds officially registered by the authorities was 21,538 of which the huge majority (19,961 birds, 92.7%) were auks (García *et al.*, 2003). Moreover, the total mortality produced for the *Prestige* oil spill was estimated at 200,000-300,000 birds (Arcos *et al.*, unpub. data).

Dead birds were collected along the coast of Asturias by volunteers and personnel of the «Guardería de Medio Ambiente del Principado de Asturias». A total of 142 Guillemots were measured and aged on the same day of their collection, and 45 more birds were stored in freezers at -20°C after collection for posterior biometric analysis and determination of age and sex. The carcasses of these animals were processed after being thawed one day before examination. Only the birds well conserved were analysed due to the difficulties of sexing animals in advanced internal decomposition. The age of the birds was determined by plumage and bill characteristics (Baker, 1993; Arcos *et al.*, 2001), distinguishing between first winter (juveniles) and «adults» (birds over one year of

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age, either immature or adults). This classification was adopted given the impossibility to distinguish the individuals of more than one year from the adults. All the animals were collected between 6th December 2002 and 25th January 2003. Four biometric measures were recorded for each bird: bill length (± 0.01 mm), bill depth (± 0.01 mm), tarsus length (± 0.01 mm) and wing length (± 1 mm). Measures were conducted using a stopped rule (wing length) and digital callipers (bill length, bill depth and tarsus length). Birds were sexed by gonad inspection. Since most casualties were highly affected by the fuel, the birds were not weighted.

Multivariate analysis of variance (MANOVA) was used to test for overall differences in biometry between age and sex groups. The sex ratio was calculated as the percentage of males in the population. The deviation of sex-ratio in relation to 1:1 (50% of males) was studied using Chi-square tests, applying the Yates correction for continuity. The same analysis was performed to study the differences in age composition. To determine the differences in sex-ratio between juvenile and adult birds a logistic regression procedure was used. All the analyses were performed with SPSS.

Significant biometric differences were found between first-year and adult Guillemots (MANOVA Wilk's $\lambda = 0.702$, $F_{4,177} = 18.72$, $P < 0.001$), being the first-year birds smaller than the adult ones. No differences in size were found between sexes (MANOVA Wilk's $\lambda = 0.929$, $F_{4,38} = 0.72$, $P = 0.58$). The 76% of the analysed Guillemots were young-of-the-year birds ($\chi^2 = 50.31$; $df = 1$; $P < 0.001$; $n = 187$). The sex distribution differed between adults and immatures, with significantly more males than females among first year birds ($\chi^2 = 25.29$; $df = 1$; $P < 0.001$; $n = 31$; Fig. 1) and no significant differences in the sex ratio of the birds older than one year ($\chi^2 = 0.071$; $df = 1$; $P = 0.78$; $n = 14$; Fig. 1). The results of the logistic regression analysis showed a significant difference in sex-ratio in relation to the age of the studied birds ($r = 0.61$; $F_{1,43} = 18.04$; $P < 0.001$).

The results of the present study support the idea of differential migration in Common Guillemots both between ages and between sexes. The majority of the wintering birds in the study area were first-year birds. This coincides with the data obtained from Galicia (García *et al.*, 2003). These results support the hypothesis that young/first-year birds migrate further south/lon-

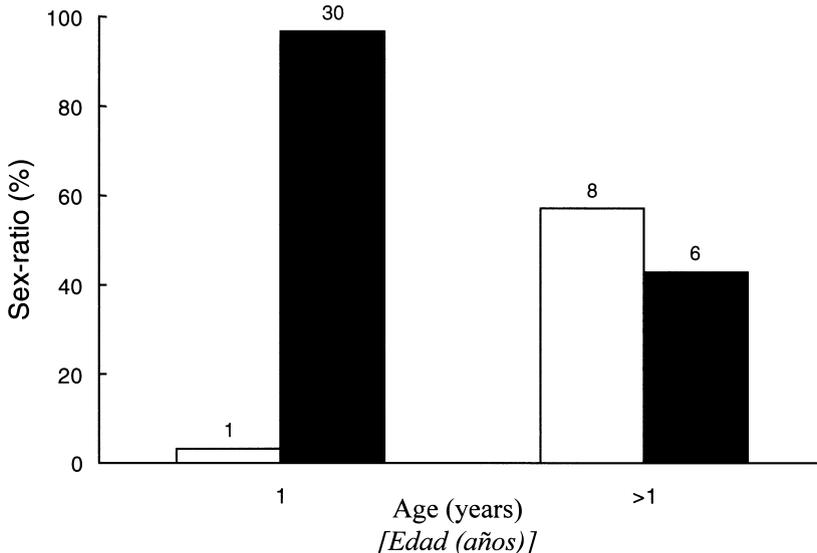


FIG. 1.—Sex-age distribution of the studied Guillemots ($n = 45$). Open bars: Females; Close bars: Males. The digits on the bars indicate the sample size of each class.

[Distribución de sexos y edades en los Araos Comunes estudiados. Barras blancas: Hembras; Barras negras: Machos. Los números de encima de las barras indican el tamaño de muestra de cada clase].

ger distances than adults (Cristol *et al.*, 1999) because it is more important for the young birds to survive the winter than to return early to the colonies to breed, thus increasing the chances of reproduction in the future (*i.e.* lifespan fitness). The small difference in size between ages not seems to be enough to explain the presence of more juvenile birds in the southern areas due to differences in fat accumulation as occur in other species (Furness & Monaghan, 1987).

The sex migration patterns in the study population of Guillemots seem to differ according to the age of individuals. Whereas first-year birds showed strong sex segregation, in adult birds the sex ratio did not significantly differ from parity. These differences can not be explained by a different sex-ratio in offspring production, since the sexual proportion of the chicks was 1:1 at hatching (Parker *et al.*, 1991). In the present work, the adults and the young older than one year were analyzed together, for which reason a possible sexual segregation in mature birds as occur in Britain (Stratford & Partridge, 1996) might not be discarded. This kind of wintering sex-segregation could be explained because the males have a greater colony attendance during winter whereas the females disperse further away (Harris & Wanless 1989, 1990). The fact that the sex-segregation in the study population happens in the first-year birds do not support that hypothesis in this case study. In dimorphic species with great differences in size between males and females, the bigger sex usually migrates further away than the smaller one (Broyer & Fournier, 1995; Cristol *et al.*, 1999). The absence of size differences between sexes in Guillemots does neither support this idea. One of the possible explanations for these results could be the existence of different wintering areas for the males and the females (competitive segregation) (Cтры *et al.*, 2004). The results obtained in Galicia, where most of the recovered birds were females (García *et al.*, 2003), might support this supposition. Another explanation is the possible competence both between sexes and between ages in this specie (Cresswell, 1994; Carbone & Owen, 1995).

RESUMEN.—*Se estudió la existencia de migración diferencial en sexos y/o edades en el Arao Común en la costa asturiana (Norte de España) afectada por la marea negra del Prestige. Se estudiaron un total de*

187 cadáveres entre diciembre de 2002 y enero de 2003. El 76% de las aves fueron jóvenes del año, en su gran mayoría machos (97%). Los adultos no presentaron diferencias en proporción de sexos. Estos resultados se podrían deber a que los jóvenes viajen más al sur, donde las condiciones son más benignas, mientras que los adultos permanezcan cerca de las colonias para asegurar la reproducción del año siguiente. Una posible hipótesis para explicar la mayor proporción de machos entre los jóvenes del año es la existencia de diferentes zonas de invernada para cada sexo.

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