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CAUSES OF MORTALITY OF THE SHORT-EARED OWL *(ASIO FLAMMEUS)* IN SPAIN

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SUMMARY.—*Causes of mortality of the Short-eared Owl* (Asio flammeus) *in Spain.* The mortality rate of the Short-eared Owl *Asio flammeus* in Spain, has been studied during winter. The main cause of mortality, 70.2 % of the total, is illegal shooting. There is a coincidence between the temporal distribution of the mortality rate and the phenology of the species in this region. The existence of two preferred wintering zones in the Iberian peninsula is confirmed. The global mortality rate caused by direct human factors reaches a worrying 83.9 %.

Key words: Asio flammeus, mortality, Spain, wintering.

RESUMEN.—*Causas de mortalidad de la Lechuza Campestre* (Asio flammeus) *en España.* Se estudia la mortalidad invernal de *Asio flammeus* en España. La principal causa de mortalidad la constituyen los disparos ilegales por arma de fuego, con el 70,2 % del total. Se observa una gran coincidencia entre la distribución temporal de la mortalidad y la fenología de la especie en la región. Parece confirmarse la existencia de dos zonas preferenciales de invernada en Iberia. La mortalidad global causada por factores directos humanos alcanza el preocupante valor del 83,9 %.

Palabras clave: Asio flammeus, España, invernada, mortalidad.

INTRODUCTION

The Short-eared Owl *(Asio flammeus)* is one of Spain's least known birds of prey. This lack of knowledge is due to its migratory habits and because it is an extremely irregular migratory species, with irruptive appearances in our country (Asensio *et al.*, 1992). There is only scant detailed information about the birds' feeding habits in a few limited areas, and reports concerning its phenology and wintering zones in the Iberian peninsula. The information available about this species' ecology, inter and intraspecific interactions, mortality rate or general biology are generally scarce in the papers published (for a revision of the available information see Asensio *et al.*,1992).

This article tries to increase the knowledge of the ecology of *Asio flammeus* in our country by analysing the mortality causes and the spatial and temporal distribution of its mortality.

The analysis of the mortality rate and its causal factors in other Strigiformes have contributed considerably to a better knowledge of these species, specially in relation with the phenomenon and causes of the population decline. These general objectives are of great importance if we consider that the species is classified as rare in our country (ICONA, 1992).

The objectives of this study are: 1) to know the causes of mortality of *Asio flammeus* and its relative importance in its wintering areas of the Iberian peninsula, with respect to the spatio-temporal distribution of its mortality, 2) to find possible differences in this mortality pattern between the two possible wintering areas in Spain, and 3) to compare this mortality pattern to that of other species of Strigiformes in the same areas.

STUDY AREA AND METHODS

The entire surface of Spain, considered as migration and winter quarters of *Asio flammeus* (Mikkola, 1983; Cramp, 1985), is the subject zone of the sampling method of this study.

A total of 221 death cases of *Asio flammeus* have been recorded in the whole of Spain

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with the method presented below. Of these, 16 cases (7.23 %) have not been considered as they concern a vast extension and are very irregularly distributed in space and time. The remaining 92.77 % ($n = 205$) are located in two well defined areas with a high concentration of data (Fig. 1). As this information coincides with that published by Asensio *et al.* (1992), only these two main areas are contemplated, excluding the small percentage mentioned above.

These two areas are:

1. Northern half of the Spanish Central plateau, the Cantabrian coastal strip and Galicia (hereafter Z1). This first study area biogeographically includes the colline bioclimatic belt of the Eurosiberian region characterized by a zonal vegetation based on *Quercus robur, Erica* and *Ulex* sp. Forestry and cattle raising (mostly grazing pastures) are the present agricultural uses. The average minimum temperatures of the coldest month is 2° C. It also includes the supramediterranean belt of the Mediterranean region, characterized by a potential vegetation of *Quercus rotundifolia, Q. pyrenaica* and *Juniperus thurifera* and its typical serial shrub composed of *Cistus, Genista*, etc. The agricultural uses of these land are mainly forestry, cattle raising and cereal crops. The average minimum temperature of the coldest month fluctuates between −4° and −1° C.

2. Eastern coast (Levante) and coastal Andalucia (hereafter Z2). This second research area corresponds to the thermomediterranean belt of the Mediterranean region, typified by a zonal vegetation of *Q. ilex* and *Q. suber* woodlands and *Pistacia* and *Olea* shrub amongst others. The predominant agricultural uses are tropical and olive tree plantations, and orchards and irrigated lands (for a more detailed description of Spain's vegetation see Rivas-Martínez, 1981). The average minimum temperature of the coldest month fluctuates between 5° and 10° C.

The diet of this owl in Zone 1 is based mainly on cyclic populations of the Common Vole *Microtus arvalis* (González *et al.*, 1980; Delibes, 1989; Delibes *et al.*, 1991), whereas in Zone 2 it is on Murids (Jiménez *et al.*, 1989; Asensio *et al.*, 1992; and own data).

The study was carried out between 1987 and 1992, with a constant research effort of data gathering during the six years. The extremely irregular and disruptive presence of *Asio flammeus* in Spain, has been taken into account for the selection and design of the research method. This same factor has made totally impossible the adoption of a sampling system that registers information regularly and constantly (for an aproximation to a standard method see Fajardo, 1990). The methodology partialy applied by Asensio *et al.*, (1992) for the same species with apparently satisfactory results, is adopted in this study.

The data presently analyzed have been obtained from:

— Ten different and preestablished road routes, no longer than 100 km, were covered twice a month in each Comunidad Autonoma (administrative regional units with a certain degree of autonomy). Areas with suitable habitats for the species were visited three times a month. This sampling method has been applied to the following Comunidades Autonomas: Galicia, Cataluña, Madrid, Castilla-León, Castilla-La Mancha, Extremadura and Asturias (Fig. 1). For Andalucía, Comunidad Valenciana, Murcia and País Vasco, the routes and visits were carried out once a month.

— The register books of the most important rescue centres for raptors in the research areas and in the rest of Spain.

— Frequent inquiries and polls to 17 experienced ornithologists and naturalists, who regularly visit localities that are ideal for detecting the presence of the species in the same regions.

— Bibliographic references have also been included, although their relative importance is minor in comparison with the rest of the sources used.

In spite of the limitations that these indirect methods create, it can be considered as the most appropriate and reliable methodology to study the causes of mortality of the Short-eared Owl. The enormous differences amongst mortality factors, the similitude between phenology (Asensio *et al.*, 1992) and the temporal distribution of mortality and the sample size indicate an acceptable level of precision of the chosen methodology.

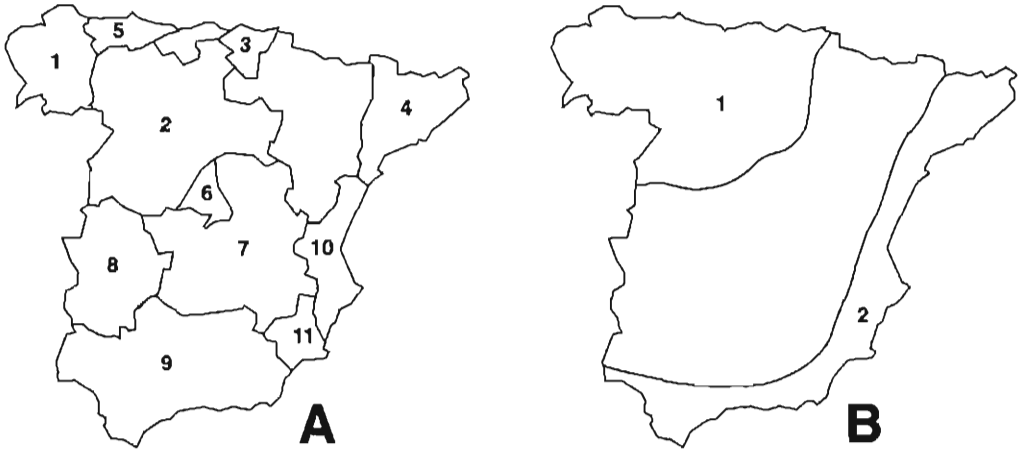

FIG. 1.—A: Comunidades Autónomas where the study has been carried out. 1: Galicia; 2: Castilla-León; 3: País Vasco; 4: Cataluña; 5: Asturias; 6: Madrid; 7: Castilla-La Mancha; 8: Extremadura; 9: Andalucía; 10: Comunidad Valenciana; 11: Murcia. B: Preferential wintering areas according to the bibliography and the data distribution recorded for this study. 1: Northern half of the Central plateau, Cantabrian coastal strip and Galicia; 2: Eastern and southern coast.
[A: Comunidades Autónomas donde el estudio se ha llevado a cabo. 1: Galicia; 2: Castilla-León; 3: País Vasco; 4: Cataluña; 5: Asturias; 6: Madrid; 7: Castilla-La Mancha; 8: Extremadura; 9: Andalucía; 10: Comunidad Valenciana; 11: Murcia. B: Areas preferenciales de invernada de acuerdo con la bibliografía y la distribución de datos aportados por este estudio. 1: Submeseta Norte, franja costera cantábrica y Galicia; 2: Levante y costa andaluza.]

The determination of the cause of death has been done based on the circumstances in which the bodies were found and the post-mortem examination by the clinical personel of the rescue centres, method already used by other authors (Marti, 1984; Kerlinger & Lein, 1988; Fajardo, 1990).

RESULTS

A total of 205 death cases of *Asio flammeus* have been finally considered and can be classified according to their cause, area and relative value as shown in table 1. Of these, 72.2 % ($n = 148$) of the total cases belong to the study area 1, the remaining 27.8 % ($n = 57$) belong to area 2. Figure 2 represents the monthly distribution of the total mortality and its distribution in both research areas. The highest percentage detected corresponds to shooting (70.2 %), an overwhelming value if compared to the rest of the recorded cases. The differences between both areas are significant ($\chi^2_1 = 4.49$, $P < 0.05$) being larger in Z1.

This cause acquires a similar value in *Bubo bubo* with 62.6 % (Hernández, 1990) but a secondary importance in *Tyto alba* with 15.5 % (Fajardo, 1990).

Other recorded causes in order of importance are: a) birds found exhausted or emaciated, b) road traffic accidents (RTAs), c) trapped birds, d) unknown causes, and e) collisions with electric lines.

The distribution is not uniform between research areas. There are highly significant differences between Z_1 and Z_2 in cases of RTAs and trapped birds, which are considerably larger in research area 2 ($\chi^2_1 = 10.27$, $P < 0.01$ for RTAs and $\chi^2_1 = 8.97$, $P < 0.01$ for trapped birds).

The losses produced by RTAs are a small proportion of the total (8.3 % for the Iberian peninsula, 4.1 % for Z1). However, in Z2 the proportion is considerable (18.3 %). In the case of other Iberian Strigiformes (*Tyto alba* and *Athene noctua*), this cause of mortality is

TABLE 1

Short-eared Owl mortality in Spain. Absolute and relative values of each mortality factor are included for both studied zones and totals.
[Mortalidad de Lechuza Campestre en España. Se representan los valores absolutos y relativos de cada causa registrada para ambas zonas de estudio y el total.]

	Total		*Zone 1*		*Zone 2*	
	N	%	*N*	%	*N*	%
Shot	144	70.2	110	74.8	34	58.6
Emaciated or exhausted	26	12.6	25	16.3	1	1.7
Rta	17	8.29	6	4.08	11	18.9
Trapped	9	4.3	2	1.3	7	12
Unknown	7	3.4	5	3.3	2	3.4
Electrocuted	2	0.97	0	0	2	3.4
	205		148		57	

of primary importance and far above the rest (36.5 % for *T. alba*).

Emaciation is an important cause in area 1, and the difference is highly significant ($\chi^2_1 = 7.41$, $P = 0.01$).

The other causes are not of great importance in our sample as their values are always under 5 % for both areas. If we add the values of the mortalities caused directly or indirectly by man, we reach a stunning 83.9 % ($n = 172$) of the total (80.2 %, $n = 118$, for area 1 and 93.1 %, $n = 54$, for area 2). The differences between Z_1 and Z_2 are significant ($\chi^2_1 = 4.15$, $P < 0.05$).

DISCUSSION

The temporal distribution of the mortality of *Asio flammeus* in Spain shows great similarity to its phenology.

On the other hand, the spatial distribution of data seems to confirm the possible existence of two preferential wintering and/or migratory areas for this species in the Iberian peninsula, as other authors have already pointed out (Asensio *et al.*, 1992).

As far as the different mortality causes are concerned, shooting is by far the most important cause of death in the whole of the country and therefore the main threat for the population of this wintering owl.

The increased mortality by collisions with vehicles in area 2 can be due to a higher concentration of the factors that propiciate RTAs for this species (for a description of these factors see Fajardo *et al.*, 1992). The higher toll of trapped birds in area 2 is caused by a characteristic and traditionally popular type of trap called «parany», which accounts for the death of many migratory birds each year (pers. obs. G.E.R.).

The importance of direct or indirect human factors, as causes of death, in both zones separately and as a whole, is so worrying that it could be considered as a cause of population decline, as it occurs with other owls (Colvin, 1985; Hernández, 1988; Fajardo, 1990; Fajardo *et al.*, 1992).

The considerable difference between research areas in the relative values of mortality caused by emaciation is difficult to interpret biologically.

For other irruptive wintering owls like the Snowy Owl *(Nyctea scandiaca)*, the importance of the mortality caused by starvation is proportionally low (14.1 %). However, this amount tends to grow in periferic zones of their wintering areas (Kerlinger & Lein, 1988). Considering the great similitude in the irregular and irruptive migratory behaviour of both species (Sparks & Soper, 1991), the conclusions reached for the Snowy Owl might be extrapolated and applied to this study of *Asio flammeus* in Spain. In that case, the importance of emaciation would depend on the year.

It can finally be concluded that the management of the species in Spain should first

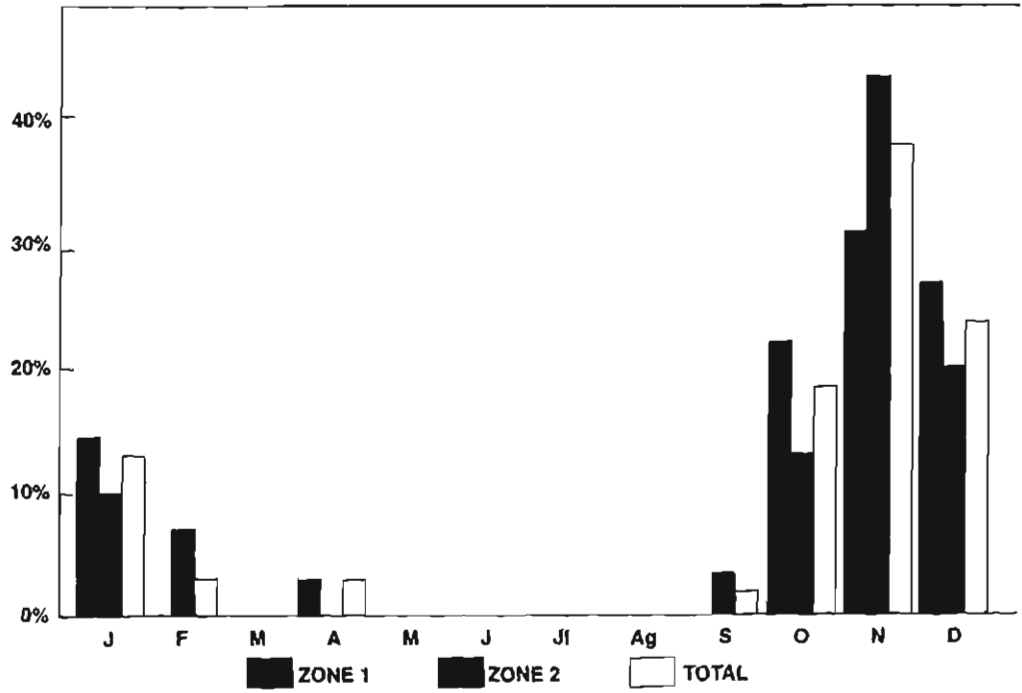

FIG. 2.—Monthly distribution of Short-eared Owl mortality in both zones and the total.
[Distribución mensual de la mortalidad de la Lechuza Campestre para las dos zonas y el total a lo largo del año.]

bear in mind the need for a reduction in the mortality caused by man. The importance of human factors might constitute a cause of regression of the breeding population.

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