

Preliminary Data for a Comparative Study of the Feeding Habits of *Asio otus canariensis* on El Hierro and Gran Canaria, Canary Islands

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ABSTRACT

From analysis of 4,446 prey items, the diets of *Asio otus canariensis* on El Hierro and Gran Canaria islands are contrasted and also compared with the data given for Tenerife.

Muridae form a substantial part of this owl's diet - up to 92.8% of the total biomass. This applies to all habitats studied, except for the endemic pine forests, where they are partially replaced by rabbits. In addition, the local use of alternative trophic sources such as birds and reptiles is confirmed.

In relation to European populations of the Long-eared Owl, several differences are noted: (1) an increase in the taking of reptiles, especially Gekkonidae, (2) a high degree of entomophagy, the families most preyed on being Tettigoniidae and Gryllidae, (3) a certain euryphagous degree.

INTRODUCTION

Two of the nine species of raptor present in the Canary Islands are Strigiformes, i.e. the Long-eared Owl *Asio otus canariensis* and the Barn Owl, represented by subspecies *Tyto alba alba* on Tenerife, Gran Canaria and El Hierro islands, and the endemic *T. a. gracilirostris* on the eastern islands and barren islets.

The Long-eared Owl is found on both the central and western islands, even spreading over the dry southern areas of Tenerife and Gran Canaria (Fig. 1). It does not, however, occupy the similar dry habitats of the eastern islands of Fuerteventura and Lanzarote. The species is widely distributed throughout the Canaries, and is found in various zones such as forests, arid lands, farming and urban areas, and even high mountain scrub.

Despite the scant literature available on the Canary Is. owls, early studies provide trophic information on both species. According to Mompo (1876), Koenig (1890) and Bannerman (1963), the basic diet of *Tyto alba* consists of small rodents, although the last author adds that they also hunt lizards and other birds. Concerning the Long-eared Owl, both Polatzek (1908) and Morphy (1964) seem to agree on its insectivorous habits, while Meade-Waldo (1890) holds that it feeds on lizards on El Hierro. Currently, Martin *et al.* (1985) and Martin & Machado (1985) are covering a

trophic study of the Barn Owl on Tenerife and El Hierro respectively. The numerous references to the Long-eared Owl (Bannerman 1963; Rey 1975; Moreno *et al.* 1984; Nogales *et al.* 1986; Rodriguez 1987) are mainly brief notes mentioning a scanty number of prey. Delgado *et al.* (1986) have recently done extensive research on the diet of this owl on Tenerife.

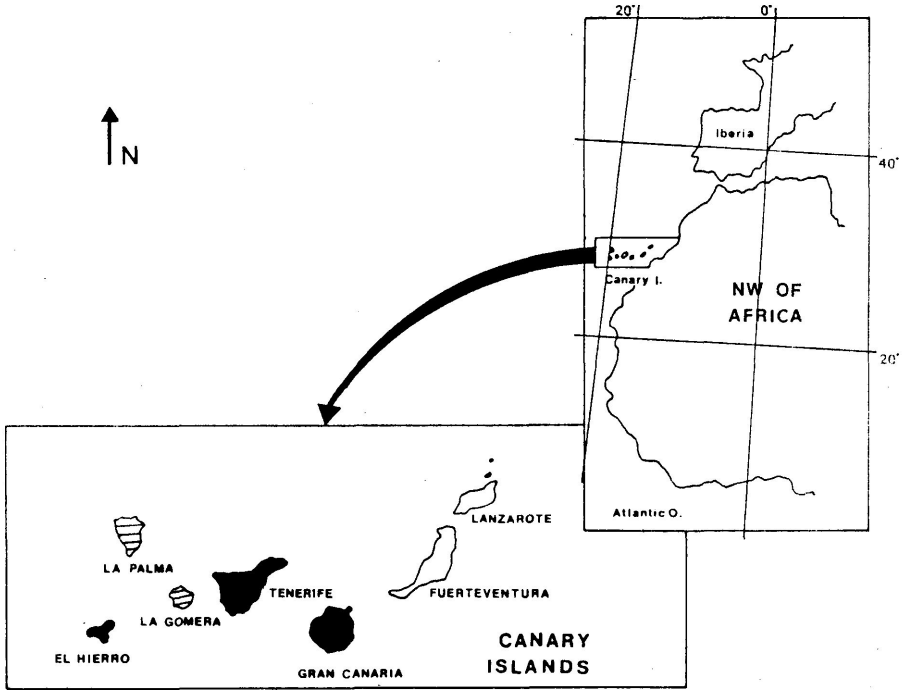


Figure 1. Distribution of *Asio otus canariensis* in the Canary Islands. Black areas: the islands covered by the study; hatched areas: islands where species is also present.

This paper presents a comparative study of *Asio otus*' trophic range on the islands of El Hierro and Gran Canaria, which is then compared with the results obtained by Delgado *et al.* (1986) on Tenerife.

STUDY AREA

Gran Canaria

Material was collected around two gorges (Barranco del Draguillo and Barranco de Silva) on the NE side of the island, 400-500 m above sea level. These two gorges are approximately 1,500 m apart. The local vegetation includes the remains of a wild olive forest. Additional minor differences in vegetation occur between the two zones, due to the micro-climatic effect produced by the accidented orography of the islands.

El Hierro

Material was collected in three different habitats:

1. Pastures (Llano de Nizdafa, 1,000 m a.s.l.) located in the central part of the island, characterised by a number of small volcanoes in a generally flat landscape. This area also contains several groves of *Pinus radiata*.
2. Remnant groves of "fayal-brezal", composed mainly of *Myrica faya* and *Erica arborea* alternated with small plantings of *Cupressus sempervirens*. This site, known as Montaña de Jares, is located in the NE part of the island, 760 m a.s.l..
3. Pine forest (Montaña de la Fuente and Llano de Guillén, 1,150 m a.s.l.): rather open forest of *cPinus canariensis* on the south side of the island.

MATERIAL AND METHODS

Pellets collected during the months given in Table 1, included 4,446 prey remains. These - 593 pellets from Gran Canaria and 253 from El Hierro - were found below several tree species, such as *Olea europaea*, *Cupressus sempervirens*, and also *Pinus canariensis* and *P. radiata* in the afforested areas.

Table 1. Collecting dates of pellets on El Hierro and Gran Canaria.

| El Hierro | | Gran Canaria | |
|---------------------|--------------|------------------------|--------------|
| Montaña de Jares | 17.04.1986 | | (12.01.1985) |
| Llano de Guillén | 16.05.1986 | Barranco Draguillo | (19.01.1985) |
| Llanos de la Fuente | (20.05.1986) | | (16.09.1986) |
| | (26.06.1986) | | |
| El Jorado (Nizdafe) | 13.10.1986 | Barranco Silva (Telde) | (10.09.1986) |
| | | | (18.10.1986) |

The pellets were analysed both in bulk and "soaked in water". Part of the material was diluted in a Petri dish and examined through a binocular microscope (Crichton 1977). It should be pointed out that an exhaustive analysis of this type would be unlikely to modify the biomass results very much, but it would probably increase the variety of prey.

The collection of the Zoology Dept. of the Biology Faculty, University of La Laguna, helped in the identification of the prey remains, both as regards quality and quantity. The quantitative evaluation was assessed according to the presence of each prey-element per pellet. In order to identify some *Passeriformes*, we also consulted the osteological key provided by Moreno (1985).

Each prey-species biomass was calculated on the basis of its representative weight, obtained from captured specimens where possible, or by comparison with closely related species of similar size and taxonomy (Mañez 1983).

RESULTS

The weight of prey ranged from 0.01 g in certain insects to 200 g in *Oryctolagus cuniculus*. The average prey weight was 17.8 g. Nevertheless the range in size was markedly larger as compared with other areas in the Iberian Peninsula (Delibes *et al.* 1983) This could be due to an expansion of the trophic niche likely to result from the absence of potentially competitive species such as *Otus scops* and *Athene noctua*.

Mammals

As in Europe (Moltoni 1937; Araujo *et al.* 1974; Corral *et al.* 1979; Village 1981; Mikkola 1983 among others) and some North American areas (Marks 1984; Marks & Marti 1984; Craig *et al.* 1985), mammals constitute the basic diet of *Asio otus* on the two islands studied (Fig. 2A). This coincides with the results obtained by Rey (1975) and Delgado *et al.* (1986) on Tenerife and also with those of Rodriguez (1987) on Gran Canaria.

On the European mainland this owl feeds basically on Microtinae, but in the absence of these in the Canaries it takes other food items such as Muridae (*Mus* spp. and *Rattus* spp.). These represent up to 92.8% of the total biomass in Gran Canaria wild olive woodlands. However, the rate changes remarkably depending on the habitat; thus the lowest percentage of Muridae, 55.6%, occurs in the pine forest on El Hierro, where the owl preys continuously on *Oryctolagus cuniculus* (Fig. 2A). This suggests that the owls are opportunistic there, a finding different from that of Lopez-Gordo *et al.* (1977) and Veiga (1978) regarding the hunting of Lagomorphs.

The capture of two specimens of *Pipistrellus* sp. present in El Hierro pine forest suggests a minimum predatory pressure on bats, which are occasional, not only in the diet of *Asio otus* in other latitudes (Moltoni 1937; Glue & Hammond 1974; Veiga 1978) but also in the diet of *Tyto alba* in the Canaries (Martin & Machado 1985). Furthermore, Hutterer (1979) mentions the finding of a *Tadarida teniotis* in an "owl" pellet on El Hierro.

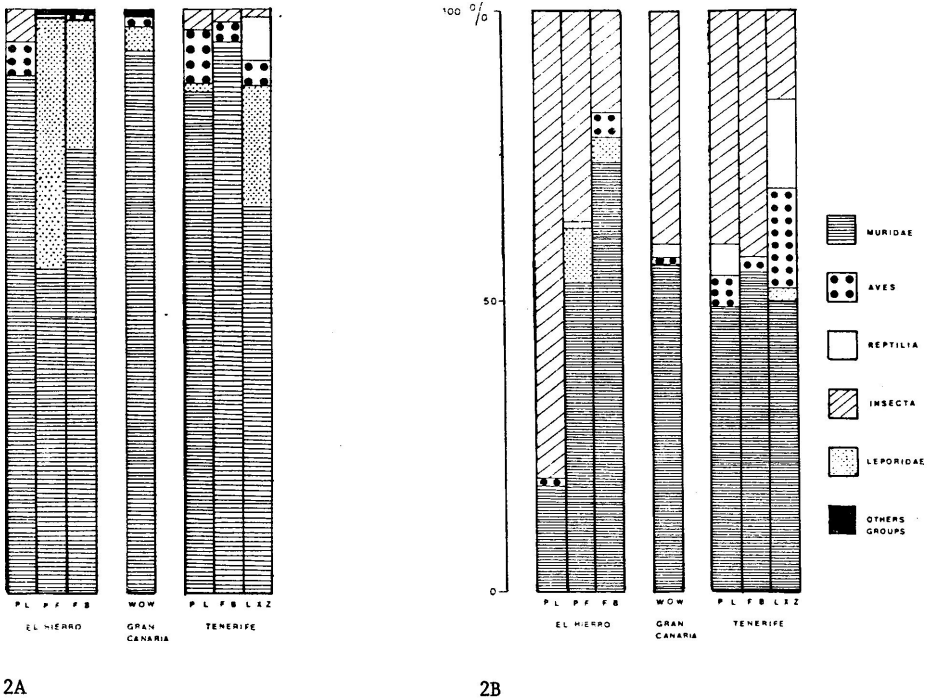


Figure 2A. Biomass percentages of the most important prey-groups found in the different habitats studied.

Figure 2B. Capture percentages of the most important prey-groups found in the different habitats studied. The data for Tenerife correspond to Delgado *et al.* (1986). PL: pasture land; PF: pine forest; FB: "fayal-brezal"; WOW: wild olive woodland; LXZ: lower xerophitic zone.

Birds

The proportion of birds taken in El Hierro pine forests stands at 0.6%, increasing to 4.6% in the remnant groves of "fayal-brezal". For the Long-eared Owl, birds constitute the second most important vertebrate prey in its diet, although their frequency of capture stands below 5%. It is in the open areas of El Hierro, in its pastures, that we find the highest biomass rate of 5.9%. A similar rate applies to the pastures and farming areas on Tenerife (Delgado *et al.* 1986) and generally for the other regions studied (Moltoni 1937; Glue 1977; Village 1981; Marks 1984; etc.). An exception here is the figure given by Amat & Soriguer (1981) in Badajoz, Western Spain, of 13.5% during summer, and also that of 15% obtained in England by Glue & Hammond (1974).

Although birds constitute an alternative source in the Long-eared Owl's diet, they can in fact form a major part of it at certain specific points on Gran Canaria (Nogales *et al.* 1986) and can even be the main food-base when the owl spends several weeks on certain migratory bird routes (Hartwig & Vauk 1969). According to findings of Veiga (1978), our capture rates, except for the maximum, are lower than those given for Germany, France, England, Scandinavia and mainland Spain.

As indicated by Araujo *et al.* (1974), the two families most heavily preyed upon are *Fringillidae* and *Ploceidae*. We found that the species most preyed on in El Hierro remnant "fayal-brezal" groves was *Serinus canaria* (4.6% of the total biomass), followed by *Passer hispaniolensis* (0.9%), particularly in the pastures when they gather to roost.

Reptiles

A less important food group for the Long-eared Owl, presenting a variation in biomass from 0.1% to 0.7%. Surprisingly, this rises to 2.5% in the wild olive woodlands of Gran Canaria.

The family most preyed on was *Gekkonidae* - *Tarentola boettgeri* on Gran Canaria and *Tarentola delalandii* on El Hierro - followed by *Lacertidae* and *Scincidae*. This barely-exploited source

becomes significant when we find that it rises to 19.4% of all captures in the lower arid (xerophytic) zone of southern Tenerife (Delgado *et al.* 1986). It is equally important in those areas of north-eastern Gran Canaria, where preying on *Chalcides sexlineatus* may amount to 20% of all captures (Moreno *et al.* 1984). Thus we believe that the importance given by Meade-Waldo (1890) to lizards in the diet of the Long-eared Owl on El Hierro is insufficiently justified.

Apart from this important local focus, reptiles are no great favourites of the owl; neither do they form a part of its diet in Europe. Veiga (1978) alone reports finding remains of an unidentified reptile.

Arthropods

On the two islands studied, the arthropod biomass rates range from 0.1% to 5.4%, apart from the high capture frequencies at the pastures, 79% (Fig. 2B). These rates are also similar to those on Tenerife (Delgado *et al.* 1986). The major part of the owl's entomophagous diet is composed of Orthoptera (Tettigoniidae and Gryllidae).

The presence of the Dermaptera *Anisolabis maxima* in the pine forests is also significant. Here too it is preferred by the Kestrel (Carrillo *et al.*, in press).

The importance of insects in this owl's diet in the Canary Islands is not a new matter. Polatzek (1908) and Morphy (1964) point out the presence of Acrididae and Gryllidae in several analysed stomach contents. Furthermore, results obtained by Rey (1975) studying pellets collected near La Laguna (Tenerife) show a 33% prey level of arthropods, slightly lower than that given by Delgado *et al.* (1986) on Tenerife.

DISCUSSION AND CONCLUSIONS

The trophic spectrum of *Asio otus* on the two islands studied follows the same basic pattern as that of European populations, with mammals exceeding a biomass level of 88.5%, rising to 99.2% in the pine forests of El Hierro.

This diet consists almost entirely of Muridae (92.8% of the total biomass in Gran Canaria wild olive woodlands), corresponding closely with the results obtained by Delgado *et al.* (1986) on Tenerife. The Muridae are particularly preyed on in such habitats as pastures, farmland (or anthropogenic areas), the remnant "fayal-brejal" groves on El Hierro and the Gran Canaria wild olive woods. Thus on the three islands studied to date we observe that absent Microtidae (i.e. *Microtus* spp., *Pitymys* spp., *Clethrionomys* spp. and even the Murid *Apodemus sylvaticus*) are replaced by the Muridae (i.e. *Mus musculus* and *Rattus rattus*) in the Canaries. All these are typical prey of the Long-eared Owl in Europe (Mikkola 1983). It is true that this species readily adapts to different habitats, using whatever resources are available (Lundberg in Amat & Soriguer 1981), as shown by our discovery of young rabbit remains, also verified by Araujo *et al.* (1974) and Lopez-Gordo *et al.* (1977) in Spain, Glue (1977) in England and Marks & Marti (1984) in Idaho (U.S.A.).

The separate distribution of Soricidae and *Asio otus* in the Canary Islands (Martin *et al.* 1984) is verified by the absence of shrews from the diet, but it should be noted that this owl's food habits have not yet been studied in those places on Tenerife where it co-exists with the Insectivora. Although these mammals do not usually form a regular prey of the Long-eared Owl (Thiollay 1968; Nilsson 1981; Delibes *et al.* 1983; Wijnandts 1984), it seems that they are taken rather more in the extreme north (Scandinavia) and the south (Spanish mainland) of Europe (Araujo *et al.* 1974). Thus Veiga (1978) remarks on the relatively high capture percentages in the Sierra de Guadarrama (Central Spain) (24.6%), mainly when he had already considered the revision carried out by Araujo *et al.* (1974).

Although birds form the second most important prey group, they seem to play a secondary role in the diet, as is also the case in Europe. The incidence of predation on them over the pastures and farming areas indicates the type of hunting ground preferred by the Long-eared Owl. It is a frequent visitor to these open spaces (Blondel 1967; Veiga 1978), particularly when Fringillidae, Ploceidae and Embericidae assemble to roost.

The taking of reptiles is minimal but significant, except for certain individuals which specialise in this resource (Moreno *et al.* 1984). Those most preyed on are generally Gekkonidae, whilst the hunting of *Lacertidae* and *Scincidae*, particularly at dawn, indicates the owl's diurnal activity, as already suspected by Veiga (1978) and also shown by Moreno *et al.* (1984). In relation to the Euro-

pean populations, an increase here in feeding on these vertebrates is noted.

Asio otus's profoundly entomophagous character in the Canary Islands (Fig. 2B) emerges as one of the most peculiar features as compared with other Iberian and European populations. This had already been accounted by Delgado *et al.* (1986) on Tenerife and is here reinforced for El Hierro and Gran Canaria as well.

Amat & Soriguer (1981) found scant predation on insects in Europe, the highest level being 13.4%. In this connection, Uttendorfer's theory (see Rey 1975) seems to be confirmed, namely that the Long-eared Owl's insect diet increases as it descends in latitude. Thus the Canarian population stands apart from the European in its much higher capture frequency of insects. Nonetheless this group of arthropods does not constitute the trophic base of the Long-eared Owl, contrary to the statements made by Bannerman (1963) and Rey (1975).

Tettigoniidae and *Gryllidae* are basic prey as other Iberian (Araujo *et al.* 1974; Amat & Soriguer 1981) and Canarian (Delgado *et al.* 1986; Rodriguez 1987) researches have proved.

In the summer, the demographic exploitation of the Orthoptera populations, mainly at El Hierro pastures (Nogales, in prep.) causes the different predators - i.e. *Asio otus*, *Falco tinnunculus* (Carrillo *et al.*, in press), *Corvus corax*, *Larus argentatus* and possibly *Buteo buteo* - to centre their hunting activities on the Orthoptera. This would confirm the discussion on the optimal diet included in Schoener's theory of feeding strategies (1971), according to which a predator should concentrate on the prey offering the best energetic efficiency, when the food supply is abundant.

Generally speaking, the diet of *Asio otus* seems to be more diversified on El Hierro than on Gran Canaria, possibly due to the greater number of habitats studied in the former. Based on the theory put forward by Delgado *et al.* (1986) and our own findings, the trophic range of *Asio otus canariensis* shows a certain euryphagous degree which differs largely from the more stenophagous one of European populations (Herrera & Hiraldo 1976; Lopez-Gordo *et al.* 1977; Amat & Soriguer 1981).

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REFERENCES

- AMAT, J. A. & R. SORIGUER 1981. Analyse comparative des régimes alimentaires de l'Effraie *Tyto alba* et du Moyen-Duc *Asio otus* dans l'ouest de l'Espagne. *Alauda* 49(2): 112-120.
- ARAUJO, J., J. REY, A. LANDIN & A. MORENO 1973 (1974). Contribución al estudio del Búho Chico (*Asio otus*) en España. *Ardeola* 19: 397-428.
- BANNERMAN, D. A. 1963. *Birds of the Atlantic Islands. I: A history of the birds of the Canary Islands and of the Salvages.* Oliver & Boyd, Edinburgh & London.
- BLONDEL, J. 1967. Reflexions sur les rapports entre prédateurs et proies chez les rapaces. II: L'influence des proies sur les rapaces. *Terre et Vie* 114(1): 33-62.
- CARRILLO, J., R. GARCIA & M. NOGALES (in press). Contribution à l'étude du spectre alimentaire de *Falco tinnunculus* L. 1758, dans l'île de El Hierro: Premières données pour les Iles Canaries. *Alauda*.
- CORRAL, J. F., A. CORTES & J. M. GIL 1979. Contribución al estudio de la alimentación de *Asio otus* en el sur de España. *Doñana, Acta Vertebrata* 6(2): 179-190.
- CRAIG, T. H., E. H. CRAIG & L. R. POWERS 1985. Food habits of Long-eared Owls (*Asio otus*) at a communal roost site during the nesting season. *Auk* 102(1): 193-195.
- CRICHTON, J. 1977. The pellet analysis technique as a method of investigating the food habits of the Kestrel (*Falco tinnunculus*). Unpubl. honours thesis, University of Edinburgh.
- DELGADO, G., V. QUILIS, A. MARTIN & K. EMMERSON 1986. Alimentación del Búho Chico en la isla de Tenerife y análisis comparativo con la dieta de *Tyto alba*. *Doñana, Acta Vertebrata* 13: 87-93.
- DELIBES, M., P. BRUNET-LECOMPTE & M. MANEZ 1983. Datos sobre la alimentación de la Lechuza Común (*Tyto alba*), el Búho Chico (*Asio otus*) y el Mochuelo (*Athene noctua*) en una misma localidad de Castilla la Vieja. *Ardeola* 30: 57-65.
- GLUE, D. E. 1977. Breeding biology of Long-eared Owl. *Br. Birds* 70: 318-331.
- GLUE, D. E. & G. J. HAMMOND 1974. Feeding ecology of the Long-eared Owl in Britain and Ireland. *Br. Birds* 67: 361-369.

- HARTWIG, E. & G. VAUK 1969. Zug, Rast und Nahrung der auf Helgoland durchziehenden Waldohreulen (*Asio otus*). *Die Vogelwarte* 25(1): 13-19.
- HERRERA, C. M. & F. HIRALDO 1976. Food niche and trophic relationships among European Owls. *Ornis Scand.* 7: 29-41.
- HUTTERER, R. 1979. Occurrence of the European Free-tailed Bat (*Tadarida teniotis*) on Hierro, Canary Islands. *African Small Mammal Newsletter* 3: 6-7.
- KOENIG, A. 1890. Ornithologische Forschungsergebnisse einer Reise nach Madeira und den Canarischen Inseln. *Journal für Ornithologie* 38: 257-488.
- LOPEZ-GORDO, J. L., E. LAZARO & A. FERNANDEZ-JORGE 1977. Comparación de las dietas de *Strix aluco*, *Asio otus* y *Tyto alba* en un mismo biotopo de la provincia de Madrid. *Ardeola* 23: 189-221.
- MANÉZ, M. 1983. Variaciones geográficas y estacionales en la dieta del Mochuelo Común (*Athene noctua*) en España. XV Congr. Int. Fauna Cinegética y Silvestre. Trujillo (España) 1981.
- MARKS, J. S. 1984. Feeding ecology of breeding Long-eared Owl in southwestern Idaho. *Can. J. Zool.* 62: 1528-1533.
- MARKS, J. S. & C. D. MARTI 1984. Feeding ecology of sympatric Barn Owls and Long-eared Owls in Idaho. *Ornis Scand.* 15: 135-143.
- MARTIN, A., R. HUTTERER & G. B. CORBETT 1984. On the presence of shrew (*Soricidae*) in the Canary Islands. *Bonn. Zool. Beitr.* 15: 135-143.
- MARTIN, A. & A. MACHADO 1985. Nidificación de le Lechuza Común (*Tyto alba*) en la isla de El Hierro, y datos sobre su alimentación. *Vieraea* 15(1-2): 43-46.
- MARTIN, A., K. EMMERSON & M. ASCANIO 1985. Régimen alimenticio de *Tyto alba* (Scopoli 1769) en la Isla de Tenerife (Islas Canarias). *Ardeola* 32(1): 9-15.
- MEADE-WALDO, E. G. 1890. Further notes on the birds of the Canary Islands. *Ibis* 6(2): 429-438.
- MIKKOLA, H. 1983. *Owls of Europe*. T. & A. D. Poyser, Calton.
- MOLTONI, E. 1937. Osservazioni bromatologiche sugli Uccelli Rapaci italiani. *Riv. Ital. Orn.* 15: 13-109.
- MOMPO, V. 1876. Catálogo de las aves de Tenerife. *Anales Soc. Esp. His. Nat.* 5: 241-258.
- MORENO, E. 1985. Clave osteológica para la identificación de los Passeriformes ibéricos. *Ardeola* 32(2): 295-377.
- MORENO, M., O. TRUJILLO & G. DIAZ 1984. Presencia de reptiles en la dieta de *Asio otus canariensis* (Madar.) en Gran Canaria (Islas Canarias). *Rapinyaires Mediterranis* II: 265-267.
- MORPHY, M. 1964. Some birds of northeast La Palma, Canary Islands, August-September 1963. *Ibis* 107: 97-107.
- NILSSON I. N. 1981. Seasonal changes in food of the Long-eared Owl in southern Sweden. *Ornis Scand.* 12: 216-223.
- NOGALES, M., C. SUAREZ & G. DIAZ 1986. Presencia de *Fringilla teydea polatzeki* en egagrópilas de *Asio otus*. *Ardeola* 1-2: 213.
- NOGALES, M. (in prep.) Biología del Cuervo, *Corvus corax tingitanus* (Isla de El Hierro) e importancia en la diseminación de plantas vasculares en el Archipelago Canario.
- POLATZEK, J. 1908. Die Vögel der Canaren. *Orn. Jahrg.* 5-6: 161-197.
- REY, J. M. 1975. Notas sobre la alimentación de *Asio otus canariensis* en Tenerife (Canarias). *Ardeola* 21: 415-420.
- RODRIGUEZ, F. 1987. Aportaciones a la dieta de *Asio otus canariensis* (Madarász, 1901) en una localidad de Gran Canaria (Islas Canarias). *Ardeola* 34(1): 99-102.
- SCHOENER, D. 1971. Theory of feeding strategies. *An. Rev. Ecol. Syst.* 2: 369-404.
- THIOLLAY, J. M. 1968. Le régime alimentaire de nos rapaces: quelques analyses francaises. *Nos Oiseaux* 319(29): 249-269.
- VEIGA, J. P. 1978. Alimentación y relaciones tróficas entre la Lechuza Común (*Tyto alba*) y el Búho Chico (*Asio otus*) en la Sierra de Guadarrama. *Ardeola* 25: 113-142.
- VILLAGE, A. 1981. The diet and breeding of Long-eared Owl in relation to vole numbers. *Bird Study* 28: 215-221.
- WIJNANDTS, H. 1984. Ecological energetics of the Long-eared Owl (*Asio otus*). *Ardea* 1: 9-2.

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