

# New knowledge on diet and monitoring of a roost of the long-eared owl, *Asio otus* (Linnaeus, 1758) (Strigiformes Strigidae) on Mount Etna, Sicily

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## ABSTRACT

A study during autumn and winter in Monte Serra area (Mount Etna) was performed on the pellets of a roost of long-eared owl, *Asio otus* (Linnaeus, 1758) (Strigiformes Strigidae). Besides, in order to better understand the feeding habits of this species on Mount Etna, the data from Monte Serra were integrated with those from Linguaglossa Pineta (breeding period). The study was performed through the analysis of 1,724 preys. The species most preyed was the Mammalia Microtidae *Microtus savii* (de Selys-Longchamps, 1838). The average weight of the preys was 23.48 g, while the average meal was 36.63 g. Besides, the results of the yearly monitoring of the roost studied are given.

## KEY WORDS

*Asio otus*; trophic niche; roost; Sicily.

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## INTRODUCTION

The trophic niche of *Asio otus* (Linnaeus, 1758) (Strigiformes Strigidae) during autumn and winter in a site of Mount Etna was studied in order to better understand that niche during all the year. The literature data concerning Sicily consist only on the information by Siracusa et al. (1996) focalized on the diet during the reproductive period in two localities (Linguaglossa and Roccapalumba). Up to now, no information on the roost monitoring in Sicily are known.

## MATERIAL AND METHODS

The studied site lies on the "Monte Serra", one of the volcanic cones of Mount Etna, at an altitude of 450 m a.s.l., which originated on the side south-

east during 122 B.C. It has a characteristic shape of a horseshoe, as a result of the collapse of the summit of the crater and of the volcano slope.

In recent centuries the landscape, due to human settlement and agricultural activities, has been progressively modified and the natural vegetation was represented just by some residual strips unevenly distributed. After the abandonment of cultivation, has started a new and slow recolonisation of the Mediterranean natural vegetation. This vegetation consists mainly in the bushes of evergreen holm oak, *Quercus ilex* L., wild olive, *Olea europaea* L., and carob, *Ceratonia siliqua* L.

The slopes of Monte Serra are covered with a shrubby in which are present the common broom, *Spartium junceum* L., and the Etna broom, *Genista aetnensis* (Raf. ex Biv.) DC, as the predominant species (Fig. 1).

At the base of the mountain, lies a forest left in its natural state, the "Forest of Cyclamen" in which the essence most represented is the tree oak, *Quercus virgiliana* Tenore, followed by hornbeam, *Ostrya carpinifolia* Scopoli, and flowering ash, *Fraxinus ornus* L.

The climatic characteristics of the study area are derived on the data of the time series of the Viagrande termopluviometric station (Fig. 2), which is located on the slope most affected by rainfall (annual rainfall higher than the whole of Etna), because invested by the moisture deriving from the Ionian Sea, which it overlooks. The study area falls within the Mediterranean Biogeographical Region, in the range of the meso-Mediterranean

climate (Brullo et al., 1996). The data on diet of long-eared owl in autumn and winter were obtained from the analysis of pellets collected in a roost located at "Parco di Monte Serra", in the period between September 2012 and March 2013.

The pellets were weekly collected. The collected material was provided on-site of a label reporting a detailed tagging, as well as the date and time of collection, the GPS coordinates of individual roost sites, weather conditions, information on the presence/absence and number of specimens observed.

The pellets were dried in the open air for a few days, wrapped in polythene bags containing camphor (to prevent any damage caused by the attack

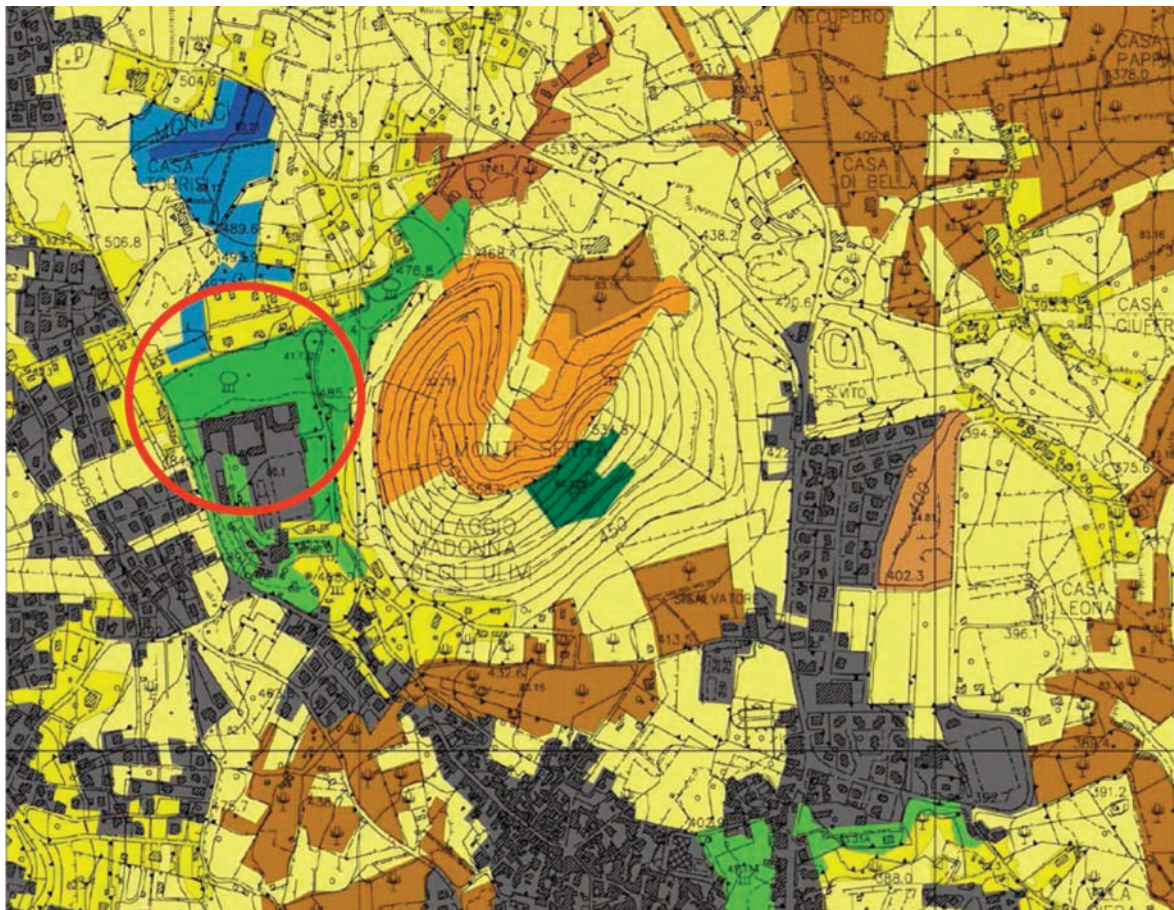


Figure 1. Land use in area of "Monte Serra" and neighboring areas (from Angelini et al., 2009, modified). Legend according to Corine Biotopes Code: 31.81(brown) Middle-European scrubs; 32.215 (orange) low scrub with *Calicotome* sp.; 34.81(light brown) Mediterranean subnitrophilous meadows; 41.732 (green) peninsular and insular Italy oak deciduous woods; 45.31A (light green) Southern Italy and Sicilian holm oak woods; 82.1 (light yellow) arable intensive and continuous; 82.3 (yellow) cultures of extensive type and complex agricultural systems; 83.11 (azure) groves; 83.21 (blue) vineyards; 83.322 (dark green) plantations of *Eucalyptus*; 83.16 (ocher brown) citrus orchards; 86.1 (gray) towns.

of scavenging arthropods) and then transported to the laboratory to be analyzed.

The content of each intact pellet was noted separately and the number of prey items concerned was taken to equal to the greatest number of identified fragments of one species (greatest number of lower jaws, etc.).

For the study of the pellets was used the pellets analysis technic (Contoli, 1980). The pellets were opened by dry technique, with the aid of a tweezers and of an entomological brush. For those too compact it was preferred the immersion in hot water for a few minutes in order to more easily separate the bones.

Before opening, were taken measures, with a digital gauge, relating to the length and the width of pellets. For the sorting of the content was used a stereoscopic microscope for better visibility of the alveoli of the molars and of the bones of small mammals.

To count the preyed specimens is considered their minimum number (Chaline et al., 1974). The jaws of the rats and the synsacrum of birds collected were measured with a digital caliper, in order to estimate the weight of the preyed specimens.

The identification of small mammals was based on the cranium features and dichotomous keys (Toschi & Lanza, 1959; Toschi, 1965; Chaline et al., 1974; Amori et al., 2008), while for the larger prey was used the morphology of the long bones.

The calculation of the biomass was carried out by assigning to each species an average weight, relative to the species of small mammals and Coleoptera in Sicily (Table 1), provided by Di Palma & Massa, 1981, and for savi's pine vole (*Microtus savii*) provided by Catalisano & Massa, 1987.

Using the equation of Di Palma & Massa (1981), the calculated average weight of the brown rat (*Rattus norvegicus* Berkenhout, 1769) results  $102.6 \pm 27.0$  (SD) g (number of sampled specimens  $n = 46$ ), and  $94.5 \pm 26.4$  (SD) g ( $n = 14$ ) regarding *Rattus* sp. The weight of 94.5 g, equivalent to that of *Rattus* sp., has been assigned also to *Rattus rattus* (Linnaeus, 1758), considering that only 2 specimens were collected and no measurable jaws were available.

Using the equation of Di Palma & Massa (1981), the calculated average weight of the birds results  $14.1 \pm 5.2$  (SD) gr ( $n = 187$ ) based on synsacrum found in the pellets.

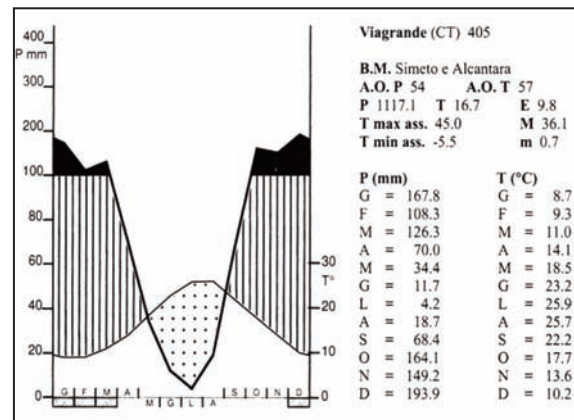


Figure 2. Climogramma of Viagrande termopluviometric station (from Zampino et al., 1997).

Taxa	Weight (g)	References
<i>Mus domesticus</i>	12.2	Di Palma & Massa, 1981
<i>Apodemus sylvaticus</i>	20.8	Di Palma & Massa, 1981
<i>Rattus norvegicus</i>	102.6	Equation of Di Palma & Massa, 1981
<i>Rattus</i> sp.	94.5	Equation of Di Palma & Massa, 1981
<i>Rattus rattus</i>	94.5	Same weight of <i>Rattus</i> sp.
<i>Microtus savii</i>	20	Catalisano & Massa, 1987
<i>Crocidura sicula</i>	6.7	Di Palma & Massa, 1981
<b>Coleoptera</b>	0.1	Di Palma & Massa, 1981
<b>Chiroptera</b>	10	( <i>Pipistrellus</i> sp.); average weight of sampled species
<b>Aves</b>	14.1	Equation of Di Palma & Massa, 1981 (synsacrum)
Not det.	34.1	Average weight of all categories of prey (excluding <i>Rattus norvegicus</i> and Coleoptera)

Table 1. Values used for the calculation of the biomass.

Besides the study of the trophic niche based on the collected pellets, the monitoring of the presence of the owls in the roost from May 2012 to June 2013 was performed (Fig. 3).

## RESULTS AND DISCUSSION

A total of entire 875 pellets were collected and examined in the Monte Serra area. The pellets have an average length of  $32.2 \pm 7.9$  (SD) mm and an average width of  $18.8 \pm 3.2$  (SD) mm. A total of 1,421 prey have been identified (Table 2, Fig. 4), with an average of 1.62 prey/pellet; 1 or 2 prey/pellet were found in most cases, 3 sometimes, 4

occasionally. During the study period, mammals are the most represented group (about 67% of the prey) followed by birds (about 32%). *Microtus savii* represents the most preyed species (50.2% of the catch), while *Apodemus sylvaticus* (Linnaeus,



Figure 3. Specimen of *Asio otus* on *Quercus* sp. (October 2012, photo by E. Musumeci).

Monte Serra					
Category of prey	n	%	weight (g)	biomass (g)	%
<i>Microtus savii</i>	714	50.25	20	14280	41.88
<b>Microtidae</b>	<b>714</b>	<b>50.25</b>		<b>14280</b>	<b>41.88</b>
<i>Mus domesticus</i>	19	1.34	12.2	231.8	0.68
<i>Apodemus sylvaticus</i>	108	7.60	20.8	2246.4	6.59
<i>Rattus rattus</i>	2	0.14	94.5	189	0.55
<i>Rattus norvegicus</i>	75	5.28	102.6	7695	22.57
<i>Rattus</i> sp.	26	1.83	94.5	2457	7.21
<b>Muridae</b>	<b>230</b>	<b>16.19</b>		<b>12819.2</b>	<b>37.6</b>
<b>Rodentia</b>	<b>944</b>	<b>66.43</b>		<b>27099.2</b>	<b>79.48</b>
<i>Crocidura sicula</i>	1	0.07	6.7	6.7	0.02
<b>Soricidae</b>	<b>1</b>	<b>0.07</b>		<b>6.7</b>	<b>0.02</b>
<b>Soricomorpha</b>	<b>1</b>	<b>0.07</b>		<b>6.7</b>	<b>0.02</b>
<b>Chiroptera</b>	<b>7</b>	<b>0.49</b>	<b>10</b>	<b>70</b>	<b>0.21</b>
<b>MAMMALIA</b>	<b>952</b>	<b>67</b>		<b>27175.9</b>	<b>79.66</b>
<b>AVES</b>	<b>452</b>	<b>31.81</b>	<b>14.1</b>	<b>6373.2</b>	<b>18.69</b>
<b>INSECTA Coleoptera</b>	<b>1</b>	<b>0.07</b>	<b>0.1</b>	<b>0.1</b>	<b>0</b>
<b>Not det.</b>	<b>16</b>	<b>1.13</b>	<b>34.1</b>	<b>545.6</b>	<b>1.6</b>
<b>Total prey</b>	<b>1421</b>				
<b>Pellets</b>	<b>875</b>				
<b>Prey/pellets</b>	<b>1.62</b>				
<b>Total biomass (g)</b>	<b>34094.8</b>				
<b>Average weight prey (g)</b>	<b>23.99</b>				
<b>Average meal (g)</b>	<b>38.86</b>				

Table 2. Results of the pellets analysis in the study area.

1758), generally the main trophic resource in wooded areas, shows the frequency of only 7.6%. Although Monte Serra is a suburban park in a discretely anthropized area, *Mus domesticus* Linnaeus, 1758 is very little represented (only 1.3%), but about 7.2% of prey (about 30% of biomass) belongs to *Rattus* spp. (Table 2): this latter result could be justified with the energetic advantage obtained by long-eared owl feed on rats, because these have a greater weight than other prey and owls could save energy by reducing the hunting with an equal gain of biomass. Soricomorpha and Chiroptera, as well as Insecta, are present in very low percentages of prey, less than or equal to 0.5%. The only found specimen of Soricidae, *Crocidura sicula* Miller, 1900, could be due to a selective choice of prey as well as environmental factors, like the pressure of the human presence in the area of Monte Serra. It should be emphasized that, although it is uncommon the predation of birds, in the examined site the percentage of this prey is significant and this is in agreement with some studies conducted on wintering sites in Northern Italy and in Spain (Albufera de Valencia) which recorded a presence of birds even higher, 50% of the total number of individuals preyed (Mastrorilli, 2000; Escala et al., 2009). The discrepancy between these results is likely attributable to the opportunistic habits of the long-eared owl that, when possible, implements group hunting strategies able to ferret out and in some cases cut off entire dormitories of passerines (Mikkola, 1983).

The data of the present study were compared with those of the long-eared owl diet during the reproductive period, detected always by the pellets analysis technic, in two sicilian sites, Pineta di Linguaglossa and Roccapalumba, characterized by different environmental features (Siracusa et al., 1996): an old pinewood and a cultivated area respectively.

A total of 191 pellets were collected and examined in Linguaglossa Pineta station (Table 3). Mammals are the most represented group (about 94% of the prey) followed by birds (about 6%). *Apodemus sylvaticus* was the most preyed species (60% of the catch) and with *Microtus savii* (32.67% of prey) represent about 93% of the preys. *Mus domesticus* is very little represented (only 0.66%), while no species of *Rattus* were collected. Soricomorpha and Chiroptera were present in very low percentages equal to 0.33% (Siracusa et al., 1996).

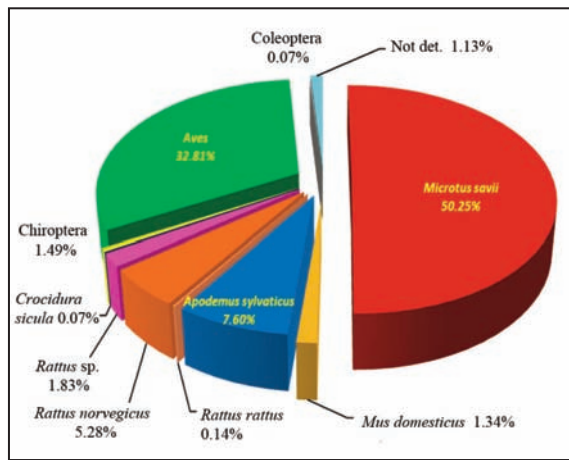


Figure 4. Graphical results of the pellets analysis in the study area.

A total of 21 pellets were collected and examined in Roccapalumba station (Table 3). Mammals are the most represented group (about 93% of the prey) followed by birds (more than 3%), arthropods (more than 2%) and amphibians and reptiles (about 1.5%). *Microtus savii* was the most preyed species (89.42% of the catches), while the other species of mammals (*Apodemus sylvaticus*, *Mus domesticus*, *Rattus rattus* and *Crocidura sicula*) were present in very low percentages, less than 2% (Siracusa et al., 1996).

In order to identify the trophic niche of the species in the piedmont areas of the Etna eastern slope, the stations of Monte Serra and Linguaglossa (a pinewood), were considered as a single sample

Category of prey	MONTE SERRA				LINGUAGLOSSA				ROCCAPALUMBA			
	n	%	biomass (g)	%	n	%	biomass (g)	%	n	%	biomass (g)	%
<i>Microtus savii</i>	714	50.25	14280	41.88	99	32.67	1683	26.34	245	89.42	4165	89.93
<i>Mus domesticus</i>	19	1.34	231.8	0.68	2	0.66	25	0.39	3	1.09	37.50	0.81
<i>Apodemus sylvaticus</i>	108	7.60	2246.4	6.59	182	60.07	4277	66.94	1	0.36	23.50	0.51
<i>Rattus rattus</i>	2	0.14	189	0.55	-	-	-	-	1	0.36	118	2.55
<i>Rattus norvegicus</i>	75	5.28	7695	22.57	-	-	-	-	-	-	-	-
<i>Rattus sp.</i>	26	1.83	2457	7.21	-	-	-	-	-	-	-	-
<i>Crocidura sicula</i>	1	0.07	6.7	0.02	1	0.33	6.5	0.10	5	1.82	32.50	0.70
Chiroptera	7	0.49	70	0.21	1	0.33	20	0.31	-	-	-	-
<b>MAMMALIA</b>	<b>952</b>	<b>67</b>	<b>27175.9</b>	<b>79.66</b>	<b>285</b>	<b>94.06</b>	<b>6011.5</b>	<b>94.08</b>	<b>255</b>	<b>93.06</b>	<b>4376.50</b>	<b>94.50</b>
<b>AVES</b>	<b>452</b>	<b>31.81</b>	<b>6373.2</b>	<b>18.69</b>	<b>18</b>	<b>5.94</b>	<b>378</b>	<b>5.92</b>	<b>9</b>	<b>3.28</b>	<b>189</b>	<b>4.08</b>
<b>AMPHIBIA + REPTILIA</b>	-	-	-	-	-	-	-	-	4	1.46	60	1.30
<b>ARTHROPODA</b>	1	0.07	0.1	0	-	-	-	-	6	2.19	6	0.13
Not det.	16	1.13	545.6	1.6	-	-	-	-	-	-	-	-
<b>Total</b>	<b>875</b>				<b>303</b>				<b>274</b>			

LINGUAGLOSSA		ROCCAPALUMBA	
Total prey	303 (243 on entire pellets)	Total prey	274 (66 on entire pellets)
Pellets	191	Pellets	21
Prey/pellets	1.27*	Prey/pellets	3.14*
Total biomass (g)	6389.50**	Total biomass (g)	4631.5 **
Average weight prey (g)	21.09**	Average weight prey (g)	16.9 **
Average meal (g)	26.78*	Average meal (g)	53.07*

Table 3. Comparison of results of pellets analysis during winter period (Mt. Serra) and during breeding period of long-eared owl from Pineta di Linguaglossa and from Roccapalumba (\* calculated only on prey on entire pellets; \*\* calculated on total prey) (from Siracusa et al., 1996, modified).

(Table 4), although the first case concerns the diet in the autumn and winter, while the second case regards the trophic niche in the reproductive period. It must be emphasized that the two sites, with different vegetations, are located both in the foothill region of Etna Mountain.

A total of 1,066 pellets were processed (Table 4). Also in this case, mammals are the most represented group (about 72% of the prey) followed by birds (about 27%), while arthropods are almost absent. *Microtus savii* is the most preyed species (more than 47% of the catches), while the Muridae provide the greatest contribution in terms of biomass (42.30% of total). Soricomorpha and Chiroptera are present in very low percentages less than or equal to 0.46%. The average weight of the preys is 23.48 g, while the average meal is 36.63 g.

The roost of Mt Serra was observed by the end of May 2012, when a young specimen has been

sighted among *Genista*, at the end of June 2013 (Fig. 5). Although traces of their presence (as plumage and very few pellets) were evident from June to August, only in early September 2012 were observed 7 specimens on an oak near the structure used by the Butterfly House as Information Point. This same roost was used by the group for most of the autumn season. During the sightings were counted from 1 to a maximum of 7 specimens, with greater presence during the afternoon hours. The owls were quite confident and they tolerated human presence. In November sporadic observations of owls were recorded and no pellets were found. The causes of this absence could, at least partially, be attributed to human disturbance or it might have been a time of reorganization of the roost. In late November (29th), after many days of absence, a roost of more than 11 specimens occupied the pines located inside the playground for children of the butterfly house. This roost, that throughout the winter period was composed of about 20 specimens, was present until the end of February. From late February to mid-March, were observed no more than 7 specimens as to restore the situation of September-November. No specimens were spotted from middle March to the end of June.

This study has allowed us to integrate knowledge about the trophic niche of the long-eared owl in Sicily for which was known a single study that refers to the diet of this species in the breeding season; however, were not known data concerning the trophic niche during the autumn-winter period and concerning the roost in wintering period. The data obtained from the pellets analysis of about 20 specimens and the analysis of the characteristics of the study area, have confirmed the selective behavior of *Asio otus* in the choice of prey, specifically the Microtids (as shown by the high percentage of *Microtus savii* found). It also highlighted a certain plasticity of the species that, if necessary, takes advantage of favorable situations such as the presence of dormitories of birds that are flushed out with a technique of group hunting. The above explains the significant number of birds found in the pellets, which is not a data usually reported in bibliography. This study is also useful for the increase of knowledge on the wintering sites of the long-eared owl in Italy and can be inserted in the national register of the roosts, set up by the project: "Gufiamo: count the long-eared owls wintering in

TOTAL MS+L				
Category of prey	n	%	biomass (g)	%
<i>Microtus savii</i>	813	47.16	15963	39.43
<b>Microtidae</b>	<b>813</b>	<b>47.16</b>	<b>15963</b>	<b>39.43</b>
<i>Mus domesticus</i>	21	1.22	256.8	0.63
<i>Apodemus sylvaticus</i>	290	16.82	6523.4	16.11
<i>Rattus rattus</i>	2	0.12	189	0.47
<i>Rattus norvegicus</i>	75	4.35	7695	19
<i>Rattus sp.</i>	26	1.51	2457	6.07
<b>Muridae</b>	<b>414</b>	<b>24.01</b>	<b>17121.2</b>	<b>42.30</b>
<b>Rodentia</b>	<b>1227</b>	<b>71.17</b>	<b>33084.2</b>	<b>81.72</b>
<i>Crociodura sicula</i>	2	0.12	13.2	0.03
<b>Soricidae</b>	<b>2</b>	<b>0.12</b>	<b>13.2</b>	<b>0.03</b>
<b>Soricomorpha</b>	<b>2</b>	<b>0.12</b>	<b>13.2</b>	<b>0.03</b>
<b>Chiroptera</b>	<b>8</b>	<b>0.46</b>	<b>90</b>	<b>0.22</b>
<b>MAMMALIA</b>	<b>1237</b>	<b>71.75</b>	<b>33187.4</b>	<b>81.97</b>
<b>AVES</b>	<b>470</b>	<b>27.26</b>	<b>6751.2</b>	<b>16.68</b>
<b>INSECTA Coleoptera</b>	<b>1</b>	<b>10.06</b>	<b>0.1</b>	<b>0</b>
Not det.	16	0.93	545.6	1.35
<b>Total prey</b>	<b>1724 (1664 on entire pellets)</b>			
<b>Pellets</b>	<b>1066</b>			
<b>Prey/pellets</b>	<b>1.56*</b>			
<b>Total biomass (g)</b>	<b>40484.30**</b>			
<b>Average weight prey (g)</b>	<b>23.48**</b>			
<b>Average meal (g)</b>	<b>36.63*</b>			

Table 4. Sum of results of the pellets analysis of long-eared owl during breeding period in Pineta di Linguaglossa and during autumn in Monte Serra. \* calculated only on prey on entire pellets (n=1664); \*\* calculated on total prey (n=1724).

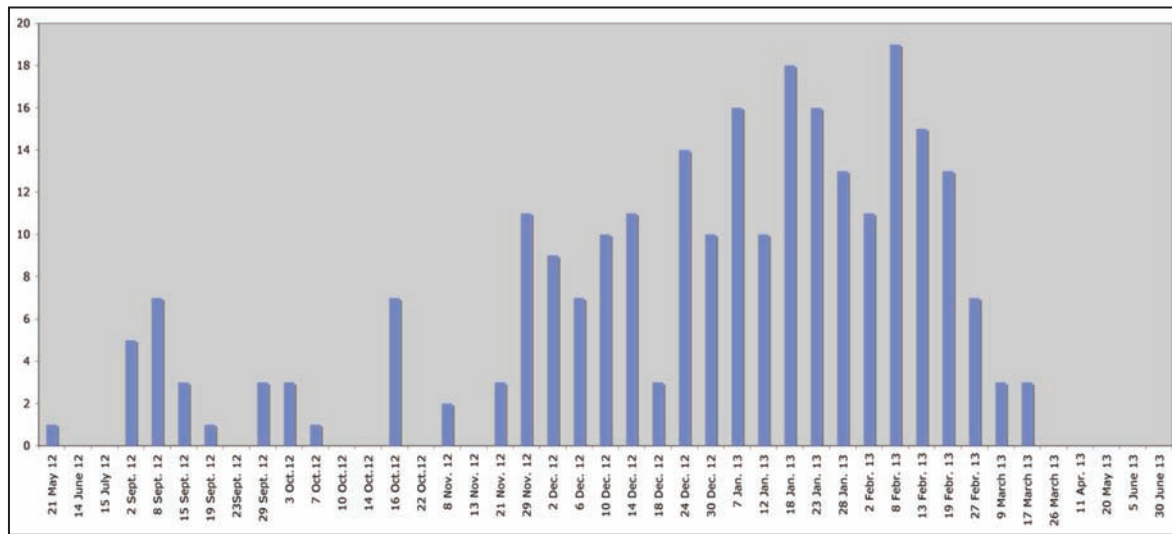


Figure 5. Histogram date/number of long-eared owl specimens observed.

Italy", started a few years ago from the collaboration of GIC & EBN Italy, with the Global owl project that provides for the establishment of a network containing data on the presence of the roosts in Italy. From the analysis of the monitoring of the roost of Monte Serra, one might assume the presence of two different populations. The first one, in the Park throughout the year, although with changes in the choice of the roost and possibly with nesting site located not many miles away.

The other population, more numerous, would take advantage of the Monte Serra Park as a wintering site. Specimens of this second population may be resident in the territory of Etna and make seasonal vertical migrations or could be migratory specimens that stop to winter. The hypothesis of two different populations is supported by the owl attitude observed in the days of collecting pellets. Whenever the collector approached at the roost, systematically, part of specimens are alerted and receding in flight; however, remained always 5-7 specimens, very confident, as if they were already accustomed to the environment and the presence of visitors to the park. Because the site is regularly occupied, this would allow regular long-term monitoring of the roost; furthermore, the use of molecular studies of feathers collected throughout the year could also clarify the phenology of the species in Sicily, whose presence as a nesting species has been established only recently.

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