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Small mammal community in a Mediterranean target area of Sicily by the data from the long-eared owl pellets

Agatino Maurizio Siracusa*, Alessandra Santitto, Daniele Camarda & Vera D'Urso

ABSTRACT. The present study was carried out through analysis of bone remains in 1003 long-eared owl pellets of *Asio otus* (Strigiformes, Strigidae). The investigated area is in the Southeastern slope of Mount Etna (Sicily) outside the boundary of Etna Park. A total of eight species were found of ten species known for the whole Sicily, such as *Microtus nebrodensis* (Rodentia, Cricetidae), *Apodemus sylvaticus, Mus domesticus, Rattus rattus, Rattus norvegicus* (Rodentia, Muridae), *Eliomys quercinus* (Rodentia, Gliridae), *Suncus etruscus* and *Crocidura sicula* (Soricomorpha, Soricidae). The most frequent species among the total specimens found in the long-eared owl pellets was vole *M. nebrodensis* with a frequency of 75.24% and composed of 57.54% of a biomass in analysed habitats. The second most frequent species was *A. sylvaticus* with a frequency percentage of 13.23%, but participates third place in the assessed biomass (10.52% of the biomass), thereas the more masses species *R. norvegicus* composed of 29.29% of the biomass and with a frequency of 7.47% in the owl pellets. The high number of species found (eight species out of ten known for the Sicilian small mammal fauna), and the medium-low diversity values (Gini-Simpson = 0.41; Shannon-Weaver = 0.64) are likely to be attributed to the fragmentation of habitats and consequent ecotone effect. The high value of the Cricetidae/Muridae ratio and the low value of the trophic level index (Soricidae/Rodentia ratio) highlight a type of agricultural anthropization. The composition and structure of the studied small mammal community confirmed a consolidated medium-high level of agricultural anthropization in a landscape characterized by a mosaic of rural and natural environments. However, the importance of these agro-ecosystems depends on the high number of small mammal species present, including some of conservation interest.

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Сообщество мелких млекопитающих на ключевой среднеземноморской территории Сицилии по данным из погадок ушастой совы

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РЕЗЮМЕ. Настоящее исследование основано на исследовании костных остатков из 1003 погадкок ушастой совы *Asio otus* (Strigiformes, Strigidae). Район исследования располагался на юго-восточном склоне горы Этна (Сицилия) за пределами границ парка Этна. Всего в погадках было выявлено восемь видов, обитающих на Сицилии, среди них *Microtus nebrodensis* (Rodentia, Cricetidae), *Apodemus sylvaticus, Mus domesticus, Rattus rattus, Rattus norvegicus* (Rodentia, Muridae), *Eliomys quercinus* (Rodentia, Gliridae), *Suncus etruscus* and *Crocidura sicula* (Soricomorpha, Soricidae). Наиболее часто встречающимся в погадках видом была полевка *M. nebrodensis* с долей 75.24%, также составляющей 57.54% биомассы среди мелких млекопитающих в анализируемых биотопах. Вторым по встречаемости в погадках видом была мышь *A. sylvaticus* с процентом встречаемости 13.23%, которая, однако, занимала третье место по биомассе (10.52 % биомассы); при этом массовый вид *R. norvegicus* с долей 29.29% в биомассе местообитаний занимает лишь 7.47% в погадках ушастой совы. Значительное

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количество обнаруженных видов (восемь видов из десяти, известных для сицилийской фауны мелких млекопитающих), а также «средне-низкое» значение индексов видового разнообразия (Gini-Simpson = 0.41; Shannon-Weaver = 0.64), вероятно, могут быть связаны с фрагментированностью местообитаний эффектом экотона. Высокое значение отношения таксонов Cricetidae/Muridae и низкое значение индекса «трофических уровней» (отношение Soricidae/Rodentia) указывают на определенный тип земледельческой антропизации. Состав и структура изученного сообщества мелких млекопитающих подтвердили «средне-высокий» уровень агроантропизации ландшафта, характеризующийся мозаичностью сельскохозяйственных и нативных выделов. Важность этих смешанных экосистем основывается на значительном количестве присутствующих видов мелких млекопитающих, в том числе представляющих интерес с точки зрения их сохранения.

КЛЮЧЕВЫЕ СЛОВА: сообщество мелких млекопитающих, погадки, *Asio otus*, Сицилия.

Introduction

Searches on communities of small mammals (Rodentia and Soricomorpha) are useful not only to increase knowledge of fauna and biogeography (Contoli, 1991) but also in ecological studies that include understanding of the effects of anthropic activities (Szpunar *et al*., 2008; Mazzotti & Tiozzo, 2013; Balestrieri *et al*., 2019) or environmental quality assesstments (Contoli, 1975; Amarena *et al*., 1994).

Small mammals are essential elements in many ecosystems, due to the functions they perform. They scramble soil, build dens, regulate invertebrate populations, and constitute a food source for many other vertebrates. For these reasons, they are considered key species, umbrella species and engineer species (Sanz & Penades, 2002; Capizzi & Santini, 2007).

To carry out the present study, common owl pellets collected near a "roost" were used, also with the aim of increasing knowledge of microteriofauna of Mount Etna; this is a peculiar territory due to its volcanic nature and for being one of the highest mountains of the Mediterranean area, and it is subjected to high anthropic pressure. In addition, Etna has been a World Heritage Site since 2013.

The use of owl pellets for the study of small mammal communities can be considered, in certain conditions, a valid alternative to the use of the more expensive, time-consuming, and damaging traps, but only after the study of the selective predatory tendencies of owls (Heisler *et al*., 2016). The long-eared owl is a predator specialized in small mammals (e.g. Sergio *et al.*, 2008; Riegert *et al*., 2009; Lesiński *et al*., 2016); because it is more generalist than previously considered, showing diet plasticity and feeding on alternative preys when the preferred one is scarce (Contoli, 1980; Canova, 1989; Galeotti & Canova, 1994; Siracusa *et al*., 1996; Pirovano *et al*., 2000; Bertolino *et al*., 2001; Tome, 2009; Benedeck & Sirbu, 2010; Martelli & Fastelli, 2013; Mori & Bertolino, 2015; Vicariotto, 2018; Birrer *et al*., 2021), at least in some conditions it can be considered a reliable sampler of small mammal fauna. The study of the remains in pellets of *A.otus* has proved to be a good practice in Mediterranean environments also (Seçkin & Coşkun, 2006; Kontogeorgos *et al*., 2019).

Materials and methods

Characterization of the investigated site

The roosting area was identified at Monte Serra Park, a peri-urban park in the municipality of Viagrande (Catania province). Monte Serra Park (about 30 hectares) is located on Mount Serra, one of the secondary volcanic cones of Etna 450 m above sea level (eruption <122 B.C.).

Such area, in the past widely cultivated with vineyards, has been subjected to strong anthropogenic pressure; today it is abandoned and recolonized by natural vegetation mainly made up of forest essences with a prevalence of evergreen oaks (*Quercus ilex*; Fagaceae), the common broom (*Spartium junceum*; Fabaceae) and the Etna broom (*Genista aetnensis*; Fabaceae) bushes predominate in the open areas on flanks of the volcanic cone (Fig. 1). See Siracusa *et al*. (2015) for habitat detailed description.

Methodologies

Samplings of several years have been treated as a single sample; this because common owl's diet may vary seasonally and yearly depending on availability and abundance of main and secondary preys; as a consequence, a study that considers together several years should furnish a reliable picture about correspondence between prey species found in pellets and the real small mammal community of the studied site. Techniques of theriological analysis (Contoli, 1980) were performed for pellet study. For individual counting, the minimum number (Chaline *et al*., 1974) was taken into consideration. Jaws of *Rattus* spp. found, were measured using a digital calliper, to estimate the actual weight of the predated specimens.

Identification of small mammals was carried out considering the cranial parts and using dichotomous keys (Toschi & Lanza, 1959; Toschi, 1965; Chaline *et al*., 1974; Amori *et al*., 2008); attention was paid to the presence of long bones for larger preys.

Data analysis

Assessment of biomass of *A. otus* preys was carried out through assigning to each species an individual average weight (Tab. 1), referring to the species of

small Sicilian mammals, supplied by Di Palma & Massa (1981), Catalisano & Massa (1987) and Amori *et al.* (2008). Equations provided by Di Palma & Massa (1981) were used for rats to correlate jaw length with weight.

Furthermore, the following indices were applied: number of predated species (S); Margalef index (DMg = (S – 1) / LgN): sensitive to frequent species (abundance and dominance) with good discrimination ability (Magurran, 1988); Gini-Simpson index H = 1 – Σ pi2 : sensitive to frequent species variations and fair distribution; Shannon-Weaver index H' = – Σ pi lnpi: sensitive to rare species; index of fair distribution of Pielou (J = H / Hmax and J' = H' / Hmax) which expresses the observed relationship between diversity and maximum diversity;

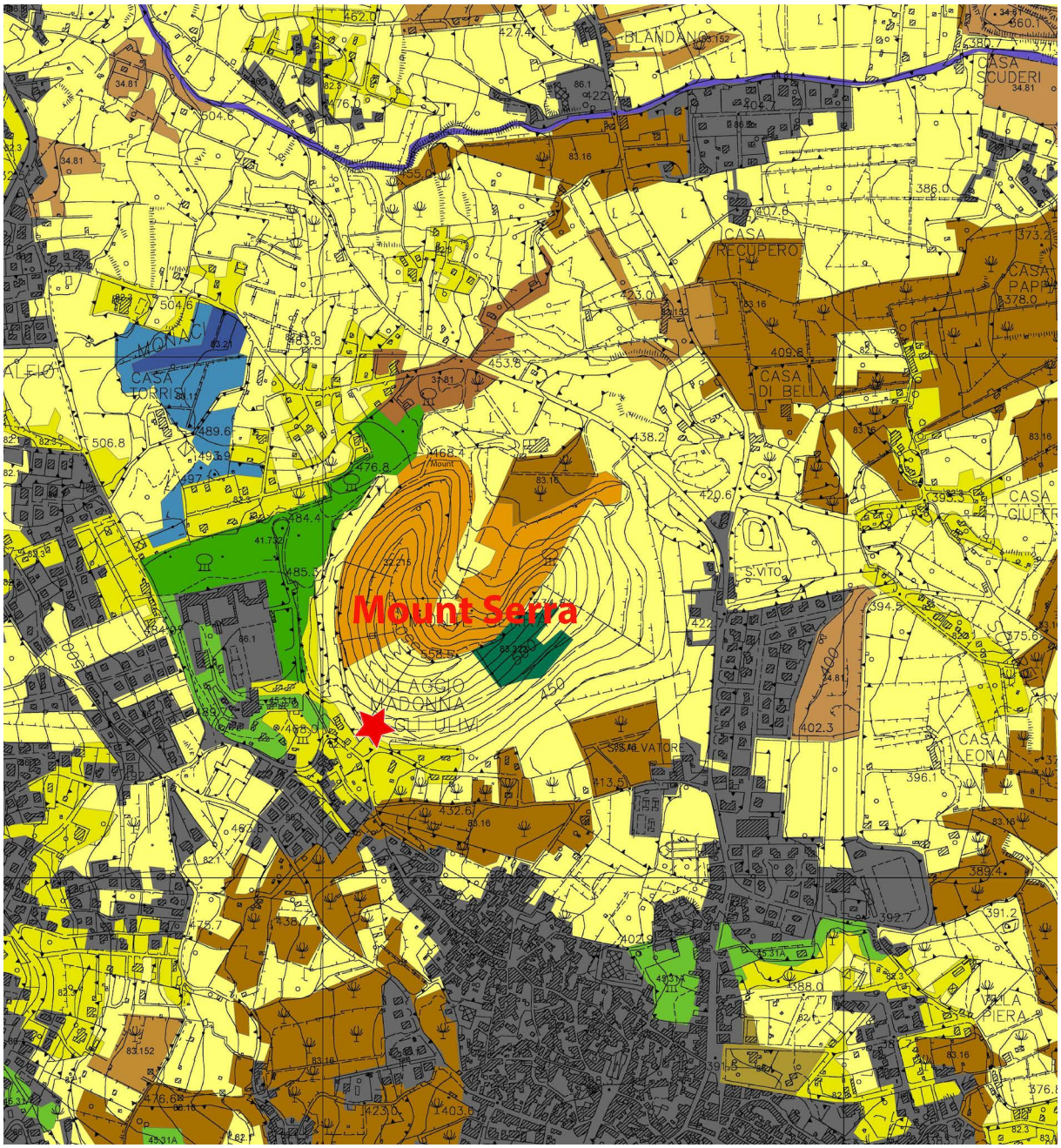

Fig. 1. Land use in the area of "Monte Serra". Legend according to Corine Biotopes Code: 31.81 (brown) Middle-European scrubs; 32.215 (orange) low scrub with *Calicotome* sp.; 34.81 (light brown) Mediterranean subnitrophilous meadows; 41.732 (green) peninsular and insular Italy oak deciduous woods; 45.31 (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 (light blue) groves; 83.21 (dark blue) vineyards; 83.322 (dark green) plantations of *Eucalyptus*; 83.16 (ochre brown) citrus orchards; 86.1 (gray) towns. The star indicates the roost examined in Monte Serra Park. From Siracusa *et al.* (2015), modified.

Table 1. Weight values used for the biomass calculation.

Species	Weight (gramme)	References
Suncus etruscus	2.0	Di Palma & Massa, 1981
Crocidura sicula	6.7	Di Palma & Massa, 1981
Microtus nebrodensis	20.0	Catalisano & Massa, 1987
Eliomys quercinus	76.5	Amori *et al*., 2008
Apodemus sylvaticus	20.8	Di Palma & Massa, 1981
Mus domesticus	12.2	Di Palma & Massa, 1981
Rattus norvegicus	102.6	Equation of Di Palma & Massa, 1981
Rattus rattus	94.5	Equation of Di Palma & Massa, 1981

Table 2. Composition of the small mammal community in the analysed locality and related biomass. Pellet collection periods: January–February 2002; September 2012–March 2013; October 2018–March 2019.

Species	Number of specimens	Portion in the owl pellets (%%)	Assessed biomass (gramme)*	Portion of the biomass (%%)
Suncus etruscus	1	0.09	2.0	0.01
Crocidura sicula	2	0.19	13.4	0.05
Microtus nebrodensis	796	75.24	15920.0	57.54
Eliomys quercinus	1	0.09	76.5	0.28
Apodemus sylvaticus	140	13.23	2912.0	10.52
Mus domesticus	37	3.50	451.4	1.63
Rattus norvegicus	79	7.47	8105.4	29.29
Rattus rattus	2	0.19	189.0	0.68
Total	1058	100.01	27669.7	100.00

Notes: * — see Table 1.

situation when all species are equally abundant: (H = Hmax = 1 – 1 / S and H' = Hmax = lnS) (Magurran, 1988). Environmental quality was evaluated using Cricetidae/Muridae index; such index is sensitive to environmental anthropic alterations, especially those caused by agricultural activities (Contoli, 1980); Soricidae/Rodentia index (or trophic level index) was used to provide indications on the use of biocides; it provides the greater sensitivity to these toxic substances to Insectivores, especially for the important role they play in trophic networks (Contoli, 1981). The following thermoxerophilic indices were also applied (Contoli, 1980): ITX = {(*Suncus etruscus*/Soricidae) + [(*Mus domesticus* + *Rattus rattus*)/Muridae]}/2; ITX1 = (*Mus domesticus* + *Rattus rattus*)/Muridae. Both indices are based on the abundance of some indicator species typical of approximately thermo-xeric areas. They produce higher values in the hottest and driest areas.

Results

A total of 1003 pellets were collected, and 1058 specimens of small mammals were identified. A total of 8 species (out of 10 present in Sicily) were found (Tab. 2). The apparent low number of species found is broadly correspondent to other searches carried out in Mediterranean islands (Kontogeorgos *et al*., 2019) just because it represents an insular fauna.

Small mammal species list from the long-eared owl pellets

Rodentia Bowdich, 1821
Family Cricetidae Fischer, 1817
Subfamily Arvicolinae Gray, 1821

Microtus nebrodensis (Minà-Palumbo, 1868) (Fig. 2)

It is a Sicilian endemic species, proved to be the dominant species in *A. otus*' diet. Present in both natural and anthropogenic open environments, it is widespread throughout Sicily. According to Amori & Castiglia (2018), the species seemed to be missing from Etna slopes, but Siracusa *et al*. (2015) and our record confirms its presence. *Microtus nebrodensis* is the only species of its genus present in Sicily, previously reported as *Microtus savii* (De Selys-Longchamps, 1838) until Bezerra *et al*., (2015) raised to the species rank the former Sicilian subspecies *Microtus savii nebrodensis.*

The vole *M. nebrodensis* is composed 75.24% among small mammal findings in the analysed long-eared owl pellets (Tab. 2). The assessed biomass of this species in the analysed Sicilian habitats is 57.54% (Tab. 2).

Family Muridae Illiger, 1811
Subfamily Murinae Illiger, 1811

Apodemus sylvaticus (Linnaeus, 1758) (Fig. 3)

It is a species with wide Palaearctic distribution, is found in woodland and Mediterranean scrub environments of Sicily; according to Sarà & Casamento (1993),

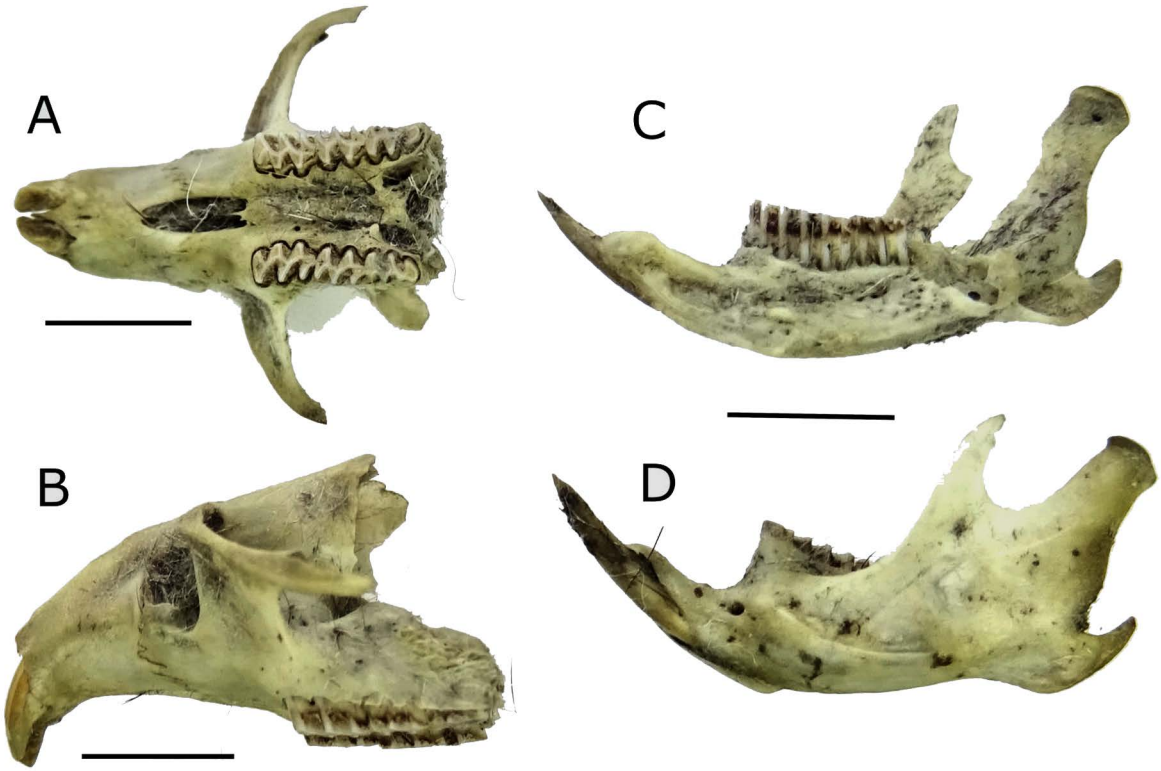

Fig. 2. *Microtus nebrodensis*: skull in ventral (A) and lateral (B) views; lower jaws in medial (C) and lateral (D) views. Scale bars = 5 mm.

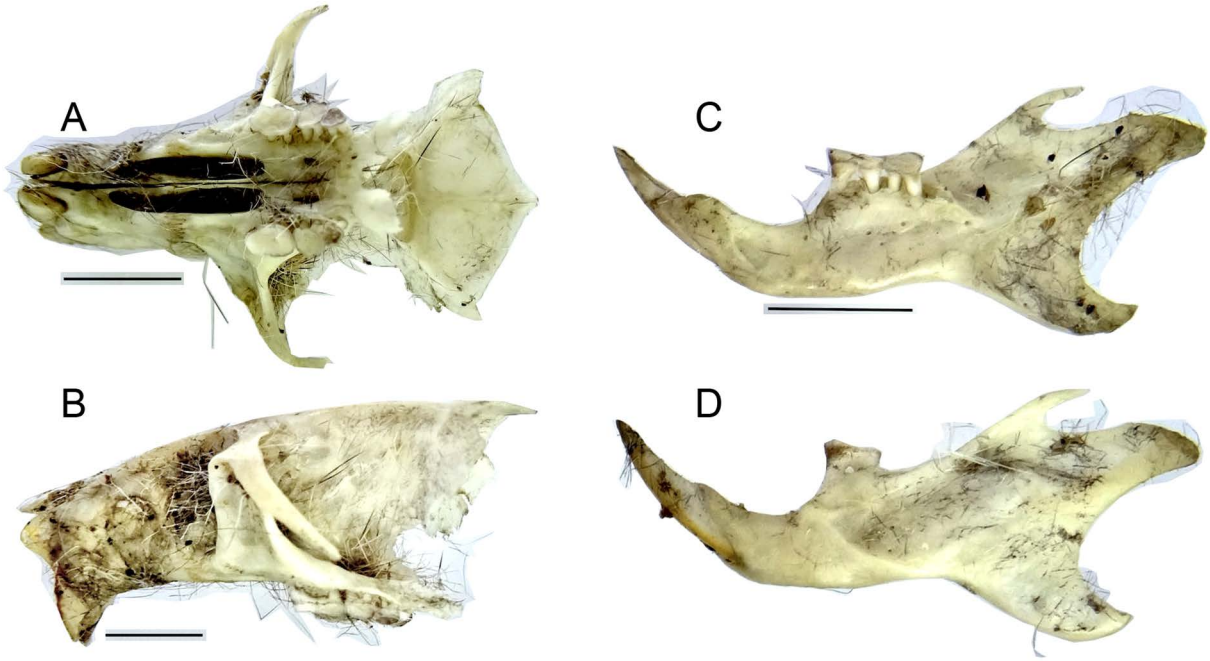

Fig. 3. *Apodemus sylvaticus*: skull in ventral (A) and lateral (B) views; lower jaws in medial (C) and lateral (D) views. Scale bars = 5 mm.

its abundance in Sicily is linked to the presence of tree covering. It is also abundant on the edges of small, fragmented woodlands (and this is the situation observed in our study area) rather than of large fragments or extensive woodland formations (Tattersall *et al*., 2002). *Apodemus sylvaticus* is much less abundant than *M. nebrodensis*, reflecting the lower frequency of shrub-woodland habitats in the study area compared to more open areas.

Apodemus sylvaticus represent the 13.23% among small mammal findings and 10.52% in terms of biomass in the Mount Serra habitats (Tab. 2).

Mus domesticus Schwartz et Schwartz, 1943

It is a species of ancient introduction into the West European and Mediterranean countries from South-Eastern Asia. The populations of *M. domesticus* are present in Sicily both in commensal and wild form. They mainly occupy rural environments but can also be present in areas of artificial woods, garrigue and Mediterranean scrub in microhabitats with moist soil and with a high percentage of surface exposure, high density of herbaceous vegetation and with the presence of small bushes (Loy & Boitani, 1984). It is a thermo-xerophilic species, favoured by climate warming (Szpunar *et al*., 2008; Mazzotti & Tiozzo, 2013).

The house mouse *M. domesticus* represent the 3.50% among small mammal findings in the analysed long-eared owl pellets and the assessed biomass of this species is 1.63% (Tab. 2).

Rattus rattus (Linnaeus, 1758)

The species has today an Asiatic-European distribution, introduced from Eastern Asia in very ancient times. *Rattus rattus* is a synanthropic species living in numerous types of environments of Mediterranean bioclimate. It also inhabits marginal areas of various wood formations from sea level to hills (Amori *et al*., 2008). It is a thermo-xerophilic species, favoured by climate warming (Szpunar *et al*., 2008; Mazzotti & Tiozzo, 2013).

Rattus rattus has been found in very low quantity within the owl pellets, representing the 0.19% of the total findings and 0.68% in terms of assessed biomass in the analysed habitat (Tab. 2).

Rattus norvegicus (Berkenhout, 1769)

It is an Asiatic-European species, native of North-Eastern Asia. *Rattus norvegicus* is closely related to human presence; it can form wild populations in different environmental contexts, especially in areas with dense vegetation cover or near water (Capizzi & Santini, 2007). This species represent the 7.47% of the total findings and 29.29% in terms of assessed biomass (Tab. 2).

Family Gliridae Muirhead, 1819
Subfamily Leithiinae Lydekker, 1896
Eliomys quercinus (Linnaeus, 1766)

It is a species with Euro-Mediterranean distribution, considered close to threat (NT) in the IUCN National Red List; its presence is significant (Rondinini *et al*., 2013). It lives especially in natural wooded areas, but it can also be found in garrigue areas with the presence of strips of Mediterranean scrub or thermophilic woods. Only one specimen belonging to *E. quercinus* has been found, representing the 0.09% of the total specimens found in long-eared owl pellets and the 0.28% in terms of biomass (Tab. 2).

Soricomorpha Gregory, 1910
Family Soricidae Fischer, 1817
Subfamily Crocidurinae Milne-Edwards, 1868
Suncus etruscus (Savi, 1822) (Fig. 4A)

It is a species widespread in Mediterranean countries and South-Western Asia and Indian region. *Suncus etruscus* is a typical species of Mediterranean bioclimate environments and usually does not exceed 800 m a.s.l. It prefers olive groves and vineyards, even if it can be present in low scrub environments and open woods. It also lives in urban environments (Amori *et al*., 2008). *Suncus etruscus* is a thermo-xerophilic species, favoured by climate warming (Szpunar *et al*., 2008; Mazzotti & Tiozzo, 2013). A single specimen has been found, representing the 0.09% of the total findings and the 0.01% of the total biomass of the specimens found (Tab. 2).

Crocidura sicula Miller, 1900 (Fig. 4B)

It is a Sicilian-Maltese endemic species, widespread in all environments from sea level up to 1600 m a.s.l., even if it tends to prefer less arid environments (Amori *et al*., 2008). *Crocidura sicula* represent the 0.19% of the total findings and the 0.05% in terms of assessed biomass (Tab. 2).

Small mammal species diversity by the owl pellets data

The high number of found species (80% of the known Sicilian small mammal species) with a conspicuous total number of specimens (1058), allows us to apply the main ecological indices to the small mammal community of our study area (Tab. 3) (see also Discussion and Conclusion sections). The value of the frequence and biomass are summarized in Table 2.

The *M. nebrodensis* was the species with the greatest presence (frequency percentage 75.24%); *A. sylvaticus* (13.23%), *R. norvegicus* (7.47%) and *M. domesticus* (3.50%) had significantly lower values. The lowest percentages of presence (0.09%) belong to *S. etruscus* and *E. quercinus* (Tab. 2). In terms of biomass, the most represented species were *M. nebrodensis* (57.54%), *R. norvegicus* (29.29%) and *A. sylvaticus* (10.52%); among the other species, only *M. domesticus* exceed 1% (1.63%) (Tab. 2).

The high value of the richness index (1) depends on the presence of numerous species in Mount. Serra area (Tab. 3). The diversity indices showed values of Gini-Simpson (H = 0.41) and Shannon-Weaver (H' = 0.64) that are within a medium-low range; they indicate a presence of high number of species with one, *M. nebrodensis*, predominant; the strong presence of above mentioned species influences the results of the equiparti-

tion indices, respectively low (J = 0.47) and medium-low (J' = 0.71) values (Tab. 3). Cricetidae/Muridae ratio had a high value (3.08) mostly due to the large number of *M. nebrodensis* specimens (793 items), while Soricidae/Rodentia ratio had a very low value (0.003) as a result of a single *S. etruscus* specimen found (Tab. 3). The low values of the thermoxerophilic indices (ITX = 0.18 and ITX_1 = 0.15; see Tab. 3) were influenced by the species *A. sylvaticus* and fall within the typical values of the mesomediterranean belt.

Fig. 4. *Suncus etruscus*: lower jaw in medial view (A). *Crocidura sicula*: lower jaw in medial view (B). Scale bar = 5 mm.

Table 3. Main ecological indices from Mount Serra and comparison with other researches.

	Mount Serra (E Sicily) Present work	Linguaglossa (E Sicily) Siracusa *et al*., 1996	Roccapalumba (W Sicily) Siracusa *et al.,* 1996	Oasi San Giuliano (S Italy) Cecere & Vicini, 2000	Sandrigo (NE Italy) Vicariotto, 2018
Species number	8	4	5	7	19**
Margalef (DMg)	1.0				
Gini–Simpson (H)	0.41				
Shannon–Weaver (H')	0.64	1.0*	0.31		
Pielou equipartition (J)	0.47				
Pielou equipartition (J')	0.71				
Cricetidae/Muridae	3.08			2.68	0.41
Soricidae/Rodents	0.003				0.04***
ITX	0.18				0.25
ITX_1	0.15				

Notes: *one *Chiroptera* specimen was included; ** 3 generic taxa were included (see Table 3 in Vicariotto, 2018); *** *Talpa europaea* was included.

Discussion

It is well known that the common owl is a predator that prefers small mammals, especially *Microtus*, but whose diet varies depending on the season, the type of habitat and geographic location, and, consequently, the availability and abundance of the various prey species. Accessibility to the preys is an essential factor for predation and depends on specific behaviour of preys themselves, seasons, and meteorological conditions (Vicariotto, 2018).

Long-eared owl proved to have region-specific dietary patterns; in North and Central Europe it behaves as a specialist feeding on a few common and abundant species, while in Southern Europe behaves as an opportunistic generalist feeding on a greater variety of preys (e.g., birds, insects, bats) in response to the seasonal availability of different preys (Bertolino *et al*., 2001; Cecere *et al*., 2013; Kontogeorgos *et al*., 2019).

According to Bertolino *et al*. (2001), in Northern Europe the common owl is a specialist, particularly on Arvicolinae; in Southern Europe (Northern Italy) it bases its diet on three main prey cathegories (in frequence order, *Apodemus* spp., *Microtus* spp., birds) with many prey species and significant variations in seasonal diet. In other italian regions, e.g. in Sicily, depending on locality and habitat type, *Microtus*, but also *Apodemus*, may prevail in the diet (Siracusa *et al*., 1996; Siracusa *et al*., 2015). In Southern Europe and in the Mediterranean basin, the common owl has at hand a wider prey variety, from which it can take advantage thanks to its trophic plasticity (see Canova, 1989, for the Italian winter diet).

Data obtained from pellets can offer a reliable picture of the composition of small mammal community, provided those data are relative to a vast territorial area (Heisler *et al*., 2016) or, as in our case-study, an estimation of the same locality whose monitoring lasted some years. Data obtained in this way cannot furnish absolute quantitative estimations of the community in an area, but they can certainly provide a reliable estimation of their biodiversity, or at least a semi-quantitative estimation.

The number of species found in our target area represent 80.00% of the species of small mammals known from Sicily (Loy *et al*., 2019) and 88.89% of the species known for Mount Etna. As a matter of fact, only *Glis glis* (Linnaeus, 1766), known from Etna, and *Muscardinus avellanarius* (Linnaeus, 1758), known from Sicily but not from the Etna, were not found.

Fourtythree species of Rodentia–Soricomorpha small mammals are known from Italy according to Loy *et al*. (2019); the rodents *Hystrix cristata* Linnaeus, 1758, *Myocastor coypus* (Molina, 1782) and *Marmota marmota* Linnaeus, 1758 were excluded because they are not micro mammals. The 8 species found represent the 18.6% of the small mammal species reported for Italy: *C. sicula* and *S. etruscus* represent the 14.3% of the italian species of Soricomorpha (in total 14 species); *M. nebrodensis, G. glis, A. silvaticus, M. domesticus, R. norvegicus, R. rattus* represent the 19.3% of the Rodentia species known from Italy (in total 31 species).

The species with the greatest presence (frequency percentage 75.24% in the diet) was *M. nebrodensis* followed by *A. sylvaticus* (13.23%). Synanthropic species such as *R. norvegicus*, *M. domesticus* and *R. rattus* show low percentages of presence. The presence of soricomorphs and *E. quercinus* proved to be occasional. However, it must be stressed that although *E. quercinus* is considered close to threat, it was anyway preyed by the common owl, confirming its capability as a sampler. The low percentage of Soricomorpha found is probably also attributable to the lower predation by the long-eared owl against this group (Birrer, 2009). More than half of assessed biomass was represented by *M. nebrodensis* (57.54%), followed by *R. norvegicus* (29.29%) and *A. sylvaticus* (10.52%) (Tab. 2).

Frequence and biomass data agree with those found by Siracusa *et al*. (2015) in the same site studied in the present search; according to those authors, mammals represented 67% of common owl's diet (the remaining fraction was almost exclusively represented by birds); *M. nebrodensis* (reported as *M. savii*) was the most frequent prey (50.25%), followed by *A. sylvaticus* (7.60%) and *R. norvegicus* (5.28%); few specimens of *M. domesticus, R. rattus*, *C. sicula* and of Chiroptera were also preyed. Among small mammals, instead, *E. quercinus* and *S. etruscus* were not preyed.

According to Siracusa *et al*. (1996) in natural pinewood (*Pinus nigra laricio*; Pinaceae) on the Etna, locality Linguaglossa, common owl, instead, preyed mostly *A. sylvaticus* (60%) and *M. nebrodensis* (32.67%); differently, in Western Sicily (locality Roccapalumba) in reforested *Pinus pinea* (Pinaceae) environment surrounded by cereal fields, it was only *M. nebrodensis* to be massively preyed. The only comparable index is Shannon-Weaver, whose value in our sampling area (H' = 0.64) falls between the values of Roccapalumba (H' = 0.31) and Linguaglossa (H' = 1.0); it should be underlined that the latter value results higher because included also Chiroptera (Tab. 3). All these data seem to confirm that the common owl in Sicily is a good sampler of small mammal communities, whose composition essentially varies depending on the habitat, and then the presence and abundance of the prey species.

Vicariotto (2018) performed a study in an anthropized plain environment typical of Northern Italy (Sandrigo, Vicenza), thus very different from a Mediterranean insular environment; the Author reported a noticeable euryphagy of the common owl which preyed 49 taxa of vertebrates and one of invertebrates. Murids resulted the most preyed taxon, representing 52% of the whole sample. Diversely from the site we analysed, in the above-mentioned study, *Mus musculus* Linnaeus, 1758 was the most preyed species, followed by *A. sylvaticus* and *Microtus arvalis* (Pallas, 1778). This because the analysed site in that search, allowed the common owl to prey both species linked to urban environments, and those linked to lawns and surrounding cultivated areas. The strong effects of the antropization in Sandrigo determined a very low value of the Cricetidae/Muridae (0.41). The value of the ratio Soricomorpha (in that study

including Soricidae and Talpidae)/Rodentia was 0.04 affected by the presence of *Talpa europaea* Linnaeus, 1758 that is a species absent in Sicily. Surprisingly, the thermoxerophilic index gave a higher value in Sandrigo (ITX = 0.25) compared to our sampling area (ITX = 0.18) (Tab. 3); this result could be influenced by the lowland urban environment in Sandrigo and by the less antrophized and hill environment of our studied area.

Cecere & Vicini (2000) reported data on small mammals in the long eared owl winter diet in Southern Italy; the dormitory was at the WWF's Oasi San Giuliano (province of Matera) in a reforested pinewood mostly based on *Pinus halepensis*, in an area characterized by cereal extensive cultivations with just few trees and shrubs. Owls preyed 9 of the 11 small mammal species present (*M. domesticus* was absent). Mammalia represented 84.90% of preys and Rodentia were dominant (83.50%). *M. savii* was of particular importance and represented 60.44% of the total prey, followed by *Apodemus* sp. (22.49%). Those data agree rather well with ours, concerning also the ratio Cricetidae/Muridae (2.68) (Tab. 3). The other indices were not compared because appear to be not clear and contradictory.

As regards searches in Mediterranean areas, Seçkin & Coşkun (2006) reported in Turkey, in an environment dominated by *Pinus nigra* and agricultural areas, 8 species of mammals preyed (Soricomorpha: *Crocidura suaveolens* (Pallas, 1811), and Rodentia: *Microtus guentheri* (Danford & Alston, 1880), *Microtus* sp., *M. musculus*, *Meriones tristrami* Thomas, 1892, *Cricetus cricetus* (Linnaeus, 1758), *R. rattus*, and *Nannospalax ehrenbergi* (Nehring, 1898)); Rodentia were dominant (95.48%) and *M. guentheri* was the most frequent mammal species preyed (71.29% of the remains found in the pellets), while the second one was *M. musculus* (19.35%).

In Crete Island (Greek), in a typical rural Mediterranean environment with prevalence of olive groves, annual crops and vineyards, Kontogeorgos *et al.* (2019) found that the common owl's diet was based on small mammals (75.8 %), represented by six species: only one was a chiropteran, while the others were mostly *M. musculus* (56.3%), and, less important, *A. sylvaticus* (9.51%) and *R. rattus* (7.9%). The data agreed with those deriving from trapping. However, one species was detected in pellets but not found in trappings (*Acomys minous* Bate, 1906), confirming common owl's efficiency as small mammal community sampler.

Although the indices we utilized provide indications influenced by variables that partially affect the presence of preys in the common owl's diet (basically: availability of the preferred preys and of alternative preys, and their body size), those indices can anyway give rather reliable indications on small mammal communities, as already expressed. The values of the thermoxerophilic indices fall within the mesomediterranean belt; these values are low due to the scarce presence of thermoxerophilic species compared to the more thermophilic ones (Tab. 3).

The medium-low diversity values (Gini-Simpson = 0.41; Shannon-Weaver = 0.64) due to the strong prevalence of *M. nebrodensis* (which prevailed in the area we examined, while in a natural wood of *P. nigra laricio*, a less anthropized environment, investigated by Siracusa *et al*., 1996*,* it is *A. sylvaticus* to prevail) and the high number of species found, indicates a medium-high degree of anthropization (Contoli, 1980; Aste & Contoli, 1987). The values of the Margalef and Pielou indices (DMg = 1; J = 0.47; J' = 0.71), a high value of Cricetidae/Muridae ratio and low value of Soricidae/Rodentia ratio found seem to confirm such degree of human impact (Tab. 3). The specific richness and diversity of small mammal communities are inversely correlated with the degree of anthropization of the studied site, though several studies proved that this is not always the case (Contoli, 1995). In fact, the specific richness may also depend on other factors, such as the existence of degrees of connectivity due to faunal corridors. The changes in agro-pastoral activities with the abandonment of traditional agriculture in favor of a more intensive one, starting from the 1950s–1960s (Massa & La Mantia, 2007), and the expansion of urbanized areas have probably contributed to influence more the relative abundance of single species, rather than their total number; this by favouring the euriecian species which are more closely linked to anthropized habitats.

In agroecosystems, the drastic modifications in landscape with changes in the structure and use of land cause a decrease in diversity index in microteriocenoses (De La Peña *et al*., 2003), while the composition in type and number of species remains unchanged.

Conclusion

The site examined in the current paper is located in a hilly area on the Southeastern slope of Mount Etna of Sicily (without specific nature protection constraints) and characterized by a mosaic of cultivated and re-naturalized areas with a network of small and medium-sized villages close to one another. The composition and structure of the studied small mammal community is typical of landscapes characterized by rural environments, even complex ones, with edges and residual formations of Mediterranean scrub and mesophilic woods. The high number of species found (eight species out of ten known for the Sicilian small mammal fauna), and the medium-low diversity values are likely to be attributed to the fragmentation of habitats and consequent ecotone effect.

The typical composition of volcanic soil influences the quality of vegetation cover (both natural and cultivated), which has consequent repercussions on the biodiversity of zoocenoses that the territory hosts.

The high value of the Cricetidae/Muridae ratio and the low value of the trophic level index highlight a type of agricultural anthropization.

Intensification of agricultural activities, including previous ones, lead to an increase in the more generalist and synanthropic species. Furthermore, the use of biocides caused the populations of invertebrates decrease, with cascading effects in food chains.

However, the importance of these types of agroecosystems must be considered both for the high

number of species they host and for the presence of species of conservation interest.

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