

Theriofauna of Site of Community Importance Poggi di Prata (Grosseto, Central Italy): Terrestrial mammals and preliminary data on Chiroptera

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ABSTRACT: Information about mammal species richness is scarce from the site Poggi di Prata (Central Italy). We performed a three-year survey with camera traps and spotlight surveys. Data on road kills and owl pellets were also collected. Bats were sampled through a bat acoustic detector, active search and occasional observations. A total of 33 native species were recorded, from seven orders: Erinaceomorpha (N = 1), Soricomorpha (N = 3), Rodentia (N = 7), Lagomorpha (N = 2), Chiroptera (N = 10), Carnivora (N = 8), Artiodactyla (N = 2). Five exotic species (*Dama dama*, *Myocastor coypus*, *Rattus rattus*, *R. norvegicus* and *Mus musculus*) are present, and an additional exotic, *Sylvilagus floridanus*, has been recorded in the 1990s, but never established. *Rhinolophus hipposideros*, is Endangered in Italy, *R. euryale*, *R. ferrumequinum*, *Canis lupus* and *Capreolus c. italicus* are Vulnerable, while *Eptesicus serotinus* and *Plecotus auritus* are Near Threatened. The presence of two Italian endemic taxa, *Capreolus c. italicus* and *Lepus corsicanus*, is noteworthy.

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INTRODUCTION

Taxonomic studies of local fauna are important for zoogeographic purposes as well as for management plans and correct drawing up of red lists (e.g. Romanazzi 2012; Crucitti *et al.* 2013; Magalhães de Souza *et al.* 2013). In Southern Tuscany (Central Italy), published lists of mammals are scarce and available only for the province of Grosseto (Sforzi and Ragni 1997). Herein, we present an annotated list of mammals detected in the Site of Community Importance Poggi di Prata (province of Grosseto, Southern Tuscany), which has been already identified as an area of conservation concern, according to the zoological entities here recorded (cf. Cantini *et al.* 2013; Vannini *et al.* 2013). The serious deficiency of local theriofauna knowledge may be deleterious in terms of conservation biology, as many mammals are bioindicator (e.g. Pearce and Venier 2005; Alleva *et al.* 2006) and keystone species. Thus, data on these species' distribution may be used (i) to address management practices, and (ii) to promote environmental protection. We aimed to provide a comprehensive and updated summary on the theriofauna of this biotope, particularly on those species not reported in the last publication by Sforzi and Ragni (1997), including the endemic and of conservation interest ones.

MATERIALS AND METHODS

Study site

The study area is located in the North-Eastern part of the province of Grosseto (Southern Tuscany), in a rural hilly area with a total extension of about 1,350 ha (475–

903 m a. s. l.) and includes a Site of Community Importance (Poggi di Prata: Tuscany Regional Law 56/2000) and an International Waterbird Census area (IWC Laghetto del Gabellino). A map of the local habitat composition was provided by the local Hunting District (ATC Gr6: Figure 1). Most of the study area (67%) is covered by deciduous woodlands, mainly composed by *Quercus cerris*, *Castanea sativa*, *Ostrya carpinifolia*, *Carpinus betulus*, *Fraxinus ornus* and *Robinia pseudoacacia*. Around woodlands, scrubwoods (*Juniperus* spp., *Rubus* spp., *Erica scoparia* and *Spartium junceum*: 1.71%) are present. Fallows count for 19.49%. Cultivations (7.78%) include mainly sunflower, lucerne, cereals and vegetable gardens. Some pinewoods (*Pinus nigra* and *Cupressus arizonica*, 2.02%), due to artificial reforestation programs, and few human settlements (1.97%) are present. Wetlands are represented by a river (Merse), six brooks (Botro Rosso, Botro ai Ponti, Carsia, Mersino, Rigagnolo, Zanca), and some ponds, both natural and artificial. Most of these torrents and ponds are fed by rainfall and water extraction is limited to the irrigation of private vegetable gardens; thus, they may dry up when summers are particularly dry.

The climate presents sub-montane features: during our 36-month survey, average annual rainfall has been 873 mm, with rare episodes of snowfall, the average annual temperature was about 14°C (cf. Mori and Plebani 2012). Human activities are limited to the downstream area (Loc. Il Gabellino) and the immediate surroundings of the village of Prata, and include agriculture, sheep/cattle breeding and lumber trade.

Data Collection

A three-year survey of terrestrial mammals (January 2011–December 2013) was carried out through a combination of methods as follows.

Direct observations were carried out through a binocular (Konus Green Life 7 x 50) for diurnal species, and through spotlight surveys for nocturnal ones. Observations were carried out by traveling both dirt and paved roads, on a regular transect of 9.5 km, twice a week. Species and number of individuals were noted regularly every time that they were identified: signs of presence (fur, excrements, footprints) were also considered, and each one ascribed to an individual.

Camera trapping (4 camera traps Ziboni Tecnofauna Explorer Case 1988 and 3 Multipir 12). This kind of survey involved 1085 trap nights at 47 trap sites between January 2011 and December 2013.

Analysis of owl pellets. We collected 109 pellets under a dormitory of six long-eared owls *Asio otus* (Linnaeus, 1758), located on a stone pine, between December 2012 and April 2013 (Mori et al. 2014a). Prey rests (skulls, mandibles) were identified through a specific atlas (Nappi 2001).

Detection of road-kills. Mammals died after collisions with vehicles detected along the transect were photographed and identified.

Data Analysis

The indices used for birds of the same area (Shannon-Wiener Index for species diversity, Pielou index for evenness, Simpson diversity index for dominance and Margalef index of community diversity) were calculated also for mammals (cf. Vannini et al. 2013).

Chiroptera were excluded from these analyses, as we have only preliminary data and few individuals have been identified to the species level, because of the impossibility to determine bat species through observations of flying individuals. Few data have been collected by visiting a cave, named "Buca del Gallo", within the study area; other data were obtained by observation of dead individuals (road-kills or killed by domestic cats) and by bat detector. Recordings were made in the time expansion mode with

a Pettersson Elektronik D-240X ultrasound detector connected to an Edirol R-09. The resulting sequence was then analyzed (BatSound 3.10) using a sampling frequency of 44.1 kHz and a 512 pt FFT. Obtained recordings were compared with Russo and Jones (2002) and private sound libraries of two authors (S. Vergari and G. Dondini).

RESULTS

We collected a total of 3345 records for terrestrial mammals, belonging to 30 species, 25 of them native (Table 1): 2287 photos in 1085 camera trapping nights, 982 direct contacts (with live individuals or presence signs), 112 remains in owl pellets and 64 road-kills.

Two species are locally extinct, the alien Eastern cottontail *Sylvilagus floridanus* Allen, 1890, introduced in the 1990s, and the native European otter *Lutra lutra* Linnaeus, 1758. Preliminary data on Chiroptera (10 species) are reported in Table 2.

A total of 19 species (47.5%) were not listed in the previous Grosseto Provincial Atlas of Mammals (Sforzi and Ragni 1997). Italian IUCN classified 73.33% of native recorded taxa as Least Concern, 10% as Near Threatened, 13.33% as Vulnerable and 3.33% as Endangered. One taxon was considered as Near Threatened globally, by IUCN, and two as Vulnerable (Tab. 1–2).

Habitat Directive listed 42.86% of the taxa detected in this survey; 31.43% are listed in the Bern Convention (Tab. 1–2).

The diversity indices (Shannon-Wiener's index: $H = 2.419$; Pielou's evenness index: $J = 0.711$; Margalef's index = 8.199; Simpson's dominance index = 0.138) showed low values of dominance for the theriological community for the studied mammal community ($N = 33$ native species and 5 alien species), associated with medium-high evenness of individuals among species, similarly to those calculated for birds (Vannini et al. 2013).

DISCUSSION

Theriofauna of "Poggi di Prata"

The present study highlights that the hilly area of Poggi di Prata, characterized by a low level of urbanization, represents an interesting site for many mammal species,

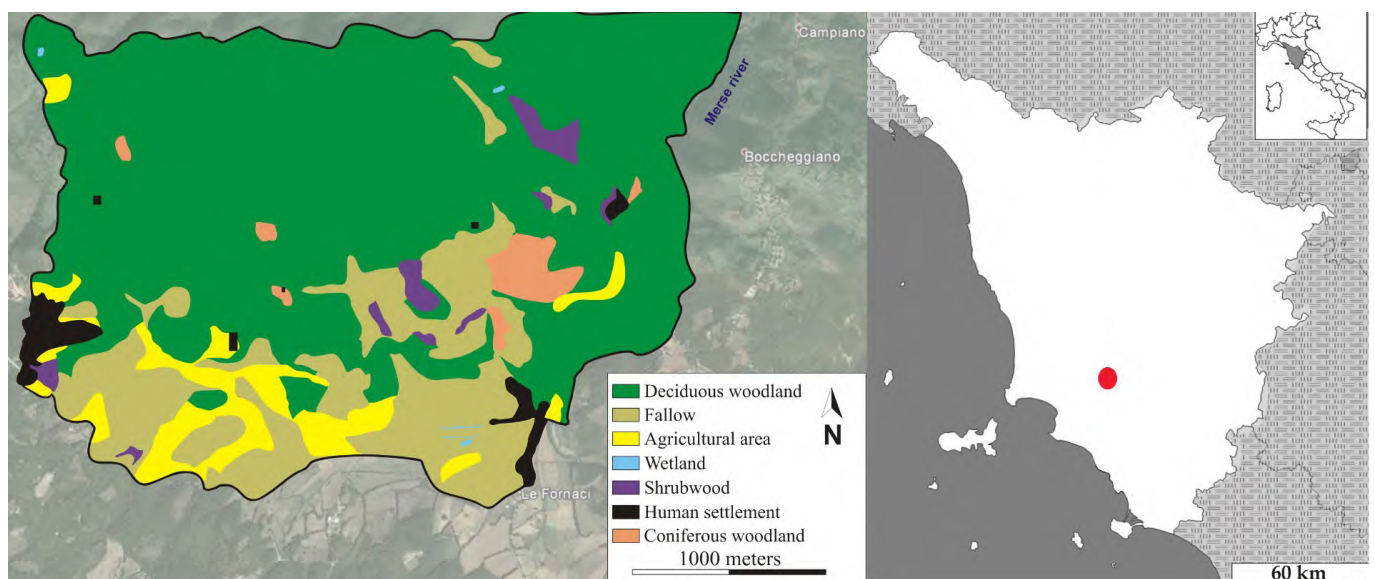


FIGURE 1. Location and habitat composition of the study area.

including some (more than 46% listed in the Habitat Directive) of relevant conservation value. The diversity indices did not show the presence of any dominant element within the theriological community, although the most abundant species are the large sized ones and well diffused even in the immediate surroundings of human settlements, i.e. *Sus scrofa* Linnaeus, 1758, *Meles meles* (Linnaeus, 1758), *Vulpes vulpes* (Linnaeus, 1758), *Hystrix cristata* Linnaeus, 1758 and *Capreolus capreolus italicus* Festa, 1925. Within the study area, *Sus scrofa* is the most observed mammal, thus confirming Sforzi and Ragni (1997) for the whole province of Grosseto. Observations of individuals with intermediate phenotype between pigs and wild boars suggest that hybridization with wild-bred herds of pigs may occur (cf. Scandura et al. 2011).

The number of individuals also shows a medium to high evenness (cf. Peet 1974) among species ($J = 0.711$), indicating probably a balanced and relatively undisturbed environment. This hypothesis is also supported by the value of Margalef's index ($M = 8.199$: cf. Angelici et al. 2009; Malavasi et al. 2009; Vannini et al. 2013). All the terrestrial mammals reported by Sforzi and Ragni (1997) for the whole Province of Grosseto were detected within Poggi di Prata, with few exceptions: *Arvicola amphibius* (Linnaeus, 1758), *Glis glis* (Linnaeus, 1766), *Eliomys quercinus* (Linnaeus, 1766), *Talpa caeca* Savi, 1822, *Sorex minutus* Linnaeus, 1766 and *Sorex samniticus* Altobello, 1926. The absence of these small species may be related to the sampling method we used, which favors the detection of medium-large mammals. This is particularly true for *Sorex* species and Gliridae, whereas moles are easily detectable through the presence of earth mounds.

The edible dormouse was reported for the study site in 1970s (Loc. Gretaia: Sforzi and Ragni 1997), but we did not find any evidence of its presence. We documented for the first time the presence of 19 species (bats included) for the study areas, some of them of high conservation values, not reported in the previous Provincial Atlas of Grosseto province (Sforzi and Ragni 1997), thus emphasizing the importance of studies at small spatial scales (cf. Romanazzi 2012; Crucitti et al. 2013). Two other species were considered locally extinct: the Eastern cottontail *Sylvilagus floridanus* (Allen, 1890), who was introduced during the 1990s, and never established, maybe because of predation by red foxes, and the European otter *Lutra lutra* Linnaeus, 1758, endangered in Italy, observed for the last time in 1989 close to Merse river, but now considered as extinct throughout Central Italy (Panzacchi et al. 2009). Indeed, transects along river sides did not provide any sign of this carnivore.

Endemic taxa

Two endemic species of the Italian peninsula have been detected. The Apennine hare, *Lepus corsicanus* (De Winton, 1898), has been camera trapped twice in the same place; this lagomorph, once present within the study areas according to local hunter and mushroom pickers, has not been recorded since the 1970s. Further researches are needed to assess the consistence of the local population, which is the northernmost known one (Mori et al. 2014b), as well as the potential threat induced by the introduction of European brown hares. The second Italian endemic

species is the Italian roe deer *Capreolus capreolus italicus* (Figure 2). The original distribution of Italian roe deer is unknown but it was historically attributed to the south of Italy, where it is currently present in a few relict areas, Poggi di Prata included (Randi et al. 2004; Biossa et al., in prep.). Hybridization with Central European pools was widely recorded in Central Italy (Randi et al. 2004; Biossa et al. in prep) but a high frequency of Italian haplotypes remained also in the study area (Lorenzini et al. 2002; Gentile et al. 2009; Biossa et al. in prep). Management practices should be adopted in relation to several factors including time of the introduction, number of released individuals, as well as habitat, landscape features and species' ecology, especially among populations with different genetic pools.

Carnivores of conservation interest

The presence of the wolf *Canis lupus* Linnaeus, 1758, not reported by Sforzi and Ragni (1997), is noteworthy. The Apennine subspecies, *Canis lupus italicus*, is classified as Vulnerable by IUCN). Our observations do not suggest the presence of stable packs, nor reproductive nuclei in the area of Poggi di Prata, although Metalliferous Hills provide environmental conditions for both temporary and permanent presence of the wolf (L. Boitani, personal communication 2014). Although no evidence of feral dogs was recorded within the study area, introgression with the domestic form is currently widespread throughout the Province of Grosseto (Caniglia et al. 2013). In contrast, observations of wild cat cubs *Felis silvestris* Schreber, 1777 emphasize the importance of conservation strategies to be applied because the presence of feral domestic cats may represent a threat for the wild genome (cf. Randi et al. 2001). The presence of pine marten *Martes martes* (Linnaeus, 1758) (Figure 3) at a relatively high frequency of observation could be due to a recent range expansion of this species, maybe helped by the human abandonment of the countryside and by the progressive advance of woodlands, the elective habitat of this species (Balestrieri et al. 2010). On the other hand, records of least weasels *Mustela nivalis* Linnaeus, 1766 were few, maybe because of the low detectability of this small mustelid. Perhaps open areas, where this species typically hunts (Zub et al. 2008), represent a negligible part of the study area.

Small mammals

Small mammals are mainly elusive species, and data are mostly related to largest species, e.g. *Myocastor coypus* (Molina, 1782), *Hystrix cristata* (Figure 4) or to the most synanthropic ones, e.g. *Erinaceus europaeus* Linnaeus, 1758, *Rattus* spp. and *Mus musculus* Linnaeus, 1758. Few data on shrews and voles were detected from owl pellets. The hazel dormouse *Muscardinus avellanarius* (Linnaeus, 1758) is a species of conservation interest, hard to observe. Its nests were observed in deciduous woodlands, mainly in the upper part of the study area. Although classified as Least Concern by both National and International IUCN assessments, the European red squirrel *Sciurus vulgaris* Linnaeus, 1758 represents for sure a species of conservation interest, being threatened by habitat fragmentation and competition with non-native species in Italy (Celada et al. 1994; Bertolino and Genovesi 2003; Mori et al. 2013a).

Bats

Bats represent the order with the greatest number of species in the area of Poggi di Prata (N = 10). Data relating to bats were particularly limited and outdated (Sforzi and Ragni, 1997). Three species relatively ubiquitous and widespread in Italy (*Pipistrellus kuhlii* (Kuhl, 1817), *Pipistrellus pipistrellus* (Schreber, 1774) and *Hypsugo*



FIGURE 2. Male individual of *Capreolus capreolus italicus*.



FIGURE 3. Young individual of *Martes martes*.



FIGURE 4. Adult *Hystrix cristata* near the entrance of its den.

savii (Bonaparte, 1837)) have never been reported in the investigated area. The finding of all horseshoe bat species reported in Tuscany, *Rhinolophus ferrumequinum* (Schreber, 1774), *R. hipposideros* (Bechstein, 1800) and *R. euryale* Blasius, 1853, is quite interesting, as these taxa are uncommon and declining on the whole Italian territory (Figure 5). The discovery of a dead specimen of brown long-eared bat *Plecotus auritus* Linnaeus, 1758 in the late spring of 2011, on a balcony of a house in the village of Prata, confirms the naturalistic value of the area covered by this survey. There are few reports of the serotine *Eptesicus serotinus* Schreber, 1774 for the central-southern Tuscany (Sforzi and Ragni 1997; Dondini et al. 1999; Dondini and Vergari 2013) while for the Daubenton's bat *Myotis daubentonii* (Kuhl, 1817) there is only one record in the surroundings of Massa Marittima, inside a cave (Sforzi and Ragni 1997). The European free tailed-bat *Tadarida teniotis* (Rafinesque, 1814) was recorded by ultrasound signals in open areas near Prata village. The number of recorded bat species is thus particularly high. The widespread availability of roosts, suitable foraging areas and linear habitats, such as hedgerows, tree lines, ditches and edges of water courses, is a main factor influencing the presence of a good bat community. These elements are important both for providing many insects, and allowing bats to move between different foraging sites and roosts. Feral cats may represent a serious threat for bat communities of Poggi di Prata (Ancillotto et al. 2013).

Alien species

Three of the alien species are amongst the most widespread distributed worldwide: the black rat *Rattus rattus* (Linnaeus, 1758), the brown rat *Rattus norvegicus* (Berkenhout, 1769) and the house mouse *Mus musculus*. Fallow deers, *Dama dama* Linnaeus, 1758, were released/escaped from captivity at the end of the 1980s, and are currently present mainly on the downstream portion of the study site, in the surroundings of fences where they were bred.



FIGURE 5. Adult female of *Rhinolophus hipposideros* (Buca del Gallo, May 2012).

TABLE 1. List of terrestrial mammal species recorded within the study areas, frequency of observation (%) for each species, national and global IUCN categories (LC, least concern; NT, near threatened; VU, vulnerable). Categories in parentheses refer to species identified at the genus level. Presence in Habitat Directive numbers refer to Annexes where the species is listed), Bern convention (*), and Sforzi and Ragni (1997) were also reported; §, alien species.

ORDER	SPECIES	FO%	IUCN Italy	IUCN Global	Habitat directive	Bern Convention	Sforzi and Ragni 1997
Soricomorpha	Bicolored shrew <i>Crocidura leucodon</i> (Hermann, 1780)	0.058	LC	LC			✓
	Lesser shrew <i>Crocidura suaveolens</i> (Pallas, 1811)	0.087	LC	LC			
	Etruscan shrew <i>Suncus etruscus</i> (Savi, 1822)	0.116	LC	LC			
	European hedgehog <i>Erinaceus europaeus</i> Linnaeus, 1758	3.425	LC	LC			✓
Lagomorpha	European brown hare <i>Lepus europaeus</i> Pallas, 1778	3.164	LC	LC			✓
	Apennine hare <i>Lepus corsicanus</i> (de Winton, 1898)	0.087	LC	VU			
Rodentia	<i>Apodemus</i> sp.	5.893	(LC)	(LC)			✓
	Black rat <i>Rattus rattus</i> (Linnaeus, 1758) §	0.871	ALL	LC			✓
	Brown rat <i>Rattus norvegicus</i> (Berkenhout, 1769) §	0.435	ALL	LC			
	<i>Rattus</i> sp. §	0.290	(ALL)	(LC)			
	House mouse <i>Mus musculus</i> Linnaeus, 1758 §	1.016	ALL	LC			✓
	Savi's pine vole <i>Microtus savii</i> (de Selys-Longchamps, 1838)	0.522	LC	LC			✓
	Bank vole <i>Myodes glareolus</i> (Schreber, 1780)	2.206	LC	LC			✓
	Hazel dormouse <i>Muscardinus avellanarius</i> (Linnaeus, 1758)	0.435	LC	LC	4		✓
	European red squirrel <i>Sciurus vulgaris</i> Linnaeus, 1758	1.655	LC	LC			✓
	Crested porcupine <i>Hystrix cristata</i> Linnaeus, 1758	10.566	LC	LC	4	*	✓
	Coypu <i>Myocastor coypus</i> (Molina, 1782) §	0.174	ALL	LC			
Carnivora	Wolf <i>Canis lupus</i> Linnaeus, 1758	0.435	VU	LC	2,4	*	
	Red fox <i>Vulpes vulpes</i> (Linnaeus, 1758)	11.959	LC	LC			✓
	Wild cat <i>Felis silvestris</i> Schreber, 1777	0.522	NT	LC	4	*	
	<i>Felis silvestris</i> vel. <i>catus</i>	1.277	--	--			
Mustelidae	Least weasel <i>Mustela nivalis</i> Linnaeus, 1766	0.087	LC	LC			✓
	European polecat <i>Mustela putorius</i> Linnaeus, 1758	0.348	LC	LC	5		
	Stone marten <i>Martes foina</i> (Erxleben, 1777)	1.248	LC	LC			✓
	Pine marten <i>Martes martes</i> (Linnaeus, 1758)	2.380	LC	LC	5		
	<i>Martes</i> sp.	0.232	(LC)	(LC)			
	Eurasian badger <i>Meles meles</i> (Linnaeus, 1758)	13.846	LC	LC			✓
Cetartiodactyla	Fallow deer <i>Dama dama</i> (Linnaeus, 1758) §	1.655	ALL	LC			✓
	Italian roe deer <i>Capreolus capreolus italicus</i> Festa, 1925	6.589	VU	VU			✓
	Wild boar <i>Sus scrofa</i> Linnaeus, 1758	28.418	LC	LC			✓

TABLE 2. List of bat species recorded within the study areas, national and global IUCN categories (LC, least concern; NT, near threatened; VU, vulnerable). Presence in Habitat Directive (numbers refer to Annexes where the species is listed), Bern convention (*), and Sforzi and Ragni (1997) were also reported.

SPECIES	IUCN Italy	IUCN global	Habitat Directive	Bern Convention	Sforzi and Ragni 1997
Mediterranean horseshoe bat <i>Rhinolophus euryale</i> Blasius, 1853	VU	NT	2, 4	*	
Greater horseshoe bat <i>Rhinolophus ferrumequinum</i> (Schreber, 1774)	VU	LC	2, 4	*	
Lesser horseshoe bat <i>Rhinolophus hipposideros</i> (Bechstein, 1800)	EN	LC	2, 4	*	✓
Serotine <i>Eptesicus serotinus</i> Schreber, 1774	NT	LC	4	*	
Savi's pipistrelle <i>Hypsugo savii</i> (Bonaparte, 1837)	LC	LC	4	*	
Common pipistrelle <i>Pipistrellus pipistrellus</i> (Schreber, 1774)	LC	LC	4		
Kuhl's pipistrelle <i>Pipistrellus kuhlii</i> (Kuhl, 1817)	LC	LC	4	*	
Daubenton's bat <i>Myotis daubentonii</i> (Kuhl, 1817)	LC	LC	4	*	✓
Brown long-eared bat <i>Plecotus auritus</i> Linnaeus, 1758	NT	LC	4	*	✓
European free-tailed bat <i>Tadarida teniotis</i> (Rafinesque, 1814)	LC	LC	4	*	

As for *Myocastor coypus*, the low number of records may be due to a possible low suitability of the area surrounding the Merse river, being it a typical lowland species (Bertolino and Ingegno 2009). Moreover, snowfall and summer drought may limit access to waterways, elective habitats for this species (Prigioni et al. 2005; Bertolino and Ingegno 2009). Origin of *Hystrix cristata* in Italy is still widely debated (Mori et al. 2013b, for a review), although recent works suggest an early-medieval introduction (Trucchi and Sbordoni 2009; Masseti et al.

2010). Estimated density of the species in the study area is one of the highest among mammals and, if confirmation of its alien origins will occur, impacts on native species should be investigated (cf. Mori et al. 2014c).

Future research

Further studies are needed to evaluate (i) the breeding success of species of conservation interest (i.e. *Canis lupus*, *Rhinolophus hipposideros*), as well as that of invasive alien species (i.e. *Myocastor coypus*) within the study area,

and (ii) the impacts of anthropogenic threats (*e.g.*, road-kills, hybridization with domestic feral species, human economic activities), to implement management programs to preserve the native mammal fauna, with particular attention to conservation priority species.

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