Checklist of terrestrial vertebrates of a northern Apennine area of conservation concern (Prati di Logarghena-Valle del Caprio, province of Massa-Carrara)

PAOLO AGNELLI, LUCIA BELLINI, STEFANO VANNI
Museo di Storia Naturale, Sede "La Specola", via Romana 17, 50125, Firenze, Italy
E-mail: paolo.agnelli@unifi.it - lucia.bellini0@alice.it
ALBERTO CHITI BATELLI, PAOLO SPOSIMO
NEMO Nature and Enviroment Management Operators Srl, Viale G. Mazzini 26, 50132, Firenze, Italy. E-mail: nemo.firenze@mclink.it
EMILIANO MORI
Dipartimento di Scienze della Vita, Università degli Studi di Siena, Via P.A. Mattioli 4, 53100, Siena, Italy. ORCID ID: 0000-0001-8108-7950.
E-mail: moriemiliano@tiscali.it

Abstract

In this work, a check-list of the species of amphibians, reptiles, breeding birds and mammals recorded in the area named "Prati di Logarghena-Valle del Caprio" (central Italy, province of Massa-Carrara) is presented. Very little is known on the vertebrate fauna of this area, located in the northern Apennines, despite being particularly interesting in a period of evident climatic change, which may affect the distribution of mountain species. We reported the occurrence for 89 species including 8 amphibians, 6 reptiles, 45 breeding birds and 30 mammals. Among those, at least 24 are protected according to European Directives: emphasis has been given to the species of remarkable concern from the ecological and conservation points of view.

Keywords: Amphibia, Reptilia, Aves, Mammalia, central Italy, Apennine ridge, biodiversity, conservation.

Riassunto

Checklist di vertebrati terrestri di un'area dell'Appennino Settentrionale di interesse conservazionistico (Prati di Logarghena-Valle del Caprio, provincia di Massa-Carrara)
In questo lavoro, è presentata la check-list delle specie di anfibi, rettili, uccelli nidificanti e mammiferi dell'area di interesse per la conservazione "Prati di Logarghena-Valle del Caprio" (Italia centrale, provincia di Massa-Carrara). La fauna vertebrata di quest'area dell'Appennino settentrionale è stata poco studiata, nonostante sia particolarmente interessante in un periodo di evidente cambiamento climatico, che può influenzare la distribuzione delle specie tipiche di habitat di montagna. Nell'area, sono risultate presenti almeno 89 specie di vertebrati terrestri, tra cui 8 anfibi, 6 rettili, 45 uccelli nidificanti e 30 mammiferi. Tra questi, almeno 24 sono protetti secondo le direttive europee: una maggiore enfasi è stata data alle specie di maggior preoccupazione dal punto di vista ecologico e conservazionistico.

Parole chiave: Amphibia, Reptilia, Aves, Mammalia, Italia centrale, Apennini, biodiversità, conservazione.

Introduction

Current climatic change is dramatically shaping and altering the animal biodiversity particularly on mountain sides (e.g. Bisi *et al.*, 2015; Elsen & Tingley, 2015). Therefore, local checklists of animal species are strongly required for zoogeographic studies and management plans, including the correct inclusion of taxa into local or national red lists (e.g. Droege *et al.*, 1998; Mori *et al.*, 2014). Particularly, historical data are necessary, but often lacking in adaptive management programs, to improve conservation status of animal species in protected areas, including Natura2000 sites. Complete vertebrate checklists are scarce for many Apennine areas (e.g. Bottacci, 2012; Stanisci *et al.*, 2012; Cianfanelli *et al.*, 2016) and they often lack historical data to assess potential species distribution shifts (cf. Scherrer *et al.*, 2017).

Herein, we provided an annotated checklist of amphibians, reptiles, birds and mammals detected in Prati di Logarghena-Valle del Caprio (province of Massa-Carrara, northern Tuscany), which has been reported as an area of conservation concern, according to biological entities and habitat types (e.g. Farina, 1981); this area is now partially included into the Tuscan-Emilian Apennines National Park and almost entirely included in the Natura 2000 Site "Monte Orsaro". Despite the high naturalistic values, the area is currently largely devoid of bibliographical references. Data were collected at the end of the 1990s and may provide a reliable historical background for updated, current checklists.

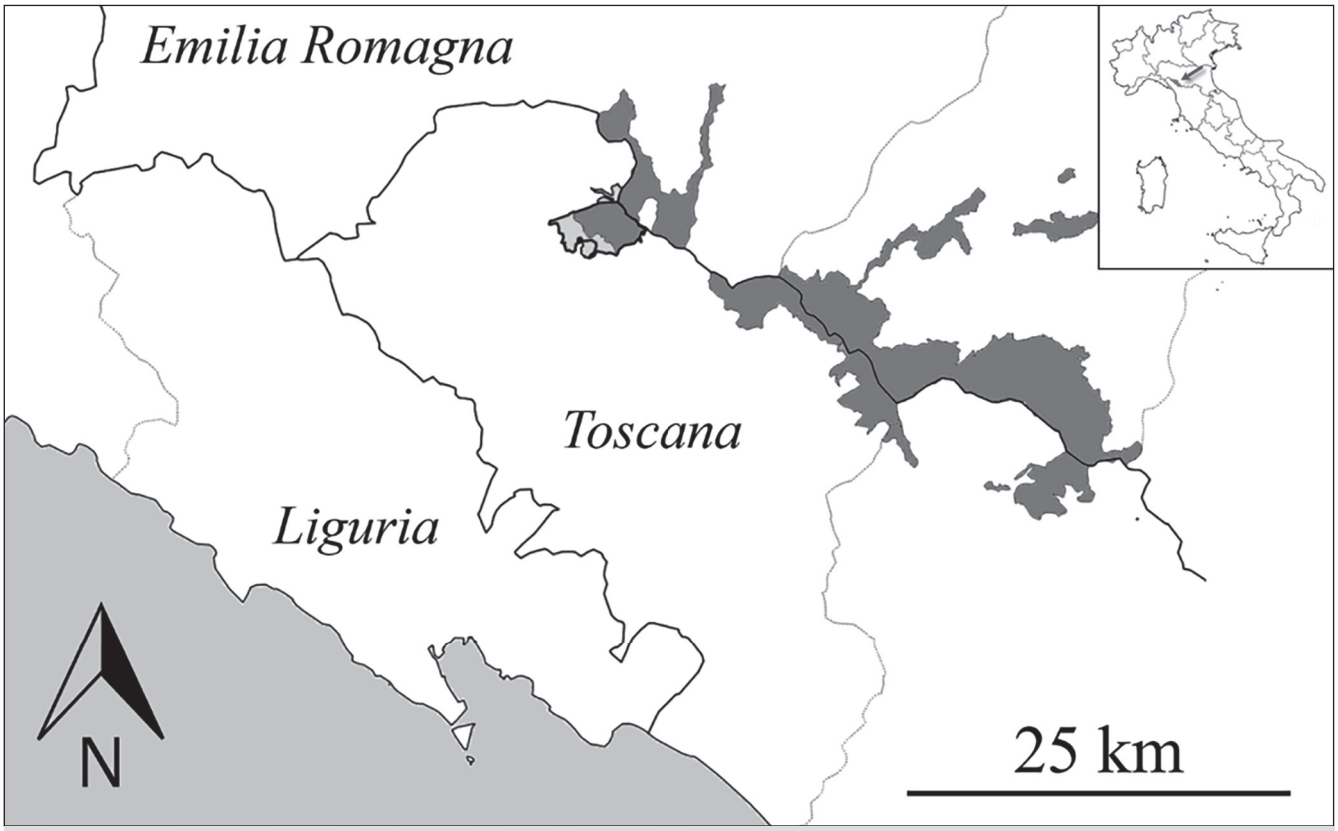

Figure 1. Study area (black line) and the boundaries of Tuscan-Emilian Apennines National Park (dark grey) and the Natura 2000 SAC "Monte Orsaro" (light grey).

Materials and methods

Study area

The study area is located on the mountain slopes of the municipality of Filattiera (province of Massa-Carrara: Figure 1), including the area named as "Prati di Logarghena" (44.394°N – 9.959°E), north to the villages of Rocca Sigillina along the valley of the Caprio river ("Valle del Caprio") and the Tuscan-Emilian Apennine Ridge (Orsaro and Brusa mountains). The vegetal landscape of the "Prati di Logarghena" has been historically conditioned by human presence. These areas derived from the destruction of the original forests and their subsequent cultivation as arable crops, pastures or permanent meadows. The abandonment of the mountain agriculture in recent decades and the consequent reduction of cultivation practices has resulted in a considerable contraction of the mowing and arable fields, which have been recolonised by herbs and shrubs (Arrigoni & Menicagli, 1999; Bertacchi *et al.*, 2005). Southern and western slopes are characterised by an Alpine morphology with rocky walls, meadows, screes and grassy altitude prairies with *Brachypodium genuense*, *Asplenium septentrionale* and *Saxifraga etrusca*. In the peak of northern slopes, *Vaccinium gaultherioides, Empetrum hermaphroditum, Rosa pendulina* and *Homogyne alpina* are present and well-preserved. Bogs and heaths (*Calluna vulgaris, Genista pilosa* and *Vaccinium myrtillus*) are widespread in the study area mostly on acidic, deep and oligotrophic soils. Western slopes are also covered with chestnut woodland *Castanea sativa*, whereas mixed deciduous woodlands (e.g. *Quercus cerris, Carpinus betulus, Ostrya carpinifolia*) mostly covered the northern slopes. The naturalistic importance of the area is confirmed by the presence of the Special Area of Conservation "Monte Orsaro", in accordance with the Directive 92/43/EEC. In addition to the study area, the area of Monte Orsaro represents an important area for plant and bird species, because of the presence of rare species such as *Pinguicola leptoceras, Pedicularis cenisia, Saxifraga etrusca, Traunsteneira globosa, Woodsia alpina* and *Primula apennina* (plants), and the common rock thrush *Monticola saxatilis* and the golden eagle *Aquila chrysaetos* (birds).

Field work

1. AMPHIBIANS AND REPTILES. After a pilot study in summer 1999, five surveys were carried out to assess the diversity of amphibians and reptiles, once a month, between May and September 2000, for a total of 80 working hours. All the habitat types were checked throughout the whole altitudinal range. Conservation status following the Habitat Directive 92/43/EEC (Annex II: species requiring designation of Special Areas of Conservation; Annex IV: species in need of strict protection), the Italian Red List (Rondinini *et al.*, 2013) and the global IUCN Red Lists (https://www.iucnredlist.org/).

2. BREEDING BIRDS. The study area has been divided into five detection units (100 hectares each), to cover all the habitat types, based on the UTM grid (1 km side); the number of breeding species and breeding pairs has been recorded in one point within each detection unit during 4 surveys (8 hours each) in June and July 1999. The relative frequency of each species (i.e. number of breeding pairs/number of total breeding bird pairs × 100) was also reported. Conservation status following the European Directive 2009/147/CE, the Italian Red List (Rondinini *et al.*, 2013) and the global IUCN Red Lists (https://www.iucnredlist.org/). We also identified the Species of European Conservation Concern (SpEC: see Vannini *et al.*, 2013).
3. MAMMALS. The survey of terrestrial mammals was carried out between May and September 2000 (250 working hours), following a pilot study in summer 1999. Small mammals (i.e. rodents and shrews) were captured through pitfall traps, i.e. plastic bottles (1.5 liters), cut at their apex and sunken in the ground. These traps contained an attractive-preservative, formalin-based bait, buffered with calcium carbonate and water. Pitfall traps were placed in 3 stations with 20 traps each. At each station, pitfall traps were separated one another by at least 15 metres. Traps were kept active for a total of 124 days and checked once a month. Furthermore, barn owl pellets (N = 120) were collected under a roost used by a breeding pair with nestlings in the top part of the church tower of the village of Serravalle. Prey rests (skulls, mandibles) were identified through standard methods and by using specific issues, atlases and local reference collections (Toschi & Lanza, 1959; Toschi, 1965; Gaggi & Paci, 2014; Mori *et al.*, 2016). 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. 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. Bats were searched through a combination of two methods. We searched for shelters used for daytime resting, reproduction or wintering, i.e. caves, artificial cavities, trunk cavities, ruins and buildings. This type of research has been integrated also by interviews with local people, to identify possible unknown cavities. Furthermore, bats were also surveyed through the use of a bat detector. Recordings were made in the time expansion and heterodyne modes with a Pettersson Elektronik D980 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 private sound libraries. Records are stored at the Museum of Natural History of the University of Florence "La Specola".

Results

In our surveys, 89 vertebrate species (except for fish) were detected.

Amphibians and Reptiles

A total of 8 amphibians and 6 reptile species were detected, three of which endemic to Italy (Table 1). Most species are classified as Least Concern by the national and global IUCN red lists. The national red list classified the common toad *Bufo bufo* as Vulnerable. Both the national and the global IUCN red lists report the Apennine yellow-bellied toad *Bombina pachypus* as Endangered. Two species recently splitted (Gvožďík *et al.*, 2013; Kindler & Fritz, 2018), i.e. the Italian slow worm *Anguis veronensis* and the barred grass snake *Natrix helvetica*, have not yet been evaluated by the global IUCN.

Order	Species		Italian red list	IUCN red list	Italian endemic
Urodela	Fire salamander *	*Salamandra salamandra*	LC	LC	No
	Alpine newt *	*Ichthyosaura alpestris* ssp. *apuana*	NT	LC	No
	Crested newt *	*Triturus carnifex*	LC	LC	No
Anura	Apennine yellow bellied toad *	*Bombina pachypus*	EN	EN	Yes
	Common toad *	*Bufo bufo*	VU	LC	No
	Italian tree frog *	*Hyla intermedia*	LC	LC	Yes
	Agile frog *	*Rana dalmatina*	LC	LC	No
	Italian stream frog *	*Rana italica*	LC	LC	Yes
Squamata	Italian slow worm	*Anguis veronensis*	LC	NE	Yes
	Common wall lizard *	*Podarcis muralis*	LC	LC	No
	Western green lizard *	*Lacerta bilineata*	LC	LC	No
	Aesculapian snake *	*Zamenis longissimus*	LC	LC	No
	Barred grass snake	*Natrix helvetica*	LC	NE	No
	Green whip snake *	*Hierophis viridiflavus*	LC	LC	No

Table 1. Herpetofauna of the study area. The solid line separated amphibians (above) and reptiles (below). IUCN risk categories are reported. LC, Least Concern; NT, Near Threatened; VU, Vulnerable; EN, Endangered; NE, Not Evaluated. *, species included in the Annexes of the Habitat Directive.

Breeding birds

A total of 45 species were detected; therefore, all of them are most likely breeding in our study area (Table 2), including 10 Species of European Conservation Concern. The most abundant breeding species in our study area are the corn bunting *Emberiza calandra*, the common whitethroat *Sylvia communis* and the red-backed shrike *Lanius collurio* (Table 2). The Eastern subalpine warbler *Sylvia cantillans*, recently splitted, is most likely to be referred to Moltoni's warbler *Sylvia subalpina* (Lozano & Robson, 2011). Most species are classified as Least Concern by the national and global IUCN red lists. The national red list classified two species as Near Threatened and eight species as Vulnerable; the Eurasian wryneck *Jynx torquilla* is classified as Endangered (Figure 2). The global IUCN red list reports the Italian sparrow *Passer italiae* as Vulnerable.

Species		Relative frequency (%)	Italian red list	IUCN red list	SpEC
Common buzzard	*Buteo buteo*	2.08	LC	LC	No
Montagu's harrier *	*Circus pygargus*	1.04	VU	LC	Yes
Common kestrel	*Falco tinnunculus*	1.04	LC	LC	Yes
Common quail	*Coturnix coturnix*	7.29	DD	LC	Yes
Barn owl *	*Tyto alba*	1.04	LC	LC	Yes
Eurasian wryneck	*Jynx torquilla*	1.04	EN	LC	Yes
European green woodpecker *	*Picus viridis*	1.04	LC	LC	Yes
Great spotted woodpecker	*Dendrocopos major*	1.04	LC	LC	No
Woodlark *	*Lullula arborea*	2.08	LC	LC	Yes
Eurasian skylark	*Alauda arvensis*	3.13	VU	LC	Yes
Barn swallow	*Hirundo rustica*	1.04	NT	LC	Yes
House martin	*Delichon urbica*	1.04	NT	LC	No
Tree pipit	*Anthus trivialis*	3.13	VU	LC	No
Water pipit	*Anthus spinoletta*	1.04	LC	LC	No
White wagtail	*Motacilla alba*	2.08	LC	LC	No
White-troated dipper	*Cinclus cinclus*	2.08	LC	LC	No
European wren	*Troglodytes troglodytes*	1.04	LC	LC	No
Eurasian robin	*Erithacus rubecula*	1.04	LC	LC	No
Black redstart	*Phoenicurus ochruros*	1.04	LC	LC	No
European stonechat	*Saxicola rubicola*	6.25	VU	LC	No
European blackbird	*Turdus merula*	10.42	LC	LC	No
Song thrush	*Turdus philomelos*	1.04	LC	LC	No
Mistle thrush	*Turdus viscivorus*	1.04	LC	LC	No
Eastern subalpine warbler	*Sylvia cantillans*	1.04	LC	LC	No
Sardinian warbler	*Sylvia melanocephala*	1.04	LC	LC	No
Common whitethroat	*Sylvia communis*	15.63	LC	LC	No
European blackcap	*Sylvia atricapilla*	4.17	LC	LC	No
Common chiffchaff	*Phylloscopus collybita*	1.04	LC	LC	No
Long-tailed tit	*Aegithalos caudatus*	1.04	LC	LC	No
Marsh tit	*Poecile palustris*	1.04	LC	LC	No
Blue tit	*Cyanistes caeruleus*	1.04	LC	LC	No
Great tit	*Parus major*	1.04	LC	LC	No
Eurasian golden oriole	*Oriolus oriolus*	2.08	LC	LC	No
Red-backed shrike *	*Lanius collurio*	12.50	VU	LC	Yes
Eurasian jay	*Garrulus glandarius*	1.04	LC	LC	No

Hooded crow	*Corvus cornix*	3.13	LC	LC	No
Italian sparrow	*Passer italiae*	1.04	VU	VU	No
Eurasian tree sparrow	*Passer montanus*	1.04	VU	LC	No
Common chaffinch	*Fringilla coelebs*	3.13	LC	LC	No
European serin	*Serinus serinus*	1.04	LC	LC	No
European greenfinch	*Chloris chloris*	7.29	NT	LC	No
European goldfinch	*Carduelis carduelis*	11.46	NT	LC	No
Eurasian bullfinch	*Pyrrhula pyrrhula*	1.04	VU	LC	No
Cirl bunting	*Emberiza cirlus*	9.38	LC	LC	No
Corn bunting	*Emberiza calandra*	17.71	LC	LC	No

**Table 2. Breeding birds of the study area. Relative frequencies and risk categories are reported. SpEC, Species of European Conservation Concern; *, species included in the Annex I of the European Directive 2009/147/CE.
LC, Least Concern; NT, Near Threatened; VU, Vulnerable; EN, Endangered; DD, Data Deficient.**

Most species are classified as "Least Concern" by the National and International IUCN red lists. The National red list classified two species as Near Threatened and eight species as Vulnerable; the Eurasian wryneck *Jynx torquilla* is classified as Endangered (Figure 2). The global IUCN red list reports the Italian sparrow *Passer italiae* as Vulnerable.

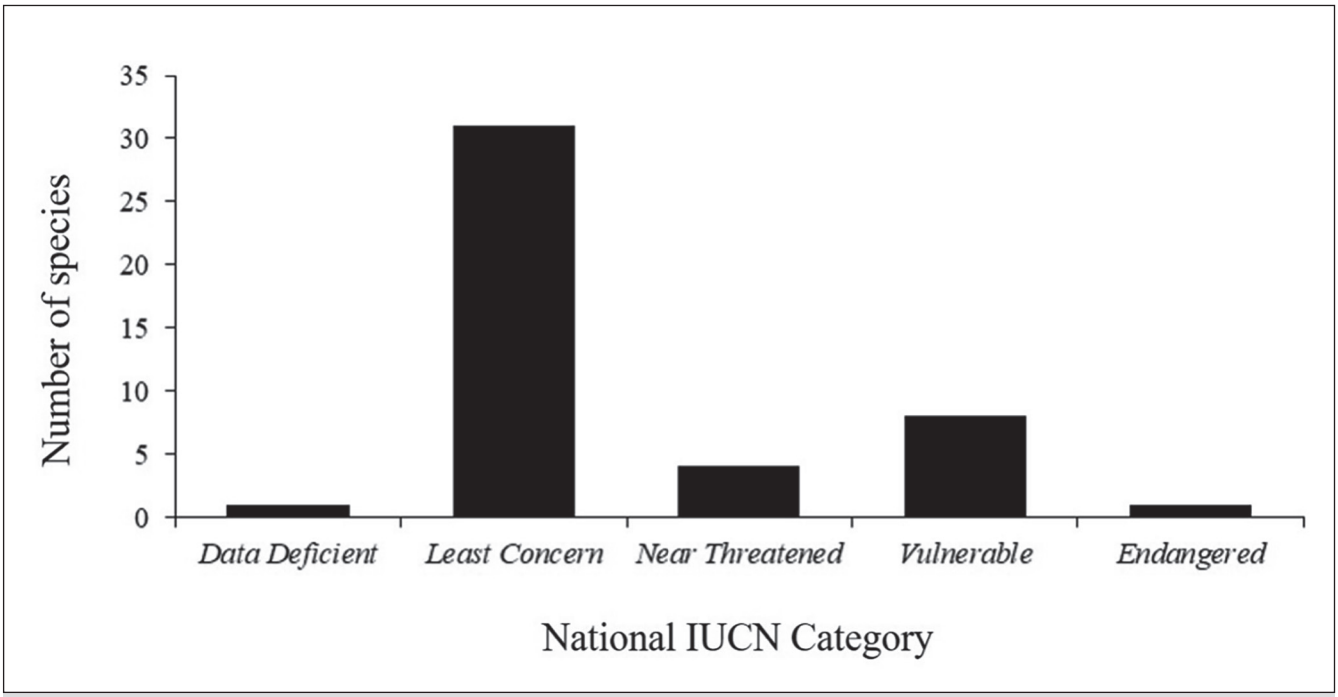

Figure 2. National IUCN categories for the breeding bird species of the study area.

Mammals

A total of 30 mammal species were detected, with one, the Apennine shrew, endemic to Italy (Table 3). Most species are classified as Least Concern by the national and global IUCN red lists. The national red list classified the grey wolf *Canis lupus* and the greater horseshoe bat *Rhinolophus ferrumequinum* as Vulnerable, the serotine bat *Eptesicus serotinus* and the lesser noctule bat *Nyctalus leisleri* as Near Threatened. All bats (Chiroptera), the crested porcupine *Hystrix cristata* and the hazel dormouse *Muscardinus avellanarius* are protected according to the Habitat Directive. Martens were only identified at the genus level.

Order	Species		Italian red list	IUCN red list
Soricomorpha	Apennine shrew	*Sorex samniticus*	LC	LC
	Valais shrew	*Sorex antinorii*	DD	DD
	Eurasian pygmy shrew	*Sorex minutus*	LC	LC
	Eurasian water shrew	*Neomys fodiens*	DD	LC
	Lesser white-toothed shrew	*Crocidura suaveolens*	LC	LC
	Bicoloured shrew	*Crocidura leucodon*	LC	LC
	Etruscan shrew	*Suncus etruscus*	LC	LC
Erinaceomorpha	Western hedgehog	*Erinaceus europaeus*	LC	LC
Rodentia	Bank vole	*Myodes glareolus*	LC	LC
	Alpine pine vole	*Microtus multiplex*	LC	LC
	Wild mouse	*Apodemus sylvaticus*	LC	LC
	Yellow-necked wild mouse	*Apodemus flavicollis*	LC	LC
	Hazel dormouse *	*Muscardinus avellanarius*	LC	LC
	Edible dormouse	*Glis glis*	LC	LC
	Eurasian red squirrel	*Sciurus vulgaris*	LC	LC
	Crested porcupine *	*Hystrix cristata*	LC	LC
Lagomorpha	European brown hare	*Lepus europaeus*	LC	LC
Carnivora	Least weasel	*Mustela nivalis*	LC	LC
	European badger	*Meles meles*	LC	LC
	Marten	*Martes* spp.	NA	NA
	Red fox	*Vulpes vulpes*	LC	LC
	Grey wolf	*Canis lupus*	VU	LC
Cetartiodactyla	European roe deer	*Capreolus capreolus*	LC	LC
	Wild boar	*Sus scrofa*	LC	LC
Chiroptera	Greater horseshoe bat *	*Rhinolophus ferrumequinum*	VU	LC
	Common pipistrelle *	*Pipistrellus pipistrellus*	LC	LC
	Kuhl's pipistrelle *	*Pipistrellus kuhlii*	LC	LC
	Savi's pipistrelle *	*Hypsugo savii*	LC	LC
	Serotine bat *	*Eptesicus serotinus*	NT	LC
	Lesser noctule bat *	*Nyctalus leisleri*	NT	LC

Table 3. Mammals detected in the study area. IUCN risk categories are reported: LC, Least Concern; NT, Near Threatened; VU, Vulnerable; DD, Data Deficient; NA, Not Applicable. *, species listed within the Annexes of the Habitat Directive.

Different methods allowed the detection of different species both of terrestrial mammals (Table 4) and bats (Table 5).

Species		Traps	Pellets	Signs of presence	Observation
Apennine shrew	*Sorex samniticus*	×	×		
Valais shrew	*Sorex antinorii*	×	×		
Eurasian pygmy shrew	*Sorex minutus*	×	×		
Eurasian water shrew	*Neomys fodiens*	×			
Lesser white-toothed shrew	*Crocidura suaveolens*	×	×		
Bicoloured shrew	*Crocidura leucodon*	×	×		

Etruscan shrew	*Suncus etruscus*	×	×			
Western hedgehog	*Erinaceus europaeus*					
Bank vole	*Myodes glareolus*	×	×			
Alpine pine vole	*Microtus multiplex*	×	×			
Wild mouse	*Apodemus sylvaticus*	×	×			
Yellow-necked wild mouse	*Apodemus flavicollis*	×	×			
Hazel dormouse	*Muscardinus avellanarius*		×			
Edible dormouse	*Glis glis*			×		
Eurasian red squirrel	*Sciurus vulgaris*					×
Crested porcupine	*Hystrix cristata*			×		
European brown hare	*Lepus europaeus*					×
Least weasel	*Mustela nivalis*			×		
European badger	*Meles meles*			×		
Marten	*Martes* spp.			×		
Red fox	*Vulpes vulpes*			×		
Grey wolf	*Canis lupus*			×		
European roe deer	*Capreolus capreolus*			×		×
Wild boar	*Sus scrofa*			×		×

Table 4. Survey methods of terrestrial mammals: pitfall traps, owl pellets, signs of presence and direct observations.

Species		Shelter detection	Bat detector
Greater horseshoe bat	*Rhinolophus ferrumequinum*	×	
Common pipistrelle	*Pipistrellus pipistrellus*		×
Kuhl's pipistrelle	*Pipistrellus kuhlii*		×
Savi's pipistrelle	*Hypsugo savii*		×
Serotine bat	*Eptesicus serotinus*		×
Lesser noctule bat	*Nyctalus leisleri*		×

Table 5. Survey methods of bats: detection of shelter sites and acoustic detection.

Discussion

Although our survey may not be exhaustive, we detected 89 vertebrate species in our study area. Even tough not very rich in species, the herpetological fauna of the area "Prati di Logarghena - Val di Caprio" is very interesting, because of the presence of species become increasingly rare and localized, thus worthy of careful protection. Among those, the Apennine yellow-bellied toad is a species at risk of extinction throughout its range (see Mori & Giovani, 2012; Rondinini *et al.*, 2013) and, therefore, it is included in two Annexes of the Habitat Directive (II/B and IV/D). The Annex IV of the Habitat Directive also includes other i.e. the crested newt, the agile frog, the Italian stream frog, the green lizard, the wall lizard, the Aesculapian snake and the whip snake.

Our research allowed us to detect the presence of 45 species of birds during their reproductive period. Species typical of meadows and shrub environments were 11, whereas forest ones were 33. A species (the dipper) attended exclusively the riparian and river environments. The quail is included amongst the Tuscan emergencies, declining because of environmental alterations of its reproductive habitat throughout Europe. Other species, linked to agroecosystems and not at immediate extinction risk in Tuscany, are decreasing in Italy or in the rest of Europe: among those the presence of the woodlark and of the red-backed shrike are interesting, as potential indicators of a good environmental quality (Tellini Florenzano *et al.*, 1997; Morelli *et al.*, 2012; Vannini *et al.*, 2013). New records for this area (cf. Tellini Florenzano *et al.*, 1997) includes the black redstart, the mistle thrush, the song thrush, the

whitethroat and the subalpine warbler (most likely, the Moltoni's warbler, see above). Our survey methodology favoured the Logarghena meadows; therefore, species of the highest conservation interest were concentrated almost exclusively in more or less shrubby prairie ecosystems. Further bird surveys, aimed at investigating wooded areas and steep mountain slopes, could lead to assess the presence of other species.

At least 30 species of mammals occur in the area of "Prati di Logarghena - Val di Caprio". Among those, two forest-dwelling rodents are listed within the Annexes of the Habitat Directive and requires a special protection, i.e. the hazel dormouse, which is threatened by habitat fragmentation (Mortelliti *et al.*, 2013) and the crested porcupine, which is expanding its range to the north (Mori *et al.*, 2018). As to small carnivores, a further research effort is required to assess the presence of the western polecat *Mustela putorius* and to clarify which species of marten is present. Accordingly, while the stone marten *Martes foina* is widespread in Tuscany, the presence of the pine marten *Martes martes*, which is listed within the annexes of the Habitat Directive, would be particularly interesting (Balestrieri *et al.*, 2019). Bat species diversity of the study area is rich and includes some paramount species. As to foraging sites, the study areas has a good potential, including many glades, pastures, ponds and streams, suitable for hunting activity of most bats. Conversely, detected species seem to be represented by only few individuals, with the exception of the Kuhl's pipistrelle, which is a widespread and common species throughout Europe (Ancillotto *et al.*, 2016). The scarce presence of bats could be linked to nocturnal temperatures which are rather low (< 20°C) even in the cold period; in these conditions the nocturnal entomofauna is scarce and, consequently, also bats range at lower altitudes. Another factor affecting local bat populations could be the scarcity of shelter sites, including buildings (particularly at the highest altitudes), which are mainly used as storage rooms for humans, thus highly disturbed. However, some wooded areas showed the presence of old trees that can potentially offer shelter to dendrophilous species such as lesser noctule bat (Ruczyński *et al.*, 2010).

To conclude, the area of the Prati of Logarghena was of considerable faunistic interest. The differences in species distribution emerged should be assessed through more detailed surveys in the future, and analysed in relation to the vegetation types and human activities (e.g. farming), to design the best management interventions. Our study area was characterized by a high naturalness (see Vannini *et al.*, 2013); It is therefore necessary to assess whether this situation have been maintained through addressed territorial management and appropriate protection levels. The area of Prati of Logarghena and the Caprio valley represent environments characterised by a high habitat richness, which may host a rich fauna. Any kind of anthropic intervention which may alter the balance occurring between human activity (e.g. mowing, sheep herding) and the natural environment must therefore be averted. Among the management criteria, the safeguarding of the existing structures from vandalism, which effects have been discovered during the research activity, deserve attention.

References

Arrigoni P.V. & Menicagli E., 1999 - Carta della vegetazione forestale. Serie Boschi e Macchie di Toscana, Regione Toscana, SELCA, Firenze, Italy.

Ancillotto L., Tomassini A. & Russo D., 2016 - The fancy city life: Kuhl's pipistrelle, *Pipistrellus kuhlii*, benefits from urbanisation. *Wildlife Research*, 42: 598-606.

Droege S., Cyr A. & Larivée J., 1998 - Checklists: An underused tool for the inventory and monitoring of plants and animals. *Conservation Biology*, 12: 1134-1138.

Balestrieri A., Mori E., Menchetti M., Ruiz-Gonzalez A. & Milanesi P., 2019 - Far from the madding crowd: tolerance toward human disturbance shapes distribution and connectivity patterns of closely related *Martes* spp. *Population Ecology*, DOI: 10.1002/1438-390X.12001.

Bertacchi A., Sani A. & Bocci G. , 2005 - Vegetazione naturale e modificazioni antropiche. Un caso di studio in Lunigiana: l'area di Filattiera (Massa-Carrara). *Informatore Botanico Italiano*, 37: 760-761.

Bertolino S., Büchner F., Mori E. & Büchner S., 2016 - Presence of the hazel dormouse *Muscardinus avellanarius* at the limit of its altitudinal range. *Hystrix, the Italian Journal of Mammalogy*, 27: 215-218.

Bisi F., Wauters L. A., Preatoni D. G. & Martinoli A., 2015 - Interspecific competition mediated by climate change: which interaction between brown and mountain hare in the Alps? *Mammalian Biology*, 80: 424-430.

Bottacci A., 2012 - La Riserva naturale biogenetica di Camaldoli. 1012-2012. Mille anni di rapporto uomo-foresta. CFS/UTB Edizioni, Pratovecchio, Arezzo.

Cianfanelli S., Vanni S., Innocenti G., Nistri A., Agnelli P., 2016 - Nota preliminare sulle emergenze faunistiche della Lunigiana (Toscana nord-occidentale, Italia). *Annali del Museo Civico di Storia Naturale "G. Doria"*, 108: 275-347.

Elsen P.R. & Tingley M.W., 2015 - Global mountain topography and the fate of montane species under climate change. *Nature Climate Change*, 5: 772.

Farina A., 1981 - Gli uccelli nidificanti nella Lunigiana (Toscana settentrionale). *Atti I Convegno Italiano di Ornitologia*, 1: 77-80.

Gaggi A. & Paci A.M., 2014 - Atlante degli Erinaceomorfi dei Soricomorfi e dei piccoli Roditori dell'Umbria. Dimensione Grafica Snc (Editions), Spello (Perugia), Italy.

Gvoždík V., Benkovský N., Crottini A., Bellati A., Moravec J., Romano A., Sacchi R. & Jandzik D. 2013 - An ancient lineage of slow worms, genus *Anguis* (Squamata: Anguidae), survived in the Italian Peninsula. *Molecular Phylogenetics and Evolution*, 69: 1077-1092.

Kindler C. & Fritz U. 2018 - Phylogeography and taxonomy of the barred grass snake (*Natrix helvetica*), with a discussion of the subspecies category in zoology. *Vertebrate Zoology*, 68: 269-281.

Lozano C. B. & Robson D. 2011 - Subalpine Warbler (*Sylvia cantillans*) and Moltoni's Warbler (*Sylvia moltonii*). *Monografies del Museu de Ciències Naturals*, 6: 182-189.

Morelli F., Santolini R. & Sisti D., 2012 - Breeding habitat of red-backed shrike *Lanius collurio* on farmland hilly areas of Central Italy: is functional heterogeneity one important key?. *Ethology Ecology & Evolution*, 24: 127-139.

Mori E. & Giovani A., 2012 - Local extinction of *Bombina pachypus* Bonaparte, 1838 in three stations: a 17 years survey in pSCI "Poggi di Prata" (Southern Tuscany, Italy). *Herpetology Notes*, 5: 407-410.

Mori E., Menchetti M., Dondini G., Biosa D. & Vergari S., 2014 - Theriofauna of Site of Community Importance Poggi di Prata (Grosseto, Central Italy): terrestrial mammals and preliminary data on Chiroptera. *Check List*, 10: 718-723.

Mori E., Mazzetto F., Menchetti M., Bodino N., Grasso E. & Sposimo P., 2016 - Feeding ecology of the scops owl, *Otus scops* (Aves: Strigiformes), in the island of Pianosa (Tuscan Archipelago, Central Italy) outside the breeding period. *Italian Journal of Zoology*, 83: 417-422.

Mori E., Sforzi A., Bogliani G. & Milanesi P., 2018 - Range expansion and redefinition of a crop-raiding rodent associated with global warming and temperature increase. *Climatic Change*, 150: 319-331.

Mortelliti A., Santarelli L., Sozio G., Fagiani S. & Boitani L., 2013 - Long distance field crossings by hazel dormice (*Muscardinus avellanarius*) in fragmented landscapes. *Mammalian Biology-Zeitschrift für Säugetierkunde* 78: 309-312.

Rondinini C., Battistoni A., Peronace V. & Teofili C., 2013 - Lista Rossa IUCN dei Vertebrati Italiani. Comitato Italiano IUCN e Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Rome, Italy.

Ruczyński I., Nicholls B., MacLeod C. D. & Racey P. A., 2010 - Selection of roosting habitats by *Nyctalus noctula* and *Nyctalus leisleri* in Białowieża Forest - Adaptive response to forest management?. *Forest Ecology and Management*, 259: 1633-1641.

Scherrer D., Massy S., Meier S., Vittoz P. & Guisan A., 2017 - Assessing and predicting shifts in mountain forest composition across 25 years of climate change. *Diversity and Distributions*, 23: 517-528.

Stanisci A., Evangelista A., Frate L., Stinca A. & Carranza M.L., 2016 - VIOLA–Database of High Mountain Vegetation of Central Apennines. *Phytocoenologia*, 46: 231-232.

Tellini Florenzano G., Arcamone E., Baccetti N., Meschini E. & Sposimo P., 1997 - Atlante delle specie nidificanti e svernanti in Toscana. Monografie del Museo di Storia Naturale di Livorno, Italia.

Toschi A., 1965 - Fauna d'Italia: Mammalia, Lagomorpha, Rodentia, Carnivora, Artiodactyla, Cetacea. Ed. Calderini, 1965.

Toschi A. & Lanza B, 1959 - Fauna d'Italia. Mammalia: generalità, Insectivora, Chiroptera. Edizioni Calderini Bologna, 4.

Vannini A., Menchetti M. & Mori E., 2013 - L'avifauna del SIC "Poggi di Prata" (Grosseto, Italia Centrale): analisi faunistica, quantitativa e considerazioni sulla gestione ambientale del sito. *Alula*, 20: 101-112.