

Preliminary data on habitat preferences in *Lepus corsicanus* and *L. europaeus* in Latium Region (central Italy)

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Introduction

The Italian hare *Lepus corsicanus* is an endemic species of southern-central Italy and Sicily. It has been recently confirmed as a true species thanks to morphological (Riga *et al.* 2001) and genetic (Pierpaoli *et al.* 1999, 2003) analyses. It is not yet recognized by the EU legislation. It is however legally protected in the Italian peninsula, but listed as a game species for Sicily, by an amendment to the Italian hunting Act (157/92). Nevertheless, in continental Italy it is considered *critically endangered* according to IUCN criteria (Angelici e Luiselli 2001). The problematic discrimination in the field between the Italian hare and the European brown hare *L. europaeus* (a game species) produces remarkable problems for an effective protection of the former species.

To contribute to *L. corsicanus* conservation, the National Wildlife Institute (formerly INFS - Istituto Nazionale Fauna Selvatica, now ISPRA) drew up the Italian Action Plan, in which the current knowledge on the status, distribution and biology of this species are synthesized, the main threats to its conservation are identified, and the main objectives for its management are highlighted. In particular, the plan stresses the strong need for further investigation to broaden the knowledge on *L. corsicanus* populations, since this is essential for their correct management (Trocchi e Riga 2001).

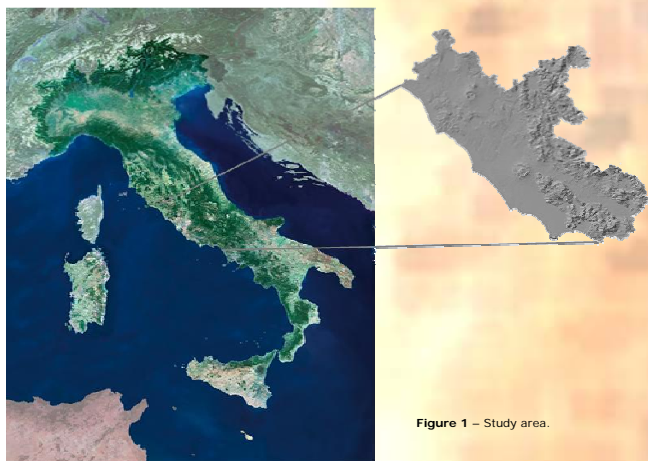


Figure 1 - Study area.

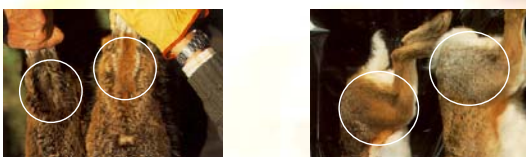
The Regional Parks Agency of the Latium Region (central Italy), in cooperation with ISPRA has undertaken an investigation on the conservation status, ecology and distribution of *L. corsicanus* in the Region. The main goal is to draw up an Action Plan for the conservation of the species in the region, that should inform the sound management of the local populations. Based on an extensive campaign of field data collection the project is expected to develop a habitat suitability model for the species and to implement a genetic data base. Finally, the project is expected to identify and implement pilot management interventions for *L. corsicanus*, such as habitat improvement and *ex situ* reproduction.

The present contribution reports the preliminary results based on the data collected in the first year of the project; in particular habitat use and altitude choices of *L. corsicanus* and *L. europaeus* are investigated and compared.

Lepus corsicanus



L. c. L. e. L. c. L. e.



Lepus corsicanus *Lepus europaeus*



Figure 2 - Phenotypic diagnostic features in *L. corsicanus* and *L. europaeus*. In the former species note white flank, dark nape and red-brown thigh.

Materials and methods

Between July 2007 and July 2008, counts of hares were carried out according to the *spotlight census* methods (Pfister, 1978; Frylestam, 1981; Barnes & Tapper, 1985) across the whole Latium Region (fig. 1). The two hare species were identified by means of phenotypic diagnostic features (cfr. Trocchi e Riga 2005; fig. 2).

Geographic location of each hare spotted in the field was calculated based on the angle and distance from the observer. Through GIS-based processing, a Digital Elevation Model (DEM) and a land use map (CORINE Land Cover) were used to obtain the altitude, land use typology and minimum distance from wood at each sighting location.

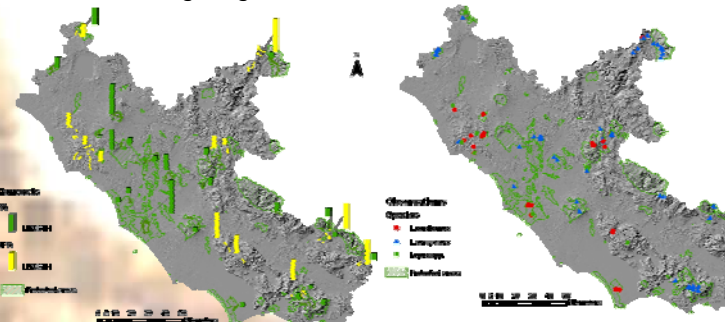


Figure 3 - Distribution of transects across the study area in protected areas and in non protected areas. Histograms are proportional to the length.

Figure 4 - *Lepus* sighting locations in the study area.

Hare sightings were classified in 1-hour intervals starting from the local time at sunset. The relative abundance of each of the two species was expressed as the number of individuals per kilometer travelled along each transect (ind/km), and was compared between protected areas (PAs) and non protected areas (NPAs).

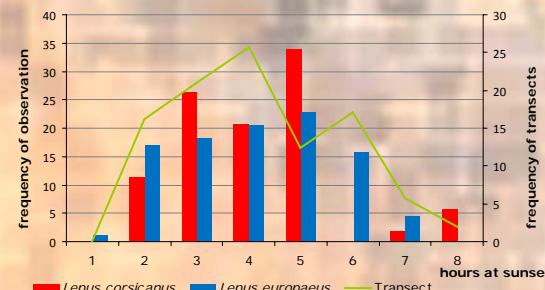


Figure 5 - Hare sighting distribution in hourly intervals (bars) starting from the sunset local time (GMT + 1,00 h). Line represents average hour between initial and final time obtained for each transect.

Results

Spotlight counts were carried out over a total of 105 transects: 72 in PAs and 33 in NPAs (Table 1; fig. 3); in 46 transects we recorded no hare. We observed 53 *L. corsicanus*, 88 *L. europaeus* and 20 unrecognized individuals (Table 2; fig. 4). The frequency of *L. corsicanus* observations was highest between the 3rd and the 5th hour after sunset (fig. 5).

	Transects	Km	Km/trans average	N° trans with <i>L.c.</i> obs.	N° trans with <i>L.e.</i> obs.
Pas	72	299,99	4,23 ± 0,46	12	27
NPAs	33	145,87	4,29 ± 0,43	9	11
ALL	105	445,86	4,25 ± 0,34	21	38

Table 1 - Number and total length of transects in protected areas and in non protected areas. The two columns report number of transect in which hares in both kinds of areas were observed.

<i>Lepus</i> spp.*	<i>L.c.</i>	<i>L.e.</i>	Ind/Km <i>L.c.</i> (all transects)	Ind/Km <i>L.e.</i> (all transects)	Ind/Km <i>L.c.</i> (transects with obs.)	Ind/Km <i>L.e.</i> (transects with obs.)
Pas	110*	37	0,23 ± 0,13 (min=0 Max=8,91)	0,28 ± 0,06 (min=0 Max=2,23)	1,47 ± 0,92 (min=0,05 Max=8,91)	0,73 ± 0,11 (min=0,12 Max=2,23)
NPAs	51*	16	0,10 ± 0,04 (min=0 Max=0,68)	0,24 ± 0,01 (min=0 Max=2,96)	0,48 ± 0,86 (min=0,12 Max=1,14)	0,73 ± 0,27 (min=0,12 Max=2,96)
ALL	161*	53	0,20 ± 0,09 (min=0 Max=8,91)	0,27 ± 0,05 (min=0 Max=2,96)	1,0 ± 0,41 (min=0,05 Max=8,91)	0,73 ± 0,11 (min=0,12 Max=2,96)

Table 2 - Total number of individuals and relative abundances of each hare species. *Lepus* spp* included also 20 unrecognized individuals. Relative abundances in the last two columns were calculated only for the transects in which hares were observed.

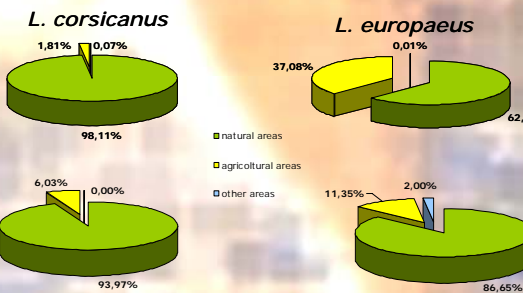


Figure 6 - Land use typology in a 300-m radius buffer drawn around each sighting location. Habitats included in each typology are reported in table 3.

Figure 7 - Land use typology in a 150-m radius buffer drawn around each sighting location as reported in investigations conducted in other Italian regions (Barone 2007). Habitats included in each typology are reported in table 3.

Description	<i>L. corsicanus</i> (%)	<i>L. europaeus</i> (%)
Natural grassland	0,760	0,358
Sparsely vegetated areas	0,010	0,256
Mineral extraction sites	0,007	0,004
Coniferous forest	0,099	0,107
Broad-leaved forest	93,820	60,438
Mixed forest	2,459	0,000
Moors and heathland	0,957	0,752
Barren rocks	0,000	0,000
Land principally occupied by agriculture, with significant areas of natural vegetation	0,021	0,022
Olive groves	0,002	0,570
Non-irrigated arable land	1,745	36,233
Complex cultivation patterns	0,003	0,000
Annual crops associated with permanent crops	0,044	0,254
Vineyards	0,000	0,000
Pastures	0,069	0,001
Transitional woodland/shrub	0,069	0,000
Discontinuous urban fabric	0,004	0,003

Table 3 - Percentage of land use typologies in a 300-m radius buffer around each sighting location. Colours indicate categories reported in figure 6.

The percentage of natural areas (woods, meadows, pastures, bushes, Table 3) around the locations of *L. corsicanus* was higher than around those of *L. europaeus*, whereas agricultural areas were more represented around the locations of *L. europaeus* (fig. 6). In figure 7 similar data from a previous study are showed (Barone 2007).

All *L. corsicanus* observations were within 350 m from woodland, whereas *L. europaeus* was observed up to a 1000 m distance from woodland (t-test: $t_{1,41}=3,12$; $p=0,002$; fig. 8). A similar tendency, even though on different distance intervals, had been observed in previous studies (fig. 9; Macchia *et al.* 2005a; 2005b; 2006). Mean altitude of observations was significantly lower for *L. corsicanus* than for *L. europaeus* (t-test: $t_{1,41}=5,1$; $p=0,000001$; fig. 10). The abundance index of *L. corsicanus* and *L. europaeus* was similar. *L. corsicanus* was more abundant in PAs than in NPAs (Table 2; fig. 11), while comparable abundances were observed for *L. europaeus* in PAs and NPAs (Table 2; fig. 11).

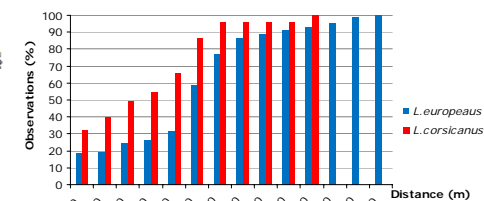


Figure 8 - Cumulative percentage of each hare species observations in relation to the distance from wood.

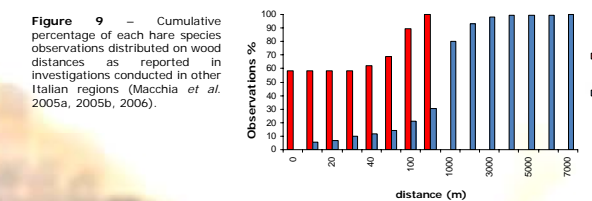


Figure 9 - Cumulative percentage of each hare species observations distributed on wood distances as reported in investigations conducted in other Italian regions (Macchia *et al.* 2005a, 2005b, 2006).

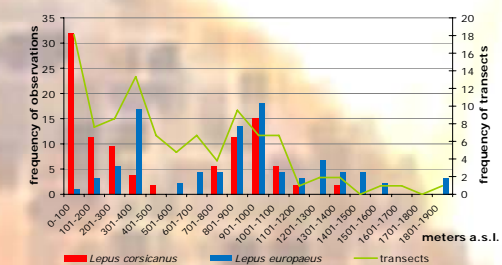


Figure 10 - Relationship between hare observations and altitude, extrapolated with Latium DEM (cells 20x20 m). Transect altitude is that of its centroid.

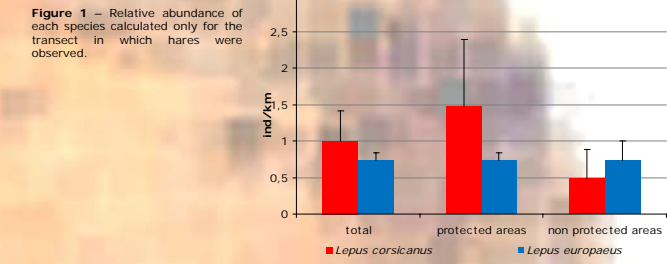


Figure 11 - Relative abundance of each species calculated only for the transect in which hares were observed.

Conclusions

The project is now collecting a larger sample of hare sightings to conduct a more in depth statistical analysis in order to confirm or exclude the reported trends. Nevertheless, the preliminary results strongly suggest differences in habitat use between the two species, with a tendency for *L. corsicanus* to inhabit areas closer to natural environments, to wood habitat (Lo Valvo *et al.* 1997; Fusco *et al.* 2007; Macchia *et al.* 2005a, 2005b, 2006), and at lower altitudes as compared to *L. europaeus* differently from what reported by Angelici e Luiselli (2007). Moreover, although *L. corsicanus* is not subject to hunting, it seems to suffer the effect of the hunting pressure on *L. europaeus* due to misidentification. Indeed, *L. corsicanus* is more abundant in protected areas, likely due to the absence of direct persecution (Trocchi e Riga 2001, 2005, Fulgione *et al.* 2007) and to the fact that no restocking of *L. europaeus* is carried out in PAs. Restocking of *L. europaeus* for hunting purposes is in fact considered one of the main threats to *L. corsicanus* conservation, due to interspecific competition risks and possibility of pathogen spreading (Trocchi e Riga 2001, 2005). Conversely, such restocking practices likely underlie the similarity in abundances of *L. europaeus* between PAs and NPAs.