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ORIGINAL PAPER

Diet of the Apennine hare in a southern Italy Regional Park

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Abstract In this study, we examined the annual diet composition of *Lepus corsicanus* in two different sites within a southern Italy Regional Park. Vegetation of site 1 was composed of a mixed scrub forest (*Viburno–Quercetum ilicis* s.l.), a ripisilva (*Roso sempervirentis–Populetum nigrae*), some thermophilous scrubs (*Pruno–Rhamnetalia alaterni*), and a *Pinus halepensis* reforested area. Site 2 comprised a mixed-oak forest (*Centaureo–Quercetum pubescentis* s.l.) with meadows and arable lands. Micro-histological analysis of faecal samples revealed that hares utilised 70 different species of plants during the year, indicating the capability of the Apennine hare of exploiting a wide variety of vegetation. Herbaceous plants (Hemicryptophytes, particularly graminoid grasses, and Geophytes) predominated in the diet. *Brachypodium sylvaticum* (9.44 %) and *Allium subhirsutum* (8.28 %) were the major contributors to the diet in sites 2 and 1, respectively. Other taxa found most often in the diet were *Trifolium pratense* (site 1: 8.19 %; site 2: 5.80 %) and *Prunus spinosa* (site 1: 7.03 %; site 2: 4.10 %). Significant differences were found between sites in terms of diet richness, diversity, and evenness. Nevertheless, both the similarity indices (Morisita–Horn: 0.79; Sørensen: 0.87) showed that the food composition of the hare's diet was broadly the same in both sites. Some qualitative and quantitative differences between sites were due to the availability or consumption of some plant species and evidenced that the Apennine hare can modify its trophic niche in order to adapt its dietary requirements to the availability of food.

Keywords *Lepus corsicanus* · Diet · Faecal analysis · Micro-histological techniques

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Introduction

Formerly described by De Winton (1898), *Lepus corsicanus*, also known as the Apennine or Italian hare, is an Italian endemic species recently revalidated by morphological (Palacios 1996; Riga et al. 2001; Angelici and Spagnesi 2009) and molecular analyses (Pierpaoli et al. 1999; Riga et al. 2003). This species is widespread in Sicily, where it lives in sympatry and syntopy with wild rabbits (*Oryctolagus cuniculus*) (Lo Valvo et al. 1997). The species was recently rediscovered in Corsica (Scalera and Angelici 2003), and studies such as that conducted by Pietri et al. (2011) have also shown that *L. corsicanus* prevails among the species of hares present in Corsica. Instead, in central and southern Italy, its population has undergone a considerable contraction mainly caused by illegal hunting activity and habitat fragmentation (Angelici and Luiselli 2001; Trocchi and Riga 2001). As a consequence, the International Union for the Conservation of Nature (IUCN) Red List currently designates the Apennine hare as 'vulnerable', because it is considered to have a high risk of extinction in the next decade (IUCN 2013).

The knowledge of diet composition is one of the most important aspects not only in the conservation of a vulnerable species, but also in the comprehension of the functioning of the ecosystem as a whole (Duffy et al. 2007). Most of the studies aimed at understanding the diet composition of

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herbivores are based on the micro-histological identification of indigestible plant epidermis fragments in the faecal pellets (Baumgartner and Martin 1939; Dusi 1949). This non-invasive technique has been widely used for studying diet composition of several hare species (Puig et al. 2007; Paupério and Alves 2008; Lorenzo et al. 2011), enabling focused and comprehensive conservation management strategies for populations.

Considering its threatened status, information about the diet of the Apennine hare is quite limited. Indeed, studies that explore the dietary preferences of this species are few and often not exhaustive (De Battisti et al. 2004; Trocchi and Riga 2005; Freschi et al. 2011). Therefore, the present research was undertaken to study the diet of *L. corsicanus* in a southern Italy Regional Park by use of faecal analysis, which allowed us to identify the plant species utilised. Our aims were to 1) record the overall pattern of annual diet composition and 2) identify the spatial variation in diet composition between two different sites.

Methods

Study areas

This study was carried out in the Regional Park of "Gallipoli Cognato Piccole Dolomiti Lucane" (40°30′49.65″N, 16°8′35.70″E), situated in the centre of Basilicata region (southern Italy). This Park safeguards a wide area (270.27 km^2) featuring different geomorphological and micro-climatic conditions that have determined the formation of a wide variety of environments.

Since 2006, the Park has joined a conservation initiative that aims to recover the Italian hare in the Basilicata region within the "Italian Action Plan for the Italian hare" (Trocchi and Riga 2001). The monitoring activities carried out by the Park within the aforementioned initiative (e.g., captures, total censuses, DNA analysis, and census of faunal mortality due to vehicular collision) proved the exclusive presence of the Italian hare in many different areas of the Park. Among them, we chose two study areas characterised by different elevation and features of vegetation (Fig. 1). The first study area (site 1) holds about 0.43 km^2 and lies within 325 to 395 m a.s.l. This site has a mean annual precipitation of 671 mm and a mean annual air temperature of +15 °C. The following phytocenoses were observed in this site: 1) a mixed scrub forest with *Quercus ilex* and *Fraxinus ornus* (*Viburno–Quercetum ilicis* s.l.); 2) a ripisilva characterised by the presence of *Populus nigra* and *Salix alba* (*Roso sempervirentis–Populetum nigrae*) and that develops along the banks of the Basento river; 3) some thermophilous scrubs with *Pyrus amygdaliformis*, *Crataegus monogyna*, and *Pistacia lentiscus* (*Pruno–Rhamnetalia alaterni*); and 4) an area which has been reforested mainly with *Pinus halepensis*. The aforementioned phytocenoses had a similar percentage of cover, ranging from 22 to 25 %. The second study area (site 2) lies within 746 to 874 m a.s.l. and covers a surface of 0.74 km^2. The annual average temperature is +11 °C, whereas the average annual rainfall is 910 mm. This site comprises a mixed-oak forest, consisting essentially of *Quercus cerris* and *Quercus frainetto* (*Centaureo–Quercetum pubescentis* s.l.) and encompassing approximately 92–93 % of the surface area. The remainder is composed of peripheral arable lands and meadows interspersed with thickets of dwarf bushes (e.g., *C. monogyna*, *Prunus spinosa*, and *P. amygdaliformis*).

Plant reference collection

A reference collection of microscope slides of plants identified and collected from the two study areas was prepared as follows: plant material was first bleached in a 2.5 % NaClO solution, and then tissues were mounted in glycerol gelatine on a microscope slide.

Faecal pellet collection

Sampling took place monthly from December 2010 to November 2011 along two replicate permanent transects (2 m× 200 m) for each study area. The transects were spatially distributed in order to cover equally the aforementioned phytocenoses. For each transect, two monthly composite samples were processed. Each sample was obtained by mixing a minimum of eight individual pellets collected from different droppings. Samples were stored at −24 °C until processing. Throughout the year, 48 composite samples per site were processed (2 samples×2 transects×12 months).

Faecal pellet analysis

Processing of faecal pellets followed the method described by Paupério and Alves (2008), with some modifications. Briefly, defrosted samples were first ground in a mortar and then cleared in a 0.05 M solution of NaOH for 2 h. Thereafter, samples were washed with distilled water over a 63 μm sieve to remove very small unidentifiable fragments. Finally, the retained material was collected over filter paper, dried, and mounted in glycerol gelatine on a microscope slide.

Identification of plant species was made by micro-histological analysis of fragments in faecal pellets as indicated by Uresk (1978). Fragments were identified with the aid of the plant reference collection. The key criteria used were characteristics of epidermal cells, cell wall, stomata, trichomes, and cellular inclusions. The nomenclature of the identified taxa has been done according to Conti et al. (2005).

Plants were also classified using Raunkiaer's life-form classification system (Raunkiaer 1934). This system

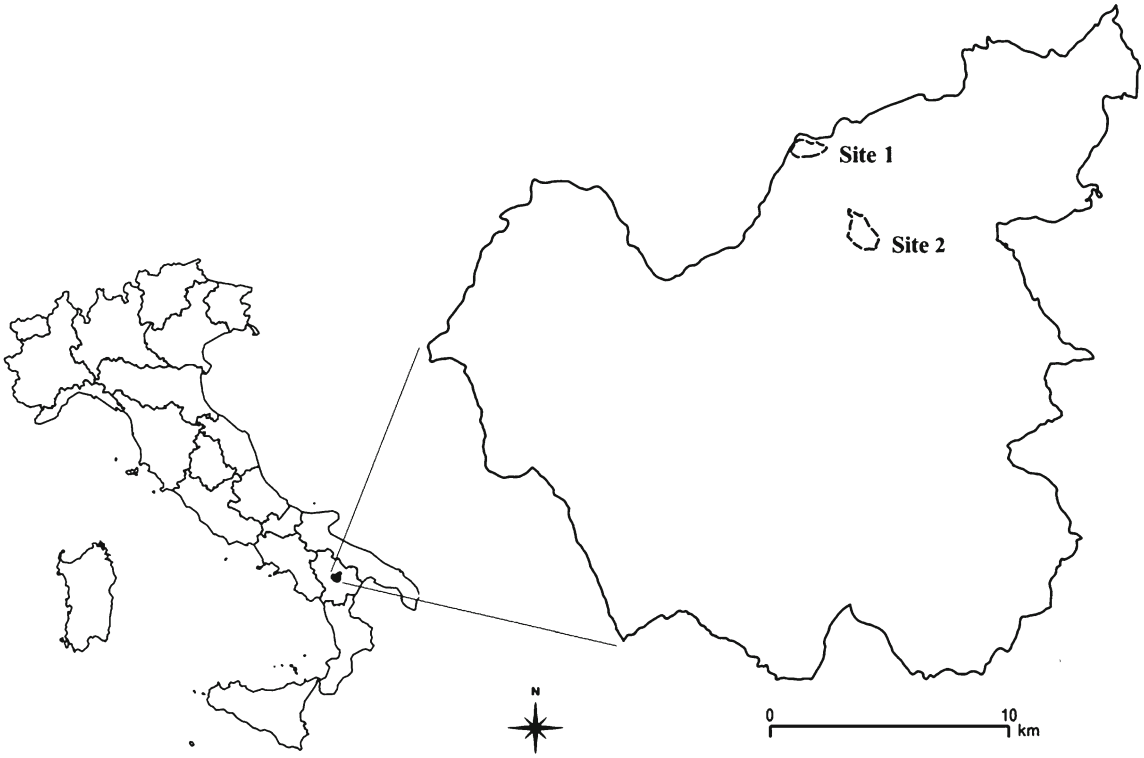

Fig. 1 Localisation of the Regional Park "Gallipoli Cognato Piccole Dolomiti Lucane"

recognises five life-form classes according to the degree of protection afforded to the permanent buds of plant species, which reflect the adaptation of plants to surviving unfavourable seasons, and are correlated with growth form: Chamaephytes (semi-shrubs), Geophytes (plants with bulbs, corms, or rhizomes), Hemicryptophytes (perennial forbs and grasses), Phanerophytes (trees and large shrubs), and Therophytes (annuals species).

Statistical analysis

Results were expressed as annual relative frequencies of plant species identified in faecal pellets from the two study areas. Relative frequencies of plant families and life forms in both sites were analysed using the *G*-test of independence (Sokal and Rohlf 1981). For this analysis, in order to avoid zero values, only plant families identified in faecal pellets in both study areas were used.

Given the absence of a comprehensive diversity index encompassing all biodiversity aspects (Magurran 1988), the following three indices of α diversity were computed: 1) species richness (*D*), for which the higher the value the greater the richness (Margalef 1958); 2) species diversity (*H*) (Shannon and Weaver 1949), whose value usually ranges between 1.5 and 3.5 and often does not exceed 4 (Margalef 1972); and 3) species evenness (Buzas and Gibson 1969), whose value ranges between 0 and 1, where 1 indicates that all the food items are used to an equal extent. Richness, diversity, and evenness indices were compared with the bootstrap procedure (Efron 1979), which was performed 1,000 times.

Two indices of β diversity were computed to assess the diet similarity of *L. corsicanus* between the two sites: 1) the quantitative Morisita–Horn index (*C*) (Morisita 1959), which takes into account the species present in each sample and their abundance (Wolda 1981; Magurran 2004) and 2) the qualitative Sørensen index (*S*) (Sørensen 1948), which only considers presence/absence data. Typically, the value of these indices ranges from 0 (complete dissimilarity between sites) to 1 (complete similarity between sites).

Results

Diet composition

In the faecal samples of *L. corsicanus*, 70 plant taxa were identified belonging to 17 botanical families (Table 1). The overall ingestion rate (relative frequency) ranged from 0.02 to 8.28 % in site 1 and from 0.02 to 9.44 % in site 2. The number of plants composing the hare's diet was higher in site 2 than in site 1 (65 vs. 59, respectively). Of all the plant species we identified, 5 were found only in site 1: *Stachys officinalis* (0.39 %), *Geranium dissectum* (0.28 %), *Cynosurus echinatus* (0.24 %), *Lathyrus venetus* (0.13 %), and *Muscari commutatum* (0.02 %). These plants, which are usually found

Table 1 Annual relative frequencies of plant species identified in faecal pellets

Species	Family[a]	Life form[b]	Site 1	Site 2
Achillea collina	Co	He	0.94	0.54
Aegilops geniculata	Gr	Th	0.88	0.52
Agrimonia eupatoria	Ro	He	0.04	0.19
Allium subhirsutum	Li	Ge	8.28	4.37
Allium triquetrum	Li	Ge	3.04	3.45
Arabis collina	Cr	He	0.04	0.03
Bellevalia romana	Li	Ge	0.64	1.56
Bellis perennis	Co	He	0.04	0.03
Brachypodium pinnatum	Gr	He	0.66	0.59
Brachypodium sylvaticum	Gr	He	7.19	9.44
Bromus racemosus	Gr	Th	0.06	0.83
Buglossoides purpurocaerulea	Bo	He	0	0.36
Capsella bursa pastoris	Cr	He	0.24	0.40
Carex distachya	Cy	He	2.87	3.89
Carex flacca	Cy	Ge	3.70	1.84
Centaurea solstitialis	Co	He	0	0.14
Cichorium intybus	Co	He	0.81	0.19
Cirsium strictum	Co	He	3.92	2.60
Colchicum neapolitanum	Li	Ge	0.79	2.71
Crataegus monogyna	Ro	Ph	0.85	0.92
Cynodon dactylon	Gr	Ge	3.02	1.06
Cynosurus echinatus	Gr	Th	0.24	0
Cytisus hirsutus	Ar	Ch	0.22	0.31
Cytisus villosus	Ar	Ph	0	0.83
Dactylis glomerata	Gr	He	0.75	0.14
Daucus carota	Um	He	0	0.02
Dianthus vulturius	Ca	He	0	0.14
Festuca arundinacea	Gr	He	5.45	3.11
Festuca heterophylla	Gr	He	0.33	5.81
Fraxinus ornus	Ol	Ph	0	0.36
Gagea lutea	Li	Ge	0.07	1.53
Geranium dissectum	Ge	Th	0.28	0
Hermodactylus tuberosus	Ir	Ge	3.29	1.63
Hypochaeris achyrophorus	Co	Th	0.35	0.30
Lathyrus digitatus	Le	Ge	0	0.26
Lathyrus jordanii	Le	Ge	0.06	0.23
Lathyrus venetus	Le	Ge	0.13	0
Leopoldia comosa	Li	Ge	1.49	1.82
Lolium perenne	Gr	He	3.35	1.08
Lolium rigidum	Gr	Th	2.13	1.53
Luzula forsteri	Ju	He	1.60	1.89
Malus sylvestris	Ro	Ph	1.55	0.31
Melica ciliata	Gr	He	0	0.89
Muscari atlanticum	Li	Ge	0.37	0.21
Muscari commutatum	Li	Ge	0.02	0
Muscari neglectum	Li	Ge	0.86	0.16
Olea europaea	Ol	Ph	0.37	0.03
Ornithogalum exscapum	Li	Ge	0.53	0.05
Phlomis herba venti	La	He	0	0.03
Picris hieracioides	Co	He	1.99	4.79
Plantago lanceolata	Pl	He	2.39	2.33
Plantago serraria	Pl	He	4.91	1.21
Poa trivialis	Gr	He	2.72	2.33
Prunella vulgaris	La	He	0.40	0.35
Prunus spinosa	Ro	Ph	7.03	4.10
Pyrus pyraster	Ro	Ph	2.32	1.09
Quercus cerris	Fa	Ph	0.02	0.23
Ranunculus repens	Ra	He	1.95	1.02
Romulea bulbocodium	Ir	Ge	0.18	4.98
Rosa canina	Ro	Ph	3.05	2.24
Sanguisorba minor	Ro	He	0	0.12
Sesleria autumnalis	Gr	He	0.28	2.52
Silene alba	Ca	He	0.09	0.61
Sorbus torminalis	Ro	Ph	0.20	2.86
Spartium junceum	Le	Ph	0	0.09
Stachys officinalis	La	He	0.39	0
Thymus longicaulis	La	Ch	0.42	1.35
Trifolium angustifolium	Le	Th	0.99	0.85
Trifolium pratense	Le	He	8.19	5.80
Trifolium stellatum	Le	Th	1.05	2.79

[a] Plant families: Ar=Aristolochiaceae; Bo=Boraginaceae; Ca=Caryophyllaceae; Gr=Graminaceae; Co=Compositae; Cr=Cruciferae; Cy=Cyperaceae; Fa=Fagaceae; Ge=Geraniaceae; Ir=Iridaceae; Ju=Juncaceae; La=Labiatae; Le=Leguminosae; Li=Liliaceae; Ol=Oleaceae; Pl=Plantaginaceae; Ra=Ranunculaceae; Ro=Rosaceae; Um=Umbelliferae

[b] Plant life forms: Ch=Chamaephytes; Ge=Geophytes; He=Hemicryptophytes; Ph=Phanerophytes; Th=Therophytes

in cultivated and waste ground and grassland, accounted for 1.06 % of the annual diet in site 1. Conversely, the following 11 species were found only in site 2: *Melica ciliata* (0.89 %), *Cytisus villosus* (0.83 %), *Buglossoides purpurocaerulea* (0.36 %), *F. ornus* (0.36 %), *Lathyrus digitatus* (0.26 %), *Centaurea solstitialis* (0.14 %), *Dianthus vulturius* (0.14 %), *Sanguisorba minor* (0.12 %), *Spartium junceum* (0.09 %), *Phlomis herba venti* (0.03 %), and *Daucus carota* (0.02 %). Altogether, these plants represented 3.24 % of the annual diet in site 2, and some of them are very distinctive of the habitats present on the site (e.g., *F. ornus* and *L. digitatus*).

The family with the greatest number of species (14 of 70) was Graminaceae. The plants of this family were the major component of the diet in both sites (site 1: 27.06 %; site 2: 29.83 %). The most consumed species among Graminaceae was *Brachypodium sylvaticum*. This perennial grass accounted for 7.19 % of the total diet in site 1 and for 9.44 % of the total diet in site 2. Other species of Graminaceae

frequently found were *Festuca* spp.: *Festuca arundinacea* and *Festuca heterophylla* accounted for 8.28 and 5.45 % of the overall diet in site 1 and in site 2, respectively. The second family for consumption and number of plant species was Liliaceae. The plants of this family (10 of 70) comprised about 16 % of the hare's diet. Among them, *Allium* spp. had the highest relative frequency, with *Allium subhirsutum* making up 8.28 % of the overall diet in site 1. The consumption of *Allium triquetrum* was similar in both sites (site 1: 3.04 %; site 2: 3.45 %). The third most abundant plant family was Rosaceae, forming 15.03 % of the diet in site 1 and 11.84 % in site 2. Of 8 plant species, *P. spinosa* was the most consumed (site 1: 7.03 %; site 2: 4.1 %) followed by *Rosa canina* (site 1: 3.05 %; site 2: 2.24 %) and *Pyrus pyraster* (site 1: 2.32 %; site 2: 1.09 %). Leguminosae and Compositae comprised about 10 and 8 % of the hare's diet, respectively. Among Leguminosae (7 species), *Trifolium pratense* was the dominant species with a relative frequency of 8.19 % in site 1 and 5.80 % in site 2. Other *Trifolium* spp. were minor contributors to the diet, since the ingestion rate ranged from 0.99 (*Trifolium angustifolium*, site 1) to 2.79 % (*Trifolium stellatum*, site 2). Concerning Compositae (7 species), *Picris hieracioides* was the most consumed in site 2 (4.79 %), whereas *Cirsium strictus* was the most consumed in site 1 (3.92 %). Plant species of other families were minor components of the hare's diet, with values ranging from 0.02 (Fagaceae, site 1; Umbelliferae, site 2) to 1.95 % (Plantaginaceae, site 1).

According to the classification of Raunkiaer (1934), most of the plant species identified in the faecal samples of *L. corsicanus* were Hemicryptophytes, which constituted over half of the hare's diet in both sites (site 1: 51.54 %; site 2: 52.59 %). The plants of this class (32 of 70) were perennial forbs and grasses (e.g., *B. sylvaticum*, *T. pratense*, and *Cichorium intybus*) that die back under conditions unfavourable for growth and propagate through buds at the ground level (Raunkiaer 1934). Over one quarter (site 1: 26.47 %; site 2: 25.86 %) of the hare's diet in both sites was composed of Geophytes, defined as perennial plants that propagate by underground bulbs or tubers or corms (Raunkiaer 1934). This class was composed of 17 plant species, such as *Allium* spp., *Cynodon dactylon*, and *Hermodactylus tuberosus*. Eleven species were included in the Phanerophyte class of plants, which accounted for 15.39 and 13.06 % of all life forms in the sampled pellets from sites 1 and 2, respectively. This class included trees and large shrubs (e.g., *P. spinosa* and *P. pyraster*). Eight plant species (e.g., *Lolium rigidum* and *Trifolium* spp.) were included in the class of Therophytes (plants that complete their life cycle from seed to seed and die) which comprised around 6 % of the hare's diet (site 1: 5.98 %; site 2: 6.82 %). *Cytisus hirsutus* and *Thymus longicaulis* were the only two observed species included in the Chamaephyte class of plants. These semi-shrubs accounted for 0.64 % of the total diet in site 1 and for 1.66 % of the total diet in site 2.

Variation between sites

Results of diversity and similarity of diet between sites are shown in Table 2. The diet richness of *L. corsicanus* was significantly distinct between sites as measured by the Margalef's index (bootstrap; $p<0.01$). The value of D was significantly higher in site 2 than in site 1 (7.39 vs. 6.74, respectively). The Shannon diversity index showed relatively small, but statistically significant differences (bootstrap; $p<0.01$) in the diet diversity between sites: H ranged from 3.45 in site 1 to 3.61 in site 2. Diet evenness also varied significantly between sites (bootstrap; $p<0.05$). The value of E was higher in site 2 than in site 1 (0.57 vs. 0.53, respectively). Both sites had high indices of diet similarity in terms of species composition (Morisita–Horn: 0.79; Sørensen indices: 0.87).

The G-test of independence revealed a significant difference in the frequency distribution of plant families between sites ($G=270.65$; d.f.=15; $p<0.001$). As shown in Fig. 2, over 80 % of Fagaceae, Caryophyllaceae, and Aristolochiaceae were consumed in site 2. Conversely, higher percentages of consumption (>60 %) of Plantaginaceae and Ranunculaceae were found in site 1. Nevertheless, the plant families which were the major components of the hare's diet (e.g., Graminaceae, Compositae, Liliaceae, and Leguminosae) were similarly consumed in both sites. Plant life-form relative frequency in the diet also varied significantly between the two study areas ($G=43.45$; d.f.=4; $p<0.001$). The observed differences were mainly due to the distribution of Chamaephytes. Their consumption was higher in site 2 than in site 1 (73.28 % vs. 26.72, respectively; Fig. 3). Consumption of the other plant life forms was similar in both sites.

Discussion

The results of this study indicate that *L. corsicanus* is capable of exploiting a wide variety of species of plants, although most

Table 2 Diet of *L. corsicanus*: diversity and similarity indices

Indices	Site 1	Site 2	Significance[a] ($p<$)
Diversity			
Margalef, D	6.74	7.39	0.01
Shannon, H	3.45	3.61	0.01
Buzas & Gibson, E	0.53	0.57	0.05
Similarity			
Morisita–Horn, C	0.79		
Sørensen, S	0.87		

[a] Statistical significances were estimated by the bootstrap procedure (1,000 replicates)

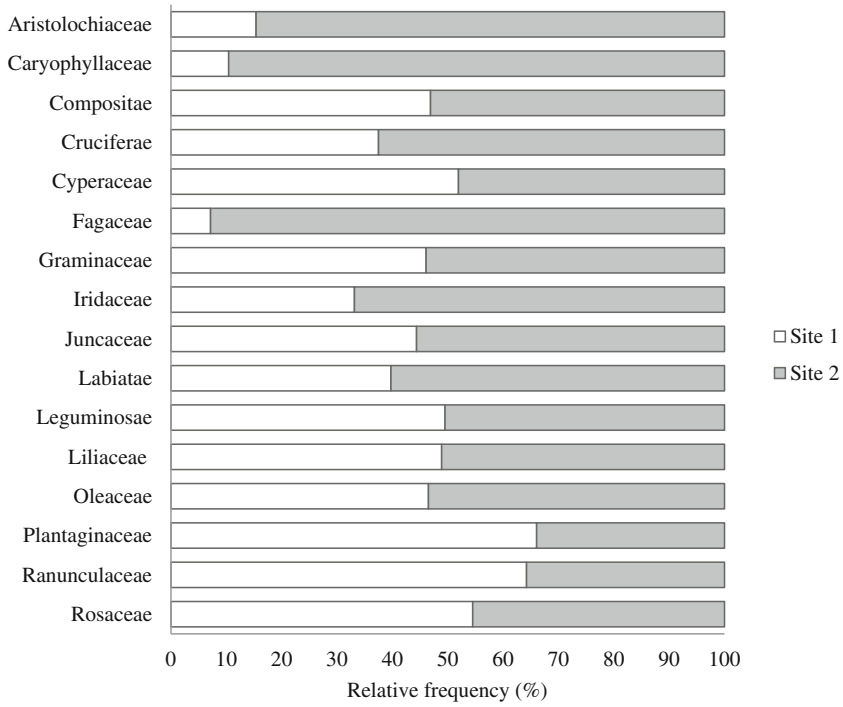

Fig. 2 Relative frequencies of plant families identified in faecal pellets in both study areas

of them were ingested in low frequencies. A similar result was described by Paupério and Alves (2008), who identified over one hundred plant species in the diet of *Lepus granatensis*, but only a small fraction of them was ingested at high rates.

In the present study, herbaceous plants (Hemicryptophytes, particularly graminoid grasses, and Geophytes) were substantial contributors to the hare's diet. In terms of plant families, Graminaceae, Liliaceae, and Leguminosae constituted over half of the hare's diet in both sites. This result confirms those found in previous studies on the Apennine hare (De Battisti et al. 2004; Trocchi and Riga 2005; Freschi et al. 2011). Several studies found herb grasses to be the main component of the diet of other *Lepus* spp., such as *Lepus europaeus* (Frylestam 1986; Chapuis 1990; Wray 1992), *Lepus timidus hibernicus* (Tangney et al. 1995; Wolfe et al. 1996; Dingerkus and Montgomery 2001), *L. granatensis* (Paupério and Alves 2008), *L. californicus* (Johnson and Anderson 1984), and *Lepus flavigularis* (Lorenzo et al. 2011).

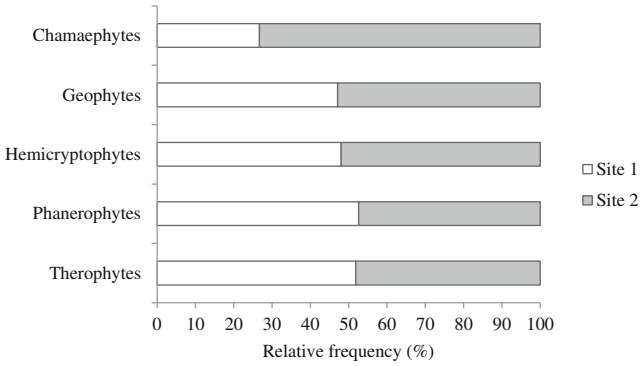

Fig. 3 Relative frequencies of life forms identified in faecal pellets in both study areas

Slender false brome (*B. sylvaticum*) was the most common grass herb; it was the major contributor to the hare's diet in site 2, whereas it was the third most frequent plant in site 1. Studies on *L. t. hibernicus*, *L. granatensis*, and *L. europaeus* reported that the grasses most frequently appearing in the diet were *Festuca rubra*, *Anthoxanthum odoratum*, and *Poa lanuginosa*, respectively (Wolfe et al. 1996; Puig et al. 2007; Paupério and Alves 2008). Overall, these results indicate that lagomorphs have a flexible foraging and nutritional strategy, which allows matching reproductive effort with different feeding resources (Flux 1981).

Consistent with previous studies on the Apennine hare (Freschi et al. 2011), we found *A. subhirsutum* to be an important contributor to the hare's diet, being the most abundant in the faecal pellets from site 1. The consumption of *Allium* spp. found in the present study has not been observed in other *Lepus* spp. The presence of these succulent plants could reflect an attempt to compensate for the total water loss occurring during dry seasons, as well as to take advantage of their anti-parasitic properties (Soffar and Mokhtar 1991; Guarrera 1999; Waller et al. 2001). In a certain way, the latter hypothesis would appear to be corroborated by a previous study concerning plant defence compounds (Bryant et al. 1992). Anyway, the capability of *L. corsicanus* to utilise *Allium* spp. demonstrate that although hares are selective foragers, they are also opportunistic feeders.

Other plant species found most often in the diet of *L. corsicanus* were *T. pratense* and *P. spinosa*. Some authors (Reichlin et al. 2006), working on stomach content of *L. europaeus*, found that *T. pratense* was highly consumed in May, when this plant was observed blooming. *Trifolium* spp. were also found to be part of the diet of *L. t. hibernicus* (Tangney et al. 1995; Strevens and Rochford 2004). Concerning *P. spinosa*, hares consumed mainly the fruits of this plant, along with those of other Rosaceae (e.g., *Malus sylvestris* and *P. pyraster*). The consumption of fruits, which has also been reported in a recent study on *L. europaeus* (Kontsiotis et al. 2011), further confirms their opportunistic behaviour in terms of use of temporary high-quality food. However, hares, in food restrictions, are also capable of selectively including in their diet raw parts of *P. spinosa*. Rödel et al. (2004) reported that, in upper Franconia (Germany), the diet of *L. europaeus* was also composed of terminal twigs of *P. spinosa* and of other woody plants. According to the authors, the preference for twigs and bark of several species of woody plants is probably related to the severe winter conditions of their study sites and, hence, to the limited access to ground vegetation by snow cover. Similarly, Pulliainen and Tunkkari (1987) reported that, in Finnish Lapland, *L. timidus* was found to browse on many tree and shrub species (e.g., *Betula* spp., *Juniperus* spp., and *Salix* spp.) due to snow cover.

When comparing the diet composition of the two study areas, we found significant differences in terms of richness, diversity, and evenness. The hare's diet was significantly richer in site 2 than in site 1, probably because a larger number of plant species were found in faeces from site 2. This implies that, throughout the year, hares exploited a broader food niche in this site. Concerning diet diversity, the Shannon diversity index was highest in site 2, giving an approximate 2 % diversity difference between the two study areas. This means that, although there were significant differences between sites, the hare's diet was quite diversified in both study areas. Our results supported previous studies in which hares have a high dietary diversity as measured by a range of diversity indices (Dingerkus and Montgomery 2001; Puig et al. 2007; Paupério and Alves 2008; Lorenzo et al. 2011). Despite significant differences of diet evenness between sites, *E* values were slightly greater than 0.5 in both sites, indicating a small tilt towards even distribution of the species eaten by hares. A similar result was observed in a study on *L. granatensis* in two different sites of a mountain ecosystem (Paupério and Alves 2008). The diet of *L. corsicanus* was quite similar in both sites as measured by the Morisita–Horn and Sørensen indices. This result is probably related to the high number of species shared by the two sites (54 of 70, >77 %). The qualitative and quantitative differences found in the hare's diet between sites were basically due to the different vegetational features (e.g., plant community structure, composition, and percentage cover) of each site.

The different plant availability in each site depends on the adaptation of plant life forms to the different environmental conditions of the two sites, which are profoundly affected by differences in elevation. According to Ricklefs (1973), different life forms are regularly associated with special climate: Phanerophytes usually correspond to tropical climates, whereas Chamaephytes mainly relate to cold, dry climates. Hemicryptophytes and Geophytes mostly associate with cold, moist climates, whereas Therophytes mainly associate with dry climates. Therefore, the higher consumption of semi-shrubs found in site 2 is probably related to a higher availability of Chamaephytes in this site, which, in turn, would seem to be a response to the colder climate of this site. In spite of these observations, given the low contribution of semi-shrubs to the hare's diet, the dietary differences between sites seem to be very low.

In conclusion, the present study has proved the generalist feeding behaviour of *L. corsicanus*, since, like other lagomorphs, its diet included several plant species with a considerable proportion of herbaceous plants, regardless of site. We also found that the Apennine hare can temporarily modify its trophic niche in order to adapt its dietary requirements. Nevertheless, to ensure the best availability of food resources for the species, the most representative plants of the diet could act as key indicators to identify and conserve its elective habitats. In this context, further studies are needed to evaluate whether *L. corsicanus* selects food items in accordance with their seasonal availability in the environment.

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