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Rock Partridge *Alectoris graeca* a good candidate for an umbrella species in rocky mountains in Italy

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Abstract – The umbrella concept is often applied in conservation management but as yet has rarely been tested empirically. *Alectoris graeca* is endemic in Europe, occurring only in the Balkans, the Alps and the Apennine Italian mountains. This species could be considered a good example of an umbrella species, that is one whose presence can imply broader biodiversity interest. Its European breeding population is relatively small and has undergone a large decline since about 1950 having suffered from habitat fragmentation and loss. The current approach for maintaining viable populations supports management of the species' habitat. We suggest that this conservation approach for the single species can also favor some other sympatric bird species and biodiversity in general. During 2004-2006, Rock Partridge and its companion bird community were censused in nine study areas from Cilento and Vallo di Diano National Park (Southern Italy). The study area consisted of dry and open rocky mountain with grassy patches and low scrubs from 1000 to 1900 m a.s.l. The classification of each site using a model of habitat suitability (including scores for various environmental traits) highlighted some significant relationships between Rock Partridge presence / abundance and suitable habitat on the other side. The species was present in seven out of nine study areas, where the suitability was optimal or good; in the remaining two areas we found a lower value of suitability. In the seven positive sites we also found the highest values of species richness of mountain bird community, ranging from 31 to 62 species: species richness values appeared to be positively correlated with habitat suitability scores. We suggest that Rock Partridge may be considered as a good candidate as an umbrella species, and in appropriate areas therefore be a useful tool for conservation of wildlife in Cilento and Vallo di Diano National Park, specifically, and potentially elsewhere within the species' range.

INTRODUCTION

Human land use is considered a determining factor on ecological processes having a profound influence on biodiversity (Ehrlich 1988, Vitousek 1994). Protecting biological diversity is a highly complex process, and managing the natural resources requires careful planning. First of all it is necessary to quantify biodiversity, defining conservation aims and measures. The quantification of biodiversity can be extremely expensive in terms of time and costs and several alternative methods have been proposed. Individual species may be useful as indicators of biodiversity if an association exists between the presence of a species and other biodiversity components (Chase *et al*. 2000). Umbrella, keystone or flagship species could be used as indicators for a larger community of organisms to help formulate conservation strategies and objectives. A number of definitions have been proposed for umbrella species emphasizing the different uses and proprieties (Zacharias and Roff 2000). Various authors suggested a broadly applicable definition for an umbrella species: i.e. a species whose conservation confers a protection to numerous co-occuring taxa (Fleishman *et al.* 2000). This concept is based on the premise that conserving one species can provide an 'umbrella' of protection for other beneficiary species, presenting similar habitat requirement and distributions (Lambeck 1997). This idea of umbrella species has gained popularity, but nowadays only few species have been tested (Suter *et al.* 2002).

The Rock Partridge, *Alectoris graeca*, is a bird of dry, rocky environments that is endemic to Europe. It occurs throughout the Alps, central and southern Apennines and Sicily, in Italy, and in the Balkans, reaching Albania and Greece (Cramp and Simmons 1980, Bernard-Laurent and

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Table 1. Characteristics of the nine study areas: extension, altitude range, habitat suitability score (HS) and density of Rock Partridge (pairs/km^2).

Site	**Extension** (ha)	**Range of altitude**	**HS**	**Density** (pairs/ km^2)
Alburni	884	1000 - 1704	98 (good)	0.55
Serra Nuda	658	800 - 1469	104 (good)	1.75
Cucuzzo	1082	800 - 1428	75 (medium)	0
Motola	512	1000 - 1743	114 (optimum)	3.48
San Giacomo	1216	1000 - 1446	110 (optimum)	1.86
Cerasuolo	400	800 - 1351	88 (good)	1.18
Cugno	330	800 - 1100	70 (medium)	0
Cervati	377	1600 - 1899	113 (optimum)	2.22
Faiatella	623	1000 - 1710	113 (optimum)	1.90

Table 2. Environmental variable included in HS analysis and relative range of value and score (from Simonetta and Dessì- Fulgheri 1998).

Environmental variables	**Value**	**Score**
Elevation	> 1000 m	0
	from 800 to 1000	1
	from 600 to 800	2
	< 600 m	3
Exposition prevalent	North	0
	East	1
	Southeast	2
	Northwest	3
	Southwest or flat	4
Slope and morphology	Strong, very bumpy	3-5
	Average, not too bumpy	1-2
	Flat, little bumpy	0
Nature of soil	Mostly clay	0
	rocky superficially	6-8
	Mostly calcareous	4-6
	Deep, rich in humus	0
Natural water features	Absent	0
	Poor or seasonal	1-2
	Abundant and perennial	3-5
Coverage plant	Meadows natural with scrubs	22-28
	Meadows natural with rocky	24-30
	Vineyards	6-12
	Lawns stable	16-22
	Lawns cultivate	9-15
Small patches of forest	None	0
	Little broad-leaved forest	3-7
	Few large blocks	1-2
	Abundant, well distributed	3-4
Woods and scrub adjacent	None	8-12
	Up to 30% of the perimeter	2-6
	From 31 to 60% of the perimeter	2-6
	Over 60% of the perimeter	2-6
Human impact	Significant	0
	Average	5-6
	Limited or absent	7-10
Predators	Poor or absent	0
	Normal density	from -1 to -2
	Very abundant	from -3 to -5

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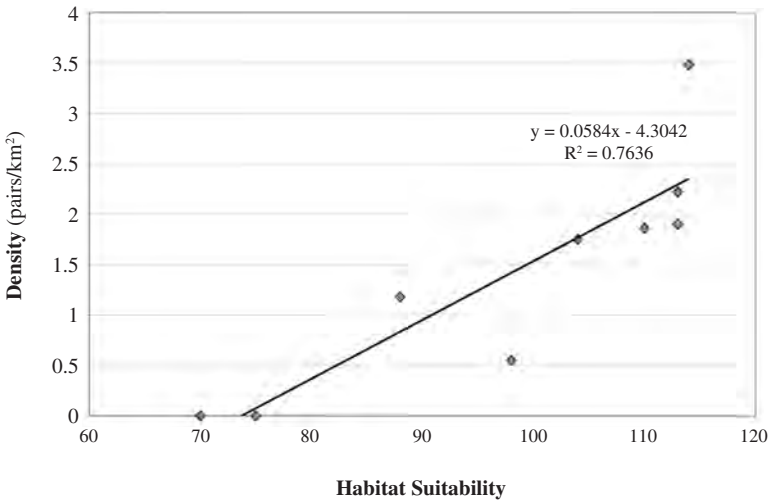

Figure 2. Correlation between habitat suitability scores and Rock Partridge density (pairs/km^2).

play-back method (Bernard Laurent and Laurent 1984). In each emission point, calls were launched in different direction for twenty seconds and repeated four or five times whit intervals of 20 seconds; two minutes were spent listening to possible responses. Calls were played at all sites (three times per site). Sighting of birds, feathers and tracks could also be considered as records of Rock Partridge presence, as this is the only Galliformes species regularly present in the area (some isolated pheasant population are introduced in the plain, outside the national Park). The density of the Rock Partridge in the various sites was calculated on the basis of the spring censuses.

To quantify the diversity of the animal community we only considered as a valuable estimate its ornithological component (Morrison 1986, Gregory *et al*. 2003). So we assessed the bird species richness at each site by means of bird counts performed with the Fixed Circular Plot method (F.C.P.; Reynolds *et al.* 1980). In particular, with this method the observer counts all birds seen or heard in a range of 100 m from the observer station (point) for 15 minutes. The number of point counts conducted varies between 12 and 30 according to the extension of the study sites. In each sites the censuses were repeated four times per breeding season. The bird species richness values were then correlated to the HS cumulative scores of the study sites.

RESULTS

The suitable habitat for the Rock Partridge show a total extension of 6082 ha, about 3.41% of the total area of Cilento and Vallo di Diano National Park (181,048 ha). Moreover, the HS for the Rock Partridge in the nine mountain sites differed considerably (see habitat suitability scores, Tab. 1).

The species was present in seven out of the nine sites. Rock Partridge has not been observed in the Cucuzzo and Cugno mountain sites, where HS accounted only for medium scores. In the other seven sites, the species density shows values ranging from a minimum of 0.55 pairs/km^2 in Alburni to a maximum of 3.48 pairs/km^2 in Motola sites. Overall, the species density was positively correlated with the HS score ($r=0.874$, $p<0.01$; see Tab. 1).

We recorded 68 bird species during the study of which seven species are endangered or vulnerable and included in Italian Red-List: *Aquila chrysaetos*, *Milvus milvus, Pernis apivorus, Pyrrhocorax pyrrhocorax, Falco peregrinus, Scolopax rusticola, Carduelis spinus* (Brichetti and Cambi 1982, Fraissinet *et al.* 1994, Calvario *et al*. 1999). Bird species richness ranged from 18 species in Cugno site to 62 in Motola site (difference significant at the chi square test: $\chi^2 = 34.0$; $P<0.01$). In detail, the lowest values of species richness were observed in Cucuzzo and Cugno sites with respectively 26 and 18 bird species. In the seven "Rock Partridge positive" sites species richness spanned from 31 to 62 species, respectively in Serre and Motola sites. Overall, species richness was found positively correlated with the HS score (Fig. 2; $r=0.775$, $P<0.05$). Interestingly, the presence of endangered/vulnerable species occurred only in the sites where Rock Partridge was present, and the number of red-listed species was also positively correlated with HS scores (Fig. 2; $r=0.781$, $p<0.05$). Golden eagle (whose the Rock Partridge is a typical prey) appears in Cervati and Faiatella, sites where the suitability

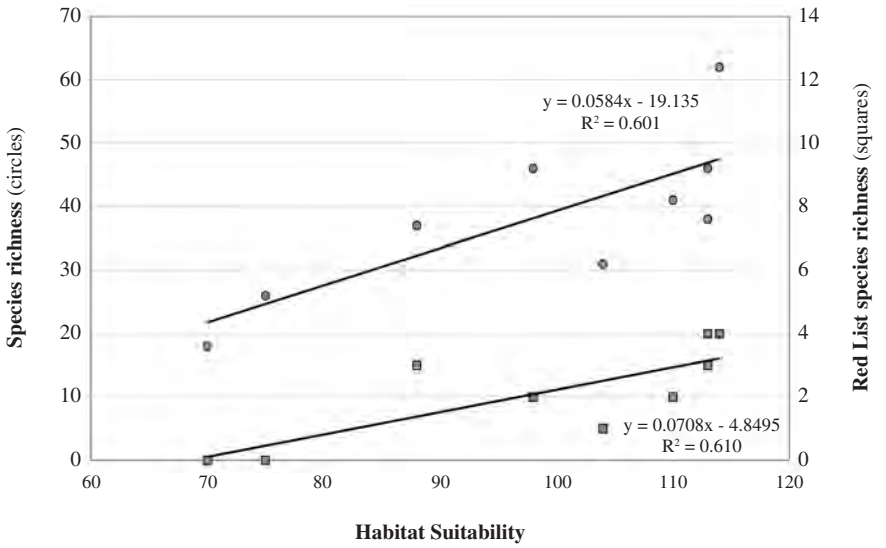

Figure 3. Correlation between bird species richness, number of red list species (RL specie richness) and habitat suitability scores (see text for further explanations).

was optimal and also Rock Partridge shows a high density, but also woodcock, *Scolopax rusticola* and red kite, *Milvus milvus*, were found into the areas with higher HS values (Motola, Faiatella and Cervati).

DISCUSSION

In Apennines and Alps mountain areas, the agricultural and grazing activities have been for long time the dominant land use (Laiolo *et al*. 2004). These man activities were contributing to create ideal habitat for the survival of many species of mountain environments such as the Rock Partridge (Baldock *et al*. 1996). After the Second World War, agropastoral practices in mountain areas have started to decrease quickly, according to the development of industry and intensive agriculture in plain areas, causing a transformation of the mountain environments that resulted in a relevant habitat fragmentation and habitat reduction (Farina 1991). The changes in land-use, and consequently land-cover, represented the most important factor causing decline of Rock Partridge and in general of a biodiversity loss in mountain areas (Farina 1991, Falcucci *et al*. 2006, Rolando *et al*. 2006).

According to our findings, the Rock Partridge density (and the Rock Partridge HS score) well describes the pattern of bird species richness, that we adopted as a biodiversity indicator. Sites with a high HS and high density of Rock Partridge show conspicuous bird diversity and presence of red-listed species, demonstrating that this species of Galliformes could be considered a good umbrella species. Therefore, habitat management toward Rock Partridge conservation could have a positive effect to preserve both this species, and its avian community in the same habitat.

To follow this suggestion, the agricultural policy should encourage traditional land-use practices, helping maintenance of diverse habitats. In particular, supervised grazing maintains open fields and increases the availability of insect preys (dung beetles, flies), thus favouring certain open-habitat species that are declining throughout Europe (McCracken *et al*. 1995); below the timberline, grazing increases habitat diversity and, in turn, bird diversity over broader scales (Rolando *et al*. 2006).

To preserve Rock Partridge populations, these management actions could be applied to the entire Cilento mountains, where biodiversity is interlinked with human land use and the maintenance of cultural landscapes (Chemini and Rizzoli 2003). A conservation management that acts under this driving principle can maintain vital Rock Partridge populations and high levels of related biodiversity. However, our conclusion is based on a limited set of data and further studies are needed to deepen the understanding of interrelationships between the presence of Rock Partridge and the transformation of mountain areas, to plan the most appropriate way for preserving biodiversity.

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