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A LITTLE IS BETTER THAN NONE: NEW INSIGHTS INTO THE NATURAL HISTORY OF THE AEOLIAN WALL LIZARD *PODARCIS RAFFONEI* FROM LA CANNA STACK (*Squamata Sauria*)

ABSTRACT

New data are given on the population size and ecology of *P. raffonei* occurring on La Canna stack, off Filicudi Island (Aeolian Archipelago). The estimates provided a consistency of 82.5 ± 52.5 individuals. Lizards occupy the whole surface of the stack, although they result more abundant (0.8 ind./m^2) in the areas more densely covered by vegetation. The diet is based mainly on ants and other arthropods, among which marine crustaceans found in the intertidal belt, and includes a significant percentage of vegetal matter. Also, the lizards feed on the prey remains from the pellets of Eleonora's falcon. All these traits reveal a remarkable level of adaptation to the chronic lack of resources that characterizes this micro-insular environment.

Key words: Aeolian Islands, Population size, Trophic ecology, Micro-insularity, Myrmecophagy

RIASSUNTO

Meglio poco che nulla: nuove conoscenze sulla storia naturale della lucertola delle Eolie Podarcis raffonei *della Canna* (*Squamata Sauria*). Alla luce dei risultati ottenuti durante recenti prospezioni, vengono forniti nuovi dati sulla consistenza e sull'ecologia della popolazione di *P. raffonei* che abita la Canna di Filicudi (Arcipelago Eoliano). Le stime hanno fornito una consistenza di 82,5 ± 52,5 individui; pur occupando l'intera superficie del faraglione, le lucertole risultano più abbondanti nelle aree con maggiore copertura vegetale, dove è stata riscontrata una densità pari a 0,8 ind./m^2. La dieta si basa principalmente su Formicidi (81% delle prede) e altri Artropodi, tra i quali i Crostacei Isopodi presenti nella fascia intertidale, ma comprende anche una significativa percentuale di sostanze vegetali; le lucertole si alimentano inoltre dei resti di prede contenuti nelle borre di falco della regina, e in generale mostrano un notevole grado di adattamento alla cronica scarsità di risorse che caratterizza questo ambiente microinsulare.

Parole chiave: Isole Eolie, Densità di popolazione, Ecologia trofica, Microinsularità, Mirmecofagia

INTRODUCTION

In 1973, a previously unknown lizard population was accidentally discovered on La Canna, a satellite stack of Filicudi Island (Aeolian Archipelago), by a group of climbers (BETTINESCHI *et al.*, 1973). LANZA (1973) supposed its belonging to the Italian wall lizard, *Podarcis siculus* Rafinesque, 1814, because at that time all the micro-insular populations of the Aeolian Islands were considered to be referred to this species. Some years later, these lizards were described by DI PALMA (1980) as a distinct infraspecific taxon, *P. sicula* ssp. *cucchiarai*. However, further genetic investigations have definitively clarified that this population belongs to the endemic, threatened Aeolian wall lizard, *Podarcis raffonei* Mertens, 1952 (CAPULA, 1994), and to the same subspecies (*P. raffonei* ssp. *alvearioi*) which occurs in the southern and western part of its range (CAPULA, 2006).

Compared to the other populations of the Aeolian wall lizard, whose biology and ecology were significantly investigated (CAPULA & LUISELLI, 1997; PÉREZ-MELLADO *et al.*, 1997; LUISELLI *et al.*, 2004; LO CASCIO, 2006; ROCA *et al.*, 2006; LO CASCIO & CAPULA, 2011; CAPULA *et al.*, 2014), that from La Canna is still by far the least known (see LO CASCIO, 2010), due to the difficulty to carry out observations on the scarcely accessible cliffs of the stack. In fact, the only available data were given by CAPULA (2006), who estimated a probable consistency of 20-60 individuals.

The aim of this paper is to provide the first information on the natural history of this population from data gathered in the last years and especially during a very recent prospecting on the stack.

MATERIAL AND METHODS

Study area

La Canna (38°34'56.13"N – 14°31'16.61"E) is a columnar stack located 1.6 km off the north-western coast of Filicudi Island (Aeolian Archipelago, Tyrrhenian Sea) (Fig. 1). It has a coastline of 225 m, a maximum elevation of 71 m a.s.l and a plane surface of 3,481 m^2, while that real is about 7,500 m^2, largely consisting in steep and bare cliffs. La Canna is the neck of a volcanic edifice emerged about 30-40,000 years B.P. and composed mostly by high-K basalts and basaltic-andesitic lavas, whose subaerial remnants include some nearby smaller rocks (LUCCHI *et al.*, 2013). Their erosion, together with the last eustatic sea event, have definitively isolated La Canna from Filicudi Island since 18,000 years B.P.

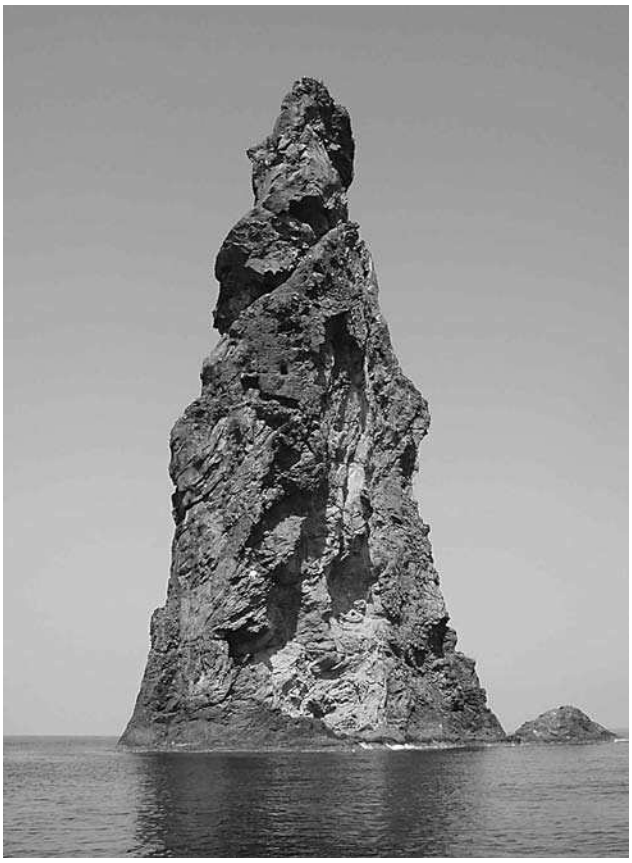

Fig. 1 — La Canna stack.

The plant assemblage is very poor and includes four species, *Umbilicus horizontalis* (Guss.) DC., *Hyoseris taurina* (Pamp.) Martinoli, *Malva veneta* (Mill.) Soldano, Banfi & Galasso, and *Dactylis* cfr. *glomerata* L., scattered on the top, the upper cliffs of the western slope, and on a very small flatter area at 50 m a.s.l. that breaks the vertical profile in the eastern slope. This latter, not wider than 5 m^2 (about 0.06% of the real surface), is also the only place where there is a thin layer of pseudo-soil and rock debris (Fig. 2).

From early winter to late spring La Canna is inhabited by few nesting pairs of Yellow-legged gull, *Larus michahellis* Naumann, 1840, while from May to late October it harbors 3-5 nesting pairs of the Eleonora's falcon, *Falco eleonorae* Gené, 1839 (Lo Cascio, 2000). Apart from the Aeolian wall lizard, no other terrestrial vertebrates have been detected on the stack.

Study lizard

Podarcis raffonei is a threatened, endemic lizard of the Aeolian Archipelago, whose distribution is limited to four relict and geographically isolated sites: a small area of Vulcano Island, the two islets of Strombolicchio and Scoglio Faraglione, and La Canna stack. That has been interpreted as result of the strong competition with *Podarcis siculus*, probably introduced since the anthropic colonization of the islands (about 7,000 years B.P.), which led to the

Fig. 2 — A very small and flat area, placed at about 50 m a.s.l., harbors most part of the vegetation occurring on the eastern slope of La Canna.

extinction of the autochthonous species in most part of its native range (see LO CASCIO, 2010).

Some biometric data about La Canna population (DI PALMA, 1980) indicate for two males and one female, respectively, a snout-vent length of 76 and 73 mm; for another adult male, measured and released in 2005 by PLC, SVL was 74.8 mm. These lizards are characterized by brownish dorsal coloration and by ventral parts pearl-grey.

Data sampling and analysis

Field work was done by two of us (LG and CS) the 28 June 2014 from 02.00 to 05.00 p.m. (solar time) in the partially shaded slope of the stack. During the climbing, particular attention was paid to the census of the individuals, to the status of their tail (if intact, broken or regenerated), as well as to the collection of faecal pellets from the substrate. Additional faecal pellets were collected by PLC during a survey in the basal belt carried out in 26 June 2005.

Due to the difficulty to perform capture/marking/recapture sessions,

visual encounter survey (VES) was preferred in order to estimate the population size (CRUMP & SCOTT, 1994; FLINT & HARRIS, 2005). VES represents a simple but rather reliable method considering both the remarkable habitat homogeneity of the studied site and the high detectability of the subjects, since according to previous climbers (BETTINESCHI *et al.*, 1973; CUCCHIARA, 1976; MAURICI & MANFRÈ SCUDERI, 2001) as well as from our observations, the lizards of La Canna do not fear the proximity of watchers. The route followed by climbers has been divided in three linear transects (from 0 to 30, 30 to 50 and 50 to 70 m of elevation, respectively), during which one observer recorded the occurrence of lizards within 4 m of distance from himself (2 m per side). Each plot is assumed as sampling area and then used to estimate the overall number within the whole surface. The estimated density index is expressed as individuals found per square meter. As the observer stopped the transects in the small flatter areas at 50 m a.s.l. and on the top, lizards sighted there were recorded but not taken into account when calculating the population density.

Faecal contents were examined in the laboratory under stereomicroscope (10-40 X). Remains were identified at order, family or species rank; item counting was based on the analysis of cephalic capsulae, wings, legs, following the minimum numbers criterion by sample. Prey length was obtained measuring the remains with a micrometer eyepiece and calculated according to the methods proposed by HÓDAR (1997). Plant matter was identified by comparison with fresh vegetal samples (flowers, fruits, leaf tissues) of the species occurring on the stack. Shannon index (SHANNON, 1948) was used to calculate the diversity of the preys range.

RESULTS

Population size and status

A single individual has been detected during the first linear transect (0-30), none in the second (30-50) and two in the last (50-70). For an overall plot of 280 m^2 (120 + 80 + 80), data from VES provide a mean of 0.011 ± s.e. 0.007 individuals per square meter. Thus, considering the real surface of the stack, the mean estimate for this population is 82.5 ± 52.5 lizards.

Including the lizards observed during the steps in the top and in the flat area, a total of 10 individuals was sighted during a 3 hours-climbing. Such number indicates as these small portions of the stack harbor a relatively greater amount of lizards, with density estimates ranging from 0.1 to 0.8

ind./m^2, respectively, on the top and at 50 m a.s.l.; this latter, in particular, represents the place where grows most part of the plants.

In 7 out of 10 lizards the tail was broken (1) or regenerated (6). Also in the male seen in 2005 the tail was regenerated. This percentage (> 70%) is comparable to that reported by DI PALMA (1980), who found tails broken/regenerated in 3 out of 4 examined specimens. Furthermore, most of the lizards detected during the climb were affected by a strong level of dehydration, with skinfolds particularly visible on the flanks and in correspondence of the collar (Fig. 3).

Diet composition

From 16 examined pellets (N = 11 sampled the 28 June 2014; N = 5 the 26 June 2005, including 1 obtained from an handled specimen), remains of 115 arthropod prey have been identified (mean = 7.18 ± s.e. 3.01 identifiable prey items per pellet). Prey size was determined for 66% (N = 76) of the examined items and ranges from 2 to 7 mm, with a mean of 3.04 ± 0.06 mm.

Fig. 3 — A male of *Podarcis raffonei* in the small flat area of the eastern slope of La Canna.

Hymenoptera Formicidae were found in 68% of the pellets and their percentage of appearance in the prey range is 81.7 (see Table 1). The mean for this taxon is 5.8 ± 2.8 individuals per pellet, with a maximum of 43 individuals found in a pellet. Nine other taxa included in the prey spectrum are generally represented with very low percentages (from 0.8 to 1.7%), except for other Hymenoptera (4.3%) and Crustacea Isopoda (5.2%). These latter are mainly belonging to the Ligiidae *Lygia italica* F., 1798 (4 out of 6 items).

Table 1

Diet composition of Podarcis raffonei *from La Canna stack expressed by number of items (n), percentage of total (%), and number of pellets containing that prey type (N); nd = not determinable. In the column % plant matter is expressed as average proportion of the overall pellets volume.*

prey category	**n**	**%**	**N**
Isopoda	6	5.2	5
Pseudoscorpiones	2	1.7	1
Araneae	2	1.7	2
Dermaptera	1	0.8	1
Heteroptera	1	0.8	1
Coleoptera	1	0.8	1
Lepidoptera	2	1.7	2
Diptera	1	0.8	1
Hymenoptera Formicidae	94	81.7	11
other Hymenoptera	5	4.3	2
Umbilicus horizontalis fruits	(3)	2.5	1
Malva veneta fruits/flowers	nd	16.2	3
Hyoseris taurina fruits	(6)	2.5	1

From the above analysis was excluded a well-preserved leg, lacking coxa only, belonging to a Coleoptera Cetoniidae, because it cannot rank as a true prey (see Discussion).

Vegetal matter was found in 31.2% (N = 5) of the examined pellets, and includes fruits and flower items belonging to 3 out of a total of 4 vascular plant species growing at La Canna (see Table 1).

The diversity of the prey range, calculated by using Shannon Index (H_s), is equal to 0.818.

Discussion

Our estimate for La Canna population of *Podarcis raffonei* provides a consistence of about 80 individuals, which did not differs remarkably from

the maximum indicated by CAPULA (2006), who calculated a range from 20 to 60 individuals. It is likely that this number may be characterized by variations over time, but a population size of < 100 individuals appears to be reliable, even in the light of the morphological and ecological traits of the site. Compared to those inhabiting Scoglio Faraglione and Strombolicchio, for which LO CASCIO (2006) and CAPULA & LO CASCIO (2011) gave estimates respectively of 200-400 and 500-700 individuals, that of La Canna is undoubtedly the smallest population of the Aeolian wall lizard.

Small-sized populations of Mediterranean Lacertidae may be viable even if their consistence is less than 10 individuals, such as some remarkable cases documented for the Balearic islets (VAN DER BERG & ZAWADZKI, 2010). Nevertheless, *Podarcis raffonei* is characterized by noticeably low level of genetic variability as well as by very low values of polymorphism and heterozygosity (CAPULA, 2006). According to CAPULA *et al*. (2002), low population density, inbreeding and apparent decline in genetic variability are considered as the main factors that may affect its survival. In this context, the small population of La Canna may be undoubtedly considered the most threatened among those of the Aeolian wall lizard inhabiting the tiny islets of the archipelago.

It is difficult to explain the high number of individuals with broken or regenerated tails, much higher than that observed in other populations (LO CASCIO, 2006). As neither the Yellow-legged gull nor the Eleonora's falcon are regular predators of lizards, this could therefore reflect the existence of (partial) cannibalistic propensities among these lizards, even not yet confirmed by the results of the analysis of faecal remains, as well as of intra- and intersexual interactions that may involve the tail autotomy.

As expected, lizards activity is mainly concentrated in the small flatter areas of the stack. At least on the eastern slope, the higher density was in fact observed in that occurring at 50 m of elevation, which despite its very small surface (about 5 m^2) is more densely covered by vegetation respect to the bare rocky cliffs of La Canna and, probably, represents the most important area for foraging and reproduction.

Also the basal belt is a suitable foraging area for the lizards, as evidenced by direct observations done in June 2005 (Fig. 4) and by the finding of *Lygia italica*, a crustacean very common in the intertidal zone, in about 20% of the examined faecal pellets. Although not previously reported for *P. raffonei*, the consumption of marine preys is known for other insular lizards (DAVENPORT & DELLINGER, 1995; LO CASCIO & PASTA, 2006; CASTILLA *et al*., 2009). The most important preys are however ants (> 80% of the prey range), an usually abundant food source, with gregarious behavior and seasonal stability, whose consumption implies a low searching effort. All these factors may compensate

Fig. 4 — A male lizard hunting *Lygia italica* in the intertidal zone of La Canna (26 June 2005).

for their low profitability and noxiousness. Also vegetal matter seems to play a significant role in the diet of these lizards, with a percentage higher than those found in other populations of *P. raffonei* (see LUISELLI *et al.*, 2004; LO CASCIO, 2006). Furthermore, with the only apparent exception of *Dactylis glomerata*, all the plant species growing on the stack are used as trophic resources by the lizards.

A leg belonging to a Coleoptera Cetoniidae within a faecal pellet reveals instead a very distinctive trait of the feeding behavior of these lizards. These large-sized beetles are generally widespread in the woodlands of Sicily or some Aeolian Islands, but their occurrence on a tiny islet just covered by few halophile vegetation seems to be highly unlikely. Nevertheless, their remains are regularly found in the pellets of the Eleonora's falcon (LO CASCIO, 2000), that may hunt these beetles at great distance from the colony. Commensal relationships between *Falco eleonorae* and some Mediterranean lizards have been observed in several micro-insular environments (DELAUGERRE *et al.*, 2012), where these latter usually feed upon carcasses of birds killed by falcons and are attracted by blood and fleshy matter. The lizards from La Canna are instead able to feed upon the prey remains included in the pellets, despite their presumably scarce digestibleness and very low nutritional value.

Only by using the broadest range of potential resources, the lizards can compensate for the paucity of preys. Despite the lower diversity of their range respect that known for other conspecific populations (H_s = 2.000 at Scoglio Faraglione, see LO CASCIO, 2006), which seems attributable to the local faunal poorness, the diet probably includes all the prey categories available on the stack, as suggested by the occurrence of both terrestrial (such as Pseudoscorpiones and Isopoda) and flying arthropods (e.g. Hymenoptera and Diptera). Some traits of the trophic ecology of these lizards, such as myrmecophagy, partial herbivory (both known also for other insular lizards of the Mediterranean: see PÉREZ-MELLADO & CORTI, 1993; VAN DAMME, 1999; CARRETERO, 2004), and especially the use of falcon pellets, reveal an extreme level of ecological adaptation as well as a long history of evolutionary responses to the severe constrains occurring in the micro-insular environment of La Canna stack.

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