SHORT NOTE:

ECOLOGICAL SEGREGATION BETWEEN *PODARCIS SICULA* AND *P. MELISELLENSIS*, (SAURIA: LACERTIDAE) IN YUGOSLAVIA

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INTRODUCTION

The Dalamatian Coast with ca. 3500 Adriatic islands supports a rich lizard fauna, notably the Wall

Lizards (*Podarcis* spp.) and Rock Lizards (*Lacerta* spp.). The habitat is generally either degraded scrub with *maquis* type vegetation growing over terraced hillsides, or *karst* type terrain.

MAP OF DALMATIAN COAST SHOWING LOCATION OF SITES STUDIED.



Fig. 1 Map of the Dalmatian Coast showing named sites and the species found at each site.

KEY A Cres (*P. melisellensis*), B Unije (*P. siculal*), C Losini (*P. melisellensis*), D Susak (*P. sicula*), E Ilovik (*P. sicula*), F Olib (*P. sicula*), G Ugljan (*P. melisellensis* and *P. sicula*), H Dugi Otok (*P. melisellensis*), I Vrana (*P. sicula*), J Vrgada (*P. sicula*), K Korcula (*P. melisellensis*).

Two widely distributed lacertids in the region are the Italian Wall Lizard (*Podarcis sicula*) and the Dalmatian Wall Lizard (*P. melisellensis*). Several workers have studied the distribution and interactions of these species, notably Radovanović (1959). In 1985 we carried out a study of the habitat differences between the two species so that the potential for interspecific competition could be investigated.

METHODS

Observations were made at one mainland and 10 island sites each with considerable variation in the types of habitat present. These are indicated in Fig. 1. The majority of the observations were made during the lizards' peak period of activity, viz. early to mid-morning on hot and sunny days. The following methods were used during the study:

(i) Using a set of pre-defined micro-habitats, the location of each lizard was recorded whilst the recorder walked in a random fashion over suitable terrain. Such counts were made for fixed time periods of either 20 or 30 minutes. The micro-habitats were defined as follows:

- A Intact walls
- B Collapsed walls
- C Base of wall
- D Isolated boulders
- E Herbaceous vegetation
- F Woody vegetation

- G Path, track or road
- H Open stony ground (karst)
- I Edge of vegetated bank
- J Sandy bank
- K Dead twigs, branches or reeds
- L Edge of a path or road
- M Edge of cultivated land
- N Other micro-habitats

(ii) For paths, tracks or roadsides, lizards were recorded in the same way as (i) for similar time periods, but without the random element of direction.

RESULTS

The abundance of lizards in each micro-habitat is shown in Fig. 2. The data show that *P. melisellensis* has a marked preference for dry-stone walls, especially overgrown and collapsed ones. In contrast, *P. sicula* was much more more diverse in its choice of microhabitat, being present in *all* the predefined microhabitat categories and showing no marked preference, but with an affinity for vegetated open ground and paths. In addition to these data, the following qualitative observations on the various species were made:

(i) At most sites, only either *P. melisellensis* or *P. sicula* were present, not both. On Ugljan, however, both species were present although they appeared not to be in sympatry. Coastal to the island's main road, in



Fig. 2 The abundance of *P. melisellensis* and *P. sicula* in each micro-habitat.

KEY A Intact walls, B Collapsed walls, C Base of wall, D Isolated boulders, E Herbaceous vegetation, F Woody vegetation, G Path, track or road, H Open stony ground (*karst*), I Edge of vegetated bank, J Sandy bank, K Dead twigs, branches or reeds, L Edge of a path or road, M Edge of cultivated land, N Other micro-habitats.

the town of Preko, *P. sicula* was abundant. Inland from the road, however, only *P. melisellensis* was present (in the *maquis*).

(ii) Both *P. melisellensis* and *P. sicula* were observed in a variety of colour and pattern combinations. Among populations of the former species, the boldlymarked green-backed variants tended to prefer lush green vegetation, whereas the unmarked brown variants were usually more abundant on or near walls and in *karst* terrain. A melanistic specimen was found in such terrain on Cres.

DISCUSSION

In most of the locations studied, there were at least five of the micro-habitats present. Therefore, it was assumed that those micro-habitats with the highest proportion of a species are the 'preference' of that species. On the basis of this, the likelihood of exclusion competitive between P. sicula and P. melisellensis could be assessed. In earlier work, Radovanović (1959) postulated that P. sicula was invading the range of *P. melisellensis* via a competitive advantage, namely superior size. He tested this hypothesis by introduction experiments on several small islands, and concluded that competitive exclusion was indeed occurring. Subsequently, Nevo, Gorman, Soulé, Suh Yung Yang, Clover and Jovanović (1972) revisited some of Radovanović's sites and found evidence to both support and refute his theory. They also found evidence from the island of Mali Obrovanj to suggest that the two species could coexist on one island, provided that at least two distinct habitat-types were present, indicating that they were probably not sympatric.

Our observations from Ugljan support their findings, although it should be stated that Ugljan is a very large island when compared with Mali Obrovanj, which only measures 80 x 50m. Clover, (1979) likewise, has observed that on some of the larger Adriatic islands, such as Ciovo, both species may occur together. This phenomenon of the two species occupying separate habitats on the rare occasions where they both occur on the same island, coupled with our observations of the lizards' preferred habitats among separate populations, suggest that the two species are not likely to be competing for the same resource and thus competitive exclusion is probably not occurring. In addition to these findings, observations were made on the Sharp-Snouted Rock lizard (*Lacerta oxycephala*) and *P. melisellensis* on the island of Korcula, where the two species appeared to be sympatric. *L. oxycephala* was, however, much more adept at climbing than the latter species. In Korcula town, *L. oxycephala* coexisted with the Turkish Gecko (*Hemidactylus turcicus*) with which it had comparable climbing abilities but, unlike the gecko, was diurnal. Thus *L. oxycephala* appeared to avoid total niche overlap with *P. melisellensis* by the superior climbing abilities of the former species, and with *H. turcicus* by the nocturnal habits of the latter species.

In summary, competition between *P. sicula* and *P. melisellensis* is avoided by:

(i) geographical separation of the individual island populations of each species, or by

(ii) significant habitat and behavioural differences between the two species where they do occur together; namely that *P. sicula* is a particularly bold, opportunist and conspicuous species prefering vegetated and open land near human habitation. In contrast, *P. melisellensis* is a more conservative species prefering a more rocky, overgrown habitat, especially dry-stone walls, often away from human habitation.

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