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SEED DISPERSAL OF *CAPPARIS SPINOSA* L. (*Capparaceae*)  
BY MEDITERRANEAN LIZARDS

SUMMARY

Mediterranean lizards are involved in the dispersion of *Capparis spinosa* subsp. *rupestris* due to their attraction by fleshy tissues of the fruits, ripening in xeric coastal environments during the summer months. The results of field observations carried out in Linosa (Pelagic Islands) are presented, showing that dispersal by *Podarcis filfolensis laurentiimuelleri* principally happens through ingestion of the seeds together with parts of the fleshy pulp. This lizard, endemic to Linosa and Lampione is widespread in different habitats and shows trophic generalism. The fruit of *C. spinosa* subsp. *rupestris*, a dehiscent berry, is described and the implications of the dispersal agents on the autecology of this plant are discussed. These observations confirm the importance of lizard-plant mutualism in the islands, where lizards are often recorded as fruit consumers.

RIASSUNTO

*Dispersione dei semi di Capparis spinosa* L. (*Capparaceae*) nel Mediterraneo per mezzo di lucertole. Le lucertole sono coinvolte nella dispersione di *Capparis spinosa* subsp. *rupestris* grazie all'attrazione esercitata dalle parti carnose dei frutti, che maturano nelle zone costiere del Mediterraneo durante i mesi estivi. Indagini condotte nell'isola di Linosa hanno permesso di osservare come *Podarcis filfolensis laurentiimuelleri* nutrendosi di parti della polpa carnosa ingerisca semi causando la dispersione. Questa lucertola, endemica di Linosa e Lampione, è caratterizzata da generalismo trofico. Viene descritto il frutto di *C. spinosa* subsp. *rupestris*, una bacca deiscente, e vengono discusse le implicazioni di questa forma di saurocoria riguardo alla distribuzione della pianta. Le presenti osservazioni confermano l'interesse delle relazioni tra lucertole e piante, con particolare riferimento agli ecosistemi insulari.

## INTRODUCTION

Lizard-plant interactions have been traditionally undervalued, but in the last decade interest in the ecology of these animals has increased and studies from widely disparate regions confirmed their role as pollinators and seed dispersers (OLESEN & VALIDO, 2003). It is remarkable that ancient groups of lizards have been recognized as important seed dispersers of the first angiosperms (TIFFNEY, 1984). BORZI (1911) firstly examined the role of lacertid lizards as dispersers of some higher plants, also describing different types of fruits consumed by them. Notwithstanding this, lizards of this group are usually not regarded as mutualistic agents, possibly because most are considered as carnivorous, but many of them have a broad diet, including flowers, fruits, nectar and pollen (COOPER & VITT, 2002). Lizards show a streptostylic mandibular suspension which precludes the use of mandibles for chewing, and they can eat only soft vegetal tissues (OSTROM, 1963; SZARSKI, 1962). Lacertid lizards are oligophagous herbivores, recognizing a limited variety of plants and eating their fiber-poor components (PÉREZ MELLADO & TRAVESET, 1999). Actually only few lizard species are recognized as strictly herbivorous, many others eating plant material in variable proportions and preferring flowers and fruits presumably because these parts are more easily assimilated than vegetative organs (SÁEZ & TRAVESET, 1995). Even if frugivory has been observed in continental populations (HERNÁNDEZ 1990; TRAVESET 1990) literature data show that dispersal by lizards is most common in the islands, e.g. sixty-eight percent of fruit eating lizards are known from island populations (OLESEN & VALIDO, 2003). This phenomenon has been explained in terms of density compensation, diet expansion and low predation levels. However PÉREZ MELLADO & TRAVESET (1999), studying two species of lizards endemic to the Balearic Islands, stated that plant consumption cannot be considered true trophic specialization; indeed these lizards show helminth infracommunities in the digestive tracts typical of insectivorous lizards (ROCA & HORNERO, 1994). Even if the coevolution between plants and animals has been stressed, much attention should be paid to the influence of the different dispersal agents on the distribution and autecology of the single species of plants. Furthermore the study of seed dispersal by reptiles has received little attention if compared to seed dispersal by birds and mammals (HOWE & WESTLEY, 1988; JORDANO, 1992).

In this paper we report our observations on fruit feeding and seed dispersal of the caper bush – *Capparis spinosa* L. subsp. *rupestris* (Sm.) Nyman – in Linosa (Pelagie Islands) by a lacertid lizard, *Podarcis filfolensis* (Bedriaga, 1876). In Italy this lizard is represented by subsp. *laurentiimulleri* (Fejérváry, 1924), endemic to Linosa and Lampione. Despite the high number of indi-

viduals it should be regarded as vulnerable (CORTI *et al.*, 1997), due to its distribution on only two small islands. In Linosa this lizard is widespread in several habitats, with higher density in the inland areas occupied by maquis (DI PALMA, 1991). The references on its diet showed a broad generalism, with high percentage of Coleoptera, ants and plant material in the stomach contents (SORCI, 1990). The Steno-Mediterranean *C. spinosa* subsp. *rupestris* is a shrub with spreading-pendulous branches, widespread in Sicily and surrounding islands on carbonatic and volcanic outcrops and old walls (FICI & GIANGUZZI, 1997; FICI, 2001). For this taxon BORZÌ (1911) recorded lizards, wasps and probably birds as seed dispersers, while recently LI VIGNI & MELATI (1999) underlined that the smell and the pulp of the ripe fruit attract lizards, wasps and ants. In northern Sicily seeds of *C. spinosa* were found in the stomach contents of wood pigeons (MASSA, *com. verb.*). Regarding lizards, fruit consumption by *Podarcis melisellensis* is recorded in TIEDEMANN & HENLE (1986), while PÉREZ-MELLADO & TRAVESET (1999) observed *Podarcis lilfordi* eating fruits of this plant in the Cabrera archipelago, but dubiously regarded this lizard as a seed disperser of *C. spinosa*. The volcanic Linosa island has been selected for our observations due to the high density of the easily observable *P. filfolensis laurentiimuelleri*, and to the presence of wild populations of *C. spinosa* subsp. *rupestris*.

## MATERIAL AND METHODS

Our data are based upon direct observations of foraging lizards, made during the peak of their daily activity period, in spring-summer 2002 and 2003. We followed individual lizards in proximity of fruiting plants of *C. spinosa* subsp. *rupestris*, from a distance of 2-3 m, during 20 minutes or until the animals disappeared. At different times of the day fruits were also placed near the burrows of the lizards, and foraging was observed. At the same time observations on the autecology, phenology and fruit characters of *C. spinosa* were carried out. Some additional observations were made examining fecal samples taken from the ground.

## RESULTS AND DISCUSSION

*C. spinosa* subsp. *rupestris* is widespread in Linosa on rocky outcrops, cliffs and old walls (Fig. 1). In the same island it is also propagated by man and planted along roadsides and slopes. Production of flower buds starts in April, prolonging to the autumn. The flower buds are traditionally collected



Fig. 1 — Natural habitat of *Capparis spinosa* subsp. *rupestris* in Linosa.

to obtain the commercial capers. The fruit is an oblong-ellipsoid berry c. 3,2-5 (-7) cm long, green when young, then reddish-violaceous and splitting along one or more ribs (Fig. 2). The seeds, c. 2-4 mm, are embedded in a pulp bad-smelling after dehiscence. BORZI (1911) underlined that the fruits of the caper bush, when ripe, lay on the rocks due to their weight and to the weak peduncle, thus they are easily reached by creeping animals. *P. filfolensis* was observed in Linosa climbing on the branches of the plants to reach the dehiscent fruits (Fig. 3), or feeding on fruits laying on the rocks and walls. Several individuals were counted simultaneously on a single plant. Lizards are mostly attracted by ripe fruits (Fig. 4), probably due to their smell, but they also feed on fruits with dried pulp, several days after dehiscence. The fruits placed near the burrows rapidly attracted the lizards, which feeding on the pulp occasionally ingested the seeds. Based on the examination of the lizard scats, seeds remained intact after passing through the intestines. Furthermore in some cases body contact of the lizard with the fruit caused an accidental adherence of the pulp to the skin. Hence, an occasional external transport of



Fig. 2 — Ripe fruit of *Capparis spinosa* subsp. *rupestris*.

the seeds by lizards should be hypothesized. The berries of *C. spinosa* subsp. *rupestris* mostly ripe during the dry summer months, when few other fleshy fruits are available. In the same period lizards were frequently observed in the island feeding on the fruits of naturalized or cultivated species, as the Barbary fig (*Opuntia ficus-indica*) and tomato (*Lycopersicon esculentum*). PÉREZ-MELLADO & TRAVESET (1999) listed some species in the Cabrera archipelago producing fruits consumed by lizards; some of these are represented in the flora of Linosa (BRULLO & SIRACUSA, 1995), i.e. *Ficus carica*, *Chenopodium murale*, *Pistacia lentiscus*, *Daucus gingidium*, *Phillyrea latifolia*, *Asparagus stipularis*. In the island lizards are also attracted by remains of different kind of food. SÁEZ & TRAVESET (1995) stated that herbivory of lizards varies with season, underlining a noteworthy reduction in percentage of plant material in the stomach contents from winter to summer. Our observations show that in Linosa the fruits of *C. spinosa* subsp. *rupestris* and other plants appear to represent an important resource for lizards during the dry season.

Based on our observations the habitat of *C. spinosa* subsp. *rupestris* in



Fig. 3 — *Podarcis filfolensis laurentiimuelleri* climbing on the branches of *Capparis spinosa* subsp. *rupestris*.

Linosa is strictly linked with the transport of seeds by *P. filfolensis laurentiimuelleri*, a lizard spending most time on walls and rocks. In Northern Sicily GIANGUZZI *et al.* (1993) recorded *C. spinosa* subsp. *rupestris* as dominant of a chasmo-nitrophilous association – described as *Capparidetum rupestris* O. Bolòs et Molinier 1958 – widespread at the basis of cliffs and on old walls. Here *C. spinosa* subsp. *rupestris* shows high cover values in communities including few other species, as *Parietaria diffusa*, *Hyosciamus albus*, *Umbilicus rupestris*, *Antirrhinum siculum*, etc. It is to be underlined that it becomes rare or absent within strictly specialized communities of the cliffs at higher altitudes, probably in relation to the habits of the dispersers. The dispersal of *C. spinosa* subsp. *rupestris* by lizards in the investigated site appears to be linked with their trophic generalism and adaptations in the diet during the summer. According to IVERSON (1985) lizards are potentially important seed dispersers for several plant species, particularly in the islands, where they are usually the dominant group of land herbivores. Since *C. spinosa* shows a



Fig. 4 — *Podarcis filfolensis laurentiimuelleri* feeding on ripe fruit.

largely disjunct distribution, being represented by several intraspecific taxa in Africa, Asia, Australia and Oceania, further observations in these areas should add new data on the dispersal agents of this ancient paleotropical and subtropical group.

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