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## Predation by scorpions (*Buthus occitanus*) on *Podarcis atrata* from the Columbretes Islands

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Lizards may constitute important parts of the diet of scorpions in xeric areas where insect prey are scarce. Several North American and African scorpions of the families *Scorpionidae* and *Buthidae* are known to prey on diurnal lizards (*Mabuya*, *Urosaurus*, *Dipsosaurus*, *Sceloporus*, *Uta*, *Cnemidophorus*) and nocturnal geckos (*Coleonyx*, *Pachydactylus*, *Palmatogecko*) (see review in McCormick & Polis, 1982). Laboratory studies have also revealed that scorpions are able to successfully capture, handle and digest lizards (Hardi, 1947; Banta, 1957; Polis, 1990). Predation by scorpions on European lacertid lizards has not been reported, except for two observations on the Columbretes Islands in 1992 where adult *Buthus occitanus* consumed 2 juvenile *Podarcis atrata* (Castilla, 1995). Here we describe a number of instances of predation by *B. occitanus* on *Podarcis atrata*, a lizard endemic to the volcanic Columbretes Archipelago (Mediterranean, Castellón, Spain), a set of very small (0,5-13 ha) islands characterized by an extreme aridity and a scarcity of insects (Castilla & Bauwens, 1991).

Between 1992 and 2007, researchers, students and game keepers of the Columbretes Natural Park have observed predation events (figure 1) by *B. occitanus* on 12 juveniles *P. atrata* ranging in age between one week to one month. Observations were made between July and September in the interval 1700-2400 h (GMT + 1). Additionally, we recorded fighting encounters and predatory events (N = 5) by scorpions on subadult lizards under captive conditions (enclosures of 50x20 cm placed outdoor in the island).

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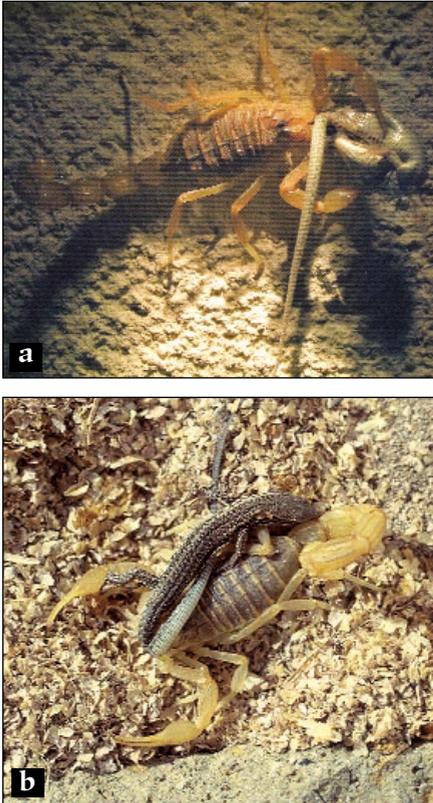


Figure 1. Scorpions (*Buthus occitanus*) preying on juveniles of *Podarcis atrata* under natural (a) and captive conditions (b).

The poison of *B. occitanus* was lethal to one juvenile lizard maintained under captive conditions. However, 10 adult males with a mass of 8-10 g and 9 adult females of 4-7g survived after being stung by adult scorpions. Only a single 5 g female died after the scorpion injected venom into the cervical region. The effect of the venom on the other lizards was variable. After being stung, lizards were licking the body part where the scorpion stinger had penetrated, shook their heads, appeared exhausted, and showed paralysis of the hind legs for a few minutes. However, we did not quantify the duration of these effects.

Density of both lizards and scorpions is very high on the Columbrete Grande, the largest island in the archipelago (13 ha; Castilla & Bauwens, 1991; Castilla & Pons, 2007), and both species share rocks to hide and protect themselves. Since both species are insectivorous, they may also compete for food.

*Podarcis atrata* also preys on scorpions (figure 2) (Castilla *et al.* 1987; Castilla *et al.*, 2008; Castilla & Herrel, in press). Thus, this provides a clear example of “cross predation” (i.e., vertebrate taxa simultaneously acting as prey and the predator; see McCormick & Polis, 1982). Cross predation has the potential to be an important factor in determining the structure of both lizard and scorpion populations and their distribution on the island (figure 3). Future studies should explore the impact of this reciprocal predation on the population dynamics of the two most abundant terrestrial species on Columbrete Grande Island.

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Figure 2.- Adult male *Podarcis atrata* predating on *Buthus occitanus* when offered in the field under captive conditions (see Castilla et al., 2008).

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Figure 3.- The density of *Buthus occitanus* in the Columbretes Islands is very high.

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