
Marine prey in the diet of *Podarcis atrata* from the Columbretes Islands

A. M. CASTILLA^{1, 2} A. HERREL³ & A. GOSÁ⁴



Lizards of the genus *Podarcis* typically occupy terrestrial habitats and commonly feed on insects and occasionally on plant materials (Arnold & Ovenden, 2002). Despite many studies that have examined the diet of *Podarcis* species in insular ecosystems, marine prey are rare (Pérez-Mellado & Corti 1993; Díaz, 1995; see also references in Van Damme, 1997; Herrel *et al.*, 2003). The only data on European lizards utilizing intertidal invertebrates (e.g., the isopod *Ligia italica*) are for *Podarcis dugesii* on Madeira Island, Atlantic, Portugal (Davenport & Dellinger, 1995) and *P. wagleriana* (Lo Cascio & Pasta, 2006). We also noted intertidal invertebrates (*Amphipoda*, *Crustacea*) as prey of an adult male *P. muralis* along the northern coast of the Basque Country (Guipúzcoa, Spain; pers. obs.). More recently (August 2007) Laura Gangoso (pers. comm.) observed in the Canary island of Alegranza (12 km₂), one adult lizard *Gallotia atlantica* swimming a distance of 2 meters from the seashore to a rock without vegetation but with many snails and algae. Alfredo Valido (pers. comm.) has observed lizards (*Gallotia* sp.) in several occasions consuming crustacean copepods and other small invertebrates in the seashore.

The lizard *Podarcis atrata* is endemic to the Columbretes (Mediterranean, Castellón, Spain), an archipelago consisting of very small islands and islets ranging in size from 0.5 to 13 hectares. The islands are characterized by an extreme aridity and a scarcity of insects (Castilla & Bauwens, 1991). On different years between 1987 and 2007, lizards have been observed near the sea shore. Females use the micro habitats near the sea shore (2-5m away from the shore) to lay their eggs

¹ Ministerio de Ciencia e Innovación, Museo Nacional de Ciencias Naturales (CSIC), Estación Biológica de Sanauja,; Ap. Correos nº 35 • 25280 Solsona, E-Lleida, Spain.
Address for correspondence

² Museo Nacional de Ciencias Naturales (CSIC). Dept. Biodiversity and Evolutionary Biology, c/ José Gutiérrez Abascal 2 • E-28006 Madrid, Spain.
aurora@mncn.csic.es

³ Harvard University. Dept. Organismic and Evolutionary Biology
26 Oxford Street, Cambridge, MA 02138, USA.

⁴ Sociedad de Ciencias de Aranzadi / Zientzia Elkarte. Departamento de Vertebrados.
Zorroagaina 11 • 20014 San Sebastián.



Figure 1.- Male *Podarcis atrata* consuming marine prey in the intertidal zone at the Columbrete Grande island.

(Castilla & Swallow, 1995). Moreover, adults of both sexes have been observed up to 20 cm from the sea water while foraging and feeding on seabird regurgitates, scavenging on carcasses and remains of gull eggs in four different islands of the archipelago (Castilla *et al.*, 1987). The lizards also show a high propensity to consume the marine isopod *Ligia italica* under experimental conditions (Castilla *et al.*, 2008). More recently, in June 2006 and May 2007 we offered decapod crabs (ca. 10 mm length) to free ranging individuals of *P. atrata* in the field. Although some lizards ignored the prey, 12 out of 16 males (75%) and 15 out of 17 females (88%) ran after the crabs and tried to consume them, despite the typical defensive behaviour

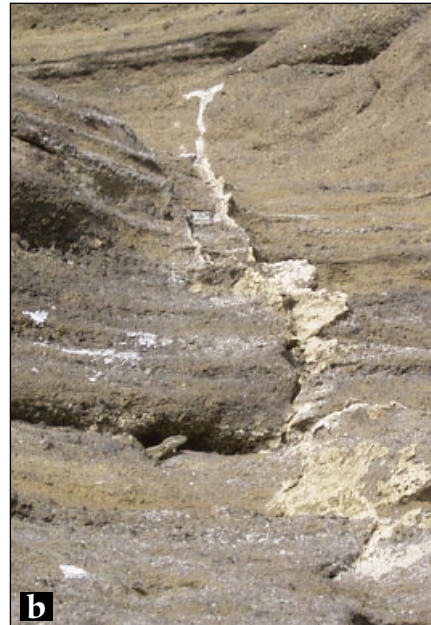


Figure 2.- Adult *Podarcis atrata* climbing vertical rocks from the sea level (a) and hidden in small crevices (b).



Figure 3.- Adult sample of *Ligia italica* (Isopoda) in the Columbrete Grande island.

displayed by the crabs. Three of the crabs that were unable to escape under rocks, were consumed by two female and one male lizards.

It is generally assumed that the inclusion of marine resources into the diet of terrestrial species is promoted by the scarcity of other food resources (Polis & Hurd, 1996; Barret *et al.*, 2005). Lizards from extreme arid coastal areas across the world are important consumers of marine and intertidal trophic resources (e.g., amphipods, isopods, crabs, shells, flies, etc) (Townsend, 1975; Catenazzi *et al.*, 2005). Although the lack of marine prey in the diet of the majority of lizards from small arid

islands in the Mediterranean and Adriatic Seas may be related to the availability of plants as an alternative food resource, our findings for *P. atrata* in the Columbretes archipelago suggests that the consumption of marine invertebrates may actually be more common than know at present. We therefore encourage European herpetologists to examine lizards from volcanic and arid islands to investigate whether the consumption of marine invertebrates by lacertid lizards may be more common than previously thought.

Understanding how lizards deal with arid environments characterised by a low abundance of insects is important in light of how global warming may affect the diversity and abundance of plants and invertebrates in small insular ecosystems. Moreover, investigating whether the consumption of marine prey is accompanied by behavioral and physiological adaptations in *Podarcis* lizards would be an important avenue for further research.

We would like to thank the Generalitat Valenciana and the Secretaría General de Pesca Marítima (MAPA) for permission to work in the islands and transportation. To the game keepers and workers of the Natural Park. Many thanks also to Pep Perolet and the boats CAT-CAT and Clavel I for transportation. We thank Dirk Bauwens for constructive comments. This work was conducted on a contract "Ramón and Cajal" from the Spanish National Science Foundation (CSIC, Ministerio de Educación y Ciencia) (to AMC), and the Project MEC CGL2005-00391/ BOS (J. Martín & P. López, MNCN-CSIC).

BIBLIOGRAFÍA

- ARNOLD, E.N. & OVENDEN, D.W. 2002. *A field guide to the reptiles and amphibians of Britain and Europe*. Collins, London, United Kingdom. 272 pp.
- BARRETT, K., ANDERSON, W. B., WAIT, A. D., GRISMER, L. L., POLIS, G. A. & ROSE, M. D. 2005. Marine subsidies alter the diet and abundance of insular and coastal lizard populations. *Oikos*, 109:145-153.
- CASTILLA, A.M. & BAUWENS, D. 1991. Observations on the natural history, present status, and conservation of the insular lizard *Podarcis hispanica atrata*. *Biological Conservation*, 58: 69-84.
- CASTILLA, A.M. & SWALLOW, J. 1995. Artificial egg-laying sites for lizards: A conservation strategy. *Biological Conservation*, 72: 387-391.
- CASTILLA, AM, VANHOODYDONCK, B. & CATENAZZI, A. 2008. Feeding behavior of the Columbretes lizard *Podarcis atrata*, in relation to the marine species, *Ligia italica* (Isopoda, Crustaceae). *Belgium J. Zoology*, 138 (1): 146-148.
- CASTILLA, A.M., JIMENEZ, J. & LACOMBA, I. 1987. Los reptiles de Columbretes. In: *Islas Columbretes. Contribución al estudio de su medio natural*. L.A. Alonso Matilla, J.L. Carretero & A.M. García-Carrascosa (eds.), pp. 181-194. Generalitat Valenciana, Valencia.
- CATENAZZI, A., CARRILLO, J. & DONNELLY, M. A. 2005. Seasonal and geographic eurythermy in a coastal Peruvian lizard. *Copeia*, 4: 713-723.
- DAVENPORT, J. & DELLINGER, T. 1995. Melanism and foraging behavior in an intertidal population of the Madeiran lizard *Podarcis* (= *Lacerta*) *dugesii* (Milne-Edwards, 1829). *Herpetological Journal*, 5:200-203.
- DÍAZ, J.A. 1995. Prey selection by lacertid lizards: a short review. *Herpetol. J.*, 5: 245-251.
- HERREL, A., VANHOODYDONCK, B. & VAN DAMME, R. 2004. Omnivory in lacertid lizards: adaptive evolution or constraint? *J. Evol. Biol.*, 17: 974-984.
- LO CASCIO, P. & PASTA, S. 2006. Preliminary data on the biometry and the diet of a microinsular population of *Podarcis wagleriana*, Reptilia: Lacertidae. *Acta Herpetol.*, 1:147-152.
- PÉREZ-MELLADO, V. & CORTI, C. 1993. Dietary adaptations and herbivory of the genus *Podarcis* from Western Mediterranean Islands (Reptilia: Sauria). *Bonn. Zool. Beitr.*, 44:193-220.
- POLIS, G. A. & HURD, S. D. 1996. Linking marine and terrestrial food webs: allochthonous input from the ocean supports high secondary productivity on small islands and coastal land communities. *The American Naturalist*, 147:396-423.
- TOWNS, D. R. 1975. Ecology of the black shore skink, *Leiopisma suteri* (Lacertilia: Scincidae), in boulder beach habitats. *New Zealand Journal of Zoology*, 2:389-407.
- VAN DAMME, R. 1999. Evolution of herbivory in lacertid lizards: effects of insularity and body size. *Journal of Herpetology*, 33: 663-674.



- Fecha de recepción/Date of reception: 20/10/2008

- Fecha de aceptación/ Date of acceptance: 20/11/2008