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Appendix: Thirty-one *Anaxyrus debilis* examined by county from New Mexico, borrowed from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California, USA.

Hidalgo LACM 87677, 87680, 87681, 87683, 87687, 87694, 123214, 171426, 184062, 184511, **Doña Ana** LACM 1106, 132630–132639, 140515, 140516, 140522, 140525, 140536, 140537, 140540, 140541; **Luna** LACM 87689, 87690.

RESEARCH ARTICLE

Diet of the Lacertid Lizard *Psammodromus algirus* in North Tunisia

Zakher Bouragaoui, Department of Biology, University Tunis El Manar, Tunis, Tunisia; *zakher.bouragaoui@fst.utm.tn*

Wael Ben Aba, Department of Biology, University of Carthage, Borj Cedria, Tunisia

Said Nouira, Department of Biology, University Tunis El Manar, Tunis, Tunisia

Abstract—The study of diet composition of *Psammodromus algirus* from north Tunisia allowed us to calculate the abundance and occurrence of each prey category. Thus, *P. algirus* demonstrated a generalist and an opportunistic behavior. The species consumed a large range of insects and invertebrates but the diet was mainly composed of Coleoptera (59.9%).

Keywords —Lacertidae; diet; Coleoptera; *Psammodromus algirus*; Mediterranean; north Africa.

Introduction

The lacertid lizard *Psammodromus algirus* is a species known for its large distribution from the Languedoc in France to the north east of Tunisia, Cap Bon Peninsula (Mamou 2016). In 2006 a population located on the northern side of the Mediterranean Sea was determined to be two separate species *Psammodromus jeanneae* and *P. manuelae* (Busack et al. 2006). This limited the distribution of *P. algirus* to the southern side of the Mediterranean Sea. Most of the dietary studies of the species were conducted on populations in Europe (Di Palma 1984, Díaz and Carrascal 1990, Díaz and Carrascal 1993) resulting in a lack of information about *P. algirus* diet from North Africa. Recently, a significant diet study was conducted in Algeria (Bouam et al. 2016) constituting great interest as Tunisia provides distribution continuity throughout the cost of North Africa. In this study, we study the northern Tunisia population as a model in order to have dietary composition insight of the species, its prey, and their availability.

Materials and Methods

Study area

The sampling was conducted from April to September 2017, in the north west and north east (Cap Bon Peninsula) of Tunisia (North Africa). Several habitats were visited in order to sample all the possibilities in

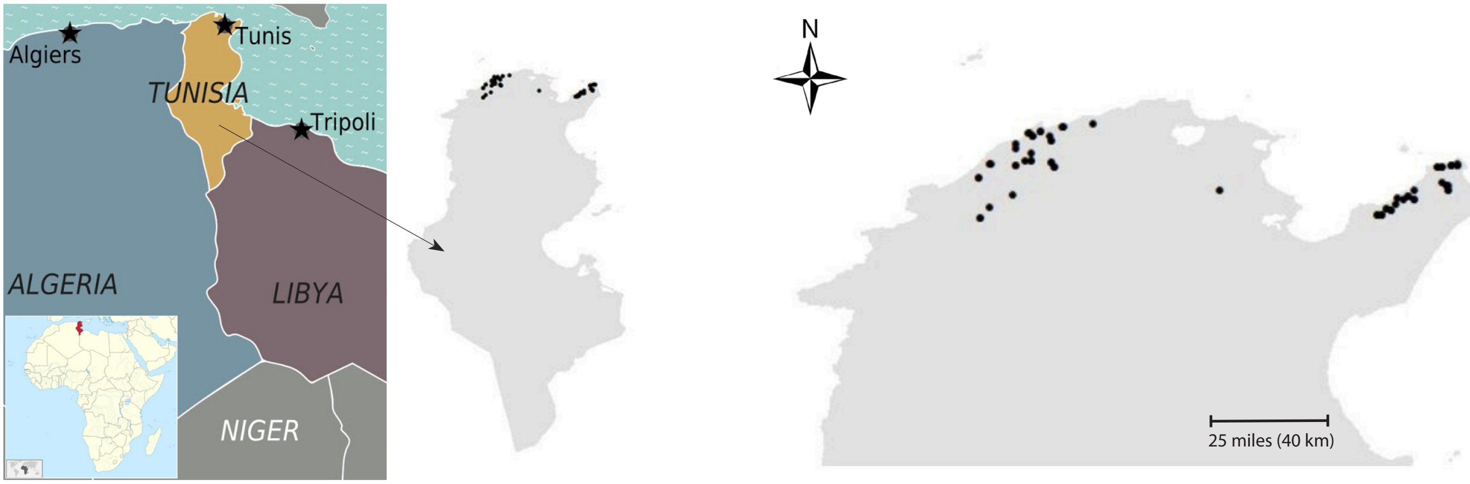

Figure 1. Sampling localities of the lacertid lizard *Psammodromus algirus* from the northwest and northeast (Cap Bon Peninsula) of Tunisia – North Africa.

which *Psammodromus algirus* can occur. The landscape in the northwest is dominated by the oak forests of *Quercus suber* and *Q. canariensis*. A small number of pine forests consisting of *Pinus halepensis* with a mixed shrub component of *Pistacia lentiscus*, *Myrtus* sp., *Erica arborea*, and *E. multiflora* was examined as well. *Eucalyptus* sp. forests were frequent due to the reforestation strategy of the General Direction of Forest – Agriculture Minister in the region. In the northeast, the landscape is dominated by *Eucalyptus* sp. forest and shrubs (*Calicotome spinosa* and *Pistacia lentiscus*) (Fig. 1).

Sampling

Lizards, captured by hand, were taken back to the laboratory where they were kept separate in small terraria. Each specimen was left for 24 hours without food until the release of feces then returned to the site of capture. The feces were diluted in water then examined under a binocular loupe. The remains of insects, invertebrates, and vertebrates were regrouped and photographed then identified and classified following their taxonomic order.

Results

Abundance

The 31 specimens were divided as follows: 17 males, 8 females, and 7 juveniles. Within the fecal samples we found 625 identifiable prey elements digested by the lizards: 334 feet, 115 elytra, 48 thorax and abdomens, 42 heads, 24 complete bodies and 12 other elements from other body parts.

Five classes, 14 orders, and 11 families were identified. The insect class had the highest abundance with 80.19%; Arachnida came second with 10.14%, followed by other undetermined classes 6.3%. Under Arachnida, we identified prey that belong to 3 orders. The most common being Araneae with 9.18%; Scorpiones and Pseudoscorpionida both had an abundance of 0.48%. Within the insect group, we identified 8 orders among which the Coleoptera was most abundant, 59.9%. Hymenoptera, Orthoptera, and Hemiptera had an abundance of 8.7%, 4.35%, and 3.86%, respectively. Diptera and Blatoodea had the same abundance of 1.93%. The least represented orders were Dermaptera with 0.97% and Neuroptera with only 0.48%. The 3 remaining classes are represented each by a single order and have the same abundance of 0.48% (Class Malacostraca was represented by the order Isopoda, class Annelida was represented by the order Haplotaxida, and class Reptilia was represented by order Squamata) (Table 1).

The observed variation of relative abundance of ingested taxon depended on both their abundance in the habitat and the alimentary behavior of the predator. Most of the prey items found in the diet of *Psammodromus algirus* were diurnal (i.e., Coleoptera and Araneae). We noted the absence of eusocial insects as prey, such as ants, although they were highly abundant in

Table 1. Relative abundance of consumed prey by the lacertid lizard *Psammodromus algirus* from northern Tunisia.

Class	Order	*n*	%
Arachnida	Araneae	19	9.18
	Scorpiones	1	0.48
	Pseudoscorpionida	1	0.48
Insecta	Coleoptera	124	59.9
	Neuroptera	1	0.48
	Hymenoptera	18	8.70
	Hemiptera	8	3.86
	Orthopterea	9	4.35
	Diptera	4	1.93
	Blattodea	4	1.93
	Dermaptera	2	0.97
Malacostraca	Isopoda	1	0.48
Annelida	Haplotaxida	1	0.48
Reptilia	Squamata	1	0.48
Other		13	6.30

Lizards, captured by hand, were taken back to the laboratory where they were kept separate in small terraria. Each specimen was left for 24 hours without food until the release of feces then returned to the site of capture. The feces were diluted in water then examined under a binocular loupe.

all visited habitats. The presence of a lizard tail from the same species in the feces of an adult female may indicate cannibalism by *P. algirus*. This phenomena was observed previously in other saurian species (Simović and Marković, Žagar and Carretero 2012, Grano et al. 2011) and is considered a common predation event (Polis and Myers 1985). It is not well studied in *P. algirus*.

Since the Coleoptera was the common prey consumed, we attempted to further identify the families of this order. Overall we identified 11 families with a relative abundance of 40.32%. For the rest of Coleoptera (59.68%), it was not possible to identify them to the family level.

The most represented families were the Dasytidae with 12.9%, Bupristidae with 11.29%, and the Carabidae with 7.26%. The next most abundant were the Chrysomelidae and the Tenebrionidae, with an abundance of 2.4% and 1.61%, respectively. The remaining 6 families, the Anabidae, Malachiidae, Curculionidae, Lampyridae, Elateridae, and Staphylinidae, shared the same abundance of 0.81%.

Occurrence

Coleoptera occurred 83.87% within all prey found. They are an essential and consistent prey for *P. algirus*. Aranae had an occurrence of 48.38%, thus considered as an important prey as well. Hymenoptera were not a common prey item, with an occurrence of 22.58%. All remaining orders (Pseudoscorpionidea, Scorpiones, Blattodea, Dermaptera, Neuroptera, Reptilia, Isopoda, and Annelida) had an occurrence less than 10%, and are considered an infrequent prey source.

Although most of the Coleoptera (61.29%) were not identified to the family level, the occurrences of some families were high. The Carabidae and Bupristidae had the highest occurrence with 25.8% and 16.12%, respectively. The Chrysomylidae had an occurrence of 6.45% and all the 6 remaining families (Malachiidae, Curculionidae, Lampyridae, Elatiridae, Staphylinidae, and Anabiidae) had an equal occurrence of 3.22% (Table 2).

Discussion

The diversity of prey shows the opportunistic behavior of *P. algirus*. This behavior was observed in other populations of the same species over the Mediterranean (Arab and Doumandji 2003, Carretero and Llorente 1993, Castilla et al. 1991). The diet was mainly composed of Coleoptera. The high abundance of Coleoptera can be explained by the synchronization of their peak of activities and our sampling period (all lizards were captured between April and May). However, some predators opt for a trophic model that tend to specialize whenever the prey are abundant (Amat et al. 2008).

Table 2. Occurrence of consumed prey by the lacertid lizard *Psammodromus algirus* from Northern Tunisia.

Order	Pi	P%
Aranae	15	48.38
Coleoptera	26	83.87
Blattodea	1	3.22
Dermaptera	1	3.22
Neuroptera	1	3.22
Hymenoptera	7	22.58
Hemiptera	4	12.9
Orthoptera	7	22.58
Diptera	2	6.45
Reptilia	1	3.22
Pseodoscorpionidea	1	3.22
Scorpiones	1	3.22
Isopoda	1	3.22
Annelida	1	3.22
Others	6	19.35

Opportunism is thus considered an adaptation to changing environmental conditions that allow *P. algirus* to consume a large variety of prey. Consequently, *P. algirus* uses less energy in searching for prey and achieves an optimal balance between the consumed energy and its energetic benefits (Schoener 1971). This behavior may also transform *P. algirus* into a specialist and selective predator within island habitats (Lo Cascio and Capula 2011). The absence of ants in the diet of *P. algirus* may be explained by the high abundance of larger prey species within the various habitats. Some researchers concluded that mermycophagy (consumption of termites or ants) in lizards may be a result of poor habitats were alimentation (nourishment provisioning) is scarce, such as within arid ecosystems and small islands (Znari and El Mouden 1997). Additional dietary study is needed within the Tunisian islands (Zembra, Zembretta, and Galiton), where the endemic subspecies *P. algirus dorei* occurs, to further explore opportunism and prey preference.

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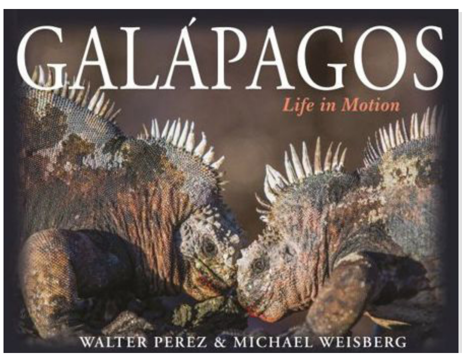
BOOK REVIEW

Galápagos: Life in Motion

Howard O. Clark, Jr., CWB®, Editor, *Sonoran Herpetologist*, Tuscon Herpetological Society, Tucson, AZ; *editor.sonoran.herp@gmail.com*

Walter Perez and Michael Weisberg have produced a delightful photo book about the wildlife dynamics on the Galápagos. The book is populated on every page with incredible color photos of Galápagos wildlife. The photos capture unique points of view of wildlife in action. The exquisite photography of Walter Perez jumps out at the reader with amazing detail. All of the classic photographic components come alive on each page. Lighting, composition, perspective — it's all here. The book is more than a coffee table curiosity. Each page contains captivating text explaining each photo — providing a caption that allows the reader to enter the Galápagos world. A reader can easily get lost within each page, studying minute details of every photo while reading the stories the authors share.



Galápagos: Life in Motion

Walter Perez and Michael Weisberg

2018 — Hardcover

$35.00 — 208 pp.
12 x 9 inches
200 color photos
Princeton University Press, Princeton, NJ

ISBN 9780691174136
E-book ISBN 9780691184579

Book cover and details.

The book is divided into five sections: (1) Many Little Worlds: The Galápagos Environments; (2) Finding Food; (3) Icons of the Galápagos: Tortoises, Mockingbirds, Finches, and Boobles; (4) Courtship, Mating, and Birth; and (5) Galápagos Animals Interacting. In addition there is a conclusion section, and a species index. The book begins with a detailed map of the Galápagos islands and their relative location to the South American mainland.

From these chapter titles, we can immediately tell that the authors did their homework, and a careful read can lead to a satisfying education on the often hidden Galápagos world. Although I did not read the book with proofreading in mind, I did note that on page 76, a caption had "vermilion" misspelled as "vermillion" in reference to the Vermilion Flycatcher. I chuckle at this observation because it's an often misspelled word in the biological universe.

Overall the book provides a vehicle into the biological and ecological exploration of the Galápagos. I highly recommend the book for the biologist and traveler alike.

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