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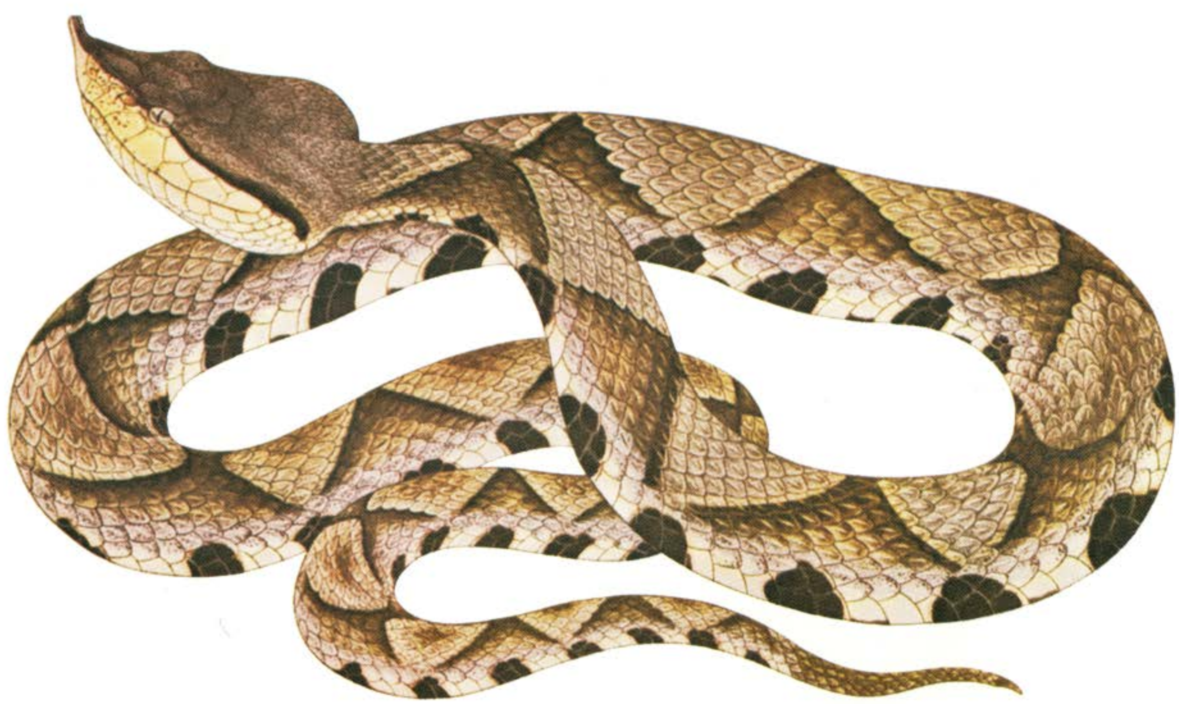

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Cover: Hundred-pace viper, *Deinagkistrodon acutus*. Drawing (as *Agkistrodon acutus*) from *A Monograph of the Snakes of Japan* by Moichiro Maki, 1931.

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Notes on the Herpetofauna of Western Mexico 27: Amphibians and Reptiles of Palo Gordo, Sierra de Tesistán, Zapopan, Jalisco, Mexico

Juan Rubén Rojo-Gutierrez [1], Israel Salcido-Rodríguez [1], David Antonio Amaral-Medrano [1], Daniel Cruz-Sáenz [2], Andrés Rodríguez-López [1], David Lazcano [3], Lydia Allison Fucsko [4] and Larry David Wilson [5]

Abstract

We present a list of amphibian and reptile species from the locality known as Palo Gordo in the municipality of Zapopan. After one year of sampling, 55 species were recorded, of which 17 are amphibians and 38 are reptiles.

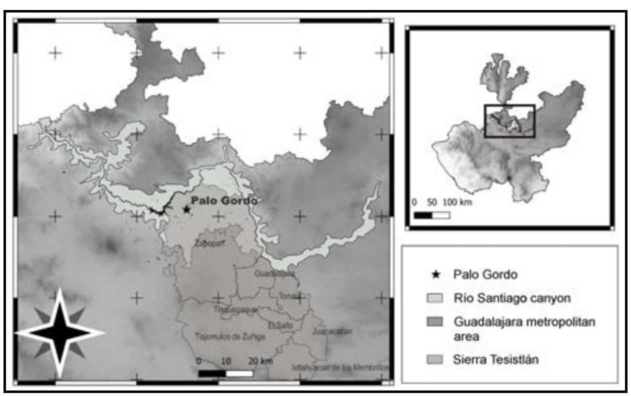
Resumen

Presentamos un listado de especies de anfibios y reptiles de la localidad conocida como Palo Gordo en el municipio de Zapopan. Después de un año de muestreo se registraron 55 especies de las cuales 17 son anfibios y 38 son reptiles.

Introduction

The great herpetofaunal diversity that Mexico harbors is well known, and is due to its variety of climates, topography and plant communities. The state of Jalisco is part of this great herpetofaunal wealth, with 151 species of reptiles and 50 of amphibians (Cruz-Sáenz et al., 2017).

Río Santiago functions as a biological corridor from the coast of Nayarit to Lago de Chapala. But it is under great pressure from the Guadalajara metropolitan area, so in 2018 it was decided to decree it as a protected natural area at the state level, this in the area of its confluences with the Río Verde that comes from the highlands of Jalisco and the Río Santiago that comes from Salto (POEJ, 2018, p. 92). The Palo Gordo area, however, which is home to great diversity, has not been considered as part of the conservation area polygon.



A portion of the Mexican state of Jalisco, showing the metropolitan area of Guadalajara, the canyon of the Río Santiago and the study site of Palo Gordo in Zapopan

Study site

The town of Palo Gordo is in the northern part of the municipality of Zapopan. It is a small town located on the edge of the Río Santiago ravine. Its vegetation in the upper part is oak forest, grasslands and cultivated areas, whereas in the lower part the vegetation is mostly deciduous tropical and gallery forest on the banks of the Río Santiago. Its elevation is 1434 masl.

Palo Gordo is in the Sierra de Tesistán. This mountain range begins at the Tepopote hill that is in front of the town of "La Primavera" and ends at the well-known Mesa de San Juan site. This site is in the middle part of the Sierra de Tesistán and falls within the Trans Mexican Volcanic Belt physiographic province (Cruz-Sáenz et al., 2017).

Methods

The sampling was carried out on a monthly basis during a year that spanned from August 2017 to July 2018. We used 40 transects of 1 km long and 10 meters wide, which were covered at least once each season of the year.

Results

After a year of sampling, a total of 55 species were recorded, of which 17 are amphibians and 38 are reptiles. Of the registered species, 16 are under some category of protection by Mexican environmental law (SEMARNAT, 2010). In addition, 34 are endemic to Mexico.

The amphibians recorded belong to seven families, 12 genera, and 17 species. As for reptiles, they belong to two orders, 16 families, and 32 species (See Table 1).

Of the 17 amphibians, 3 (17.6%) are listed in SEMARNAT

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Table 1. Species of herpetofauna recorded from Palo Gordo, Sierra de Tesistán, Zapopan Jalisco, Mexico. **NOM** = protection status under NOM-ECOL-059-2010 (SEMARNAT, 2010): Pr = *protección especial* (special protection); A = *amenazada* (threatened). **IUCN** = protection status according to the International Union for Conservation of Nature (IUCN, 2017): LC = least concern; VU = vulnerable; EN = endangered; NT = near threatened; DD = data deficient; NE = not evaluated. **EVS** = Environmental Vulnerability Score sensu Wilson et al. (2013a, b): L = low risk (3–9); M = medium risk (10–13); H = high risk (14–20). **Endemism**: E = endemic to Mexico.

Family	Species	NOM	IUCN	EVS	Endemism
Bufonidae	*Incilius occidentalis*	—	LC	11 (M)	E
	Rhinella horribilis	—	NE	3 (L)	—
Craugastoridae	*Craugastor augusti*	—	LC	8 (L)	—
	Craugastor hobartsmithi	—	EN	15 (H)	E
	Craugastor occidentalis	—	DD	13 (M)	E
Eleutherodactylidae	*Syrrhophus modestus*	Pr	VU	16 (H)	E
Hylidae	*Agalychnis dacnicolor*	—	LC	13 (M)	E
	Dryophytes arenicolor	—	LC	7 (L)	—
	Dryophytes eximius	—	LC	10 (M)	E
	Smilisca fodiens	—	LC	8 (L)	—
	Tlalocohyla smithii	—	LC	11 (M)	E
Leptodactylidae	*Leptodactylus melanonotus*	—	LC	6 (L)	—
Microhylidae	*Hypopachus variolosus*	—	LC	4 (L)	—
Ranidae	*Lithobates forreri*	Pr	LC	3 (L)	—
	Lithobates neovolcanicus	A	NT	13 (M)	E
	Lithobates psilonota	—	DD	14 (H)	E
Scaphiopodidae	*Spea multiplicata*	—	LC	6 (L)	—
Anguidae	*Elgaria kingii*	Pr	LC	10 (M)	E
Dactyloidae	*Anolis nebulosus*	—	LC	13(M)	E
Helodermatidae	*Heloderma horridum*	A	LC	14 (H)	E
Iguanidae	*Ctenosaura pectinata*	A	NE	15 (H)	E
Phyllodactylidae	*Phyllodactylus lanei*	—	LC	15 (H)	E
Phrynosomatidae	*Sceloporus horridus*	—	LC	11(M)	E
	Sceloporus melanorhinus	—	LC	9 (L)	—
	Sceloporus nelsoni	—	NE	15 (H)	E
	Sceloporus spinosus	—	LC	11 (M)	E
	Sceloporus torquatus	—	LC	11 (M)	E
	Sceloporus utiformis	—	LC	15 (H)	E
	Urosaurus bicarinatus	—	LC	12 (M)	E
Scincidae	*Plestiodon callicephalus*	—	LC	12 (M)	—
Teiidae	*Aspidoscelis communis*	Pr	LC	14 (H)	E
	Aspidoscelis gularis	—	LC	9 (L)	—
Xantusidae	*Xantusia sanchezi*	P	LC	16 (H)	E
Boidae	*Boa sigma*	A	NE	10 (M)	—
Colubridae	*Drymarchon melanurus*	—	LC	6 (L)	—
	Drymobius margaritiferus	—	NE	6 (L)	—
	Lampropeltis polyzona	—	NE	11 (M)	—
	Leptophis diplotropis	A	LC	14 (H)	E
	Masticophis mentovarius	A	LC	6 (L)	—
	Oxybelis microphthalmus	—	NE	5 (L)	—
	Senticolis triaspis	—	LC	6 (L)	—
	Sonora mutabilis	—	LC	14 (H)	E
	Trimorphodon tau	—	LC	13 (M)	E
	Tantilla bocourti	—	LC	9 (L)	E
Dipsadidae	*Coniophanes lateritius*	—	DD	13 (H)	E
	Hypsiglena torquata	Pr	LC	8 (L)	E
	Imantodes gemmistratus	Pr	NE	6 (H)	E
	Leptodeira maculata	Pr	LC	7 (L)	—
	Leptodeira splendida	—	LC	14 (H)	E
	Rhadinaea hesperia	Pr	LC	10 (M)	E
Leptotyphlopidae	*Rena humilis*	—	LC	8 (L)	—
Natricidae	*Thamnophis cyrtopsis*	—	LC	7 (L)	—
	Storeria storerioides	—	LC	11 (M)	E
Viperidae	*Crotalus basiliscus*	—	LC	18 (H)	E
Kinosternidae	*Kinosternon integrum*	Pr	LC	11(M)	E

Four photographs of habitat in the area of Palo Gordo, Sierra de Tesistlán, Zapopan, Jalisco, Mexico. Photographs by Israel Salcido-Rodríguez.

(2010). Of these, one is threatened (A) and the other two are special protection (Pr). Thus, 14 (82.4%) are unevaluated. As for the reptiles, one is in danger of extinction (P), three are threatened (A), and seven are special protection (Pr).

The International Union for Conservation of Nature (IUCN) categorizations are as follows: EN (endangered)—1; VU (vulnerable)—1; NT (near threatened)—1; LC (least concern)—41; DD (data deficient)—3; and NE (8)—8. The overwhelming prevalence of LC categorizations for the 55 Palo Gordo species (74.5%), as well as the sizeable representation of NE species (14.5%), is indicative that these categorizations have yet to catch up with the reality of the effect on the populations of these creatures of the encroachment of the metropolitan area of Guadalajara and that there is a need for an across-the-board population assessment for the 55 Palo Gordo species.

The EVS categorizations by group are as follows: low (20); medium (19); and high (16). These figures are definitely not in agreement with those from either the SEMARNAT or the IUCN assessment, and provide further evidence of the need for an overall appraisal of the population status of the entire Palo Gordo herpetofauna.

The data in Table 2 demonstrate that the species richness of the Palo Gordo region is among the highest in comparison to other surrounding areas in Jalisco studied in the relatively recent past; only the Bosque de "La Primavera" (56 species) and the Hostotipaquillo region (61) have more species than does the Palo Gordo region (55). The number of protected species in the six areas in Table 2 range from 10 to 21; the value for the Palo Gordo region is the second lowest of the six regions, at 16. The number of endemic species is the highest of that in the six areas, but second in proportion to that of the Volcán de Tequila. In general, the data in this table indicate that the Palo Gordo herpetofauna is of significant importance, as measured against the situation in the other areas listed in the table.

Discussion and conclusion

Due to its isolation, this site has high species richness, but above all significant endemism (61.8%), compared to the other sited localities; thus, its conservation is a priority.

The metropolitan area of Guadalajara is expanding rapidly and some areas of this mountain range are beginning to be impacted by the sale of land to build country houses, cabins, and roads.

It is very important that the municipality and the state ensure the protection of this site, due to the diversity and the conservation significance of the herpetofaunal species it houses. Ideally, it should be included within the polygon of the protected natural area "Natural monument of state interest: Barrancas de los Ríos Santiago y Verde."

Sierra de Tesistán is an important biological corridor between Barranca del Río Santiago and Bosque de "La Primavera." Additionally, its biological wealth and high level of endemism is similar to that of the protected natural area Bosque de "La Primavera."

Here we document the presence of *Xantusia sanchezi*. That lizard was previously reported for the state of Jalisco by Cruz-Sáenz and Lazcano (2012), but there was no record of the species for the Sierra de Tesistán.

Reflection

The state of Jalisco has an area of 78,588 km^{2,} ranking seventh nationally, and has a population of 8,348,000. The Metro-

Table 2. Species richness and numbers of Mexican protected and endemic species from Palo Gordo compared to surrounding areas in Jalisco that have been studied in the past.

Locality	Species richness	Protected species	Endemic species	Reference
Huaxtla	36	10	19	Cruz-Sáenz et al., 2011
Bosque de "La Primavera"	56	17	13	Reyna-Bustos et al., 2007
Hostotipaquillo, Jalisco	61	21	28	Flores-Covarrubias et al., 2012
Volcán de Tequila	31	18	22	Rojo-Gutiérrez, 2018
Arcediano	44	21	24	Cruz-Sáenz et al., 2009
Palo Gordo	55	16	34	This paper

Anolis nebulosus.

Craugastor hobartsmithi.

Dryophytes arenicolor.

Elgaria kingii.

Leptodeira maculata.

Leptophis diplotropis.

Sceloporus horridus.

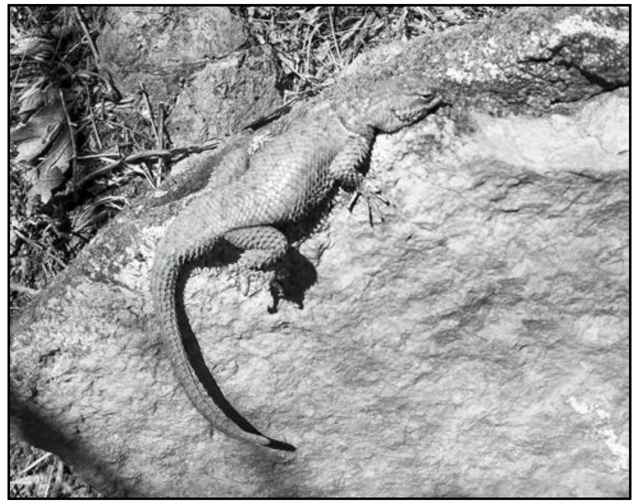
Sceloporus utiformis.

All photographs by Israel Salcido-Rodríguez.

politan Area of Guadalajara (MAG) consisting of 10 municipalities has a population of 5,268,642 (IIEG, 2021, p. 151), which subjects the surrounding natural environments to great pressure, this due to the exploitation of different resources such as water. In addition the city is increasingly occupying new natural areas in the Sierra de Tesistán for its growth. These areas are important conservation sites because of their proximity to the MAG. It is vital to conserve sites such as Palo Gordo because of their high biological wealth. So far only the herpetofauna has been explored, but certainly other zoological groups will reflect the same high value.

Acknowledgments

We want to thank all the people, like José López-González and Isaura Lucia Luna-Valdez, who participated in the fieldwork. Without those workers this project would not have been possible.



Sceloporus melanogaster. Photograph by Israel Salcido-Rodríguez.

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Notes on Reproduction of Oak Toads, *Anaxyrus quercicus* (Anura: Bufonidae)

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Abstract

I conducted a histological examination of gonads from 12 *Anaxyrus quercicus* adults from the southeastern USA, consisting of 7 males and 5 females. Males contained sperm from all months examined: April, July and August. The smallest mature male (sperm in lumina of seminiferous tubules) measured 24 mm SVL and was from April. Females in spawning condition were found in all months examined: April, May and August. The smallest mature female (spawning condition) measured 26 mm SVL and was from May. All females contained some atretic follicles. Three smaller *A. quercicus* (18, 18, 23 mm SVLs) were not histologically examined, bringing my total sample to 15.

Anaxyrus quercicus (Holbrook, 1840) occurs in southeastern Louisiana to southeastern Virginia along the Gulf and Atlantic Coastal Plain, all of peninsular Florida and the Coosa Valley of Central Alabama (Frost, 2022). It is the smallest North American toad (Dodd, 2013). *Anaxyrus quercicus* are active mainly during the humid, warm summer months of May to July (Dodd, 2013), although choruses are heard as late as October in Florida (Einem and Ober, 1956). The biology of *A. quercicus* is summarized in Ashton and Franz (1979). In the current paper I present data on the *A. quercicus* reproductive cycle from a histological examination of gonadal material. Utilization of museum collections for obtaining reproductive data avoids removing additional animals from the wild.

A sample of 15 *A. quercicus* collected 1938 to 1979 (Appendix) from Georgia (N = 6), North Carolina (N = 4), and South Carolina (N = 5) consisting of 7 adult males (mean SVL = 27.9 mm ± 2.7 SD, range = 24–33 mm), 5 adult females (mean SVL = 26.8 mm ± 1.9 SD, range = 24–29 mm) and three presumed juveniles (SVLs = 18, 18, 23 mm), was examined from the herpetology collection of the Carnegie Museum of Natural History (CM), Pittsburgh, Pennsylvania USA (Appendix). An unpaired *t*–test was used to test for differences between adult male and female SVLs (Instat, vers. 3.0b, Graphpad Software, San Diego, CA).

A small incision was made in the lower part of the abdomen of the 12 adults and the left testis was removed from males and a piece of the left ovary from females. Gonads were embedded in paraffin, sections were cut at 5 μm and stained with Harris hematoxylin followed by eosin counterstain (Presnell and Schreibman, 1997). Three smallest *A. quercicus* (18, 18, 23 mm SVLs) were not histologically examined. Histology slides were deposited at CM.

There was no significant difference between mean SVL of adult males versus adult females of *A. quercicus* ($t = 0.739$, df = 10, $P = 0.48$). The testicular morphology of *A. quercicus* is similar to that of other anurans as described in Ogielska and Bartmanska (2009a). Within the seminiferous tubules, spermatogenesis occurs in cysts which are closed until the late spermatid stage is reached; cysts then open and differentiating sperm reach the lumina of the seminiferous tubules (Ogielska and Bartmanska, 2009a). Six of seven *A. quercicus* adult males were undergoing sperm formation (= spermiogenesis) in which clusters of sperm filled the seminiferous tubules. A ring of germinal cysts was located on the inner periphery of each seminiferous tubule. By month, numbers of *A. quercicus* males (*n* = 6) exhibiting spermiogenesis were: April (N = 1), June (N = 2), July (N = 1), August (N = 2). In addition, one male from July, SVL = 28 mm, (CM 36334) exhibited testicular recrudescence in which primary spermatocytes predominated. No spermatids or spermatozoa were present. It is not known when sperm formation (spermiogenesis) would have commenced. The smallest mature male (sperm in lumina of seminiferous tubules) measured 24 mm SVL and was from April (CM 116562). Wright and Wright (1933) reported adult *A. quercicus* males ranged from 19 to 30 mm in body size.

The ovaries of *A. quercicus* are typical of other anurans in consisting of paired organs located on the ventral sides of the kidneys; in adults they are filled with diplotene oocytes in various stages of development (Ogielska and Bartmanska, 2009b). Mature oocytes are filled with yolk droplets; the layer of surrounding follicular cells is thinly stretched. Two stages were present in the spawning cycle (Table 1): "Ripening condition" in which follicles were accumulating yolk (CM 26490) and "Ready to spawn condition" in which mature oocytes predominate. It is not unexpected that the one female in "Ripening condition" was found early in the spawning period. The smallest mature *A. quercicus* female (ready to spawn condition) measured 26 mm SVL (CM 27747D) and was from May. Wright and Wright (1933) reported adult *A. quercicus* females ranged from 21 to 32 mm in body size.

Atretic follicles were noted in the ovaries of 5/5 (100 %) of the. *A. quercicus* females (Table 1). In early atresia the granulosa layer is slightly enlarged and contains ingested yolk granules. In late atresia the oocytes of these females are replaced

Table 1. Two monthly stages in the spawning cycle of five adult female *Anaxyrus quercicus*. All females contained some atretic oocytes.

Month	*n*	Ripening condition	Ready to spawn condition
April	2	1	1
May	2	0	2
August	1	0	1

Table 2. Periods of reproduction for *A. quercicus* from different states.

Locality	Breeding period	Source
Alabama	April to July	Mount, 1975
Florida	April 1 to September 5	Carr, 1940
Florida	April to October	Krysko et al., 2019
Carolinas and Virginia	spring and summer	Beane et al., 2010
Georgia	May to August	Wright, 1932
Georgia	April through September	Jensen et al., 2008
Louisiana	mid-April to mid-August	Boundy and Carr, 2017
North Carolina	April to August	Dorcas et al., 2007
Southeast	predominantly in spring	Dorcas and Gibbons, 2008
No specific locality	April 1 to September 5	Wright and Wright, 1933

by brownish vacuolated granulosa cells which invaded the lumen of the oocyte or solid black pigment containing cells. Atresia is a widespread process occurring in the ovaries of all vertebrates (Uribe Aranzábal, 2009). It is common in the amphibian ovary (Saidapur, 1978) and is the spontaneous digestion of a diplotene oocyte by its own hypertrophied and phagocytic granulosa cells which invade the follicle and eventually degenerate after accumulating dark pigment (Ogielska and Bartmanska, 2009b). See Saidapur and Nadkarni (1973) and Ogielska et al. (2010) for detailed descriptions of follicular atresia in the frog ovary. Atresia plays an important role in fecundity by influencing numbers of ovulated oocytes (Uribe Aranzábal, 2011). The causes of follicular atresia in non–mammalian vertebrates are not fully understood although it is associated with captivity, food availability, crowding and irradiation (Saidapur, 1978). In amphibians adverse environmental conditions such as starvation and suboptimal lighting may cause atresia of vitellogenic oocytes (Jørgensen, 1992). Incidences of follicular atresia increase late in the reproductive period (Saidapur, 1978). Saved energy will presumably be utilized during a subsequent reproduction.

Times of breeding for *A. quercicus* throughout its range are shown in Table 2. My findings are in accordance with previous reports of *A. quercicus* reproduction. I was, however, unable to find information as to whether *A. quercicus* spawns more than once in the same year. Histological evidence that a frog spawns more than once in the same year may be suggested by the concurrent presence of postovulatory follicles from a previous spawning (*sensu* Redshaw, 1972) and mature (yolk-filled) follicles for an upcoming spawning. Histological examination of additional *A. quercicus* females are warranted to ascertain if multiple spawnings occur in the same reproductive season.

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Appendix

Fifteen *Anaxyrus quercicus* examined by county from the herpetology collection of the Carnegie Museum, (CM), Pittsburgh, Pennsylvania, USA. **GEORGIA:** Appling, CM 17900F; Chatham, CM 27747D, 116549; Liberty, CM 17929, 25371; Wayne, CM 17907K; **NORTH CAROLINA:** Hyde, CM 15125; Martin, CM 36334; Onslow, CM 26490; Wayne, CM 73628; **SOUTH CAROLINA:** Berkeley, CM 21762, 25181; Charleston, CM 26499; Jasper, CM 116562, 116565.

Diet Records for Snakes from Guinea, West Africa

Olivier S. G. Pauwels [1], Laurent Chirio [2] and Wouter Dekoninck [1]

Abstract

We present various predation records based on museum-preserved snakes from southeastern Republic of Guinea, West Africa: *Aparallactus niger* (Atractaspididae) on an earthworm (Oligochaeta); *Crotaphopeltis hotamboeia* (Colubridae) on *Sclerophrys* sp. (Anura; Bufonidae); *Grayia smithii* (Colubridae) and *Natriciteres variegata* (Natricidae) on *Arthroleptis* sp(p). (Anura; Arthroleptidae); *Grayia tholloni* on *Xenopus* cf. *tropicalis* (Anura; Pipidae); *Toxicodryas pulverulenta* (Colubridae) on *Agama* cf. *sankaranica* (Agamidae); *Elapsoidea semiannulata moebiusi* (Elapidae) on *Hemisus* cf. *guineensis* (Anura; Hemisotidae); *Naja savannula* (Elapidae), *Afronatrix anoscopus* (Natricidae) and *Causus maculatus* (Viperidae) on *Sclerophrys regularis*; *Psammophis phillipsii* (Psammophiidae) on *Trachylepis* cf. *affinis* (Scincidae); *Causus maculatus* on *Ptychadena* sp. (Anura; Ptychadenidae); *Limaformosa guirali* (Lamprophiidae) on *Atheris chlorechis* (Viperidae); and *Atheris chlorechis* on *Hyperolius* sp. (Anura; Hyperoliidae). Diagnostic morphological characters are provided for all snakes involved in these records, as well as clutch sizes for pregnant females (*Crotaphopeltis hotamboeia* and *Causus maculatus*). We provide identifications for some insects found in the stomachs of the ingested amphibians.

Keywords

Herpetofauna, Squamata, Anura, Insecta, ecology, predation, food chain, Guinea Conakry, Afrotropics

Introduction

In spite of several recent major contributions (among others, Böhme, 2000; Ineich, 2003; Böhme et al., 2011; Trape and Baldé, 2014), the snake fauna of the Republic of Guinea remains poorly studied. This is even more true for the snakes' ecology and their place in the local food chain. A general classification of Guinean snakes according to their food niches was provided by Böhme (2000), but few documented predation records for Guinean snakes are available to date. Amphibians are an important component in the diet of many snakes, as is also shown in our results below, and the ecology of most Guinean species is still poorly documented (Doumbia *in* Rödel et al., 2021).

In the course of a study on West African preserved snake material housed in the collections of the Royal Belgian Institute of Natural Sciences (RBINS), we came across several individuals from forested southeastern Guinea that had full stomachs, including some being pregnant. We dissected them and present here a compilation of their stomach contents and clutch sizes, as a contribution to the understanding of the importance of snakes and their prey items in the local food web, and to the knowledge of their reproductive biology.

Material and Methods

We dissected only snakes for which we had detected stomach contents or eggs by palpation. Snakes and other squamates were identified using the keys and morphological information provided by Wagner et al. (2009), Trape et al. (2012) (as corrected by Pauwels and Kok [2013]), Wüster et al. (2018), Chippaux and Jackson (2019) and Greenbaum et al. (2021). We identified amphibian prey items using Laurent (1972), Schiøtz (1999), Evans et al. (2015) and Channing and Rödel (2019). Among the insects found in the frogs ingested by the snakes, some were still in good condition, and were transferred within RBINS from the herpetological collections to the entomological collections; the transferred specimens are marked with an asterisk (*).

Morphological data of all snakes involved in the diet and clutch records are presented in Table 1. Snake ventral scales were counted according to the method of Dowling (1951). Snake dorsal scale rows were counted at one head length behind head, at midbody (above the ventral corresponding to half of the total number of ventrals), and at one head length before vent; subcaudal counts exclude the terminal pointed scale. Paired meristic characters are given left/right.

The specimens reported here originate from eight localities in southeastern Guinea: Bankoro Fassirou (9°12'59.0"N, 8°59'41.0"W; alt. 524 m above sea level), Préfecture de Kérouané; Balagbeni (= Baragbéni; 9°12'16.0"N, 8°53'7.0"W; alt. 682 m asl), Préfecture de Kérouané; Damaro (9°07'50"N, 8°54'7"W; alt. 720 m asl), Préfecture de Kérouané; Gpaolé (7°38'22.0"N, 9°13'45.0"W; alt. 411 m asl), Préfecture de Yomou; Guérédou (9°22'30.9"N, 8°54'45.4"W; alt. 732 m asl), Préfecture de Kérouané; Koundian (= Kounian; 9°23'42"N, 8°55'57"W; alt. 588 m asl), Préfecture de Kérouané; Ouetoua (= Oueta; 7°37'8.0"N, 9°16'19.0"W; alt. 417 m asl), Préfecture de Yomou; and Saniamoridou (9°05'35"N, 9°01'17"W; alt. 558 m asl), Préfecture de Kérouané.

Abbreviations: Institutions: RBINS = Royal Belgian Institute of Natural Sciences, Brussels, Belgium. Morphology: A = anal

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Table 1. Morphological data for Guinean snakes. FF = pregnant female. NA = not available/not assessed. For the other abbreviations see Material and Methods.

Species / Specimen	Sex	SVL (mm)	TaL (mm)	DSR	PV+VEN	A	SC	SL	IL	Lor	PreO	SubO	PoO	AT
Atractaspididae														
Aparallactus niger														
RBINS 20301	M	372	105	15-15-15, K	1+146, U	S	1D+62S, U	7(3-4)/7(3-4)	7(4)/7(4)	0/0	1/1	0/0	1/1	0/0
Colubridae														
Crotaphopeltis hotamboeia														
RBINS 20269	FF	470	68	17-19-15, K	2+159, U	S	35, D, U	8(3-5)/8(3-5)	10(5)/10(5)	1/1	1/1	0/0	2/2	1/1
Grayia smithii														
RBINS 20162	M	366	155	17-17-15, U	2+147, U	D	97, D, U	7(4)/7(4)	9(5)/10(5)	1/1	1/1	0/0	2/2	2/2
Grayia tholloni														
RBINS 20166	F	551	347	15-15-15, U	2+146, U	D	112, D, U	8(4-5)/8(4-5)	10(5)/10(5)	1/1	1/1	0/0	2/2	2/2
Toxicodryas pulverulenta														
RBINS 20288	NA	352	95	19-19-15, U	1+249, U	S	114, D, U	8(3-5)/8(3-5)	13(5)/12(4)	1/1	½	0/0	2/2	2/2
Elapidae														
Elapsoidea semiannulata moebiusi														
RBINS 20273	NA	356	26	15-13-13, U	2+152, U	S	17, D, U	7(3-4)/7(3-4)	7(3)/7(3)	0/0	1/1	0/0	2/2	1/1
Naja savannula														
RBINS 20266	F	450	89	23-19-13, U	1+227, U	S	65, D, U	7(3-4)/7(3-4)	8(4)/8(4)	0/0	1/1	0/0	3/3	1/1
Lamprophiidae														
Limaformosa guirali														
RBINS 20292	NA	NA	NA	NA	1+>5	NA	NA	7(3-4)/7(3-4)	8(4)/8(4)	1/1	1/1	0/0	1/1	1/1
Natricidae														
Afronatrix anoscopus														
RBINS 20325	F	490	>101	23-23-19, K	1+139, U	D	>39, D, U	9(0)/9(0)	10(5)/10(5)	1/1	1/1	¾	2/1	1/1
RBINS 20322	F	276	97	23-23-20, K	2+140, U	D	68, D, U	9(0)/8(0)	9(5)/9(5)	1/1	1/1	3/3	2/2	1/1
Natriciteres variegata														
RBINS 20324	NA	153	>27	15-15-15, U	3+131, U	D	>29, D, U	8(4-5)/8(4-5)	8(4)/8(4)	1/1	2/2	0/0	3/3	1/1
Psammophiidae														
Psammophis phillipsii														
RBINS 20286	F	330	>87	17-17-13, U	3+169, U	S	>61, D	8(4-5)/8(4-5)	9(4)/9(4)	1/1	1/1	0/0	2/2	2/2
Viperidae														
Atheris chlorechis														
RBINS 20279	F	394	70	29-31-20, K	1+158, U	S	1D+53S, U	12(0)/12(0)	13(2)/11(3)	NA	NA	2–3 rows	NA	NA
RBINS 20291	F	505	94	30-31-23, K	1+158, U	S	1D+52S, U	NA	NA	NA	NA	NA	NA	NA
Causus maculatus														
RBINS 20265	M	369	39	19-19-12, K	3+134, U	S	17D+4S, U	6(0)/6(0)	9(4)/9(4)	1/1	2/2	1/1	2/2	2/2
RBINS 20274	F	391	28	19-19-13, U	3+141, U	S	16D+1S, U	6(0)/6(0)	9(4)/10(4)	1/1	2/2	1/1	2/2	2/2
RBINS 20275	NA	242	20	19-19-13, U	3+139, U	S	15D+3S, U	6(0)/6(0)	9(4)/9(4)	1/1	2/2	2/1	2/2	2/2

plate; AT = anterior temporals; D = divided; DSR = number of dorsal scale rows; IL = number of infralabials, followed in brackets by the number of IL in contact with the first pair of sublinguals; K = keeled; Lor = number of loreal scales; PoO = number of postoculars; PreO = number of preoculars; PV = number of preventrals; S = single; SC = number of subcaudals; SL = number of supralabials, followed in brackets by the SL in contact with the orbit; SubO = number of suboculars; SVL = snout–vent length; TaL = tail length; U = unkeeled; VEN = number of ventral scales.

Results

Atractaspididae

Aparallactus niger Boulenger, 1897

The stomach of the adult male RBINS 20301 from Guérédou contains a partly digested, more than eight cm long, earthworm (Oligochaeta). As is typical for this snake species, it has seven infralabials, its prefrontals are fused, and its dorsals and supracaudals show discreet keels. Its ventral number (146) is lower than the range of 151–175 indicated by Chippaux and Jackson (2019). The difficulty to detect by palpation stomach contents as soft as a (partly digested) earthworm might explain the lack of diet records for this snake species.

Colubridae

Crotaphopeltis hotamboeia (Laurenti, 1768)

The stomach of the adult pregnant female RBINS 20269 from Balagbeni contains the remains of a *Sclerophrys* sp. ingested head first. The anterior part of the toad is mostly digested, and its own stomach contents are exposed, including remains of three workers and three small soldiers of *Pseudacanthotermes militaris* Hagen, 1858 (Isoptera: Termitidae, Macrotermitinae)*, elytra of a beetle (Coleoptera: Chrysomelidae), and eight different ant species (Hymenoptera: Formicidae)*. The most abundant ant species were two *Pheidole* spp. of which more than 20 minor workers were counted for both species. Other ant species present were *Anochetus katonae* Forel, 1907 (three specimens), one major and three minor workers of *Camponotus* sp01, one minor worker of *Camponotus* (*Orthonotomyrmex*) sp01, two workers of *Tetramorium cristatum* Stitz, 1910 and one worker of a Ponerinae (probably *Mesoponera* sp.). The nine eggs of the *Crotaphopeltis* are aligned between ventrals 100 and 152. The first supralabial of this herald snake is in contact with the loreal on the right side, but separated from it on the left side (in the identification key provided by Chippaux and Jackson [2019], *Crotaphopeltis hotamboeia* is separated from *C. degeni* (Boulenger, 1906) and *C. hippocrepis* (Reinhardt, 1843) based on contact vs. no contact between the 1st supralabials and the loreal). Its dorsal scales are mostly smooth, except some posterior ones showing a very poorly marked keel.

An analysis of 283 diet samples of Nigerian *Crotaphopeltis hotamboeia* by Eniang et al. (2013) showed that *Sclerophrys* toads were the second most common prey after *Phrynobatrachus*.

Grayia smithii (Leach, 1818)
The stomach of the juvenile male RBINS 20162 from Koundian contained a male *Arthroleptis* sp. (Anura; Arthroleptidae: removed and registered as RBINS 18409) ingested legs first, as well as several large nematodes (the latter not originating from the frog). The squeaker frog measures 12 mm SVL, and shows a horizontal pupil, unwebbed toes and fingers, toe and finger tips only slightly expanded, a well-marked *canthus rostralis*, a distinctly elongated third finger, a single subgular vocal sac; dorsal surface of head light brown, dorsum light brown with a light vertebral stripe and two pairs of dark brown paravertebral patches; flanks are dark brown, with white patches on the lower flanks. The *Grayia*'s dorsal scale row reduction from 17 to 15 involves the fusion of rows 3 and 4 above ventrals 117 (left) and 136 (right).

The aquatic *Grayia smithii* seems to feed exclusively on fish and anurans, with a marked preference for clawed frogs (*Xenopus*, Pipidae) (Leston and Hughes, 1968; Pauwels et al., 2000; Akani and Luiselli, 2001; Luiselli, 2006). The frog genus *Arthroleptis* has not previously been listed as part of its prey spectrum.

Grayia tholloni Mocquard, 1897
The adult female RBINS 20166 from Bankoro Fassirou had ingested, legs first, an adult *Xenopus* cf. *tropicalis* (Gray, 1864) (Pipidae) (Figure 1). The stomach also contained a specimen of a dealate termite (Insecta: Isoptera, Termitidae), probably from the frog's stomach whose contents are partly exposed, and a long grass-like leaf, the latter probably accidentally ingested while the snake was catching the amphibian. The clawed frog measures about 55 mm SVL, and shows a smooth dorsum, a short subocular tentacle, and three clawed toes plus a claw on the prehallux (one leg is mostly digested, the other is extended anteriorly along the body and mostly preserved). The frog's cloacal area is digested, including the cloacal lobes.

Toxicodryas pulverulenta (Fischer, 1856)
The stomach of the juvenile RBINS 20288 from Gpaolé contains an *Agama* cf. *sankaranica* Chabanaud, 1918 (Agamidae: removed and numbered RBINS 20430) (Figure 2). The agama,

Figure 1. Preserved adult *Grayia tholloni* from Bankoro Fassirou, southeastern Guinea, and its prey, and adult *Xenopus* cf. *tropicalis*. Photograph by O. S. G. Pauwels.

of which the skin of the head is partly digested, measures 41 mm SVL, with a tail length >39 mm (tip missing). It has homogeneous dorsal scalation, 66 scale rows around midbody, and 34 vertebral scales between the level of the posterior insertion point of the anterior members and the anterior insertion point of the posterior members. Four black dorsal bars join each a pair of white irregular, elongated spots on the flanks. It shows no dorsal or caudal crest, no light vertebral line, and no black spot on each side of the neck.

Böhme et al. (2011) reported cases of predation on an agamid of the *Agama agama* complex and on mice by *Toxicodryas pulverulenta* from southeastern Guinea. Following a recent revision of the genus (Greenbaum et al., 2021), *Toxicodryas pulverulenta* has been restricted to West Africa and is confirmed to feed on a wide variety of vertebrate prey, including lizards, birds, shrews and rodents.

Elapidae
Elapsoidea semiannulata moebiusi (Werner, 1897)
The subadult individual RBINS 20273 from Bankoro Fassirou has ingested, head first, an adult female *Hemisus* cf. *guineensis*

Figure 2. Preserved juvenile *Toxicodryas pulverulenta* and its prey, an *Agama* cf. *sankaranica*, from Gpaolé, southeastern Guinea. Photograph by O. S. G. Pauwels.

Figure 3. Preserved subadult *Elapsoidea semiannulata moebiusi* from Bankoro Fassirou, southeastern Guinea, and the adult female *Hemisus* cf. *guineensis* removed from its stomach. Photograph by O. S. G. Pauwels.

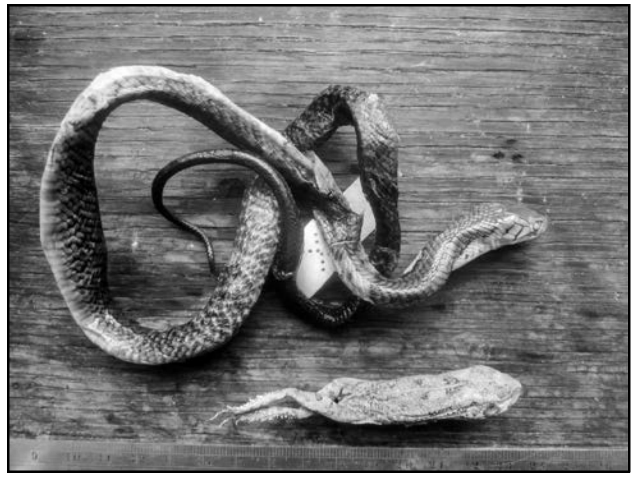

Figure 4. Preserved juvenile *Naja savannula* and its prey, a subadult *Sclerophrys regularis*, from Balagbeni, southeastern Guinea. Photograph by O. S. G. Pauwels.

Cope, 1865 (Anura; Hemisotidae: removed and numbered RBINS 18417) with SVL about 55 mm. While the skin of the head of the piglet frog has been digested, the body is still in good condition, and shows a black dorsum dotted with small, irregular yellow spots (Figure 3).

Mané and Trape (2017) noted that amphibians represented more than a third of the prey items recovered from 13 Senegalese *Elapsoidea semiannulata trapei*. It seems that the fossorial frog genus *Hemisus* had not yet been recorded in this snake's diet.

Naja savannula Broadley, Trape, Chirio & Wüster *in* Wüster et al., 2018
The stomach of a juvenile individual (RBINS 20266) from Balagbeni contains a well preserved subadult *Sclerophrys regularis* (Reuss, 1833) (Anura; Bufonidae: removed and numbered RBINS 18408) with SVL of 44 mm, ingested head first (Figure 4).

No natural history data for this recently described cobra, long confused with *Naja melanoleuca* Hallowell, 1857, were included in its original description (Wüster et al., 2018).

Lamprophiidae
Limaformosa guirali (Mocquard, 1887)
Villagers of Balagbeni encountered an adult individual (RBINS 20292) while it was beginning to swallow an adult female *Atheris chlorechis* (RBINS 20291), head first. The predator snake was killed with a machete and only its head was preserved, while its prey, with its head still within the mouth of the *Atheris*, was entirely preserved (Figure 5). The head scalation of the *Atheris* is hence not accessible, but it was identified based on the other diagnostic characters given in Table 1.

Böhme et al. (2011) recovered a *Boaedon virgatus* (Hallowell, 1854) (Lamprophiidae) from the stomach of a Guinean *Limaformosa guirali*.

Natricidae
Afronatrix anoscopus (Cope, 1861)
The stomach of the adult female RBINS 20325 from Saniamoridou contains the remains of a toad ingested head first, and several nematode worms. The head and forebody of the toad are mostly digested, but the posterior part of the body, a hand and the legs are still in good condition, and show the same morphological characters and coloration presented by an intact, slightly smaller *Sclerophrys regularis* (RBINS 18408, see account for *Naja savannula*) from Balagbeni, and we regard them as conspecific. The toad's stomach contents are exposed and include a femur of a small Orthoptera and an elytra of a small beetle (Coleoptera). The stomach of the subadult female RBINS 20322 from Damaro contains disassembled remains of a fish skeleton.

Böhme et al. (2011) recovered three fish species and unidentifiable frog remains from the stomachs of *Afronatrix* specimens from southeastern Guinea. Trape et al. (2008) found five fish species and one anuran species in the digestive tracts of southeastern Guinean *Afronatrix*. These data agree with observations made by Luiselli et al. (2003) and Luiselli (2006) who recorded only fish and anurans in the diet of *Afronatrix* in southern Nigeria. Within these two vertebrate groups *Afronatrix* however shows a wide eclecticism in its diet and seems to be very opportunistic.

Natriciteres variegata (Peters, 1861)
The juvenile RBINS 20324 from Damaro had ingested two frogs

Figure 5. Preserved adult *Atheris chlorechis* being predated by a *Limaformosa guirali*, from Balagbeni, southeastern Guinea. Photograph by O. S. G. Pauwels.

Figure 6. Preserved adult *Atheris chlorechis* from Ouetoua and its prey, a *Hyperolius* sp. Photograph by O. S. G. Pauwels.

Figure 7. Preserved juvenile *Causus maculatus* from Saniamoridou, southeastern Guinea, along with its prey, a *Ptychadena* sp. Photograph by O. S. G. Pauwels.

head first: one partly digested *Arthroleptis* sp. (Arthroleptidae) with a SVL of ca. 11 mm, and another larger frog, ingested earlier, of which only the legs are still undigested, and which cannot be properly identified.

Extensive studies by Akani and Luiselli (2000) and Luiselli (2003) in southern Nigeria showed that *Natriciteres variegata* consumes a variety of invertebrates and anurans, with a strong preference for the latter, and occasionally fish. Oligochaetes and other soft invertebrate prey items are probably often overlooked, due to their elongate shape and the difficulty to detect them by palpation of the snakes.

Psammophiidae

Psammophis phillipsii (Hallowell, 1844)

The juvenile female RBINS 20286 from Gpaolé had ingested a subadult *Trachylepis* cf. *affinis* (Gray, 1838) (Scincidae). The sand snake's supraocular is in contact with the prefrontal. The skink is in poor condition, with its head and shoulders mostly digested. The skink's intact trunk allows to examine the 28 scale rows around midbody and the tricarinate dorsal scales, and shows a pattern consisting of a brown dorsum with black, irregular paravertebral spots, and on each flank a dark brown stripe separated from the background color by an upper and a lower parallel, discontinuous beige stripes, the lower being more marked. The skink's belly is uniformly beige.

Viperidae

Atheris chlorechis (Pel, 1852)

The female RBINS 20279 from Ouetoua had ingested an adult *Hyperolius* sp. (Anura; Hyperoliidae: removed and numbered RBINS 18410) (Figure 6). The reed frog, ingested legs first, is nearly intact, and shows a SVL of 32 mm, a horizontal pupil, a snout longer than the eye, a uniformly brown dorsum, a dark brown, irregular stripe on the flanks, extending from the snout to the groin; yellow irregular spots on the lower flanks under the dark brown stripe; and belly and lower surfaces of head and limbs uniformly beige. The viper shows 20/18 circumoculars, and a paraventral row much broader than the other dorsal rows (this latter character in contradiction with the identification key and account provided by Chippaux and Jackson [2019]).

Captive *Atheris chlorechis* fed on *Sclerophrys regularis*, *Hemidactylus* "*brookii*" Gray, 1845, and *Trachylepis affinis* (Leston and Hughes, 1968). This viper is an opportunistic predator. See also account for *Limaformosa guirali*.

Causus maculatus (Hallowell, 1842)

The stomach of an adult male (RBINS 20265) from Balagbeni contains the remains of an adult *Sclerophrys regularis* ingested head first. Only the toad's feet are still intact, and the rest of its body is mostly digested, except for its stomach contents, which are still in relatively good condition. They include three workers of the African Stink Ant *Paltothyreus tarsatus* (Fabricius, 1798) (Formicidae Ponerinae)*, one weevil of the genus *Brachycerus* (Curculionidae Brachycerinae)*, and the remains of small Orthoptera. We identified the toad species based on a morphological comparison with an intact conspecific individual from the same locality (see account for *Naja savannula*). This adult *Causus* shows poorly marked keels on its posterior dorsal scales; the anterior dorsals are unkeeled. The pregnant female RBINS 20274 from Saniamoridou contained a partly digested juvenile *Sclerophrys* sp., the feet and some leg bones of an adult *Sclerophrys* sp., and nematodes of various sizes. The clutch includes five eggs, aligned between ventrals 81 and 113. We recovered the posterior part of the body and the legs of a *Ptychadena* sp. (Ptychadenidae) from the juvenile RBINS 20275 from Saniamoridou (Figure 7). The head and forebody of the frog, ingested head first, are digested, but its hands, detached from the body, are still intact.

Leston (1970) found *Sclerophrys regularis* to be the most common prey of *Causus maculatus* living in southern Ghana. Ineich et al. (2006) found *Sclerophrys* spp. to be by far the most common prey for *Causus maculatus* among the anurans they could identify until genus level. Mané and Trape (2019) analyzed the stomach contents of 105 Senegalese *Causus maculatus* and found only amphibians; they mentioned that most were bufonids, but they unfortunately did not provide identification for any of the prey items. Our new records confirm this viper to be a specialist feeder on anurans.

Discussion

Diet spectra attributed in the literature to a number of snake species are artificial, because they are in fact referable to several species before they were separated following taxonomic revisions. In West Africa, recently subject to many revisions and new species descriptions, this is especially true for the genera *Toxicodryas*, *Naja*, *Psammophis* and *Causus*, and other genera are being reviewed, with additional splitting expected. This is why it is important to properly document predation records, localize them geographically, and provide morphological data on the snakes involved, in order to be able to correctly refer the natural history data to the involved species after the taxonomic revisions take place.

Soft and elongate invertebrates, such as worms and many larvae, are probably an important component of the diet of some snakes, but might often be overlooked because they cannot easily be detected by palpation. The same is true for tadpoles. Revealing them requires systematic dissections, often not done if results are not guaranteed, because they damage the snake specimens. This could explain why the dietary spectra of some snakes, such as *Aparallactus niger*, are still so poorly known. That is why systematic dissections of large series of a single species in a given area such as was done by Luiselli's team in southern Nigeria or Trape et al. (2008) in Guinea are important. Such large-scale studies over the long term are rarely possible, and must be done only under controlled circumstances (Trape and Mané, 2019), but remain the best way to clearly understand the predator role of a species in its environment.

Acknowledgments

We dedicate this contribution to the late Georges L. Lenglet (16 February 1949 – 17 March 2022), former curator of the RBINS vertebrate collections. The above listed material was collected in the course of an environmental impact assessment with the financial support of SNC-Lavalin. We are grateful to the *Service de la Faune Sauvage et des Aires Protégées de Guinée* for the authorizations for our study, to Jean-François Trape (Institut de Recherche pour le Développement, Dakar) for useful information, and to the RBINS team of librarians for their help with literature.

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Minutes of the CHS Board Meeting, May 13, 2022

A virtual meeting of the CHS board of directors via Zoom conference video/call was called to order at 7:35 P.M. Board members Stephanie Dochterman, Kyle Houlihan and Margaret Ann Paauw were absent. The meeting was also attended by Jenny Hanson. Minutes of the April 15 board meeting were read and accepted.

Officers' reports

Treasurer: Rich Crowley went over the April financial report.

Membership secretary: Mike Dloogatch read through the list of those whose memberships have expired. Mike reported that the online membership dues payments are no longer working. Until this is corrected, dues will have to be paid by check.

Sergeant-at-arms: Tom Mikosz reported 19 attendees in person at the April 27 meeting, plus 15 online.

Old business

John Archer once again asked board members to come up with ideas for questions for an online poll of the membership.

New business

The next board meeting will take place on Tuesday night, June 14.

The meeting adjourned at 8:13 P.M.

Respectfully submitted by recording secretary Gail Oomens

NEW CHS MEMBERS THIS MONTH

Lawrence Curtis
David Grow
Robert W. Mendyk

Advertisements

Line ads in this publication are run free for CHS members—$2 per line for nonmembers. Any ad may be refused at the discretion of the Editor. Submit ads to mdloogatch@chicagoherp.org.

UPCOMING MEETINGS

Please try to join us *in person* or online for the next meeting of the Chicago Herpetological Society, to be held at 7:30 P.M., Wednesday, June 29, at the Peggy Notebaert Nature Museum, Cannon Drive and Fullerton Parkway, in Chicago. This meeting will combine a members' **show & tell** with a **photo and art contest**. All CHS members are encouraged to display one of their favorite animals either at the in-person meeting or via Zoom. Be prepared to give a short (under five minutes) presentation to the group. Don't be shy. Neither age (yours) nor commonness (the animal's) should be a limitation. If you wish to present via Zoom, you must notify Rachel Bladow (rbladow@chicagoherp.org) beforehand. Photographs and artwork for the contest must be submitted online. Send your entries to Rachel Bladow (rbladow@chicagoherp.org). Winners in each category will be chosen by a vote of the members in attendance (both in person and online). The winners will appear on the cover of a *Bulletin*.

The speaker at the July 27 meeting will be **David Lazcano**, who recently retired from his position as professor of biology at the Autonomous University of Nuevo León in San Nicolás de los Garza, Mexico. [David had been scheduled to speak in May, but had to postpone his talk.] David and his students and colleagues have contributed many articles to the CHS *Bulletin* over the past 30 years. David will speak about ongoing projects and activities in the herpetology lab at the university.

Please check the CHS website or Facebook page each month for information on the program. Information about attending a Zoom webinar can be found here:
<https://support.zoom.us/hc/en-us/articles/115004954946-Joining-and-participating-in-a-webinar-attendee->

Board of Directors Meeting

Are you interested in how the decisions are made that determine how the Chicago Herpetological Society runs? And would you like to have input into those decisions? The next board meeting will be held online. If you wish to take part, please email: jarcher@chicagoherp.org.

REMINDER

When you shop AmazonSmile and select the Chicago Herpetological Society as your charity, Amazon will make a donation to the CHS. <https://smile.amazon.com/>

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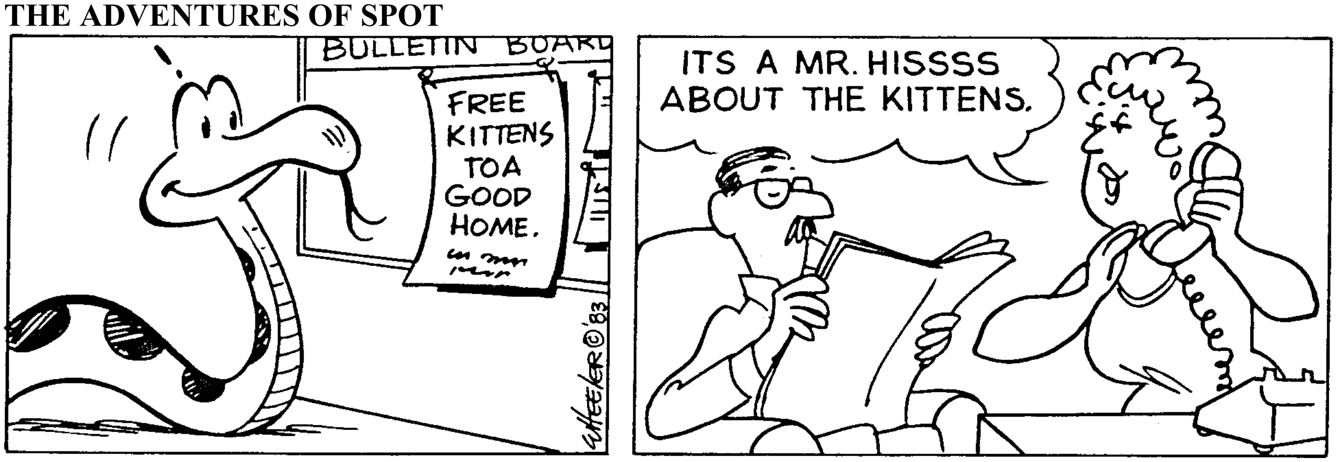

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