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THE HERPETOLOGICAL BULLETIN

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Observation of a subadult olive ridley turtle *Lepidochelys olivacea* from Gahirmatha marine sanctuary, Orissa, India

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KNOWLEDGE of marine turtles is mostly limited to adults and hatchlings. Juvenile and subadults rarely come to the shore and are difficult to observe in the open ocean due to their coloration, small size and agility (Witham, 1980). Therefore any information on juveniles or subadults is generally considered useful among sea turtle biologists as it can shed some light on the mysterious “lost years”.

Olive ridley turtles *Lepidochelys olivacea* are globally distributed and well known for their synchronous nesting behaviour, also called arribada (Spanish for “arrival”) in which several hundred thousand female olive ridleys nest en masse (Bernardo & Plotkin, 2007). They prefer to nest on tropical sandy beaches with major mass nesting beaches in Pacific Mexico (Marquez, 1990), Costa Rica (Hughes & Richard, 1974) and Orissa coast in India (Pandav et al., 2000).

Gahirmatha marine sanctuary (200 44' 57" N, 870 05' 19" E) is the northernmost olive ridley mass nesting rookery in the Bay of Bengal, Orissa and is one of the largest arribada beaches in the world (Bustard, 1976). On 11 August 2010 at approximately 09:00 (IST) a turtle was sighted swimming in the water between Ekakula and Babubali Island (200 44'08" N, 870 03'30" E). Even though sporadic nesting occurs in Orissa coast throughout the year (Dash & Kar, 1990), turtle sighting in the near-shore waters during this season is rare. The turtle was struggling to dive and filamentous algae was attached all over its carapace and head. The turtle was caught and examined for any injuries after hauling onboard a boat using a scoop net. The turtle was confirmed to be a female olive ridley from its morphometric characters,

as described by Marquez (1990). The turtle was a subadult measuring 44.1 cm curved carapace length (CCL) and 45.4 cm curved carapace width (CCW). The weight of the turtle was approximately 5 kg. The central portion of all the vertebral scutes were slightly elevated. The turtle appeared frail and malnourished. The filamentous algae on its carapace, plastron and head were gently scrubbed using the foliage of *Casuarina* (*Casuarina equisetifolia*). There were no facilities to treat injured or ailing marine animals nearby, neither with the local forest & wildlife department nor with the local veterinary hospital. The turtle was therefore released back to the water after removing the algae from its body (Fig. 1).

To the best of our knowledge this could be the first time a live subadult olive ridley has been recorded from the Gahirmatha Marine Sanctuary. During 1979, Kar (1980) and Dash & Kar (1990) reported three dead subadult olive ridley turtles from Gahirmatha. Pandav et al., (1995) reported two dead subadult olive ridley turtles from the sanctuary in 1995 (Table 1). During December 2009 a carapace of a juvenile olive ridley measuring 21 cm CCL and 19.5 cm CCW was found washed ashore on the beach of Babubali Island (Satyaranjan, Pers. observ.) (Fig. 2).

Subadult green turtles (*Chelonia mydas*) are known to migrate along with the adults to some breeding grounds (Cornelius, 1976; Meylan, 1982). We speculate that a similar event occurred on this occasion for the olive ridley that we encountered. It may have joined the adults during the breeding migration from feeding grounds and due to its ill health, may have stopped its return migration. Currently we do not have an explanation for the

Year	Number	Month	Fate	Life stage	CCL (cm)	CCW (cm)	Source
1979	3	April	Dead	Sub-adult	46.5	-	Kar, 1980
		October	Dead	Juvenile	22	16	Dash & Kar, 1990
		October	Dead	Juvenile	20	15	-do-
1995	2	March	Dead	Sub-adult	57	56	Pandav et al, 1995
		April	Dead	Sub-adult	58	57	-do-
2009	1	December	Dead	Juvenile	21	19.5	Present reporting
2010	1	August	Alive	Sub-adult	44.1	45.4	Present reporting

Table 1. Details of subadult and juvenile olive ridley turtles recorded from Gahirmatha marine sanctuary.

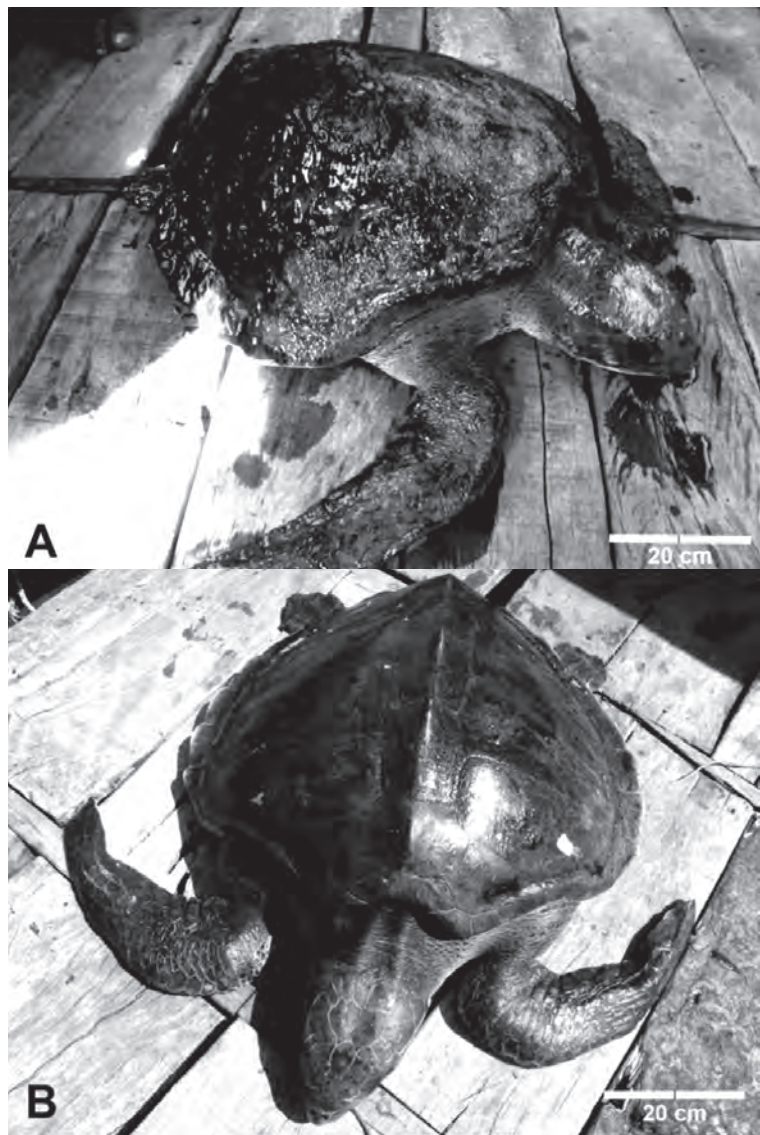


Figure 1. Live subadult olive ridley from Gahirmatha marine sanctuary onboard boat. A - turtle with algae all over its body. B - Cleaned turtle ready for release. Photographs by Satyaranja Behera.

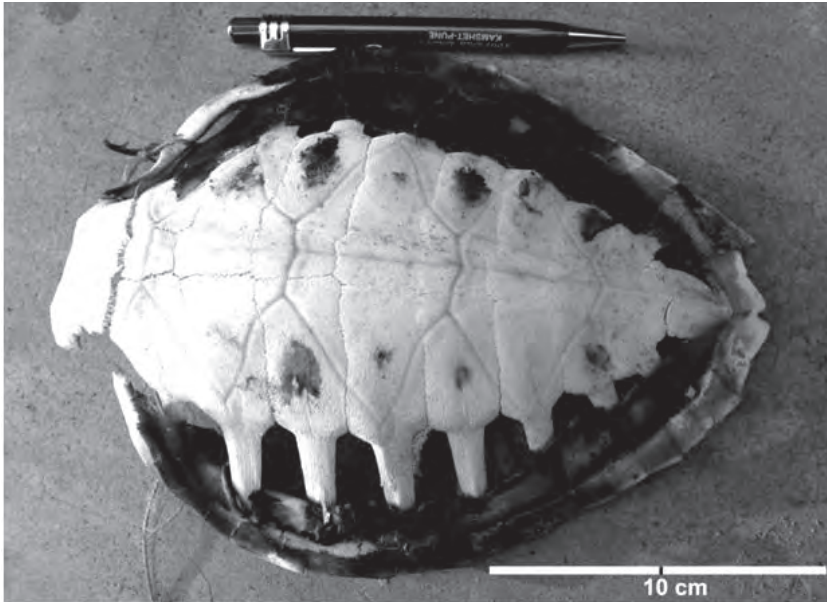


Figure 2. Stranded carapace of juvenile olive ridley from Gahirmatha marine sanctuary.
Photograph by Satyaranja Behera.

presence of a juvenile olive ridley turtle in the adult's breeding ground however future studies in the near and offshore areas of the sanctuary may provide some interesting observations on the elusive lives of juvenile and sub-adult olive ridley turtles.

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New observations of amphibians and reptiles in Morocco, with a special emphasis on the eastern region

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ABSTRACT - This study reports the observations of 54 species of amphibians and reptiles obtained during four field surveys to Morocco, including the southern and southeastern regions. Our records reveal a notable expansion of the current distribution range for several species especially in the eastern part of the country, highlighting the need for more intensive sampling within this region.

MOROCCO is one of the most biodiverse regions in north Africa (Bons & Geniez, 1996). It covers a total area of more than 450,000 km² (Schlüter, 2006) and has a Mediterranean and sub-saharan climate with mean annual precipitation ranging from 300 to 600 mm (Michard et al., 2008). Morocco shares similar topographic characteristics with Algeria and Tunisia and together they constitute the western Maghreb. However, Morocco differs by its greater geological complexity and higher elevation (Michard et al., 2008), with several mountain systems reaching more than 3000 m ASL, including the highest peak in north Africa (Jbel Toubkal, 4.167 m ASL). Moreover, its proximity to Europe (separated by only 14 km) and its contact

during the Messinian stage of the late Miocene (5-6 Mya, Hsü et al., 1973) is fundamental in explaining the richness of amphibians and reptiles of both African and European origins and its high number of endemisms (Bons & Geniez, 1996). In 2006, 12 species of amphibians and 95 species of non-marine reptiles were recognized (Cox et al., 2006). Although this country is one of the best sampled areas of the western Maghreb (Bons & Geniez, 1996; Real et al., 1997; Fahd & Pleguezuelos, 2001; Brito, 2003; Crochet et al., 2004; Guzmán et al., 2007; Harris et al., 2008; Pleguezuelos et al., 2008; García-Muñoz et al., 2009; Ceacero et al., 2010; Harris et al., 2010), there are still some regions in south and southeastern Morocco that have been

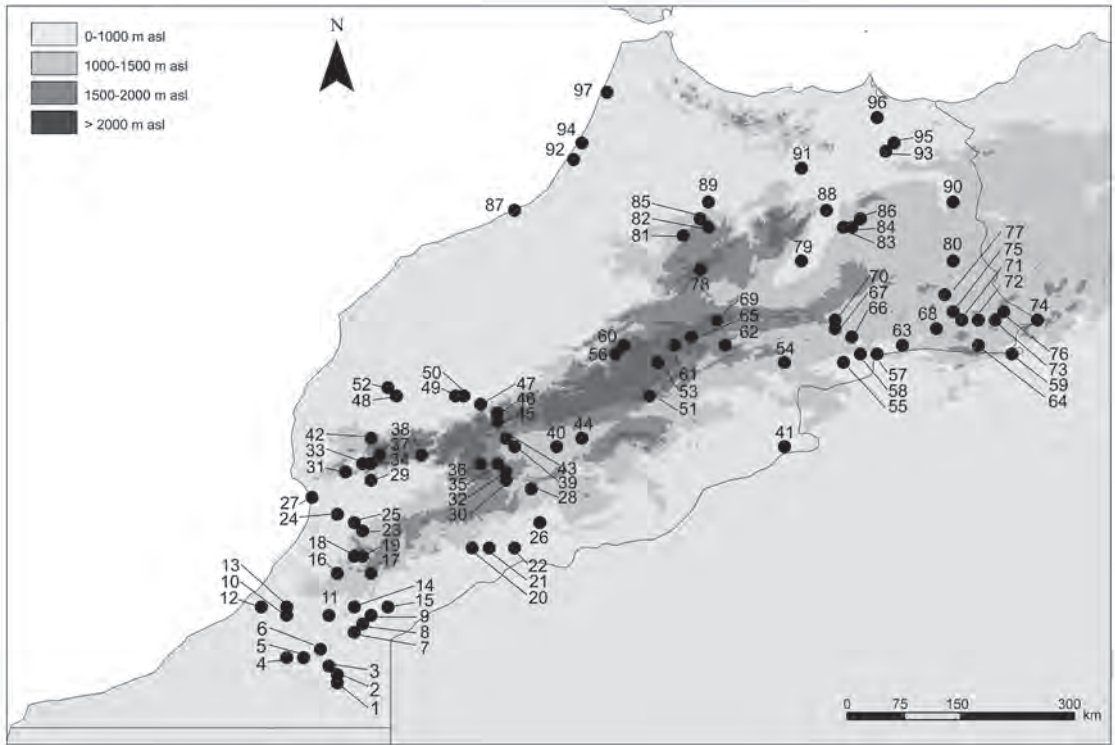


Figure 1. Map of Morocco with the distribution of the sampling localities presented in this study.

poorly surveyed (Bons & Geniez, 1996).

This study compiles the records from three surveys performed in May 2008 and May and July 2009 in central and western Morocco, and one survey in September 2009 in southern (Souss-Massa-Drâ and Guelmim-Es Mara) and southeastern (Oriental and Méknes-Tafilalet) provinces. In total, 342 records of 54 species of amphibians and reptiles from 97 localities were reported (Fig. 1). All specimens found were located with GPS and were identified using morphological characteristics and using the most updated taxonomy. Detailed information on species per locality is given in Table 1 (Appendix) and those species with records of particular interest or that have been subject to recent taxonomical changes are discussed.

AMPHIBIA

ANURA

Bufonidae

Bufo mauritanicus Schlegel 1841 was reported in 17 localities (17, 26, 31, 33, 37, 39, 43, 46, 47, 49,

50, 51, 58, 65, 74, 86 and 97, Table 1). Although considered incertae sedis by Frost et al. (2006), it clearly belongs to the *Amietophrynus* clade (Harris & Perera, 2009). This species, one of the most abundant in Morocco (Bons & Geniez, 1996), was reported in 17 localities mostly associated to wet central regions. However, the finding of individuals further south, in Fom Zguid (locality 26), Bouanane (locality 58) and Ich (locality 74), confirms the existence of isolated populations in the fringes of the Sahara (Bons & Geniez, 1996; Schleich et al., 1996; Brito, 2003; Guzmán et al., 2007). Despite its wide distribution, *B. mauritanicus* exhibits low levels of genetic variation, indicating a recent post-glacial expansion into this region (Harris & Perera, 2009).

Pseudepidalea viridis (Laurenti 1768). Localities 24, 25, 29, 56, 59 and 64 (Table 1). Historically included as a member of the genus *Bufo* prior to Frost et al. (2006), and considered by some authors as *P. boulengeri* (Stöck et al., 2008 but see

Speybroeck et al., 2010), this species is abundant and widespread (Bons & Geniez, 1996), being able to penetrate more than other toads into desert areas.

Ranidae

Pelophylax saharicus (Boulenger 1913). Localities 4, 17, 19, 26, 31, 51, 65 and 66 (Table 1). Previously considered *Rana saharica*, but recently reassigned to the genus *Pelophylax* (Frost et al., 2006; Speybroeck et al., 2010), it displays enormous morphological variation (Bons & Geniez, 1996; Schleich et al., 1996) but minimal mtDNA sequence variation within Morocco (Harris et al., 2003a).

REPTILIA

TESTUDINES

Geoemydidae

Mauremys leprosa (Schweigger 1812). Localities 52 and 95 (Table 1). The study published by Fritz et al. (2006) proposes a reduction in the number of existing subspecies to two, *M. l. leprosa* (Schweigger 1812) and *M. l. saharica* Schleich 1996 distributed across north and south of Morocco respectively and separated by the Atlas mountains.

SQUAMATA

Agamidae

Trapeus mutabilis Merrem 1820. Localities 1, 3, 5, 6, 7, 9, 14, 20 and 73. All localities reported belong to the southern province of Guelmim-Es-Mara with the exception of a single individual found in the Oriental province (locality 73).

Uromastyx acanthinura Bell 1825. Localities 2, 3, 4, 6, 7, 8, 9, 10, 11, 15, 21, 28, 57, 75 and 76. This species, endemic to north Africa was reported in two new localities in the Oriental province, expanding northwards the distribution of the species in the area (localities 57, 75 and 76).

Chamaeleonidae

Chamaeleo chamaeleon (L. 1758). Localities: 33, 42 and 66. Individuals found in Ksar Morhel (locality 66) indicate, for the first time, the presence of this species in the southern area of the Oriental province (Bons & Geniez, 1996). In total, three individuals, a male and two females

(one of them gravid) were found. With the finding of an eastern Mediterranean haplotype in Tunisia and other distinct haplotypes in western Morocco, Dimaki et al. (2008) suggest the existence of a phylogeographic break in northwestern Africa.

Phyllodactylidae

Tarentola mauritanica (L. 1758). Localities 34 and 52. Recent molecular studies show the complexity of this group, with multiple highly divergent genetic lineages across Morocco (Harris et al., 2004; Rato et al., 2010) that do not match current subspecific taxonomy.

Tarentola deserti Boulenger 1891. Localities 57, 58, 59, 71 and 76 (Table 1 and Fig. 2A). Fieldwork in the Oriental province resulted in new locations (localities 57, 58, 71 and 76) linking the two known distribution areas for this species in Morocco: the triangle Tinerhir-Boudenib-Taouz, that holds the bulk of the distribution (Bons & Geniez, 1996) and the isolated localities in Figuig (locality 59 and Bons & Geniez, 1996). All specimens were confirmed genetically (Perera, pers. comm.).

Ptyodactylus oudrii Lataste 1880. Localities 30, 57 and 65. A recent study concerning the genetic variation of the fan-footed gecko in Morocco reported very high divergence levels among the populations from eastern Atlas, western Atlas and AntiAtlas, suggestive of cryptic species (Perera & Harris, 2010). New records in Beni Yatti (locality 57) expand its distribution more than 50 km eastwards.

Sphaerodactylidae

Quedenfeldtia trachyblepharus (Boettger 1874). Locality 35. This Moroccan endemism can be found at altitudes up to 4000 m (Bons & Geniez, 1996). Individuals from Jbel Siroua region, considered as “indeterminated” by Bons & Geniez (1996) were confirmed as *Q. trachyblepharus* (Locality 35).

Quedenfeldtia moerens (Chabanaud 1916). Localities 12, 34, 37, 38, 53 and 61. This endemic, not so restricted to high altitudes as *Q. trachyblepharus* (10-2700 m altitude), is widely distributed across the High Atlas, AntiAtlas, Jbel

Ouarkik and near the Middle Atlas, reaching coastal habitats (Bons & Geniez, 1996). "Indetermined" individuals from Agoudal (Bons & Geniez, 1996) were identified as *Q. moerens* (locality 53).

Stenodactylus sthenodactylus (Lichtenstein 1823). Locality 64 (Table 1 and Fig. 2B). The finding of two individuals in Jboub Zoulai, more than 150 km from other known localities in Morocco (Bons & Geniez, 1996) suggest a possible relationship with the closer Algerian populations (Sindaco & Jeremcenko, 2008).

Saurodactylus mauritanicus (Duméril & Bibron 1836). Localities 91 and 96 (Table 1). This small gecko is distributed across northeast Morocco and north of Algeria (Sindaco & Jeremcenko, 2008). The finding of an individual near Irhoudane (Locality 91) expands 70 km southwest the current known distribution for *S. mauritanicus* in Morocco.

Saurodactylus fasciatus Werner 1931. Locality 89 (Table 1). This endemic, associated to stony areas in north and west of the Atlas system and southwest of the Rif, has a distribution limited to fewer than 40 localities across its range (Bons & Geniez, 1996; Harris et al., 2008; Harris et al., in press). This new observation expands south the distribution of the eastern populations by 20 km.

Lacertidae

Scelarcis perspicillata (Duméril & Bibron 1839). Localities 34 and 78. This climbing lizard extends across the middle and high Atlas regions, mostly associated with water sources and abundance of cliffs or rocks. Although there are three described subspecies (*S. p. perspicillata* (Duméril & Bibron 1839), *S. p. chabanaudi* (Werner 1931) and *S. p. pellegrini* (Werner 1929)) recognisable by their colour pattern, molecular studies do not show direct congruence between external pattern and genetic lineages (Harris et al., 2003b; Perera et al., 2007). The finding of individuals identified morphologically as *S. p. pellegrini* in Tasguint (locality 34) expands its current known distribution 40 km westwards in the High Atlas. The species was found coexisting with *Q. moerens* and *T. mauritanica*.

Acanthodactylus erythrurus lineomaculatus Duméril & Bibron 1839. Localities 94 and 97. Recent molecular analyses do not support the specific differentiation of *A. e. lineomaculatus* (Schinz, 1838) and *A. e. belli* Gray 1845, indicating that both morphotypes are probably ecotypical adaptations to different habitats (Fonseca et al., 2009).

Acanthodactylus boskianus (Daudin 1802). Localities: 1, 2, 64, 66, 70 and 73. This survey to the Oriental recorded two new localities, Jboub Zoulai (locality 64) and Bouarfa (locality 73).

Acanthodactylus pardalis complex: Localities 24 and 71. Two new localities for this group were found, one locality with several individuals identified as *A. busacki* Salvador 1982 in Imi Mqoum (locality 24) and another in Bouarfa (locality 71) where individuals were identified as *A. pardalis* Lichtenstein 1823, although this appears genetically to be a species complex (Fonseca et al., 2008).

Scincidae

Chalcides ocellatus (Forskål 1775). Localities 4, 72, 74, 77, 80, 88 and 90 (Table 1 and Fig. 2C). Individuals from the south were identified as *C. o. ocellatus* (Forskål 1775) (locality 4), although specimens observed in the Oriental Province (localities 72, 74, 77 and 80) could not be identified as belonging to the subspecies *C. o. tiligugu* (Gmelin 1789) or *C. o. subtypicus* Werner 1931. Recent studies show high genetic divergences between the southern and northern subspecies (Kornilios et al., 2010), although more studies are needed to confirm this differentiation.

Chalcides manuei Werner 1931. Locality 35. The range of this endemic skink, known only from 8 different localities (Bons & Geniez 1996), four of them near Essaouira, was considerably extended to the east with its recent finding in Jbel Siroua (Harris et al., 2010). Locality 35 confirms the existence of the species in the area. The specimens found were first identified as *C. montanus* (also reported for this area) because of the striped coloration, very different from the homogeneous pattern

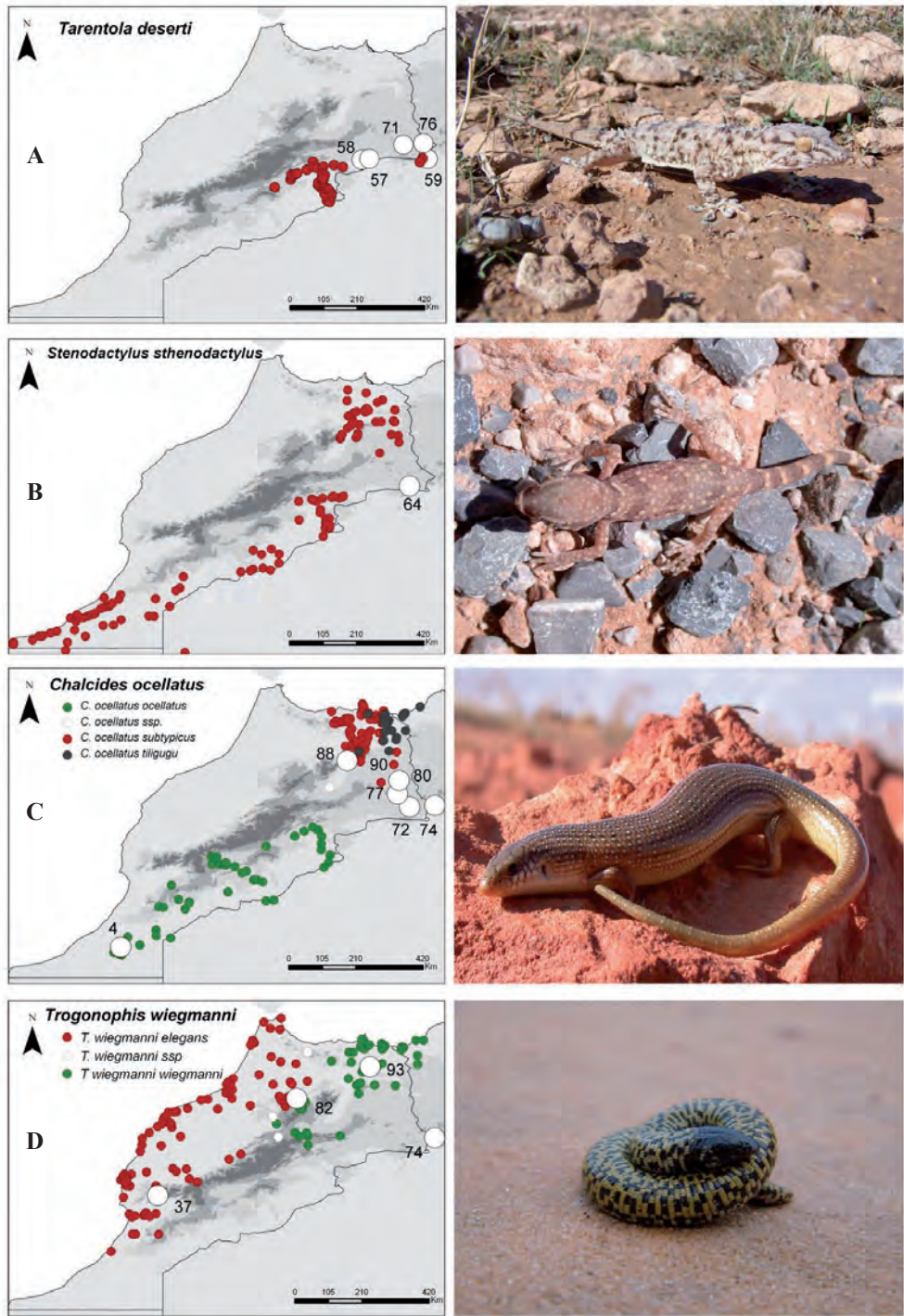


Figure 2. Distribution map and photographs of A) *Tarentola deserti*, B) *Stenodactylus sthenodactylus*, C) *Chalcides ocellatus*, D) *Trogonophis wiegmanni*. Color dots represent published observations (Bons and Geniez, 1996; Guzmán et al., 2007; Harris et al., 2008; Harris et al., 2010) and white dots show new localities included in this study.

typical for *C. manueli* (Bons & Geniez, 1996). However, despite the morphological patterns observed, individuals were confirmed genetically as *C. manueli* using DNA sequencing (Barata, pers. comm.).

Trogonophidae

Trogonophis wiegmanni Kaup 1830. Localities 37, 74, 82 and 93 (Table 1 and Fig. 2D). This endemic to the Maghreb is distributed across the humid, semihumid, arid and semiarid climates (Bons & Geniez, 1996) previously suggested to not exceed 1900 m altitude (Bons & Geniez, 1996). Two subspecies are recognized, *T. w. wiegmanni* (Kaup 1830) in the western, and *T. w. elegans* (Gervais 1835) in the eastern region, morphologically distinguishable and genetically distinct (Mendonça & Harris, 2007). The finding of an adult in Jbel Aoulime (locality 37), at 2084 m altitude, represents a new high altitude register for this species. On the other side, the finding of an individual in Ich oasis (locality 74) indicates for the first time the presence of this species in the south of the Oriental province geographically well separated from other Moroccan populations, but close to western Algerian ones (Sindaco & Jeremcenko, 2008).

Leptotyphlopidae

Leptotyphlops macrorhynchus (Jan 1861). Locality 57 (Fig. 3A). With only 11 localities reported for this species in Morocco, this is one of the rarest snakes in the country. An individual was found in Beni Yatti, 65 km northeast of the previous known distribution range (Bons & Geniez, 1996).

Colubridae

Scutophis molensis (Reuss 1834). Localities 6, 43, 54, 55, 63 and 68 (Table 1 and Fig. 3F). New localities extend the range across the south of the Oriental province, being found between Boudenib and Figuig where it was previously thought to be absent (Bons & Geniez, 1996).

Psammophis schokari (Forskål 1775). Localities 2, 6, 19, 36, 55, 58, 79, 83 and 84. Although various colour patterns exist (Bons & Geniez, 1996) these do not show corresponding mtDNA genetic differentiation within Morocco (Rato et al., 2007).

Spalerosophis dolichospilus (Werner 1923). Localities 67 and 71 (Fig. 3C). This snake is restricted to the pre-Saharan regions of Morocco, Algeria and Tunisia (Pasteur 1967; Bons & Geniez, 1996). Two new records in Ait Yakoub (locality 67) and Bouarfa (locality 71) represent the first two observations of this species on the oriental province and expand its known distribution considerably in Morocco.

Telescopus tripolitanus (Werner 1909). Locality 59 (Fig. 3D). Previously named *Telescopus dhara* (Crochet et al., 2008) it was discovered for the first time in Morocco only in 1989 (Böhme et al., 1989). It remains one of the least reported snakes in Morocco, with only 5 known localities restricted to the Moroccan pre-Sahara (Bons & Geniez, 1996). One individual, with black head and light brownish/orange colour and darker bands across its body (Fig. 3D) was found in Figuig during a crepuscular survey.

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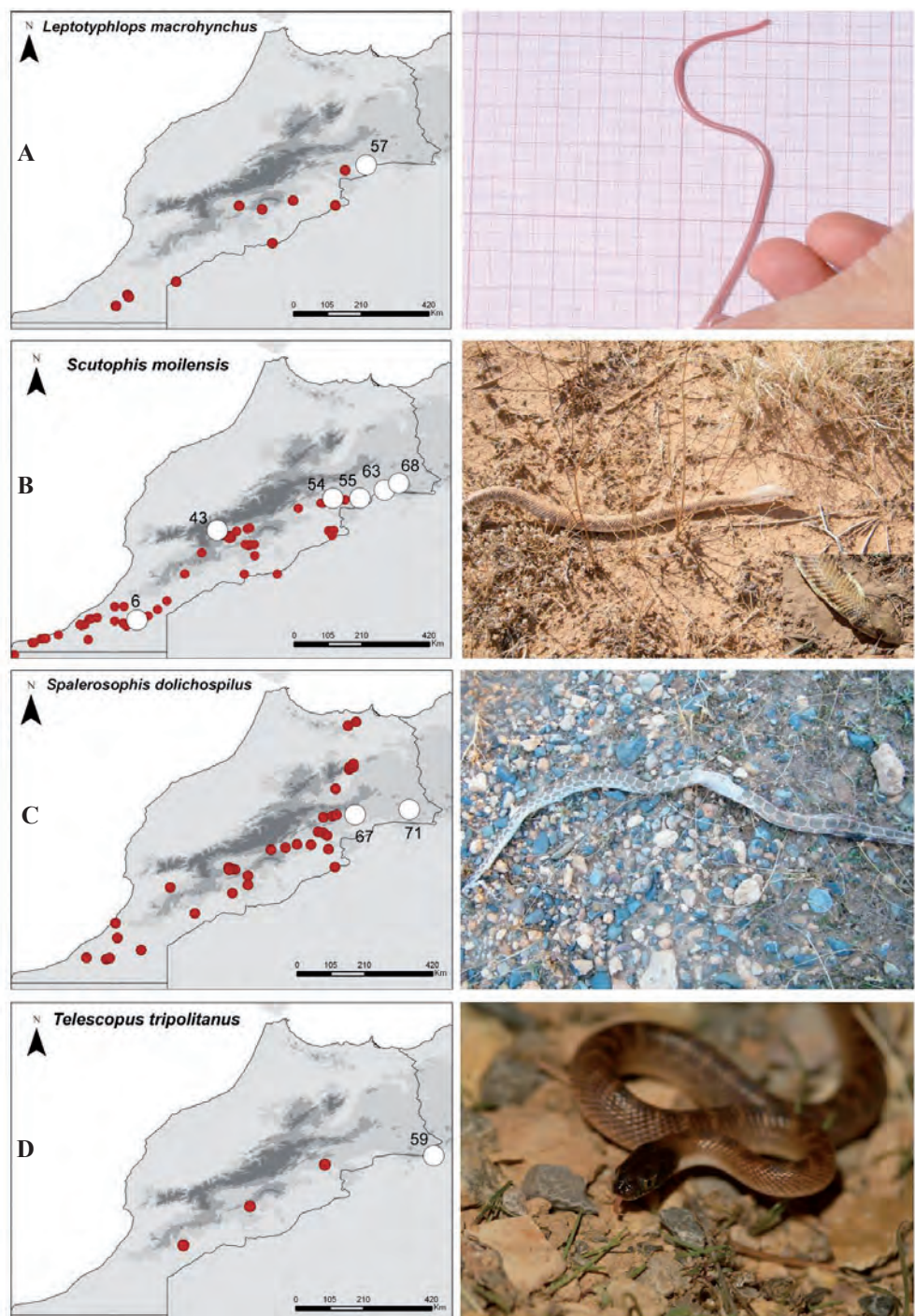


Figure 3. Distribution map and photographs of A) *Leptotyphlops macrohynchus*, B) *Scutophis moilensis*, C) *Spalerosophis dolichospilus*, D) *Telescopus tripolitanus*. Colour dots represent published observations (Bons & Geniez, 1996; Guzmán et al., 2007; Harris et al., 2008; Harris et al., 2010) and white dots show new localities included in this study.

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APPENDIX

Table 1. Localities sampled in this study. For each locality, GPS coordinates (WGS84 decimal degrees) and list of the species found is given.

Local n°	Locality	Lat.	Long.	Species found
1	20 km north Zag	28.21	-9.30	<i>A. boskianus</i> , <i>T. mutabilis</i>
2	5 km south Tistguezemtz	28.29	-9.34	<i>A. boskianus</i> , <i>C. cerastes</i> , <i>P. schokari</i> , <i>U. acanthinura</i>
3	Tistguezemtz	28.41	-9.41	<i>A. impalearis</i> , <i>C. cerastes</i> , <i>T. mutabilis</i> , <i>U. acanthinura</i>
4	Aouinet Torkoz	28.53	-9.86	<i>C. ocellatus</i> , <i>H. algirus</i> , <i>M. guttulata</i> , <i>P. saharicus</i> , <i>S. boulengeri</i> , <i>U. acanthinura</i>

5	Between Aouinet Torkoz/Tadachacht	28.49	-9.65	<i>T. mutabilis</i>
6	Near Assa	28.57	-9.50	<i>A. impalearis</i> , <i>C. cerastes</i> , <i>S. moilensis</i> , <i>P. schokari</i> , <i>T. mutabilis</i> , <i>U. acanthinura</i>
7	Near Tanezida	28.77	-9.11	<i>T. mutabilis</i> , <i>U. acanthinura</i>
8	Between Tanezida	28.89	-8.99	<i>U. acanthinura</i>
9	Foum el Hassane	28.99	-8.91	<i>T. mutabilis</i> , <i>U. acanthinura</i>
10	5 km north Taourirt Doubiane	28.98	-9.90	<i>U. acanthinura</i>
11	Nr. Taghjicht/ Bouizakarne	29.05	-9.35	<i>U. acanthinura</i>
12	Gorges nr Guelmin	29.07	-10.25	<i>E. algeriensis</i> , <i>Q. moerens</i>
13	N1 Ouayoutelt	29.09	-9.89	<i>S. brosetti</i>
14	Bouizakarne	29.11	-9.14	<i>T. mutabilis</i>
15	Between Tizgui/Icht	29.07	-8.70	<i>U. acanthinura</i>
16	Kerdous	29.55	-9.33	<i>A. impalearis</i>
17	10 km north Aguerd Imelal	29.54	-8.87	<i>B. mauritanicus</i> , <i>P. saharicus</i>
18	Near Aimou road	29.65	-9.06	<i>A. impalearis</i>
19	3 km north Ayerd	29.67	-8.96	<i>A. impalearis</i> , <i>P. schokari</i> , <i>P. saharicus</i> , <i>S. brosetti</i>
20	2 km west Akka Iguirene	29.76	-7.73	<i>T. mutabilis</i>
21	Kasba El Joua	29.85	-7.47	<i>A. impalearis</i> , <i>U. acanthinura</i>
22	N12 Mrimina	29.81	-7.20	<i>N. maura</i>
23	4 km north Ifrhel	29.96	-9.01	<i>A. impalearis</i> , <i>S. brosetti</i>
24	4 km n.Imi Mqoum	30.18	-9.28	<i>A. busacki</i> , <i>P. viridis</i> , <i>S. brosetti</i> , <i>S. spheopsiformis</i>
25	Ait Baha Barragem	30.06	-9.12	<i>A. impalearis</i> , <i>P. viridis</i>
26	Foum Zguid	30.09	-6.88	<i>B. mauritanicus</i> , <i>P. saharicus</i> , <i>T. boehmei</i>
27	Agadir	30.42	-9.61	<i>A. aureus</i> , <i>S. spheopsiformis</i>
28	North Foum Zguid	30.49	-7.00	<i>U. acanthinura</i>
29	Taoudant-Tasguint	30.63	-8.91	<i>P. viridis</i>
30	Tazenakht	30.63	-7.27	<i>P. oudrii</i>
31	10 km sth Argana	30.74	-9.18	<i>B. mauritanicus</i> , <i>P. saharicus</i>
32	N10 to Anezal	30.71	-7.29	<i>M. mauritanica</i>
33	Near Argana	30.84	-8.99	<i>B. mauritanicus</i> , <i>C. chamaeleon</i>
34	Tasguint	30.78	-8.86	<i>Q. moerens</i> , <i>S. perspicillata</i> , <i>T. mauritanica</i>
35	Road to Jbel Siroua	30.79	-7.59	<i>H. meridionalis</i> , <i>A. erythrurus</i> , <i>C. manueli</i> , <i>A. andreanskyi</i> , <i>T. tangitanus</i> , <i>P. vaucheri</i> , <i>Q. trachylepharus</i>
36	West Anezal	30.78	-7.37	<i>P. schokari</i>
37	Jbel Aoulime	30.89	-8.81	<i>A. impalearis</i> , <i>B. mauritanicus</i> , <i>Q. moerens</i> , <i>T. wiegmanni</i>
38	Tasguint	30.91	-8.31	<i>Q. moerens</i>
39	Near Agadir	30.97	-7.22	<i>B. mauritanicus</i> , <i>C. cerastes</i> , <i>M. mauritanica</i>
40	N10 n. Ouarzazate	30.98	-6.74	<i>M. guttulata</i>
41	Jboub Zoulal	31.01	-4.00	<i>M. rubropunctata</i>
42	Talaint N8	31.10	-8.94	<i>C. chamaeleon</i> , <i>S. brosetti</i>
43	Afela n'lsly	31.07	-7.26	<i>B. mauritanicus</i> , <i>S. moilensis</i>
44	Skoura N10	31.10	-6.43	<i>M. cucullatus</i>
45	Taddert	31.30	-7.41	<i>A. andreanskyi</i> , <i>P. vaucheri</i>
46	N9-Ait Mannsour	31.39	-7.40	<i>B. mauritanicus</i>
47	Tashimout	31.55	-7.60	<i>B. mauritanicus</i>
48	Mzouda N8	31.58	-8.55	<i>A. erythrurus</i> , <i>C. mionecton</i> , <i>S. brosetti</i>
49	N9 s. Marrakech	31.59	-7.92	<i>B. mauritanicus</i>
50	Oulad el Guern	31.58	-7.82	<i>B. mauritanicus</i>
51	Gorges du Todra	31.59	-5.59	<i>B. mauritanicus</i> , <i>P. saharicus</i>
52	Near Sidi-Chikér	31.75	-8.74	<i>C. polylepis</i> , <i>M. leprosa</i> , <i>S. brosetti</i> , <i>T. mauritanica</i>
53	Agoudal	31.97	-5.49	<i>A. erythrurus</i> , <i>T. tangitanus</i> , <i>P. vaucheri</i> , <i>Q. moerens</i>
54	Near Tazzouguert	31.97	-4.02	<i>S. moilensis</i>
55	Belibilia	31.98	-3.27	<i>S. moilensis</i> , <i>P. schokari</i>

56	Road to Imilchil	32.10	-5.95	<i>P. viridis</i>
57	Beni Yatti	32.09	-3.10	<i>L. macrorhynchus</i> , <i>P. oudrii</i> , <i>T. deserti</i> , <i>U. acanthinura</i>
58	Near Bouanane	32.11	-2.88	<i>B. mauritanicus</i> , <i>P. schokari</i> , <i>T. deserti</i> , <i>T. tripolitanus</i>
59	Figuig	32.11	-1.25	<i>P. viridis</i> , <i>T. deserti</i> , <i>T. tripolitanus</i> (<i>T. dhara</i>)
60	Jebel Morrik	32.18	-5.88	<i>P. vaucheri</i>
61	Road Imilchil-Rich	32.17	-5.34	<i>P. vaucheri</i> , <i>Q. moerens</i>
62	Rich	32.22	-4.68	<i>H. hippocrepis</i>
63	Near Ain Chair	32.20	-2.59	<i>S. moilensis</i>
64	Jboub Zoulai	32.24	-1.72	<i>A. boskianus</i> , <i>P. viridis</i> , <i>S. sthenodactylus</i>
65	Jbel Aderdouz	32.26	-5.15	<i>B. mauritanicus</i> , <i>H. hippocrepis</i> , <i>N. maura</i> , <i>P. algirus</i> , <i>P. oudrii</i> , <i>P. saharicus</i>
66	Ksar Morhel	32.25	-3.18	<i>A. boskianus</i> , <i>C. chamaeleon</i> , <i>P. saharicus</i>
67	Ait Yakoub	32.36	-3.44	<i>S. dolichospilus</i>
68	N10 to Mengoub	32.39	-2.19	<i>S. moilensis</i>
69	Cirque de Jafar	32.54	-4.79	<i>A. andreanskyi</i>
70	Talsint	32.49	-3.41	<i>A. boskianus</i> , <i>A. impalearis</i> , <i>N. maura</i>
71	N17 to Bouarfa	32.51	-1.93	<i>A. pardalis</i> , <i>S. dolichospilus</i> , <i>T. deserti</i>
72	N17-Jboub Zoulai	32.48	-1.72	<i>C. ocellatus</i>
73	N17 to Bouarfa	32.51	-1.50	<i>A. boskianus</i> , <i>T. mutabilis</i>
74	Ich	32.52	-1.01	<i>A. impalearis</i> , <i>B. mauritanicus</i> , <i>C. ocellatus</i> , <i>T. wiegmanni</i>
75	Bouarfa	32.57	-2.02	<i>A. impalearis</i> , <i>U. acanthinura</i>
76	N18 to El Mlalih	32.56	-1.37	<i>C. cerastes</i> , <i>T. deserti</i> , <i>U. acanthinura</i>
77	Bouarfa	32.84	-2.07	<i>C. ocellatus</i>
78	Lake Aguelmame Sidi Ali	33.07	-5.01	<i>T. tangitanus</i> , <i>N. maura</i> , <i>P. vaucheri</i> , <i>S. perspicillata</i>
79	Teggour	33.24	-3.83	<i>P. schokari</i>
80	N17 to Tendara	33.21	-2.02	<i>C. ocellatus</i>
81	R707 to Ifrane	33.54	-5.16	<i>C. lanzai</i>
82	Imouzzar Kandar	33.63	-4.90	<i>A. erythrurus</i> , <i>T. tangitanus</i> , <i>P. vaucheri</i> , <i>P. algirus</i> , <i>T. wiegmanni</i>
83	Bouloutane	33.58	-3.33	<i>A. impalearis</i> , <i>P. schokari</i>
84	Bouloutane	33.57	-3.21	<i>P. schokari</i>
85	Imouzzar Kandar	33.66	-5.04	<i>T. tangitanus</i> , <i>P. vaucheri</i>
86	El Hamar	33.71	-3.05	<i>B. mauritanicus</i>
87	Between Casablanca/Rabat	33.78	-7.23	<i>E. algeriensis</i> , <i>N. maura</i>
88	N15 to Zerzaia	33.78	-3.48	<i>C. ocellatus</i> , <i>E. algeriensis</i>
89	Sefrou	33.85	-4.86	<i>S. fasciatus</i> , <i>T. graeca</i>
90	Near Ain Benimathar	33.89	-2.02	<i>C. ocellatus</i>
91	N6 to Irhoudane	34.25	-3.85	<i>S. mauritanicus</i>
92	A1 to Akbate	34.43	-6.52	<i>H. hippocrepis</i>
93	N6-Moulay Bagdad	34.52	-2.84	<i>T. wiegmanni</i>
94	El Behara	34.65	-6.41	<i>A. e. lineomaculatus</i>
95	N7-Moulay Bagdad	34.57	-2.73	<i>M. leprosa</i>
96	N19-Oulad Bouihia	34.94	-2.88	<i>S. mauritanicus</i>
97	Larache	35.17	-6.12	<i>A. e. lineomaculatus</i> , <i>B. tingitanus</i> , <i>B. mauritanicus</i> , <i>M. cucullatus</i> , <i>T. graeca</i>

Breeding habitat and natural history notes of the toad *Melanophryniscus pachyrhynus* (Miranda-Ribeiro, 1920) (Anura, Bufonidae) in southern Brazil

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THE genus *Melanophryniscus* Gallardo, 1961 comprises 25 Bufonidae species with geographic distribution in central and northern Argentina, southern Bolivia, southern and southeastern Brazil, Paraguay, and Uruguay (Frost, 2010). These toads are arranged in three phenetic species groups according to morphological features; *M. moreirae*, *M. stelzneri* and *M. tumifrons* groups (Cruz & Caramaschi, 2003). At least eight species are currently in the *M. tumifrons* group, which is restricted to southern parts of south America between 26° to 32°S and 49° to 57°W in southern Brazil, Argentina and Uruguay (Caramaschi & Cruz, 2002). The species are *M. cambaraensis* Braun & Braun, 1979, *M. devincenzii* Klappenbach, 1968, *M. macrogranulosus* Braun, 1973, *M. orejasmirandai* Prigioni & Langone, 1986, *M. pachyrhynus* (Miranda-Ribeiro, 1920), *M. simplex* Caramaschi & Cruz, 2002, *M. spectabilis* Caramaschi & Cruz, 2002 and *M. tumifrons* (Boulenger, 1905). This group is defined by species possessing highly developed warts with an apical corneous spine on dorsal surfaces and flanks, a dorsal colour pattern without contrasting dots, and a conspicuous, rounded protuberance on the snout between the eyes (Cruz & Caramaschi, 2003). Among the species in the *M. tumifrons* group, *Melanophryniscus pachyrhynus* is considered large and is distinguished by presence of small tubercles on the dorsum and venter, protuberance on the

snout from between the eyes to near the upper eyelids, and in life a ventral colour of reticulated orange. It also has vestigial black reticulated spots and a large trapezoidal red spot on femoral region (Vaz-Silva et al., 2008). *M. pachyrhynus* was known only by two specimens collected at the type locality (São Lourenço do Sul), in the state of Rio Grande do Sul, Brazil, one hundred years ago (Vaz-Silva et al., 2008). Therefore, this toad species has been listed as 'data deficient' at the global level due the absence of data on distribution, abundance and ecology (Garcia & Segalla, 2004). A recent study rediscovered this species in Brazil and extended its geographic distribution to five localities in the Brazilian state of Rio Grande do Sul (municipalities of Caçapava do Sul, Dom Feliciano, Porto Alegre, São Jerônimo and São Lourenço do Sul) (Vaz-Silva et al., 2008), and one locality in Uruguay (Cuchilla de Mangrullo, Departamento de Cerro Largo) (Borteiro et al., 2005). The range of *M. pachyrhynus* seems to be associated with upland environments in the Pampa biome (Planalto Sul-Rio-Grandense). This habitat is characterised by rocky outcrops, natural grassland mosaics (Campos) and seasonal forests (IBGE, 2004). However, much of the ecology of *M. pachyrhynus* remains unknown (Kwet et al., 2005; Maneyro & Kwet, 2008; Vaz-Silva et al., 2008). Herein we report on the first known breeding habitats of *M. pachyrhynus* and describe a calling site for this species. On 19



Figure 1. Landscape and breeding habitat of *Melanophryniscus pachyrhynus* at municipality of São Sepé, state of Rio Grande do Sul, Brazil: A) Bottom of temporary stream, B) natural grasslands, C) seasonal forest and D) cultivated land.

November 2009 five male *M. pachyrhynus* were observed calling along a temporary stream (50 cm wide) flowing in natural grassland and cultivated land (wheat) (Fig. 1), in the municipality of São Sepé (30°14'58.26"S, 53°35'20.90"W, 163 m ASL), Rio Grande do Sul State, Brazil. Three specimens were collected and deposited in the Herpetological Collection of the Universidade Federal de Santa Maria (ZUFMS 4405-07). Males of *M. pachyrhynus* called from among herbaceous vegetation, on the ground, in shallow water (1 cm deep), with the head directed against the flow of water (Fig. 2A). The toads called from sunset (18:30 hrs) until 20:30. The calling behaviour of *M. pachyrhynus* was similar to that observed for males of *M. devincenzii* in Rivera and of male *M. orejasmirandai* in Maldonado, Uruguay (Maneyro, pers. obs.). Reproduction of *Melanophryniscus* sp. mostly occurs after heavy rain and takes place in lentic and lotic environments such as in small streams, shallow pools and flooded areas (Kwet & Di-Bernardo, 1999; Vaira, 2005; Achaval & Olmos, 2007; Cairo et al., 2008; Maneyro & Kwet, 2008). Only two recently described species (*M. alipioi* and *M. vilavelhensis*) differ from this, they breed inside phytotelms (Langone et al., 2008; Steinbach-Padilha, 2008). According to the current literature most species of the *M. tumifrons* group breed in temporary streams (Table 1) in the same manner we recorded for *M. pachyrhynus*. This indicates the species group likely prefers specific breeding habitat. We also observed individuals of *M. pachyrhynus* using a breeding habitat impacted by

agricultural activities, suggesting this species may have some tolerance to disturbed areas. However, longer studies over time that evaluated the affect of landscape usage on the species persistence would be necessary to assess population trends and conservation status of *Melanophryniscus* spp. Until recently, all *Melanophryniscus* spp. were considered diurnal breeders (Garcia & Vinciprova, 2003), but nocturnal breeding activity has now been reported for *M. simplex* and *M. vilavelhensis* (Colombo et al., 2007; Steinbach-Padilha, 2008). In our study area, *M. pachyrhynus* presented diurnal and nocturnal calling activity, suggesting that nocturnal breeding activity among this species may be more common than currently acknowledged. This hypothesis is reinforced by records of several calling males and amplexant pairs of *Melanophryniscus* aff. *devincenzii* found during the night during December 2009 in a temporary stream at Itaara municipality, Rio Grande do Sul State (Maneyro, pers. obs.). When handled, adults of *Melanophryniscus pachyrhynus* displayed the unken reflex (Fig. 2B and C).

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Figure 2. Adult male *Melanophryniscus pachyrhynus*: A) at the calling site, B) and C) after manipulated, exhibiting the typical defensive behaviour ‘Unken reflex’.

Species	Breeding habitat	Breeding season	Source
<i>M. devincenzii</i>	Ephemeral streams	Winter and spring, after heavy rainfall	Maneyro & Kwet (2008)
<i>M. cambaraensis</i>	Flooded areas near small streams or ditches	Summer, after heavy rainfall	Garcia et al. (2004a)
<i>M. macrogranulosus</i>	Unknown	Unknown	Garcia & Vinciprova (2003), Silvano & Garcia (2004)
<i>M. orejasmirandai</i>	Permanent small streams	Spring (Sept./Oct.), after heavy rainfall	Prigioni & Langone (1990), Lavilla & Langone (2004)
<i>M. pachyrhynus</i>	Ephemeral streams	Summer (November),	This study
<i>M. simplex</i>	Temporary streams	Winter (August)	Colombo et al. (2007)
<i>M. spectabilis</i>	Temporary streams	Unknown	Garcia et al. (2004b)
<i>M. tumifrons</i>	Temporary pools	Unknown	Garcia et al. (2004c)

Table 1. Breeding habitat and breeding season of the *Melanophryniscus tumifrons* group.

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Traditional indigenous perspectives on soil-dwelling vertebrates in Oku, Cameroon, with special reference to the caecilian *Crotaphatrema lamottei*

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ABSTRACT - The limbless and mostly tropical and soil-dwelling caecilian amphibians (Gymnophiona) are an extremely poorly known vertebrate order. Some species sometimes occur in agricultural settings, where being mistaken for earthworms or snakes and their accidental and purposeful killing are almost the only human cultural interaction yet recorded. *Crotaphatrema lamottei* is a caecilian endemic to the top of Mount Oku, Cameroon, and is poorly known scientifically, with only eight specimens ever having been recorded. Fieldwork in 2008 aimed at finding *C. lamottei* included interviewing people of the native, traditional Oku community who encounter this species while working the soil. Oku people recognise *C. lamottei* and consider it, along with other soil-dwelling vertebrates (Kefa-ntie), harmful to encounter but bad juju to kill. Oku people tainted by encountering *C. lamottei* seek a cleansing potion from a medicine man. The potion is produced in a traditional multi-person ceremony, and is made from ground herbs, palm oil and chicken blood. It is administered by being smeared on the base of the tainted person's thumb and licked off. Following the acquisition of the potion, more *C. lamottei* were presented to the field team by members of the Oku community. Understanding local perspectives can be helpful when researching rarely encountered and poorly known species.

OF the three orders of living amphibians, by far the least is known about the biology of the approximately 180 species of limbless and mostly tropical and soil-dwelling Gymnophiona or caecilians. This applies to all areas of caecilian biology, and is exemplified by knowledge of their conservation biology, where approximately two thirds are categorised as Data Deficient in the IUCN Redlist because of inadequate taxonomic, distributional, and ecological data (IUCN, 2010). Indeed, many caecilian species are known from only one or very few specimen records (Gower & Wilkinson, 2005), and a similar lack of data occurs also for many other soil-dwelling herpetofauna (e.g. Measey, 2006). The Cameroon endemic genus *Crotaphatrema* is typical in many respects, with the three nominal species (*C. bornmuelleri*, *C. lamottei*, *C. tchabalmbaboensis*) known from only 14 specimens, from three point localities (Doherty-Bone et al., 2011). During recent fieldwork at the only known locality for *C. lamottei* (Mount Oku,

northwest Cameroon), two of us (TMD-B, RKN) spent time with the local Oku people, a local community with many aspects of their culture still intact (Koloss, 2000). It became apparent that *C. lamottei* was sometimes encountered by Oku people in agricultural soils, and was incorporated into their traditional belief system. We report here on these anthrozoological observations.

METHODS

Fieldwork took place from October to December 2008, in farmland on the northern slopes approaching the rim of the Lake Oku crater. This focused around the Oku settlements of Jikijem and Elak-Oku (see Doherty-Bone et al., 2011), where agriculture consists mostly of mixed smallholdings (including coffee and maize), some small fish ponds and limited amounts of livestock with grazing occurring more intensively on montane grasslands above the settlements.

The main aim of the fieldwork was to locate

specimens of *C. lamottei* in order to improve knowledge on the taxonomy and natural history of this species. Three main methods were applied, pitfall trapping, timed digging surveys and interviews with local people and showing them specimens and photographs of caecilians (Doherty-Bone et al., 2011). In applying the latter approach it emerged that *C. lamottei* was recognised by local people who believed this species to have adverse effects when encountered that could be cured only with a cleansing potion prepared in a ritual led by a medicine man. Given the perception that *C. lamottei* is harmful, local people were reluctant to find and/or collect specimens unless the potion was available. TMD-B and RKN participated in a traditional cleansing potion ritual near Elak-Oku on 1 November 2008 and subsequently administered the concoction to local people as they assisted in searches for specimens. These events were recorded through field notes and photographs. Local people were urged not to harm animals, and this was observed except when digging soil caused accidental injury.

RESULTS

In traditional Oku culture, *C. lamottei* is classified with other burrowing vertebrates including moles (*Chrysochloris balsaci*), scolecophidian snakes (at least *Rhinotyphlops* sp.) and probably other burrowing snakes (e.g. Atractaspididae) under the single term Kefa-ntie (= thing in the ground). Oku people commonly believe that Kefa-ntie can cause degeneration of any limb that contacts these animals, and to kill one (even accidentally) is considered bad juju. The contacted limb reportedly swells up and becomes covered in sores. When women came across Kefa-ntie, they would be unable to return home without taking a specific curative potion produced in a ritual led by a medicine man, in the belief that otherwise their next child would be born with bad luck. Anyone who encounters the animal without potion has to bring the Kefa-ntie to the medicine man. Dried moles and caecilians were often encountered at the hut of one medicine man near Jikijem, these apparently are not incorporated into the potion, but brought to prompt its preparation or administration.

The potion-making ritual that TMD-B and RKN

participated in was led by a local medicine man, began in the morning and took a leisurely six hours or so. Several other local men, including a second medicine man, participated in and witnessed the ritual. One woman was present and also took part in the collection of herbs. Women otherwise do not participate in Oku rituals (Koloss, 2000). The ritual was initiated by the medicine man anointing the door frames of a medicine house (nda emkum [Koloss, 2000]) with traditional paint (Fig. 1) before leading the participants into the building. Participants entered in single file holding on to each other's shoulders. Ground green herbs were taken by the participants (Fig. 1) in turn, placed on the base of the thumb of the left hand by the medicine man, and washed down with palm wine. Eggussi (pumpkin seed pudding) was consumed by the participants. The participants sat opposite the "medicine-corner", around a central fire. A clay vessel (Fig. 2, "wine vessel of the juju" [Koloss, 2000]) was filled with palm wine and several whole, empty shells of giant snails (Achatinidae). Palm wine was drunk throughout the ritual, a common social practice among the Oku and other ethnic groups in the region. The medicine man addressed the group and gently cast morsels of eggussi around the room.

The medicine man then led the participants on a short (c. 45 minutes) walk outside to collect herbs (Fig. 1). The medicine man stabbed at the ground with a spear ("spear of the juju" or Egbong emkum [Koloss, 2000]) and threw feathers plucked from a live chicken to indicate which herbs to collect. The party stopped frequently and all the participants were expected to collect herbs at each site and place them in a single woven bag. The contents of an ants' nest were also collected (Fig. 1) and bagged up with the herbs, perhaps based on the belief that ants are ubiquitous and can contact killed animals to beg forgiveness (Koloss, 2000). The party returned to the hut, where the contents of the bag were reduced to ash in a pot on the fire (Fig. 2). The core of the ceremony included the telling of fortunes of the main participants using cowry shells, and then the preparation of the remedy using the ashes from the herbs, palm oil and the blood of a freshly killed chicken (Fig. 2). The concoction was prepared in the

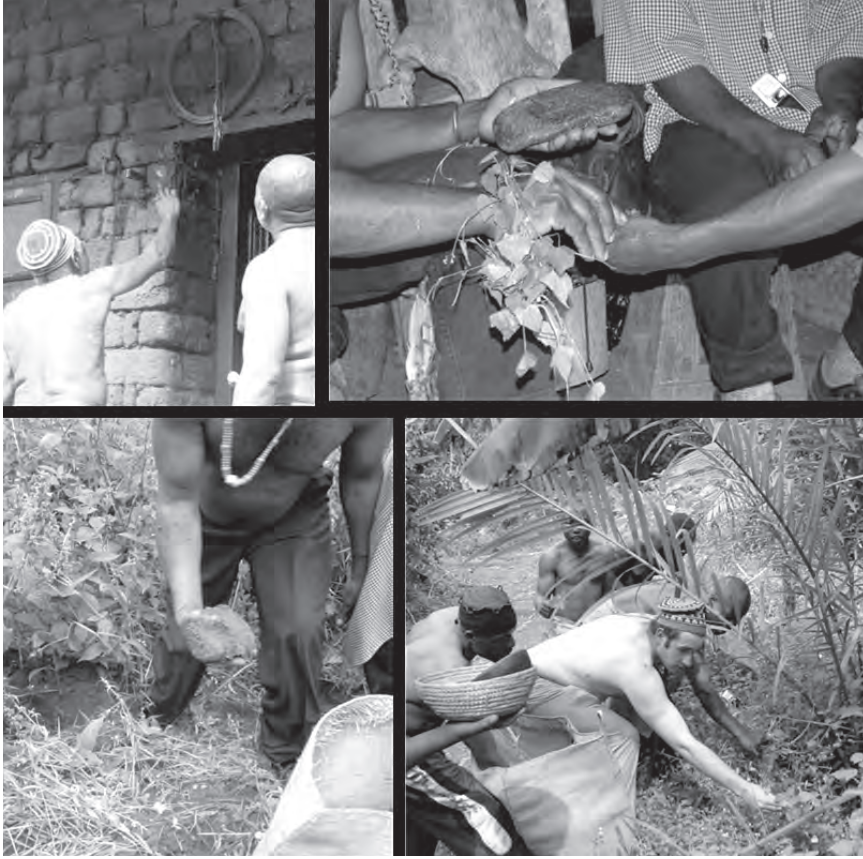


Figure 1. Beginning of potion preparation ceremony. Clockwise from top left: Medicine man anoints the door of the medicine house prior to the group entering. Ground herbs are given to each participant at the start of the ceremony, placed on the base of the left thumb to be consumed. Collection of herbs, which are placed into a bag woven from *Raphia* palms. Contents of an ants' nest are added to the woven bag.

horn of an antelope (Fig. 2; possibly a Bushbuck, *Tragelaphus scriptus*). The resulting paste was kept in the horn and used to cleanse people who encountered Kefa-ntie, administered (Fig. 2) by placing the paste on the base of the thumb of the left hand, to be licked off by the recipient. The killed chicken was cooked and eaten by the participants with fou-fou (maize flour bread).

Following TMD-B and RKN's participation in the ritual, community members were much more forthcoming in presenting caecilians ($n = 5$), moles ($n = 2$) and scolecophidian snakes (*Rhinotyphlops* sp., $n = 2$) to the field team, and in each case the potion was provided to the contributor for cleansing. TMD-B and RKN were also instructed to take the potion and, on one occasion, they were asked by a

man to provide an aliquot in a plastic bag so that he could subsequently give it to his wife.

DISCUSSION

Reports of human interactions with amphibians have typically been restricted to frogs (e.g. Tyler et al., 2007), with an increasing literature from Cameroon and western central Africa (Akani et al., 1998; Pauwels et al., 2003; Gonwouo & Rödel, 2008; Mohneke et al., 2010). Human interactions with soil-dwelling herpetofauna have very rarely been documented and the extent of the human cultural interaction with caecilians on Mount Oku is exceptional, though some of the 'interactions' might be based on Oku people confusing *C. lamottei* with other limbless burrowing animals. Other

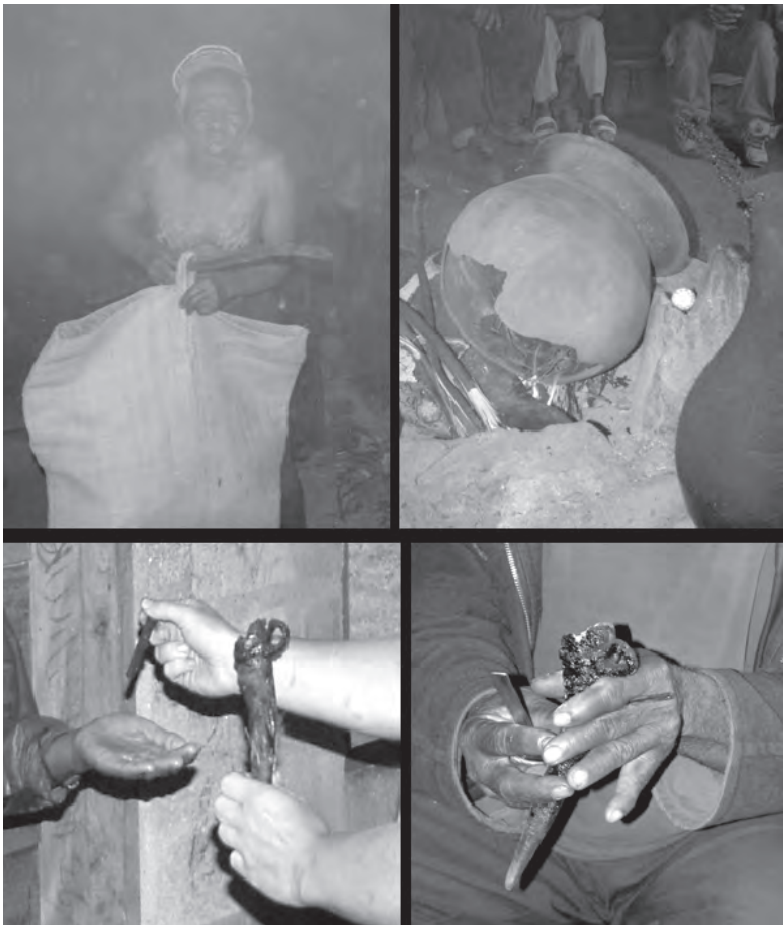


Figure 2. End of potion preparation ceremony. Clockwise from top left: Medicine-man receives bag containing collected herbs. Herbs are burned to ash. Ashes are gathered, placed into an antelope horn and mixed with palm oil. A freshly slaughtered chicken is bled (below) onto the horns with blood also mixed into the powder and oil. The resulting potion is provided to a member of the Oku community who has presented a caecilian to the fieldworkers and wishes to be cleansed of the bad juju.

reports of human perceptions of, and interactions with, caecilians are very rare and light on detail. Where humans and caecilians interact, the latter frequently seem to be viewed as snake-like and potentially dangerous, to the extent that they are routinely killed, such as occurs in agricultural communities in Kerala, India (Gower & Wilkinson, 2005; Ramachandran & Oommen, 2008). Other than exceptional cases where special conservation effort and education is carried out (e.g. for the Kenyan *Boulengerula niedeni*, see Wojnowski & Malonza [2009]), perhaps the best that can be hoped for the conservation of caecilians in many



human-modified habitats is that they are mistaken for harmless (perhaps even beneficial) earthworms. Where caecilians tolerate human disturbance, they can even be found in dung and compost heaps (e.g. Nussbaum & Gans 1980), and this is possibly the source of stories that they enter the anus of humans (Campbell, 1998) or domesticated animals (Taylor, 1968).

It is likely that, as with many frogs and salamanders, the skin secretions of most or all caecilians are toxic to some degree (e.g. Moodie, 1978; Toledo & Jared, 1995; Schwartz et al., 1999) and those of at least one East African scolecomorphid have been recorded as irritating to humans (Measey & Turner, 2008). Descriptions by Oku people of swollen limbs following contact with Kefa-ntie bear a resemblance to pathologies of envenomation by mildly venomous snakes. Mildly venomous burrowing snakes of the family Atractaspididae do occur in the Oku area (Chirio & LeBreton, 2007), and there has been at least one documented occasion where one of these snakes envenomated an individual who had mistaken it for a harmless scolecophidian snake (Durrell, 1954). We, however, suspect that the mistrust of *C. lamottei* on Mount Oku is as likely attributable to beliefs about the uncleanness of soil-dwelling animals more generally (e.g. Koloss, 2000) than evidence among local people of unpleasant interactions with this caecilian.

The understanding of Oku local beliefs by field workers proved to be vital for observing a very rarely encountered species of amphibian. Only two specimens of *Crotaphatrema lamottei* were located by field workers without assistance from local donations. The utilisation of local knowledge is not a novel technique for carrying out scientific studies of rarely encountered soil-dwelling herpetofauna (e.g. Loader et al., 2004; Gower & Wilkinson, 2005), but this study's engagement with Oku perspectives and customs has added another dimension to the potential importance of local knowledge.

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Bicephaly in the anuran *Pseudophryne pengilleyi*

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BICEPHALISM, or axial bifurcation, is a congenital malformation in which a single-bodied embryo develops with two heads. This condition has been reported on numerous occasions in mammals and reptiles, especially snakes (Wallach, 2007) and turtles (Hildebrand, 1938; Diong et al., 2003). Despite malformations involving missing or extra limbs and digits occurring quite commonly in amphibians (Johnson et al., 2003; Lannoo, 2008), there have been very few reports of bicephalism.

Bicephalism has been reported in at least four caudate species (Pereira & Rocha, 2004; Velo-Anton et al., 2007) and five anuran species (Lebedinsky, 1921; Dragoiu & Busnitza, 1927; Schwind, 1942; Lynn, 1944). Each of these cases documents the condition in amphibian larvae only, rather than the adult form. Here we report a case of bicephalism in the Australian northern corroboree frog (*Pseudophryne pengilleyi*), that to our knowledge is the first record of a bicephalic amphibian tadpole successfully metamorphosing.

A small population of adult *P. pengilleyi* is held at Taronga Zoo, Sydney, as a component of a recovery programme for this endangered species. All adults were reared to maturity in captivity after being collected from the wild as eggs. On 4 July 2010, 79 live captive-produced *P. pengilleyi* eggs, representing clutches from up to six females sired by a single male, were retrieved from a communal nest located under moist sphagnum moss on a gravel base. Five of the females housed in the breeding enclosure were unrelated to the male, whilst one was a direct sibling, resulting in a 17% chance that offspring could be from closely related parents. The eggs, laid during February and March, were placed in 220 litres of water in a tank (135

x 55 cm, filled to 30 cm deep). They were fully developed at Gosner stage 25 (Gosner, 1960) prior to placement in the larval tank, and hatched between 4-13 July 2010. Delayed hatching is normal for this species, where eggs may not hatch until the nest is inundated.

In December 2010, a tadpole was discovered with two heads, including two pairs of eyes and nostrils and two apparently functional mouthparts (Figs. 1 and 2). It had a severely kinked tailed, so its swimming attempts were limited to gradual circular turns. At this time it measured 8.5 mm and weighed 0.25 g. It had not been seen earlier due to its coloration matching the silty substrate in the tank and its limited movement. There were no other abnormalities observed in this clutch.

The tadpole reached Gosner stage 42 on the 21 December 2010, when it developed two forelimbs. Metamorphosis was completed on the 28 December 2010 (Fig. 3). The frog was 8.1 mm in length and weighed 0.07 g, which is very small for this species. Four other metamorphs in this tank averaged 13.5 mm and 0.32 g.

Both heads appeared equal in size and neither seemed dominant. Each pair of eyes appeared functional and it was capable of opening both mouths. The frog was able to move through the sphagnum moss substrate of its enclosure but its movements were unstable. This was most apparent on a flat surface, with the frog frequently flipping over and unable to right itself. The frog demonstrated no feeding response when offered hatchling house crickets (*Acheta domestica*) and a wide range of appropriate sized leaf-litter invertebrates. Despite placing these directly in front of each head and on both its mouths, no feeding response was elicited. The individual died on 16 January 2011 and was preserved.

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Figure 1. Dorsal view of bicephalic *Pseudophryne pengilleyi* tadpole.

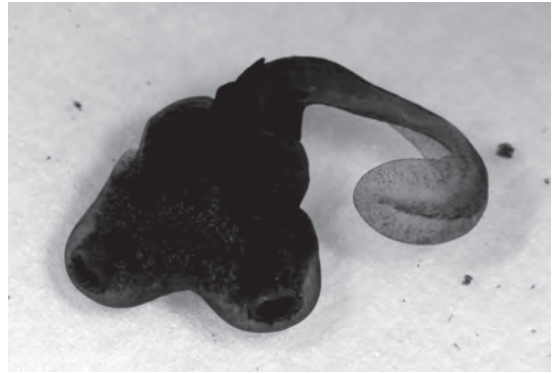


Figure 2. Ventral view of bicephalic *Pseudophryne pengilleyi* tadpole.



Figure 3. Bicephalic *Pseudophryne pengilleyi* at nine days post-metamorphosis.

Captive breeding, egg incubation and rearing of the red-tailed ratsnake *Gonyosoma oxycephala*

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THE red-tailed ratsnake *Gonyosoma oxycephala* (Fig. 1) is one of the most impressive ratsnakes in the world. The species is widely distributed throughout tropical Southeast Asia, Indonesia and the Philippines (Staszko et al., 1994). It is an arboreal species that will, when threatened, inflate its body and strike (Whitaker & Captain, 2004). Captive bred animals are available but most are wild imports and are generally heavily parasitized (Mattison, 1998).

A pair of *G. oxycephala* was used in this breeding programme. The male was wild caught, measured 120 cm and weighed 500 g. The female was captive bred, measured 180 cm and weighed 800 g. The two snakes were housed individually and only introduced together when attempting to breed. The male was housed in a vivarium measuring 60 x 45 x 45 cm (L x W x H) with branches and a large basking area. The female was housed in a larger vivarium measuring 100 x 75 x 75 cm (L x W x H) with similar furnishings.

The ambient day temperatures were kept between 25 and 32°C with night time temperatures between 18 and 20°C. *G. oxycephala* is a tropical ratsnake and therefore the specimens were kept at 50-90% RH. The male was fed 4 or 5 mice per month whereas the female was fed 10 to 12.

Breeding Attempt 1 (2007-2008)

Between November and March the pair of *G. oxycephala* did not receive a temperature reduction. Instead, temperatures continued between 32-18°C. Both specimens were fed throughout this period with neither refusing meals. Toward the end of April 2008, the male was introduced to the female's enclosure. Within five minutes of introduction courtship behaviour was observed but no copulation was witnessed. Throughout June 2008 the female basked daily. Towards the end of

June four eggs were laid. These were transferred to an incubator. The eggs appeared infertile and were opened to reveal a large egg mass with no embryonic development.

Breeding Attempt 2 (2008-2009)

During November 2008 and February 2009, both specimens were cooled by gradually reducing the ambient temperature from 30 to 16°C over a five-day period. Both specimens ceased feeding during these months. The female gradually began to darken in colour during this period of temperature decline. Temperatures were gradually raised at the beginning of February from 16 to 30°C over a five-day period.

Both specimens were fed one week after temperatures returned to normal. During February 2009 the male was introduced to the female's enclosure for breeding. Courtship was observed immediately and copulation was observed within one hour. On one morning copulation was observed again after spraying the enclosure with warm water. In March 2009 the female appeared gravid and was moved to a smaller enclosure (as per 2007-2008 breeding attempt) ready for oviposition. During April four fertile eggs were laid in the hide box overnight among sphagnum moss. These appeared different to the eggs laid in 2008. They were pearly white in colour, full in appearance and larger (Fig. 2). The eggs were removed and transferred to an incubator.

Incubation of First Clutch

The eggs were incubated in a clear plastic container that fits within the incubator. Vermiculite mixed with water (ratio 2:1) was used as a substrate. A small depression in the vermiculite was made for the eggs to sit in. Eggs were only half buried using this method. A clump of damp sphagnum moss was

placed over the eggs to raise humidity to 100% RH. They were incubated at 30°C. The container lid was opened every two days to allow the eggs to freely exchange oxygen and carbon dioxide with atmospheric air (Deeming, 2004).

After 40 days of incubation two of the eggs began to discolour. The remaining two looked healthy. By day 54, all eggs had become discoloured and began to smell. All four eggs were opened up and revealed embryonic death. The embryos were dead and the interior of the egg was dry.

Sperm Retention in *Gonyosoma oxycephala*

In late June 2009 a second clutch of four fertile eggs was laid overnight in damp sphagnum moss. The female was found coiled around them (Fig. 3). As the female was isolated in March 2009 and was not introduced to the male after her previous clutch I suggest that sperm storage from the previous mating fertilised the eggs. The eggs were removed and artificially incubated.

Incubation of Second Clutch

The second clutch of eggs was incubated using the same method as the previous clutch, with the only difference being the use of sphagnum moss. Instead of smothering the eggs, damp sphagnum moss was placed around the eggs allowing greater access to air. After 36 days in incubation, one egg began to discolour and desiccate. After 87 days, the first hatchling began to hatch and was followed by a second on day 88 (Fig. 4). The hatchlings were transferred from the incubator to small rearing enclosures. The last hatchling emerged on day 89 but was still attached to the umbilicus that was secured to the egg. The specimen was left in the incubator for a further two days, still attached to the umbilicus. Intervention was required after two days and the umbilicus was tied off using cotton. After two days the hatchling was free and the remaining tissue began to atrophy and was shed away after the first slough.

Rearing of Hatchlings

All hatchlings weighed 21 g on emergence. They were housed in small plastic containers measuring 27 x 15 x 10 cm. Orchid bark mulch and sphagnum moss was used as a substrate to improve humidity.

Bamboo sticks were added to provide climbing opportunities. Hatchlings, however, were observed to be shy and spent most of their time buried under the sphagnum moss. They were only rarely observed climbing or perching.

Hatchlings sloughed 10-14 days after emerging from the egg. They were fed on pinkie mice, that were left in the enclosure with them overnight. All hatchlings reacted defensively when food was offered on tongs. One specimen did not feed after several attempts so a method of reflex feeding was adopted by utilising the snake's strike reflex (Ross & Marzec, 1990). All three hatchlings were feeding regularly within a month of hatching.

Conclusion

A two-month cooling period may be important for the production of fertile eggs. Precise incubation techniques may need refining in future breeding attempts and further research is necessary. The correct use of sphagnum moss may also be important when incubating *G. oxycephala* eggs. Smothering the eggs with damp moss likely killed the embryos in the early stages of development. It is possible that gaseous exchange was inhibited due to the moss covering the surface area of the eggs. When damp moss was placed around the eggs a 75% hatch rate was recorded. Temperature during incubation may also have a considerable effect on development of eggs. The egg incubation period is highly variable, from 80-180 days (Mattison, 1991).

To the best of my knowledge this is the first record of sperm retention in *G. oxycephala*. This process of reproduction has been described in snakes such as pythons and boas (Ross & Marzec, 1990) and a rattlesnake (Mattison, 1998). It has also been observed in *Pantherophis guttatus*, *Lampropeltis getulus californiae* and *Lampropeltis triangulum campbelli* (pers. obs.).

G. oxycephala is both a rewarding and challenging species to maintain in captivity. Future documenting of breeding attempts would be needed to determine whether sperm retention is a common reproductive mechanism, or maybe just a sporadic occurrence induced by environmental conditions.



Figure 1. Adult male *Gonyosoma oxycephala*.



Figure 2. Second clutch of eggs 2008-2009.



Figure 4. Egg clutch with hatchling 2009.



Figure 3. Adult female *Gonyosoma oxycephala* coiled on eggs.

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Figure 1. Close-up of adder consuming great tit fledgling.

VIPERA BERUS (adder): FEEDING. On 5 July 2010 at 14.30 hrs an adult adder was photographed consuming a fledgling in the garden of a house in Tangham Forest, Suffolk (OS grid reference TM 35 48) (Front cover & Fig. 1, op. pg.). The garden is surrounded by forestry plantation and adders regularly enter from there. Weather conditions were sunny, with occasional cloud and air temperature approximately 24°C. The bird appears to be great tit fledgling (Mike Toms, pers. comm.).

Adder diet includes a range of small mammals, reptiles and amphibians. Birds and their eggs are also taken, but there are few specific published examples. Appleby (1971) records a fully fledged bird, the size of a sparrow, regurgitated by an adder and Street (1979) relays a reliable report of an adder raiding a woodlark nest, although he does not record whether eggs or fledglings were involved. Frazer (1983) includes a photograph of an adder consuming a merlin chick. It is also repeatedly stated that the adder may climb to prey on birds or their eggs, in spite of the fact that this snake is not a habitual climber (Smith, 1964; Appleby, 1971; Street, 1979).

It is unclear whether, in this instance, the adder killed a fledgling, or whether it scavenged an already dead bird. On several occasions prior to this observation, however, this adder was seen on the edge of the garden's pond and under nearby shrubbery. Birds use the shallow edges of the pond to drink and bathe, so it is possible that the adder took a bird, alive, from there.

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CROTALUS VIRIDIS (western rattlesnake) and **PITUOPHIS CATENIFER** (gopher snake): REPRODUCTION. Although successful interbreeding between closely-related species of snakes in captivity has been reported (Bechtel et al., 1960), the likelihood of inter-genus or inter-family hybridization in captivity or in the wild is negligible. To our knowledge, there is no documented account of inter-family reproduction in snakes. Herein, we report an observation of copulation between two species of snakes from two different families; *Crotalus viridis* (western rattlesnake), Viperidae, and *Pituophis catenifer* (gopher snake), Colubridae, and discuss why inter-family hybridisation may not be feasible.

On 14 May 2009 during a herpetological monitoring survey in the Briones Region, Contra Costa County, northern California, USA (37.950135°N, 122.217778°W, datum: WGS 84), we found four adult (two females and two males) gopher snakes (*Pituophis catenifer*) and one adult female western rattlesnake (*Crotalus viridis*) in a funnel trap associated with a drift fence placed at the edge of coastal scrub/chaparral and grassland habitats. Close examination of the captive snakes in the trap revealed that one male gopher snake and the female western rattlesnake were copulating (Fig. 1). The female *C. viridis* was quietly coiled in the corner of the trap facing the opposite direction to the male *P. catenifer*; the copulatory lock seemed to be carried out with both hemipenes. When the snakes were pulled out of the trap for photographic documentation and the pair placed on the ground, the female rattlesnake started dragging the male gopher snake away.

Despite the fact that the colour pattern and defensive behaviour of gopher snakes mimic those of rattlesnakes and in spite of their close karyotypic structure (Baker et al., 1972) hybrids between these higher taxonomic groups are not viable. Their differences are vast, which suggests that there is a long evolutionary history that separates them. For



Figure 1. *Pituophis catenifer* and *Crotalus viridis* copulating.

example, the reproductive strategy of gopher snakes is oviparous while that of rattlesnakes is viviparous. Furthermore, the two species' reproductive organs (i.e., hemipenes) are morphologically dissimilar and the sex-pheromones that are elicited during oestrus and courtship behaviour may differ (Mason et al., 1989; reviewed in Houck, 2009). Once copulation takes place, unique hormones (chemical messengers) that help sperm to penetrate an egg vary between species and the maternal immunorecognition system is activated effecting fertilisation probabilities (Olsson et al., 1997). Moreover, it has been considered whether females have the ability to discriminate between sperm—sperm choice—of different hetero- and conspecific males (Olsson et al., 1996) and sperm competition in snakes is prevalent female reproductive behaviour (Schulte-Hostedde & Montgomerie, 2006).

It is not clear what led these two distinct species

to copulate in this situation. We hypothesise, however, that the presence of two other female gopher snakes and their pheromones (during oestrus) may have elicited male sexual behaviour bringing the male gopher snake to copulate by “mistake” with the western rattlesnake whose reproductive season coincides with that of the gopher snake (Fitch, 1949; Ernst & Ernst, 2003). In garter snakes (*Thamnophis* spp.), males do not exhibit courtship behaviour unless they perceive specific pheromones on the female's skin (Noble, 1937; Mason & Crews, 1985; Mason et al., 1989). The female sex pheromones of the gopher snakes may have been transferred to the skin of the female rattlesnake. Male snakes are known to respond behaviorally and physiologically to sex pheromones (Huang et al., 2006). Given that female rattlesnakes remain passive during mating events with their conspecific males (Ernst & Ernst, 2003

and references therein) there may have not been any avoidance behaviour by the female rattlesnake. Instead, the presence of the female rattlesnake in the “courtship ball” may have been stressful for her and as a normal response she may have gaped her cloaca to express cloacal gland secretions (Graves & Duval, 1988; Moore et al., 2000; R. Mason, pers. comm.). This event could be considered a misguided copulation if the male gopher snake was searching for the female gopher snake’s cloaca and happened upon the rattlesnake’s instead.

In the Mediterranean climate of California, a “hybrid zone” may occur where the ranges of the two unrelated families meet (Fitch, 1949; Macartney et al., 1988; Yacelga, pers. obs.). The niches of these two species overlap to some degree and the onset of the reproductive season also overlaps (Fitch, 1949). This observation raises a number of questions. Does interbreeding occur in the wild? Do snakes interbreed up to the family level? This observation may not be of an adaptive behaviour of two species of snakes in the wild. It could be considered, rather, an isolated event or simply the result of the individuals being enclosed in the trap. Additional observations of this aberrant behaviour may elucidate the above questions.

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NATRIX NATRIX (grass snake): EGG-LAYING SITE. Grass snakes require warm, moist microhabitat for the successful incubation of their eggs, and decomposing vegetation provides such conditions (Beebee & Griffiths, 2000). Most egg-laying sites in Britain are made by humans, including compost or manure heaps, piles of sawdust and woodchips, hayricks and behind warm brickwork (Smith, 1964; Appleby, 1971; Street, 1979; Frazer, 1983; Beebee & Griffiths, 2000). Rotting wood may be a more natural egg-laying medium. Smith (1964) refers to cavities in old tree trunks, a survey carried out by the Fauna and Flora Preservation Society recorded two cases of 'rotting logs' among 31 egg-laying sites (Langton, 1986), and a photograph of many clutches of grass snake eggs in a rotten log, taken by Richard Revels, appeared in *British Wildlife* (Alexander et al., 2006). From continental Europe, Street (1979) found multiple clutches beneath a rotting tree trunk and Luiselli et al. (1997) found natural sites within rotting logs, as well as under large rocks and wet moss.

Given the relative lack of information on natural egg laying-sites in Britain, a description of a semi-natural site is provided from Thetford Forest, Norfolk (TL 95 91). The site was a cut hornbeam stump, in a bracken-dominated open area, within a mixed plantation managed for forestry and wildlife interest. The stump measured approximately 70 cm high with a diameter of 90 cm mid-way up the remaining trunk.

On 18 September 2009, hatchling grass snakes were found basking at the foot of the stump, indicating that it might be an egg-laying site. On investigation, the central core of the stump was found to be highly decomposed, comprising friable fragments of timber, with the consistency of damp sawdust. The outer layers were less decomposed and although these maintained the structure of the stump, it was easily broken open by hand. Five clutches of eggs were found within the central core of the stump. Two clutches had hatched, leaving empty egg shells. Snakes were hatching from the third clutch. The remaining two clutches had not hatched, but appeared viable. The wood fragments were replaced after locating the eggs.

The egg site was visited again on 23 September 2009. Of the two previously unhatched clutches,

snakes had hatched from one, and the remaining clutch was in the process of hatching; some egg shells were empty and one hatchling was in the process of emerging.

There was no readily apparent heat generation from the decomposing wood. Air temperature and temperature within the core of the stump were recorded using a digital thermometer. On the first visit temperature in the centre of the stump, where the eggs were located, was similar to the external air temperature, both being 18°C. On the second visit air temperature was 20-21°C, but temperature within the stump was still 18°C. The stump was shaded by trees until mid-morning.

There are some similarities between the egg-laying site in Thetford Forest and that photographed by Richard Revels. The latter was within a beech log, measuring approximately 250 cm long, with a diameter of approximately 75 cm. Decomposition was such that the log was broken open by hand, which revealed approximately 100 hatched eggs, just under the upper surface, within decomposed material, the consistency of sawdust (Andy Darrington & Richard Revels, pers. comm.).

Both of the above are artificial egg-laying sites in the respect that they were created by cutting timber. However, large tree stumps and fallen logs, produced through natural senescence, may have been more common in the past than they are today. Forests in Europe have less than 5% of the deadwood expected to occur under natural conditions (Dudley & Vallauri, 2004). The microhabitat provided within dead wood in advanced stages of decomposition may have provided grass snakes with egg-laying sites prior to the human-made egg-laying heaps more commonly found today.

ACKNOWLEDGEMENTS

I am grateful to Natural England for funding survey work and Andy Darrington and Richard Revels for their observations of a grass snake egg-laying site.

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Figure 1. Hornbeam stump used as grass snake egg-laying site.



Figure 2. Grass snake eggs in decomposing timber.

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ITAPOTIHYLA LANGSDORFFII (casque-headed treefrog): MALE COMBAT. *Itapotihyla langsdorffii*, of monotypic genus, has a wide distribution in the Atlantic Forest from the south of Sergipe State to Rio Grande do Sul State, Brazil, northeastern Argentina and central-south Paraguay (Arzabe & Loebmann, 2006; Lignau et al., 2006). It is a large treefrog (up to 100 mm SVL) that occurs in forested areas. Some of its populations are considered in decline, especially due to habitat loss (Aquino et al., 2004). Publications on the biology and ecology of this species are scarce (Vrcibradic et al., 2009). *Itapotihyla langsdorffii* belongs to the tribe Lophiohylini, a monophyletic group from south America which includes “casque-headed” treefrogs and currently contains 10 genera



Figure 1. *Itapotihyla langsdorffii* males after combat, Cerrado habitat, southeastern Brazil.

(Faivovich et al., 2005). Male-male combat among amphibians is common especially due to disputes over territories or mates and includes aggressive and violent fights (Wells, 2007). The most violent combat among anurans is reported for gladiator frogs, *Hypsiboas boans* group (Kluge, 1979). Most of these species have well developed prepollical spines that are used in combat, causing injury (Duellman & Trueb, 1994).

Here we report a combat between two *Itapotihyla langsdorffii* males in a Cerrado area, southeastern Brazil. The event was observed in the early evening (19:28; 20°C) on 1 October 2009 in a gallery forest located in Rio Pardo II Farm, municipality of Avaré, State of São Paulo (22° 50' 12" S, 48° 58' 54" W; 650 m a.s.l.). Approximately 25 individuals were found calling in a flooded area formed by rainwater, near Palmital River. Two males were perched on a bush, one metre above the water, in the forest edge. Below them was a larger individual that was not calling, most likely a female. One of the males (intruder) began to emit aggressive calls, approaching the other male (resident). Then, the intruder jumped onto the same perch as the resident

male. One minute later, the resident male started the physical combat, physically shoving and beating the opponent's head with its forelimbs, in an apparent attempt to dislodge its rival from the perch. The resident male lost its equilibrium but did not leave the perch. Occasionally, the intruder male emitted aggressive calls. During one of the attacks by the intruder male, both individuals fell onto another perch below and combat ceased. The two individuals stood with their backs to each other (Fig. 1). After several minutes, the intruder male desisted and jumped onto another bush. The duration between the first agonistic interaction and the end of the combat was less than ten minutes. According to Vrcibradic et al. (2009), there is considerable sexual size dimorphism in *I. langsdorffii* with females (mean SVL 103 mm) being significantly larger than males (mean SVL 81 mm). Therefore, our record disagrees with that of Shine (1979), who stated that in species presenting male combat, males are often larger than females. Halliday & Verrell (1986) consider separation of amphibians into "combat" and "non-combat" species, and state that their phylogeny must be

taken into account. In many cases, male-male combat occurs in species presenting prepollical spines (Faivovich et al., 2005), but this is not the case of *I. langsdorffii* and other species of the tribe Lophiohylini. Combat in species of such a tribe is not common; however, Silva (2006) reported disputes between *Trachycephalus mesophaeus* males over the possession of females during amplexus. These disputes include shoves and kicks in order to dislodge rivals and may involve up to 12 males per female. Our study represents the first record of combat between *Itapotihyla langsdorffii* males and enhances the knowledge about the natural history of species of the tribe Lophiohylini.

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CLELIA PLUMBEA (mussurana): PREY. The genus *Clelia* currently comprises eight species of medium to large size Pseudoboini snakes found in almost all Neotropical regions, from Mexico to Argentina: *Clelia clelia* (Daudin, 1803), *Clelia equatoriana* (Amaral, 1924), *Clelia errabunda* (Underwood, 1993), *Clelia hussami* Morato, Franco & Sanches, 2003, *Clelia langeri* Reichle & Embert, 2005, *Clelia plumbea* (Wied, 1820), *Clelia rustica* (Cope, 1878) and *Clelia scytalina* (Cope, 1867) (Zaher, 1996; Reichle & Embert, 2005; Zaher et al., 2009). Seldom seen, these snakes are probably suffering population decreases making natural history information important (Pizzatto, 2005).

Clelia plumbea occurs from south of the Amazon river in the Brazilian Amazon basin, through the Cerrados of central Brazil and the Atlantic Rainforest in Brazil, Argentina and

Paraguay (Zaher, 1996; Scott-Jr. et al., 2006). It can be easily distinguished from its congeners by a completely spineless hemipenis and the presence of 19 dorsal scale rows at midbody. It also lacks a left lung and dorsally convex Duvernoy's glands (Zaher, 1996).

Species of the genera *Boiruna*, *Clelia* and *Mussurana* are known as snake predators but there is still much to learn about their diets. Pinto & Lema (2003) examined the stomach contents of 42 specimens and identified the non-venomous snakes *Echinanthera cyanopleura* (Cope, 1885) and *Liophis miliaris* (Linnaeus, 1758), the pit-viper *Bothrops jararaca* (Wied, 1824), and the four-eyed opossum *Metachirus nudicaudatus* (E. Geoffroy, 1803) as prey items. Teixeira & Vrcibradic (2003) reported scavenging behaviour after collecting a specimen that ingested an apparently road-killed *Liophis miliaris*. Bernarde & Abe (2010) documented the rainbow boa *Epicrates cenchria* (Linnaeus, 1758) as prey of *C. plumbea* in southwestern Amazon. Herein, we report the predation by *C. plumbea* on another snake species, the pit-viper *Bothrops moojeni* Hoge, 1966.

On 02 May 2008, at 22:00, on a road at Cavalcante (GO-241), state of Goiás, in Cerrado area of central Brazil (13°47'13.04" S, 47°23'38.18" W) LOD found a male *C. plumbea* (107.4 cm SVL; 25.2 cm Tail L) ingesting a dead *Bothrops moojeni* (male; 70.3 cm SVL; 12.6 cm Tail L) (Fig. 1). The predator was collected and induced to regurgitate its meal, which was likely road-kill, determined by having a wound near the cloacal region, and some exposed viscera. The ground was also stained with blood, probably from the pit-viper.

Our observation represents a new prey record for *C. plumbea* and contributes a second record of scavenging by this species. Although poorly reported for most snake species, scavenging behaviour is apparently widespread in the group, since carrion provides a food source that can be obtained relatively safely and with low energetic costs compared to live prey (Sazima & Strüssman, 1990; DeVault & Krochmal, 2002). Additionally, dead animals can often be found in predictable places like roadsides (DeVault & Krochmal, 2002). In the case of reptiles, sun-warmed roads are

attractive for thermoregulation, that may result in high rates of road-kill (Shine et al., 2004). During four days of fieldwork (from April 30 to May 03), when the record herein was made, four other road-killed reptiles were found along along 13 km of the GO-241 road; *Crotalus durissus* Linnaeus, 1758, *Leptodeira annulata* (Linnaeus, 1758) and *Oxyrhopus guibei* Hoge & Romano, 1978, and the lizard *Tupinambis quadrilineatus* Manzani & Abe, 1997.

The pit-viper *Bothrops moojeni* occurs in riparian areas in central and southeastern Brazil, throughout the Cerrado morphoclimatic domain (Nogueira et al., 2003). Records of pit-vipers as prey items of *Clelia* and the known resistance of *C. clelia* to the venom of some viperids and elapids suggest a possible adaptive evolutionary relationship between members of this genus and highly venomous serpents (Delia, 2009).

Due to its under-represented status in our collections, *C. plumbea* and its prey (*B. moojeni*) was deposited in the Museu de Ciências Naturais, Pontifícia Universidade Católica de Minas Gerais, Belo Horizonte, MG, Brazil (*C. plumbea* MCN-R 3185; *B. moojeni* MCN-R 3186).

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Figure 1. A male *Clelia plumbea* (MCN-R 3185) regurgitating a road-killed *Bothrops moojeni* (MCN-R 3186) at Cavalcante, state of Goiás, in a Cerrado area of central Brazil. Photograph by L.O. Drummond.

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LACERTA BILINEATA (western green lizard): FIELD INJURY. Reptiles sustain natural injury for many reasons including attacks by predators, accidents and intrasexual conflicts (Borczyk, 2004; Gregory & Isaac, 2005; Meek, 2007). Injuries have important consequences for population ecology, including loss of body condition, reduced mobility and decreased alertness to predators, factors that may ultimately impact on survival (Harris, 1989). This note reports on a field injury in a western green lizard *Lacerta bilineata*. On 31 April 2010 an adult male *L. bilineata* was found alive, but apparently immobile, on a minor road near the village of Chasnais in the Vendée, France (46°27'N). The road was bordered by a hedgerow and woodland on one side and agricultural land and a grassy clearing on the other. The weather was sunny with air temperature approximately 20°C. The lizard presented no resistance and was easily collected. It measured 105 mm snout to vent length and had a partly regenerated tail. It had sustained head trauma with lacerations to the right eye and jaw musculature that appeared to have been caused by the teeth of another animal (Fig. 1A).

The lizard was housed in a vivarium and given basic medical treatment (antibiotics and wound care) and after three days began feeding on wax worms and mealworms dusted with a multivitamin supplement. General recovery was relatively rapid, healing taking no more than 14 days, with improvement to the eye wound noticed on 20 May. General recovery was apparent by 6 June. Perhaps unexpectedly, the lizard appeared to have regained use of the injured eye, although vision may have been impaired to some extent since it did not open fully (Fig. 1B). The lizard was released on 26 June. Reptiles frequently suffer head injuries in the field and survive (Borczyk, 2004; Meek, 2007), although in this instance possible limited eye use would surely limit survivorship potential, reducing abilities to detect predators and secure prey items.

Predators of *L. bilineata* are numerous in the locality, as indicated by the frequency of individuals with tail loss, which has been related to the abundance of *Hierophis viridiflavus* (Rugiero & Luiselli, 2004; Luiselli et al., 2005), a common species in the area. Other potential predators include mustelids and birds of prey.

Given the lizard's immobile condition and location when found, however, it might be expected that a predator would have followed up the attack. A second possibility is intraspecific combat. This species is highly territorial, particularly during April and May when male combat is intense, with serious injury and even death resulting from encounters (Beebee & Griffiths, 2000). Adult males in this area measure up to 119 mm snout to vent length (Meek, 2009; Meek pers. obs.) and a smaller male might be expected to fare poorly in such encounters. If the injury did indeed result from male combat, it highlights the consequential costs of such behaviour by increasing the probability of additional life threatening situations, including mortality from road traffic (Lebboroni & Corti, 2006; Meek, 2009) and increased vulnerability to predators.

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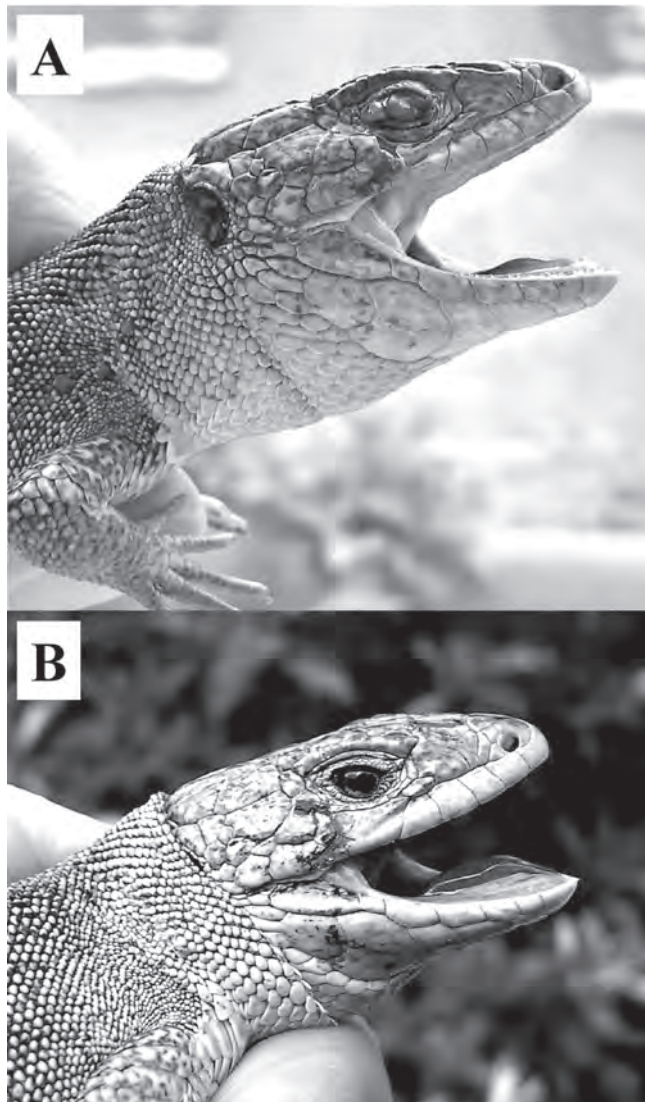
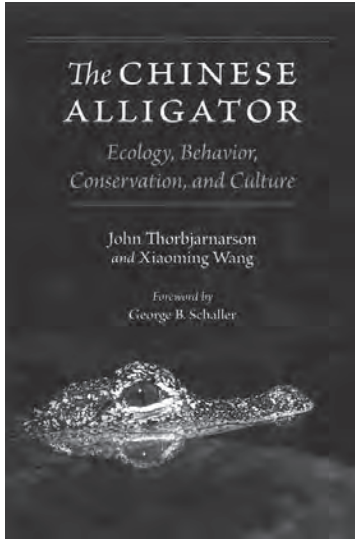


Figure 1. Western green lizard *Lacerta bilineata* showing lacerations to right eye and jaw musculature (A) and after recovery (B).

BOOK REVIEWS

The Chinese Alligator: Ecology, Behavior, Conservation and Culture

John Thorbjarnarson and Xiaoming Wang
2010, John Hopkins University Press, 265 pp.



When it comes to rare and endangered animals, there is usually a good selection of literature available. Unfortunately the same cannot be said for the Chinese alligator. Its scarcity in the wild and the fact that its home range is well within the confines of Red China has probably contributed to this. The lack of information on this animal becomes all too apparent once you start to read this book.

The authors, Xiaoming Wang and the late Thorbjarnarson, had unique access to this animal in both the wild and in captivity within the captive breeding centres set up in China to help save the Chinese alligator from extinction. They have compiled what seems like every available known detail that there is within this book. Due to the lack of research in the wild because of its scarcity, the American alligator is continually referred to throughout the book for comparisons.

The first chapter deals with the authors' personal experiences of visiting the last remaining sites where wild populations still occurred and the captive breeding centres set up to help save the

species. They paint a pretty bleak picture of this animal's fate in the wild which sets the general tone of the book. The account details the lack of suitable remaining habitat and sustainable wild populations. The second chapter covers crocodilians in general and conservation efforts around the world, again, using the American alligator as a comparison.

From here things start to go off a little on a tangent. Possibly due to the lack of information on this species or because the authors wish to give readers a better feel for the last remaining areas where they can be found, the next couple of chapters cover the history of crocodilians in China and the possibility of alligators being the origin of the mythical dragons of folklore, both western and eastern. The authors discuss the alligator's place in Chinese culture throughout history and its association with various superstitions and myths. As these chapters account for more than one fifth of the actual text, I think they would probably have served better towards the end of the volume and seem to hold you back to getting to the "meat" of the book.

After this the authors finally get down to the finer details of the alligator's ecology and behaviour. This chapter gives us an in-depth and detailed account of the Chinese alligator both in the wild and within the captive breeding centres. The information is concise and well documented, covering everything from reproductive strategies and hibernation to population dynamics and diet. The only disappointment with this chapter is the lack of detailed colour photographs. With such an enigmatic and rare species it is unfortunate not to have captured it visually. Even a simple physical overview of the animal, with colour plates, would be a much welcomed addition.

The final two chapters deal with the existing habitat and population status, and the outlook for this species in the future. Again, these subjects are well covered and comprehensive, detailing existing problems and barriers to conservation efforts and laying out possible strategies for future efforts.

While the future for this animal is bleak, the authors remain optimistic but also realistic, detailing potential for future success. Chinese alligators are on the brink of extinction in the wild, but there

are healthy captive populations. The authors point out that their future in the wild will depend on the ability to provide suitable habitat.

This book is probably the most up-to-date and informative account of Chinese alligators available. While it may not appeal to every reptile enthusiast or herpetologist, it is an incredible resource for anyone dealing with or interested in crocodilians or conservation. The Chinese alligator is a prime example of a species that can come back from the brink of extinction if given the chance and there are valuable lessons to be learned from the account of this species through this book in relation to all endangered species. The inclusion of detailed specimen pictures in future editions would be a welcomed enhancement to the book.

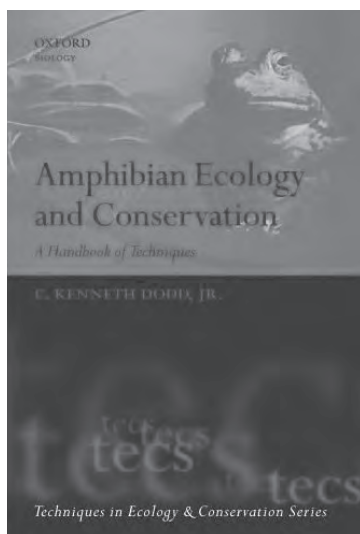
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***Amphibian Ecology and Conservation:
A Handbook of Techniques***

C. Kenneth Dodd
2009, Oxford University Press. 556 pp.



When Heyer et al. (1994) arrived in press it was a perfectly poised manual for all amphibian biologists and ecologists. It became an important purchase for people designing research experiments for amphibians. I read it cover to cover and put its methods into action. A decade later *Amphibian Ecology and Conservation: A Handbook of Techniques* has arrived. Kenneth Dodd states that the book is not a replacement for Heyer et al. (1994) but prefers to consider it an addition to it, presenting modern methods that supplement it.

When browsing through the contents it is clear that *Amphibian Ecology and Conservation: A Handbook of Techniques* brings together a distinguished, international group of amphibian ecologists to provide a state-of-the-art review of many of the newer and exciting techniques used to study amphibians, investigate their populations and determine their conservation status.

The book is divided into five parts. Part 1 discusses the study of amphibians and how to design clear and focused research objectives. Part 2 includes chapters on larval morphology, sampling, project design, dietary analysis and water quality. Part 3 includes chapters on marking, egg mass, egg counts, diet, home range and tracking movements and terrestrial experimentation. Part 4 includes chapters on amphibian populations, sampling methods for capture and detection, trapping, area-based survey methods, rapid assessment, auditory survey methods and measuring habitat covariates. Part 5 addresses amphibian communities and provides chapters on estimating diversity, landscape ecology, conservation and management of amphibian populations.

I found the most useful chapters to be the modern technique summaries such as landscape ecology, larval sampling and biochemical analysis. Methods have raced ahead over the years in these areas and it is a welcome introduction to have huge swathes of literature summarised for easy reading and reference. I especially enjoyed the chapters on the latest statistical approaches in amphibian field ecology, the use of models and the interpretation of their results. Much of this information is scattered in the scientific literature or not readily available. The chapter is also co-written by John Nichols – one of the leading experts in the topic. I was particularly

impressed by the choice of authors invited to edit each chapter.

There are a few typographical errors in some chapters, but hardly worth criticising as they do not detract from the content at all.

This book was written as a reference more than a manual for graduate students, researchers and conservationists, and it will likely serve this purpose well. It is succinctly written and its English is accessible for those who do not come from an academic background. A useful glossary is also provided.

I will be recommending that students use both Heyer et al. (1994) and Dodd as there are still many useful undergraduate techniques in Heyer et al. (1994) that are not covered in, or preplaced by, Dodd (e.g., collection and tissue preservation,

specific to amphibians). Together, considering the two texts side-by-side will save painstaking amounts of literature surfing for any amphibian biologist and provide essential cornerstones for all amphibian research programmes.

REFERENCES

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