

The  
**HERPETOLOGICAL  
BULLETIN**

Number 108 – Summer 2009



PUBLISHED BY THE  
**BRITISH HERPETOLOGICAL SOCIETY**

Contents

NEWS REPORTS . . . . . 1

RESEARCH ARTICLES

A survey of reptiles and amphibians on Kinmen Island, Taiwan  
*Daniel Saenz, Heather V. Podlipny, Pei-Yu Tasi, D. Brent Burt and Hsiao-Wei .  
Yuan . . . . . 3*

Sighting record and range extension of *Calliophis* (= *Callophis*) *bibroni* Jan, 1858  
(Reptilia, Squamata, Serpentes, Elapidae)  
*P. Gowri Shankar and S. R. Ganesh . . . . . 10*

Frogs of Dominica, with notes on habitat use by two species of *Eleutherodactylus*  
*Ruth E. Carter, Craig S. Berg, Jeffrey W. Ackley and Robert Powell . . . . . 14*

Coelomic helminths in the Northern Cat-eyed Snake, *Leptodeira septentrionalis*  
(Serpentes: Colubridae) from Costa Rica  
*Stephen R. Goldberg and Charles R. Bursey . . . . . 24*

First record of *Trachemys dorbigni* (Duméril & Bibron, 1835) (Testudines, Emydidae)  
in a remnant of mesophytic semideciduous forest of São Paulo State, southeastern  
Brazil  
*Tiago Gomes dos Santos, Tiago da Silveira Vasconcelos, Flavio de Barros . . .  
Molina and Hussam Zaher . . . . . 27*

CAPTIVE HUSBANDRY

Aspects of captive husbandry of Taylor's Bug-eyed Frog, *Theloderma stellatum*  
(Taylor, 1962)  
*Benjamin Tapley . . . . . 31*

NEW METHODOLOGIES

The Snake Box: a novel approach for safely restraining venomous snakes  
*Thomas Long and Andre Pires-daSilva . . . . . 34*

NATURAL HISTORY NOTES

*Philodryas nattereri* (Paraguay Green Racer): ophiophagy  
*Paulo Cesar Mattos Dourado de Mesquita and Diva Maria Borges-Nojosa . 36*

*Siphlophis longicaudatus* (Brazilian Spotted Night Snake): habitat  
*Laura Rodrigues Vieira de Alencar, Alexandre Ferreira Righi, Luciana Barreto  
Nascimento and Sérgio Augusto Abrahão Morato . . . . . 37*

*Ablepharus kitaibelii* (Snake-eyed Skink): habitat  
*Alex J. Ramsay and Todd R. Lewis . . . . . 40*

# THE HERPETOLOGICAL BULLETIN

---

*The Herpetological Bulletin* is produced quarterly and publishes, in English, a range of articles concerned with herpetology. These include society news, selected news reports, full-length papers of a semi-technical nature, new methodologies, natural history notes, book reviews, letters from readers and other items of general herpetological interest. Emphasis is placed on natural history, conservation, captive breeding and husbandry, veterinary and behavioural aspects. Articles reporting the results of experimental research, descriptions of new taxa, or taxonomic revisions should be submitted to *The Herpetological Journal* (see inside back cover for Editor's address).

ISSN 1473-0928

© The British Herpetological Society. All rights reserved. No part of this publication may be reproduced without the permission of the Editor.

Printed by: Bruce Clark (Printers), Units 7-8, Marybank Lane, Dundee, DD2 3DY.

---

## Guidelines for contributing authors

1. Authors are advised to consult the BHS Website or contact the editor for full guidelines. Contributions should be submitted preferably in electronic form, either by e-mail or as text files on CD or DVD in Windows® format only. The Bulletin is typeset directly from the author's electronic file, so wherever possible all manuscripts should be prepared using standard word-processing software. Articles should be arranged in the following general order: *Title*; *Name(s)* of author(s); *Address(es)* of authors (please indicate corresponding author); *Abstract* (optional - if included should not exceed 10% of total word length); *Text*; *Acknowledgements*; *References*; *Appendices*. Footnotes should not be included. Refer to this issue for style and format information.
2. High resolution scanned images (TIFF or JPEG files) are the preferred format for submission of illustrations, although good quality slides, colour, and monochrome prints are also acceptable. All illustrations should be entirely relevant to the text and numbered sequentially with Arabic numbers. All images must be sent separately from the contributor's text file and in full resolution.
3. Authors will be informed promptly of receipt of their manuscript. Acknowledgement of the receipt of work **does not** indicate acceptance for publication. All contributions are liable to assessment for suitability and ethical issues, and all articles included in the main 'Research' section are subject to review. The Editor reserves the right to shorten or amend a manuscript, although substantial alterations will not be made without permission of the primary author.
4. Authors are supplied with a portable document file (pdf) of their published article and also receive a complimentary copy of the full printed issue. Slides, artwork, and other original material will be returned following publication.
5. The significance and importance of some articles may be such that the Editor will offer the author a year's free subscription to the Society for their work.
6. The Editor is keenly aware that contributors may find some of these instructions difficult to comply with and is anxious that the pages of the Bulletin should remain open to as wide a range of correspondents as possible. Therefore, if an author has concerns about the suitability of a manuscript, or would like help in preparing it, please contact the Editor to discuss.

**Further information for contributing authors is available at:** [www.thebhs.org](http://www.thebhs.org)

The views expressed by the contributors to the Bulletin are not necessarily those of the Editor or the British Herpetological Society.

All manuscript submissions and correspondence arising from the Bulletin should be sent to the Editor, Todd Lewis, Westfield, 4 Worgret Road, Wareham, Dorset BH20 4PJ, United Kingdom, [herpbulletin@thebhs.org](mailto:herpbulletin@thebhs.org). Books submitted for review purposes should be sent directly to the Reviews Editor, Neil D'Cruze (contact details on inside back cover of this issue).

# BRITISH HERPETOLOGICAL SOCIETY COUNCIL 2009/2010

Society address: c/o Zoological Society of London, Regent's Park, London NW1 4RY

Website: [www.thebhs.org](http://www.thebhs.org)

<b>President:</b>	Prof. T.J.C. Beebee	Department of Biochemistry, School of Life Sciences, University of Sussex, Falmer, Brighton BN1 9QG. <a href="mailto:t.j.c.beebee@sussex.ac.uk">t.j.c.beebee@sussex.ac.uk</a>
<b>Chairman:</b>	Mr. J. Coote	<a href="mailto:chair@thebhs.org">chair@thebhs.org</a>
<b>Treasurer:</b>	Mr. M. Wise	Tel: +44 (0)207 793 1102 (eves) or +44 (0)7531 336995. <a href="mailto:treasurer@thebhs.org">treasurer@thebhs.org</a>
<b>Secretary:</b>	Mr. T. Rose	11 Strathmore Place, Montrose, Angus DD10 8LQ. Tel: +44 (0)1674 671676; Mob: 07778 830192. <a href="mailto:secretary@thebhs.org">secretary@thebhs.org</a>

## *The Herpetological Journal*

<b>Receiving Editor:</b>	Dr. R. Jehle	Salford University, School of Environment & Life Sciences, Peel Building, Salford Crescent, Salford, Greater Manchester M5 4WT. Tel: +44 (0)161 295 2146. <a href="mailto:herpjournal@thebhs.org">herpjournal@thebhs.org</a> or <a href="mailto:r.jehle@salford.ac.uk">r.jehle@salford.ac.uk</a>
<b>Managing Editor:</b>	Dr. E. Price	International Training Centre, Durrell Wildlife Conservation Trust, Les Augrès Manor, La Profonde Rue, Trinity, Jersey JE3 5BP. <a href="mailto:eldom@jerseymail.co.uk">eldom@jerseymail.co.uk</a>

## *The Herpetological Bulletin*

<b>Editor:</b>	Mr. T.R. Lewis	Westfield, 4 Worgret Road, Wareham, Dorset BH20 4PJ. <a href="mailto:herpbulletin@thebhs.org">herpbulletin@thebhs.org</a>
<b>Co-Editor</b>	Mr. J.M.R. Baker	Tel: +44 (0)1986 872016. <a href="mailto:johninhalesworth@aol.com">johninhalesworth@aol.com</a>
<b>Reviews Editor:</b>	Mr. N. D'Cruze	The World Society for the Protection of Animals, 89 Albert Embankment, London SE1 7TP. <a href="mailto:neildcruze@wspa.org.uk">neildcruze@wspa.org.uk</a>

## *The Natterjack*

<b>Editor:</b>	Ms. M. Lock	54 Hillside, Dover, Kent CT17 0JQ. <a href="mailto:natterjack@thebhs.org">natterjack@thebhs.org</a>
----------------	-------------	---

<b>Librarian:</b>	Mr. D. Bird	Jacaranda Cottage, New Buildings, Spetisbury, Blandford Forum, Dorset DT11 9EE. <a href="mailto:drbird.herpl@virgin.net">drbird.herpl@virgin.net</a>
-------------------	-------------	--

<b>Development Officer:</b>	Mr. M. Hollowell	<a href="mailto:markh22@btinternet.com">markh22@btinternet.com</a>
-----------------------------	------------------	--

<b>Webmaster:</b>	Vacant.	
-------------------	---------	--

<b>Conservation Officer:</b>	Mrs. J. Clemons	34 Montalt Road, Cheylesmore, Coventry CV3 5LU. <a href="mailto:janice.clemons@virgin.net">janice.clemons@virgin.net</a>
------------------------------	-----------------	--

<b>Trade Officer:</b>	Mr. P. Curry	90 Brook Crescent, Chingford, London E4 9ET. <a href="mailto:peter.curry@eurorep.co.uk">peter.curry@eurorep.co.uk</a>
-----------------------	--------------	---

## **Captive Breeding Committee**

<i>Chairman:</i>	Dr. S. Townson	103 Chancellors Road, Stevenage Old Town, Hertfordshire SG1 4TZ. <a href="mailto:simon.townson@ntlworld.com">simon.townson@ntlworld.com</a>
------------------	----------------	---

## **Education Committee**

<i>Chairman:</i>	Mr. D. Freeman	272 Whaddon Way, Bletchley, Milton Keynes MK3 7JP.
------------------	----------------	--

## **Research Committee**

<i>Chairman:</i>	Dr. C. Glead-Owen	CGO Ecology Limited, Flat 5 Cranbourne House, 12 Knole Road, Bournemouth, Dorset BH1 4DQ. <a href="mailto:research@thebhs.org">research@thebhs.org</a>
------------------	-------------------	--

## **North-West England Group Representative:**

Mr. R. Parkinson	24 Orwell Close, Bury, Lancashire BL8 1UU. <a href="mailto:northwest@thebhs.org">northwest@thebhs.org</a>
------------------	---

## **Scottish Groups**

<i>Liaison Officer:</i>	Mr. F. Bowles	37 Albany Terrace, Dundee DD3 6HS. <a href="mailto:fdb@bowles.org.uk">fdb@bowles.org.uk</a>
-------------------------	---------------	---

## **Ordinary Members**

Mr. N. D'Cruze	WSPA, 89 Albert Embankment, London SE1 7TP. <a href="mailto:neildcruze@wspa.org.uk">neildcruze@wspa.org.uk</a>	(2 <sup>nd</sup> year)
Mrs. J. Spencer	Corn Barn Cottage, Moorside Farm, Station Road, Backwell, Somerset BS48 1TH. Tel: +44(0)1275 858243. <a href="mailto:jspencer@bristolzoo.org.uk">jspencer@bristolzoo.org.uk</a>	(1 <sup>st</sup> year)
Mr. D. Willis	<a href="mailto:davewillishbs@yahoo.co.uk">davewillishbs@yahoo.co.uk</a>	(1 <sup>st</sup> year)

## **Fellows of the British Herpetological Society**

Prof. T.J.C. Beebee, Prof. J. Cloudsley-Thompson, Mrs. M. Green, Dr. R.A. Griffiths, Mrs. E. Haslewood, Mr. T.A. Rose, Mr. V.F. Taylor, Dr. S. Townson.

## **Past Presidents (retiring date)**

Dr. M.A. Smith (1956), Dr. J.F.D. Frazer (1981), The Earl of Cranbrook (1990), Prof. J.L. Cloudsley-Thompson (1996), Dr. R. Avery (1997), Dr. H. Robert Bustard (2005)

---

## NEWS REPORTS

---

### NEW POPULATION OF MOUNTAIN YELLOW-LEGGED FROG (*RANA MUSCOSA*) DISCOVERED

For the first time in nearly 50 years, a population of a nearly extinct frog has been re-discovered in the San Bernardino National Forest's San Jacinto Wilderness. Biologists from the U.S. Geological Survey (USGS) assessing suitability of sites to re-establish frogs and scientists from the San Diego Natural History Museum retracing a 1908 natural history expedition both rediscovered the rare Mountain Yellow-legged Frog (*Rana muscosa*) in the San Jacinto Wilderness near Idyllwild, California (Fig. 1 and 2).



**Figure 1.** *Rana muscosa* in amplexus.

© Vance T. Vredenburg

This re-discovery, along with the San Diego Zoo's first successful breeding of the frog in captivity, and successful efforts by California Department of Fish and Game to restore frog habitat, renews hope of survival for this southern California amphibian. Globally, amphibians are on the decline because of habitat loss, effects of climate change and the spread of Chytrid fungus. The Mountain Yellow-legged Frog is one of three frogs or toads on the federal Endangered Species List in southern California.

Prior to this recent discovery, USGS researchers had estimated there were only 122 adult Mountain Yellow-legged Frogs in the wild. USGS and San Diego Natural History Museum biologists found the endangered frog during separate trips in June 2009. The frogs were

spotted at two locations about 2.5 miles apart in the Tahquitz and Willow creeks in the San Jacinto Mountains. The number of frogs in the area has not yet been determined. 'If this population is large, it could play an important role in the re-establishment of this species across Southern California,' said Adam Backlin, a USGS scientist who led the survey team that spotted the first new Tahquitz Creek frogs on June 10. Biologists from the San Diego Natural History Museum made their find June 25. The museum scientists were retracing the path of a 1908 expedition by the Museum of Vertebrate Zoology, University of California, Berkeley. During that expedition, which covered all elevations and faces of the



**Figure 2.** *Rana muscosa* mountain habitat.

© Vance T. Vredenburg

San Jacinto Mountain region, the frog was collected at five sites. The San Diego Natural History Museum's team is searching for all species of vertebrates in a study of biological change in the region. The biologists were in the Tahquitz Valley area the week of June 21 when Drew Stokes, a field biologist with the museum, found and photographed a single Mountain Yellow-legged Frog in Willow Creek, a tributary of Tahquitz Creek.

The museum's study will continue until biologists have completed three surveys at each of the 19 sites studied by the 1908 expedition. Mountain Yellow-legged Frogs are not known to migrate far, possibly indicating a significant population. The size of the site represents much more habitat than occupied by the eight other

Mountain Yellow-legged Frog populations in the San Jacinto, San Bernardino, and San Gabriel mountain ranges. In those areas, the frog occupies less than half a mile of stream. This rediscovery is a windfall for all the partners working to increase the number of Mountain Yellow-legged Frogs in the wild by government and non-profit partners.

In addition to the USGS and the San Diego Natural History Museum, the effort involves collaboration between the San Diego Zoo's Institute for Conservation Research, California Department of Transportation (Caltrans), U.S. Fish and Wildlife Service, U.S. Forest Service, University of California and California Department of Fish and Game. The San Diego Zoo's Institute for Conservation Research was the first to breed Mountain Yellow-legged Frog in captivity. That amphibian has recently metamorphosed from a tadpole into a juvenile frog. 'Historically, scientists have had great difficulty breeding frogs in captivity,' said Jeff Lemm, an animal research coordinator for the San Diego Zoo. 'We are excited by this success and cautiously optimistic we will have more eggs soon.'

In December 2008, researchers at the Institute for Conservation Research discovered a clutch of about 200 eggs in one of its tanks. Researchers were surprised because the frogs were younger than is typical for breeding. Because of the frogs' young age, only a handful of the eggs were fertile. The one frog to mature is thriving. The next breeding season is expected to be December 2009 to March 2010. The goal of the breeding program is to return the Mountain Yellow-legged Frog to its native habitat. The Zoo's breeding programme, in conjunction with its partners, began after the rare frogs were rescued from a drying creek. Anne Poopatanapong, a wildlife biologist for the San Jacinto Ranger District in the San Bernardino National Forest was monitoring declining creek water levels in Dark Canyon in August, 2006, when she noticed many pools drying up, including one where frogs had been living. Concerned about losing the tadpoles, she called the Fish and Wildlife Service and the salvage effort started the next day. A USGS

team led by Dr. Robert Fisher rescued 82 tadpoles, which were taken to the San Diego Zoo's Institute for Conservation Research. The frog recovery effort has been funded by Caltrans in part to mitigate for emergency work to stabilize a slope near the frog's habitat on state Route 330 in the San Bernadino Mountains. 'The emergency slope reconstruction project had the dual benefit of opening a road that was about to fail as well as helping to ensure that the last known population of the Mountain Yellow-legged Frog in the San Bernardino Mountains had a programme in place to aid the frog's recovery,' said Craig Wentworth, a senior environmental planner/biologist with Caltrans. Jim Bartel, the field supervisor for the Fish and Wildlife Service office in Carlsbad, said his agency is pleased to participate in the effort to rescue the Mountain Yellow-legged Frog and conserve its remaining riparian habitat. 'We look forward to reintroducing the species to its native habitat,' Bartel said.

Habitat protection and restoration, combined with efforts to reintroduce these frogs to areas where they have been decimated, offer the best hope of returning Mountain Yellow-legged Frogs in southern California to a healthy, self-sustaining population. The California Department of Fish and Game is dedicated to the completion of the Little Rock Creek trout removal project to benefit the endangered Mountain Yellow-legged Frog. Working with USGS and U.S. Fish and Wildlife Service, trout populations have been significantly reduced in Little Rock Creek in the Angeles National Forest. As a result, frog presence in the section of the creek where the fish were removed has increased, demonstrating the success of this collaborative effort.

Adapted from:

Salzberg, A. (2009). Population of nearly extinct Mountain Yellow-Legged Frog discovered. *Herpetol. Digest*, 9 (34), 4. (Online: Accessed 2 August 2009).

Submitted by: TODD R. LEWIS (EDITOR)

## A survey of reptiles and amphibians on Kinmen Island, Taiwan

DANIEL SAENZ<sup>1,4</sup>, HEATHER V. PODLIPNY<sup>2</sup>, PEI-YU TASI<sup>3</sup>,  
D. BRENT BURT<sup>2</sup> and HSIAO-WEI YUAN<sup>3</sup>

<sup>1</sup> Southern Research Station, Forest Service, U.S. Department of Agriculture, 506 Hayter Street,  
Nacogdoches, Texas 75965-3556, USA.

<sup>2</sup> Department of Biology, P. O. Box 13003, Stephen F. Austin State University, Nacogdoches, Texas  
75962-3003, USA.

<sup>3</sup> School of Forestry and Resource Conservation, National Taiwan University, Taipei, Taiwan.

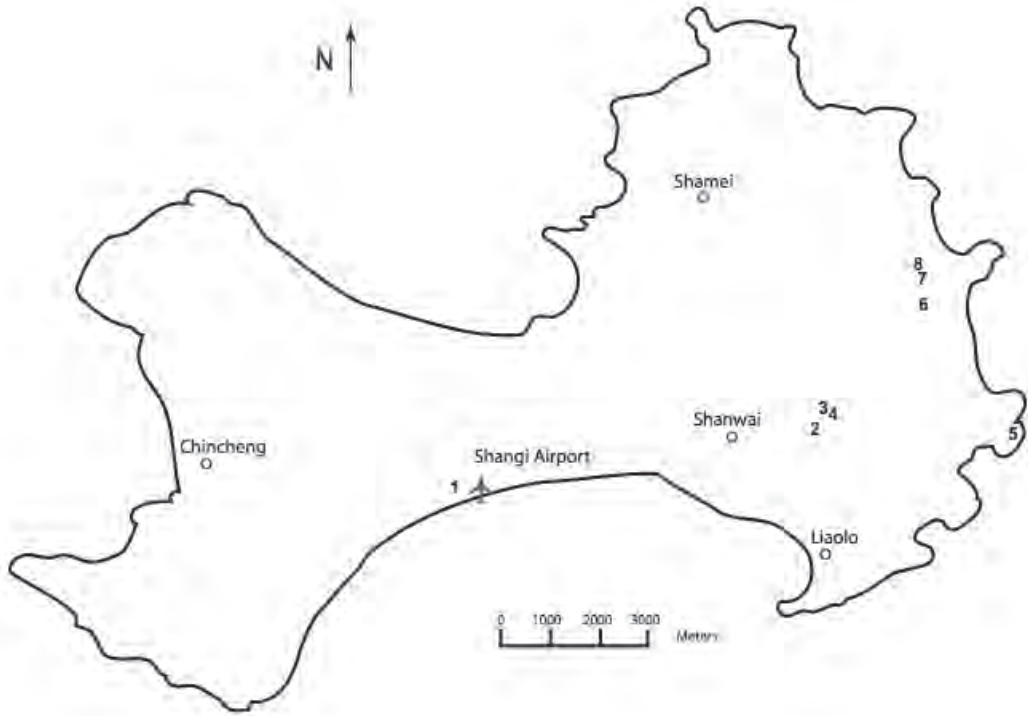
<sup>4</sup> Corresponding author: [dsaenz@fs.fed.us](mailto:dsaenz@fs.fed.us)

**ABSTRACT** - Little is known about the reptiles and amphibians of Kinmen Island, Taiwan. Until recently, Kinmen had been off-limits to outsiders. It was not until the mid 1990s that civilian travel was allowed to and from the island. We surveyed eight sites from 19 May through 18 July 2005, using 15 m drift fences with collapsible funnel traps on the ends. We observed 258 individuals of seven species during our survey. The herpetofauna encountered consisted of two anuran, two lizard, and three snake species. The two anuran species made up over 97% of the individuals captured in traps. Reptiles were encountered or captured less frequently. Since we sampled a limited number of sites, our study serves as a basis upon which future reptile and amphibian inventory studies, conducted on Kinmen, could be based. A more thorough inventory is needed to fully understand the natural history of herpetofauna on the island.

**H**ISTORICALLY, Kinmen Island (also known as Greater Quemoy) has been a significant outpost during the Chinese civil uprisings (Clark & Tsai, 2002). The massive construction of ships by the late Ming patriot Cheng-Kung, who fought against the Manchu court of the succeeding Ching Dynasty, denuded the island of trees in the mid 17<sup>th</sup> Century. The deforestation lasted nearly 300 years (Lai, 2004) causing shifting sand dunes that buried entire villages on the east side of the island and erosion that shaped the modern landscape (Clark & Tsai, 2002). In more recent times, after the Chinese Civil War, the island was the site of extensive military shelling between the People's Republic of China (PRC) and the Republic of China forces (ROC) in the 1950s and 1960s (Chang & Di, 1993). A long-time military outpost, the island was returned to the civilian government in the mid-1990s and travel to and from Taiwan was allowed. Although Kinmen is administered by the ROC, it is also claimed as part of the territory of the PRC. Direct travel between mainland China and Kinmen was opened in 2002 and there has subsequently been extensive development on the island. Currently, Kinmen has a population of

approximately 50,000 people. Reforestation has taken place with the planting of *Casuarina equisetifolia*, *Acacia confusa* and *Pinus elliottii*. Wooded land now covers 50% of the island (Clark & Tsai, 2002). Many reservoirs, artificial lakes, and fish ponds have also been constructed for storing water, aquaculture, irrigation, and for recreation on the island (Hung et al., 2004).

Kinmen Island, Taiwan is approximately 134 Km<sup>2</sup>, and is located ca. 11 Km east of Xiamen, Fujian Province, China, with the shortest distance from the island to the mainland at only ca. 6.9 Km. Kinmen is separated from Taiwan Island by ca. 277 Km of the Taiwan Strait (Clark & Tsai, 2002). Located at 24° 27' N, 118° 23' E, the climate of Kinmen is affected by monsoons. Approximately 80% of the island's precipitation falls between April and September with typhoons often striking the region between July and August. Kinmen's average annual rainfall is ca. 105 cm with a year-round temperature averaging ca. 21°C. The average temperature in the summer is 28.2°C and the winter average is 12.8°C. The island's geology is primarily granite with the highest point, Mt. Taiwu, peaking at 253 m above sea level.



**Figure 1.** Map of Kinmen Island showing the locations of the eight drift fence arrays used in this study (Site 1:24° 25' 40 N, 118° 21'16 E, Site 2:24° 26' 58 N, 118° 26' 09 E, Site 3:24° 27' 05 N, 118° 26' 13 E, Site 4:24° 27' 03 N, 118° 26' 17 E, Site 5:24° 26' 37 N, 118° 28' 13 E, Site 6:24° 28' 07 N, 118° 27' 15 E, Site 7:24° 28' 21 N, 118° 27' 13 E, Site 8:24° 28' 24 N, 118° 27' 12 E).

Little is known about Kinmen island's wildlife due to its history of political isolation. Some restoration efforts to preserve the rare Asian Horseshoe Crab (*Tachypleus tridentatus*; Yang, 2004), Eurasian Otter (*Lutra lutra*; Hung, 2004), and research on nesting birds (Yuan et al., 2006) has been achieved. A single species list of herpetofauna from Kinmen Island was prepared for Kinmen National Park (Lue, 1998). We conducted a herpetofauna trapping survey to determine relative abundance of the herpetofauna of the island and the seasonal phenology of their activity. We also made inferences about the effects of soil type and proximity to water on the occurrence of herpetofauna.

#### METHODS AND MATERIALS

Eight drift fence arrays were built near Blue-tailed Bee-eater (*Merops philippinus*) nesting sites (Fig. 1). The focus of a related study was to

determine the abundance of large predatory snakes, using Bee-eater colonies as feeding grounds (Podlipny, 2006). The drift fences were constructed of either clear, flexible plastic, or thin, fine mesh fabric. Each fence was fifteen meters long and was positioned in front of, and as near to the center of, the colony as possible. Stakes were driven into the ground and the fence material was zip-tied to the stakes. The bottom of the fence was buried approximately 2-5 cm to prevent reptiles or amphibians from crawling underneath. Two collapsible minnow traps were placed at each end of the drift fence for a total of four traps per array in an attempt to capture reptiles or amphibians that reached the fence (Fig. 2). In theory, animals that came in contact with the fence were funneled towards and into one of the traps (Crosswhite et al., 1999). The traps were made of flexible mesh material, stretched over a wire frame, with two entry holes. The tops of the traps were covered





**Figure 2.** A drift fence array in front of a Blue-tailed Bee-eater colony on Kinmen Island in May 2005.

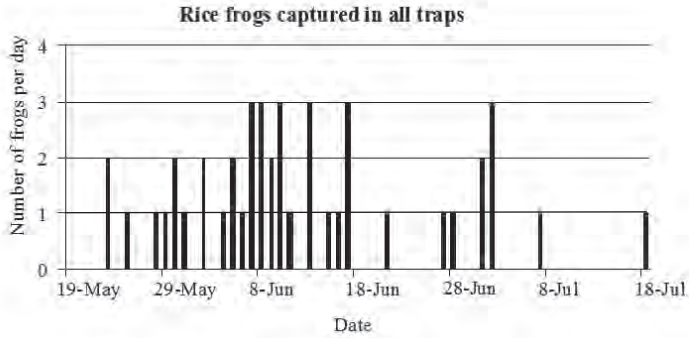
with cardboard to shield captured animals from the sun. Sand was packed up the entrance of each funnel to increase the chance of the animals entering the traps. Traps were checked twice daily; beginning at 06:30 every morning and most afternoons at 16:00. Traps were kept open for most of the bee-eater breeding season, from 19 May through 18 July 2005. In addition to reptiles and amphibians captured in our traps, we also recorded incidents of animals encountered near the trap arrays, and animals encountered en route between arrays. For this study, we considered each drift fence array as a single trap. Four of our traps were

continuously functional for the 61 day trapping period. However, the remaining four traps were not in use for some portion of the time. Traps had to be removed from one site for 17 days because of flooding. Trapping was also not commenced on another site until 20 June 2005, 32 days later than the other sites. Finally, traps at two sites were removed for a six-day period, starting at the end of June and continuing into July, because they could not be checked for logistical reasons. All of the turtle species from Kinmen Island are either sea turtles or freshwater aquatic species (Lue, 1998). Aquatic turtles are not typically captured in

Species	Nomenclature	Total Number
Spectacled Toad	<i>Bufo melanostictus</i>	197
Ornate Rice Frog	<i>Microhyla ornata</i>	44
Elegant Skink	<i>Plestiodon (Eumeces) elegans</i>	4
Bowrings Gecko	<i>Hemidactylus bowringii</i>	1
Checked Keelback Watersnake	<i>Xenochrophis piscator</i>	1/2*
Oriental Ratsnake	<i>Ptyus muscosus</i>	2*/3**
Many-banded Krait	<i>Bungaris m. multicinctus</i>	2**

Notes: \* Individuals observed near traps but not captured within the array; \*\* Individuals observed enroute between traps.

**Table 1.** Total number of reptile and amphibian species recorded from Kinmen Island from 19 May-18 July 2005.



**Figure 3.** Number of Rice frogs (*Microhyla ornata*) captured in all traps on Kinmen Island from 19 May through 18 July 2005.

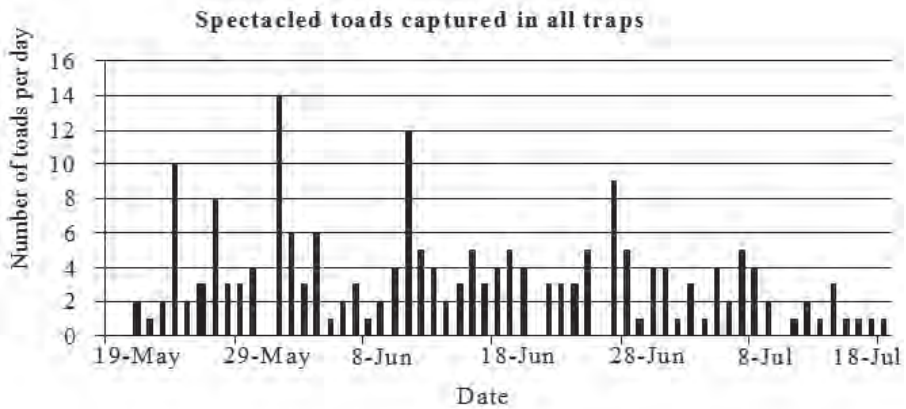
terrestrial drift fence traps like the ones we used. Therefore we excluded this group of reptiles from our study. Although we observed Red-eared Sliders (*Trachemys scripta*), and numerous individuals of at least one other aquatic turtle species in a pond at Kinmen National Park headquarters, we did not attempt to quantify their encounter.

Since our trapping efforts began in mid May, we expected that reptile and amphibian captures would decline as the summer progressed and air temperatures increased. We conducted a Cox and Stuart test for trends (Conover, 1980) to test the null hypothesis that the number of individuals per trap, of a given species captured, did not decline throughout the duration of the study. We tested this

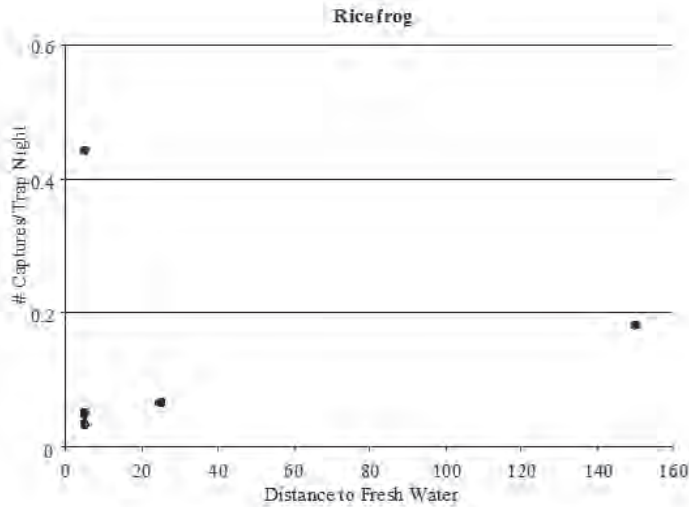
at alpha level 0.05. We only tested for trends on species with at least 40 captures.

**RESULTS**

The eight sites were sampled for reptiles and amphibians for 427 trap days (the cumulative number of days all traps were opened). During our 61 day survey on Kinmen Island, we encountered seven different species of reptiles and amphibians, consisting of two species of anuran, two species of lizard, and three snake species. We captured 247 individuals in our traps, and encountered 11 additional animals (all snakes) either near the traps or en route to the traps, for a total of 258 individuals. Amphibians (the two anuran species)



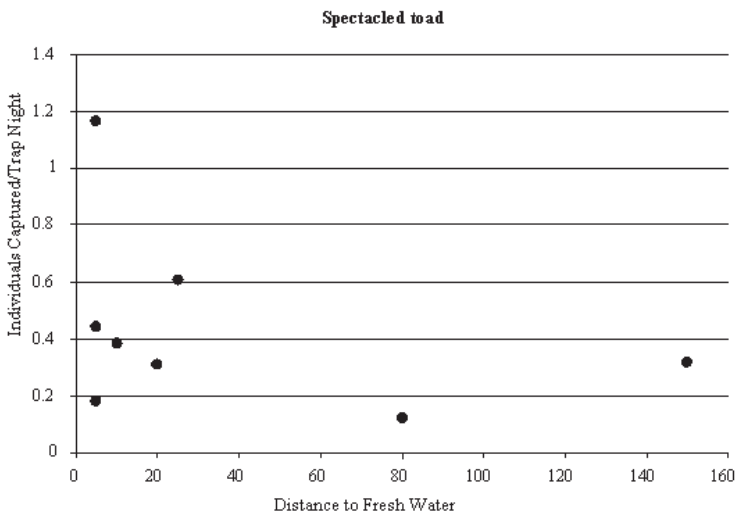
**Figure 4.** Number of Spectacled Toads (*Bufo melanostictus*) captured in all traps on Kinmen Island from 19 May through 18 July 2005.



**Figure 5.** Points represent mean number of individual Rice frogs (*Microhyla ornata*) captured per night at each trap location and the distance of the traps to nearest permanent freshwater source.

made up over 97% of the animals captured in our traps, while the snake species were more frequently encountered near the traps or en route to the traps (Table 1). The Spectacled Toad (*Bufo melanostictus*) and Ornate Rice Frog (*Microhyla ornata*) were the only species that we captured frequently in our traps. We encountered

all other species in very low numbers; less than five individuals of any species during the survey (Table 1). Therefore we only used the most abundant anuran species for analysis. Both species of amphibian were captured throughout the sampling period. However, we found a significant trend for *M. ornata* which was captured frequently



**Figure 6.** The mean number of individual Spectacled Toads (*Bufo melanostictus*) captured per night at each trap location, and the distance of the traps to the nearest permanent freshwater source.

in early months of early in the study but declined as the summer progressed ( $T = 5$ , Fig. 3). However, we could not determine a trend of decreasing captures for *Bufo melanostictus* ( $T = 13$ ; Fig. 4). When we combined all the amphibians, we found a significant trend of more frequent captures early and fewer towards the end of summer ( $T = 8$ ). *B. melanostictus* were captured at all eight trapping arrays at a mean rate of 0.46 individuals per trap day, while *Microhyla ornata* was captured at only five of the sites at a mean rate of 0.10 individuals per trap day. Capture rates for *B. melanostictus* and *M. ornata* might be higher at sites that were closer to permanent water sources (Figs. 5 & 6) but the data was insufficient to test for trends of this.

Only five individual lizards, of two species, were observed during the sampling period and all specimens recorded were captured in different trapping arrays. Snakes were encountered more frequently than lizards, but only one individual was captured in a trap, while 11 were observed near trap arrays or seen en route to an array.

## DISCUSSION

In the 61 days we recorded data on reptiles and amphibians on Kinmen we encountered seven species comprising 70% of the species expected or known to be on the island, excluding turtles. The amphibians were the most easily trapped and greatly outnumbered the reptiles in this survey. Our traps appeared to be quite ineffective at capturing snakes, while other reptiles and amphibians seemed to enter them readily. Future studies may benefit from our experience if they were to use other sampling techniques to better sample the various groups that make up the herpetofauna of the island. Timing of the survey was also important since we found a seasonal shift in the detectability of amphibians in this study.

In addition to the reptile and amphibian species differing in relative abundance, some appeared to differ in their distribution on the island. Some species seem to be ubiquitous while others may be more selective in their choice of habitat. The Spectacled Toad was the most frequently encountered species in the study, being observed at all sampling sites. Given the ability of this toad's skin to resist desiccation, compared with other

amphibians, it was not surprising that it was more widely distributed on the island, even at sites far removed from freshwater sources. However, our study was not intended to determine the habitat use of the various reptile and amphibian species. We focused our efforts mainly in the sandier sites that are typically used by the Blue-tailed Bee-eater in the eastern half of the island (Fig. 1). A more thorough survey could include a wider variety of habitats that are available on the island (see Yuan et al., 2006).

Given the long history of isolation from outsiders the herpetofauna of Kinmen Island is poorly known. Our attempt to survey the reptiles and amphibians of Kinmen is by no means an exhaustive effort and constitutes a brief look at a subset of the species that inhabit the island. It could serve as a basis for future studies. A more thorough survey would be needed to determine the species diversity that inhabit the island. More research would also be needed to understand the relationship between habitats that exist on the island and the relative abundance of the various reptile and amphibian species.

It is important to collect such data in the near future since the island has only recently been opened to travel from the Chinese mainland and Taiwan. Increased travel between these areas and Kinmen Island could possibly lead to colonization of Kinmen Island by additional herpetofauna, or impacts from tourism. Such potential impacts could then be detected with future monitoring studies.

## ACKNOWLEDGEMENTS

We thank Nancy Koerth and Cory Adams for reviewing an earlier draft of this manuscript. We thank Nancy Koerth for her assistance with the statistical analyses in this study. Brent Burt, Heather Podlipny and Dan Saenz received financial support from the Office of Research and Sponsored Programs and the Department of Biology at Stephen F. Austin State University. Heather Podlipny received additional support from a Fellowship from the National Science Foundation's East Asia and Pacific Summer Institutes for U.S. Graduate Students.

## REFERENCES

- Chang, G.H. & Di, H. (1993). The absence of war in the US-China confrontation over Quemoy and Matsu in 1954-1955: contingency, luck, deterrence? *Am. Hist. Rev.* **5**, 1500-1524.
- Clark, E. & Tsai, H.M. (2002). Co-evolution under globalization- boundary lessons from Kinmen Island. Proceedings of IUCN/WCPA-EA-4 Taipei Conference 2002, 423-433.
- Conover, W.J. (1980). *Practical nonparametric statistics, 2nd Edition*. New York: John Wiley.
- Crosswhite, D.L., Fox, S.F. & Thill, R.E. (1999). Comparison of methods for monitoring reptiles and amphibians in upland forests of the Ouachita Mountains. *Proc. Oklahoma Acad. Sci.* **79**, 45-50.
- Hung, C.M., Li, S.H. & Lee, L.L. (2004). Faecal DNA typing to determine the abundance and spatial organization of otters (*Lutra lutra*) along two stream systems in Kinmen. *Anim. Conserv.* **7**, 301-311.
- Lai, M.J. (2004). Vegetation reconstruction on Kinmen Island- an island forest attempt based on ecological engineering. Islands of the World VIII International Conference 2004, 253-259.
- Lue, K.Y. (1998). Reptiles and amphibians of Kinmen. A special report published by Kinmen national park (Chinese only).
- Podlipny, H.V. (2006). Mobbing behavior and nesting success in colonial and solitary Blue-tailed Bee-eaters. M.Sc. Thesis. Texas: Stephen F. Austin State University, Nacogdoches.
- Yang, M.J., Chen, C.A., Yeh, H.Y. Lin, P.F. & Chen, C.F. (2004). Conservation of the Horseshoe Crab for sustainable coastal development on Kinmen Island, Taiwan. Islands of the World VIII International Conference 2004, 377-386.
- Yuan, H.W., Burt, D.B., Wang, L.P., Chang, W.L., Wang, M.K., Chou, C. R. & Ding, T.S. (2006). Colony site choice of Blue-tailed Bee-eaters: influences of soil, vegetation, and water quality. *J. Nat. Hist.* **40**, 485-493.

# Sighting record and range extension of *Calliophis* (= *Callophis*) *bibroni* Jan, 1858 (Reptilia, Squamata, Serpentes, Elapidae)

P. GOWRI SHANKAR<sup>1</sup> and S. R. GANESH<sup>2</sup>

<sup>1</sup> *Agumbe Rainforest Research Station, Agumbe, Thirthahalli Thaluk, Shimogga, Karnataka, India.*  
pogirishankar@rediffmail.com

<sup>2</sup> *Dept. of Zoology, Divn. of Wildlife, A.V.C. College, Mannampandal, Mayiladuthurai, Tamil Nadu, India.*

**C**ALLIOPHIS BIBRONI Jan, 1858 is endemic to the Western Ghats, southern India. It is terrestrial in habit, inhabiting moist deciduous forests within an altitudinal range 900-1000 m. Its distribution records are from three fragmented localities; Muthanza, Wyanad wildlife sanctuary, Kannur district, Silent Valley. The most recent field studies on this species were in 1996 from Parasanikadavu Snake Park, Kerala. The IUCN status for this species has is Endangered (EN), based on criteria that include; restricted distribution, limited location, continuing decline in extent of occurrence, severely fragmented area of occupancy and or quality of habitat. However, as per the Indian Wildlife (Protection) Act, 1972, it is listed in Schedule IV (Anonymous, 2001). This species is known from the Western Ghats as far north as Coorg (Smith, 1943). This article provides a record of two live individuals of *Calliophis bibroni* observed during reptile surveys in and around Agumbe, Karnataka, India. The photographs herein are the first for the species.

## MATERIALS AND METHODS

Meristic and morphological characters such as standard scalation detail, measurement, coloration and body pattern of both the snakes were recorded. These details were collected from the live individuals without using any chemical immobilizing agents. Meristic data included the main, species-specific characters like the number of scales in a row around the body (near the neck, at mid-body and near the vent), number of ventrals, subcaudals, labials and internasals. The dorsal scale rows were counted one head length posterior to head (near neck), in the middle of snout-vent

length (at mid-body) and at one head length anterior to vent (near tail) (David & Vogel, 1998). Scales after the preventrals up to the scale before the anal scale were counted as ventrals (Dowling, 1951) and those after the anal, up to the penultimate scale (i.e., prior to terminal scale) were counted as subcaudals. Scales between rostral and the final scale bordering the jaw angle were counted as supralabials. Scales between the mental and final scale bordering the posterior genials were counted as infralabials. Scales surrounded by supralabials, postoculars and parietals were counted as temporals (Whitaker & Captain, 2004).

Symmetrical head scalation character values were given in left, right order. In addition to meristic data, morphologically diagnosable qualitative characters are also equally significant in species-identification (Vogel et al., 2007). Coloration and pattern present on the dorsum, venter and tail were noted. Morphometry (i.e., snout-vent length, and total body length) were measured with a string and a standard measuring tape (L.C = 1 mm; Butterfly brand) and the values recorded in mm. Sex-determination was done by inserting a thin, smooth, metallic probe. Photographs of the live specimens were taken prior to release. Photographs were documented in natural habitat background, using a Canon EOS 400 D model camera. Geographic coordinates and altitudes (m) of localities of capture were recorded using a Garmin 12™ Channel GPS. Habitat type followed Champion & Seth (1968). The map was modified from Gururaja et al., (2007).

## Coloration in Life (Figs. 1-3 and 5-6)

The snakes were dark purplish above with black

bands that continued on to the ventral region which was bright coral red. Each dorsal body scale was dotted in the middle with scarlet red. Scales were smooth without any carination. Each black band was 3-5 times the scale's width. The inter-band distance was greater (1.5 times) than the band width. The bands were best visible from the lateral region, where the dark black colour contrasted with the scarlet, instead of the dark purple colour on the dorsum. A few bands were laterally divided. The snout and eye were black in colour, with a bright yellowish orange band that almost divides the parietals, which broadens laterally to meet the temporals. The neck was blackish with purple sides. The bands continued from the laterals on to the ventrals, where they fail to meet and form a complete cross band (Fig. 6). Preventrals and first few ventrals were less intensely coloured than the rest.

### Habitus

Head depressed, body moderately slender, neck not evident, tail relatively short.

### Ecological Notes

Two individuals were sighted within eight months in moist deciduous forests at around 600-700 m altitude. They were encountered on the move at night. The snakes flattened their bodies when

handled. Both the snakes were sighted in and around human habitation; the first one from a roadside and the second one from a plantation. The places of sighting were surrounded by houses, paddy, areca nut plantations and some patches of moist deciduous forest. Another coral snake species, *Calliophis nigrescens* was recorded to be syntopic with *C. bibroni* in both localities.

### Locality (Fig. 4)

The first individual was found during September 2007, in Thirthahalli (N 13° 70' E 075° 23') and the second during April 2008, in Mandal Mane (N 13° 40' E 075° 23'). Both locations were present within Shimoga district of Karnataka state.

### DISCUSSION

Precise distribution and collection data for this species is: *Calliophis bibroni* (10) – INDIA: Karnataka: Kodagu: Coorg, BNHS 2119, BMNH 1937.4.3.15; Kerala: Kannur: Thottada, ZSI (Calicut) 18-viii-1996; Kasaragod: Cherupuzha, ZSI (Calicut) 12-vi-1996; Wayanad: Wynad, BMNH, 1922.5.25.58, 72.1.2.7; 3000 ft, BMNH 1946.1.17.93; south India: Unknown, ZSI (Calcutta) 11376; Tamil Nadu: Nilgiris: Mudumallays, BMNH 74.4.29.51, BMNH 74.4.29.53 (Smith et al., 2008).

Only 10 deposited specimens are known for

Characters	Smith, 1943	Individual I	Individual II
Sex	-	Female	Female
Scales (smooth)	13:13:13	13:13:13	13:13:13
Supralabials (enters orbit)	7 (3,4)	6 (3,4)	6 (3,4)
Infralabials	-	5	5
Preocular	Nil	Nil	Nil
Postocular	1	1	1
Loreal	-	Nil	Nil
Temporal	1	1	1
Ventrals	219 – 227	229*	234*
Anal	-	1	1
Subcaudals	25 – 38	32	32
Total body length	775	601	451
Snout-vent length	645	556	416
Number of bands	-	34 on body, 5 on tail.	36 on body, 5 on tail.

**Table 1.** Meristic, morphologic and metric details of two live adult female *Calliophis bibroni*. \* denotes additional data to Smith's data range.



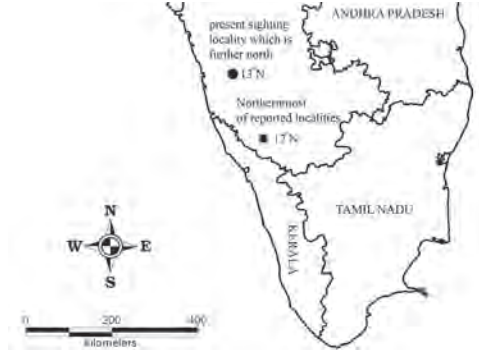
**Figure 1.** *Calliophis bibroni* - dorsal head view showing the black snout and first band across the parietals.



**Figure 2.** *Calliophis bibroni* - ventral head view showing smaller posterior genials, chin shields and preventrals.



**Figure 3.** *Calliophis bibroni* - lateral head view showing orange supralabials and temporals.



**Figure 4.** Map showing extended distribution, modified from Gururaja et al. (2007).



**Figure 5.** Live adult female *Calliophis bibroni* showing various diagnostic characteristics. All photographs by P. Gowri Shankar.



*C. bibroni*. This species was described by Jan, in 1858. The paucity of *C. bibroni* specimens can be clearly understood by the vast time span of almost 150 years, (i.e., from the year of description, to the current records).

Regarding distribution, *C. bibroni* has been recorded only from following localities: Manantoddy, Malabar, Muthanza, Kannur, Silent Valley and Coorg in the states of Kerala and Karnataka (Smith, 1943; Anonymous, 2001; Smith et al., 2008) respectively. These localities fall into the inter-state region in western Nilgiris (12° and 11° N lat. blocks of the Western Ghats). The sighting herein, recorded from Thirthahalli and Kanave (i.e., 13° N lat.) extends the range for the species, considerably northwards, by around 250-300 Km. Moreover, the paucity of sightings and or collection for this species, combined with the extended scalation range and distribution, are noteworthy for the species.

#### ACKNOWLEDGEMENTS

We thank Romulus Whitaker, Founder Director, Agumbe Rainforest Research Station for the support, Mr. Maruthi and Sandesh Kadur for helping us in sighting records.

#### REFERENCES

Anonymous. (2001). Note book for Reptiles. CAMP. CBSG South Asian Reptile Special Interest Group / South Asian Reptile Network, Taxon Data Sheets, 1998, 226 pp.

- Champion, H.G. & Seth, S.K. (1968). *A Revised Survey of the Forest Types in India*. New Delhi, India: Manager of Publications.
- David, P. & Vogel, G. (1998). Redescription of *Trimeresurus huttoni* Smith, 1949 (Serpentes, Crotalinae), with a discussion of its relationships. *Hamadryad* **22**, 73-87.
- Dowling, H.G. 1951. A proposed standard system of counting ventrals in snakes. *British J. Herpetol.* **1** (5), 97-99.
- Gururaja, K.V., Dinesh, K.P., Palot, M.J., Radhakrishnan, C. & Ramachandra, T.V. (2007). A new species of *Philautus* Gistel (Amphibia: Anura: Rhacophoridae) from southern Western Ghats, India. *Zootaxa* **1621**, 1-16.
- Smith, E.N., Arachchi, M.K. & Somaweera, R. (2008). A new species of coral snake of the genus *Calliophis* (Squamata: Elapidae) the central province of Sri Lanka. *Zootaxa* **1847**, 19-33.
- Smith, M.A. (1943). *Fauna of British India, including Ceylon and Burma, Vol. III Serpentes*. London: Taylor & Francis Limited, 583 pp.
- Vogel, G., David, P., Lutz, M., Rooijen, V.J. & Vidal, N. (2007). Revision of the *Tropidolaemus wagleri*-complex (Serpentes, Viperidae, Crotalinae). I: Definition of included taxa and redescription of *Tropidolaemus wagleri* (Boie, 1827). *Zootaxa* **1644**, 1-40.
- Whitaker, R. & Captain, A. (2004). *Snakes of India – The Field Guide*. Chengalpet: Draco Books, 481 pp.



**Figure 6.** (x2) *Calliophis bibroni* - ventral and subcaudal scales showing characteristic scarlet red colour and alternate black patches.

---

# Frogs of Dominica, with notes on habitat use by two species of *Eleutherodactylus*

RUTH E. CARTER<sup>1</sup>, CRAIG S. BERG<sup>2</sup>, JEFFREY W. ACKLEY<sup>3</sup> and ROBERT POWELL<sup>4,5</sup>

<sup>1</sup> Department of Biology, Earlham College, Richmond, IN 47374, USA. recarter07@earlham.edu

<sup>2</sup> Milwaukee County Zoo, Milwaukee, WI 53213, USA. cberg@milwcnty.com

<sup>3</sup> Department of Biology, Eckerd College, St. Petersburg, FL 33711, USA. ackleyjw@eckerd.edu

<sup>4</sup> Department of Biology, Avila University, Kansas City, MO 64145, USA.

<sup>5</sup> Corresponding author: robert.powell@avila.edu

**ABSTRACT** - One species of *Leptodactylus* and three species of *Eleutherodactylus* have been recorded from Dominica, a Lesser Antillean island of recent volcanic origin. The Mountain Chicken Frog (*Leptodactylus fallax*) is native and listed on the IUCN Red List as “critically endangered” due mainly to overhunting, habitat loss, and the effects of chytridiomycosis. *Eleutherodactylus amplinympha* and *E. martinicensis* are native, and the former is an island endemic. *Eleutherodactylus johnstonei* is invasive and thought to have arrived on the island in the aftermath of Hurricane David in 1979. However, it has not been found during recent surveys. Using timed 50- and 100-m transects, we surveyed five sites at different elevations and subjected to varying levels of human and natural disturbances to assess frog numbers, microhabitat associations, and perch heights. Both *E. amplinympha* and *E. martinicensis* used available habitat, demonstrating no apparent bias for particular perches or microhabitats. Both species are polymorphic, but no variation in colour or pattern appears to be specific to either species.

**D**OMINICA, with a topography dominated by nine currently dormant volcanoes, is one of the Windward Islands in the Lesser Antilles. Although monocultures such as banana (*Musa*) and coconut (*Cocos*) are abundant, natural island habitats are proportionately more abundant than on any other West Indian island. This is largely attributable to the lack of level lowlands suitable for sugar plantations and the prevalence of steep slopes that preclude most agriculture (bananas are a notable exception). Natural areas as well as those disturbed by human activities, provide habitats for the 20 species of terrestrial frogs and reptiles known to occur on the island (Malhotra & Thorpe, 1999; Malhotra et al., 2007; Daniells et al., 2008).

Four species of frogs have been recorded from Dominica. *Leptodactylus fallax* (Leptodactylidae; Fig. 1), locally known as the Crapaud or Mountain Chicken, is native. The species also occurs on Montserrat, and once may have occurred on St. Christopher (Johnson, 1988), Guadeloupe, Martinique, St. Lucia, and St. Kitts (Gibson & Buley,

2004). Because of its large size (maximum male SVL 158.7 mm, [Heyer, 1979]; maximum female SVL 210 mm, [Daltry & Gray, 1999]), Mountain Chickens are hunted for food and considered to be delicacies, especially among tourists (Fa et al., 2004). The IUCN Red List designates the species as “critically endangered” (Fa et al., 2004) due to declining populations attributable to over-hunting, anthropogenic habitat losses, volcanic eruptions, hurricanes, and effects of chytridiomycosis (Kaiser & Day, 1995; Fa et al., 2004). On Dominica, this fungal disease reduced populations by 70% between 2002 and 2004 (ZSL, 2008).

Three species of *Eleutherodactylus* (Eleutherodactylidae) have been reported on Dominica. Like most *Eleutherodactylus*, they are small brown frogs characterised by dark canthal and supratympanic lines or bars, light and dark banding on the hindlegs, and two- or three-note rising whistle-like calls. The three species known from Dominica are part of a monophyletic group of Greater Antillean origin and are one another's

closest relatives (Kaiser et al., 1994a). All are highly polymorphic and can be difficult to distinguish without genetic evidence.

*Eleutherodactylus martinicensis* (Fig. 2), locally called Tink Frogs, have tubercles on dorsal surfaces, pink on the inner thighs and venters, slender bodies, and relatively small toepads. Males have bi-lobed glandular vocal sacs and produce a two-note call, which is almost indistinguishable from that of *E. johnstonei* (Kaiser, pers. comm.; Malhotra & Thorpe, 1999). Malhotra & Thorpe (1999) also indicated that *E. martinicensis* has a stippled venter and distinctly spotted throat, but ventral stippling is evident on both *E. martinicensis* and *E. amplinympha* when exposed to daylight (when frogs generally appear to be much darker), but disappears at night (Kaiser et al., 1994a; pers. obs.). The largest recorded male and female were 32 and 47 mm SVL, respectively (Kaiser & Hardy, 1994b). The species is considered native (Hedges et al., 2004a) and is abundant on Dominica. It can be found in disturbed as well as pristine habitats (Ackley et al., 2009), including rainforests, dry woodlands, banana and coconut plantations, gardens, and along streams and roadsides in both lowland and upland areas from sea level to 1,250 m (Henderson & Powell, 2009). Despite this, the IUCN Red List classifies *E. martinicensis* as “near threatened” (Hedges et al., 2004a) because it inhabits less than 5,000 Km<sup>2</sup> and because of the threat of invasive predators, such as cats, rats, and mongooses (which have not become established on Dominica), the effects of pesticides, and possible competition from *E. johnstonei*.

*Eleutherodactylus amplinympha* (Fig. 3) was first recorded as a species distinct from *E. martinicensis* in 1992 (Kaiser & Henderson, 1994), but was not formally described until 1994 (Kaiser et al., 1994a). The species is endemic to Dominica, where it is called the Gounouj. These frogs have slender bodies, pointed snouts, relatively long hind limbs, and comparatively large toepads. Males have bi-lobed glandular vocal sacs and produce a three-note rising call. The largest recorded male is 26.4 mm SVL. Females often exceed 35 mm SVL (Kaiser et al., 1994a) and the largest female recorded had a SVL >50 mm (Malhotra & Thorpe, 1999). The species is restricted to montane habitats

at elevations of 300-1,200 m (Hedges, 1999) and are most abundant at elevations over 700 m in rain and cloud forests, palm brakes, and moss mats on the slopes of Morne Diablotin (Kaiser & Henderson, 1994) and Morne Macaque (Kaiser et al., 1994a). Because of its restricted distribution, high probability of habitat decline due to human expansion, hurricanes, and volcanism, the species is listed as “endangered” on the IUCN Red List (Hedges & Powell, 2004).

*Eleutherodactylus johnstonei* has a smooth dorsal surface, rounded snout, and relatively small toepads. Males have single-lobed glandular vocal sacs and produce a two-note call (Kaiser, pers. comm.; Malhotra & Thorpe, 1999). The largest male and female snout-vent lengths (SVL) recorded are 25 mm and 35 mm, respectively (Kaiser & Hardy, 1994a). These frogs are often associated with disturbed habitats and artificial sites that include roadsides, gardens, plantations, and open areas cleared by hurricanes from sea level to ~1,300 m (Henderson & Powell, 2009). These frogs are remarkable colonisers, with populations on many Lesser Antillean islands as well as Jamaica, Bermuda, Trinidad, Curaçao, and the Neotropical mainland (e.g., Lever, 2003). This species is considered introduced on Dominica. Crombie (in Kaiser, 1992) proposed that the species arrived on the island after Hurricane David in 1979. Johnson (1988) noted the severe damage caused by the hurricane, which presumably provided the disturbed areas *E. johnstonei* exploited during colonisation. Because amphibians are generally intolerant of exposure to salt water, Kaiser (1992) stated that the species probably was not transported by the hurricane. More likely, Dominican *E. johnstonei* arrived as stowaways among vegetables and other supplies from neighbouring islands that were providing aid (Kaiser, 1997). Uncertainty about the origin of these Dominican frogs presumably led Hedges et al. (2004b) to list *E. johnstonei* as a native Dominican species on the IUCN Red List. On some islands, populations established in lowland habitats that have been disturbed by human activity have expanded into more pristine habitats at higher elevations. On St. Vincent (Mallery et al., 2007) and Grenada (Germano et al., 2003) in particular, these frogs have become ubiquitous



*Leptodactylus fallax*.  
Photograph © Arlington James.



*Leptodactylus fallax*.  
Photograph © Jeffrey W. Ackley.



**Figure 1.** *Leptodactylus fallax* (Leptodactylidae), locally known as the Crapaud or Mountain Chicken, is native to Dominica. Photograph © Arlington James.



*Eleutherodactylus martinicensis*.  
Photograph © Robert Powell.



*Eleutherodactylus martinicensis*.  
Photograph © Robert Powell.



**Figure 2.** *Eleutherodactylus martinicensis*, locally called Tink Frogs, are exceedingly variable in colour and pattern.  
▲▼ Photographs © Robert Powell. ▲



*Eleutherodactylus martinicensis*.  
Photograph © Robert Powell.



**Figure 3.** *Eleutherodactylus amplinympha* is endemic to Dominica, where it is called the Gounouj.  
Photograph © Robert Powell.

and may be displacing populations of endemic frogs, *Pristimantis shrevei* and *P. euphronides* (Kaiser, 1997). S.B. Hedges (in Johnson, 1988) also suggested that female *E. junori* on Jamaica have difficulty finding males because the calls of introduced *E. johnstonei* are so loud. However, introduced populations may have failed to become established on Dominica (Kaiser & Hardy, 1994a). The species has not been encountered during recent surveys (e.g., Quick, 2001; Alexander, 2007; A. James, pers. comm.) and is therefore no longer included by the Department of Forestry, Commonwealth of Dominica, on lists of Dominican species (A. James, in litt., 3.VIII.2008).

**METHODS AND MATERIALS**

From 6–22 June 2008, we surveyed frog numbers and microhabitat use along 1,000 m in 11 timed transects at five sites on the leeward slopes of Dominica (Fig. 4). We characterised microhabitat use by the perches on which frogs were observed within transects. We surveyed each of nine 100-m transects for 30 min and two 50-m transects for 15 min, sampling each transect twice on non-consecutive nights.

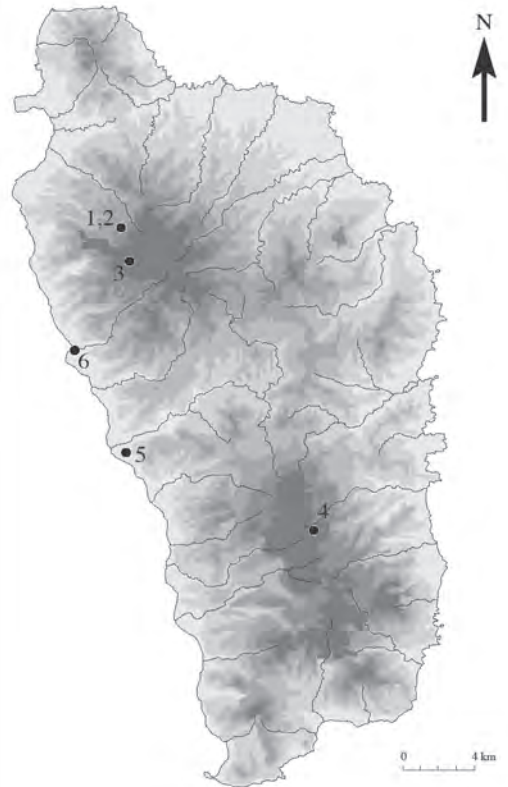
**Site Descriptions**

We described sites based on elevation, temperature and humidity data, variety of microhabitats, and levels of human disturbance. We used a HOBO® Tidbit® v2 Submersible Temperature Logger (accurate to 300 m) to record temperature at site 5 and HOBO® Temperature/RH Data Loggers U23-001 to record temperature and humidity data at sites 1 and 3-5.

Site 1 consisted of two 100-m transects within Syndicate Park Reserve in Morne Diablotin National Park (approximately 540 m above sea level). From 10-19 June 2008, mean temperature and relative humidity were  $22.2 \pm 1.0^{\circ}\text{C}$  (19.7-26.7°C) and  $94.0 \pm 3.4\%$  (80.3-98.4%), respectively. Based on the relatively sparse density of the canopy, the forest at this site was “young.” Understorey growth consisted mainly of small broadleaf shrubs. *Selaginella* sp., bromeliads, and other epiphytes were abundant, as were woody debris and leaf litter. Human activity was largely restricted to established trails with a few wooden bridges, log

steps, and signs. Disturbance was minimal.

Site 2 consisted of one 100-m and two 50-m transects in an agricultural field across a road from the entry to Syndicate Reserve. Elevation, mean temperature and relative humidity data are the same as for site 1. Almost all native trees had been cleared and the relatively open field planted with citrus and banana (most no more than 3 m tall) and pineapple. Patches of grassy and herbaceous



**Figure 4.** Map of Dominica showing locations of study sites (see text). Contour intervals = 300 m.

growth (mostly dead) and piles of woody debris were scattered throughout the site. Evidence of pesticide use and other human disturbance was abundant. Plastic jugs (one of motor oil), extensive trenches, and a dirt road were present within the transects.

Site 3 consisted of two 100-m transects along the trail to Kachibona Lake in old-growth forest (approximately 755 m). From 8-23 June 2008, mean temperature and relative humidity were 21.5

$\pm 1.5^{\circ}\text{C}$  (18.9–28.0 $^{\circ}\text{C}$ ) and  $88.1 \pm 7.6\%$  (66.2–98.4%), respectively. Topography was decidedly uneven, with both steeply sloped (ca. 30 $^{\circ}$ ) and relatively level sections. Canopy was nearly complete and undergrowth was correspondingly sparse. The area was characterised by broadleaf shrubs, woody debris, leaf litter, exposed rocks and patches of bare soil, with the more level stretches also supporting scattered *Selaginella* sp., palms, ferns, broadleaf razor grass, and herbaceous growth. Human disturbance was minimal. Only a small path had been cleared and a few trees had been painted or otherwise marked to show the direction of the path.

Site 4 consisted of two 100-m transects along the trail to Boeri Lake in Morne Trois Pitons National Park (approximately 865 m). From 9–16 June 2008, mean temperature and relative humidity for the period sampled was  $21.0 \pm 0.8^{\circ}\text{C}$  (18.7–24.3 $^{\circ}\text{C}$ ) and  $98.4 \pm 1.7\%$  (91.6–99.9%), respectively. Abundant condensation allowed for lush vegetation such as bromeliads, other epiphytes, *Selaginella* sp., mosses, grassy and herbaceous growth, ferns, palms, *Heliconia* sp. and Ginger to grow along with trees and saplings and other broadleaf shrubs. Woody debris and leaf litter covered the substrate. Human disturbance was minimal. Log steps, ditches and signs served to identify a trail.

Site 5 consisted of two 100-m transects in a coconut (*Cocos nucifera*) grove at sea level. From 11–21 June 2008, mean temperature was  $27.6 \pm 2.7^{\circ}\text{C}$  (23.0–33.0 $^{\circ}\text{C}$ ). From 17–21 June 2008, mean temperature and relative humidity within a husk pile (on which frogs were frequently encountered) were  $25.2 \pm 0.7^{\circ}\text{C}$  (24.4–26.7 $^{\circ}\text{C}$ ) and 104.1%, respectively. Regularly spaced coconut trees and piles of *Cocos* debris (husks, fronds etc.) were interspersed by stands of grasses, scattered herbaceous growth and small (ca. 2 m) broadleaf shrubs. Evidence of human disturbance was abundant, with the cleared site paralleling the main coastal road.

### Microhabitats

We identified six microhabitat categories: (1) broadleaves, (2) tree or sapling trunks, (3) ferns, (4) low herbaceous growth, (5) leaf litter, and (6) woody debris, each of which included different

perch types. The broadleaf category included broadleaf shrubs, broadleaf razor grass, banana, bromeliads, other epiphytes, Ginger, *Heliconia* sp. and pineapple plants. The tree or sapling trunks category included trunks of trees (>10 cm diameter at breast height [DBH]), saplings (<10 cm DBH), tree ferns, and coconut (*Cocos*) palms. The ferns category included leaves and branches from both tree and ground ferns. The low herbaceous growth category included grassy and herbaceous growth, mosses, *Selaginella* sp., and ground orchids. The leaf litter category included leaf litter, coconut husks, soil, and rock. The woody debris category included dead branches, fallen logs, sticks and tree stumps. Not all elements in each microhabitat category were found at every site.

For all sites, we counted frogs only if seen. Due to the lush overhead microhabitat provided by bromeliads, other epiphytes, and ferns, especially at site 4, frog counts may have been overly conservative as several frogs were heard calling from unobservable elevated perches and were not included in our data. For statistical tests, we included only those data for frogs whose sex we could positively determine due to large body size or the presence of eggs (seen through the body wall) in females or male calling behaviour.

### Size and Morphology

We collected frogs at sites 1 and 3–6 (Fig. 4). Site 6, along the Batali River, was at sea level and experienced regular human disturbances. For all frogs examined, we characterised pattern and colour, measured snout-vent length (SVL), head length (HL), head width (HW), eye diameter (ED), eye-narial distance (EN), diameter of the tympanum (TD), interorbital distance (IOD), femoral length (FL), tibial length (TL), length of the foot (LF), and fourth-toe length (FTL) using SPI 2000 dial calipers (Forestry Suppliers, Jackson, Michigan, USA) and Mitutoyo Absolute digimatic digital calipers (Mitutoyo America Corp., Elk Grove Village, Illinois, USA), and weight using an Ohaus HH 120D digital scale (Ohaus Corp., Pine Brook, New Jersey, USA) and Pesola 10-g and 30-g spring scales (Pesola AG, Baar, Switzerland). All data were log-transformed prior to statistical analyses. We used Statview 5.0 (SAS Institute, Cary, North

Carolina, USA) for all statistical tests. For all analyses,  $\alpha = 0.05$ .

## RESULTS AND DISCUSSION

### Elevational Effects

We encountered only *E. amplinympha* along the trail to Boeri Lake (site 4), which was the highest elevation site sampled. We never observed *E. amplinympha* and *E. martinicensis* together, although a very few *E. amplinympha* were heard calling from the trail to Kachibona Lake (site 3). All frogs at sites 1, 2 and 5 were *E. martinicensis*. We encountered no *E. johnstonei*. This is consistent with other studies (Kaiser et al., 1994a, 1994b; Kaiser & Henderson, 1994; Malhotra & Thorpe, 1999; Evans & James, 1997; Alexander, 2007) that found *E. amplinympha* only in upland pristine habitats and *E. martinicensis*, more of an ecological generalist, abundant in both upland and lowland habitats, regardless of disturbance level. Our failure to encounter *E. johnstonei* is consistent with recent surveys (e.g. Quick, 2001; Alexander, 2007) and supports the conclusion that *E. johnstonei* failed to establish a permanent presence on Dominica.

### Habitat Availability and Use

Frequencies of perch types did not differ significantly between any two sites (Wilcoxon Signed Rank, all  $P \geq 0.35$ ). Frequencies of perch type use also did not differ significantly from frequencies of perch type availability at any site (Wilcoxon Signed Rank, all  $P \geq 0.24$ ). Neither *E. amplinympha* nor *E. martinicensis* appeared to favour any particular perches. At site 1, nine of 15 frogs were on broadleaves at heights of 0.50-1.75 m and four were on tree or sapling trunks at heights of 0.25-1.67 m. At site 2, five of six frogs were on broadleaves at heights of 0.25-2.00 m. At site 3, 10 of 31 frogs were on trunks at heights of 0.5-1.0 m and nine were on broadleaves at heights of 0.25-1.00 m. At site 4, two of six frogs were on litter at ground level and all of the others were on different perch types. At site 5, 26 of 29 frogs were on elevated perches at heights of 0.2-2.0 m. Most were on broadleaves. Disparity between perch type use versus availability might have been greater if larger sample sizes for sites 2 and 4 had been available. Site 2 consisted mainly of low (albeit

dead) herbaceous vegetation. The lush vegetation at Site 4 provided potential perch sites extending from the ground well into the canopy. Several frogs were heard calling from the canopy, but were not seen and therefore not counted. Had these frogs been observed, trunks and epiphytes might have accounted for a larger percentage of perches utilised than those nearer the ground.

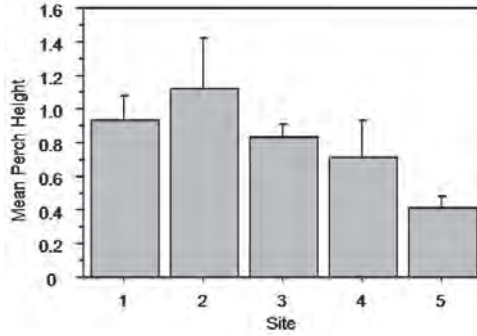
### Perch Height

Perch heights differed significantly between sites (ANOVA,  $df = 4$ ,  $F = 5.51$ ,  $P = 0.0006$ ; Fig. 5), with significant differences (Fisher's PSLD) between sites 1 and 5 ( $P = 0.0007$ ), 2 and 5 ( $P = 0.001$ ), and 3 and 5 ( $P = 0.0008$ ). Site 5 consisted mainly of low broadleaf growth, litter, and coconut (*Cocos*) tree trunks, but had been purposefully cleared of most understorey and woody debris. Consequently, frogs were largely restricted to low and very high perches. Sites 1-3 had many moderately sized broadleaf shrubs and copious amounts of woody debris that were used by frogs. When data for all sites were combined, perch heights did not differ significantly between species (Mann-Whitney U,  $Z = -0.03$ ,  $P = 0.97$ ) or between male and female *E. martinicensis* ( $Z = -0.15$ ,  $P = 0.88$ ).

### Size and Morphology (Table 1)

Female *E. martinicensis* are larger than males. Although log-SVL only approached significance (ANOVA,  $df = 1$ ,  $F = 3.81$ ,  $P = 0.06$ ), log-weight and all other measured variables differed significantly (ANCOVA with log-SVL as the covariate, all  $P \leq 0.02$ ). The sole female *E. amplinympha* in our sample was larger in all measurements than any conspecific male. Males of the two species did not differ significantly in log-SVL (ANOVA,  $df = 1$ ,  $F = 0.52$ ,  $P = 0.48$ ) and, although limb measurements for *E. amplinympha* were longer than in *E. martinicensis*, no other measured variables differed significantly (ANCOVA with log-SVL as the covariate, all  $P \geq 0.19$ ), except log-weight, for which male *E. amplinympha* were proportionately lighter than *E. martinicensis* ( $P = 0.03$ ). The sole female *E. amplinympha* in our sample exceeded the mean measurements for female *E. martinicensis*.





**Figure 5.** Mean perch heights ( $\pm$  one SE) of frogs at five study sites on Dominica.

**Polymorphism**

Both *E. martinicensis* and *E. amplinympha* demonstrated considerable polymorphism (e.g. Kaiser et al., 1994a; Alexander, 2007). Dorsal pattern elements, which were either present or absent, included a wide or narrow mid-dorsal line, narrow dorsolateral lines, a wide interorbital line, or a darker mid-dorsal region contrasting with lighter sides. Dorsal background colours ranged from light and dark brown to olive, bronze, brass, or even red. Mid-dorsal, dorsolateral, and interorbital lines were usually orange or cream and were sometimes bordered in black or dark brown. Tubercles on dorsal surfaces may or may not be

present. No single dorsal pattern was unique to either species. Pattern variants may merely reflect genetic diversity, although Woolbright & Stewart (2007) associated specific variants of *E. coqui* with different microhabitats on Puerto Rico. Our sample sizes were insufficient for associating any effects of microhabitat on dorsal patterns.

**ACKNOWLEDGEMENTS**

Peter J. Muelleman, Patrick A. Turk, Natalie N. Wyszynski and Nelson J. Vélez Espinet helped in the field. Robert W. Henderson and John S. Parmerlee, Jr. helped take morphological and polymorphic data, and provided useful comments

Measurement	Species			
	<i>E. martinicensis</i>		<i>E. amplinympha</i>	
	Male (N = 13)	Female (N = 18)	Male (N = 8)	Female (N = 1)
Snout-vent length	22.5 $\pm$ 1.1	29.7 $\pm$ 2.3	23.4 $\pm$ 0.6	39.5
Head width at jaw	9.3 $\pm$ 0.3	12.7 $\pm$ 0.7	9.1 $\pm$ 0.2	15.6
Head length <sup>1</sup>	9.8 $\pm$ 0.3	13.0 $\pm$ 0.6	9.7 $\pm$ 0.5	15.8
Eye diameter	3.2 $\pm$ 0.1	4.0 $\pm$ 0.2	3.2 $\pm$ 0.1	4.3
Eye-naris distance	2.7 $\pm$ 0.1	3.7 $\pm$ 0.2	2.7 $\pm$ 0.1	4.5
Tympanum diameter	1.6 $\pm$ 0.1	2.1 $\pm$ 0.1	1.8 $\pm$ 0.1	2.2
Interorbital distance	2.8 $\pm$ 0.2	3.7 $\pm$ 0.2	2.8 $\pm$ 0.1	4.9
Femur length <sup>2</sup>	9.1 $\pm$ 0.3	12.2 $\pm$ 0.6	9.7 $\pm$ 0.3	14.8
Tibia length <sup>3</sup>	10.8 $\pm$ 0.4	14.3 $\pm$ 0.6	11.3 $\pm$ 0.4	18.7
Foot length <sup>4</sup>	14.9 $\pm$ 0.5	20.5 $\pm$ 1.1	15.5 $\pm$ 0.4	25.5
4th toe length	2.8 $\pm$ 0.1	3.9 $\pm$ 0.2	2.8 $\pm$ 0.1	4.7
Weight	1.0 $\pm$ 0.1	2.5 $\pm$ 0.3	0.7 $\pm$ 0.1	3.0

<sup>1</sup> jaw to tip of snout, <sup>2</sup> venter to knee, <sup>3</sup> knee to heel, <sup>4</sup> heel to tip of longest toe

**Table 1.** Measurements taken from nine *Eleutherodactylus amplinympha* and 31 *E. martinicensis* from Dominica. Measurements were taken from either side of adult animals and recorded in mm except weight, which was recorded in g. Means are presented  $\pm$  one SE.

on a previous draft of this manuscript. Arlington James, Forest Officer, Forestry, Wildlife, and Parks Division, Ministry of Agriculture & the Environment, Commonwealth of Dominica, issued permits to conduct research in Dominica and was incredibly helpful in assisting our efforts. This project was funded by a grant from the National Science Foundation (USA) to Robert Powell (DBI-0242589).

## REFERENCES

- Ackley, J.W., Muelleman, P.J., Carter, R.E., Henderson, R.W. & Powell, R. (2009). A rapid assessment of herpetofaunal diversity in variously altered habitats on Dominica. *Applied Herpetology* **6**, 171-184.
- Alexander, K. (2007). A photographic field guide to the reptiles and amphibians of Dominica, West Indies. Unpublished report, Texas A&M University Study Abroad, College Station, Texas [http://dominica.tamu.edu/student%20projects/projects\\_by\\_year.htm](http://dominica.tamu.edu/student%20projects/projects_by_year.htm).
- Daltry, J.C. & Gray, G. (1999). Effects of volcanic activity on the endangered Mountain Chicken Frog (*Leptodactylus fallax*). *Froglog* **32**, 1-2.
- Daniells, E.A., Ackley, J.W., Carter, R.E., Muelleman, P.J., Rudman, S.M., Turk, P.A., Vélez Espinet, N.J., White, L.A. & Wyszynski, N.N. (2008). An annotated checklist of the amphibians and reptiles of Dominica, West Indies. *Iguana* **15**, 130-141.
- Evans, P.G.H. & James, A. (1997). *Dominica Nature Island of the Caribbean: Wildlife Checklists*. Roseau, Dominica: Ministry of Tourism.
- Fa, J., Hedges, B., Ibéné, B., Breuil, M., Powell, R. & Magin, C. (2004). *Leptodactylus fallax*. In 2007 IUCN Red List of Threatened Species. <[www.iucnredlist.org](http://www.iucnredlist.org)>.
- Germano, J.M. Sander, J.M. Henderson, R.W. & Powell, R. (2003). Herpetofaunal communities in Grenada: A comparison of altered sites, with an annotated checklist of Grenadian amphibians and reptiles. *Carib. J. Sci.* **39**, 68-76.
- Gibson, R.C. & Buley, K.R. (2004). Maternal care and obligatory oophagy in *Leptodactylus fallax*: A new reproductive mode in frogs. *Copeia* **2004**, 128-135.
- Hedges, S.B. (1996). Historical biogeography of West Indian vertebrates. *Ann. Rev. Ecol. Syst.* **27**, 163-196.
- Hedges, S.B. (1999). Distribution Patterns of Amphibians in the West Indies. In: *Patterns of Distribution of Amphibians: A Global Perspective*, pp. 211-254. W.E. Duellman (Ed.). Baltimore, Maryland: The Johns Hopkins University Press.
- Hedges, S.B. & Powell, R. (2004). *Eleutherodactylus amplinympha*. In: 2007 IUCN Red List of Threatened Species. <[www.iucnredlist.org](http://www.iucnredlist.org)>.
- Hedges, S.B. Ibéné, B. Breuil, M. & Powell, R. (2004a). *Eleutherodactylus martinicensis*. In: 2007 IUCN Red List of Threatened Species. <[www.iucnredlist.org](http://www.iucnredlist.org)>.
- Hedges, S.B. Ibéné, B. Koenig, S. La Marca, E. Ibáñez, R. & Hardy, J. (2004b). *Eleutherodactylus johnstonei*. In: 2007 IUCN Red List of Threatened Species. <[www.iucnredlist.org](http://www.iucnredlist.org)>.
- Hedges, S.B. Duellman, W.E. & Heinicke, M.P. (2008). New World direct-developing frogs (Anura: Terrarana): Molecular phylogeny, classification, biogeography, and conservation. *Zootaxa* **1737**, 1-182.
- Henderson, R.W. & Powell, R. (2009). *Natural History of West Indian Amphibians and Reptiles*. Gainesville, Florida: University Press of Florida.
- Heyer, W.R. (1979). Systematics of the *pentadactylus* species group of the frog genus *Leptodactylus* (Amphibia: Leptodactylidae). *Smith. Contrib. Zool.* **301**, 43 pp.
- Johnson, T.H. (1988). Biodiversity and conservation in the Caribbean: Profiles of selected islands. International Council for Bird Preservation Monograph **1**, 143 pp.
- Kaiser, H. (1992). The trade-mediated introduction of *Eleutherodactylus martinicensis* (Anura: Leptodactylidae) on St. Barthélémy, French Antilles, and its implications for Lesser Antillean biogeography. *J. Herpetol.* **26**, 264-273.
- Kaiser, H. (1997). Origins and introductions of the Caribbean frog, *Eleutherodactylus johnstonei* (Leptodactylidae): Management and conservation concerns. *Biod. and Cons.* **6**, 1391-1407.
- Kaiser, H. & Day, M.L. (1995). Abiotic disturbances in the Lesser Antilles. *Froglog* **15**. <[www.open](http://www.open)>.

- ac.uk/dapft/froglog/FROGLOG-15-2.html>.
- Kaiser, H. & Hardy, J.D., Jr. (1994a). *Eleutherodactylus johnstonei*. *Cat. Amer. Amphib. Rept.* **581**, 1-5.
- Kaiser, H. & Hardy, J.D., Jr. (1994b). *Eleutherodactylus martinicensis*. *Cat. Amer. Amphib. Rept.* **581**, 1-4.
- Kaiser, H. & Henderson, R.W. (1994). The conservation status of Lesser Antillean frogs. *Herpetol. Nat. Hist.* **2** (2), 41-56.
- Kaiser, H. Green, D.M. & Schmid, M. (1994a). Systematics and biogeography of Eastern Caribbean frogs (Leptodactylidae, *Eleutherodactylus*), with the description of a new species from Dominica. *Can. J. Zool.* **72**, 2217-2237.
- Kaiser, H. Sharbel, T.F. & Green, D.M. (1994b). Systematics and biogeography of Eastern Caribbean *Eleutherodactylus* (Anura: Leptodactylidae): Evidence from allozymes. *Amphibia-Reptilia* **15**, 375-394.
- Lever, C. (2003). *Naturalized Reptiles and Amphibians of the World*. New York: Oxford University Press.
- Malhotra, A. & Thorpe, R.S. (1999). *Reptiles and Amphibians of the Eastern Caribbean*. London: Macmillan Education Ltd. 134 pp.
- Mallery, C.S., Jr. Marcum, M.A. Powell, R. Parmerlee, J.S., Jr. & Henderson, R.W. (2007). Herpetofaunal species of the leeward slopes and coasts of St. Vincent: A comparison of sites variously altered by human activity. *Applied Herpetology* **4**, 313-325.
- Quick, B. (2007). A field guide to the herpetofauna on Dominica, W. I. Unpublished report, Texas A&M University Study Abroad, College Station, Texas [http://dominica.tamu.edu/student%20projects/projects\\_by\\_year.htm](http://dominica.tamu.edu/student%20projects/projects_by_year.htm).
- ZSL (Zoological Society of London). (2008). Chytridiomycosis and the Caribbean. <[www.zsl.org/conservation/animals/amphibians/mountain-chicken,830,AR.html](http://www.zsl.org/conservation/animals/amphibians/mountain-chicken,830,AR.html)>.
-

# Coelomic helminths in the Northern Cat-eyed Snake, *Leptodeira septentrionalis* (Serpentes: Colubridae) from Costa Rica

STEPHEN R. GOLDBERG<sup>1,3</sup> and CHARLES R. BURSEY<sup>2</sup>

<sup>1</sup> Department of Biology, Whittier College, Whittier, California 90608, USA.

<sup>2</sup> Department of Biology, Pennsylvania State University, Shenango Campus, Sharon, Pennsylvania 16146, USA. cxb13@psu.edu

<sup>3</sup> Corresponding author: sgoldberg@whittier.edu

Information on metazoan parasites and their life cycles in Neotropical hosts is limited (Salgado-Maldonado et al., 2000). For example, of the 133 species of Costa Rican snakes (Savage, 2002), metazoan parasites are known from just 17 (13%) (Goldberg & Bursey, 2004). The purpose of this paper is to report coelomic metazoan parasites from the Northern Cat-eyed Snake, *Leptodeira septentrionalis*, from Costa Rica and to establish an initial parasite list for this species. *Leptodeira septentrionalis* (Fig. 1.) ranges from extreme southern Texas through Mexico and central America to northern Colombia and northwestern Peru and has been reported to feed on frogs, toads and some lizards (Savage, 2002).

## METHODS AND MATERIALS

Fifty-two *L. septentrionalis* from Costa Rica (mean snout-vent length = 416.5 mm  $\pm$  124.5 SD; range = 159-617 mm) in the Natural History Museum of Los Angeles County (LACM), Los Angeles, California, USA, were examined. Permission was given to examine only the posterior third of the body cavity. The body was opened by a longitudinal incision. Organ surfaces and mesenteries in the posterior third of the body cavity were examined visually for parasites. The lumen of the digestive tract and the lungs were not examined. Nematodes were cleared in a drop of glycerol on a glass slide, cover-slipped and identified under a compound microscope. Cestodes and acanthocephalans were regressively stained in hematoxylin and studied as whole-mounts in Canada balsam. Voucher helminths were deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland, USA.

## RESULTS AND DISCUSSION

Found were one species of Cestoda represented by tetrathyridia of a species of *Mesocestoides*; one species of Nematoda represented by larvae in cysts of a species of *Porrocaecum*; one species of Acanthocephala represented by cystacanths assignable to the family Oligacanthorhynchidae. Selected specimens were deposited in the United States National Parasite Collection as: *Mesocestoides* sp. (USNPC 101172); *Porrocaecum* sp. (USNPC 101173); Oligacanthorhynchid cystacanth (USNPC 101174). Infected *L. septentrionalis* by Costa Rica Province were as follows: *Mesocestoides* sp. (Puntarenas, LACM 151817, 151823); *Porrocaecum* sp. (Guanacaste, LACM 151797; Limón, LACM 151783, 151821; Puntarenas, LACM 151813, 155788); Oligacanthorhynchid cystacanth (Cartago, LACM 155793, Puntarenas, LACM 151794).

The life cycle of species of *Mesocestoides* is thought to require three hosts, thus it is unique among cyclophyllidean cestodes: The first larval stage thought to occur in ants: The second larval stage, tetrathyridium (Fig. 2), has been found in vertebrates representing more than 200 species, including amphibians, reptiles, birds and mammals; the strobilar stage occurs in mammals, rarely in birds (Rausch, 1994; Padgett and Boyce, 2005). A list of amphibian and reptilian hosts of tetrathyridia was provided by Goldberg et al. (2004). It appears that *L. septentrionalis* becomes infected by ingesting prey harbouring tetrathyridia and, as Bolette (1997) suggested for snakes in general, also serves as a paratenic host. Prevalence of infection in *L. septentrionalis* was 2/52 (4.0%), which is similar to the rate of infection by tetrathyridia (1-4%) in

small mammals (Gubanov & Fedorov, 1970). *Leptodeira septentrionalis* represents a new host record for tetrahyridia of *Mesocestoides*.

Species of *Porrocaecum* are intestinal parasites of birds; eggs ingested by earthworms hatch and develop to third stage larvae; vermivorous animals act as paratenic hosts (Anderson, 2000). Larvae of *Porrocaecum* spp. in cysts have previously been reported in the coelomic cavities of snakes



**Figure 1.** *Leptodeira septentrionalis*, Limón Province, Costa Rica. Photograph by Todd R. Lewis.

from Costa Rica (Goldberg & Bursey, 2004). Presumably snakes acquire larvae of *Porrocaecum* by ingestion of infected food items; these larvae re-encyst without further development. Prevalence of infection in *L. septentrionalis* was 5/52 (10%). *Leptodeira septentrionalis* represents a new host record for larvae of *Porrocaecum* spp.

All acanthocephala utilize an arthropod intermediate host in which larval development proceeds to the cystacanth stage that is infective to the definitive host (Kennedy, 2006). As in the cases

of tetrahyridia of *Mesocestoides* and larvae of *Porrocaecum*, snakes most likely become infected with cystacanths by ingesting prey items that had ingested infected insects. The presence of cystacanths in snakes from Costa Rica has previously been reported (Goldberg & Bursey, 2004). Prevalence of infection in *L. septentrionalis* was 2/52 (4%). *Leptodeira septentrionalis* represents a new host record for Oligacanthorhynchid cystacanths.



**Figure 2.** *Mesocestoides* sp. (tetrahyridium). Photograph by Charles R. Bursey.

Snake coelomic parasites would appear to form a group in which neotenic capabilities, i.e., prolongation of the larval state, are integral to the life cycle. Thus, during the life of the parasite, rather than truncation of the life cycle, additional opportunities to gain the definitive host can occur.

#### ACKNOWLEDGEMENTS

We thank Christine Thacker of the Natural History Museum of Los Angeles County (LACM) for permission to examine specimens. The snakes used in

this study are part of the Costa Rica Expeditions Collection that were donated to LACM by Jay Savage in 1998.

#### REFERENCES

- Anderson, R.C. (2000). *Nematode Parasites of Vertebrates. Their Development and Transmission*. Oxford: CABI Publishing.
- Bolette, D.P. (1997). First record of *Pachysentis canicola* (Acanthocephala: Oligacanthorhynchida) and the occurrence of *Mesocestoides* sp. tetrathyrida (Cestoidea: Cyclophyllidea) in the western diamondback rattlesnake, *Crotalus atrox* (Serpentes: Viperidae). *J. Parasitol.* **83**, 751-752.
- Goldberg, S.R., & Bursey, C.R. (2004). Coelomic metazoan endoparasites of 15 colubrid and two elapid snake species from Costa Rica. *Carib. J. Sci.* **40**, 62-69.
- Goldberg, S.R., Bursey, C.R., & Telford, Jr., S.R. (2004). Helminths of six species of snakes from Honshu Island, Japan. *Comp. Parasitol.* **71**, 49-60.
- Gubanov, N.M., & Fedorov, K.P. (1970). Fauna of helminths of mouse-like rodents of Yakutiya. In: *Fauna Sibiri*. pp. 18-47, Cherepanov, A.I. (Ed). Novosibirsk, Russia: Nauka (In Russian).
- Kennedy, C.R. (2006). *Ecology of the Acanthocephala*. Cambridge UK, Cambridge University Press.
- Padgett, K.A. & Boyce, W.M. (2005). Ants as first intermediate hosts of *Mesocestoides* on San Miguel Island. *J. Helminthol.* **79**, 67-73.
- Rausch, R.L. (1994). Mesocestoididae Fuhrmann, 1907. In: *Keys to the Cestode Parasites of Vertebrates*. pp. 309-314, Khalil, L.F., Jones, A. & Bray, R.A. (Eds), Oxford: CABI.
- Salgado-Maldonado, G., García Aldrete, A.N., & Vidal-Martínez, V.M. (2000). Metazoan Parasites in the Neotropics: A Systematic and Ecological Perspective. Mexico: Instituto de Biología, Universidad Nacional Autónoma de México.
- Savage, J.M. (2002). *The Amphibians and Reptiles of Costa Rica: a Herpetofauna Between Two Continents, Between Two Seas*. Chicago: University of Chicago Press.
-

---

# First record of *Trachemys dorbigni* (Duméril & Bibron, 1835) (Testudines, Emydidae) in a remnant of Mesophytic Semideciduous Forest of São Paulo State, southeastern Brazil

TIAGO GOMES DOS SANTOS<sup>1,3</sup>, TIAGO DA SILVEIRA VASCONCELOS<sup>1</sup>,  
FLAVIO DE BARROS MOLINA<sup>2</sup> and HUSSAM ZAHER<sup>2</sup>

<sup>1</sup> *Laboratório de Herpetologia, Departamento de Zoologia, Instituto de Biociências, Universidade Estadual Paulista (UNESP), Caixa Postal 199, 13506-900 Rio Claro, SP, Brazil.*

<sup>2</sup> *Museu de Zoologia da Universidade de São Paulo (MZUSP), divisão científica: anfíbios e répteis, Avenida Nazaré, 481, Ipiranga, 04263-000 São Paulo, Brasil, www.mz.usp.br.*

<sup>3</sup> Corresponding author: frogomes@yahoo.com.br, www.rc.unesp.br

**T**RACHEMYS DORBIGNI (Duméril & Bibron, 1835) is a cryptodire turtle that belongs to the Emydidae family (Uetz et al., 1995-2008; Bickham et al., 2007). According to Cabrera (1998) and Fritz & Havas (2006) the distribution of *T. dorbigni* encompasses northeastern Argentina, Uruguay, and southern Brazil (state of Rio Grande do Sul). *T. dorbigni* is a typical semi-aquatic turtle of Pampean Province (e.g., Lema & Fabián-Beurmann, 1977; Lema & Ferreira, 1990; Lema, 1994; Cechin et al., 2002; Bérnills et al., 2008), inhabiting lentic and lotic water bodies, dams, lagoons, ponds, floodplains and rivers of pristine and anthropic areas (Gomes & Krause, 1982; Lema et al., 1984; Lema & Ferreira, 1990; Achaval & Olmos, 2003; Santos et al., 2005; Quintela et al., 2006; Bager et al., 2007; Bujes & Verrastro, 2007). This turtle is omnivorous (Lema & Ferreira, 1990; Cabrera, 1998; Achaval & Olmos, 2003; Bujes et al., 2007) and its nesting season begins in early spring (September) extending until summer (February) in southern populations (Krause et al., 1982; Bager et al., 2007). Here, we recorded for the first time the presence of *Trachemys dorbigni* in a natural habitat of São Paulo State, southeastern Brazil, extending the species known range by approximately 750 Km from the nearest natural occurrence.

## RESULTS AND DISCUSSION

One female *T. dorbigni* was recorded on October 2006 at Morro do Diabo State Park (MDSP), municipality of Teodoro Sampaio, walking in forest edge (22° 36'58.6" S and 52° 09'57.9" W; 265 m

a.s.l.), 50 m from a permanent pond inside forest and approximately at 500 m from the Paranapanema River, an affluent of Parana River. The specimen was hand captured, photographed and released at the same location (Fig.1). The MDSP belongs to the Paranaense Province and its vegetation is characterized by Mesophytic Semideciduous Forest, a physiognomy of Atlantic Domain (sensu Ab'Saber, 1977), and Cerrado savanna (Durigan & Franco, 2006). The present record of *T. dorbigni* out of the Pampean Province possibly represents a recent colonization or a human introduction in southeastern Brazil (see discussion in Pritchard & Trebbau, 1984). The range of *Trachemys dorbigni* includes the Argentinean, Uruguay and Paraná rivers drainages (Cabrera, 1998; Uetz et al., 1995-2008), and therefore its record in MDSP (Fig. 2) may represent a dispersal of this turtle species to the upper basin of the Paraná River. Fifty years ago, when turtles were not common in the Brazilian pet trade, Adler (1958 a,b) described three specimens of *T. dorbigni* from Ribeira River, collected near the junction with Itararé River, São Paulo State, an affluent of Paranapanema River. On the other hand, human introduction cannot be ruled out because *T. dorbigni* is commonly sold as a pet in Brazil (Molina & Rocha, 1987; Lema & Ferreira, 1990; Molina, 1996). Its frequent presence in urban areas in many cities outside Rio Grande do Sul state (Molina, 2006) confirms how easily people release them. Introduced specimens of *Trachemys dorbigni* have already been reported in other Brazilian states like Paraná (southern Brazil), Minas Gerais



**Figure 1.** A female *Trachemys dorbigni* from Morro do Diabo State Park (MDSP), municipality of Teodoro Sampaio, São Paulo State, southeastern Brazil. Photograph by A.R. Quilice.

(southeastern Brazil), Goiás (central Brazil), Bahia (northeastern Brazil) and Tocantins (northern Brazil) (Pritchard & Trebbau, 1984; Seidel, 1989; Iverson, 1992; Moreira, 1994; Malvasio, 2005). Future studies are necessary to investigate the natural and introduced range of *Trachemys dorbigni* in south America and the possible impacts that established human introduced populations may have on natural aquatic environments.

#### ACKNOWLEDGEMENTS

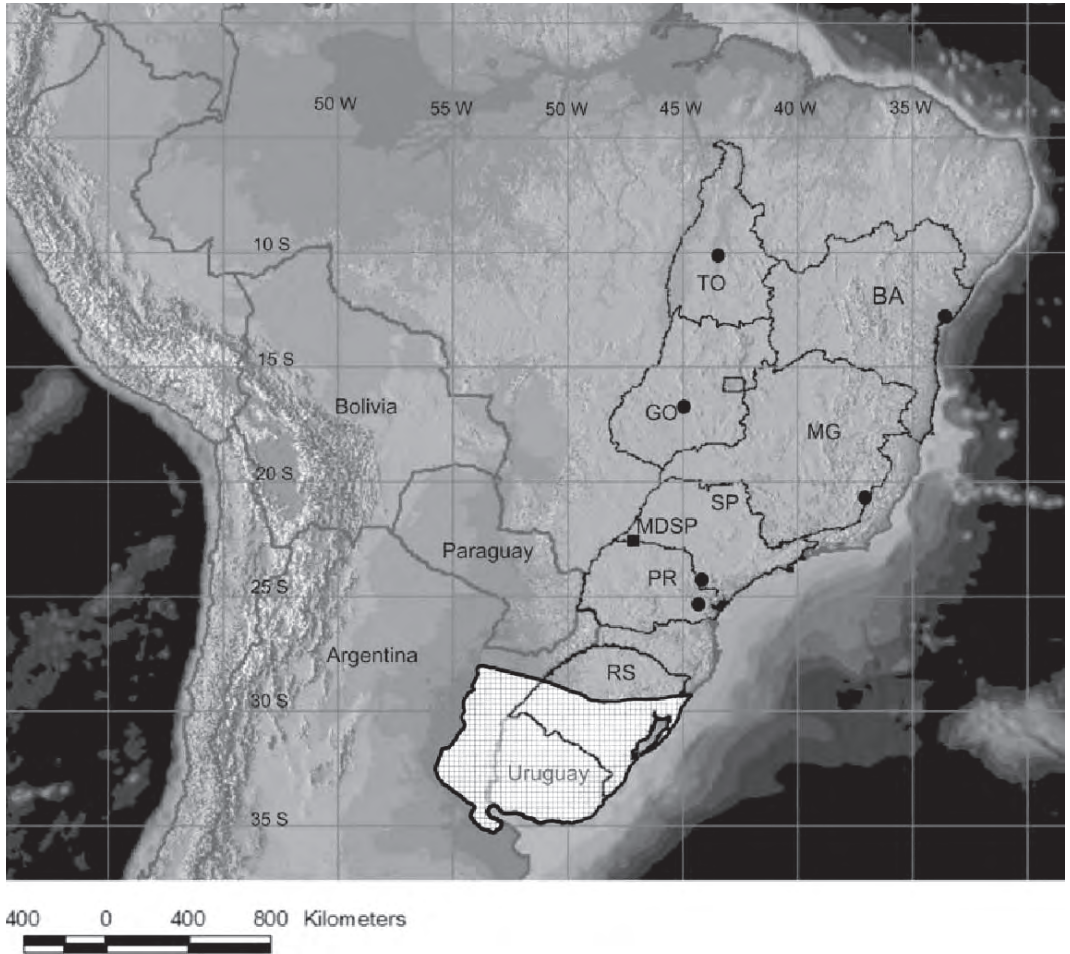
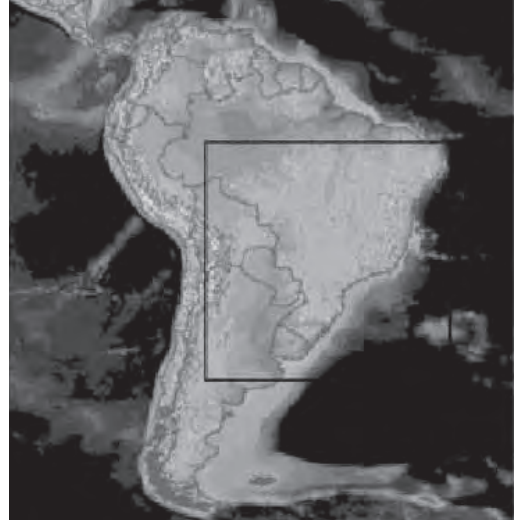
The authors are grateful to A.R. Quilice for the photograph of *T. dorbigni*, the staff of Morro do Diabo State Park for authorization and logistic support during in the field, P.S. Martinez for the construction of the map, and to FAPESP (process 02/13602-4), CAPES, and CNPq for the financial support.

#### REFERENCES

- Ab'Saber, A.N. (1977). Os Domínios Morfoclimáticos na América do Sul. *Geomorfol.* **52**, 1-159.
- Achaval, F. & Olmos, A. (2003). *Anfibios y Reptiles del Uruguay*. Montevideo: Graphis Impresora. 136 pp.
- Adler, K.K. (1958a). An abnormal *Pseudemys dorbigni* (Duméril & Bibron) from Brazil. *J. Ohio Herpetol. Soc.* **1**, 13.
- Adler, K.K. (1958b). List of the specimens of Chelonia and Crocodilia preserved in the author's private collection. *Ohio Herpetol. Soc. Spec. Publ.* **2**, 8-21.
- Bager, A., De Freitas, T.R.O. & Krause, L. (2007). Nesting ecology of a population of *Trachemys dorbignyi* (Emydidae) in southern Brazil. *Herpetologica* **61**, 56-65.
- Bérnills, R.S. Giraudo, A.R. Carreira, S. & Cechin S.Z. (2008). Répteis das porções subtropical e temperada da região Neotropical. *Cienc. & Amb.* **35**, 101-136.
- Bickham, J.W., Iverson, J.B., Parham, J.F., Philippen, H.D., Rhodin, A.G.J., Shaffer, H.B., Spinks, P.Q. & Van Dijk, P.P. (2007). An annotated list of modern turtle terminal taxa with comments on areas of taxonomic instability and recent change. *Chelonian Res. Monogr.* **4**, 173-199.
- Bujes, C.S. & Verrastro, L. (2007). Biología e conservação de quelônios do Parque Estadual Delta do Jacuí - RS, Brasil. In: *Conhecer para Gerenciar: Aspectos Ambientais e Sociais da Hidrográfica Lago Guaíba*. pp. 334-341, Guerra, T. (Ed.). Porto Alegre: Nova Prova.



**Figure 2.** Geographic distribution of *Trachemys dorbigni* in south America: white grid represents the natural species distribution in the Pampean Province of Argentina, Uruguay and Brazil (state of Rio Grande do Sul, RS) (modified from Lema & Ferreira [1990]); dots indicate specimens of *T. dorbigni* previously found in the Brazilian states of Paraná (PR), São Paulo (SP), Goiás (GO), Minas Gerais (MG), Bahia (BA) and Tocantins (TO); and square represents the species record in the MDSP, state of São Paulo (SP), southeastern Brazil.



- Bujes, C.S. Ely, I. & Verrastro, L. (2007). *Trachemys dorbigni*. *Diet. Herpetol. Rev.* **38**, 335.
- Cabrera, M. (1998). Las Tortugas Continentales de Sudamérica Austral. Argentina: Privately printed. 108 pp.
- Cechin, S.Z. Hartmann, P.A. & Kopp, K.A. (2002). Répteis. In: *Quarta Colônia: Inventários Técnicos*. pp. 207-214, Itaqui, J. (Ed.). Santa Maria: Condesus Quarta Colônia.
- Durigan, G. & Franco, G.A.D.C. (2006). Vegetação. In: *Parque Estadual do Morro do Diabo: Plano de Manejo*. pp. 111-118, Faria, H. H. (Ed.). Santa Cruz do Rio Pardo: Editora Viena.
- Fritz, U. & Havas, P. (2006). *Checklist of Chelonians of the World*. Dresden: German Federal Ministry of Environment, Nature Conservation and Nuclear Safety and Museum of Zoology Dresden. 230 pp.
- Gomes, N. & Krause, L. (1982). Lista preliminar de répteis da Estação Ecológica do Taim, Rio Grande do Sul. *Rev. Bras. Zool.* **1**, 71-77.
- Iverson, J.P. (1992). *A Revised Checklist with Distribution Maps of the Turtles of the World*. Richmond: Privately printed. 358 pp.
- Krause, L. Gomes, N. & Leyser, K.L. (1982). Observações sobre a nidificação e desenvolvimento de *Chrysemys dorbignyi* (Dumeril & Bibron, 1835) (Testudines, Emydidae) na Estação Ecológica do Taim, Rio Grande do Sul. *Rev. Bras. Zool.* **1**, 79-90.
- Lema, T. de & Fabián-Beurmann, M.E. (1977). Levantamento preliminar dos répteis da região Brasil-Uruguai. *Iheringia (Zool.)* **50**, 61-92.
- Lema, T. de & Ferreira, M.T.S. (1990). Contribuição ao conhecimento dos Testudines do Rio Grande do Sul (Brasil) – lista sistemática comentada (Reptilia). *Acta Biol. Leopold.* **12**, 125-164.
- Lema, T. de (1994). Lista comentada dos répteis ocorrentes no Rio Grande do Sul, Brasil. *Comun. Mus. Cienc. PUCRS Ser. Zool.* **7**, 41-150.
- Lema, T. de, Fabián-Beurmann, M.E., Araújo, M.L., Alvez, M.L.M. & Vieira, M.I. (1980). Lista de répteis encontrados na região da Grande Porto Alegre, Estado do Rio Grande do Sul, Brasil. *Iheringia (Zool.)* **55**, 27-36.
- Lema, T. de, Vieira, M.I. & Araújo, M.L. (1984). Fauna reptiliana do norte da grande Porto Alegre, Rio Grande do Sul, Brasil. *Rev. Bras. Zool.* **2**, 203-227.
- Malvasio, A. (2005). Base de Dados sobre Espécies Exóticas Invasoras em I3N-Brasil. <www.institutohorus.org.br>. (Accessed: May 2008).
- Molina, F.B. (1996). Os quelônios e sua biologia: o tigre d'água, *Trachemys dorbignyi*. *Chelonia* **16**, 2.
- Molina, F.B. (2006). Ambientes urbanos e a fauna de répteis no Estado de São Paulo: entre desconhecidos, desaparecidos e indesejáveis. In: *Parques Urbanos e Meio Ambiente: Desafios de Uso*. pp. 203-222. Glezer, R. & Mantovani, M. S.M. (Eds.), São Paulo: Parque Cientec/USP.
- Molina, F.B. & Rocha, M.B. (1987). *Tartaruga japonesa: biologia e manejo*. *Aquacult.* **3**, 27-28.
- Moreira, G.M. (1994). Dados preliminares do projeto de distribuição, status populacional e manejo dos quelônios de água doce da Mata Atlântica do Brasil. *Chelonia Neotrop.* **1**, 9-11.
- Pritchard, P.C.H. & Trebbau, P. (1984). The turtles of Venezuela. *Contrib. Herpetol.* **2**, 1-403.
- Quintela, F.M., Loebmann, D. & Gianuca, N.M. (2006). Répteis continentais do município de Rio Grande, Rio Grande do Sul, Brasil. *Biociências* **14**, 180-188.
- Santos, T.G., Kopp, K.A., Spies, M.R., Trevisan, R. & Cechin, S.Z. (2005). Répteis do Campus da Universidade Federal de Santa Maria, RS, Brasil. *Biota Neotrop.* **5**. <www.biotaneotropica.org.br>. (Accessed May 2005).
- Seidel, M.E. (1989). *Trachemys dorbigni*. *Cat. Amer. Amph. Rept.* **486**, 1-3.
- Uetz, P., Etzold, T. & Chenna, R. (1995-2008). The EMBL Reptile Database. <reptile-database.org>. (Accessed: May 2008).

### Aspects of captive husbandry of Taylor's Bug-eyed Frog, *Theلودerma stellatum* (Taylor, 1962)

BENJAMIN TAPLEY

*Durrell Wildlife Conservation Trust, Les Augrès Manor, La Profonde Rue, Trinity, Jersey, Channel Islands, JE3 5BP.*

**T**AYLOR'S Bug-eyed Frog (*Theلودerma stellatum*) is a small Rhacophorid listed as Near Threatened on the IUCN Red List as the extent of its habitat is declining and becoming increasingly degraded (IUCN et al., 2006). It has been recorded in eastern Thailand and south of central Vietnam and southern Laos (Orlov et al., 2002). Recently *T. stellatum* has been recorded in Eastern Cambodia (Stuart et al., 2006). It is found from 300-1,500 m above sea level (IUCN et al., 2006). *T. stellatum* inhabits lowland rainforest and montane forest, and has been found in rubber plantations (IUCN et al., 2006). In Cambodia *T. stellatum* was found in hilly evergreen forest mixed with Bamboo and deciduous trees (Stuart et al., 2006). This species is one of relatively few amphibians which breeds in water-filled tree holes (Duellman & Trueb, 1994), and does so in both living and fallen, rotten trees.

*Theلودerma stellatum* has a triangular head and prominent eyes (Fig. 1). The toes are webbed but the fingers are free. Each toe terminates in a large disc. Specimens measure up to 39 mm (snout vent length) when full grown. The dorsal surface is dark brown to black in colour. On lighter coloured substrates cream and grey blotches may appear. The ventral surface is dark with light reticulations. Males have pale nuptial pads on the inside of the thumbs; these are more obvious in the breeding season. The call of the male is a 'Peep' sound.

In the wild, amplexant pairs and calling males can be found from May and June. Clutches and tadpoles of different stages can still be found in December. Eggs are laid in small clutches of six to eight above the water on the inside of water-filled tree holes (Orlov, 1997). Eggs measure 3.5 mm in diameter. Tadpoles drop into the water after hatching. They possess a mosaic of feeding structures associated with the extremes

of microphagy and macrophagy (Wassersug et al., 1981).

Lifespan and age at sexual maturity in the wild have not been reported. The maximum lifespan in captivity is also unknown; to date captive individuals have been recorded to live five years (Ilze Duncce, pers. comm). Sexual maturity can be reached in five to six months in captivity (water temperatures 21-26°C).

#### CAPTIVE HUSBANDRY

##### Management

At Durrell captive bred individuals of this species have been housed and bred in plastic containers (Pal Pens™), measuring 350 x 200 x 300 mm. The Pal Pens were filled with water to a depth of 4 cm. Lengths of cork bark and inverted Coconut shell halves, each with a single aperture, were provided as refugia for the frogs. Artificial plants were submerged to provide additional refugia (Fig. 2). One group was housed in a more sanitary set up with a pile of small rocks in place of the coconut shell hides. The room this species was housed in was heated to between 23 and 27°C (night/day summer) and 20 and 25°C (night/day winter). A Reptisun™ 2.0 strip light was used for lighting.

Powder free latex gloves are used at all times when servicing amphibians at Durrell. All animals were visually inspected every two days. On these days the enclosure and all furnishings were thoroughly scrubbed (with a brush and water, no chemical cleaners or disinfectants were used).

*Theلودerma stellatum* were fed on live invertebrates, predominantly Crickets (*Gryllus assimilis* and *Gryllus bimaculatus*) and occasionally the Cowpea Beetle (*Callosobruchus chinensis*). Juvenile animals were fed on live pin head crickets and Fruit flies (*Drosophila hydei*). All food items were dusted with Nutrobal® (vitamin and

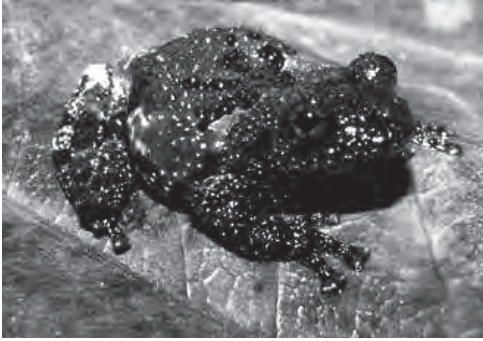


Figure 1. Juvenile *Theلودerma stellatum*.



Figure 2. Housing for *Theلودerma stellatum*.

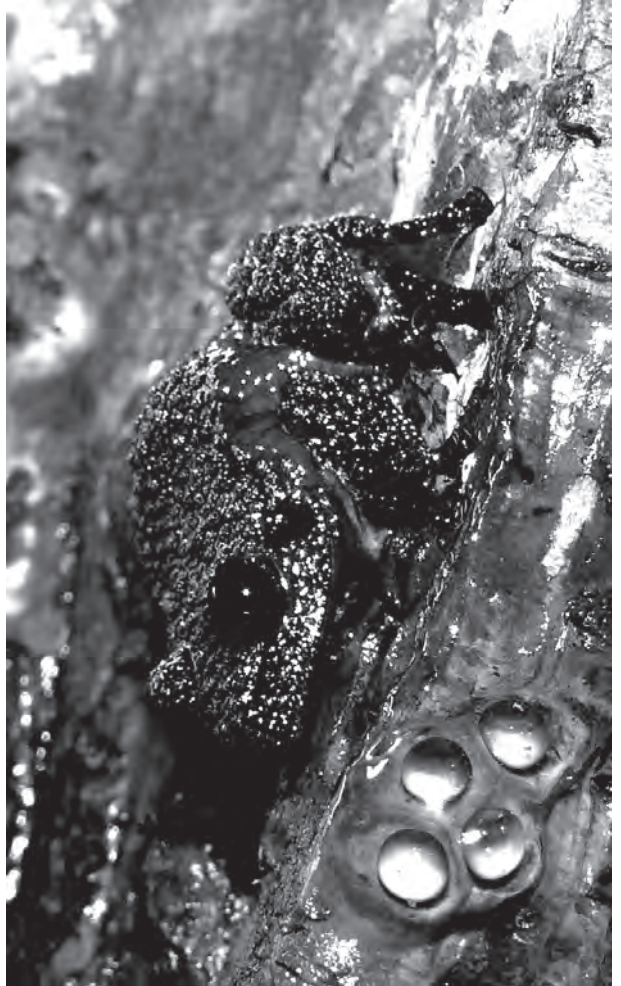


Figure 3. *Theلودerma stellatum* with eggs.

mineral supplement) immediately prior to being fed. Adults frogs were fed every three to six days (depending on season and condition); juveniles up to six weeks of age were fed daily.

### Reproduction

*Theلودerma stellatum* bred during the warmer months (April through to October). Interclutch intervals were, on occasion, as brief as ten days. Amplexus was axillary. Despite breeding in tree holes in the wild, in captivity *T. stellatum* readily oviposited on any surface over-hanging water (Fig. 3). Eggs were usually left in-situ because they frequently went mouldy if removed from the adult enclosures. As adult frogs were often observed

sitting next to or even across the egg clutches, we speculated that the adult's secretions might prevent the eggs from going mouldy. It should be noted, however, that when small rocks were used as oviposition sites in place of cork bark and coconut shell (Fig. 2), eggs hatched successfully even when removed from the enclosure.

Tadpoles hatched after ten days, and dropped down into the water. After hatching, tadpoles were transferred to a glass tank measuring 400 x 250 x 250 mm. Tap water was used to rear tadpoles, and oak leaves were added to soften the water. Partial (20-30 %) water changes occurred two to three times per week. Air stream sponge filters were used for filtration and were cleaned in water removed

from the tank at each partial water change. The water was not heated and ranged in temperature from 23-26°C. Tadpoles were fed on a powdered tadpole food (components: ground tropical fish flake, grass pellet, Trout pellets, Tubifex, River Shrimp, *Spirulina* algae and Cuttlefish bone). They metamorphosed in approximately 75 days at the above temperatures.

Metamorphs were housed in small Pal Pens in groups of up to 8 (groups were divided amongst larger Pal Pens as individuals grew). These were set up in the same way as the adult enclosures, but with shallower water (2.5 cm in depth). The metamorphs were raised at the same temperature as the adults (23-27°C), and were provisioned with a Reptisun™ 2.0 strip light. Metamorphs were fed daily until about six weeks of age with pin head crickets and (occasionally) *Drosophila* spp. All food items were dusted with Nutrobal®. After eight weeks, the feeding interval was gradually increased to once every three days.

### Health

This species is hardy, although other institutions have reported metabolic bone disease in some specimens.

All imported specimens were treated for *Batrachochytrium dendrobatidis* (Chytrid fungus) by bathing them in Itraconazole solution (1 part Itraconazole: 99 parts water) for five minutes daily

for 11 days. There was zero mortality of specimens during this treatment.

### ACKNOWLEDGEMENTS

I would like to thank Matthias Goetz, Kay Sara Bradfield and Ilze Dunce for their comments on the original manuscript.

### REFERENCES

- Duellman, W.E. & Trueb, L. (1994). *Biology of Amphibians*. Baltimore: John Hopkins University Press. 672 pp.
- IUCN, Conservation International, and NatureServe. (2006). Global Amphibian Assessment. <[www.globalamphibians.org](http://www.globalamphibians.org)>. (Accessed: October 2007).
- Orlov, N.L., Murphy, R.W., Ananjeva, N.B., Ryabov, S.A. & Thu Cuc, H. (2002). Herpetofauna of Vietnam, a checklist, part 1. Amphibia. *Russian J. Herpetol.* **9** (2), 81-104.
- Orlov, N.L. (1997). Die *Theلودerma* – Arten Vietnams. *Herpetofauna* **19** (110), 5-9.
- Stuart, B.L., Sok, K. & Neang, T. (2006). A collection of amphibians and reptiles from Hilly Eastern Cambodia. *Raffles Bull. Zool.* **54** (1), 129-155.
- Wassersug, R.J., Frogner, J.K. & Inger, R.F. (1981). Adaptations for life in tree holes by rhacophorid tadpoles from Thailand. *J. Herpetol.* **15** (1), 41-52.

### The Snake Box: A novel approach for safely restraining venomous snakes

THOMAS LONG and ANDRE PIRES-DASILVA\*

*Department of Biology, University of Texas at Arlington,  
Arlington, Texas 76010-0498, USA*

\* Corresponding author: [apires@uta.edu](mailto:apires@uta.edu)

Physical examination of venomous snakes is sometimes required for veterinary treatment, sex determination, assisted feeding and various research applications (e.g., scale counts, blood or tissue sampling, etc.). However, this is a dangerous task; 87.5% of snakebite incidents in academic institutions with venomous snakes resulted from suboptimal techniques in capturing and restraining methods (Ivanyi & Altimari, 2004).

A standard technique for close examination of snakes is tubing, which consists of restraining the snake in a clear acrylic tube (Murphy, 1971). To place the snake into the tube, the animal is usually first moved to a low table or to the ground, and its head is gently guided into the tube with a snake hook. After the snake has entered the tube ca. one third of its body length, it is restrained by grasping the posterior body and the tube. In this way, the head of the snake is safely in the tube and the body is held so that the snake cannot move forward or backwards out of the tube. To gain better control of the snake, the other hand is used to restrain the rest of the body. The tube must be of adequate diameter to prevent the snake from turning around once inside.

Guiding aroused snakes into the restraint tube is a difficult and time-consuming task. In our experience *Crotalus atrox* (Western Diamondback Rattlesnake) tends to strike and bite the tube when it is placed in front of the snake's head, increasing the risk of teeth injuries and subsequent infections.

We developed a new method to easily and safely guide snakes into the restraint tube. The technique utilizes a rectangular box with internal angled walls, which create a V-shaped channel along the length of the box. The internal lateral walls have

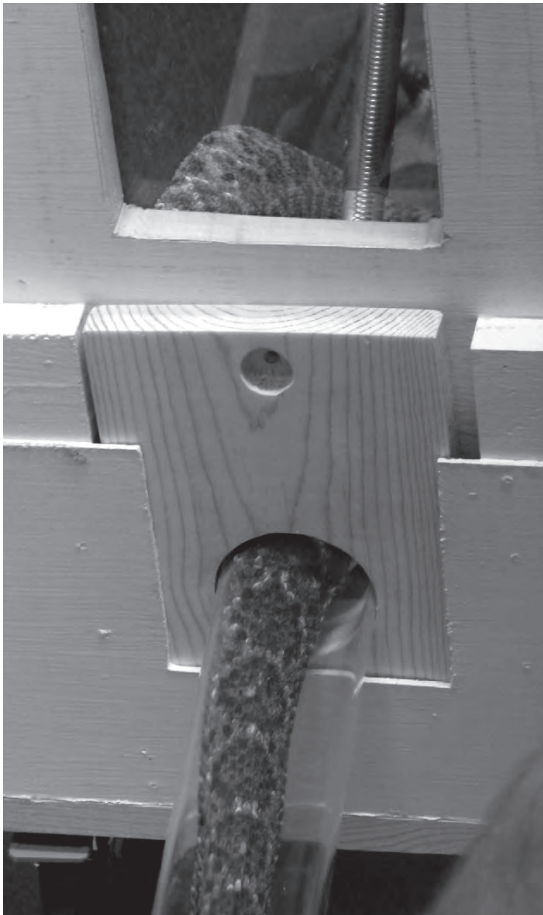
smooth surfaces which prevent the snake from crawling out (Fig. 1). One end of the box (in the longest dimension) has an opening in which a sliding door can be fitted. Alternatively, a door with porthole can be placed in the fitted brackets (Fig. 2). Several doors were manufactured, each with a porthole of different diameter. The diameter of the porthole is chosen according to the diameter of the tube to be used (based on the size of the snake being handled). Once the tube of adequate diameter is inserted into the porthole fitted in the box, the snake is placed into the box. We noticed that when the tube is covered with a dark fabric sleeve, the snake tends to enter more readily into the tube. After the snake has entered sufficiently, the tube and snake can be held in one hand and slid out of the box from the outside.

Our snake box consisted of an open-top 30.5 x 122 x 91.5 cm (width x length x height) box made of medium density fibreboard and roof decking plywood (1.6 cm thickness). The internal lateral walls are 0.3 cm panel boards, and the sliding doors are of wood 2.54 x 15.2 x 20.3 cm. To facilitate safe monitoring of the snake when inside the box, the anterior part of the box has a 15.2 x 20.3 cm plexiglass window. Rubber wheels (7.6 cm) with locks were added to facilitate easy transportation.

The introduction of the snake box into our laboratory protocols has made the handling of venomous snakes considerably safer and less stressful for both our research staff and the animals. The snakes crawl into the tube within a few minutes, allowing us to restrain several snakes in less time than would be required using traditional approaches.



**Figure 1.** *Crotalus atrox* contained within the snake box for observation. Note the following components of the snake box design: V-shaped channel, monitoring window and solid sliding door.



**ACKNOWLEDGEMENTS**

We thank J. A. Campbell and J. M. Meik for providing valuable comments regarding the design of the box, and Dallas and Alyssa Long for their assistance in the building of the snake box. Husbandry procedures were conducted under University of Texas at Arlington Institutional Animal Care and Use Committee guidelines (permit number A08.009).

**REFERENCES**

Ivanyi, C. & Altimari, W. (2004). Venomous reptile bites in academic research. *Herpetol. Rev.* **35**, 49-50.

Murphy, J.B. (1971). A method for immobilising venomous snakes at Dallas Zoo. *Int. Zoo Yearbook.* **11**, 233.

**Figure 2.** View from the outside of the porthole end of the snake box with acrylic tube inserted through one of the porthole doors. The door has a circular recession (visible above the tube) allowing the tip of a snake hook to manipulate the door. The trunk of a *Crotalus atrox* is visible through the plexiglas monitoring window and inside the acrylic tube. Also visible is the snake tongue used by an assisting researcher (cylinder behind Plexiglas).

## NATURAL HISTORY NOTES

**PHILODRYAS NATTERERI** (Paraguay Green Racer): OPHIOPHAGY. The Colubrid snake *Philodryas nattereri* is a medium sized snake widely distributed in the Brazilian semi-arid habitats (Rodrigues, 2003). *P. nattereri* is diurnal and mainly terrestrial and can also be found foraging in residential roofs (pers. obs.). Its diet consists of mainly lizards but also anurans, birds and small rodents (Vitt & Vangilder, 1983). The species is considered to be a general specialist. The ingestion of other snakes is relatively well reported for the genus *Philodryas* but it is apparently restricted to a single species. *Philodryas patagoniensis* is known to feed on a range of Colubrids such as *Philodryas olfersii*, *Thamnodynastes strigatus*, *Clelia occipitolutea*, *Liophis poecilogyrus*, *Liophis jaegeri*, *Helicops carinicaudus*, *Lystrophis dorbignyi* (Lema et al., 1983), *Lygophis dilepis* (López & Giraudó, 2008), *Pseudablables agassizi* and conspecifics (Hartmann & Marques, 2005). There is also a record of one individual that fed on a Viperid snake of the genus *Bothrops* (Perroni & Travaglia-Cardoso, 2007). Here we report a case of an unexpected prey—a Vine Snake *Oxybelis aeneus* found in the digestive tract of a *Philodryas nattereri*. We analysed the digestive tract content from an adult female collected in Pentecoste, State of Ceará, Brazil (03° 44'25.4" S. 39° 18'26.0" W; GPS Datum: WGS84), on 26 January 2009 at 10:20 hrs. The snake measured 1034 mm snout-vent length (SVL), 336 mm tail length (TL), 25.5 mm head length and weighed 268 g. After examining the digestive tract content of the snake we found two prey items: a lizard *Cnemidophorus ocellifer*, partially digested, and an arboreal snake *Oxybelis aeneus* (Fig. 1). The snake had ingested the prey head first and it was almost intact with an SVL of 497 mm, TL 306 mm and mass of 19 g. The prey/predator mass and SVL length rates were 0.07 and 0.48 respectively. Both snakes were deposited in the Collection of Herpetology of Universidade Federal do Ceará with the codes CHUFC 3144 for the *P. nattereri* and CHUFC 3155 for the *O. aeneus*. *Oxybelis aeneus* is an agile and irascible arboreal snake that readily presents defensive display if disturbed (Greene, 1979; Martins et al., 2008) and strikes when touched (pers. obs.). Despite *O. aeneus*' known defensive behaviour,

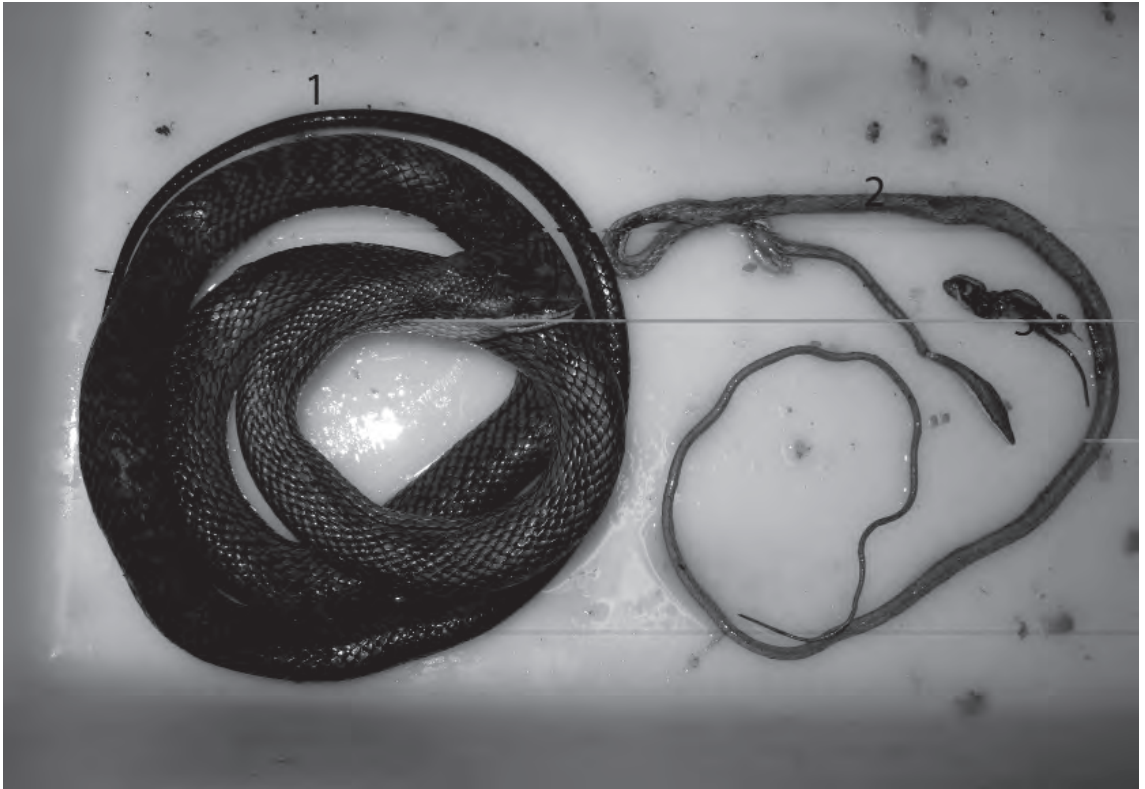
the difference in size between predator and prey presented here must have allowed the *Philodryas nattereri* to prey on the *O. aeneus* without no harm. Ophiophagy seems to be merely incidental to individuals of *Philodryas nattereri*. In spite of the existence of vast data for this species' dietary habit (Vitt, 1980), to our knowledge this is the first report of snake ingestion by *Philodryas nattereri*.

We thank the Fundação Cearense de Amparo a Pesquisa (FUNCAP) for financial support, the Instituto Brasileiro do Meio Ambiente e Recursos Naturais (IBAMA) for the license (License number: 18596-1) to collect snake samples in the studied area during December 2008.

### REFERENCES

- Greene, H.W. (1979). Behavioral convergence in defensive display of snakes. *Experientia*. **35**, 747-748.
- Hartmann, P.A. & Marques, O.A.V. (2005). Diet and habitat use of two sympatric species of *Philodryas* (Colubridae), in South Brazil. *Amphibia-Reptilia* **26**, 25-31.
- Lema, T., Araújo M.L. & Azevedo, A.C.P. (1983). Contribuição ao conhecimento da alimentação e do modo alimentar de serpentes do Brasil. *Com. Mus. Ci. Tecnol. PUC-RS. Zool. Série*. **26**, 64-65.
- López, M.S. and Giraudó, A.R. (2008). Ecology of the Snake *Philodryas patagoniensis* (Serpentes, Colubridae) from Northeast Argentina. *J. Herpetol.* **42** (3), 474-480.
- Martins, M., Marques, O.A.V. & Sazima, I. (2008). How to be arboreal and diurnal and still stay alive: microhabitat use, time of activity, and defense in Neotropical forest snakes. *S. Amer. J. Herpetol.* **3** (1), 60-69.
- Perroni, L.P.G. & Travaglia-Cardoso, S.R. (2007). *Philodryas patagoniensis* (Parelheira) venomous snake (a Crotalid) as prey. *Herpetol. Bull.* **101**, 37-39.
- Rodrigues, M.T. (2003). Herpetofauna da Caatinga. In: *Ecologia e Conservação da Caatinga*. pp.181-236. Leal, I.R., Tabarelli, M., Silva, J.M.C. (Eds). Recife, Pernambuco: Universidade Federal de Pernambuco, PE.





**Figure 1.** (1) *Philodryas nattereri* - CHUFC 3144 and the ingested items: (2) *Oxybelis aeneus* - CHUFC 3155 and (3) *Cnemidophorus ocellifer*.

Vitt, L.J. (1980). Ecological observations on sympatric *Philodryas* (Colubridae) in northeastern Brazil. *Pap. Avul. Zool.* **34**, 87-98.  
 Vitt, L.J. & Vangilder, L.D. (1983). Ecology of a snake community in northeastern Brazil. *Amphibia-Reptilia* **4**, 273-296.

Submitted by PAULO CESAR MATTOS DOURADO DE MESQUITA<sup>1</sup>, DIVA MARIA BORGES-NOJOSA<sup>2</sup>

<sup>1</sup> *Plínio Monteiro St. 123, Luciano Cavalcante, CEP 60811-285, Fortaleza, CE, Brazil. paulocmdm@gmail.com.*

<sup>2</sup> *Universidade Federal do Ceará, Núcleo Regional de Ofiologia da Univ. Fed. Ceará (NUROF-UFC), Depto. Biologia, Campus do Pici, Bl. 905, CEP 60.455-760, Fortaleza-Ceará, Brazil. dmbnojosa@yahoo.com.br.*

***SIPHLOPHIS LONGICAUDATUS*** (Brazilian Spotted Night Snake): HABITAT. The genus *Siphlophis* Fitzinger, 1843 belongs to the Pseudoboini tribe and comprises six species which occur mostly in south America in tropical rain forests (Peters & Orejas-Miranda, 1970; Duellman, 1978; Sazima & Argôlo, 1994; Martins & Oliveira, 1998; Starace, 1998; Bernarde & Abe, 2006; Uetz, 2007). These snakes are known as mainly nocturnal with semi-arboreal habits. Their diets include mostly lizards, occasionally snakes, mammals, anurans and lizard eggs (Sazima & Argôlo, 1994; Martins & Oliveira, 1998; Prudente et al., 1998; Marques et al., 2001). *Siphlophis longicaudatus* Andersson 1901 is known from the Atlantic forest of southern and southeastern Brazil, occurring from Espírito Santo to Rio Grande do Sul States (Peters & Orejas-Miranda, 1970; Prudente & Feio, 2001). Despite some information about its diet (Prudente et al., 1998), there is little data on the ecology of

this snake. Here we provide a new habitat record based on one individual collected in Minas Gerais State, southeastern Brazil. On 16 April 2005 around mid-day, we found an adult female specimen *Siphlophis longicaudatus* (788 mm in snout-vent length) resting in a rock crevice which was about 1 m above the ground at the municipality of Diamantina (18° 13' 57.2" S, 43° 35' 14.9" W, 1250 m above sea level), Minas Gerais State, Brazil. This locality is in the Cerrado domain, in the meridional segment of Serra do Espinhaço Mountain Range. The highest average temperature is 20°C and the lowest 18°C, with higher temperatures occurring from October to March and the lowest from April to September. Most of the rainfall occurs from November to March (223.19 mm) and the drier periods occur from June to August (8.25 mm). The relative humidity ranges from 72.33 % to 89.75 % (Silva et al., 2005). The area where the snake was captured can be classified as a "campo rupestre" which is characterized by the domain of grasslands and shrubs that occur in the middle of rock formations in open areas (Fig. 1). The vegetation is composed of Asteraceae, Melastomataceae, Gramineae, Cyperaceae, Cactaceae, Ericaceae, Leguminosaceae, Velloziaceae, Eriocaulaceae and Xyridaceae (Silva et al., 2005). The adaptations to arboreality of *S. longicaudatus* (i.e., a slim body and a long tail, Lillywhite & Henderson, 1993) could be useful in this environment by improving locomotion around the rock complexes. Lizard species that occur in rocky habitats are known for this locality and include: *Phyllopezus* cf. *pollicaris*, *Gymnodactylus guttulatus*, *Ameiva ameiva*, *Kentropyx* cf. *paulensis*, *Polychrus acutirostris*, *Tropidurus montanus*, *T. torquatus*, *Eurolophosaurus nanuzae*, *Cercosaura* sp. and *Ophiodes* sp. (A. Righi & S.A.A. Morato, pers. comm.). All of these lizards are potential prey for snake species inhabiting the area. No gut contents were observed in the collected specimen. *S. longicaudatus* was only recently recorded in Minas Gerais State at the Parque Estadual do Rio Doce, municipality of Marliéria (Prudente & Feio, 2001). This locality comprises an Atlantic Forest fragment. As far as we know, this is the second record for this species in Minas Gerais State. The Cerrado biome represents the second largest

neotropical ecosystem and a unique savanna hotspot. However, there are few ecological studies covering the herpetofauna in this diverse biome (Valdujo & Nogueira, 2001; Nogueira et al., 2008). The observation of a snake that is considered to be arboreal and inhabit forested habitats, in such a vast open area in the Cerrado biome, emphasises the need of focus more attention on this poorly known Brazilian ecosystem. The specimen (MCNR1807) was collected by A. Righi, L. Alencar, R. Filogônio and F. Zaidan and is deposited in the herpetological collection of the Natural Science Museum of PUC Minas, Belo Horizonte, Minas Gerais State, Brazil.

We thank Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for granting support to Alexandre Righi (PROBIC/PUC Minas 2005/02); Fundo de Incentivo a Pesquisa (FIP/PUC Minas) and Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG) for financial support to Luciana Barreto Nascimento.

## REFERENCES

- Bernarde, P.S. & Abe, A.S. (2006). A snake community at Espigão do Oeste, Rondônia, Southwestern Amazon, Brazil. *S. Amer. J. Herp.* **1**, 102-113.
- Duellman, W.E. (1978). The Biology of an equatorial herpetofauna in Amazonian Ecuador. *Misc. Publ. Kansas Mus. Nat. Hist.* **65**, 1-352.
- Lillywhite, H.B. & Henderson, R.W. (1993). Behavioral and functional ecology of arboreal snakes. In *Snakes: Ecology and Behavior*, pp. 1-48. Seigel, R.A. & Collins, J.L. (Eds.). New York: McGraw-Hill.
- Martins, M. & Oliveira, E. (1998). Natural history of snakes in forests of the Manaus Region, central Amazonia, Brazil. *Herp. Nat. Hist.* **6**, 78-150.
- Marques, O.A.V., Eterovic, A. & Sazima, I. (2001). *Serpentes da Mata Atlântica: Guia Ilustrado para a Serra do Mar*. Riberião Preto: Holos Editora. 184 pp.
- Nogueira, C., Colli, G. & Martins, M. (2008). Local richness and distribution of the lizard fauna in natural habitat mosaics of the Brazilian Cerrado. *Austral Ecol.* **34**, 83-96.



**Figure 1.** The habitat where *Siphlophis longicaudatus* was captured. This locality belongs to the municipality of Diamantina, Minas Gerais State, Brasil. Photograph by Alexandre Righi.

Peters, J.A. & Orejas-Miranda, B. (1970). Catalogue of the Neotropical Squamata I. *Bull. US. Natl. Mus.* **297**, 1-347.

Prudente, A.L.C. & Feio, R.N. (2001). *Siphlophis longicaudatus*. Geographic Distribution. *Herpetol. Rev.* **32**, 125-125.

Prudente, A.L.C., Moura-Leite, J.C. de & Morato, S.A.A. (1998). Alimentação das espécies de *Siphlophis* Fitzinger (serpentes, Colubridae, Xenodontinae, Pseudoboini). *Rev. Bras. Zool.* **15**, 375-383.

Sazima, I. & Argôlo, A.J.S. (1994). Natural History Notes. *Siphlophis pulcher*. (NCN). *Prey. Herpetol. Rev.* **25**, 126-126.

Silva, A.C., Pedreira, L., Abreu, P. (2005). Serra do Espinhaço Meridional. *O Lutador.* **1**, 209-230.

Starace, F. (1998). *Guide des Serpents et Amphisbènes de Guyane*. Paris: Ibis Rouge Éditions. 449 pp.

Uetz, P. (2007). The new reptile database. Karlsruhe. <[www.reptile-database.org](http://www.reptile-database.org)>.

Valdujo, P.H. & Nogueira, C. (2001). New records of squamate reptiles in the central Brazilian Cerrado: Emas National Park Region. *Herpetol. Rev.* **32**, 128-130.

Submitted by: LAURA RODRIGUES VIEIRA DE ALENCAR<sup>1</sup>, ALEXANDRE FERREIRA RIGHI, LUCIANA BARRETO NASCIMENTO<sup>2</sup> and SÉRGIO AUGUSTO ABRAHÃO MORATO<sup>3</sup>

<sup>1</sup> *Laboratório de Ecologia e Evolução de Vertebrados, Instituto de Biociências, Universidade São Paulo, Rua do Matão, Travessa 14, Cidade Universitária, São Paulo, SP, Brasil, CEP 05508-090.* [laura.alencar@globocom](mailto:laura.alencar@globocom)

<sup>2</sup> *Programa de Pós-graduação em Zoologia de Vertebrados, Museu de Ciências Naturais, Dept. de Ciências Biológicas, Pontifícia Universidade Católica de Minas Gerais, Avenida Dom José Gaspar, 290, Bairro Coração Eucarístico, Belo Horizonte, Minas Gerais, Brasil, CEP 30535-610.*

<sup>3</sup> *3 STCP Engenharia de Projetos Ltda. Rua Euzébio da Motta, 450, Bairro Juvevê, Curitiba, Paraná, Brasil, CEP 80530-260 and Faculdade de Ciências Exatas e de Tecnologia, Unisid. Tuiuti do Paraná. R. Sydney A. Rangel Santos, 238, Bairro Santo Inácio, Curitiba, Paraná, Brasil, CEP 82010-330.*

**ABLEPHARUS KITAIBELII** (Snake-eyed Skink):  
**HABITAT.** *Ablepharus kitaibelii* is a diminutive (up to 13.5 cm) glossy lizard that is stocky in appearance. It is glossy bronze-brown with darker dorsolateral coloration. It is a fast moving lizard that often escapes by burrowing into substrate using a serpentine locomotion. Its habitats include south facing slopes, meadows, Oak (*Quercus* spp.) and Chestnut (*Castanea* spp.) forest edge and clearings. It ranges from Hungary through to the southeast Balkans, the Aegean Islands and parts of southwest Asia (Arnold & Ovenden, 2002; Böhme et al., 2008). Here we document an unusual and potentially harmful environment for *A. kitaibelii*.



**Figure 1.** Kalloni saltpans. Photograph by Alex Ramsay.

On 9 November 2007 at 11.45 am three rapidly burrowing *A. kitaibelii* were observed at the southwest margin of Kalloni Saltpans, Lesvos Island, Greece (Fig. 1). The sandy soil that the lizards dived into upon disturbance derived from the drainage ditch surrounding the main saltpan. The salinity of the soil the lizards were burrowing into was confirmed by a distinct lack of vegetation, dry soil on the ditch margins and abundant salt crystals in the soil. The loose soil was easily dug out by hand, and on examination yielded a number of adult *A. kitaibelii*. This unnatural halophytic habitat has not been noted previous for *A. kitaibelii*. Most temperate lizard species do not, to the best of our knowledge, generally favour strongly saline environments. To remain active in such soil, combined with the dry climate and intense sunlight, could cause rapid dehydration in a small bodied squamate lizard (Pough et al., 1998). What is also interesting is that threats to *A. kitaibelii* are currently noted to include afforestation, deforestation and conversion of suitable habitat to agriculture,

forestry or industrial use (Gasc et al., 1997; CoE, 2003; Böhme et al., 2008). This observation of *A. kitaibelii* active within a secondary, manufactured environment, may, if confirmed with further observation, suggest that *A. kitaibelii* is tenacious to its preferred edge niches. Whether the lizard's interest in the habitat was physiological for the warm, loose soil for burrowing, or for reproduction or prey resource, invites further study.

## REFERENCES

- Arnold, E.N. & Ovenden, D. (2002). *Reptiles and Amphibians of Britain and Europe*. London: Collins Publishing.
- Council of Europe (2003). Convention on the Conservation of European Wildlife and Natural Habitats. Group of experts on the conservation of Amphibians and Reptiles. Malmö (Sweden), 26-27 Sept. Report T-PVS, 18.
- Gasc, J.-P., Cabela, A., Crnobrnja-Isailovic, J., Dolmen, D., Grossebacher, K., Haffner, P., Lescure, J., Martens, H., Martínez-Rica, J.P., Maurin, H., Oliveira, M.E., Sofianidou, T.S., Veith, M. and Zuiderwijk, A. (1997). *Atlas of Amphibians and Reptiles in Europe*. Paris: Societas Europaea Herpetologica and Musée National d'Histoire Naturelle.
- Böhme, W., Lymberakis, P., Ajtic, R., Tok, V., Ugurtas, I.H., Sevinç, M., Crochet, P.A., Haxhiu, I., Sterijovski, B., Krecsák, L., Isailovic, J.C., Kaska, Y., Kumlutaş, Y., Avcı, A. & Jelić, D. (2008). *Ablepharus kitaibelii*. In: IUCN 2009. IUCN Red List of Threatened Species. Version 2009.1. <www.iucnredlist.org>. (Accessed: 11 August 2009).
- Pough, F.H., Andrews, R.M., Cadle, J.E., Savitzky, A.H., Crump, M.L. & Wells, K.D. (1998). *Herpetology*. New Jersey: Prentice Hall.

Submitted by: ALEX J. RAMSAY<sup>1</sup> and TODD R. LEWIS.

<sup>1</sup> RSK Carter Ecological Ltd, 40 The Green, South Bar, Banbury OX16 9AE. aramsay@rskcarterecological.co.uk.

<sup>2</sup> Westfield, 4 Worgret Road, Wareham, Dorset, BH20 4PJ.