www.captiveandfieldherpetology.com

Captive & Field Herpetology Ltd

The Captive & Field Herpetology Journal - Volume 4 Issue 2 - 2020 - ISSN - 2515-5725

The Captive & Field Herpetology Journal

Volume 4 Issue 2

2020

ISSN - 2515-5725

Published by Captive & Field Herpetology Ltd

Cover Image and above:

Indonesian spitting cobras (*Naja sputatrix*) hatching at the Ciliwung Herpetarium in Bogor, West Java, Indonesia. The herpetarium is managed by the Indonesia Herpetofauna Foundation, functioning as an educational facility, temporary holding space for rescued reptiles, and a herpetological laboratory for research of Indonesian amphibians and reptiles.

Photographer:

Nathan Rusli is an Indonesian herpetologist and Executive Director of the Indonesia Herpetofauna Foundation. His main focus is science communication and conservation of herpetofauna. He has also written several books and scientific publications about Indonesian snakes and herpetology, the most recent one being "A Photographic Guide to the Snakes of Java" which can be purchased through Captive & Field Herpetology.

The Captive & Field Herpetology Journal focusses on publishing natural history notes, observational based notes and reviews. Submissions can focus on in and ex-situ herpetology but must aim to improve our current understanding of amphibians and reptiles. Articles which include herpetofauna-human conflict are welcomed, particularly when involving venomous snake-human conflict. Experiment based articles are generally not considered but contact us if you feel you have an article which would suit the C&FH Journal. Reviews can focus upon past literature but also on a single piece of literature such as a book.

For all submissions, please see our submission guidelines and submit via the submission form found on our website. Any submissions which do not follow the guidelines will be rejected immediately.

Field Reports

Natural history notes

Behavioural observations

Dietary observations

Disease & illness

Geographic based notes - new locality records, range extensions etc

Captive Reports

Breeding notes

Care and culture notes

Novel techniques

Disease & illness

Behavioural observations

Reviews

Literature reviews focussing on old and recent literature

Book reviews

Casual Reports

We feature one casual report per issue. These are a relaxed style report, usually focussing on a field trip, expedition or similar. Whilst these articles are not subjected to peer-review, they will be subjected to editorial checks for writing quality. Due to only featuring one per issue, there may be some delay in publication.

Upon submission, an editorial check will be carried out pre-peer-review. Following editorial checks, all articles will be sent to two reviewers. Author details will be kept anonymous during the review process and we aim to complete the review process within 4 weeks of submission.

Please see previous issues for examples of published articles.

For any enquiries, including submission, formatting or the review process, please feel free to contact us.

www.captiveandfieldherpetology.com

captiveandfieldherpetology@gmail.com

Submissions:

For exact formatting of your manuscript, see the submission form on our website. Abstracts may be included but are generally only included during the publication stage for longer, more complex articles. Figures/illustrations/tables should be sent separately, alongside the submission form and be accompanied by a suitable legend (figures/illustrations) or title (tables).

References should be cited consistently in the format of 'LastName et al., Date'. Reference lists should be consistent and follow the style below.

Chan-ard, T., Parr, J.W.K. & Nabhitabhata, J. (2015) A Field Guide to the Reptiles of Thailand. Oxford University Press, New York. 292-293

Vogel, G. & David, P. & Pauwels, O. (2004) A review of morphological variation in Trimeresurus popeiorum (Serpentes: Viperidae: Crotalinae), with the description of two new species. *Zootaxa* **727**: 1-63.

Citation strings should be separated via semi-colons and sequenced in chronological order.
Other formatting:

Time should follow the 24 hr format eg. 0900 h

Temperatures should be in celsius eg. 20°C

GPS coordinates should be in decimal degrees (DD) eg. 53.306514, -4.699404

There is no word count limit for any submission category but we advise all submissions to be as concise as possible. See previous issues for examples.

All submissions should be sent to us via email, using the submission form to captiveandfieldherpetology@gmail.com.

Volume 4 Issue 2 2020

Index:

Casual Report

Field Reports

 ISSN - 2515-5725

Of frog legs and turtle soup in Singapore

Webster Cheong[1, *]

[1]Wildlife Reserves Singapore, 80 Mandai Lake Road, 729826, Singapore

[*]Corresponding author: Webster Cheong; webster.cheong@wrs.com.sg

The Republic of Singapore is an island city-state situated in Southeast Asia and has a total land mass of 721.5 square kilometres. While it is now known as a sprawling metropolis, it was a very different place not too long ago. Go back less than a century and you would find Malayan tigers (*Panthera tigris tigris*) roaming the jungles. These tigers often preyed on livestock, causing friction with the local communities; on 26 October 1930, the last wild Malayan tiger was shot and killed. Photographic records show that exotic meats (pangolin, monitor lizards, snake, etc) were sold openly in food markets in the 1960s. Times have changed and with it, so has the Singaporean society. Over the years Singapore has lost 95% of its historical forests due to rapid urbanisation. Although only a small portion of undisturbed forested land remain, Singapore remains a hotspot for biodiversity. There are 30 lizard species, at least 55 species of snakes, 24 anuran species, six native chelonian species, one crocodilian (*Crocodylus porosus*), and one caecilian species on mainland Singapore.

The implementation of tough wildlife laws has protected the native flora and fauna that are still extant on the island. Together with the educational efforts of various government agencies, non-governmental organisations, and schools, the younger generation are taught the plight that both wildlife and their natural habitats face. Community outreach events also broaden the demographic reach; people from all age groups and walks of life are exposed to conservation messages. This is still an on-going process as while the younger folk generally shy away from exotic animal products, some of the older generation still believe in the benefits of certain products.

Figure 1. Species from left to right: Asiatic softshell turtle (*Amyda cartilaginea*), Chinese softshell turtle (*Pelodiscus sinensis*), red-eared slider (*Trachemys scripta elegans*). Photographed by David Tan.

Figure 2. *P. sinensis* in nylon mesh bags in shallow water to be sold for food. The mesh bags were presumably used to prevent bites.

The commonly consumed meats in Singapore are chicken, beef, pork, mutton, duck, and seafood. Other less common, more exotic but legal meats include frog, turtle, and crocodile. The majority of the latter are consumed in the form of herbal turtle soup, crocodile soup, Chinese frog dishes, and a Chinese dessert known as guilinggao or tortoise jelly. Packaged frozen crocodile meat can be found in the local supermarkets; these are farm-bred and imported from Indonesia. The three commonly available chelonian species sold for the food trade are Asiatic softshell turtle (*Amyda cartilaginea*), Chinese softshell turtle (*Pelodiscus sinensis*), and red-eared slider (*Trachemys scripta elegans*) (Figure 1). Both *P. sinensis* and *T. scripta* are not native to Singapore and imported from Indonesia and China; both species have also been classified as invasive due to errant pet practices and religious mercy release. *P. sinensis* are used for herbal soups while the hard carapaces of *T. scripta* are used for tortoise jelly. American bullfrog (*Lithobates catesbeianus*) is the only anuran species sold for human consumption; these are farm-bred locally and sold throughout the country at Chinese restaurants. All the species mentioned above are those sold openly in wet markets and food stalls. According to a recent local news report, there are only four remaining stalls that still legally sell live turtles. Furthermore, tenders for new stalls have been banned since 2012. Dried Tokay gecko (*Gekko gecko*) was still openly sold in traditional Chinese medicine (TCM) stores due to the unfounded belief that dried gecko contained the cure for HIV/AIDS and cancer. A TRAFFIC report found the trade of dried gecko to have declined significantly by 2013, and sales within Singapore have stopped since the species was listed in the CITES Appendix II in 2019.

Given the rich biodiversity and strict wildlife laws, I wanted to find out whether food markets and traditional Chinese medicine stores in Singapore still sold exotic meats and products. The methods were simple and concise. I selected two wet markets around the island which have high traffic flow: the sites were Chinatown complex (site 1), and Tiong Bahru wet market (site 2). The TCM stores I surveyed were also around the Chinatown area. Information such as where the animals originated from, the numbers of animals sold and for what purpose were gathered by means of oral questioning.

Site 1: I first surveyed this site in December 2018 and found just two stalls selling exotic meats. *T. scripta*, *A. cartilaginea*, and *P. sinensis* were the only chelonian species being sold. The only amphibian species encountered was *L. catesbeianus*. I performed another survey in February 2019, just before the Lunar New Year; the species remained the same, however the number of individuals seemed to have diminished. The impending festivities might have caused the surge in sales.

I surveyed TCM shops around Smith Street and Temple Street, both within the Chinatown vicinity in May 2019 but found no instances of exotic meats being sold.

Site 2: I surveyed this market in March 2019 but failed to detect any presence of exotic meats at any of the stalls, neither were there any stalls with the facilities to house livestock. I did not carry out a second follow-up survey at this location.

Figure 3. An *A.cartilaginea* in shallow water with visible wounds on the rear left margin of the carapace.

None of the stallholders were particularly receptive with being questioned about the provenance of their animals even though everything was sold openly. One of them mentioned that the *A. cartilaginea* and *P. sinensis* were imported from Indonesia; these included both farm-raised and wild caught animals. The reliability of the statement is questionable. The conditions the animals were kept in were dismal; many had injuries from overcrowding or abrasion from being confined in nylon nets (Figure 2). Space was extremely limited even for the animals that were housed alone; most could barely turn in the containers (Figure 3). Water depth provided for the animals were also inadequate, almost all were kept in water below the carapace. All photographs were taken discreetly. These animal welfare issues should definitely be addressed by the local authorities; namely the Animal & Veterinary Service (AVS).

Before commencing the surveys, I expected to find Malayan box turtle (*Cuora amboinensis*), giant Asian pond turtle (*Heosemys grandis*), and spiny turtle (*Heosemys spinosa*) in the markets. These three species are found locally in Singapore and due to their terrestrial to semi-aquatic habits, might prove easier to capture than fully aquatic softshell turtles. However as mentioned above, only *A. carilaginea*, *P. sinensis* and *T. scripta* were sold in the markets. One of my goals when I first decided to do these surveys was to ascertain if these stalls sold native species and if so, whether they were locally poached. I achieved one portion of my goal but the other portion cannot be proven due to noncompliance on the stallholders' ends; there was no way to tell with certainty if the A. cartilaginea were locally poached. However one can take solace from the fact that it was the only locally found species available for sale in the market.

The demand in the consumption of exotic meats can be inferred from the number of stalls that sell them. There are no more than twenty food stalls in the country that still sell turtle soup, and even fewer with crocodile meat. The practice of consuming exotic meats is no longer commonplace, and in some ways frowned upon by a more modern society; just last year, an online petition garnered over 7000 signatures in a bid to remove the sale of rabbit meat in a local restaurant. The future of the exotic meat industry in Singapore looks grim as the mindset of the society moves towards a more wildlife-friendly and sustainable direction.

The first record of green toads *Bufotes* sp. from the island of Ios, Cyclades, Greece, with notes on the distribution and conservation of green frogs *Pelophylax kurtmuelleri* (Gayda, 1940) on Ios and Milos

Stuart Graham[1*], Anatoli Togridou[2], Ilias Strachinis[3], Andrea Place[4] and John W. Wilkinson[5]

[1] School of Natural Sciences, Bangor University, Bangor, Gwynedd, LL57 2UW, Wales, United Kingdom
[2] Hednesford, Cannock, Staffordshire, England, United Kingdom.
[3] Department of Genetics, Development and Molecular Biology, School of Biology, Aristotle University of Thessaloniki, Greece.
[4] Franklin House, Essex, England, United Kingdom.
[5] Amphibian and Reptile Conservation, 744 Christchurch Road, Boscombe, Bournemouth BH7 6BZ, England, United Kingdom.

[*] Corresponding author. E-mail: stuartgrahamuk@hotmail.co.uk

Introduction

The Cyclades Archipelago comprises about 20 Greek islands in the Aegean Sea, centred around the capital island of Syros (Gaki-Papanastassiou *et al*., 2010). Most of these islands, formed by metamorphic and igneous processes (Hejl *et al*., 2002), are the peaks of previously exposed mountains. The numerous small islands outcrops on the plateau today are the result of a complex geomorphology (Kapsimalis *et al*., 2009), with the exception of the volcanogenic islands of Milos and Santorini (Gaki-Papanastassiou and Papanastasiou, 2014). Milos hosts a unique herpetofaunal diversity that includes four taxa endemic to the Milos archipelago (Vervust *et al*., 2013): the viper *Macrovipera schweizeri* (Werner, 1935), the wall lizard *Podarcis milensis* (Bedriaga, 1882), the Balkan green lizard *Lacerta trilineata hansschweizeri* (Müller, 1935), and the grass snake *Natrix natrix schweizeri* (Müller, 1932) (Chondropoulos, 1986, 1989). The presence of so many endemic reptiles makes the existence of an endemic amphibian expectable (Vervust *et al*., 2013); however, fresh water is a rare commodity in the Cyclades (Kyriakopoulou-Sklavounou, 2000) and this scarcity shapes the distribution of amphibians there. Amphibians known from the Cyclades include *Bufo bufo* (Linnaeus, 1758), *Hyla arborea* (Linnaeus, 1758), water frogs (genus *Pelophylax*; Broggi, 2000, 2007, 2011; Valakos *et al*., 2008) and green toads (genus *Bufotes*), most of them occurring only on some islands (Lymberakis *et al*., 2007; Sillero *et al*., 2014). The taxonomic status of both of the latter genera in the Cyclades remains unclear at the present time (Vervust *et al*., 2013; Dufresnes *et al*., 2018, 2019).

The Balkan water frog (*Pelophylax kurtmuelleri* (Gayda, 1940)) is distributed primarily in Greece but extends into southern Albania, with introductions elsewhere (AmphibiaWeb, 2008). Detailed information

Figure 1. Male Green toad *Bufotes sp*. identified at Mylopotas, Ios, Cyclades, Greece (Photo by Stuart Graham).

on the species' life history etc., as distinct to other *Pelophylax* species is notably lacking. Vervust *et al*. (2013) suggested that Balkan water frog on Milos were quite distinct as compared to other *P. kurtmuelleri* populations and these Cycladic island forms should at least be considered "evolutionary significant units" (ESUs).

The green toad (*Bufotes viridis* (Laurenti, 1768)) sensu lato complex of species extends from North Africa, throughout much of Europe, into western and Central Asia (AmphibiaWeb, 2008), and it is considered a species complex requiring additional taxonomic work (e.g., Dufresnes *et al*., 2018, 2019). In Greece, green toads are found on the mainland and on most of the islands (Valakos *et al*., 2008). Dufresnes *et al*. (2018) discovered a new and distinct mitochondrial lineage of green toads endemic to Naxos (central Cyclades), which appears to be the result of Quaternary sea level changes that lead to vicariant isolation. Dufresnes *et al*. (2019) revised taxonomy asserts that most Greek (including mainland) *Bufotes* populations should be considered *B. viridis*, with *B. sitibundus* occurring in the eastern and central Aegean, however this is as yet

Table 1. Amphibian survey results for the islands of Ios and Milos in the Cyclades archipelago, Greece, in 2018 and 2019. Asterisks (*) indicate a reduced accuracy due to site permissions. The octothorpe (#) indicates site is subject to Presidential Decree 229/2012.

Island	Date	Site type	Coordinates	Species present
Ios	07 April 2019	Garden pond, 120 m East of Mylopotas Reservoir Protected Wetland	36.425°N, 25.182°E*	*P. k.* adults, tadpoles
	07 April 2019	Reservoir#	36.4252°N, 25.1837°E	none
	08 April 2019	stream pools east of Ostria village	36.4256°N, 25.1828°E	none
	08 April 2019	Wetland	36.7258°N, 25.2740°E	*P. k.* adult (calling)
	08 April 2019	Seasonally flooded area, 1.16 km west from East of Mylopotas Reservoir Protected Wetland	36.7147°N, 25.2955°E	*B. v.* adults
Milos	02 October 2018	Natura 2000 lake#	36.6875°N, 24.4425°E	none
	13 April 2019			*P. k.* Adults (calling)
	03 October 2018	Two waterbodies (dry in 2018, wet in 2019) #	36.7057°N, 24.4866°E	none
	09 April 2019			*P. k.* Adults
	04 October 2018	Drainage culvert (wet in 2018, dry in 2019) 0.12 km east of Zefyria (disused) Brickworks Protected Wetland	36.7055°N, 24.4884°E	*P. k.* Adults, sub-adults
	09 April 2019			none
	09 April 2019	Drainage culvert under road 0.28 km north-east from former salt extraction of Aliki Protected Wetland	36.42485°N 24.29331°E	*P. k.* Adult
	10 April 2019	Former mine workings	36.7232°N, 24.5249°E	*P. k.* (possible splash heard)
	11 April 2019	Seasonally flooded area/culverts#	36.7013°N, 24.4842°E	*P. k.* Adult (calling)
	12 April 2019	Field pond 0.73 km west from Katsaronas Protected Wetland	36.4357°N, 24.3111°E	none
	12 April 2019	Field pond	36.4514°N, 24.3138°E	none

not widely accepted and requires further investigation. We therefore refer to green toads encountered during this study as *Bufotes* sp. (figure 1). This article provides an update on the distribution of amphibians present on the Cyclades Islands of Ios and Milos, along with suggestions for their conservation.

Methods

Surveys were undertaken on the islands of Ios (07–08 April 2019) and Milos (02–04 October 2018 and 09–13 April 2019) in the Cyclades Archipelago, Greece, with the primary objective of identifying extant localities for *P. kurtmuelleri*. A desktop study was conducted to identify waterbodies and locations on these two islands. A literature review was also undertaken to identify waterbodies and locations on these two islands where *Pelophylax* sp. had been previously recorded. Field surveys adopted methodologies detailed within Wilkinson (2015). Equipment (dip-nets, boots, sample tray and in contact survey equipment) was appropriately sterilised adopting guidelines detailed in ARG UK (2017). Amphibians were identified utilising Broggi (2000), Valakos *et al*. (2008) AmphibiaWeb (2008) and Dufresnes *et al*. (2018). Upon capture or observation, all locations were recorded utilising a Garmin GPSmap 60CSx (+/- 2-5 m) with images of individuals taken with a Ricoh WG-50 (16MP).

Results

Survey results are presented in Table 1. We encountered *P. kurtmuelleri* at two of five localities on Ios and at six of eight localities on Milos. We made only a single observation of *Bufotes* sp. on Ios.

Discussion

This study presents the first published record of the occurrence of green toads on the island of Ios and the first published update on the amphibian fauna of Milos since Broggi (2000). Grey literature suggests the presence of green toads on Ios, however this is the first confirmed published record of green toads on the Island. Wilson (2019) and Bok (2013) made mention of one unspecified locality of *P. kurtmuelleri* on Ios. This study details the location and confirms the presence of *P. kurtmuelleri* on Ios. Since Ios lies merely some 12 km to the south of Naxos, the exact identity of the Ios green toads needs further investigation. Further studies are required regarding genetic analysis and species assignment, along with surveys of additional water bodies across the island to establish distribution.

Substantial rains in the Cyclades over winter 2018-19 may have improved the breeding conditions for (and detection of) amphibians there but, despite this, the persistence of both species on these islands is likely to be conservation dependent.

The apparently small populations of amphibians found on Ios and Milos appear to be particularly vulnerable, experiencing extreme isolation within highly fragmented hydrological systems, and possibly extreme weather-driven fluctuations in population size as a result. Anthropogenic factors result in additional threats to these insular amphibians, increasing their risk of extinction. Small island wetlands are specifically protected in Greece through a Presidential Decree (229/2012). Activities should promote the sustainability of wetland habitats and any development within the wetlands that can affect their integrity and hydrology prohibited. Only light development activities are permitted, that aim to enhance the wetlands and inform the public. Our survey results indicated that only two out of the six (private garden pond not included) wetlands are protected under the Presidential Decree.

Ios, Garden Pond. The pond lies within the grounds of a family house, approx. 262m west of a reservoir protected under the Presidential Decree. There is a high risk for the pond to be lost/grounds to be modified through landscaping. Although not known if this is a relic population or introduction, this breeding locality needs to be maintained in its current state to ensure breeding/overwintering sites are not lost. No other Balkan water frog breeding sites on Ios can currently be confirmed. Further surveys are required to adjacent water systems to better understand if Balkan water frogs are using the ditch systems that lead to the reservoir. The results of this survey may indicate that this ditch system is important for the survival of fragmented Balkan water frog population(s) in this location and should be included under the Presidential Decree.

Ios, Port Wetland. The wetland area showed visual signs of petrochemical pollution. Experimental studies have confirmed the toxicity of these pollutants to amphibians (Heatwole & Wilkinson, 2009). The greatest risk in this area seemed to be future developments as it is located in the middle of a residential, touristic and partly industrial area. Destruction of habitat that leads to fragmentation is perhaps the major present cause of decline in amphibians (Lemckert *et al*., 2012). High numbers of mosquito larvae were recorded throughout the marshland area. Due to the proximity to residential houses, there is a risk of industrial insecticide use as well as draining of the marshland, to control the mosquito population (e.g., Kolimenakis *et al*., 2019). The marshland area needs to be protected against drainage operations and any form of development till further population studies are undertaken.

Ios, Mylopotas Beach. Sandwiched between hotel complexes, located 1.15 km west of a reservoir protected under the Presidential Decree. The greatest risk in this area seemed to be future development. Being adjacent to hotel developments, there is a risk of industrial insecticide use and development of the wetland area to control any mosquito population present and increase business opportunities. Amphibians may also be the subject of persecution at touristic locations in Greece, as observed by Kaczmarski & Zurawlew (2019), perhaps because of some perception of nuisance to visitors. This wetland area needs to be protected against any form of development till further population studies are undertaken. An understanding of the population will provide future management objectives to safeguard the population.

Milos, Achivadolimni Lake. This is the largest natural wetland in the Cyclades. It belongs to the regional network of Natura 2000 sites of the European Union and therefore enjoys a degree of protection. The lake is further protected under Presidential Decree; protection of small wetlands found across the Greek islands. Though we cannot confirm breeding of *P. kurtmuelleri* there from our surveys in 2018 and 2019, it seems likely that this remains at least periodically feasible.

Milos, Brickworks Factory. The brickworks factory is surrounded by farmland and included on the list of small wetlands found across the Greek islands protected under the Presidential Decree. Drainage pipes were observed in the water bodies abstracting water for adjacent agricultural irrigation. Water was recorded only after a wet year (2019), immediately following the winter months. It is therefore considered likely that this current practice could have dramatic effects on the breeding success and persistence of the Balkan water frog population, especially in (the more normal) drier years. It is advised that water abstraction is ceased at this location, and that the ponds be managed to provide a permanent or at least more reliably persistent water body. Further population monitoring is required to formulate a sustainable conservation strategy.

Milos, Road Culverts. Both road culverts, east of the brickwork factory and north of the airport wetland, which may represent a key aquatic refuge while other wetlands are dry, are currently managed using heavy machinery to prevent flooding. This could have a detrimental impact on the survival of the species in this culvert network. We recommend that clearance operations be timed to avoid key breeding and overwintering periods and carried out using light machinery only. In addition, the culverts should be sectionally cleared over a four-year rotational basis to avoid 'total' habitat destruction in any one season.

Milos, Katsaronas Mine Workings. We infer the presence of *P. kurtmuelleri* here only from a distinct "splash" typical of a Balkan water frog diving into the flooded mine workings. However, this waterbody is located 440m north-west to a historically known site, ca. 720 m to the west (36.7222˚N, 24.5306˚E), which is a pond formed at the bottom of another former open-cut mining site, protected under the Presidential Decree. No Balkan water frogs were heard calling during a repeat visit under favourable survey conditions on the same night.

Acknowledgements

We thank Petros Lymberakis (NHMC) for his advice and assistance.

References

AmphibiaWeb (2008) Pelophylax kurtmuelleri: Balkan frog Available at: http://amphibia web.org/species /4988. Accessed on 20 June 2020.

ARG-UK (Amphibian and Reptile Groups of the United Kingdom), (2017) Advice Note 4. Amphibian disease precautions: a guide for UK fieldworkers. Version 2. ARG-UK.

Broggi, M.F. (2000) Herpetological notes on the islands of Milos and Sifnos (Cyclades, Greece) (Amphibia, Reptilia). Herpetozoa, 13, 89—93.

Broggi, M.F. (2007) Herpetological notes on the island of Amorgos (Cyclades, Greece). Herpetozoa, 20, 94—96.

Bok, B. (2013) Amphibians and Reptiles of Europe: Greece 27 April until 12 May 2013. Available at: https://www.herpsafari.nl/trip-reports-eu/2013-4-greece-milos-and-mainland. Accessed 20 June 2020.

Broggi, M.F. (2011) The semi-aquatic herpetofauna of Serifos (Cyclades, Greece) including conservation aspects (Amphibia, Reptilia). Herpetozoa, 24, 13—22.

Chondropolous, B.P. (1986) A checklist of the Greek reptiles. I. The lizards. Amphibian-Reptilia, Leiden, 7, 217—235.

Chondropolous, B.P. (1989) A checklist of the Greek reptiles. II. The snakes, Herpetozoa, Wein, 2, 3—36.

Dufresnes, C., Lymberakis, P., Kornilios, P., Savary, R., Perrin, N., Stöck, M. (2018) Phylogeography of Aegean green toads (*Bufo viridis* subgroup): continental hybrid swarm vs. insular diversification with discovery of a new island endemic. BMC Evolutionary Biology, 18(1), 67.

Dufresnes, C., Mazepa, G., Jablonski, D., Oliveira, R.C., Wenseleers, T., Shabanov, D.A., Auer, M., Ernst, R., Koch, C., Ramirez-Chaves, H.E. and Mulder, K.P. (2019) Fifteen shades of green: the evolution of *Bufotes* toads revisited. Molecular Phylogenetics and Evolution, 141, 106615.

Gaki-Papanastassiou, K., Evelpidou, N., Maroukian, H., & Vassilopoulos, A. (2010) Palaeogeographic evolution of the Cyclades islands (Greece) during the Holocene. In: Coastal and Marine Geospatial Technologies, p. 297—304.

Green, D.R., Ed., Dordrecht, Netherlands, Springer.

Gaki-Papanastassiou, K. and Papanastasiou, D. (2014) Volcano Tourism in Greece: two Case studies of Volcanic islands. In: Volcanic Tourist Destinations (Geoheritage, Geoparks and Geotourism), p. 80—87.

Erfurt-Cooper, P., Ed., Berlin, Germany, Springer.

Hejl, E., Riedl, H., Weingartner, H. (2002) Post-plutonic unroofing and morphogenesis of the Attic-Cycladic complex (Aegean, Greece). Tectonophysics, 349, 37—56.

Kaczmarski, M. and Zurawlew, P. (2019) Mass extermination of green toad metamorphs (*Bufotes viridis*) in Greece. Herpetological Bulletin, 150, 33—34.

Kapsimalis, V., Pavlopoulos, K., Panagiotopoulos, I., Drakopoulou, P., Vandarakis, D., Sakelariou, D., Anagnostou, C. (2009) Geoarchaeological challenges in the Cyclades continental shelf (Aegean Sea). Zeitschrift für Geomorphologie, Supplementary Issue 53 (1), 169—190.

Kolimenakis, A., Latinopoulos, D., Bithas, K., Richardson, C., Lagouvardos, K., Stefopoulou, A., Papachristos, D., Michaelakis, A. (2019) Exploring public preferences, priorities, and policy perspectives for controlling invasive mosquito species in Greece. Tropical Medicine and Infectious Disease, 4, 83—95.

Kyriakopoulou-Sklavounou, P. (2000) Adaptations of some amphibian species to Mediterranean environmental conditions. Belgian Journal of Zoology, 130, 109—113.

Lemckert, F., Hecnar, S.J., Piliod, D.S. (2012) Loss and modification of habitat. In: Conservation and Decline of Amphibians: Ecological Aspects, Effect of Humans, and Management, p. 3291—3342.

Heatwole, H., Wilkinson, J.W., Eds., Baulkham Hills, [NSW], Australia, Surrey Beatty and Sons.
Lymberakis, P., Poulakakis, N., Manthalou, G., Tsigenopoulos, C.S., Magoulas, A., Mylonas, M. (2007) Mitochondrial phylogeography of Rana (Pelophylax) populations in the Eastern Mediterranean region. Molecular Phylogenetics and Evolution, 44, 115—125.

Sillero, N., Campos, J., Bonardi, A., Corti, C., Creemers, R., Crochet, P.A., et al. (2014) Updated distribution and biogeography of amphibians and reptiles of Europe based on a compilation of countrywide mapping studies. Amphibia-Reptilia, 35 (1), 1—31.

Valakos, E.D., Pafilis, P., Sotiropoulos, K., Lymberakis, P., Maragou, P., Foufopoulos, J. (2008) The amphibians and reptiles of Greece. Frankfurt am Main, Germany, Edition Chimaira.

Vervust, B., Brecko, J., Pafilis, P. (2013) Preliminary data on the differentiation of Milos Island water frogs. Journal of Biological Research Thessaloniki, 20, 290—295.

Wilkinson, J.W. (2015) Amphibian survey and monitoring handbook. Exeter, UK, Pelagic Publishing.

Wilson, M. (2019) Greek Islands: Summer 2019. Amphibian and Reptile Travels. Available at https://mwilsonherps.com/greece/greek-islands-summer-2019-new. Accessed 20 June 2020.

Edible Anurans: Predation on a Juvenile Malayan Horned Frog *Megophrys nasuta* (Schlegel 1858) by a Long-legged House Centipede *Thereuopoda longicornis* in Selangor State, Peninsular Malaysia.

[1*]Tom Charlton, [2]Steven Wong Siew Por and [3]Kurt H.P. Guek

[1]Department of Natural Sciences, Manchester Metropolitan University, UK
[2]Jalan Damai Perdana 3/2, Bandar Damai Perdana, Cheras 56000, Kuala Lumpur, Malaysia
[3]Orion Herp Adventure, Jalan 22/38A, Taman Sri Sinar 51200 Kuala Lumpur, Malaysia

*Corresponding author: Tom@ecoanimalencounters.co.uk

Predation on pre- and post-metamorphic (tadpole, juvenile and adult) anurans by invertebrates is a well-documented occurrence (McCormick & Polis 1982, Toledo 2005). Whilst the majority of recorded instances are attributed to arthropods such as giant water bugs (Belostomatidae) and spiders (including Araneidae, Ctenidae, Lycosidae and Pisauridae), less frequently, predators of anurans also include scorpions (Buthidae), harvestmen (Opiliones), giant centipedes (Scolopendridae), ants and wasps (Hymenoptera) and beetles (Carabidae) (Warkentin 2000; Toledo 2003; Toledo 2005; Castanho & Pinto-da-Rocha 2005; Wizen & Gasith 2011; Muscat *et al*. 2014; Arrivillaga & Oakley 2019, Menegucci *et al*., 2020). Furthermore, a single record of an unidentified long-legged house centipede of the family Scutigeridae predating on a juvenile western tree frog (*Polypedates occidentalis*) has been reported from Karnataka State, India (Seshadri et al., 2017). Critical periods for predator-prey interactions between invertebrates and anurans have been identified as during the tadpole stage and/or breeding period, when frogs enter waterbodies and therefore at risk to predation by aquatic invertebrate predators, as well as for juveniles shortly following metamorphism as they move from aquatic to terrestrial environments and are susceptible to a wider variety of predators (Toledo, 2003).

The Malayan horned frog (*Megophrys nasuta*; Schlegel, 1858) is a large frog species occurring in tropical lowland and submontane rainforests up to 1600 m ASL (Inger and Stuebing, 2017), and has a wide distribution encompassing southern Thailand, Peninsular Malaysia, Singapore, Sumatra and Borneo. It is strongly terrestrial and known to feed on a variety of invertebrates and small vertebrates. This species relies on cryptic camouflage as its primary defensive strategy, laying stationary on the forest floor to remain undetected by potential predators. However, observations of predation on *M. nasuta* appear to be poorly recorded. Herein, we report the first known record of predation on *M. nasuta* by the long-legged house centipede *Thereuopoda longicornis*.

Figure 1. *Thereuopoda longicornis* predating on juvenile *Megophrys nastua* within the Sungai Tua Forest Reserve of Selangor State, Peninsular Malaysia (Photos: Tom Charlton).

On the night of 29th February 2016 at approximately 22:30 h (MYT) we observed an adult *T. longicornis* in the process of predating on a juvenile *M. nasuta* within the Sungai Tua Forest Reserve of Selangor State, Peninsular Malaysia (approximate GPS: 3°20'0.84"N 101°42'11.69"E). Both were situated on a broad-leaf plant around 20 cm above ground on the verge of a forest trail. Neither animal was accurately measured though the *M. nasuta* was estimated to be 10 mm (SVL) and the *T. longicornis* 50 mm (TL, excluding antennae and terminal legs). At the time of the initial encounter the *M. nasuta* was alive but seemingly subdued and with an injury visible to the left eye, with the *T. longicornis* seizing the frog by its hind legs. Our approach disturbed the act of predation, and after watching for several minutes without any further movement from either animal we left. Upon our return to the same spot later in the evening, both animals were re-encountered on the same broad-leaf plant; the centipede had proceeded to kill and begin consuming the *M. nasuta*, eating soft tissue from the underside of the frog. The long-legged centipede was identified through our photographic records as *Thereuopoda longicornis* (order Scutigeromorpha, family Scutigeridae) (Figure 1).

Anurans are an important prey for a variety of animals, both vertebrate and invertebrate, and with body size being a significant factor in a frog's ability to evade predation, they therefore are particularly vulnerable during early life stages (Toledo, 2006). *M. nasuta* are large and robust frogs as adults, though tadpoles and juveniles of this species will be at risk to a wide variety of predators. As the frog increases in size, its ability to avoid predation greatly improves and predator-prey interactions between this species and invertebrates in particular will shift more favorably towards the *M. nasuta*. Long-legged house centipedes of the genus *Thereupoda* are opportunistic predators with a diet largely comprising arthropods (Lewis, 1981), though the observation reported here coupled with one further observation made by Seshadri *et al* in 2017 indicates that vertebrate prey is occasionally taken. Whilst invertebrates are considered capable of predating anurans during all stages of their amphibious lifecycles, to the best of our knowledge this is the first known record of *T. longicornis* predating on a post-metamorphic *M. nasuta*.

References

Arrivillaga, C., Oakley, J. and S. Ebiner 2019. Predation of *Scinax ruber* (Anura: Hylidae) tadpoles by a fishing spider of the genus *Thaumasia* (Araneae: Pisauridae) in south-east Peru. Herpetological Bulletin. 148, 41-42.

Seshadri, Kadaba S. & Shashwat, Jaiswal & Gururaja, Kotambylu V. (2017). *Polypedates occidentalis* (Western Tree Frog). Predation. Herpetological Review. 48, 414–415.

Castanho, L. and R. Pinto-da-Rocha. 2005. Harvestmen (Opiliones:Gonyleptidae) predating on treefrogs (Anura: Hylidae). Revista Ibérica de Aracnología. 11, 43–45.

Inger, R.F. and R.B. Stuebing 2017. A Field Guide to the Frogs of Borneo. Natural History Publications Borneo. 95-96.

Lewis J.G.E. 1981. The biology of centipedes. Cambridge: Cambridge University Press.

McCormick, S., & Polis, G. A. (1982). Arthropods That Prey on Vertebrates. Biological Reviews. 57(1), 29-58.

Menegucci, R., E. Muscat, R. Tanaka & D. Stuginski. (2020). Predation on Hylodes phyllodes (Anura: Hylodidae) by the harvestman Heteromitobates discolor (Arachnida: Opiliones). Phyllomedusa: Journal of Herpetology. 19, 121-124.

Muscat, E., E. L. Rotenberg, and C. A. Chagas. 2014. Predation of Scinax littoralis (Anura: Hylidae) by Eriophora fuliginea (Arenae:Araneidae) in Southeastern Brazil. Herpetology Notes. 7, 169–170.

Toldeo, L.F. 2003. Predation on seven South American anuran species by water bugs (Belostomatidae). Phyllomedusa. 2(2), 105-108.

Toledo, L.F. 2005. Predation on juvenile and adult anurans by invertebrates: Current knowledge and perspectives. 36(4), 395-400.

Toledo, L.F., R.S Ribeiro & C.F.B. Haddad 2006. Anurans as prey: an exploratory analysis and size relationships between predators and their prey. Journal of Zoology. 271, 170-177.

Warkentin, K. M. 2000. Wasp predation and wasp-induced hatching of red-eyed treefrog eggs. Animal Behaviour. 60, 503–510.

Wizen, G. & A. Gasith. 2011. Predation of amphibians by carabid beetles of the genus Epomis found in the central coastal plain of Israel. ZooKeys. 100, 181.

ISSN - 2515-5725

Predation on the Common Blind Snake (*Indotyphlops braminus*; Daudin, 1803) by the Brown-headed Snake (*Furina tristis*; Günther, 1858) in Central Province, Papua New Guinea.

[1*]Tom Charlton & [2]David Nixon

[1, 2]MZ International Snakebite Mitigation Program, Central Province, Papua New Guinea

[*]Corresponding author: Tom@ecoanimalencounters.co.uk

The brown-headed snake, *Furina tristis* (Günther, 1858), is a medium-sized (<1 m) nocturnal and terrestrial member of the elapid family with a distribution that encompasses Northern Australia, Torres Strait Islands, and Papua New Guinea. It is a secretive species that occupies primary and secondary forests as well as highly-disturbed areas including plantations and the surroundings of human settlements. *F.tristis* is known to feed primarily on lizards (O'Shea, 1996), with a single record of ophiophagy reported from Queensland,

Figure 1. Deceased juvenile male *Furina tristis* with two ingested *Indotyphlops braminus*, one of which was found to contain three eggs (Photo: Tom Charlton)

Australia consisting of a predation attempt on the Torres Straits blind snake, *Anilios torresianus* (Lettoof & Natusch, 2015). Here we report the first known case of *F.tristis* predating on the common blind snake, *Indoyphlops braminus* (Daudin, 1803).

On 8 November 2018 an examination took place of a recently deceased juvenile male F. tristis (SVL 486mm, weight 26 grams) (Fig 1). The snake had been collected the previous day at 14:00 h within the vicinity of Lea Lea village of Central Province, Papua New Guinea, after it was found deceased on a road. It was presumably hit by motor vehicle though no obvious signs of injury to the snake were present. The surrounding habitats consisted of open grassland, isolated pandanus groves and saltmarsh, along with several blocks of commercial warehouse buildings. Dissection revealed that the collected specimen had recently consumed two adult blind snakes, confirmed as *Indotyphlops braminus* (common blind snake). One of the specimens retrieved during the examination measured 162 mm and contained three eggs; the other measured 140 mm. No further evidence of prey items were discovered within the stomach contents. I. braminus is an all-female species that was introduced to the island of New Guinea from Asia (O'Shea 1996) and has since become well established, reproducing through parthenogenesis.

Although *F. tristis* has previously been recorded to predate on blind snakes, to our knowledge this is the first known record of predation by this species on *I. braminus*. We would like to thank Mark O'Shea for his assistance with identification of the blind snakes.

References

O'Shea (1996). A Guide to the Snakes of Papua New Guinea. Independent Publishing Limited, Port Moresby, PNG. 152-153.

Lettoof, Damian and Daniel Natusch. 2015. *Furina tristis* (brown-headed snake) diet. Herpetological Review. 46(4): 644.

.

Notes on the discovery of fluorescence in Australian Scolecophidians in the genus *Anilios* Gray 1845 (Serpentes: Typhlopidae).

[1*]Scott C. Eipper, [2]Adam Elliott, & [1]Tyese Eipper

[1]Nature 4 You, Logan, Queensland, Australia
[2]Beaufort, Victoria, Australia

*Corresponding author: admin@wildlifedemonstrations.com

Fluorescence in terrestrial vertebrates is seemingly quite rare, however it has recently been shown to occur in a number of species of Chameleons; *Archaius, Bradypodion*, *Brookesia*, *Calumma*, *Furcifer*, *Palleon*, *Kinyongia*, *Trioceros* (Prötzel *et al*. 2018.) and in the tree frog Boana punctata (Taboada *et al*., 2017). Here we detail the preliminary inadvertent discovery of fluorescence in Australian blindsnakes, *Anilios bituberculatus* (Peters, 1863) and *Anilios proximus* (Waite 1893). We also give some initial observations of fluorescence in museum specimens held in Australia by using the same ultraviolet emitting Light Emitting Diode (L.E.D) torch. The torch is made up of 51 Light emitting diodes fitting into the reflector, emitting light at 395 Nm.

On the 16th of January 2006 20:45 AEST, one of the authors (A.E) was in south-east of Nhill, Victoria Weather conditions were approximately 26 degrees Celsius with relative humidity of 60%, the sky was clear with lunar cycle two days post full moon. The habitat was typical mallee heathland with a sandy loam. While searching for scorpions with an ultraviolet emitting LED torch, the first Prong-snouted blindsnake *Anilios bituberculatus* was noticed fluorescing in the torch beam, on a patch of bare sand at a distance of approximately twelve metres away. The snakes were fluorescing in a similar manner to the scorpions present but much less luminescent. In total, four *A. bituberculatus* were located that evening, each of the specimens gave off a similar greenish- blue glow.

On 16 December 2008 at 20:40 AEST, one of the authors (S.E) found a road killed *A. proximus* from Beechmont, Queensland which also exhibited limited fluorescence. A live specimen from Beechmont, Queensland was seen and photographed that night at

Figure 1. *Anilios proximus*, Beechmont, Queensland (Image lit with flash) S. Eipper

Figure 2. *Anilios proximus*, Beechmont, Queensland (Image lit with UV emitting LED torch) S. Eipper

22:17 AEST using only an ultraviolet emitting LED torch as the light source (See figures 1 and 2) weather and habitat conditions were not recorded.

During 2018, museum specimens of 26 species were examined in an effort to determine whether preserved specimens also exhibited fluorescence. We used the same ultraviolet emitting LED torch as the sole light source in the specimen examination laboratories. By switching off all room and desk lighting we arrived with the results detailed in table 1. Some species showed no or limited luminescence while others showed significant luminescence. One specimen of

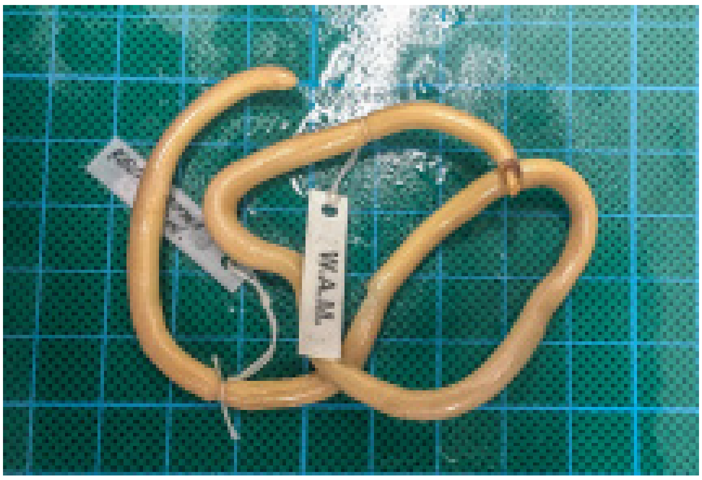

Figure 3. *Anilios margaretae* Neale Junction, Western Australia (Image lit with flash) S. Eipper

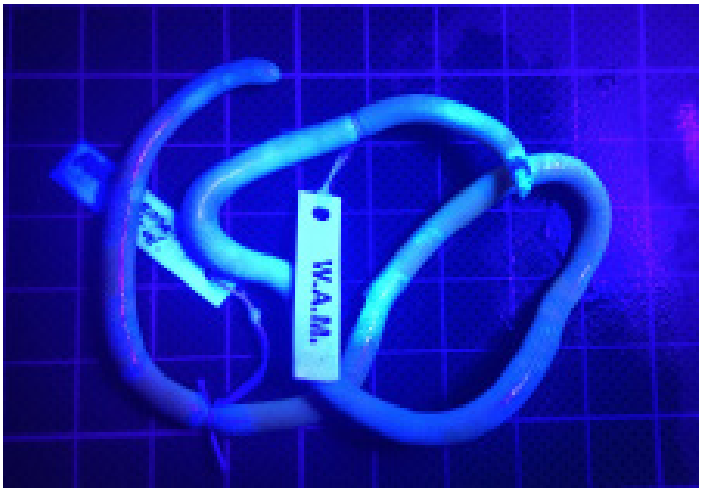

Figure 4. *Anilios margaretae* Neale Junction, Western Australia (Image lit with UV emitting LED torch) S. Eipper

interest was *Anilios margaretae* (R163269) from Neale Junction, Western Australia, apparently plain in normal light, when lit using an ultraviolet emitting LED torch some unusual markings that fluoresced more strongly than other parts of the dorsum that were visually normal under typical light conditions. No signs of damage to the specimen were apparent on examination. (See figures 3 & 4).

An additional point of interest, is that only live *Anilios bituberculatus* exhibited fluorescence. Preserved specimens gave little or no apparent signs of fluorescence. Potential explanations for this could be due to the specimens coming from significantly different locations (Eipper, 2012)., different wavelength torches (Blass & Gaffin, 2008), cryptic speciation (Marin et al, 2013), age, position within the ecdysis cycle (Eipper, 2012), preservation practices or a combination of multiple conditions.

The significance of what role fluorescence might play in the ecology of *Anilios* is unclear. Blind snakes have

Table 1. Specimens examined and reactivity to exposure under ultraviolet emitting LED torch.

Species	Live /dead/preserved	Strong	Weak	Negilible/ Not apparent
Anilios affinis	Preserved		X	
Anilios aspina	Preserved			X
Anilios batillus	Preserved		X	
Anilios bituberculatus	Preserved			X
Anilios bituberculatus	Live	X		
Anilios chamodracaena	Preserved	X		
Anilios diversus	Live		X	
Anilios guentheri	Preserved		X	
Anilios howi	Preserved		X	
Anilios insperatus	Preserved	X		
Anilios leptosoma	Preserved	X		
Anilios leucoproctus	Preserved			X
Anilios ligatus	Preserved		X	
Anilios ligatus	Live			X
Anilios longissiumus	Preserved	X		
Anilios margaretae	Preserved	X		
Anilios micromma	Preserved		X	
Anilios nigrescens	Preserved		X	
Anilios nigrescens	Live			X
Anilios obtusifrons	Preserved		X	
Anilios proximus	Preserved	X		
Anilios proximus	Live		X	
Anilios proximus	Dead		X	
Anilios robertsi	Preserved			X
Anilios silvia	Preserved		X	
Anilios splendidus	Preserved		X	
Anilios torresiannus	Dead			X
Anilios torresiannus	Preserved			X
Anilios troglodytes	Preserved		X	
Anilios weidii	Live			X
Anilios yampiensis	Preserved		X	
Anilios yirrikalae	Preserved			X
Anilios zonula	Preserved	X		
Anilios sp. (Mt Isa)	Dead			X
Ramphotyphlops exoceti	Preserved			X

poor eyesight, are usually fossorial or subterranean and prey upon the larvae of ants and termites (Eipper & Eipper, 2019; Cogger, 2018; Wilson & Swan, 2017). It is potentially a byproduct of another physiological process or as an anti-predation/detection agent allowing the snake to enter the nest galleries of its prey undetected. It could also be an anti-predation strategy while they are exposed on the surface. Many species of birds can see in the UV spectrum (Withgott, 2000) and it may act as a warning to being unpalatable. Further research is required to determine if certain wavelengths show higher or lower rates of luminescence and if preservative degrades or increases the luminescence.

Acknowledgements

We thank Andrew Amey and Patrick Couper at the Queensland Museum, Stephen Mahony and Jodi Rowley at the Australian Museum and Paul Doughty at the Western Australian Museum for access to specimens in their care. We also thank Stuart Graham, John Benjamin Owens, Janne Torkkola and Hal Cogger for their constructive comments.

References

Blass, G.R.C.& Gaffin, D.D. (2008) Light wavelength biases of scorpions Animal Behaviour. 76, 365-373

Cogger, H. (2018). Reptiles and Amphibians of Australia (Updated Seventh Edition). CSIRO Publishing, Collingwood.

Eipper, S.C. (2012). A guide to Australian snakes in captivity- elapids and colubrids. Reptile Publications, Burleigh.

Eipper, S.C. & Eipper, T. (2019). A Naturalist's Guide to the Snakes of Australia. Beaufoy Publishing, Oxford.

Marin, J., Donnellan, S.C., Hedges, S.B., Puillandre, N., Aplin, K.P., Doughty, P., Hutchinson, M.N., Couloux, A. & Vidal, N. (2013). Hidden species diversity of Australian burrowing snakes (Ramphotyphlops) Biological journal of the Linnean Society. 110, 427-441.

Prötzel, D., Heß, M., Scherz, M.D., Schwager, M., Van't Padje, A. & Glaw, F. (2018). Widespread bone-based fluorescence in chameleons. Scientific Reports. 8(698), 1-9.

Taboada, C., Brunetti, A.E., Pedron, F.N., Neto, F.C., Estrin, D.A., Bari, S.E., Chemes, L.B., Lopes, N.P., Lagorio, M.G. & Faivovich, J. (2017). Naturally occurring fluorescence in frogs. PNAS. 114(14), 3672-3677.

Withgott, J. (2000). Taking a Bird's-Eye View... in the UV. BioScience. 50(10), 854-859.

Wilson, S.K. & Swan, G. (2017). A complete guide to Reptiles of Australia. 5th Edition. New Holland, Chatswood.

 ISSN - 2515-5725

A case of tail bifurcation in *Notophthalmus viridescens*: a rare condition or an increasing phenomenon in Urodeles?

[1*]Francisco Javier Zamora-Camacho

[1]Department of Biological Sciences, Dartmouth College, 78 College Street, 03755, Hanover, New Hampshire, USA.

*Corresponding Author: zamcam@ugr.es

On 28 July 2019, I captured an adult female *Notophthalmus viridescens viridescens* (red-spotted newt) with tail bifurcation (Figure 1) in a vernal pond in Norwich, Vermont, USA (43.7486°N, 72.3394°O). The individual weighed 3.552 g. Its snout-vent length was 51 mm, with a 47-mm-long primary tail, and a 15-mm-long supernumerary tail branching as a lateral bifurcation from the left side of the primary tail, 27 mm from the cloaca (Figure 1). Besides tail bifurcation, the newt had a normal appearance (Figure 1). Immediately after taking biometrics and photos, I released the individual in the pond where I had found it.

Figure 1. Adult female red spotted newt (*Notophthalmus viridescens viridescens*) with a bifurcated tail sampled in a natural, unpolluted pond in Norwich (Vermont, USA) in July 2019.

With only a handful of cases reported in the last centuries (reviewed in Henle *et al*., 2012), bifurcations or duplications of tails are often considered among the least prevalent of morphological abnormalities in urodeles (Henle *et al*., 2012; Smirnov, 2014; Zamora-Camacho, 2020). However, in the last decade, tail bifurcation has been reported in Plethodontids: *Bolitoglossa heiroreias* (Medina-Florez & Townsend, 2014), *Desmognathus fuscus* (Hartzell, 2017), and *Plethodon cinereus* (Liebgold, 2019), as well as in Salamandrids: *Triturus dobrogicus*, *T. carnifex* (Henle *et al*., 2012), *Calotriton arnoldi* (Martínez-Silvestre *et a*l., 2014), *Calotriton asper* (Gosá *et al*., 2019), *Lissotriton vulgaris* (Smirnov, 2014), *Salamandrina perspicillata* (Romano *et al*., 2017), *Pleurodeles waltl* (Zamora-Camacho, 2020), and *N. v. viridiscens* (this study).

This growing number of recent cases reported calls into question the alleged low prevalence of this phenomenon. This tendency could result from a greater awareness of researchers regarding amphibian abnormalities (Peltzer *et al*., 2011; Lunde & Johnson, 2012). As an alternative, but non-mutually exclusive explanation, some of the stressors that trigger these anomalies, such as pollution, ultraviolet radiation, and abnormal temperatures (Reeves *et al*., 2010), are increasingly pervasive in the context of global environmental change (Vitousek, 1994), which could bolster tail bifurcation prevalence in urodeles.

Acknowledgements

I thank Ryan Calsbeek for his constant support.

References

Gosá, A., Sanz-Azkue, I., Izagirre, A., Prieto-Argarate, I. (2019). Un adulto de Calotriton asper con cola bifurcada. Boletín de la Asociación Herpetológica Española. 30, 23-24

Hartzell, S.M. (2017). Tail bifurcation in a Northern Dusky Salamander, *Desmognathus fuscus* (Caudata: Plethodontidae). Herpetology Notes. 10, 181-182.

Henle, K., Mester, B., Lengyel, S., Puky, M. (2012). A review of a rare type of anomaly in amphibians, tail duplication and bifurcation, with description of three new cases in European species (*Triturus dobrogicus, Triturus carnifex*, and *Hyla arborea*). Journal of Herpetology. 46, 451–455.

Liebgold, E.B. (2019). A tale of two tails: a rare occurrence of tail bifurcation in the red-backed salamander (*Plethodon cinereus*). The Herpetological Bulletin. 148, 35-36.

Lunde, K.B. and Johnson, P.T.J. (2012). A practical guide for the study of malformed amphibians and their causes. Journal of Herpetology. 4, 429-441.

Martínez-Silvestre, A., Amat, F., Carranza, S. (2014). Natural incidences of body abnormalities in the

Montseny newt, *Calotriton arnoldi Carranza* and Amat, 2005. Herpetology Notes. 7, 277-279.

Medina-Florez, M. and Townsend, J.H. (2014). *Bolitoglossa heiroreia*s. Tail bifurcation. Mesoamerican Herpetology. 1, 154-155.

Peltzer, P.M., Lajmanovich, R.C., Sanchez, L.C., Attademo, A.M., Junges, C.M., Bionda, C.M., Martino, A.L., Bassó, A. (2011). Morphological abnormalities in amphibian populations from the Middle-Eastern region of Argentina. Herpetological Conservation and Biology. 6, 432-442.

Reeves, M.K., Jensen, P., Dolph, C.L., Holyoak, M., Trust, K.A. (2010). Multiple stressors and the cause of amphibian abnormalities. Ecological Monographs. 80, 423-440.

Romano, A., Avella, I., Roger, D.S. (2017). Body malformations in a forest-dwelling salamander, *Salamandrina perspicillat*a (Savi, 1821). Herpetological Conservation and Biology. 12, 16-23.

Smirnov, N. (2014). About the morphological abnormalities in newts of the genus *Lissotriton* (Salamandridae, Caudata) in Western Ukraine. In: Vershinin, V. L., Dubois, A., Henle, K. & Puky, M. Amphibian and reptile anomalies and pathology. Yekaterinburg (Ural University). 165–171.

Vitousek, P.M. (1994). Beyond global warming: Ecology and global change. Ecology. 75, 1861-1876.

.

Zamora-Camacho, F.J. (2020). Morphological abnormalities in a population of *Pleurodeles waltl* (Caudata: Salamandridae) from southwestern Spain. Phyllomedusa. 19, 131-135.