



The Herpetological Bulletin

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THE HERPETOLOGICAL BULLETIN

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Front Cover: The Munchique rufous lancehead *Bothrocophias colombianus* from Colombia, see article on p. 46.
Photographed by Juan Camilo Mantilla-Castaño.

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Exciting new developments at *The Bulletin*



The Bulletin is moving with the times and there are several changes in this issue. From now on, the PDF of the full issue of *The Bulletin* will have its table of contents hyperlinked to the articles. This makes all articles just a click away. And for ease of access, this table of contents has been moved to the front inside cover although it will remain on the back cover of *The Bulletin* hardcopy.

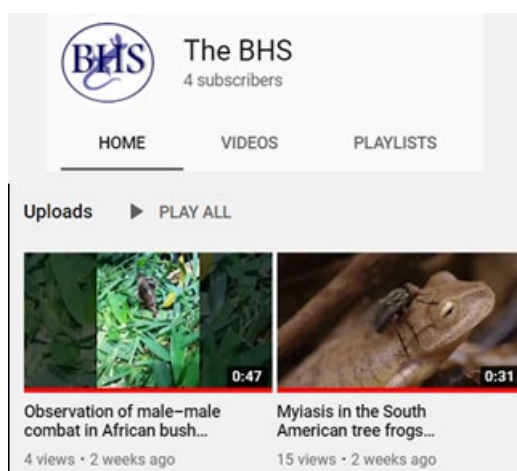
There is another electronic development. The BHS has now established its own video channel on YouTube that you can see [here](#). *The Bulletin* encourages authors to enliven their articles by linking them to informative video footage. Articles with such links are open access from the time of publication (other articles are embargoed for a year). All 'Bulletin videos' are posted on the BHS video channel, so you can easily browse the full video collection to find ones of interest. Should you wish to delve deeper into the subject then just click the link provided in the accompanying introductory text to go to the original article on the BHS website.

For those who receive the hardcopy of *The Bulletin* there is a further development. From this issue onwards, *The Bulletin* will be printed in full colour (the PDF on the website has always been in full colour). No more black and white images of your favourite species or maps and figure where colour would have made them much more interesting. Finally, for those who like to dig back into the archives, all

back issues of *The Bulletin* are now available on the BHS website, all the way back to Issue 1 in 1980. Apart from the four most recent issues (which are members-only for the first year), these are all open access.

In this issue of *The Bulletin* we kick off 2021 with a cracking range of 20 articles; there has been no shortage of submissions to choose from (see *The Bulletin* Report in this issue). Four of the articles connect to video footage – the breeding biology of *Indirana cf. tysoni* from India, the invasive Johnson's whistling frog from Colombia, observations on behaviour akin to parental care in a slow worm, and male combat in a kukri snake from Thailand. There are also articles on a frog eating spider, the oldest captive Madeira rock lizard, and observation in Dorset of aggressive behaviour between the exotic wall lizard and native sand lizard. And to top all that, there is a review of the world's most comprehensive book on lizards.

Rick Hodges
Scientific Editor



Check out the new BHS video channel that houses videos linked to Bulletin articles. You can browse the videos and then, by following hyperlinks, see the original articles. These articles are open access from the time of publication.

Nesting frogs - the breeding biology of *Indirana cf. tysoni* in the Western Ghats, India

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ABSTRACT - Frogs of the genus *Indirana* are endemic to India. Previous research on these frogs has focussed on taxonomy and systematics but their behaviour remains largely understudied. Here we report the breeding behaviour of *Indirana cf. tysoni*, including nest building, male to male combat, inguinal amplexus, egg clutch guarding, tadpoles and polymorphism. We also analyse advertisement calls and present a comparative analysis with previously published data. Lastly, we discuss the need to study these breeding behaviours in-depth in order to help frame appropriate conservation plans.

INTRODUCTION

The frog family Ranixalidae Dubois 1987 is endemic to India. It comprises two genera; *Indirana* Laurent, 1986 (14 spp) and *Walkerana* Dahanurkar, Modak, Krutha, Nameer, Padhye, and Molur, 2016 (4 spp). Ranixalid frogs are of an ancient lineage that has persisted due to the long-term climatic stability of the Western Ghats (Roelants et al., 2004). Many *Indirana* are known to live close to human modified areas in low to mid elevation, 66–1508 m a.s.l., in mixed forest types (Garg & Biju, 2016; Mudke et al., 2020). Previous research on *Indirana* has focused on taxonomy and systematics (e.g. Dahanurkar et al., 2016) but much of the behaviour and natural history of the genus remains a mystery (Nair et al., 2012; Dahanurkar et al., 2016; Garg & Biju, 2016).

There are relatively few published descriptions of the calls made by *Indirana* species (Kadadevaru et al., 2000; Kuramoto & Joshy, 2001; Kuramoto & Dubois, 2009; Modak et al., 2016) which are known to have more than one call type (Gaitonde & Giri, 2014; Modak et al., 2016). *Indirana* exhibit sexual size dimorphism with females larger than males (Gopalan et al., 2012). Primitive inguinal amplexus within the members of this genus has been documented by Gaitonde & Giri, (2014). *Indirana* lay terrestrial eggs which may be attached to tree bark or within rocky crevices (Sekar, 1992; Tapley et al., 2011; Nair et al., 2012; Gaitonde & Giri, 2014; Mudke & Thunga, 2020). These eggs hatch into semi-terrestrial tadpoles that develop on moist rocky surfaces (Kuramoto & Joshy, 2002; Veeranagoudar et al., 2009; Gopalan et al., 2012). There are also reports of nest building in *Indirana duboisi* (Mudke & Thunga, 2020) and possible egg clutch guarding in *Indirana cf. semipalmata* (Tapley et al., 2011).

In this study, we report novel aspects of the breeding biology and describe the advertisement call of *Indirana cf. tysoni* Dahanurkar, Modak, Krutha, Nameer, Padhye and Molur 2016. The species is restricted to the southern Western Ghats

of India and is currently known from Ranipuram in Kerala and from Chikmagalur district (Charmadi Ghats) and Kodagu district (Bhagamandala, Coorg, Madikeri and Thalakaveri) in Karnataka (Dahanurkar et al., 2016; Garg & Biju, 2016). The species has not been assessed by the International Union of Conservation of Nature (IUCN).

MATERIALS AND METHODS

All individuals in this study were assigned to *I. tysoni* on the basis of external morphology as this species can be distinguished from its potentially sympatric congeners by the tympanum diameter being visibly smaller than eye diameter (Dahanurkar et al., 2016; Garg & Biju, 2016). Our study location was only 0.24 km away from a published record (12° 13'12.36" N and 75° 39'20.52" E) of *I. tysoni* (see Garg & Biju, 2016) where species identity was confirmed with molecular data.

Our study was undertaken in Yevakapadi hamlet, Kodagu District, Karnataka State, India (12° 13'7.32" N and 75° 39'26.28" E, 1157 m a.s.l.). A single person (MM) made all the observations in this study. Observations were made for 5 hours daily from 19:30 to 00:30 h from the 24th to 26th August 2017 and from the 6th to 9th July 2018. All the observations were made under red light as we have observed that frogs continue to exhibit behaviours such as calling in red torchlight whereas such behaviours were interrupted when frogs were illuminated with white light. White light was used only for photographs. Videos and calls were recorded at a distance of approximately 30 cm from the frogs (Crump, 2010; ARG-UK, 2008) using an iPhone SE A1723 in-built camera and voice recording app. The ambient temperature and humidity were recorded using a Brunton ADC Pro handheld weather station but only in the year 2018, this equipment was not available in 2017. Snout-vent lengths were measured using a ruler in the field in July 2018 for one male and one female at our

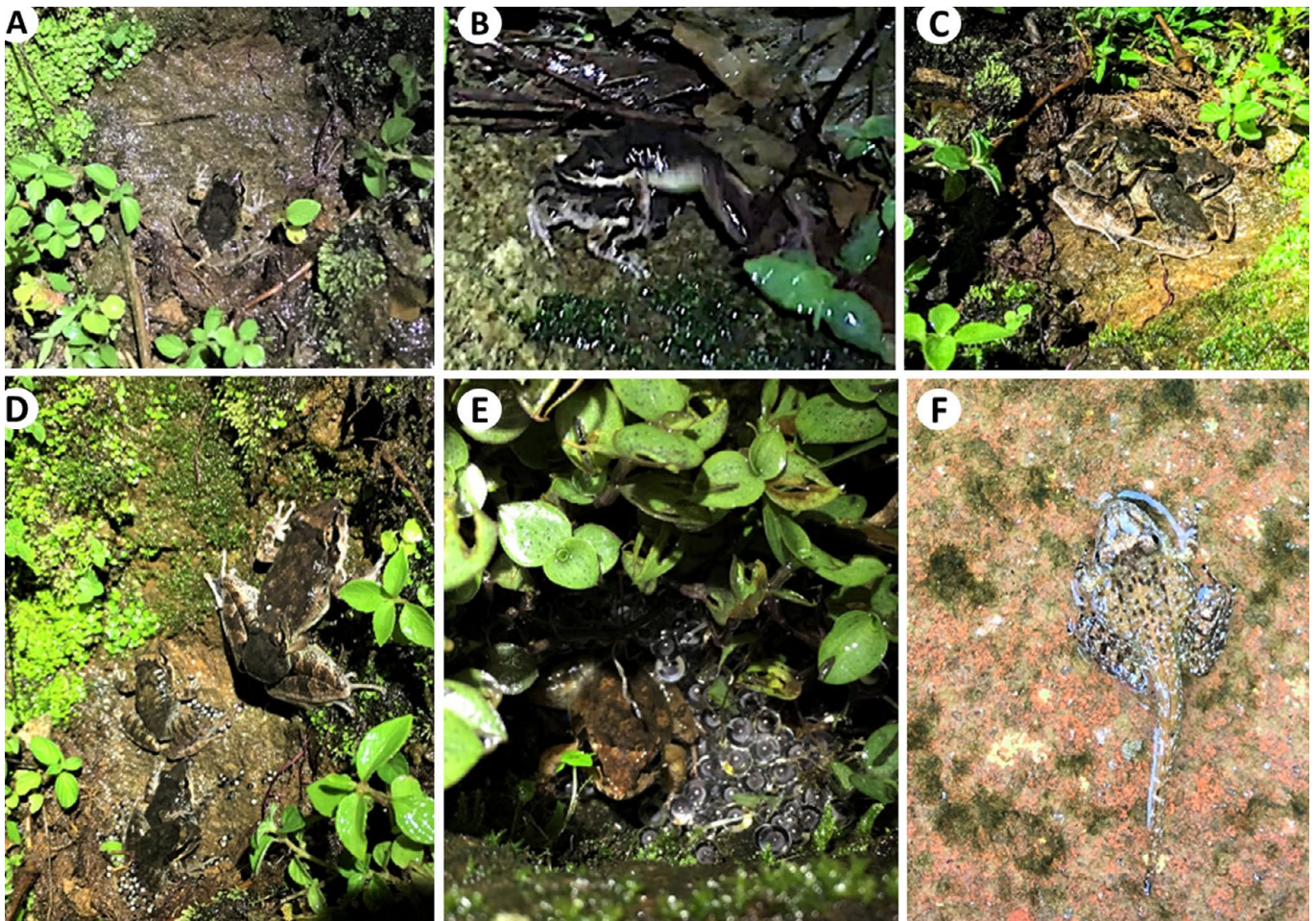


Figure 1. The breeding behaviour of *Indirana cf. tysoni* at a single nest site- **A.** Male at a cleared nest site, **B.** Male to male combat in the form of wrestling between two males, **C.** At least three males trying to mount the female at the same time at the nest site, **D.** The primary pair in inguinal amplexus with other males appearing to fertilise eggs at the nest site, **E.** Male attending to the eggs at a different nest site, **F.** A semi-terrestrial tadpole on a wet rock surface at the study site

study site. Only two frogs were measured as the process of measuring was deemed disruptive to the process of observing natural behaviours. The number of eggs within an egg clutch was counted from photographs that were taken of six separate egg clutches; this egg counting method was chosen to minimise disturbance. A single clutch was classified as all the eggs that were visible in a single ‘nest’. The number of males attending eggs, the presence of markings and colour of the dorsum (to track individual frogs over time) and breeding behaviours were noted opportunistically in field.

Two advertisement calls were recorded and analysed with Raven Pro© v.1.5 software (Center for Conservation Bioacoustics, 2014). The audiospectrograms were calculated with fast Fourier transform (FFT) of 512 points, 50 % overlap using Hanning windows. Call groups and pulses definitions follow Duellman (1970). An ‘advertisement call’ is defined here as a single vocalisation produced during one expiration following Brown & Richards (2008). Temporal and spectral parameters of calls were measured as given by Cocroft & Ryan (1995). We measured the call duration (ms), intercall interval (ms), call repetition rate (calls/s), number of pulses per call, and dominant frequency (kHz) following the the call-centered terminology of Köhler et al. (2017). Comparative advertisement call records for *Indirana* species were taken

from the published literature describing the advertisement calls of four species; *Indirana cf. beddomii* (Kadadevaru et al., 2000), *I. semipalmata* (Kuramoto & Joshy, 2001), *I. gundia* (Kuramoto & Dubois, 2009) and *I. chiravasi* (Modak et al., 2016). Since some of the published studies did not report all call parameters in the same way, we were unable to provide a consistent comparison of calls between all species.

RESULTS

We confirmed sexes by observing sexual size dimorphism as seen in the field (Fig. 1D), male (SVL = 21 mm) and female (SVL = 45 mm), and by observing the smallest individual vocalising (there are no published records of female ranixalid frogs vocalising). To view some details of frog behaviour and micro-habitat view our video ([BHS video, 2021](#)).

Nest building

A ‘nest’, in this context, is defined as a site for oviposition associated with habitat alteration by the species, nest construction and nest attendance (Peter & Reid, 2010). *Indirana cf. tysoni* males were observed clearing a site using their hind limbs. The males cleared space on a mound consisting of ephemeral vegetation, mosses, algae and moist

rocks. We observed males clearing a space of debris, leaves, vegetation, gravel, mud, algae and mosses to prepare the site for oviposition since the males used this cleared space to make advertisement calls and for amplexus. In one instance the male also used forelimbs to clear required space. A total of three such nest building events were recorded during our night time observations (6th July 2018; 19:40 h; 7th July 2018; 20:05 h and 22:45 h). Only once was nest building observed (22:45 - 22:55 h) followed by subsequent amplexus and oviposition (23:15 - 00:25 h), on 7th – 8th July 2018 (Fig. 1 A&D). Other characteristics typical of nesting sites included the continuous dripping of water into the cleared space with an outflow.

Male to male combat

One instance of male to male combat was recorded at the nesting site depicted in Figure 1. After the male frog had constructed a nest (7th July 2018; 22:45 - 22:55 h) he began calling from the edge of it (hereon nest constructing males are termed 'primary males'). At the time, no eggs were seen in the nest. At 22:59 h another male (intruder) approached the primary male. Both the males called frequently whilst facing each other. Within the next five minutes, two more intruding males approached the nest. All were croaking at each other whilst moving closer to the nesting site. Thereafter male to male combat ensued where males kicked with their hind limbs, wrestled with their forelimbs and jumped over each other in order to take their position on the nesting site (Fig. 1B). At least five males were seen at the single nest site, four minutes before a female approached the site. The male to male combat lasted for a total of 11 minutes from when the intruder males entered the nesting site to the primary male engaging in inguinal amplexus with a female. We closely observed the primary male who had built the nest and he remained closest to the cleared site within the nest despite the presence the intruder males. All the males remained nearby, almost in sight of the observer, when the female approached the nest site.

Amplexus and oviposition

The female approached the nest site described above at 23:14 h. At 23:15 h, the primary male and the female were in inguinal amplexus while other males attempted amplexus with her (Fig. 1C). Only the primary male engaged in amplexus and did so for a total of 71 minutes before separation (Fig. 1D). Whilst the pair was amplexant, several intruder males tried to mount the female but were unsuccessful. We did not observe any attempts by the other males to dislodge or disrupt the amplexant male. All the males remained in the nest site until the female had laid eggs (Fig. 1D). The female positioned herself just above the nest, and deposited the eggs into it. Immediately after oviposition (00:25 h), all the intruder males moved from the amplexant pair towards the egg clutch and gathered on and around it. Multiple males appeared to be fertilising the eggs (Fig. 1D) as they all deliberately positioned their cloaca directly above the eggs. The pair remained in amplexus for a further 30 seconds after the female had laid her eggs. She then moved out of the nesting site (00:27 h) and the primary male moved towards the eggs. The following morning, the primary male, identified

by his distinct dorsal patterns, was seen guarding the egg clutch. Intruder males had departed from the site.

Egg clutch attendance

Egg attendance, in this case, is defined as, 'a parent remaining at the egg mass at a fixed location' (Wells, 2007). Individual males were observed attending eight egg clutches among the 11 that we assessed over the study period. Adult males were seen sitting approximately 2 to 3 cm away from the deposited egg clutch (Fig. 1E). In two instances the males were seen sitting within the egg clutch with eggs on their dorsum. Adult male frogs remained at the nest site for at least three days but it was not confirmed that they remained with the eggs until they hatched as this would have required observations beyond the study period.

Clutch size

Out of the 11 egg clutches assessed in this study, we made egg count estimates for only six egg clutches since photographs of the five other clutches were discounted due to poor quality. The mean egg count was 200.3 (range 94 – 306, N = 6) (Fig. 1E).

Tadpoles

During the field survey, we recorded semi-terrestrial tadpoles on almost all wet rocks at the study site on 25th August 2017 and 7th July 2018. Tadpoles were seen at three different developmental stages; stage of 17 - 21, stage of 26 - 40 and almost a full grown froglet with tail (stage > 41) as per Gosner (1960) (Fig. 1F).

Variation in dorsal colour

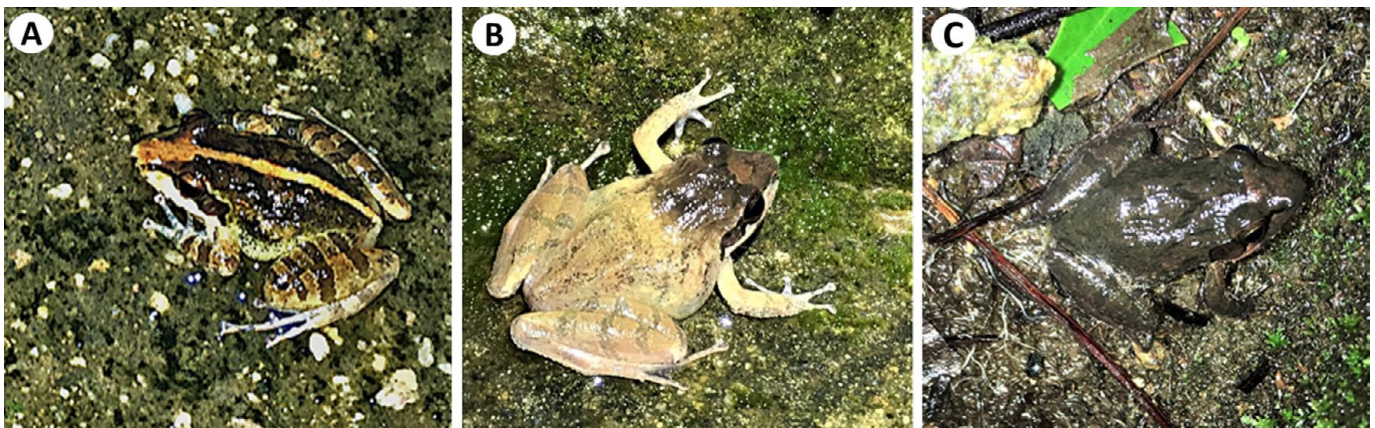
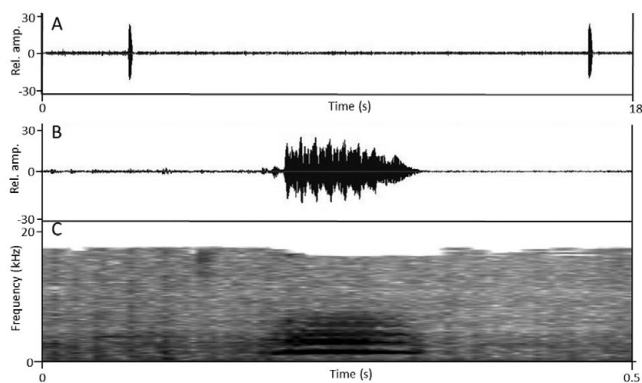
Indirana cf. tysoni is polymorphic; we recorded three different types of dorsal coloration and pattern among 15 males. A single male was seen with bright ochre yellow snout and dorsal midline, another was seen with a light tan dorsum (Figs. 2A & B); 13 males were seen with a dark, unmarked brown dorsum (Fig. 2C). Most of the males with darker dorsal surfaces were engaged in breeding activities such as egg attendance, fertilisation of eggs and male to male combat while the others were seen moving away from the breeding habitat.

Call analysis

We recorded two male advertisement calls from a single individual on 7th July 2018, the ambient temperature and humidity were 22 °C and 93 %. A sharp 'krck' call was emitted by a male at the nest site, whilst he was guarding eggs (Fig. 3). The mean call duration was 129 ms (128 – 130 ms, N = 2), the intercall interval was (13.8 ms, N = 1) and the dominant frequency was 1.3 kHz (N = 2) and calls had 8 pulses (N = 2). The details of our call recordings and comparisons with the calls of congeners are given in Table 1. We also recorded a second call type, which to the human ear was a 'krck-krck-krck-rrr-rrr-rrr'. These calls were continuous in nature and were emitted by several males in combat, during amplexus and while fertilising eggs. However, due to low quality of recording and continuous background noise we were unable to analyse these calls.

Table 1. Measurements of advertisement call parameters for male *Indirana* sp. * denotes mean value

	Total number of calls analysed	SVL of calling male (mm)	Call duration on (ms)	Intercall interval (s)	Dominant frequency (kHz)	Pulses per call	Ambient temperature (°C)	Ambient humidity (%)	Date of recording	Reference
<i>I. cf. tysoni</i>	2	21	129* (128–130)	13.8	1.3	8	22.0	93	7 July 2018	This study
<i>I. chiravasi</i>	19	Not reported	100	Not reported	1.74* (1.13–3.56)	Not reported	22.5	94	12 June 2015	Modak et al., 2016
<i>I. cf. beddomii</i>	32	Not reported	109–134	14.4* (5.5–35)	0.8–1.8	12.3* (10–14)	20.0	Not reported	June–August 1995–1996	Kadadevaru et al., 2000
<i>I. semipalmata</i>	13	28	130	Not reported	1.6	Not reported	22.0	Not reported	30 June 1999	Kuramoto & Joshy, 2001
<i>I. gundia</i>	27	26.0* (23.7–30.0)	10* (60–140)	24.1* (3–50)	1.4	6.9* (4–10) at low frequency	Not reported	Not reported	26 July 1984	Kuramoto & Dubois, 2009

**Figure 2.** Dorsum colour variation in *Indirana cf. tysoni* males- **A.** Midline and snout bright ochre yellow, **B.** Bright yellow dorsum, and **C.** Dark dorsum**Figure 3.** Advertisement call of *Indirana cf. tysoni*, recorded at an ambient air temperature of 22.0 °C- **A.** 18 s waveform of relative amplitude (Rel. amp.) over time for two calls, **B.** 0.5 s waveform of relative amplitude over time for one call, and **C.** 0.5 s spectrogram of frequency of a single call

DISCUSSION

These are the first published data on the reproductive biology of *I. cf. tysoni*. All the nests we observed had a water source dripping into the nest cavity as well as an outflow. This observation implies that the frogs maybe choosing nesting areas where there is an existing source of dripping water and a source of outflow on a gradient. These characteristics might ensure the maintenance of humidity, temperature

and availability of water for oviposition and the subsequent development of terrestrial eggs. Nest building has been previously reported in several anuran families including Conrauidae (Schäfer et al., 2019); Dicroglossidae (Emerson, 1992); Hylidae (Lutz, 1960; Kluge, 1981) and Leptodactylidae (Heyer, 1978; Narvaes & Rodrigues, 2005; Faggioni et al., 2017). To our knowledge, this is the first detailed report of nest building along with oviposition in the family Ranixalidae although it would appear that *I. duboisi* constructs a similar nest with water dripping into the nest site and flowing out of it (Mudke & Thunga, 2020). Our report of male to male combat in *I. cf. tysoni* is also the first published report of this behaviour in a ranixalid frog. In terrestrial egg laying frogs, nests are often vigorously defended by male frogs as the construction of a nest amounts to a significant investment in time and energy (Wells, 2007), it is therefore unsurprising to find that ranixalid frogs also aggressively defend nests. Whether nesting and combat behaviours are exhibited by other ranixalid frogs is unknown.

Whilst other studies have reported multiple male *Indirana* present at oviposition sites (Modak et al., 2018), the subsequent gathering of males on top of the clutch immediately after it was deposited, is to our knowledge, the first published report of this behaviour in ranixalid frogs. We were unable to confirm whether eggs were fertilised by more than one male but our observation lends further support to an hypothesis that a single clutch may be fertilised by multiple males (Modak et al., 2018) and we suggest that this

could be an intriguing area for future study. The presence of groups of males at a nest site suggest lekking (Gaitonde & Giri, 2014) where the calls of these males may attract the female to the nest site, further observations are required to confirm this.

The most detailed published accounts of *Indirana* breeding behaviour and reproductive biology have not reported any form of parental care, including egg guarding (Gaitonde & Giri, 2014; Modak et al., 2018). Egg guarding was suggested but not confirmed by one other brief report on *I. cf. semipalmata* (Tapley et al., 2011) where a male individual was observed in close proximity to an egg clutch on two occasions. Further study is required to ascertain whether or not males guard the eggs until hatching and time lapse photography would facilitate this. Whilst we have classified male presence as parental care, male frogs could remain at nest sites to attract other females as it is feasible that more than one clutch could be deposited within a single nest in a single breeding season.

Unlike other studies on ranixalid frogs (Kanagavel et al., 2018; Modak et al., 2018), we report two distinct call types, an advertisement call and another call emitted during male to male combat, amplexus and egg fertilisation. Our limited data preclude any inference on the function of this second call. Gaitonde & Giri (2014) studied *I. cf. beddomii* and also reported two call types, an advertisement call and a more vigorous and frequent call emitted by male frogs when a female was in sight.

This work and other preliminary studies indicate that ranixalid frogs may have diverse vocal repertoires. Our study was limited by the fact that we did not have permits to collect voucher specimens or tissues for subsequent molecular analysis and so we are unable to categorically state that the frogs and tadpoles we observed were *I. tysoni* as frogs of the genus *Indirana* are morphologically conserved. Our study indicates, in the case of dorsum colour that this population of *I. cf. tysoni* is polymorphic. However, frogs in this study did conform to the published descriptions of *I. cf. tysoni* (Dahanukar et al., 2016; Garg & Biju, 2016). Nevertheless, these observations offer a tantalising glimpse of the relatively complex behavioural repertoires that exist in this ancient lineage of frogs. Our study has wider implications in elucidating the habitat that *I. cf. tysoni* requires for breeding. Such information can lead to a better understanding of species conservation and framing of appropriate conservation action plans.

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Sleeping site fidelity in three neotropical species of herpetofauna

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INTRODUCTION

All animal species studied to date have shown sleep or sleep-like behaviour (Tobler, 2000). Sleep aids in a variety of processes including recovery of cellular and endocrine systems through to learning, memory and energy conservation (Mignot, 2008; Libourel & Herrel, 2016). At the same time, periods of sleep could present risks as an animal may be exposed to predation while inactive (Amlaner & Ball, 1983). Regardless of its functions, sleep is among the most prominent of animal behaviours and as such is likely to be a behaviour that responds dynamically and adaptively to different environmental variables (Tobler, 2000).

Sleeping site selection must play an important role in obtaining the benefits of sleep while avoiding predation (Amlaner & Ball, 1983). It is likely influenced by microhabitat preferences, the need for protection from predators or exposure, and remaining within territories to avoid competition (Christian et al., 1984; Clark & Gillingham, 1990). Thus, once selected, a sleeping site may be maintained through days, weeks, or longer, to retain these benefits over time (González-Zamora et al., 2015). However, to date studies of sleeping site preferences or site fidelity have focused mainly on endotherms (mammals and birds) rather than ectotherms such as reptiles, amphibians, fishes or invertebrates (Amlaner & Ball, 1983; Campbell & Tobler, 1984; Christian et al., 1984; Clark & Gillingham, 1990; Hartse, 1994). In reptiles specifically, sleeping sites have been recorded widely in anoles, including some Amazonian species such as *Anolis punctatus*, *Anolis trachyderma* and *Anolis transversalis*. However, there is far less information for other reptiles and amphibians (Clark & Gillingham, 1990; Vitt et al., 2002; Vitt et al., 2003a; Vitt et al., 2003b; Poche et al., 2005). Here we report sleep site fidelity for two species of lizard *Enyalioides laticeps* (Guichenot, 1855) and *Anolis fuscoauratus* D'Orbigny, 1937 and one amphibian species, the toad *Rhinella margaritifera* (Laurenti, 1768).

To gather data, we undertook day and night-time visual encounter surveys between June and August 2019 in the camping area of the Sani Reserve, Sucumbíos, Ecuador (0° 26' 18.47" S, 76° 16' 45.11" W). The habitat in the Sani Reserve is a mixture of mostly terra firme forest, igapó (blackwater flooded forest) and varzea (white water flooded forest) with the Challuacocha lagoon and its surrounding

reeds and grasses located around the reserve's ecolodge (Hollamby, 2010). Six trails were surveyed on separate days on a rotational basis. During these surveys we first recorded *E. laticeps* and *R. margaritifera* sleeping on 10th July, and recorded them again on 17th July. Sleeping was determined through behavioural indicators such as closed eyes upon our arrival, lack of escape behaviour, or time of observation outside the reported diel activity pattern. In the camp, we recorded an individual *A. fuscoauratus* that was returning to sleep in the same site from the 19th July. We placed flagging tape a few metres from the sleeping sites of *E. laticeps* and *R. margaritifera* as a warning so that we could approach slowly when nearby while also not drawing attention to the specific site. We then visited these flagged sites daily from 24th July 2019 to 4th August 2019 and the *A. fuscoauratus* site (in camp) from 19th July to 4th August 2019. We did not visit any of the sites on Mondays, as we were not in the reserve. We were unable to reach the *E. laticeps* and *R. margaritifera* sites on the 1st and 3rd of August due to bad weather, but we could still observe *A. fuscoauratus* as this was within the camp. During each visit we recorded the presence or absence of the individuals at the sites. To characterise the microhabitats used for sleeping, we photographed each location (Fig. 2A, 3A, 4A) and in each case measured the height from the ground and distance from the trail where applicable. The animals were not captured so morphometric data was not collected. Based on their size, all three individuals were considered to be adults and each had unique colour patterns that allowed us to confidently recognise the same individual on successive occasions.

Amazon forest dragon - *Enyalioides laticeps*

This is a small, ornamented arboreal lizard that ranges throughout Amazonia (Bartlett & Bartlett, 2003). We have observed that this species tends to 'hug' thin sticks and remain there during sleep (Fig. 2). They remain immobile and seem unbothered by flashlights or by people moving in their vicinity. We recorded one adult individual sleeping repeatedly at the same site across seven different nights (Fig. 1). The individual used two sleeping sites within one small area. The first site (hereafter: EL-A) was a small plant 95 cm from the edge of the trail where the lizard slept on a foliated branch measuring 23 cm wide, 20 cm long and 92 cm above the ground (Fig. 2B). The second sleeping site (EL-B) was on a

thin stick (Fig. 2C) located 73 cm away from EL-A and 131 cm from the edge of the trail. The lizard's perch on the stick was 49 cm above the ground. On 28th July 2019 at 15:08 h the lizard was seen a few metres from the sleeping plant showing that it was leaving the perch for other activities.

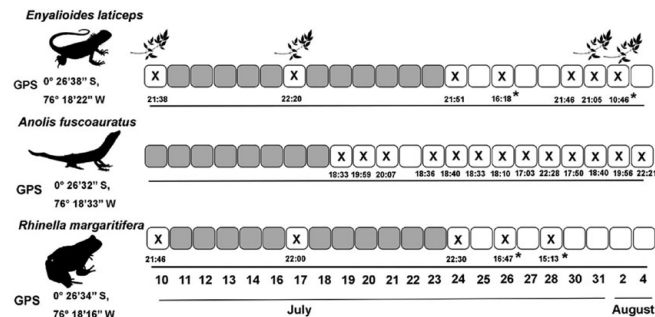


Figure 1. Date and time records for each individual recorded in their sleeping site across our surveys, the boxes represent days. Grey boxes represents days in which we did not survey the individuals. An X within a box denotes presence of the individual and clear boxes absence of individuals. Asterisk (*) next to time denotes where a record was at a time early enough that we cannot be sure the animal was sleeping. For *E. laticeps* there are two sub-sites, the foliated branch (EL-A) indicated by a symbol of a foliated branch above a box and a thin stick sleeping site (EL-B) with no symbol.

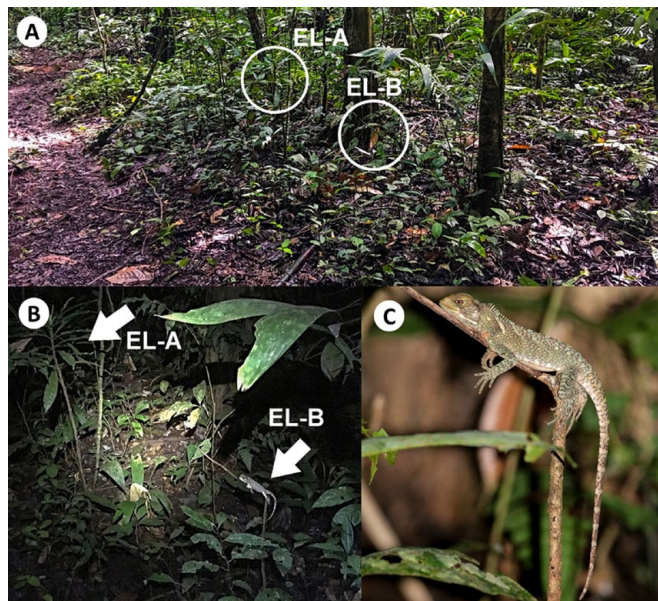


Figure 2. *Enalyioides laticeps* sleeping site - **A.** Circle EL-A indicates the first location in which the lizard was encountered sleeping and circle EL-B indicates the second location, **B.** A closer image of the sleeping site with the respective perches indicated by arrows EL-A and EL-B, the lizard can be seen in-situ at EL-B below arrow 2, **C.** Close up of the individual *E. laticeps* on the small stick at EL-B

Slender anole - *Anolis fuscoauratus*

This is a cryptically coloured, arboreal lizard that is found in clearings as well as within the forest throughout the amazon basin and are often recorded sleeping over leaf surfaces, or on thin sticks (Bartlett & Bartlett, 2003; Fig. 3). One adult male individual was recorded returning to the same perch over the

13 nights that we checked the location (Fig. 1). The sleeping site was a dead 'Cruz Caspi' (*Browneopsis* sp.) stem in a pot on a table of one of the camp's raised platforms, covered by a roof made from palm leaves (Fig. 3A). The sleeping perch on the plant was 77 cm above the table it was resting on, whilst the total height from the ground to the sleeping perch was 286 cm. We did not observe the lizard arriving to rest every night, however on 27th July 2019 at 17:03 h, during heavy rainfall, the lizard made its way across the handrail and jumped from the handrail to the stem (roughly 10 cm). It then came to rest at the small fork towards the distal end of the stick (the same position as in previous observations) and fell asleep (Fig. 3B), 17:03 h was the earliest time of arrival recorded for the lizard, perhaps due to the rain. We also noted that the lizard became habituated to both the stick bouncing as a result of the floor moving from foot traffic, and to head torch shine, which normally awoke this species found sleeping on the trails.



Figure 3. *Anolis fuscoauratus* sleeping site – **A.** The thin, dead branch that the anole slept, held up by the plastic bottle into which it was inserted, the white arrow indicates the fork in the branch where it slept, **B.** the anole sleeping at the fork of the branch with its head facing the terminal end of the branch

Crested forest toad - *Rhinella margaritifera*

This medium-sized toad ranges across northern South America and inhabits the leaf litter on forest floors for which it is well camouflaged (Ortiz et al., 2018; da Fonseca et al., 2019). This adult toad was first observed sleeping on a large, flat leaf on a thin stemmed plant. The large leaf upon which it was sleeping was 127 cm above the ground and measured 44 cm in the length and 19 cm in width at the widest point (Fig. 4A). The toad was recorded again sleeping on the same perch on two other days (Fig. 1). On 26th July 2019 at 16:47 h the toad was present but was accidentally disturbed causing it to jump from the plant to the ground and into the leaf litter. Though unfortunate for the animal, this proved that the individual had the intent and ability to climb back up to the site, since we observed it back up on the leaf on 28th July 2019 at 15:13 h (Fig. 4B). This behaviour is interesting as *R. margaritifera* is reported as being terrestrial, thus climbing this plant suggests unexpected arboreal abilities in this species. We did not encounter the toad again at the site after 28th July 2019.

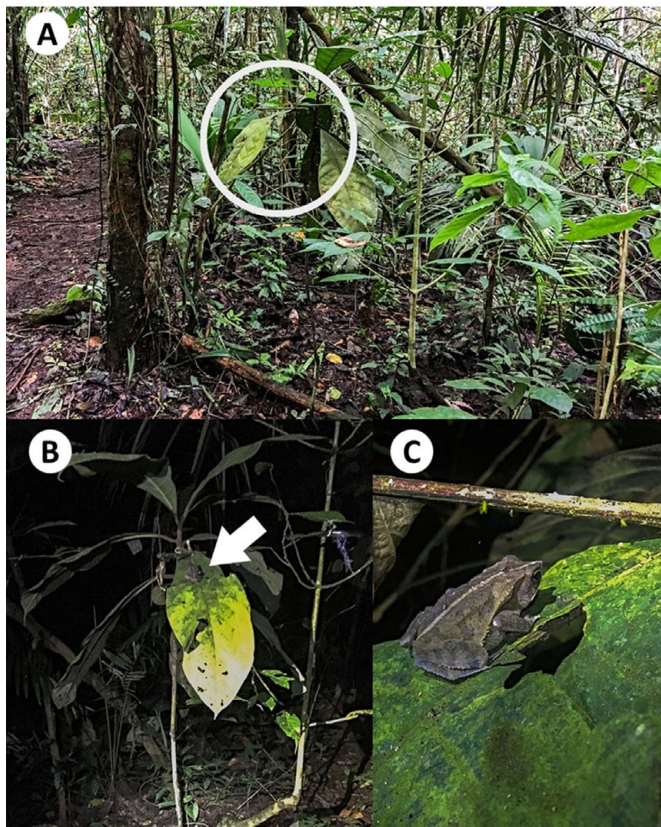


Figure 4. *Rhinella margaritifera* sleeping site – **A.** View of the sleeping site, the white circle indicates the leaf upon which the individual was observed sleeping, 127 cm above the ground, **B.** Close up image of the plant where the individual was sleeping, the white arrow indicates the individual in-situ, **C.** Close up of *R. margaritifera* in-situ on the leaf

Avoiding or diminishing predation risk has been proposed as one of the main features that leads individuals to choose a sleeping site (Lima et al., 2005). But, factors other than predation may be more important in sleeping site selection and fidelity. For instance, selection of sleeping sites could be based on site structure (leaf area) or stability, which by extension could help to minimise predation or exposure, or perhaps to improve thermoregulatory opportunities in the morning (Christian et al., 1984; Clark & Gillingham, 1990; Mohanty et al., 2016).

Additional observations of sleeping perches for these species, which were recorded outside the period of this study, include: for *E. laticeps*, branches of small trees and shrubs, normally about 1–2 m above the ground; for *R. margaritifera*, small plants at the trail edge; and for *A. fuscoauratus* the terminal ends of thin branches of vegetation at chest-height. Detailed information on the sleeping perches of *A. fuscoauratus* have been recorded previously but without mention of sleeping site fidelity (Vitt et al., 2003b). The somewhat artificial environment of the camp likely provided added protection for *A. fuscoauratus* from predators and may have been why this individual remained there over several days.

The information gathered here for these three species is a first step in understanding what sleeping sites they select and the degree of site fidelity they show. Further detailed work

is needed to understand how these species select sleeping sites and the characteristics of sites to which they would show fidelity.

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Interdigital membrane of the Hokkaido salamander *Hynobius retardatus*

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INTRODUCTION

Salamanders stand out among vertebrate animals in the following characteristics: their ability to regenerate body parts, their large and variable genome size, and larval phenotype variation (Kohmatsu, 2001; Kishida et al., 2009; Sessions & Wake, 2020).

The Hokkaido salamander, *Hynobius retardatus* Dunn (1923) (Urodela: Hynobiidae), is a pond-type salamander indigenous to Hokkaido and at the northern limit of the genus *Hynobius* in Japan (Fig. 1A, B) (Sato & Matsui, 2013; Tokuda, 2015). Interestingly, this species was discovered in the neotenic zone in Lake Kuttarush (Fig. 1A), that is located in the eastern region of Noboribetsu Onsen as type

locality (Dunn, 1923; Sasaki & Nakamura, 1937). Only in this population has sustained neoteny been observed (Jia & Gao, 2016; Jiang et al., 2018). In May 2018, I obtained two capsules of fertile eggs from a private garden in Kayabe-gun (Fig. 1A, C, D). This was a new record for a natural population from 100 km south of the Noboribetsu area (Fig. 1A, C, D). It seems to be the southernmost population of *H. retardatus* in Hokkaido. Over the Tsugaru Strait another pond-type species, *Hynobius lichenatus*, is distributed in the Shimokita peninsula in northern Honshu.

The stages of larval development in the family Hynobiidae have been investigated and enumerated (Iwasawa & Kera, 1980; Iwasawa & Yamashita, 1991). Recently there have been several studies describing the development

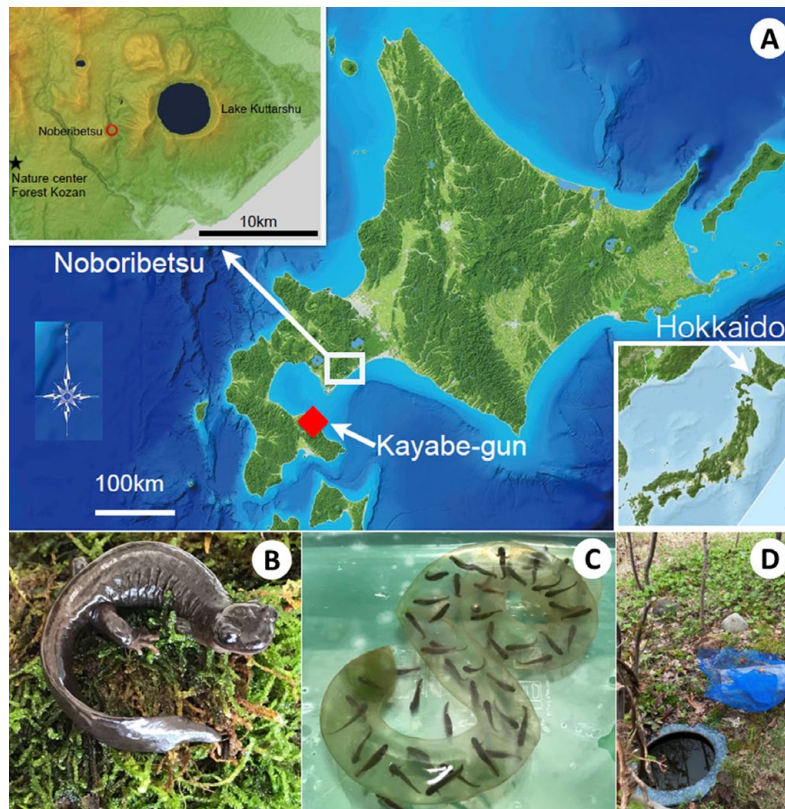


Figure 1. A. Maps showing the type locality of *Hynobius retardatus*- white rectangle indicates Noboribetsu region, red circle is the type locality, black star is the location of the Nature Center, Forest Kozan, Noboribetsu-shi, red diamond is the collection site of fertile eggs in Kayabe-gun, Lake Kuttarush is the crater lake where neotenic specimens were observed about 80 years ago but are now extinct, **B.** Adult specimen from Forest Kozan, Noboribetsu-shi, **C.** Two egg capsules (lab photo), **D.** Collection site of a private garden in Kayabe-gun

of interdigital membranes (IMs) or vestigial membranes during limb development in hynobiid salamanders from the islands of Honshu - *Hynobius lichenatus*, *Hynobius nigrescens*, *Hynobius tokyoensis*, and Kyushu - *Hynobius dunni* (Table 1) (Iizuka et al., 2005; Iizuka, 2009; Iizuka et al., 2010; Iizuka & Akiyama, 2018). In this paper I present observations on the development of the IM in limbs of *H. retardatus* from the island of Hokkaido.

MATERIALS AND METHODS

This study was included as part of an investigation of salamander chromosomes in accordance with the direction and guidance of the Nanae-cho Ramsar Convention in Ohnuma quasi-National Park and the Ministry of the Environment of the Hokkaido Government in Hakodate and Sapporo, Hokkaido. Two egg sacs were collected in Honbetsu, Shikabe-cho, Kayabe-gun (42° 01'92" N; 140° 78'65" E) (Fig. 1A, C, D). The embryos and larvae from the two egg sacs (Fig. 1C) were placed in an aquarium kept in a wine cellar at 8 °C and their developmental stages identified according to those already described for *H. nigrescens* (Iwasawa & Yamashita, 1991). At selected intervals two or three larvae of each stage were fixed in buffered 75 % ethanol and photographed.

RESULTS AND DISCUSSION

All specimens examined in this study had interdigital membranes (IM, Fig. 2). These pond-type larvae also had well-developed balancers (Fig. 2A-C). The early forelimb buds show a spear-like morphology that, by the 2-digit stage, resolves itself as a symmetrical structure consisting of a pointed IM, with digits 1 and 2 developing on either side (Fig. 2A-E). As the forelimb develops, the IM regresses and is nearly gone by the 3-digit stage (Fig. 2D). As in most other salamanders with aquatic larvae, the development of the hindlimbs is delayed relative to the forelimbs (Fig. 2F). It is noteworthy that in this species the hindlimbs also develop a distinct IM that regresses as the limbs develop (Fig. 2F).

The patterns of forelimb and hindlimb development of *H. retardatus* appear to be identical to that of other pond-type species (Table 1) (Iizuka et al., 2005; Iizuka et al., 2009; Iizuka & Akiyama, 2018), having a fin like IM that forms between digits 1 and 2 during early limb development which then disappears as limb development proceeds (Fig. 2). Among hynobiid salamanders only the pond-adapted species have well-developed IMs. Systematic analyses of hynobiid and non-hynobiid salamanders, including the present one, indicate the presence of vestigial IM during limb development of the forelimbs on stage 51 of larva (Table 1; Fig. 2) (Iizuka et al., 2005; Iizuka, 2009; Iizuka et al., 2010; Iizuka & Akiyama, 2018). This reinforces our previous conclusions that 1) an IM is probably a character specific to cryptobranchoid salamanders, 2) the IM seems to have some functional significance in pond-larva habitat, since IM is absent in larvae living in fast-stream habitats, and 3) the IM has evolved or disappeared two or three times independently in cryptobranchoid lineages (Table 1) (Iizuka et al., 2005; Iizuka, 2009).

Table 1. A list of larval habitat and interdigital structures* among salamanders

	Species	Larval habitat	Interdigital structure
Hynobiidae			
<i>Salamandrella</i>	<i>S. keyserlingii</i>	pond	IM
<i>Hynobius</i>	<i>H. retardatus</i>	pond	IM
	<i>H. abei</i>	pond	IM
	<i>H. lichenatus</i>	pond	IM
	<i>H. nigrescens</i>	pond	IM
	<i>H. tokyoensis</i>	pond	IM
	<i>H. dunni</i>	pond	IM
	<i>H. kimurae</i>	stream	vIM
	<i>H. formosanus</i>	stream	vIM
	<i>H. sonani</i>	stream	vIM
<i>Onychodactylus</i>	<i>O. japonicus</i>	stream	IW
Cryptobranchidae			
<i>Andrias</i>	<i>A. japonicus</i>	stream	vIM
<i>Cryptobranchus</i>	<i>C. alleganiensis</i>	stream	vIM

*IM - interdigital membrane, vIM - vestigial interdigital membrane, IW - interdigital web

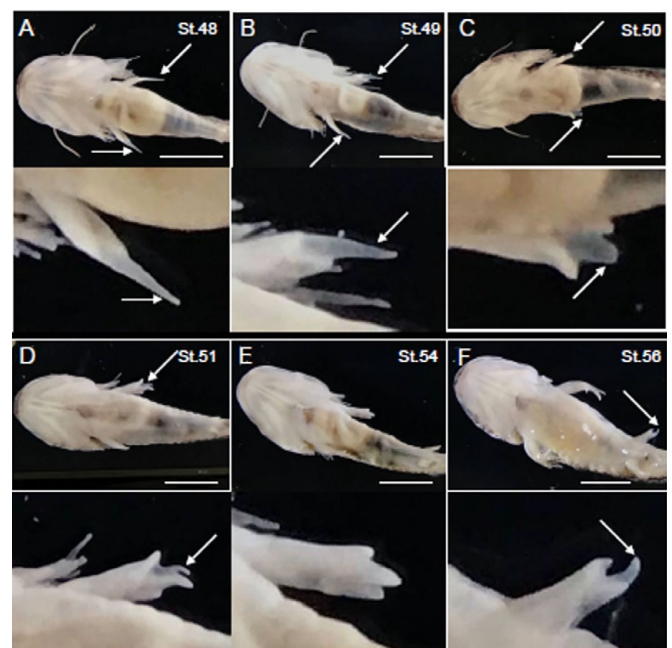


Figure 2. A-F. Ventral views of larval *Hynobius retardatus* at different stages (stage number shown upper right of each image) with the anterior balancers projecting laterally in A-C. Lower associated images are close ups of the interdigital membrane (arrows) of the forelimb, except in F. where the hindlimb is shown. Interdigital membranes disappear soon after stages 51-52 so that in E. (stage 54) a prominent 3rd digit has developed after apoptosis of the IM. The scale denotes 5 mm.

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Exceptional longevity of a male Madeira rock lizard *Teira dugesii* maintained in captivity for 41 years

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Maintaining reptiles in captivity can give clues about their longevity. As expected, longevity in captivity have increased with the development of better care and husbandry; the first reports on reptiles life spans achieved in zoological gardens (Flower, 1925) are shorter than those reported in more recent studies (Bannert, 1998; Slavens & Slavens, 1999; Mendyk, 2014b). Herein, we recount the remarkably 41 year lifespan of a captive male *Teira dugesii* (Milne-Edwards, 1829).

THE LIZARD AND ITS HUSBANDRY

The *T. dugesii* of this account had been offered for sale at the front door of a family member of the first author in October 1977 by two boys. It was an adult male and was probably already 2 or 3 years old at purchase. Unfortunately, the buyer did not ask for the geographical origin of the lizard. It is assumed that the specimen was captured in the wild. Figure 1 shows a close-up of the head of the specimen in 1979, age 2+ years old. The head is without a remarkable spot pattern; the dorsal scales are small and granular. The nostril is separated from the first upper labial scale by contact between the postnasal and supranasal scales below it (unusually). Characteristic is the absence of an enlarged masseteric scale in the temporal region (Arnold et al., 2007). Measured after death, our specimen had a total body length of 18.4 cm and a snout vent length of 7.4 cm. The tail length of 11 cm had been shortened by a single caudal autotomy (Fig. 2). Regeneration took place before acquisition.



Figure 1. *Teira dugesii*, adult male head in 1979, age 2+ years old



Figure 2. *Teira dugesii*, habitus adult male in August 2013, age 35+ years old (arrow indicated position of tail regeneration)

For almost all the years of its life the lizard was kept alone in a rectangular terrarium (60 x 30 x 30 cm) with potting compost as ground cover and with a shallow water dish. Branches and tree stumps and artificial plants formed the furnishing elements and also facilitated climbing by the lizard. Some twigs in the water dish prevented the small food insects from drowning. The water dish was cleaned weekly and regular water renewal ensured that clean water was always available. The only heating was provided by a 25 Watt spotlight with an aluminium foil hood that directed light and heat onto a branch used as a basking position.

Food consisted of all kinds of larger invertebrates from the garden, such as crane flies (*Tipulidae*), blowflies and other Diptera, woodlice (*Isopoda*) and from time to time industrially reared fly larvae and house crickets. However, surprisingly the lizard disliked mealworms which although offered at the outset were usually rejected. In the last ten years of the lizard's life, fruit especially banana and fruit juice were added to the diet. It had been shown that these can form a substantial part of the natural diet of both *T. dugesii* and *Podarcis lilfordi* (Sadek, 1981; Cooper, et al., 2014). No food supplements or extra vitamins were offered.

OBSERVATIONS IN CAPTIVITY

Following 35 years in captivity, in 2013 the lizard showed hardly any external signs of aging (Fig. 2) and the femoral pores of hind legs were in good condition (Fig. 3). Just

following death in 2018, when 41+ years old the dorsal and ventral view of the lizard still showed the animal to be in apparent good health (Fig. 4 a & b) except for the femoral pores which showed degenerative impaction (Fig. 5). Within a year of these symptoms the lizard was dead. This ailment results when the lizard no longer rubs itself on tree branches and could be linked to an abrupt stage of senescence.

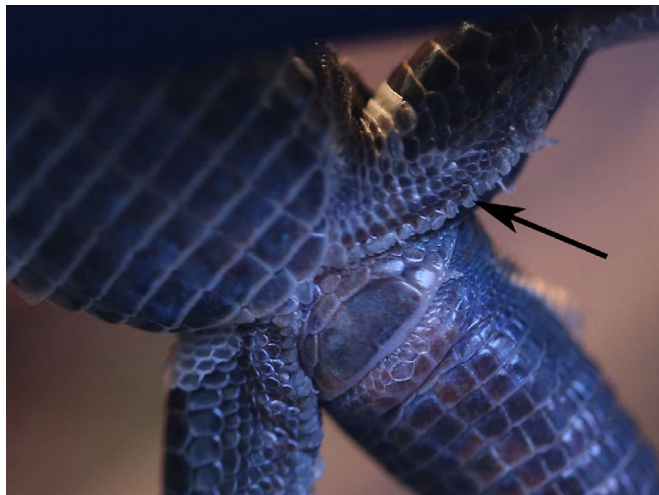


Figure 3. *Teira dugesii*, adult male with femoral pores (indicated by arrow) in good condition in August 2013, age 35+ years



Figure 4. A & B. The dorsal and ventral views the *Teira dugesii* male in January 2018 just after death at 41+ years old



Figure 5. Adult male *Teira dugesii* showing femoral pores (indicated by arrow) of the left hind leg with degenerative impaction, January 2018

The lizard was active year-round. In the first thirty years it flourished on an almost exclusively carnivorous diet. It had always had good appetite, even in the winter. Only subsequently was fruit and fruit juice consumed. No signs of malnutrition, such as swollen limbs or toes, eye infections, metabolic bone disease, muscle degeneration, rhabdomyolysis (muscle breakdown) were ever observed. Neither were periods of poor appetite or lethargy at the end of its life.

Maintained in solitary conditions, the lizard was free from the social stresses that would be associated with conspecifics living in the same terrarium. It finally died unexpectedly on 8th January 2018 with no obvious fatal change in body condition. The only injury noted following death was a broken middle toe of the right hind leg.

DISCUSSION

Several publications have reported increases in reptile life expectancy in captivity. These increases can largely be attributed to substantial improvements in husbandry. However, the present *T. dugesii* male grew old and reached a record survival age with very simple indoor husbandry, without UVB-lighting, without hibernation, without food supplements, and without extra vitamins (except for those present in fruit). The absence of UVB-lighting might have been thought to reduce longevity; especially as in nature *T. dugesii* spends many hours a day basking in sunshine (Malkmus, 1995). The diet in the first thirty years of the lizard's life in captivity hardly contain any vegetable material even though this is an important part of the natural diet of a number of Mediterranean small lacertas (Sadek, 1981; Rubinstein & Abbot, 2017). However, Sleijpen (1995) notes that only in the absence of arthropod prey was a captive breeding group of *T. dugesii* in the Netherlands interested in eating soft ripe fruit (bananas as well as fruit juice).

Published report on palearctic Lacertini in captivity have suggested longevity of at least 6 to 18 years (Bannert, 1998) and a male *Timon lepidus* was reported with a lifespan of 35 years (Böhme & Esser, 2015). These authors also report a female *T. lepidus* living in the same breeding group being 30 years and still alive at the time of publication. In contrast to our *T. dugesii* male this particular *T. lepidus* showed the first age-related handicaps when it was only 20 years old. The responses of eight experienced herpetoculturalist from Germany and The Netherlands to an unpublished questionnaire about lizard longevity in captivity, indicated that lifespans of Lacertini range from 14 to 26 years in small lacertas (e.g. *Podarcis*, *Archaeolacerta*) while in a larger species (*Lacerta bilineata*) 18 to 23 years.

Despite the lack of what nowadays may be considered 'indispensable' elements in lizard husbandry, the *T. dugesii* male of this report was not prevented from achieving a lifespan of more than four decades in good health. We suggest that low-quality nutrition reduces growth rates, promotes a relative decline in reproductive rates (although not relevant in this case) and thus prolongs life. Nevertheless, good husbandry is an important factor affecting the welfare and lifespans of reptiles, as has been comprehensively reported

over the last three decades (Iverson et al., 2004; Mason, 2010; Mendyk, 2014a, 2014b; Scharf et al., 2015; Wolterman, 2018).

The observed longevity of our captive *T. dugesii* is clearly exceptional even among other captive Lacertini. In the wild, longevities would be expected to be much shorter as demonstrated in a long-term mark and recapture study of *T. dugesii* which had a maximum longevity of 16 years (Jesus, 2012). Notwithstanding our impressive example, the record for small lizard longevity still remains with a slowworm (*Anguis fragilis*) that lived in captivity for at least 54 years in Copenhagen Zoo (Schmidt & Inger, 1957).

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First records of Johnstone's whistling frog *Eleutherodactylus johnstonei* from two departments in south-western Colombia

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Eleutherodactylus johnstonei Barbour, 1914 is a small frog that completes metamorphosis within the egg to emerge as a froglet, i.e. there is no free living tadpole. The species is native to some islands of the Lesser Antilles (Kaiser, 1997) but it has a long history of being introduced into several Caribbean islands, Bermuda, some countries in Central America, South America and even Europe (Kaiser et al., 2002; Savage, 2002; Leonhardt et al., 2019; Frost, 2020; Moravec et al., 2020). Introductions typically occur through the ornamental plant trade, with or without the deliberate help of humans (Kaiser et al., 2002; Leonhardt et al., 2019). Compared to other countries, Colombia has a long history of *E. johnstonei* introductions and consequently the species is well established there with a large number of reported populations, so that it is deserving of special attention (Leonhardt et al., 2019).

The first occurrence of this species in Colombia was in 1992, based on a single specimen collected in Barranquilla, department of Atlántico (Ruiz-Carranza et al., 1996). Subsequently, the species was reported towards the south of the country through vouchered or non-vouchered records from the departments of Santander (Bucaramanga), Valle del Cauca (Cali), Bolívar (Cartagena), Tolima (Mariquita, Ibagué) and Cundinamarca (Chinauta-Fusagasugá) (Ortega et al., 2001; Kaiser et al., 2002; Montes & Bernal, 2012; Gómez-Martínez et al., 2016). About 25 years after the first introduction, Leonhardt et al. (2019) provided the first systematic and comprehensive countrywide assessment of *E. johnstonei* in Colombia, confirming all previous records and adding records from the departments of Antioquia (Medellín) and Magdalena (Santa Marta). Here we report the presence of this species in two additional departments in south-western Colombia (Fig. 1), based on both audio-visual and voucher records. The specimens collected were euthanised with 2 % lidocaine hydrochloride, fixed in 10 % formalin, preserved in 70 % ethanol, and stored in the herpetological collection of the Museo de Historia Natural of the Universidad del Cauca, Colombia (MHNUC). To see and/or hear the frogs, view our video (BHS video, 2021).

E. johnstonei in the department of Cauca

In the peri-urban area of Santander de Quilichao on 18th

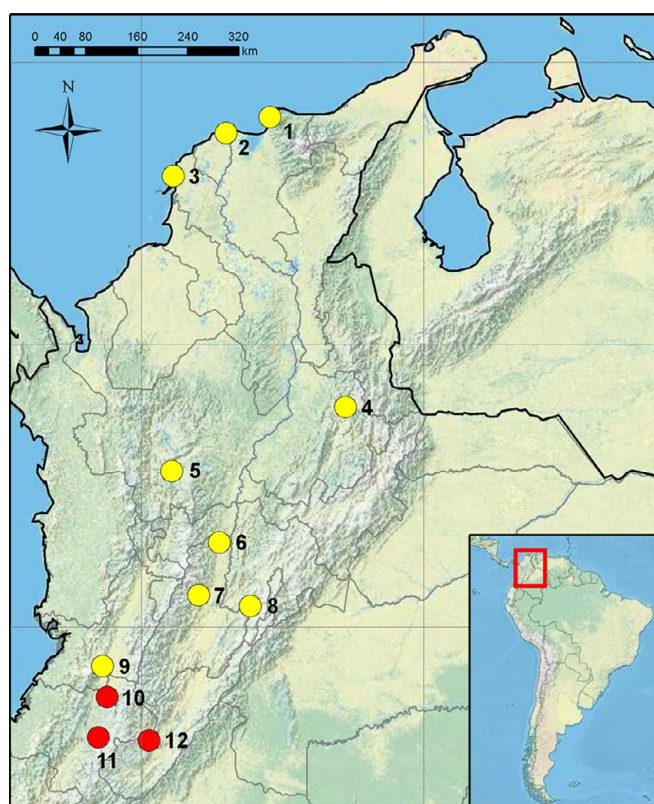


Figure 1. Distribution of *Eleutherodactylus johnstonei* in Colombia. Yellow dots indicate previous records summarised by Leonhardt et al. (2019): **1.** Santa Marta, Magdalena; **2.** Barranquilla, Atlántico; **3.** Cartagena, Bolívar; **4.** Bucaramanga, Santander; **5.** Medellín, Antioquia; **6.** Mariquita and **7.** Ibagué, Tolima; **8.** Chinauta-Fusagasugá, Cundinamarca; **9.** Cali, Valle del Cauca. Red dots indicate the new records: **10.** Santander de Quilichao and **11.** Popayán, Cauca; **12.** La Plata, Huila

December 2015 (18:25 h), some individuals were heard and one photographed in a restaurant. Then on 24th February 2018 (19:30 h), other individuals were also heard and one collected (MHNUC-He-An-1241) in a private garden in the urban area of this municipality (3° 0'37" N, 76° 28'56" W, 1061 m a.s.l.). The species was also found in the municipality of Popayán; a single individual was heard and photographed on 14th December 2019, in a street garden in the Las

Américas neighbourhood (2° 26'19" N, 76° 36'41" W, 1730 m a.s.l.). Furthermore, on 29th November 2020 (20:30 h) three individuals were heard in private gardens in the peri-urban condominium 'Sendero de Eucaliptos' (2° 29'30" N, 76° 33'29" W, 1848 m a.s.l.), one of which was collected (MHNUC-He-An-1326). *E. johnstonei* has also been heard at three other sites in Popayán not visited by us, but it was absent in seven nurseries that were visited or contacted by us.

E. johnstonei in the department of Huila

In late March 2020, the species was initially heard at night in the Las Quintas neighbourhood, municipality of La Plata. Subsequently, several individuals were heard (> 5 calling males) or observed in each of at least seven locations in the municipality, among two plant nurseries, the cemetery and private gardens of urban and peri-urban areas, always associated with ornamental plants. One individual was collected (MHNUC-HE-An-1325, Fig. 2) on 25th September 2020 (20:31 h) at Finca La Praderia, vereda Panorama (2° 24'27" N, 75° 52'55" W, 960 m a.s.l.). Information provided by some property owners suggests that the species has been established in La Plata at least since late 2018, and in two independent cases it appeared after they brought ornamental plants from Cali; whereas both plant nurseries visited by us receive all their plants exclusively from larger nurseries in Chinita-Fusagasugá, Cundinamarca, where the species is not abundant (Leonhardt et al., 2019). However, both the property owners and ourselves have noticed a rapid proliferation of these frogs inside the plant nurseries at La Plata (> 20 calling males), from where the species appears to have been transported as evidenced by the complaints of some clients who later heard the frogs in their gardens.

Species identification

In mainland Colombia, no frog species other than *E. johnstonei* is strictly associated with gardens in urban and peri-urban areas, and the species can be detected easily by its distinctive two-note calls where the second note is higher and longer than the first (Kaiser, 1992). In addition, the species can be identified according to the descriptions and keys provided by Savage (2002) and Köhler (2011). All three specimens collected showed the diagnostic characteristics described by the aforementioned authors, some of which can be appreciated in Figure 2.

The records of *E. johnstonei* presented here are the first from the departments of Cauca and Huila, extending its distribution more than 100 km (in a straight line) from Cali, making them the southernmost locality records in Colombia. The species presumably arrived in Cauca from populations in Cali (Valle del Cauca) due to the proximity and high commercial flow between these departments; whereas in Huila it was introduced independently from Cali and Cundinamarca. The species continues to show a discontinuous distribution pattern in Colombia (Fig. 1) so that its presence in these additional departments is more likely related to passive movements mediated by humans rather than natural dispersal as suggested by Leonhardt et al. (2019).

The presence of *E. johnstonei* at 1848 m (Popayán, Cauca) confirms its ability to live at high altitudes, surpassing the previous highest records from Venezuela (Mérida, up to 1400

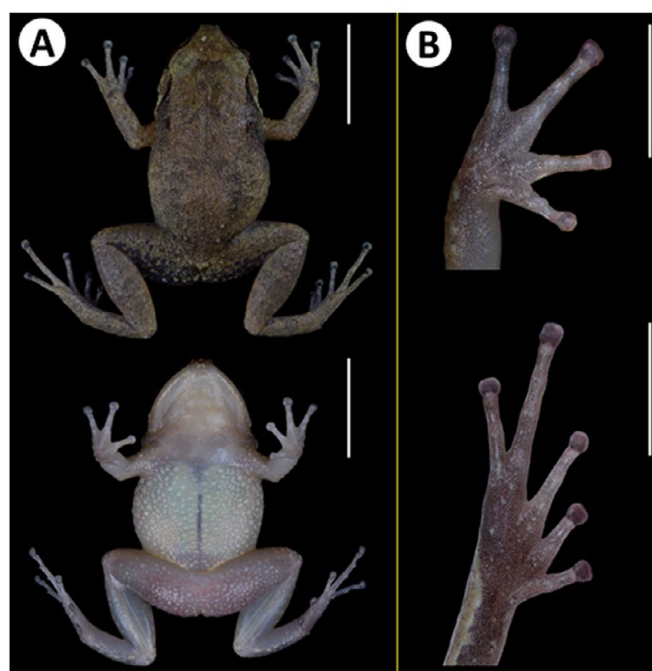


Figure 2. Specimen of *Eleutherodactylus johnstonei* from La Plata, Huila (MHNUC-He-An-1325) - **A.** Dorsal (upper) and ventral (lower) views, **B.** Ventral views of right hand (upper) and right foot (lower). Scale bars- A. = 10 mm, B. = 5 mm

m) and Colombia (Fusagasugá, 1717 m) (Kaiser et al., 2002; Leonhardt et al., 2019). However, the population appears to increase only slowly at such altitude in Popayán (<5 calling males per site), and similarly in Fusagasugá abundance is low (Leonhardt et al., 2019).

In the places where we found *E. johnstonei*, most of the property owners were not bothered by the frogs' calls; some owners even felt comfortable and sufficiently used to the calls that they would regularly water their gardens to hear 'their little frog'. However, this attitude was not universal. One owner in the Las Americas neighbourhood, Popayán, Cauca expressed annoyance with the species' call. At La Plata, two clients of the plant nurseries were annoyed by the calls and one property owner, who had initially felt comfortable a few months earlier, was no longer sympathetic due to the subsequent proliferation of these frogs in his garden (> 30 individuals heard/observed).

According to the testimony of a person from Popayán, who has the species in his garden, these frogs are offered along with the sale of ornamental plants in at least one nursery in Cali. This amounts to intentional distribution of an alien species which is of questionable legality. We confirmed this bad practice which had been reported initially in Bucaramanga (Ortega et al., 2001).

We believe that the current distribution of *E. johnstonei* in Colombia is underestimated and that it will continue to grow due to increases in the ornamental plant trade, the intentional dispersal by some nurseries, and to a lack of control measures by the government. Although the species does not currently appear to represent a threat to native fauna in Colombia, economic and mental health effects on people related to the noise pollution generated by the frog's calls have been predicted (Gómez-Martínez et al., 2016;

Leonhardt et al., 2019). Faced with this, we agree with the proposals of the aforementioned authors for the need to have intensive systematic monitoring of this species in Colombia as well as to implement control measures and management techniques in nurseries and gardens.

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Polymely in the smooth newt *Lissotriton vulgaris* and the palmate newt *Lissotriton helveticus*

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The smooth newt (*Lissotriton vulgaris*) is a widespread amphibian species found throughout western Europe and is the most common newt species in the British Isles (Speybroeck et al., 2016). Adults grow to 11 cm in length and can be found in a variety of habitats from garden ponds to lakes and streams. The palmate newt (*Lissotriton helveticus*) is the smallest newt species in Britain reaching a maximum length of 10 cm (Speybroeck et al., 2016). Its range is more restricted in mainland Europe and Britain than the smooth newt and it is typically found in shallow pools on heathland and moorland, but can on occasion be found in less acidic environments and sometimes in the presence of other native newts (Speybroeck et al., 2016).

Amphibians can exhibit a number of different limb deformities (Laurentino et al., 2016). The presence of an additional limb (polymely) is often the most cited amphibian deformity in the scientific literature although as extra limbs are particularly conspicuous they may be reported disproportionately (Ouellet, 2000). Polymely mostly results from an incomplete injury that sometimes causes a limb to both heal and regenerate (Nye et al., 2003) but it may also result from parasitic infection (Sessions & Ruth, 1990). The presence of additional limbs has been recorded in many amphibian species, but mostly from frogs and toads rather than newts (Canestrelli et al., 2006). Polymely has previously been recorded in smooth newts (see Vershinin & Berzin, 2018) but there do not appear to be reports of this anomaly occurring in palmate newts.

The first case is of a female smooth newt with a supernumerary left hindlimb (Fig. 1). This newt was discovered during an evening toad patrol organised by the Hampshire and Isle of Wight Amphibian and Reptile Group on 21st February 2020 at Wildmoor Lane, Sherfield-on-Loddon (51° 18' 24.4" N 1° 00' 48.2" W). The newt was collected from a road surface while migrating towards a pond on the nearby Sherfield Oaks Golf Course and placed in a bucket. Before the newt was released in the nearby pond it was sexed and at that time the supernumerary hindlimb was detected. The extra limb comprised a secondary fibula, tibia and foot, attached to the anterior surface of the right hindlimb (Fig. 1). Apart from being less developed than the adjoining limb (the extra foot was roughly 60 % smaller) all five digits were present and moved independently of the main foot.

The newt's movement did not seem to be impaired by the additional limb.



Figure 1. Female smooth newt (*Lissotriton vulgaris*) with an extra limb on the anterior surface of the right hindlimb, anterior view (left) and dorsal view (right)

The second case was of a female palmate newt with a supernumerary right forelimb (Fig. 2). The newt was maintained in a captive population in North Wales, housed in an artificial greenhouse pond along with two other newts species, the Macedonian crested newt (*Triturus macedonicus*) and the Bosnian alpine newt (*Ichthyosaura alpestris reiseri*).

The pond was stocked with hornwort (*Ceratophyllum demersum*) and contained potential predators such as dragonfly larvae and water beetles. Similar to the first case, the affected newt had an entire additional limb complete with humerus, radius and ulna although digits II and III were united (syndactyly) (Fig. 2).



Figure 2. Female palmate newt (*Lissotriton helveticus*) with an extra limb extending from the distal end of the right humerus (NB the pale stripe on both front forelimbs is believed to be a reflection of light from the wet skin)

In both cases the supernumerary limbs are most likely to have been caused by an injury, such as an unsuccessful predation attempt.

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Behavioural response of the brown-banded water snake *Helicops angulatus* to simulated predation

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Animals display a wide array of antipredator responses, which can directly influence their survival and fitness. When confronted by a predator, an individual may use a variety of different defensive behaviours in response to relative risks, energetic demands, and intrinsic constraints (Greene, 1988; Bateman et al., 2014). To understand fully the mechanisms and factors underlying antipredator behaviour, it is essential to describe the individual behavioural sequences deployed. However, such behaviours are rarely observed in the wild, especially for elusive taxa such as snakes. Instead, simulated predation experiments can offer insights where field observations are lacking. The brown-banded water snake *Helicops angulatus* (Linnaeus, 1758) is a medium-sized, aquatic and nocturnal species that inhabits still waterbodies in forested and disturbed areas of northern South America (Bartlett & Bartlett, 2003). This snake is known to exhibit antipredator behaviour such as dorsoventral body flattening, thrashing, and striking (Martins & Oliveira, 1998). Here I describe the behavioural sequence of *H. angulatus* against simulated predation, with the first observation of balling in the species.

From 8th to 10th March 2019, I captured six juvenile and one adult *H. angulatus* by hand during the night at a pond surrounded by secondary forest in Madre de Dios, Peru (12° 53' 90" S, 71° 21' 48" W, WGS84, 498 m altitude). The snakes were brought back to a lodge where they were measured with a tape measure for snout-vent length and weighed using an electronic scale (Table 1). They were kept overnight in a plastic container with freshwater up to 5 cm deep. Then at 15:00–18:00 h on the day after capture, they were removed individually from the container and placed gently onto an indoor arena (at ambient 23–26 °C) to observe their defensive responses. Each snake was left undisturbed for 10 seconds before there was a simulated attack from an avian or mammalian predator in which the snakes were gently tapped and occasionally picked up using metal forceps for juveniles or using a snake hook for the adult (procedure modified from Mori et al., 1996). No snakes were harmed during the process. The tactile stimuli were applied for one minute, and if the snake performed balling, they were continued for another minute. Shortly after the trials were terminated, the snakes were released at their capture location. All snakes swam away with no apparent deleterious effects from the experiments.

Table 1. Body measurements and behavioural responses of *Helicops angulatus* to simulated predation. Duration of each behavioural phase is shown in parenthesis. The subsequent phase is noted after the semicolon.

Snake ID	SVL	Mass (g)	Behavioural sequence
Juveniles			
1	175	6.3	Body flattening & occasional striking (1 min)
2	185	6.6	Body flattening & occasional striking (1 min)
3	180	5.6	No reaction (12 sec); Escaping (11 sec); Body flattening (6 sec); Balling (41 sec); Body flattening
4	186	7.7	Body flattening (41 sec); Escaping
5	180	6.7	Body flattening (55 sec); Balling (> 1 min)
6	175	6.6	Body flattening & occasional thrashing (1 min)
Adult			
7	400	59.5	Occasional striking (31 sec); Balling (>1 min)

The behavioural sequences displayed by each individual are shown in Table 1. When the trials started, five of the six juvenile snakes initially displayed dorsoventral body flattening, with the body in a circular or undulating shape (Fig. 1A). Three of those juveniles, while flattening the body, occasionally made sudden strikes at the forceps with the head elevated from the ground or thrashed the body with the head touching the ground in response to the physical contact of the stimuli. Two juveniles attempted to escape by lateral undulation. The adult snake did not seem to flatten the body but struck at the snake hook. Three individuals including the adult adopted a balling posture after the initial responses had lasted for 28–55 seconds (Fig. 1B). The rather cylindrical 'ball' was made of two or three tight coils of the body, with the head positioned either on top, inside, or underneath the coils. For most of the time the long, slender tail protruded from the ball. One juvenile resumed body flattening after keeping the balling posture for 41 seconds. For the other two balling snakes, the posture persisted for more than one minute until the stimulus was terminated.



Figure 1. Antipredator responses of juvenile *Helicops angulatus* from Madre de Dios, Peru- **A.** Body flattening, **B.** Balling

Previously body flattening, striking and thrashing behaviour have been recorded as initial responses of *H. angulatus* when confronted by a terrestrial predator (Martins & Oliveira, 1998). However, during the current study balling was observed only after the tactile stimuli were continued for over 28 seconds. Balling is a behaviour displayed by various unrelated snake taxa, including boids (e.g. *Candoia aspera*, *Calabaria*, *Lichanura*, Bustard, 1969; *Eunectes*, Dirksen et al., 1998; *Tropidophis*, Hoefer et al., 2019), pythonids (*Python regius*, Schmidt & Inger, 1957), and colubrids (e.g., *Tretanorhinus variabilis*, Petzold, 1967; *Dipsas pratti*, Barros et al., 2012). The behaviour presumably functions to protect the vulnerable head (Dirksen et al., 1998). While some boids and pythonids perform balling so perfectly that the whole body forms a uniform sphere with the head completely concealed within it (Bustard, 1969), *H. angulatus* seemed to be less specialised since the 'ball' is rather cylindrical, and the head and tail remain relatively exposed. My observations suggest that balling is a last resort for both juvenile and adult *H. angulatus*, which is used only after the initial antipredator responses such as body flattening, striking, thrashing, or escaping have proved futile.

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Observations on the year-round communal use of an artificial structure by Northern Pacific rattlesnakes *Crotalus oreganus oreganus* in coastal Central California

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Communal gatherings of snakes have been recorded in temperate regions of the Northern Hemisphere, and species documented in such congregations include several species of *Crotalus* (Fitch, 1949; Hirth, 1966; Brown & Parker, 1976; Prior & Weatherhead, 1996). These congregations are typically observed in and around communal hibernacula, usually in high altitude or high latitude environments (Hamilton & Nowak, 2009). In these locations, seasonal climatic conditions are unfavourable for year-round snake activity so that hibernation is essential for some months of the year. Suitable hibernation sites are limited and as a consequence high densities of snakes may be observed in small areas (Drda, 1968; Klauber, 1997; Gienger & Beck, 2011). Such congregations dissipate during the active season as individuals disperse into different habitats to forage and reproduce (Fitch, 1949; Gannon & Secoy, 1985; Putman et al., 2013). While congregations during the active season are known for several species of snakes, these have been of gravid females in communal breeding sites (Graves & Duvall, 1995). Evidence of year-round communal living in snakes appears to be lacking.

Here, we report observations of a small group of Northern Pacific rattlesnakes (*Crotalus oreganus oreganus*) living communally throughout the year in an artificial pit in Central California. Our observations were made on the University of California Fort Ord Natural Reserve (FONR), located in Monterey County, California. The FONR is a protected research reserve built around the former Fort Ord Army Base and it harbours remnants of artificial structures related to past military activities. These wood and concrete structures are now broken down and covered in vegetation; they provide shelter for small animals.

While conducting herpetological surveys on the FONR on 8th April 2018, we observed two adult *C. o. oreganus* basking around the edges of a degraded concrete pit (36.6856° N, 121.7755° W; WGS 84). The entrance of the pit was covered by poison oak (*Toxicodendron diversilobum*). Subsequent observations in the following weeks found several individuals using the pit communally. From May, we conducted visual encounter surveys (VES) around the pit on a daily basis between 11:00 h and 14:00 h. We considered

marking individuals using a method such as painting of rattle segments (Putman et al., 2013) to document the number of rattlesnakes using the structure, but to avoid unnecessary handling we instead photographed the dorsum of all individuals encountered around the pit. By slowly approaching basking individuals from behind with a camera, we were able to photograph rattlesnakes from a safe distance. Photographs of dorsal patterns were sufficient to recognise individuals, as dorsal patterns of rattlesnakes have unique combinations of blotches varying in size and shape. We also recorded approximate snout-to-vent length (approx. SVL) for all identified individuals. In July, we installed a trail camera (Bushnell Corporation, USA) approximately four meters away from the pit entrance to observe rattlesnake behaviours in and around the pit with minimum disturbance. The camera was set to activate with the detection of movement and was retrieved after 10 days.

Throughout mid-April to late September, we identified at least eight different individuals using the pit through our VES (Fig. 1). These individuals varied in growth stage from neonate (~ 17 cm approx. SVL) to fully-grown adult (~ 85 cm approx. SVL). Both our VES and video recordings showed that rattlesnakes came out from the pit to bask from approximately 10:00 h to 13:00 h. During this time, the snakes were frequently observed basking on concrete surfaces of the pit with their bodies extended. No rattlesnakes were observed around the pit after 14:00 h. Although regular observations of this group ended by December 2018, the same snakes were observed again basking in April 2019, suggesting that this group is not an ephemeral congregation.

One possible explanation for this congregation is security of the pit. The pit had numerous cracks and holes, and we observed snakes readily retreating into these places. The poison oak brush covering the broad entrance of the pit from above may provide additional protection from aerial predators and other carnivores of the reserve. Snakes may potentially also use internal structures of the pit as a hibernaculum. Snakes often travel long distances to reach suitable hibernacula (Hirth et al., 1969; Brown & Parker, 1976; Brown et al., 1982) and can be exposed to predation during migration (Kingsbury & Coppola, 2000; Rudolph et al., 2007).

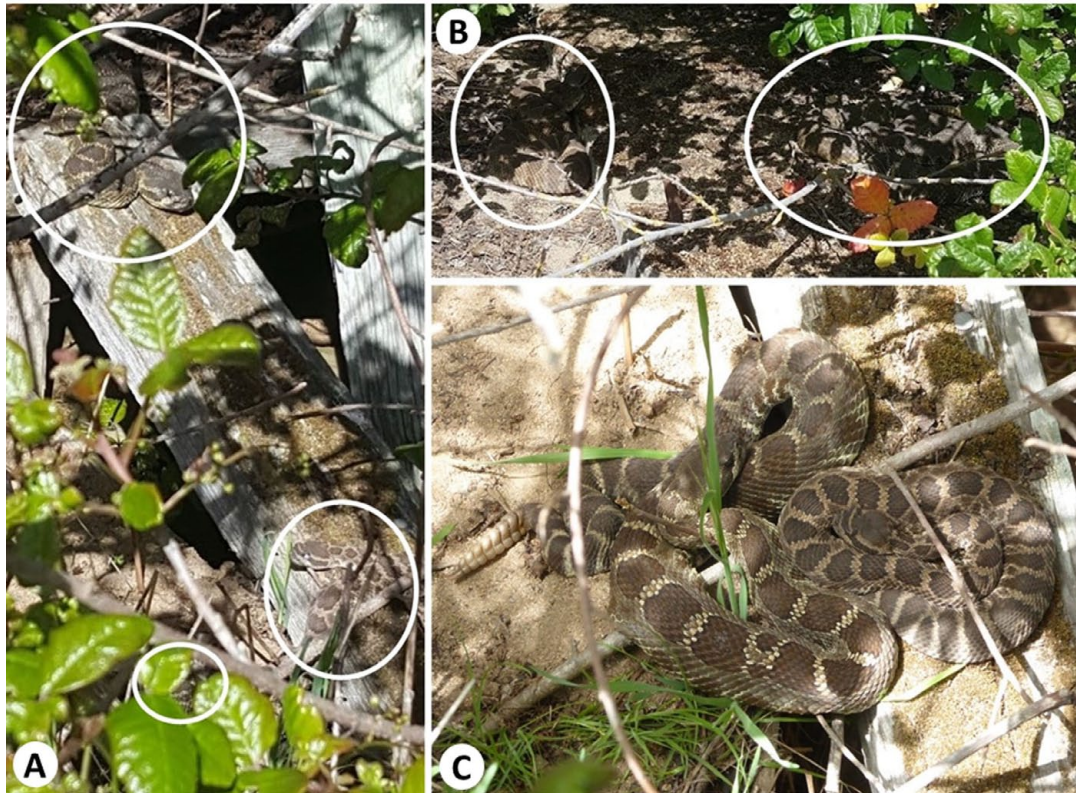


Figure 1. Communal use of man-made pit by *Crotalus oreganus oreganus* individuals of different ages – **A.** Three individuals of different ages basking together on 20th April 2018. Large adult (top), subadult (bottom left, hidden under leaves), and juvenile (bottom right), **B.** Two adults basking together on 18th June 2018, **C.** Subadult (left) and juvenile (right; same juvenile from A.) basking together on 28th April 2018.

If the pit provides both security and a suitable hibernaculum, the snakes can avoid unnecessary migration to hibernacula and risk of predation. However, we did not determine the extent of internal structuring of the pit or whether snakes actually use the pit as a hibernaculum, although this is highly likely.

Another potential explanation for the year-round congregation is the abundance of diverse food resources in the area. For example, through VES, video recordings, and separate faunal surveys of the FONR, we recorded eight species of rodents (*Chaetodipus californicus*, *Dipodomys heermanni*, *Neotoma fuscipes*, *Peromyscus californicus*, *P. maniculatus*, *P. truei*, *Reithrodontomys megalotis*, *Thomomys bottae*), one species of rabbit (*Sylvilagus bachmani*), and three species of lizards (*Elgaria multicarinata*, *Phrynosoma blainvillii*, *Sceloporus occidentalis*) in and near the pit. Regular monitoring of rodents in the shrublands directly adjacent to the pit yield approximately 20 rodents in a 0.25 ha area. Although we did not observe foraging near the pit, the diversity of prey items could benefit snakes across a range of growth stages.

Our observations indicate that *C. o. oreganus* may live communally throughout the year, given favourable conditions. Furthermore, to the best of our knowledge this report is the first to document year-long communal living in a rattlesnake species. Additional groups of *C. o. oreganus* living in similar conditions may be found with further surveys. Although our report is descriptive and limited to visual observations, detailed research using individual marking and radio telemetry may help to determine the stability of such

congregations and activity dynamics throughout the day and year.

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Aggressive interactions between a sand lizard *Lacerta agilis* and a common wall lizard *Podarcis muralis* in England

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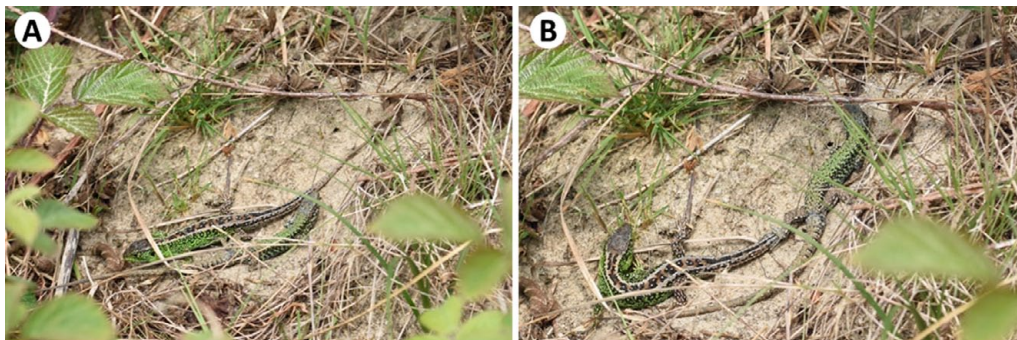
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In Germany, the native sand lizard (*Lacerta agilis*) and the invasive alien wall lizard (*Podarcis muralis*) have been observed to have strongly overlapping local distributions with a very high rate of overlap in substrate selection, especially between the males of the two species (Heym et al., 2013). However, interspecific interactions were apparently rare (mainly basking at a distance). Nevertheless, in England the native *L. agilis* has been observed to respond to the scent of *P. muralis* with direct aggression while in another native lizard species, *Zootoca vivipara*, the response was only avoidance (Williams et al., 2020).

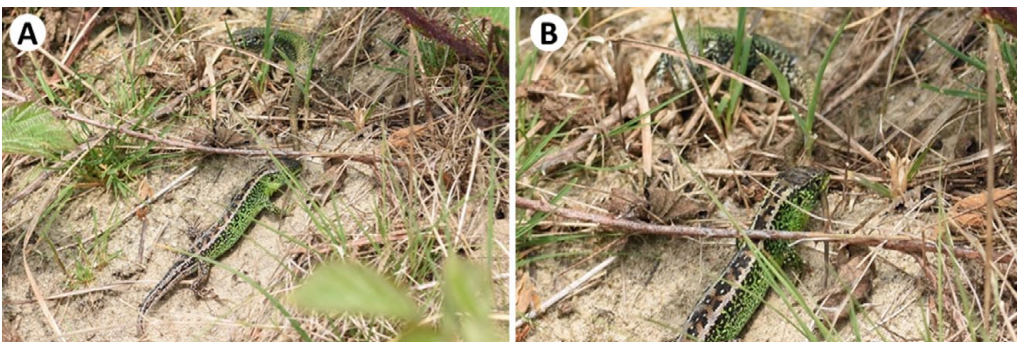
In Poole, Dorset (England) in one of the few areas where both *L. agilis* and the alien *P. muralis* can be observed in close proximity, I made further observations that confirm the aggressive responses between the two species. At around 13:00 h on 29th April 2019, I observed an adult, male wall lizard. It was basking on a low, sandy bank backed by cliffs adjacent to a busy footpath close to the sea, on a sandy area between the vegetation, facing slightly up the gradient

and away from the footpath. An adult, male sand lizard in breeding condition then approached the area from higher up the slope and slowly crawled alongside the wall lizard, close enough for the back legs of the two lizards to be in contact, the sand lizard facing down the slope towards the footpath (Fig. 1A). Almost at once the wall lizard began to move away, taking a couple of paces up the slope before stopping and turning its head to look in the direction of the new arrival. At this time the wall lizard was standing on the tail of the sand lizard. The sand lizard then turned towards the departing lizard which then moved off again a few centimetres up the slope (Fig. 1B).

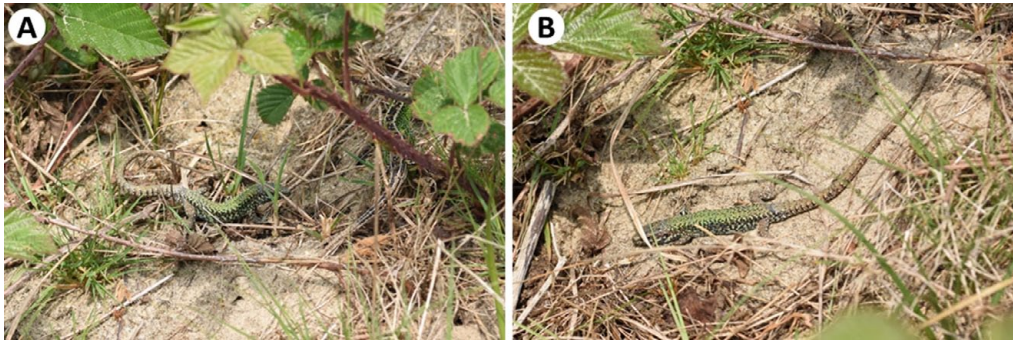
The sand lizard then followed after the wall lizard which was moving away slowly. The larger sand lizard then grasped the tail of the other lizard in its jaws, about 3 cm from the tail tip. The wall lizard continued on for another couple of paces and appeared to be dragging the sand lizard along behind it before turning back down the slope to face towards its attacker (Figs. 2A & B).



Figures 1A & B. Initial interactions between a male *L. agilis* and *P. muralis*- **A.** The male *L. agilis* has arrived to lie parallel to the basking *P. muralis*, **B.** The male *P. muralis* begins to move away



Figures 2A & B. Further interaction between the male *L. agilis* and *P. muralis*- **A.** The male *L. agilis* chases after the male *P. muralis* and grasps its tail, **B.** The male *P. muralis* turns to face the *L. agilis*



Figures 3A & B. Final interactions between the male *L. agilis* and *P. muralis* - **A.** The male *P. muralis* has lunged at the male *L. agilis* which is now in retreat and soon to disappear, **B.** The male *P. muralis* has now returned to its original basking spot and is basking

The wall lizard, with an open gape, then lunged towards the sand lizard which immediately released the tail and moved rapidly up the slope and away from the confrontation by 7 to 10 cm. The wall lizard inflated its body and slowly waved its tail from side to side whilst watching the departure of the sand lizard up the slope (Figs. 3A) and then out of view. Within a few seconds of this, the wall lizard had returned to the original basking spot, this time facing down the slope, towards the footpath (Fig. 3B).

Despite watching for a further ten minutes the male sand lizard was not seen again and the wall lizard remained, eyes closed, basking in the sunshine. It is clear from these observations that the males of the two species, in the breeding season, are aggressive towards each other and that at least in this case the wall lizard was able to defend its basking spot against significant aggression from a larger male sand lizard.

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Male combat in the striped kukri snake *Oligodon tenuis*

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The striped kukri snake *Oligodon tenuis* (Günther, 1861), is a relatively small (~450 mm), opisthoglyphous (rear-fanged) snake species which occurs in Thailand, Laos, Cambodia and southern Vietnam (Uetz, 2020), and one of several within the genus distributed throughout Asia. Although poorly documented in the literature, open-source observations of the species indicate similar natural history and habitat preferences to that of many other *Oligodon* species, whereby they have high tolerance for human disturbed habitats, roads, and agricultural areas, where they are typically found and recorded by citizen scientists (personal observation). There have only been two published records of intraspecific combat for an *Oligodon* sp. This was among Taiwanese kukri snakes (*Oligodon formosus*) where both males and females were defending their resources (sea turtle nests) (Huang et al., 2011 and male combat in *Oligodon fasciolatus* in Thailand (Ward, et al., 2021).

Here we describe an observation of the first recorded instance of combat between males in *Oligodon tenuis*, where the individuals are tightly wrapped in an attempt to subdue the other by keeping its head and weight on top (Fig. 1). Combat behaviours in snakes differ from mating behaviours, which have been described by the inclusion of hemipene insertion as well as “chin rubbing, body jerks or caudocephalic waves, cephalocaudal waves, tail searching, pushing, nudging, biting, and tail raising” (Carpenter, 1977). The individuals in Figure 1 are assumed to be males due to the tail length, which have been shown to be longer in males than in females of other *Oligodon* species (Vassilieva, 2015) and the visibility of the ventral scales which exhibit no protruding of, or insertion of, hemipenes. The individuals were photographed at approximately 10:00 h in a village area of Sanam Chai Ket district, Chachoengsao, Thailand (approx. 13° 68'32.7" N, 101° 67'07.7" E), elevation ~83 m, April 2003, in the back yard of a domestic residence.

Male-male combat in colubrid snakes has been shown to be an indicator that males are typically larger than females in a population, given that the larger of the two participants is usually considered the victor and best-fit mate (Shine, 1978; Shine et al., 1981). Intrasexual combat rituals support an evolutionary hypothesis of divergent traits in major snake families (Senter et al., 2014), and further information strengthens these hypotheses. There are really very few natural history observations for the majority of south-east Asian snake species and only a single previous



Figure 1. Two male *Oligodon tenuis* wrapped around each other in combat

record of intraspecific combat in an *Oligodon* species. This documentation contributes to filling gaps in the scarce knowledge of this data deficient species, and also to the growing body of data which supports the understanding and theory of evolution of courtship and combat in snakes

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First observation of male combat in the greater black krait *Bungarus niger*

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The greater black krait *Bungarus niger* Wall, 1908 (Serpentes: Elapidae) is a venomous snake distributed from north-east India, Nepal, Bhutan and Bangladesh to Myanmar (Whitaker & Captain, 2004; Leviton et al., 2008; Lalremsanga & Lalronunga, 2017; Uetz, 2020). It is easily identified by its coloration (iridescent black to dark chocolate dorsally and off-white ventrally) and presence of enlarged hexagonal vertebral scales (Whitaker & Captain, 2004). Little information is available on the natural history of *B. niger* especially its reproductive behaviour and no intraspecific competition had been recorded previously. Male combat has been observed and described in many species of snakes from different families, with varying rituals and behaviours (Shine, 1978; Senter et al., 2014) including the Malayan krait, *Bungarus candidus* (Shine, 1978). Herein, we report the first record of male combat behaviour in *B. niger*.

On the 2nd October 2017 at 13:53 h, we witnessed two adult male *B. niger* engaging in male combat (Fig. 1) near Lamchhip village, Aizawl District, Mizoram, north-east India (23° 26.497' N, 92° 47.114' E; 1,177 m asl). The snakes were caught in the act and the bout was observed for about 10 minutes, until they moved out of sight into a thicket along the road, continuing with the combat. The two snakes intertwined their bodies while moving forward (Fig. 1A - D), raised their head almost up to a fifth of their total length (Fig. 1D) and tried to push the head of the opponent to the ground (Fig. 1A - B). One male was observed biting the neck of its opponent (Fig. 1C), which is an apparently rare phenomenon in male combat (Senter et al., 2014).

During the encounter, no female was sighted nearby although this would be expected as male combat in snakes is normally associated with competition to mate with a

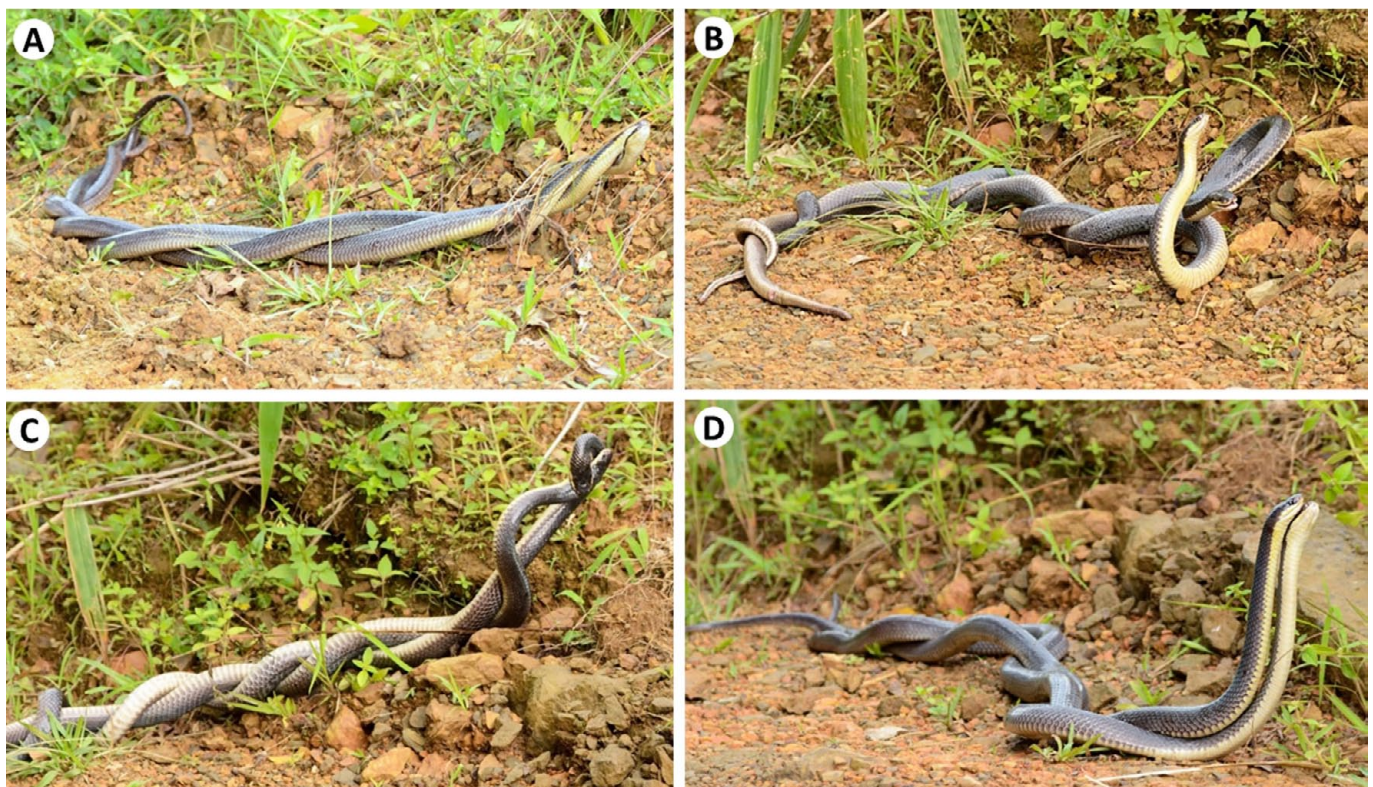


Figure 1. A sequence of photos of male combat in *Bungarus niger*

female. It seems likely that in this case the female remained hidden in the adjacent vegetation. As to the fate of the male that was bitten on the neck, we do not know if it suffered any ill effects. It is believed that venomous species are less susceptible to their own venom but are not completely resistant to it, a recent report of a lethal self-inflicted bite in the case of the lesser black krait *Bungarus lividus* is a case in point (Purkayastha et al., 2021).

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A tree frog *Scinax perereca* predated by a wandering spider *Phoneutria keyserlingi* in Brazil

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Amphibians are an important component of food chains in natural ecosystems (Wells, 2007; Haddad et al., 2008). They are preyed upon by a large variety of taxa both vertebrates and invertebrates such as ants, beetles, crabs and spiders (Duellman & Trueb, 1994; Toledo, 2005; Toledo et al., 2007). Spiders of several families have been recorded as anuran predators (Menin et al., 2005) and we present here the first report of the spider *Phoneutria keyserlingi* Perty, 1833 (Araneae, Ctenidae) preying upon the tree frog *Scinax perereca* Pombal, Haddad & Kasahara, 1995 (Anura, Hylidae).

Scinax perereca ranges from São Paulo to Rio Grande do Sul states in Brazil, north-eastern Misiones Province in Argentina to southern Paraguay (Frost, 2020; Aquino et al., 2004). It inhabits forests and forest edges between 0 to 1,000 m asl, where it reproduces in temporary or permanent pools and is also commonly observed sheltered in human habitations (Aquino et al., 2004; Pombal et al., 1995). *Phoneutria keyserlingi* is a wandering spider from the Atlantic Forest distributed on the coastal regions of São Paulo, Rio de Janeiro, Paraná and Santa Catarina states in Brazil (Martins & Bertani, 2007).

Our field observations were made on 25th July 2011 at 18:50 h, at Ponta-do-Araçá Environmental Protected Area, municipality of Porto Belo, Santa Catarina state, southern Brazil (27° 07'21.10" S; 48° 30'53.30" W; 70 m asl). We observed a spider (*P. keyserlingi*) that had grasped a tree frog (*S. perereca*) dorsally with its chelicerae in a bromeliad on a tree (Fig. 1), a few meters from a small lake surrounded by secondary growth tropical moist forest. The observation lasted a few minutes, but neither the spider nor the tree frog were collected.

Leaf litter anurans can be a potential prey to ground-dwelling spiders, especially from the families Ctenidae and Pisauridae (Menin et al., 2005). There are at least five published reports of anuran predation by ctenid spiders of the genus *Phoneutria* relating to *Phoneutria nigriventer*, for example Folly et al. (2017). Since the current predation event occurred in a bromeliad at approximately 2 m above the ground, it must be the case that tree frogs such as *S. perereca* are part of the diet of wandering spiders when they are foraging above the forest floor.



Figure 1. Predation of the tree frog *Scinax perereca* by the spider *Phoneutria keyserlingi* in a bromeliad

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A case of facultative aggregation in the oriental garden lizard *Calotes cf. versicolor* Daudin, 1802 (Squamata: Agamidae)

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The evolution of sociality in animals has long fascinated biologists (Wilson, 1975). The simple act of initiating and maintaining contact with conspecifics may have been a precursor of complex social behaviours (Rabosky et al., 2012). There have been a significant number of longstanding studies on the evolution of social behaviours among birds, mammals, and certain insect orders (Wilson, 1975) while for reptiles such studies are much more recent (Graves & Duvall, 1995; Gardner et al., 2015; Whiting & While, 2017).

Over 94 species of reptiles belonging to 22 families are reported to show some form of aggregation or group living (Gardner et al., 2015). This number constitutes a minute proportion of the 9000+ extant species of reptiles. Aggregations are defined as “a group of conspecifics, composed of more than just a mated pair or a family, gathered in the same place but not intentionally organised or engaged in cooperative behaviour” (Wilson, 1975).

Here, we report an aggregation of *Calotes cf. versicolor* (Daudin, 1802) in Bolpur, Birbhum district, West Bengal state, India. On 12th December 2011, 11:00 h, an individual was spotted basking just outside a tree hole; subsequently, a second individual was seen emerging and a close-up photograph revealed the presence of a third individual inside the same tree hole (Fig. 1).

The individuals were provisionally identified as *Calotes cf. versicolor* by observing the laterally compressed body, distinctly keeled dorsal scales pointing backwards and upwards, absence of fold or groove in front of the shoulder, a continuous nuchal and dorsal crest, and two well-separated supratympanic spines (see Smith, 1935). Furthermore, we suspect one of the individuals to be an adult female based on the following secondary sexual characters - shorter nuchal and dorsal spines than males, absence of gular sacs, dorsum with dark crossbars on the lateral sides, and paired light yellow dorsolateral stripes running along the body length. (Pal et al., 2018; Smith, 1935). The sex of the other two individuals could not be determined.

Refuge sharing is particularly interesting as *C. versicolor* is popularly known to show agonistic behaviour towards conspecifics; adult male-male fights are common, and female-female aggression has also been observed in juveniles (Pandav et al., 2007; Ammanna et al., 2013; Ammanna, 2015; Barnes & Tipprapatkul, 2019). However, a “dear enemy” phenomenon was suggested by Ammanna et al. (2013) based on their intraspecific interaction studies on



Figure 1. Three *Calotes cf. versicolor* sharing a hollow in a tree - **A.** Female basking on the trunk, a second individual coming out of the hollow and a third individual within the hollow (indicated by white arrow) **B.** Close up of the tree cavity showing the second individual and a third individual (indicated by white arrow)

captive specimens. They reveal the presence of differential aggression towards familiar and non-familiar conspecifics, where the specimens showed reduced aggression towards familiar individuals and the familiarity dissipated after 30 days of physical separation. While this may have led to the mutual tolerance between the three individuals reported in this article, the cause for the aggregation in the tree hole may be associated with thermoregulation and predator avoidance. The average temperature in Bolpur during the winter months is around 15 °C with night time temperatures dropping well below that (Nandi et al., 2001). In such situations, the tree cavity provides relatively insulated protection from low temperatures, high winds, and predators when compared to their general nocturnal habit of sleeping exposed on plants and trees with the body pressed against the substratum (Khan & Mahmood, 2004). A congregation in reptiles may also augment inclusive fitness by increased warmth and protection from predators (Graves & Duvall, 1995).

The extent of such aggregations and conspecific tolerance in *C. versicolor* and allied taxa remains unexplored. Questions on the proximate causes and benefits of such aggregations in terms of collective fitness should be investigated using experimental studies.

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Apparent parental care in the slow worm *Anguis fragilis*

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The slow worm (*Anguis fragilis*) is a limbless anguid lizard native to Great Britain. This semi-fossorial lizard has a wide distribution across Europe and can be found in a variety of habitats with a preference for high levels of ground cover, where for most of the time it remains hidden in thick vegetation or underground (Beebee & Griffiths, 2000). While *A. fragilis* is possibly the most commonly encountered native reptile in Britain, and many aspects of slow worm biology are understood, their cryptic habits make them difficult to study. Much of what is known about slow worm behavioural ecology comes from observations associated with artificial cover objects (refuges) commonly utilised in reptile surveys (McInerny & Minting, 2016). Communal basking and hibernation assemblies involving multiple age groups of slow worms entwined together have been recorded underneath refuges, with other reptile species also regularly present (Wareham, 2008; McInerny, 2017). How the individual slow worms are related to one another in these assemblages is usually not known and the genetic tools required to create such pedigrees are usually beyond the scope of most reptile surveys. It would be logical to assume that in a species with limited dispersal capacity and small home ranges, as is the case with *A. fragilis*, many of the individuals seen together would be closely related. Therefore, it is not unreasonable to make inferences on their behaviour based on this assumption.

Evidence of parental care in *A. fragilis* is lacking but it is known in other anguid lizard species, with some oviparous species exhibiting clutch guarding behaviours and subsequent attendance of neonates (Greene et al., 2006). Previous observations of captive *A. fragilis* females suggest they may actively attend their young, but do not exclude the possibility that observations come from passive sharing of refuges (Greene et al., 2006). McInerny and Minting (2016) suggest that postpartum care in slow worms is limited with neonates moving away from the natal site quickly after birth.

Here we report on an observation that may constitute an incidence of parental care in slow worms. At 09:43 h on 27th August 2020 two adult female *A. fragilis* (TL ~24 cm and ~25.5 cm) and five neonates were found under a metal survey refuge during a search for survivors after a wildfire on Chobham Common NNR, Surrey, (GPS: 51° 23'13" N 00° 36'58" W). On initial discovery, the lizards were sheltering communally, with some individuals clustered together and overlying, with others separate from this group. All lizards under this refuge were collected into a plastic box (Fig. 1)



Figure 1. Two adult female and five neonate *Anguis fragilis* collected from under a refuge after a wildfire



Figure 2. One adult female *Anguis fragilis* coiling around one subadult and four neonates approximately 30 minutes after collection

with a cloth bag placed over the top to reduce stress. An additional subadult female slow worm (TL ~17 cm) was also rescued from a separate refuge and added to the box. At 10:16 h the cloth bag was removed for release, revealing an adult female *A. fragilis* coiled up with four of the neonates and the subadult (Fig. 2). The larger adult female and the fifth juvenile were separate from the coiled group and remained motionless upon removal of the cover. Shortly after the photograph was taken the subadult female left the coiled group. For more details see our video (BHS video, 2021).

Whilst communal sharing of refuges has been recorded (Wareham, 2008), parental care in wild *A. fragilis* has not been previously documented. In England, captive females have been known to have coiled with their young in a hollow on the day of birth (Anne Riddell, pers. comm.) and "...tended to be scattered under the refuges and rarely coiled up together" (Greene et al., 2006). To our knowledge this is the first observation of wild *A. fragilis* displaying a behaviour akin to juvenile defence, based on the assumption that the adult female is the mother of the juveniles.

The response of these slow worms to capture raises interesting questions on the role pheromone release may play in eliciting the defensive coiling behaviour seen. Conversely, it is also debatable that proximity may play a greater role in attracting members of a defensive coil during a stress event. That a subadult individual, with an unknown relationship to the assumed parent-neonate grouping, also formed part of the coil also raises interesting questions given that one neonate did not join the coil or, at least, was triggered to abandon the coil upon disturbance associated with removing the cloth bag cover. Kin recognition through olfactory cues is known between common lizard, *Zootoca vivipara*, mothers and their offspring (Léna & de Fraipont, 1998) and male slow worms have been shown to discriminate between conspecific male and female scents (Gonzalo et al., 2004). The observation could also be attributed to thigmotactic behaviour, where the slow worms may simply have wrapped around each other for stability due to the lack of suitable substrate in the plastic container. Further investigation is needed to assess parental care, defensive behaviours, and kin recognition in *A. fragilis*.

While this observation does not definitively provide a record of parental care in *A. fragilis*, it does corroborate previous observations by Anne Riddell and provides evidence for our suggestion that slow worms engage in altruistic defensive behaviours. It is also likely that this defensive coiling behaviour occurs at much greater frequencies but has gone unnoticed. At its most basic, this report should encourage debate and adds to the limited knowledge on the behavioural ecology of slow worms.

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A case of kyphosis in adult male Cyren's rock lizard *Iberolacerta cyreni*

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Vertebral malformations have been reported previously from a wide range of reptile taxa. Kyphosis refers to an abnormally excessive convex curvature of the spine in the thoracic and sacral regions, while if the deviation affects the lateral plane of the spinal column, the condition is known as scoliosis. In some cases, these two types of malformation can be combined in the same animal, known as kyphoscoliosis (Garín-Barrio et al., 2011). It appears that kyphosis mainly affects species adapted to aquatic environments (e.g. turtles and crocodiles; Tucker, 1997; Boede & Sogbe, 2000; Tucker et al., 2007), while scoliosis is more common in terrestrial species (snakes and lizards; Grogan, 1976; Simbotwe, 1983; Frutos et al., 2006). Reports of kyphosis (and kyphoscoliosis) from wild lizard populations have increased lately (e.g. *Liolaemus koslowskyi* (Iguanidae) Avila et al. (2013); *Sceloporus torquatus* (Phrynosomatidae) Pérez-Delgadillo et al. (2015); *Norops sericeus* (Dactyloidae) Domínguez-De la Riva and Carbajal-Márquez (2016); *Sceloporus vandenburgianus* (Phrynosomatidae) Valdez-Villavicencio et al., (2016); *Stenocercus guentheri* (Tropiduridae) Ramírez-Jaramillo, (2018); *Marisora brachypoda* (Scinidae) Arrivillaga & Brown, (2019)).

Cyren's rock lizard *Iberolacerta cyreni* (Müller & Hellmich, 1937) is a medium-sized lacertid (average male snout-vent length = 73-80 mm, Martín 2015), distributed along the mountain ranges of Sierra de Guadarrama, Sierra de Gredos and Sierra de Béjar in the Iberian Peninsula (Almeida et al., 2002; Arribas, 2010), where it is restricted to subalpine-alpine habitats (1760 - 2500 m asl) characterised by high cover of granite rocks (Monasterio et al., 2010).

On 4 June 2014, we noosed an adult male individual at the 'Alto del Telégrafo' peak (Sierra de Guadarrama, Madrid Prov., Central Spain, 40° 47' N, 04° 01' W) at an elevation of 1900 m asl. The lizard had vertical curvature of six vertebrae, two behind the head in the thoracic region, one over the pelvic girdle and three along the base of the tail (Fig. 1). Regarding the exact origin of the spine abnormality in this specimen, we could only speculate. According to Martínez-Silvestre et al. (1997) exposure to chemical agents, such as herbicides, may result in spinal malformations and in two reports of kyphosis agrochemicals have been invoked as the causative agents (Pérez-Delgadillo et al., 2015; Ramírez-Jaramillo, 2018). Here,

it is unlikely that the malformation was induced by chemical contamination. Environmental effects such as abnormal incubation temperature, embryonic anoxia, excessive relative humidity, desiccation or dehydration of the egg, problems of yolk retraction/ premature fusion of the shell, insufficient nutrients in embryonic development or metabolic bone disease are more plausible (see Martínez-Silvestre et al., 1997; Mader, 2006; Idrisova, 2018; DiGeronimo & Brandão, 2019). However, the habitat of the population of origin is affected by anthropogenic-induced habitat deterioration (i.e. construction of ski infrastructures), which could have a negative effect on body condition of lizards (Amo et al., 2007). Nevertheless, the potential effects of such human activities on embryonic development are yet to be explored in this population.



Figure 1. Kyphotic adult male *Iberolacerta cyreni* captured at the Alto del Telégrafo (Sierra de Guadarrama, Madrid Prov., Spain)

It is of interest to consider the impact of such a potentially damaging malformation as kyphosis on the lives of lizards. It has been suggested that the generally low prevalence of kyphosis in natural populations may be the outcome of increased mortality rate of affected individuals (Garín-Barrio et al., 2011). On the other hand, in a substantial number of reports the authors mention no negative effects of kyphosis on foraging and mobility (see Martínez-Silvestre et al., 1997; Garín-Barrio et al., 2011; Avila et al., 2013; Pérez-Delgadillo et al., 2015; Domínguez-De la Riva & Carbajal-Márquez, 2016;

Valdez-Villavicencio et al., 2016), suggesting that it might not reduce the chance of survival of affected individuals. Further, Mitchell and Johnston (2014) showed that the growth pattern of a Florida chicken turtle (*Deirochelys reticularia chrysea*) with kyphoscoliosis did not differ from that of individuals of the same population with no abnormalities. Our specimen clearly had adult coloration and did not show any sign of malnutrition. As its malformation apparently had no, or limited, effect on its locomotion during a few days of captivity, we released it at the original capture site.

In summary, this is the first reported occurrence of vertebral malformations in the genus *Iberolacerta*. Reports of kyphotic cases from the wild are increasing in a wide range of lizard genera, consequently, future research should investigate the potential links between anthropogenic activities (e.g. use of agrochemicals, habitat deterioration) and such vertebral malformations. Also, we still have limited knowledge on the long-term survival and reproductive outcome of individuals with kyphosis.

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First record of male combat in *Oligodon fasciolatus*

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The banded kukri snake (*Oligodon fasciolatus*) is a primarily nocturnal, terrestrial species that reaches a maximum length of 920 mm in males and 863 mm in females. It is typically grey in colour but may vary from red to brown. Encountered throughout mainland south-east Asia, this species is a habitat generalist being found in agricultural landscapes and tropical forests up to 900 m asl (Cox et al., 2012). *Oligodon* species possess enlarged posterior maxillary teeth that evolved to slice through a specialised diet of frogs and reptile eggs. This dentition results in bites that are characterised by deep, clean, bloody wounds.

Herein we present only the second report of combat between males in the genus *Oligodon*; with a historic report in *Oligodon taeniatus* recently being uncovered (Gray, 2021). During a herpetofaunal survey on the 26th December 2018 in Sakaerat Biosphere Reserve, Nakhon Ratchasima, Thailand (14.5025° N, 101.9248° E, Datum 47P, 511 m asl), we observed two adult male *O. fasciolatus* engaged in combat; shown in our photographs (Figs. 1 & 2) and our video (BHS video, 2021). The snakes were 5 m from the road within dry evergreen forest, consisting of little ground vegetation and a thick layer of dry fallen leaves. The battle occurred just after sunset (17:50 h), with an ambient temperature of 25 °C and 72 % relative humidity.



Figure 1. Two male *Oligodon fasciolatus* engaged in combat, exhibiting mounting behaviour

The authors' attention was first drawn to the snakes by the rustling of dry leaves as they fought. Combat continued as the presence of observers was ignored. The battle was characterised by raised heads and coiling around each other



Figure 2. The posteriors of two male *Oligodon fasciolatus* tightly entwined during combat

with their posteriors tightly entwined (Fig 2). From here each snake attempted to mount and press downward on the other with its head and neck (Fig 1). All movement was slow and graceful until one became pinned, where it would quickly jerk its head to the side to get free. This sequence of behaviour continued with the position of dominance switching between the two males. Combat continued until 18:10 h, where they broke apart and moved in different directions, with no sign of an apparent winner. Both specimens were caught and processed using isoflurane anaesthesia via inhalation and then released back to their place of capture within 24 h, permitted under: National Research Council of Thailand 110/61. Both individuals were probed and confirmed to be male, with a total length of 858 mm, 189.7 g (grey male) and 839 mm, 171.7 g (red male).

Although biting is common in the male combat of many non-venomous snake species, no bite wounds were observed nor found when the males were examined. An explanation for this may be attributed to the trauma inflicted from bites of this species. As with male combat in venomous species, the males may not be trying to incapacitate their opponent, just show dominance in intrasexual competition (Shine, 1994). This contrasts to intraspecific territorial behaviour over turtle nest food resources, where Huang et al. (2011) observed biting between *Oligodon formosanus*.

Intraspecific male combat in Old World colubrids has rarely been observed, particularly never in a small bodied semi-fossorial species. Shine (1978, 1994) predicted that in

all snakes where males grow larger than females, there will prove to be competitive interactions between reproductive males. This observation provides additional evidence for this prediction as male *O. fasciolatus* grow ~7 % larger than females. This observation contributes to the growing body of knowledge that male combat occurs in a greater number of snake species than previously thought, furthering our knowledge of the evolution of courtship and combat in snakes, with particular attention to its presence and rarity in smaller taxa (Senter et al., 2014).

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First report of albino green toads *Bufo viridis* in Greece

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The green toad, *Bufo viridis* (Laurenti, 1768) (Anura: Bufonidae) is a medium-sized toad, with pale white, grey or brownish background colour, randomly covered with green patches, resulting in a camouflage pattern. Red or orange warts might be scattered on the dorsal area, whereas the ventral side is pale, whitish and patternless (Arnold & Ovenden, 2002). The green toad is a common species on the Greek mainland (Valakos et al., 2008), although in some cases insular populations can be seriously threatened (e.g. Strachinis & Artavanis, 2017). Three different subspecies of green toad are currently recognised in Greece, with the nominate one occurring on the mainland and the Peloponnese (Dufresnes et al., 2020). Hitherto, no cases of albinism in green toads have been documented from Greece, and only a few cases are reported from the rest of the species' range (i.e. Flindt, 1985; Andrä, 2011; Lunghi et al., 2017). In this note we present the first records of albino green toads from Greece.

On 4th July 2019, in an urban park in the center of Kalamata city, Peloponnese (southern Greece), we spotted two albino green toad tadpoles amongst hundreds of typical ones, inside a fountain (the exact location is withheld to protect this population). As the fountain was soon to be drained for annual maintenance, we captured the two albino tadpoles and then in captivity raised them to adults. The captive tadpoles successfully metamorphosed after 50

days and were fully functional after one and a half year of growth, showing no other malformations. Their main dorsal colour was yellowish to light orange with scattered red spots on warts, and their irises were red. The ventral area was whitish, patternless and spotless (Fig. 1A). In due course they were deposited in the Natural History Museum of Crete.

On a second visit to the urban park in 19th June 2020, but inside another fountain near the first one, found 14 albino tadpoles forming a separate cluster (Fig. 1B) among hundreds of typical green toad tadpoles. It has been shown that albino tadpoles face a high rate of predation (Childs, 1953), which can explain the rarity of this phenotype in the wild (Escoriza, 2012). Since it appears that there are no serious tadpole predators in the urban park, which is surrounded by several city blocks, it seems quite possible that albino tadpoles and metamorphosed toads benefit from a scarcity of predators. However, a survey during the green toad's breeding season is needed to determine whether there are any albino adults in the area or whether albino tadpoles are exclusively the progeny of normal coloured parents that are heterozygous for albinism.

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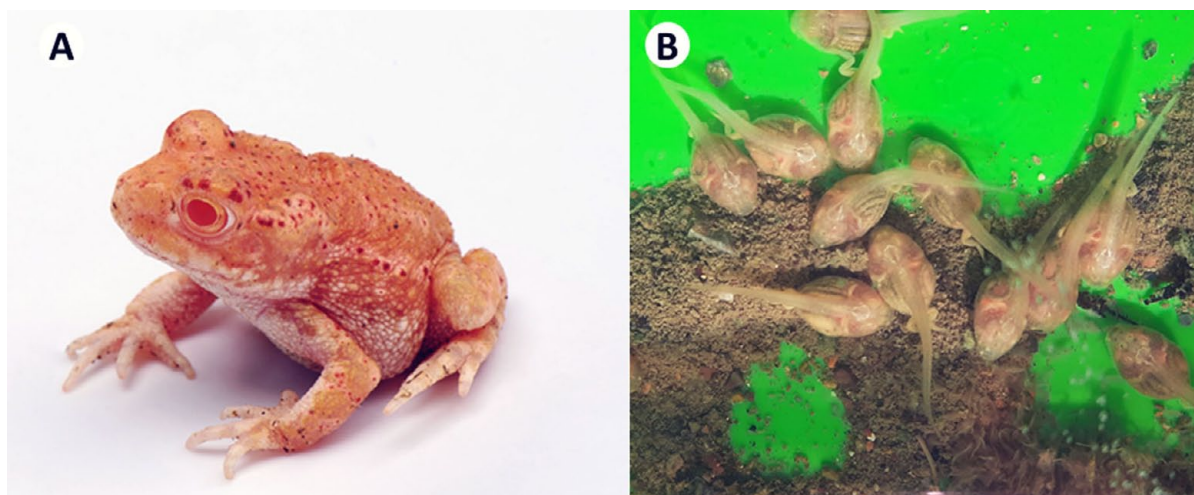


Figure 1. Albino green toads *Bufo viridis* – **A.** Juvenile toad that metamorphosed in captivity from a tadpole collected from a fountain in an urban park in July 2019, **B.** Albino tadpoles photographed in June 2020 in the same urban park but in a different fountain

taken in his photographic studio and Stephen Roussos for a pre-peer review of the manuscript. Animals were collected under the addendum of 18th February 1981 of the Greek Presidential Decree no. 67 (Official Government Gazette 23/A/30-1-81, "On the protection of wild flora and fauna and the determination of the procedure of coordination and control of research"), regarding domestic institutions' research.

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Range extension of the Munchique rufous lancehead *Bothrocophias colombianus* in Colombia

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The South American pitvipers of the genus *Bothrocophias* are corpulent, moderate-sized snakes with non-prehensile tails, mainly terrestrial and active at night and twilight. They are associated with primary forests, mature secondary forests and are frequently found in riparian forests. They feed mainly on rodents, although lizards, caecilians, frogs and even other snakes are also included in their diet (Wüster et al., 2002; Campbell & Lamar, 2004; Cisneros-Heredia et al., 2006; Rojas-Rivera et al., 2013). The highest species richness of *Bothrocophias* is found in Colombia, where 5 of the 7 currently recognised species occur (Uetz et al., 2020), of which *Bothrocophias myersi* and *Bothrocophias colombianus* (Rendahl & Vestergren, 1940) are endemic and only known from a few localities in the Colombian Pacific region. These are thus the most geographically restricted species within the genus (Campbell & Lamar, 2004; Castro et al., 2005).

The Munchique rufous lancehead *B. colombianus* is distributed along the western slopes of Cordillera Occidental in Colombia between 800-2300 m, in the municipality of El Tambo, department of Cauca, inside the protected area and buffer zones of Parque Nacional Natural Munchique and in surrounding areas, such as Reserva Natural Tambito (Rendahl & Vestergren, 1941; Castro et al., 2005; Ayerbe-González et al., 2007; Folleco-Fernández, 2010). In that area, the species has been reported as common and relatively abundant (Vera-Pérez et al., 2018). Here we add a new locality of the species in the Colombian Pacific region (Fig. 1), which represents a significant expansion of its geographical range.

Bothrocophias colombianus in the department of Risaralda

On 25th November 2015 an adult individual of *B. colombianus* (Fig. 2) was collected by Juan Camilo Mantilla-Castaño. This was during a herpetological study using the Visual Encounter Surveys method (VES) (Crump & Scott, 1994) in the Área de Manejo Especial Étnico Alto de Amurrapá, Santa Cecilia township, municipality of Pueblo Rico, department of Risaralda, Colombia (5° 18'43.50" N, 76° 9'22.84" W, 1233 m a.s.l.). The snake was found at night (18:55 h) on the leaf litter 1 m away from a slowly flowing body of water. The specimen was stored at the zoological collection of Corporación Universitaria de Santa Rosa de Cabal, where it was catalogued with the code CUS-R 0092.

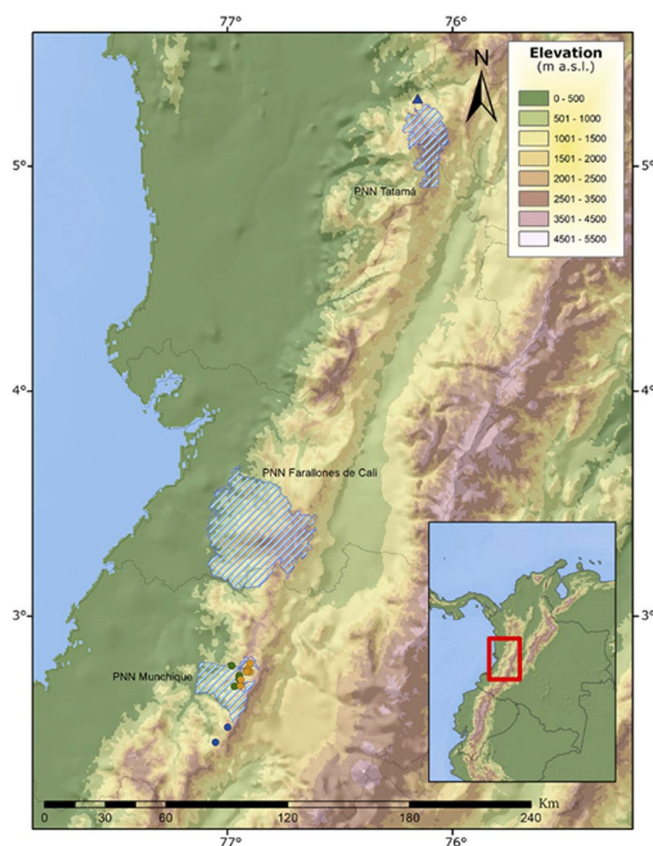


Figure 1. Geographic distribution of *Bothrocophias colombianus* in Colombia. Dots indicate previous records from the department of Cauca; triangle indicates the new record from the department of Risaralda. Green symbols are records inside protected areas (hatched areas), orange symbols are from buffer zones, blue symbols are from surrounding areas

Species Identification

Under unknown circumstances, the specimen CUS-R 0092 disappeared from the herpetological collection where it was deposited, so a complete review of it was not possible. Species identification is based on some data obtained after the snake was euthanised, as well as on the photographic record, taking as references the original description by Rendahl & Vestergren (1940) complemented by Campbell & Lamar (2004). The specimen CUS-R 0092 was identified as *B. colombianus* according to the following characteristics: adult, robust body, dorsal scales with tubercular keels in 25 rows



Figure 2. *Bothrocophias colombianus* from Risaralda, Colombia (CUS-R 0092) in life

at midbody, non-prehensile tail; canthals 1/1, canthorostrals absent, labials separated from loreal pit (lacunolabial absent); ventrals 170, subcaudals divided; black postorbital stripe, white edged, as are some other dark spots or blotches on the lateral and ventral surfaces of the head; dorsal ground colour grey, with dark brown to reddish lateral triangles with grey centers, black bordered followed by whitish borders that are more conspicuous on the posterior triangles, and, a reddish vertebral stripe, more noticeable from midbody (Fig. 2).

This record of *B. colombianus* extends the geographical distribution of the species northwards by about 289 km in a straight line from El Rosal sector, Parque Nacional Natural Munchique, municipality of El Tambo, department of Cauca, to Santa Cecilia township, municipality of Pueblo Rico, department of Risaralda (Fig. 1). This species was hitherto considered to have a very restricted distribution (Campbell & Lamar, 2004; Castro et al., 2005; Folleco-Fernández, 2010), covering less than 38 km in a straight line between the northern and southernmost localities. Its distribution range is now increased to around 333 km, and it seems likely that the species may occur in other localities in the Pacific region of Colombia, among the departments of Cauca, Valle del Cauca, Chocó and Risaralda, and even in adjacent departments such as Nariño and Antioquia.

The extension in the geographic distribution of this Colombian endemic pitviper, added to the fact that most of its records correspond to localities within or near protected areas, are important aspects to take into account for a future evaluation of its conservation status. Likewise, a redescription of *B. colombianus* is necessary, since most diagnostic characters are based on only three specimens (Campbell & Lamar, 2004), therefore very little is known about its intraspecific variation. Several specimens collected in the region where its type locality is assumed are available at Museo de Historia Natural of the Universidad del Cauca, in Popayán, Colombia. However, the specimen CUS-R 0092 is the only one known outside the municipality of El Tambo, so, although its characteristics do not seem to differ from what is known for the species, a detailed review of it will be essential. We hope that this specimen will reappear soon, but above all, that the responsible entity will carry out an investigation of this fact, taking measures to ensure that it does not happen again.

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We thank Sonia Cortés, Henry Mosquera, Yolanda Maturana and Iván Pareja for their contributions and support in the field work. To Corporación Autónoma Regional de Risaralda (CARDER) for the institutional agreement with Corporación Universitaria de Santa Rosa de Cabal, from which the collection permit was obtained.

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New locality records of the Mixteca cloud forest tree frog *Charadrahyla sakbah* from Guerrero, Mexico

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Hylid frogs are among the most studied anurans of Middle America, and yet basic knowledge beyond original descriptions on many species is scarce or non-existent. The Sierra Madre del Sur of Guerrero and Oaxaca is one of the most diverse regions of Mexico, and harbours as many as 99 species of amphibians, of which 36 are hylids and 20 of them are restricted to that region (Mata-Silva et al., 2015; Palacios-Aguilar & Flores-Villela, 2018). Recently, a new species of hylid frog, *Charadrahyla sakbah* Jiménez-Arcos, Calzada-Arciniega, Alfaro-Juantorena, Vázquez-Reyes, Blair & Parra-Olea (2019) was described from the cloud forests of western Oaxaca. Here we present the first records of this species in the state of Guerrero, Mexico.

On 21st April 2018 during an environmental impact survey a subadult female of *C. sakbah* (Museo de Zoología, Facultad de Ciencias, UNAM [MZFC] 35630) was collected inside a bromeliad on a pine tree in a ravine near La Sabana, municipality of Tlacoapa, Guerrero, Mexico (17.29685°N, -98.71607°W; 2121 m). This locality extends the known distribution of the species 101 km west of the nearest record at Río Chite Ku'e (Río de las Mil Cascadas), San Isidro Paz y Progreso, Oaxaca, the type locality of the species (Jiménez-Arcos et al., 2019).

Two inactive subadults of *C. sakbah* (MZFC 35633–634; Fig. 1) were collected on boulders from Arroyo Totoapa, between Chilmixtla and Los Mesones, municipality of Atlixac, Guerrero, Mexico (17.54415° N, -98.89146° W; 1760 m), on 29th December 2019 between 10:00–13:00 h. This locality is 129 km west-north-west from the type locality and 34.5 km north-west from the Tlacoapa record reported herein. Additional specimens (University of Texas at Arlington [UTA-A] 54815, and MZFC 16897) from "120 km by road E Chilpancingo, stream jct W of Mezones (17.54783° N, -98.899° W; 1795 m)" have been reported by Campbell et al. (2009) as *Charadrahyla trux* but not plotted on their map. This locality is approximately 1 km west from our records from Arroyo Totoapa and the specimens are metamorphosing young.



Figure 1. Subadult specimen of *Charadrahyla sakbah* from Arroyo Totoapa, Atlixac, Guerrero, Mexico in life (MZFC 35634)

The specimens reported herein were identified as *C. sakbah* by the presence of axillary membranes, conical tubercles on the sides of the cloaca, white ventral coloration, and banded limbs (see Campbell et al., 2009 and Jiménez-Arcos et al., 2019 for comparative tables for the genus).

With the additional records herein, the distributional range of *C. sakbah* has been increased greatly (Fig. 2). The species is now known from the eastern portion of the Sierra Madre del Sur of Guerrero, westwards to Santiago Yosondúa, Oaxaca (Mata-Silva et al., 2019; MZFC 34760, 34807–34808), in an altitudinal range of 1390–2120 m a.s.l. It is likely that the species' distribution is restricted to the west of Atlixac, Guerrero by several semi-arid valleys covered by tropical deciduous forest and to the east of Yosondúa, Oaxaca by the tributaries of the Río Verde (Fig. 2). The known localities of *C. sakbah* and *C. trux* are separated by ca. 110 km, and although it is likely that the geographic range of both species might be expanded towards the west and east respectively,

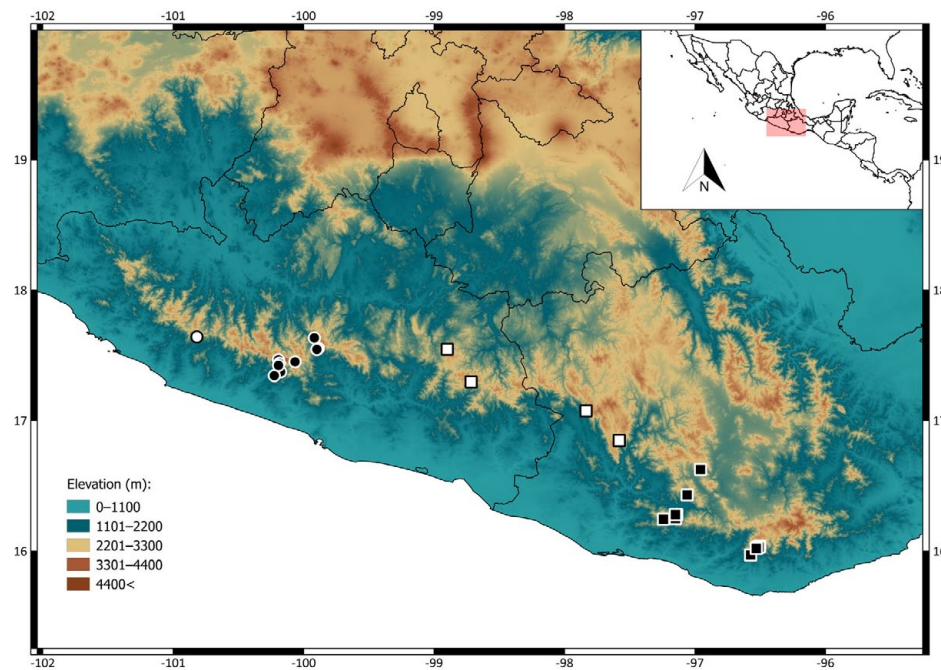


Figure 2. Distribution of the 'large-bodied' species of the genus *Charadrahyla* in the Pacific versant of the Sierra Madre del Sur. Open circle- *C. tecuani*; closed circles- *C. trux*; open squares- *C. sakbah*; and closed squares- *C. altipotens*

both species seem to be isolated from each other by a series of intermontane valleys and lower elevations that break the continuity of cloud and oak forests which makes the sympatry of the two unlikely (Campbell et al., 2009; Duellman, 2001). The same might apply to *Charadrahyla altipotens* and *C. sakbah*, separated by about 75 km and the tributaries of the Rio Verde (DeSantis et al., 2016; Mata-Silva et al., 2019).

A new panorama of the biogeography of these frogs is emerging, where apparently the allopatric speciation by vicariance may have played an important role shaping the diversity of the genus, as has been reported similarly in other amphibian groups (Rovito, 2017). The use of molecular techniques would help to elucidate questions regarding the evolutionary history, speciation patterns and the species limits of these and other amphibian groups of southern Mexico.

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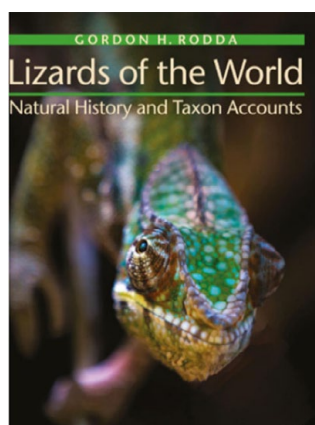
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Lizards of the World: Natural History and Taxon Accounts

Gordon H. Rodda

Johns Hopkins University Press, ISBN 9781421438238 (hard cover),
9781421438245 (ebook), pp 801.



When I heard on the grapevine that Gordon Rodda was writing a book on the natural history of the world's 6,528 lizard species (the cut-off point for the count was May 2017) I thought "this is too big a task for one person, it can't be done". Well, it can.

Then the review copy landed on my doorstep – a massive tome which of the books on my shelves is exceeded in weight only by

Volume 1 of the concise edition of *The Birds of the Western Palearctic*. My first reaction was "what information can this contribute that I can't get free on the web from sites such as reptile-database"? Then I began reading, and it soon became apparent that the answer to this question is "a lot". In fact, this book isn't just physically big – it's intellectually overwhelming.

The core of this volume is Chapter 5, headed Taxon Accounts. It runs to 578 pages – nearly three quarters of the whole. This, like the rest of the book, is derived from a database which, as well as taxonomic information, includes 170 "most important natural history attributes". This apparently took eight years to compile: the database has 1,109,760 cells. The author decided that the most convenient way to arrange the material is alphabetically by genus, because it's so much easier than needing to know a species' place in the taxonomic hierarchy before you can find it. So the chapter starts with *Ablepharus* and finishes with *Zygaspis*. Amphisbaenids and *Sphenodon* are included as lizards, and whatever one may feel about the appropriateness of this, it does aid comparisons. Did you know, for example, that *Sphenodon punctatus* has the highest biomass density of any lizard as defined here? Each genus has on average about half a page of text describing its biology, and the individual species are listed as boxed tables, with two lines per species. These are in a standard format: to give an idea of what information is available, the box for *Podarcis muralis* (chosen by me as a species with which I'm very familiar) looks like this. I have made a few small changes for clarity.

<i>muralis</i>	Common wall lizard	Europe
	diurnal omnivore 62 4.50	refugia-anchored ground lizard

The numbers are mean snout-vent length and body mass, the dietary and behaviour categories are defined in Chapters 1 and 4. Note that there is no information about thermoregulation; this is dealt with in the genus accounts, in this case the relevant entry reads "Fifty-two percent (v.25 %) bask directly, and their mean active body temperature is average for lacertids (33.2 °C v 33.3 °C)".

Podarcis muralis features specifically twice in the text relating to the genus. The first is "At least five species show a pattern of high moves per minute, while showing a percentile for time spent moving that is at least twenty percentiles lower... *muralis* (95/68)... but the general pattern suggests that there is a component to the movement of *Podarcis* that accentuates MPM over PTM; apparently they dart very expeditiously or for very short distances". The second is "the species' means (for biomass density) range from 0.3 kg/ha (*muralis*) to 15.9 kg/ha (*lilfordi*, *siculus*)". These short quotations illustrate features which are a major strength throughout the chapter – an attention to detail and quantification of statements, comparisons and comparative variables (such as "small" or "relatively large") whenever this is possible.

The database that I referred to above makes it possible to find correlations between species, states and variables, and Chapter 3 – at 62 pages, the second longest in the book – does just this. I cannot, in a short review, begin to do justice to the richness of this material. Correlation is, of course, only suggestive of causation: so here is enough data-derived speculation to keep an army of researchers busy for years. If this were the only chapter in the book, it would still have immense value.

I loved the first sentence of Chapter 4 – "Lizard ecologists may have been misled by endotherm envy": this book isn't all just turgid scientific prose. What the chapter is about is trying to find a classification for life-style characteristics of lizards – the author calls them "ecological business models" – because these are needed for the database. There are 14 of them. Some, like "giant herbivore" or "glider", are relatively straightforward. Others have an element of arbitrariness. I would be hard put, for example, to find the boundary between "refugia-anchored diurnal ground lizard" (which is how he classifies *Podarcis muralis*) and "wide-ranging chemosensor".

The remaining two chapters are "housekeeping". Chapter 1 is an Introduction which also includes an account of the methods employed in compiling and using the database, and definitions of terms used in the book. Chapter 2 is titled

“What are lizards?” and its 13 pages are a short overview of the characteristics of lizards as a whole.

The first words of the book succinctly describe its aims: “I wish to describe for you the natural histories of all lizards. For example... I describe the environment in which each species lives, what it eats and how it reproduces. I do not help you to identify lizard species or distinguish higher taxa... nor do I report the evolutionary history of lizard species...”. Does the book succeed in achieving these aims? The answer is emphatically “yes”, with the proviso that it cannot, of course, give full details for all of the facts on which generalisations are made, nor can it give literature citations for every statement. This isn’t a criticism – just a comment on what isn’t possible within the bounds of a single volume which deals with more than six thousand species of animals. Given its size and scope, it’s remarkably free from errors, and the publishers have done justice to the importance of the material in the quality of production. It must be becoming apparent by now that all of this won’t come cheaply, and of course it doesn’t: the hardback version costs £111. Although this is an eye-watering sum, it’s actually quite modest by the standards of book-production in 2020.

I finish with a speculation. This book is going to be of huge value to lizard ecologists for a long time to come. Who will rise to the challenge of doing the same thing for the snakes of the world?...

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HERPETOLOGICAL BULLETIN REPORT

March 2021

In the last year, all four issues of *The Herpetological Bulletin* were published on time. Of the manuscripts accepted, 56 % were published within three months of submission and 100 % within six months. Previously, 99 % of accepted manuscripts have been published within three months. Lead times to publication have increased due to a much greater number of manuscript submissions, as explained below.

There were 158 manuscripts submitted in the last 12 months, an increase of 53 (+50 %) from the previous year (Table 1). However, this increase was not evenly distributed between the types of article. Natural History Notes and Short communications increased by 88 %, Short Notes by 58 %, but Full papers remained much the same. Our fellow journal, *Herpetological Notes*, has likewise recorded a large increase in the submission of shorter articles while the rate for longer articles has been static. This may be attributable to the COVID-19 pandemic that may have disrupted the field activities associated with larger pieces of work but created more time at home to write up incidental observations. *The Bulletin's* overall acceptance rate was 43 %, a modest decrease from the previous year's 50 %, but historically typical.

Table 1. Submission and acceptance rates for manuscripts received in 2020 (2019)

	No. submitted	No. accepted	% accepted
Full papers	17 (18)	7 (13)	41 (72)
Short Notes	19 (12)	11 (5)	57 (42)
Natural History Notes*	122 (65)	50 (34)	41 (52)
Totals	158 (105)	68 (52)	43 (50)

*Also includes Short Communications

If you are looking for information on reptile species then the internet site to consult is 'Reptile Database'. This catalogues the classification and bibliography of all living reptiles. Now that all back issues of *The Bulletin* are accessible on the BHS website, a complete listing of all reptile articles was submitted to the Reptile Database so that users can connect directly to all 696 of *The Bulletin's* reptile articles (609 of our articles concern amphibians alone).

The BHS is very grateful to the following people who gave their time and expertise reviewing manuscripts for the Bulletin in 2020: - Roger Avery, John Bielby, Andy Buxton, Miguel Carretero, Ashok Captain, John Cooper, Thomas Doherty Bone, Roger Downie, Stuart Graham, Richard Griffiths, James Harris, Ben Hassine, Klaus Henle, Axel Hernandez, Anthony Herrel, Rick Hodges, Robert Jehle, Jim Labisko, Todd Lewis, Roger Meek, Khaled Merabet, Nitya Mohanty, John Murphy, Kanto Nishikawa, Andrea Phillott, Anthony von Plettenberg Laing, Thomas Rainwater, Max Ringler, Sean Rovito, Ben Tapley, Christine Tilley, and Wolfgang Wüster.

Rick Hodges
Editor

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