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The Captive and Field Herpetological journal is an open access peer-reviewed online journal which aims to better understand herpetology by publishing observational notes both in and ex-situ. Natural history notes, breeding observations, husbandry guidelines are all examples of the articles featured within C&F Herpetological journals. Each issue will feature one literature or book review in an effort to resurface past literature and ignite new research ideas.

For upcoming issues we are particularly interested in articles demonstrating:

- Contact between wild herpetofauna and humans, specifically venomous snakes
- Successful in-situ breeding
- Herpetofauna behaviour in human-disturbed habitats

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‘Herping against the weather’

Bangor University Herpetological Society (BUHS) and Captive & Field Herpetology (C&FH) Croatia/Slovenia field trip report

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This field report has not undergone academic peer-review and is used only to briefly discuss Captive & Field Herpetology’s latest expeditions, for further information contact the above authors

Bangor university is well known in the UK for its wealth of experience in herpetological research. The university also has an extremely active student herpetological society which arranges site visits, training and conferences on a regular basis and has a meeting every week. A student committee arrange a herpetological seminar every week which in the past has included other students, zoo workers, ecological consultants and researchers and plenty in between! The committee also organises a short field excursion abroad, yearly in the Spring for some lucky members. In 2018 the logistical side of this trip was being handled by a new organisation, Captive and field Herpetology, which is itself owned and founded by a Bangor alumnus. C&F lead herpetological excursions, primarily to India but with more destinations on the horizon, with an emphasis on community engagement and research and try to escape the well-trodden herping paths wherever possible. Slovenia and Croatia were chosen as this year’s BUHS trip destination, following a successful visit there by a previous student group. Unfortunately only a single member from that previous trip managed to join us this year and so most of us had no experience herping whatsoever in these countries. We visited (or attempted to visit!) a few locations used by the previous group but largely relied on opportunistically identified habitat from satellite images and records of species from social media. The rest of this report consists of day by day accounts of the places we journeyed to and the amphibians and reptiles found at each, with healthy doses of field observation and anecdote thrown in for good measure.

March 25th London Stansted ---> Ljubljana
The first day didn’t see much in the way of herping. Our evening flight from London to Ljubljana was delayed and after losing a further hour to the time difference and

arriving at the address of a horse stable instead of our accommodation everybody was thoroughly exhausted! A few unidentified amphibians were spotted in the car headlights on the way from the airport to the accommodation and plenty of mammals were spotted either side of Slovenia’s twisty mountain roads, including a suspected stone marten (*Martes foina*). We suspected some truly amazing views were in store for us the following day but couldn’t help but notice the abundance of snow either side of the road and the temperatures, far lower than what we had left behind in London!

March 26th Herping near Kočevska Reka, Southern Slovenia
Sunlight confirmed our two major impressions from the previous night’s drive. 1: Slovenia is a very beautiful country, 2: it was currently also

a very cold country! Not an ideal start to a trip looking for animals that depend on heat for their activity above ground. After a lovely breakfast in the attached restaurant the organisers decided to break everybody in gently with a hike up a logging road into the mixed forest above the accommodation. The weather remained well below 10°C and the ground was soggy, feeling very familiar to the Welsh students on the trip, and the snow wasn't going anywhere soon. A small, deep pool on the logging trail produced our first herps of trip: the common frog (Rana temporaria) and some newts which we would identify later at night. The cold conditions hadn't perturbed the local amphibian life as the frogs were already in amplexus when found. A nearby rock was flipped to confirm our second species in quick succession- the beautifully coloured alpine newt (Icthysaura alpestris). This was the first new species to many members on the trip although the Welsh contingent were already familiar with this as an invasive species in numerous places in N. Wales. In the UK they are suspected to be vectors of the *Batrachochytrium dendrobatidis ('Chytrid')* fungus, thus posing a threat to the native great crested newt but it was a relief to finally see this species in its native range, and not having to feel slightly guilty about it!

A hike further into the snowy forest eventually led to a promising looking rocky outcrop. The previous visit had found the nose-horned viper (*Vipera ammodytes*) in Slovenia in similar situations however we only got the considerably less exotic common toad (*Bufo bufo*) for our efforts. It proved a charming subject to photograph however as is usual with toads and, with many amphibian lovers in the group, morale was still high despite the frostbite and runny noses.

The afternoon saw us venture out in overcast weather (which will become an oft-recurring theme in this report) to the Kolpa (=Kupa in Croatian) river, the natural border between SE Slovenia and Croatia. Here, the previous group had found dice snakes (*Natrix tessellata*), an interesting, highly aquatic piscivorous relative of our native grass snake in addition to the green lizard (*Lacerta viridis*) which got the lizard guys excited. Unfortunately the weather was once again not on our side with no signs of snakes or large lizards, or even consolatory amphibians near the river. A ruined building and cliff wall did turn up our first reptile species of trip however, the common wall lizard *Podarcis muralis*. This is another species familiar to British herpers as an invasive in several parts of the country, where even in the depths of December it has been observed basking outside holes in walls on sunny days. This cold tolerance helped our species list creep further towards our goal of 21 from the previous trip (a little competition always keeps things interesting!). Another night time torch of our previous pond revealed the same newts and frogs as before (with the same pair of frogs still in amplexus!).

A return to the local pond that night with some powerful torches revealed many more common frogs and the newts here were also confirmed as alpine newts. Luckily for us, a lek had aggregated in a shallower section of the pool where several males were observed wafting pheromones with their tails at a single, massive female. This was a hit with the group and everybody went to bed happy and ready to venture further afield the following day.

Figs: Alpine newts breeding and bufo, Podarcis muralis on wall

March 27th lost in the mountains

Today was the big day, some marginally less grey weather was being hailed as our shot at *V. ammodytes* and we ventured forth into the

Left. *Salamandra salamandra* **Right** Bear tracks (*Ursus arctus*)

higher altitude coniferous forests to try to reach a viper site given to us by the previous group. GPS coordinates showed a rocky ridge and cliff face, surrounded by verdant forest with obvious trails and tracks leading nearby. Reality gave us a single muddy logging road, bounded by knee deep snow and the hazy memories of the single veteran from the previous group, who hadn't been a driver at the time. We reached the end of the track we thought we needed and alighted, shivering, in a small quarry. The group got out to stretch their legs and another *P. muralis* was found and photographed. The cold tolerance of this species is astonishing as the slightest hint of slightly-less-grey clouds seemed to summon them from their rock crevices. Luckily they are very easy to photograph when unable to move at their usual rapid pace! We returned down the hill, searching for any landmarks to jog our veteran's memory of the parking space for the trail we needed, eventually reaching the suspected side road to find it blocked by a drift. Minibuses and Opel astra estates are not known for their rallying prowess and so we decided to improvise and try what had looked like another trail further up.

We were greeted by ominous looking tracks in the snow. Bangor University runs an undergraduate field course to Arizona where some lucky members had come into contact with black bears (*Ursus americanus*). These are impressive beasts but the tracks here indicated a much larger animal. The park we were staying in is famous for its brown bear (*U.arctos*) population with bears adorning signage and murals in many places and these tracks drove home the presence of megafauna to many members of the group who had yet to experience anything larger than a rabbit by the side of the road in the UK. The tracks led up the trail we wanted to take but with a less-than-stealthy group of 11 students we reassured them any self-respecting bears in the area would hear us coming from miles away. Several stumbles into knee deep snow later we reached the rocky brow of a kaarst which looked ideal habitat for vipers. We proceeded to check under at least 90% of the rocks and cover on the hill top to no avail and as rain had just started to dampen spirits a little our leader bellowed from behind a tree.

We gathered quickly to see something at odds with the grey and white landscape. The black and yellow aposematic colours of a fire salamander (*Salamandra salamandra*). This was a dream species to find for the amphibian crew and deeply impressed even the most stalwart ophidiophiles too. Their slow biology is well adapted to such a cold environment and captive specimens suffer at even slightly high temperatures. It is not a common species to find in the area, less so at a site where they are not already known from. Our individual was a

Image. Olm (*Proteus anguinus*), captive specimen

very large adult and made the whole ordeal of reaching the location more than worthwhile. On the return to the cars a small wooden structure was located near the road, containing several small pools full of *Salamandra* larvae and mating common frogs. The karstic limestone landscape of the area means that water erodes and flows through the rock, collecting in caves deep underground and makes surface water fairly scarce and so amphibians are mostly concentrated around these sporadic resources. The water that drains down into the rock carves out subterranean caverns that present novel, highly stable environments for colonisation by organisms, including Slovenia's most famous herp.

March 28th : In search of the human fish I

In one town this famous herp species is the lifeblood of the tourist industry with signs displaying it, gift shops selling fluffy versions of it and even restaurants named after it. It is the bizzare troglodyte salamander: the olm (*Proteus anguinus*) or 'human fish'. This species is endemic to cave water courses under the Dinaric alps. The more familiar, white olm was first discovered, resembling an elongated albino axolotol, their eyes have regressed and become covered in skin and their snouts have become elongated and covered in sensory organs. They are neotenic, like axolotols (they do not undergo metamorphosis and retain larval gills etc) and display very slow life history strategies to survive in the nutrient deprived water systems they inhabit. A black form was discovered at a later date with less troglodytic characteristics and more developed eyes. It is thought this form is the result of a second, more recent colonisation of the cave systems, resulting in the less extreme adaptations to caves than the white form. Originally described as a sub species (*P.a.parkelj*) (Stet & Arntzen, 1994), genetic evidence points to this form being well nested within several populations of the white form (Trontelj et al., 2009) despite its distinct

Left. *Zamenis situla* **Right.** Views from the Slovenia - Croatia border

morphology (Ivanović et al., 2013) and olms likely represent a species complex. The white form is visible in breeding tanks in the town of Postojna however the black form is not and occasionally washed to surface water after heavy rains. We had managed to identify some promising looking springs for the black form in the towns it was described from and found them all to be fenced off on arrival. Some consolation frogs and a toad at a nearby stream helped to dull the disappointment of not actually herping our own wild olm but the chances had always been slim to none. On the way back to the accommodation we stopped off at some large ponds near the accommodation to witness large breeding congregations of *R. temporaria* and *B. bufo*, including lots of spawn of the former. Walking back up the road we rescued many migrating toads from the wheels of oncoming traffic.

Figs: frog orgy and spawn, toad on road

March 29th : In search of the human fish II

Today was a tourist day and to make up for our failure to find a wild olm we headed to the town of Postojna, olm central where a thriving tourist industry is built largely off this single amphibian species and the caves it inhabits. We all booked onto a tour that led into the cave where we were promised a look at some captive olms at the end. The students mulled around behind the main group, paying varying amounts of attention to the geology of the system and varying amounts spotlighting the numerous pools. The whole system was brightly illuminated to serve the thousands of tourists that visit here and so was now useless as habitat for our photosensitive quarry. We reached the end of the impressive subterranean system and finally got to see what we came here for. In an unlit section of cave and with several guides and warning posters around, prohibiting flash photography was a large aquarium with several of the elusive cave dwelling salamanders inside. This species is truly bizarre, reacting to the slightest light from a camera's autofocus and hiding its head in the gravel substrate. They move very slowly, preferring to crawl along the bottom of the tank rather than use their relatively small tail as propulsion. The experience was an excellent herpetological highlight to end our time in Slovenia with and we would urge anybody to visit these caves if you get the chance. The guide conveyed the possibility of organising special tours into the deeper parts of the cave with wild olms for us in future trips which is something I'm sure we will eagerly pursue!

March 30th : Finding the silver lining around the clouds

It was finally time to say a bittersweet goodbye to Slovenia. It had been a lovely place but the better weather the forecast promised us at the coast meant everybody was raring to head to the island of Krk in Croatia to hopefully see some more reptiles. We were stopped at the border crossing for what seemed like hours as an amusing border officer rooted through our

Top Left. *Bufotes viridis* **Top Right.** *Bufo bufo* **Bottom.** *Podarcis siculus*

bags, giggling at the mostly alcoholic content (you can't take undergrads anywhere) and bizarre zoologist paraphernalia dangling from the bags. A ram's skull was unearthed from one bag (you can't take wild animals or parts thereof over the border, officially) but as it was a domestic animal the student was allowed to keep the festering memento and we were eventually on our way.

We had several hours to pass before we were allowed to check in at our apartments on Krk and so stopped at some coastal scrubland on mainland Croatia we had identified previously from satellite imagery. We spent some time hiking through the scrub and scouring rock walls but the weather, although warmer now, was still overcast and didn't produce anything of note. A suspected scheltopusik (*Pseudopus apodus*), a very large anguid related to slow worms, was glimpsed under a turned rock but retreated down a burrow faster than an identification could be confirmed. It is a species I have previously found in Turkey and was disappointed to not get the chance to show the students their incredible ability to produce foul smelling musk continuously for minutes at a time. We returned to the road when a small group ahead of the rest of us shouted the word which gets everybody on a herp trip running, no matter the sore legs "SNAKE!". It turned out to be a Leopard snake (*Zamenis situla*), arguably the most beautiful colubrid in Europe and the species I had personally most wanted to see on the trip. It was a good sized male with prominent dark edging to the scales and an overall orange hue which seems to be common here in the Northern part of the species' range. *Zamenis situla* are a fairly cryptic, rock-favouring snake and are not often found in the area (only a few records exist from the rocky areas of neighbouring Krk). It was active on the surface in overcast conditions (surprise, surprise) and had not had the chance to reach

Left. *Zamenis longissimus* **Top Right.** *Algyroides nigropunctatus* **Bottom Right.** *Hyla arborea*

near its optimum temperature, judging by sluggish movements, which were nonetheless ample to draw blood from one unsuspecting handler. It was released after an eager photo session and we proceeded onto the picturesque island of Krk.

Our apartments on Krk were situated in the coastal town of Silo. Here in the off season we were greeted by a very friendly host and a near-silent town. There were few supermarkets and fewer restaurants open so many students reverted to their barbaric primal ways (cold frankfurters and beer became the staple diet of one such specimen) while the postgrads enjoyed a much more sophisticated Mediterranean diet of cold meats, bread and smoked cheese all of which are apparently delicious in Croatia. We were kindly presented with slices of one of Croatia's favourite dishes: whole roast suckling pig, by our host, which went down a treat with the carnivores among us. After stuffing ourselves we set about tracking down herping destinations on an island entirely covered in favourable habitat and juggling the now mangled itinerary to best combat the unpredictable weather and hopeless forecasts.

31st March: Krk; slightly less soggy

Our first full day on Krk consisted of a visit to a well-known reservoir with a very diverse herp assemblage that had been given to the previous Bangor contingent by local herpers. It consisted of a walk along a track with very enticing stone walls on either side to a large reservoir, bordered by a dilapidated building and woodland edge vegetation. We had been promised the site to be crawling with *Natrix* however a soggy Italian wall lizard (*Podarcis siculus*), a few small marsh frogs (*Pelophylax ridibundus*) and an enormous female common toad were all that was found during our first visit here. Two students reported seeing a large black snake that retreated into a rock wall

which we couldn't identify conclusively from the photo taken at the time but would return to the part of the wall it was seen in later. We vowed to come back to the reservoir in "better weather", which ended up applying to most places we visited during this trip. After pushing the Opel out from the mud we headed home to dry off and went out for some more substantial food at one of only two restaurants seemingly open in the whole town.

After food we headed out to a pond on the South of the island which looked like ideal habitat for green toads (*Bufotes viridis*). This species is restricted to the Southern end of the island in rocky coastal habitat and after a roadkilled adult was found on the journey down our expectations rose. Sure enough we located several large adults floating on the surface of the pond and photographed a particularly nice individual, another score for the amphibian crew.

1nd April: April fools hunting for treefrogs

For our second day we targeted a fairly exotic looking and sounding species, the European tree frog (*Hyla arborea*). These had been recorded, along with smooth newts from a different pond, North of our previous day's destination. The newts were found immediately, bumping our amphibian species count up to five but there was no sign of the elusive tree frogs. A *P.siculus* was found drowned in an old bath but otherwise the morning remained devoid of reptiles. As we returned to the main road to attempt access to the far end of the pond we noticed a smaller track running parallel to the main road. We drove down here for a while until we came across every herper's dream- a giant pile of rubbish. As the sun actually begun to make a rare appearance we descended like vultures and it wasn't long before an aesculapian snake was unearthed, this time of the normal form I was more familiar with. It showed none of the usual snappy attitude of juveniles of this species and was amenable to a short photo session. As the temperatures warmed, *Podarcis* emerged in good numbers and another familiar species, the slow worm (*Anguis fragilis*) was located under some more rubbish. A brief photo shoot later and herps were turning up all over the place with the final new species of the afternoon, a Dalmatian algyroides (*Algyroides nigropunctatus*) spotted by the lizard crew basking on a rock wall. This species is reminiscent of a dwarf cordylid with its bright display colours on the ventrum and enlarged keeled scales and spiny tail elsewhere, no doubt convergeantly evolved traits for a crevice dwelling lifestyle.

That evening we returned the treefrog pond on a mission. Further rain had made the bank waterlogged, to the detriment of an idiot in flip flops (yours truly) but the brief spell of sunshine earlier had resulted in a much warmer (and mozzie-r) night. Anuran calls were heard almost immediately after turning off the main road and continued down to our previous parking place. The majority were identified as *Hyla* calls from youtube videos (herping is far too easy these days), to building excitement from the student mob with a few *Pelophylax* and squeaky *Bufo* thrown into the cacophony too. *H. arborea* seemed to stop calling when spotlighted and the first was found through trial and error and brief beams of torchlight. A calling male was found and photographed and a female full of spawn was also found shortly afterwards. Success!

2nd of April: Praise the sun!

We had thus far missed out on *V.ammodytes* to snow and bad directions and had decided to take the situation into our own hands. The experienced field herpers had managed to

Images. *Natrix natrix persa,* image on right shows the individual feigning death, a common defensive strategy observed in this species.

triangulate records and reports of vipers from the island to some favourable looking rocky habitat from satellite images and found some likely looking roads and trails to get the cars close enough to hike there. We prioritised this activity for the ***single*** full day of sun we experienced on the whole trip and set off in search of the nose-horned viper. Initial expectations were high as we trekked up through unforgiving vegetation and very sharp rocky terrain to a rock strewn hillside that looked very similar to previous wide angle shots from the island (a good lesson of why not to post images with plenty of background scenery of sensitive species, we could've been poachers). After a while of scouring south-facing slopes and wind-sheltered bushes no snakes were found and even the *Podarcis* were thin on the ground. Once the group dropped our collective guard and splintered off a shout was carried on the wind from the opposite side of the hill and some garbled sound came through the radio. We managed to call the other group over a stable 4G signal (herping is definitely way too easy these days) and it transpired a *V.ammodytes* had been seen but had retreated into a rock crack. We converged to find the main group sitting, staring desperately at the rocks. There was no sign of any snakes and so we began to explore around. Another *V.ammodytes*, this time a female, was soon found nearby in a much more open location with a third, a beautifully coloured small male, found under a rock next to it. We gave the spiel about not posting photos or disclosing locations to avoid poachers replicating what we had just done, took our photos and then headed back to the cars. We briefly observed a juvenile Balkan green lizard (*Lacerta trilineata*) retreat into a thorny bush under a crag, found another green toad in a rocky valley and came across some ponds containing more marsh frogs and smooth newts on the way down.

On the drive back to the accommodation both drivers simultaneously spotted a likely looking pond near the side of the road with some familiar looking dark shapes on the rocks within. Upon parking up and exiting the cars we heard the splashes of the ever-wary red-eared slider (*Trachemys scripta elegans*) as several large adults fled at the first hint of danger. This large turtle has been introduced to waterways worldwide where it tends to outcompete whatever native chelonian life is present. In N. wales several are known from ponds but the cold winters and meagre growing season are thought to, at least currently, curtail their breeding success. A third, smaller and darker coloured turtle remained basking and allowed us to get fairly close for better

photographs. This was the species we had hoped for, the European pond turtle (*Emys orbicularis*) a near threatened chelonian with a black carapace and yellow speckling. We also heard the high-pitched squeak of suspected yellow bellied toad (*Bombina variegata*), a species suspected of occurring on Krk, from across the road but could not locate them and suspect they were further back on private land.

In the late afternoon we returned to the water reservoir where *Podarcis* and *Algyroides* were now evident, basking on the rock walls and several snakes were witnessed zooming off into undergrowth or under large rocks including a melanistic *Natrix* and a Balkan whip snake (*Hierophis gemmonesis*) which eluded the organisers' best efforts of diving into a thorn bush to get to it. The more elusive wall lizard in the area, *P.melisellensis,* was also seen amongst the gaudier coloured *P.siculus*. As the sun was setting the organisers redeemed themselves with a nice striped grass snake (*Natrix natrix persa*) that was moving along the edge of a field.

April 3rd : back to the reservoir yet again

Some marginally nice weather saw us returning to our favourite reservoir with a big target in mind. The previous Bangor group found the majestic four-lined ratsnake here (*Elaphe quatorlineata*) without much trouble. We scoured the place, turning up several of the black form of the western whipsnake (*Hierophis viridiflavus carbonarius*) which the mysterious 'big black snake' from the previous visit turned out to be. This species showed a strong preference for the stone walls at this site, retreating into them immediately when disturbed. Unfortunately one individual showed signs of snake fungal disease caused by the pathogen *Ophidiomyces ophiodiicola.* This condition is specific to snakes and causes skin lesions. The snake was in generally poor condition with cloudy, dirt-encrusted eyecaps, several lesions dorsally and ventrally and a partial tail with many more lesions and heavily damaged skin. The same baby combinations of young *Natrix* and *P.siculus* were seen and the giant toad was back under its paving slab.

The afternoon saw us venture further afield to the South of the island in search of an elusive colubrid that was high on many people's wanted lists. I tried to manage expectations of finding the crepuscular European cat snake (Telescopus fallax) by pointing out how few had been recorded on Krk but to no avail. The site looked promising and will be revisited in future but pessimism proved the winner on this afternoon as our most significant find turned out to be a large *Scolopendra sp*. that bit Ben's finger.

Left. *Vipera ammodytes* **Right.** *Emys orbicularis*

April 4th

Using familiar looking scenery from photos we set out in search of *Pseudopus apodus* and *Testudo hercegoviensis*, both rare species on the island. We managed to find suitable habitat for both species including likely looking burrows and gaps under vegetation for the latter but the weather once again had the last laugh and not even a *Podarcis* was seen on the way back to the cars as the rain started. In the afternoon we headed to the larger town of Krk for boring touristy stuff and consumption of ice cream before heading back to the apartments for some tasty fajitas cooked by the C&F crew.

April 5th

It was our last day of a fun if somewhat chaotic trip. We had planned to stop off on the three hour drive back to Ljubljana at sites for *Malpolon* and *N. tessellata* on the mainland but rain soon put a stop to that plan. A brief stop at a confirmed locality for *Pseudopus* in Northern Krk however was braved to make sure everybody that joined was thoroughly soaked before the flight home, to end the trip as it had began. An excited cry from Ben turned out to be the result of the smaller, more familiar anguid of the area and so we once again returned to the cars defeated. After cranking the heaters up we set out for the remainder of our journey where this time the border crossing from Croatia into Slovenia took no more than a few minutes and we returned to Ljubljana airport to find that our flights had, once again, been delayed and that a new dent had mysteriously appeared on the Opel. We said a fond goodbye to Slovenia and €300(!) before heading back to the more predictable grey drizzle of the UK. Slovenia and Croatia are both beautiful countries with friendly people, tasty food and great herps. Another two weeks would have likely seen our herp count rise even more but the snow storms of March 2018 had delayed herp activity and emergence in our case. It had nonetheless been a great trip and despite the weather's best efforts we had still racked up an impressive 23 species in 10 days, improving on the previous Bangor trip's count without using many of the previously known localities. I would like to once again thank everybody involved and to thoroughly recommend these great herping destinations!

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A Description of the Successful Hatching of the Fijian Banded Iguana (*Brachylophus bulabula*) and Observations on Vermiculite Moisture

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The Fijian banded iguana (*Brachylophus bulabula* KEOGH, EDWARDS, FISHER, AND HARLOW, 2008) is endemic to the north western islands of Fiji, including Ovalau, Gau, Kadavu, and Viti Levu; the species has also been introduced to the island of Vanuatu (Keogh *et al*., 2008). Along with the other extant members of the *Brachylophus* genus, *B. bulabula* populations are under threat. Now restricted to just a few islands, numbers have declined by 50% in the past few decades (Fisher *et al*., 2012). This has contributed to its classification as 'endangered' by the IUCN and its listing under appendix 1 of the Convention on International Trade in Endangered Species (Fisher *et al*., 2012). The latter being the CITES category a species is assigned to facilitate providing it with the highest possible level of protection. Wild populations are at particular risk from a combination of habitat destruction and fragmentation leading to a loss in genetic diversity (Tershy *et al*., 2016).

Invasive species, most notably black rats (*Rattus rattus*) and domestic cats (*Felis catus*) predate on the iguanas and their eggs (Tershy *et al*., 2016). Furthermore feral goats (*Capra aegagrus*) both destroy habitat and as folivores/frugivores directly compete with *B. bulabula* for food (Tershy *et al*., 2016). Despite the significant decline of *B. bulabula* in the wild and the aforementioned causes being clear and understood there are no conservation measures in place to protect this species (Fisher *et al*., 2012). Whilst *in-situ* conservation is typically the most effective way to protect an organism, it is evident that not all species can be successfully preserved in their natural habitats (Witzenberger & Hochkirch, 2011). Therefore increasingly *ex-situ* conservation in the form of captive breeding is required to act as an insurance policy preserving a species until a reintroduction effort becomes feasible. Although it may not be ideal, *ex-situ* conservation may be the only realistic option to ensure that much of Fiji's endemic herpetofauna persist for the foreseeable future (Narayan *et al*., 2009).

Some lizard species, such as the green iguana (*Iguana iguana*) have been bred in captivity with great success for decades (Jacobson, 2003). This has culminated in a huge body of species specific literature in both books and peer-reviewed articles. From vitamin and mineral supplementation of diet to mating introduction methods, such information on *B. bulabula* is sparsely recorded. Required egg incubation temperatures and humidity levels being no exception. Anecdotal reports published online by both private herpetoculturists and zoo employees attempting to breed this species have stated problems with this fundamental aspect of captive reproduction. We describe our findings with regards to this topic here.

In June of 2013 an unrelated, two year old pair of captive bred *B. bulabula* were imported into

the UK from Austria. On arrival they were housed individually for a one month period of acclimatisation. The male was then introduced to the female's enclosure under close supervision in case either iguana became aggressive. The enclosure in question was a glass and wood, vertically oriented vivarium (122cm long, 61cm deep and 183cm tall). Panels of cork bark where attached to the back and sides of the enclosures interior increasing surface area for activity. Cork bark tubes of varying lengths and diameters were positioned within the vivarium providing the iguanas with basking and refuge sites. Plastic artificial foliage in the vivarium further increased surface area for activity and provided both animals with areas of cover to reduce stress. A 10cm deep layer of coarse orchid bark was used as the enclosure substrate to help maintain ambient humidity. Two 160W mercury vapour lights bulbs in reflectors provided heat and UVB. This combined light and heat source was controlled by a timer switch set to give the iguanas twelve hours of daylight all year round. This ensured one aspect of abiotic environmental consistency. The lights were positioned on top of mesh covered sections cut into the vivarium roof preventing the occupants coming into direct contact with them and getting burnt. Two digital thermometers were used to monitor ambient temperature both at the hottest and coolest areas within the enclosure. To do this the temperature sensor of one thermometer was placed at the basking site directly below the lights and the other near the enclosure floor. During daylight hours the basking site temperature would fluctuate between 38˚C and 41˚C whilst the coolest area of the enclosure remained at 24˚C. This temperature gradient allowed the *B. bulabula* to easily thermoregulate. At night the entire enclosure temperature would drop to 21˚C. The *B. bulabula* pairs' diet was diverse including fruit (blueberries, apple, grapes and raspberries), vegetables (carrots and fresh peas) as well as dark leafy greens (rocket and dandelion). Every feed was lightly dusted with a specific herbivorous lizard vitamin and mineral supplement. Once every two weeks six 5th instar, live locusts were offered to the *B. bulabula* pair as a source of protein and to promote natural predatory behaviours. Before being fed to the iguanas these prey items were 'gut loaded' with fresh fruit and dusted with calcium powder.

On the 5/07/2016 three eggs were deposited in a designated egg laying site (41cm long, 35cm deep and 25cm tall deep plastic container filled with damp vermiculite) within the enclosure. Two were white in coloration with a slight pink hue. The third was a fraction of their size, miss shaped, dehydrated and yellow. The two eggs that appeared fertile were quickly removed and prepared for incubation. To do this a Tupperware container (25cm long, 20cm wide and 15cm deep) with six ventilation holes punctured in its lid was filled with vermiculite to a depth of 10cm. The vermiculite had been soaked in lukewarm water before excess moisture was removed by compressing it between two hands. The eggs were then half buried in this incubation medium and the Tupperware containers lid secured. This was then placed in a 'Zoo Med Reptibator' (www.zoomed.com) reptile egg incubator with the built in thermostat set to 27˚C. A digital thermometer probe was inserted into the egg incubation container to monitor the ambient temperature. Its digital readout positioned outside of the incubator was checked at least once a day until the eggs hatched. The incubation temperature remained at 27˚C whilst the vermiculite slowly dried.

Within two months this incubation medium was dry to the touch. However, contrary to expectations the eggs showed no signs of dehydration, the usual evidence of which being concavities of the shell. The decision was made not to rehydrate the vermiculite. From this point on the eggs were monitored several times a day for expected signs of dehydration. However despite this considerable drop in vermiculite moisture content lasting until the very end of the incubation period the eggs remained healthy. What is not clear is whether *B. bulabula* eggs are resilient to the dehydration of incubation medium or require it for successful development.

Five days before hatching a considerable concavity was observed in one of the eggs. Initially thought to be a sign of dehydration this concavity disappeared in minutes without any increase in incubation medium moisture content or ambient humidity. It is hypothesised that this was the nearly fully developed iguana moving inside its egg. In retrospect such an observation could be used as an indication that hatching is imminent. Beginning at approximately 8am on the 12/01/2017 both iguanas (one male and one female) hatched within an hour of each other. Minutes after emerging from their eggs, both hatchlings exhibited considerable aggressive behaviour (chasing and biting each other). Consequently the means to separate hatchling *B. bulabula* in the same incubation container immediately after hatching must be prepared for in advance. The two iguanas were then set up in individual enclosures and now ten months on (December, 2017) are fully established and growing quickly.

As previously stated the extent to which the drying out of the vermiculite incubation medium is required or simply tolerated for successful *B. bulabula* egg development is uncertain. It is hypothesised that as the vermiculite dried ambient humidity surrounding the incubating eggs dropped. However humidity measurements were not taken to prove this hypothesis. When the authors are next presented with eggs from this pair of *B. bulabula* the egg incubation protocol outlined here will be repeated. However along with monitoring temperature routine measurements of ambient humidity within the egg incubation container will be taken with a digital hygrometer.

It is hoped that the previously stated observations will be applied by all those individuals and institutions attempting to breed this endangered species and so increase the captive population. There could also be broader *ex-situ* conservation applications as the observations outlined here may be applicable to breeding other members of the *Brachylophus* genus. This can only be proved if information collected by those involved in the husbandry and captive propagation of the taxonomic relatives of *B. bulabula* (*B. fasciatus* and *B. vitiensis*) are recorded and then shared.

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Observations on the reproduction and feeding habit of a rare colubrid, Indian bridal Snake *Lycodon nympha* Daudin 1803 (Serpentes:Colubridae) from Southern India.

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Abstract: The reproductive biology and dietary habits of *Lycodon nympha,* a small, rare colubrid that occurs in India and Sri Lanka, are mostly unknown, except for a few notes on its reproduction. Herein we provide the basic data on their reproduction (clutch size, dimensions of the eggs, incubation period, morphometry and physical description of the hatchlings) and detailed description of their unique feeding habit (oophagy) based on observations on ten specimens. We also report of the largest specimen of this species recorded so far.

Keywords: Colubridae; *Lycodon nympha*; India; Natural history; Oophagy; Reproduction; Serpentes.

Introduction: The Asian endemic genus *Dryocalamus* comprised six species of rare and poorly known colubrids distributed across South and Southeast Asia until it was synonymized with the genus *Lycodon* in 2016 (Figueroa et al. 2016, Wostl et al. 2017). In India this genus was represented by two species namely *Dryocalamus nympha* and *Dryocalamus gracilis* (Smith, 1943).

These small, semi-arboreal snakes are excellent climbers and strictly nocturnal in habit (Whitaker and Captain 2004), mostly encountered under the loose bark of large trees, eg. tamarind trees (*Tamarindus indica*), or in the entangled aerial roots of banyan trees (*Ficus benghalensis*) (pers.obs). They have an affinity to enter human settlements, probably in search of gecko eggs. *Lycodon nympha* shows similarity to juvenile common Kraits, *Bungarus caeruleus* and common wolf snake *Lycodon aulicus* [which is a well known Batesian mimic of common Kraits (O'Shea et al. 2018)]. As a result, *L. nympha* and *L. aulicus* are often killed due to misidentification, although *L. nympha* are rarely encountered.

Various aspects of the life history of this species including major ecological traits like reproduction, diet etc., still remain dubious or undetermined due to the paucity of observations. For example, information on reproductive biology of this species are scarce, limited only to short notes about copulation observed in the wild (Krishnakumar 2014), an observation of a female with eggs (Krishnakumar et al. 2016) and sightings of three juveniles (Kartik 2017). No publications on feeding habits exist, the only anecdotal information on possible food items are provided by various authors and consist of geckos and skinks (Wall 1921; Whitaker and Captain 2004; Das and De Silva 2005).

Here we contribute new data on basic reproductive information such as clutch size, dimensions of the eggs, incubation period, morphometry and physical description of the hatchlings and a repertoire of feeding behavior

(oophagy) by *L. nympha*, along with a brief discussion on the probable correlation between this particular diet and the reproduction.

Methods and materials: Observations were made on ten specimens (males: n=3; SVL:TL=394mm:98mm; 330mm:91mm; 213mm:59mm); (females: n=5; SVL:TL= 460mm:114mm; 404mm:108mm; 393mm: 108mm; 390mm:93mm; 270mm:89mm), (neonates: n=2; SVL:TL=138mm:42mm; 146mm,44mm; sex undetermined). Individual snakes were housed in 36×30×18cm well-ventilated plastic containers, provided with bark, branches, and ad libitum access to water in bowls. Moistened vermiculite was used as the incubation medium.

The feeding trials included neonates and juvenile geckos (appropriate to the gape size of each specimen) of the species namely, *Hemidactylus brooki, H. frenatus, H. laschtenaulti, H. triedrus, and Cnemaspis sp*., young skinks: *Eutropis carinata*, and *Lygosoma punctata*, hatchling garden lizards (*Calotes versicolor*), hatchling fan throated lizards (*Sitana ponticeriana)*, eggs of *C. versicolor* (range=14.2-16.01mm in length), *H. brooki, H. frenatus,* (range=7.98-9.46mm, at the longest part of the egg) and common house crickets (*Acheta domesticus*).

All photos were taken with Canon EOS 7D DSLR camera. The temperature and humidity were measured with a digital temperature and humidity meter (Extech Instruments; www.extech.com/display/?id=14444). The following data were collected: 1. Length (SVL and TL in mm) of the adults and the hatchlings (using measuring tape to the nearest 0.1 mm and millimeter graph sheet respectively), 2. Dimensions of eggs (with Mitutoyo digital vernier caliper; of accuracy ±0.1mm). 3. Weight of the hatchlings (in g with Eagle digital weighing machine, of accuracy ±0.1g). 4. Sex (with professional sexing probe).

All snakes were released in their respective spots of capture after the study.

Observation:

Reproduction: Data herein reported were obtained from the gravid female (SVL 404 mm, TL 108 mm, caught on June 13th 2015) and the neonates.

1. Oviposition: The snake laid two eggs (fig. 2A) on June 23rd 2015, at around 00:30 h IST. Completion of the process took nearly two hours. The eggs measured 31.3×9.8 mm and 38.2×9.9 mm.

2. Incubation and hatching: For incubation, the eggs were kept on moistened vermiculite with humidity maintained above 95% at all times. The temperature was between 28°c to 30°c during the incubation period.

The first egg (31.3×9.8 mm) was observed hatching (fig. 2B) on August 20th (58th day of laying) at around 02:30 h IST. Later on the same day at around 23:15 h IST the second egg (38.2×9.9 mm) hatched (fig. 2C).

3. Description of the hatchlings: The first hatchling measured 180 mm in total length (SVL-138 mm, TL-42 mm), weighed 1.6g and had 49 bands from head to tail tip.

The second hatchling measured 190mm in total length (SVL-146mm, TL- 44mm), weighed 1.7g and had 53 bands from head to tail tip.

Both the hatchlings were black above and on the sides, while the ventral sides were uniform white. Prominent bluish-white bands (n= 49 and 53) were present from the back of the head to the tail tip. Each band width occupied roughly two scales, scales on the bands lacked spots; most of the bands were forked on the sides. Bands on the posterior part of the head

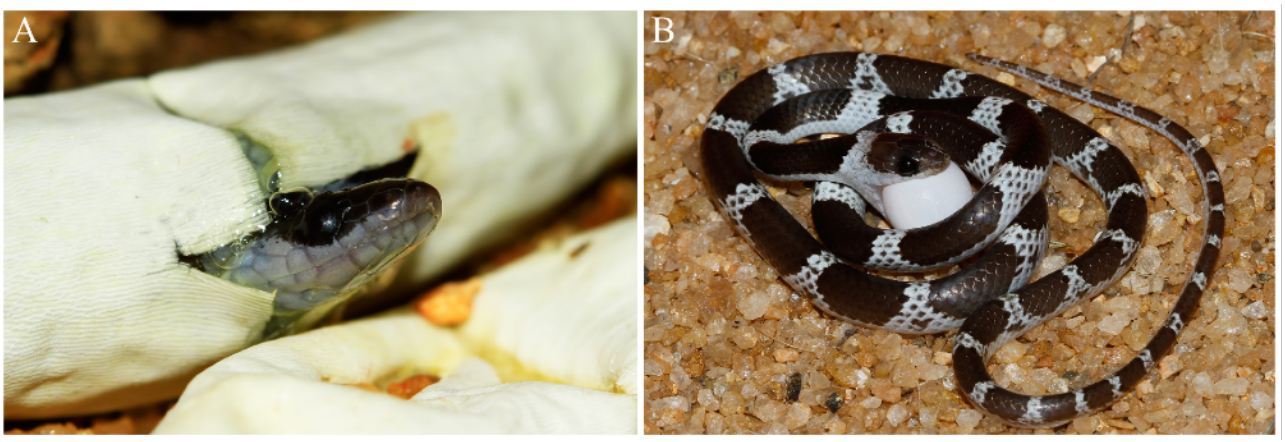

Figure 1. *Lycodon nympha* **A.** hatching; **B.** feeding on a gecko egg. Photo by G. Melvinselvan

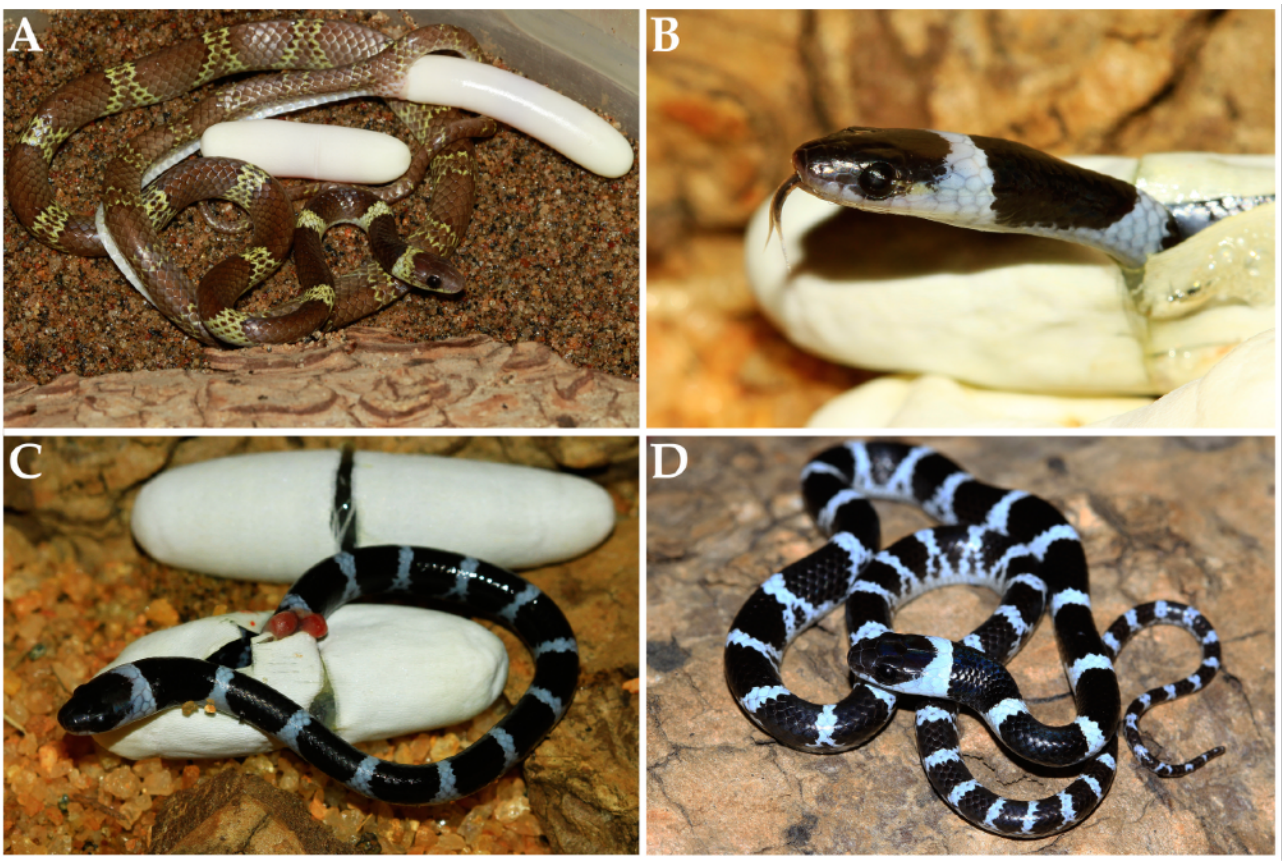

Figure 2. Oviposition and hatching in *Lycodon nympha*. **A**. the female depositing eggs, **B.** hatching of the biggest egg (38.2×9.9 mm.) and **C.** hatching of smallest egg (31.3×9.8 mm) **D.** a hatchling (SVL-138mm, TL-42mm),after its first slough. Photo by G. Melvinselvan

and nape were the widest, forming the characteristic 'veil' of the species (latin *nympha* = bride). No significant change in the appearance was observed after the first slough, except the bands turned whiter (fig. 2D).

Feeding habit:

The snakes only accepted gecko eggs in the feeding trials, except one specimen that showed interest in a *Calotes* egg but failed in the attempt to puncture the leathery eggshell.

Following the introduction of a gecko egg in the individual containers, the snakes exhibited slight increase in tongue flicks, and eventually started investigating the egg by making frequent contact with the eggshell by its tongue (fig. 3A). After confirmation of the introduced object as food the snakes started encircling the egg (fig. 3B; probably to prevent the egg from rolling over as gecko eggs are round and calcified, thus prone to get displaced with minimal force). This typical manner of seizing

the egg was followed by grasping the egg by extending the jaws forward over the other end of the egg, until the enlarged posterior maxillary teeth and anterior enlarged mandibular teeth are properly placed on the eggshell (fig. 3C and 3D). Occasionally they pushed the egg against their body to gain advantage in pushing the jaws forward (in case the eggs are bigger than the relative gape size of the snakes).

Following the engagement of the jaws on the eggshell great force was applied that resulted in cracking of the shell.

In a few cases (especially if the snakes are juvenile) they used a body coil to apply additional pressure at the tip of their snout (fig. 3E) which altogether acts as leverage, the pressure point being the enlarged maxillary teeth.

The snakes were then observed to insert their upper jaw into the punctured point of the shell (fig. 4A), swallowing the egg content simultaneously (fig. 4B and 4C), while the anterior enlarged mandibular teeth holds and prevents the egg from getting displaced.

By reciprocating jaw movement the egg content was swallowed by the snakes entirely (they likely do not puncture the extra-embryonic membrane that separates the egg content and the shell). Parts of the broken shell were swallowed along with the content and any liquid oozing out of the snakes mouth or from the egg was never observed.

Peristaltic movements of the esophageal muscles were observed as the snake swallowed the egg content. After the entire feeding episode was over, the leftover eggshell without any sign of moisture inside was discarded (fig. 4D).

Discussion:

Reproduction: Neonates have been observed during August-September (pers. obs.). However a copulating pair was observed in late August in northeastern Tamil Nadu (Krishnakumar 2014), further in 2017 a snake with 3 eggs were sighted in early August in the Coromandel coastal plains (Krishnakumar et al. 2016), and two juveniles were sighted in March and August in northeastern Tamil Nadu and another in October in south Tamil Nadu (Kartik 2017). These observations may suggest the hatching time to coincide with the onset of the monsoon. This arrives around June in the Western Ghats (South-West monsoon), whereas in the northeastern region it starts around October (North-East monsoon). Detailed study is required on the seasonal reproductive pattern to understand if this species reproduces throughout the year or if a more seasonal reproductive cycle exists. These data will also predict the sexual maturity, fecundity and reproductive frequency for individual snakes.

We hypothesize that the relatively large size of the hatchlings is directly related to the habit of feeding on gecko eggs. In the present study the mean ratio of the hatchling's SVL to the mother's SVL is 0.4; and the clutch size (n=2, total length of both eggs-69.5 mm).In the previous report clutch size n=3, dimensions of the eggs 21×8mm, 27×9mm and 28×7mm (Krishnakumar et al. 2016).We suspect the size of the hatchlings facilitates feeding on the smallest available gecko eggs (suitable to the gape size of the hatchlings) and producing young of this size results in lesser number of eggs, probably restricted to only two to three eggs per clutch. The data on clutch size of this species are limited only to these studies (present and Krishnakumar et al. 2016), but considering the large size of the females (total length 512mm in present study and 515mm in

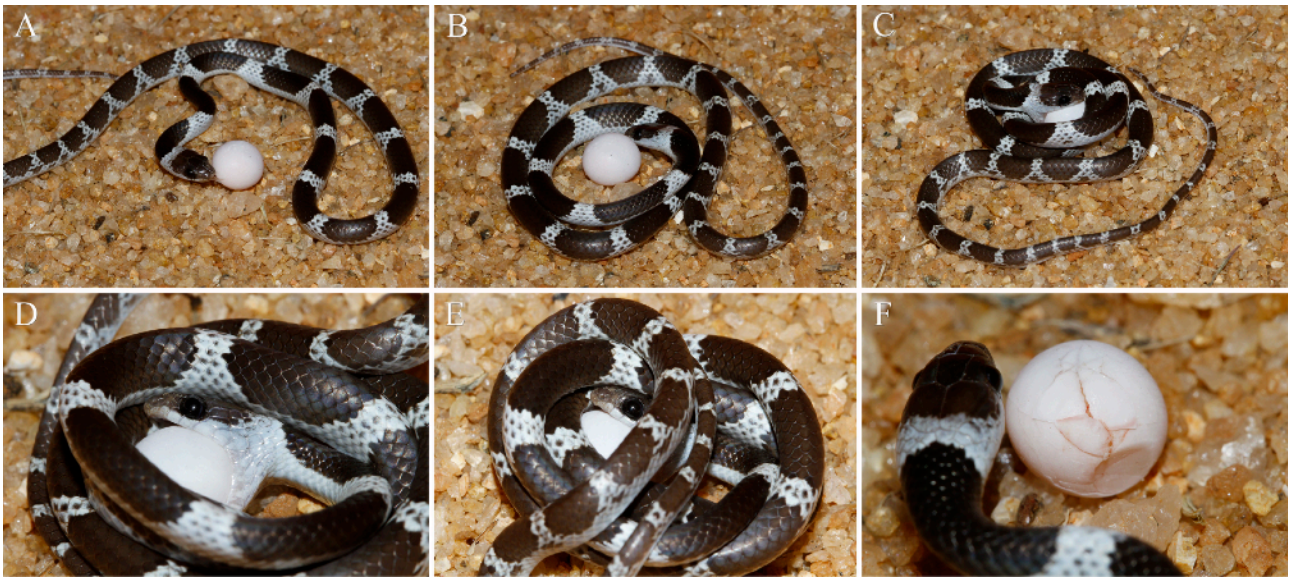

Figure 3. Feeding repertoire of *Lycodon nympha*. **A.** investigating the egg by making frequent contact with the eggshell by its tongue, **B.** encircling the egg **C.** grasping the egg by extending the jaws forward over the other end of the egg, **D.** positioning the enlarged posterior maxillary teeth and anterior enlarged mandibular teeth on the eggshell, **E.** using the body coil to apply additional pressure at the tip of the snout, **F.** prominent puncture marks on the egg shell and comparison of the head size with the egg size. Photo by G. Melvinselvan.

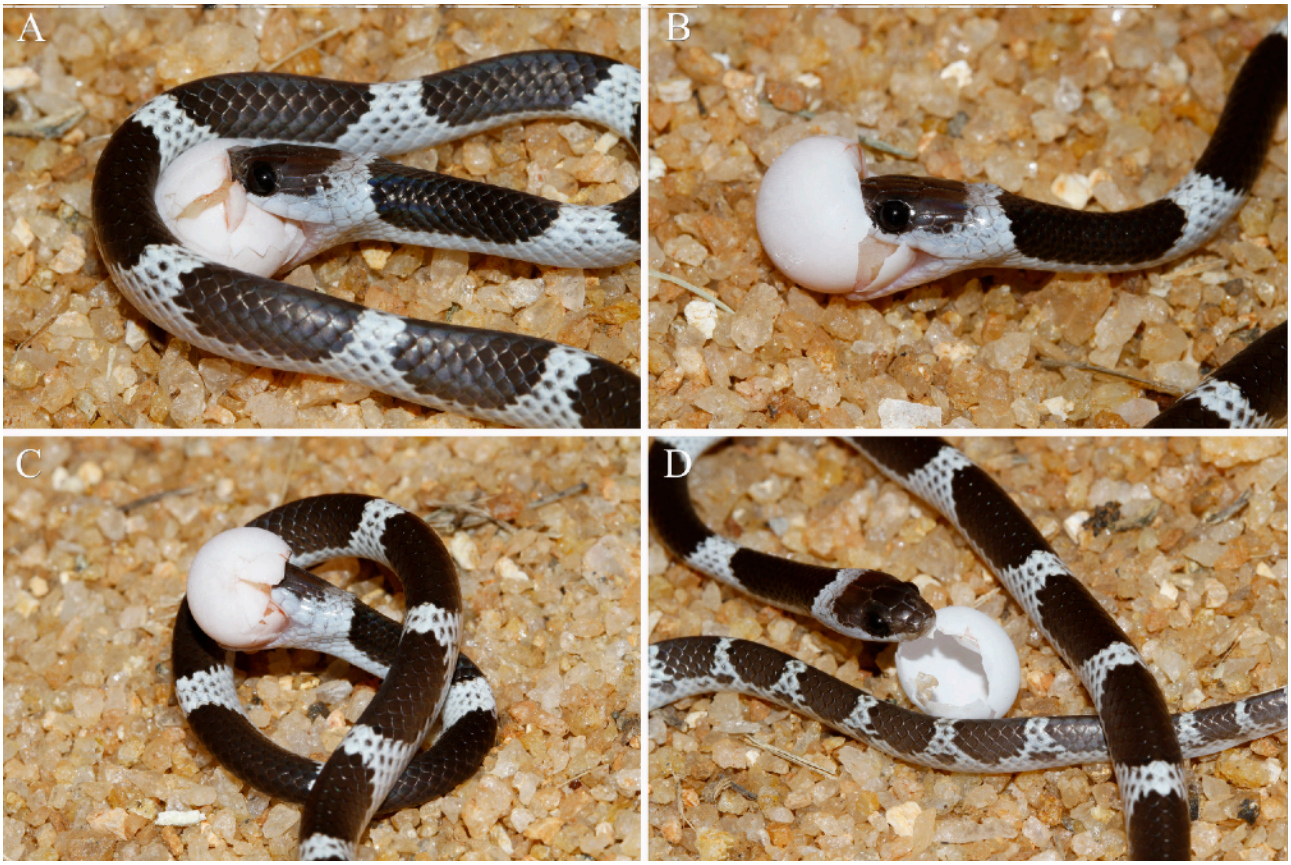

Figure 4. A. inserting the upper jaw from the punctured point of the shell, **B.,C.** swallowing the egg content simultaneously (along with the broken eggshell), while the anterior enlarged mandibular teeth holds the egg from getting displaced. **D.** discarded leftover eggshell, without any sign of moisture inside. Photo by G. Melvinselvan.

Krishnakumar et al. 2016; maximum size reported 520mm, Wall 1920, Smith

1943,Whitaker and Captain 2004), the number of eggs laid, is significant. Moreover lower clutch number probably indicates the high survivorship of the neonates.

There is a conspicuous difference in appearance of the neonates and that of the mother. The neonates were black with white bands, whereas the female was brown in color with yellowish bands. The bands were 3-4 scales wide with a dark spot on each band scale for the female, while the hatchlings had

narrower bands that were two scales wide, and the band scales lacked spots.

The maximum length for the species is 520 mm (total length) as cited in Wall 1920, Smith 1943, and Whitaker and Captain 2004. However the present study reports of a female of length 574 mm (SVL 460mm, TL 114mm) that appears to be the largest specimen of the species recorded thus far.

Feeding habit:

Dentition: Ten maxillary teeth, without grooves, conical and stout, increasing in size posteriorly, diastemae absent; palatine and pterygoid teeth very small and all of about the same size; nineteen mandibular teeth, the first five of which are slightly enlarged (Müller 1924).

Selection of a particular food item among a range of other options provided probably indicates that the diet of *L. nympha* consists of a specific food type, precisely calcified reptile eggs of diameters suitable to relative gape size of the snakes. From this it can be hypothesized that the shape and position of different sized teeth on the jaw help in holding the calcified egg in place between the jaws and asserting enough muscular effort to break open the egg, the position of the enlarged maxillary teeth is advantageous for exerting greater mechanical effort on a restricted area, but are certainly not suitable for any sawing or piercing action required to slit open flexible leathery shelled eggs of snakes and lizards. As observed in this study, *L. nympha* consumes as much as half of the eggshell in the process of breaking the shell and eating the egg content, and digests the egg shell, it can be assumed that smaller eggs of other species of geckos, e.g dwarf geckos (*Cnemaspis spp*.) can be swallowed entirely by larger specimens and digested.

In peninsular India geckos (*Hemidactylus brookii, H. frenatus, H. laschtenaultii, H. triedrus, Cnemaspis spp.* etc) lay eggs almost throughout the year yielding an abundant and constant supply of food for *L. nympha*. Moreover competition over gecko eggs between *L. nympha* and its sympatric snake species is less, as the other specialized and facultative-egg-eating snakes found in the region consume leathery shelled reptilian eggs and hard shelled avian eggs predominantly.

The data presented here will help in understanding the basic reproductive biology of these snakes. But this study is certainly not exhaustive, still various topics like sexual size dimorphism, gestation period, growth rates, sexual maturity, fecundity, reproductive frequency etc., remain unknown or data deficient. Further studies are needed to fill the knowledge gaps, which will help us in understanding these rare snakes better.

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Eaten Alive: Predation of *Philothamnus semivariegatus* by *Varanus albigularis*

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On 25. Oct 2017 at 13:15 h local time (UTC+02:00), a male Rock Monitor Lizard (*Varanus albigularis* DAUDIN, 1802) measuring approximately 1.2m (total length) was observed dragging a medium sized (0.6-0.7m) Spotted Bush Snake (*Philothamnus semivariegatus* SMITH, 1840) into a Nyala tree (*Xanthocercis zambesiaca*) (Figure 1). The lizard had caught the snake by the tail and the snake attempted to escape by winding itself around the lizards neck to free its tail. Once the lizard had found a position in a tree fork, 10m above the ground, he started swallowing the snake from the tail (Figure 2). The snake attempted to free itself continuously whilst it was still alive and until it was completely eaten. At 13:24 h the head of the snake disappeared into the monitor's mouth.

After the snake was completely taken in, there were still movements visible when the monitor shortly opened his mouth to swallow the rest.

After it had eaten, the monitor remained in the Nyala tree. It came down approximately 1.5 hours later and walked slowly to the tree where it usually resides, around about 200 m away. It climbed up and remained there.

Figure 1. Male *Varanus albigularis* successfully predating on a *Philothamnus seminaratus* 10m above ground level in a Nyala tree.

Figure 2. *Varanus albigularis* swallowing an individual *Philothamnus semivariegatus* after successfully capturing and incapacitating it.

The event was observed at the Eco Training camp in Makuleke, Parfuri, Kruger National

Park, South Africa. The lizard is a resident animal living in this camp. It usually spends the night in a tree hole, approximately 4m above the ground. On warm and sunny days it is often observed within a radius of 200 - 400m around this tree foraging for food.

On 21st December 2017, the same individual was observed catching another Spotted Bush Snake (total length 0.3-0.4m) and eating it on the ground, approximately 20m away from the Nyala tree mentioned above.

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Lampropeltis abnorma (Colubridae; Squamata): documenting a regurgitated prey item from Cusuco National Park, Honduras

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Introduction:

The *Lampropeltis* genus is well known and documented in captivity, with its bright colouration, convincing mimicry and harmless yet hardy temperament making it a popular and diverse group among snake keepers. The popularity of this species among enthusiasts has led to the accumulation of substantial knowledge about its care and diet in captivity; for this reason it is likely the "best known snake of the neo-tropics" (Kohler 2008). Unfortunately, this captive reputation often means in-situ species observations from nature are over-looked or unpublished. Numerous reports of in-situ *Lampropeltis* diet have been documented, describing feeding behaviour on small mammals (Aguilar-López and Pineda, 2013; Kohler *et al.* 2017), eggs (Groves, 2014; Hollingsworth and Walsh 2016), and other snake species (Marquez *et al.* 2013). In captivity, *Lampropeltis* species are known to have a very diverse diet, ranging from rodents, lizards, frogs, snakes and birds (Kohler 2008).

Natural History:

In Honduras, the sub-species previously regarded as *Lampropeltis triangulum hondurensis* (Williams, 1978) was revised recently by Ruane *et al*. (2014) to *Lampropeltis abnorma* (Bocourt, 1886), and was first reported from Cusuco National Park (CNP) in 2005 (Townsend *et al.* 2006). This large (Total length – ca. 2000mm), strong and broad-bodied colubrid is "pre-dominantly a nocturnal forest dweller" (Kohler, 2008), yet is also active during the day on the ground amongst leaf-litter. In CNP, *L.abnorma* has been observed utilising a variety of habitats, ranging from disturbed agricultural areas to lowland-broad-leaf rainforest and montane cloud forest. Individuals have been found basking in sun-lit areas of leaf-litter, but also utilising a variety of microhabitats such as rotten/hollow logs, holes at the base of trees and buttress roots when actively foraging or resting (pers.observ.). Throughout the Honduran part of its range, this species occurs naturally in two primary colour morphs, the typical tri banded (Red, Black, Yellow, Black, Red) phase and red-tangerine phase. In CNP, two adult individuals were observed in 2016; both had typical tri-coloured patterning, and high levels of dark pigmentation. This darkening of the aposematic colouration is commonly observed within individuals of the species at higher elevations, having more pigmentation than those inhabiting lowland areas. It is suggested that perhaps a dark colouration could help aid basking potential within these dense mountainous forest habitats, as found in other reptiles (Levesque, 2015).

Diet :

The observation commenced on 24 March 2016, around 14:25hrs, when the author (TWB) opportunistically observed and captured a wild adult female (ca. 1200mm total

Figure 1. *Lampropeltis abnorma* pictured alongside feet of regurgitated Mexican deer mouse (*Peromyscus mexicanus)* in Cusuco National Park, Honduras. © *Tom W. Brown*

length/450g 'post-regurgitation' weight). The individual was basking in sun-lit leaf-litter alongside a trail in broad-leaf rain forest nearby to a locality known as Guanales (15 29 21.6 N, 88 14 01.9 W, 1271m above sea level). The snake was contained safely in a purpose-made cotton bag until morphometric data could be collected back at camp (approx. 20min). Within this short amount of time, an entire albeit partially digested rodent was regurgitated (Fig. 1).

The rodent, which measured 122mm from head to tail base, was later identified to species level by consulting the book and author of 'Mammals of Central America (Reid, 2009), and was found to be a Mexican deer mouse (*Peromyscus mexicanus*) based on paw structure and pad patterning. Further confirmation was provided by ruling out co-occurring alternatives such as the Spiny-Pocket Mouse (*Heteromys desmarestianus*), as multiple *P. mexicanus* and *H. desmarestianus* were captured in Sherman traps during small mammal surveys through Operation Wallacea in July 2016; allowing for in-hand comparison and validation against the regurgitated specimen, which was preserved at the time using 90% ethanol and stored in the CNP Visitors Centre.

The Mexican deer mouse (*Peromyscus mexicanus)* is an abundant species throughout the forests of Central America, ranging from Mexico to Panama (Reid, 2009; Trujano-alvarez and Alvarez-castaneda, 2010). In CNP, it has consistently been (alongside *H. desmarestianus*), the most commonly captured rodent species during small mammal surveying performed by Operation Wallacea (H. Hoskins pers.comm; Gilroy *et al.* 2017). The genus of deer mice *Peromyscus* is a common prey source for numerous snakes, including *Lampropeltis* (L. W. Porras. pers.comm; Greene and Rodriguez-robles, 2003). Specifically, *P. mexicanus* was also reported from CNP as a prey item for Honduran palm pit viper (*Bothriechis marchi)* (Solis and Brown, 2016). While a diet of rodents may not be unexpected in the genus *Lampropeltis,* this observation offers yet further confirmation that *P. mexicanus* is an important component in the diet of co-occurring snakes, presenting a valid in-situ record for the natural diet of *L. abnorma*.

Acknowledgements:

I show great appreciation to Operation Wallacea for facilitating annual herpetology research in the cloud forest at Cusuco National Park, Honduras; and indeed the staff, volunteers and local guides who provide invaluable field support. I also thank Fiona Reid for her expert advice regarding mammal

identification on her visit to KURCF, Isla de Utila, Honduras; Hannah Hoskins of Queens University Belfast, UK, for the information on small mammal community composition in Cusuco National Park, Honduras; and finally Louis W. Porras for his reviews prior to publication. All field data collection (Reptiles and Mammals) was performed under valid biological research and collection permits (Dictamen técnico ICF-DVS-104-2016; ICF-193-2016); issued to Operation Wallacea by the Instituto Nacional de Conservación y Desarrollo Forestal, Áreas Protegidas y Vida Silvestre (ICF), Tegucicalpa, Honduras.

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New locality records of Nagarjunsagar Racer, *Platyceps bholanathi*, Sharma 1976 from Tamil Nadu, southern India

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Introduction:

The elusive Nagarjunsagar Racer, *Platyceps bholanathi (*Sharma, 1976) (Wallach *et al*. 2014) is one of the least known, endemic colubrids found in the southern parts of India. Since its discovery in 1976 only few publications have contributed valuable information on its distribution, glimpses of its ecology and the comparison to its congener *Platyceps gracilis* (Günther, 1862). This species has been reported from four states (fig 2.), 1. Andhra Pradesh: Nagarjuna hills, Guntur district (Sharma, 1976, type locality); Kapilatheertham, Seshachalam hills, Chittor district (Guptha *et al*. 2013); Rishi valley, Madanapalle, Chittor district (Deshwal and Becker 2017); 2.Telangana: Devarakonda, Nalgonda district (Ganesh *et al*., 2013), Golconda fort complex, Hyderabad

(Seetharamaraju and Srinivasulu 2013); 3. Karnataka: Bellary Gudda, Bellary district (Sharma *et al*., 2013); 4. Tamil Nadu: Thally, Hosur district (Ganesh *et al*. 2013); Gingee hills, Viluppuram district (Smart *et al*., 2014); Sigur, Nilgiri district (Samson *et al*., 2017). Here we present the first reports of *Platyceps bholanathi* from two districts of Tamil Nadu, Padmapuram (13.0894˚N, 79.4186˚E, 347m

Fig 1. Dorsal view of a neonate *Platyceps bholanthi* (specimen 2), from Sanyasikundu foothills (11.6332˚N, 78.1887˚E 329m a.s.l), Salem district, Tamil Nadu. Photo by G.Melvinselvan

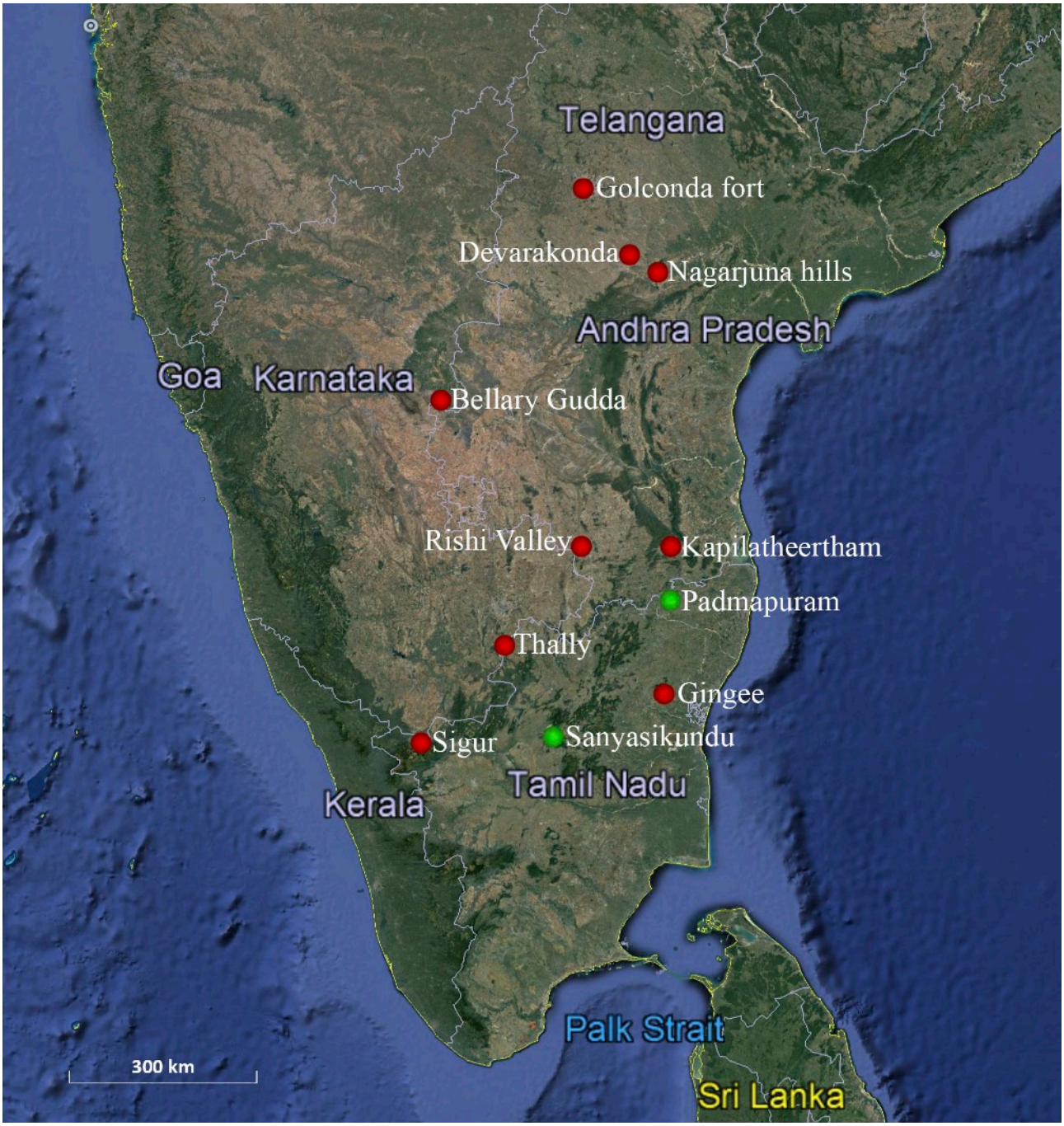

Fig 2. Distribution of *Platyceps bholanathi,* Red circles - existing records, Green circles - new records.

a.s.l) of Thiruvallur district and Sanyasikundu foothills (11.6332˚N, 78.1887˚E, 329m a.s.l) of Salem district.

Methods and materials:

Photographs were taken with Canon EOS 7d DSLR camera with a 100mm lens. The following data were collected: 1.Snout-vent length (SVL) and Tail length (TL) in cm, using measuring tape to the nearest 0.1cm, 2. Meristic data: Ventral scales were counted according to Dowling (1951). Dorsal scales were counted according to Peters (1964), species identification keys were followed after Sharma *et al*., 2013. The snakes were released back at same spot of capture after the data was collected.

Observation:

On 6th January 2017 at ca. 09.20 hrs in Padmapuram, the snake (specimen 1) was found basking on a boulder near Lakshmi

Narasimha Temple. The other snake (specimen 2) from the Sanyasikundu foothills was rescued on 8th December 2017 at ca. 17.40hrs, from a storage room of a local nursery. The habitats of both the locations comprise of rocky hillocks with large boulders and loose rocks, with major vegetation being thorny shrubs, the climate being predominantly hot with low humidity.

Table 1. Morphometric and meristic features of the specimens, *P. bholanathi*

	Specimen 1	Specimen 2
SVL	47.0cm	17.4cm
TL	15.4cm,	06.1cm
Sex	unsexed,	unsexed
Dorsal	19:19:15	19:19:15
Ventral	209	211
Subcaudal	108	111
Supralabial	9, 5th touching eyes	9, 5th touching eyes
Loreal	1	1
Preocular	2	2
Postocular	2	2
Temporal	2+2	2+2
Infralabial	10	10

Discussion:

The current study contributes two more new locality records that are significant for future research and conservation efforts on the species and its preferred habitat as well. The snake sighted in Sanyasikundu foothills was the smallest (23.5 cm total length) recorded specimen so far, the earlier smallest record being 24.6cm found in September 2016 (Samson, 2017). These observations might suggest that the hatching occurs during or post monsoon (September – November). Further studies are required to gain knowledge on the natural history of this understudied, rare colubrid, especially on its reproduction.

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Predation of the Javan spitting cobra (*Naja sputatrix)* on a Painted Bronzeback (*Dendrelaphis* cf. *D. pictus*) in the Sangiran area, central Java, Indonesia

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Introduction:

The Javan spitting cobra, *Naja sputatrix* (Boie, 1827) (Family Elapidae) is widely distributed from western Java to eastern East Nusa Tenggara (De Lang, 2011). It is a medium-length, heavy-bodied cobra that occupies a wide variety of habitats including dry woodlands, deciduous monsoon forests and cultivated fields and hills (Auffenberg, 1980; Suhono, 1986; Boeadi et al., 1998). The fangs of *N. sputatrix* are characterized by reduced, rounded venom discharge orifices, capable of spraying venom as a defense mechanism (Bogert, 1943; Wüster and Thorpe, 1992).

The systematics of Asiatic cobra genus *Naja* has long been contentious. Previously, all Asiatic *Naja* were placed in a single species (*Naja naja*) with up to 10 subspecies (Klemmer, 1963; Harding and Welsch, 1980). More recent work has shown that most of these subspecies form distinct species (Wüster and Thorpe, 1989; 1990; 1991; Wüster et al., 1995; Wüster, 1996).

Asiatic cobras of the genus *Naja* have been reported to feed on rodents, frogs, lizard's eggs and other snakes (Mao, 1970; Daniel, 2002; David and Vogel, 1996; Stuebing and Inger 1999.). Prey remains assessed from gut contents of 84 *N. sputatrix* from central Java were found to be 59% mammalian (likely rats) with the remainder dominated by frogs (Boeadi et al., 1998).

Naja sputatrix are the third most intensively commercially used snake taxon in Indonesia (CITES, 2000) and the only snake taxon for which an annual harvest quota is provided by the Indonesian government (Iskandar and Erdelen, 2006). As of 1998, between 44,855 and 109,650 N. sputatrix (Erdelen, 1998; Boeadi et al., 1998; Sugardjito et al., 1998) were harvested for leather meat and blood (the latter two consumed primarily by ethnic Chinese customers). At least 2,000,000 Asiatic cobras were exported between 1990 and 1998 (for all purposes including the pet trade), greatly exceeding government quotas (CITES, 2000). The most current export quota for Indonesia, last updated in 2011, is 450 specimens for the pet trade and 134,550 for the skin trade (CITES website; Iskandar et al., 2012). Most specimens were obtained from human-modified habitats such as rice fields. Anecdotal evidence suggests that species

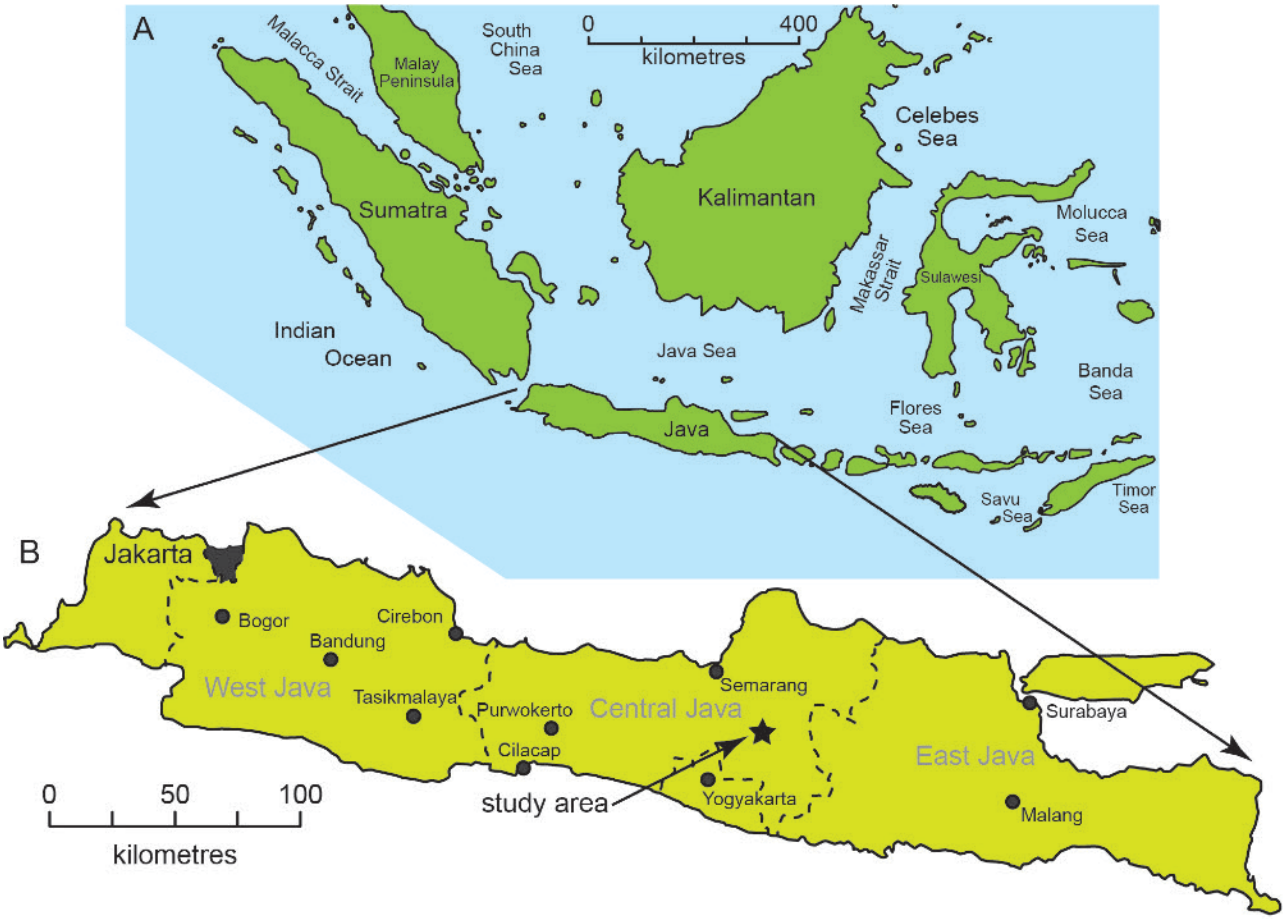

Figure 1. Location map of the study area. The *Naja sputatrix* predation discussed herein occurred near the village of Ngargorejo in Central Java province, Indonesia (star) at 07° 27' 39.95''; 110° 51' 15.13''.

Figure 2. Javan spitting cobra (*Naja sputatrix*) swallowing a painted bronzeback (*Dendrelaphis pictus*). The cobra is ~85 cm in length whereas the bronzeback is close to ~96 cm. Photographed from a distance of 5 metres using a Canon EOS 70D with a Canon EF 100-400mm f4.5-5.6 IS USM lens.

numbers have declined in recent years however the IUCN Red list categorizes N. sputatrix as 'least concern' (Iskandar et al., 2012).

Snakes remain Indonesia's least understood reptiles from a conservation and population perspective (Iskander and Erdelen, 2006). Despite the abundance of *N. sputatrix* in Java, and its importance in trade and as a component of numerous ecosystems, only a single published systematic analysis of the food preferences of *N. sputatrix* is available (Boeadi et al., 1998). Herein we describe the attempted predation by an individual *N. sputatrix* on a painted bronzeback snake (*Dendrelaphis pictus*; family Colubridae).

Observation and Discussion:

On the afternoon of April 15, 2017 (ca. 15:45) a small (~80 cm) *Naja sputatrix* was encountered by palaeontological field researchers in a dry creek bottom in a wooded area fringing extensive rice fields near the village of Ngargorejo in Central Java province, Indonesia (07° 27' 39.95"; 110° 51' 15.13"; Figure 1). *Naja sputatrix* in central Java generally retreat rapidly and thus are rarely observed in the open. This individual however was observed in an open area, approximately 1 metre from cover, with a partially swallowed *Dendrelaphis pictus* in its mouth (Figure 2). The *N. sputatrix* was thus unable to escape quickly. Initially it attempted to slither to cover with it's prey however our approach apparently startled the *N. sputatrix* sufficiently that it started to regurgitate its prey. Although we backed off to give it space, the *D. pictus* was entirely regurgitated and the *N. sputatrix* rapidly escaped into dense brush on the side of adjacent rice fields. An hour later, when we passed by the original location, the dead *D. pictus* remained abandoned in the dry streambed.

Both the *N. sputatrix* and the *D. pictus* appeared to be in good health with smooth scales and muscles and no visible ectoparasites. The *D. pictus* was quite slender but measured 960 mm from snout to tip of tail (335mm cloaca to tail tip). The *N. sputatrix* could not be measured directly but in comparison with the *D.* pictus it is estimated that it was 800-850 mm in total length. Owing to the healthy nature of the victim, and observation of a single puncture mark 11 cm's posterior to the head, it is presumed that the cobra had killed its prey through a venomous bite. Curiously, *N. sputatrix* is typically nocturnal (Boeadi et al., 1998) while *D. pictus* is diurnal. They would thus seem unlikely to encounter each other under typical circumstances.

Asian grass frogs (*Fejervarya limnocharis*), *D. pictus* and common sun skinks (*Eutropis multifasciata*) were commonly observed during our fieldwork, particularly on the edges of rice fields. An individual *D. pictus* was observed preying upon a small frog (presumably *F. limnocharis*) approximately 100 metres west of the *N. sputatrix* predation site. It is presumed that these frogs are also preyed upon by *N. sputatrix*. The present sighting is clear evidence that, in addition to frogs and rodents (Boeadi et al., 1998), snakes are also a component of the diet of *N. sputatrix*. Additional work is necessary to assess whether *N. sputatrix* have adapted their behaviour to hunt this specific diurnal prey.

Acknowledgements:
The observations made herein occurred during a palaeontological field excursion to the Sangiran Dome. Funding for this project was provided by a grant to RC from the University of Iowa, ongoing National Geographic funding for Indonesian palaeontological field research and a NSERC Discovery Grant to JPZ. Ben Owens is thanked for his encouragement in writing this article and the Herping The Globe Facebook community is thanked for helpful suggestions in identifying the taxa discussed herein.

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Figure 1. Initial location of krait 2.5 m above ground on tree trunk (A), continued climbing following release (B).

Unexpected Arboreality by a Malayan krait (*Bungarus candidus*) in Thailand

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Introduction:

The Malayan krait *Bungarus candidus* is distributed throughout much of Southeast Asia and thought to primarily inhabit forests, plantations, and adjacent agricultural lands (Chan-ard et al., 2015; Wogan et al., 2012; Knierim et al., 2018). Malayan kraits produce potent venom, causing neurotoxic effects, potentially leading to respiratory ptosis and death in humans (Looareesuwan et al., 1988). Many studies have focused on krait's potent venom and the synthesis of anti-venom to treat bites (Othman et al., 2014; Rusmili et al., 2014). However, few studies have investigated the scantly understood ecology of Malayan kraits. Currently, only three studies have assessed the spatial use and ecological habits of Malayan kraits (Knierim et al., 2018; Crane et al., 2016; Mohammadi et al., 2014), none of which reported arboreality. Herein we report our observations on the arboreal behavior of a wild Malayan krait in Northeast Thailand.

Observation and Discussion:

We observed the Malayan krait climbing up a tree at 22:30 h on 12 May 2018 during a night survey at the Sakaerat Biosphere Reserve, Nakhon Ratchasima, Thailand (14.4991° N, 101.9413° E; 349 m ASL.). We initially spotted the krait at an approximate height of 2.5 m above the ground. The tree trunk was near vertical; however, the krait made use of adjacent branches and vines to assist in its ascent (Figure 1A). The ambient temperature was (24.3ºC) and relative humidity (94.4%) during our observation. We immediately captured the individual to determine sex and record biometrics.

The individual was an adult male, weighing 346.1 g and measuring 121.2 cm snout to vent length (SVL) and 137.2 cm total length. We released the krait at its initial position on the tree the following night. Upon release, the krait proceeded to climb to the top of the broken trunk, approximately 5 m above the ground (Figure 1B). Our survey and handling methods were carried out with the approval of Suranaree University of Technology's Animal Use and Ethics Committee and permitted by the National Research Council of Thailand (permit No. 0002/10662).

Our novel observation contributes to the limited ecological knowledgebase on the cryptic, yet medically significant, Malayan krait. Interestingly, several species of non-venomous snakes of the family Colubridae co-occur geographically with kraits, while also exhibiting similar banding patterns. These species likely mimic kraits through Batesian mimicry, taking advantage of predator's aversion to the potentially lethal warning colors. Some banded species from our study site, such as the Malayan bridal snake, *Dryocalamus subannulatus*, even display threat behaviors resembling those of kraits (Karraker et al., 2014). The Malayan bridal snake is an arboreal species (Grismer et al, 2013), whose shared space use with Malayan kraits likely led to the evolution of its advanced mimicry.

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Book review - Venom: The Secrets of Nature's Deadliest Weapon

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Venom: The Secrets of Nature's Deadliest Weapon. Ronald Jenner and Eivind Undheim (2017). Natural History Museum, Cromwell Road, London, SW7 5BD. 208 pp. ISBN 978 0565 0 94034. UK £14.99 (paperback).

In 2017, the exhibition *Venom: Killer and Cure* opened at the Natural History Museum in London, its organisation headed by researcher, Dr. Ronald Jenner. In conjunction with the exhibition, Jenner, and co-author Dr. Eivind Undheim of the University of Queensland, have written this popular science book on the subject of venom.

Following an introductory chapter, which defines what is meant by venom – 'nature's ultimate weapon' – the book goes on to summarise the many animal groups with venomous members, as well as venom's different functions, and mechanisms for its delivery. Subsequent chapters cover the techniques by which venomologists study their subject, including the collection of venom from live animals and the use of LD_{50} values to quantify toxicity; the physiological actions of venom on the target's body; and how natural selection acts upon venom, from ecological influences, to its metabolic cost. The history of our own relationship with venomous animals – particularly snakes – is largely saved for the penultimate chapter, though several case studies of envenomated humans are described earlier on.

The book is well illustrated, with colour photographs placed at relevant locations within the text. Tables and diagrams are also used effectively to convey information, such as a run-down of numbers of venomous species and how many times venom is believed to have independently evolved. It ends with a relatively short glossary, which still manages to cover most of the terminologies that were not already explained in the text itself.

Jenner and Undheim put effort into explaining what an important evolutionary invention venom is, and successfully engage the reader, using both examples and their style of delivery. They convey their points in terms that any reader can appreciate, such as references to the beauty (or ugliness) of some venomous animals – and, in the case of the slow loris, the problems that can arise from being too aesthetically appealing. There are humorous moments, such as Jenner's own recollection of being "assaulted by a venomous animal" while on holiday in Malaysia. (I won't spoil what kind.) From the beginning, the authors note how people tend to automatically fear venomous animals and consider only a few particular examples (e.g. snakes, scorpions), before quickly explaining how widespread the usage of venom actually is, and the many positive impacts of the over 200,000 animal species which use it (including, but not limited to, the medical benefits of venom components). The whole book gives a very wide coverage of the subject of venom in the space available, utilising many different taxa as examples throughout.

For the most part, the book also succeeds in striking a balance between being comprehensible to the average reader while not sacrificing too much scientific detail. Almost all of the scientific terminology used is explained either in the text or the glossary. Jenner and Undheim explain their principles as clearly as possible without oversimplifying, though some sections feel more aimed at readers already familiar with science –

particularly Chapters 4 and 5, which cover how toxins act on ion channels, and why cysteine-rich peptides are good candidates for recruitment into venom.

Overall, Dr. Ronald Jenner and Dr. Eivind Undheim have produced a book which should appeal to a wide range of readers, including scientists: in terms of its ability to bring the fascinating and complex subject of venom to a general audience, it is certainly a great success.