Responsible Herpetoculture Journal

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- THE TREE MONITORS OF RAJA AMPAT
- THE NATURAL HISTORY AND CAPTIVE HUSBANDRY OF THE MOLE LIZARDS
- THE HISTORY AND FUTURE OF ANTWERP ZOO, BELGIUM
- A GUIDE TO THE NEWTS OF GERMANY
- CONSERVATION OF THE ENDANGERED THREE-COLOURED HARLEQUIN TOAD
- BREEDING GALAPAGOS GIANT TORTOISES AT "CROCODILES OF THE WORLD"
- BEHIND THE SCENES AT TONG REPTILE FACILITY, HONG KONG

Photo Credit by Dmiti Tkachev

When the Conservation of Amphibians and Reptiles is not Enough...

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CONTENTS

FOREWORD: REPTILE AND AMPHIBIAN CONSERVATION

Author(s): ***Thomas Marriott***, *Executive Editor of the Responsible Herpetoculture Journal, UK*

Figure 1. Author, Thomas Marriott with one of less than 50 *Atelopus tricolor* known to science.

According to the International Union for Conservation of Nature (IUCN), 21% of reptiles and 41% of amphibians are threatened by extinction, making them some of the most imperilled groups of animals on Earth. Biodiversity loss is affecting the entire world and even the most wild places are now intrinsically entangled with human civilisation and growth. Social and political ideas and a globalised consumer market are exacerbating population declines and, sadly, there is very little that the individual can do to stop this. However, there are a million ways in which people can support conservation initiatives across the globe. From sharing knowledge, to donating to international organisations, conservation is a multi-faceted objective and understanding more about the link between herpetoculture and conservation can help individuals make a real impact.

Over the last five months, I have travelled across South America with a primary focus on finding and photographing reptiles and amphibians in their natural habitats. Whilst I am always fascinated by the natural world, captive breeding is becoming ever-more important across the world. On the Galapagos Islands, I saw the fantastic results of captive-breeding almost all giant tortoise species across three separate facilities on three different islands. In Bolivia, I joined the Bolivian Amphibian Initiative to monitor some of the rarest amphibians on Earth, only to find that the institution is desperately trying to establish a captive population. In Guatemala, I visited Rowland Griffin to see the work he is doing at Zoologico Nacional La Aurora and his work captive-breeding and reintroducing beaded lizards to the wild. Even when sitting back and drinking a beer in Panama, the "golden frog" (*Atelopus zeteki*) can be found on drinks, food and souvenirs to help raise the profile of this species and its related captive-breeding projects.

Private herpetoculture, when done responsibly, opens doors to new conservation possibilities. From understanding the practical husbandry methods required to captive-breed endangered species to sharing stories and information with the next generation of inspired naturalists, herpetoculture has a vast range of conservation benefits. In fact, private herpetoculturists are largely responsible for the first captive-breeding successes of many species and, with Planet Earth now deep in the Anthropocene, keepers (both private and within zoos) must band together to share their information and resources to ensure that we retain biodiversity in captive collections until effective habitat restoration initiatives, re-wilding attempts and conservation-led land acquisition can create a haven for the world's herpetofauna.

Sadly, uneducated collection of wild animals has prompted population declines, especially in highly-localised species.

Figure 2. A Critically Endangered big-headed turtle (*Platysternon megacephalum*) bred at London Zoo using knowledge acquired from private keepers.

Figure 3. The blue tree monitor (*Varanus macraei*) – a species that is Critically Endangered and threatened by over-harvesting but is now frequently bred in captivity. © Chris Applin

Ungoverned collection for the pet trade remains a threat to wild animals, but a greater understanding of captive breeding allows in-situ projects to become more successful; a story that is exemplified by the work of conservationists in Madagascar working with ploughshare and radiated tortoises.

Today, it is extremely important to not only source animals responsibly, but to share as much information about captive-bred specimens as possible. That is why this issue of the Responsible Herpetoculture Journal will be made available to anyone who is interested and why we continue to approach keepers across the world to share their research on an easily-accessible platform.

It is vitally important that reptile keepers understand their perimeters and boundaries before choosing to care for a large collection of animals, as welfare standards must be achievable. However, keepers of all species can contribute to shared knowledge through engagement on social media, or by writing for publications such as the Responsible Herpetoculture Journal. We, at the RHF are working hard to make this process easy for everyone. We now have an international editorial team engaging with potential authors covering stories on a wide range of species and we are continuing to reach out to members of the herpetoculture community to share their knowledge and experience. We have ambitions to bring the world of herpetoculture - from news and literature reviews to breeders' manuals and conservation features - onto one easy-to-use platform. By supporting the Responsible Herpetoculture Journal you are helping to fund the progression of herpetoculture as a discipline as well as several conservation initiatives we hope to announce officially, very soon.

Figure 4. Author, Thomas Marriott with a Parson's chameleon (*Calumma p. parsonii*) in Eastern Madagascar. This species is threatened by deforestation.

IHS Breeders Meeting Update

The International Herpetological Society (IHS) enjoyed another successful Reptile Show on 24th June. The show was well received by visitors, with a generally positive reaction to the new Milton Keynes venue. June's show was the first time the event has been held outside its usual venue in Doncaster and was another successful day for the IHS.

Unfortunately, unknown circumstances have caused the IHS to cancel the upcoming 3rd September show. At the time of writing, the society has managed to secure a new venue and the show has been rescheduled to the 17th September. Details on the new venue have not yet been announced, but the IHS is hopeful that the new venue will be as well-received as the short-lived MK venue.

Alongside the success of the June show was the sad news that at the end of April, Doreen Brooks, the first female president elect of the IHS, and membership secretary since 2008, passed away. She was a much-loved member of the society who was an integral part of the shows and a familiar face to all who attended.

FBH publishes response to new Animal Welfare Committee proposal

The Animal Welfare Committee has published an official "opinion" to form new minimum-size guidelines for snake enclosures in commercial premises in the UK. The proposal demands that snake enclosures must be longer than the length of the snake's body. Despite publishing a full "Code of Conduct" that has been widely implemented by reptile shops across the country, the work of the Federation of British Herpetologists appears to have gone unrecognised in the AWC's proposal.

The FBH proposes that captive snakes should be allowed to stretch their entire body out, but that it must not be dictated by enclosure length and three-dimensional movement should be considered. They also propose that businesses housing animals temporarily should also be assessed on "Animal Activities Licensing" guidelines as opposed to the new AWC proposal.

Criticism for the proposal is stated as the FBH do not believe that: "the AWC in its current form is a suitable group to produce impartial and evidence-based conclusions relating to reptile keeping in the UK." "The evidence presented in in the AWC Opinion i) a comprehensive review of evidence-base, ii) supports the conclusion for either vivarium size requirements or the definition of temporary accommodation."

The full species count as of July. A report will be published soon.

Exotics Keeper Magazine announces competition winner

UK reptile magazine, Exotics Keeper, last month announced the winner of their survey competition. Richard Wall, the lucky keeper of a Horsfield tortoise, won £1,000 store credit to spend at his local reptile shop, Wilton Pet Centre in Basildon. Although the competition has now closed, the survey continues to accurately document the reptile-keeping hobby in the UK. It has counted over 1,300 unique species, including over 850 reptiles and amphibians. This data is now being dissected by independent analysts and will be published in a full report in 2024.

Frog ID reaches half a million records

The Animal Welfare Committee has published an official The fourth annual release of the FrogID dataset in Australia has just been published. The citizen conservation initiative asks members of the public to record sightings of frogs across Australia. It is a project that has been widely supported by government and the Australian Museum. Since its launch in 2017, over 23,000 people have submitted sightings on the platform, accounting for records of 218 of Australia's 247 native frog species. Now, the data is being used to form "The Frog Atlas", a public resource that allows anyone from researchers to land managers, understand more about Australia's native amphibians.

The FrogID platform, listing a variety of Anurans and associated sightings across Australia

Australian researchers discover extinct giant shingleback skink

An extinct species of shingleback skink has been discovered by researchers at Flinders University in Australia.
The *Tiliqua frangens* species, thought to have been covered with thick spiny armour, was directly related to modern shingleback skinks from Australia and were around the size of a human arm.
They existed in Australia around two million years ago during the Pleistocene period and went extinct around 47,000 years ago.
Dr Kailah Thorn, WA Museum Technical Officer for Terrestrial Vertebrates, described the extinct species: "Frangens was 1000 times bigger than the Australian common garden skink and reveals that even small creatures were supersized during the Pleistocene."
The discovery could offer useful insight into the plight of the modern species.
"Deciphering how Pleistocene animals adapted, migrated, or what eventually caused their extinctions might help us conserve today's fauna, which faces pressures such as changing climate and habitat destruction," said Dr Thorn.

A shingleback skink (*T. rugosa rugosa*) from Victoria, Australia. Today's relative of *Tiliqua frangens*

Louisiana pine snakes released in Memphis breeding programme

Five Louisiana pine snakes bred at Memphis Zoo in Tennessee have been successfully released into the wild as part of an ongoing conservation programme. Memphis zoos and the Texas cities of For Worth and Lufkin have collaborated to support the conservation of the species which has been classified as 'threatened' by the federal government.
Every year, pine snakes are released into Kisatchie National Forest in central Louisiana, a precious resource for the conservation programme as the species cannot survive easily in other habitats.
This year alone, more than 100 captive-bred pine snakes will be released. The forest is the ideal habitat for the snakes, with a high tree canopy, plenty of grass, and sandy soil. The area is also popular with gophers, the prey of the pine snake, whose burrow system the snakes use to live and hibernate.
Steve Reichling, Memphis Zoo's Director of Conservation and Research, said: "We provide the snakes in our snake factories, which are funded by the U.S. Forest Service, into habitat that the Fish and Wildlife Service and Forest Service have developed. It's just a perfect marriage, really."

https://apnews.com/article/louisiana-pine-snake-release-ad5add13103d324f6c1c6373c6f86337

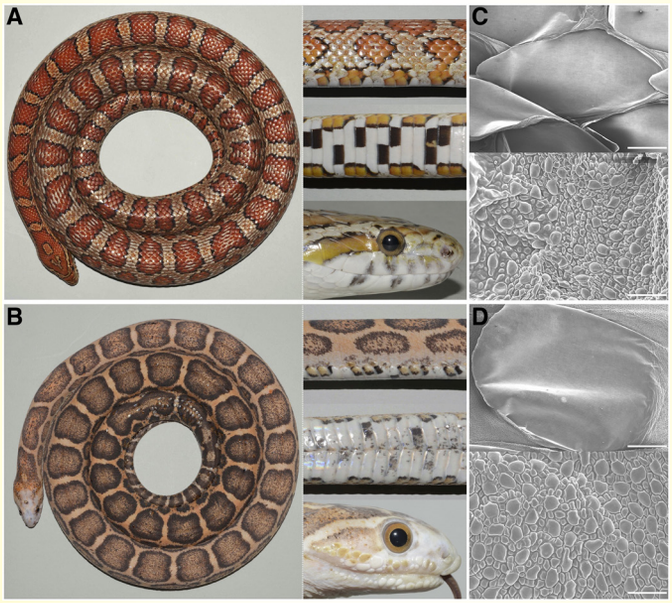
New *Stefania* frog species described in in Brazil

A new species of *Stefania* frog, found in the Wei-Assipu-tepui tabletop mountains in Brazil, has been described.
The *Stefania maccullochi sp. nov.* is a larger species of the Stefania genus, with the female holotype measuring 72.9mm in length and the male measuring 54.6mm in length.
The *Stefania* carries its eggs and froglets on its back and the new species is a medium brown with dark markings. The nocturnal frog is classed as critically endangered by the International Union for Conservation of Nature (IUCN).
The species was described by Philippe Kok from the Department of Ecology and Vertebrate Zoology at the University of Łódź in Poland.

Kok, Philippe. (2023). Bones and all: a new critically endangered Pantepui species of *Stefania* (Anura: Hemiphractidae) and a new osteological synapomorphy for the genus. Zoological Letters. 9. 10.1186/s40851-023-00209-6.

Researchers hatch first gene-edited corn snake

Researchers at the University of Geneva and the University of Zurich have collaborated to create the first gene edited corn snake, using the CRISPR-Cas9 system.
Their efforts show that that gene disruptions are responsible for differences in scale placement in the snakes which aid their movement.
The experiment involved researchers injecting five scaled female corn snakes and breeding them with both scaleless corn snakes and heterozygous males, meaning they have two forms of the same gene. The results show that the snakes have no dorso-lateral scales due to a disrupted EDARADD gene.
The females laid 69 eggs, 54 of which hatched. Four were scaleless, laid by a female that had mated with a scaleless male. The others were all scaled, apparently due to a recessive gene.



(A and B) Scale distribution in a scaled (A) and a scaleless (B) adult corn snake. A dorsal view (left) and close-ups of lateral, ventral, and head views (right) are shown. Adult corn snakes measure approximately 1.2 m. (C and D) Micrographs of dorsal scales (top; scale bars, 500 µm) and interscale skin (bottom; scale bars, 50 µm) of a scaled (C) and a scaleless (D) animal.

Athanasia C. Tzika, et al - Somitic positional information guides self-organized patterning of snake scales.Sci. Adv.9,eadf8834(2023).DOI:10.1126/sciadv.adf8834

American crocodile lays viable eggs via 'virgin birth'

The first known case of parthenogenesis in an American crocodile has been recorded at Parque Reptilandia in Costa Rica.
The crocodile has been kept alone for 16 years and produced viable eggs in 2018, aged 18. Researchers at Virginia Polytechnic Institute and State University, the Chiricahua Desert Museum, Illinois Natural History Survey, Reptilandia Reptile Lagoon and Parque Reptilandia have recently published their findings that the eggs were produced via parthenogenesis.
Parthenogenesis is the process of an animal producing viable young without any other genetic contribution. The phenomenon has been recorded in invertebrates, fish, amphibians, reptiles and birds.
While none of the 14 eggs laid by the crocodile hatched, despite seven being transferred to an incubator, researchers reported that they had been viable. One had progressed to a the form of a recognisable crocodile hatchling that was almost identical to the mother.

https://www.nationalgeographic.com/animals/article/american-crocodiles-virgin-birth-parthenogenesis#:~:text=Scientists%20have%20just%20discovered%20that,%2C%20or%20%E2%80%9Cvirgin%20birth.%22

TOADS ON THE EDGE OF EXISTENCE: MONITORING THREE-COLORED HARLEQUIN TOAD WITH THE BOLIVIAN AMPHIBIAN INITIATIVE

Author(s): ***Thomas Marriott***, *Executive Editor of the RHJ, UK*

Foreword: Few groups of amphibians are quite as imperilled as the *Atelopus* toads of Central and South America. With 99 recognised species of *Atelopus* (commonly referred to as stubfoot toads, harlequin frogs and toads, and other colloquial names) all except five species are either Endangered, Critically Endangered, Extinct in the Wild or Data Deficient. Several species have been considered extinct for decades, only to reappear in extremely delicate ecosystems in small, localised populations. One species for which this mysterious Lazarus tale rings true is the three-coloured harlequin toad (*Atelopus tricolor* Boulenger, 1902). Thomas Marriott, Executive Editor of the Responsible Herpetoculture Journal joined the Bolivian Amphibian Initiative in May 2023 to understand the complexities of protecting a species on the edge of existence.

Figure 1. The three-coloured harlequin toad (*A. tricolor*) © Thomas Marriott.

Figure 2. *A. tricolor* being held to be swabbed for Chytrid © Thomas Marriott.

Figure 3. All clothing must be disinfected before and after entering the *Atelopus* location.

Three colours

The "three-coloured harlequin toad" is a species of *Atelopus* that was previously found in tropical and subtropical Andean forests of southern Perú and Bolivia. It is the southernmost occurring species of *Atelopus* and the only species found in Bolivia. *A. tricolor* was once considered a common species across its reasonably extensive range but seemed to almost vanish in the early 00s, with no sightings of the toad from 2003 until January 2020. After a re-classification of *A. tricolor*'s conservation status in 2019, herpetologists began searching for the rare toads once again. In 2020, by some miracle, a Bolivian photographer named Mauricio Pacheco, managed to locate a toad in the Caranavi Province of La Paz, Bolivia. He contacted the Bolivian Amphibian Initiative immediately and work began to protect the toad. A three-phase project was outlined to first understand the toad, then understand the habitat and then create strong relationships with the local communities that live alongside this rare species.

In 2020, four specimens were found. Since then, the BAI has found more individuals within the area and is carefully monitoring the population which sees seasonal fluctuations each year. A spokesperson for the Bolivian Amphibian Initiative said: "More attempts to try to find other new populations were unfortunately unsuccessful. During this period, we found that the habitat where this species is present is under high risk because it is surrounded by different agricultural and even touristic activities that could wash off the only known population of this critically endangered toad. At the same time, we are evaluating the presence of Bd in the species and exploring if other

species in the area are affected. We also found that local communities and local authorities were not aware of the presence of this toad, they wanted to do something to improve the situation of this species, but most of the time they came up with some ideas that could not be the most beneficial for the species."

Now, the organisation has unfortunately discovered the worst, confirming that the toads do carry Bd but are seemingly unaffected by the fungal disease. Patricia Mendoza-Miranda is the President of the Bolivian Amphibian Initiative. She told Exotics Keeper Magazine: "Of course, Chytrid is a big threat. We now know that the population here *does* have Chytrid so we need to monitor their health but also be very careful about the spread of pathogens. We have a strict biosecurity protocol when working with this population. We must disinfect our boots when entering the site and again once we leave the river. So far, it looks like the toads are surviving with Chytrid and the population is healthy, but we have only been monitoring them for two years, so we still have a lot to learn. It is also difficult to explain to local people that ecotourism does not work here. This year, we have the opportunity to establish ecotourism in the area to help the local community, but not with the toads. Perhaps birds would be better, and we can work with local people to educate them on other species in the area."

It is not just Chytrid that threatens these toads. Environmental factors are thought to present an even greater threat than the deadly fungal disease. Patricia explained: "*Atelopus* are found in from tropical wet forests along the Pacific coast and the Amazon basin to the montane and paramos regions of the Andes. *A. tricolor* need a very unique habitat and have very specific temperature and humidity requirements. Unfortunately, the climate in Bolivia is changing. This year, for example, we have not had as much rain as in other years, it has been extremely dry! The people say this is because we are not taking care of the forest. This could have a serious impact on the toads."

"Contamination of water sources is also a very dangerous threat. The education about the ecosystems and environment is not good here and the local people use pesticides in their soil when they farm. These chemicals can run directly down the river and this poses a big problem. We still need to learn more about the impact of this but I think that pesticides are certainly affecting the *Atelopus* here."

Figure 4. A healthy *A. tricolor* © Thomas Marriott.

Three phases

BAI is currently working on a three-phase plan that will inevitably span 2 years with the *A. tricolor*. Having already spent two years in the field, monitoring the population almost every month since the project began, attention is now turning towards a long-term model of protection. The primary method here is through community outreach, although the project has also recently put forward proposals for the funding of a captive-breeding project.

Patricia continues: "The third phase is research. We need to know the species so we have the data available to us if we need to set up a captive breeding project in the future. Also, education is very important, too. We need to work with authorities over time and also work with students to teach them about the project and the biological tools we are using for the Atelopus Project. Phase three is community outreach. Our main goal for this project is that the people protect this species and it is only the project coordinator of BAI that works with the people. I collated the project but it is down to the community to take the lead on this."

Whilst joining Patricia and Rene Carpio in the field, we visited two primary schools and delivered talks to students and teachers about the importance of conservation, particularly that of *A. tricolor.* Throughout the week, Patricia also delivered presentations within the local community to other stakeholders who could potentially protect the toads. "We need them to think that *Atelopus* is his or her species, so they become the protectors of the species" adds Patricia. "We have created stickers on WhatsApp of 'Aty' our cartoon *Atelopus* mascot, that the children can use when sending messages. We know children spend more time looking at their phones than in the forest, so it is important that we create ways to remind them of the *Atelopus*."

As well as developing mascots and producing novelty masks and various other creative outreach ideas, the Bolivian Amphibian Initiative also works with fundraising organisations to provide educational books on a wide range of biodiversity across the country. When presenting the books to a school's headteacher, he told us that the snake on the cover of the book was a bad omen and that if a black and red snake crosses someone's path, they will have bad luck until they kill the animal. Patricia explained: "There are a lot of false tales about reptiles and amphibians in Bolivia, particularly in rural communities. We call these 'mitos'. For example, some species of amphibians including Critically

Figure 5. Patricia, engaging with pupils of the local primary schools, wearing *Atelopus* masks.

Figure 6. "Aty" the *Atelopus* sticker pack, developed for WhatsApp.

Figure 7. Patricia donating books to a Headteacher at a local primary school.

Endangered *Telmatobius* are said to spread skin diseases and warts if a person touches them. We are working hard to create comic strips that dispel these myths, but it is very difficult to change a person's mindset when their parents and the generations before them think that something is true. Luckily, there are no mitos around the *Atelopus* as they are very small and in a very restricted area. The local people do not visit the streams at night because it is dangerous, so they don't see them too often."

The monitoring process

Patricia and Rene spent one week in the Caranavi Province as part of the project. During this time, the populations are monitored. This is usually done at night as it is easier to spot and identify the toads, although it is possible to monitor the population during the day. Patricia and Rene had set up a camp on the grounds of a local primary school close to the *Atelopus* population, sleeping in tents and cooking food each day before undertaking different tasks. Some of these tasks included

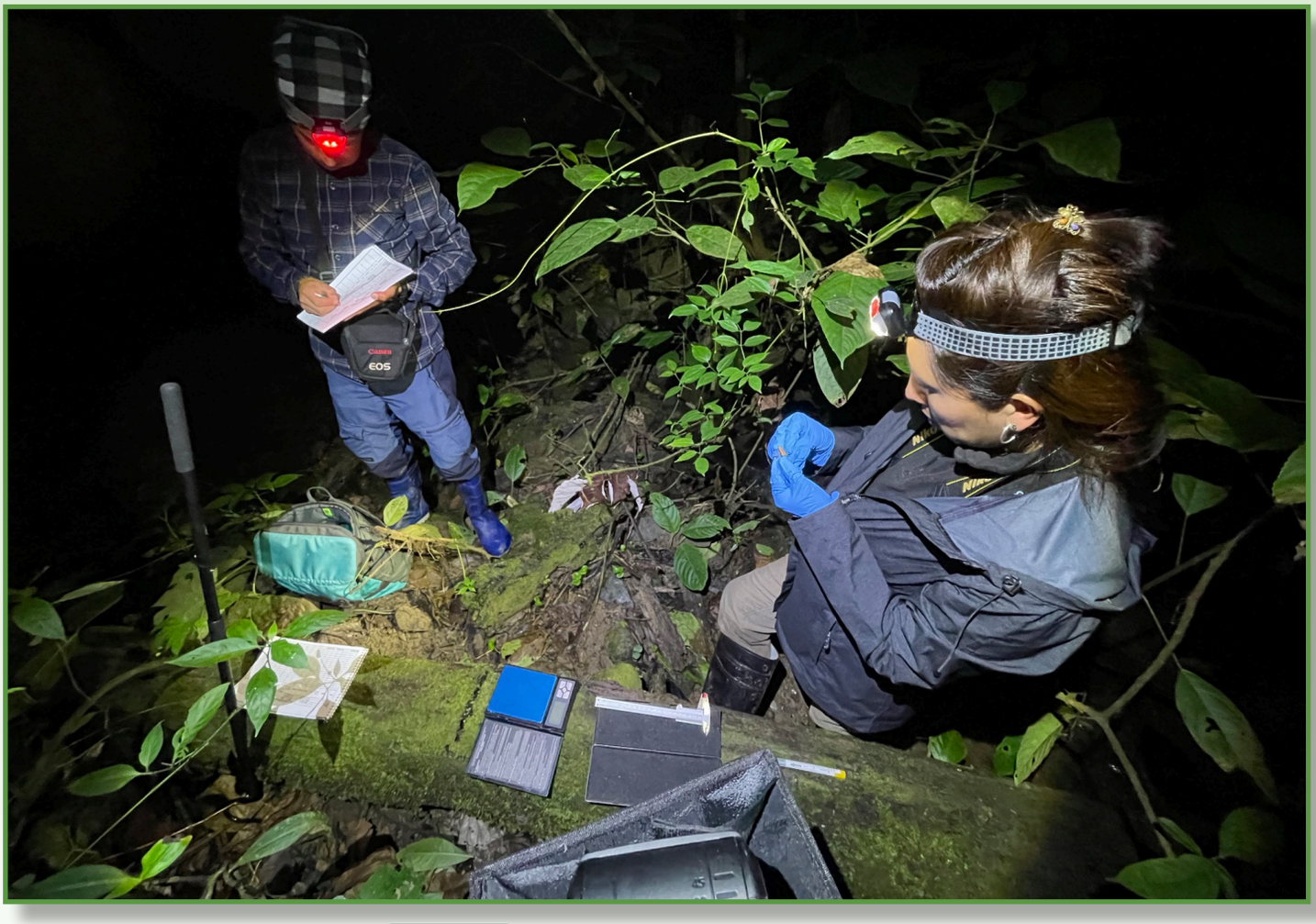


Figure 8. Patricia and Rene in the field.

outreach projects to build relationships with local people, book donations, habitat analysis and mapping, environmental data recording and more. Rene would measure temperature, UV and humidity levels periodically through the day. May marked the "winter" season for the region, when the amphibians are less active. As BAI visits the *Atelopus* location roughly each month, the exact environmental data needs to be collected as frequently as possible to paint an accurate picture of the toad's requirements.

After visiting two local communities and cooking some dinner, we headed out to the *Atelopus* site. This is a fast-running and very steep stream that trails down the mountainside. Equipped with headlamps, waders, cameras and long-sleeved tops we clambered down the stream in search of the toads. Several data sets were required for each toad. Basic health checks such as size (snout-to-vent length (SVL)) and weight were necessary to understand the toads. Females are typically larger than males and as with a few species of *Atelopus*, the three-coloured harlequin toad population is dominated primarily by males. Females are generally larger than the males, so they are quite easy to identify. Understanding the sex ratios within the population will provide valuable data on the natural history of the toads, the feasibility of the population and help inform potential future captive breeding projects.

Figure 9. The unique dorsal patterns of *A. tricolor* ©Thomas Marriott.

Figure 10. The underside of an *A. tricolor* ©Thomas Marriott.

Figure 11. A newly-metamorphosed froglet © Thomas Marriott.

The individual toads are then identified to help keep track of numbers. Each animal has a unique dorsal pattern that Patricia photographs and cross-references with a database of similar images at the office. This has allowed BAI to confidently identify just over 30 unique individuals in the two years that the population has been monitored. During this trip, we also discovered a newly metamorphosed *Atelopus* froglet. At little over 5 mm (0.20 in) in length, it was impossible to take any useful readings of this animal and extremely difficult to photograph. However, as the first *A. tricolor* froglet photographed (perhaps even sighted) in over 20 years, its presence alone was a valuable insight into the population's health and reproductive patterns.

The adult toads are also swabbed for Chytrid before being released back into the same spot where they are found. In most cases, this is atop a low-lying broadleaf close to the water's edge. Patricia told us that most of the frogs return to the same rough location each time they are monitored. If, for example, a specimen escapes whilst being photographed, the researchers have a very good chance of finding the exact same animal in the same patch of river the following evening. This means that monitoring such a tiny population is comparatively successful because finding and identifying the individuals is quite straightforward once the initial challenge of accessing the river is overcome.

Captive Breeding

Last month, Patricia and the rest of the team at the Bolivian Amphibian Initiative submitted a proposal for funding to embark on a captive breeding project for *A. tricolor*. Having already successfully bred *Telmatobius culeus* (Garman, 1876) for over a decade, the organisation sees great potential in formulating a captive population to protect and reinstate the population from potential future hazards.

Patricia continued: "I think captive breeding could definitely work for *Atelopus* but it is very difficult with this species. We have far more males than females and we only have a few individuals isolated in a small area. This is very different to *Telmatobius* for example. It is necessary, however, because there are

many threats here so we don't have time! Perhaps the next threat that arises will wipe out the *Atelopus* altogether. We have many years of experience with *Telmatobius* and have now put together a good plan for the Atelopus that we feel will work."

"We would have to first do a breeding programme with a model species, perhaps *Rhinella*. We don't know exactly which species we will use, but we are studying other species that occupy this habitat to inform our decision-making. *Rhinella* is in the same group as *Atelopus,* which is ideal. First, we need to learn about the model species, then we can start the project with *A. tricolor*."

The Bolivian Amphibian Initiative is currently in the process of reaching out to donors to support the scheme. Science, particularly herpetology, is underfunded in Bolivia. For a country with some of the greatest levels of biodiversity in the world, there is not a single laboratory available for herpetologists to complete DNA sequencing when describing new species. Instead, samples are shipped abroad at very high costs and therefore, herpetological breakthroughs are consistently thwarted by financial challenges. Luckily, the dedication of BAI is helping to protect species at a grassroots level and hopefully in the coming years, the work of Patricia, Rene and the entire BAI organisation will pay off with international support for this very rare and very unique little amphibian.

Patricia concluded: "Bolivian Amphibian Initiative, in my opinion, is like a phoenix. I worked with BAI for many years, but in 2018 BAI started again. The people that work with BAI are extremely passionate about frogs and conservation and it's very important to be surrounded by these kinds of people. Now, BAI has members and volunteers. We are trying to give students and members their own projects within BAI, because we have many species that need conservation projects within Bolivia. Now we have members from different regions in Bolivia that work with active members, passive members and volunteers. Each member works in his or her city with their own project. For example, we have Felipe Tellez in Sucre who has a project with *Telmatobius simonsi* Parker, 1940 BAI gives him the resources to work on this. In Cochabamba, we also accept proposals from members and students and BAI provides financial support. This allows us to work with a wide variety of species." BAI spent many years studying *Telmatobius*. The species *T. culeus* was once Critically Endangered, now it is Endangered and that is very important to our team. The BAI now works with *Atelopus* and we really hope that we can do the same thing here."

Figure 12. *A. tricolor* © Patricia Mendoza.

The future of Atelopus

Sadly, a mix of threats similar to those that affect the three-coloured harlequin toad also imperil almost every other member of the *Atelopus* genus. Whilst some are more at risk of Chytrid and others are perhaps more endangered by habitat alteration, a global concerted effort to protect the genus is needed to see this group of amphibians survive long enough for the next generation of conservationists to even attempt to protect them. A paper published in 2005 by Venezuelan Herpetologist, Enrique La Marca et al states that "Of [at the time of writing] 113 species that have been described or are candidates for description, data indicate that in 42 species, population sizes have been reduced by at least half and only ten species have stable populations. The status of the remaining taxa is unknown. At least 30 species have been missing from all known localities for at least 8 yr and are feared extinct. Most of these species were last seen between 1984 and 1996. All species restricted to elevations of above 1000 m have declined and 75% have disappeared, while 58% of lowland species have declined, and 38% have disappeared." Sadly, the situation looks even more perilous and whilst new species have been described since 2005, even more have been confirmed extinct or described as localities of existing species. For such a widely distributed genus of amphibians, populations reducing to single streams and rivers across a once enormous South American range paints a deeply disturbing picture of conservation in the tropics.

In some cases, the removal of wild populations of *Atelopus* for captive breeding has saved entire species from extinction, as is the case with *Atelopus zeteki* Dunn, 1933, the Panamanian golden "frog". The last remaining of these toads were collected in 2006 and were filmed for the last time on the same expedition for the Sir David Attenborough-narrated BBC documentary 'Life in Cold Blood'. Since then, zoological institutions across the US, fronted by San Diego Zoo have captive-bred the species and produced over 500 toads. However, with the threat of Chytrid and deforestation still rife in the cloud forests of West Panama, these toads are unable to be released into the wild. Whilst initiatives such as the Panama Golden Frog Project are working with local communities and protecting reserves that may one day host truly wild "golden frogs", even the most successful captive breeding attempts face immense challenges when reinstating such delicate species. However, the more we learn as a herpetoculturist community and the more information that is shared between keepers of all amphibians, the greater chance accredited institutions stand at successfully producing Critically Endangered species. A change in attitudes around the environment at both global and localised levels, combined with sheer dedication from conservation programmes may be the only way forward for the harlequin toads of the *Atelopus* genus.

Figure 13. Patricia and Rene seeking out some of the last remaining *A. tricolor* on Earth.

HUSBANDRY OF HELMETHEAD GECKOS

Author(s): ***Hubert Dobosz***, *Private breeder, Poland.*

Helmethead gecko *Tarentola chazaliae* (Mocquard, 1895), was described in 1895 as *Geckonia chazaliae* Mocquard, 1895. The specific name, chazaliae, is in honor of the yacht Chazalie, which belonged to French naturalist Raymond Comte de Dalmas (1862–1930), the collector of the holotype **(https://en.wikipedia.org/wiki/Helmethead_gecko)**.

It is a small species with a body length of approximately 7 to 10 cm (2.75-3.94 in). It is naturally found in Cap Blanc, French West Africa (generally including Senegal, Mauritania, Western Sahara, and southern Morocco) (Mocquard, 1895). The head of the helmethead gecko is adorned with tiny granulations, while the tubercles located at the rear of the head are enlarged and take the shape of a prominent casque. Its digits are flattened and shaped like spatulas. On its dorsal side, the helmethead gecko exhibits a range of colors, spanning from light grey to dark brown, appearing either as a solid hue or with pale or dark blotches. The ventral side of the gecko is characterized by a light-colored tone (Carranza et al., 2002; Gramentz, 2005). *T. chazaliae*, primarily active during the night, possesses unique adaptations compared to most diurnal lizards. While diurnal lizards typically rely solely on cones and lack rod structures in their retinas, this gecko has undergone further eye adaptations, allowing it to perceive some degree of color vision in

Figure 1. One of my *T. chazaliae*.

low-light conditions. It has developed a multifocal optical system, enabling the distinction of light at various wavelengths. During the night, the gecko's pupils are circular, but during the day, they transform into a pair of pinhole-sized pupils in each eye. The precise purpose of this change remains uncertain, but one theory suggests that the pinhole pupils may reduce visibility to potential predators while the gecko basks in sunlight. Notably, helmethead geckos are the first documented vertebrates capable of discerning color under extremely low light levels, exhibiting night vision that is 350 times more acute than that of humans (Roth et al., 2009).

The habitat of this gecko consists of sandy and rocky desert areas with sparse vegetation, primarily in the coastal zone where humidity is higher. Due to their nocturnal lifestyle, they hide during the day under roots, rocks, and other hard-to-reach places, basking on sun-warmed stones at night.

Keeping

This gecko species is quite sensitive. Fine sand or sand mixed with gravel or clay pellets works well as a substrate. They do not tolerate direct contact with water, which should be provided in a shallow dish. Lightly misting the terrarium during the day, preferably near the corner, or using a fogger for a gentle mist is

Figure 2. My *T. chazaliae* breeding group 1.2.

Figure 3. Another look at my breeding group *T. chazaliae*.

Figure 4. Interior decoration of a terrarium, where I keep my *T. chazaliae* group.

sufficient. Despite preferring to hide during the day (there are plenty of shelters of different types (Fig. 4)), they willingly utilize UVB lighting (UVB 10.0). Along with other breeders of this species, it was observed that it has a positive impact on the geckos' lives. They self-regulate the amount of UVA and UVB rays they receive, which aid in their metabolic processes, enhance activity, stimulate appetite, and encourage reproductive behaviors, as well as stimulate vitamin D3 synthesis.

Diet

These geckos are insectivorous and are excellent hunters, showing no interest in non-moving prey. They can pursue their prey for several minutes. The feeder insects should be appropriately sized, but larger ones are also acceptable. If necessary, despite their robust body structure, they can break down their food. They are not picky about the insect species, but the insects should resemble those found in their natural habitat. One of the best options is the tropical house cricket *Gryllodes sigillatus* (Walker, 1869), which contains approximately 71.8% water (which the gecko's body absorbs and stores), 6.3% fats, 16.5% protein, and other nutritional values. All insects are dusted with calcium powder.

Breeding

Before the breeding season, geckos should be subjected to a period of hibernation at a temperature of around +10 °C (50.0 °F). Their activity and appetite decrease during this time. *T. chazaliae* eggs have «hard shells.» The eggs should be incubated on dry sand. In the center of the incubation container, a moisture source such as a dish with wet cotton balls should be provided. Alternatively, although

Figure 5. *T. chazaliae* female with a freshly laid egg.

Figure 6. My cb juveniles of *T. chazaliae*..

less effective, the eggs can be placed directly on moist substrate with successful results. Regarding incubations, there are different schools. The most success I've heard of is incubating them on sand with a moist cap in the middle, at +28-32 °C (82.4-89.6 °F) in the air. They also reproduce very well in a terrarium, if you have a constant temperature without big day-night drops. The most successful incubation temperatures according to my experience ranges from +28 to +30 °C (82.4-86.0 °F), maintaining a consistent temperature without fluctuations.

Due to its limited distribution, the helmethead gecko faces challenges, including being captured for the pet trade. Unfortunately, its population trend is declining due to habitat degradation caused by coastal development, particularly in Morocco. Recognizing these threats, the International Union for Conservation of Nature (IUCN) has classified the helmethead gecko as «vulnerable» in terms of its conservation status (https://reptile-database.reptarium.cz/species?genus=Tarentola&species=chazaliae).

Therefore establishing this species in herpetoculture is an important step to ex situ conservation of the species, providing valuable information for potential reintroduction projects and fulfilling the needs of the reptile trade.

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MEXICO'S COOLEST REPTILE: THE MEXICAN MOLE LIZARD

Author(s): ***Carl J. Franklin***, *President of Texas Turtles, USA*

All photos are provided by the author and are used with his permission.

With body movements not unlike progressing accordion bellows creeping along and inspired by peristaltic undulations combined with an almost caterpillar motion, the mole lizard goes undetected by most. The sight of a preserved specimen certainly stokes the curiosity, but observing a living specimen reveals a spectacular example of a not often traversed expression in the annals of tetrapod evolution.

The Mexican Mole Lizard (*Bipes biporus*, Cope 1894) of Baja California pushes its body forward while forelimbs equipped with massive hands bearing five clawed digits clear a path through sandy substrata. All the while waves of muscular contractions pulse in sequence towards the directed path. When the Bipes changes directions, the muscular contractions change as well. While the bodily movements are interesting to say the least, they are quite functional as they serve to anchor and push or pull against points of resistance within their burrows. This effectively assists in providing the thrust needed to push through soil.

For a terrestrial vertebrate to maintain a successful subterranean lifestyle a compact and solidly fused skull is essential. In addition, *Bipes* lacks external ear openings, and possesses only small vestigial eyes located anterior lateral on the head just beneath the outermost surface of the skin. The iris is dark pink to reddish, and the pupil is dark grey to black, jaw is counter sunk.

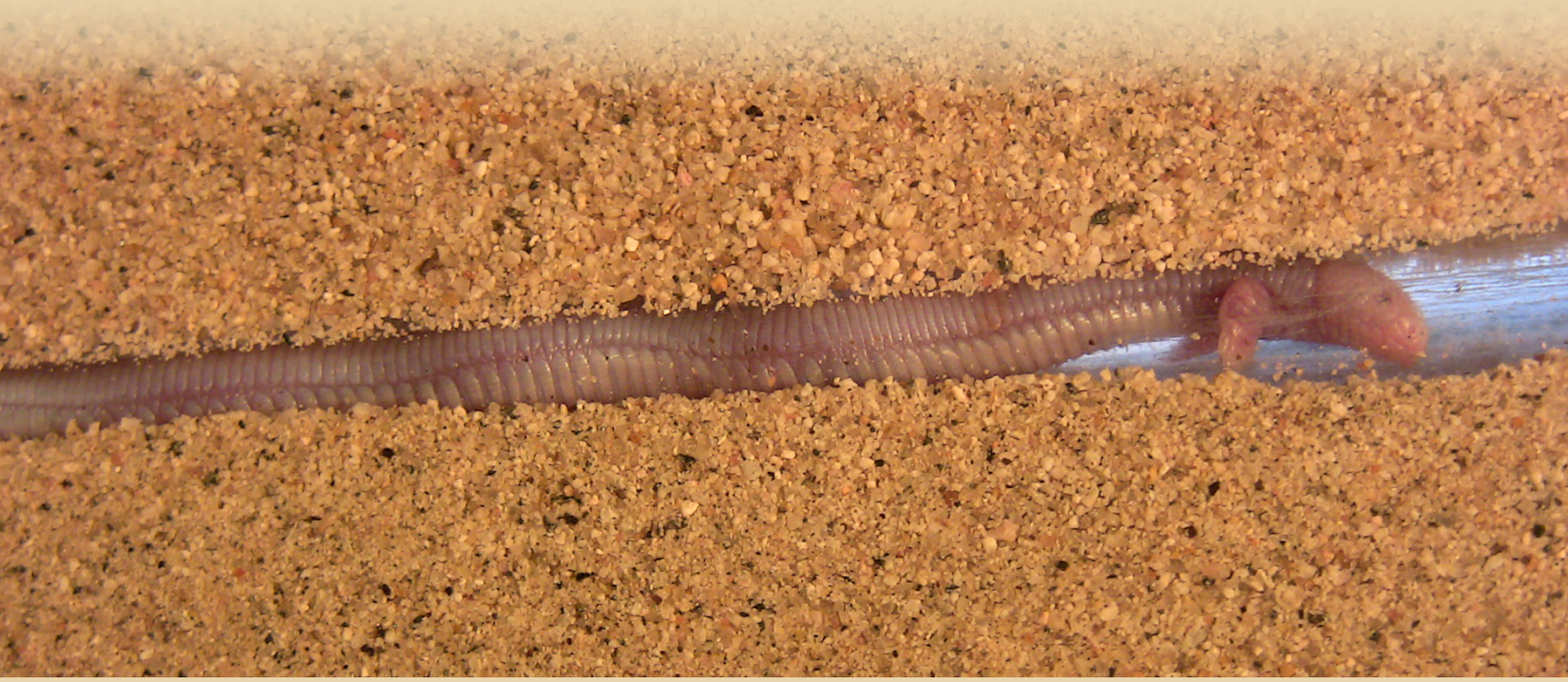

Figure 1. While this simulated tunnel may not entirely portray the movements of *Bipes* below the surface, it nonetheless inspires the imagination regarding how these creatures negotiate a dark subterranean realm.

B. biporus is a small reptile with adults reaching a maximum length of 7 to 9.5 inches (18-23.8 cm). Two forelimbs are present, and each has a hand bearing five large digits with well-developed claws. The forelimbs and hands are used to begin and continue the digging process whenever *Bipes* makes its exit from the surface or excavates from under it. When arm movement is not necessary for locomotion the limbs are neatly tucked away in a recessed section of the anterior lateral area of the body just behind the head. The arrangements of the body scales are semi-annulated with their division occurring along the mid lateral line.

The coloration of hatchlings and young specimens is bright pink. As specimens become older the bright pink fades to a more buff pink with intermittent pale patches. Sensitive to the daytime surface heat and vulnerable to visually oriented predators, the small, thin skinned pink reptile primarily leads a subterranean existence devoid of light.

Bipes belongs to the order Squamata which contains two familiar distinctive reptile lineages, the lizards and snakes. Neither a snake nor a lizard, *B. biporus* is a member of a distinctive suborder of reptiles, the Amphisbaenians (collectively referred to as worm lizards). *Bipes* is considered basal in terms of amphisbaenian evolution (Kearney, 2003) and possesses a suite of physical traits that are less derived than its other worm lizard counterparts among which include functioning front limbs and a blunt skull that is not specialized beyond the fact that it is solidly built.

"Worm lizard" is an appropriate namesake for members of this group of reptiles. Many amphisbaenians are pinkish in color; all spend most of their lives underground and in the instance of *Bipes* when grabbed or alarmed they will even perform spasmodic movements not unlike an earthworm in distress. However, like lizards and snakes, it will release musk and may defecate if handled while frightened. However, unlike other squamates, frightened *Bipes* will quickly bring their heads into contact with the posterior portion of the body in a rapid manner, alternating from side to side. This often causes the body to leave the ground and sometimes be able to 'leap' from one's hand.

The name amphisbaenian literally translates to "to go two separate directions". The similarities between the actual creatures and the fantastic root meaning of the term become apparent at first sight. Along with their subterranean lifestyle, many are encountered accidentally during digging, plowing or moving ground cover. Perhaps watching one advance from and retreat within an exposed tunnel network is what provided the insight that this creature can "move in both directions".

According to fossil specimens, amphisbaenians are a recently developed suborder of the squamates. To some authorities their fossils date back to the Cretaceous (ca. 160 million years ago) while fossils of lizards and snakes are much older and date back to the Jurassic. The debate over which fossil represents the oldest amphisbaenian most recently involved the Hodzhakulia magma from early Cretaceous deposits in Uzbekistan. However, the identity of this species is based entirely upon incomplete maxillary and dentary bones and these limited characters are considered too weak to base a phylogenetic relationship with the amphisbaenians (Kearney, 2003).

Not surprisingly, visuals conjured by thoughts of snakes and lizards do not completely adhere to the image afforded by *Bipes*. Vestigial hind limbs are a documented but cryptic physical characteristic for amphisbaenians and are even found among some lizards and snakes. However, *Bipes* is the only living representative of its suborder to have front limbs.

Range and distribution

Currently, there are three described species of *Bipes*, all of which are endemic to Mexico. *B. biporus* occupies a geographic distribution that begins in the extreme southern portions of peninsular Baja California Norte extending southward through the peninsula to San Jose del Cabo. However, despite its considerable range, it is a series of locations within and near the vicinity of La Paz where finding this species has proven to be the easiest. In fact, when I set out to look for specimens, I typically remain well within the urban landscape of La Paz. Away from the

Figure 2. The well developed claws used for digging by *B. biporus* are visible.

nearby idyllic desert scenery and amid the dirty trash strewn vacant lots is where I spend a considerable amount of time looking for *B. biporus*.

Without a doubt I would much rather spend time in a habitat that supports a diverse array of flora and fauna. However, when searching for a fossorial reptile is my priority, I will do whatever it takes to improve my odds. In the city of La Paz, I have found an equal number of specimens during the early morning hours as I have at night. My search routine consists of locating a site with ground cover suitable or likely to provide sanctuary for small animals and inspecting beneath those items.

In addition to looking under objects, I also keep an eye on the surface especially in locations where there are open sandy areas. In open areas I have not only found extensive amounts of tracks but actual *Bipes* moving about as well. One evening in April 2010, I ventured onto an area that was recently cleared of vegetation for a real estate development and found a large specimen crawling on the surface at 19:30 hours just as the sun was beginning to set.

After finding a specimen in the open, I decided to continue searching the location and upon returning to the site where the specimen was collected, I found a short set of tracks and a recently shed skin. I continued patrolling the area into the night and soon became very frustrated. Walking in a circular pattern trying to visually spot a small pale reptile against the light-colored sand for a few hours can definitely challenge one's eyesight at night. However, the source of my frustration came from encountering fresh surface tracks in places where I had just stepped mere moments before! Once I came across a fresh set of tracks in the sand I would "erase" them with my foot thus I would know when new tracks were made.

Often, I found new tracks at the location where I had just previously removed them! It soon became apparent that I had to change my search strategy. I decided to sit in the middle of the cleared area and simply scan the

Figure 3. This location is just outside of La Paz, and while it appears to be a good location for *Bipes*, stick with trashy empty lots in town if you want to enhance your odds at finding *Bipes*.

ground with my flashlight. By using this method, I was able to find additional specimens, but when I turned around to look behind me (about a minute after sitting down) there were fresh tracks there as well!

This strategy was carried out one night for hours on end and resulted in 4 specimens found actively walking across the surface, and several other tracks created and erased throughout the evening into the early morning. I returned to the location later that morning and discovered a series of tracks on the surface that extended approximately 15 m (45 ft). Not only was it interesting to note that much surface activity, but the tracks were not created entirely by one specimen.

Two *Bipes* had left their tracks alongside one another in a parallel fashion for several meters. Every so often there were clear marks in the sand of lateral undulations. Were these side-by-side surface movements accompanied by signs of conspicuous lateral movements, a testimony to reproductive behaviors? Soon I began noticing their trails in seemingly surprising places including modest areas of soil surrounding a telephone pole that was itself surrounded by sidewalks, buildings and a highway. These were possibly specimens whose habitat was fragmented away from what was once a larger population. Due to the surrounding environmental conditions, I doubt that they migrated to these exact locations. Two noted researchers of Baja California herpetology Ted Papenfuss and Lee Grismer have both indicated that surface activity among *B. biporus* is a rare occurrence (Papenfuss, 1982; Grismer, 2002).

Figure 4. *Bipes* eating grubs.

My first visit to La Paz was in 2000. Since then, the population of the city has grown, and as a result so has the land development. Interestingly the general populace seems to be less aware of the area's native herpetofauna now than they were then. This type of a "disconnect" from the natural world is not unique to Mexico as it can be noted in virtually every urban area worldwide. When looking beneath cover for *Bipes*, the best results are had during the cooler early morning hours as well as the evening to night. During the peak winter or summer months, temperatures may dictate a significant challenge in locating any. However, I have yet to visit known locations for *Bipes* in La Paz and not be able to find any. In my experience, extra effort was required to locate specimens during the months bearing the region's high or low temperatures.

In La Paz, across the street from Hotel Calafia was once a vacant lot occupied by nothing but desert brush, rocks and sand. My friend and Director of El Serpentario de La Paz, Victor Velasquez, informed me that in recent years past during the months of April and May he would notice the trails of several *Bipes* moving on the surface between plant to plant. In 2009 the area was being prepared for the arrival of a new shopping center and we spent an hour following the progress of an earth moving machine with no success.

Victor told me that he used to see flocks of birds feasting on *Bipes* that were suddenly brought to the surface following in the wake of earth moving machinery. In April of 2010 I was invited to a friend's home to look for *Bipes*. It was a recent home built in central La Paz and a bulldozer was being brought in to move dirt and level the backyard. We had three days to visit the home before the heavy machinery came and found a modest number of *Bipes* at night beneath the bricks used to line their driveway. The next day arrived and so did the bulldozer. Some quick checks under the same bricks revealed recently shed skins and new tunnels which confirmed the presence of additional *Bipes*. When the bulldozer started excavating and moving the sandy soil Victor and I, our friends, and the bulldozer supervisor all carefully inspected each scoop. In the end we had procured six specimens in an hour. Unfortunately, 3 of them were killed by the machine. One of the deaths was obvious as internal organs erupted from the body due to the trauma. The other two that were killed died the following day. A small bruise was initially noticed through the thin skin of each. It became apparent that the bruise was an indicator of internal bleeding as upon their death pooled blood was present in the location of the injury. Interestingly one of the specimens was found as it was rapidly leaving the ground while the bulldozer was in operation. When this specimen exited it was at least 30' from the machine. However, strong vibrations could be felt in the ground. Given their similarity to earthworms I wonder if worm 'grunting' might be a successful means to collect specimens. Perhaps underground vibrations are just plain annoying to subterranean dwellers. As a side note of curiosity, I have not yet tried using an electronic worm probe but I should give it a try on my next visit to La Paz. Many of the specimens I have found in La Paz were in environments that appear to be less than conducive to good reptile collecting.

The most intensive investigation pertaining to the ecology and natural history of *B. biporus* to date was undertaken by Theodore Papenfuss

Figure 5. *B. biporus* eating Mazuri insectivore.

from 1972-1979. In fact, the location for his study site was near the corner of the Transpeninsular Highway and Calle Colima. During this time, he collected more than 2,600 specimens. Today the only vestige of this habitat that remains is less than an acre in size. Interestingly enough it is located just behind the Hotel Calafia.

Predators

Although *Bipes* has a subterranean lifestyle, this does not necessarily exempt it from exploitation of predators. To help cope with the event of predation, all three species of *Bipes* can perform tail autotomy.

Tail autotomy is the act of detaching the tail from the body via fracture planes that are situated in the musculature between each caudal vertebra. This practice is employed by most lizards, amphisbaenids, some snakes, and many salamanders.

Many specimens found do lack their tail, and it only stands to reason that being predated upon in a tunnel allows about a fifty percent chance of survivorship. This, of course, is based upon whether or not the predator attempted to consume a *Bipes* head or tail first. In La Paz, Baja California Sur, the Common Night Snake (*Hypsiglena torquate* Gunther, 1860) has been found containing remains of *B. biporus*. The meal, of course, was swallowed head-first.

Another documentation was noted when four coral snakes (*Micrurus laticorallis* Peters, 1870) were found while digging in the banks of the Rio Balsas for *Bipes canaliculatus* Bonnaterre, 1789. Two of the coral snakes were found in the burrow systems of the *Bipes* and one of them contained a *B. canaliculatus* that had also been swallowed head-first (Papenfuss, 1982).

Since my first visit in 2000, La Paz has grown significantly in population and that equates to more developed infrastructure. Many of the activities and past ways of life that put people into more direct daily contact with wildlife have ended, and inhabitants of the city are more and more focused on daily life. This became more evident with each year as fewer and fewer people Victor and I spoke with about *Bipes* even knew what they were. Of course, many of the lifelong residents knew of, or had seen an ajolote, but the number of cautious warnings pertaining to their purported penchant of unspeakable intent also diminished.

On my first visit to southern Baja California I began looking for *Bipes* in earnest digging near the bases of mesquite trees and shrubs and even asking people. I quickly learned that asking people for ajolotes was often a cause for concern. It all began as my wife (who coincidentally is of Mexican descent and did

Figure 6. *B. biporus.*

not believe that her own countrymen would subscribe to such a myth) and I were driving to Mira Flores. On our way we stopped at two men on horseback. I introduced myself and explained that I was studying reptiles and was looking for one in particular, the ajolote. Both men froze then slowly looked at each other each with a slightly twisted face. Then one looked and noticed the Texas licence plates on our car. He looked at his friend and said "Can you believe this guy drove all the way from Texas just to stick something up his rear?" He then looked into our car and noticed my wife to whom he said "mother of god! You're Mexican. You KNOW Better!" We bid them farewell and about 10 miles later we came across another quaint pueblo.

At the edge of town, I stopped and asked a fellow walking beside the road about ajolotes. He backed up and said "Hey mister we're decent people here we don't want any trouble. My uncle already called and warned me that you were heading this way!" While I haven't yet tried to repeat either of the aforementioned incidents the last time anyone acted "odd' after the mention of el ajolote was in 2005 when an elderly man told me to watch my language as there were women nearby. Victor Velasquez has also noticed a decline in the number of people aware of *Bipes*.

While the aforementioned scenario may seem incredible to the reader, they were motivated by an old myth. Essentially the myth of the ajolote is if someone answers a call of nature outdoors or is otherwise partially disrobed and sits upon the ground, an ajolote could enter their body by most unspeakable means, whereupon they would either impregnate a woman or kill a man via gastrointestinal trauma. That's quite an awful reputation for such a small and inoffensive creature!

While I do enjoy less suspicion among people when I tell them what I am looking for in La Paz, it also suggests an ever-increasing disconnect from the natural world.

Collecting Specimens in Mexico

I am sometimes asked how to obtain permits and how to export reptiles from Mexico. The answer is simple, but the process is not, and the scope of required intricacies is beyond that of this article. Simply put, you obtain the collecting permit from the Mexican government entity SEMNARAT (Secretaria de Medio Ambiente y Recursos Natural, www.semarnat.gob. mx) and you obtain the export permit from another entity of the Mexican government PROFEPA (Procuraduria Federal de Proteccion Ambiente http://www.profepa.gob.mx/). These are formal procedures required to legally collect specimens in Mexico and they often require several months of preparation in advance prior to any field activity. Both of these government organizations have some fairly intricate processes for carrying out legal herp collecting, but in the end, they are worth the effort as specimens acquired via these means are legal. Once I had a collecting permit, I had to then begin the process for the export of the specimens before I even got to collect. This process required several months to complete. When working with foreign permit offices and officials it is crucial to remain patient as well as an active participant to the process. I have always been treated courteously and

professionally when working with permit offices in Latin America. I would expect the same for anyone else following the established regulations for collecting herpetological specimens in a foreign country. While the aforementioned provides a general scope of requirements from the Mexican government there is a major requirement necessary for legal entry into the United States.

The US Fish and Wildlife Service requires that all specimens (live or dead) of animals or plants or their byproducts must be declared at the port of entry before being allowed into the country. This is accomplished by filing a 3-177 form. More information and a means to electronically file declarations can be provided online at https://edecs.fws.gov/. Additional information for the US Fish and Wildlife Service can be found at **www.fws.gov**.

Captive Maintenance and Husbandry: Hydration

The husbandry of amphisbaenians is among the least established protocols in all reptilian husbandry. Regardless, a secure enclosure, sufficient water and food are necessary to meet the bare essentials of successful maintenance in captivity.

Most wild-caught *B. biporus* have a flaccid appearance especially around the tail. In addition, the ventral surface may have a furrow. I have found that allowing them access to water for at least a few hours once a week can help remedy the condition. During the time that I was collecting specimens I did not want to inadvertently cause any decline in the health of the specimens I had already collected, while I was collecting additional specimens. Water was provided in the form of a few droplets inside a plastic storage container. The *Bipes* crawled until they eventually contacted one of the drops with their face which resulted in drinking. Soon afterwards defecation often followed. An important consideration to make is that an adult *B. biporus* can drown in a miniscule amount of water. I once placed an adult specimen in no more than 1 mm of water for a few hours. When I placed the specimen in it began drinking and with such a shallow depth appeared to be fine. However, even 1 mm deep water was too much as I returned, and unfortunately the specimen drowned. Given the unfortunate scenario, I now provide water

Figure 7. This specimen was found in 2009 and is doing well in captivity today. Notice the flaccid appearance of the tail.

via droplets, or a small jar lid used as a shallow water dish. This allows access to drinking water while not providing too much water and causing the sand to become muddy.

Wet sand adhered to the body doesn't sound like an enjoyable prospect for us, and it appears to be no different for *B. biporus*. When a specimen becomes wet and subsequently has sand stuck to its body the body movements become greatly impeded. All the specimens I have found were dry and from relatively dry environs. I have found them in sandy soil that ranged from being almost powder like and too dry for maintaining tunnels to slightly moist with well-defined tunnel systems.

Observations of captive specimens on sand that has become wet suggest that they may obtain some amount of their water intake by sucking it directly from the sand. Although none of the specimens in my care have demonstrated any challenge with shedding their skins, a humid location within their enclosure is helpful in reducing any challenges from ever arising.

Housing In its most simplistic form, an adequate housing arrangement for *Bipes* can consist of an escape proof (yet ventilated) box with two inches of clean sand and shallow water dish. For the past year I have been maintaining my specimens in plastic translucent shoe boxes. With each shoe box housing two to three specimens each. This allows for ease in checking on specimens, monitoring food intake and assessing their condition. Specimens under my care are maintained at room temperatures between 72.0-78.0 °F (+22 - +25,5 °C).

Figure 8. *Bipes* will readily eat crickets, alive and dead, in captivity.

At the time of writing, no lighting or thermo-gradient was provided. It is interesting to note that for three months in 2010, I maintained all of them in groups of two or three in translucent shoeboxes on a table in a sunlit room. The sun did not change the temperature in the room. However, the interiors of the enclosures were fully illuminated, and the *Bipes* were frequently observed crawling about their enclosures or merely sitting with their head exposed. They would even eat on the surface while illuminated. Sand is replaced in each enclosure every two months.

Feeding

Bipes do not rely upon sight for finding their food. However they are strongly dependent upon chemosensory cues to locate prey items. Stomach contents from wild caught *B. biporus* reveal a rather opportunistic consumer. While termites comprised 24% of the dietary intake of more than 200 specimens examined, cockroach eggs constituted the majority of prey items at 34% (Kearney, 2003).

Reproduction

Currently, there are some challenges to the successful captive breeding of this species. Standard sexing methods such as probing have thus far been inconclusive. Tail length and sub caudal scale counts are also unreliable ways of determining sex as females can have tails as long as or longer than males.

Candling the animals by holding them against a strong light will highlight a good amount of their internal anatomy, including the skeleton, heart, digestive system and major arteries. However, organs such as testes are simply too small and discrete to notice with this technique.

Females collected in late June to early July 1972 contained enlarged ovarian and oviducal eggs. Out of 101 females gathered

during this time frame, 26 were gravid and all but two of these were more than 185 mm in body length. No gravid females were ever found during any other month of the year. In addition, *B. biporus* is considered to reproduce biannually (Papenfuss, 1982).

Eggs are laid in July and hatchlings appear in August to September (Victor Velasquez, personal comm.). Due to the challenges in accurately sexing the specimens it is recommended that they be maintained in small groups (up to 5 specimens together) to increase the chances that males and females are together.

Additional Considerations

Bipes are definitely one of the more interesting of reptiles, and in my opinion, the most interesting reptile in the Western Hemisphere. This sentiment is shared by many herpetological enthusiasts and the black market trade in illegal *Bipes* substantiates the aforementioned statement. However, one thing is certain there is no legal trade in *Bipes*. There has not been any known captive breeding to date, and any specimens seen outside of their natural habitat were wild collected. I would like to actively encourage enthusiasts to "curb" their enthusiasm should any be made available commercially as these are most certainly illegal specimens. Participating in unscrupulous animal dealings does nothing more than make legitimate research more difficult to accomplish. That being said there are many legal ways to achieve herpetological or herpetocultural goals, and in the end pursuing those avenues is the most rewarding. My fascination with this species began in 1982, and when I look back at what it required to get to this point I get even more excited about what the future holds.

Acknowledgements

Having the opportunity to pursue an ambition and curiosity born in one's childhood is an uncommon privilege. For helping me with this I am indebted to several people. Jacqueline Franklin for her unwavering support in my 28-year goal of acquiring a live colony of *B. biporus*, Jesse Meik for use of his photograph, Ruben Tovar for providing X-rays, Oscar Flores (UNAM) and Andrés Alberto Mendoza Hernández (AMH) and Adrian Espinosa (PROFEPA) were invaluable for assisting with the necessary intricacies of the Mexican permit system. Jonathan A. Campbell provided encouragement and support of this project, and for direct assistance in the field and in the government offices Victor Velasquez is deserving of more gratitude than I can express in this context. Last but certainly not least I am grateful to the unknown number of generous and kind individuals in La Paz and the surrounding communities who have provided helpful information over the past 11 years. Por todos muchisimas gracias.

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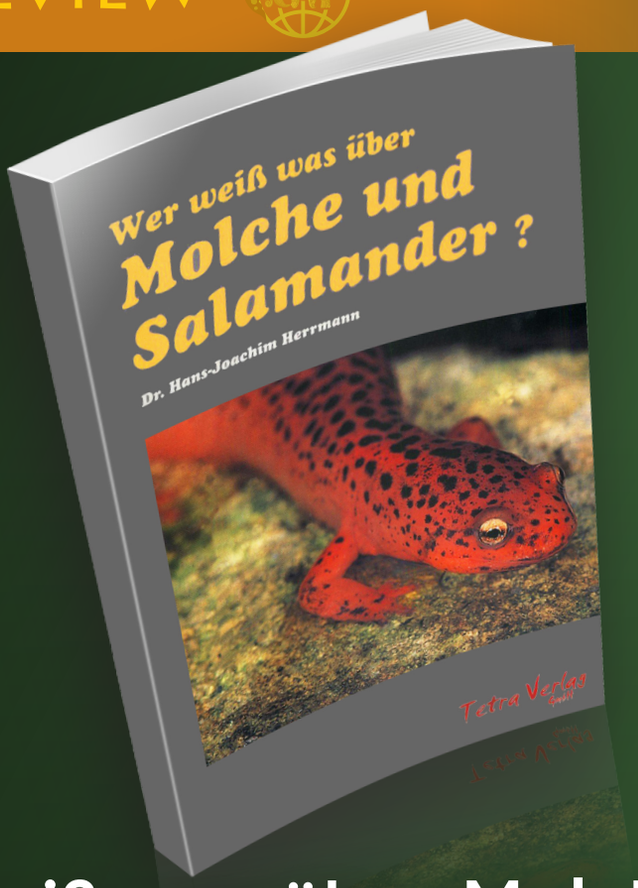
Book review



• Wer weiß was über Molche und Salamander? (Who knows what about newts and salamanders?) by Dr. Hans-Joachim Herrmann

In 2000, an interesting book worth reading was published in the German-speaking world: «Wer weiß was über Molche und Salamander?» (translated: Who knows what about newts and salamanders?) was written by the well-known author Dr. Hans-Joachim Herrmann and published by Tetra Verlag GmbH. As the title anticipates, the small handy book is about newts and salamanders. Already the Red Salamander (*Pseudotriton ruber*) on the cover makes an impression. The book is highly recommended, especially for beginners. The author has structured the content sensibly: Thus, one gets a brief introduction to the fauna of newts and salamanders. Distinguishing features between both caudates are listed and examples are given. It continues with the chapter «Understanding through biology», which deals with the way of life as well as the annual activity period and reproduction and development. Now follow chapters which are relevant to husbandry: The next chapter is about creating a terrarium for caudates. Here also the technology does not come too briefly. The optimized and correct nutrition, as well as hygiene by water changes and the correct spraying to keep the humidity, are explained in detail in the following chapter. Finally, various representatives of newts and salamanders are presented and their special features are discussed. Thus, the reader can get a small overview and already get a small idea, which species is suitable for him as a pet. All in all, it is a nice read, which is especially recommended to every beginner.

Leandro Bergmann, Contributing Editor, Responsible Herpetoculture Journal

OBSERVATIONS FROM FIELD HERPING IN KANSAS

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All photos are provided by the author and are used with his permission.

Introduction

An impressive 99 species of reptiles & amphibians can be located within Kansas (*Kansas Herpetofaunal Atlas*). The eastern portion of the state is covered in a mixture of tallgrass prairie and forests, while the central and western portions are generally shortgrass prairie (Kansas Native Plant Society). For the purposes of this article, I have chosen several species or locations that I have spent the most time seeking out. This is not meant to be the definitive guide to herping Kansas, rather a collection of my experiences with field herping. My goal of this article is to highlight the diversity of herpetofauna in a state that is often overlooked as a flyover state.

To the east, Copperheads (*Agkistrodon contortrix,* Linnaeus 1766) are found primarily near the riparian, forested habitats. The Copperheads of Kansas form a hybrid zone

Figure 1. Two *Agkistrodon contortrix/laticinctus* within the hybridization zone.

Figure 2. A strongly banded *A. contortrix/laticinctus.*

in the southeast portion of the state between the Eastern Copperhead (*A. contortrix*) and the Broad-banded Copperhead (*Agkistrodon laticinctus*, Gloyd & Conant, 1934). Most of the copperheads I have spent time finding are in this zone. (Fig. 1, two animals; Fig. 2, strongly banded animal).

Just from my experiences, copperheads can be incredibly abundant in some locations. A small stretch of road measuring 1.27 miles yielded 17 individuals spotted within only an hour during the spring of 2021. These snakes seem to be most active on warm, humid nights after rain, and just after sunset. Activity has always been at its highest between sunset and 10 PM, and completely dying down by about 11 pm. One individual during the fall of 2019 was photographed consuming a desiccated Brownsnake (*Storeria dekayi,* Holbrook 1839) carcass (Fig. 3). The individual was observed and photographed, eventually backing away into the brush, taking the carcass with it.

Timber Rattlesnakes (*Crotalus horridus,* Linnaeus 1758) can be found in many of the same forested locations as copperheads. These snakes are protected in the state of Kansas, listed as a species in need of conservation (Kansas Department of Wildlife & Parks). *C. horridus* often den in the same hibernacula, year after year (Clark et al., 2008) so caution should be taken when sharing any sightings of these snakes with others. When den sites are made public it can lead to destruction of the site, stress from over-herping and/or poaching.

Over 6 different outings, I so far have only located 2 *C. horridus*. Both were found during the same trip in the summer of 2020, one live, one dead on the road (DOR). This was my first "lifer" moment in Kansas, and I very much yelled in excitement when I saw a *C. horridus* crossing the road (Fig. 4). I stayed in the location while the snake crossed the road to ensure it made it safely, which took longer than expected. Unlike the other rattlesnakes in the state, this

Figure 3. A. contortrix/laticinctus consuming a desiccated *Storeria dekayi* (photo taken by Yang Zhou, and used with permissions).

Figure 4. *C. horridus.*

Figure 5. *C. atrox.*

snake did not become defensive and flee, or even rattle. It sat in the road without much reaction, eventually moving at its own pace. Within a short distance, the recently road-killed specimen was located. This was an agricultural road nearby a forest, and presumptuously, it was hit by one of the farm vehicles that were still out working.

The Western Diamond-back Rattlesnake (*Crotalus atrox,* Baird & Girard, 1853) has an interesting history within the state. *C. atrox* has a few modern sightings along the southern Kansas/northern Oklahoma border, but can also be found far out of their range in Kanopolis State Park. This is not concurrent with their naturally occurring range, and appears to be an introduced population (Matlack, Rehmeier, 2002). There have been sightings for 32 years now, but it is unclear if they are reproducing.

In 2021, I was fortunate enough to be invited by a local naturalist to join a day trip to search for these introduced *C. atrox*. The goal was to see how many could be found and to collect specimens for scientific purposes (with the proper permits). Three snakes were found that day, and two were collected (Fig 5.). We were looking on a cool, April day, with the snakes just beginning to leave their hibernacula. The canyon has several shallow caves where they can be found in many of the crevices by flash lighting. During the peak of the day, they could be found outside of these rocky caves, basking under grasses on the sunny slopes.

Searching the "Red Hills" region in south central Kansas will yield an impressive array of southwestern species that have the very tip of their natural ranges entering the state. This portion of the state is my favorite to spend time in, simply due to the number of animals

that can be located. I was introduced to this region in the summer of 2019, and have spent most of my summers since out there as often as possible. This region has very little to flip, aside from a rock pile next to a public road here or there. Most of the land is sectioned off as private ranchland, so surveying is mostly restricted to driving the public roads. The earth is generally a red clay soil, which has caused some of the species to develop a reddish color or tone. Many species that are common elsewhere in the state can be found with beautiful coloration that matches this environment, such as the common Woodhouse Toad (*Anaxyrus woodhouse*, Girard 1854) (Fig. 6) or Brownsnake *(Storeria dekayi* (Holbrook, 1836)) (Fig. 7).

The region is rich in numbers for certain species. At dusk on most nights, Slender Glass Lizards (*Ophisaurus attenuatus,* Baird 1880) litter the roadways in truly magnificent numbers (Fig 8). When visiting with herpers out in this area, I often joke that you'll be sick of glass lizards after the first few! They often are easy to differentiate from snakes on the road, as their scales have a distinctive sheen. These lizards are clumsy on the road as they try to gather traction, which can often exaggerate this light reflecting off their scales. Care should be taken when photographing these lizards, as they live up to their namesake. They will shatter their tails quickly, leaving only twitching pieces behind.

Figure 6. *A. woodhousi.*

Figure 7. *S. dekayi;* both species (*A. woodhousi* and *S. dekayi*) begin to show various levels of red color within the Red Hills region.

Figure 8. *O. attenuates.*

It's best to spend as little time as possible disturbing them for photographs.

Texas Horned Lizards (*Phrynosoma cornutum,* Harlan 1825) are occasionally encountered on the road. These small lizards often look like blotches of dirt on the roadways. Most of my encounters are animals that are flattening themselves out on the asphalt before sunset to get the last warmth of the day. July and August are generally when the heat peaks for the year, before cooling in September. This past June though, it got so warm, we road-cruised *P. cornutum* occasionally from 11 pm - 1 am basking on the road once the temperatures had cooled to safer levels (Fig. 9).

Many species of snakes can be observed within the South-Central counties of Kansas, but one in my experience has always been the most common: Brownsnakes (*S. dekayi*). *S. dekayi* has had the single highest count of an ectotherm on a herping outing, with a total of 110+ on a single night. While I have

Figure 9. *P. cornutum,* cruised at 1 AM during a stretch of very warm nights.

Figure 10. *S. dekayi* can be variable in phenotype.

encountered them throughout most of the active season, cooler nights (65.0-75.0 °F (+18,3 - +23,9 °C) that are humid or post-rains have always yielded many sightings. Despite their commonality, they are one of my favorite snakes to find. They have proven to be highly variable, with specimens found that are red, lavender, silver-gray, red with brown striping, (Fig. 10) etc.

Western Massasaugas (*Sistrurus tergeminus,* Say 1823) are not far behind in numbers. Within this region, a local herper once told me he stopped counting them on a night after he surpassed 50 within an hour. I have not yet had a night on that level, but they are seen on almost every outing (Fig. 11). Often when encountered, they will begin rattling their tail, but also flicking their heads rapidly as well. While small, these snakes are quite athletic and can launch themselves a decent distance if overly provoked. On one occasion I watched a juvenile strike backward, almost doing a complete back flip before landing. Adults are very easily differentiated from the local Prairie Rattlesnakes (*Crotalus viridis,* Rafinesque 1818), but during

Figure 11. *S. tergeminus* are very plentiful, especially during newborn season.

Figure 12. A dark example of *C. viridis* from Ellis County, KS.

Figure 13. *C. viridis* in a defensive stance.

September-early October, it can be difficult with the influx of newborns. *S. tergeminus* and *C. viridis* newborns/juveniles can be distinguished most easily by the size of the scales on the top of the head. *S. tergeminus* has 9 large scales while *C. viridis* is adorned with many small scales.

The Prairie Rattlesnake (*C. viridis*) can be encountered with some frequency, although is not nearly as numerous on my trips compared to *S. tergeminus* within the Red Hills. In other portions of the state, they can be just as plentiful! My one trip to Ellis County was met with an impressive quantity of *C. viridis* as the sun began to set (Fig. 12). Large and pugnacious, it stands its ground when encountered, rattling with ferocity and moving its tongue slowly up-and-down (Fig. 13). *C. viridis* is not hesitant to defend itself by striking if it feels threatened. These snakes are fairly common, starting from the central portion of the state and continuing throughout the west. Caution should be taken if you are not comfortable being around these snakes, as they can move astonishingly fast when being approached.

Two kingsnake species call Kansas home, the Speckled Kingsnake (*Lampropeltis holbrooki* Stejneger 1902) (Fig. 14) and the Prairie Kingsnake (*Lampropeltis calligaster,* Harlan 1827*)* (Fig. 15). Both can be found concurrently throughout the state. Most of my herping is done via road cruising, where I find significantly more *L. calligaster*. Friends report they find a decent number of *L. holbrooki* when flipping the Flint Hills region to the east. Interestingly, *the L. calligaster* in the state seems to mimic the head shake and tail rattling of the Western Massasauga (*Sistrurus tergeminus*). The *L. holbrooki* do not share this trait, with the exception of some tail rattling while musking which many harmless colubrids do. They are more likely to flee compared to *L. calligaster* in my experience.

Figure 14. *L. holbrooki.*

Figure 15. *L. calligaster* juvenile.

Figure 16. *R. lecontei* juvenile.

The Long-Nosed Snake (*Rhinocheilus lecontei,* Baird & Girard 1853), Chihuahuan Nightsnake (*Hysiglena jani,* Dugé 1865), Glossy Snake (*Arizona elegans,* Kennicott 1859) and Plains Black Headed Snake (*Tantilla nigriceps,* Kennicott 1860) are all fossorial, but can still be road cruised with time and patience.

R. lecontei has been my rarest species, with only two accounts. One was DOR and the other was a live specimen (Fig. 16). Other herpers have reported seeing up to 3 per year on average, however many hours were needed to acquire these sightings. It took me 3 years before I finally even found the DOR animal. These snakes spend most of their time underground, so finally catching one on the move and alive was exhilarating. As beautiful as they are, they are not hesitant to musk, and will also defensively secrete blood from their mouth and cloaca (Ernst et al., 2003).

H. jani can be flipped with regularity in the Spring in some locations, but I only have observed a handful of hatchlings on the road in late Summer and Fall. These are so small that it is difficult to spot them while on the move. It doesn't help that their background coloration is gray or brown, with black blotching or bands, which can blend in very well on certain roadways. The first time I found one, I thought my eyes were playing tricks on me while the sun was setting. I got out of my car and searched before seeing the tiny, coiled snake just by my car tire (Fig. 17).

A. elegans has been located most frequently during my outings. Most animals I have found are hatchlings, although I photographed one truly impressive animal that was just over 41 inches long (Fig. 18). During the fall of 2021, I encountered nights where *A. elegans* hatchlings swarm the roads en masse. This is not unusual during the fall baby boom for many herps as hatchlings/newborns are ending their first season, trying to get in their last meals and bits of warmth before winter begins. That season has been a one off for me so far, with findings being scarce or nonexistent in 2019, 2020 and 2022.

T. nigriceps are one of my favorite snakes to find while herping. One of their most interesting traits is their proclivity for consuming centipedes (Ernst et al., 2003). As their name suggests, they have an all-black colored head (Fig. 19). Their ventrum is a striking orange/pinkish-orange coloration. Their scales have a smooth, shiny look which can be used to distinguish them from *S. dekayi* or other micro snakes in headlights. Anecdotally, I have often found these snakes on some of the warmest nights of the year, where little else has been moving. They are clumsy on the road, and often thrash about until they can reach the grass or soil.

Figure 17. A hatchling *H. jani* found by road cruising.

Figure 18. This *Arizona elegans* measured an impressive 41.489 in (105,38 cm).

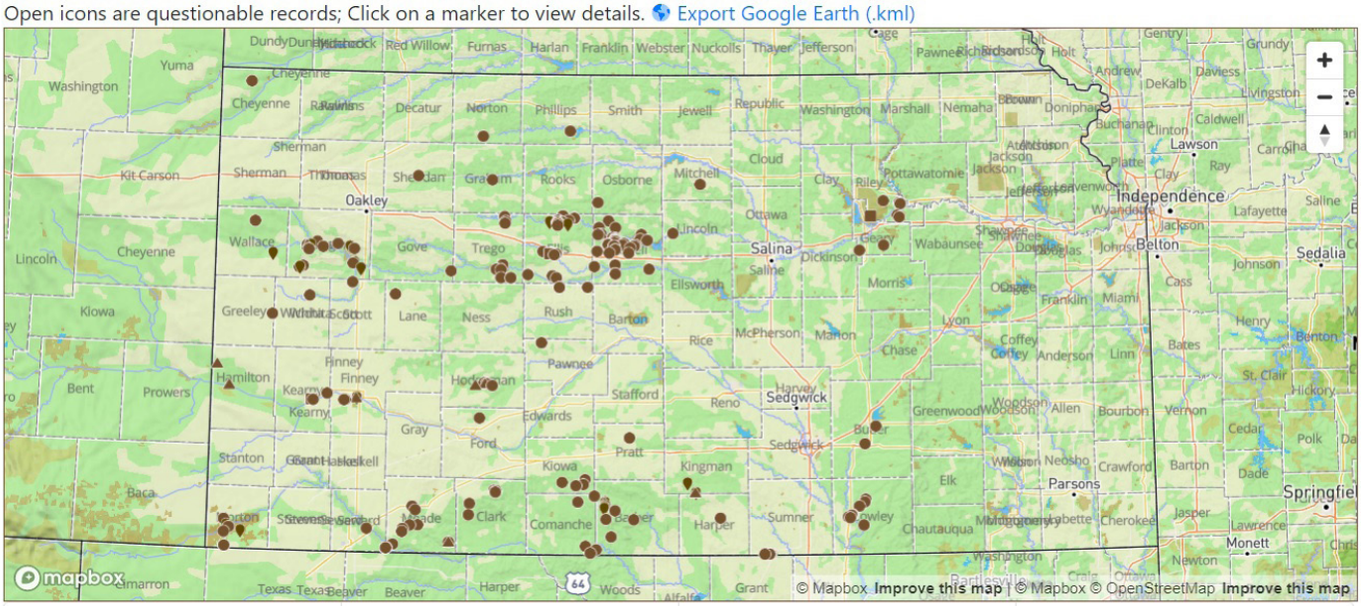
Part of what makes Kansas herping so special is the Kansas Herpetofaunal Atlas. This resource was developed between Fort Hays University (Travis Taggart) and the Sternberg Museum of Natural History (Curtis Schmidt), to catalog reptile & amphibian sightings throughout the state. While herping is an enjoyable hobby by itself, it's rewarding to be able to contribute "citizen science" out of what is normally just a fun outing. Sightings that are added to the KHA are tallied by county and graphed by month to document activity/range of a given species (Fig. 20). There is also the option to add notes per finding (i.e. weather data, unique behavior, alive or dead on road etc.). Recently it was linked with iNaturalist to allow for a greater range of records to be added. KHA's website also has the history of

Figure 19. *T. nigriceps.*

Kansas herpetology, species accounts and a library of academic articles that reference (or are) pertinent to Kansas herpetofauna.

My interest in writing this article stemmed from my belief when I moved here that a state such Kansas wouldn't be overly interesting. Local herpetologists, amateur and professional, quickly proved me wrong, introducing me to the great herpetofauna in the area. What started as infrequent trips has turned into spending almost every weekend in the field. In 2020, I set my first field goal to photograph all the pitvipers in the state. After I had finished finding/photographing them all, my attention turned toward filling out the Kansas Herp Atlas. Now, my primary focus is to attempt to locate secretive species that need more documentation. My hope is that others will read this and appreciate what can be found around them, spending time herping and contributing to the herpetology of their own state.

Known from the western two-thirds of Kansas. Isolated populations in the Flint Hills in Riley/Geary and Cowley/Butler counties.
(●, ○ Museum Voucher) (▲, △ Observation) (■, □ Literature Record) (♦, ◊ iNat Record), (✝ Fossil)
Open icons are questionable records; Click on a marker to view details. Export Google Earth (.kml)



Occurrence Summary:	278 Records	263 Museum Vouchers	15 Other Observations

Some county occurrences indicated below may be too imprecise to map above.

County Breakdown: County Name (# occurrences):

Barber (14); Butler (2); Cheyenne (1); Clark (6); Comanche (4); Cowley (30); Douglas (1); Ellis (38); Finney (5); Ford (1); Geary (4); Gove (1); Graham (1); Greeley (1); Hamilton (3); Harper (3); Hodgeman (9); Kearney (3); Kingman (1); Kiowa (5); Lincoln (1); Logan (21); Meade (17); Mitchell (1); Morton (8); Ness (2); Norton (1); Osborne (1); Pawnee (1); Phillips (1); Pratt (1); Riley (7); Rush (4); Russell (53); Scott (2); Seward (1); Sheridan (1); Sumner (8); Trego (10); Unknown (1); Wallace (2); Wichita (1);

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ON THE SH(ELL)DERS OF GIANTS: BREEDING GALAPAGOS GIANT TORTOISES

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Foreword: The Galapagos Islands are an archipelago of Pacific Islands around 1,000km off the shore of Ecuador. There are 19 "large" islands in this group with a total of 127 islets, rocks and islands. Famously, the Galapagos Islands are a hub for biodiversity, their unique volcanic structures amidst the ocean means that the flora and fauna found here have been isolated for hundreds of thousands of years. Eventually, this led to speciation that helped Darwin formally recognise the theory of evolution. There are countless unique species found across the islands, but perhaps the most majestic are the giant tortoises of the genus *Chelonoidis*. Exploited by pirates and early settlers for hundreds of years, each unique species of Chelonoidis has faced immense conservational adversities which are only recently being addressed. In the last few decades conservation and in-situ captive breeding of giant tortoises has been broadly successful, but now zookeepers across the world are starting to learn more about the genus. Recently, keepers at Crocodiles of the World in Brize Norton, UK managed to successfully captive-breed giant tortoises in a UK zoo first. We caught up with Jamie Gilks, Head of Reptiles, to find out more:

Sourcing an icon

Being a reptile-focused collection, and housing so many large reptiles, of course, iconic species such as Galapagos tortoises had been on our collection plan for a long time. Our opportunity to house «Galaps» first came in early 2018 after the arrival of three females from Chester Zoo. The females all hatched at Zoo Zurich in 2001 and are hybrids between *Chelonoidis becki* (Rothschild, 1901), a species found on the north of Isabela Island, and *Chelonoidis porteri* (Rothschild, 1903) a species from the west of Santa Cruz.

Dirk, our male's history is not as clear-cut as the females. We know he first came to Europe in 1965 and has moved between a few collections before coming to us from London Zoo in July of 2018. As a wild hatch, Dirk has the potential to be a very important animal when it comes to future breeding efforts within the European population. Because of this

Figure 1. Enclosure for our giant Galapagos tortoises.

potential, Dirk, alongside a few animals in the European studbook, is awaiting results from blood samples sent off earlier this year. The results from these samples will hopefully confirm exactly what species he is.

Housing flagship species like Galapagos tortoises will always be very important for zoological institutions whether they're a pure species, or hybrids, particularly when it comes to Galapagos tortoises. Hybridisation between different species of Galaps is an interesting topic within itself. They can play an important role when it comes to species recovery, especially if they carry the genes of extinct, or functionally extinct species. Even sterilised hybrids were released on Pinta Island to act as stand-in eco-engineers, and these make for great platforms when speaking with our visitors about Galaps, and some of the struggles they face.

Husbandry methods

The exhibit for our adult group is a total of 183 m^2. 97 m^2 of that is usable indoor space for the tortoises, and the rest makes up their outdoor paddock. Like any reptile, maintaining appropriate temperatures is incredibly important and we only give our Galaps access to their paddock when outdoor temperatures are above +14 °C (57.2 °F).

As for life support systems, our setup is fairly standard for larger reptile exhibits. The exhibit has two basking areas, one larger and one smaller. The larger basking zone has two 8 x 54W lightwave units working alongside two 1.5kw shortwave infrared heaters, and the smaller basking area has one of the 8 x 54W lightwaves and one infrared heater. All the lightwave units in this exhibit are fitted with four 14% T5 tubes and 4 of the 6500 kelvin grow

Figure 2. Basking zone.

Figure 3. Our Galaps' enclosure from other points of view.

Figure 4. Visual barriers.

Figure 5. Bath time.

lamps that come with the unit and run for 10 hours a day throughout the year, and we get UVI readings of 4-5 depending on the basking zone and who might be in it. Any additional lighting comes from the exhibit glass and skylights that are subject to our photoperiod here in the UK. Additional ambient heating is provided by two 5kw air source heat pumps that also have the option to run them on air conditioning modes, this can be very handy for us during the summer as the building is so well insulated, and there are short periods where we may need to keep the tortoises in to help the grass in their paddock recover. However, we do keep the use of air conditioning to an absolute minimum due to running costs, and the air conditioning can reduce the humidity levels within the exhibit, but we can counteract this with our misting system if needed.

We provide our group with two main seasons throughout the year, with gradual increases and decreases in parameters to help ease between the two seasons. October to March is our cooler and drier season, and this is when our females will usually nest and lay eggs. During this time temperatures will usually range between night time lows of +18 °C (64.4 °F) to daytime highs of +26 °C (78.8 °F).

April to September is our breeding season and this is when we will provide warmer and wetter conditions that range between around +22 °C and +32 °C (71.6 and 89.6 °F).

When feeding our tortoises, we follow a rolling diet sheet that is based upon the group's current weight each month, this helps us increase food intake during the summer, which also happens naturally when the tortoises have more grazing access in their paddock, then in

turn slightly reduce their intake during winter. We offer a staple diet of Agrobs and hay with supplementation throughout the year, but we will make this mix a little wetter in the warmer months. On top of their staple, we also add seasonally available weeds, greens, Opuntia and another browse daily.

Too much of a good thing

For us, the biggest challenge we have faced was managing the group dynamic. For the first two years of keeping the species, our temperatures were a bit higher than the ones mentioned above and the use of the rain system in the exhibit was done at a similar consistency throughout the year. This essentially caused us to have a prolonged breeding season. Although we wanted the animals to breed, we didn't want this to happen at the expense of our females. Like most tortoises, male Galapagos tortoises aren't the most delicate when it comes to breeding, and they can be relentless. Dirk, our male, is over 100 kg heavier than our lightest female so continuous mating throughout the year was an obvious concern. It was at this point we looked to improve the seasonal parameters we were offering and added a refuge area for our females. The refuge area was made by installing a series of removable posts that divided off approximately a quarter of our indoor house, the spaces between these posts allows the females to pass through freely whilst being too narrow for our male to access.

Breeding begins...

Pre-conditioning for breeding began two years before our first viable eggs. We did this by going back to basics and improving the parameters to better reflect those within the natural range. This helped offer more defined seasons in which breeding and nesting would take place. One thing we have learnt is that the time spent not breeding is equally as important as the breeding season itself, and as a result, I believe we have reduced the level of stress for our females and in turn have a generally happier group.

Although we'd like to take some credit for the breeding, all the hard work came from the tortoises themselves. We were already

Figure 6. Mating of Galapagos tortoises.

collecting eggs before any changes were made; however, these eggs weren't viable. I don't think the changes we made necessarily improved fertility either, at the time our females would have been around 20 years old and Galapagos tortoises usually start reproducing at around 25 years in the wild, so I think our girls were just a bit too young at that time.

We had always noticed that eggs were laid in the wintertime and nesting usually began as light levels reduced later in the afternoons, the nesting and laying process would usually go into the evening and take about 3-4 hours from start to finish. As this process generally happened when we weren't around a camera system was installed so we would know who had laid the eggs, and where we would need to dig the eggs up from the next morning. The nests for our Galaps will usually measure 30 cm (11.81 in) deep, with a chamber width of around 20 cm (7.87 in) and so far we've had a varying number of eggs in each clutch from 2-16 eggs. Once eggs are collected, we artificially incubate them, and all our hatchlings so far have been incubated at +28 °C (82.4 °F), we have found that at this temperature our average incubation period is 120 days.

Figure 7. Fertile egg.

Juvenile giants

Although not commonplace, captive breeding of Galapagos tortoises has been well documented for a long time. However, most breedings have occurred within the tortoise's natural range, and in the United States. Breeding in Europe is less frequent, with only a handful of collections successfully breeding Galapagos tortoises over the years, and of course, we were thrilled to produce the UK's first hatchlings.

There is not much difference between the adults and hatchlings in terms of general care. Our hatchlings are kept in a different building from our adults. This building is a little warmer, and more humid throughout the year, with temperatures rarely dropping below +25 °C (77.0 °F), but I'm sure our hatchlings would still do very well under the same conditions as the adults.

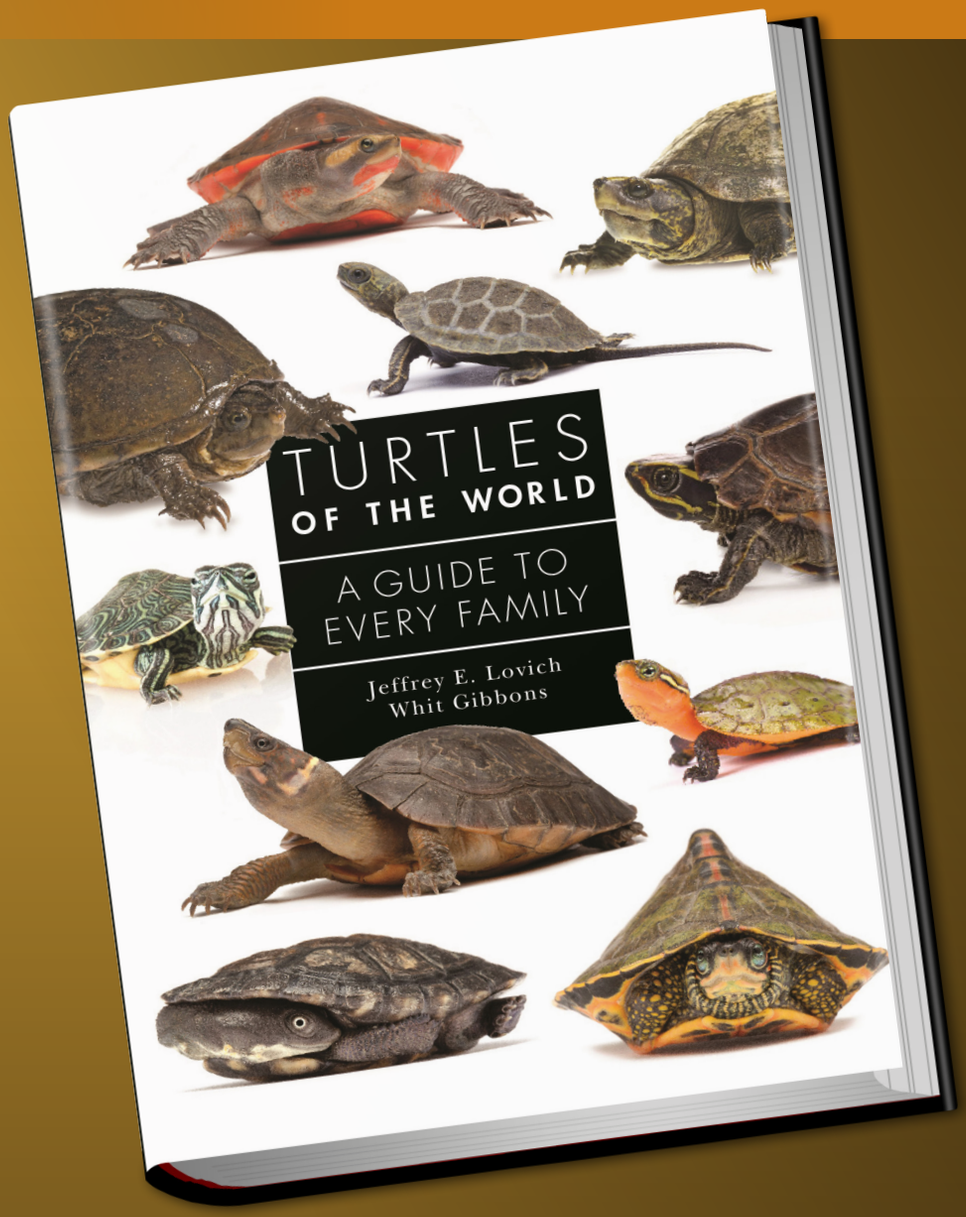
All ten of the hatchlings are still housed with us now, but ultimately, I think their futures will be with other institutions. We're very happy with the growth rate so far. Generally, captive individuals in Europe and the US have grown at a much faster rate than their wild counterparts, even when compared to captive-bred individuals within their natural range. Because of this, we've been quite cautious when it comes to their diet and growth because we don't want to grow them too quickly when compared to their wild counterparts, and we want to make sure their shells grow as smooth and evenly as possible. Our first two hatchlings both hatched at close to 70 g and now they weigh closer to 150-160 g and are in great shape and condition.

Public perception

Public perception has been great, everybody seems to love tortoises' whether they're a reptile enthusiast or a member of the public. I would say our Galap exhibit has become one of our most popular and also receives great dwell time because there is always something going on. We even

Figure 8. Measuring juvenile tortoise.

introduced a «meet a keeper» session at our Galap exhibit because we were getting so many questions about them. One of the biggest misconceptions we get is from visitors thinking that all Galapagos tortoises are the same, or even extinct, mainly because visitors are often aware of the press coverage back from when Lonesome George died. These misconceptions often turn into some of the better conversations between our team and visitors. Our tortoise feeding experience has been very popular too, by running these experiences we have the opportunity to make financial donations and support The Galapagos Conservation Trust, which does great work, not just for tortoises but also for other species on the Galapagos Islands.



• Turtles of the World: A Guide to Every Family

Turtles of the World is the latest instalment of a larger herpetological collection from Princeton University Press, addressing groups of species from across the world. This visually-enticing book has over 250 full colour photos that help the reader understand the dramatic diversity across Chelonian species. Written by US authors and biologists, Jeffrey E. Lovich and Whit Gibbons, the book introduces readers to every family and genus in an easy-to-understand chapter breakdown. Presented in such a way that novices can gain as much enjoyment as the academic, Turtles of the World offers profile descriptions, distribution maps, tables of information and more. At the time of writing, this publication is available for just $22, making a must-have for anyone with an interest in herpetology and understanding more about global herpetofauna.

THE TREE MONITORS OF RAJA AMPAT

Author(s): ***Nurdin Ohorella*** *(Tour Guide in Raja Ampat, West Papua)*
with a Foreword by ***Thomas Marriott*** *(RHJ Executive Editor), UK*

Foreword: The "tree monitors" of Raja Ampat are some of the most sought-after reptiles in herpetoculture. Visually striking, remarkably intelligent and highly active, these Varanids are perfectly suited to the expert keeper. However, they are highly localised lizards, with each species occupying a different island in West Papua. Naturally, their limited distribution makes them all threatened with extinction with several species being considered Critically Endangered by the IUCN.

Despite being bred in captivity quite frequently, animals are still being exported from the wild in reasonably large numbers. According to Indonesian law, these animals are being relocated to breeding facilities in Java, however, there is

Figure 1. A blue tree monitor (*Varanus macraei* Böhme & Jacobs, 2001) in-situ in Batanta © Chris Applin.

some contention around this subject. Now, eco-tourism is offering a new way for local people to benefit from the presence of these marvellous lizards and Nurdin Ohorella is one of the pioneers behind this. It is thought that Nurdin is responsible for introducing the Western world to the "blue tree monitor" and this article discusses his relationship with the tree monitors of Raja Ampat.

The early discoveries

I began my career as a tour guide in 1992. Because I could speak English, even though only a little, I often met many foreign tourists visiting the town of Sorong that like to see animals such as snakes, crocodiles, lizards and birds of paradise. Hence, I was interested to know and learn more about reptiles. So, one day in 1996, I met Dr. Thomas Schultze Westrum from Germany in Sorong. He was a biologist scholar looking for an English speaking guide and soon hired me as his guide.

Since then, I had always guided him to the islands of Batanta and Salawati to meet with the local community. In the Islands, he advised the local community about the importance of nature conservation, namely protecting forests and animals for the sake of nature's preservation.

Because of my additional experience as a guide who knew more about reptiles such as snakes, lizards and other animals, Dr. Thomas came to Sorong in 1999 with crews of the Partridge Film from England to hire me as a guide to take part in a documentary film about the lizard called *Varanus salvadori* (Peters and Doria, 1878) (Crocodile monitor) in Salawati and Batanta. During the same year, I saw the blue tree monitor lizard (*V. macraei*) the first time at the village of Yenenas at Batanta Island,

The first blue tree monitor that I saw was brought to me by a local child and I had no idea what species it was. He told me that he caught it on a coconut tree on the small island named Ayem between Amdui village and Yenenas.

In the year of 2000, I met one of my German friends, Manfred Resingery in Sorong and I told him about the blue lizard that the child showed me. He was so interested specifically in monitor lizards, and so he visited Batanta and caught one specimen of *V. macarei*. In fact, it is probably because of him that the rest of the world knows about the blue tree monitors.

Figure 2. Nurdin Ohorella with a blue tree monitor (*V. macraei*) © Chris Applin.

Figure 3. Nurdin Ohorella with a blue tree monitor (*V. macraei*) © Chris Applin.

Nowadays, herpetologists have given the species the scientific name of *V. macraei*. After this discovery I was invited to arrange the crew and the field needs of a camera crew who visited Batanta to create a documentary film. To my knowledge, since the species was officially described in 2000, *V. macraei* has only ever been found on the island of Batanta, not even close islands such as Sulawati, Waigeo or the Papuan mainland.

The tree monitors of Raja Ampat

Raja Ampat is named after "The King of the Four Islands" (*Raja* meaning King and *Ampat* meaning four). These islands consist of Waigeo, Batanta, Salawati and Misool. Each island has a very different species of tree monitor lizard, but they all belong to the family Varanidae. These lizards are entirely arboreal and they eat, sleep and hunt in the trees. Although each island has a different species of tree monitor, except for Waigeo which has two.

In Waigeo there are two species of the tree monitor lizard, In the western part of the island lives the black tree monitor lizards, *Varanus beccarii* (Doria, 1874), which is also found on the Aru Islands. But, on the eastern part of Waigeo lives another species called the golden spotted tree monitor lizard or Varanus Boehmei. Waigeo Island is the only location in the archipelago that hosts two species of tree monitors.

Batanta Island is home to the *blue* tree monitor, whereas Salawati (a small island that is connected to the mainland of Papua) is home to the nominal form of the "*prasinus* complex', the *green* tree monitor (*Varanus prasinus* (Schlegel, 1839)). This species is also found across the mainland of West Papua and is protected from poaching by law.

The last tree monitor species is found on the island of Misool Island and is commonly called the "yellow" tree monitor (*Varanus reisengeri* Eidenmüller & Wicker, 2005). It was once said that *Varanus boehmei* Jacobs, 2003, *V. macraei* and *resingeri* were subspecies or colour localities of *V. prasinus*, but herpetologists now categorise each lizard as its own individual species.

Figure 4. The 'prasinus' complex of tree monitors from left to right; *V. beccari, V. reisengeri, V. prasinus, V. macraei.*

The most popular monitor lizard in Raja Ampat is the blue tree monitor lizard (*V. macarei*) because it is so unique and endemic to such a small island. Nowadays, it is in high demand by tourists from abroad wanting to see it.

The trade of macraei

Since the species' discovery a lot of people have wanted to harvest the species from Batanta. There are catchers that work across the island who catch the animals to be

Figure 5. Nurdin in the boat, preparing to visit the different islands of Raja Ampat on a tourist expedition.

Figure 6. *V. macraei* on a "small tree" used for basking and hunting.

shipped to breeding projects in Java. I don't know much about their endeavours, but when I have guests who want to see the monitor lizards, we work with the catchers to find and photograph the animals. Our guests will generally pay the price of a wild-caught lizard [around €60] to catchers to incentivise them to find more animals to photograph.

I have recently seen a sharp decline in the number of wildlife collectors in West Papua due to the firmness of the government which has issued laws on the protection of wild animals. The protected wild animal and plant species in West Papua law number 5-1990 concerns the conservation of natural resources and their ecosystems. This law prohibits everyone from catching, killing, keeping, trading and transporting plants and animals, alive or dead. Anyone who intentionally violates them will be punished with five years' imprisonment and fined 100,000,000 IDR [€5,950].

There are a number of Varanus species that are protected by this law, including *V. prasinus, V. reisengeri* and *V. boehmi*. Other reptile species in the region are also protected including green tree pythons (*Morelia viridis* (Schlegel, 1872)). *V. macraei*, are still unprotected due to the possibility that there are still many on the island of Batanta.

Finding and catching tree monitors

As far as my knowledge in the field and the experience of local catchers knows, there is no significant difference in the behaviour or habitat of each species of tree monitor. To find them, one must understand the habitat and pay close attention to the weather. They are most active during the sunniest parts of the day and they are very difficult to find when it rains.

At night the monitor lizards will take shelter in the tallest, most robust trees to avoid them falling to the ground in strong winds and bad weather. In the morning on a sunny day, from about 09.00 am until 14.00 pm, the tree monitors come down to the small trees to hunt and search their diet of locusts and other insects.

In this way, there are a few methods we can use to find them and identify the trees that they are hunting on. Firstly, to hear the sound of dried leaves falling under the tree, which means the lizards are moving on the branches to hunt for insects. We can also find small trees that receive a lot of sunlight as the lizards will rest on smaller trees to bask in the early hours of the day before they begin to hunt.

As you can imagine, catching them is not easy! The local people in the villages must be strong tree climbers. The tool usually used by a catcher is a straight, long, bamboo pole with a noose on the tip. The catcher will climb up a nearby tree that is in reach of the lizard's preferred tree. Then, he will attempt to lasso the lizard with the noose to capture it. This is the only way to capture them alive.

Eco-tourism in Raja Ampat

Eco-tourism in Raja Ampat specifically in the interest of herping or reptiles is not growing as fast as diving. In fact, diving is becoming very popular (and birding is also quite popular too) and continues to attract a lot of tourists to the archipelago.

I believe that herpers across the world probably don't have the full information about the possibilities of herping in West Papua. Raja Ampat has a lot of natural potential but the infrastructure here has not been built up yet. Most accommodation on the islands consists of traditional homestays and remote villages, particularly in the habitat locations of the most popular reptiles, on Batanta, Misool and Waigeo. These are very different compared to the boats that divers will take out for a day or a for multiple days, which can be fully prepared with supplies from the mainland before the trip and are generally more luxurious for tourists travelling a long way across the world.

I do feel that ecotourism can very much benefit the region of Raja Ampat. It allows tourists to understand more about the reptiles that live here, but also bring more money into the economy and lessen the need for local people to harvest animals from the wild.

Currently, it is only a small number of tour guides that are promoting the amazing eco-tourism opportunities of herping in Raja Ampat through social media. Even in the wider West Papua region, there is only some promotion of eco-tourism through magazines and travel agents. I think it is the responsibility of the local government in West Papua to do more to promote the potential of ecotourism. Furthermore, the government institution should seriously consider implementing training programmes and education on the natural conservation and wild ecosystems of Raja Ampat. This education could help more people understand the biodiversity of the region and help them protect their own natural resources so that they have good populations of wildlife for eco-tourists to see, if the industry does develop here in Raja Ampat.

Figure 7. A catcher preparing a noose to catch tree monitors with.

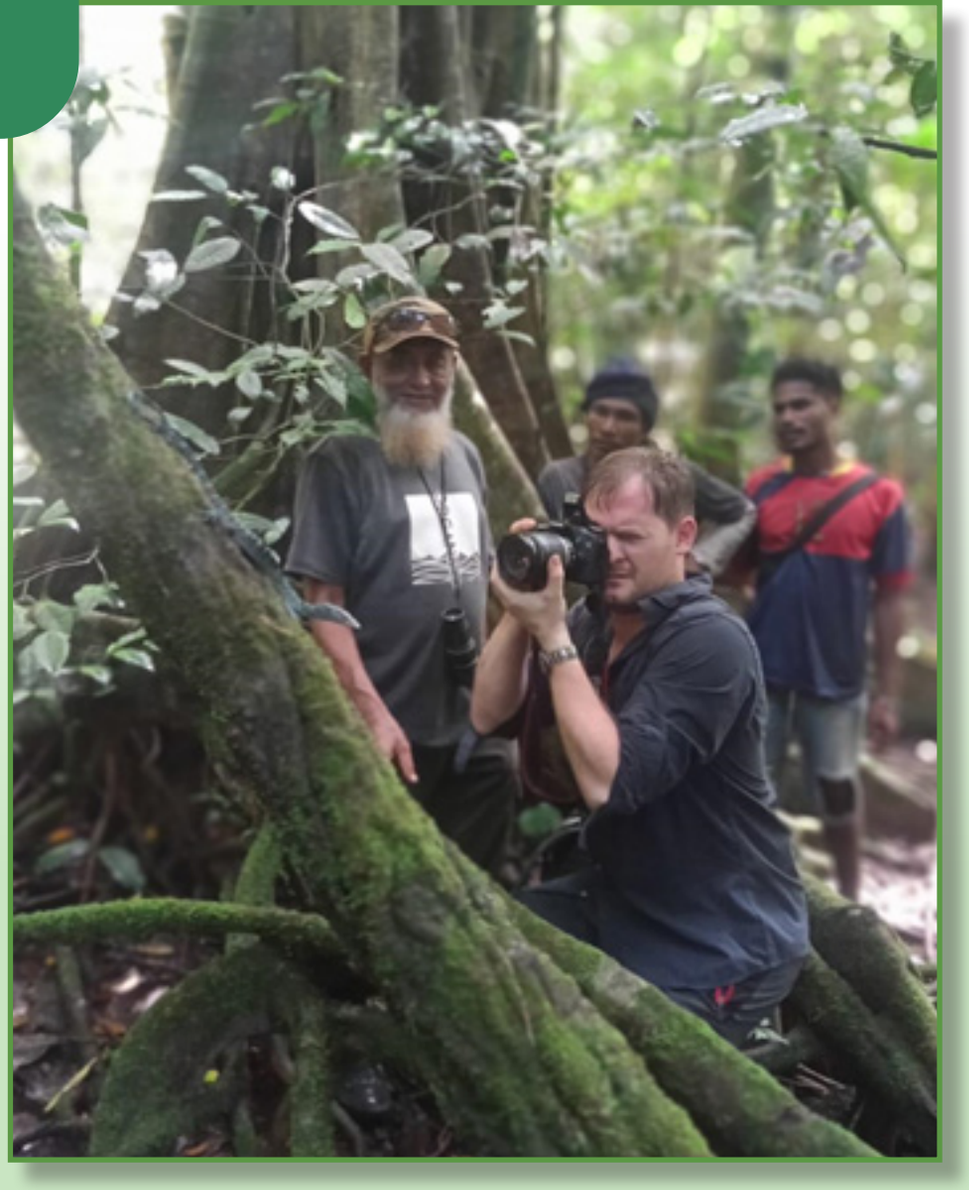


Figure 8. Eco-tourist, photographer and Varanid breeder, Chris Applin taking photos of tree monitors in-situ.

Figure 9. Nurdin with two catchers from the village of Andui on Batanta.

EK MAGAZINE
EXOTICS KEEPER

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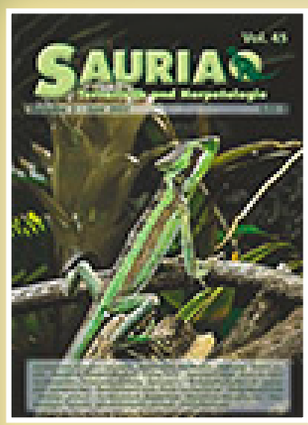
July issue of Exotics Keeper Magazine

Exotics Keeper Magazine (June / August)
The two issues of Exotics Keeper Magazine that have passed since the launch of RHJ10 have covered a variety of topics. In July, the magazine focused on private keeping and breeding of numerous species including rhino ratsnakes (*Gonyosoma boulengeri*) and hippie anoles (*Anolis fraseri*). The magazine also featured a new European conservation project aimed at saving the sturgeon.
In August, the magazine turned its attention towards the veterinary needs of tarantulas with specialist exotics vets, Dr Michaela Betts and Dr Benjamin Kennedy. The publication also covered the captive care needs of Texas alligator lizards (*Gerrhonotus* infernalis) and Dumeril's boas (*Acrantophis dumerili*), with a focus on their natural behaviours.
The publication's survey initiative has now reached over 8,500 people and data has been collected on the captive care of over 1,300 different species. Exotics Keeper Magazine will be publishing these results in an annual report, designed to protect herpetoculture from misinformed legislative changes across the world. The survey is still open and people from across the world can show support by participating here: **www.survey.exoticskeeper.com.**



SAURIA
A great new issue has also appeared at SAURIA. The issue covers various interesting topics from herpetology and terraristics. Sven Lembgen reports on the repeated breeding of the crowned basilisk, while Manuel Sacha writes again about crocodiles in captivity. Klaus Kabisch brings a supplement to his article published in the previous issue about the climbing ability of *Natrix natrix*. Wolfgang Grossmann, Thomas Kowalski and Christian Schäfer report on herpetological experiences on Pulau Tulai, with remarks on *Gekko monarchus*, Ayuthavel Kalaimani reports from India on the tail bifurcation in *Hemidactylus leschenaultii* and Wolfgang Denzer, Ingomar Kiehlmann and Ulrich Manthey address the question whether there are two species of *Aphaniotis* on the Malay Peninsula. We continue with a record of *Hydrophis cyanocinctus* off the coast of Iraq, written by Omar F. Al-Sheikhly, Wolfgang Böhme and Ahmed M. Al-Dirawi. Christian Langner, Markus Auer, and Farhad Ahmed Khudhur bring a second record for Iraq for *Rana macrocnemis*, while J. Lindley McKay and Olga Milenkaya provide a first record of *Helicops petersi* from Colombia. Last, Ho Yuen Yeung, Jiangbo Zhao, and Jian-Huan Yang report an occurrence of *Micryletta menglienica* in a Chinese province, and Stephen R. Goldberg provides notes on the reproduction of *Sphenomorphus papuae* from Papua New Guinea.
Photo SAURIA: **https://www.sauria.de/**

vda-aktuell and DATZ
The association magazine from VDA has also published a fantastic new issue. The vda-aktuell deals mainly with topics on fish and aquaristics, but there is also a terrarium topic in each issue. In issue "3|2023", the reader is informed about the learning ability of turtles. The feature provides insight into appropriate enclosure design to give the turtles the best opportunity for enrichment. Another feature also focuses on the worldwide dramatic decline of frog populations and lists the reasons for this.
Similar to the vda-aktuell, the DATZ is structured with a primary focus on aquaristic topics, with an accompanying article on terraristics. In the latest issue, insects are featured, with a detailed article about the habits, care and reproduction of Phasmids.

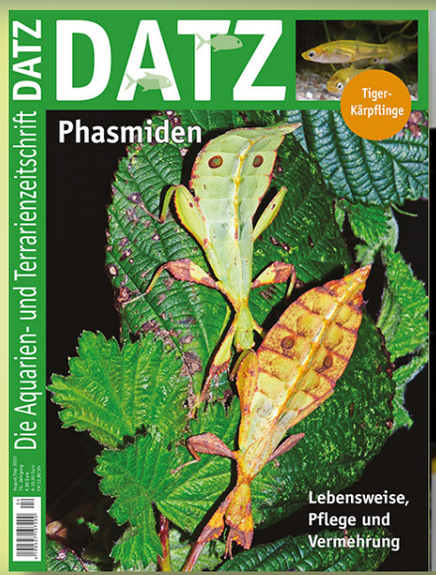


Photo DATZ: https://www.ms-verlag.de/

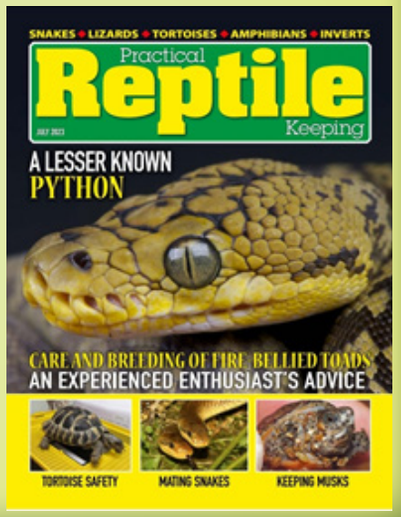
The full species count as of July. A report will be published soon.

REPTILES

The world's leading reptile magazine, REPTILES, has also produced a fine and interesting issue. The latest issue includes a vet report on Florida FWC's Holy Thursday Massacre, written by Eric Los Kamp. Billy Fraser and Jason Nelson report on the rat snakes oft he USA. Eric Los Kamp reports in another article on how to choose the appropriate substrate for your terrarium. Leandro Bergmann provides detailed information on keeping and breeding fire-bellied toads in human care. B. P. Ross reports on «the tortoise girl of antigua», while Forster Reves tells about snake discovery's Emily Roberts. Rounding out the issue is a report by Robert Michelson on the conservation of the spotted turtle, and Staff reports on products to help achieve climate goals for your herps.

Practical Reptile Keeping

In the UK, the digital magazine, Practical Reptile Keeping continues to cover a variety of topics. In the latest issue, you can find the second part of the article by Leandro Bergmann about the genus *Bombina*. A whole range of topics relating to this genus were covered, from keeping and breeding to a whole presentation of all (sub)species in a separate article to biology and way of life. Julia Mueller-Paul reports about the mating behavior of snakes. The magazine also explores crickets and their position as a popular live food. Beginners can receive advice on how to choose the right lizard, whilst specialists snake keepers will rejoice at a feature focusing on the Timor python. Recurring features such as «news and views», «out of africa» and «q & a» are also filled with interesting facts.



ELAPHE

The fourth issue of elaphe has been published, with the cover topic of water frogs. These were also chosen by the DGHT as the amphibian of the year 2023. The identification of water frogs is not easy, but the author duo Martin Schlüpmann and Thomas Mutz have teamed up to write three interesting articles that deal with the distribution and ecology of *Pelophylax lessonae*, the possibility of identifying water frog taxa, and lastly the genus *Pelophylax* and its population systems in the Mediterranean region. Furthermore, Axel Meier reports from Uwemajo, a reptile zoo for the conservation of the mangrove forest on Zanzibar, Ole Dost writes about Francesco Redi and the Rediviper named after him - an experiment with taxonomic consequences. Andreas R. Hassl reports onTiburnia's vipers, while Philip-Sebastian Gehring writes about successfully keeping the fire salamander in a light well. In addition, there are two research articles, one dealing with a fungus affecting snakes, and another from the conservation sector, dealing with the composition of the gut microbiome in pure and hybrid *Podarcis muralis*.

REPTILIA

The well-known, German Terraristikmagazin, REPTILIA, also concentrated on something «special» in its latest issue: spiders. More precisely, tarantulas and their husbandry requirements. The subject is discussed in detail in three articles by T. Hauke. As well as invertebrates, there are also topics about reptiles; L. Spinner talks about keeping and breeding king snakes, while O. Gius reports on reptiles in the Bible account. C. and A. Schäberle report on Gallotia stehlini in nature and in private breeding, while S. Friedli provides a travel log about Tunisia. Photo REPTILIA: **https://www.ms-verlag.de/**

HISTORY OF KEEPING REPTILES AND AMPHIBIANS AT THE ROYAL ANTWERP ZOOLOGICAL SOCIETY

Author(s): ***Erik Block***, *President of the Belgian Dutch Zoo Keeper Association, Zoo Keeper at the Antwerp Zoo, Belgium.*

Brief History

The Antwerp Zoo, also known as the Royal Zoological Society of Antwerp, is one of the oldest zoos in the world. The zoo first opened on July 21, 1843, and like many older zoos in Amsterdam or London, had no geographical themes or sections. animals were instead displayed by taxonomic groups, e.g., Monkey House, Carnivore House.

The Aquarium opened in 1908, with the reptile building opening shortly afterwards in 1910. The Aquarium is one of the oldest in the world. It has 4 systems, cold water and warm water, saltwater and freshwater. The famous Greek temple, located above the Aquarium, displays the rich reptile collection and also has a long history.

First reptiles

The first reptiles held at the zoo were housed in the museum next to the entrance, and later terraria were placed inside the former Carnivore House. Inside this building was a large hall for cold-blooded animal exhibits. Here a row of vitrines (vivariums) with glass panels on all sides were decorated with live plants, and included a wide variety of chameleons, monitors, other lizards and snakes for display to the public.

Starting in 1910, the reptiles, amphibians and invertebrates were housed in the Greek Reptile Temple above the aquarium. Over the

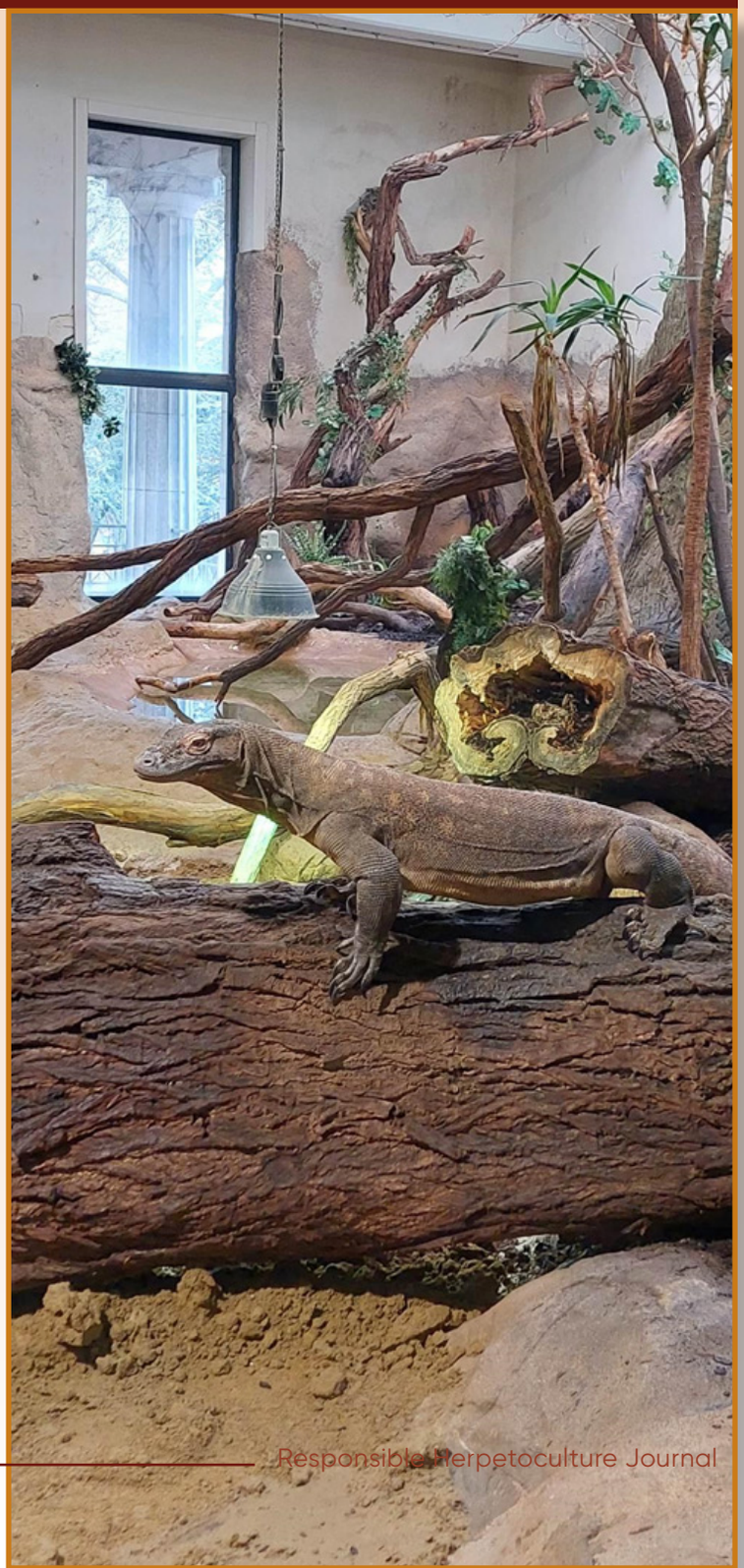


Figure 1. Female Komodo dragon "Pintar".

Figure 2. *Varanus komodoensis* exhibit.

Figure 3. The Central Australia exhibit which houses *Tiliqua rugosa* (Gray, 1825), *Chlamydosaurus kingii, Pogona vitticeps, Varanus acanthurus Boulenger,* 1885 and *Bellatorias frerei* (Günther, 1897).

years, the building received two major renovations, one in the early 1970s and again in 2006.

The building was built between 1905 and 1910 and was designed by Emile Thielens who designed many of the buildings at the zoo. The Greek temple looks like the Acropolis in Athens with a long front with two identical porticos, each with four Dorian pillars.

In 1972, architect René Grosemans renovated and enlarged the Reptile House.

By the 1930's, the zoo had already kept its first Komodo dragon that was a present from the Dutch-Indian Government to King Leopold III. In 1937, another Komodo Dragon arrived at the zoo but was killed during the bombing in 1944 along with many other animals. Another pair was gifted to the zoo by President Soeharto from Indonesia.

Over the years, Antwerp had many Komodo dragons in its collection following the male they received in 1938. After the second world war, the next dragon did not arrive until 1958, which was a male from Copenhagen, followed by two other males that same year. In 1973, with the opening of the renovated Reptile House, a female arrived from Surabaya, and

Figure 4. *Chlamydosaurus kingii Gray*, 1825 and *Pogona vitticeps* (Ahl, 1926) in the Australia exhibit

another male came in 1977. In 2007, after the second major renovation, a new exhibit was created where a male from London Zoo and a female from Colchester Zoo were housed. Just recently, the latest dragon to arrive is a female from Artis, Amsterdam.

The old building's glass terraria were placed with two rows and there was a large open pond in the center that displayed several species of crocodiles. Over the years a wide variety of species have been displayed in this building.

In 1973 the building was renovated, and some new inventions were added. One of these was an open cage system where snakes were kept behind a cold air strip. The theory

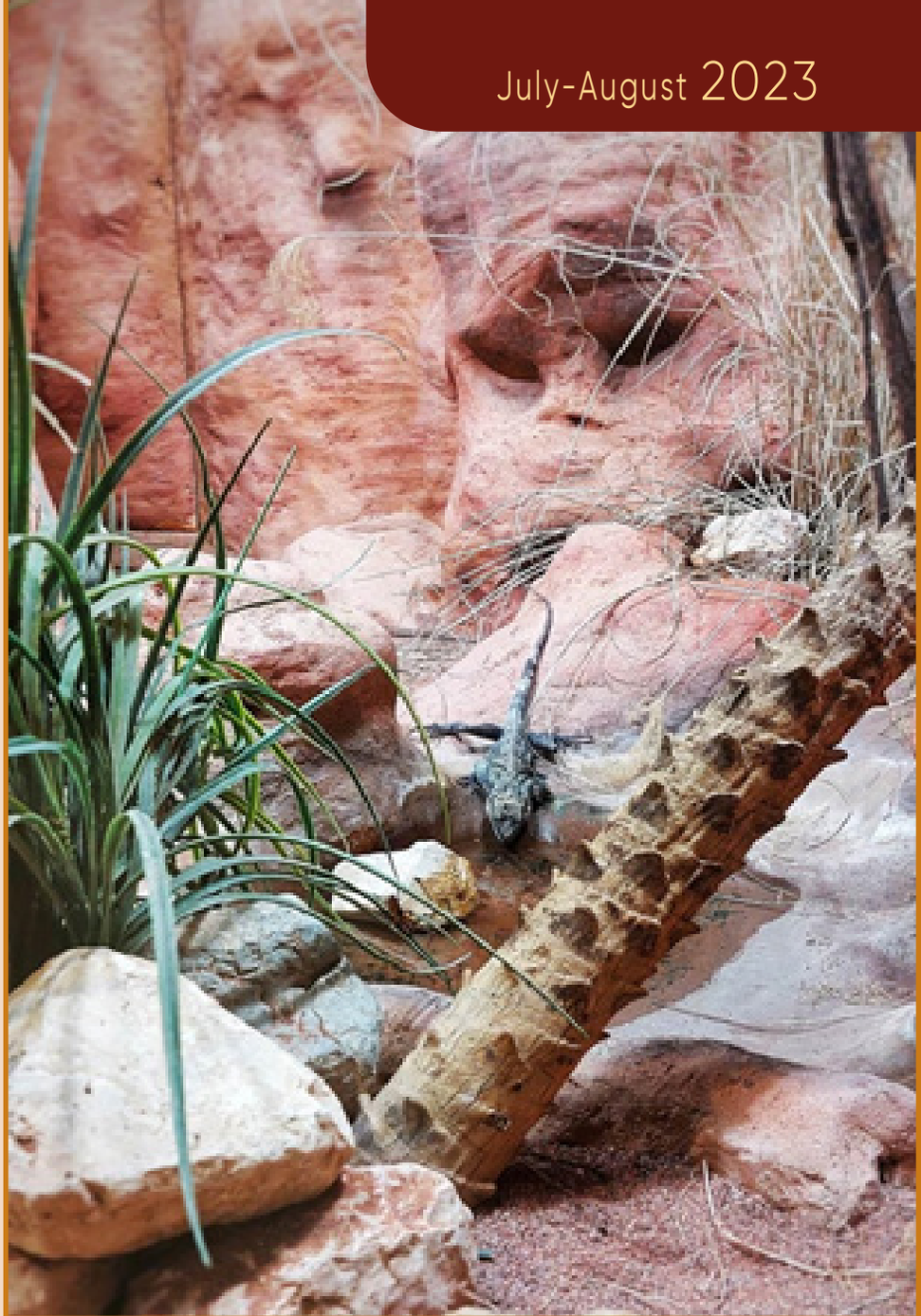


Figure 5. *C. kingii* drinking water in the Australia exhibit.

was that they wouldn't cross the cold strip (an area filled with ice). However, the snakes moved up on the strip, and stayed there, which caused a number of predictable problems, so was not a success. Another invention was the Thunder and Lightning by the crocodiles. As these animals don't move that much, visitors would get a "thunder" show every hour for about 5 minutes. A third invention was an automated feeder that would catapult live crickets and grasshoppers at different times into the exhibit. This was an early enrichment idea, but the device was not a great success, as after only a few days the lizards learned to simply wait in front of it for the next grasshopper to jump out.

The entrance of the building was a tropical walk-through garden. The terraria in the main hall were made out of epoxy with semi-transparent painted backgrounds. These were placed along each side of the building with an access corridor behind each row of terraria. I believe there were three standard sizes of these terraria, large ones for pythons, mid-sized for larger lizards or smaller snakes, and small ones for lizards and frogs. At the end of the line was the large Crocodile Jungle Pond. During the zoo's peak days of displaying as many different species as possible (1960's and 70's) the zoo exhibited 6 species of crocodiles, totalling 17 specimens in 1973.

Figure 6. Southwestern America exhibit for *Heloderma suspectum* Cope, 1869, *Sauromalus ater* Dumeril, 1856, *Dipsosaurus dorsalis* (Baird and Girard), 1852 and S. serrifer.

Figure 7. North Africa exhibit for *Eumeces schneideri* (Daudin 1802), *Uromastyx nigriventris* Rothschild & Hartert, 1912, *Gerrhosaurus* sp. and *Malacochersus tornieri* Siebenrock, 1903.

Figure 8. Exhibit for *Cyclura nubila* (Gray, 1831) and *Chelonoidis carbonaria* (Spix, 1824).

After the second renovation the building was organized into several themes. The two largest themes are rainforest and desert exhibits, others included island reptiles, venomous snakes, amphibians, and a nursery. Most of the larger terraria were decorated with nice rockwork, the designs based on characteristic habitats from all over the world. The three main large desert exhibits house mixed species groups of reptiles. Australia is home to frill-necked lizards, shingleback skinks, major skink, bearded dragons and spiny-tailed monitor lizards.

The North Africa exhibit contains a mix of pancake tortoises, *Uromastyx*, berber skinks and plated lizards.

The North America exhibit is home to Gila monsters, desert iguanas, *Sceloporus serrifer* Cope, 1866 and chuckwallas.

For many years the zoo was one of the only centers in Belgium to receive confiscated reptiles and amphibians. Today there are more organizations that can keep them as well. The zoo also used to provide training to the local police, fire and customs personnel to handle reptiles, amphibians and invertebrates safely as these groups of animals have become popular pets.

Figure 9. Views of the zoo reptile exposition.

Figure 10. Winter garden for *Centrochelys sulcata* (Miller, 1779) and *Iguana iguana* (Linnaeus, 1758).

Exhibits

All the exhibits in front of the public have artificial rockwork made from concrete. The bedding on the floors are based on the needs of the particular species being displayed, and include: soil, leaves, forest floor, eco-earth, bark, Reptisand, or loam. Most of the terraria have sections of floor heating as well. Natural stones, branches, and both real and artificial plants are also integrated into the exhibits. All exhibits are provided with heated basking spots and UV-lighting as well.

Species

The zoo has kept a wide variety of reptiles and amphibians over the years. The following are lists of a selection of the species the zoo has worked with, but is not a complete list.

Lizards

Iguanid and Agamid lizards at the zoo have included Club-tailed iguana, Weber's sailfin lizard, Cuban rock iguana, black iguana, Fiji banded iguana, rhinoceros iguana, Indonesian giant sailfin lizard, Texas horned lizard, Starred agama, desert spiny lizard, green spiny lizard, emerald spiny lizard, Texas spiny lizard, Guatemalan spiny-tailed iguana, Haitian curly-tailed lizard, Cuban brown curly-tailed lizard, Tiburon green anole, brown basilisk, serrated casque-headed iguana, Leptiens spiny-tailed lizard, butterfly lizard, red-banded butterfly lizard, Moroccan spiny tailed lizard, Philippine sailfin lizard, eastern bearded dragon, Australian water dragon, green prickle nape, common flying dragon, and the rare Moloch or thorny devil.

Varanid and Helodermatid species at the zoo have included Mexican beaded lizard, gila monster, yellow monitor, Dumeril's monitor, savanna monitor, Nile monitor, green tree monitor, rough-necked monitor, Asian water monitor, Timor monitor, Bengal monitor,

Lace monitor, white-throated monitor, (only one was in captivity at that time?), sand goanna, and Spencer's goanna,

Skinks have been represented at the zoo by the following species, Senegal mabuya skink, major skink, western shingleback, king's skink, Hosmer's skink, red eyed crocodile skink, berber skink, fire skink, Cunningham's skink, Solomon Island skink, Fernand's skink, African five-lined skink, and Zoutpansberg girdled skink.

Gecko species that the zoo has work with has included giant wonder gecko, turquoise dwarf gecko, ring-tailed gecko, Smith's green-eyed gecko, standing's day gecko, marbled gecko, fat-tail gecko, common wonder gecko, Kuhl's flying gecko, smooth-backed gliding gecko, ring-tailed gecko, and desert banded gecko, among others.

Chameleons have always been popular, and the zoo has kept several species including Karoo dwarf chameleon, flap-necked chameleon, warty chameleon, Meller's chameleon, Cape dwarf chameleon, Mediterranean chameleon, giant Madagascar chameleon, Jackson's chameleon, Johnston's chameleon, peacock chameleon, and helmeted chameleon.

Today they house several breeding groups of Chinese crocodile lizards, along with a variety of girdled lizards, Teiids and Anguids including yellow-throated plated lizard, black-lined plated lizard, Sudan plated lizard, Madagascar girdled lizard, Karsten's girdled lizard, giant plated lizard, giant ameiva, Bonaire giant whiptail, black tegu, golden tegu, Northern caiman lizard, slowworm, and sheltopusik.

Snakes

Venomous snake species kept at the zoo have included Great Lakes bush viper, timber rattlesnake, rhinoceros horned viper, forest cobra, king cobra, snouted cobra, monocled cobra (albino), Egyptian cobra, spitting cobra, desert horned viper, Gaboon viper, western diamond rattlesnake, western bush viper, Mexican cantil, twig snake, puff adder, Mexican moccasin, Southern copperhead, Northern copperhead, Eastern cottonmouth, Western rattlesnake, prairie rattlesnake, West African leaf viper, and Russell's viper.

Colubrid species at the zoo have included black tree snake, Eastern indigo snake, Taiwan beauty snake, baron's green racer, green vine snake, false water cobra (aka Brazilian smooth snake) African house snake, mole snake, banded cat-eyed snake, forest vine snake, *Pseudoboa neuwiedii* (A.M.C. Duméril, Bibron & A.H.A. Duméril, 1854), mangrove snake, dog-toothed cat snake, green cat snake, chicken snake, common egg eater, Asian longnose whipsnake, and San Francisco garter snake.,

Boas, pythons and other primitive snakes at the zoo have included Dumeril's boa, Malagasy tree boa, common northern boa, rosy boa, Jamaican boa, Madagascar ground boa, Pacific tree boa, Haitian boa, Cook's tree boa, emerald tree boa, Tartar sand boa, red sand boa, green anaconda, yellow anaconda, children's python, black-headed python, Macklot's python, Savu python, diamond python, jungle carpet python, Sumatran short-tailed python, Central African rock python, amethystine python, Baja rosy boa, and Javan wart snake.

Tortoises and turtles

A wide variety of turtles have been kept at the zoo, including mata-mata, common snapping turtle, alligator snapping turtle, Nubian flapshell turtle, African softshell turtle,, Branderhorst' snapping turtle, loggerhead turtle, hawksbill turtle, Blanding's turtle, European pond turtle, Barbour's map turtle, Mississippi map turtle, Asian leaf turtle, stripe-necked leaf turtle, giant Asian pond turtle, striped mud turtle, razorback musk turtle, Chinese soft-shelled turtle, pig-nosed turtle, Murray River turtle, South-American snake-necked turtle, Krefft's river turtle, western twist-neck turtle, Hilaire's side-necked turtle, Northern Australian snapping turtle, common toad-headed turtle, common helmeted turtle, West African mud turtle, yellow-spotted and Amazon river turtle.

Tortoises held at the zoo have included Aldabra giant tortoise, pancake tortoise, Galapagos tortoise, spider tortoise, Madagascar radiated tortoise, Kleinmann's tortoise, yellow-footed tortoise, Boulenger's Cape tortoise, Indian star tortoise, western hinge-back tortoise, Speke's hingeback tortoise, and Horsfield's tortoise.

Crocodiles and alligators

The crocodilian species kept at the zoo over the years have included spectacled caiman, Colombia spectacled caiman, broad-snouted caiman, American alligator, dwarf crocodile, Nile crocodile, West African Nile crocodile, Cuban crocodile, slender-snouted crocodile, Siamese crocodile and false gharial.

Amphibians

Today the zoo has several breeding rooms for frogs, newts, and caecilians. The large collection of frogs has included Pebas stubfoot toad, red-backed poison frog, waxy monkey tree frog, Maranon poison frog, golden poison frog, Smokey Jungle frog, Congo dwarf clawed frog, Hahnel's poison frog, Malaysian leaf frog, Amazon milk frog, Brazilian poison frog, variable poison frog, file-eared tree frog, Lake Oku clawed frog, emerald-eyed tree frog, African bullfrog, Senegal running frog, Power's toad, Mountain Chicken frog, false tomato frog, tomato frog, golden sedge frog, red-eyed tree frog, golden mantella, mimic poison frog, common Surinam toad, several species of Ranitomeya, several locales of *Dendrobates tinctorius* Cuvier, 1797, and golden bellied frog.

Salamanders and newts held at the zoo have included, Laos warty newt, Kaiser's spotted newt, Olm, Japanese giant salamander, Japanese sword tail newt, Chuxiong fire-bellied newt, greater siren, Himalayan crocodile newt, and amphiuma. The zoo has also kept a few species of caecilians including the familiar rubber eel, and the Rio Cauca caecilian.

Figure 11. Terrarium for *Dendrobates auratus Girard*, 1855 and *Ranitomeya variabilis* (Zimmermann and Zimmermann, 1988).

Figure 12. *Litoria infrafrenata* Günther, 1867 terrarium.

Breeding and conservation

Currently we work with a team of five specialists. We care for 23 species of amphibians, 64 species of reptiles and 12 species of invertebrates. Aside from the breeding programmes we are involved in, each year we try to focus on several new species to breed. The collection contains a total of between 400 and 600 animals.

Perhaps one of the best results was that in 2017 we were the first Zoo in the world to breed the Branderhorst's Snapping Turtle!

Today we work on several breeding and conservation programs (EEP and ESP). The zoo is a member of WAZA and EAZA. We have a very large percentage of the world's captive *Nuerergus kaiseri* Schmidt, 1952 in our collection (1/9 of the zoo population). They are kept and bred in their own behind the scenes room. Another project at the zoo is the breeding group of *Shinisaurus crocodilurus* Ahl, 1930. We have kept them for about 10 years now with successful production of offspring every year.

We have successfully contributed to the Jamaican boa breeding program as well, and last year (2022) we were lucky to have successfully bred our first Cuban rock iguanas and chuckwallas.

For many years the Antwerp Zoo has specialized in breeding poison dart frogs and tree frogs. We have a specialized room behind the scenes for keeping and breeding several species.

The CRC (Research and Conservation Centre) also called Zoo Science at the Antwerp Zoo has now conducted a lot of research on amphibians.

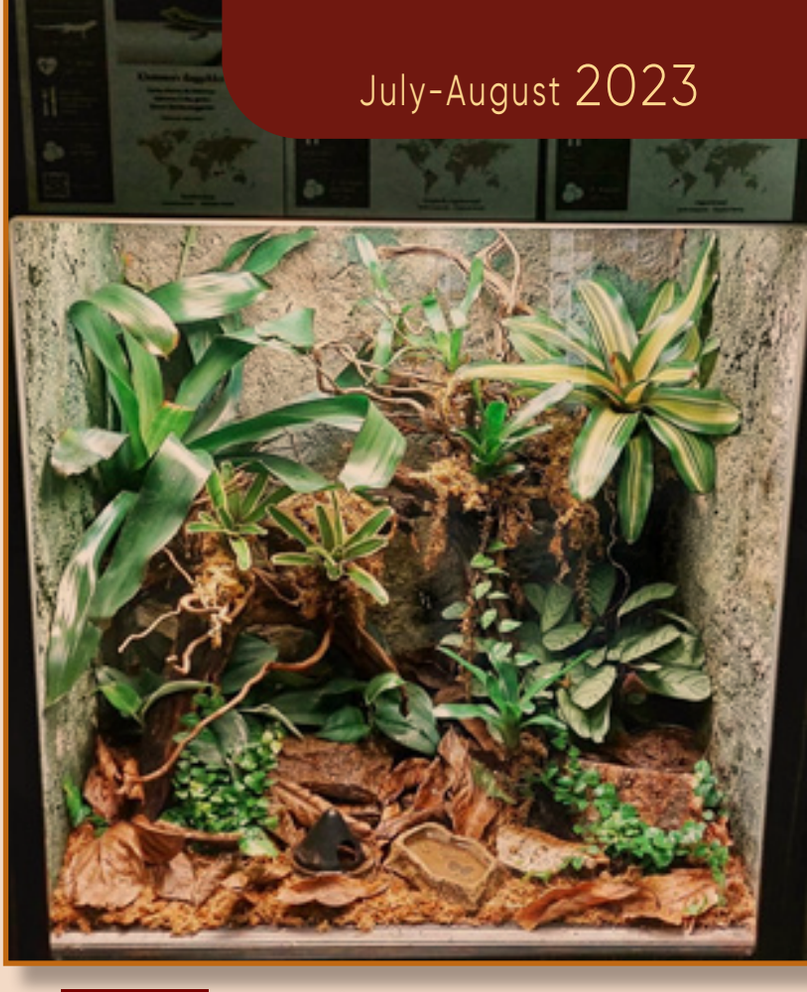


Figure 13. Terrarium for *Ranitomeya imitator* (Schulte, 1986), *Dendrobates leucomelas* Steindachner, 1864 and *Phelsuma klemmeri* Seipp, 1991.

The Education Department has a Zoo Class, formerly called "Kiss a frog" or "Dirty Creatures." The department has several terraria with amphibians and reptiles to teach school children about these species, and where they can get hands-on experience with some of these amazing reptiles and amphibians.

Figure 14. Nursery where we keep and show our offspring.

HUSBANDRY AND BREEDING OF THE APENNINE YELLOW-BELLIED TOAD

Author(s): ***Markus Harzdorf***, *Private breeder, Germany.*

Besides the European fire-bellied toads - *Bombina bombina* (Linnaeus, 1761) and yellow-bellied toads - *Bombina variegata* (Linnaeus, 1758), which also occur in Germany, there is the third, but controversial species within Europe - *Bombina pachypus* (Bonaparte, 1838), the Apennine yellow-bellied toad or Italian yellow-bellied toad. Some authors list it as a separate species *B. pachypus*. Other systematists call these toads subspecies *Bombina variegata pachypus* (Bonaparte, 1838). However, it is a fact that the animals differ in behavior and preferences as well as in their optical appearance to normal yellow-bellied toads.

Also the natural range of both forms is clearly separated and does not overlap. While in northern Italy the nominate form *Bombina variegata variegata* (Linnaeus, 1758) still occurs, it is replaced by the Apennine yellow-bellied toad in the south of the Po Valley. The distribution range of the latter, on the other hand, extends as far as southern Calabria (Harzdorf, 2022a).

Figure 1. Adult male of *B. pachypus*.

Figure 2. Young *B. pachypus* with a high proportion of black on the ventral side.

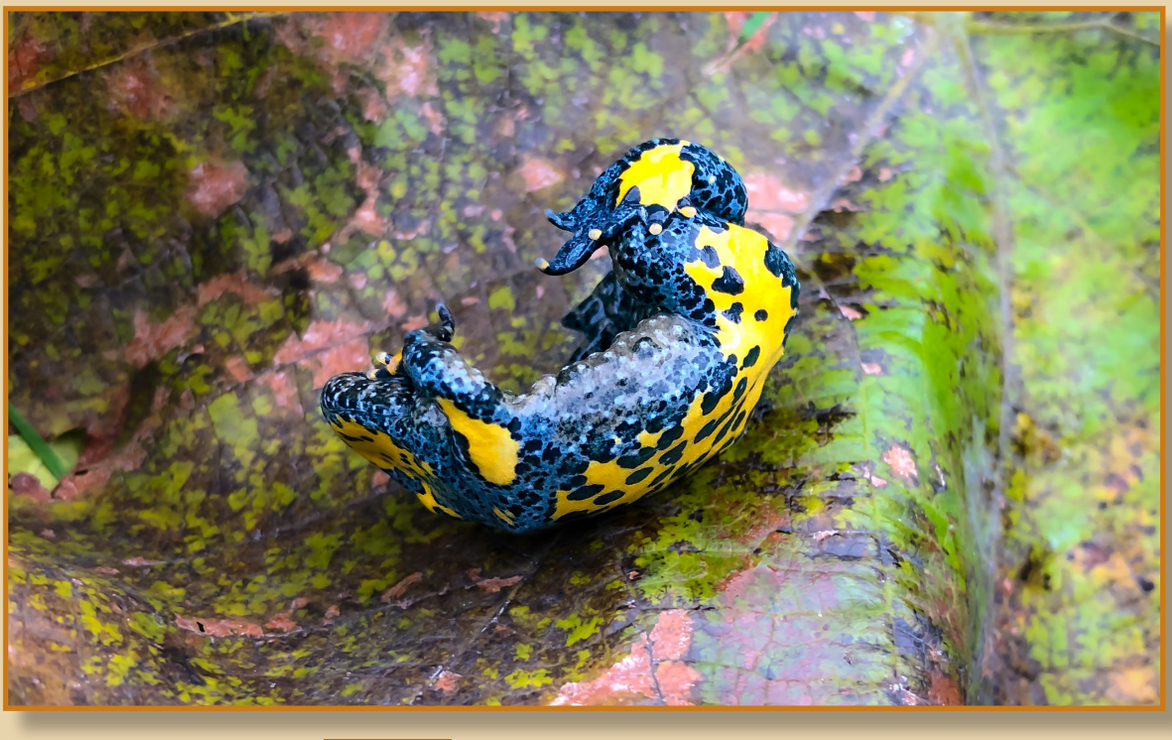


Figure 3. Unkenreflex of *B. pachypus.*

In size and call, Apennine yellow-bellied toads resemble normal yellow-bellied toads. Differences are found in the body shape. In direct comparison to the nominate form, the head appears somewhat more pointed or angular in the area of the nostrils and snout. Also feet and hands are more massively formed especially in male adult Italian yellow-bellied Toads and therefore appear almost clumsy. The coloration of *B. pachypus* is also different. On the dorsal side sandy to yellowish gray areas dominate. In contrast, depending on the mood and background, darker spots are present as well as dark gray to black stripes on the upper side of the limbs. The belly is also intensely yellow to orange in this species. The inside of the lower legs and forearms are black to dark blue. This is also one of the prominent as well

Figure 4. Outdoor terrarium for *B. pachypus.*

Figure 6. Indoor terrarium for *B. pachypus.*

as species-typical visual characteristics. These blackish-bluish areas can extend to the chest and throat area and form a great contrast to the strong colored underside. The actual belly is rather provided with many, small black spots, whereby also individuals without or with only few black spots occur (Harzdorf, 2022a).

Apennine yellow-bellied toads are severely threatened in their native habitat and populations are declining. In Germany, this (sub) species is also listed as specially protected in the Bundesartenschutzverordnung (BArtSchV). In the Bundesnaturschutzgesetz (BNatSchG) it is even considered strictly protected. It

Figure 7. *B. pachypus* amplexus.

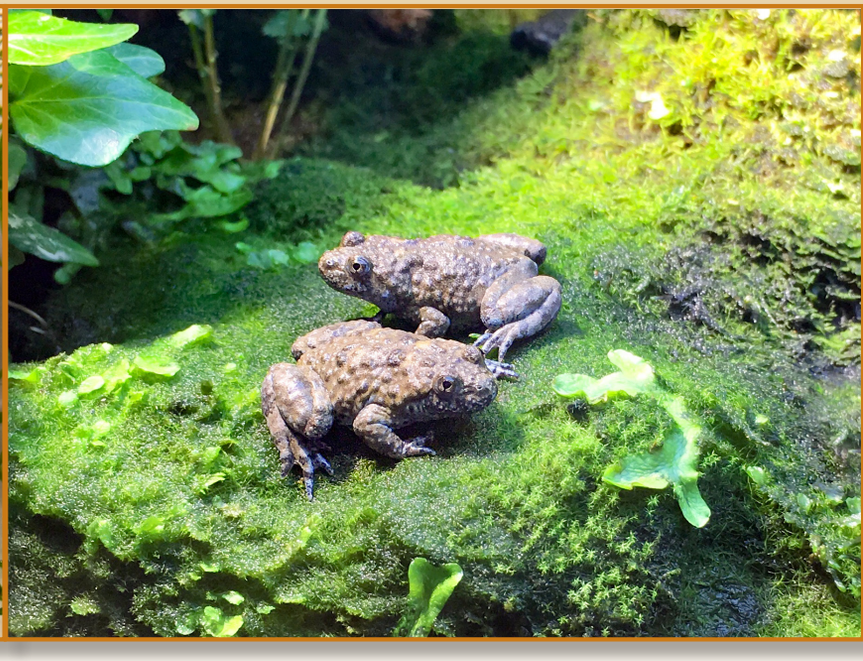


Figure 8. *B. pachypus* sunbathing under the UVB lamp.

needs (§46 BNatSchG) therefore a proof obligation (origin proof with the acquisition). Furthermore, according to §7 of the BArtSchV, there is a reporting obligation for especially protected animal and plant species. Therefore, acquired Apennine Yellow-bellied Toads must be reported to the authority responsible for the respective federal state (lower nature conservation authority, regional council, etc.). With a registration form of the respective authority, the proof of origin of the breeder or seller necessary for the legally acquired animals must be submitted (Harzdorf, 2022a).

The information provided in 2022 Issue #5 RHJ (Harzdorf, 2022b) regarding the husbandry and breeding of fire-bellied toads, largely applies to the Apennine yellow-bellied toad as well. This applies to setup, food, or even overwintering. Therefore, only specific supplementary information is explained here. Compared to normal yellow-bellied toads, *B. pachypus* have somewhat more specific requirements . The species is less suitable for care in a room terrarium. They are true sun worshippers and also need it relatively warm. Therefore, they must be kept in a sunny outdoor terrarium where possible. It is noticeable that the animals are active only at higher temperatures.

While in the outdoor terrarium, normal yellow-bellied toads already follow their habits from about +10 °C (50.0 °F), Apennine yellow-bellied toads show up only from almost +20 °C (68.0 °F) in the plants. Below this temperature they are seldom seen, as they remain secluded under stones or roots and usually only leave these hiding places at night to search for food. When the air temperature is around +25 °C (77.0 °F), the species develops high activity phases, which includes calling, mating and spawning. If it is not possible to keep the animals in an outdoor facility, this can also be done in an indoor terrarium. Here it is recommended to install an additional UVB lamp. It provides the necessary UV light and warmth. It is sufficient if the spotlight is switched on for a few hours per day in addition to the normal lighting.

Figure 8. *B. pachypus* eggs.

Figure 9. *B. pachypus* tadpole.

Figure 10. *B. pachypus* toadlets on the final stages of metamorphosis.

Figure 11. *B. pachypus* toadlet after four weeks after leaving water.

The rearing of the tadpoles is similar to the previous species, but the larvae must be kept warmer. Optimal temperatures are also around +25 - +27 °C (77.0-80.6 °F) water temperature, which can be quickly realized with a heater including thermostat. At permanently cooler temperatures, the tadpoles can stagnate in growth, develop very poorly or even die. Fish flake food, scalded spinach or lettuce leaves and frozen *Artemia* also serve as food. Depending on the stocking density, frequent water changes are also necessary. If all conditions are fulfilled, the larvae become strong and grow fast. After 4 - 6 weeks you can expect the first landers, which after metamorphosis reach a body size of 1,5 cm to almost 2 cm (0.59-0.78 in).

Author's note. This text was first published in German in the magazine REPTILIA issue 156.

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2. Harzdorf, M. 2022b. Husbandry and breeding of fire-bellied toads. *Responsible Herpetoculture Journal*, 5: 67-83.

Die Terrarientiere 1 (The Terrarium Animals 1) by Günther Nietzke

A really very informative and practical book is the German language book «Die Terrarientiere 1 - Schwanzlurche und Froschlurche (Translated: The Terrarium Animals 1 - Caudates and Frogs) by Günther Nietzke. It belongs to the somewhat older literature, the fourth edition of the book (see picture) was published in 1989 by Eugen Ulmer. The book gives information about the natural habitat and climatic conditions, the construction and technical equipment of terrariums, as well as the diet and feeding of terrarium animals. After a preface and an introduction to the book, one learns extensive details about the history of development, vegetation zones and climatic zones. All of this is illustrated with graphs and drawings. This is followed by a lengthy chapter on terrarium construction, setup, and techniques. The author describes, using pictures and drawings, what dimensions the terrarium should have, what types of terrariums there are, how to plan and carry out the construction of such a terrarium and finally how to set it up. The following chapter is dedicated to nutrition, food and feeding. For this purpose, the author has also created lists of which food animals are suitable for which caudates or frogs. The food animals are presented systematically and the breeding and catching in nature is discussed and tips are given. After the legislation and regulations for keeping and breeding amphibians are discussed, Günther Nietzke introduces representatives of the caudates and frogs in informative portraits, which are well suited for keeping in the terrarium. Here, after a short description of the species, he goes into the conditions for successful housing and sheds light on keeping and breeding. After this volume, 2 more from the series have been published: The second volume is devoted to turtles, tuataras and lizards. The third one is dedicated to snakes and crocodiles. All in all, all three volumes are worth reading despite the fact that they are a bit older and can still offer one or the other practical tip for beginners as well as for advanced keepers.

Leandro Bergmann, Contributing Editor, Responsible Herpetoculture Journal

TONG REPTILE BREEDING AND PROPAGATION CENTER IN CHINA

Author(s): ***Kairy Tong***, *Owner, Tong Reptile Shop, China.*

Tong Reptile Shop is located in Haizhu District, Guangzhou, Guangdong, China (Nanbian Road 38th). Our shop first started in a local pet market with the scale of only about 20 m² and now gradually moved to the new place with the scale of more than 1000 m². This area gives us the chance to establish a new reptile shop in a best possible way. By now we are a reptile's educational center for proper husbandry, including enclosures, decorations, equipment, plants and much more. I believe we are the only one of such type by now.

Figure 1. Entrance to the **Tong Reptile** Center

Figure 2. Education excursions inside **Tong Reptile** facility.

Figure 3. **Tong Reptile** facility for mass breeding of different reptile species.

Figure 4. Visiting our shop usually resembles an excursion.

Figure 5. We provide a wide assortment of herpetoculture-related products.

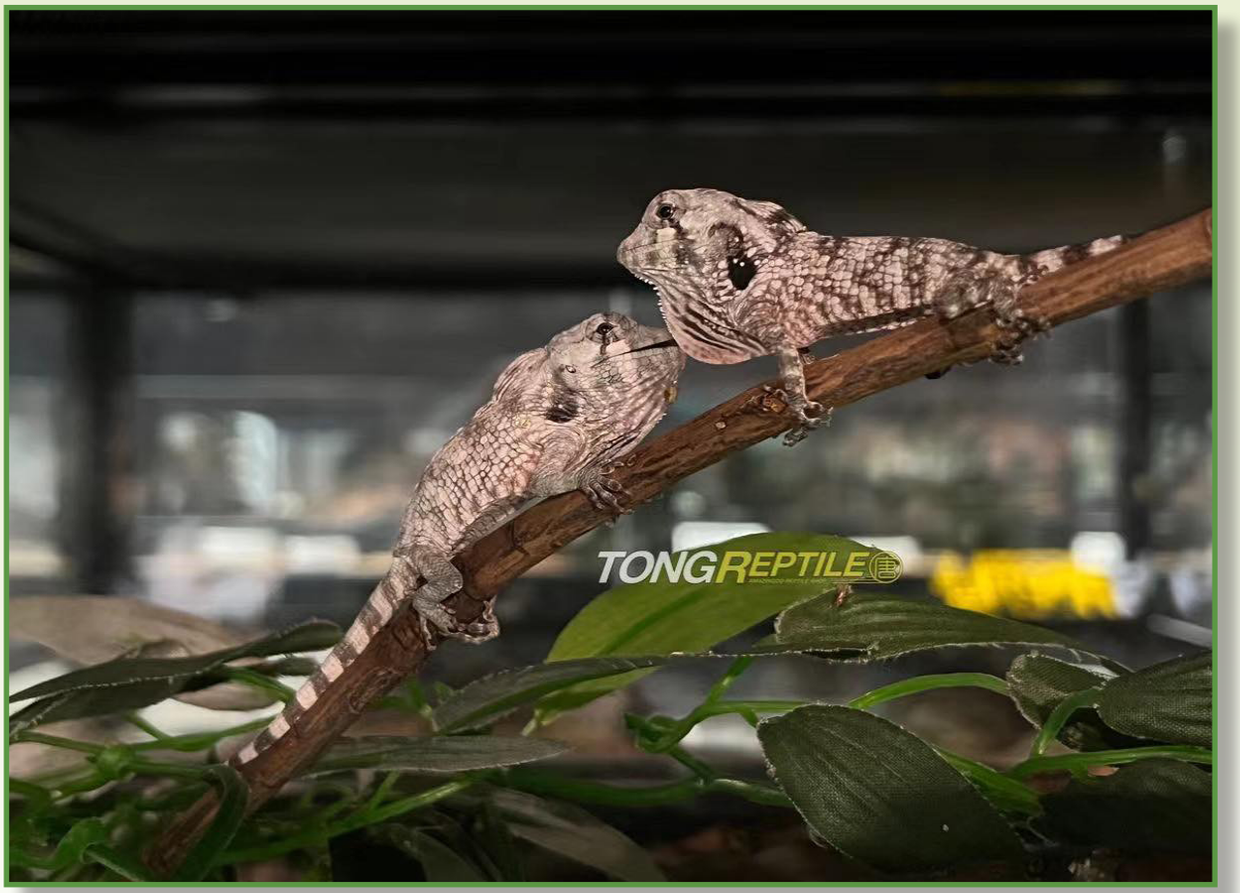


Figure 6. Our facility is able to produce healthy captive bred reptiles of many species (e.g. *Chamaeleolis* spp.).

Figure 7. Sales department in **Tong Reptile**.

We have 2 floors: the first is mainly for exhibition and breeding, and the second one is mostly a shop. We have separate rooms for different species because they have different needs for temperature and humidity. For example, we have AC set at a constant temperature of +26°C (78.8 °F) in the *Rhacodactylus* room and the day temperature in our snake room is around +30°C (86.0 °F).

We check every enclosure in the breeding rooms on a regular basis to make sure that our animals have a clean environment and access to fresh water. During the breeding season, we also keep an eye on the breeding stock and are always excited to see any eggs or babies.

For the exhibition area, we design various types of terrariums to match different biotopes. These include desert, rock and rainforest environments in order to display different species in the best possible way.

Animals like Australian bearded dragons (*Pogona vitticeps* Cuvier, 1829), the ocellated lizard or jewelled lizards (*Timon lepidus* (Daudin, 1802)) and Australian and New Guinean frill-necked lizards (*Chlamydosaurus kingii* Gray, 1825) etc. are kept in enclosures with UVA and UVB while animals like common leopard geckos (*Eublepharis macularius* (Blyth, 1854)), Centralian knob-tailed geckos (*Nephrurus amyae* Couper in Couper & Gregson, 1994) and corn snakes (*Pantherophis guttatus* (Linnaeus, 1766)) are kept in the racks. *Rhacodactylus* spp and animals of similar type are kept separately in the coolest place of our center.

Figure 8. General view of **Tong Reptile** exhibition area.

Figure 9. Display for venomous arboreal snakes.

Figure 10. Desert terrarium with an educational component about soil structure.

Figure 11. Display paludarium divided into subsections.

Keeping in mind that we have more than 60 species now (and this figure is constantly growing), we are working all time to increase the professional level of husbandry and breeding at our team.

The education purpose is our priority by now. Thus, we provide the following sets of educational services for our clients and visitors:

1) Reptile and enclosures' introduction tour (family tour with general reptile info.
2) Contact (under strict control) with touching and feeding reptiles.
3) Discussing the most suitable animals for the created artificial environment. monthly lectures about different reptiles) for the beginners.
4) Necessary equipment.
5) Necessary facilities.

Figure 12. Interactive room for lectures.

Figure 13. Enclosure for bearded dragons.

Figure 14. Enclosure for Australian water dragons

Figure 15. Display enclosure for venomous snakes.

Figure 16. Enclosure for plumed basilisk (*Basiliscus plumifrons* Cope, 1875), also called the green basilisk, double crested basilisk, or Jesus Christ lizard.

Future plans

Because we are located in mainland China, we couldn't keep species listed in CITES. Hopefully one day in the future, our legislation will be changed in a more progressive way.

A more ambitious goal is...well...maybe to create the best and largest Reptile Education and Propagation Centre in China. We support the Responsible Herpetoculture Project and are inspired by the Responsible Herpetoculture Journal!

THE NEWTS OF GERMANY

Author(s): ***Leandro Bergmann***[1], ***Bastian Forkel***[2], [1] – *Contributing Editor, Responsible Herpetoculture Journal, Germany;* [2] – *Nature conservationist and private keeper, Germany*

Besides frogs, toads, fire-bellied toads, salamanders, snakes, turtles and lizards, the German herpetofauna has even more to offer: Newts. Native to Germany are the alpine newt (*Ichthyosaura alpestris* (Laurenti, 1768)), the northern crested newt (*Triturus cristatus* (Laurenti, 1768)), the smooth newt (*Lissotriton vulgaris* (Linnaeus, 1758)) and the palmate newt (*Lissotriton helveticus* (Razoumovsky, 1789)). Like almost all amphibians, they are water-bound. In early spring, the newts set off in search of suitable spawning waters. As is often the case in the animal kingdom, newts also have to impress females and win them over. To do this, they rely on a very special tactic: after hibernation, they have developed a strong dorsal seam, which is useful to them for the water phase and also attracts attention. When they have found a female, they sniff her and present her flank. They wag their rudder tail under vibrating movements to the female sex scents. In between, the male proudly presents his broadside, comb and coloration. The females appear rather inconspicuous, they have (almost) no comb

Figure 1. Female of *T. cristatus* under water.

Figure 2. The development and metamorphosis of *I. alpestris*.

developed. If the female engages in courtship, she swims at the male. Now the male moves backwards and makes wave-like movements with his rudder tail. The female touches him with her snout, whereupon the male releases a spermatophore, which with the help of the male enters the female's cloaca. Internal fertilization takes place. After mating, the female lays her eggs individually on submerged vegetation or other underwater structures. Eggs develop into aquatic larvae, commonly called efts, which undergo metamorphosis.

The Alpine newt (*I. alpestris*)

The alpine newt, scientifically known as *I. alpestris*, is a species of newt that is native to various parts of Europe, including Germany. It is commonly found in the southern and central regions of the country, particularly in Bavaria and Baden-Württemberg. However, the species can also be found further north in the country.

The alpine newt is characterized by its distinct appearance and coloration. Adult males typically reach a length of up to 9 cm (3.54 in), while females can grow slightly larger, measuring around 10 to 12 cm (3.94-4.72 in). The males display vibrant colors during the breeding season, featuring a bright orange or red underside, a dark back that sometimes can be blue.

These amphibians inhabit a range of freshwater habitats, including ponds, lakes, marshes, and slow-moving streams. They have a preference for bodies of water with dense aquatic vegetation, as it provides them with cover and suitable breeding sites. The newts can sometimes even be found in small puddles with nearly no vegetation. The alpine newt is primarily active during the nighttime and spends the day hiding under rocks, logs, or vegetation near water. Only in the mating season the adults can be seen during the day.

Figure 3. Breeding for alpine newts typically occurs in the spring, usually from March to May, depending on local climate conditions.

Figure 4. Another specimen with the typical pattern (photo by Bastian Forkel).

The northern crested newt (*T. cristatus*)

The great crested newt (*T. cristatus*), is by far the biggest newt that is native to Germany. It is widely distributed throughout the whole country. The great crested newt is known for its distinctive appearance, with males reaching a length of up to 18 cm (7.09 in) and females growing slightly larger, measuring around 10 cm (3.94 in). However, most representatives of their kind never reach such a size. They have a dark, velvety black body with a bright yellow or orange belly marked with black spots. Adult males have a jagged crest along their back during the breeding season, which gives them their name.

These newts prefer ponds with abundant aquatic vegetation, as it provides them with shelter and suitable breeding grounds. However, the water should not be too overgrown. The waterbody must have a certain size and depth to be suitable for the northern crested newt. *T. cristatus* never uses small puddles, water-filled lanes or any other such small water bodies as spawning waters. The northern crested newt spends on average 5 months in the breeding waters. The northern crested newt stays in the spawning waters the longest period of time of all newt species occurring in Germany.

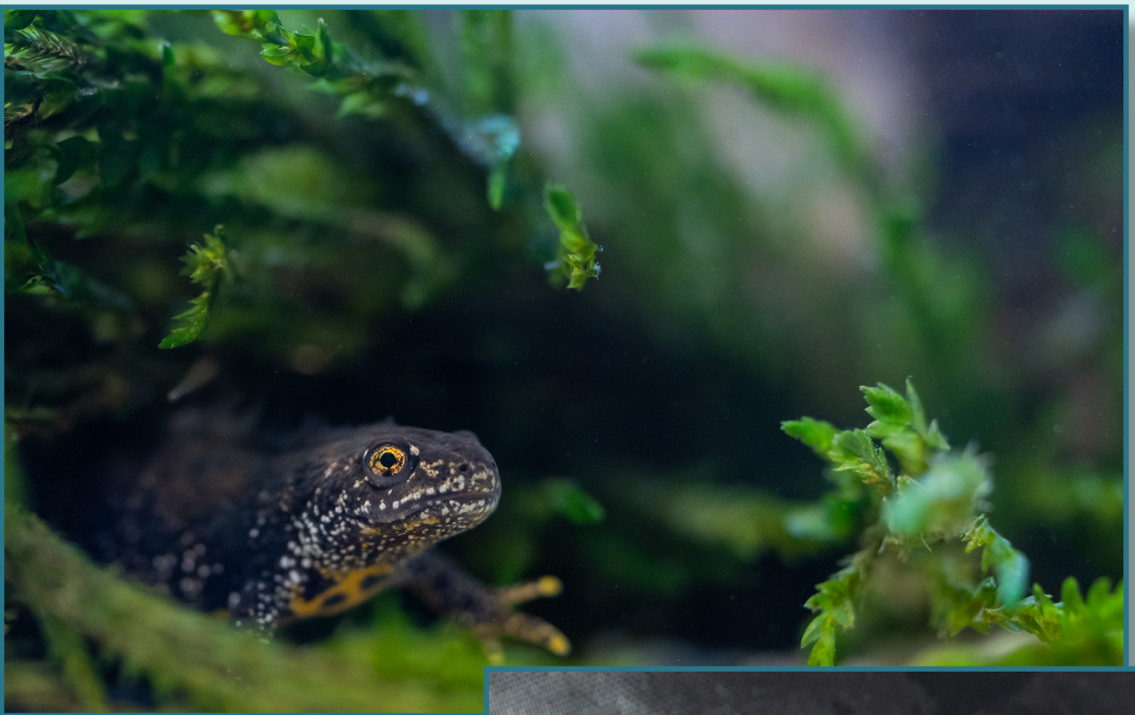


Figure 5. Male of *T. cristatus* (photo by Bastian Forkel).

Figure 6. Female of *T. cristatus* (photo by Bastian Forkel).

Figure 7. Larva of *T. cristatus* (photo by Bastian Forkel).

Even many juveniles migrate to the water body in the spring and spend a few months there. If the water is deep enough, even the adult animals overwinter in the spawning water. This behavior is usually only observed in northern crested newts. All other newt species in Germany hibernate on land.

The smooth newt (*L. vulgaris*)

The smooth newt (*L. vulgaris*) is one of the most common and widespread newt species in Germany. The smooth newt is characterized by its relatively small size, with adults usually reaching a length of 6 to 11 cm (2.36–4.33 in). Their bodies are usually brown or olive green. Males often have large roundish dark

Figure 8. Male of *L. vulgaris* (photo by Bastian Forkel).

Figure 9. Female of *L. vulgaris* (photo by Bastian Forkel).

Figure 10. Larva of *L. vulgaris* (photo by Bastian Forkel).

spots. In contrast, the females, which are more monotonously colored and show at most a few small spots. In the middle of the belly the male is bright yellow to orange colored. Towards the outside the coloration becomes lighter. Spots are often found here as well. The female is somewhat paler in coloration by comparison and again has smaller spots.

These newts inhabit a variety of freshwater habitats, including ponds, lakes, water-filled alleys, and many other types of water bodies that require at least some sun.

The breeding season of smooth newts usually begins with the first warm (>6 °C) and rainy nights, usually in late February or early March. The last adults leave the waters in June. After mating, the female lays her eggs singly on aquatic vegetation.

The palmate newt (*L. helveticus*)

L. helveticus - the palmate newt - is a species of newt that can be found especially in the west and southwest of Germany.

The palmate newt is the smallest German newt. Adult males typically grow to a length of 7 to 9 cm (2.76–3.54 in), while females are slightly larger, measuring around 8 to 10 cm (3.15–3.94

Figure 11. Female of *L. helveticus* (photo by Bastian Forkel).

in). The females look almost exactly like female smooth newts (*L. vulgaris*). they can only be distinguished by a few characteristics.

These newts can be found in a variety of aquatic habitats, almost like the Smooth Newt (*L. vulgaris*), but with the difference, that Palmate Newts can breed in shady waters.

Breeding for palmate newts typically occurs in the spring, usually from April to June. After successful mating, the female lays her eggs individually on aquatic vegetation. The eggs hatch into larvae, which then go through an aquatic phase of development before transforming into terrestrial adults.

Figure 12. Symbol picture: specimens from Belgium
(Photo by Gilles San Martin from Namur, Belgium – *L. helveticus*, CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=45480665

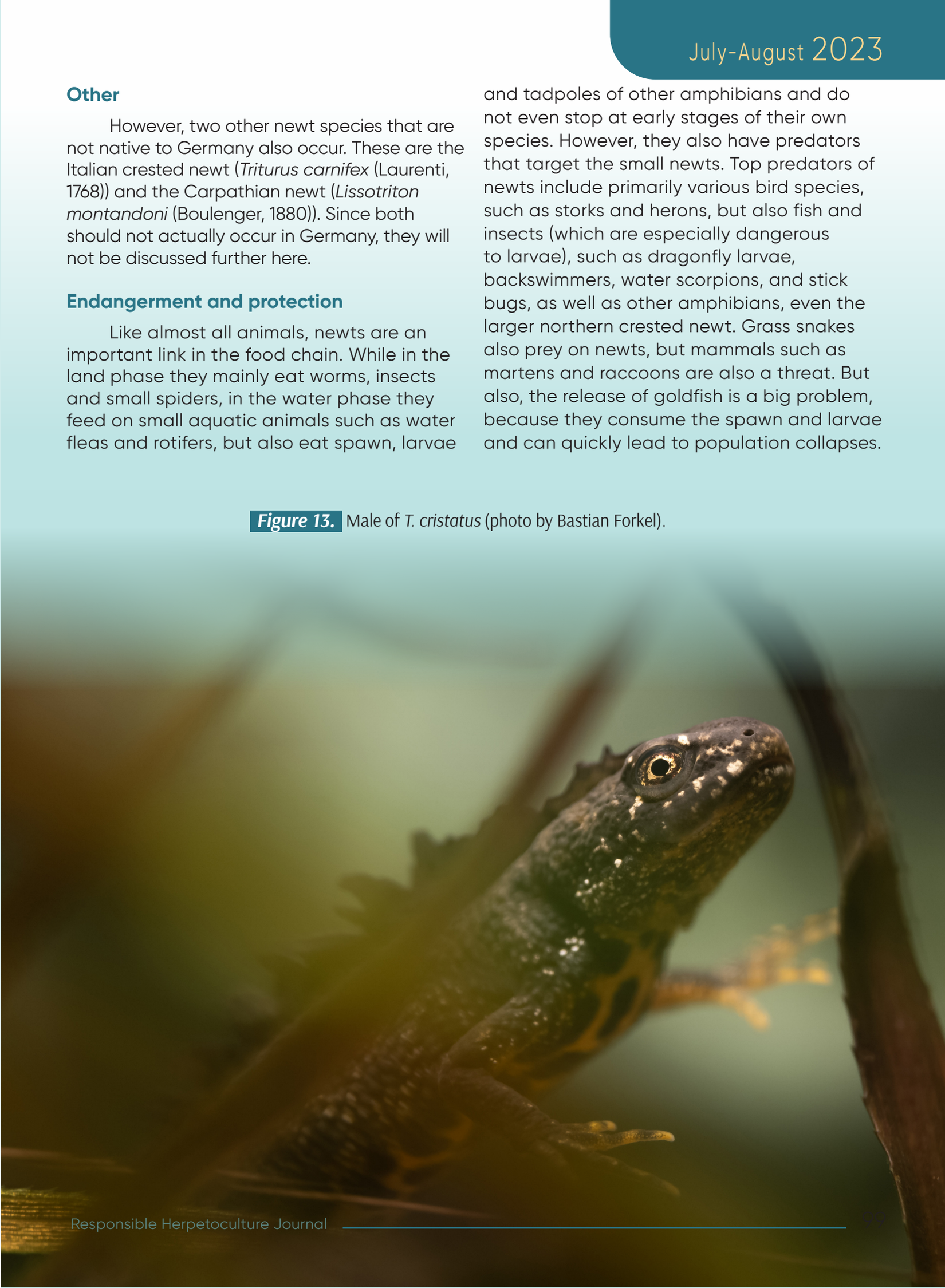
Other

However, two other newt species that are not native to Germany also occur. These are the Italian crested newt (*Triturus carnifex* (Laurenti, 1768)) and the Carpathian newt (*Lissotriton montandoni* (Boulenger, 1880)). Since both should not actually occur in Germany, they will not be discussed further here.

Endangerment and protection

Like almost all animals, newts are an important link in the food chain. While in the land phase they mainly eat worms, insects and small spiders, in the water phase they feed on small aquatic animals such as water fleas and rotifers, but also eat spawn, larvae and tadpoles of other amphibians and do not even stop at early stages of their own species. However, they also have predators that target the small newts. Top predators of newts include primarily various bird species, such as storks and herons, but also fish and insects (which are especially dangerous to larvae), such as dragonfly larvae, backswimmers, water scorpions, and stick bugs, as well as other amphibians, even the larger northern crested newt. Grass snakes also prey on newts, but mammals such as martens and raccoons are also a threat. But also, the release of goldfish is a big problem, because they consume the spawn and larvae and can quickly lead to population collapses.

Figure 13. Male of *T. cristatus* (photo by Bastian Forkel).



In addition to this natural cycle, however, other factors are affecting declines. Some newt species, such as the smooth newt and the alpine newt, are still quite common in Germany, but they are also experiencing declines. Newts are strictly protected in Germany, and they are also listed under various categories in the Red List.

However, there are other threats that are responsible for the decline: One threat is humans. The animals suffer from the destruction or degradation of small water bodies through littering or filling. Since the skin of amphibians is very thin and permeable, toxins such as fertilizers and liquid manure as well as other pollutants quickly enter the body and can lead to the death of the animals. It also happens that forest roads are filled by construction debris, so that the given dynamics are interrupted by the emergence of natural temporary water bodies. The loss of such habitats is dangerous for the newts.

Also, during the annual amphibian migrations many newts die when they get under the wheels and are run over.

But protective measures can be put in place: The preservation of habitats is very important. For example, some conservationists take care of the preservation by creating new water bodies, protecting them from siltation and regularly monitoring them. Some associations and organizations take care of fences for the amphibian migrations. So that the animals land safely in catch buckets and can be carried just as safely across the road.

To what extent diseases such as *Bsal* (caused by *Batrachochytrium salamandrivorans* Martel A., Blooi M., Bossuyt F., Pasmans F. (2013) fungus) will continue to have a negative impact remains to be seen.

Figure 14. Run over and dead *T. cristatus* (photo by Bastian Forkel).

Figure 15. *I. alpestris* with Bsal (skin ulcers) (photo by Frank Pasmans).

THE NEW FACE OF REPTILE SHOWS

Author(s): ***C.M Hanes***

Foreword: *Christopher Hanes is a professional wildlife photographer with over thirty-five years of experience. Chris originally got his start working in the exotic pet trade and wildlife rehabilitation in Southern California and currently self-publishes under Wildlife Conservation Photography to multiple platforms.*

Thirty-five years ago, if you opened the wrong door in my house, you might find yourself eye to eye with a pair of over fifteen-foot Burmese pythons waiting for lunch. These days my home is a little more on the conventional side than terrariums doubling for every possible piece of furniture. The ever-evolving zoo has been replaced by a single 150 lb dog that frequently makes me wonder if I am living in an episode of Scooby-Doo. I still enjoy attending exotic animal-related events but, instead of begging breeders and vendors to take my grocery money and sustaining life on Top Ramen until my next payday, now I take away nothing but smiles and photographs.

Figure 1. Crested geckos are becoming increasingly popular due to an increase in morphs © C.M Hanes

Figure 2. 'Nice Balz' ball python breeders' stall.

Figure 3. A stall selling crested geckos at the Nassau Expo.

Over the weekend I attended the Nassau Reptile Expo at the Global Sports Arena in Garden City, New York, along with about a thousand of my closest strangers. This event, which draws a "Who's Who" of vendors and spectators alike, is the brainchild of two young men with an enthusiasm that rivals a toddler with a puppy and a triple espresso, Anthony (Tony) Saravo and Louis Torres. Relative newcomers to the professional side of herpetoculture, what these guys lack in experience they more than make up for in enthusiasm, attitude and fresh perspective.

Walking through the entrance you are immediately aware this is not your typical reptile swap-meet in a school gymnasium. The domed arena with its artificial grass that normally would play host to a soccer pitch and hundreds of screaming fans has been transformed into a bustling market fit to rival Morocco or Bangkok. Upbeat music sets the mood for this immersive experience, accompanying the thousands of reptiles headlining the event. Interactive exhibits, a reptile show by Uncle Tony's Reptile Shack for the kids, bodegas catering to your favorite finicky furless friend, there is something for everyone, and just in case you get a little peckish they didn't forget the snack bar.

As I navigated the pseudo tropical terrain of terrariums with Lauren, my production assistant, trading quips with old acquaintances and new it was hard to remember we were there in a professional capacity. Like kids in a candy store racing from one technicolor treasure to another, the excitement with each discovery was contagious. It doesn't matter if you are five, fifteen, or fifty when someone holds out their hands with a brightly colored ball of big-eyed brilliance you are instantly transported to the wide-eyed days of youth and fascination.

I caught up with Tony and Lewis for a few minutes late in the afternoon to congratulate them on the turnout and talk about what's next. Riding on the success of the new venture and hot on its heels the guys are already in gear for another show in December, just in time for the holidays. Long term, Tony said, he and Louis plan to hold three expos each year in the venue located just outside New York City. Given the success of the inaugural event and the enthusiasm of these two friends from middle school, I would say the odds are pretty good.

When older people and younger people get to discuss common interests, it seems the conversation inevitably drifts into a then-and-now comparison. As you can probably guess between 1988 and 2023 with a whole new generation of enthusiasts a lot has happened. If you were to hold up a picture of a reptile

Figure 4. There are countless ball python morphs now available, that are frequently sold at expos.

Figure 5. DNA Breeders' stall at the expo.

show from the eighties next to any one of the events of the modern day the first thing you would notice is the absence of wild-caught imported giants. In place of giant reticulated pythons (*Malayopython reticulatus* (Schneider, 1801)), black caiman (*Melanosuchus niger* (Spix, 1825)) and savannah monitors (*Varanus exanthematicus* (Bosc, 1792)) you will find their far smaller and more delicate captive bred designer cousins in colors and patterns Mother Nature never dreamed of. Gone is the day of the monsters, usurped by the mighty "Morph".

Figure 6. *Boa constrictor* Linnaeus, 1758 morphs are still incredibly popular.

Figure 7. The striking 'new joker' morph of corn snake.

Selective breeding by professionals and amateurs alike has created a cornucopia of subgroups with a list of descriptors that reads less like titles and more like a menu at a SoHo Espresso Bar, and the results are stunning. At the center of this trend is a favorite pet from my youth, the ball python (*Python regius* (Shaw, 1802)), with designer examples ranging from a couple of hundred dollars to well into the thousands. Far from the appearance of their wild predecessors, these pudgy little guys with big eyes and broad snouts come in a range of colors and patterns that defy definition, from brilliant pastel violet, pink, yellow or white, all the way to midnight black. With patterns ranging from nothing to spots or even tiger stripes, I could publish a coffee table book on designer ball pythons alone.

This shouldn't come as a surprise, after all since time unremembered people have taken wild animals and bred them selectively to emphasise desired traits, producing what we now call domestic animals. In the early eighties the designer pet craze kicked in with the advent of glowing aquarium fish and hybrid bird species, so why not reptiles and amphibians? Who wouldn't like to see a powder puff purple python or a bioluminescent axolotl?

Snakes aren't the only thing getting a fresh new look. While we were there, we got up close with «Snow White» tegus, Frosty Geckos, Candy Colored Chameleons, and Tangerine Dragons. From terrapins to tarantulas and anoles to zebra skinks, even the most seemingly inconsequential stall in this pop-up bazaar housed some far-out creatures to defy imagination.

As a conservationist, you might expect me to disapprove of the exotic animal trade and in its traditional form, you would be correct. However, in this case, I see multiple advantages. By creating these dimorphic apparitions not only do we get exciting new looks, but we remove a significant percentage of the market access from poachers and smugglers by shifting attention away from wild-caught imports. An additional benefit is that at a time when ecosystems are being decimated by invasive species in most cases, these designer pets are far less likely to survive in the wild. Coupled with appealing to a more diverse portion of society and opening up opportunities for education, these "New Faces" just might bring us a little closer to restoring and protecting the delicate balance of this magnificent biosphere called Earth.

So, if you want to take a walk on the wild side, grab the kids, bring the friends, or even just treat yourself to a day of the unreal. You won't regret it, and who knows you might just make the world a little better place. As for this guy, if I find a turquoise Texas Tiger I just might have to start collecting again.

Figure 8. A snow white Argentine tegu (*Salvator merianae* A.M.C. Duméril & Bibron, 1839).

Women in Herpetology

The "Women in Herpetology" project is a collection of over 50 stories from herpetologists across the world. Each herpetologist represents a different country and there are multiple species at the heart of the project. "Women in Herpetology" plays an important role in representing women from different cultures within Biology. The project is now crow-funding to release a fully-illustrated book that shares these stories with the world. Teaming with interesting tales of conservation and herpetological study, as well as hand-drawn original images, maps and caricatures, the book appears to offer an easy introduction to the fascinating world of reptiles and amphibians whilst containing professional insights into individual projects. Readers can support the project by visiting the website: **www.womeninherpetology.com.**

AN INTERVIEW WITH ANDREW LOLY, REPTILE OIL PAINTER

Author(s): ***Andrew Loly***, *Reptile Oil Painter*

Foreword: Andrew Loly is an oil painter who depicts reptiles in his artwork. His unique style portrays an array of species in a new light. Responsible Herpetoculture's Executive Editor, Thomas Marriott caught up with Andrew to talk about his history as a painter and some of his favourite pieces. Readers can find Andrew's work on Instagram, Facebook and **andrewloly.wixsite.com.**

Can you tell us about yourself and your early influences in painting?

I was born in Ireland, but when I was 9 my family moved to South Africa. I grew up in KwaZulu Natal, which is a beautiful province on the east coast of South Africa, possessing wonderful wildlife and patches of forest that looks almost tropical. I had always loved drawing and in school there I started copying Old Master sketches (mostly Da Vinci and Michaelangelo) from library books about Renaissance art, which no doubt influenced the direction I took.

Why do you choose to use oil paints as your medium?

I only touched oils once before I was 20 years old, in an attempted portrait of King Shaka Zulu when I was 16. Several years later I copied a Rubens portrait and it seemed to go very well and naturally (I didn't use any oil though, only turpentine...). There followed a few years of painting in a kind of Expressionist style, covering political topics (I was furious about the wars in Iraq and Afghanistan), and then I started focussing on traditional oil painting methods and improving my realism. I always loved old oil paintings and that's probably why I like the medium - it has a feeling of weight and depth. This can also be achieved in, for example, watercolours, but they are lighter and brighter, and I like the possibilities of very deep shadows in oils (most of the images here are acrylic and tempera, which works in a very similar way to oils, though now I am painting almost exclusively in oil paint).

How does herpetology influence your art? Are you interested in reptiles and amphibians or simply find them interesting subjects?

Regarding herpetology, I always loved snakes and other reptiles (and wildlife in general), but for many years I was painting portraits, still life, Old Master copies, etc. Then one day I found myself living in Austria and I discovered where I could see *Vipera ammodytes* in the wild. At some point I started drawing this species, and then painting it. Then I was in the Netherlands and visited a site to see *Vipera berus* (Linnaeus, 1758) and made a painting of this species as a gift for a couple I was briefly staying with. From there, I started painting other snake and reptile species. So, I had an interest already, but it took a long time before I started combining snakes and art. I have also tried painting amphibians a few times and will probably experiment more with this in the future.

Apart from becoming a subject for painting, I've had to develop my techniques and knowledge to be able to paint snakes. Painting scales is very different from painting clouds or flesh. It involves a lot of repetition and detail, which can be challenging. Add to that the colours and patterns and you can end up with a complicated painting process that can involve a lot of planning and corrections. In oils, this can be particularly difficult, but the results can be beautiful.

Your artistic direction seems to pair a historic style with a modern understanding of zoology. Why is this important to you?

As I mentioned, I love old art. There were excellent snake painters in the 17th century, such as Frans Snyders and Otto Marseus van Schrieck. They weren't so concerned with being scientifically accurate - sometimes you can see the snake in the painting is dead from the way it is lying, or the head scales are incorrect for the species. Van Schrieck actually kept snakes in his garden shed (very unusual for his time, living in the 1600s), but without using a camera it would have been very hard to paint a living snake up close. Today it's easier to get zoological accuracy because of photography. Ultimately it's about creating a beautiful painting - to paraphrase the great Alexander von Humboldt, to understand Nature you cannot just describe it scientifically, you need to feel it with your emotions. Hence, in the end, I try to create slightly romanticised images and not scientific illustrations because I really want to use the techniques of the past to express something intimate and beautiful about these creatures.

Do you have any advice for aspiring artists with a fascination for reptiles and amphibians?

For anybody painting reptiles and amphibians, I would try starting with watercolours. They are perfect for sharply detailed work. In oils it is more difficult. I started painting snakes in watercolours first and this helped immensely. I also look at the way that other artists have painted reptiles and amphibians. Once again, Otto Marseus van Schrieck is a perfect example if you are painting in oils. It's also good to draw some reptile skulls to understand some inner anatomy and draw any dead specimens you find in nature. Reference photos are always good for helping with colours and scale patterns. For reptiles, you need some good quality smaller brushes with soft hairs. And painting on a flat surface like wood or paper is easier for sharp details than painting on a canvas.

Can you talk us through the process of creating one of your paintings?

The painting process can vary from painting to painting. First is some inspiration - deciding what species I want to paint, something that I'm excited and enthusiastic about helps. Then I usually draw the composition from my imagination. If possible you don't want to directly copy a photograph - photographs are only there to 'flesh out' the details that your imagination cannot invent, like scale patterns and colouration. I like to work on paper for reptiles, even when I'm using oils. I prime the paper first so it can endure oil painting, and begin with a grey ground colour (you can also use brown, red, or even white, depending on your style). Then I draw out the composition in black paint. The next steps can vary - sometimes I start in full colour on the part I find most interesting, for example, the head, or I might work on the whole picture in just a few basic colours like black, brown, yellow and white, which form the guideline for the other stages. After this, I add more intense colours, sharper details and highlights, and deeper shadows. I finish with a very thin varnish to give the colours more depth.

Do you have a favourite reptile-related piece and why?

One of my favourite reptile-related artworks is Head of Medusa by Peter Paul Rubens. The snakes and other animals in the painting were thought to have been painted by Frans Snyders. There are two versions of this painting, one in Vienna and one in Brno. I saw the Brno copy in the city art gallery when I was living there. It is an exceptional painting. It features many grass snakes (*Natrix natrix* (Linnaeus, 1758)) and smooth snakes (*Coronella austriaca* Laurenti, 1768). I love this painting partly because Snyder's expression of the snakes is unequalled. I am still trying to figure out how the scales were actually painted... Perhaps the technique is lost in time.

Where to see my art:
https://andrewloly.wixsite.com/paintings
https://www.facebook.com/andrew.loly.7
https://www.instagram.com/andrewloly/

Banded Gila Monster (*Heloderma suspectum cinctum* Bogert & Martín Del Campo, 1956)

This was a fantastic commission from a UK Heloderma keeper. He specifically wanted his specimen painted and sent me several reference photos so I could get the colours and pattern just right. The composition came from my imagination, and the details from his photos - my favourite approach. When it was all done, I was particularly happy with the head. So, I sent an image to Michael - he replied that everything was fine, but the head was too big!! I tried to save this part of the painting which I was so happy with and had put so much effort into - I tried cutting parts off and moving little bits, but in the end, there was nothing for it but to erase and repaint the head. It's one of the most difficult things to do in a painting, removing a well painted part for whatever reason. I repainted the head and, as often is the case, the customer was right - the painting looked much better and ended up being my most popular print so far.

Guatemalan Beaded Lizard (*Heloderma charlesbogerti* Campbell & Vannini, 1988)

I recently returned to Heloderma as I had taken several reference photos of a large Beaded Lizard (*Heloderma horridum* (Wiegmann, 1829)) from Brno Zoo when I was living in Czech Republic. After painting *H. horridum*, I got inspired to paint something

Figure 1. Banded Gila Monster (*Heloderma suspectum cinctum* Bogert & Martín Del Campo, 1956) Tempera/Watercolour/etc. on Paper, 2020, 32cm x 42cm.

really special - the rarest of Heloderma, *H. charlesbogerti*. Although I didn't have an individual to paint (there are only 200 in the wild, and of course they are several thousand kilometres from me) I could put myself in their environment with very little imagination, being that here in Andalusia it reaches 45°C in the summer and doesn't rain for months at a time. I used my *H. horridum* photos to get the pose right, and got some advice on colour and pattern from my previous customer who commissioned the Gila Monster, Michael Nolan, which really helped to get the look right. In the end, I feel this painting will be just as successful as the Gila Monster.

Albino Monocled Cobras (*Naja kaouthia*, Lesson, 1831)

A very unusual commission was this pair of albino Monocled Cobras (*N. kaouthia*). It's a widespread and common Asian species of cobra, but albino specimens are extremely rare. This story had a bit of a twist. After completing the painting, I couldn't get a reply from the customer. I held onto the painting for a long time - I wanted the man to get the painting and I hadn't taken any deposit. After trying to reach the customer again, I finally donated the artwork to a conservation auction for Herpetological Conservation International. In the end this piece raised money for wildlife conservation and has a new owner who is

Figure 2. Guatemalan Beaded Lizard (*Heloderma charlesbogerti* Campbell & Vannini, 1988) Oil on paper, 2023, 30cm x 42cm.

delighted with it - and I learned the hard way to take a deposit for commissions!

Mountain Pit Viper (*Ovophis tonkinensis*, Bourret, 1934)

I learnt about this beautiful viper while looking up reference photos for new species to paint. I like snakes that are cold-hardy, such as *V. berus*, so I was very excited about *O. tonkinensis* dwelling in places like the mountains of Hong Kong. I had been in contact with the internationally renowned herpetologist Austin Stevens and his wife Amy, who had agreed to accept a gift of a signed print of one of my artworks after I had confirmed to them that I was involved in wildlife conservation efforts (I donate

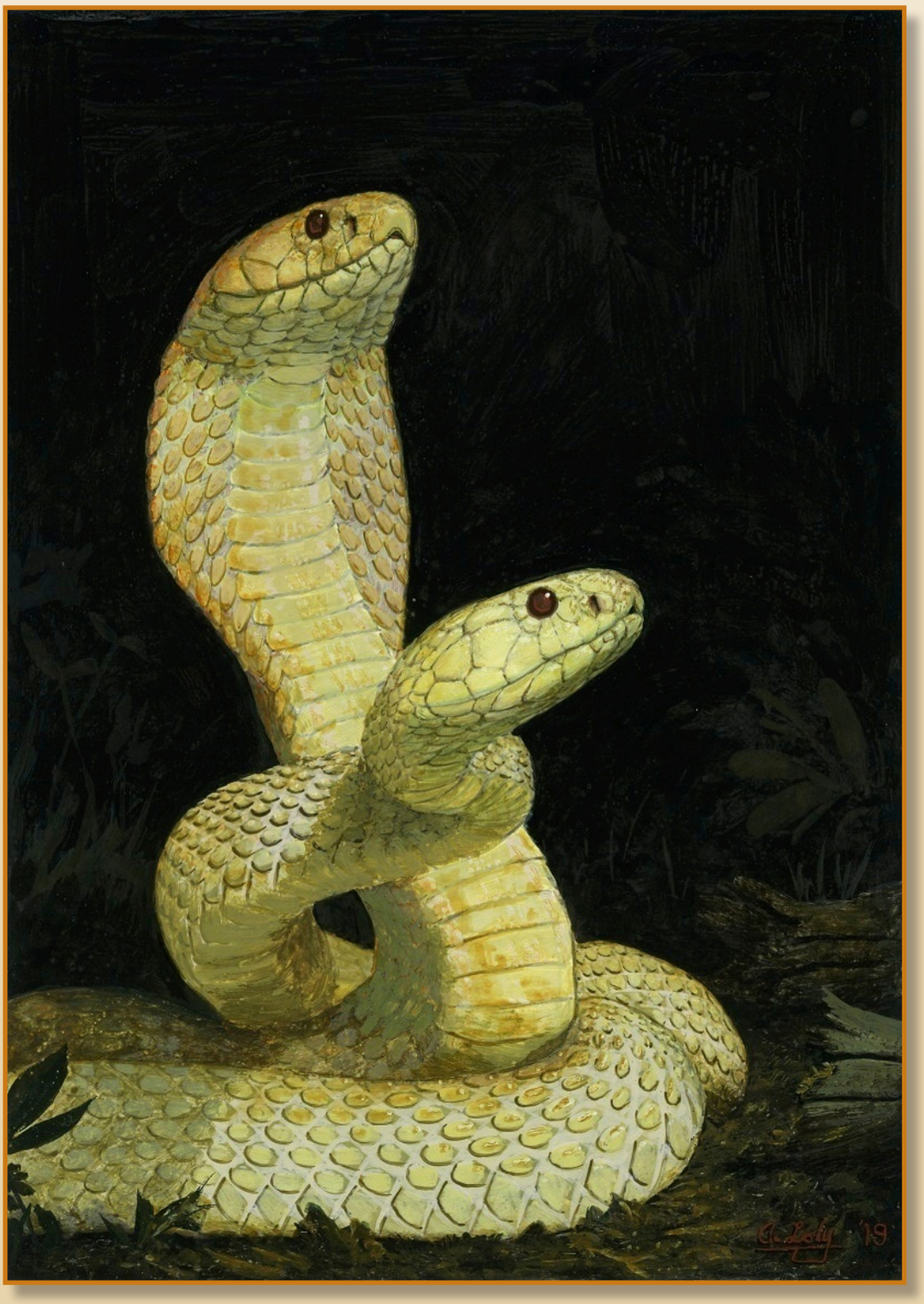


Figure 3. Albino Monocled Cobras (*Naja kaouthia*, Lesson, 1831) Watercolour on Paper, 2019, 42cm x 30cm.

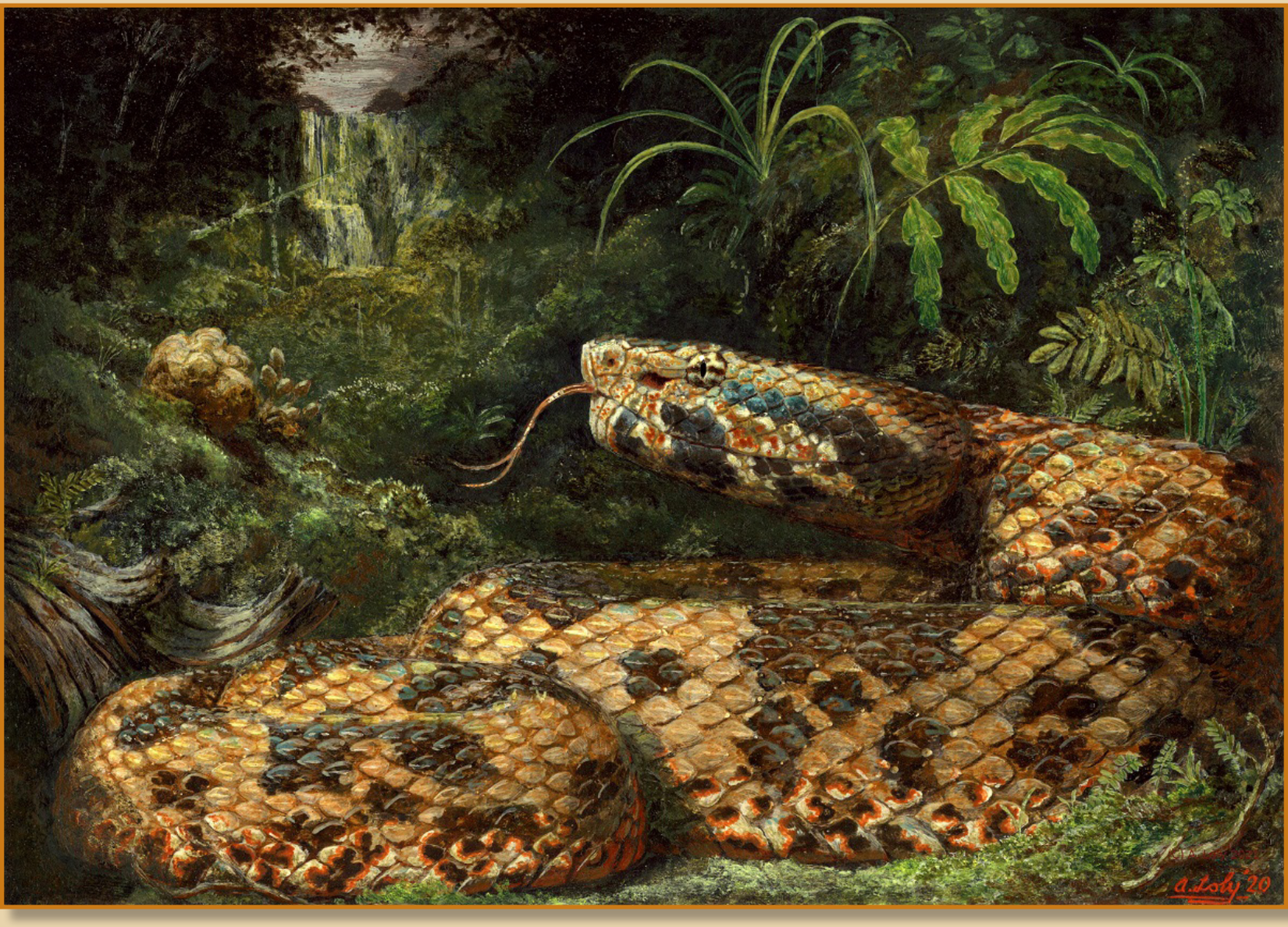


Figure 4. Mountain Pit Viper (*Ovophis tonkinensis*, Bourret, 1934) Acrylic/Tempera on Paper, 2020, 32cm x 42cm.

paintings to conservation fundraising auctions every year). Of all my paintings, Austin and Amy chose *O. tonkinensis*. This was a high honour! A high-resolution printable digital version is now available for free download on my website at https://andrewloly.wixsite.com/paintings/freesamples

Common Adder (*Vipera berus*, Linnaeus 1758)

After finding *Vipera ammodytes* in Austria, I became a bit obsessed with finding *V. berus*, which I had not yet seen in the wild. Over the next year I ended up seeing many specimens, mostly in the Netherlands. Then I moved near Brno in the south of Czech and discovered, rather disappointingly, that where I had moved was a blank spot on the map for vipers. I wrote to a local snake specialist who confirmed that they could not be found in the vicinity around Brno. However, he told me I could try looking at a spot an hour away by car, in an area of forested hills and fields. I went looking there with a friend, with no specific location and several square km to investigate. But something drew me to one specific spot - and despite the odds I found a viper resting on an overgrown mound at the top of a sloping and rough patch of land. To top it all, the name of the area was 'Hadek' - which is Czech for 'Snake'!

Eyelash Viper (*Bothriechis schlegelii*, Berthold, 1846)

I try to avoid painting snakes directly from a photograph because I feel that it is not the artist's job to copy the camera. However,

Figure 5. Common Adder (*Vipera berus*, Linnaeus 1758) Acrylic/Tempera on paper, 2021, 21cm x 32cm.

Figure 6. Eyelash Viper (*Bothriechis schlegelii*, Berthold, 1846) Tempera/Watercolour/etc. on Paper, 2020, 32cm x 42cm.

Figure 7. Mangshan Pit Viper (*Protobothrops mangshanensis*, Zhao, 1990) Acrylic/Tempera on paper, 2021, 30cm x 42cm.

sometimes I come across a photo that is so well composed that I must break this rule. I had been approached in the past by Cesar Barrio Amorós for the use of my *Lachesis* (Bushmaster) paintings in his excellent publication about this genus, which I was more than happy about. One day I saw one of his photographs of *B. schlegelii*, a favourite species, and I knew I had to paint this image, with just a few changes to make it unique. The tables were turned now I was the one asking Cesar if I could use one of his images! He kindly agreed, and this was the result, which I was very happy about.

Mangshan Pit Viper (Protobothrops mangshanensis, Zhao, 1990)

I include this image not so much for the story behind the painting, but more for the species itself. I had of course not seen a Mangshan Pit Viper in the wild (very few people have), but I had seen an individual in Pilsen Zoo in Czech Republic and had my own collection of reference photos from that meeting. I was fascinated by the story of this viper: In the late 1980's a worker at a forest farm in China was bitten by a large, unidentified snake. Nobody knew what it was until it was finally described in 1990. Until that time, this 6ft (2m) egg-laying viper, now almost extinct in the wild, was unknown to science. This is also the first painting where I painted an amphibian, another reason why I want to include it here - the Mangshan horned toad (*Megophrys mangshanensis* Fei & Ye, 1990) is another species that was first described in 1990 and is also known only from the area of Mount Mang.

AN INTRODUCTION TO EDIBLE PLANTS

Author(s): *Thomas Marriott*, *Executive Editor for the Responsible Herpetoculture Journal, UK*

Foreword: Edible plants can be anxiety-inducing for many keepers. Although nowadays there are plenty of resources online as well as 'edible plant' products that ensure that the keeper is choosing non-toxic varieties to feed to their animals, the possibility of a hidden pesticide or a misidentified species slipping into our beloved pet's salad bowl can prevent keepers from providing an eclectic mix of vegetation. Furthermore, the species that our pets encounter in the wild are very often not the varieties which are commercially farmed or can be maintained in our back gardens. This guide aims to provide helpful tips for feeding herbivorous reptiles.

Identifying plants

Most herbivorous animals, particularly reptiles, are generalists when it comes to diet. Few have such highly specialised diets that they will only feed on specific species. Whilst it's true that any species can have 'too much of a good thing', in the wild, a varied diet consisting of different types of vegetation in different quantities at different times of the year will help combat this issue. In captivity, this is sometimes difficult to replicate and so we must firstly research the species we are catering for and secondly, provide an eclectic mix of vegetation that most closely resembles the natural diet of our animals. Nowadays, there are far more resources online to help identify plants, as well as better transparency of external ingredients and pesticides on our food products.

For experienced hobbyists looking to go one step further, the online resource iNaturalist allows people to photograph flora and fauna and record their exact coordinates. Whilst this is a well-known resource to naturalists who are looking to identify specific varieties and localities of individual species, it also tracks the types of plants that grow in the area. For zookeepers, using this resource to find an image of a niche species, locating the exact location it is found, then analysing the flora that is also found in that region can provide valuable insight into which vegetation might be eaten in the wild. This resource is available to everyone, for free. This should only be used as a rough guide and expert knowledge should be applied before concluding that a particular species of plant is appropriate for a captive animal. However, it can provide valuable inspiration for exotics keepers.

Edible plants for gut-loading

Edible plants are also great for gut-loading feeder insects. Carrots, beetroots, pumpkins, sweet potatoes, tomatoes, bell peppers and apricots are all rich in carotenoids. When fed to a feeder insect, these pigments not only help enhance the colours of the animals but also provide powerful antioxidant properties. Try to feed a variety of brightly-coloured vegetation to your feeder insects alongside a nutrient-rich gut loading formula. However, keepers must be careful that these plants are organic and have not been exposed to insecticides, as even small amounts, when fed over a long time, could affect the health of your animal. Consider your live food as a vessel of nutrition, a "sandwich" to feed to your reptiles – what is within your live foods is also passed on to your reptile.

Planting edible plants in the terrarium

Providing live, growing plants within a terrarium is an excellent source of enrichment. Not only does it give the inhabitant a tasty snack, but it can encourage problem-solving, patience, and mimic wild feeding opportunities. In zoos which have large exhibits, plants are often fixed into naturalistic positions.

For example, drilling a hole in a branch and fixing vegetation into an existing perch will allow arboreal lizards to graze naturally in an elevated position. If the vegetation is still attached to its original branch and requires the animal to pull leaves from the branch, this will encourage even more natural behaviour. Instead of feeding a herbivorous reptile from a pre-prepared salad bowl, consider sourcing entire plants, or place leaves in interesting positions across the terrarium.

Prickly pear or *Opuntia* pads are perfect for planting in an arid bioactive setup. As well as providing a highly nutritious source of food, they are extremely hardy and will grow into a soil-based substrate easily. Like most desert plants, they are slow growing so it's highly likely the bearded dragon, tortoise of Uromastyx will have eaten the cactus before the keeper notices any considerable growth, but this kind of natural foraging should be encouraged.

For plant species that will naturally trail to the floor or grow out into larger bushes, the keeper can use an adhesive to attach the plant pot to an area that is usually out of reach. Once the plant begins to grow, it will trail towards an accessible area (such as a branch, ledge, or elevated rock) and allow the species to graze naturally without them destroying the entire plant. Plant guards can also be used to protect the stem of the plant. This cycle will also naturally produce more vegetation at times when the keeper provides a longer photoperiod and more misting, thus creating a naturalistic spring/summer season. Many species will naturally consume more vegetation during spring, or more flowers/fruits during wet seasons so growing plants naturally in the terrarium will also help support these seasonal fluctuations in diet.

Homegrown plants

Growing your own fruit and veg is not only a rewarding pastime, but it also saves money and produces guaranteed-organic foods for both the keeper and the kept. Suitable for all herbivorous taxa (including feeder insects), home-grown fruit, veg and leaves are the best way to spoil our beloved pets. The keeper can select plants with specific nutritional benefits for their animals and their live foods. Chalk and limestone can also be added to the soil of a planter to boost the calcium content of homegrown plants. Although they will still require additional supplements, this technique will ensure that the vegetation has its highest possible calcium content. In Southern and Eastern Europe (where the most popular pet tortoises come from), the soil is rich in limestone and the cacti and other vegetation that grows there has an exceptionally high calcium content, particularly during spring when the calcium is concentrated within the shoots of the plant. This helps Mediterranean tortoises receive their natural calcium requirements as soon as they awake from hibernation. \

Edible plant kits are ideal for people living in apartments or areas where garden space is limited. They can be placed on a windowsill and with an occasional watering, sprout an ongoing supply of healthy plants that are ideal for some of the more popular species of bearded dragons, *Uromastyx*, turtles and tortoises. Many leafy greens that are bought commercially have reasonably low nutritional value (especially those with high water content such as iceberg lettuce) so the selection of dandelion, plantain, *Callisia repens* (Jacq.), *Prunella vulgaris* L. and *Rumex acetosella* L. provides a guaranteed healthy alternative.

Edible Natural Forage

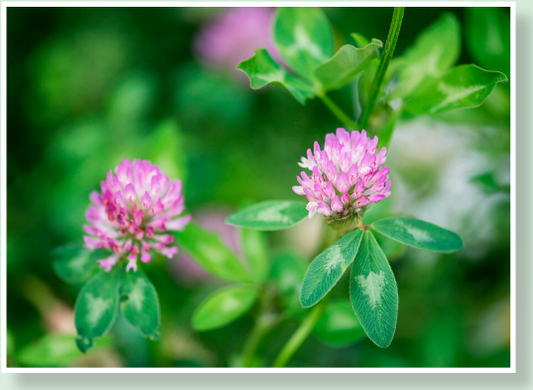
The following plants are found across Europe and the rest of the world. They are safe to feed to most Mediterranean tortoise species and therefore, likely to be non-toxic to most reptiles and amphibians. Ensure all plants are sustainably sourced and washed thoroughly before feeding to a captive animal.

- Flowering maple (*Abutilon* spp.)*

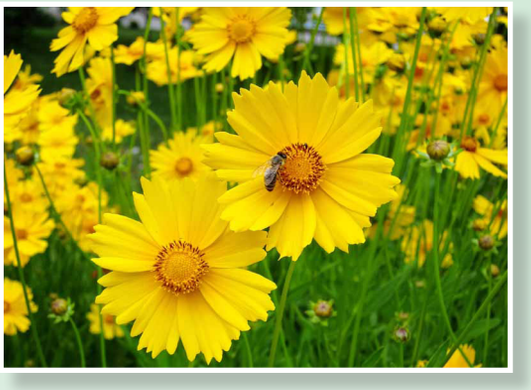
- Alexanders (*Symernium olustratum* L., *Symernium perfoliatum* L.)

- Bergamot (*Monardo* spp.)

- Bristly Oxtongue (*Helmintia echiodes* (L.) Holub)



- Clover (*Trifolium* spp.)



- Tickseed (*Coreopsis* spp.)

- Corn Salad (*Valerianella* spp.)

- Cranesbill Geranium (*Geranium* spp.)

* Pictures taken from Internet open sources.

- Dandelion (*Taraxacum officinale* (L.) Weber ex F.H.Wigg)

- Evening Primrose (*Oenethera biennis* L., *Oenithera speciosa* Nutt., *Oenithera* spp.)

- Flowering Currant (*Ribes sanguineum* Pursh)

- Forget-Me-Not (*Myosotis* spp.)

- Goat's Beard (*Astilbe* spp.)

- Hollyhock (*Alcea rosea* L.)

- House Leek (*Sempervivum* spp.)

- Knapweed (*Centaurea scabiosa* L., *Centaurea nigra* L., *Centaurea stoebe* L.)

- Livingstone Daisy (*Mesembryanthemum criniflorum* L.fil.)

- Milk Thistle (*Silybum marianum* (L.) Gaertn.)

- Mind-Your-Own-Business (*Soleiriolia soleiriolii* (Req.) Dandy)

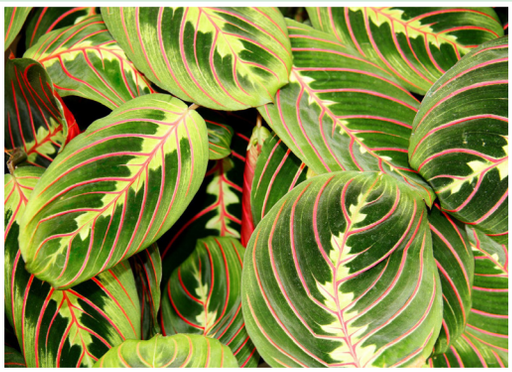
- Musk Mallow (*Malva moschata* L.)

- Nemesia (*Nemesia* spp.)

- Opuntia (*Opuntia* spp.)

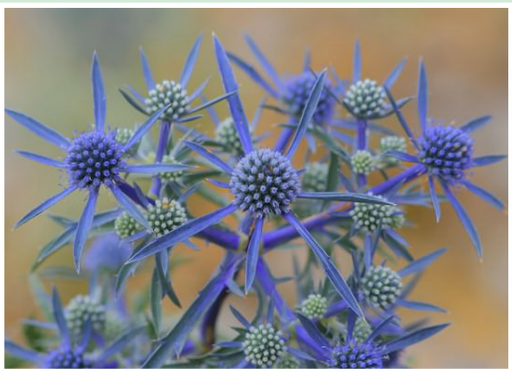
- Pansy/Violet (*Viola tricolor* L.)

- Peperomia (*Peperomia* spp.)



- Prayer Plant (*Maranta leuconeurea* É.Morren)

- Red Valerian (*Centranthus ruber* (L.) DC.)



- Sea Holly (*Eryngium* spp.)

- Sow Thistle (*Sonchus* spp., *Sonchus oleraceus* L.)

- Spider Plant (*Chlorophytum comosum* (Thunb.) Jacques)

- Teasel (*Dipascus fullonum* L.)

- Thyme (*Thymus* spp.)

- Violet (*Viola* spp.)

Important note!

«Dear reader! Taking into account the latest information and scientific work made by the staff of Cherkasy Zoo and one of our subscribers - Dmytro Kudlaienko - we have to inform that the article on husbandry of New Guinea snake-necked turtle titled as «Keeping and breeding of New Guinea snake-necked turtle (Chelodina novaeguineae Boulenger, 1888) at Cherkasy Zoo» actually refers to another species of the genus - Chelodina siebenrocki or Northern snake-necked turtle. This was the result of clarifying studies of the morphology of turtles that are kept in the zoo. Nevertheless, the article contains valuable information about keeping and breeding, although of a different species, and does not lose its value for herpetoculture. We are grateful to the authors and subscribers for their honest work.»

APRIL-MAY 2022

KEEPING AND BREEDING OF NEW GUINEA SNAKE-NECKED TURTLE AT CHERKASY ZOO

Author:
Iryna Solov'yova, Zoologist of "Aquaterrarium» Department, Cherkasy Zoo, Ukraine (the pictures were kindly provided by the Cherkasy Zoo)

The New Guinea snake-necked turtle (*Chelodina novaeguineae* Boulenger, 1888) belongs to the Chelidae family. *Chelodina novaeguineae* lives in semipermanent, seasonally ephemeral swamps (Kennett et al., 1992). The turtle either aestivates or migrates to a more permanent waterbody when the swamps dry up. This species is fairly easy to identify by the oval, compacted olive-brown carapace, slightly extended to the tail. The whole plastron is yellow, only the seams between the shields have dark edges. The upper part of the head, neck and limbs is from gray-brown to black, other unprotected parts are light-olive (Fig. 1). The membranes are rough, with long sharp claws. The jaws are wide and the maxillae compose more of the palate than in other Chelodina.

The neck is comparatively short and thin, only about 55-60% of the carapace length, and its dorsal surface is covered with large, rounded tubercles (https://turtles.linnaeus.naturalis.nl/linnaeus_ng/app/views/species/taxon.php?id=792&p=11).

Figure 1. *C. novaeguineae* inside its aquaterrarium

When resting, *C. novaeguineae* twists its long neck off to the side for protection. The highly flexible neck permits foraging in mud as well as snorkeling. It also allows the turtle to strike quickly to capture prey (https://en.wikipedia.org/wiki/New_Guinea_snake-necked_turtle). The New Guinea snake-necked turtle is oviparous. Average clutch size ranges from 17 to 21 eggs. Incubation lasts for 75–110 days depending on temperature.

KEEPING CONDITIONS

One of the main criteria for successful husbandry is using of spacious aquaterrarium with a deep enough pond and a good filtration system. Depending on the size of the individuals, we keep them in pairs, or in groups consisting of one male and two or three females (Fig. 2). In our enclosures we also use foggers to maintain fairly high humidity level. Water temperature is about +28 °C (82.4 F) during the day, with a slight decrease to +25 °C – +26 °C (77.0 – 78.8 F) at night. Presence of an artificial island with a gentle descent to let the animal in and out of the water is mandatory. The turtles usually climb on island and bask under the lamps. They use this part of land (made of mix of soil and sand) to lay eggs. The aquaterrarium is equipped by lamps with ultraviolet radiation – Exo Terra «ReptiGlo UVB 100», plus infrared lamp for heating of land and water.

Figure 2. Young *C. novaeguineae* resting on stone.

DIET

We feed our turtles mainly on fish, mollusks, squids, shrimps and sometimes on insects. Occasionally they can take a plant food. We offer food by tweezers, because these turtles are quite aggressive and compete with each other. This makes quite easy to keep track of the amount of food consumed by each individual. We practice the offering of live fish under the supervision of employees in order to let the turtles hunt on their own. It should be noted that they enjoy this process a lot. Considering that fish and mollusks are possible carriers of various worm infestations, we provide deworming therapy using anti-helminth treatment every 3 months.

BREEDING

We obtained our pair from a private collection. Before laying first clutch, the male and female spent six months together. The first clutch was observed in November 2020. The female dropped 8 eggs in the water, which we moved to the tray of the incubator with a moist substrate. At the incubation temperature of +28 °C (82.4 F) the first 4 babies hatched in 156 days. Next day another one came out. At the end of incubation period two unfertilized eggs and one with a dead embryo were found. The cause of the death is unknown. The next laying season was in August 2021 with 8 eggs, which were dropped in water same as in previous case. We incubate this clutch at +28 °C (82.4 F).

Figure 3. *C. novaeguineae* clutch of 11 eggs.

• Die Chinesische Rotbauchunke Bombina orientalis (The Chinese Fire-Bellied Toad Bombina orientalis) by Manfred Rogner

Fire-bellied toads are very fond of. Especially the colorful and attractive Chinese fire-bellied toad enjoys worldwide popularity. The author Manfred Rogner has also recognized the potential of this species. Thus, he has many years of experience in keeping and breeding various fire-bellied toad species, including the Chinese fire-bellied toad (*Bombina orientalis*), about which he eventually wrote a book. The book is part of the «Art für Art» series published by Natur und Tier Verlag and thus consists of the typical 64 pages. These 64 pages shine in an appealing design and are abundantly filled with information as well as pictures. At the beginning there is a short preface, which introduces well into the book. After the introduction of the genus *Bombina* follows a description and a description of the distribution including habitat. Now the author goes into detail about the way of life. Besides the activity times he explains the prey pattern of fire-bellied toads, locomotion, flight, protection and calls. He also discusses mating behavior and the different stages of development. Based on this, the interesting part for the attitude follows: Manfred Rogner explains how to properly house fire-bellied toads, how to design the aqua-terrarium optimally and attractively, and how to organize the necessary technology. In addition, he explains how the breeding and rearing in the terrarium succeeds well and easily. To round off the book optimally the author goes at last still on the deficiency phenomenon with the belly coloration and explains, how one reaches the red coloration. Crossing attempts are also briefly discussed. It is an ideal book for people who would like to take up the keeping of fire-bellied toads.

Leandro Bergmann, Contributing Editor, Responsible Herpetoculture Journal

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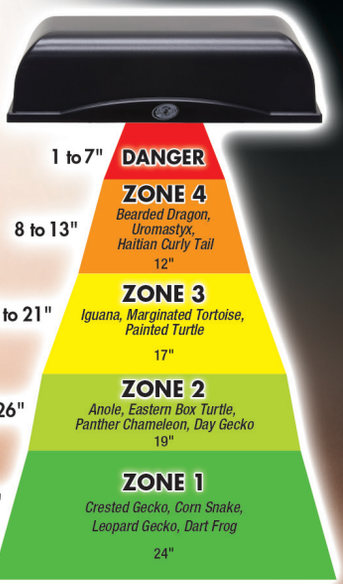

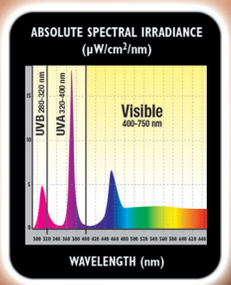

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