citizen conservation

#Reptiles

Basic information and husbandry guidelines for *Goniurosaurus huuliensis*, Huu-Lien tiger gecko

Status: 7 April 2025 | *Goniurosaurus huuliensis*, Juvenile | Photo: Thomas Ziegler

Contents

1. Profile

Scientific name: *Goniurosaurus huuliensis* Orlov, Ryabov, Nguyen, Nguyen & Ho, 2008
Colloquial name: Huu Lien Tiger Gecko
Head-torso length: 9,7–13,5 cm
CC#Reptiles-Category: III (also suitable for beginners)
Endangered status according to IUCN Red List: „critically endangered"
CITES protection status: Appendix II
Protection status EU species protection regulation: Annex B
Accommodation: For a pair or 1.2 animals Terrariums from 80 x 50 x 50 cm. Basic lighting from fluorescent lamps or LED bars. In the summer months 23.5-26 °C during the day with a slight drop at night. No long-term temperatures above 28 °C. In winter, reduced lighting duration and temperatures of 18-22 °C during the day and 14-18 °C at night.
Required equipment: Substrate of potting soil-sand mixture, pine bark, coconut fibres or similar. A layer of leaves on top. Add plants and roots, cork bark, stone slabs etc. as hiding places and structural elements. Design the back and side walls as a rock wall. Water dish. Eggs can also be incubated without an incubator (24-27 °C), rearing with the parents in the terrarium is possible in the first few months.
Care: Low maintenance; always fresh water in the drinking bowl, daily spraying. Drier in winter. Droppings are deposited by the geckos in a fixed 'toilet corner' and should be removed regularly.
Feeding: About twice a week, feed insects and invertebrates, e.g. crickets, grasshoppers, cockroaches, caterpillars, beetle larvae, etc. Always powder with a vitamin-mineral preparation before feeding.
Life expectancy: unknown, estimated at 15-20 years

Status: 7 April 2025 | *Goniurosaurus huuliensis*, adult animal | Photo: Thomas Ziegler

2. Why is *Goniurosaurus huuliensis* a Citizen Conservation Species?

As a habitat specialist, the Huu Lien tiger gecko is tied to evergreen forests in karst mountains and only occurs in a very small distribution area. This makes it particularly susceptible to impacts from human activities, such as limestone mining, which lead to habitat fragmentation or degradation. Tiger geckos are also threatened by the progression of climate change and thus the further decline in suitable habitats, as well as by illegal harvesting for the pet trade.

Terrarium room at the Melinh Biodiversity Station in Vietnam, here with tiger gecko conservation breeding facilities; from right to left: Phung H. Dang, Station Director, Christian Niggemann, Dr Cuong T. Pham, IEBR and Anna Rauhaus | Thomas Ziegler

Field studies on the population size of the Huu Lien tiger gecko have shown that the total population in the wild is well below the number of individuals required for a viable population; the population density is also very low (Ngo et al. 2023). The species is therefore listed as 'critically endangered' on the IUCN Red List and on Appendix II of the Washington Convention on International Trade in Endangered Species.

In addition to species conservation measures on site, e.g. the creation of further protected areas, the establishment of a reserve population in human hands is an important component in order to preserve the species and potentially be able to return animals at a later date should the decline in the wild continue. To this end, an international conservation breeding network of zoos and scientific institutions is being established in cooperation with the country of origin, Vietnam. This network also includes private keepers who are organised via Citizen Conservation.

This is also entirely in line with the 'One Plan Approach' developed by the IUCN, which aims to develop more integrative strategies for the protection of endangered species that promote the cooperative interaction of measures *in situ* (in the habitat) and *ex situ* (in human care, outside the habitat) as well as expert groups.

Another aim of the campaigns for the Huu Lien tiger gecko and other endangered geckos is to draw attention to the precarious threat to this group of reptiles and to raise awareness of the need to protect these animals and their habitats.

Rearing terrariums for *Goniurusaurus huuliensis* at Cologne Zoo | Anna Rauhaus

3. Biology and conservation

Goniurosaurus lichtenfelderi from northern Vietnam is a representative of the *G. lichtenfelderi* species group | Thomas Ziegler

The Cat Ba tiger gecko (*Goniurosaurus catbaensis*) originates exclusively from the Vietnamese island of Cat Ba and belongs to the *G. luii* species group. | Thomas Ziegler

3.1 Biology
- Classification

The tiger geckos (genus *Goniurosaurus*), also known as East Asian clawed or leopard geckos, belong to the eyelid geckos. According to Uetz et al. (2025), the family of eyelid geckos (Eublepharidae) currently comprises six genera with 48 species.
Four groups are distinguished within the genus *Goniurosaurus*:
1) The *G. kuroiwae* group with seven species that occur exclusively on islands in the Ryukyu archipelago, Japan;
2) the *G.-lichtenfelderi* group with five …
3) … and the *G. luii* group with nine species that occur on islands or the mainland in China and Vietnam;
4) the *G. yingdeensis* group with five species distributed on the Chinese mainland.

17 of these 27 species have only been described in the last 20 years. The tiger geckos are now the most species-rich genus within the eyelid geckos. The Huu Lien tiger gecko is assigned to the *G. luii* group, together with the Vietnamese tiger gecko (*G. araneus*), the Cat-Ba tiger gecko (*G. catbaensis*), the Chinese tiger gecko (*G. luii*), the Gezhi tiger gecko (*G. gezhi*), the Kadoories tiger gecko (*G. kadoorieorum*), the Guangxi tiger gecko (*G. kwangsiensis*) and the Libo tiger gecko (*G. liboensis*).

Habitat of *Goniurosaurus huuliensis* - threatened by increasing cultivation, among other things | Hai Gno Ngoc

- Distribution

The distribution of tiger geckos extends from northern Vietnam and south-west China - including some islands in the South China Sea such as Hainan - northwards to the Riu-Kiu archipelago in Japan. All species occurring in Vietnam inhabit geographically isolated distribution areas; none of the species occur sympatrically, i.e. in the same habitat, with other representatives of the genus.

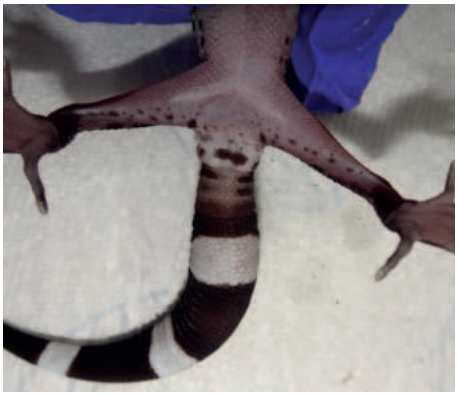
For a long time, the Huu Lien tiger gecko was only known from its type locality in the Huu Lien Nature Reserve in Lang Son Province in northern Vietnam. Recently, further occurrences have been found in the neighbouring province of Thai Nguyen (Ngo et al. 2022).

- Habitat

Huu Lien tiger geckos inhabit isolated karst mountains at altitudes of 176-500 metres above sea level. They are usually found in limestone formations surrounded by evergreen deciduous forest, interspersed with ferns, vines and bush vegetation. The habitat is characterised by dense vegetation cover, high humidity, a relatively stable ambient temperature and the presence of dry rocks.

During field studies, the majority of the animals found were located near large caves, where there are often several animals within a short distance of each other.

Goniurosaurus huuliensis from the type locality | Nicolai Orlov



Male ...

.... and females of *Goniurosaurus huuliensis* can be easily distinguished by the precloacal pores and the thickening at the base of the tail by the hemipenial pockets of the males. | Anna Rauhaus

- Appearance

Like all representatives of the *G. luii* group, *G. huuliensis* has a slender and graceful body structure with a triangular head that is clearly separated from the slender neck and relatively long limbs. The species reaches a head-torso length of 9.7-13.5 cm, making it the largest species of the genus *Goniurosaurus*.

The head, body and limbs have a greyish to dark brown basic colouring on the upper side, with dark spots on the top of the head and lower flank region. There are usually five yellow to orange-brown, dark brown bands across the top of the body, including a V-shaped nuchal band, three bands between the front and hind legs and one at the base of the tail.

The tail is also dark brown in colour, with 3-6 white bands. The underside of the head and body are matt white in colour with a few dark brown spots on the edge of the throat region and the base of the legs. The iris is a strong red-brown colour.

Further diagnostic features according to Ngo et al. (2021): Nostrils bordered by 6-8 nasalia, supraorbital region with a row of enlarged tubercles. 1-2 internasals, rarely completely absent. 9-12 supralabialia, 9-12 infralabialia, 14-20 preorbital scales, 51-59 lid margin scales, 2-4 postmentals. Gular region below mandible with enlarged tubercle scales, 31-37 paravertebral tubercles. 118-130 rows of scales around the centre of the body. Tubercles each surrounded by 11-13 granular scales. Deep axillary pockets. 21-25 subdigital lamellae under the fourth toe.

25-30 precloacal pores in males.

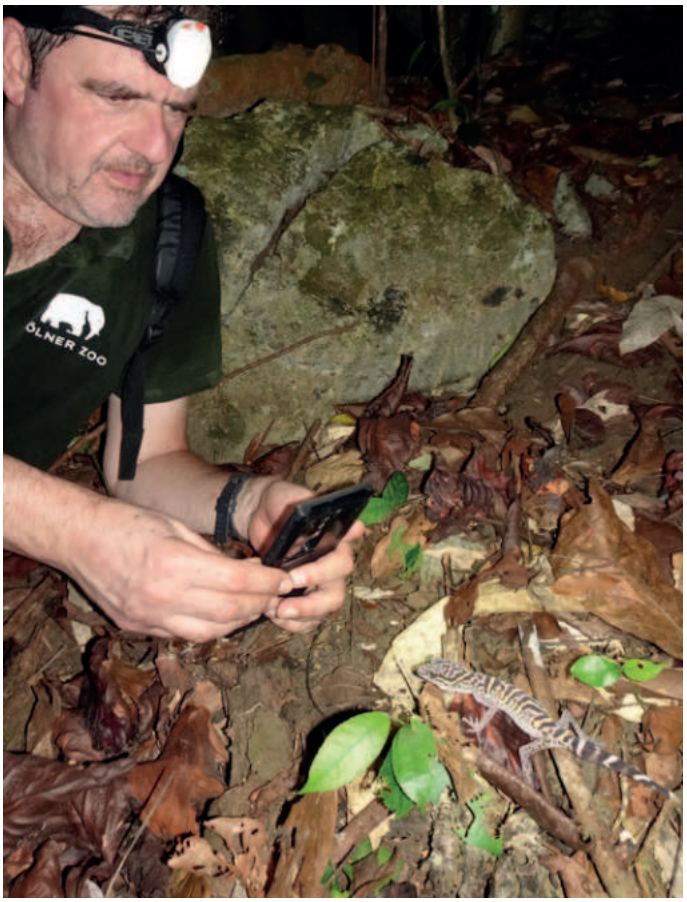
- Ecology, behaviour

Tiger geckos are nocturnal; in field studies, most *G. huuliensis* were observed between 20:00 and 03:00, with the main time of activity being between 21:00 and 01:00.

Most individuals sat on dry rocky ground at an average height of 70 cm above the ground. During the day, the animals hide in crevices of larger caves or individual karst rocks.

- Life expectancy

As the species was only described in 2008, no data is yet available on the maximum age to be reached. Life expectancy is estimated at 15-20 years (Langner et al. 2022); however, when looking at other species of Eublepharidae, it can be assumed that this age can be significantly exceeded (e.g. Berghof 2019). The oldest animals kept at Cologne Zoo are still reproductively active at ten years of age (as of 2025).



Tiger geckos are nocturnal - here, conservation curator Thomas Ziegler from Cologne Zoo photographs the closely related *Goniurosaurus catbaensis* in its habitat.
| Thomas Ziegler

Adult Huu Lien tiger gecko. Life expectancy of this species is still unkown. | Thomas Ziegler

3.2 Threat situation and conservation efforts

Dr Hai Ngoc Ngo completed his doctorate in Germany on tiger geckos at the University of Cologne and in the working group at Cologne Zoo, here with the Cat Ba tiger gecko. This enabled him to collect data on the species' way of life in its distribution area for the first time. His work was supported by the DAAD and funding from European zoos. | Mona van Schingen-Khan

All tiger geckos are endangered due to their small-scale distribution and small population sizes, particularly as a result of human influences such as habitat destruction and harvesting (Ngo et al. 2019, 2022b, c; Grismer et al. 2021). The genus *Goniurosaurus* is therefore one of the most endangered genera within the gecko family.

As a habitat specialist, the Huu Lien tiger gecko, which is only found in very small areas, is strictly bound to the presence of evergreen forests in karst mountains and only occurs in a very small distribution area. The international working group led by Prof Dr Thomas Ziegler from Cologne Zoo in cooperation with Prof Dr Truong Q. Nguyen from the IEBR in Hanoi, investigations were carried out for the first time into the ecology and endangerment potential of the Vietnamese tiger gecko species. As part of Dr Hai Ngoc Ngo's doctorate supervised by the German-Vietnamese team, the population size, microhabitat and exact distribution of the Huu Lien tiger gecko were investigated for the first time, allowing conclusions to be drawn as to which areas should be given special priority for the protection of the species (Ngo et al 2023).

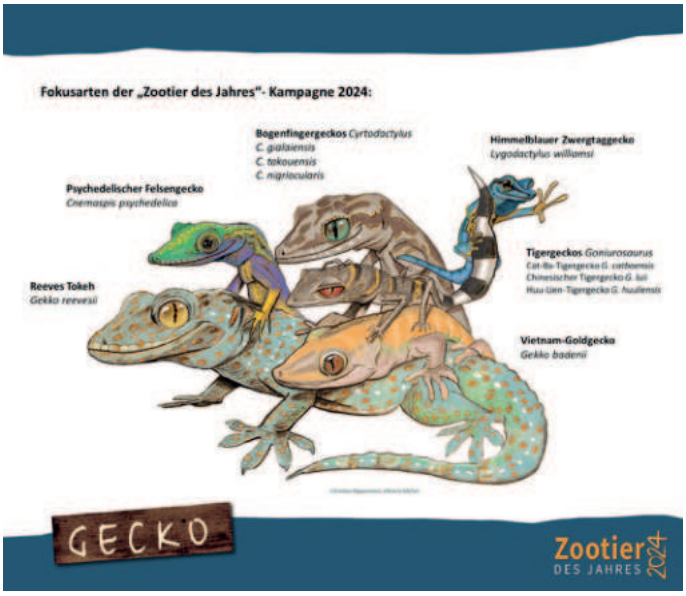
The extraction of raw materials for cement production and deforestation are also threatening factors for the Huu Lien tiger geckos, which are only found in very small areas. | Hai Ngo Ngoc

The habitat of the tiger geckos is being destroyed by the extraction of limestone for cement production and, for example, the construction of new roads in connection with urbanisation. Furthermore, even within the protected areas there is a high level of forest fragmentation due to logging; the deforested areas are gradually being turned into grassland or used for plantations.

In addition, Ngo et al. (2019a, 2019b) documented in the context of animal trade analyses and interviews that large numbers of tiger geckos were illegally collected for both the national and international animal trade.

Niche models, which can be used to calculate the influence of various temperature scenarios on current and potential populations of the species in the coming decades, have also shown that the species' populations could decline sharply or even disappear completely by 2070 as climate change progresses, as there will be virtually no suitable habitats left (Ngo et al. 2021a). Warmer temperatures could also upset the gender balance within the populations.

In cooperation with Citizen Conservation and others, Cologne Zoo is setting up a conservation breeding network for endangered tiger geckos such as *Goniurosaurus huuliensis*. The geckos are bred and exhibited in Cologne Zoo's aquarium to raise public awareness of the precarious situation.
| Thomas Ziegler



The Huu Lien tiger gecko was one of the focus species in the 'Zoo Animal of the Year 2024' campaign.
| Drawings Christian Niggemann, colouring V. Michel

This data ultimately contributed to the listing of tiger geckos from Vietnam and China on Appendix II of the Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora (WA/CITES), which created an international protected status. Since then, the Vietnamese tiger gecko species have also been protected by Governmental Decree 06/2019/ND-CP (Group IIB), i.e. a national decree within the country.

The species is listed as 'critically endangered' in the IUCN Red List.

As part of the cooperation between Cologne Zoo and the Institute of Ecology and Biological Resources (IEBR), a first reserve population was established at the Melinh Biodiversity Station in northern Vietnam; the species is successfully bred there on a regular basis. Following reassurance and approval from both the Vietnamese partners and colleagues from the Federal Agency for Nature Conservation, Cologne Zoo received animals from a private breeder who wanted to reduce his stock in order to set up a further reserve holding in European zoos. The geckos have been kept and bred at Cologne Zoo since 2019. Numerous offspring have already been transferred to other zoos in Europe and to Prof Dr Lee Grismer from La Sierra University, one of the world's leading gecko specialists, in the USA to build up an international reserve population. Citizen Conservation will now also give private keepers the opportunity to participate in the conservation breeding programme for the Huu Lien tiger gecko.

The Huu Lien tiger gecko was also one of the focus species of the 'Zoo Animal of the Year 2024' campaign initiated by the Zoological Society for Species and Population Conservation (ZGAP), which centred on geckos. The aim of the campaign was to draw attention to the critical threat situation for numerous gecko species, raise public awareness of the problem and raise funds for conservation projects in the countries of origin. A total of 200,000 euros was raised for gecko conservation, part of which will also benefit *Goniurosaurus huuliensis*.

Finally, the species is also one of the focus species of the 'VietnAmazing' campaign 2024/2025 of the European zoo association EAZA, which aims to draw attention to the biodiversity hotspot Vietnam and its threat situation. The funds from the 'Zoo Animal of the Year' and 'VietnAmazing' campaigns have been used to support conservation breeding efforts on the ground in Vietnam as well as specific conservation measures in gecko habitats and scientific research into the species. All these measures also offer the opportunity to secure and increase the ex-situ population of *Goniurosaurus huuliensis* and other highly endangered geckos worldwide - should it one day be necessary to return them to their country of origin to increase the population, we would be prepared to do so.

PR work for endangered tiger geckos with Anna Rauhaus and Christian Niggemann from Cologne Zoo - film and photo opportunity at the press event at Cologne Zoo | D. Schneider

Zoo network for species conservation: Cologne students who wrote their theses in the German-Vietnamese working group on the gaps in species conservation in front of VietnAmazing posters in the Zoom adventure world in Gelsenkirchen | R. Pubanz

In the service of environmental education: Cologne Zoo animal keeper Christian Niggemann in front of his mural in the Melinh Station for Biodiversity with tiger gecko | Thomas Ziegler

Prof Dr Lee Grismer with Sarah Goymer and Dr Jesse Grismer have received tiger gecko offspring from Cologne Zoo for the establishment of a tiger gecko conservation breeding programme at La Sierra University in California. Citizen Conservation is also part of this international conservation breeding network. | D. Tucker

4. Keeping

The Huu Lien tiger gecko is a gecko that is relatively easy to care for, can be left to well-informed beginners to keep and requires little effort in terms of terrarium size or technique to breed successfully.

These husbandry recommendations were largely drawn up by Anna Rauhaus from Cologne Zoo and are based on the experience of keeping and breeding the species in the aquarium at Cologne Zoo and the Melinh Biodiversity Station in Vietnam.

Anna Rauhaus (centre) cares for and breeds tiger geckos at Cologne Zoo and was responsible for drawing up these husbandry recommendations. Thomas Ziegler (right) from Cologne Zoo is curator for species conservation at Cologne Zoo and has built up an extensive network for the in-situ and ex-situ conservation of endangered Vietnamese species with his Vietnam working group. Here together with Verena Kaspari from the ZGAP board at the press announcement of the 'Zoo Animal of the Year 2024' campaign for the protection of geckos. | Verena Kaspari

4.1 Requirements and documentation obligation

Goniurosaurus huuliensis is protected under Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, Appendix B of the EU Species Protection Ordinance and 'specially protected' under the Federal German Nature Conservation Act. This means that keepers in the EU must be able to prove the legal origin of the animals and register their population and any changes to the population with the responsible local authority. You can easily find your responsible authority online by entering the name of your place of residence and the keyword 'notification of protected animals' or similar.

At CC, keepers always receive the animals with a certificate of origin, which is recognised for deliveries within the EU to prove the legal origin. Accordingly, CC breeders must ensure that the 'Proof of origin and handover certificate' form provided by CC is completed in full and signed when handing over their animals.
Not only should the origin of the parent animals of the offspring be stated, but also that of the parents of the parent animals. This ensures complete back documentation. All papers that are handed over within CC or from CC must be sent immediately as a scan or photo to the CC office (reptiles@citizen-conservation.org).
The obligation to register applies to the owners, i.e. those who actually keep the animals, irrespective of the fact that the animals are the property of CC. The official notification should be made immediately after the handover; it is best to submit a copy of the CC certificate of origin and handover or adequate proof of origin. Any changes to the stock must also be reported regularly to the authorities, i.e. both offspring and deaths or transfers.

Different rules apply to imports and exports from or to outside the EU (e.g. Switzerland, Great Britain). Appropriate export and import documents must be applied for in advance.
All CC animals are the property of the non-profit Citizen Conservation Foundation gGmbH or are managed by it in trust. This also applies to all resulting offspring (see CC guidelines and recruitment contract). Keepers are therefore not allowed to give or sell the animals or offspring themselves. Offspring are distributed within the project as long as this makes sense in terms of population management. If offspring cannot or should not be distributed within the project, they can be sold outside of the project after prior consultation with the CC office or can be arranged by the CC office. If income is generated, this will go to CC and contribute to the funding of our species conservation programme.

Keepers must report offspring of the Huu Lien tiger gecko to the competent authority because the species is listed in Annex B of the EU Species Protection Regulation.
| Thomas Ziegler

An essential part of CC is the coordination of our inventory, which is why we must always be informed about its development. CC participants are therefore contractually obliged to submit a stock report twice a year, on 1 March and 1 September. This stock report (number of animals, their sex if possible, animals that have died or bred in the last six months, egg laying etc.) can be submitted online. You will be reminded by the CC office in good time; you will be informed at the same time of the current procedure for submitting the stock report. In addition, we are pleased to receive information on observations and experiences gained in keeping and breeding, as an important aim of CC is to generate knowledge on ex-situ keeping and the biology of the species managed in our conservation breeding network.

We are also always happy to receive photos of the animals and terrarium; also of the keepers in front of the terrarium or during care. CC can then use these for publications or social media, for example. Permission to use the images as part of the CC programme is deemed to have been granted upon sending them, unless expressly objected to; the consent of any persons who may be seen in the photos is also deemed to have been granted unless expressly objected to. CC always names the authorship of the images in publications, unless expressly objected to.

Please also inform the CC office briefly and informally by email to reptiles@citizen-conservation.org of any deaths that appear to be unusual, even between stock reports, so that further steps can be discussed if necessary, such as examinations of other animals in care, a necropsy or veterinary care.

If keepers can no longer or no longer wish to keep the animals or offspring, the CC office must be informed as early as possible so that we can place the animals in the following homes.

Veterinary tests must be carried out in accordance with the relevant advisory board whenever animals are moved within CC, i.e. from one person to another. The CC office will provide information on this. In the case of *Goniurosaurus huuliensis*, this is currently a faecal sample. A corresponding examination order for a suitable examination laboratory is available from the CC office. The costs for the faecal examination when changing location are borne by CC (but not other veterinary or examination costs incurred as normal care costs during keeping).

Under no circumstances should the animals be mated with other *Goniurosaurus* on their own initiative! It is crucial for the establishment of long-term conservation breeding that the genetic background of the animals can be traced, which is why uncontrolled mixing with animals from outside must be avoided. It is often desirable from the point of view of studbook management to avoid mixing between generations. Therefore, please only use animals selected by the CC office for mating and do not mate young animals with their parents without consultation with CC.

In principle, the regulations in the general CC guidelines (https://citizen-conservation.org/wp-content/uploads/2024/05/CC-Terms-and-Conditions.pdf) and in the recruitment contract apply to all CC animals.

For transport, the geckos are packed individually in plastic tins with a little flow paper and placed in a sturdy polystyrene box. In warm weather, a cool pack helps to prevent overheating. | Anna Rauhaus

4.2 Transport

You normally receive the animals in the Citizen Conservation #Reptiles programme directly from the breeders or previous owners. The future owners are responsible for organising the transport themselves; any costs incurred (i.e. travel costs to the breeders, shipping costs if applicable) must be borne by you. The CC office may be able to help arrange shipping - however, in order to minimise the effort and administrative costs, we ask that you organise the transport yourself if possible. Only forwarding agents authorised to transport live animals may be used for shipping; the relevant guidelines for shipping and all legal regulations must be complied with!

At each change of location, the animals undergo a veterinary examination in accordance with the CC#Reptiles advisory board (see section 4.1). Parasites may still be present; not every parasite load is worthy of treatment. In addition, there is always a risk that pathogens will not be recognised despite examinations.
The usual quarantine rules in terraristics should also be observed by the new owner when taking over CC animals.

For transport, the tiger geckos are placed individually in sturdy plastic boxes or small fauna boxes, which are lined with cellulose or kitchen paper; some loosely crumpled kitchen paper or sphagnum moss can also be placed in the box as a hiding place. The tins are placed in a thermostable container (polystyrene box) to protect them from the weather and to prevent them from slipping, being thrown around or falling over.

It may be necessary to add a cool pack or heat pack to the box in winter or summer. Caution - make sure that the geckos in their box cannot overcool or overheat due to the cool or heat pack. Heat packs must not be placed in the polystyrene boxes immediately after activation; they become too hot at first and consume too much oxygen. To be on the safe side, you can stick them in front of a small hole in the outer packaging of the box. Overheating must be avoided, especially in summer.

Breeding terrarium for *Goniurosaurus huuliensis* at Cologne Zoo | Anna Rauhaus

Terrarium for keeping *Goniurosaurus huuliensis* with CC participant Alina Bertram | Alina Bertram

The terrarium is set up with cork reeds as climbing and hiding places and various plants. | Anna Rauhaus

Branches suitable for climbing complete the terrarium equipment. | Anna Rauhaus

4.3 The Terrarium

The minimum requirements for keeping reptiles in Germany (BMEL 1997) stipulate a minimum terrarium size for ground-dwelling geckos, which is calculated by multiplying the head-torso length by 4 x 3 x 2 (length x width x height). However, a terrarium of this size is recommended at most as a quarantine or rearing terrarium for young animals.

Terraria with basic dimensions of 80 x 50 x 50 cm have proven to be a tried and tested size for keeping *G. huuliensis* (Langner et al. 2022). They are kept in pairs or groups of 1.2 animals in such terrariums. At Cologne Zoo, adult *G. huuliensis* are kept in terrariums measuring 100 x 55 x 60 cm or 100 x 100 x 80 cm.

A mixture of potting soil and sand is suitable as substrate, pine bark or coconut fibres can also be used as substrate. A layer of leaves can be scattered on top. The plants used at Cologne Zoo include birch fig (*Ficus benjamina*), monocotyledon (*Spatiphyllum wallisii*), cob thread (*Aglaonema sp.*), Vietnamese cannon flower (*Pilea caderei*), climbing fig (*Ficus pumila*), ray-leaved aralia (*Schefflera arboricola*) and various ferns (*Asplenium, Pteris, Adiantum*) as well as cushion or sheet moss.

The other terrarium furnishings consist of stones, branches, roots and cork tubes as climbing and hiding places as well as a water container. The back and side walls are covered with plastic textured back panels or decorative cork panels as additional climbing areas or can be modelled as a rock wall.

The water in the water container is changed daily and faeces and food remains are removed from the terrarium. As the tiger geckos are rarely seen during the day, the hiding places should be checked regularly. As long as the climatic conditions in the terrarium are right, further daily cleaning and care requires little effort, especially as the animals generally use fixed droppings spots.

4.4 Terrarium technology and climate

The requirements of *Goniurosaurus huuliensis* in terms of terrarium technology are easy to fulfil. | Anna Rauhaus

At Cologne Zoo, the basic lighting in the terrariums is provided by LED strips or T5 fluorescent tubes with a lighting duration of 11.5 hours and basic temperatures between 23.5 and 26 °C from March to the end of October, with a slight drop in temperature at night.
Higher temperatures can also be tolerated for short periods or locally as long as cooler and moist retreats are available in the terrarium; in general, however, tiger geckos are quite sensitive to temperatures above 28 °C.

In the winter months, the lighting time is reduced to 10.5 hours and temperatures are lowered to 19-22 °C. Colder temperatures of 18-20 °C during the day and 14-16 °C at night are also tolerated during the winter months and are successfully practised by other keepers.
In a tiger gecko terrarium in the visitor area of Cologne Zoo, the lighting rhythm was changed so that the main lighting is used at night and the terrarium is dimly lit during the day by a blue LED strip to make the nocturnal animals visible to visitors through small viewing windows in the pane darkened with a habitat photo.

The terrariums are sprayed daily, the relative humidity is between 70 and 90 %; during the cooler winter phase, slightly less is sprayed.

4.5 Feeding

The mating season begins in spring, after temperatures and humidity have risen. Most egg-laying at Cologne Zoo has so far taken place between June and September. The clutches usually consist of two soft-shelled eggs, more rarely only one egg is laid.

Goniurosaurus huuliensis when fed with grasshoppers that have previously been powdered with a vitamin-mineral preparation.
| Anna Rauhaus

4.6 Offspring

The mating season begins in spring, after temperatures and humidity have risen. Most egg-laying at Cologne Zoo has so far taken place between June and September. The clutches usually consist of two soft-shelled eggs, more rarely only one egg is laid.

The females usually produce between one and three clutches per year; up to four clutches per year are possible (Seufer et al. 2005). During this period in particular, it is important to ensure that the females have a sufficient supply of calcium; in some cases it may also be useful to temporarily separate the females for regeneration. The eggs are buried by the females in the soil substrate.

At Cologne Zoo, the clutches are incubated in closed plastic containers about 1/3 buried in slightly moist vermiculite at the same temperatures as in the parent terrariums (approx. 23.5-26 °C with fluctuations); for this purpose, the incubation containers are simply left in the terrarium room or on the terrariums. Constant incubation in the incubator is also possible; temperatures between 24 and a maximum of 27 °C are recommended here.

The incubation period is on average around 70-75 days, but can also be significantly longer depending on temperatures. Hatching is usually signalled by the release of fluid from the egg shell. After the first scratching of the egg shell, the young can hatch within a short time, but the hatching process can also take several hours. As a rule, the young shed their skin shortly after hatching. At Cologne Zoo, they are left in the incubation box for another day or transferred to another closed box on moist cellulose if there are other eggs in the incubation box that could be disturbed by the hatchlings running around.

Hatching of young *Goniurosaurus huuliensis* | Anna Rauhaus

Successfully bred at Cologne Zoo: *Goniurosaurus huuliensis* | Thomas Ziegler

Natural breeding in the terrarium is also very possible. In Cologne Zoo, for example, most *G. huuliensis* juveniles are found in their parents' terrarium after hatching, with some animals even remaining undiscovered for weeks. The offspring can be left in the parents' tank for the first few months without any problems; it is then advisable to separate them from the parents before they reach sexual maturity - especially as the males are incompatible with each other.

Natural breeding in the terrarium is also possible - under suitable conditions, the young hatch in the parent terrarium and can live there without any problems until they change colour; these geckos are not cannibalistic towards their offspring.
| Anna Rauhaus

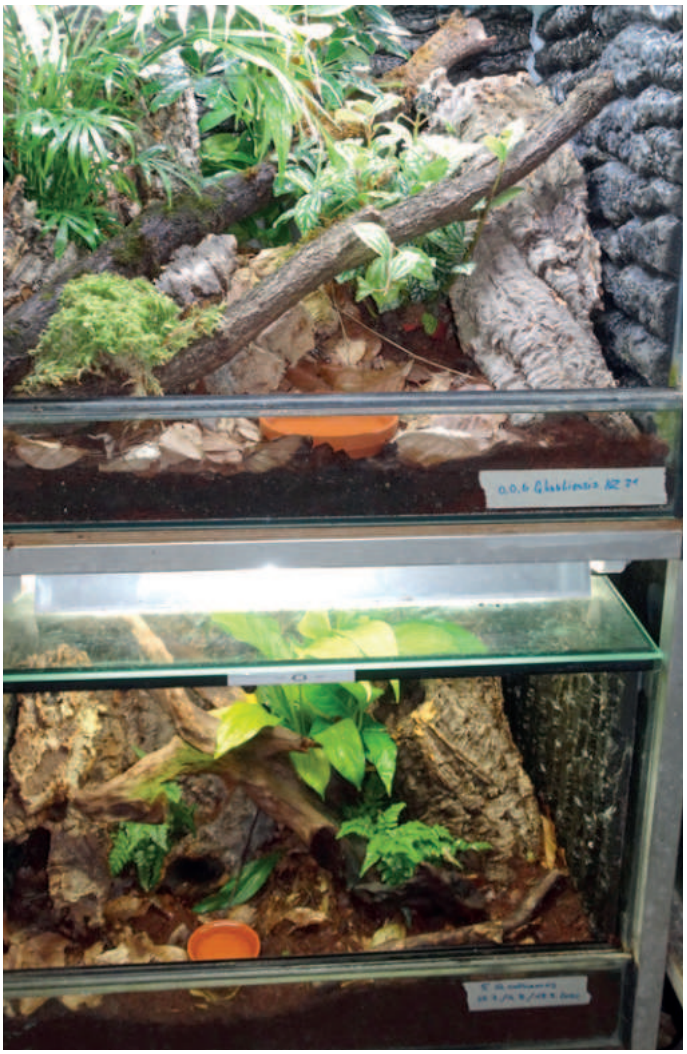
4.7 Rearing the young animals

As soon as the first moult has been completed and it has been ensured that the abdomen is completely closed, the offspring can be transferred to their rearing containers. In order to ensure good control of food intake, Cologne Zoo uses fauna boxes (approx. 30 x 20 x 20 cm) for this purpose, in which the young animals are kept in groups of 2-3 animals each for the first few weeks after hatching. The fauna boxes are furnished with coconut fibre substrate, a plant if necessary, a damp corner with some sphagnum moss, hiding places in the form of pieces of cork and a small water bowl and are checked and sprayed daily.

The first food in the form of small crickets is offered around three days after hatching and feeding takes place three times a week during the first few months of life. After a few weeks, the young animals move to terrariums between 40 x 40 x 35 cm and 60 x 50 x 40 cm for further rearing, which are furnished with plants, climbing and hiding places to match the parent terrariums.

View into a rearing box | Anna Rauhaus

Breeding boxes for *Goniurosaurus huuliensis* at Cologne Zoo | Anna Rauhaus



Rearing terrariums for older juveniles of *Goniurosaurus huuliensis* | Anna Rauhaus

Tiger geckos undergo an ontogenetic (age-dependent) colour change; the body colouration of the hatchlings consists of light transverse bands (white, greyish or yellowish to light orange) on a uniform dark grey, sometimes also slightly brownish or violet background, the tail is black with white bands. In the species within the *G. luii* group, the juveniles can hardly be distinguished from each other, even if they are sometimes very differently coloured as adults. As they grow up, the yellow to orange colouring of the bands and their dark edging develop, and later in *G. huuliensis* the dark spot pattern on a light background develops on the previously uniformly dark grey body parts on the head and flanks.

From around six months of age, the sexes can be distinguished by the distinct bulge of the hemipenial pouches at the base of the male's tail. The animals become sexually mature at around two years of age.

Young animal in terrarium | Anna Rauhaus

Portrait of a young *Goniurosaurus huuliensis* | Anna Rauhaus

Juvenile at the beginning of colour change | Anna Rauhaus

4.8 Problems

In suitable climatic conditions, keeping tiger geckos causes few problems.
Particularly during the reproduction phase, care should be taken to ensure that the females have an adequate supply of calcium, as otherwise deficiency symptoms such as rickets or egg loss may occur.

As with all reptiles, it is advisable to have faecal samples examined regularly for parasites.

No need to worry - cleaning their mouth and eyes with their tongue is part of the normal behavioural repertoire of tiger geckos.
| Thomas Ziegler

5. Further Reading

Berghof, H.P. (2019): Wie alt werden eigentlich die Geckos? – Reptilia 24(138): 8–10.

BMEL (Bundesminsteriums für Ernährung, Landwirtschaft und Forsten 1997): Gutachten über Mindestanforderungen an die Haltung von Reptilien vom 10. Januar 1997. – DGHT, Rheinbach

CITES (2019): CoP18 Proposal 27: The inclusion of all species of the genus *Goniurosaurus* from People's Republic of China and the Socialist Republic of Viet Nam, namely the *G. lichtenfelderi* group, the *G. luii* group, and the *G. yingdeensis* group in Appendix II of CITES. – https://cites.org/eng/cop/18/proposals_for_amendment (gelesen 14.08.2021).

Grismer L.L., H.N. Ngo, S. Qi, Y.Y. Wang, M.D. Le & T. Ziegler (2021): Phylogeny and evolution of habitat preference in *Goniurosaurus* (Squamata: Eublepharidae) and their correlation with karst and granite-stream-adapted ecomorphologies in species groups from Vietnam. – Vertebr Zool 71: 335–352. https://doi. org/10. 3897/ vz. 71. e65969

Langner, C., B. Pfau, M. Bernardes, U. Gerlach, F. Hulbert, M. van Schingen-Khan, U. Schepp, C. Arranz, M. Riedling & A. Kwet (2022): Evaluation of the Captive Breeding Potential of Selected Amphibian and Reptile Taxa Included in Appendices I and II at CITES CoP18 Evaluation of the Captive Breeding Potential of Selected Amphibian and Reptile Taxa Included in Appendices I and II at CITES CoP18 Results of the identical F+E-project (FKZ: 3520 53 2054). – 10.19217/skr627. https://www.bfn.de/sites/default/files/2022-04/Skript625.pdf

Ngo, N.H., Q.H. Nguyen, Q.T. Phan, M.H. Tran, Q.T. Nguyen, T. Ziegler & D. Rödder (2021a): Vulnerability of an endemic Tiger Gecko (*Goniurosaurus huuliensis*) to climate change: modeling environmental refugia and implications for in-situ conservation. – Salamandra 57(4):464–474.

Ngo, N.H., Q.T. Nguyen, Q.T. Phan, M. van Schingen & T. Ziegler (2019): A case study on trade in threatened Tiger Geckos (*Goniurosaurus*) in Vietnam including updated information on the abundance of the endangered *G. catbaensis*. – Nat Conserv 33:1–19. https://doi.org/10. 3897/ nature-conservation. 32. 33590

Ngo, N.H., Q.H. Nguyen, Q.T. Phan, Q.T. Nguyen, M. van Schingen-Khan & T. Ziegler (2022a): Ecological niche overlap of two allopatric karst-adapted tiger geckos (*Goniurosaurus*) from northern Vietnam: microhabitat use and implications for conservation. – J Nat Hist 56:37–40. https://doi.org/ 10. 1080/ 00222 933.2022. 21204 37

Ngo, N.H., Q.H. Nguyen, H.M. Tran, H.T. Ngo, M.D. Le, L.R. Gewiss, M. van Schingen-Khan, T.Q. Nguyen & T. Ziegler (2021b): A morphological and molecular review of the genus *Goniurosaurus*, including an identification key. – Eur J Taxon 751: 38–67. https://doi. org/ 10. 5852/ ejt. 2021. 751. 1379

Ngo, N.H., Q.H. Nguyen, M.H. Tran, Q.T. Phan, R.L. Gewiss, D. Rödder, Q.T. Nguyen & T. Ziegler (2022b): Living under the risk of extinction: population status and conservation needs assessment of a micro-endemic tiger gecko in Vietnam. – Anim Biodivers Conserv 45(2):175–188. https://doi.org/10.32800/abc.2022.45.0175

Ngo, H.N., D. Rödder, L. Grismer et al. (2023): Extraordinary diversity among allopatric species in the genus *Goniurosaurus* (Squamata: Eublepharidae): understanding niche evolution and the need of conservation measures. – Biodivers Conserv 32, 1549–1571 (2023). https://doi.org/10.1007/s10531-023-02564-4

Seufer, H., Y. Kaverkin & A. Kirschner [Hrsg.] (2005): Die Lidgeckos. – Rheinstetten (Kirschner und Seufer Verlag): 238 S.

Uetz, P., P. Freed, R. Aguilar, F. Reyes, J. Kudera & J. Hošek (Hrsg.) (2023): The Reptile Database, http://www.reptile-database.org

Goniurosaurus huuliensis, grown animal | Thomas Ziegler