citizen conservation

#Reptiles

Basic information and care recommendations for Cuora cyclornata, Vietnamese three-striped box turtle

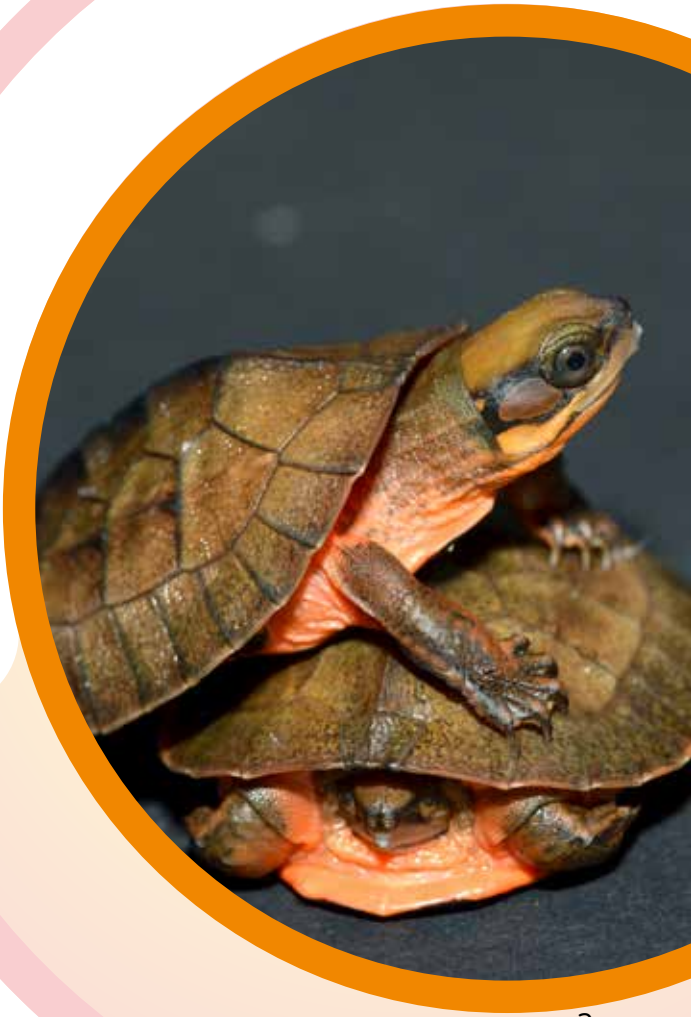
Status: 1 December 2024 | *Cuora cyclornata cyclornata* | Photo: Christian Langner

Contents

Diese Haltungsempfehlungen basieren im Wesentlichen auf Meier et al. (2024).

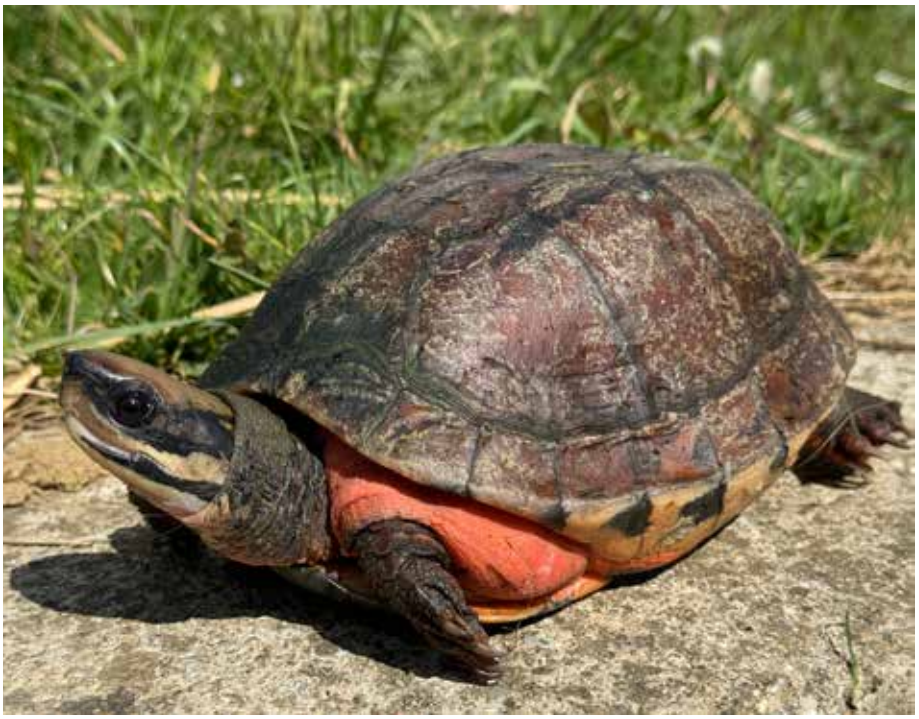
1. Profile

Scientific name: *Cuora cyclornata* Blanck, McCord & Le Minh, 2006
Common name: Vietnamese Three-Striped Box Turtle
Back carapace length: 20-35 cm, depending on subspecies and sex
CC#Reptiles category: III (also suitable for beginners)
Endangered status according to IUCN Red List: „critically endangered" (still included in the Red List as a subspecies of *C. trifasciata*)
CITES protection status: Appendix II (as *C. trifasciata*)
Protection status EU species protection regulation: Appendix B (as *C. trifasciata*)
Accommodation: Keep individually! Aquaterrarium, water section at least 2/3. Aquaterrarium size should 'grow' with the animals; young animals from 40 x 40 x 30 cm; adult animals from 150 x 80 x 60 cm. Spotlights above the land section, temperatures of 35° in the basking area. Temperatures otherwise fluctuate between 9-14 °C in winter and 25-35 °C in summer, depending on the season.
Required equipment: Landing area for juveniles or males also possible with cork bark or similar. For females, integrated terrestrial part with at least 25 cm substrate layer of sand and moss. Water section without substrate, but with hiding places and structural elements (e.g. roots, caves).
Care: Change the water regularly, about once a month in winter and once or several times a week in spring/summer, depending on how dirty it is.
Feeding: Young animals are completely carnivorous, with age increasingly also ripe fruit or pellets. Feed a varied diet: earthworms, crickets, grasshoppers, cockroaches, mussel meat, shrimps, fish, 'turtle pudding' ...
Growth: After one year approx. 5-8 cm; after 3-4 years approx. 12-15 cm; sexual maturity in males after approx. 8, in females after approx. 10 years.



Status: 1 December 2024 | Hatchlings of *Cuora cyclornata* | Photo: Torsten Blanck

2. Why is *Cuora cyclornata* a Citizen Conservation Species?



Without ex situ conservation breeding, the Vietnamese three-striped box turtle has no chance of survival; here a *Cuora cyclornata meieri*.
| Torsten Blanck

The Asian turtle crisis is one of the most dramatic challenges in international species conservation. The entire group of turtles is threatened with extinction on the Asian continent. The main reason for this is their capture for human consumption as food or medicine. Added to this is the destruction of habitats in large parts of the distribution areas.

Box turtles of the genus Cuora are particularly affected because they still have a relatively high market value. This makes it attractive for the often poor local population, but also for organised turtle smugglers, to collect the animals. Despite protection laws and efforts to put a stop to this development, the animals are still being collected, meaning that the already very small remaining populations will probably be largely or completely gone in the foreseeable future.

Another threat has recently emerged: Precisely because Box turtles have a considerable market value, they are now being bred on commercial farms for human consumption. However, no consideration is given to the origin and taxonomy of the different species and subspecies, resulting in large-scale hybridisation. From a species conservation point of view, these breeding stocks are not only worthless, but there is also a risk that animals from them will end up in stocks that are still pure and contaminate them through hybridisation, thus contributing to their disappearance.

Currently, the only realistic chance of preserving Box turtles of the genus *Cuora* (as well as numerous other Asian turtle species) is through coordinated conservation breeding of animals with a secure pedigree in human care.

This also applies to *Curoa cyclornata*, the Vietnamese three-striped box turtle. The taxonomy of this Box turtle is complex and has been the subject of much discussion and re-evaluation in the recent past. Until recently, *Cuora cyclornata* was regarded as part of *C. trifasciata*. However, *C. trifasciata* as a whole (i.e. including the Vietnamese populations, which are now predominantly regarded as a separate species *C. cyclornata*) was already listed on the Red List of the International Union for Conservation of Nature (IUCN) in the highest endangerment category 'critically endangered'. This applies even more so to the Vietnamese sub-populations. The IUCN specialists expressly recommend ex situ conservation breeding to save these turtles (Fong et al. 2020).

The International Centre for Turtle Conservation (IZS) at the Allwetterzoo Münster, along with other institutions, has dedicated itself to the conservation breeding of *C. cyclornata* and has successfully bred the species for years (see 3.3). Nevertheless, it is unfortunately not yet possible to speak of a secure ex-situ population - further breeding capacity is required. In order for such a 'backup' to really work over many decades without the genetic diversity of the animals decreasing too much or even producing unwanted hybrids, it is essential to coordinate the various husbandries. Zoos alone cannot fulfil this task, even their capacities are finite, and unfortunately only relatively few institutions deal with such special tortoises as Cuora anyway. Nevertheless, there are EEPs, i.e. European Endangered Species Programmes of the European Association of Zoos and Aquaria (EAZA), for various species of the genus Cuora. However, there is no EEP for *C. cyclornata*. This is one of the reasons why the species has now been included in the Citizen Conservation breeding programme.

3. Biology und Conservation

Cuora trifasciata trifasciata (left) and *Cuora cyclornata cyclornata* in comparison | Roland Wirth

3.1 Biology -Classification and taxonomy

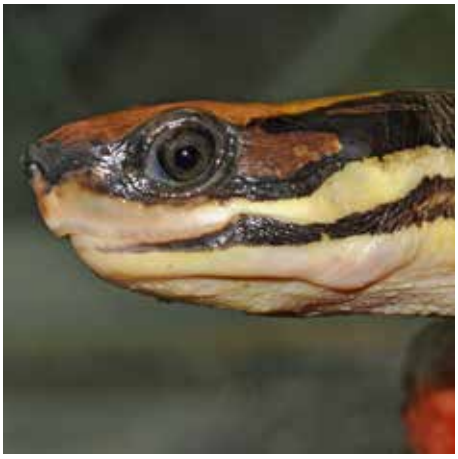
Cuora cyclornata is a textbook species for the concept of saving species through conservation breeding. The need for ex situ husbandry to save this turtle from extinction is scientifically undisputed.

At the same time, however, this species also shows that it is not enough for a number of keepers to simply breed animals. A closer look reveals that we are dealing with rather complex and not yet fully understood family relationships. However, the aim of any conservation breeding programme must be to preserve the animals as they occur in nature, including their natural diversity. This means that only animals that actually belong to a reproductive community should be brought together for reproduction. Otherwise, different characteristics will mix or risk being lost.

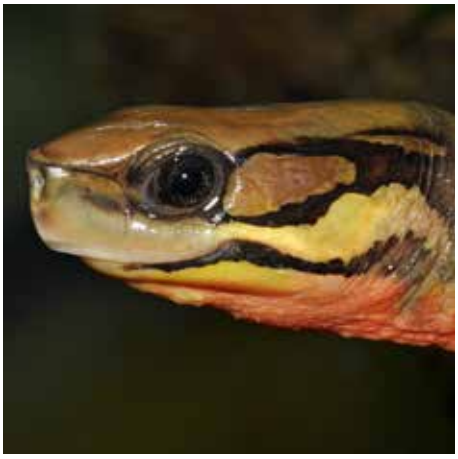
For a long time it was assumed that the three-striped Box turtle, *Cuora trifasciata*, was a single species with a relatively large distribution area in China, Vietnam, Laos and Hong Kong. For a long time, the Vietnamese populations were only regarded as colour variants, but were then described as a separate species, namely *C. cyclornata*, by Blanck, McCord & Le in 2006. In the meantime, this split has also been genetically confirmed (Tiedemann et al. 2014).

Cuora cyclornata is further subdivided into three subspecies: In addition to the nominate form *C. c. cyclornata*, *C. c. meieri* was already recognised as a separate taxon by the first describers. In 2017, *C. c. annamitica*, which was described by Blanck, Protiva, Zhou, Li, Crow & Tiedemann, followed as the third in the group. A more detailed description of the three subspecies is provided below.

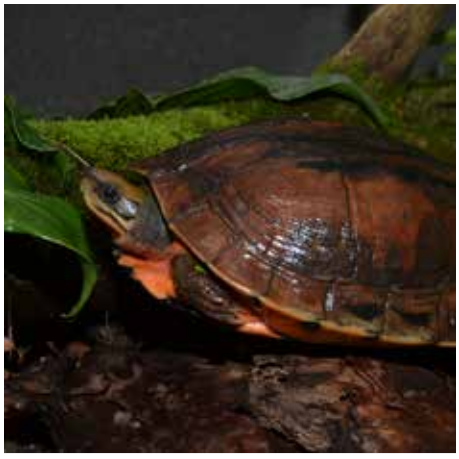
C. trifasciata has also been split into two subspecies, so that the former species *C. trifasciata*, which was already assessed as 'threatened with extinction', has now become five independent taxa worthy of conservation, with correspondingly much smaller populations. The situation for each of these taxa is very serious and hopeless without conservation breeding in human care.



Portrait of *Cuora cyclornata meieri*
| Roland Wirth



Portrait of *Cuora cyclornata cyclornata*
| Roland Wirth



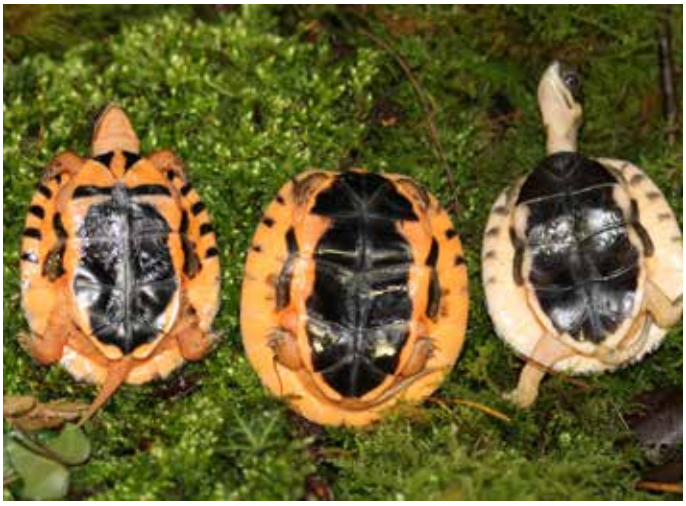
Cuora cyclornata annamitica
| Torsten Blanck

- Description

Cuora cyclornata differs from the closely related *Cuora trifasciata* in that it is larger and its dorsal carapace, the carapace, is generally rounder and usually flatter. Unlike *C. trifasciata*, the representatives of *C. cyclornata* have a white or pink to orange throat, depending on the subspecies, as well as an orange-brownish olive-coloured dorsal pattern and fewer black parts in the colouration. The ventral carapace, i.e. the plastron, is equipped with the transverse joint typical of Box turtles. This allows the animals to close their abdominal armour in such a way that the openings for the head, tail and limbs, which break through the outer protection of other tortoises, are also largely closed. An ingenious anatomical design for even more safety.

Females of *C. c. cyclornata* can reach a maximum carapace length of 35 cm and a weight of up to 6 kg. However, these are large animals bred on farms. Normally, large adult females reach a carapace length of 30 cm and a weight of 3 kg. Females of *C. c. annamitica* and *C. c. meieri* can presumably reach similar dimensions to those of the nominate form under farm conditions. Under normal conditions in terrariums, however, they only reach a carapace length of 20-25 cm and a weight of 1.4-3 kg.

Males generally remain significantly smaller and realistically reach a weight of 600-1,000 g. They have a longer and thicker tail than the females. By comparison, the Chinese three-striped Box turtle, *Cuora t. trifasciata*, is by far the smallest form of this species complex. Males usually reach their final weight at 600-800 g, females at 900-1,400 g. *Cuora trifasciata luteocephala* is already significantly larger, the males in Münster weighed 700-1,100 g, the females 1,700 g. Farm animals can deviate significantly upwards in all forms due to fattening.



The subspecies can only be distinguished by the amount of black and the pattern of the anterior plastral lobe. Plastron pattern and chin colour are stable even in young animals and do not change. From left to right: *Cuora cyclornata cyclornata, C. c. annamitica, C. c. meieri.*
| Heinrich Altenfeld

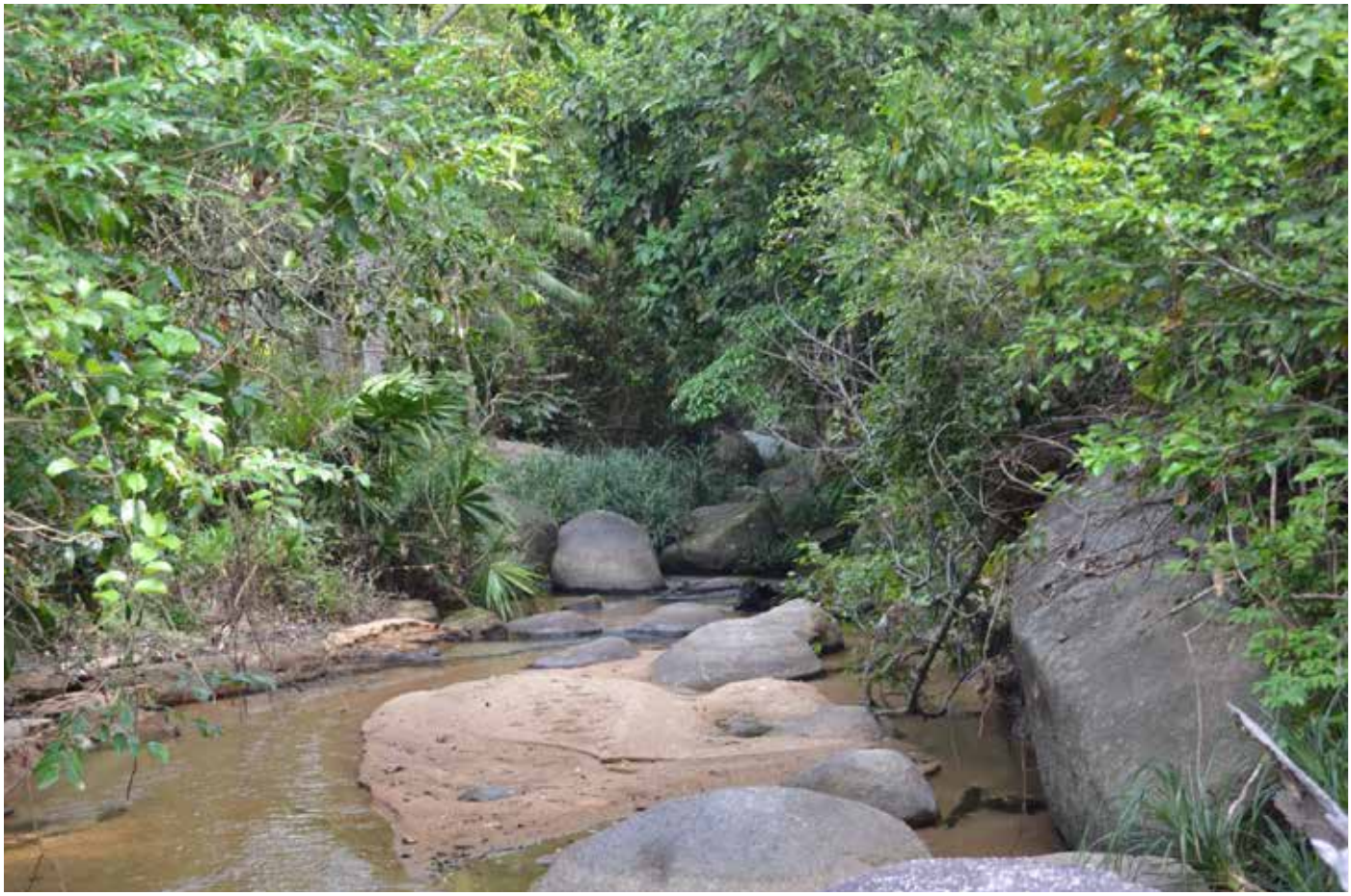
Comparison: Adult specimens of the five different forms of the *Cuora trifasciata* complex in dorsal (A) and ventral view (B). From left to right: *Cuora trifasciata trifasciata, C. t. luteocephala, C. cyclornata meieri, C. c. annamitica, C. c. cyclornata.*
| Torsten Blanck

The three subspecies differ not only in size but also in the colouring of the chin and plastron and, of course, in their distribution areas:

***Cuora cyclornata cyclornata*, Central Vietnamese three-striped box turtle:** Chin colouration varies from pale pink to bright orange-red, upper side of head from olive green to brownish; plastron with reduced, mostly symmetrical black colouration on the gular and humeral shields; largest subspecies; the distribution area is in south-central Vietnam and neighbouring Laos, possibly also in the far east of Cambodia; type locality: Phong Nha Ke Bang, Vietnam.

***Cuora cyclornata annamitica*, Annam three-striped box turtle:** Chin colouration and skull roof as in the nominate form *C. cyclornata cyclornata*; plastron predominantly black; the differences in the ventral carapace pattern (black in *C. c. annamitica* vs. reduced black colouration in *C. c. cyclornata*) are the most reliable distinguishing feature of the two subspecies; the distribution area in north-central Vietnam extends to south of Hanoi, southwest of the Red River. Type locality: Vietnam, Nghe An Province, Tan Ky district, near Ky Son Village.

***Cuora cyclornata meieri*, Meier's three-striped box turtle:** Chin colouration snow white; skull roof light brown to chocolate brown; plastron predominantly black; the distribution area is clearly delimited from that of the other forms; it lies north and east of Hanoi, northeast of the Red River, and extends into the neighbouring southern Chinese Guangxi Province; type locality: Tam Dao, Vinh Phu Province, Vietnam.
C. c. meieri is separated from the occurrence of *C. trifasciata* further east by a broad lowland plain.

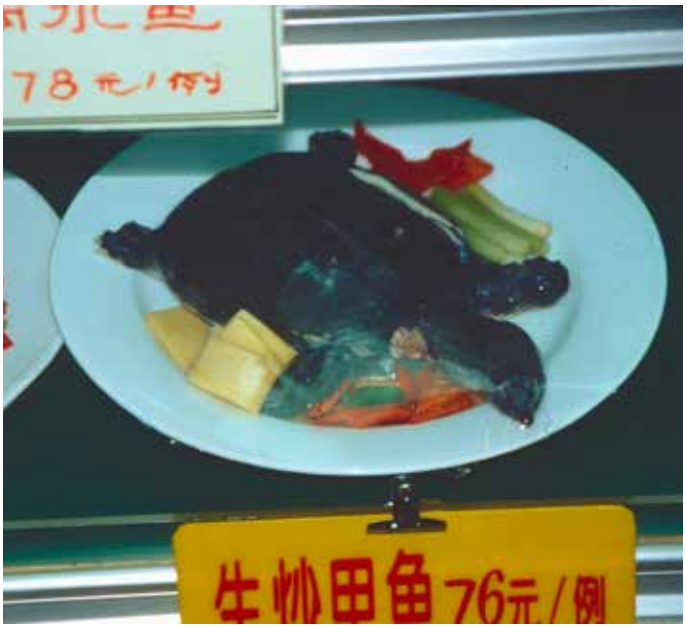


Habitat of *Cuora cyclornata* in Vietnam | Torsten Blanck

- Habitat and behaviour

Vietnamese three-striped box turtles were once widespread in their rather large area of origin. They inhabited forest areas in mountainous regions from low to medium altitudes and were found there along fast-flowing forest streams. *Cuora cyclornata* lives semi-aquatic, i.e. closely tied to the water, but also frequently lives on land. It loves extensive sunbathing on land.

3.2 Threat situation



Consumption as a threat in Asia: soft-shelled turtle in a bed of rice | Jürgen Wigge

Street stall with turtles in Vietnam | Edgar Lehr

Unfortunately, just like their Chinese relatives of the species *Cuora trifasciata*, Vietnamese three-striped box turtles are considered to be highly effective in Asian folk medicine. All five three-striped box turtle varieties are still highly sought after in traditional Chinese medicine and Chinese cuisine.

With the opening of the border between Vietnam and China in 1991, an excessive collection of the animals began immediately. As a result, the populations quickly and drastically collapsed. In addition, the price on the markets rose steadily, which drastically exacerbated the crisis for all forms of three-striped box turtles. Due to unsuitable husbandry methods and a lack of knowledge on how to hatch males, prices for males had risen into the five-digit dollar range by 2010! It is therefore no wonder that the animals were collected from every stream where they could be found.

Another problem is large-scale habitat destruction due to deforestation and dam projects.

Ready for consumption: Hatchery with turtles in Vietnam
| Edgar Lehr

The different subspecies of *Cuora cyclornata* and *C. trifasciata* are mixed uncontrollably on breeding farms in China.
| Markus Bauer

The situation is grave: in recent years, only fewer than 20 specimens have been sighted at markets, and there are probably fewer than 500 animals left in the wild (Cuora Conservation Centre 2023). There is no known area with a stable population and the species has probably already been wiped out in most of its original range.

Due to its still high market value, the species is still collected today despite bans if animals are found anywhere. In China, three-striped box turtles, both *C. cyclornata* and *C. trifasciata*, are now bred in their hundreds of thousands for the food trade and traditional Chinese medicine. According to Blanck (ed.), it is estimated that there are still around 5,000 genetically clean wild-caught fish in the farm ponds, but their numbers are steadily decreasing. This is because the subspecies of all five forms are mixed indiscriminately on the farms. The farm stocks are therefore practically worthless for the conservation of the species in its natural diversity. The resulting hybrids even pose a further threat to the natural forms when they enter the natural habitats.

3.3 Conservation Efforts

For their services to saving Asian tortoises such as *Cuora cyclornata*, terrarium owners Elmar and Ingrid Meier were awarded the Federal Cross of Merit on Ribbon in 2024, the highest civilian honour in the Federal Republic of Germany | Allwetterzoo Münster

Exterior view of the International Centre for Turtle Conservation (IZS) at Münster All-Weather Zoo | Heiko Werning

View into one of the IZS breeding rooms | Heiko Werning

Collection from the wild is now banned in Vietnam, but there is a lack of effective enforcement of this ban. Collection pressure is still considered to be very high, provided that any animals still occur in their natural habitat.

The survival of the species is therefore dependent on ex-situ conservation breeding programmes. Fortunately, such efforts were initiated some time ago. The survival of Cuora cyclornata to this day is probably largely due to the work of a private terrarium-keeping couple, Elmar and Ingrid Meier, who recognised the seriousness of the situation at the end of the 1990s and initiated the International Centre for Tortoise Conservation (IZS), which can be regarded as an early model project for joint ex situ conservation breeding efforts between private animal keepers and zoos at Münster All-Weather Zoo (for more details, see Werning 2024).

The Cuora Conservation Centre (CCC) in Austria (a private initiative) and the IZS at the Allwetterzoo Münster are home to a total of 11 unrelated, genetically tested (Tiedemann et al. 2014) specimens of *C. c. annamitica*, 12 of *C. c. cyclornata* and 10 of *C. c. meieri* (as of June 2024). In the USA, according to Blanck (mdl. Mittl. 2024), there are 20 *C. c. annamitica*, no *C. c. cyclornata* and 12 *C. c. meieri*. This means that 65 founder specimens are available for coordinated breeding projects in the western world. The IZS and the CCC have together produced 327 juveniles in recent years, all from parents of pure subspecies. In order to build up a long-term stable ex situ population with these valuable animals, it would be particularly important for other private and institutional keepers to participate in the care and propagation of this species.

In view of the low number of animals in coordinated breeding projects, the small number of facilities and the likely imminent extinction in the wild, more keepers are urgently needed to build up a long-term stable ex situ population.

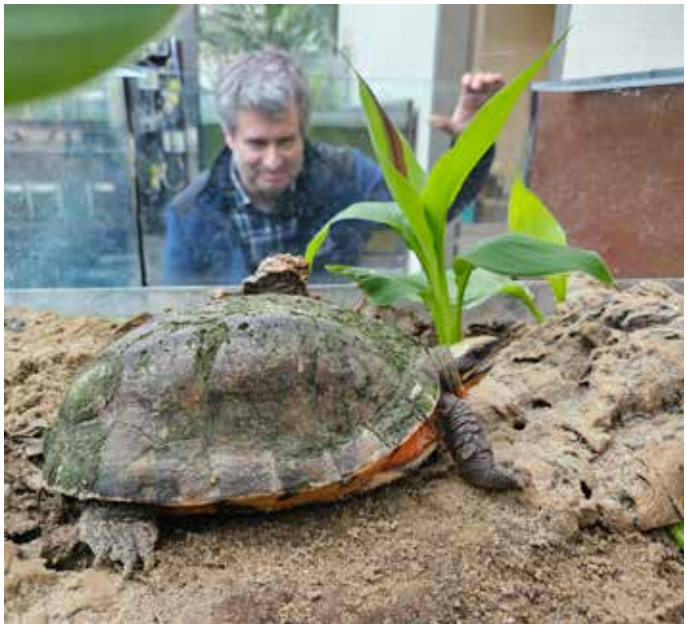
If protected areas are established and the animals are effectively protected from being collected, the prospects for reintroduction in the future can be considered favourable (Cuora Conservation Center 2023). So there is certainly a hopeful outlook for this species - but the time until then must be bridged in human care according to the Ark principle. At the moment, the situation in the habitat continues to deteriorate.

4. Care and Keeping

Provided the conditions described in detail here are observed, in particular solitary keeping, hibernation and regular water changes, *Cuora cyclornata* is a relatively low-maintenance tortoise that is easy to keep. In principle, it would be good if keepers already have experience in keeping terrariums or, better still, keeping tortoises, but with thorough familiarisation it is also possible for beginners to keep them successfully, especially when taking on a young animal, as you have enough time to develop a feeling for handling the animals in view of their late sexual maturity before greater challenges arise with the offspring.

In principle, keeping this species for CC is also possible if you only keep a single juvenile. The animals require strict solitary accommodation anyway, and the aforementioned late date of sexual maturity means that other animals are not necessary for years. If breeding is to take place later, it is also practicable to bring the animal together with the one from another enclosure for mating.

The following recommendations on keeping and breeding this species are essentially based on the decades of experience of Elmar Meier, both privately and at the International Centre for Turtle Conservation (IZS) at the Allwetterzoo Münster, which he initiated and supervised for many years. This was supplemented by the experience of his successor at the IZS, CC Advisory Board member Christian Langner, and Torsten Blanck from the Cuora Conservation Centre in Austria. The CC care and husbandry recommendations are essentially based on the article by Meier, Langner, Wagner & Werning (2024).



Under observation: *Cuora cyclornata* under the watchful eye of CC advisory board member and species conservation curator Philipp Wagner at the Allwetterzoo Münster. The experience gained over two decades at the International Centre for Turtle Conservation (IZS) there forms the basis of these husbandry recommendations. | Heiko Werning

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

4.1 Requirements and documentation obligation

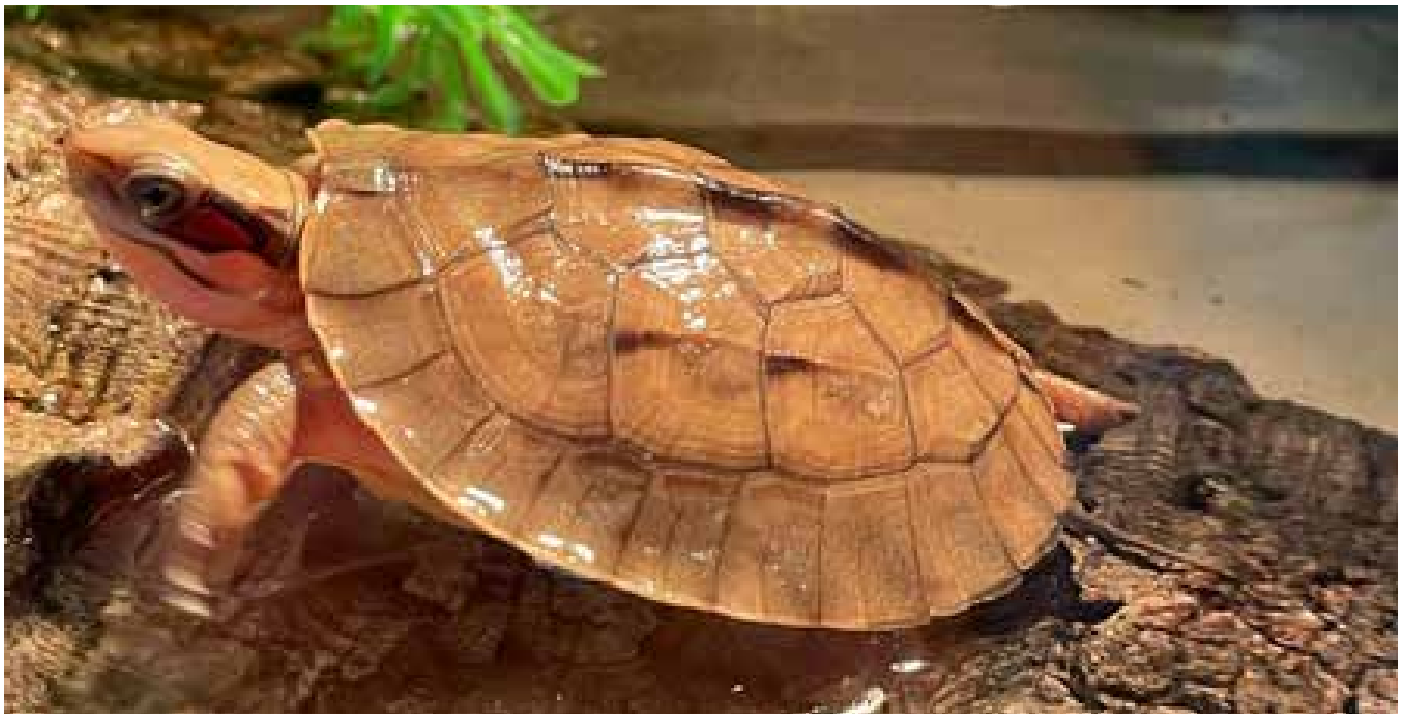
Cuora cyclornata (still listed as *C. trifasciata*) is protected under Appendix II of the Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora, under Appendix B of the EU Species Protection Ordinance and 'specially protected' under the Federal Nature Conservation Act. This means that keepers 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 google the responsible authority by entering the name of your place of residence and the keyword 'protected animals' or similar; it is usually the lower nature conservation authority of the city or district.

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 the origin of the parent animals of the offspring should 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 emailed to the CC office (reptiles@citizen-conservation.org) immediately as a scan or photo. The obligation to register applies to the owners of the animals, i.e. those who actually keep them, irrespective of the fact that the animals are the property of CC. The official notification should be made immediately after the transfer, preferably by submitting a copy of the CC certificate of origin and transfer 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.

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 also be informed of the current procedure for submitting the stock report. In addition, we are happy 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 always happy to receive photo submissions from the CC enclosures - picture of a *Cuora cyclornata* moving into the aquaterrarium of a CC participant | Susann Schmidt

We are also always happy to receive photos of animals and their husbandry. We can then use these for publications or social media, for example. Permission to use the images within the framework of the CC programme is deemed to have been granted upon sending them, unless expressly objected to; CC always names the image authorship in publications, unless expressly objected to.

Please also inform the CC office about deaths informally by e-mail to reptiles@citizen-conservation.org between the stock reports, so that further steps can be discussed, such as examinations of other animals in care, a necropsy or veterinary care.

If owners 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 subsequent 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. Instructions and the necessary dry swab or faecal sample tubes, for example, can be provided by CC; the costs of the tests are borne by CC. A corresponding test order for a suitable test laboratory is available from the CC office.

Under no circumstances should the animals be mated with other Box turtles on their own initiative! It is crucial for the development 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. So please only use animals selected by the CC office for mating.

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!

Each time the animals are moved, they are given 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, especially in tortoises. In addition, there is always a risk that pathogens will not be recognised despite examinations.

The usual quarantine rules in the terrarium hobby should also be observed by new keepers when adopting CC animals.

For transport, the tortoises are best packed individually in plastic boxes, as is usual in terraristics. It is important that the air holes do not have any inward edges so that the tortoises do not injure themselves on the sometimes sharp-edged plastic. Place suitable, slightly moist substrate or similar in the box beforehand. These transport containers are then placed in a polystyrene box or insulated bag, secured against slipping, to protect the tortoises from external weather influences such as overheating or hypothermia. In winter or summer, it may be necessary to add a cooling battery or heat pack to the crate. Caution - always separate such elements securely from the transport boxes (e.g. wrap in a towel) so that the turtles cannot overcool or overheat in their box through direct contact with a neighbouring cooling or heating element. Heat packs must not be placed in the polystyrene boxes immediately after activation; they initially become too hot 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.

Box turtles arrive at the IZS of the Allwetterzoo Münster - Torsten Blanck (left) and Elmar Meier transfer the highly endangered animals from the transport boxes to the quarantine facility. | Torsten Blanck

Installation based on the 'Meier system' at the Cuora Conservation Centre in Austria: turtle tubs from a German manufacturer with an attached land section. Basic dimensions 240 x 80 cm each for keeping a Box turtle.
| Torsten Blanck

Aquaterrarium for *Cuora cyclornata* with integrated land section in the IZS | Heiko Werning

4.3 The aquaterrarium

In accordance with their semi-aquatic way of life and their size, *Cuora cyclornata* require spacious aquaterrariums with a large water and fixed land section.

Semi-adult to almost adult specimens are kept in aquaterrariums measuring at least 150 x 80 x 60 cm (length x width x height) at the IZS in Münster Allwetterzoo. Larger tanks with a land section and a base area of 180 x 120 cm are better for adult animals. If this land section is integrated into the tank and raised by 10-12 cm, the animals really enjoy using it as a hiding place.

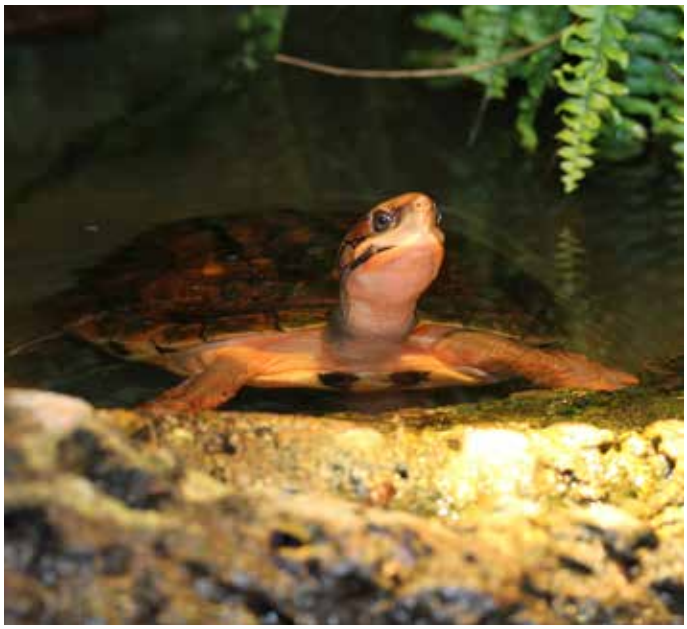
The female turtles' tanks are equipped with a permanently integrated egg-laying area as a land section, which takes up around a quarter of the base area.

All aquaterrariums are fitted with a drain. Substrate is not used in the water section for hygienic reasons. The land section is filled with a layer of sand approx. 15-20 cm high, on which a 10-15 cm thick layer of moss is placed during the egg-laying period (see below). Partial planting is possible for visual reasons. If the males do not have a fixed land part, sufficiently large pieces of cork bark, roots or similar structures are required on which the animals can leave the water completely, sunbathe and dry off completely.

A mixed light spotlight (spotlight with UV component) is placed above the land part so that the cone of light is around 35 °C.

4.4 Water purification

Cuora cyclornata spends a lot of time in the water section, ...
| Christian Langner



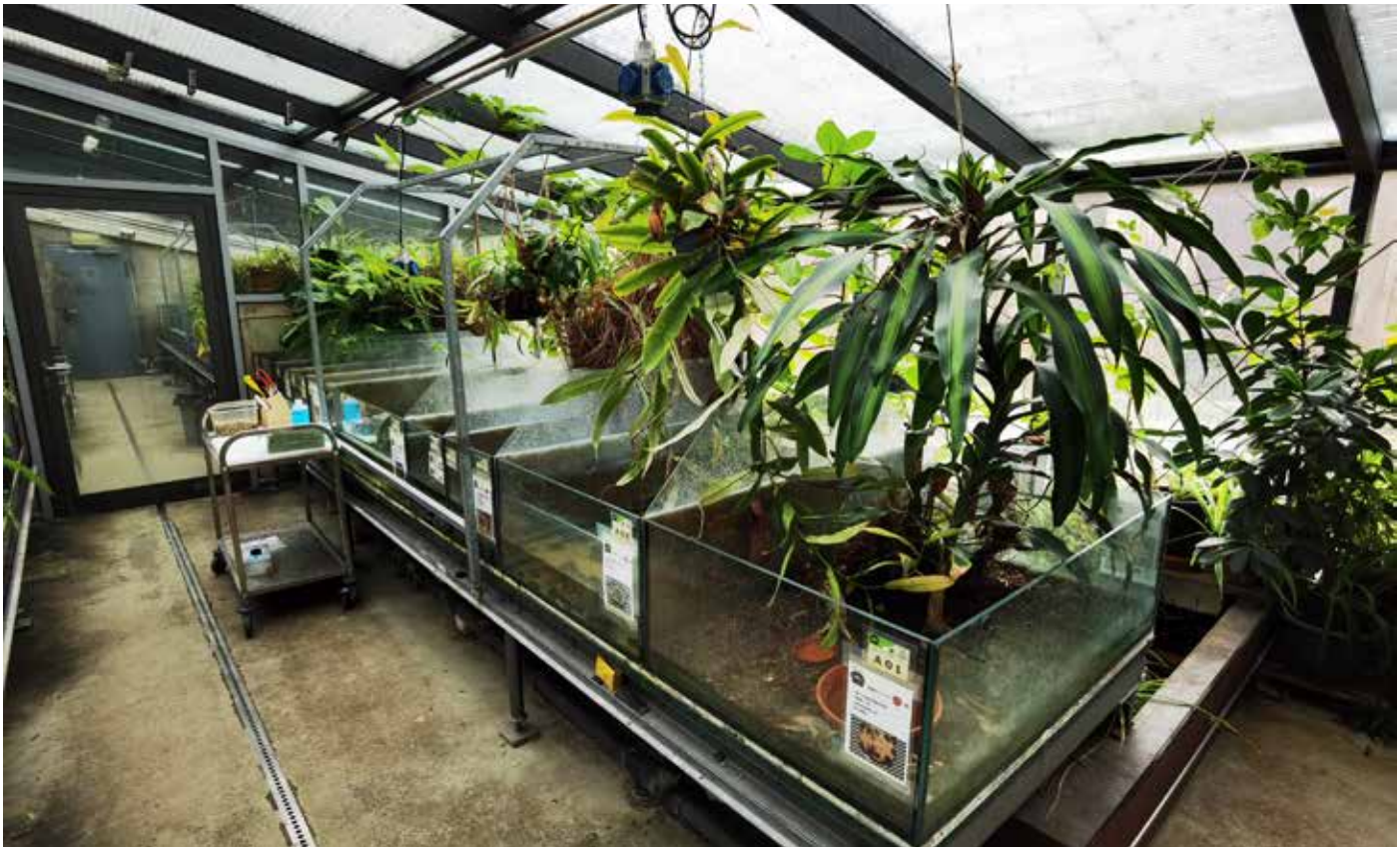
... Clean water is therefore a decisive factor in keeping them.
| Heinrich Altenfeld

The water should be changed depending on how dirty it is. The degree of soiling is related to the feeding frequency: the water becomes soiled more quickly with more frequent feeding. It is important not to feed too much. Anything that is not eaten immediately by the turtles must be removed from the tank immediately. Otherwise the water will spoil, making an immediate water change necessary.

In small breeding tanks, the water should be changed at least two to three times a week during the turtles' activity period. For large tanks, a weekly water change is usually sufficient. During the resting phase from mid-November to mid-February, a monthly water change is usually sufficient. Ultimately, this information is only a guideline and what counts most is observation and instinct.

Although the frequency of water changes can be significantly reduced by using a filter, experiments with filtration have not yet proved successful in the IZS. Other keepers have also experienced health problems with their animals when using filter systems. In principle, we currently recommend aquaterrariums without filtration with regular water changes.

However, installing a water outlet in the base plate of the aquaterrarium has proved to be very effective in making work easier.



Space for subtropical tortoises such as *Cuora cyclornata* at the IZS Münster; under such greenhouse conditions, the natural annual temperature curve can be ideally reproduced. | Christian Langner

4.5 Temperatures over the course of the year

This subtropical species requires a pronounced seasonal change to stimulate reproduction. From the end of October / beginning of November to the end of February/ beginning of March, the animals should undergo a moderate hibernation. At the IZS, all three subspecies of the Vietnamese three-striped box turtle are housed in the 'winter cold' room. Under the greenhouse conditions there, temperatures average 9-14 °C in winter. During the cool winter months, the turtles usually rest in the water or buried on land and are barely active. They are not fed and disturbances, e.g. water changes, are kept to an absolute minimum (as mentioned above: about once a month). However, if temperatures rise in winter - in the greenhouse, for example, due to sunny periods - the tortoises do become active during this time.

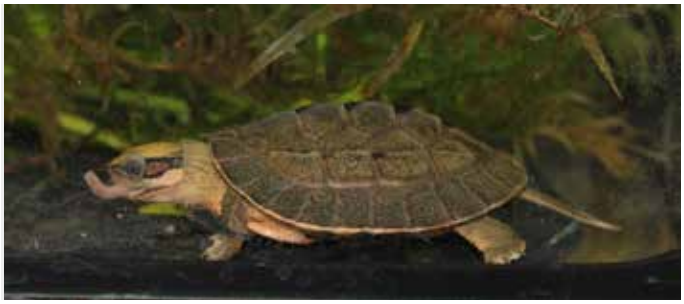
Due to the greenhouse effect, the temperature in the IZS quickly rises well above 20 °C when the sun shines in February. From this point onwards, feeding is cautiously resumed.

In the summer months, the air temperature is 25-35 °C; the water is not heated separately, but adapts to the air temperature accordingly. Water temperatures permanently above 32 °C should be avoided and cooled down by changing the water. Under greenhouse conditions, the turtles can normally cool down well in the water section during very hot phases. Nevertheless, care must be taken to ensure that overheating is not possible in hot summers.

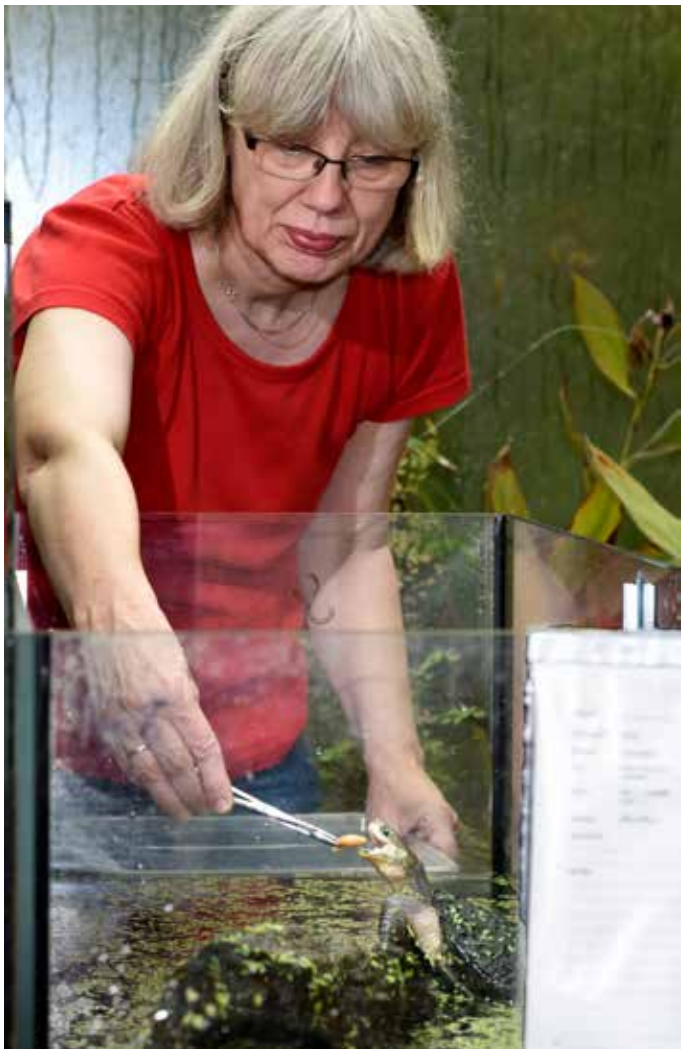
4.6 Feeding

Cuora cyclornata hatchlings are initially carnivorous. Insect larvae, small earthworms, amphipods and, later on, pellet food or similar foods are very popular. The older the animals get, the more ripe fruit enriches their menu. Fruit such as banana, mango, kiwi or melon are then very popular. Classic 'greens' such as lettuce are generally rejected. The most varied carnivorous food range possible includes fish, mussel meat, crab meat, shrimps, earthworms, zophobas and rose beetle larvae, grasshoppers and crickets as well as ready-made food pellets for water turtles or koi carp and turtle pudding supplemented with mineral and vitamin powder from our own production.

The frequency of feeding is always closely related to the activity temperature and time of year (see above). From the middle/end of November to the middle of February at around 10 °C room temperature, they are not fed at all. From the middle/end of February to the end of April (under greenhouse conditions), feeding takes place three to five times a week, depending on the room temperature, and four to six times a week from May to September. After that, the feeding frequency is reduced again to around two to three times a week until November. Under these conditions, the tortoises show healthy growth, and with the fasting period in winter, there has never been any fatty degeneration in the IZS.



Young *Cuora cyclornata* feed exclusively carnivorously and like to eat earthworms, for example | Heinrich Altenfeld



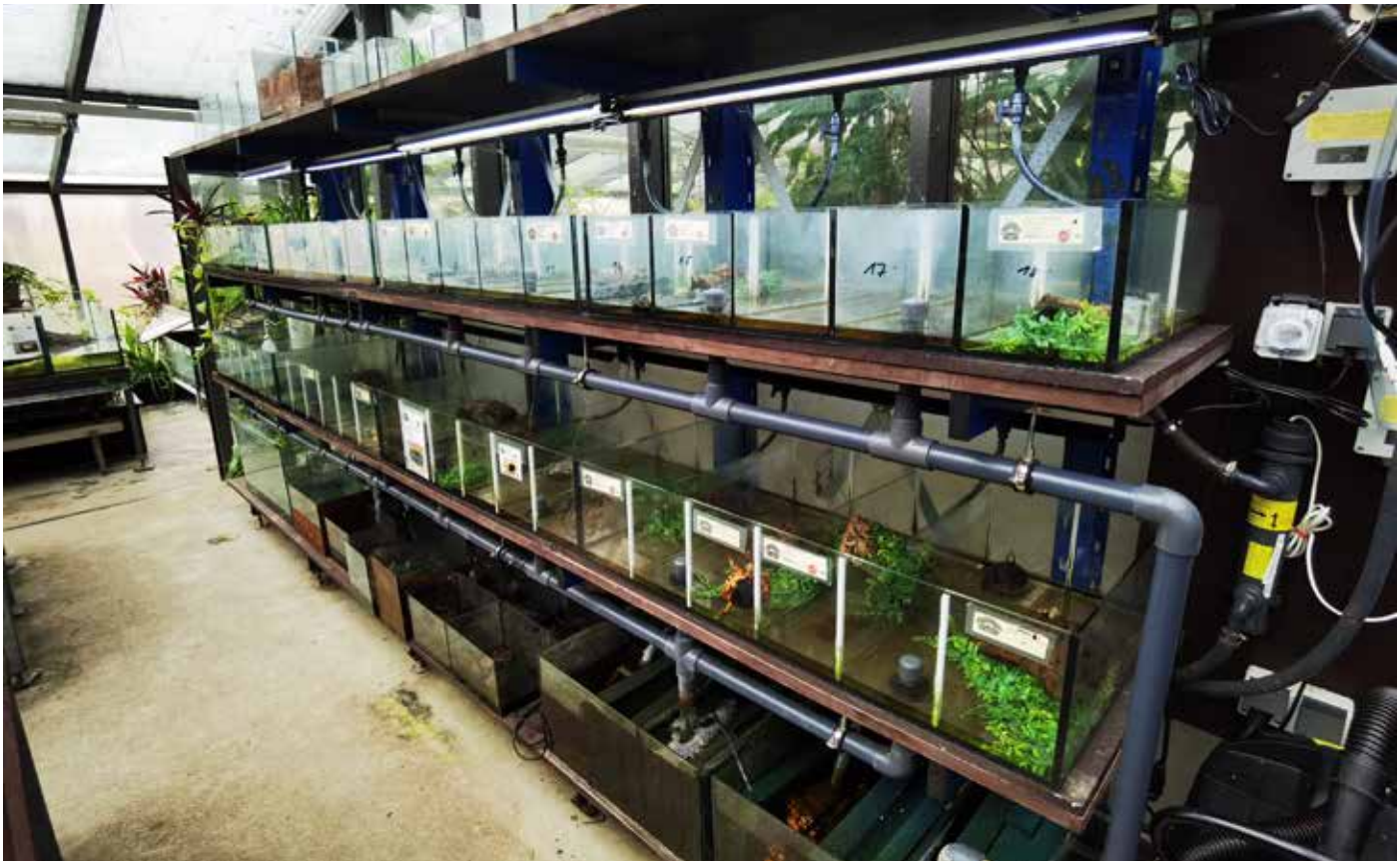
Feeding the carnivores - Ingrid Meier with tortoises at the IZS Münster | Benny Trapp

4.7 Socialisation

One of the most important prerequisites for successfully keeping and breeding these very territorial and incompatible tortoises is to keep all animals strictly on their own. Any visual contact with neighbouring specimens of the same species should be avoided at all costs, at the latest when they reach sexual maturity!

Another important advantage of individual husbandry in a coordinated species conservation breeding project is that the parents can be clearly related to each other, which is not the case with species kept in groups.

Keeping even one pair together permanently will inevitably lead to losses due to social stress. Even short-term co-habitation in pairs during the mating season for several hours without supervision or overnight can result in deaths! There are known cases of both box and spotted tortoises (*Clemmys guttata*) in which an animal has died after the pair was put together for mating and left together in the terrarium overnight.



Facility for keeping Cuora offspring individually; only young animals may be kept together in small groups for a while.
| Christian Langner

4.8 Offspring

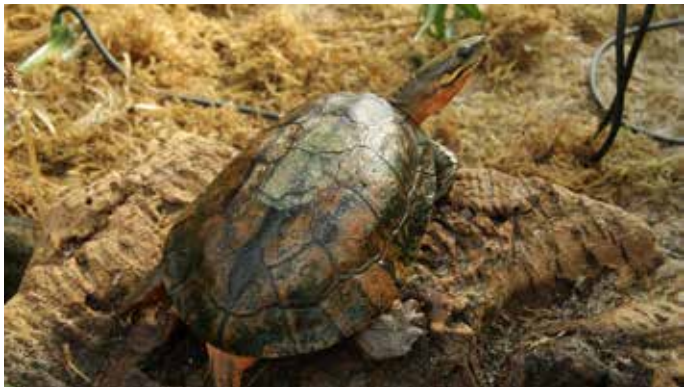
The basic prerequisites for successful breeding are, on the one hand, the annual rhythm with cool hibernation and warm summer months (see 4.4) and the strict individual rearing of the animals (see 4.6).

The turtles are therefore only put together during the mating season and only specifically for mating and must remain under permanent supervision. They are then immediately separated again, regardless of the success or failure of a possible mating. If the mating is unsuccessful, a new attempt is made every one to two weeks. Successful matings are mainly recorded in early autumn and spring, usually around the equinox (21.3./22.9.). There is a time window of around six weeks for this, i.e. mating can take place from around the beginning of March to mid-April and from the beginning of September to mid-October.

Successful courtship and mating can be easily recognised by the behaviour of the animals. Both usually take place in the water. The male initiates the courtship of the female by nodding his head. If the female tolerates the approach, in the second phase the male begins to swim under the female and bend his neck. Finally, in the third phase, the male tries to ride up on the female's carapace from behind and bite into the female's neck or front leg. This can take a while, and there are always small, 'friendly' bites by the male. This continues until the female adopts a clear mating posture. The female stretches her head and forelegs very far forwards, bucks up her abdomen a little with her hind legs, spreads her tail wide, opens her cloaca and then remains motionless. Then copulation takes place.

Sometimes, however, these phases are largely skipped and mating takes place immediately. In other cases, the animals take a while to get going. This can take up to one, sometimes up to two hours. If nothing has happened by then, the pair must be separated.

A delicate moment - two solitary animals must come together. The mating of *Cuora cyclornata* may only take place under supervision, so that immediate intervention is possible if the animals do not get along. Otherwise serious injuries are possible! | Heinrich Altenfeld



A thick layer of moss on the sandy substrate is necessary for the females to lay their eggs. | Heinrich Altenfeld

Freshly uncovered clutch of *Cuora cyclornata meieri* on the land part of the aquaterrarium | Christian Langner

Close-up of the same clutch | Christian Langner

If the animals are not ready to mate, there will not be the 'friendly' biting described above, but clearly recognisable hostile biting. Separation is then necessary immediately. Even in this case, you can make another attempt to put them together after about two weeks.

If the mating was successful, it is particularly important to provide the female with an optimum supply of food, vitamins and minerals during pregnancy.

Eggs are usually laid in the IZS from mid-May to June. There are special requirements for the oviposition site. The females absolutely need a covering layer of slightly damp moss (some keepers also use leaves, you can also mix them) at least 10 cm high on top of the 15 cm high substrate, which usually consists of sand. A mixture of coarser-grained river sand and finer-grained play sand is well suited. The sand must be slightly damp and able to be dug into, but must never be wet. If the spotlight is installed above the land section, a temperature gradient is automatically created in the substrate that is suitable for egg laying.
The female then lays an egg chamber at a depth of 5-8 cm, 'disappearing' completely under the covering layer of moss or leaves during egg-laying. Once the eggs have been successfully laid, the egg chamber is carefully sealed. If the covering layer of moss or foliage is missing, the females can discard their clutches in the water, or a laying emergency develops.
The clutch size varies between two and nine eggs. Usually only one clutch is laid per season in the IZS. With a little practice, you can immediately recognise whether the eggs are fertilised by their appearance. After one to three days, a white spot forms on the upper side of fertilised eggs, which expands over the next few days to form a band typical of turtle eggs.

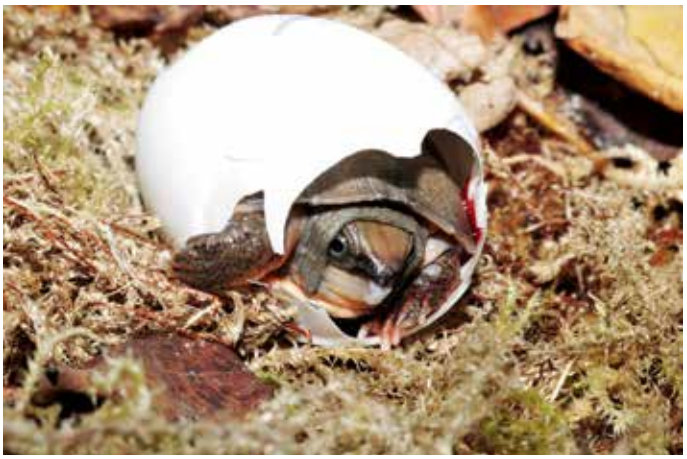
The eggs are incubated in slightly moist, coarse vermiculite at 98-99 % humidity and completely but thinly covered with substrate. We recommend only moistening part of the vermiculite very slightly and then mixing it again with dry vermiculite to ensure that the substrate is only slightly moist. The mixed substrate should not be so moist that it sticks to the hand, but should still trickle off the hand. The frequently practised procedure of getting the vermiculite wet and then pressing it out is not recommended for Box turtles. For one thing, pressing destroys the structure of the material and for another, it is still too moist as a result, to which the turtle eggs react sensitively.

The position of the eggs must not be changed during incubation. It is best to mark the eggs with a soft pencil with a cross on the top before transferring them to the incubator.

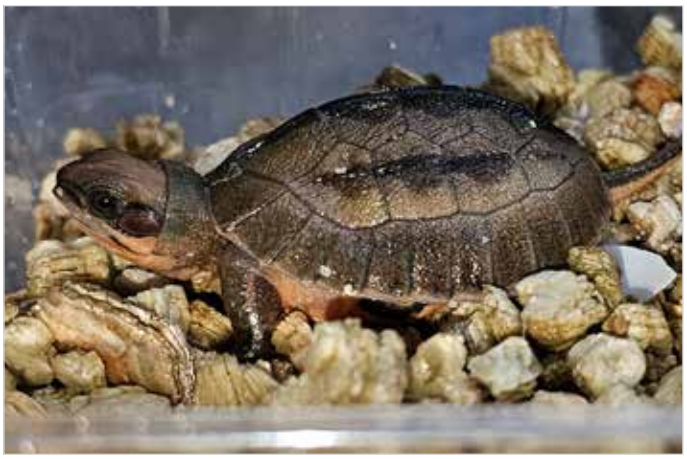
At incubation temperatures between 25 and 30 °C, the incubation period is between 80 and 100 days. As the incubation substrate is only very slightly moist, it must be very carefully moistened several times during the incubation period, depending on the ventilation of the incubator. The eggs themselves must not come into contact with water.

Females hatch at high incubation temperatures of 29-30 °C, males at 26-28 °C. At significantly cooler incubation temperatures of 23-24 °C, only females will hatch. Temperatures above 30 °C should be avoided at all costs.

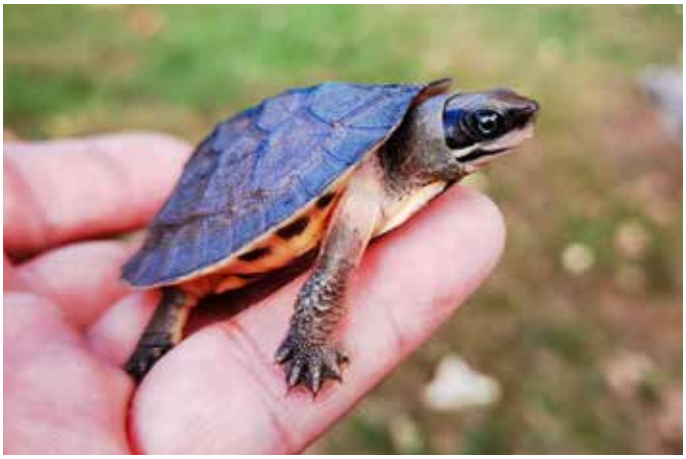
It is best if the incubation temperatures are not constant, but fluctuate within the specified range. Then both sexes will hatch and experience has shown that the young animals are the fittest.



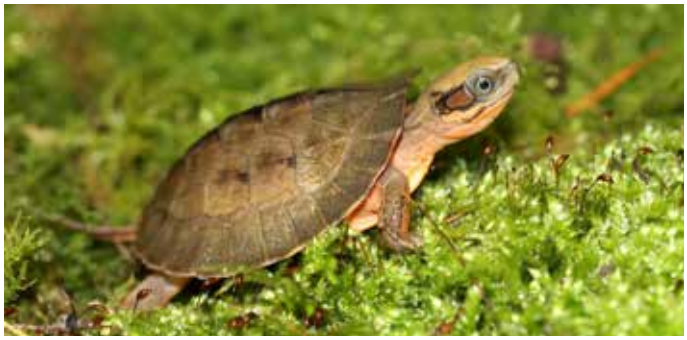
Hatching of *Cuora cyclornata meieri* | Christian Langner



Newly hatched *Cuora cyclornata* in the incubator | Markus Auer



Hatchling of *Cuora cyclornata cyclornata* | Christian Langner



Juvenile of *Cuora cyclornata* | Heinrich Altenfeld

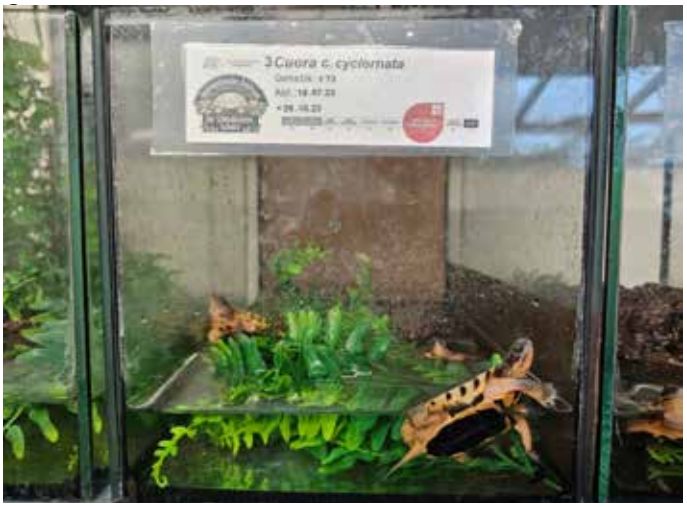
4.9 Rearing

The young animals should be reared individually as soon as possible after hatching. Group rearing of up to five animals is possible in the first twelve months, but even at this young age, incompatibilities can occur that require immediate intervention. Close monitoring is therefore necessary and all animals must be separated immediately if biting occurs, as once one of the small tortoises starts biting its siblings, e.g. on the tail, the others will immediately follow suit. Further joint rearing is then no longer possible! To avoid such problems, we strongly recommend keeping the animals individually from the outset, especially as it is then much easier to control their food intake and behaviour.

Only when feeding the hatchlings for the first time is group housing often still very helpful. If one hatchling accepts a new, previously unknown food, all the others will immediately join in out of food envy.

In terms of climatic conditions and nutrition, rearing is the same as keeping the adults. However, not only the food, but also the aquaterrarium should be adapted to the size of the young animals and 'grow' with the animals in several size steps.

Young animals can be kept well in small aquaria measuring approx. 40 x 30 x 30 cm for the first few months up to a maximum age of one year. There is no substrate, pieces of cork are sufficient as a land part. If you create herbaceous areas with aquatic plants where the animals can find cover and on which they can lie down and thus 'dry out', these are readily accepted. Live plants are quickly destroyed in small tanks, both when kept in groups and individually, making water hygiene more difficult. However, it is generally possible to use them if you have enough waterweed or hornwort. Both the IZS and many private keepers have had good experiences with plastic plants, which the animals can both sit on and crawl under.

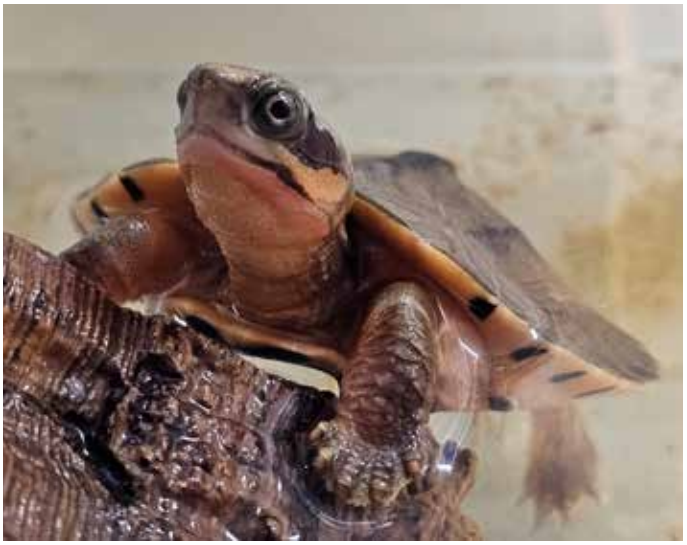


Cuora cyclornata in the rearing aquaterrarium | Heiko Werning

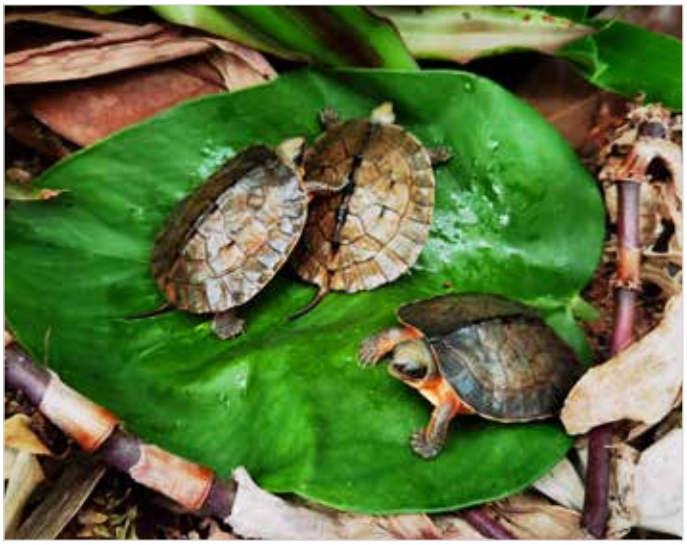
At one year old at the latest and with a carapace length of 5-8 cm, the aquarium should have a base area of approx. 80 x 40 cm. For further growth, we recommend that the aquarium length should always be at least five times the length of the animals' carapace. If this mark is exceeded, a move to a larger tank is necessary. The growth of the animals is heavily dependent on temperature and feeding. Overly rapid growth should be avoided.

An 80 cm aquarium is therefore well suited for animals with a carapace length of up to around 12-15 cm and an age of 3-4 years. Up to a carapace length of 20 cm, we recommend tanks with a base area of 150 x 80 x 60 cm.

Males reach sexual maturity at around eight years, females at ten years. This is the latest point at which they should be moved to the aquaterraria for adult animals mentioned above.



Breeding can initially be done well in aquariums with pieces of cork bark or aquatic plants floating on the surface as 'islands' | Markus Auer

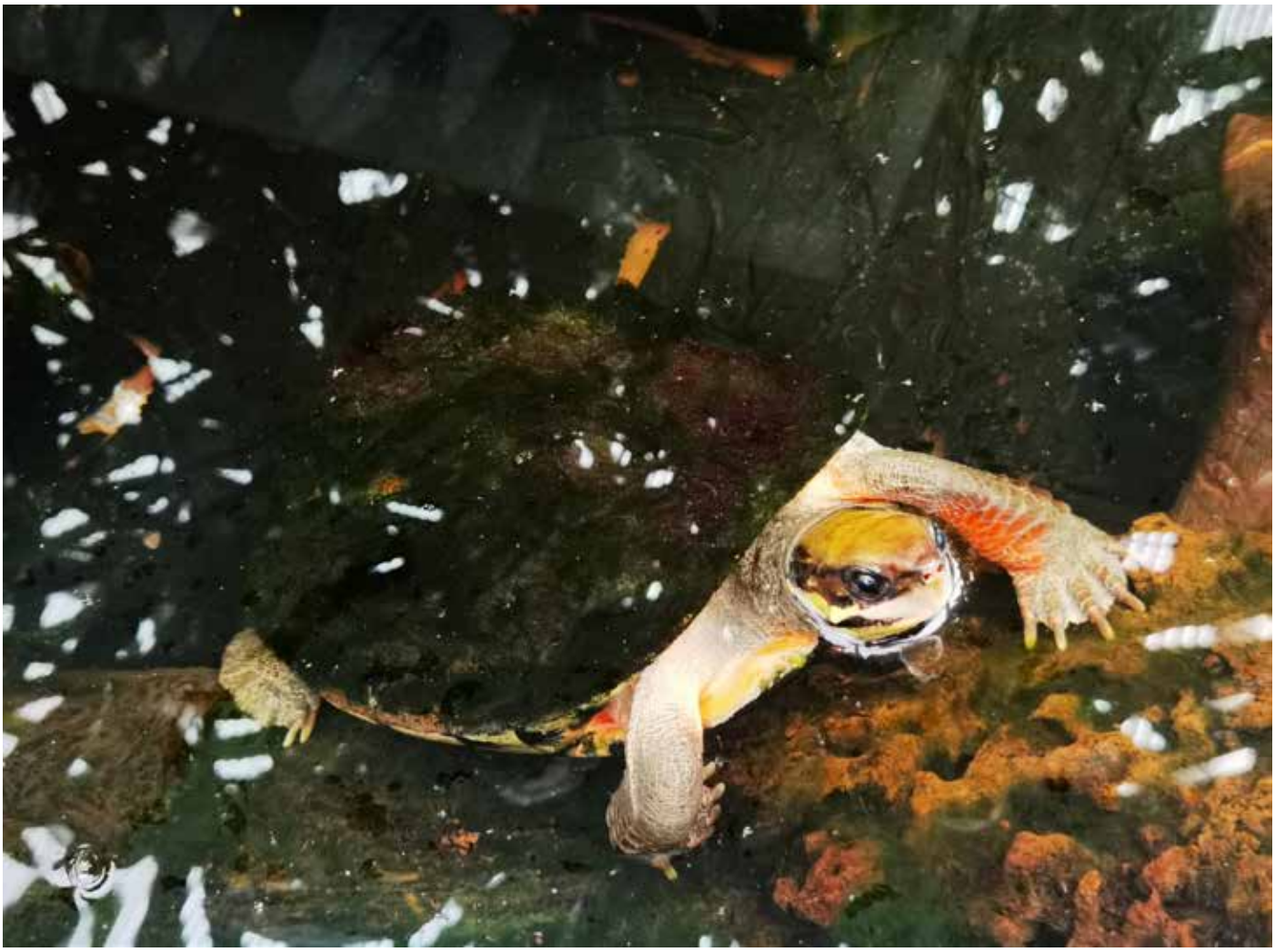


Juveniles of *Cuora cyclornata cyclornata* | Markus Auer

4.10 Problems

The most common husbandry problems are caused by socialising with other tortoises, including conspecifics. This is why they should be kept strictly alone. The only exception may be keeping hatchlings, but only until the first incompatibility occurs, then immediately separate all animals. Mating is also problematic and must be carried out under constant supervision, as the tortoises will seriously injure or kill themselves if they are not ready to mate.

Skin and carapace problems occur quickly if the water is not clean enough. Regular water changes are therefore essential. Previous experience with filter systems is often unsatisfactory. We recommend classic water changes. Do not feed too much so that food residues do not spoil the water.



Single housing and always clean water are the key requirements for keeping Vietnamese three-striped box turtles healthy | Christian Langner

5. Further Reading

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