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Building of a Conservation Breeding Facility for the Psychedelic Rock Gecko (*Cnemaspis psychedelica*) in Southern Vietnam

Aufbau einer Erhaltungszuchtanlage für den Psychedelischen Felsengecko (*Cnemaspis psychedelica*) in Südvietnam



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Abstract

Vietnam belongs to the global hotspots of biodiversity, and new vertebrate species have been regularly discovered from this country. Lizards and in particular geckos are among the groups with the highest discovery rates. One of the most beautiful geckos recently discovered from Vietnam is the Psychedelic Rock Gecko (*Cnemaspis psychedelica*), an endemic species of Hon Khoai Island, a small island with a total area of only 8 km² in Ca Mau Province, southern Vietnam. Although Hon Khoai is protected through the Ca Mau Biosphere Reserve, and collecting and exporting of the wild fauna and flora for commercial purpose is prohibited, the beautiful geckos made their way to the international pet trade. But the species is not only threatened by illegal collecting for the pet trade, but also by macaques introduced on this island. To act against this alarming development, Wildlife at Risk (WAR), the Institute of Ecology and Biological Resources (IEBR) and Cologne Zoo decided to cooperate in building up a gecko house as basis for the establishment of a reserve population, which could become the beginning of a potential conservation breeding program for *C. psychedelica*. The gecko house was planned in May 2014 and finished in November 2014 in WAR's Hon Me Station in

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Kien Giang Province, southern Vietnam. It has a movable rain cover with sunblind and contains ten large terraria consisting of aluminium, metal gauze and glass. Terrarium furniture mainly consists of cemented rock walls, plants, and natural soil with leaves. The gecko house also has a double door system to prevent accidentally escaped geckos from breaking out. The exterior of the gecko house is covered by a large water proof poster which points both in English and Vietnamese languages to the threats to the Psychedelic Rock Gecko and the background of the conservation project. First small gecko breeding groups were transferred from Hon Khoai Island to the Hon Me Station in March 2015, with relevant permits provided by the respective authorities. Furthermore we report about our first experiences with the keeping and breeding of *C. psychedelica*, and document colour pattern change during juvenile development.

Keywords: Gekkonidae; *Cnemaspis psychedelica*; Facility building; Husbandry; Conservation breeding; Vietnam

Introduction

Vietnam belongs to the global hot spots of biodiversity, and new vertebrate species have been regularly discovered from this country (e.g., Ziegler & Nguyen, 2010). Lizards and in particular geckos are among the groups with the highest discovery rates. For example, at the end of the past millennium, there were only four Bent-toed Geckos (genus *Cyrtodactylus*) known from Vietnam, but these days the number already has increased towards more than 35 species (Nguyen et al., 2015; Ziegler, 2015), and there is still no end of new descriptions in sight. But also among the Common Dwarf Geckos (*Hemiphyllodactylus*), Leaf-toed Geckos (*Dixonius*), True Geckos (*Gekko*) and Tiger Geckos (*Goniurosaurus*) diverse species descriptions from the Indochinese region have been published in the past decade (e.g., Botov et al., 2015; Luu et al., 2014; Ngo & Ziegler, 2009; Nguyen et al., 2014; Wang, Jin, Li, & Grismer, 2014). Also the Rock Gecko genus *Cnemaspis* is famous for numerous new discoveries from Southeast Asia during recent times, so that it is difficult meanwhile to keep track of the enormous *Cnemaspis* species diversity (e.g. Grismer et al., 2014). The species *Cnemaspis psychedelica* (Fig. 1) was recently described by Grismer, Ngo, and Grismer (2010) and certainly belongs to the most spectacular gecko discoveries in a world wide scale. This extremely gorgeous species is currently known only from Hon Khoai Island in Ca Mau Province, 18 km off the southern tip of the Ca Mau Peninsula in southern Vietnam. The species name refers to its bright, incongruous colouration and pattern. It is the most uniquely coloured rock gecko in that both sexes have bright orange forelimbs, forelegs, hands and feet, a bright orange tail, a dense yellow reticulum on the neck overlying thick black longitudinal lines, and a blue-gray to light purple trunk bearing yellow transverse bars on bright-orange flanks. The diurnal species lives on large granite boulders in the shade of the forest canopy. At night it usually is restricted to deeper areas of crevices and only rarely is seen outside the rock cracks. Reproduction takes place via eggs (usually two per female) which are deposited on the undersides of overhanging boulders (Grismer et al., 2010). As Hon Khoai Island is a very small island, with ca. 8 km² surface, the population size of *C. psychedelica* is rather small (Ngo, Nguyen, Nguyen, van Schingen, & Ziegler, submitted). A potential threat to the Psychedelic Rock Gecko (in Vietnamese



Fig. 1. The Psychedelic Rock Gecko (*Cnemaspis psychedelica*). Photo: T. Ziegler.

“Tac ke duoi vang”) may be introduced Long-tailed Macaques, as they are known to feed on geckos and gecko eggs (Grismer et al., 2010). Although this island is protected through the Ca Mau Biosphere Reserve of southern Vietnam, and collecting and exporting of the wild fauna and flora is prohibited, the Psychedelic Rock Gecko recently appeared in the international pet trade and now is offered to hobbyists for high prices. Offers have been made, for example, from Russia, Spain, Czech and Germany – also for the international reptile market in Hamm (see www.terraristik.com). Since 2015, the species is also offered from the US (Auliya et al., in press). However, unregulated, illegal pet trade can severely harm the natural populations. An example is the Tiger Gecko species *Goniurosaurus luii* which immediately after its discovery has been extirpated at the type locality due to the commercial pet trade (Stuart, Rhodin, Grismer, & Hansel, 2006). Also the only recently discovered, alarmingly small population of the Crocodile Lizard (*Shinisaurus crocodilurus*) in Vietnam is seriously threatened by the pet trade (Van Schingen, Ha, et al., 2016; Van Schingen, Pham, et al., 2014; Van Schingen, Schepp, Pham, Nguyen, & Ziegler, 2015). Whilst the building up of a captive reserve population for the latter *Shinisaurus* population already has been started at the Melinh Station for Biodiversity of the Institute of Ecology and Biological Resources (IEBR), Hanoi (Van Schingen, Schepp, et al., 2015; Ziegler, 2015), there exist no comparable conservation measures for *C. psychedelica*. To prevent the Psychedelic Rock Gecko, which is regarded as endemic to Hon Khoai Island, from extirpation due to predation by introduced mammals and in particular over collecting for the animal trade (see also Bethge, 2014), Wildlife at Risk (WAR) together with the IEBR, Hanoi, and the Cologne Zoo in Germany have decided to develop a facility for the endemic species in WAR’s Hon Me Rescue Station in southern Vietnam’s Kien Giang Province, nearby the border with Cambodia to build up a reserve colony (see Ziegler, Rauhaus, Nguyen, & Nguyen, 2015). Herein we report in detail about the planning and building of the Psychedelic Rock Gecko facility and about our first husbandry and breeding experiences with this so far poorly known gecko species.

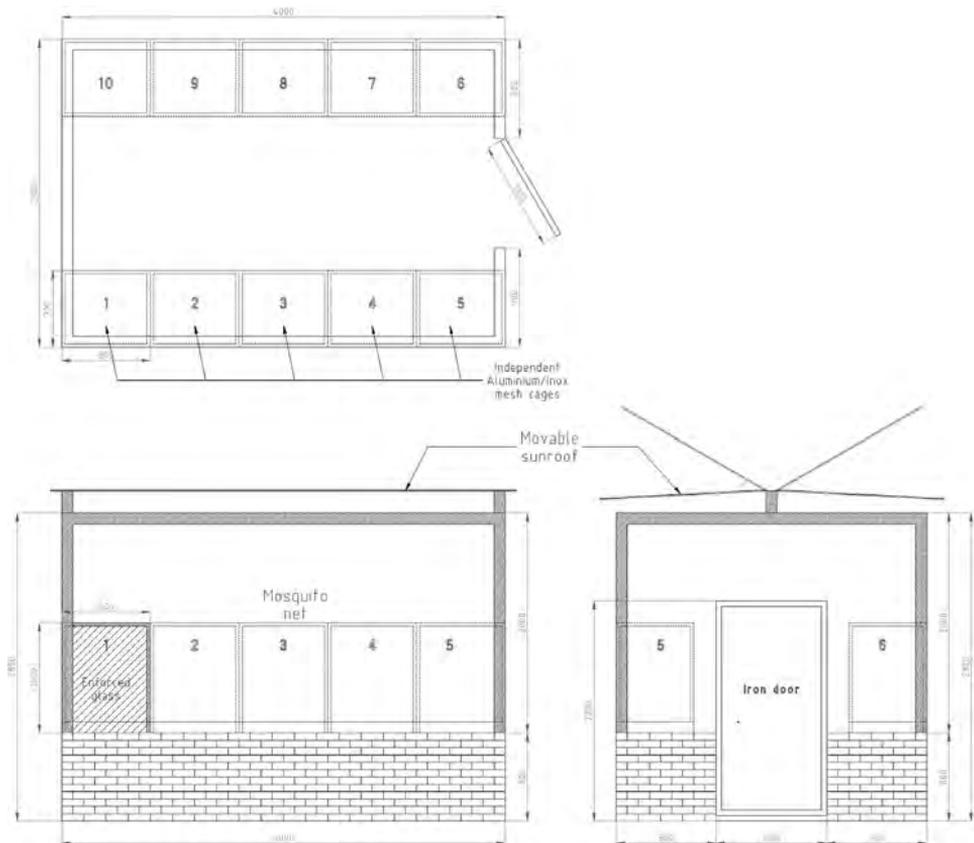


Fig. 2. The first plan of the gecko house; later, we decided to enlarge the entrance area to insert a double door system and to increase the dimensions of the gecko house towards 5 m × 3 m × 2.8 m (length (L) × width (W) × height (H)).

Planning and Building of the Gecko Facility

The planning, building and completion of the gecko facility took place within seven months, between May and November 2014. Our first plan of the gecko house is shown in Fig. 2. At that time, the dimensions were 4 m × 2.8 m × 2.8 m (length (L) × width (W) × height (H)). Later, we decided to enlarge the entrance area to insert a double door system to prevent accidentally escaped geckos from breaking out. By adding the double door system, the dimensions of the gecko house were increased towards 5 m × 3 m (L × W). In parallel to the gecko house planning, the land selected for the building of the gecko house was prepared by clearing vegetation and removing rocks on a surface of about 5 m × 5 m. Subsequently the foundation was prepared by concrete. The building phases are visualized in Figs. 3–5. A drainage pipe was inserted in the right corner for leading rain water outside. To make sure that no gecko can escape from inside the house and no animals from outside can come in, the hole in the floor inside the house was covered by metal gauze (1 mm mesh



Fig. 3. Building phase 1: (A) This part of the Hon Me Station was selected for the building of the gecko house (phot. A. Rauhaus), (B) measuring and marking the cleared site, (C) starting with the fundement, (D) base plate and walls, (E) insertion of iron frames, (F) insertion of tables for the terraria. Photos: K.V. Nguyen.

aperture), the pipe ending on the outer side of the house can be closed by a valve and is only opened for cleaning purposes or during rain, also to prevent ants coming inside the house. The walls of the house consist of a base made by bricks and concrete and a top made by iron frames covered with metal gauze (1 mm mesh aperture). The concrete walls are 80 cm (measured from outside) or 50 cm high (measured from inside), respectively. The roof also consists of metal gauze (1 mm mesh aperture) on an iron frame. In addition, an oblique iron frame covered with wire mesh is attached on top of the roof as a base for



Fig. 4. Building phase 2: (A) Double door system, (B) development of the first terrarium, (C) bringing in of the terraria, (D) inside view of the gecko house with inserted terraria. Photos: K.V. Nguyen.

three separately rollable plastic sheets, both serving as rain cover and sun protection. The iron bars used for the frames measure 5 cm × 10 cm. Around the house a 15 cm high wall consisting of bricks and concrete was built in 20 cm distance towards the gecko house serving as a water canal (15 cm in width) for ant prevention. In front of the house, an area of 130 cm width was piled with stones as a visitor's platform. The double doors for keeper access to the house measure 104 cm × 248 cm × 6 cm ($W \times H \times$ thickness) and are installed in 110 cm distance from each other. Inside the gecko house contains each five terraria on



Fig. 5. Building phase 3: (A) Overall view of the gecko house with inserted terraria (phot. K. V. Nguyen), (B) building of the back walls (phot. T. Ziegler), (C) completed terrarium with geckos inside (phot. K. V. Nguyen), (D) inside view of the gecko house with most of the terraria being equipped and fans installed. Photos: T. Ziegler.

both sides, so altogether ten terraria. Terraria are placed on a 50 cm high and 70 cm wide metal table (iron frame thickness 3 cm) which is at the back side attached to the wall and on the front side based on four table-legs. First we planned and built a single, movable terrarium with the measurements $0.8 \text{ m} \times 0.7 \text{ m} \times 1.2 \text{ m}$ ($L \times W \times H$), consisting of aluminium, metal gauze and glass. The frame consisted of 3.8 cm thick aluminium rods. Every ground board consisted of an aluminium plate and contained a drainage hole of 2.5 cm diameter, covered by metal gauze. Around the ground board there were 10 cm high aluminium walls for being able to insert soil in sufficient height (for digging in plants, etc.). The sides, the front side and the roof are entirely covered by metal gauze (1 mm mesh aperture). The lower half of the back side was built by a 5 mm thick glass panel, towards which the rock habitat could be cemented later. The upper half of the back side consisted of metal gauze (likewise 1 mm mesh aperture), so that sunlight/UV rays also can shine into the enclosure from the sides. The front side is movable via table-tracks on both sides, has a grip on the bottom and can be opened bottom-up and fixed by each two latches in 55 cm or 80 cm height, respectively, for having access to the terrarium for working/cleaning, etc. After that the remaining nine terraria were likewise built. All terraria of one side of the house are combinable as the dividing walls in between can be slid out with a metal grip, which is not in use so far but was planned for optional flexibility. The drainage holes in the terraria are



Fig. 6. Furnished terraria: (A) Terrarium (see Fig. 5C) at a later stage with more dense vegetation, providing for sufficient shadow and shelter, (B) this terrarium, which is directed towards the visitor's path, has a back side consisting of glass, so that visitors have the chance to see the geckos without entering the house. Photos: T. Ziegler.

attached to a PVC tube system which collects the water from the terraria and leads water to the drainage hole on the floor. Another PVC tube system is attached on top of the terraria and leads water from the freshwater access to a sprinkling/rain nozzle on each terrarium. The outermost left terrarium of the front of the gecko house, which is directed towards the visitor's path, had a back side consisting of glass, so that visitors have the chance to see the geckos through this glass panel from outside and without entering the house (Fig. 6). Before the ten enclosures were moved into the gecko house and installed on the side tables, the electricity (two LED lamps and two fans) and the water access were set up both from sources of power and water, in about 50–70 m distance. Finally, for creating the fitting terrarium interior we used microhabitat pictures from Hon Khoai Island; the habitat occupied by the geckos consisted of partly shaded, big stones surrounded by trees and other plants. Thus, as terrarium background we cemented rock walls, also including overhanging structures. The terrarium furniture furthermore consisted of branches, plants, natural soil, leaves and each a drinking vessel. Between the outermost left terrarium with its glass panel for visitor's insights and the entrance, the exterior of the gecko house was covered by a large water proof poster which points both in English and Vietnamese languages to the threats to *C. psychedelica* and the background of the conservation project (Figs. 7 and 8).



Fig. 7. The gecko house was finished in November 2014: on the top the manually adjustable rain and sun protection is visible; on the left there is the enclosure visible for visitors from outside, in the middle the weatherproof project banner, and on the right the double door system. Photo: A. Rauhaus.

After the finishing of the gecko facility and completing the terraria and their equipment, we conducted a comprehensive theoretical and practical keeper training in November 2014, comprising terraristics in general, husbandry of lizards, handling and sexing, as well as breeding of feeder insects, both for the staff of the Hon Me Rescue Station and for the staff of the close U Minh Thuong National Park.

Husbandry Conditions

First small gecko breeding groups were transferred from Hon Khoai Island to the Hon Me Station in March 2015, with relevant permits provided by the respective authorities. During the time on Hon Khoai Island we collected data concerning the microhabitat of the geckos and respective climatic conditions (temperature, humidity), to use this information for creating optimum terrarium conditions in the gecko house. Temperatures at Hon Khoai ranged from 28 to 32 °C, the humidity was from 64 to 79% (recorded data from 8 to 10 March 2015). On Hon Khoai Island we found the Psychedelic Rock Geckos to be active during the daytime and also in the evening, usually seen on big stones under the forest canopy, and resting at night on tree branches or in crevices and holes between stones, approximately between 0 and 1.5 m above the ground. During daytime geckos could be seen basking on stones in forested environment. In the Hon Me Station, geckos were split in groups consisting of couples or two or three individuals per terrarium. The geckos well tolerated the transfer from the island to the station. After the arrival of the geckos in the Hon Me Station, in April and May 2015, the climate was very dry, similar to the situation on Hon Khoai Island. After short adaptation of few days the geckos readily accepted provided food, consisting



Fig. 8. Self-made banner in front of the gecko house pointing to the threats to the Psychedelic Rock Gecko in English and Vietnamese language (layout: M. v. d. Ploeg, vdp-design; text, pictures, design and logo: T. Ziegler, T.Q. Nguyen, A. Rauhaus, K.V. Nguyen, T.M. Phung, R. Dieckmann).

of small insects. Food (mainly beetle larvae and crickets) generally is provided three times a week, and powdered with vitamin and mineral supplements. Feces samples were taken, which revealed some of the geckos being infected with nematodes (oxyurids, heterakids) and coccidians, which were treated with fenbendazole and toltrazuril. To provide optimum climatic conditions, fans can be switched on very hot, windless days for providing air movement, and for providing optimum humidity, terraria are sprayed with water by means of the irrigation system. Temperature and humidity is controlled by means of minimum-maximum thermometers, data loggers, and infrared thermometers. Terraria and geckos are checked several times every day (health condition of geckos, activity) and for activating sun/rain protection, if required.

First Breeding Successes

The first egg depositions occurred at the end of May 2015. Clutches consisted of two eggs which were attached to the terrarium surface (branches, walls) at elevated, rather dry and in part sunny sites. Eggs were nearly round, white, and measurements ranged between 1.2–1.4 mm × 1.0–1.2 mm. After some of the first clutches obviously were destroyed by the parents, eggs were covered by a gauze basket or taken out of the terrarium, if possible,

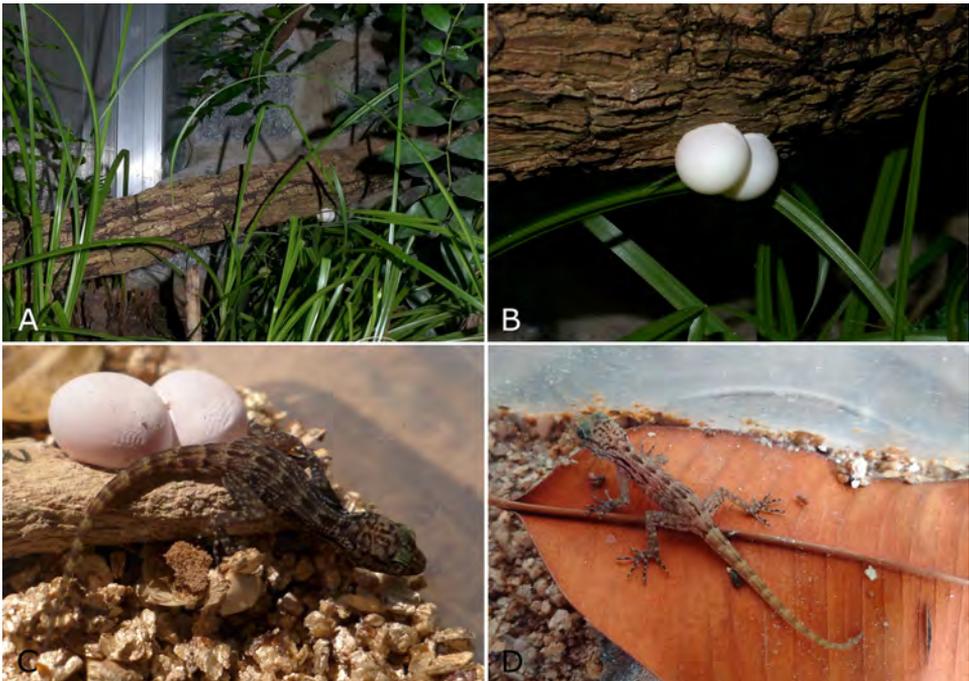


Fig. 9. First reproduction success in the gecko house: (A–B) Deposited eggs, (C) hatchling, (D) young gecko at the age of three days with food (fruit fly) and freshly deposited feces inside the rearing box. Photos: K.V. Nguyen.

and transferred to a plastic box with vermiculite. First juveniles hatched at the beginning of July 2015. The first hatchlings showed malformations such as a curled up tail in one case or dull eyes together with respiratory problems in another case and died rather fast after hatching. Subsequently we tried to improve the feeding by a wider variation of feeder insects together with increased mineral and vitamin supply, as at least the egg destruction behavior of the adults points to insufficient calcium supply. The first successful rearing happened at 4 December, resulting in a healthy juvenile which readily accepted fruit flies as food (Fig. 9). Juveniles at time are reared separated from the adults in small plastic terraria with soil as ground substrate and branches and leaves as climbing and hiding opportunities. In contrast to [Grismer et al. \(2010\)](#) who stated that all age classes have bright orange forelimbs, forelegs,

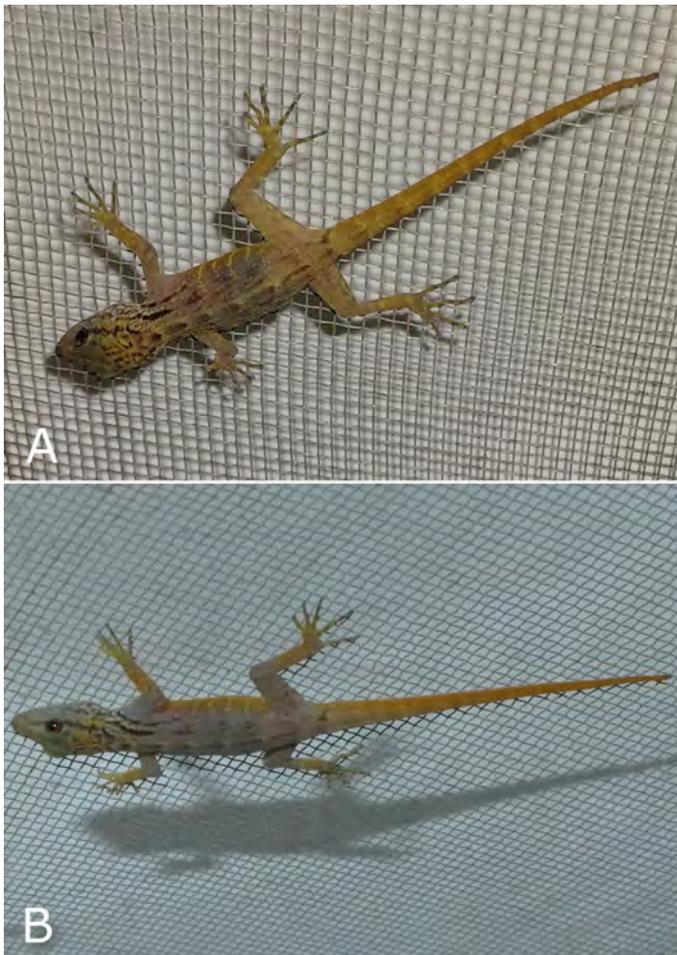


Fig. 10. The hatchling depicted in [Fig. 9](#) at an age of: (A) 37 days (10 January 2016) and (B) 59 days (1 February 2016); the change towards the adult colour pattern in the second month of development is obvious. Photos: K.V. Nguyen.



Fig. 11. The hatchling depicted in Fig. 9 at an age of three months. Photo: T. Ziegler.



Fig. 12. After eight months of keeping, all adult Psychedelic Rock Geckos (*Cnemaspis psychedelica*) are doing well in the gecko house. Photo: T. Ziegler.

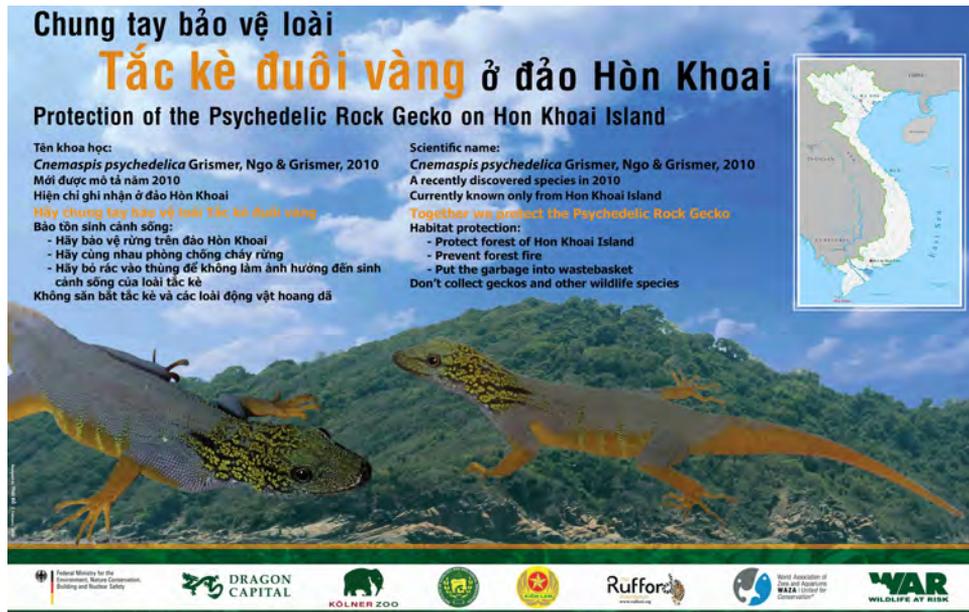


Fig. 13. Self-made poster to point to the threats and conservation needs of the Psychedelic Rock Gecko in English and Vietnamese language (layout, text and pictures by Thai Do and the authors).

hands and feet, a bright orange tail, a dense yellow reticulum on the neck overlying thick black longitudinal lines, and a blue-gray to light purple trunk bearing yellow transverse bars on bright-orange flanks, we observed colour pattern change from juvenile to adult colour pattern to take place in the second month after hatching (see Figs. 10 and 11).

Outlook

Our first experiences with the keeping and rearing of the Psychedelic Rock Gecko (*C. psychedelica*) showed up that adults do well in captivity (Fig. 12), when proper environmental and climatic conditions are provided (sufficient temperature, humidity and air circulation; suitable places for climbing and sun basking, but also cooler areas and hiding possibilities). For successful breeding diversified food and in particular sufficient mineral and vitamin supply seem to be crucial (Fig. 11). Whatsoever, we must collect further experiences with the long-term keeping and breeding of this gecko species, in particular as the facility in southern Vietnam is run by local staff which can only be advised and trained during one or two annual short visits of the reptile team of Cologne Zoo and otherwise can only be guided by e-mail communication. It would be desirable to establish a successful long term rock gecko keeping with subsequent F2 breeding. By doing so, after having initiated the buildup of this captive reserve colony, this could be the beginning of a conservation breeding programme, which could be extended to other institutions in the future. In parallel, conservation based in situ ecological research is conducted by our working group with support of

the Federal Ministry of Environment, Nature Conservation, Building and Nuclear Safety (BMUB) and the Rufford Foundation (Grant No. 18631-2) (Ngo et al., submitted) and an awareness campaign is currently being built up (see Fig. 13), which will be dealt with in detail elsewhere.

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We thank the directorates of the Ca Mau Forest Protection Department and Hon Khoai Unit for issuing relevant permits. Many thanks to the staff of the Hon Me Station for the great support in building and running the gecko station. Thanks also to Theo Pagel and Christopher Landsberg (Cologne Zoo) for the ongoing support and co-funding of the gecko facility. Many thanks to Trung My Phung (Dong Nai) for sharing pictures and habitat information from Hon Khoai Island with us. We further thank Ruth Dieckmann (Cologne Zoo), and Marc van der Ploeg (vdp-design) for their help in creating the gecko house poster layout. Cologne Zoo is partner of the World Association of Zoos and Aquariums (WAZA): Conservation Project 07012 (Amphibian and Reptilian Breeding and Rescue Stations).

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