BIAWAK

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On the Cover: *Varanus acanthurus brachyurus*

The *Varanus acanthurus brachyurus* depicted on the cover and inset of this issue was photographed by **H. J. Buys** in July 2010. This particularly attractive specimen was seen scurrying between spinifex clusters around flat-lying topography at midday near Cloncurry, Queensland. It sprinted between flat rocks scattered across the open landscape depicted in the figure below, taking cover under them in an effort to evade the photographer.

Varanus acanthurus brachyurus occupies arid terrain dominated by very old metamorphosed schistose rocks that erode away, breaking off in sheets and piling in odd arrangements that fill with fine rock fragments and soil. These conditions provide a suitable means for burrow construction. *Varanus acanthurus brachyurus* are often seen from a distance on rock outcrops observing their surroundings.

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INTERNATIONAL VARANID INTEREST GROUP
www.varanidae.org

The International Varanid Interest Group is a volunteer-based organization established to advance varanid research, conservation, and husbandry, and to promote scientific literacy among varanid enthusiasts. Membership to the IVIG is free, and open to anyone with an interest in monitor lizards and the advancement of varanid research. Membership includes subscription to *Biawak*, a quarterly journal of varanid biology and husbandry, and is available online through the IVIG website.

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Varanus albigularis microstictus and jackals. Tsavo East National Park, Kenya.
Photograph by **Doug DeNeve** deneved@hotmail.com

NEWS NOTES

Los Angeles Zoo Hatches Komodo Dragons

Twenty-two Komodo dragons (*Varanus komodoensis*) have been hatched at the Los Angeles Zoo, US, representing the first time this facility has successfully reproduced this species. The offspring will eventually go to various zoos across the country, including eleven to Ohio's Columbus Zoo.

Source: Associated Press, 26 August 2010

St. Augustine Alligator Farm's Komodo Dragon Dies

Krakatoa, a Komodo dragon kept at the St. Augustine Alligator Farm for over three years, has died at the age of nine. Though a necropsy has yet to be performed, it is believed the cause of death was due to either encephalitis or West Nile Virus. The animal had recently undergone treatment at the University of Florida after park staff noticed unusual behavior and symptoms. Park director John Brueggen noted Krakatoa's particularly calm disposition among staff members. A 2008 photo of a birthday celebration for Krakatoa showing him eating a "cake" of dead rats was widely circulated in the national and international media.

Source: The St. Augustine Record, 8/16/10

New Rules in Florida Concerning Possession of Nile Monitors

Nile monitors (*Varanus niloticus*), along with certain species of pythons and other species listed as reptiles of concern, have been added to the FWC's Conditional Reptiles list. This listing effectively prevents Florida residents from acquiring these species as pets. However, under an amnesty program keepers who already possess specimens will be allowed to retain them. Breeders, researchers, and other will be allowed to continue to possess this species but only for sale outside the state. New regulations regarding enclosures and the transport of animals also go into effect, as does a requirement that specimens be micro-chipped. These new regulations will not affect owners of the similar ornate monitor (*V. ornatus*), which is not listed by FWC officials as a conditional species.

Source: Florida Fish and Wildlife Conservation Commission, accessed 25 August 2010

Monitor Seizures in China

Two water monitors (*Varanus salvator*) and one Burmese python (*Python bivittatus*) were seized by the Yunnan Honghe forest police from a minibus traveling

Varanus bengalensis. Ranthambore National Park, Sawai Madhopur, India. Photograph by **Saurabh Dasgupta**

from Honghe to Kaiyuan, Yunnan Province, China. The investigation is ongoing.

In a non-related seizure on 9 July 2009, police in Taizhou, Jiangsu Province confiscated an assortment of protected animals and animal products including 11 live *V. bengalensis*, from a vehicle traveling from Wenzhou, Zhejiang Province to Jinan, Shandong Province. The live lizards and snakes confiscated by authorities were transferred to the Nanjing Hongshan Forest Zoo. The investigation is ongoing.

Source: Traffic Bulletin, 2010. Volume 22, No. 3: 133

Dead Body Consumed by Monitor Lizards

A body found near a roadside pond in Thailand, originally believed to have been that of a murder victim, was largely consumed by monitor lizards. Wan Saengthong, 74, is believed to have died from natural causes before having much of his lower body consumed by the lizards. The condition of the body had originally lead many villagers to believe it was the work of a killer.

Source: Bangkok Post, 21 July 2010

Komodo Dragons Arrive at Sosto Zoo, Hungary

Partnering with Ragunan Zoological Park, in Jakarta, Indonesia, Sosto Zoo, of Nyíregyháza, Hungary received a breeding pair of *Varanus komodoensis* born at the Ragunan Zoo in February 2010. The dragons, along with other Indonesian species such as orang-utans, greater one-horned rhino, and Bali mynahs were unveiled in a new exhibit which opened in April 2010. The current EEP population of *V. komodoensis* is 52 animals (19.14.19) maintained in 16 institutions.

Source - Papp, E. 2010. In a collaborative move, Komodo dragons have arrived at Sosto Zoo in Hungary. Zooquaria 70: 27.

Guilty Plea in Australian Reptile Smuggling Case

Big Game Reptiles owner Michael Plank has pleaded guilty to wildlife trafficking. Plank was caught at Los Angeles International Airport upon arriving from Australia with fifteen live lizards concealed in a money belt; among these were two monitors (identified from

Varanus scalaris. Keep River, NT. Photograph by **Ingo Oeland Photography.**

Varanus gouldii. Willandra, NSW. Photograph by **Ingo Oeland Photography**.

published photos as *Varanus pilbarensis*). Plank had switched from an original plea of 'not guilty' and will be sentenced in October. He faces up to twenty years in jail and a quarter of a million dollar fine.

Source: NineMSN, 28 July 2010

Report from the 2010 General Meeting of the AG Warane

Due to last minute alterations to the program of the second annual meeting of the AG Warane earlier this year [see report in Biawak 4(2): 48], the general 2010 meeting of the AG members took place on 4 September 2010 at the Senckenberg Museum, Frankfurt on the main, in the course of the annual meeting of the DGHT. As a consequence of the discussion with Ursula Bauer from Aktion Tier e.V. (a German animal welfare organization) at the annual meeting in Hanau, she recently met Silvia Macina, the executive secretary of the DGHT, in Berlin to discus future cooperation between both organisations. Further information about the project will be published in Elaphe, the DGHT newsletter.

In absence, Carlo Bayer and Christina Rüggeberg were acknowledged for their engagement with the AG Warane. Due to personal reasons, they will no longer be available serve on the AG board. Ramona Jünemann was elected successor of Christina Rüggeberg as treasurer of the AG. In addition, Manfred Gessner will support the board and manage the AG homepage (www.agwarane.de) in the future. He will also introduce a logo for the AG Warane to enhance the professionality of the working group.

The discussion and voting on a putative cooperative publication with the IG Warane was cancelled due to missing information.

As another point, the 2011 annual meeting was discussed by the attendees. At the request of some AG members, next-year's meeting will not take place in Hanau as in previous years, but will be held at the Zoological Research Museum Alexander Koenig in Bonn (www.zfmk.de). There are already some proposals for referees. Those interested may contact Kay Uwe Dittmar (working group leader) at dittmar@ag-warane.de or André Koch (scientific leader) at a.koch.zfmk@uni-bonn.de. Further information will follow in Elaphe and the next issue of *Biawak*.

ARTICLES

Biawak, 4(3), pp. 82-92

First F2 Breeding of the Quince Monitor Lizard *Varanus melinus* Böhme & Ziegler, 1997 at the Cologne Zoo Aquarium

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Abstract - We report the first breeding of the quince monitor lizard *Varanus melinus* in a European Zoo, which at the same time represents to our knowledge the first F2 breeding of the species in general. In June 2009, a clutch containing nine eggs was produced at the Aquarium of the Cologne Zoo by a *V. melinus* pair received seven years earlier as offspring from a private breeder. Two of these eggs showed no development and one egg contained dead conjoined twins. Six offspring with weights of 33-35 g (mean 34 g) and total lengths of 266-281 mm (mean 274 mm) finally hatched in December 2009 from eggs measuring 47.1-58.6 mm (mean 54.0 mm) x 32.0-36.0 mm (mean 34.2 mm) in size, after 164–166 (mean 164.8) days of incubation at 29° C. A second clutch comprised of five eggs was laid in September 2009, about three months after the deposition of the first clutch. Two of these eggs showed no development and one egg contained a dead, slightly malformed embryo. Two *V. melinus* subsequently hatched from this second clutch in February 2010 after 164–165 days of incubation at 29° C. We compare our data with previously published information on the successful breeding of the species. All eight *V. melinus* hatched at the Cologne Zoo are developing well, and some will be subsequently provided for conservation breeding projects. Because this attractive species seems to play an important role in the international animal trade, and due to only very few husbandry and breeding reports available, we herewith intend to encourage the conservation breeding of this monitor lizard and to add to the scarce knowledge of the natural history of this beautiful species through both ex situ zoo breeding efforts and in situ population research, to finally contribute to improved conservation measures.

Introduction

The quince monitor lizard (*Varanus melinus*) was described thirteen years ago by Böhme & Ziegler (1997) based on pet trade specimens originating from the Sula-Archipelago, Moluccas, Indonesia. The discovery of *V. melinus* might have been correlated with the disastrous forest fires in Indonesia in 1997, because new collecting areas had to be found to replace traditional, known collecting sites. Ziegler *et al.* (2007b) summarized the islands of Banggai, Bowokan, Mangole, Sanana, and Taliabu as being inhabited by *V. melinus*. However,

recent investigations by Weijola & Sweet (2010) could only prove an occurrence of *V. melinus* with certainty for Mangole and Taliabu Islands.

Varanus melinus is a representative of the mangrove monitor group (*V. indicus* species group), which currently comprises the following 13 species (in chronological order, see Koch et al, 2009; Ziegler *et al.*, 2007a; 2007b; Weijola & Sweet, 2010): *V. indicus*, *V. doreanus*, *V. jobiensis*, *V. finschi*, *V. melinus*, *V. yuwonoi*, *V. caerulivirens*, *V. cerambonensis*, *V. juxtindicus*, *V. zugorum*, *V. rainerguentheri*, *V. lirungensis*, and *V. obor*. *Varanus melinus* is medium-sized, with a maximum total length surpassing 128 cm. Characteristic is its yellow ground coloration in adults, with a more or less discernible dark reticulated pattern on the body, neck, limbs and tail base. Hatchlings are black with a light yellow pattern consisting of transverse rows of yellow ocelli on the dorsum. With age, the dark coloration of the head and neck region is gradually replaced by the yellow ground coloration seen in sub-adults and adults (Ziegler & Böhme, 2004).

Ziegler & Böhme (2004) also summarized what is currently known about the natural history of *V. melinus*, which in most instances derives from captive conditions. Only scarce data are known from the natural habitat. Bayless & Adragna (1999) reported *V. melinus* to inhabit interior tropical lowland forests on Taliabu, which are characterized by a high density of dipterocarp trees; however, these authors never set foot on the original habitat of the species. Based on actual field observations, Weijola & Sweet (2010) recently stated that *V. melinus* seems to prefer more open habitats away from the immediate mangrove zone. Weijola & Sweet (2010) also commented that the colorful and highly sought-after *V. melinus* has, according to the local animal trader on Mangole, experienced a serious population decline, resulting in the removal of more than 10,000 animals in the past decade.

Although this attractive species seems to play an important role in the animal trade, unfortunately very few husbandry and breeding reports have been published to date. To our knowledge, zoo breedings of this species are known only from the Wildlife Conservation Society's (WCS) Bronx Zoo and from the Fort Worth Zoo, both located in the United States (e.g., see Biawak 2008: 2(1): 6-7). The first, and to our knowledge the only breeding report of *V. melinus* in captivity appeared ten years ago from a private facility (Dedlmar & Böhme, 2000), the offspring of which built up the breeding stock at Cologne Zoo. Thus, with the current breeding report, which is to our knowledge the first breeding of the species in a European zoo as well as the first F2 breeding of the species in general, we intend to encourage further breeding and to add to the scarce knowledge of this beautiful species, which is likely threatened by extinction in its natural habitat.

Breeding Pair

On 15 March 2003, Cologne Zoo received six yearling *V. melinus* from a private keeper in Germany. These animals originated from clutches that hatched on 3 March and 16 April 2002, respectively. Two of these animals made up the breeding stock of Cologne Zoo. In May 2010, at an age of more than eight years, the female measured 395 mm in snout-vent length (SVL) and had a tail length (TL) of 550 mm, whereas the male measured 500 mm SVL and 780 mm TL. All specimens were undoubtedly members of the *V. indicus* group, and assignable to the species *melinus* based on their lack of tail prehensility, with tails laterally compressed towards the tail tip, in combination with a yellow ground colouration with more or less developed dark marbling, the lack of any turquoise or blue colouration, a light pink-colored, tongue, and a low (124-133) midbody scale count (Ziegler & Böhme, 2004; Ziegler *et al.*, 2007).

Housing

For quarantine, we housed the juvenile *V. melinus* individually in large 100 x 50 x 60 cm (length x width x height) glass terraria. The substrate consisted of pine bark. Besides drinking vessels, the quarantine terraria also contained cork pieces and cork tubes for climbing and hiding. Light was provided by fluorescent tubes in combination with basking lamps (60 W) which also supplied ultraviolet light. Photoperiod was approximately 12:12 (light:dark). Ambient temperatures ranged between 26.5 and 32.5° C, with a maximum temperature of up to 40° C directly beneath the basking lamps.

Following the quarantine period, during which one of the juveniles died, the remaining five *V. melinus* were kept in groups of two and three individuals under similar conditions in two 150 x 90 x 80 cm (l x w x h) terraria. During this time, we did not observe any conflicts between the animals.

At the same time, we constructed a large enclosure in the visitor's area of the Cologne Zoo Aquarium (Fig. 1) measuring ca. 300 x 180 x 250 cm (l x w x h). The background and the side walls were covered in a rough and climbable rock surface with elevated resting areas.

Fig. 1. *Varanus melinus* exhibit at the Cologne Zoo Aquarium (2 May 2005). Photograph by **Thomas Ziegler**.

This public enclosure was further equipped with large branches, some plants (*Pandanus*, *Ficus*), cork tubes, and a wooden nesting box for refuge, sleeping, and egg deposition. The substrate consisted of rough pine bark atop a base layer of gravel. The enclosure further provided a large water basin, with a maximum diameter of 120 cm and a depth of 80 cm, for swimming and diving. Light was provided by one HQI basking lamp (400 W), one Osram Ultravitalux basking lamp (300 W), and four Reprolux basking lamps (160 W) which also supplied ultraviolet light, together with four fluorescent tubes. Ambient temperatures in the terrarium ranged from 26.5-33.5° C with a maximum temperature of up to 45° C directly beneath the basking lamps. The minimum water temperature was 27° C; water changes were regularly conducted.

Upon completion of the public enclosure in April 2005, we transferred three of the then three year old *V. melinus* to this exhibit, keeping the remaining two individuals separately in the aforementioned glass terraria behind the scenes, inaccessible to the public. In the large public enclosure, it was obvious that the largest individual occupied the highest resting area. At the time, we also observed scattered aggression between this animal and the smaller inhabitants of the enclosure. On the morning of 18 May 2005, we found one dead *V. melinus* in the water basin of the public enclosure. It showed bite injuries on the head, body, and limbs. The postmortem analysis proved the existence of large cysts in the body cavity and pneumonia. At the time, we could not determine whether these injuries were inflicted on the animal while it was alive or once it was dead. Thus, we transferred one of the two *V. melinus* kept behind the scenes to the public exhibit two months later on 23 July 2005. However, this move proved to be fatal, as this animal was found dead in the public enclosure, with similar, massive bite injuries after just two days. Another death, though not aggression-related, took place on 5 August 2005, unfortunately leaving just two of the six originally received *V. melinus* alive.

In early 2007, a large *V. melinus* pair was donated to the zoo. In May 2010, the male measured 510 mm SVL and 670 mm TL (Fig. 2); together with our breeding male (1280 mm total length), these two specimens currently represent the largest known individuals of the species. Due to the large size of the newly received *V. melinus* pair, we transferred our remaining pair from the public enclosure to a terrarium behind the scenes.

This terrarium, which could be separated into two halves if separation of the the pair was needed, measured 400 x 100 x 150 cm (l x w x h) and was constructed of laminated wood. The substrate consisted of pine bark and the enclosure was equipped with large branches, cork tubes and a 70 L water basin. Light was provided in each unit (200 x 100 x 150 cm) by two T 5 fluorescent tubes (80 W) and two basking lamps (160 W) which also supplied ultraviolet light. Ambient temperatures in the terrarium ranged from 26.5-33.5° C, with a maximum temperature of 45° C directly beneath the basking lamps. For egg deposition, we inserted a natural, hollow tree trunk nest box that measured 80 x 50 x 25 (l x w x h) cm and was half-filled with peat soil, leaves, and a layer of sphagnum moss.

Adults were fed vertebrate prey (mice, fish, or poultry)

Fig. 2. Tongue flicking, large male *V. melinus* (total length 1,180 mm) in the public exhibit depicted in Fig. 1. Photograph by **Rolf Schlosser**.

once a week, and invertebrates, locusts in particular, were usually offered in between weekly vertebrate feedings. Vitamins and minerals were occasionally supplemented by providing minced beef heart mixed with chicken eggs and powdered with Kalkamineral.

Courtship and Egg Deposition

Matings were not seasonally related and took place year round. We observed copulation on the ground, in and on cork tubes, as well as directly underneath the basking lamps. Introducing the sexes together appeared to be the trigger for mating. We separated the male from the female around two weeks after observed copulations. Gestation was more noticeable by an increased and voracious appetite rather than observable increases in body volume.

Signs of egg deposition by the large *V. melinus* pair kept since 2007 in the public exhibit were initially determined by defecated egg shells. From a clutch which must have been laid in the public exhibit in early 2008, we retrieved two eggs on 2 February 2008. However, these eggs showed no signs of development. Unfortunately, the large female kept on public exhibition died on 24 October 2008 at the age of 8.5 years from bacterial sepsis. Thus, besides the large male on exhibit, there remained just the pair received in 2003 housed off exhibit (Fig. 3). Since the large male on exhibit proved to be somewhat aggressive, we decided not to risk the life of our last remaining female by introducing it to this unrelated male. This proved to be the right decision, because the first successful egg deposition occurred roughly eight months later, on 20 June 2009. At that time, the parents were seven years and two months and seven years and three months old, respectively. The clutch comprised nine eggs (Fig. 4), and was deposited in the above described natural tree trunk half-filled with peat soil, foliage and a layer of sphagnum moss.

Just three months after deposition of the first clutch, a second clutch consisting of five eggs was laid on the 10 September 2009. Three months after the second clutch was laid, a third clutch must have been laid in

mid December 2009, evidenced by four discarded egg shells.

Egg Incubation and Hatching

For incubation, eggs were removed from the terrarium and carefully placed in plastic boxes which were half-filled with an incubation medium of vermiculite and sand at a ratio of 2:1 by volume (Table 1). The eggs were not turned, and were placed on the surface of the vermiculite. To guarantee saturated air humidity, we covered the opening of the incubation boxes with plastic sheeting, which also protected the eggs from intrusive pests such as flies and cockroaches. For ventilation, the plastic sheeting was removed at least once a week. Two eggs from the first clutch showed no signs of development, and were discarded after a few days. Of the remaining seven eggs, one showed a conspicuous,

Fig. 3. The breeding pair of *V. melinus* that produced the F2 offspring: A) sire (total length 1,280 mm); B) female (total length 945 mm). Photographs by **Detlef Karbe**.

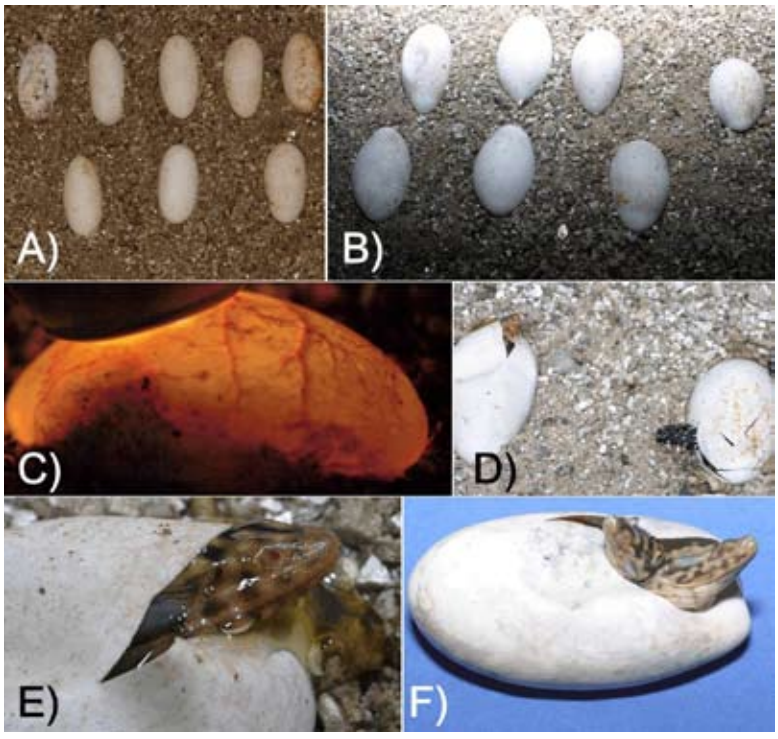

Fig. 4. Eggs and hatchlings of *V. melinus* at the Cologne Zoo Aquarium: A) eggs four days after deposition (24 June 2009). Photograph by **Detlef Karbe**; B) eggs few days before hatching. Photograph by **Thomas Ziegler**; C) candled egg at 157th day of incubation (24 November 2009). Photograph by **Detlef Karbe**; D) hatchlings on 30 November 2009. Photograph by **Thomas Ziegler**; E) close up of hatchling (30 November 2009). Photograph by **Thomas Ziegler**; F) conjoined twins (1 December 2009). Photograph by **Thomas Ziegler**.

Table 1. Egg measurements of the first six successfully hatched *Varanus melinus* immediately before hatching.

Egg Length (mm)	Egg Width (mm)
54.0	35.0
56.3	36.0
58.6	34.0
47.1	34.0
52.9	32.0
55.3	34.0

Table 2. Egg shell measurements of the last two successfully hatched *Varanus melinus* (animals 7 and 8) immediately after hatching.

Egg Shell Length (mm)	Egg Shell Width (mm)
52.0	32.0
64.5	32.6

Table 3. Snout-vent length (KRL), tail length (TL), total length (ToL) and weight of the first six hatchlings of *Varanus melinus* measured shortly after hatching (3 December 2009).

SVL (mm)	TL (mm)	ToL (mm)	Weight (g)
115	157	272	33
112	158	270	34
111	165	276	33
109	157	266	34
116	163	279	35
115	166	281	35

persistent dent on 26 November 2009.

On the morning of 30 November, we recognized the first slit on one of the non-dented eggs. Shortly thereafter, the snout and a leg protruded from the egg. By the afternoon of the same day, a total of three eggs showed slits, and the juveniles were occasionally seen circling inside their lacertated eggs. On the morning of 1 December 2009, after 164 days of incubation at a temperature of 29° C, the first juvenile emerged. The second hatchling emerged some hours later, during the night. The third emergence was observed in the morning of the following day. At that time we also carefully opened the conspicuously dented egg. Contained within this egg, which then measured 55.2 x 31.0 mm, were dead conjoined twins. The twins were well developed, and conjoined at the head and abdominal region. Two additional juveniles hatched after 165 days of incubation on the morning of 2 December 2009. The sixth and final juvenile of this clutch hatched one day later, on 3 December. All six juveniles proved to be healthy and strong (see Figs. 4-7, Table 3).

Concerning the second clutch (see Table 2), we removed two eggs which showed no development on 28 October and 20 December 2009. Of the remaining three eggs, the first hatched on 21 February 2010, after 164 days of incubation. The second emergence took place one day later, and the third egg, which measured 57.9 x 33.9 mm, was manually opened on 3 March 2010, and contained a well developed, but dead juvenile with an open abdomen (with protruding internal organs) and a slightly malformed cranium.

Development

The six juveniles from the first clutch were transferred to an upbringing terrarium measuring 60 x 100 x 75 cm (l x w x h). The two juveniles from the second clutch were transferred to a terrarium measuring 60 x 60 x 70 cm (l x w x h). These upbringing terraria were constructed of glass and were equipped with several branches, cork and bamboo tubes, plants (e.g., *Ficus*) and drinking vessels. The substrate consisted of pine bark pieces, and misting with rain water was provided daily. Light was provided by T5 double fluorescent tubes and two basking lamps (160 W) which also supplied ultraviolet light. Ambient temperatures of 26.5-32.5° C were provided by light sources with a maximum temperature of up to 40° C directly beneath the basking lamps.

After four to five days, the hatchlings were first offered house crickets, which were refused until after the tenth day. A few weeks later, we offered baby mice. At this time, the diet consisted of invertebrates such as house crickets (*Acheta domesticus*), and locusts which were offered every other day, with baby mice offered from time to time. The juvenile *V. melinus* proved to be such voracious feeders that care was taken not to over-feed them. Thus, individuals were only fed with forceps to guarantee equal amounts of food. Nevertheless, some individuals grew somewhat faster than others, which may be related to sex or hierarchy.

On 18 May 2010, we transferred four juveniles from the first clutch at the age of about 5.5 months to an exhibit in the visitors area measuring 165 x 140 x 120 cm (l x w x h). Terrarium composition and climate was similar to the conditions previously described. By this stage,

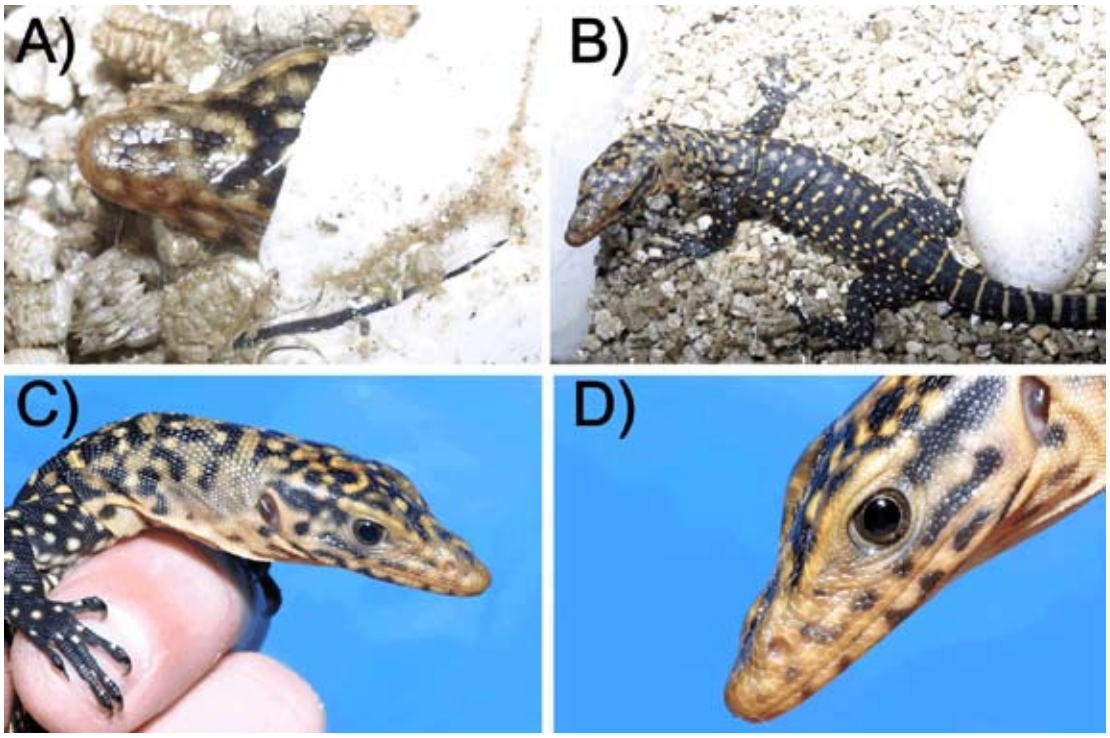

Fig. 5. First hatchling of *V. melinus* at the Cologne Zoo (1 December 2009) during A) hatching process (the egg tooth is well visible), and B-D) shortly after emerging from the egg. Photographs by **Thomas Ziegler**.

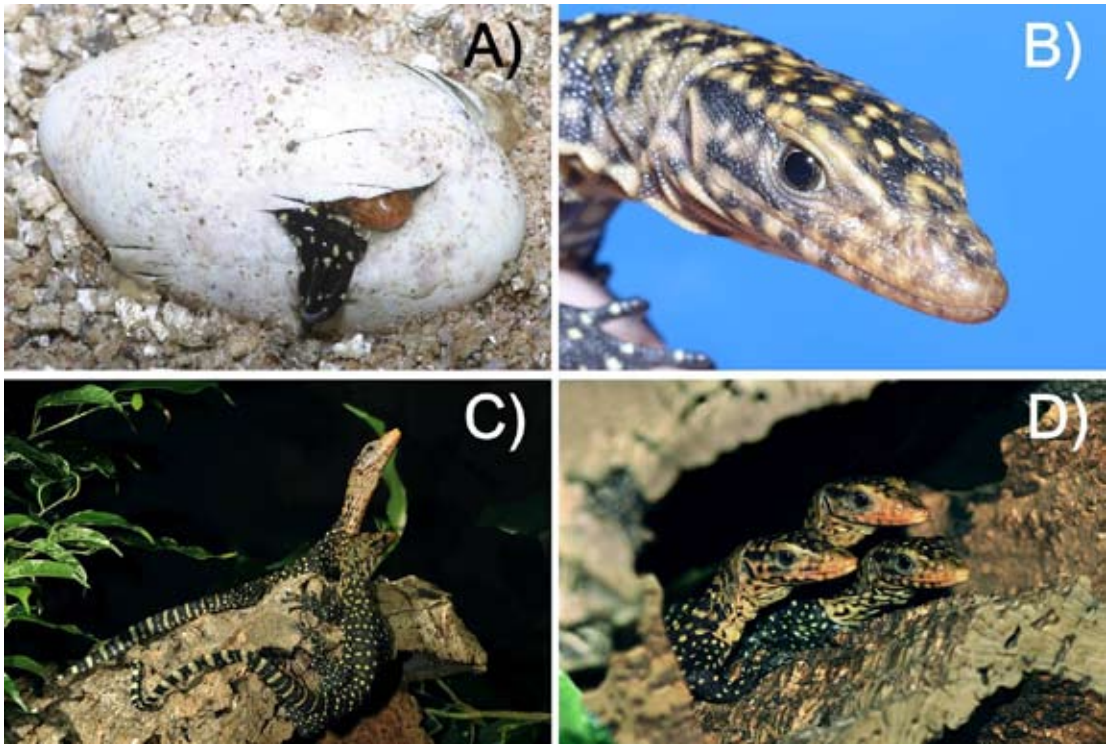

Fig. 6. A-B) Another hatchling of *V. melinus* (2 December 2009). Photographs by **Thomas Ziegler**; C-D) juvenile *V. melinus* at a few months old. Photographs by **Rolf Schlosser**.

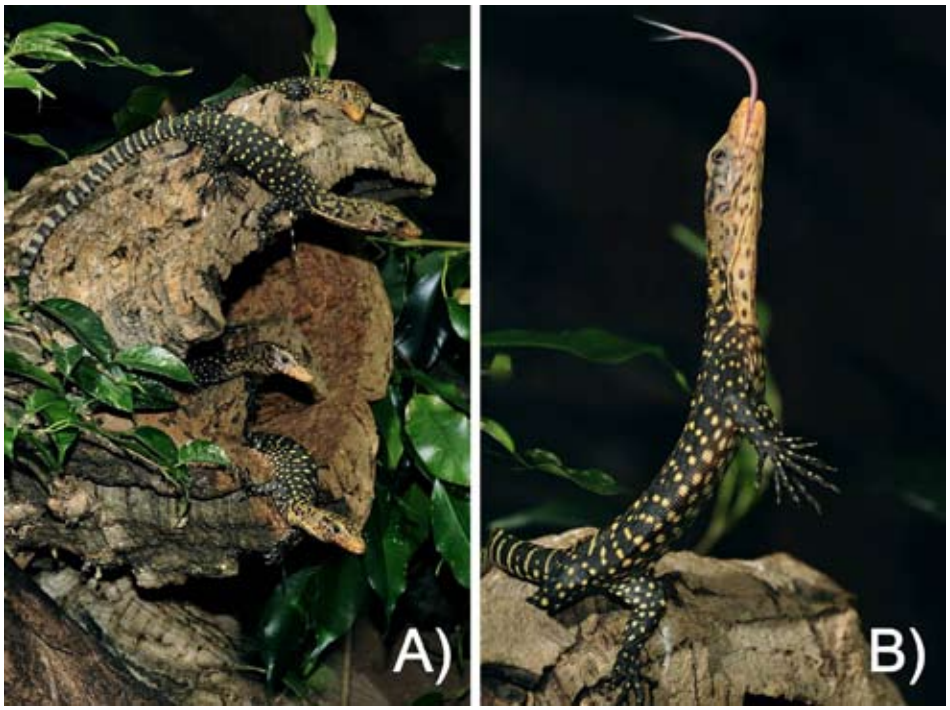

Fig. 7. A-B) Juvenile *V. melinus*. Photographs by **Rolf Schlosser**.

the juveniles had noticeably grown, and were about 1/3 longer and heavier than at the time of hatching (Table 4). The typical color pattern change between juvenile and adult stages had also started (Figs. 8-9). The black dorsal pattern was reduced to thin markings surrounding the dorsal ocelli. These thin black borders around the ocelli further reduce with age and sometimes lead to irregular black reticulation patterns. We also observed that the head and neck regions on our 5.5 month old juveniles started to become distinctly yellow. At this stage, the venter was grey-brown, with numerous light ocelli. The throat pattern consisted of some elongate dark blotches, which were marginally fused in part to longish stripes.

Ziegler & Böhme (2004) indicated the lack of dark temporal stripes as one of the diagnostic features of adult *V. melinus*. However, due to our current knowledge based on observations of a number of captive specimens, dark blotches behind the eyes that may be fused to a more or less temporal stripe-like shape may exist in some individuals.

Table 4. Total length (ToL) and weight of the first six hatchlings of *Varanus melinus* measured on 18.5.2010, at an age of about 5.5 months.

ToL (mm)	Weight (g)
370	46
375	50
395	55
375	45
370	41
380	47

Discussion

According to Lemm (1998), *V. melinus* females have cycled in captivity in both private collections and zoos, although eggs have been infertile. The first successful captive breeding of the species was reported by Dedlmar & Böhme (2000). To our knowledge, this remains the only published reproduction report for *V. melinus*. According to Dedlmar & Böhme (2000), one pair yielded four clutches consisting of 2-7 eggs each (mean 4.8) which were deposited at intervals of 3.5-8 months (mean 5.2). After 168-171 days of incubation (mean 170) at 28.5° C, five juveniles hatched from a single clutch containing six eggs measuring 65-67 mm (mean 66 mm) x 23-27.5 mm (mean 26 mm) in size. Hatchlings measured 210-225 mm in total length (mean 216 mm), with a weight of 21-23 g (mean 22 g).

In comparison with Dedlmar & Böhme (2000), the maximum clutch size of *V. melinus* at Cologne Zoo was slightly larger (9 versus 7). Maximum clutch sizes of up to 12 eggs are known for the species (Ziegler & Böhme, 2004). The incubation temperature at Cologne Zoo was 0.5° C higher than that used by Dedlmar & Böhme (2000), and thus, hatchlings at Cologne Zoo hatched 2-

Fig. 8. Young *V. melinus* 5.5 months after hatching (18 May 2010) with a total length of 370 mm and a weight of 46 g; the pattern is distinctly beginning to brighten up. Photograph by **Detlef Karbe**.

Fig. 9. Release of ca. 5.5 month old *V. melinus* into their public exhibit at the Cologne Zoo Aquarium (18 May 2010). Photograph by **Detlef Karbe**.

7 days earlier. The minimal interval between clutches at Cologne Zoo was roughly three months (versus 3.5 months in Dedlmar & Böhme 2000); however, the clutch size after this three month interval at Cologne Zoo was distinctly smaller than that of the previous clutch (5 versus 9 eggs). Hatchlings at Cologne Zoo were also larger (mean total length 274 mm versus 216 mm) and heavier (mean weight 34 g versus 22 g) than those reported by Dedlmar & Böhme (2000), although the Cologne Zoo female was slightly smaller (total length 945 mm versus 950 mm).

With respect to the conjoined twins, twinning has only been reported for nine species of varanid lizards, of which three (*V. indicus*, *V. kordensis*, and *V. macraei*) belong to the subgenus *Euprepiosaurus* (see overview in Mendyk, 2007). This represents the first case of conjoined twins in *V. melinus*, which will be dealt with in detail separately. Although we have contacted several experts, we failed to find an appropriate research method or technique to determine the cause of the conjoined twinning (e.g., genesis by chance versus inbreeding). Of course, it would have been better to pair together unrelated adults; however, due to the limited number of adult animals available at the time, and due to our

previous keeping record and loss of specimens (e.g., due to unfortunate pairings), we did not want to risk the health of additional specimens. At this time, we do not know cause for the conjoined twins or the dead, slightly malformed juvenile from the second clutch. Despite these problems, eight healthy juveniles emerged from both clutches at the Cologne Zoo Aquarium which are strong and developing well.

When further critically reviewing our breeding success, attention should be paid to removing eggs from the terrarium immediately after deposition, so that no damage to the eggs by the mother (e.g., ovophagy) can occur. Although Dedlmar & Böhme (2000) did not observe any aggressive behavior when introducing their breeding pair, we could show that the compatibility of animals should be tested and carefully observed. Of the six *V. melinus* received by the Cologne Zoo in 2003, only two survived. However, both remaining specimens proved to become a stable breeding pair which has produced eight sound offspring to date, all of which will hopefully mature and be able to contribute on their part to captive conservation breeding projects.

Outlook

Of the nearly 70 currently recognized species of monitor lizard, ten have been discovered in just the past decade. Especially diverse are the mangrove and emerald tree monitor lizard groups, which are currently comprised of 22 species in total, of which 64% have been discovered in the past twenty years. Many of these species are known only from a few museum specimens, and virtually nothing is known about their natural history. Since we are only able to protect what is well known to us, there is a high demand for ecological research. Because many monitor species live in remote and difficult to access habitats, ex situ studies also become important. Thus, the zoo community can contribute towards a better understanding of the natural history of monitor lizards. Through captive husbandry and breeding, important data can be obtained for further captive conservation efforts. Building up a zoo population based on captive bred animals may also someday serve as a basis for reintroduction, particularly when species like *V. melinus* are concerned, which seems to have a very restricted geographical distribution. Thus, juvenile *V. melinus* will be raised at Cologne Zoo with some of them provided to other accredited zoos with reptile breeding/conservation projects for starting a captive breeding program.

It will be crucial to combine aforementioned ex situ efforts based on sustainably-acquired, captive bred animals with in situ research, such as studies of the species' habitat requirements and estimations of the remaining population size. The trial of the German Federal Government to elevate the species to CITES Appendix I status was unfortunately dismissed (with the justification "data deficient") at the Nairobi CITES Conference some years ago.

Facing the recently published, alarmingly high numbers of wild-caught *V. melinus* (Weijola & Sweet, 2010), one really seriously wonders why such an enigmatic flagship species for beautiful, diversity-rich, and still largely unknown Indonesian island ecosystems is left abandoned to its fate.

It is really high time to conduct population analyses (and that such research is supported and commissioned, respectively). Given that the wild-caught numbers provided by Weijola & Sweet (2010) are affirmed in the near future and thus the natural population has in fact drastically declined, adequate conservation measures must urgently follow (i.e., habitat protection, strict export quotas, possibly population reinforcement), if it is not already too late.

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A Remarkable Feeding Behavior and a New Distribution Record of *Varanus salvator salvator* (Laurenti, 1768) in Eastern Sri Lanka

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Abstract- We describe a unique feeding behavior of *Varanus s. salvator* observed within Lahugala National Park, Sri Lanka. The lizard was observed lashing its tail quickly from side to side while submerged in a shallow waterhole, which displaced water and fishes from the waterhole onto the land. More than 30 fishes were expelled onto the land, of which many were subsequently consumed by the monitor. This observation highlights the significance of isolated waterholes in the dry zone to sustain wildlife populations during the dry season, and represents a new distribution record for *V. s. salvator* in eastern Sri Lanka.

Introduction

Varanid lizards (Genus: *Varanus*) in Sri Lanka are represented by *V. bengalensis* Daudin, 1802 and *V. salvator salvator* Laurenti, 1768 (Das, 2001; Deraniyagala, 1944). Both species are common in Sri Lanka as well as in neighboring India (Daniel, 2002; De Silva, 1998). The water monitor, *V. s. salvator*, as implied by its common name, prefers aquatic habitats and is widely distributed throughout Sri Lanka in wet, dry, and intermediate zones up to elevations of about 1000 m (De Silva, 1996; Gaulke & De Silva, 1997; Karunarathna *et al.*, 2008b). Generally, *V. s. salvator* reaches a total length of over 2 m and is primarily diurnal by habit, active between 0700-1700 h (Wikramanayake & Dryden, 1993). *Varanus s. salvator* are useful as pest control agents, despite being categorized as scavengers that mainly feed on animal carcasses (Das & De Silva, 2005; Deraniyagala, 1953; Rathnayake, 2001).

Many different feeding behaviors have been described in varanid lizards (e.g., King & Green, 1993; Horn, 1999; Pough *et al.*, 2004; Traeholt, 1993, 1994). Here we describe an unusual feeding behavior in *V. s. salvator* which is markedly different from those previously described for varanids.

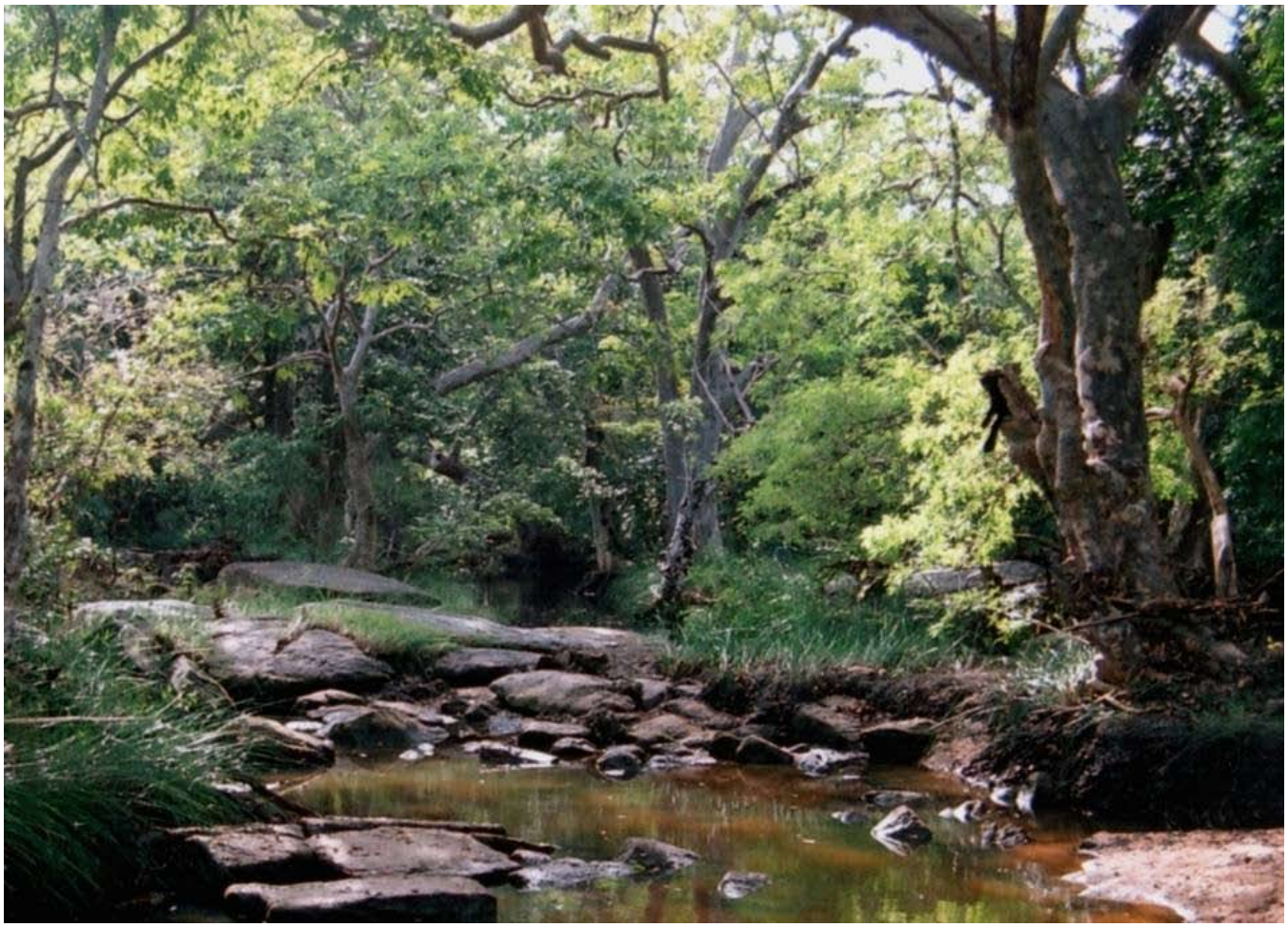

Fig. 1. Isolated waterhole in Lahugala National Park during the dry season.

Field Observation

The following observation was made in Lahugala National Park, located in the low country dry zone of Sri Lanka (81°42'10" E; 06°54'21" N), at 1120 h on 12 November 2005. The park belongs to Lahugala divisional secretariat division of Ampara District (Somasekaran, 1988). The mean annual temperature at Ampara, recorded from the closest meteorological station, is 29.8 ^{o}C, and relative humidity averages 64%, with the highest humidity levels recorded in December (Meteorological Dept. Data, 2010). The annual rainfall of the area is ca. 100–150 cm (Somasekaran, 1988). The vegetation of the site can be classified as tropical dry mixed evergreen forest (Gunatilleke & Gunatilleke, 1990), dominated by *Terminalia arjuna* (kumbuk), *Diospyros ebenum* (kaluwara), *Drypetes sepiaria* (weera) and *Manilkara hexandra* (palu) trees (Fig. 1). Three small waterholes were present at the field site, measuring ca. 200 x 100 x 30 cm, 400 x 200 x 30 cm, and 300 x 200 x 30 cm (length × width × depth).

A sub adult male *V. s. salvator* measuring approximately 60 cm in SVL, with a total length of ca. 1.5 m (Fig. 2), was first observed walking towards one of the shallow waterholes, which it then settled itself into. The lizard began rapidly waving its laterally compressed tail side to side, displacing water and some small fishes out of the waterhole (Fig. 3). After performing this behavior for about five minutes, more than 30 fishes, identified as catfish (*Mystus* sp. and *Heteropneustes* sp.), barbs (*Puntius* sp.), and climbing perches (*Anabas testudineus*) (Maduranga, 2003; Pethiyagoda, 1991), had been expelled onto the land. The monitor crawled out of the waterhole and consumed more than 10 fishes varying in size between 10 and 15 cm in length. Interestingly, it seemed to prefer *Puntius* and *Heteropneustes*, but ignored *Mystus*.

Discussion

Upon review of existing literature, we failed to find any reference to this interesting and unusual feeding

Fig. 2. Sub adult *Varanus s. salvator* in Lahugala national park (total length ca. 1.5 m).

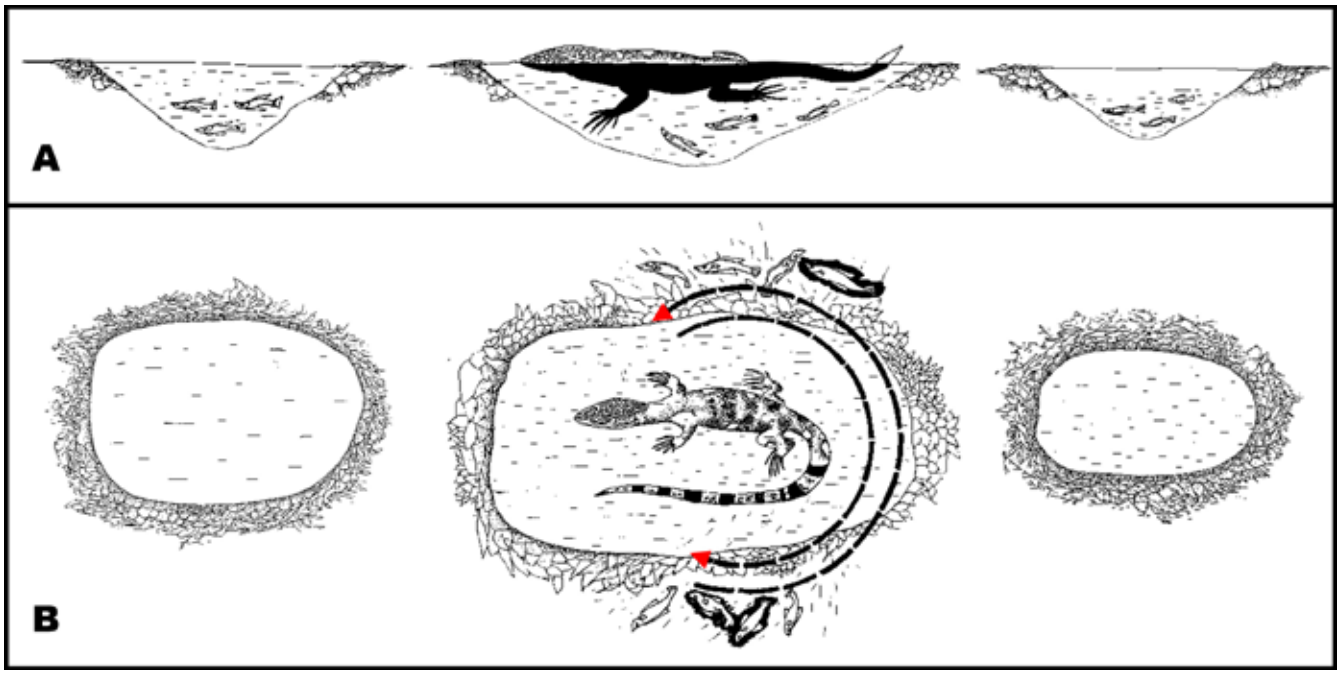

Fig. 3. Sketch of the water holes and fish feeding behavior of *Varanus s. salvator* in Lahugala: A) lateral view and B) dorsal view of three small waterholes. Red arrows indicate the direction of tail movements.

behavior in *V. salvator* or any other varanid (Cota *et al*., 2008; Deraniyagala, 1953; De Lisle, 2007; Halliday & Adler, 2002; Horn, 1999; Khan, M. 1969; Pough *et al*., 2004; Rathnayake, 2001; Smith, 1935; Somaweera & Somaweera, 2009; Traeholt, 1993, 1994). Hermes (1981) and Keith & Ginsburg (2010) described fish capturing behaviors in *V. mertensi* and *V. niloticus* which remind us of our own observation. In both of these species, the tail was curled into the shape of the letter C and used to corral fish in the shallows, making them easier to capture (Hermes, 1981; Keith & Ginsburg, 2010). This behavior is similar to the one reported here for *V. s. salvator*, in that both behaviors employed use of the tail to take advantage of fish trapped in shallow pools. However, since the tail was used in our own observation to expel fish from the water rather than trap them, we can conclude this new feeding behavior in *V. s. salvator* is very distinctive from that used by *V. mertensi* and *V. niloticus*.

This observation also happens to be a new distribution record for *V. s. salvator* in Sri Lanka, extending its range to the Lahugala area. Somaweera *et al.* (2004) have sighted *V. s. salvator* from Panama, ca. 20 km south-east of Lahugala, but Somaweera & Somaweera (2009) state that it is very rare in eastern parts of the country. We also conducted several field trips to Panama in search of *V. s. salvator*, but failed to locate any specimens. Whitaker & Whitaker (1980) and other scientists (Somaweera & Somaweera, 2009), report that the species is absent from the south-eastern coast, and Somaweera & Somaweera (2009) noted that this species was not found east of the Walawe river. *Varanus s. salvator* is absent from Yala National Park complex, probably due to the high abundance of crocodiles (De Silva & De Silva, 2004; Somaweera & Somaweera, 2009), and it is also absent in areas subject to drought that are frequented by wild boar which are believed to prey upon hatchlings and juveniles (Deraniyagala, 1953). Recent work conducted by Bambaradeniya (2001) recorded *V. s. salvator* in Bundala National Park, and a larger population was reported from Rathgama area in Galle district (Amarasinghe *et al.* 2009).

According to the surveys we have carried out interviewing villagers in these areas, 96% of villagers have not seen this species in past 20 years (Fig. 4). Hence, this account does not only represent an unusual behavioral observation, but also a significant site record of the species. It also emphasizes the importance of isolated waterholes as a food source for *V. s. salvator* during the dry season. Although *V. salvator* is largely known as a scavenger, it is quite capable of capturing live prey (Amarasinghe *et al.* 2009; Das & De Silva, 2005; Deraniyagala, 1953; Karunarathna *et al.* 2008a; Pough *et al.* 2004; Rathnayake, 2000; Rathnayake,

Fig. 4. Wetland habitat surrounding Lahugala village during the wet season.

2001; Smith, 1935; Somaweera & Somaweera, 2009; Uyeda, 2009). The monitor's avoidance of *Mystus*, which is probably due to its spiny exterior (although Karunarathna *et al.* (2008a) report a case of predation on a large fish with sharp and spiny fins), suggests that *V. s. salvator* may be capable of discriminating between favorable and unfavorable prey items of a similar type. However, we recommend further detailed studies on the feeding behaviors of commonly distributed *V. s. salvator* in Sri Lanka.

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Human Food Scrap Ingestion in Two Wild Lace Monitors *Varanus varius*

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Abstract – Monitor lizards are known for being both predators and scavengers in their search for food. Their ability to be opportunistic is clearly demonstrated where large species live in close proximity to humans and take advantage of any food that may be accessible. In some situations this habit can be detrimental to the health of monitor lizards, and in some cases may lead to a slow and agonizing death. This record illustrates the risk food scraps can pose to monitors accessing non-natural food items in camping areas and picnic grounds, and highlights the need for the proper disposal of food waste, utensils and other waste items in areas where they may be accessible to wild animals.

Introduction

The lace monitor, *Varanus varius,* is common along the east coast of Australia and prefers well-timbered habitat (Wilson, 2005). Subsequently, in national park and recreational areas including picnic and camp grounds, there is indirect interaction between people and monitors. Monitor lizards exhibit both predatory and scavenging behavior (Wilson, 2005) and are generally reported to feed on birds, mammals, reptiles, insects, vertebrate eggs and carrion (Weavers, 1989; Guarino, 2001). Both visual and olfactory cues play an important role in prey detection.

Varanus varius often frequent picnic and camp grounds in search of human food scraps, particularly coinciding with weekends and public holidays where human use of these areas is highest (Fig. 1). Not surprisingly, the number of monitor lizards is often influenced by the presence of human food scraps and it is not unusual to have multiple monitors foraging within a single picnic area. Some specimens even climb tables and chairs or enter tents, all in the presence of humans (Fig. 2; pers. obs.). Conversely, *V. varius* that are not regularly exposed to people become wary, and routinely retreat up trees if disturbed.

Unnatural food items are a potential health hazard to monitor lizards, as they are for many other wild animals. Multiple complications such as gastrointestinal blockages, perforations, suffocation and poisoning can occur when these items are eaten. Freshly cooked bones and plastic bags containing meat are particularly attractive to carnivorous species such as monitor lizards and are commonly discarded in picnic areas. If food items are found by a monitor lizard, they will often try to ingest them whole, as they would with natural prey. If discarded bones are large, have sharp points, or are unusually shaped, complications with ingestion may occur. Little scientific information is published on this subject, and it is hopeful that the case studies presented herein will assist with public awareness on this issue.

Fig. 1. *Varanus varius* basking at a pinic ground. Rainbow Beach area, southeast Queensland.

Fig. 2. This scavenging *V. varius* is searching for an entry point into a tent in the presence of humans. Southeast Queensland.

Observations

Case 1

On 31 December 2009, a 1.9 kg *V. varius* was presented for veterinary assessment after being collected from the Teewah Beach area, Queensland, Australia with a sharp bone protruding from its throat.

On presentation the animal was active and alert, but extremely dehydrated and emaciated. The throat of the animal was severely distorted by a large, hard, bony mass. Approximately 6 cm of bone protruded through the skin on the right side of the neck and two wounds over part of the hard mass were visible on each side of the neck (Figs. 3 & 4). Tissue fibrosis had formed around the wound; however, no other injuries or overt sign of disease were identified. It was presumed that the monitor's emaciated state was due to lack of food intake resulting from the oesophageal obstruction. The animal was anaesthetized to facilitate removal of the object.

Once anaesthetized, further investigation of the mass and an oral examination revealed the object to be a large bone from a T-bone steak, the longest portion of the bone measuring approximately 16 cm. Surgical bone cutters were used to remove the protruding end of bone, while the rest was manipulated and removed via the mouth.

Fig. 3. Bone from T-bone steak in situ.

Fig. 4. Approximately six cm of bone protruding through skin on the right side of the neck.

The oesophagous was inspected thoroughly for signs of damage and the oesphageal mucosa thoroughly debrided, flushed with antiseptic solution and sutured closed. The external skin wounds were similarly treated. There appeared to be no damage to the bony and cartilaginous structures of the throat.

Antibiotic and fluid therapies were instituted, and food and water withheld for 24 h. The animal also received an injectable deworming solution at the time of the procedure.

Twenty four hours after surgery, the monitor was offered a small amount of food in the form of defrosted rodents, which it ingested without complication; increasing amounts of food were offered over the next week. The monitor ate extremely well in captivity and remained in care for a further four weeks, allowing it time to recover fully before successfully being released.

Case 2

A 4.5 kg *V. varius* was presented for veterinary assessment on 26 January 2010 after picnic goers in Noosa National Park, Queensland observed it ingesting a plastic fork which had a piece of meat attached.

The monitor was extremely alert and active on presentation and required general anaesthesia for examination. Palpation of the cranial abdomen revealed a firm mass in the stomach region. Further examination included radiographs which did not clearly define the palpable mass in the cranial abdomen.

No treatment was instituted, and within 24 h. the monitor regurgitated food scraps and a single plastic fork. The animal remained extremely active and was released 24 h later.

Discussion

The only other documented record of food scrap ingestion of this nature in a monitor applies to a *V. panoptes* at Lichfield National Park, Northern Territory. This animal was found in an advanced state of decay with three wooden barbeque skewers located approximately where the stomach would have been (Trembath & Freier, 2005).

Beaches and national parks are popular camping and picnicking spots for locals and tourists, with wildlife being one of the main attractions. Unfortunately, however, there is a common interaction between humans and wildlife involving unnatural food items. Presented here are vivid examples of how animals can be impacted by ingesting inappropriate items, which highlight the need for secure and proper rubbish disposal.

In order to increase awareness amongst the scientific and public arenas on the danger unnatural food item ingestion poses to wildlife, we encourage readers to publish their records relating to such matters.

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Husbandry and Reproduction of *Varanus glauerti* in Captivity

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Abstract- This article describes the successful breeding of *Varanus glauerti* in captivity. In 2010 a breeding pair laid four consecutive clutches totaling 24 eggs. Eighteen eggs have successfully hatched to date and three eggs remain incubating at the time of this writing.

Introduction

Described by Mertens in 1957, *Varanus glauerti* is a small (ca. 60-70 cm in total length) rock- and tree-dwelling monitor lizard indigenous to northern Australia. Due to its beautiful coloration and overall appearance, *V. glauerti* is populair in captivity. Successful incubation of its eggs can be difficult; however, an increasing number of specimens are being kept and bred in Europe. Despite its growing popularity in captive collections, few reports on the husbandry and breeding of *V. glauerti* exist (Retes & Bennett, 2001; Bedford, 2005; Husband & Bonnett, 2009). This report seeks to contribute to what is currently known about the captive management of *V. glauerti* by providing details on its husbandry and reproduction.

Acquisition and Husbandry

A female *V. glauerti* (Fig. 1) hatched in December 2008 by a Swedish breeder was obtained in March 2009 as an unsexed juvenile. A young sub-adult male (Fig. 2) hatched by a German breeder in November 2008 was acquired in September 2009. The pair was introduced together in September 2009 to a wooden enclosure measuring 190 x 100 x 105 cm (length x width x height), with a 15 cm deep substrate comprised of sand and humus at a ratio of 3:1 (Fig. 3). Cork tiles were affixed to the walls and the enclosure was furnished with many branches and hollow cork logs. Ambient temperatures ranged between 26-32° C and two basking spots ranging from 45-55° C were provided by outdoor Philips par38 80W lamps and a Megaray 120W lamp. Additional

Fig. 1. Adult female *Varanus glauerti*.

Fig. 2. Adult male *V. glauerti*.

lighting was provided by a Truelight 38w TL. To maintain adequate humidity levels of around 60-80%, the enclosure was misted twice a week.

The pair was fed three times a week, mainly with crickets (*Gryllus assimilis*), roaches (*Blabtica dubia*), and occaisonly sub-adult mice. Crickets and roaches were gutloaded and dusted with a mineral supplement.

The pair showed no noticeable signs of aggression and were very tolerant of eachother, seen basking together on many occasions.

Beginning in late October 2009, the photoperiod was slowly decreased from 12:12 to 8:16 h and the enclosure was kept a bit drier than usual. In early January 2010, the photoperiod was slowly adjusted back to 12:12 h and the enclosure was sprayed heavily twice a week.

A nest box constructed of an opaque plastic box measuring 50 x 30 x 35 cm (l x w x h) was placed in the enclosure in December 2009. A plywood sheet with an access hole 40 mm in diameter served as the lid of the nest box. Inside, the substrate was comprised of a slightly moistened mixture of sand and humus at a ratio of 1:1 by volume. A 7W heat mat was placed beneath one corner of the nest box for additional heating.

Courtship, Copulation and Nesting

Courtship and mating were first noticed in late January 2010. The male approached the female multiple times while frequently tongue-flicking the female's body. Although the female was not interested in the male's

Fig. 3. Vivarium housing an adult pair of *V. glauerti*.

advances for the first few days, the male persistently followed the female around the enclosure until the female finally accepted mating. Copulation occurred several times a day for about three days.

A few days after copulations had ended, the female's abdomen began to increase in size, and over the following week, substantially increased its food intake, which consisted predominately of *B. dubia* and sub-adult mice offered every other day. One week after the last observed copulation, the female began digging throughout the enclosure, searching for a nest site. The nest box was quickly discovered, and a dozen test holes were made in it. Two weeks after copulations had ceased, the female could be seen basking for extended periods of time throughout the day and began to refuse food more frequently, stopping altogether a few days prior to oviposition. In the final week prior to nesting, the female was frequently seen hanging vertically from the cork tiles.

Eight eggs were laid by the female around 22 February 2010, but were not found until approximately two days after their suspected laying date. The eggs were buried deep in a corner of the nest box above the heat mat at a temperature of 28.8° C (Fig. 4), and were removed as quickly as possible for artificial incubation. Removal of the eggs caused considerable stress for the female, since she inspected the nest box for several hours after they were removed.

In the week following egg deposition, the female consumed an enormous amount of food, primarily sub-adult mice and *B dubia*. The mice were injected with a water/calcium solution to provide additional water and calcium to improve the female's strength. One week after oviposition, the pair began to copulate again. On 23 March 2010, exactly 22 days after the first day of mating, the female laid a clutch of four eggs. Unlike the previous reproductive event, the female did not refuse any food during gravidity.

Two successive clutches of nine and three eggs were laid on 18 April and 21 May 2010, respectively. The female refused food approximately one week prior to nesting for the third clutch, but not for the fourth. Since food was refused for eight and nine egg clutches and not for clutches of three or four eggs, the female's feeding patterns while gravid may be influenced by clutch size. To prevent exhaustion and calcium depletion, the female was separated from the male and housed individually following the fourth consecutive clutch. The pair will be reintroduced in late 2010.

Incubation and Hatching

Upon their retrieval, each clutch was placed in a 4.5 l plastic container for incubation with the eggs partially buried in perlite. The perlite was first sifted to remove any dust, and then baked for 2.5 h at 250° C in an oven to eliminate any residual moisture. Once dried, the perlite was then mixed with water at a ratio of slightly less than 1:1 by weight. The containers were placed in a homemade incubator modified from a refrigerator and maintained between 28.5 and 29.5° C. Initially, the containers were vented twice a week for oxygen exchange; towards the end of incubation, the containers where vented daily.

Two eggs from the first clutch and one egg from the third were discarded within the first few weeks of incubation. Eggs from the first clutch also started to dent mid-incubation. These dented eggs where moved towards the sides of the incubation container and buried deeper in the perlite, which allowed them to take on more humidity from the substrate. These eggs also began

Fig. 4. Clutch of *V. glauerti* eggs deposited in the nest box.

Table 1. Egg and hatchling data for *Varanus glauerti*. Data represent measurements taken from one egg and hatchling from each clutch. All eggs were incubated at 28.5-29.5 °C.

Clutch No.	Gestation (days)	No. Eggs	Egg Length (cm)	Egg Weight (g)	Incubation Period (days)	No. Hatchlings	Hatchling Weight (g)	Hatchling SVL (cm)	Hatchling TL (cm)
I	~21	8	-	-	104-105	6	2.3	5.6	9.1
II	~21	4	2.8	6.6	107-109	4	3.6	6.3	9.5
III	~21	9	2.9	7.2	108-110	8	4.2	6.7	10.1
IV	~21	3	3	6.9	*	*	*	*	*

* *currently incubating*

to dent two weeks prior to hatching; however, this time no action was taken. The most dented egg from the first clutch was the first to pip on 7 June 2010; all other eggs started to pip within 24 hours.

Eggs from the second and third clutches grew slowly in size for around the first 3/4 of incubation, then began to lose some volume and eventually dented a few days prior to hatching.

Once pipped, the eggs where moved to another container where the hatchlings remained in their eggs for ca. 24 h to absorb their yolk sacks before emerging. Interestingly, there was a strong odor of ammonia when the third clutch pipped that wasn‘t noticed in the first two clutches. Upon emergence, one hatchling from the first clutch had a large yolk sac which was not absorbed. The yolk sac was tied off close to the body with wire and then cut with scissors. This animal was kept in a small container inside the incubator for ca. 72 h, and was then later placed in the same enclosure as its siblings, where it has grown and developed well.

Husbandry of Hatchlings

After emerging from their eggs (Fig. 5), the

Fig. 5. Recently-hatched *V. glauerti* offspring.

Fig. 6. Captive-bred *V. glauerti* offspring at 2 months in age.

hatchlings were kept in the incubator for ca. 48 h, and then transferred together to wooden enclosures measuring 60 x 40 x 40 cm (l x w x h); each enclosure housed no more than four hatchlings. Paper towels were used as a substrate for the first two weeks, which were then replaced with cypress mulch. The enclosure was simply furnished, with only a stack of wooden boards beneath the basking spot and a plastic hide box on the cool side (Fig. 6). The ambient temperatures were kept between 28-32° C, with a basking spot of 55° C on the surface of the wooden boards. Basking temperatures were provided by a 25W e27 Philips spotlight, and a 23w Nambia terra UV-plus D3 compact lamp provided UV-B and additional lightning. The hatchlings were noticeably active when there was a higher humidity, so the enclosures were misted daily.

The hatchlings began feeding after a week, primarily on small crickets and chopped sub-adult mice. They remained extremely shy and could not be observed eating during the first month. However, after a month, they became less wary and could be seen chasing and eating crickets throughout the enclosure.

One of the four hatchlings from the third clutch died unexpectedly 22 days after hatching. The belly was abnormally-colored, which might suggest an infection of the umbilical tissue. All other hatchlings from the three clutches developed normally, and there were no signs of dehydration or picky feeders.

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