REPTILE RAP

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An observation on suspected death of Indian Rock Python (*Python molurus molurus*) because of Jungle Cat (*Felis chaus*)

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Pythons are known to feed on a variety of mammals, birds and reptiles including frogs, toads, monitor lizards, poultry, wild ducks, peafowl, rodents, porcupine, langur, jackal, mouse deer, hog deer, spotted deer, sambar fawn, barking deer, chinkara and even leopards (Smith, 1935; Daniels, 1983).

There are a few reported cases where pythons have died after swallowing prey because of movement after the meal resulting in either suffocation or pierced horns, antlers, quills (in case of porcupine) from the gut of the python.

We came across a similar looking but rather complicated case. In January 2001, I was working in Ranthambhore Tiger Reserve, Rajasthan, on a project 'population monitoring of tigers using their pugmarks'. On 15 January 2001, we were following a tigress in Anantpura area of Ranthambhore. After following it for 4km, we lost track of the tigress as she entered a dry river bed and disappeared into the thickets (mainly of *Butea monosperma*). In an effort to follow up the alarm calls of chital and langur, we were walking on the river bank when we were struck by a nauseating stench emanating from somewhere close by. On investigation, we found a rotten carcass of a large snake. It was almost bare of skin and most of the ribs and vertebral column were lying exposed. On examining it closely we found it was a python, which was further confirmed by its skull and jaws. A few patches of skin were still attached to the carcass. We tried to straighten up the carcass to measure its length, and to our surprise found a few more bones entangled with the python carcass near its abdominal portion. The bones consisted of a complete forelimb and a few bones of a hind limb. The forelimb bones had paw-bones intact and the paw was jutting out of the abdominal ribs of the python carcass.

On inspecting the paw we found retractile claws on the phalanges, which gave us a clue that it was of some felid. There was a mass of hair attached to the paw. We examined these hairs with the reference slides of cat hairs and confirmed that the paw belonged to a Jungle Cat (*Felis chaus*).

We suspect that the python might have caught the Jungle Cat and after swallowing it, the paws of the cat might have pierced open the belly of the python because of its movement. The paws and attached limb bones were found entangled with the ribs of abdominal portion of python. We did not find any other part of the skeleton of the Jungle Cat. The length of the python carcass was 165cm.

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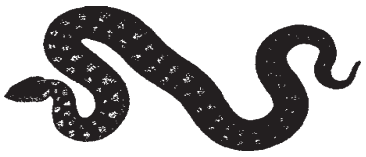

A note on external injury in wild Travancore Tortoises (*Indotestudo travancorica*).

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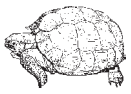
During the course of a study on the Travancore tortoise (*Indotestudo travancorica*) conducted from December 2002 – March 2003, in the Indira Gandhi Wildlife Sanctuary (Tamil Nadu), three injured tortoises were found. Since there is no information regarding this aspect, details are given here:

Two live tortoises found in Anaikundhy Shola were fire-scarred. In one individual, the carapacial scutes had peeled off, exposing the underlying bones while in the other, the scutes resembled molten plastic and there was a small hole in the plastron which also had a mildly melted appearance. The last record of a forest fire in that area was around 10 years ago (Forest Dept. staff, pers. comm.), so the injuries were probably sustained at that time. Another individual found in Sichali, had a large circular depression on its carapace, with a crack along one side. According to the tracker, it had probably been lying in swampy ground when it was stamped by an elephant, and was therefore merely injured and not dead. In spite of severe external injury, all three tortoises were observed moving around and feeding normally.

Acknowledgements

I would like to thank the Tamil Nadu Forest Department for permits; Centre for Herpetology, Madras Crocodile Bank for funding the study on Travancores, and Ganesan anna for his expertise in field.

TSA Announces Conservation Plans for Indian Turtles



Rick Hudson
TSA Co-chair

Introduction

The Madras Crocodile Bank Trust, in conjunction with the IUCN Turtle Survival Alliance, has announced a collaborative program designed to develop and implement conservation action plans for some of India's endangered freshwater turtles. "This is an exciting time for TSA because this is the first range-country program that we have launched. This effort will depend on strategic partnerships, and will focus attention on a country with an incredibly rich and diverse turtle fauna," said TSA co-chair Rick Hudson. In terms of assessing Asian countries that are the most important to devote limited resources for turtle conservation, India ranks high, actually fifth behind China, Myanmar, Vietnam and Indonesia. This composite evaluation (Stuart & Thorbjarnarson, CCB,Vol. 4, No.3) was based on three factors including species richness, degree of endemism and degree of endangerment.

With so much of the conservation focus on Southeast Asian species, India's turtles often are overlooked because they are infrequently seen in the pet trade. However large numbers are collected for internal use and a number of species are often reported in Chinese markets. For the past few years India has risen in importance because of the perception, right or wrong, that little was being done to address some of the critical issues facing turtles in that country.

Based on the wide-held belief that the Madras Crocodile Bank Trust (MCBT) would be the logical location from which to launch a comprehensive conservation program for Indian turtles, a team representing the Turtle Survival Alliance visited India in October 2003 to assess that institution's potential. That team consisted of TSA chair Rick Hudson, Hugh Quinn and Don Boyer, and based on that visit, a conservation action plan is now beginning to take shape. During the course of our meeting with MCBT co-founder Rom Whitaker and Director Harry Andrews and his staff, a five-year plan was drafted that lays the groundwork for a multi-species, multi-faceted program that includes a range of components including field surveys, captive breeding/management and public awareness.

Background

The MCBT was founded by Rom and Zahida Whitaker in 1976 to conserve crocodilians and establish programs for the conservation and propagation of other species of endangered reptiles. Research within MCBT and in the field has covered a wide range of herp topics that since 1976 has resulted in over 300 scientific publications. Also a number of very well-known researchers and their projects have been based out of the MCBT over the past twenty years. The Centre provided logistical support and served as Ed Moll's home base during his WWF funded survey work on Asian riverine turtles in the 1980s. During the period 1984-1994 the Centre worked extensively with Jeff Lang on defining Temperature Sex Determining (TSD) patterns as well as other reproductive strategies in the Mugger crocodile. Later the Centre hosted Michael Ewert as he investigated egg incubation strategies in chelonians.The incubation facilities remain operational and continue to be utilized by Harry Andrews for TSD research. Additionally, *Hamadryad*, the Journal of the MCBT Centre for Herpetology, is widely recognized as a reputable and high-quality scientific journal. Their herpetological library is extensive and complete, and is considered to be the best resource of its kind in India.

The MCBT is financially stable and self-sustaining, and among Indian zoological institutions, is considered a model for fiscal responsibility. The budget is about $100,000 US per year with 90% of this being raised through gate revenue; visitation is about 500,000 per year. Staff size is 17. MCBT has a large collection of crocodilians, with over 2,800 specimens, representing 14 species.They have a history of success with a number of India's freshwater turtles and, with moderate assistance, are capable of doing much more.The collection at MCBT consists of 300 turtles, representing 16 of the 33 taxa found in India.

The Center has bred several of these species, and recently announced the world's first captive breeding of the Painted roofed turtle, *Kachuga kachuga*, ranked as Critically Endangered by the IUCN Red List. They have done extensive research with their collection, especially in the field of egg incubation and TSD studies. In fact, due to their strong working relationship with the State Forestry Departments and the three gharial rehab centers in the North (sites of ongoing turtle hatching and headstarting programs), their existing infrastructure of enclosures and support facilities (including incubation room), their expertise, knowledge and desire to push turtle conservation, the MCBT is well positioned to catalyze a major turtle initiative in India. Their recognition as a well-respected conservation organization, both in India and worldwide, make them the logical choice as a partner to launch a turtle recovery program.

In short, most of the pieces are in place to do this, both at Madras and the gharial facilities in the North, such that a modest amount of funding will almost certainly produce some substantial results. A turtle conservation network consisting of four captive management facilities, with MCBT as the catalyst and focal point, and with MCBT-based staff providing logistical and technical support, is currently envisioned.

This is the first breeding of the critically endangered turtle in India. Harry Andrews prepared a five-year project proposal for $56,000 US, the bulk of which will support two PhD students that would be based out of MCBT. The first year expenses to get started are $15,000, half of which ($7,500) was pledged by Walter Sedgwick (Island Conservation) contingent on matching funds. Recently the Turtle Conservation Fund ($6,000) and TSA ($1,500) matched that challenge thus securing the $15,000 in start-up funds needed for Year 1.

Improvements to existing facilities at MCBT are also needed that will enable them to breed and maintain larger numbers of species; these costs are estimated to run $8,000. To meet this need the British Chelonia Group (BCG) conducted a fund-raising campaign that successfully raised this amount that is specifically earmarked for construction costs. Plans call for the conversion of a series of existing grow-out ponds for young crocodilians into an aquatic turtle breeding and management facility.

Annual expenses for this program are estimated at roughly $8,000 - $10,000 per year, and these funds will support two PhD students dedicated to turtle conservation in India. One is a field

position, with primary duties of conducting turtle surveys, networking with existing turtle conservationists, and conducting public awareness campaigns for turtles in targeted areas. Primary responsibilities of the second position will be to catalyze appropriate captive management of targeted turtle species among Indian institutions (zoos and the three satellite facilities in the north). The person selected will also manage the turtles at MCBT. To date over $26,000 has been raised to support this new program over the next two years.

The next critical step, already in the planning stages, is a workshop to develop a strategy for conservation of Indian turtles and to set this process in motion. Bringing together all the primary players from the State Forestry Departments and participating universities, and organized by Zoo Outreach Coordinator Sally Walker, this workshop should establish a planned agenda, defining the following:

- ➔ Priority species
- ➔ Site selection: which species will be housed at which of the four facilities
- ➔ Acquisition strategy: collection of eggs, hatchlings or adults from wild
- ➔ Type of activity: headstarting/release vs. captive breeding
- ➔ Captive rearing and release strategy
- ➔ Size of desired captive population
- ➔ Timelines: who will do what and when
- ➔ Production of educational materials, identification guides and fieldguide books in local languages

Funds for this workshop, planned for January 2005, are also in place, thanks to generous support from TSA Partners Jim and Kirsten Kranz plus funds from Conservation International. We predict that this workshop will produce a blueprint for conservation action for the next five years, and provide a sound basis for seeking support from outside funding agencies.

Summary

Due to their reputation and high standing, both nationally and within the international herpetological community, the MCBT is uniquely positioned to catalyze a broad range of conservation initiatives for India's freshwater turtles and tortoises.

Widely recognized throughout India and the rest of the global conservation arena, the MCBT has the scientific ability to coordinate and manage a turtle recovery program. Infrastructure, in the form of captive facilities and husbandry skills, are already largely in place but need some refinement. Perhaps more importantly, the desire and will to develop such a program also appears to exist.

The critical components are, for the most part, in place and will coalesce given some modest funding. The primary funding needs (given that the structural improvements to MCBT facilities are already funded) are for two PhD students to focus on both captive and field aspects, and to develop a network of turtle biologists and facilities all working towards the implementation of a unified conservation strategy. A turtle conservation network consisting of existing headstart and management facilities, plus a number of zoos, with MCBT as the catalyst and focal point and with MCBT-based staff providing logistical and technical support, is currently envisioned. An integral part of developing such a strategy will be a planning workshop involving all the players and stakeholders that have the capacity and desire to contribute. In summary, the strength of this proposal is that it initiates a comprehensive range-country program that is broad-based, providing coverage for multiple taxa and involving multiple institutions. Support of this proposal however, should not be seen as a single year investment, but moreover a multi-year commitment on behalf of both the Turtle Conservation Fund and the Turtle Survival Alliance.

To be successful this effort must continue to grow as a collaboration between partners, and we will be seeking to develop new partnerships as we move this process forward. The TSA will also be launching a major fund-raising campaign in the near future so stay tuned for further news.

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Observation on some snake species of Kedarnath WLS, Garhwal Himalaya

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Kedarnath Wildlife Sanctuary is situated in western Himalaya ($30^0$25'–$30^0$45'N & $78^0$55'–$79^0$22'E) sprawling over an area of 975km^2. It is one of the largest protected areas of Garhwal Himalaya. The altitude range in the sanctuary is from 1160m to 7068m. Kedarnath WLS is home to Musk Deer and other Himalayan fauna.

I visited Kedarnath WLS in June 2000. Within a period of four days I came across six snakes of two different species, which were identified as Himalayan Pit Viper (HPV) (*Agkistrodon himalayanus*) and Banded Racer (BR) (*Argyrogena fasciolata*) using Smith (1935).

I found one HPV in a meadow in Sokharak (3050m). This snake was basking in the sun, just after the rain. Remaining two specimens were seen the next day on the way towards the Hindu shrine *Tungnath*. They were basking on the bridal path at an altitude of 3400m. I managed to catch one of them, while the other one disappeared into a rock crevice. The HPV is known as '*Lender*' amongst locals.

The BRs were found at three different locations. I caught one of them near the base camp at Sokharak (3050m). The other specimen was caught near the Mandal rest house (1800m). The third BR was found as a road kill on Mandal–Chopta road at an altitude of 1700m. The other snake species reported from Kedarnath WLS was Boulenger's Keelback (*Amphisma parallela*) by Green (1985).

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POSTER PRESENTATIONS & ABSTRACTS FROM THE 4TH WORLD HERPETOLOGICAL CONGRESS, 2001

Phylogenetic relationships, character evolution and historical biogeography of the subfamily Lygosominae (Reptilia: Scincidae) inferred from mitochondrial DNA sequences

Masanao Honda

The subfamily Lygosominae contains over 600 species mainly distributed in temperate and tropical Asia, Australia, central and southern Africa, Madagascar, the western Indian Ocean islands, southeastern North America, and central and South America including the Caribbean islands. Within this subfamily, three evolutionary lineages (i.e., the Eugongylus Group, the Mabuya Group and the Sphenomorphus Group) have been recognized on morphological, karyological and immunological data. However, there still remain a number of debates regarding the phylogeny of those major lineages, and relationships and generic classification within each of them. Due to the scarcity of informative characters, it is not easy to formulate a sufficiently reliable phylogenetic hypothesis for this subfamily solely on the morphological ground. In collaboration with several colleagues, I have tried to elucidate the phylogenetic relationships of the subfamily on the basis of approximately 1,250 base positions of mitochondrial DNA sequence of 12S and 16S rRNA genes. On this occasion, I give summary of results of this project, and discuss the pattern and process of diversification and the historical biogeography of the subfamily.

Our results supported the monophyly of the Lygosominae, but suggested the presence of five distinct infra-subfamilial lineages. Of these, the Sphenomorphus Group appears to have diverged first, followed by the Lygosoma Group and the Egernia Group, leaving the Eugongylus Group and the Mabuya Group as sister groups. This negates the monophyly of the Mabuya Group in the former definition (i.e., as including the Lygosoma Groups and the Egernia Group), for which a number of morphological and karyological studies yielded supportive evidence. Morphological and karyological features shared within the Mabuya Group in the former definition may actually represent plesiomorphic character states. Our results also contradict the previous hypothesis, formulated on the basis of morphological and immunological data, which argued for the sister relationship between the Egernia Group and the Eugongylus Group. In the Australian region (including Papua New Guinea and adjacent islands), the Egernia Group, the Eugongylus Group and the Sphenomorphus Group have their representatives, and so do the Lygosoma Group, the Mabuya Group and the Sphenomorphus Group in the African region (including Madagascar). Because each of these local assemblages does not constitute a monophyletic cluster (see above), the phyletic diversity of lygosomine skinks in both regions is most likely to have increased through multiple colonizations from Southeast Asia, which neighbors both of the former regions and has high lygosomine diversity. Some authors predicted the possible non-monophyly of the genera Mabuya and Sphenomorphus due to its wide distribution and great morphological diversity. Present study confirmed substantial phylogenetic heterogeneity of both of these genera.

Diagnosis, treatment and management of a cranial abscess in a Wild Cat Snake *(Boiga forsteni)*

U.L.D. Jayantha & D.D.N. de Silva

Cat snakes *(Boiga* spp.), which are slightly venomous arboreal colubrids, show a wide distribution in the old world ranging from Australia to Africa. Out of four Boiga species (Mapila in Sinhala) found in Sri Lanka, Forsten's Cat Snake is the largest. This uncommon low country snake is recorded in two distinctive colour verities. The most common variety, which has grayish brown, black and white markings on its dorsum, is known as Naga Mapila (Naga = cobra) in Sinhala. L. Mapila (L. = blood) in Sinhala has uniform red or crimson brown colouration all over the body except the ventral aspect, which is whitish. The subject under discussion, 171 cm long, adult, female Forsten's Cat Snake weighing 350 g was collected from a disturbed rain forest in Labugama in Colombo district in mid June, 2001. Since the snake showed a swelling over its right eye, it was kept in captivity for study purposes. In spite of this cranial swelling, the specimen was observed having a sound physical condition and a normal behavior. Upon clinical examination following physical restraint on 21.07.2001, a soft swelling was palpated over the right supraocular scale measuring about 8x6x3 mm. Further, areas covered by frontal, prefrontals and intranasals showed gaps in between due to the pressure exerted by the swelling underneath. The dorsal conjunctiva of the right eye was also appeared swollen and protruded. The lesion has not affected the eyeball and the vision was also intact. It was suggestive that the clinical condition could be a bone tumor, a cyst, a seroma, an abscess or a hematoma. Therefore, other diagnostic aids were used for the confirmatory diagnosis. Dorso-ventral and lateral radiographs of the cranium revealed no bone involvement, but soft tissue swelling was evident about the right orbit. A 21 G needle was inserted in between supraocular- frontal and supraocular- prefrontal borders and inspisated pus and blood were discovered on aspiration. After taking into consideration the findings of the investigation, the condition was diagnosed as an abscess and the prognosis was thought to be good. Pus was evacuated from the abscess and was treated with systemic antibiotics. Ampicillin at rate of 40 mg/kg intramuscularly used in alternative days. A slight response to the treatment was observed in two weeks time. The swelling over the snout had subsided completely as indicated by the close approximation of frontal, prefrontals and intranasals. Although the supraocular region had regressed slightly it remained at the same size for another week. Since there was no complete regression, a decision was made to intervene the abscess surgically. The snake was starved for five days and on 17.08.2001 was anaesthetized using Ketamine hydrochloride ("Ketaset") at a rate of 70 mg / kg intramuscularly. The effect of the drug was evident 5 mm after administration, at which time the snake made sluggish response to pain stimulation. The head was restrained, kept on a flat surface and the surgical site was disinfected. Using a sterile scalpel an incision was made along the cranial and lateral margins of the supraocular scale. The flap of scale was lifted slightly. A whitish granular material was observed in a cavity measuring about 8x6x2 mm. Abscess material was carefully removed by scarification using a sharp, stainless steel probe. The cavity was rinsed with normal saline and swabbed. The incision was left unsutured. In about 30 min following anesthesia the snake showed signs of recovery (responded to pain stimulation) and the whole surgical procedure took about 35 min. Total recovery was observed 3 hrs following the completion of surgery. Microbial isolation of the abscess material revealed *Aeromonas* species. Since Ampicillin therapy showed a satisfactory response, postoperative antimicrobial therapy was continued as earlier with the same. In two weeks time the incision had been healed completely and the swelling over the eye had been subsided almost up to the normal level. The affected conjunctiva became normal. During the period in captivity snake was force-fed with beaten egg yolk and white in 5 days intervals, 55- 60 ml at a time. Since the antibiotics continued more than one week, a vitamin B oral supplement was also added. Throughout the period the snake remained in a good physical condition and was able to shed once.

Coral reef habitat use of the Hawksbill Turtle, *Eretmochelys imbricata*, in the South Male Atoll of Maldives

Naoki Kamezaki, Izumi Sakamoto, Takihiko Sakamoto & Naoki Kamezaki

The Hawksbill Turtle, Eretmochelys imbricata, is distributed in coastal waters containing coral reefs. Vadoo island is located at the northern marginal reef of the South Male Atoll of Maldives. The Maldives are known as a living habitat of hawksbill turtles. However, biological study of the sea turtles in this oceanic area has not previously been

carried out. In this study, a total of 103 turtles were caught 206 times by Scuba diving in April and December 1997, December 1998, August 1999, April 2000, and March 2001. The turtles were released after measurements of straight carapace length (SCL) and body mass (BM), and attachment of plastic tags. All turtles were within the size range 353 to 745 mm SCL. The peak of the SCL frequency distribution was found to be in the size class 500-600 mm, which accounted for 53% of all captures, followed in decreasing order by the size classes 400-500 mm (27%), 600-700 mm (11%), 300-400 mm (6%). Two adult turtles with SCL of greater than 700 mm were captured on a total of five occasions. Because the proportion of turtles caught only once in the size class 300-400 mm is with highest at 92%, turtles of this size are considered to be recent recruits from pelagic habitats or other coral reef habitats. Furthermore, the relatively short visits of turtles in the small size classes, such as those in the 300-400 mm SCL class, suggest that it is hard for small turtles to settle on this coral reef and join the population using it as a feeding ground. In the 500-600 mm SCL class, 65% of all captures were recaptured turtles. This high frequency of recaptures indicates turtles in this size class tend to live on the reef for relatively long periods. Since turtle captures in the 600-700 mm SCL class are much fewer than those in the 500-600 mm SCL class, it is thought that hawksbill turtles move away to find new feeding grounds when they reach the SCL of approximately 600 mm. The conclusion that prowling behavior is prevalent in this size class is supported by the relatively high percentage (57%) of turtles caught only once for all captures in this class. Tagging of captured turtles yielded 92 growth rate data for 50 turtles. The rate of increase of SCL and BM decreased with increasing turtle size. The most rapid growth rates, SCL increase of 36.8±11.9 mm/yr (n=24) and BM increase of 2.8±1.0 kg/yr (n=24), were demonstrated for turtles in the 400-500 mm SCL class. Turtles in the 600-700 mm SCL class were found to have much slower growth rate (SCL increase of 2.2±3.7 mm/yr (n=7) and BM increase of 0.5±0.7 kg/yr (n=7)). We sometimes observed hawksbill turtles eating sponges living in the crevices of the coral reef. The slow growth rate of the larger turtles indicates that the supply of sponges may be limited in this coral reef. Growth and population size of hawksbill turtles are thought to be affected by the standing crop and growth rate of sponges.

Travelling turtles, many peoples, one big story: indigenous management of sea turtles in northern Australia

Rod Kennett, Ilse Kiessling, Nanikiya Mununguritj & Kelvin Leitch

Description of project: Aboriginal people (Yolngu) of north east Arnhem Land in the Northern Territory, Australia are custodians of internationally significant rookeries of four species of sea turtle, including green *(Chelonia mydas),* flatback (*Natator depressus),* olive ridley *(Lepidochelys olivacea)* and hawksbill *(Eretmochelys imbricata)* turtles. Acting on concerns about global and regional declines in turtle numbers and fulfilling long-held management responsibilities, Yolngu people through the Dhimurru Land Management Aboriginal Corporation, initiated a sea turtle (miyapunu) research project that combines traditional knowledge and law with contemporary scientific methods to develop a strategy for sustainable subsistence use (Mununguritj 1998; Yunupingu 1998). The project is addressing management and conservation issues such as habitat mapping and monitoring of nesting turtles; sustainable traditional harvest practices; entanglement and stranding of turtles in discarded fishing gear and mapping sea turtle migration routes. The latter was achieved using satellite telemetry to follow the post-nesting movements of 20 turtles and has enabled Yolngu to identify coastal communities with whom they share turtle management responsibilities. Encouraged by the results of their project, Yolngu and other Aboriginal people are establishing a network of communities to share traditional and contemporary knowledge of turtles and promote cooperative management of turtles in the region. These community networks, coupled with ongoing meaningful collaboration between indigenous and nonindigenous Australians in research and management activities, will be critical for the survival of sea turtles in the region.
Relevance to the Symposium: The project provides a good example of how a community based approach to a conservation issue has provided culturally appropriate information and direction for on-ground management activities. The project has yielded information that contributes significantly to the regional understanding of turtle biology as well as building linkages between indigenous communities responsible for globally significant marine turtle populations and habitats.

Monosystemic effects of Russell's Viper envenoming in Sri Lanka: isolated neurotoxicity, nephrotoxicity and haematotoxicity

S.A.M. Kularatne & I.B. Gawarammana

Introduction: Russell's viper *(Daboia russelii russelii),* locally named *thith polonga* is responsible for most cases of severe and fatal envenoming, accounting for 48% of snake bite admissions to hospitals in Sri Lanka. Russell's viper is distributed throughout the island and it's bite is an occupational hazard, mostly of the poor paddy farmers. Very often, envenoming leads to multisystem dysfunction in combination. However, presentation with the involvement of a single system is a rarity, which invariably leads to diagnostic dilemma, if the offending snake is not available for identification. We describe four such patients (authenticated Russell's viper bite) presented to the General Hospital, Peradeniya.
Case 1: A forty year old man was bitten by a young Russell's viper (45 cm long). He was oliguric and became anuric in 48hours. His blood pressure was 180/120, serum creatinine 1120/mol/L and ECG showed features of hyperkalaemia. He developed neither haematotoxicity nor neurotoxicity, however showed swelling at the site of the bite. He made a recovery after 12 days of intensive peritoneal dialysis.
Case 2: A 55 year old man developed external opthalmoplegia and ptosis after Russell's viper bite. He never developed clinical or biochemical evidence of haematotoxicity and nephrotoxicity and made an uneventful recovery.
Cases 3 and 4: Two victims, aged 40 and 43 years manifested bleeding tendency with prolonged whole blood clotting time after Russell's viper bite, but never developed neurotoxicity and nephrotoxicity.
Discussion: These cases highlight the diverse nature of the venom toxicity and also the practical difficulty in making a clinical diagnosis in the absence of the offending snake. One example was a former case report titled as " unidentified snake bite with pure nephrotoxicity (Ceylon Medical Journall995;40:45.). The question raised here could be explained with the present experience of monosystemic manifestations. Furthermore, the knowledge of monosystemic presentation is very important as the offending snake for correct diagnosis is not available in most of the time in clinical practice(Rate of specimen availability in Russell's viper bite is 21%). Monosystemic effect may mimic the envenoming of other poisonous snakes such as krait, cobra or hump-nosed viper. In this scenario, is it worth developing monovelant antivenom against the poisonous snakes in Sri Lanka?

Autopsy study of Common Krait *(Bangarus caeruleus)* Bite

S.A.M. Kularatne & Neelakanthi Ratnatunge

Out of eight autopsies, offending snakes were identified in 5 and the rest were diagnosed clinically. There were 5 males, 3 females and the age ranged from 8 to 31 years. Three patients died within 24h (acute deaths) and 5 died later (late deaths) after the bite. Time for acute deaths were 4,8 and 17 hours after bite and all showed big blotch of submucosal haemorrhage in the stomach (range of diameter 5 to 9 cm). The patent who died in 4hs had macroscopically normal other organs but the histology showed acute renal tubular necrosis and pan lobular microvesicular fatty changes in the liver. The patient died at 8hrs showed petichial haemorrhages in the myocardium,

renal cortex and adrenal gland macroscopically. The patient died at 17hrs had been ventilated 2h before death showed severely congested, firm, bluish lungs and petichial haemorrhages in the adrenal glands. All late death patients were ventilated before death(duration 4 to 14 days). There were erosions, patchy haemorrhages in the stomach seen in three patients and one showed microscopic necrosis of gastric mucosa. Four cases had grossly congested heavy lungs suggestive of adult respiratory distress syndronie(ARDS) and histology revealed hyaline membrane in alveolar ducts, vascular thrombosis confirming ARDS in one of them. There were microvesicular fatty change in the liver in two cases and evidence of pericarditis one case. Microscopically the adrenal glands were normal in two cases and haemorrhages seen in one case. Congestion of kidneys with cortical haemorrhages seen in one cases. In conclusion, gastric bleeding is the constant feature which might explain the symptom of abdominal pain in common krait bite. Many changes in late deaths such as ARDS, gastric erosions could be due to secondary complications of prolonged ventilation. However, acute internal bleeding and renal tubular necrosis need a explanation.

Introduction to applied herpetology

Michael R.K. Lambert

Applied herpetology may be defined by those studies in herpetology that concern man and his interests, or result from human interference. Among the subjects so far identified as being embraced by "applied herpetology" are:-

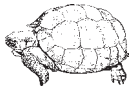
natural products development: amphibians and reptiles as a source of bioactive material antibiotics, analgesics, diuretics and anticoagulants; toxinology (snake and lizard venoms) and pharmacology (amphibian skin secretions).

environmental monitoring: amphibian teratological studies to monitor environmental health via incidence of abnormalities in populations; bioaccumulation of heavy metals and pollutants such as pesticides in tissues of amphibians and reptiles, and the use of species in turn as bioindicators of habitat contamination (ecotoxicology); endocrinological disruption from pollution.

farming: captive breeding and husbandry techniques to maintain stocks for teaching, exhibition, experimental purposes, food and other commodities (reptile leather industry; tortoiseshell), as well as for the restocking of wild populations; pathology and disease.

conservation and wildlife management: species protection and autecology; biodiversity assessment and monitoring; preparation of country checklists and annotated inventories; use of species richness, and assemblages/associations as bioindication of habitat quality and change; habitat management; establishment of faunal reserves; reintroduction and relocation (including mitochondrial DNA determination); veterinary aspects; sustainable utilization of economic species.

legal aspects: welfare; conservation; international trade. This introduction will open a congress workshop on applied herpetology during which selected authorities will review work in their respective fields. Since it is likely in the future that little research funding will be made available for work in herpetology that is not applied, proposals for further subject coverage are invited. It is intended that manuscripts will be prepared from the presentations, and will be compiled to form a set of review papers for publication as the first issue, and thus launch a new journal, *Applied Herpetology,* which is to be sponsored and promoted by VSP International Science Publishers, Zeist (a subsidiary of Brill Academic Publishers, Leiden), the Netherlands, and for which associate editors and members of editorial and international advisory boards are presently being sought. Invitations could at the outset be extended to individuals with related interests participating at the workshop.



The perversities of pitvipers: a snake preview

Anita Malhotra

The *Trimeresurus* group of Asian pitvipers is an important, but remarkably poorly understood, radiation of over 40 species. In this talk I will briefly review the group and demonstrate how a molecular approach is revolutionizing our understanding at a variety of evolutionary levels. Once considered congeneric, up to six genera are currently recognized (*Trimeresurus sensu stricto, Tropidolaemus, Ovophis, Protobothrops, Ermia, Triceratolepidophis*). Recent molecular results demonstrate that the current taxonomy does not adequately represent either the relationships or the true diversity present. Although the data, which is largely based on mitochondrial genes, provide few definite conclusions to be drawn about deeper events, a number of well-supported conclusions suggest a radical re-interpretation of the systematics of the group is necessary. These include th paraphyly and presence of several divergent clades within *Trimeresurus sensu stricto* (s.s), and the monophyly of *Protobothrops* but not of *Ovophis*. The congruence of morphological characters with the clades identified within *Trimeresurs sensu stricto* suggests that further splitting may be warranted. At the species level, a number of externally extermely similar species that are referred to as bamboo vipers or green pitvipers are a particularly challenging problem. I will present a combined molecular and morphological approach to show that the diversity within these bamboo vipers has been underestimated, and that at least, *T. albolabris* and *T. stejnegeri* (and possibly other currently accepted species) are composed of a number of distinct taxa. Moreover, the boundaries of these new species generally do not correspond to currently defined subspecies. Finally, at the intraspecific level, I will report on a study of the Taiwan bamboo viper, *T. stejnegeri*. Phylogenetic analysis of mitochondrial genes across the main island and satellite islands indicates the presence of two divergent evolutionary lineages, which are partially geographically separated and are most likely to have arisen by multiple colonisation events during successive periods of lowered sea levels. The content of the venoms of 70 individuals was investigated by direct analysis of crude venom by MALDI-TOF mass spectrometry. The masses of the main components detected correspond to a suite of phospholipase A_2 enzymes, with a number of possible isoforms present in each sample. The distribution of these isoforms does not correspond to evolutionary lineage but, instead, to dietary differences between the populations. In conclusion, the variability that has been discovered in the group by the application of modern molecular and biochemical methods requires a re-evaluation of their evolution, biogeography, conservation status and antivenom strategy.

Evolution and biogeography of the East Asian Japalura (Squamata: Agamidae)

Hidetoshi OTA, Masanao Honda, Szu-Lung Chen and Tsutomu Hikida

The genus Japalura consists of 23 species distributed in subtropical and temperate Asia. Geographic range of this genus is divided into two substantially isolated regions - a broad area from northern India to central continental China, and several islands of Taiwan and the Ryukyu Archipelago. From the latter, five species are recognized, of which four are endemic to Taiwan, and the remaining one (J. polygonata) is distributed from northern Taiwan to the central Ryukyus. In this study, we examined phylogenetic relationships of these five species on the basis of sequence variations in parts of the mitochondrial 12S and 16S ribosomal RNA genes.

A total of 53 specimens from 36 localities were examined. Of these, 19 specimens from 16 localities represented J. swinhonis that occupies almost throughout the low altitude Taiwan. Each of the three montane species, J. brevipes, J. luei, and J. makii, was represented by two specimens from one or two localities. A total of 28 specimens from 17 localities represented all of the three recognized subspecies of J. polygonata throughout their ranges. Besides these, a specimen of J.

splendida, a continental species showing a great similarity to the island species in external morphology, was examined. Specimens of Gonocephalus grandis, Aphaniotis fusca and Calotes versicolor were also added to the analyses as outgroups. Data for approximately 860 aligned sites from the PCR-direct sequencing procedure were analyzed by the neighbor-joining (NJ), maximum-likelihood (ML), and maximum parsimony (MP) methods. Robustness in each of the relationships indicated by these analyses was assessed by 1000 times of bootstrap resamplings. In all analysis, monophyly was supported with high bootstrap proportions (BPs: 86-100%) for each of the five Taiwan - Ryukyu species, for the three montane species, and for an assemblage of these species and J. polygonata. By contrast, monophyly was not supported with substantial BPs for the five island species as a whole against the continental species, J. splendida, or for each of the three subspecies of J. polygonata. Our results strongly suggest occurrences of initial divergences among the three montane species and J. polygonata within Taiwan. Considering that these species have remarkably divergent karyotypes consisting of 36-46 chromosomes, it is probable that the chromosomal rearrangements played an important role as the major cause of reproductive isolation in their speciation. Infraspecific phylogeny inferred for J. swinhonis suggests an initial isolation of its populations in a few localities in southern eastern, and western - northern Taiwan, and its recent rapid range extension particularly in the western - northern region. It is probable that the latter event was involved by an extension of the subtropical climate into that region with a recession of the late Pleistocene glacier. On the other hand, our results suggest more than one time of dispersals of J. polygonata from Taiwan into the southern Ryukyus. They also suggest a recent, rapid dispersals of this species between the southern and the central Ryukyus, and over the whole of the latter region most likely by extensive raftings.

The thermal behavior, diurnal activity patterns and body temperature of Water Monitor *Varanus salvator* in central Sri Lanka

Nimal D. Rathnayake, Nadeeka D. Herath, Kalinga K. Hewamathes

The thermal behavior and daytime activity patterns of water monitor lizards was studied in Kandy, in central Sri Lanka. The frequency of activity types observed varied during different times of the day. Early in the morning, more lizards were observed foraging in water, but by late morning activity in water decreased. Instead more animals were seen basking or resting out of water by late morning and during the afternoon. Fewer active lizards were seen during continuous rainy days. The mean body temperature of active lizards was 28.9C, which was similar to other studies of water monitor lizards, and is lower than other varanids. Body temperature of lizards foraging in the water (avg 26.2C SD 2.2) was also lower than the body temperature of animals that were resting or basking (avg 29.1 SD 3.6).

Preventive medicine in reptiles and amphibians

Walter Sachsse

The title should be understood in a wider sense: prevention of all adverse influences during short housing, long tem husbandry, or conservation breeding.

1. Physical factors as light, temperature, stucture of containers and enclosures.
2. Protection against infectious diseases and parasites
3. Some basic considerations on the contents and safety of food are given.
4. Social compatibility has a wide range of constellations tobe taken into account for survival of the specimens.
5. What do we know about inborn malformations, how to prevent them?
6. A few remarks on how to preserve genetic diversity- how to avoid inbreeding depression.

Plasma progesterone levels and luteal activity during gestation and prolonged oviductal egg retention in the tropical lizard, *Calotes versicolor* (Daud.)

B.A. Shanbhag, R.S. Radder & S.K. Saidapur

Plasma progesterone (P) levels and luteal and adrenal activities were studied during normal gestation and unusual prolonged period of oviductal egg retention in a multiclutched lizard, *Calotes versicolor.* The normal gestation period (~15 days) was categorized into four stages: stage I-a few hours following ovulation; stage II-eggs with shell and embryo at primitive streak; stage III-embryonic stages 16-20; and stage IV-prior to oviposition (stages 26-27). The gravid lizards maintained in captivity retained eggs in their oviduct for 45 days. Plasma P levels were low in stage I, increased significantly during stage II, declined in stage III and reached lowest in stage IV of gestation. 3. - hydroxysteroid dehydrogenase (3. - HSDH) activity was more in luteal cells at stage II and was present in traces in stage IV of gestation. Interestingly, plasma P titers that were greater in lizards with eggs retained longer though the corpora lutea (CL) showed a trace 3. -HSDH activity. However, 3. -HSDH activity was greater in the adrenocortical cells in these lizards than that in lizards during a normal gestation period. The present study on *C. versicolor* shows that the CL remains active and secretes P during early part of gestation. The drop in P level during the later part of gestation might facilitate growth of a second set of vitellogenic follicles. During unfavorable conditions when the lizards are forced to retain eggs in the oviduct, the adrenal gland seems to secrete P to help in egg retention and in inhibition of oviposition.

The Asian turtle crisis - an update

Peter Paul van Dijk

In the past decade, trade in Asian tortoises and freshwater turtles has expanded to unprecedented quantities. What used to be mainly local and regional trade of modest quantities of turtles for consumption developed into a well-organised international trade supplying great volumes of live turtles, from mostly South and Southeast Asia, for consumption in mostly East Asia, as well as turtle bones for use in traditional Chinese medicines. Following isolated voices of concern initially, a regional workshop was held in Phnom Penh, Cambodia, in December 1999, to examine the extent and impact of this trade on the conservation of Asian tortoises and freshwater turtles. Organised by WCS, WWF and TRAFFIC, the workshop brought together some 40 conservationists, turtle biologists and government authorities from Asia and beyond to identify the problems and develop solutions. The problem is severe: in the 2000 IUCN Red List, conservation status assessments are presented for 89 species of Asian turtles. Of these, 67 species are listed as threatened, meaning Critically Endangered, Endangered or Vulnerable. 21 species are considered 'near threatened' and 'least concern', or Data Deficient. This is a remarkable increase from even the 1996 Red List, which listed only 33 Asian Turtle species as threatened. Also remarkable is that not a single species was considered at less risk in 2000 than in 1996. Of the 18 Asian turtle species listed in the 2000 IUCN Red List as Critically Endangered, exploitation is recorded as a cause of endangerment for 15 species while habitat degradation impacts 7 species. Similarly, of 27 species listed as Endangered, direct exploitation endangers 19 species while habitat impacts endanger 11 species. A major finding of the workshop delegates was that the national and international legal protection of Asian turtle species is often adequate, but that enforcement of this protection is usually inadequate. Other findings were that responsibility for implementation is unclear in a number of countries, that placement of confiscated animals is an issue of concern for the responsible authorities, and that awareness of the problem is low among decision-makers and the general public. Considering these and other findings, the delegates urged all responsible authorities to enforce existing legislation, and to review, clarify and improve legislation where appropriate. The

implementation and enforcement of IATA guidelines for shipping live turtles were considered a high priority. Guidelines and realistic solutions to deal with confiscated turtles needed to be developed. Listing of additional freshwater turtle species in the CITES Appendices was recommended, as was continuing research into the trade, status and conservation biology of Asian turtles. The delegates supported the efforts made by in-situ and ex-situ conservation breeding programs and recognised these efforts' contribution to preserving species in their natural habitats. Commercial farming of freshwater turtles was supported as part of a package of conservation measures, for its potential to shift large segments of the trade from wild collection to farming and thus reduce impact on wild populations, but the need was recognised to regulate and monitor farming and its potential impacts on natural turtle populations and on ecosystems. Finally the delegates recommended ongoing research into sustainable sources and alternatives to the use of turtle shell in Traditional Chinese Medicine and ongoing efforts to raise public awareness of the Asian Turtle Crisis in both source and consumer countries. Two years will have elapsed between the Phnom Penh workshop and the 4WCH, and much progress has been made to implement these recommendations. The genus *Cuora* was included in CITES Appendix II; several major trading countries have improved their legal framework and/or implementation of turtle protection measures; an Asian Turtle.

Venomous snakes of South and South East Asia: venoms and snake bite

David A. Warrell

Venomous snakes: The region's herpetofauna includes some 30 taxa of major medical importance. Notable for causing mortality and morbidity are the genera Bungarus, Naja, Ophiophagus, Daboia, Echis, Calloselasma, Deinagkistrodon and Gloydius and for causing many bites with low mortality, Trimeresurus and, in Sri Lanka, Hypnale. Genera subject to recent taxonomic revisions and new species include Trimeresurus (Malhotra & Thorpe. Mol Phylogen Evolution 2000; 16: 199-211; Giannasi et al. Mol Ecology 2001; 10: 419-26), oriental coral snakes [Calliophis, Maticora, Hemibungarus and Sinomicrurus (Slowinski et al. Herpetologica 2001; 57: 233-45)], *Naja mandalayensis* (Slowinski & Wiister. Herpetologica 2000; 56: 257-70), *Triceratolepidophis sieversorum* (Ziegler et al. Russian J Herpetol 2000; 7: 199-214), *Trimeresurus sumatranus* and *Tmalcolmi* (Stuebing & Inger. Raffles Bull Zool 1998; 46: 325-8). Ophiophagus is due for revision. Some geographically restricted, "rediscovered" species, such as T *kanburiensis* have proved capable of severe envenoming (Warrell et al. Trans R Soc Trop Med Hyg 1992; 86: 95-9).

Venoms: Elapid venoms in this region are characterised by a rich diversity of neurotoxins acting preand post-synaptically at the neuromuscular junction (eg. - and . - bungarotoxins) and on other neuroreceptors (eg - -bungarotoxin). Toxic phospholipases A_2, especially rich in venoms of Hydrophiinae, also cause rhabdomyolysis. Venoms of Asian Naja have a variable capacity for local necrosis attributable to digestive enzymes and polypeptide cytotoxins. Only east of the Moluccas are there Australasian elapids whose venoms contain medically-important anti-haemostatic components (eg *Micropechis ikaheka* - Sundell et al. Brit J Haem 2001; 114: 852-60). Asian viperid venoms are characterised by a variety of digestive, procoagulant and thrombin-like enzymes, haemorrhagic metalloproteinases and, in a few taxa, clinically-important neurotoxic phospholipases A_2 (eg *Gloydius blomhoffii* subspecies, *Daboia russelii* in Sri Lanka). Venoms of the sole medically-important colubrid genus in the region, Rhabdophis, contain procoagulants and haemorrhagins.

Epidemiology of snake bite: Predominantly an occupational hazard of farmers, plantation workers, fish farmers, fishermen and staff of snake restaurants, snake bite has a high seasonal incidence associated with planting and harvesting rice. Epidemics are associated with flooding. Distinctive species-associations are D *russelii* and Naja species with rice farming; *Calloselasma rhodostoma* and Trimeresurus species with rubber/coffee/tea plantations; Bungarus species with sleeping on the ground.

Prevention: Snake bites could be prevented by avoidance of high risk activities and by taking special care at particular times of day and seasons, avoiding intimate contact with snakes and the wearing of simple protective clothing (eg viper-proof boots). Immunisation is not an option!

Clinical effects of snake bite: Serious local effects at the site of the bite include necrosis (viperids and most Naja species) with potential for permanent physical handicap (eg following amputation), life-threatening infection or malignant transformation at the site of chronic ulceration. Acutely life-threatening effects are shock and intracranial or massive systemic haemorrhage (viperids and Rhabdophis); rhabdomyolysis (Hydrophiinae and D *r russelii* in Sri Lanka); paralysis (elapids, *Gloydius blomhoffti* sub sp and D *r russelii* in Sri Lanka) and kidney failure (D *russelii*, H *hypnale* and Hydrophiinae).

Treatment: First-aid remains controversial but, based on clinical experience, immobilisation of patients, especially their bitten limbs during transport (by stretcher) to medical care is recommended and, in the case of elapid bites, Sutherland's pressure-immobilisation method which should be applied immediately after the bite and not delayed until signs of envenoming develop. Discredited and dangerous methods include incision, suction (including the vacuum extractor), electric shock, tight tourniquets/ligatures, instillation of chemicals, cryotherapy, topical application or ingestion of emetic herbal remedies and invasive ayurvedic techniques. Antivenom remains the only specific antidote but antivenom design (monospecific vs polyspecific, coverage of clinically-important species), refinement (IgG vs F(ab.)$_2$ vs Fab), choice of animal (horse vs sheep vs hen), formulation (liquid vs lyophilised) and, most of all, economic sustainability of production, remain controversial, prompting only the second WHO meeting in 22 years (London, February 2001). Risk-benefit considerations restrict antivenom treatment to patients with systemic or severe local envenoming. The risk of early anaphylactic antivenom reactions may be reduced by prophylactic subcutaneous adrenaline (epinephrine). Efficacy and the average initial dose of antivenoms can only be established by clinical trials which are rarely attempted. Repeat dosage is controlled by clinical signs and/or the 20 minute whole blood clotting test. Supportive treatment may be essential: initially during resuscitation and to tide the patient over temporary respiratory paralysis or acute kidney failure. Early surgical debridement of necrotic tissue is crucial, but fasciotomy should be reserved for those few cases in which intracompartmental pressure is measurably high and antivenom treatment, adequate to correct anti-haemostatic defects, has been given.

Acute anaphylaxis: After snake bite may be a direct effect of venom (autopharmacological action) or from hypersensitization through previous bites (especial risk of snake handlers). It should be treated with intramuscular adrenaline (epinephrine). The danger of snake bite to zoologists working in remote locations is specially poignant, considering the deaths of H Schnurrenberger, envenomed by *Sinomicrurus macclellandi* (Kramer. Rev Suisse Zool 1997; 84: 721-61) and JB Slowinski, who died on Sept 11 this year after envenoming by *Bungarus multicinctus*. Correct first-aid procedure, including pressure-immobilisation for all elapid bites, immediate evacuation of the victim towards medical care and, in some cases (Figure 3), use of antivenom are appropriate, even in the absence of a qualified medical officer.

Further Reading:

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Summary of 48,000 snakebites in Kannur District, Kerala, India

R. Whitaker & J. Lenin

Kannur District is located in northern Kerala on India's West Coast. It is 3000 sq.km in area with a population of two and a quarter million people, a density of 750 humans per sq. km. This densely populated area is also home too four species of highly venomous snakes: the cobra (*Naja naja*), common krait (*Bungarus caeruleus*), Russell's viper (*Daboia russelii*), and saw-scaled viper (*Echis carinatus*). The Russell's viper accounts for more than 50 % of the venomous bites. Mortality was 0.5%. The Pappinisseri Visha Chikilsa (Venom Treatment) Society has treated over 48,000 snakebites since 1964 using an effective combination of antivenom serum to immediately neutralize action of the venom and ayurveda to treat the local effects. Cases of renal failure (common in severe Russell's viper envenomation) are referred to a nearby General Hospital for dialysis. The poster will summarize the data collected at the Society's treatment center over the past 37 years with a more detailed analysis for the period 1990-2000.

Captive husbandry of the King Cobra *(Ophiophagus hannah)* at the Centre for Herpetology/Madras Crocodile Bank, India

R. Whitaker, G. Martin & N. Whitaker

King Cobras have been bred in several overseas zoos and once before in India, at the Madras Snake Park. This is a brief review of these successes in propagating what is surely the most magnificent serpent on earth. The paper also contains notes on two king cobra nests found in the wild and some notes on capture and behavioural observations. The main body of the paper describes the techniques used to successfully breed the king cobra at the Centre for Herpetology. It documents the Centre for Herpetology's programme for supplying captive-bred king cobras to zoos to discourage removing them from the wild where they are under extreme pressure because of habitat destruction.

Breeding the Travancore Tortoise *(Indotestudo travancorica)* at the Madras Crocodile Bank

Nikhil Whitaker

The breeding biology of *Indotestudo travancorica* was monitored between 17th December 1999 and 17th January 2001. Clutch sizes of 15 nests collected within this period ranged from 2 - 5 eggs. Embryonic development was monitored, determination of initial viability/non-viability of eggs was not accurate. Chalking of eggs in this species indicates severe dehydration. Incubation temperature averaged 25.5 C for, 11 clutches, and average incubation period was 141.5 days. Incubation of eggs from *Indotestudo travancorica* at constant temperatures of 31.0 C & 32.5 C without media resulted in 0% hatching success. Carapace length averaged 46.6 mm, carapace width 45.6 mm, plastron length 39.5 mm, plastron width 37.2 mm, and weight averaged 26.4 gms for seven successfully hatched Indotestudo travancorica. Average egg weight as compared to hatchling weight was 10.2 gms heavier.

Captive care of Indian reptiles

Nikhil Whitaker, Gerard N. Martin, Brian A. Stacy, & Romulus Whitaker

We present captive management guidelines for Indian crocodilians, snakes, and small lizard collections The section on crocodilian management discuss management of eggs, hatchlings and adults, nutrition, crisis management, implications of osmoregulation and thermoregulatory behvavior on captive management, and the future of crocodilians in India. The section on snakes involves discussing the ethics of obtaining wild caught stock and enclosure maintenance. In addition, experiences of the authors in witnessing excessive numbers and improper handling of snakes in captivity are put forth, and their consequences discussed. Identification and treatment of dysecdysis and infectious stomatitis, two prevailing disease processes in snakes in captivity, are outlined. Lastly, we look at species specific selection of small lizards, handling, housing, the importance of light, heat, and humidity on good health, feeding and water, breeding and monitoring of incubation, and the maintenance of hatchlings.

Composition and distribution of reptiles in the Walawe River Basin of Sri Lanka

L.J. Mendis Wickramasinghe & C.N.B. Bambaradeniya

The Walawe river is one of the three major river basins that extend from the wet central mountain massif to the coastal dry zone in Sri Lanka. It covers an area of 2,442 km^2 -approximately 4% of total land area in Sri Lanka, and extends from Horton Plains (3rd Peneplain - 2200m a.s.l) to the southern coast in the Hambanthota District. The Walawe basin falls through 5 of the 15 proposed bio-regions in the island; the wet highlands, intermediate highlands, intermediate zone, dry zone and the arid zone, in descending order respectively. The present survey was carried out to determine the species composition of reptiles and their variation in distribution along the Walawe river basin. The study extended from mid 1999 to raid 2001 (2 years), during which 10 representative sites along the entire Walawe basin were surveyed. Selection of sites was based upon variations in altitude, climate and major natural vegetation types. The reptiles in each of the 10 sites were recorded by random visual encounter surveys, carried out at both day and night, during the wet and dry seasons. Using the qualitative data gathered, the differences in sampling sites based on species composition of reptiles was examined through a multivariate analysis of data (TWINSPAN method), using the PCORD4 software. A total of 90 species of reptiles, belonging to 18 families were recorded from the entire Walawe basin. These represent 58% of the total reptiles of Sri Lanka. Of the total species recorded, 27 (30%) are endemic, while 39 (43%) are threatened. The highest number of species was recorded from the intermediate zone upland bio-region (consisting of moist evergreen forests and riverine forests), while the wet highlands (consisting of montane evergreen forest and wet patana grassland) harboured the lowest number of species (Table 1). Multivariate analysis of data in the 10 sites resulted in the separation of the sites into three distinct clusters, based on the species composition of reptiles (Figure 1). The three divisions corresponded with the three major peneplains in the island. Furthermore, sub-divisions within these main clusters were evident, and this could be related to differences in major natural vegetation types within each bio-region. A two-way ordered table showed that the total 90 reptile species in the Walawe basin were separated into 10 distinct groups, based on their distribution. Of the total species documented, only 2 species (Common Lanka Skink *Lankascincus fallax* and the Common Rat Snake - *Ptyas mucosus)* occurred, throughout the Walawe river basin.

Breeding biology of the Green Pit Viper *(Trimeresurus trigonocephalus)* under captive conditions

L.J. Mendis Wickramasinghe

The Green Pit Viper *(Trimeresurus trigonocephalus)* is an endemic, mildly poisonous arboreal snake in Sri Lanka. It is distributed mainly in the wet and intermediate zones in the island, while a few observations have been made in the dry zone. The Green Pit Viper (GPV) exhibits marked variation in color patterns. The populations in the wet zones are dark green in color, while those In the dry and intermediate zones are light green in color. Rapid destruction of forest habitats over the past 50 years, together with indiscriminate killings, have resulted in the disappearance of the species from some of its former localities in the above zones. As a result, it is now considered as a nationally

threatened species. The present study was intended to document the breeding biology of the GPV in order to consider reintroduction of this species into its former habitats. The study was carried out throughout January to December 1999. Initially, a mature male and a female were taken into captivity from the dry zone and the wet zone respectively. The two individuals were introduced into a tank (1.5 x 1.5 x 2.5 feet), that had an artificial environment quite similar to the original habitat of GPV. They were kept separately for a month in order to familiarize them into the captive environment. They were fed with rats, chicks and frogs at five to seven day intervals. Later the male was introduced into the female's cage. The pair took approximately four months to exhibit breeding behavior. Breeding behavior took place 3 days, and copulation was observed on five occasions, of which the first copulation lasted for 40 minutes while the longest copulation lasted for 4.5 hours. Once breeding behavior was completed the male was separated from the cage. The female gave birth to seven live juveniles and 16 partially hatched eggs. Of the live juveniles, the 5th, 6th and 7th individuals had no eyes, and the seventh individual died soon after the birth. Of the live juveniles, two were males while four were females. The average length of male hatchling wasl99 mm while that of the females was 196.6mm. The color pattern of the mature male was evident in one individual, while that of the mature female was represented in 5 individuals. The hatchlings underwent their first molt 48 hours after birth, after which they were offered small frogs, garden lizards, Geckos and Mice. However, they consumed only frogs throughout their captive period, which lasted for 6 weeks. The feeding behavior (prey capture) of the blind individuals was different to that of the others. The former relied on vibrations and heat of the prey introduced, when ready for capture. All juveniles were released 6 weeks after their birth into a forest habitat in the Wet Zone. This study shows that the GPV can be bred successfully under captive conditions. However, it is important to monitor the status of individuals that were re-introduced into wild habitats, using a suitable method.

Group hunting and mass feeding by Checkered Keel-back Water Snake (*Xenochrophis piscator*) in Shipra River, Ujjain

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On 8 October, 1996, I was sitting on a bridge over river Shipra in Ujjain. This bridge had sluice gates, which are used to control the water level. The river becomes a small reservoir when the sluice gates are closed. It was after dusk (around 1830hr), I saw some movement on the water surfaceand going closer to the bank, I saw eight sub adult Checkered Keel-back Water Snake (*Xenochrophis piscator*). They were catching fish in a strange way. This group of eight snakes formed a semi circle around a fish school (most of which were of size class 3-4cm) and by swimming in this horse-shoe formation they cornered the school near the sluice gates. Then they tightened this semi-circle by moving closer and when they were close enough to the school, the fishes started jumping out of the loop. The snakes caught many of the jumping fish in midair and swallowed them. They also caught the fishes inside the water and gulped them. In this frenzy the formation would break within a few minutes and the process of encircling another school of fish was repeated three times and then the snakes moved apart.

It took about 10-15 minutes to make the horse-shoe formation around the school and then cornering them, but the catching and feeding session would last for not more then 2-3 minutes.

On searching the literature for similar incidents I found a reported incident of mass feeding by Dog-faced Water Snakes (*Cerberus rhynchops*) in Sumatran mudflats (Giesen, 1993). He observed the snakes coming out enmasse on overcast moonless night on a mud flat and catching the mud skippers (*Periophthalmus* sp.). He counted 20 snakes around his boat and suspected that there were more snakes around.

Similar observations of group hunting of fishes by Marsh Crocodile (*Crocodylus palustris*) were reported by Lenin (2003) in Sri Lanka. She reported that during this group hunting the crocodiles would drive fishes from one end of the water body to the other and then launch onto them. This activity was repeated across the other shore.

Though mass feeding by snakes was reported earlier (Giesen, 1993) but the strange behaviour of group hunting by Checkered Keel-back Water Snakes is presumed to be reported for the first time in this note. I have been to the same place a few more times but have never seen the same phenomenon afterwards.

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An observation of the foraging behavior of *Ceratophora tennentii* Günther, 1861 Knuckles Forest Range in Sri Lanka

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Ceratophora tennentii (Leaf-nosed Lizard) belongs to the family Agamidae (Lizards) and sub family Lyriocephalinae which consists of three endemic genera, *viz*., *Cophotis*, *Ceratophora* and *Lyriocephalus*. The genus *Ceratophora* is represented by five species; *C. tennentii*, *C. stodartii*, *C. aspera*, *C. eardlarnii* and *C. karu* (Pethiyagoda, 1998).

C. tennentii is distinguished from all other Ceratophorans by the complex, laterally compressed rostral appendage (Pethiyagoda, 1998). The total length of the adult male is about 185 mm and the adult female is about 183mm.

Predominant colour of the dorsum and sides of mature individuals is reddish-brown to olive green; larger scales more greenish than smaller ones. The eyes and sides of the neck have black margins. There are about ten broad, dark brown bands on tail separated by narrow, lighter interspaces. Venter is usually whitish. Male is darker than female (Manamendra-Arachchi, 1990). Juvenile lizard is dark brown both dorsally and laterally (Pethiyagoda, 1998).

Distribution of the *C. tennentii* is restricted to Knuckles mountain region, at an altitude of 760-1220m (Pethiyagoda, 1998), which has been isolated from rest of the central hills by the Mahaweli River. Most of the habitats of this species are now under cardamom (*Elettaria cardamomum*) plantations, with its concomitant clearing of undergrowth. This slow moving lizard, which was frequently seen on the ground and moss covered tree trunks, is not uncommon even in cardamom plantations now.

Location: The Observation was made in a cardamom plantation in Reverse Turn in Knuckles forest range. The site was adjacent to the Mathale–Pallegama main road.

Habitat: The habitat was a disturbed montane forest; the under growth was covered with Cardamom mixed with small bushes. The place was shady and the ambient temperature was 24.5^{0}C. The canopy allowed only a small amount of sunlight to penetrate through to the forest.

Method of Observation: The observations were made by the naked eye, 2m away from the lizard, on 28 May 2002 from 1500 to 1530hr. No disturbance was made to the animal during the time of observation.

Behavior of the lizard: The adult male lizard was found about 1.5m above the ground level on a plant (Family Rubiaceae) and was aiming to a green moth larva resting on a branch, which was about 4.5cm in length. The lizard made slow movements towards the caterpillar and leaving about 1cm distance it stood still for a few minutes. Then the lizard suddenly grabbed the larva's anterior part and squeezed it hardly. The larva was kept by the lizard approximately for one-and-a-half minute. Next, the lizard expelled the larva out and started smacking continuously while the caterpillar was observed traumatized and secreting a green fluid (haemolymph). Then the lizard moved away as it had decided to give its prey.

Two extreme types of foraging behaviour by reptiles have been identified by Pough *et al*. (2001): sit-and-wait foraging and active foraging. *C. tennentii* obviously showed active foraging behavior type. In active foraging (also referred to as wide foraging) the animal moves frequently, searches large areas and may dig or probe actively for a concealed prey. Prey are usually detected at close range and captured with little or no pursuit (Pough *et al*., 2001). Some caterpillars are poisons to the predators and they can actively secrete unpleasant fluids (Monastyrskii & Devyatkin, 2002), which may have been the reason for *C. tennentii* to release its prey.

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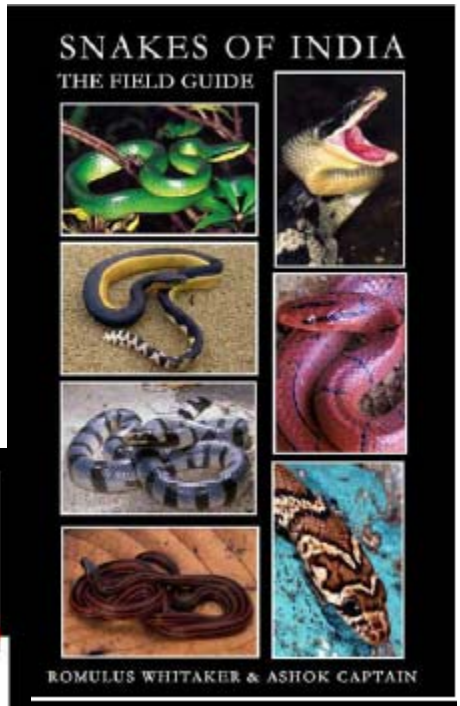

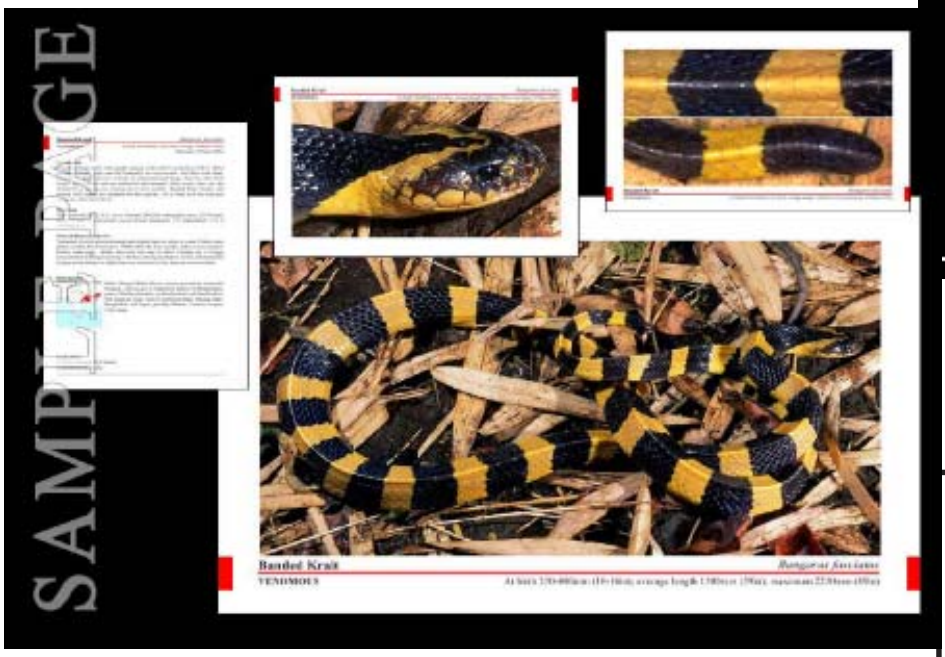

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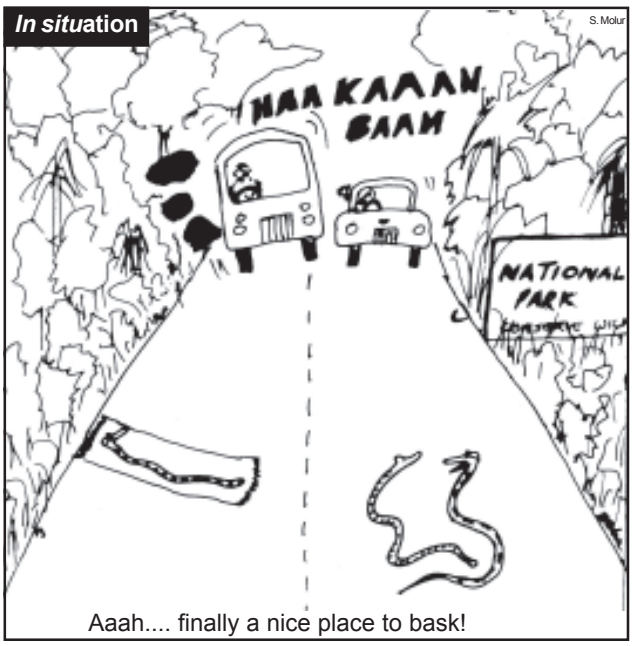

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