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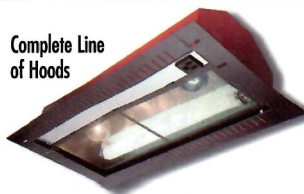
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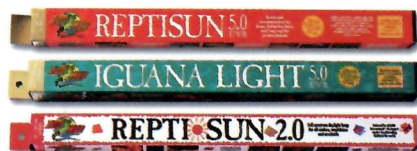


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the VIVARIUM

Volume 8 Number 4

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PUBLISHER

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STAFF

Editor

Susan Donoghue, VMD, MS, DACVN

Associate Editor

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CONTRIBUTING WRITERS

Kevin Wright, DVM
Dave and Tracy Barker
Winston Card
Ellin Beltz
Danté Fenolio
Roy Pinney
Randall Gray

ADMINISTRATIVE STAFF

Office Manager

Tammy McClendon

Accounting

Peter Sciumbata

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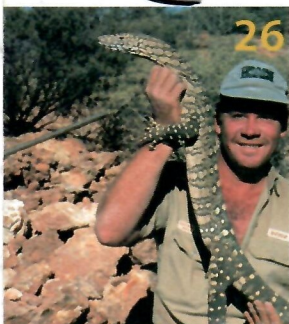
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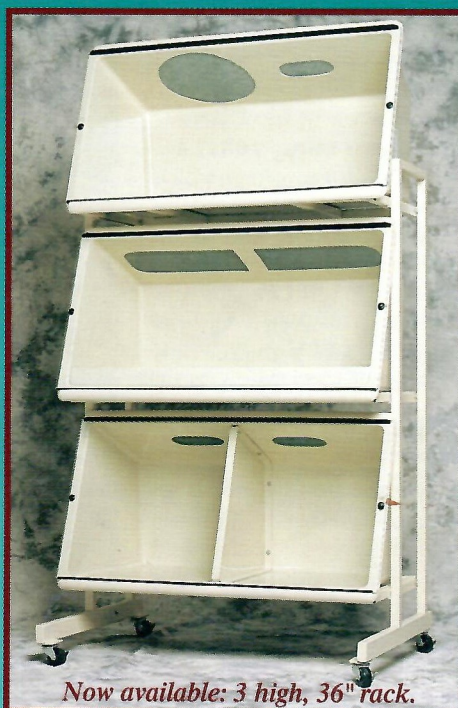




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Notes on the Natural History and Husbandry of Hamilton's Pond Turtle (*Geoclemys hamiltonii*) at Lowry Park Zoo

by Richard Reams

Geoclemys hamiltonii (Gray 1831) belongs to the turtle family Emydidae, which is the largest and most diverse family of turtles, containing 33 genera and 91 living species. There are representatives of this family on all continents except Australia and Antarctica. *Geoclemys* is a monotypic genus, with *hamiltonii* being the only species.

Morphology

Hamilton's spotted pond turtle is an attractive, medium sized freshwater turtle with an elongated, three-keeled domed carapace. Black is the predominant color with a large number of white to cream-colored triangle-shaped marks on the pleural and marginal scutes. Older specimens often lose this pattern and become nearly solid black. The plastron is hingeless and cream-colored with numerous black markings.



Brightly patterned juvenile Hamilton's pond turtle.

The front and hind legs, as well as the head, have relatively large, bright yellow spots. Males have a more concave plastron and thicker tail than females. There are reports (Barbour and Ernst, 1989) of specimens reaching a carapace length of 13.8 inches (35 cm). The zoo's largest specimen is 12.6 inches (32 cm). Juveniles are black with dozens of white spots and the keeled scutes on the carapace are more pronounced than on adults.

Range

Geoclemys hamiltonii is considered a rare species found only in the Indus and Ganges River drainages of southern Pakistan, northern India, Bangladesh, and Assam. Very little is known about this turtle in its natural habitat. However, Pritchard (1979) reported it from oxbow lakes and sloughs in quiet, shallow, rather clear waters containing considerable aquatic vegetation.

Captive Husbandry

Quarantine - On 27 April 1992, the Lowry Park Zoo received three male and fifteen female Hamilton's pond turtles from a United States Fish and Wildlife Service confiscation. Unfortunately, no locality data were available.

These specimens had an average carapace length of 10.5 inches (26.7 cm) and the largest specimen weighed 7.9 lbs (3586 g). After being measured, weighed, and notched on the marginal scutes for identification, all the specimens were quarantined for 45 days.

During quarantine the turtles were housed outdoors in a galvanized trough measuring 10 feet (3 m) in diameter and 2 feet (61 cm) high. The trough was filled with 1 foot (30.5 cm) of well water which was changed every other day due to the high density of turtles. A large cypress log was provided for basking.

On 8 April 1992, all 18 specimens were prophylactically dewormed with levamisole, metronidazole, and praziquantel; second doses were given two weeks later. One week after the second dose, fecals were analyzed and found to be negative for parasite ova. Upon completion of the 45-day quarantine period, all 18 specimens were placed on exhibit in a pre-existing woolly monkey enclosure.

On Exhibit - The turtle's exhibit was surrounded by a moat which measured approximately 10 feet (3 m) x 40 feet (12 m) x 4 feet (1.2 m) deep at the lowest point. An artificial stream ran into one side of the pool, maintaining a continuous slow circulation. The land area of this exhibit was about two-fold the size of the moat area. The turtles appeared most active when temperatures were 75–85° F (24–29.5°C). Most specimens spent a large amount of the day on land in shallow depressions which they had excavated. During the winter, when tempera-



Adult Hamilton's pond turtle (*Geoclemys hamiltonii*)- Older adult animals tend to lose their shell pattern.

tures ranged between 55–64° F (10–18°C), most of the turtles were still very active. All specimens remained in the exhibit until temperatures dropped below 38° F (3°C), when they were moved indoors.

The following diet was fed three times per week: Reptomin,[®] Purina Monkey Biscuits,[®] Nebraska Bird of Prey Diet[®] and various types of fish including capelin, smelt, and live shiners. Fruits and vegetables were offered but never eaten.

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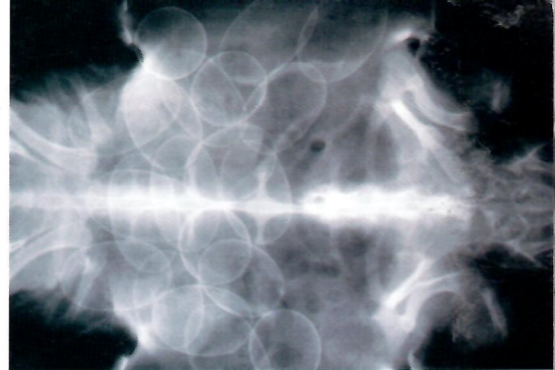
Courtship occurred typically in water, and was observed during March, April, and May. The males faced the females and bit lightly at their front legs and heads.

Some mounting was observed, but no copulation could be seen due to the distance between the observer and the turtles.

On 3 May 1995, one female appeared to be dehydrated with slightly sunken eyes. This female was removed from the exhibit and radiographed. The radiographs revealed that she was gravid with twenty well-calcified eggs. This observation prompted radiographs of eight additional females. Only one other animal was gravid; she had 17 eggs.

used as the incubation medium. Eggs were partially buried with the top third of the egg exposed.

Fourteen days after oviposition, the eggs were candled and vascularization was evident. On 1 June, three eggs began to hatch. Only eggs that were incubated at 84° F (29°C) hatched. Eggs #1-6, #9 and #11 were infertile. Eggs #14, #17, and #18 went full term but died shortly before hatching. Eggs #15, #16, and #19 hatched and appeared healthy.



Radiograph of female Hamilton's pond turtle showing twenty well-defined eggs.

ment, where they began eating live tropical plants in their enclosure. After this was observed, leafy green vegetables were offered and consumed.

Between 10 June and 20 June 1995, 14 additional neonates were discovered in the primate exhibit where the adults were housed. Four specimens were discovered dead and were assumed to have drowned in the deeper part of the enclosure.

Hamilton's pond turtles are uncommon in zoos, and prior to hatching 17 neonates at the Lowry Park Zoo, it was estimated that only 31 specimens could be found in United States zoological facilities and fewer than that in private collections.

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Barbour, R. W. and Ernst, C. H. 1989. *Turtles of The World*. Smithsonian Institution Press, Washington, D.C.

Pritchard, P. C. H. 1979. *Encyclopedia of Turtles*. T.F.H. Publications, Neptune, NJ.

About the author: Richard Reams is senior keeper of the reptile department at the Dallas Zoo. Prior to this position, he was assistant curator of reptiles at the Lowry Park Zoo in Tampa, Florida, and in previous years maintained a large private reptile collection.



Eggs incubated in vermiculite. They are numbered for identification.



The woolly monkey enclosure where Hamilton's pond turtles are exhibited.

On 4 May 1995, an off-exhibit enclosure was constructed for the turtles using old railroad ties. The enclosure measured 6 x 10 x 2 feet high (1.8 x 3 x 0.6 m) with a floor of natural Florida soil. A small plastic pool was used as a water source. On 8 May, 20 eggs were discovered in the off-exhibit enclosure. The average egg weights and lengths were 0.47 ounce (13.3 grams) and 1.34 inches (3.4 cm), respectively. The nest from which the eggs were excavated measured 6 inches (15.2 cm) deep and 3 inches (7.6 cm) in diameter.

The eggs were numbered and placed into three different incubators. Eggs #1-6 were incubated at 79° F (26°C), #7-13 at 81° F (27°C), and #14-19 at 84 degrees (29°C). Egg #20 was severely cracked and discarded. Vermiculite:water at 1:1.5 was

After hatching, the neonates were moved to a plastic shoe box containing damp paper towels, until the excess egg yolks were absorbed. Neonates were measured and weighed on 4 June; carapace length averaged 1.3 inches (3.3 cm), carapace width 1.1 inches (2.8 cm), plastron length 1.2 inches (3.0 cm), and weight averaged 0.3 ounces (8.5 grams). Hatchlings were then placed in a ten gallon (38 liter) aquarium with two inches (5 cm) of water and plastic plants for security.

On 10 June, the three juveniles began feeding on Reptomin,[®] earthworms, two-week-old crickets, and small pieces of fish. No vegetable material was accepted. However, approximately one year later four specimens from a subsequent clutch were sent to the Dallas Zoo Reptile Depart-

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MORE ON LIGHTING

To the editor:

It is with great interest that we read Dr. Gehrman's interesting and informative article on reptile lighting (Volume 8, Number 2). In 1995, an independent laboratory ran a detailed spectrographic analysis on our full spectrum bulb and found it to have UVB emissions equal to, or greater than, the industry leader at that time. We have received recently data from a second independent laboratory which also suggests that there is no significant difference in UVB emissions at 280–315 nm between our full spectrum tube and the original competitor, as well as one of the tubes ranking highest in UVB output (at 300 nm) in Gehrman's article.

We have obtained information from two sources suggesting that ordinary portable or hand-held meters are not satisfactory for evaluating full spectrum tubes intended for reptile use. Do you agree that only a dedicated double monochromator spectroradiometer can realistically evaluate full spectrum tubes?

What instrumentation did Dr Gehrman use to arrive at his ranking system? His article may have unfairly implied that ReptiGlo® is insufficient in terms of UVB emission.

According to Bernard et al. (1996), dermal and epidermal conversion of vitamin D precursors takes place from 280 to 315 nm, not 290–300 nm as Bernard was quoted in Gehrman's article. ReptiGlo® has emissions both above and below 300 nm comparable to almost any other full spectrum bulb on the market. The data from Gehrman's table are for a single wavelength, 300 nm. Is this not significant? Because light sources tend to produce fluctuating values at these wavelengths (Schneider, 1991), reading at one particular wavelength may present a skewed picture.

Many authors including Dr Gehrman (1996) have described correlated color temperature and color rendering index (CRI) as a part of a full spectrum tube evaluation system (Goldstein, 1990), something that was not published for each of the tubes in his article. The actual luminance (lux) of the tubes was also ignored in the ranking system. I understand that the ranks were based on supposed UVB output, but to a consumer, being at the bottom of the list implies many things.

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ues listed, a higher CRI than the other full spectrum bulbs tested for us by an independent laboratory, and a higher color temperature than the other bulbs.

L. Bauck, BSc, DVM, MVSc
Rolf C Hagen Inc
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Goldstein, R. G. 1990. "Spectrum lighting." *Reptile & Amphibian Magazine*, pp. 18–21.

Schneider, W. E. 1991. Measuring solar spectra; problems and solutions. *Lasers and Optronics*, pp 63–65.

Dr Gehrman responds:

The instruments used for measuring UVA and UVB irradiances, and illuminance from each of the lamps, are stated in the description of Table 1. The UV meters are indeed Spectronics Corp. broadband radiometers. Single value readings from these meters must be interpreted with caution. For example, if I record an irradiance of 30µw/cm² with the UVB meter, I don't know how this value is partitioned among wavelengths between 280–320 nm. In contrast, the output from a \$50,000 spectroradiometer would show this distribution clearly. Nevertheless, I felt justified in reporting the values because they serve as guide posts until more refined data are published.

The ranking of lamps by UVB irradiance in my table was simply a means of imposing some organization on the values. I did not mean to imply a hierarchy of biological efficacy, and I was perhaps remiss in not including a statement to that effect in the table heading. I do so now: the relationship between values reported in the table and long-term maintenance and reproduction in reptiles has not been determined experimentally.

The band between 290–300 nm was termed "D-UV" by Dr. Bernard in her dissertation (1995) because **most** vitamin D₃ is synthesized by UV within this band.

The values listed in the table for UVB are not for a single wavelength of 300 nm but rather the band between 280–320 nm.

I reported illuminances simply as measured and made no attempt to expand on biological significance among lamps because I don't know what those are. There is no doubt, however, that the Repti-Glo® lamp has the highest light output per watt among all the fluorescent tubes tested.

William H. Gehrman, PhD
Fort Worth, TX

PHOTO CAPTIONS

To the Editor:

I would like to take this opportunity to mention that our hognose snake article (Volume 8, Number 2) has a few minor errors in it, and I don't want readers to be misled. The mistakes pertain to photos. The habitat photo of hognose snakes was taken in extreme southwestern New Mexico, not Arizona. However, the mountains in the background are the Chiricahua Mountains of southeastern Arizona. The cage photo was mislabeled. There was no green lid used as a hide area; instead it was a plastic hide box designed for use in herps. Lastly, the final photograph was not taken *in situ*, but is a studio shot. Thanks for taking the time and space to print this letter and keep up the good work on a great magazine.

Thurgess Cranston

We welcome your letters. Please address them to the Editor, The Vivarium, American Federation of Herpetoculture, PO Box 300067, Escondido, CA 92030-0067. Please include full name and address. Letters accepted for publication may be edited for length and clarity.

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Herp News From Around the World

by Ellin Beltz

NEW RECRUITS?

• "Police in Java say they plan to start using venomous cobras to break up mass demonstrations and compel crime suspects to confess... [Police are] working with snake handlers... to develop the 'poisonous' weapon," reports the *Shropshire Star* [January 13, 1997 from Mark O'Shea].

• The *Shropshire Star* reports: "A jilted woman released six cobras in a crowded karaoke bar in central Jakarta [Indonesia] to teach her former boyfriend a lesson... One of the cobras was clubbed to death by policemen and the bar's security guards but no one was bitten." *The Independent* reports that "The woman and the cobras were taken into police custody." [Both January 21, 1997 from Mark O'Shea.]

GREAT KARMA, BAD ECOLOGY

• Some Buddhists free captive animals in an effort to generate merit and improve their karma. Unfortunately this practice can lead to an ecological nightmare, as recently happened when seven people from a Manhattan temple released 2,500 pet shop goldfish into a reservoir for the city of New Brunswick. One monk said that there are at least 20 temples in New York City who make a habit of releases, usually in large numbers. State officials have found dead turtles that on necropsy were found to have died of exposure. Neighbors reported seeing people in yellow robes releasing the turtles at the state park. The wildlife pathologist said, "These kinds of releases generally have bad outcomes. The person releasing the turtles may have meant well, but it was fatal to these creatures." [The *New York Times*, January 11, 1997 from P.L. Beltz].

• Meanwhile in Bogota, Colombia government officials are planning to spend \$79,000 dollars in an effort to eradicate introduced American bullfrogs which have begun to "destabilize the natural order in some areas because of its voracious appetite for small amphibians and insects," reports the *Associated Newspapers of Ceylon* (Sri Lanka), October 29, 1996 from Wes von Papineau and Kimberley Heaphy.

• Wildlife agencies releasing animals taken on a "nuisance" basis may need to revise their programs based on work being done with Western diamondbacks near Sedona, Arizona. Seems the snakes are either site specific or struck with a form of wanderlust which results in them roaming and never quite settling down. Most snakes have regular patterns and the control group in the recent study showed that they have a relatively small home range. A Canadian study showed that relocated snakes can't seem to find suitable hibernation sites; the majority die over winter. Of the seven snakes moved in the present study, two returned home, four were wandering and one disappeared the night after it was released. Another Tucson study showed that of eight snakes with transmitters, one died by being bulldozed for a housing development, one was eaten by a badger, and one killed by humans. The other five are still out there, somewhere. [Tucson *Citizen*, November 8, 1996 from Jerry L. Boyer (I think, no name on clipping)].

NOW HERE'S A THOUGHT

• G.D. Gearino of Raleigh, NC wrote: "If it turns out heaven is run by snakes, a whole bunch of us are in trouble. It could happen. Remember, we're all God's creatures, so it's possible that when your soul arrives at St. Peter's gate for its pre-induction physical, some snake will be there giving everyone who passes through the once-over. 'That's him!' the snake will shriek as you approach.. 'That's the guy who sliced off my head with a

hoe. Don't let him in.' So you'll be pulled aside and made to explain how it is you came to decapitate this creature... It won't matter what I say. It'll be clear I'm a serial snake-killer. In short, it's time for me to become a friend to snakes."

Attending a snake-petting session at the museum apparently helped. [The *News and Observer*, October 4, 1996 from K & W Herp Haven].

SNAKES ON THE LOOSE

• Tut, the Stoneham, Massachusetts Egyptian cobra missing since last August was found in early November by a fourth grade student reaching for his lunch box. The 9-year-old said, "I jumped about three feet back when I saw it. I was scared." Three cheers for the fourth grade teacher, though; by the time authorities arrived Tut was trapped and secured in a recycling bin. The teacher said, "Well, now we can use the [grassy] field... it puts some closure on the whole thing. We don't have to worry where it is anymore." [The *Boston Globe*, November 7, 1996 from K & W Herp Haven].

• A seven-foot Burmese python was found slithering around in a Fort Worth, TX neighborhood early one morning after it had gotten into a garage and was trying to eat a kitten it found there. The kitten was rescued by a neighbor who endured python bites which resulted in six stitches and a blast of antibiotics. [Fort Worth *Star-Telegram*, July 10, 1996 from Jonathan C. Lewis IV].

• The *Weekly World News* featured huge, banner herpetological headlines which I'd summarize for you but it's too hard to type with one hand while my other hand is holding my nose shut. In one article a mother rescued her five-year-old son from the mouth of a 12-foot Burmese python. The photo shows the mom waving a poker and a bloody knife. [October 15, 1996 from Spering Scott].

• An eight-foot long king cobra escaped from exhibit at "Temple Ruins" in the Tropical Discovery exhibit at the Denver Zoo. Spokesperson Suzanne Juhas said "At no time was the public ever in danger," however the "danger to zoo staff was deemed unacceptable... [and the cobra] was shot by keepers after efforts to capture him failed," according to *The Rocky Mountain News* [December 10, 1996 from Petra Lowe].

• Poor St. Patrick must be spinning! After all his efforts to banish snakes from the Emerald Isle, the snakes win. An office worker in Belfast puttering with a fritzzy photocopier found a black and yellow snake. He said, "I shot back about ten feet." Seems the shop downstairs, City Reptiles, had misplaced the "American grass snake." [The *Times*, London, January 3, 1997 from K & W Herp Haven].

• A Lancaster, Pennsylvania family had a really big surprise one morning at 5 a.m. when they discovered a two-foot long python. The husband told his wife, "You won't believe this... There's a snake in the bathroom. It came out of the toilet bowl and pushed the seat up to get out." She called 911; officers responded and took the snake out of the medicine cupboard and took him off to city hall. The next day, a 22-year-old woman claimed the snake as the one-year-old ball python she had misplaced about ten days previously while she was moving out of the building. How did "Athena" get out? The woman said "I had taken her out for exercise. She was crawling on my neck and then crawled down on the floor while I was reading a book... when I looked for her, she was gone." [New Era, December 30 and 31, 1996 from Michael J. Shrom].

SOUTH AFRICAN NEWS

• Animals confiscated from an Egyptian traveling circus by the government of South Africa were due to be released in early November. The six lions, three tigers, an African python, three horses and five dogs had been abandoned to starve when the circus left Maputo. Genetic material from three of the lions indicates they may be a species of Barbary lions previously believed to be extinct. They were being held pending confirmatory testing. [South Africa *Saturday Star*, November 23, 1996 from K&W Herp Haven].

• Pretoria Zoo suddenly received 2,000 reptiles when a shipment from a reptile farm in Mozambique to Florida was opened and discovered in "appalling condition," according to reports from *The Citizen* and *The Star*. Officials didn't speculate why the people who shipped the animals left half the consignment behind, but stated the case was one of "gross neglect," that the crates were substandard and up to 200 animals died of suffocation. "Puff adders and sungazer snakes were packed in bags on top of one another," said the SPCA spokesperson. [July 11, 1996] Contributor Mike Penrith, head of the Aquarium and Reptile Park of the National Zoological Gardens of SA Pretoria, wrote, "... When opened, only 210 of the 295 Chameleons were still alive and another 40 plus died within 48 hours. There were deaths among the other reptiles and arachnids as well but not as extreme, thanks mainly to the animals being removed from the shipping containers in time."

ON THE OTHER COIL

• Contributor Mary McDonald writes: "After all the 'python kills tot' stuff in our tabloids, its nice to see that The New York Times thinks snakes are fashionable and it's not snake skins." The attached photo-essay shows chic New Yorkers with stuffed, fake fur, snake shaped, neck warmers. Apparently, it's become quite the thing in the Big Apple to stroll around in summer with something big and serpentine wrapped around your neck. [December 1, 1996].

HOP-, SLITHER- AND WRIGGLE-NEWS

• The *Lancet* reports that the number of people killed by poisonous caterpillars has now surpassed deaths from snake bite in some regions of Brazil. [South Africa *Mail and Guardian*, October 18, 1996 from Wes von Papineau and Kimberley Heaphy].

• A Mexican artist was earning up to \$20,000 a piece for large, colorful oil paintings — until gallery owners discovered that it was really his pet boa, dipped in paint, making the designs. [Weekly *World News*, June 25, 1996 from K & W Herp Haven].

• Headline: "Goodby cruel world: \$10,000 trained frog hops into toilet bowl — and gets flushed down the commode." Accompanying photo: the frog's companion people are shown mourning at the porcelain pit fall. They had spend months training the frog, who in hopper days had been featured by the paper in his own tiny decorated rooms — including a bathroom! [Weekly *World News*, December 3, 1996 from Wes von Papineau and Kimberley Heaphy].

• A Largo, Florida resident, trying to protect his poodle, shot a local alligator which he felt had come a bit too close for comfort. He said "I don't think I did anything wrong. I wouldn't have done it if I had known it was a felony," reports *The Argus*. The wounded alligator was only a little one, about three feet, and it was taken care of until it died by a wildlife rehabilitator. The man is out on \$1,500 bail. [August 12, 1996 from Matthew and Laurie Aikawa].

• The *Bangkok Post* reports "Damam, UAE: A Saudi woman complained of 'strange movements down her back' during a plane flight to see her daughter. At her destination, the daughter pulled back the folds of her mother's dress to take a look, and was bitten by a poisonous viper... The girl died." [October 29, 1996 from Wes von Papineau and Kimberley Heaphy].

• It was reported that a tourist to Ecuador brushed against a poison arrow frog which resulted in the man being taken to hospital with a violent reaction. Local people suggested that he might not make it. He did; and for the next eight months suffered joint pains and other odd symptoms. [Weekly *World News*, January 12, 1997 from Wes von Papineau and Kimberley Heaphy].

• Two teenage boys dipped lizards in gasoline, set them on fire and released them. The resulting flames destroyed several homes including one which housed a herpetological collection of research materials and reptiles. [Nevada *Appeal*, June 27, 1996 from Allen Salzberg].

HOPPINESS IS SEVEN STORIES ABOUT FROGS

• "Hero frog hops five miles to save master's life" shouts *Weekly World News*. The critter pictured is an Argentine Horned Toad (*Ceratophrys ornata*). The story they report is that a man had taken his pet frog along on a day fishing trip, as he was in the habit of doing regularly, and passed out on the bank of the stream. The frog supposedly hopped five miles back to the house, and alerted the man's wife and brother that something was wrong. [August 23, 1996 from K&W Herp Haven].

• "Fly-sized frog found hopping it up in Cuba" reports the Tacoma, Washington *News Tribune*. The story, which had great 'legs,' tells of a frog small enough to sit on a dime (actual size about 2/5ths of an inch or 1 cm) being found in a Cuban rainforest by researchers. When found, one female was actually with her egg. Researchers speculate that the frog lays only one egg at a time due to her tiny body size. [December 6, 1996 from Alan Tuley].

• Have three frog species gone extinct in New South Wales, Australia? The Frog and Tadpole Study Group's annual frog survey revealed that three species are entirely missing from this year's census. If you'd like to volunteer: FATS, P.O. Box A2405, Sydney South, 2000 Australia. [Sydney Morning Herald, November 6, 1996 from Wes von Papineau and Kimberley Heaphy].

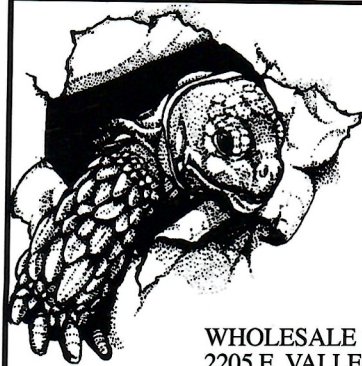
• "The mystery of the frogs: deformed amphibians with extra or missing legs... are being found around the U.S." was addressed by *The Los Angeles Times*. The take-home message of the article was scary: "Since the investigators have no idea what they are looking for, unraveling the mystery could take years. Even if they narrow their search to pesticides, there are hundreds to test for — and infinite combinations." [November 25, 1996 from new contributor Joseph M. Luna].

• *The Globe and Mail* (Toronto) reports: "Zoologists at the University of Michigan have taken photographs of an East African amphibian, the *Scolecophorus kirkii*, popping its eyes out of its head on stalks." [October 22, 1996 from K&W Herp Haven].

• O.K. froggies, exhale. Researchers at the University of New Orleans have learned how to synthesize a chemical venom for which the only previous source was live, wild-harvested frogs. "The frog population was being devastated," said a research chemist at the University. [*Electronic Telegraph* (UK), October 22, 1996 from Kimberley Heaphy and Wes von Papineau].

• The *South African Star* reports: "Once upon a time there were thousands of frogs who hibernated on one side of a busy British [road... and crossed it every year to breed.]... Sadly many were crushed by cars in their lust for life. So the scientists built them a tunnel of love under the road, a sort of concrete condom to guarantee safe sex. But while the toads were dying for love, they refused to use the tunnel: it was too cold and airless... scientists are planning to install air conditioning and heating. And so the mad frogs and Englishmen lived happily ever after." [November 18, 1996 from K&W Herp Haven] Worse than any preceding, the *Star's* headline read "Frigid no more."

Thanks to this month's contributors and to: Debra Patla, unknown in Philadelphia (please put your name on every clipping!), Roger Featherstone, Alan Rigerman, P.R.S. (?), Funk, Mark Paul Henderson, Jerry L. Boyer, Matthew and Laurie Aikawa, Christopher Knuth, Alan Tuley, Bryan McCarty for sending clippings, articles, photos and cards. You can contribute, too. The best way is to take the whole sheet(s) of newspaper, fold a minimum number of times, and write your name on each piece. About five pages and an envelope are one ounce (\$0.32). Think about all the fun you'll have showing friends and family your name in an upcoming column! Join my other fantastic contributors and keep my mailman svelt. (Mail to the address on the masthead; e-mail only to <e-beltz@neiu.edu>.)



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Dear AFH: I've been given two crocodile geckos. I was told that they are nocturnal and from arid areas but I cannot find any information on their care. Help!

Philippe de Vosjoli responds: Crocodile gecko is the pet-trade name for the Moorish gecko (*Tarentola mauritanica*), a neat broad-headed species with tubercled skin that hails from the Mediterranean and North Africa. They are currently imported from Egypt. The Moorish gecko is best thought of as saxicolous (rock dwelling) and is common on stone walls. Although some writers will call the lizard nocturnal I have seen it spread out cryptically on walls around Monte Carlo, basking in the morning and late afternoon. If threatened, these geckos scurry into crevices. Thus, rock surfaces are essential landscaping when designing a vivarium for these geckos. Limestone, or even concrete block or rubble work well. The rocks should be stacked and stood on their sides to provide shelters and means for animals to escape and hide if attacked by others.

A sandy soil works well as a substrate. Sansevieria and pony-tail palm (*Beaucarnea recurvata*) are suitable plants. Although these geckos are found in arid regions, relative humidity should be about 50-60%.

This species should be kept in large enclosures — 20 gallon (76 l) or more — because it is competitive and territorial. Moorish geckos are best kept as single pairs, for large males will attack, bite and kill smaller males. In very large vivaria with lots of rock work, an additional female or two can be added. Animals housed together should be in the same size range.

Spotlights for basking [80's° F (high 20's°C) during the day, upper 70's° F (mid 20's°C) at night] as well as full-spectrum fluorescent bulbs are recommended. At night a 25 watt red incandescent bulb can be used to provide heat.

The Moorish

gecko feeds on insects and can be raised on crickets and mealworms. These should be offered two to three times a week and be dusted once to twice a week with a 50:50 mix of vitamin/mineral supplement: calcium carbonate.

Imported lizards may be parasitized. If an animal is losing weight or listless, or excreting loose feces, a fecal sample should be taken to a veterinarian for examination and the appropriate treatment initiated.

Breeding Moorish geckos requires winter cooling in the 60's° F (mid- to high-teen's°C) combined with reduced photoperiod. Under optimal conditions females lay four to six clutches of two hard-shelled eggs at three-week intervals during the breeding season.

The Moorish gecko can be kept with diurnal lizard species in the same general size range and with similar requirements but inhabiting a different vivarium niche, e.g. terrestrial instead of saxicolous. I have kept them successfully with collared lizards (*Crotaphytus* spp.) in a six foot (1.8 meter) long vivarium.

Recommended reading: Henkel/Schmidt. 1995. *Geckoes*. Krieger. Malabar, FL.

Philippe de Vosjoli
Escondido, CA

Do you have questions about herpetoculture? Send your questions to our panel of experts at Questions, The Vivarium, PO Box 300067, Escondido, CA 92030-0067. Questions accepted for publication may be edited for length and clarity.

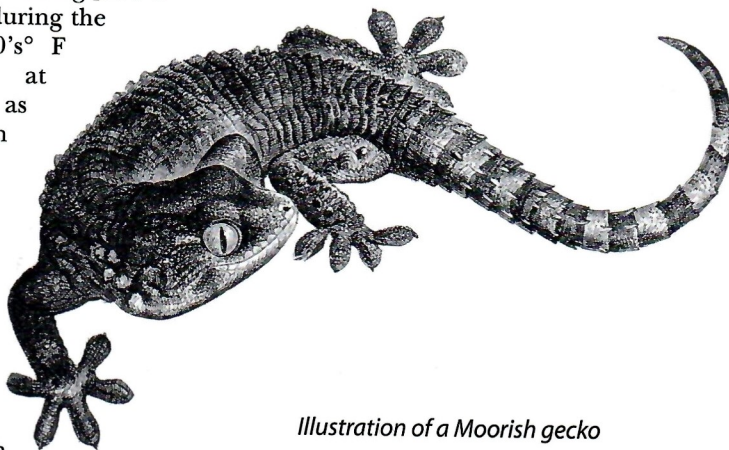


Illustration of a Moorish gecko

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Amphibians

Raising Tadpoles

by Philippe de Vosjoli and
Robert Mailloux

Throughout the world, spring is the time when many species of frogs and toads congregate in ponds, pools and streams to breed. Invariably, children are drawn in biophilic fascination to the aquatic larval beings we call tadpoles; kids will collect them in jars and want to take them home.

For many children, the process of growth and metamorphosis which can be observed when raising tadpoles in the home has provided a key lesson in the ways of nature. Raising tadpoles was once tantamount to a cognitive stepping stone which determined whether one would become fascinated by nature or remain fixed on human sociocultural landscapes.

Tadpoles, perhaps because they appear so innocuous, have also been some of the first pets to be kept by children. How much harm can there be to a jar of pond water? Although we are now plagued by excesses of wildlife legislation that may one day make any child collecting tadpoles a potential criminal, we can safely assume that for years to come thousands of children and in some cases adults will bring home jars of alien metamorphing

beings to raise and observe. Nonetheless, for the sake of being "politically correct" (Yuch!), we must inform readers to please check with their state fish and game agencies to determine the legality of collecting and raising tadpoles in their area.

As a result of these annual tadpole collecting practices, pet stores and herpetological societies are often asked about methods for raising tadpoles. The following is a step-by-step guide to raising the more common tadpoles in captivity. In the great majority of cases you should be successful using this system, not only with the tadpoles of temperate frogs but also with the tadpoles of many other species kept in captivity.

A step by step approach to rearing common tadpoles

1) If collecting tadpoles from a pond or stream, only collect a small number — ten or less — to raise in captivity. It requires a lot of space and time to raise large numbers of tadpoles and considerably more space, time and money to raise large numbers of frogs. Moreover, by collecting just a few tadpoles, it is unlikely that your capture would in any way affect the wild population of the species you are collecting.

2) Always bring tadpoles home in a container with water from the area of collection. This cannot be emphasized enough. Bring at least a gallon (3.8 l) of the original water with you, if possible.

3) Once you have the tadpoles home, you will then have to set them up. The first step is to select an enclosure. This can be as simple as a large, clean half-gallon (1.9 l) jar or larger, plastic food-storage container, fish bowl or aquarium. Glass or food-storage quality plastic is the safest because chemical leaching is unlikely. As a general rule, figure four tadpoles per gallon (3.8 l) for most species but only one tadpole per gallon for larger species, such as bullfrogs (*Rana catesbeiana*).

4) This step — assuring good water quality — is one of the most critical. Water direct from the tap kills most tadpoles, particularly when the amphibians are in the early stages of development. That is the primary reason for collecting water before bringing tadpoles home; it gives you time to solve the water quality problem.

In most cases, but not in areas where tap water is of poor quality, tap water can be conditioned to be usable for tadpoles. Never use water directly from the tap, but let it sit overnight. This will allow dissolved gases (the cause of gas bubble disease) to rise and dissipate as well as chlorine to break down. Chloramines which are now used in some water processing plants are more difficult to break down. Adding a dechlorinating-dechloraminating compound to the water (available in aquarium stores everywhere) will prove useful in these cases.

If the quality of water from your tap is poor, filter the water through activated



Tadpoles of Chacoan treefrogs (*Phyllomedusa sauvagei*) at various stages of development. Photo by David Travis



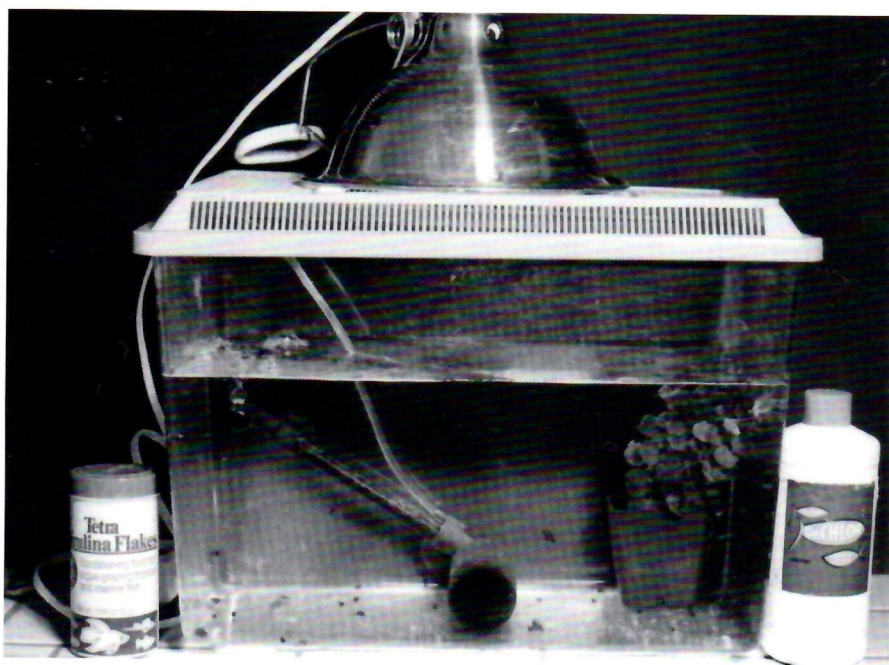
Eggs of Pacific chorus frogs (*Pseudacris regilla*) in various stages of development. The white embryos and tadpole are albinos. Photo by David Travis.

carbon. Tap water that is filtered through a water softener is **not recommended for raising tadpoles**. Neither are purified and distilled water. For many tadpole species, bottled drinking water or carbon filtered water (not reverse osmosis, which removes minerals, or distilled water) generally works well.

Many who desire to raise tadpoles don't want to go through great expense to do so, but a wise investment is a simple pH test kit available in pet stores. By testing the pH of the water collected with the tadpoles and comparing it to the pH of the water from the tap, one is alerted to discrepancies in the alkalinity or acidity of the water samples. Usually, tap water ranges from nearly neutral to slightly al-

5) Water temperature should generally be in the same range as the temperature of the water in which the tadpoles were found. In temperate climates, good success has been noted with water kept at room temperature. To prevent shock to tadpoles when changing water, allow a container of replacement water to sit at least four hours in the same room where the tadpoles are kept.

6) The water should be kept clean by filtering, or by partial water changes once or twice a week. In general the best filters for raising tadpoles are air pump driven, sponge filters because they eliminate the risk of accidental suction of tadpoles into the filtering unit.



A more elaborate system for rearing tadpoles indoors. A Tetra Billi sponge filter connected to a small Second Nature pump provides both biological and mechanical filtration. Moneywort in sand was placed in a pot on the right side. The lid of the large plastic terrarium was removed and a 40 watt bulb in a reflector type fixture used to provide heat and light. Tetramin® staple flakes are one of the best products for raising tadpoles. We also like Tetra Spirulina Flakes and with small tadpoles use Sera Micron in the early stages. Water quality is critical. The water must be aged at least 24 hours and dechlorinated. Wastes on the bottom should be siphoned with airline tubing to prevent sucking up tadpoles. The water should be partially changed, about 20%, once or twice a week depending on tadpole density.

kaline and problems occur when tadpole species found in acid waters are placed in alkaline water.

For those who are more detail-oriented, a water hardness kit can also be useful when comparing water quality and assessing the cause of failures raising tadpoles.

7) Although there is a great deal of variation in the dietary habits of tadpoles — from vegetarianism to carnivory to cannibalism to oophagy (egg-eating) — the great majority of tadpoles are primarily vegetarian. Tadpoles have been raised successfully on diets of briefly-boiled leafy greens such as romaine lettuce, but fish flakes sold in pet stores are generally the

diet of choice. All fish flakes are not the same and cheap brands, such as bulk products sold in some stores, do not work well; tadpoles leave too much food behind which fouls their water. Tetramin® Staple Food flakes are generally a good choice for many species. An alternative which may prove superior are spirulina flakes such as Tetra Spirulina Flakes and Wardley's Spirulina Plus.® Fish foods with algae or plant matter such as diets for live-bearing fish tend to be accepted readily, too. For very small tadpoles the powdered Sera Micron® is a good starter food. Flake foods have proven to be excellent diets for raising tadpoles of all kinds, whether green treefrogs (*Hyla cinerea*), Pacific treefrogs (*Pseudacris regilla*), leopard frogs (*Rana pipiens*) or more exotic species such as red-eyed treefrogs (*Agalychnis callidryas*), White's treefrogs (*Pelodytes caerulea*), or poison dart frogs (*Dendrobates* spp.).

7) After a few weeks or months, depending on the species, tadpoles will show the first signs of metamorphosis — the formation of hind legs and, later yet, the emergence of front legs. This period of front leg emergence is critical for most frogs and toads because it is associated with other changes in structures, such as the mouth and skin, as well as functions, such as respiration.

The water should be lowered to a height of about twice the thickness of the tadpole and an area for emergence from the water provided. Otherwise, froglets of terrestrial and arboreal species such as toads and treefrogs will drown. The emergence ramp can consist of clean sloped aquarium gravel, rocks, or plants in the water, such as pothos.

8) Once the froglets or toadlets are out, a special vivarium will have to be designed for rearing. Small live foods such as week-old gray crickets and large flightless fruitflies, available through specialized reptile stores, are required to feed the tiny froglets. In terms of expense, setup, space and labor, raising frogs and toads will be another order of difficulty. You should refer to one of the many good books now on the market for the best way to accommodate a particular species. In general, smaller species such as green treefrogs (*Hyla cinerea*) or gray treefrogs (*H. versicolor*) will prove easier to maintain than large species or semi-aquatic species such as bullfrogs and leopard frogs (*Rana* spp.).



Ethnoherpetology

Herpetoculture, Biodiversity, and Biointegration

by Stephen W. Bullington

Part I: Background and Definitions

Several years back I worked as the Assistant Curator in an Entomological Museum. Upon leaving to start my own consulting business, I happened to mention to the curator that I intended to raise exotic tarantulas as a hobby. His first, immediate, and almost instinctive response was to ask why I had chosen that particular hobby, when it was "against the principles of biodiversity." Although he immediately ameliorated his response as a matter of courtesy, I soon came to realize that most life-science professionals regard the private keeping of exotic animals with the same disdain. This is equally true whether the animals are lions, leopard geckos, or, as in my case, tarantulas and scorpions.

I reflected a long time on this attitude. Why would normal, well-educated people, in love with animals and research, and otherwise so much like myself, take such a dim view of what I found to be one of life's greatest pleasures? I came to the following conclusions about what is wrong and about how to fix it.

My old colleague was correct. The word *biodiversity* is responsible. Not that it started out to be a bad word. Quite the contrary. It originated as a reaction to the once-prevalent attitude that most animals, including herps, could all be classed as game, vermin, or stock, and, simply as animals (captive or otherwise) had no aesthetic or other less-definable value to speak of. This attitude, so foreign to most of the readers of this magazine, may once have been justifiable. As the pioneers moved west, they had no time for life's more subtle pleasures, and in any case found they had more nature and animals than they could realistically deal with.

The original reaction that engendered the concept of biodiversity grew out of industrialization. Machine power replaced animal power, and machine technology, from repeating rifles to revolving dynamos, pushed nature back in all directions. Since there was less of nature, it became more valuable. But the old atti-

tude did not go without a fight. And to fight it was the unrewarding task for a whole generation of writers. These writers found it hard to change the minds of people who had grown up on the frontier. They had trouble describing the incredible beauty and aesthetic value of animals in words. So more often than not they took a sort of short cut to make the man-on-the-street want to conserve things. Specifically, they took to saying that this or that animal had a "right to exist," apart from any perceived value it might have to us as humans.

This of course was twisting the truth. But those who promulgated this idea looked upon deception as a necessity. That an industrially-armed public might exterminate or otherwise inalterably change what they themselves thought most of was a real possibility. That organisms had an intrinsic right to exist was a simple message that was easy to preach. Specifically, it was easier to drill this idea into peoples' heads than to instill the capacity to see beauty in living things.

The somewhat twisted idea that we as humans had to recognize another species' right to exist was eventually formalized in the new term *biodiversity*. We as humans should do everything we could to promote a maximum number of species. Not necessarily at any one location, but worldwide. This is the idea of biodiversity in a nutshell.

But definitions that do not embody the whole truth have a fatal flaw. When they are pursued to their logical ends they usually wind up directly in opposition to what they originally stood for. This is exactly what has happened with biodiversity, *vis a vis* the impulse that originally gave it birth. Let me explain.

Once government got into the act, the task of preventing the loss of biodiversity was naturally 'assigned' to the publicly-funded life-science professionals in our universities, zoos, and museums. These people rightly saw themselves as having been asked to maximize biodiversity whenever possible. But the term biodiversity stood for maximizing planetary species diversity. It made no reference to people. Specifically, it lacked the original, all-important reference to the needs of private people for interacting with nature. These were the very needs which those original writers valued so highly, found so hard to express, and found so difficult to instill into other

people quickly. In other words, the term lacked the kernel of truth it was originally intended to help germinate. It was an empty, sterile shell.

The results have been disastrous. Fewer normal people now interact directly with nature than ever before. The main reason is that they are prohibited or discouraged by law from doing so. For example, in many states it is currently against the law to have more than three individuals of any reptile or amphibian found naturally there, and in at least one state no native vertebrate can be kept as a pet. These laws all make it illegal for a child to bring home a mayonnaise jar full of tadpoles. Not to mention that they effectively squash any attempts at captive breeding, and the gain in knowledge and appreciation to be gained from that activity. Further, they are not the worst of the lot. In Virginia it is currently illegal to collect any invertebrate other than an insect or an earthworm, without first obtaining a permit. This law applies even to private lands. So that if you see a beautifully colored jumping spider on your back deck, and put it in an empty jelly jar to inspect with a hand lens, you are in violation. But should you wish to step on the spider, or bludgeon it to death with a broom, you are on safe ground. Nothing could be more calculated to discourage the interaction and understanding of nature that was the goal of such classic nature books as *A Sand County Almanac*. This unhealthy state of affairs can be laid squarely at the door of biodiversity.

Further, it may get worse. Far too many life-science professionals have the attitude that the general public has no business interacting with any animal other than a dog or cat, unless supervised by themselves or another professional. This attitude is most often expressed something like "This organism cannot be kept except for scientific or educational purposes," meaning of course, unless by a verifiable member of the scientific and educational bureaucracies. In effect, some of these people view themselves as priests, who serve as the interpreter and intermediary between a sacred nature and the unholy mass of mankind. To continue my analogy, some law enforcement officials have bought into this vision, and at least act as if they were guardians of the temple, enfranchised to keep the public's hands off the relicts inside.

Before I go further I need to insert a disclaimer here. Although, as you all

know, there have been problems, so far academic herpetology has had an extraordinarily good relationship with herpetoculture. So my remarks are not directed specifically at herpetologists. All I can say is, keep up the good work. But as a great ocean swell can sink all the ships in a harbor, so can a professional class attitude eventually engulf all disciplines. And the attitude I have described is rampant in some other disciplines.

I also want to make it clear that I am not directing censure at individual people in *any* professional discipline. They are just doing what they were hired to do. The censure belongs solely to the "project" they have been given to execute, not to the zeal with which they have gone after it. This project is to maximize biodiversity. Given the definition of the term biodiversity, everything else that has happened was bound to follow.

As you've probably guessed, the best way out of this mess is to retrace the path we used to get into it. We must redefine the idea now denoted by the word biodiversity. The new idea should have a new term to go with it. The definition should include the idea that interaction with a varied nature is essential to man's continued happiness. It should also make it very clear that the *relation* between the individual and nature is an important thing, and not simply the nature apart from those who admire it. E. O. Wilson's term *biophilia* comes to mind as a candidate. But it does not sufficiently express the idea of integration and interaction. So I am proposing the word *biointegration*.

Biointegration stands for sustainably maximizing the unsupervised interaction between the individual citizen and the portions of the amazingly varied and wonderful organic diversity that fulfill his or her specific needs.

Biointegration is not a term I see as being limited to herpetoculture or even to private individuals. Although private individuals (being most individuals) are the main focus, there is room for everybody. Museums, zoos, and universities can do many things which individuals would find impossible. I will give only one example. A cottage-industry herpetocultural program cannot adequately insure the survival of Komodo dragons or saltwater crocodiles. Yet many, perhaps most, of those interested in herps would be willing to pay handsomely to see these magnificent animals. I certainly would. So professionals need not worry. There will be plenty for them to do.

Since it is defined differently, the new term would preclude the types of errors referred to earlier. But reforming laws is not my purpose here. I simply want to change the overall goal. If we can change the goal, the laws will take care of themselves.

Changing the goal from biodiversity to biointegration will be a big job. It will also take a number of years. Many might be tempted to look at the formidable array of what appears to be the opposition and shrink back. But they should not be discouraged. The nineteenth-century philosopher and historian Thomas Carlyle is credited with the phrase "Might makes right." It is less generally known that he considered this a two-way relation. The principle "Right makes might" is fully as operative as its converse. Nothing is more right than an idea whose time has come. And biointegration is an idea whose time has come.

The biggest hurdle is the one we are taking now by defining the idea in the first place. Having a word to represent what we are aiming at is like having a theme for an essay; without it, no matter how much we write, the result will be disorganized and ineffective. With it, every thing we do can have one easy-to-remember, take-home message: we are making the world people actually live in more varied, and therefore better suited to meeting their potential needs.

The next part of this essay will explain in more detail the main tenets of biointegration. 

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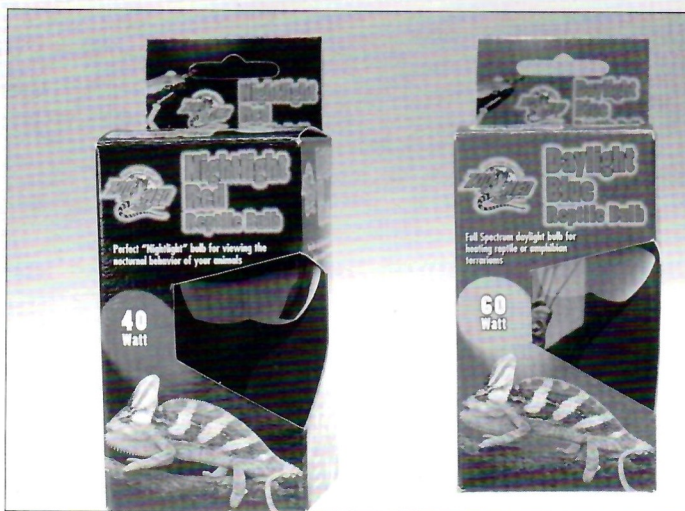
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Chameleons

A Simple Egg-laying Container for Chameleons

by Philippe de Vosjoli



A gravid female Fischer's Chameleon (*Chamaeleo fischeri*). This is a hardy species which typically descends to the ground when ready to lay eggs. Fischer's chameleons will readily initiate the egg-laying process with the bucket system presented in this column.

A common question of herpetoculturists with gravid female chameleons is how to set up the animals for egg-laying. It is critical that, prior to egg-laying, gravid females be kept under optimal conditions. They need the right temperature range and to be well hydrated; they also need high quality diets and supplementation with calcium. Ill or weak females are unlikely to complete the egg-laying process successfully. They risk egg retention and becoming egg-bound. Typically, when gravid females are ready to lay, they descend to ground level and start investigating potential egg-laying sites.

After a gravid female is observed walking about the bottom of her enclosure, she needs to be provided with a suitable egg-laying site. The exact criteria for selection of egg-laying sites have not yet been investigated fully but we know that damp substrate and a visual/physical obstacle such as the base of a tree or plant are important cues that stimulate nest-digging behavior. One method used by herpetoculturists who keep chameleons in large enclosures is to place several bucketfuls of damp soil at the base of a plant such as *Ficus benjamina*. The substrate depth should be at least six inches (15 cm) for small species such as *Chamaeleo fischeri* and a foot (30 cm) or more for large species such as *Chamaeleo africanus*. If that doesn't work, placing a small board on top of the heaped soil can sometimes provide the stimulus for nest digging.

Buckets of Eggs

One of the most reliable methods which yields a high rate of success is the now well known *bucket method*. Take a five gallon bucket and fill it two-thirds with damp soil. Pat the surface by hand to com-

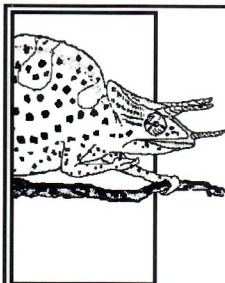
compact the soil. Then introduce the female chameleon. Place a screen top above the bucket.

Cover half of the screen top with cardboard and place an incandescent bulb in a reflector-type fixture about two feet above the bucket. Use a bulb that allows the temperature inside the bucket to be in the low 70's° F (low 20's°C). The main purpose of the light, however, is simply to provide light. Chameleons typically lay while it's still daylight. If a female is ready she will usually lay eggs in the bucket within 24 hours. If not, remove the female, return her to the vivarium and try again in a day or two.

A female in a bucket will initially explore the edges and typically start digging near the edge, eventually forming a burrow. Usually female chameleons will dig down until they are completely underground and at an angle to the original di-

rection of the burrow. Most of the time a female will dig down to the bottom of the bucket and that is where the eggs will be laid. When the female is done she will exit the burrow and begin filling it in. Once the process is complete the surface of the substrate will appear as smooth as when the female was first introduced. After the laying process the female appears, markedly thinner. She should be removed to her vivarium and water provided. Food should be offered within 24 hours.

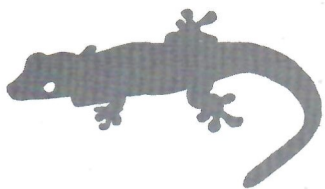
The substrate in the bucket should then be carefully removed, either by hand or with a rounded tablespoon, until the eggs are exposed. The eggs should then be transferred to an incubation container.



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Geckos

RED LIGHT DISTRICTS AND CLOSET GECKOPHILES

by Jack Therhac

One of the criticisms of keeping nocturnal geckos is that for the most part they are invisible during the day and therefore rather boring. Nothing could be further from the truth. Most nocturnal geckos are fascinating to watch at night and display a wide range of interesting behaviors, particularly when kept in groups within large enclosures containing relatively elaborate landscapes.

Vivarium Set-up

The first trick is to provide a large enclosure with naturalistic landscaping. Then add one or more light fixtures with



The author's 4' x 2' desert vivarium for leopard geckos and Peruvian swifts. It contains 100 lbs of decomposed granite sand and 180 lbs of rock. Flattened rocks were stacked to create natural shelters and basking sites. Four species of semi-cylindrical snakeplants (*Sansevieria*) were selected to add color and dimensionality to the display. Full spectrum fluorescent lights and incandescent bulbs in reflector type fixtures provide light and heat. Photo by Philippe de Vosjoli.



Leopard geckos sleeping in rock shelters. Photo by Philippe de Vosjoli.

25 watt incandescent red bulbs plugged into a timer so that the lights come on in the evening. Nocturnal geckos are undisturbed by the red lights and behave as if their habitat was dark.

Gecko Watching

Under this lighting regimen, observing geckos can be more interesting than, say, watching a sitcom on television. Terrestrial geckos, such as leopard geckos (*Eublepharis macularius*) and frog-eyed geckos (*Teratoscincus*), demonstrate exploratory and territorial behaviors, social interactions, and hunting activities not usually observed in the sweater-box and ten-gallon setups so commonly used. Semi-arboreals such as bent-toed geckos

(*Cyrtodactylus*) and New Caledonian crested geckos (*Rhacodactylus ciliatus*) emerge from their terrestrial shelters and climb on cork bark and branches. Surface-clinging geckos such as tokays (*Gekko gecko*), white-lined (*G. vittatus*), flying geckos (*Ptychozoon lionatum*) and others scurry along walls and bark surfaces, interacting. In most cases, breeding behavior of nocturnal geckos can be observed only under these red light conditions.

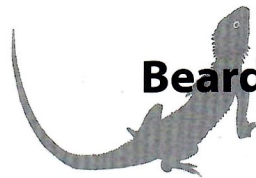
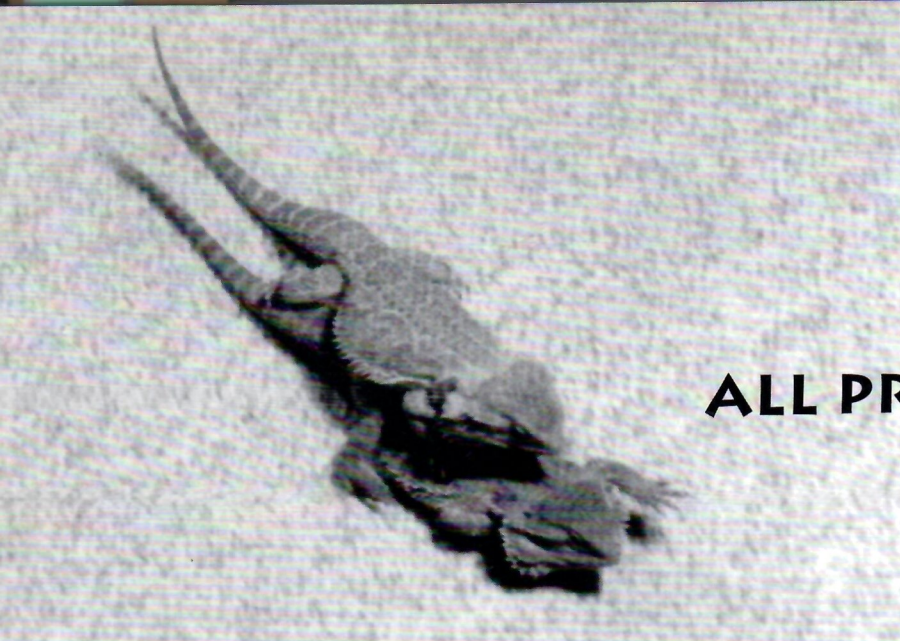
For terrestrial geckos, stratifying topography with caves, tunnels, mini-hills and ledges, then watching the ensuing behaviors, demonstrates the importance of topography and its relationship to more varied behavior. With climbing or semi-arboreal species, cork sections, bamboo criss-crossing the tank, ledges and select plants elicit behaviors not observed in simply- designed four-sided enclosures.

More Complex Vivaria

Some nocturnal geckos start being active at dusk and may catch the slanted rays of the setting sun. More intricate designs — with angled spotlights illuminating late in the day before the red lights come on — can be assembled to observe these interesting behaviors.

Using a walk-in closet, a reverse day/night cycle can be established with lights coming on at night and red lights coming on during the day, which then makes daytime observation possible in the dark closet. Beware, however, that you could one day be accused of the heinous crime of being a closet geckophile. In any case, you now know why they sell red incandescent bulbs in hardware stores.





Bearded Dragons

ALL PREDICTIONS ARE...

by Philippe de Vosjoli and Robert Mailloux

...THAT 1997 WILL BE THE YEAR OF THE DRAGON

Male bearded dragon preparing to breed with a female minutes after the pair was placed on a floor. Photo by Philippe de Vosjoli.

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Current estimates are that at least 250,000 inland bearded dragons (*Pogona vitticeps*) will be produced in the United States this year and probably one million or more in 1998. The bearded dragon, herpetoculture's version of the guppy or goldfish, is destined to overtake a market once dominated by the green iguana (*Iguana iguana*). For the bearded dragon, the popularity of this ideal pet lizard is about to soar and become global. Neat looks, an easily manageable size, docility, hardiness, high reproductive rate and variability of color and pattern make this Australian species one of the most exciting reptiles to have ever appeared on the herp scene.

Breeding secret of the dragon masters revealed

Much to the surprise of experienced hobbyists who have observed the sexual vigor of properly conditioned and housed bearded dragons, there are many people who, come springtime, have animals that are generally aloof and sexually indifferent. Successful breeding depends on several factors, including a winter cooling period and decreased winter photoperiod followed by increased spring temperatures, photoperiod and light intensity.

Enclosure size is important, too. Small enclosures may result in poor breeding performance for a variety of reasons, such as inadequate space for sexually related behaviors and possibly sensory deprivation and/or habituation (defined here as a failure to react to familiar stimuli).

If your pair is reluctant to breed, a trick that works the great majority of the time

is to simply take the pair out of their cage and set them on the floor of a well-lit room. Use a spotlight if the room is too dark. The novelty of the situation provokes the male to see the female in a 'new light' and within minutes mating will often be attempted and may be successful if the female is receptive.

The puzzle of color in bearded dragons

Bearded dragon breeders are producing increasingly select colors and patterns, yet it is becoming obvious that genetics alone don't account for the lizard's color. Sandfire dragons, for example, have a genetic propensity for intense orange/red with reduced pattern, which is characteristic of this strain, but rearing conditions play a key role in the intensity of the coloration. Also, color is influenced by environmental factors such as temperature and, more significantly, light quality. The most brightly colored bearded dragons are reared in outdoor greenhouses and pens. Light intensity and possibly UV radiation may determine the predominance of certain pigments in bearded dragons. For lizards housed indoors, increasing the number of high-UVB reptile bulbs combined with access to warm basking sites in the 90's° F (low 30's°C) may optimize the desirable red and orange colors. Certain plant pigments may also affect skin color. The role of these various factors needs to be researched further.



Review by Michael Balsai

Advances in Herpetoculture

Advances in Herpetoculture. 1996. Peter D. Strimple (editor). Special Publication of the International Herpetological Symposium, Inc. Number 1, June 1996. International Herpetological Symposium, Inc., P. O. Box 176, Norwalk, IA. 167 pp. About 40 black and white photos, eleven drawings and figures (two maps), 22 tables. \$34.95. Paperback.

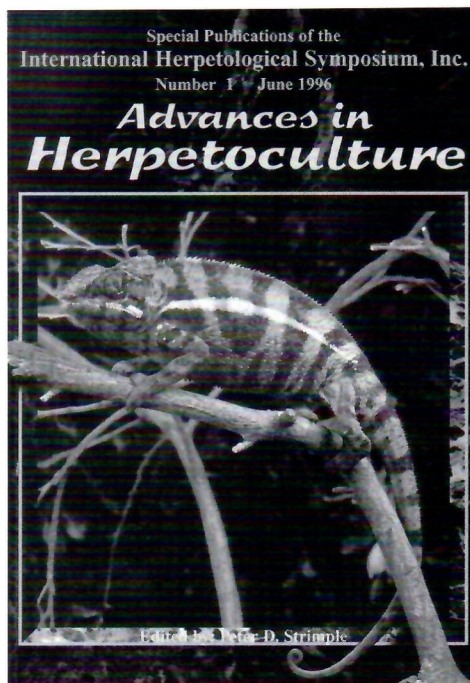
As most readers know, the International Herpetological Society (IHS) publishes a journal called *Herpetological Natural History* and have been the publishers of many International Herpetological Symposia on captive propagation and husbandry. Now they have released the first in a series of occasional publications; this one concerns herpetoculture and was published to recognize the 20th anniversary of the IHS.

There are 25 articles in this book: five about frogs, one about caecilians, two on chelonians, six concern lizards, seven about snakes, one on general husbandry (about a substrate material), and three concern veterinary topics. The editor of this publication, Peter D. Strimple, is a columnist for *Reptiles* (he writes *Reptile News and Trivia*) and has edited a book published by the Greater Cincinnati Herpetological Society (Strimple and Strimple, 1992).

A forward by David Chiszar notes the contributions herpetoculture has made to herpetology. He notes some of the important information gleaned as a result of the captive maintenance of herp species, such as the importance of hibernation for reproductive success in temperate species, the effect of small temperature variations on sex determination of certain species, and the need for adequate concealment for the successful captive maintenance of many species.

Upon reading through the articles concerning the propagation and husbandry of particular species (19 of the articles), details recorded by the various authors included aspects of temperature preferences, photoperiods, housing, and foods. Many of the articles included graphs and charts showing information on weight fluctuations, cumulative numbers of eggs, hatchlings per month, kinds of prey taken (for species of caecilians).

Of all the articles in this book, several were of particular interest to me. Two concerned varanids. The first, by Quetzal Dwyer and Mark Bayless, concerned the breeding of the Argus monitor (*Varanus gouldii horni*). The Argus monitors were bred multiple times and live offspring resulted on more than one occasion. The second varanid article, by Steven Hubbard, discussed fork removal from an overly enthusiastic white-throated monitor. The lizard had ingested the fork while



being fed dog food by the owner. I was pleased that the author discouraged diets of dog food for monitors and also discouraged forks as a means of offering food.

An article by Scott Stahl, DVM concerned the veterinary management of Old World chameleons; it was thorough, reasonably complete and succinct. This article should make the book a "must have" for any chameleon enthusiast. I would hope Stahl's article could serve as a model for similar articles devoted to other popular herps.

Dr. Mark Wilson's article about "the parasite dilemma" should prove a useful summery for veterinarians and herpetoculturists. Neil Davie presents a convincing pitch for the use of Lite and Easy® as a substrate for snakes, and possibly for some other herps as well.

Bill Branch and Mike Griffin authored an article on Namibian pythons and their distribution, conservation and captive

breeding programs. The major focus was the Angolan dwarf python (*Python anchietae*) and the piece included a disturbing note about the potential value and effect of captive breeding programs on this species. They noted that such programs did not seem to be needed at present in order to maintain this species and feared that the snake's relative rarity may encourage an increased demand for the species (the only reproductive pair in a North American zoo is at Dallas [Franklin, 1997]). The authors note that although captive breeding programs are claimed to be potentially instrumental in the preservation of endangered species, actual instances of progeny reintroduced successfully back to the wild are attempted rarely.

There are articles devoted to the captive breeding of venomous squamates — two about snakes and one for helodermatids. An article by Sherman Minton concerning colubrid envenomation is also included. I found this article enlightening and it prompted me to recall an incident some years ago when a friend purchased a *Rhabdophus* species, completely oblivious to the potential for trouble. Minton helpfully listed a table of colubrid genera involved in human envenomation incidents, and some of those genera listed might raise a few eyebrows! The rest of the snake related articles involve boids.

Other articles about lizards involved the husbandry and breeding of frilled lizards (*Chlamydosaurus*), crag lizards (*Pseudocordylus*, which is by the venerable Bert Langerwerf), the striped pygopodid (*Delma impar*), and the bizarre looking crocodile skink (*Tribolonotus gracilis*). Those for chelonians concerned matamatas (*Chelus fimbriatus*) and the Travancore tortoise (*Indotestudo travancorica*).

The vast majority of amphibians considered were anurans, but an excellent and interesting review of techniques for the husbandry of caecilians by James O'Reilly is also included. One of the articles described observations concerning aggregation and sibling recognition behavior for the tadpoles of the Houston toad (*Bufo houstonensis*). This article discussed the types of behaviors and their importance to many anurans, which, of course, may be critical when trying to breed these animals.

I suspect the majority of readers of the

Vivarium will find much of interest in this volume. My only criticisms concern the price (\$34.95 is a bit high for a 167-page paperback book with no color graphics inside) and a few minor qualms about the physical appearance of the book. Some of the type-setting is quirky. For example, superscripts tend to merge with the line of type immediately above. A few of the photos are somewhat unclear (eg., Figure 3 on page 78 and Figure 3 on page 114). And a few typos appear (eg. Table 2 page 130, *Echis carinatus* is a viperid). However, there is no doubt that the usefulness and quality of the information of the articles contained within the covers of this volume more than compensate for these minor publishing peculiarities. 

Literature Cited

Franklin, C. 1997. Dallas Zoo reports breeding of Angolan pythons. *Communicuë* January, p. 14.

Strimple, P. D. and Strimple, J. L. (eds). 1992. *Contributions in Herpetology*. The Greater Cincinnati Herpetological Society, Cincinnati, OH. 109 pp.



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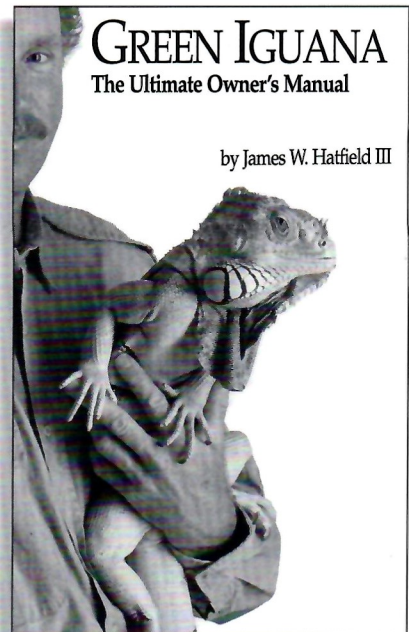
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Chihuahuan Ridge-nosed Rattlesnake (*Crotalus willardi silus*), Mexico. Photo by Michael and Patricia Fogden, from *Snakes*.

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Colubrids

The Incubation of the Eggs of Popular Colubrids

by Jack Therhac

It's almost that time of the year when stores and breeders get swamped with calls inquiring about the incubation of snake eggs. The following is a basic how-to for novice snake breeders.

1) Pre-laying - Gravid snakes exhibit obvious swelling from midbody to vent and appear lumpy after the eggs are shelled. Prior to egg-laying, the snakes typically go through a pre-laying shed, usually six days to two weeks before egg deposition.

2) Laying Containers - Gravid snakes should be provided with an egg-laying container. Plastic storage containers work well, and if clear-sided containers are used (most storage containers are translucent) one can monitor the female's behavior and know when the eggs are laid.

Construction of an egg-laying site is easy. Select a plastic storage container, and cut a hole out of the side at a height about twice the diameter of the snake's body (at its thickest point). Then fill up to the hole, or up to one-third the height of the container, with damp, loose potting

soil or moistened sphagnum or green moss. Moistened vermiculite can be used as well. The substrate should be moist, not soaking wet.

Place the lid back on the container and set it at one side of the snake enclosure with the opening facing out and easily accessible by the female.

3) Egg Removal - After the eggs are deposited, take the female out of the egg-laying container and remove the container from the cage. Then open the lid and carefully remove the eggs for placement in an incubation container. If the eggs are stuck together in a clump, lift the clump as is and place it in the incubation container in the same general position that it was found.

4) Incubation Containers - Plastic food storage and shoe box size or larger storage containers are ideal for incubation. Rubbermaid® is one of the more popular brands but others work fine also. The containers can be bought at department stores such as Target® and can also be found in larger drug stores. Prior to using the incubation container, drill very small holes, using a 1/16- or 1/8-inch (1.5–3 mm) drill bit, at about mid-height of the container, to allow for air exchange.

5) Incubation medium - Vermiculite (heat expanded mica) remains the most popular incubating medium with snake breeders, although some are turning to perlite. Both of these are available in nursery supply stores or garden supply depart-



Green red-tailed ratsnakes (*Gonyosoma oxycephalum*) hatching in vermiculite and sphagnum mix. Photo by Chris Estep.

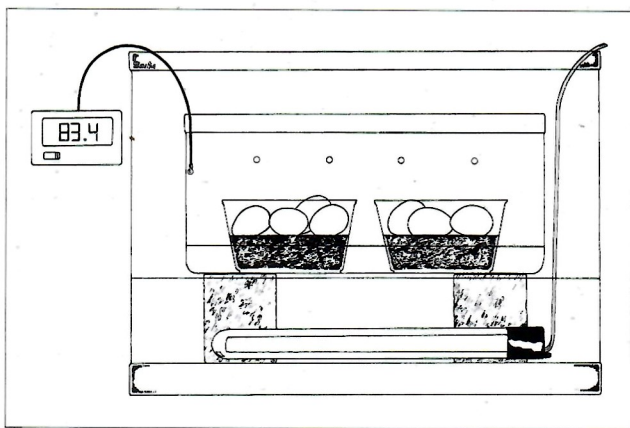
ments of large stores. For vermiculite, coarse grade #3 is preferable to the fine powdery grade.

For years the general recommended formula for incubating colubrid eggs has been a one-to-one (1:1) ratio of vermiculite to water *by weight* but recent work by Hammack (1991) suggests that less water may be preferable. Good incubation results have been obtained using two parts vermiculite to one part water (2:1) by weight. Even ten parts vermiculite to one part water (10:1) can yield good results with certain species.

Add a layer of moistened vermiculite to the incubation container up to a depth of from one to one and a half times the width of the eggs. Place the eggs on their sides (unless they are adhered in a clump) and bury them half-way into the incubating medium. Space the eggs a distance of about an egg-width between each egg. The surface area covered by eggs should be no more than 50% of the total area available.

Adding a small open container (such as an empty film canister) with water in the incubating box will help reduce moisture loss from the incubating medium and maintain near saturation relative humidity.

6) Incubators - Many large-scale breeders don't use incubators but simply place the eggs on shelves in an area of their reptile room where the temperature is within the range desired, usually 82° F (28°C) ± 2°. Eggs safely tolerate lower temperatures [mid 70s° F (23°C)] for brief periods. A digital thermometer with an external probe will prove essential in assessing the incubation temperature.



Front view of an incubator using an aquarium and a submersible heater. The eggs are placed in containers inside a storage box on two bricks. Enough water is added to cover the submersible heater which is then adjusted with the aid of a thermometer. The top of the aquarium is then covered leaving a small space for airflow.

If you do not have a heated reptile room, then another option is to purchase or construct an incubator. Lyon, who in the past have specialized in bird incubators, have modified some of their line for the incubation of reptile eggs. These are a good option if you seek a precision, ready-made incubator. The Hovabator® is an inexpensive polystyrene incubator with a wafer thermostat that is popular for those with small numbers of eggs to incubate.

Incubators can be constructed using an aquarium, two bricks, a submersible heater, glass top, and digital thermometer (see illustration). For incubating large numbers of eggs, a used refrigerator shell allows one for little money to have many shelves, on which to place several incubating boxes, as well as an insulated, large enclosure. To heat the refrigerator, one may use a light bulb plus a fan to move the heat, and a thermostat such as Biostat DP® or Helix Control.® Alternative heat sources include a submersible heater in a shallow aquarium at the bottom of the refrigerator, or a heat cable wrapped around the perimeter of the shell. Again, a thermostat plus digital thermometer with probe is required.

7) **Caution** - One of the more common errors of first time breeders is failure to properly calibrate the temperature of an incubator. For this reason an incubator should be calibrated and set up *at least two days before the eggs are introduced*. Only high quality thermostats such as Biostat® or Helix Controls® can shorten this process and even then they should be used properly, with the temperature probe at the correct level. Extra caution is particularly required if you are using a wafer type thermostat or a thermostat in a submersible heater for calibration. As a general rule, have the external probe of the thermometer in the incubator, with an external read-out. Then adjust the setting and read every two hours until the temperature is stable. Remember that cooking your eggs is irreversible. Read all instructions accompanying your equipment carefully.

8) **Monitoring eggs and medium** - During the course of incubation (the incubation time for most colubrid eggs is around 60 days) eggs should be monitored on a regular basis, about every one to two days. If they are molding or seeping, collapsing and/or becoming discolored, then the eggs may be infertile or dead. If the eggs are swelling so that there are semitrans-

Continued on page 56



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Courtship, Mating and Egg Deposition by the Captive Perentie *Varanus giganteus* (Gray, 1845)

by Steve Irwin

Photos by the author
unless noted
otherwise.



Pete and Crinkle mating.

The perentie *Varanus giganteus* is the largest lizard in Australia (King and Green, 1993a) growing in length to at least 79 inches (two meters), although there have been unsubstantiated claims of lengths exceeding this (Bustard, 1970; Minton and Minton, 1973; Vernet, 1984; Wilson and Knowles, 1988). It is the world's third largest monitor, being exceeded in both body mass and total length by *V. salvator* and *V. komodoensis* (King and Green, 1993b). Unconfirmed reports of the New Guinean arboreal varanid *V. salvadorii* growing to over 13 feet (about four meters) (Bustard, 1970; Schutze-Westrum, 1972; Vernet, 1984) have been questioned (Auffenberg, 1981; King, 1991). Aspects of the perentie's ecology and physiology have been studied extensively in several areas of its range (Pianka, 1982 and 1986; Green et al., 1986; King et al., 1989).

There are many records of varanid courtship and mating behavior, either in captive or wild specimens, for example Peters (1969) for *V. storri*, Murphy (1972) for *V. acanthurus* and *V. varius*, Schimda (1975) for *V. gilleni*, King and Green (1979) for *V. rosenbergi*, Carlzen (1982) for *V. prasinus*, Eidenmuller and Horn (1985) for *V. storri*, Tasoulis (1985) for *V. varius*, Shine (1986) for *V. panoptes*, Carter (1990) for *V. varius*, and McCoid and Hensley (1991) for *V. indicus*.

This paper reports the first account of captive perentie courtship behavior as well as other aspects of their reproductive biology. Perenties are just one of a number of varanids that have been successfully bred at the Queensland Reptile and Fauna Park, Beerwah, Queensland, Australia since the early 1970s (Irwin, 1986; Irwin et al., 1985; Irwin et al., in press; Horn and Visser, unpub. data).

Distribution and Habitat

Perenties prefer rocky habitat throughout the arid and semi arid interior of Australia, ranging from Eromanga in far western Queensland, through Alice Springs, Northern Territory, to Barrow Island, Western Australia.

Ecology and life history

These varanids forage and mate among rocky escarpments and outcrops. Although sometimes travelling long distances away from rock in search of food, the lizards seek refuge and shelter in caves, crevices and cracks. If alarmed or disturbed, they will retreat quickly to the security of their crannies.

During the summer months these

varanids avoid excessive heat by foraging in the mornings and afternoons. During the heat of the day, they retreat to their well-insulated, rocky lairs. Often, these species have calloused foot pads, abdomens, and tails, from traversing the scorchingly hot rocks and substrate.

The varanids become less active during autumn, spending more time basking outside their lairs, and less time foraging for food.

During the winter, perentie become dormant, relying on the insulation of their rocky lairs to protect them from severe cold. In late winter/early spring, they become more active, venturing to the entrance of their lairs to bask. In spring, the lizards grow more active, basking on the warm rocks until they reach their desired temperature.

Mating occurs in spring. Females excavate deep holes where they deposit six to 13 eggs, from November to January. The female is very meticulous filling in the nest hole and camouflaging the entire nest site.

Conservation Status and Threatening Factors

The perentie population is considered very sparse to sparse; its status is thought to be secure (Ehmann, 1992). Spread throughout their range are areas which have been designated National Parks or similar sanctuaries.

Ferals could impact wild populations, however the remoteness of the lizards' habitat throughout the majority of their distribution provides some protection.

These varanids are protected by state, federal and international legislation. Permits to collect these species from the wild are granted only for research purposes and approved zoological institutions.

Housing

The Queensland Reptile and Fauna Park houses four perenties (two males, one female, and one juvenile) in a concrete block enclosure, 36.7 ft by 23 ft x 6.5 ft (11.2 m x 7.0 m x 2.0 m) with a slip panel of 1.8 ft (0.5 m) around the top.

The enclosure has a substrate of coarse sand, with sandstone boulders and hollow logs. A sand bank, facing north at a camber of 30 degrees has been constructed at the rear of the enclosure to maximize exposure to sunlight.

Breeding

The perentie was first bred in captivity in 1986 (Bredl, 1987; Bredl and Horn, 1987). This species was also bred at the Queensland Reptile and Fauna Park in that year, although the eggs did not hatch until the following year. Mating and egg deposition have been observed over a number of years, although this has not always resulted in successful egg location or incubation (Table 1).

Courtship and Mating

The first detailed record of courtship behavior was taken during the 1994 breeding season. On 19 October 1994 at 8:00 a.m., the female, named Crinkle [captive born 18 June 1989; total length (TL) 4.3 ft (1.3 m)] and the younger, subordinate male named Pete [captive born 18 June 1989; TL 4.6 ft (1.4 m)] became very agitated and began pacing up and down the enclosure. Although Crinkle approached the older, dominant male, named Ledge [wild caught, 17 March 1985; TL 5.9 (1.8 m)], he showed no interest. By 9:00 a.m., however, both males were agitated, judging from their increased rate of tongue flicking, especially in the regions where Crinkle had walked.

On one occasion Crinkle and Pete came together with the usual tongue flicking around the eyes and head. Pete mounted Crinkle and was then allowed to rake one of Crinkle's back legs up and roll her tail over. He then moved his cloaca alongside hers and copulation followed. Both animals lay still, while joined, for approximately ten minutes. The only movement was the occasional shutting and opening of the eyes. The other male, Ledge, observed this mating some 1.8 ft (0.5 m) away, but did not get involved. Crinkle and Pete were seen to engage in copulation on two occasions. In spite of repeated mounting, Ledge was never

seen to raise Crinkle's legs in order to engage in copulation.

One of the most surprising aspects of the courtship period was the lack of aggression between the two males in the enclosure. The fourth perentie in the enclosure, a juvenile and presumed female named Missy, stayed several meters away from the other perenties and showed no interest in any of the behaviors.

By 28 October, mating had become more intermittent. By 1 November, it had virtually ceased and Ledge was becoming much more assertive over Pete. Over the next two weeks, the female undertook much digging, spending more time relaxing, often sleeping, occasionally in the water bowl.

Although Ledge hadn't been observed to mate successfully with Crinkle, he assumed a territorial role, protecting his female and her immediate territory. She acknowledged his role and would side up to Ledge. He would respond by standing guard, obviously defending her. He became aggressive towards Pete and would endeavor to attack him, biting the base of his tail if he came too close to Crinkle.

Test Hole Digging

On 14 November Crinkle became more active and three days later was occupied digging a number of test holes. She would spend all day digging one hole to a depth of approximately 1.8 ft (0.5 m). When digging a hole, the perentie embeded her snout in



Female perentie in trance-like state, depositing her first egg.



The female perentie pushes sand onto the clutch with her snout.



During the strain of backfilling and packing substrate on top of her clutch, the unaware female deposited an egg.



Steve Irwin collecting eggs from a female perentie's nest site. Photo by Wes Mannion.



Last season's neonatal perenties hatching at Queensland Reptile & Fauna Park. Photos by Terri Irwin.

the substrate, then raked outward with her forelegs.

Egg Deposition

On 18 November 1994 the female perentie refused food, which is a sign that egg deposition is imminent. The next day at 4:00 p.m., Crinkle walked up the sand-bank and, head first, into a test hole which she had dug previously, and commenced excavating the hole deeper. After 30 minutes, she turned in the hole and rested, facing out of the entrance, exposed to her front shoulders.

Within ten minutes, she raised her head from the resting position, her eyes opened wide and she strained for 30 seconds, then deposited her first egg. The eggs were deposited at intervals between five to ten minutes. Each time an egg was deposited Crinkle raised her head, opened her eyes wide, and strained, taking two deep breaths with her mouth slightly ajar. No tongue flicking was observed at any stage.

At 6:18 p.m. Crinkle had finished deposition and was resting with her eyes open. By 7:43 p.m. her eyes closed and she slept. At 8:00 p.m. she awoke and was alert, and with tongue flicking she examined the hole entrance, then proceeded head first down the hole and examined her eggs with tongue flicks.

Backfilling

Apparently satisfied with the state of her clutch, Crinkle then commenced backfilling and packing substrate on top of the eggs. She achieved this by utilizing her snout to cave sand down from the roof and sides of the hole. Once a satisfactory amount of sand had covered the clutch,

she packed it down by exerting a repetitive downward pressure with her snout, often so strenuously that all four legs would come off the ground. As backfilling and packing progressed closer to the entrance, Crinkle utilized her head as a shovel to scoop and push substrate from the entrance down the hole. During this procedure the female was alert and would stop work and tongue flick toward any noise or disturbance.

At 9:05 p.m. Crinkle exerted so much force packing with her snout that all four feet came off the ground and an egg squeezed out of her cloaca. She noticed the egg when she drew back out of the hole to shovel in more substrate. After tongue flicking the egg, she touched it with her snout tip, then rolled the egg towards the hole entrance by nuzzling it with her snout. Grabbing it gently with her mouth she realigned the egg, then nuzzled it down the hole. Once satisfied with its placement, she resumed backfilling and packing.

By 10:00 p.m. Crinkle had filled and packed to a depth of eight inches (20 cm) from the entrance and was now raking substrate with her forefeet backwards towards the entrance, then packing it down.

At 12:32 a.m. Crinkle ceased work and walked 6.5 ft (2 m) away under a rock and slept.

At 7:00 a.m. Crinkle recommenced backfilling and packing, completing the task at 12:20 p.m. The hole and entrance were completely camouflaged.

Territorial Defense

Crinkle's attitude towards the other perenties then changed. She was intolerant of Pete around the nest site and

became agitated, then wrestled with him. She sided up with Ledge, who's attitude had altered too. He assumed a protective role, guarding Crinkle and her immediate territory. If Pete came within about ten feet (3 m), Ledge would strike and endeavor to bite the base of Pete's tail. Crinkle acknowledged Ledge's protective role by moving alongside him when she felt threatened by Pete's presence. Ledge would respond by assuming a sentinel stance and occasionally striking and chasing Pete. Over the next three days, Ledge caught Pete twice and inflicted deep lacerations in the base of his tail.

Clutch

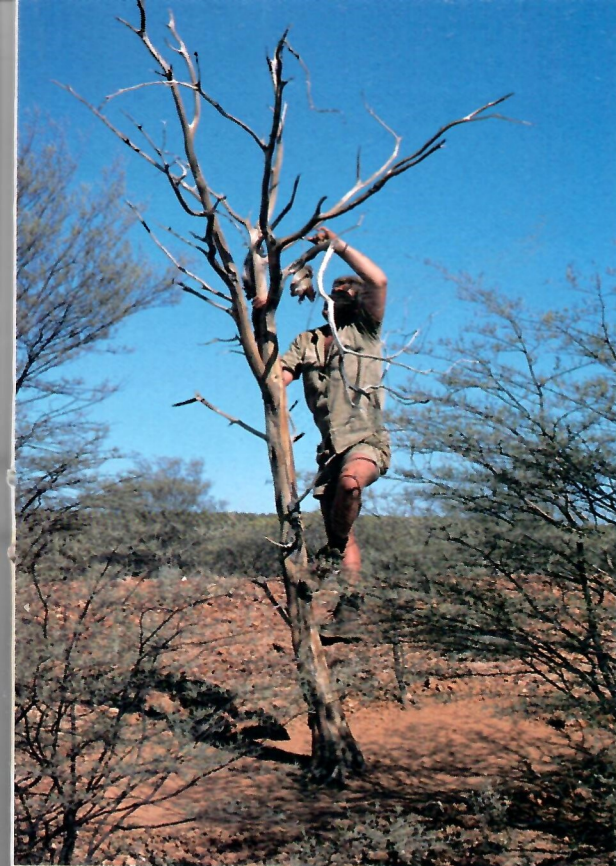
Thirteen eggs were collected and the total clutch was 2.7 lb (1234 g). Data for individual eggs are shown in Table 2.

Comments

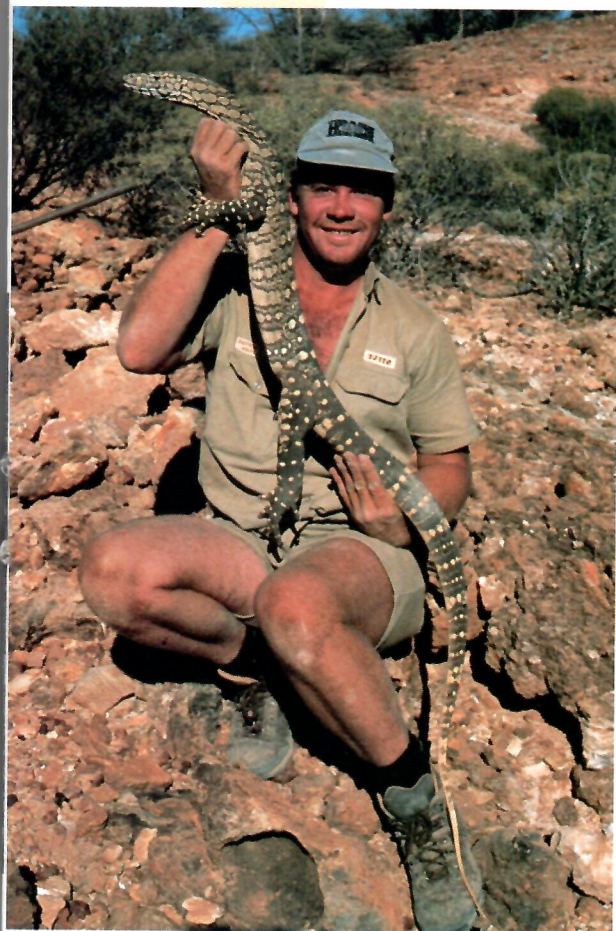
Further to our current research on nocturnal nesting of Australian varanids, the Queensland Reptile and Fauna Park is currently in its third year of scientific research on a wild population of perenties, east of the Simpson Desert in central Australia. Location and observation of wild perenties are a challenge. To maximise long-term data collection we utilize unobtrusive techniques such as examination of scats to determine their prey. We set up bait-stations in trees (up high to avoid dingoes) to attract resident perenties, and study tracks and basking marks. Catching and restraining these wild perenties are absolute last resorts. As this species is very secretive and elusive,



Perenties are fast, agile and secretive. If threatened they disappear into cave's cracks and crevices of their rocky habitat.



Steve Irwin setting a bait high in a tree (to avoid dingoes) to attract resident perenties at the study site. Once perenties attack the bait they are then tracked back to their lairs, unaware they are being observed. Photo by Wes Mannion.



any disturbance makes them more timid and often they will never be seen again. Wild perenties have very acute senses and I have documented them spotting people and retreating at 328 yds (300 m). The greatest honor is the very occasional moments a perentie allows us to share a rocky outcrop for an afternoon bask.

Table 1. Perentie breeding records from Queensland Reptile and Fauna Park, Glasshouse Mountains, Tourist Road, Beerwah, Queensland 4519 Australia.

17 Mar 1985	wild caught 1.1.0
3 Oct 1985	wild caught 0.1.0
22 Nov 1986	mating
31 Dec 1986	eggs
22 Aug 1987	hatching (234 days incubation)
	no mating record
21 Dec 1987	eggs
	died during incubation
2 Nov 1988	mating
30 Nov 1988	eggs
18 Jun 1989	hatching (200 days incubation)
11 Dec 1989	mating
	no eggs located
	no hatching
5 Nov 1991	mating
7 Dec 1991	eggs
13 Aug 1992	hatching (249 days incubation)
3 Nov 1992	mating
28 Nov 1992	eggs
30 Jul 1993	hatching (228-233 days incubation)
4 Aug 1993	hatching
20 Oct 1993	mating
20 Nov 1993	eggs

Table 2.

Perentie eggs, 20 November 1994.

Egg No.	Length,mm	Width,mm	Weight,g
1	86.5	45.5	96
2	89.0	43.5	96
3	85.0	45.0	92
4	90.5	44.5	101
5	85.5	46.0	96
6	88.0	44.5	96
7	88.0	44.0	94
8	86.5	44.0	92
9	88.5	44.5	98
10	83.0	44.5	88
11	90.5	44.0	100
12	83.5	45.0	94
13	91.0	43.5	100

Steve Irwin with a young adult, 5.9 ft (1.8 m), male perentie, caught at the Queensland Reptile and Fauna Park's study site in far-western Queensland. Photo by Terri Irwin.

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An ancient male perentie, measuring over 6.5 ft (2 m), nicknamed Old Timer, located at the Queensland Reptile & Fauna Park's perentie study site in far-western Queensland, Australia.



Feeding this wild perentie (Old Timer) was one of the highlights of our lives. He was emaciated after his dormant winter period and tolerated our presence for a meal of feral pig. Photo by Terri Irwin.



Black-headed monitors (*Varanus tristis*) frequent the perenties' habitat and make up a large portion of their diet.



Bearded dragon's (*Pogona vitticeps*) threat display will not deter a hungry perentie.



Scats reveal that reptiles make up the bulk of wild perenties' diet. This scat contains belly scales from an adult king brown snake (*Pseudechis australis*).



In captivity perenties are fed whole food items to ensure their dietary requirements are met.



Wes Mannion, the Park's Curator, locates a black-headed monitor (*V. tristis*) which climbed to safety from perentie predations into the roof of a cave.

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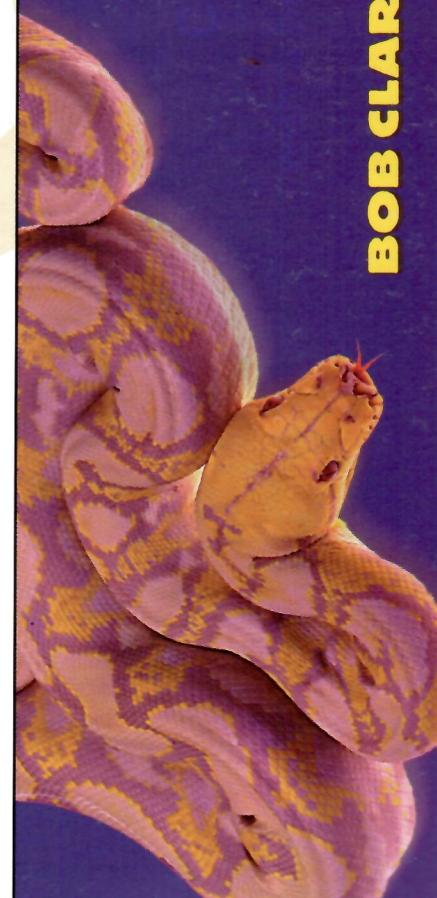
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MELANISTIC IGUANAS

by Steve Raymond and
Ernie Wagner
Photos by Steve Cooper

The common iguana (*Iguana iguana*) ranges from central Mexico to central South America and is an inhabitant of primarily rain forest areas. Everyone is familiar with the bright green coloration of this lizard, which often tends to turn darker with age.

In recent years a number of color variations and genetic mutations have appeared in the pet trade. The most spectacular of these was the appearance of a pair of hatchling albino iguanas which were bright yellow with pink eyes. Another color phase which has been appearing is the "blue" iguana which has to a varying degree, a bluish tint to the green pigment.



Melanistic iguanas (Iguana iguana), might genetically assist in producing snow iguanas.

At Rare Reptiles, we have recently received a pair of juveniles which have a great deal of black pigmentation throughout their bodies. They do show some trace amounts of green on their undersides, but they are definitely a different color from the average common iguana.

It's hard to say at this point if this is a genetic defect of a color gene, or a lizard which has come out of a new area where selective pressures have made darker pigment of higher survival value, but these are interesting lizards and should provide some fascinating possibilities for a breeding project.

Ultimately, it will take a black iguana, bred to the yellow albino to produce a solid white iguana, the same way the "snow" corn snake was created. If the albino "yellow" iguanas is missing all the black (or bluish) pigment which combines with the yellow to make a green lizard,



ard, then a black lizard missing all the yellow will be needed for the next step. Breeding a black lizard to the "yellow" albino will produce all normal babies, but they will be heterozygous for missing both colors. These babies, when raised and bred to each other will produce three yellow babies, three black babies, nine normal babies and one white baby, missing both colors.

This would be a very long term project which would be well worth the investment of time and effort to accomplish, creating a lizard which nobody has ever seen before. 

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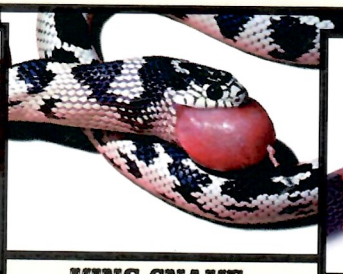
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Herpetological Photography

those mechanical or electronic gizmos which perpetuate the sinister idea that a machine can do it better.

Automatix were supposed to free our minds to be more creative. Instead of creative-minded photographers, however, automatix have produced market-minded photographers with no heart or feeling for their work. Being concerned only with the marketability of an image leads to an empty, mechanized look and feel to the images produced by these photographers. It's a look I do not want to possess.

Automatic cameras are like automatic transmissions in cars. They are great for the average driver in ordinary situations. But if a photographer is to compete with other photographers for a share of the market, there must be an edge which the other photographer with the same equipment does not have. That edge comes from inside the head, not from the equipment. How many race cars do you think there are with automatic transmissions?

Cameras

Herp photography has a higher requirement for sharpness than most other forms of photography. Few other sciences count scales to determine a species. Despite the necessity for high quality optics, herptile photography can be one of the least expensive forms of photography to get into. It's a matter of getting the right equipment and camera system for the job. The most expensive camera system to build is the system that must do everything. Once we assign a specific purpose to our camera system, we can begin selecting equipment best suited to that task. If we select things fitted to that task and that task only, it is surprising what we do *not* need to spend our money on.

Let's assume you want to build a system suited for photography of reptiles and amphibians and you're not concerned with doing everything.

There are several things you should know when building a camera system. Right now, the top three cameras on the market are Canon, Nikon and Minolta. All three have similar systems, features

and quality. You could not make a mistake choosing any of these. My personal preference is Canon equipment. I have used exclusively Canon cameras and lenses for more than 25 years. I have found the mechanical aspects of Canon's equipment to be flawlessly reliable and believe their optical quality to be the finest in the world. However, for our purposes, it makes little difference which camera brand you prefer, even if it is not one of the above-mentioned cameras.

Wildlife Artist, Heather Bobbing with *Phyllomedusa hypochondrialis*.

At 1:1, a 50mm macro lens will have to be this close to the subject.

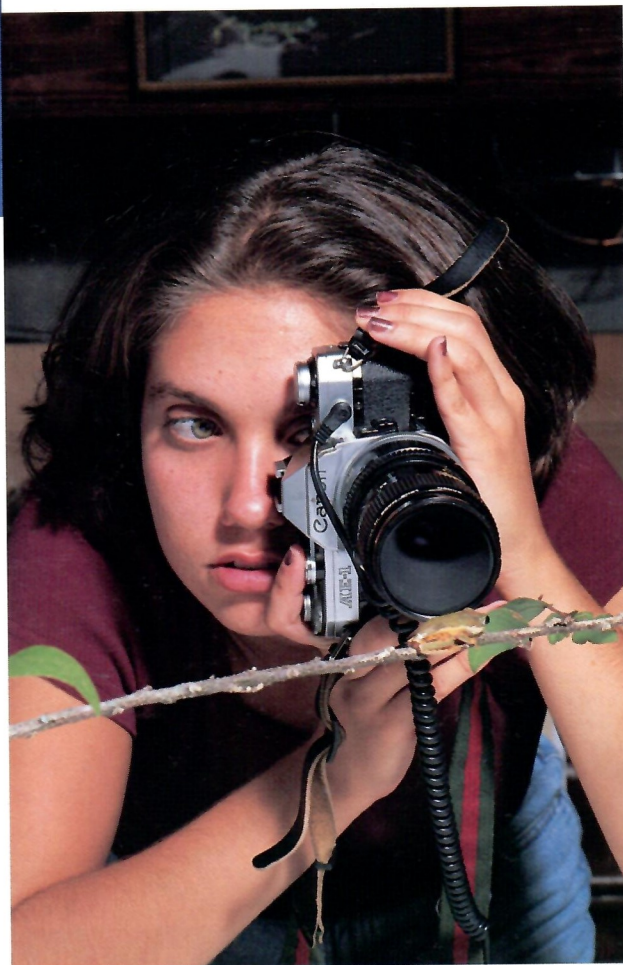


Canon 50mm & 100mm Lenses with Frogs (*Scaphiophrynne gottlebei* and *Phyllomedusa tomopterna*). Macro lenses with "Life Size Adapters"

Camera Equipment

by Jim Bridges
All photos by author.

"What camera do you use?" It's one of the first questions asked of a photographer, and it's a little like asking a track star what shoes he wears. "Photographers, not the cameras they use, take good pictures." However, there are so very few esthetically pleasing herp images being created today, it would be easy to think otherwise. This is largely due to *automatix*. Automatix are



The Lens

A camera is nothing but a glorified film holder. The *lens* is what determines the quality of the image. Spending large amounts of money on a name brand camera body makes no sense if you are going to use *off-brand* lenses on it. In doing so you have an off-brand quality image, not the name brand you bought. Camera manufacturers have a reputation for quality to uphold. An off-brand lens manufacturer has a price to beat. For the best quality image possible from your brand camera, use your camera manufacturer's lenses.

If you do not yet have a camera and are thinking about buying one, try to buy it without a *normal* lens. The standard lens is not well suited for our purposes. However, because of the way in which cameras are marketed, a camera *body only* may be difficult to purchase. The price for a camera body only is sometimes almost the same as a camera with a normal lens. In this case, you might just as well buy it with the normal lens. This lens may be useful for family photos. If it turns out that you must buy a normal lens, get the least expensive manufacturer's normal lens. This will be somewhere around 50mm f1.8. Oddly enough, the slower, less expensive manufacturers' lenses are usually a higher quality lens and far superior in picture quality to the faster lenses in the same focal length.

The most popular lenses for photographing herptiles are *macro focusing* zoom lenses. Although the quality of zoom lenses has improved greatly in the last 20 years, this lens remains a less than good choice for herp photography.

A zoom lens must do the job of many lenses, and to do this the optical quality is compromised. Optical quality is sacrificed in one area of the zoom range so that another focal range can be made more usable. At no point along the zoom range does the quality match that of a fixed focal length lens. However, the convenience of a lens that can do so many jobs outweighs the loss in quality for the person with no need of fine optics. A macro focusing zoom lens is simply a zoom which can focus very close. It is intended to enable a photographer to try out, or play with, macro photography and

does not have the optical quality and sharpness needed for the more demanding field of professional herp photography.

A true macro lens is a fixed focal length lens specifically designed for close-up photography. Almost every camera manufacturer makes a macro lens with a focal length around fifty millimeters. A 50mm macro lens can do all the jobs of a normal lens and do them better than the standard lens. In addition, most camera manufacturers also make a macro lens around 100mm and a few even make a 200mm macro lens. In herp photography a 50mm macro lens is the most useful.

A macro lens focuses from infinity to about one-half life size, without any adaptors. With the addition of a *life size adaptor* the lens will focus from half-life size to life size (magnification ratio, 1:5 to 1:1).

A 1:1 ratio (read: one to one) basically means the subject is the same size on the film as it is in real life. If you photographed a dime at 1:1, you could place the dime on the film and the image would be the same size as the real dime. The advantage of a 100mm macro lens is that you basically get the same size image as with a 50mm, but at twice the distance.

When trying to photograph at 1:1 with a 50mm lens you are in so close to the subject that it is difficult to get light on it. The extra working distance that a 100mm lens affords a photographer not only makes it easier to light the subject, but keeps the photographer at a distance more likely to be tolerated by a herptile. A 200mm lens increases the working distance to four times that of a 50mm lens, while still giving the same size image on the film. The down side to long macro lenses is that a 100mm lens is two times



Cuban treefrog (*Osteopilus septentrionalis*) on foxtail. In South Florida

harder to hold still than a 50mm, with a 200mm being four times harder to hold still.

What's wrong with automatics

Automatic exposure, automatic focus and automatic flash are the real automatix of the photography field. The reason Mr. and Mrs. Average are happy with their pictures of little Johnny is because they don't know any better. Their images may be a little dark, totally blue and not very sharp, but "Hey! Isn't Johnny cute"! My point is that these systems don't work that well even under ordinary circumstances. Mr. and Mrs. Average are not looking for quality. They're looking for Johnny! To consistently get top quality images out of an automatic camera, the automatic exposure systems must be outsmarted by the photographer.

The problem with automatics in camera systems is that they are so easily fooled, yet the user believes them to be infallible. Auto exposure and auto flash are based on the amount of light coming into the camera. When your automatic camera looks at a snake on a dark background, the camera tries to make the whole scene lighter. When you point your camera at a lizard in white sand, the automatic system tries to make everything darker. Even if your camera can give you a light or flash reading of just the subject, the exposure system within the camera will still try to make the subject equivalent to the system's standard (usually 18% gray). The image will still not be exposed correctly unless the subject happens to be the same density as the system standard.

With print film and some expensive darkroom work, maybe a good print could be made. However, if you are hoping to publish your photographs, you'd

better be shooting slide film. All major publications want transparencies, not prints.

Even though slide or transparency film has little or no margin of error, you should never have to throw away slides because of incorrect exposures. Once you master manual exposure, you will never



Albino Southern Toad (*Bufo terrestris*).
Range Virginia to Louisiana

have to worry about exposure again. If you cannot count on every exposure being correct, it's probably the automatix and not you.

Auto focusing systems aren't much better. In low light and low contrast situations most automatic systems can't focus at all. Many herptiles are low contrast and blend into their surroundings. The ambient lighting is often poor when we photograph herptiles. Yet, none of this is really a problem.

At close distances you don't use the lens focus anyway. That's right! At close distances the focusing ring on the lens is

used only to size or frame the image. Once the subject is the desired size in the view finder, focusing is accomplished by teetering or slightly swaying back and forth to move the focused field into position and correct last minute framing. Unnecessary movement, such as twisting the focusing ring is both frightening and distracting to the subject and can account for many lost shots.

Okay, automatic is out. But a look around the camera market will reveal that this eliminates all of the new cameras. They're all automatic! So, what do you do now? And what if you already own an automatic camera?

The answer is, buy whatever automatic camera you like and turn off the automatix. Just make sure there is at least a plus and minus, two f-stop manual override on the auto systems.

In the issues to come we will discuss everything you need to know about kicking the automatix addiction and why producing top quality herptile images is a matter of using your head, not a machine.



Helix Controls

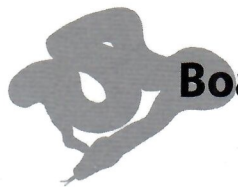


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Boas & Pythons

Tiger, Tiger...

by Bob Clark
Photos by Al Baldogo

I saw my first tiger reticulated python at the Orlando Expo in 1992. My friend Karl Hermann of St. Paul Minnesota had just hatched a clutch from his strange looking male retic and a normal looking female. A little more than one half of the babies looked like their unusual father. All had patterns duplicated laterally, similar on either side of the dorsal midline. All had very reduced patterns, some with only a thin, broken black stripe down the center of the back. The white spots on the sides were elongated and overall color was more gold than the darker siblings. None had the typical dorsal head stripe extending forward from the eyes. Interestingly all seemed calm and perfectly at ease with all the attention they were getting. In contrast, most other baby pythons would have taken the opportunity to get in a nip or two.

Unlike all other known genetic mutations of color and patterns in reptiles, the tiger trait is expressed in the first generation of offspring. Half of the first clutch

...one-fourth of a new type the Baldogos have named the "super tiger".

from the original male showed the trait. That snake, we now know, was heterozygous for the tiger trait and therefore could only pass the trait to half of his progeny. The normal looking siblings to the tiger babies are, just that, normal. Last year Al and Cindy Baldogo of Fontanelle,

I saw my first tiger reticulated python at the Orlando Expo in 1992.



Tiger Reticulated Python

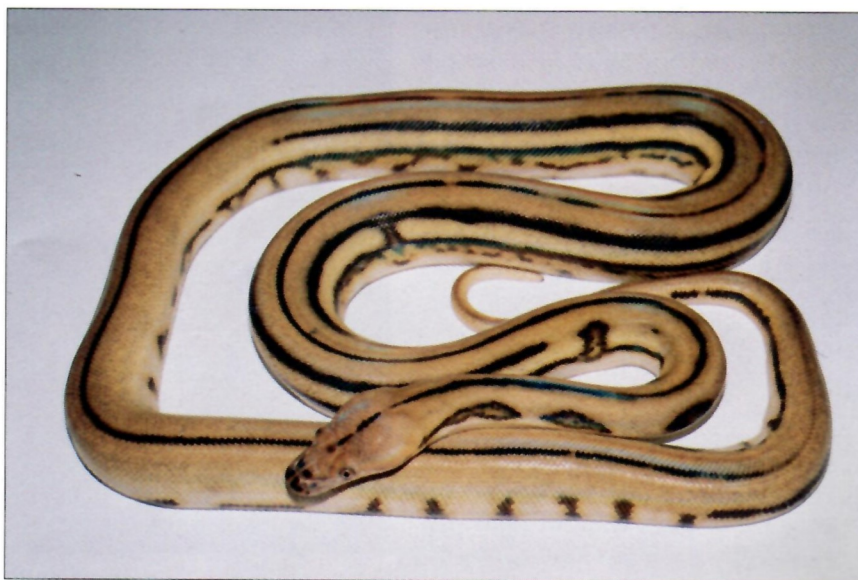
Iowa were successful in breeding a pair of tiger retics. This produced a litter of about one-half tigers, one fourth normal, one-fourth of a new type the Baldogos have named the "super tiger".

The super tiger is homozygous for the tiger trait. These snakes have an extremely reduced pattern and are lighter

in color. The dorsal pattern consists of a thin broken black line. The lateral white spots are connected to form a white stripe on the sides. All pattern disappears near the tail. The temperament of super tigers is also good. The tiger trait has been described as co-dominate or dominate with incomplete penetration. A breeding

of a super tiger to a normal should produce all tiger offspring and super tigers bred together should produce all super tiger offspring.

From the perspective of the average hobbyist, until recently, all retics looked basically the same. Now the tiger trait is available in two forms and I should have a beautiful albino morph available next season. I've made some progress toward producing an albino tiger retic as well. In addition to these mutations several geographic variations are now becoming available. It is likely that some populations of reticulated pythons do not reach the very large sizes typical of the species. Smaller, well-tempered animals available in several pattern and color combinations are likely to increase the appeal of these snakes as pets. 



Super Tiger Reticulated Python



IBD: Coming to your collection next?

by Roger Klingenberg, DVM

In the previous issue of the *Vivarium* we had introduced a client of mine, Lola, and her dilemma. She owned a group of six Argentine boas, one of which had been treated initially for *star gazing* and subsequently euthanized due to chronic deterioration. A necropsy (animal autopsy) was performed after routine laboratory tests failed to reveal useful information, and we've anxiously awaited the results. I was at my clinic at 1:00 a.m. on an emergency call when the fax machine kicked on and a lab report popped out. One term stood out as I scanned the pathology report — IBD. Tilley was diagnosed with **Inclusion Body Disease (IBD)**, also referred to as Inclusion Body Disease Virus (IBDV) in the literature.

It was one of those days when I had to hit several clients with bad news, and I reluctantly reached for the phone. Lola was speechless on the other end of the line and I feared that she had either hung up or fainted. After a long, awkward pause, she returned to the phone and in a trembling voice that didn't hide the fact that she had been crying, she asked the simple question, "What now?" Simple question, indeed. I only wish the answers were as simple.

I asked Lola to make a diagram or flow-chart showing which of her 44 boas and pythons had direct contact with Tilley and how and where the others were housed. Hopefully this would help us to logically identify those snakes most at risk and prioritize the testing of the other snakes. Tilley had direct contact (in cages for breeding) with the other five Argentine boas, so we decided to test these first by performing complete blood cell counts (CBCs) and biopsies. Why CBCs and what type of biopsies will give us the most information?

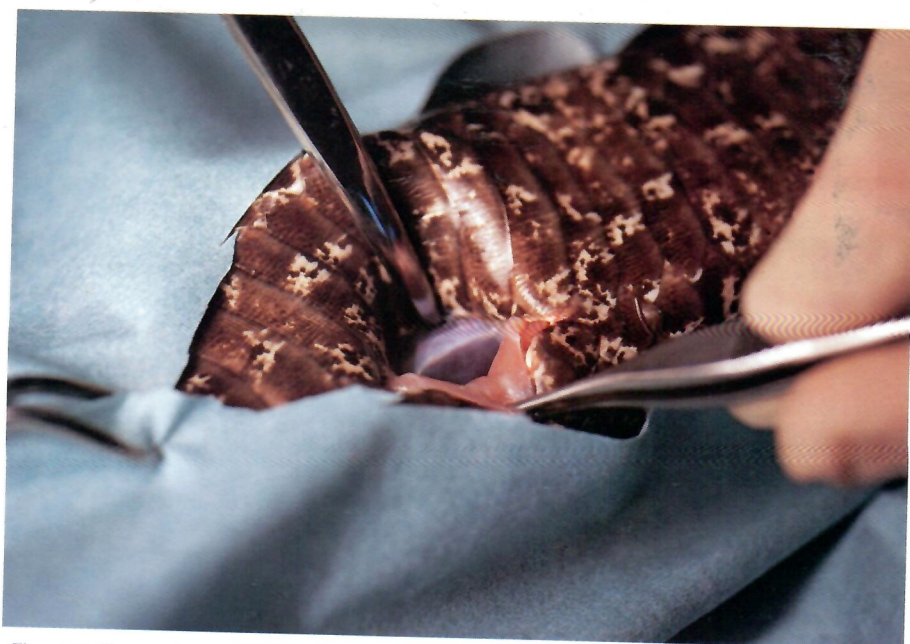


Figure 1. The surface of the liver is visualized through the small surgical incision in this Argentine boa.

Blood Tests and Biopsies

Published work by Schumacher et al. (1994) indicated that the IBD virus created a disease characterized by the formation of intracytoplasmic inclusions in the epithelial cells of the internal organs and neurons in the central nervous system. In every snake examined, inclusion bodies were found in 100% of the pancreatic acinar cells. However, the pancreas can be very difficult to locate, and isn't tolerant of tissue invasion. Inclusion bodies were also found at high frequencies in the kid-

ney and liver (70%) (Schumacher et al. 1994), and these organs are more amenable to biopsy. Dr. Elliott Jacobson prefers to obtain samples from the esophageal tonsillar tissue, liver, and gastric lining using an endoscope to increase the odds of finding inclusion bodies and establishing a valid diagnosis (Jacobson, personal communication). After discussing the options with Lola, including cost considerations, we compromised by deciding to do a liver biopsy on these snakes using a conventional surgical approach.



Figure 2. The liver is gently elevated through the incision and a metal biopsy needle introduced parallel to and into the liver. A small core of liver parenchyma is all that is required for pathologists to find the characteristic inclusion bodies.

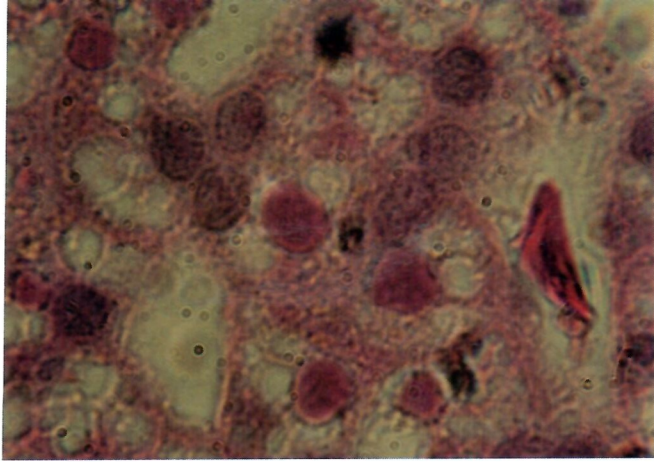


Figure 3. An inclusion body in the cytoplasm of a red blood cell from an Argentine boa with IBD. The author is investigating the prevalence of inclusion bodies in peripheral blood cells.

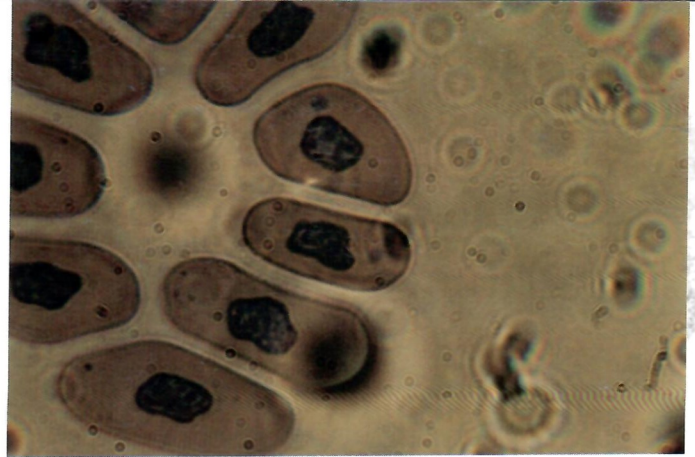


Figure 4. An inclusion body in a section of liver from an Argentine boa that had IBD.

Blood was collected for CBCs because Dr. Jacobson had noted that most acute cases had increased numbers of white blood cells, particularly lymphocytes. Dr. Jacobson had also noted that inclusion bodies were occasionally seen in lymphocytes (pers. comm.). Tilley had large numbers of inclusion bodies in her red blood cells (RBCs), and this would be monitored in the other snakes tested.

After inducing anesthesia, liver biopsies were performed and submitted to Dr. Dave Getzy, a pathologist with Colorado Veterinary Laboratories. Of the five other Argentine boas, four were found to have massive numbers of inclusion bodies in their livers and RBCs and thus were proven to be IBD positive.

Client Choices

Now what? What choices does our client have? Schumacher et al. (1994) indicated that all infected snakes are chronic carriers, there is no effective treatment, and that remission has never been seen in affected snakes. If emotions are put

aside and sanity rules, then euthanasia is the obvious and appropriate answer. If emotions rule, intensive supportive care measures can prolong a snake's life.

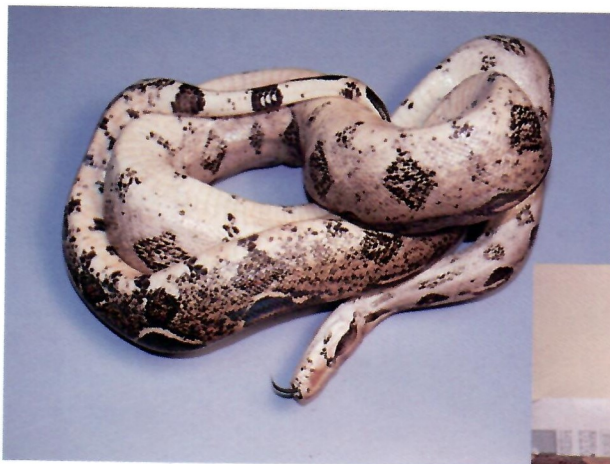
No veterinarian should force a client to euthanize a pet. However, if the decision is made to treat the pet, the owner needs to strictly quarantine the snake and employ sound hygienic practices. Lola reluctantly chose to euthanize the four positives as she had dozens of other snakes to take into consideration.

What to do with the one snake that had a negative (no inclusion bodies seen) liver biopsy and CBC? Experience would suggest that this is an affected snake which fits into the 30% of snakes that don't have inclusion bodies in the liver. Lola chose to take this snake home and strictly quar-

antine it. In four to six weeks we'll re-biopsy with tissues taken from alternate sites such as the gastric mucosa, kidneys, and esophageal tonsils. I feel this snake is a carrier just waiting to be proven.

We tested nine other snakes from Lola's collection prior to this article being submitted to the editor (deadlines!). Eight of these were Colombian boas and the other a Brazilian rainbow boa. None of these snakes had direct contact with the Argentine boas, but were housed nearby in the same room. Lola admitted to having fought widespread mites for over a year, which she felt had originated with some feeder anoles, then migrated to the Colombian boas and then to the entire collection. While the Brazilian rainbow boa had no inclusion bodies in its liver or RBCs, seven of the eight Colombian boas tested so far have both liver and RBC inclusion bodies.

The further we get into the colony, the more that reality sinks in. The probability of the entire collection being infected is very high. Similar to the Argentine boa that previously had a negative liver biopsy, the Brazilian and Colombian boas with no



Figures 5 and 6. Which of these two common boas looks most like an IBD victim? The boa on the left was suffering from bacterial meningitis and chronic malnutrition, mirroring what one might imagine an IBD snake to look like. The boa on the right was extremely well cared for and in excellent health except for an acute onset of mental dullness, lack of fine motor control, and failure to eat. A liver biopsy confirmed that it had IBD. This widespread viral disease can present with very subtle symptoms in addition to the more classic severe signs.

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inclusion bodies will be isolated strictly and re-tested in four to six weeks. At this point I would like to commend Lola's commitment to the testing of all of her susceptible snakes (boids and pythons). Testing is not only emotionally exhausting, but financially draining, too. She is determined that her problem not become *your* problem.

IBD Transmission

It is widely assumed, but not proven, that mites are one of the main sources of transmission. This assumption is made because entire large collections have become infected in instances where fastidious hygiene and cleaning methods were employed.

Mites from infected snakes are being collected for a research team at the University of Florida School of Veterinary Medicine with the hope that a molecular based test will be developed that will determine the presence of the IBD virus (Jacobson, E., pers. comm.).

We can also assume that oral/fecal contamination could harbor shed virus and snakes housed together are at greater risk. Another assumption, based on observation, is that the offspring of infected mothers are also infected (Mader, pers. comm.). For suggestions as to what you can do to protect your collection, see Table 1. Remember that these are *assumptions*, based on experience and observation.

Research

Was this article written to describe a rare and isolated situation that won't happen to any of you, or to myself for that matter since I have a substantial collection with boas and pythons? A resounding "NO!" Although IBD has been recognized for over 20 years, it was just recently that a retrovirus was isolated by Jacobson's group at the University of Florida (Jacobson, pers. comm.).

I confess to having missed some cases in the past which I would call 'classic' now. This was based on the naive view that these bad diseases occur 'somewhere else,' such as California or Florida. Let's be real! This disease is rampant in boids, and collections all over the United States are infected. As these snakes are passed from one owner to another, from one city to another, from one state to another, the likelihood of this disease arriving in *your* collection increases.

A vital key to controlling this disease is the development of a simple diagnostic kit that would allow for the screening of boas and pythons. However, due to the lack of funding it is unlikely that an experimental, much less a commercially available test, will be available within the next two years (Jacobson, pers. comm.). The problem is that despite IBD being the most significant disease to occur in reptiles, there are not enough individuals or organizations to invest in diagnostic tools such as those we have for controlling paramyxovirus and mycoplasmosis. Will this failure to act doom herpetoculturalists to remain backroom breeders who place emphasis on facilities and cages, and not on disease control? What can one person do? Please refer to Table 2 for details on how to contribute to the research required for this insidious disease.

Can the presence of inclusion bodies in RBCs be used as a screening test for IBD? In this group of snakes all of those that had inclusion bodies in the liver, also had them in the RBCs. While the author will continue to investigate this finding, it should *not* be assumed that this is a good screening tool. This finding may simply be due to the chronicity of these cases and may not be present in acute cases, or other boids and pythons for that matter.

In the meantime, may your boas and pythons enjoy good health. I know that Lola, for one, has stated that she would not wish IBD on her worst enemy.

The author thanks Drs. Doug Mader

and Elliott Jacobson for sharing their insights and experiences with IBD, and Dr. Dave Getzy for his excellent pathology work and support. ✈

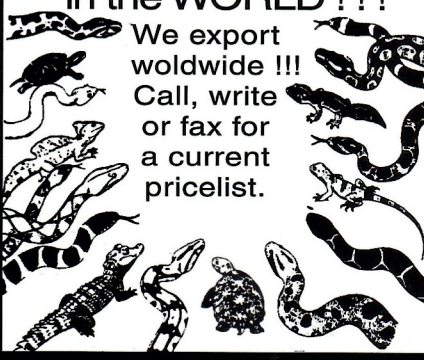
Table 1. Protecting Your Collection From IBD.

- 1) Buy your boas and pythons from long-term, reputable dealers. This is not a 100% guarantee of perfect health, but you're dealing with someone who wants repeat business and is in this for the long haul.
- 2) Quarantine all new pythons for at least three months, and boas for at least six months. This may not prevent a boid carrier from sneaking through, but at least mites are controlled and obvious poor doers will be noted.
- 3) Do not bring in, or send out, boas and pythons for breeding unless strict quarantine measures are followed.
- 4) Avoid house-sitting snakes in your home or business where your snakes are housed.
- 5) Never bring an ill snake into your group, even those that are "too good to pass up."
- 6) Employ fastidious hygiene practices in your collections. Wash hands and cleaning implements between handling snakes and cleaning cages. Don't rotate uneaten food items or non-disinfected cage furniture between cages.
- 7) Poor-doing boas and pythons, and boas and pythons exhibiting central nervous system (CNS) signs should be considered potential IBD cases, and a veterinarian specializing in reptiles should be consulted.

Table 2. Contributions for IBD Research.

The author commends those individuals and reptile groups that have donated over \$25,000 to the University of Florida's research team for IBD. However, this is woefully short of the amount needed to support ongoing work. Those individuals and groups interested in donating to this worthwhile cause should contact Dr. Elliott Jacobson at: College of Veterinary Medicine, Dept. of Small Animal Clinical Sciences, University of Florida, PO Box 100126, Gainesville, FL 32610-0126

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New trends in the colubrid market

by Vivarium Research Group

New perspectives on the display of reptiles are slowly changing the face of herpetoculture. For the breeders of many of the smaller colubrids including milksnakes, mountain kingsnakes, hognose snakes and some of the ratsnakes, this means new opportunities in a market that became sluggish in 1996. For commercial breeders, survival in the 1997 market will mean a shift from the declining retail customer market to the growing wholesale market (offering snakes at discounted prices to distributors and retail stores).

The growing vivarium movement

Philippe de Vosjoli predicted five years ago trends in the evolution of herpetoculture, culminating in what he called the Third Wave of Herpetoculture, which would focus on naturalistic vivarium design. His predictions have proven accurate to the degree that product manufacturers and retail stores have been increasingly offering a variety of products aimed to give a more natural appearance to reptile enclosures.

Until recently much of the colubrid market had been animal-centered with minimal attention given to the design of reptile environments. Most of the efforts in that area had been in developing simple space- and labor-effective systems geared mostly to the breeder, or to the child or basement hobbyist. As a general rule, these were not enclosures that most of the public would find appealing as a display in their family room or living room, and consequently this has limited the potential popularity of the hobby.

Following in the footsteps of the tropical fish trade, which in recent years has undergone a major revolution with the mini-reef system for keeping salt water fish and the naturalistic Dutch aquarium system for keeping freshwater fish, the new emphasis in herpetoculture is on the display environment. Beautiful animals in beautiful vivaria that give pleasure and a sense of peering into a section of nature are the objectives now at the forefront of thinking in the herpetocultural industry.



A Queretaro kingsnake (*Lampropeltis ruthveni*) in a Virtual Nature Vivarium by Vivarium Research Group Inc.. The background is a hand-made and painted fiberglass rock background by famous rock artist Bill Johnson. These backgrounds although expensive were cast from actual rock surfaces in Arizona and look identical to rock. They are usable in a wide range of vivaria even aquatic ones and give an instant naturalistic feel to displays and are highly recommended for store displays. Photo by Philippe de Vosjoli.

New methods for colubrid care and display

This new approach emphasizes large enclosures. Most smaller colubrids under the naturalistic vivarium protocols would be kept in 4 foot (1.2m) or longer vivaria. This would be the size recommended for a pair or trio of Western hognose snakes or Arizona mountain kingsnakes or California kingsnakes. Sand is a popular substrate when keeping colubrids from desert areas and has been used successfully by Robert Applegate and is also recommended by Philippe de Vosjoli in *Design and Maintenance of Desert Vivaria*.

Stratifying the topography of the vivarium using rock, wood and plants is a key landscaping factor that makes a naturalistic vivarium visually interesting. It also results in environments that allow snakes the opportunities for a greater range of behaviors. With this new naturalistic approach to complex vivarium design, colubrid snakes, in contrast to animals kept in two dimensional environments (such as the plastic boxes so commonly used by breeders), will be seen to be active, explorative

and climbing to varying degrees. In these setups, rock shelters above ground may harbor coiled snakes visible during the day. Adding angled spotlights to simulate dusk or dawn and red incandescent lights to observe nocturnal behavior can add to the excitement generated by this growing and eye-opening hobby. With naturalistic vivarium design, a window has been opened on a world unknown by the great majority of human beings. Some say that to date herpetoculture which has focused on production has been human-oriented but

that the Third Wave caters to the area of interface appealing to the aesthetics and biophilic needs of humans as well as providing enriched environments for animals.

In future columns, step-by-step designs will be presented for keeping snakes in large vivaria. 

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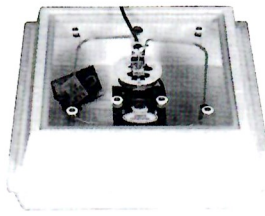
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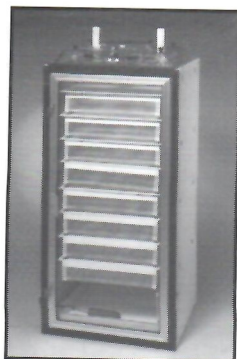
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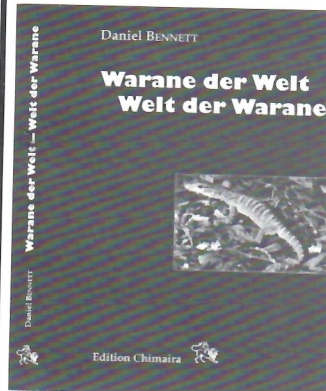
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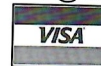
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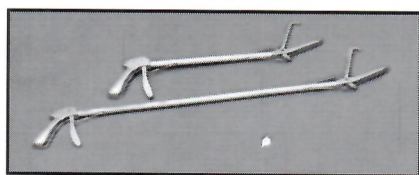
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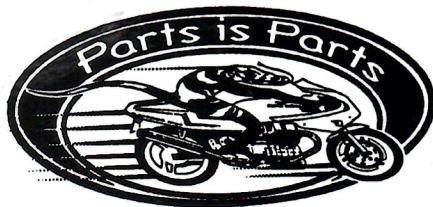
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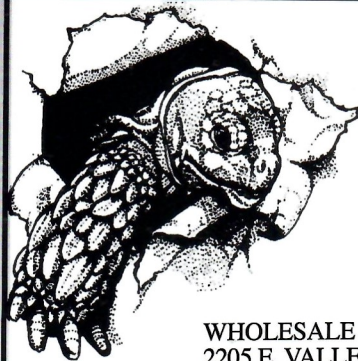
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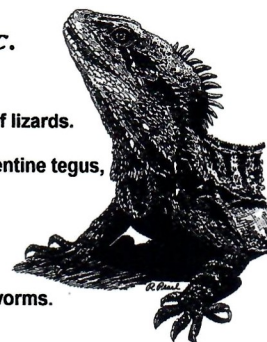
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May 17-18: Reptile Expo will be held at the Arizona State Fairgrounds, Phoenix, AZ. For info contact: (707) 578-3976.

May 24-25: The Chicago Herpetological Society's Fourth Annual Live Reptile and Amphibian Exhibition will be held at the Clarion International O'Hare Hotel in Rosemont, IL. For info call: (773) 477-3645.

May 30-June 1: Exotics & Family Pet Showcase will be held at the Allentown Fairgrounds, Allentown, PA. For info call (215) 721-7199.

May 31 - June 1: Reptile Expo will be held at the Sonoma County Fairgrounds, Santa Rosa, CA. For info contact: (707) 578-3976.

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June 25-July 2: The A.S.I.H. (American Society of Ichthyologists and Herpetologists) will meet in at the University of Washington, Seattle, Washington. Robert E. Espinoza Biology Dept., (702) 784-4565, fax 784-1369.

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August 2-3: The International Reptile Breeders Convention will be held at the Community Conference Center, Mesa AZ. For info call Ray Busby at (619) 263-6898.

August 9-10: Reptile Expo will be held at the Portland Expo Center, Portland, CA. For info contact: (707) 578-3976.

August 16-17: 1997 National Reptile Breeder's Expo will be held at the Radisson Twin Towers Hotel, Orlando Florida. For info call Wayne Hill (941) 294-2235.

August 16-17: 3rd Annual Captive-bred Reptile and Small Exotic Animal Show & Sale, to be held at Puyallup Fairgrounds, Expo Hall Seattle, WA. For info. call

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August 23: The New York Herpetological Expo will be held at the LeMoine Manor Hotel in Liverpool (Syracuse) NY. For info call Bob Cunningham at (315) 446-9292.

August 23: The New England Reptile Expo will be held at the Tolland Agricultural Center, Vernon, CT. For info contact Steve Baker (860) 644-2367 or email: crwinc@aol.com

August 30: The Spring Eastern Herpetological Expo will be held at the Sunnybrook Ballroom, Pottstown, PA. For info call (215) 257-6088.

August 30: Georgia Herpetological Society's Atlanta Reptile & Amphibian Breeder's Expo will be held at the Cobb Galleria Center, Atlanta, GA. 10am - 6pm. For info write to GHS, P.O. Box 464778, Lawrenceville, GA 30046.

August 30 - September 1: Reptile & Amphibian Show to be held at the Oregon Museum of Science & Industry (OMSI). 9:30 am - 7:00 pm. For more information call: Raylea Pickett, (503) 797-4677.

September 6-7: Reptile Expo will be held at the Orange County Fairgrounds, Costa Mesa, CA. For info contact: (707) 578-3976.

September 13-14: Pet Mania Pet and Reptile Expo. Benton-Franklin Fairgrounds, Kennewick, Washington. For info call Larry Bright (509) 375-0435.

September 13-14: Mid-Atlantic Reptile Show held at the

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September 20-21: Reptile Expo will be held at the Arizona State Fairgrounds, Phoenix, AZ. For info contact: (707) 578-3976.

September 27-28: Florida International Reptile Show will be held at the Florida State Fairgrounds Expo Hall, Tampa, FL. For info contact: Doug Wagner (813) 771-1368 or email DWagner200@aol.com

September 28: The 7th Annual Midwest Breeders Expo sponsored by the Kansas City Herpetological Society will be held at the Airport Hilton Hotel in Kansas City, MO. For more information call (816) 468-5609.

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October 18: Southern California Herpetology Association Annual Reptile and Amphibian Show & Sale. 10 am - 4 pm: El Dorado Park Recreation Center, 2760 Studebaker Road, Long Beach, CA. Info contact Steve (562) 498-3211.

October 18-19: Reptile Expo will be held at the Sonoma County Fairgrounds, Santa Rosa, CA. For info contact: (707) 578-3976.

November 1-2: Exotics & Family Pet Showcase will be held at the Memorial Hall at York Fairgrounds, York, PA. For info call (215) 721-7199.

November 1-2: Reptile Expo will be held at the Santa Clara County Fairgrounds, San Jose, CA. For info contact: (707) 578-3976.

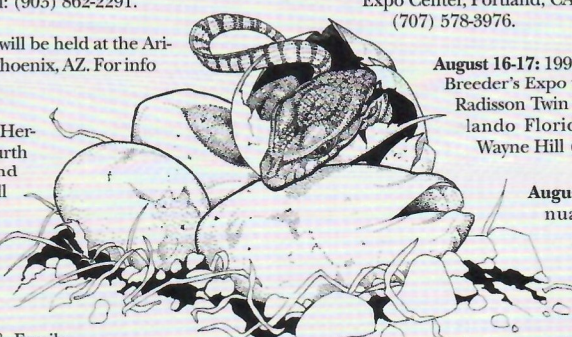
November 6-9: The Long Island Pet Expo held at Nassau Coliseum, Long Island, New York. For info call (800) 886-8000.

November 22-23: The International Reptile Breeders Convention is in Mesa, AZ at the Community and Conference Center. For info call Ray Busby at (619) 263-6898.

December 6-7: Reptile Expo will be held at the Pomona Fairplex, Pomona, CA. For info contact: (707) 578-3976.

December 13-14: Reptile Expo will be held at the Cow Palace, San Francisco, CA. For info contact: (707) 578-3976.

Editor's Note: Herpetological societies and non-profit organizations are encouraged to notify *The Vivarium* of events of interest so they may be included in our Coming Events section.





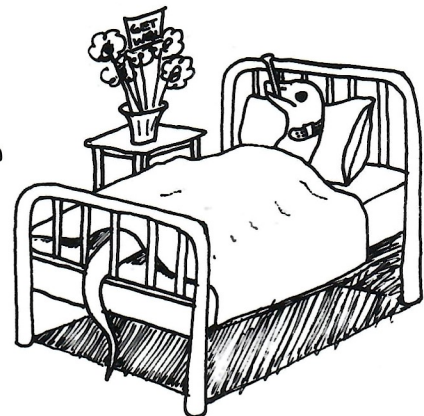
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Send your classified to: **The Vivarium Classifieds**, P.O. Box 300067, Escondido, CA 92030-0067.

Issue	Deadline
Volume 8.5	May 10, 1997
Volume 8.6	July 10, 1997

ANIMALS

QUALITY REPTILES at affordable prices. Snakes, lizards, turtles, tarantulas, frogs and a complete line of dry goods and frozen feed. For free monthly price list call or send SASE to Special Care 5, W. Prospect Ave. Pittsburgh, PA 15205. (412) 928-9433. Fax (412) 279-2913.

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ALL CAPTIVE-BORN - CURRENTLY AVAILABLE: Boas - Amazon basin emeralds, Dumeril's, Argentines. Pythons - green trees well started from high yellow or turquoise blue w/black highlighted adults. LATER IN '97": Boas *Sanzinia*, emeralds, Peruvian redtails, Brazilians. Pythons - Aru and other locality green trees, ball, Malaysian bloods. Guaranteed feeding. Quantity discounts call Mark (215) 453-7026.

ALBINO BOA CONSTRICTORS and possible heterozygous boa constrictors due early August. My collection is small but maintained very well with over 20 years breeding experience. Please call Gary Lum, (301) 972-6314.

QUALITY captive produced snakes, Boas: Hogg Island, Suriname red tails, Bolivian *amarali* red tails, Dumeril's. Pythons: Womas, diamond pythons, yellow and black jungle pythons. Our bloodlines were CAREFULLY selected and guaranteed to be exceptional. Top quality is the nature of our business. For more information PLEASE contact Tim Belknap, P.O. Box 574 Canoga Park, CA 91307, (818) 999-1436.

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HAWAII JACKSON CHAMELEON CONNECTION. 4"-6" pr \$50, trios \$70. 7"-13" monsters pr \$80, trios \$110. Live delivery guaranteed! Send money order to Michelle Nelson, 662 Hilinai St., Wailuku, HI 96793. ph (808) 242-7418.

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located in Chicagoland area. We ship nationwide. Call (708) 539-7025.

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RHINOCEROS IGUANAS! Captive-bred *Cyclura cornuta*, 8 bloodlines, F1 + F2 + F3 breeding pairs, adults, sub-adults, worlds largest private breeder, highest quality animals at best prices to good homes. We will beat any price. Robert (305) 872-9811.

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EXPECTING IN 1997: Albino boas, possible het and normal boas, albino, green, albino-green and normal Burmese. Call or write Bob Hammond, PO Box 5418, Cleveland, TN, 37320, (423) 478-2020.

BRAZILIAN RAINBOW BOAS. Babies from gorgeous orange parents, Retail/wholesale (quantity discounts ... inquire). Specializing in Brazilian rainbows exclusively. Send stamp for additional information and photographs. Scott Schuett 1820 Bigelow, Toledo, OH 43613. (419) 473-0518. Web site: www.nlogix.com/~hanley/scott/

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MOTLEY COLOMBIAN BOAS, blood boas, blue phase b/w tegus pictured in The Vivarium 8.2. Call to get on the waiting list. Also red & argentine b/w tegus, Cape monitors, rhino iguanas, Rankins dragons plus much more all domestically captive bred for 1997. Call Ron St. Pierre ph/fax (305) 685-3725.

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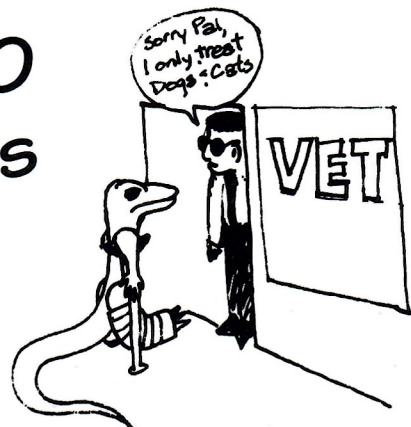
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EVENTS

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PET MANIA! PET AND REPTILE EXPO. September 13th - 14th. Benton-Franklin Fairgrounds, Kennewick, Washington. Info and booth reservations call Larry Bright Phone/Fax: 509-375-0435 or 509-546-1311.

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BOOKS WANTED: *Keeping Reptiles and Amphibians as Pets*, by Chris Banks (1980) and *Encyclopedia of Australian Animals: Reptiles*, by Harold Ehman (1992). Terry Gentry 121 Westminster Dr., Mt. Laurel, NJ 08054 (609) 234-4918.

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ORGANIZATIONS

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BULLETIN BOARDS

HERPETOLOGY NETWORK invites AFH members to participate in its international communication system for the study, propagation/conservation of herpetozoa. Herp-Net exchanges information/ideas among herpetoculturists, veterinarians, zoos, and others. Supports >2,000 members. Discussions on husbandry, medicine, captive requirements, reproduction, laws, more. Information, programs and photos are available. Herpetoculturists post CB stock lists - no charge! Herp-Net 24 hours/day via ANY computer: 215-464-3562 (300-2400 bps), 215-698-1905 (9600-28.8k). Set communication: 8 bits, No parity, 1 Stop bit. Non-profit project supported by private contributions. Questions? Mark Miller, P.O. Box 52261, Philadelphia, PA 19115-7261; Email mmiller@mail.tju.edu

Red-eared sliders, various box turtles, wood turtles, spotted, softshells, pancakes, Russians, and Egyptians—just to name a few of the species our members care for. The Carapace is our bi-monthly newsletter in which information about our organization and meetings is listed. Annual membership is \$15.00 for an individual, or \$20.00 for a family (U.S. and Canada). For more information write, National Turtle & Tortoise Society, P.O. Box 66935, Phoenix, AZ 85082-6935. Phone (602) 275-6887.

THE AMERICAN DENDROBATID GROUP. Interested in poison frogs (dendrobatids), mantellas, or Atelopid toads. Consider the ADG. Bi-monthly newsletter for \$15.00/calendar year. Back issues available 1992-\$5; for 1993 and 1994-\$10 per year; 1995-\$12.50. Write Charles Powell, II, 2932 Sunburst Dr., San Jose, CA 95111-2264. Tel. (408) 363-0926.

THE INTERNATIONAL HYLID SOCIETY. A nonprofit organization comprised of institutions and individuals from around the world who keep and study TREE FROGS. Members receive quarterly bulletins filled with articles, classified ads and full color photography. Membership fees: \$15.00 per year. Make checks to International Hylid Society and payable in US dollars. Send to: International Hylid Society 2607 Thomas Rd., Valparaiso, IN 46383. Phone: (219) 464-1922.

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The INTERNATIONAL VENOMOUS SNAKE SOCIETY is a one-of-a-kind publication recognized worldwide on the subject of venomology and venomous snakes of the world. Membership rates: \$10 a year, \$17.50 for Mexico and Canada, \$35 for all Foreign memberships. Publications printed 3X/year. PO Box 4498 Apache Junction, AZ 85278-4498.

SOUTHWESTERN HERPETOLOGISTS SOCIETY founded 1954. Monthly meetings in Los Angeles and Santa Barbara, California areas. Monthly newsletter, journal herpetology. Knowledgeable speakers, books, publications discounts. Individual membership \$20, family membership \$25—foreign add \$10. For more information contact: SWHS, PO Box 7469, Van Nuys, CA 91409.

The EAST TEXAS REGIONAL HERPETOLOGICAL SOCIETY, a learning environment for hobbyists, amateur, and professional herpetologists. Meeting the second Saturday of every month at the University of Texas at Tyler, Science Bldg. For information, call (903) 675-3244 or e-mail xpython@cleaf.com

CENTRAL ILLINOIS HERPETOLOGICAL SOCIETY, promoting the appreciation and conservation of reptiles and amphibians since 1960. Monthly meetings, field trips, bi-monthly newsletter, annual show. \$12.50 Ind., \$15 Fam. P.O. Box 6413, Peoria, IL 61601-6413.

WESTERN AUSTRALIAN SOCIETY OF AMATEUR HERPETOLOGISTS, INC. Fighting for equal rights for all herps! WASAH's objective is the legal keeping of herptiles in WA. Annual membership includes *Herpetofauna* and 4 issues of the *WASAH Newsletter*. Overseas membership \$20 U.S./year. 69 Egina Street, Mount Hawthorn 6016, Australia.

Live in Southern California? If you do JOIN THE SOUTHERN CALIFORNIA HERPETOLOGY ASSOCIATION (SCHA) at their monthly meetings held on the second Monday of each month at 7:00 pm in Houghton Park, Long Beach, CA. SCHA is a non-profit, education and recreation club for persons with an interest in reptiles and amphibians. SCHA is dedicated to conservation and education in the field of herpetology, and is actively involved in public education through its many free shows and exhibits. For more information about membership, shows, or *Reptiles* (the SCHA's monthly newsletter) write to the SCHA, P.O. Box 90083, Long Beach, CA 90809-0083 or call Steve at (562) 498-3211.

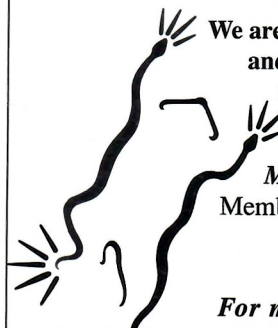
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Continued from page 25

parent windows or streaks, then the medium is too wet. Raise the eggs above the medium to allow them to dry partially. If the eggs are showing a slight loss of turgidity then they may be drying out, unless they are near hatching in which case the dimpling of eggs is normal about 18 - 24 hours prior to hatch.

During incubation, the incubating medium should be checked on a regular basis. The medium will invariably lose water during this time. Slightly misting the surface will help replenish the moisture level. 

Recommended Reading

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Outdoor Vivaria

by Bert Langerwerf with Dr Mark Paris. Drawings by Dr Russell Pearl. Photos by Bert Langerwerf.

Wherever I have lived, even in the Netherlands at 52° northern latitude, I have kept all of my lizards in outdoor vivaria. Indeed, in 25 years of keeping lizards, over a hundred species have been bred in outdoor vivaria. In central Alabama where night temperatures fall to the teens almost every winter and to single digits in some winters, temperatures within our outdoor vivaria remain above freezing.

Why Outdoors?

There are several reasons to choose outdoor, instead of indoor, vivaria. First is aesthetics. I keep lizards because of their beauty. But this beauty is not just in the appearance of the lizard alone. There is beauty in the activity of that animal inside a natural habitat. When I lived in Holland I never bothered to look at tulips in a tulip field, for a flower is most beautiful when growing amidst other vegetation.

If we keep lizards because we love and admire nature, then we need to create a whole mini-landscape in which our lizards are only one component. An outdoor vivarium is a living painting. The easiest way to make that piece of art for ourselves is to build it outdoors, honing skills in landscaping, gardening and herpetoculture.

Cost effectiveness - In a well-made outdoor vivarium with suitable lizards, there are no electricity costs. This benefits one's personal economy, but also avoids burdening nature by excessive use of fossil fuels.

Without the need for additional heat, the costs of maintaining



Agama International is the largest breeder of the Eastern water dragon (*Physignathus lesueurii*) a beautiful species where males develop light colored heads with a crisp black pattern and brilliant red suffusing extensive portions of the body.

outdoor vivaria remain relatively stable and immune to rising energy costs, permitting long-term operation of the facilities.

Ease of operation - In outdoor vivaria, the breeding of lizards which are suited to our created microclimate becomes easier. Appropriate UVB light, photoperiods, and seasonal cycles are provided automatically, without extra costs or work.

Vacations - Who hasn't suffered burn-out at one time or another while keeping herps? Another plus for outdoor vivaria, especially those in temperate climates, is the opportunity for a dormant (winter) period when we can give less attention to the lizards, freeing us for travel and time off.

Stable income - Ease of breeding and low operational costs lead to routine production of offspring which in turn stabilizes income. Many wild-caught lizards destined for the pet trade are exported from developing countries in the tropics. When large numbers are exported to the United States, wholesale and retail prices for these lizards drop.

Export numbers are difficult to predict. What may be exported in limited numbers today may increase tomorrow, with rapid declines in sale prices. For example, compare prices of *Cordylus cataphractus* with *Cordylus spp* from Tanzania. Blotched blue-tongue skinks (*Tiliqua nigrolutea*) with Indonesian blue-tongue skinks (*Tiliqua gigas*) or Argentine tegus with Colombian tegus or Australian water dragons with Asian water dragons.

In contrast to wild-caught imports, domestic production



An overview of outdoor vivaria at Agama International



Above: A simple outdoor vivarium, constructed from aluminum sheeting, one of many under a large stretch of bird netting.

Right: A battery of outdoor vivaria partially built below ground surface using concrete and blocks. In these ground insulated vivaria many species can remain outdoor year round as long as some precautionary measures are taken.



of captive-bred lizards stabilizes the market. Low operational costs ensure market competitiveness.

How to Start

First, know your lizard. Find data about the species in reliable herpetological literature (flashy color photos are not necessarily an indication of sound information). Learn specific locales. Find habitat ranges and not simply country of origin. Especially learn about the climate in which the lizards live naturally.

As herpetoculturists, we need to inform ourselves about climate around the world, using a good atlas and books on climate, such as *World Weather Guide* by Pearce and Smith (1984). Find other places in the world where the climate is similar to that in your locale. Even herpetoculturists living in cold regions of the continental United States have many possibilities for keeping exotic lizards in outdoor vivaria. For example, in the area between Boise and Salt Lake City, Idaho the climate is similar to that found in central Asia, which is the habitat for such interesting lizards as desert monitors (*Varanus griseus*),

frog-eyed geckos (*Teratoscincus scincus*), and toad-headed agamas (*Phrynocephalus mystaceus*).

Furthermore, we are able to keep lizards from climates which are moderately warmer than our own by constructing vivaria in ways which make the microclimate warmer than the actual outside temperature. Rainfall frequency and amounts may be manipulated easily, too. Ambient humidity is the most difficult factor, which we can alter only slightly in open outdoor vivaria.

There are many lizards which could live in cooler climates except for short summer seasons which prevent eggs from hatching before the cooler temperatures of autumn. We need

only to dig up the eggs from these lizards for artificial incubation. Using this method, I have kept jewelled lacertas (*Lacerta lepida*) outdoors in the cool climate of the Netherlands.

Types and Construction of Vivaria

Simple outdoor vivaria - Rings of galvanized sheet metal or, better yet, aluminum coil are used to construct the simplest outdoor vivarium. The ring is joined with blind rivets. Microclimate can be manipulated even in these simple vivaria.

Manipulating microclimates - For a drier microclimate, add a hill of sandy, loose soil in the middle of the ring and gravel along the perimeter, just inside the sheet-metal. Stack natural stones on top of the hill in a shape that is rounded to the north and straight to the south (in a half-moon shape).

For a more humid microclimate, we utilize pools and aquatic plants. Shallow plastic containers may be used for pools. Many nurseries sell aquatic plants.

To winterize this simple vivarium, we use a child's plastic playpool. In late summer, when the playpools are on sale, we buy a pool which we can get even cheaper if we discover one that leaks. We cut the pool into equal halves and fit one half upside down on our stone stack. If necessary, the stone stack is modified to fit the pool's size. Later in the fall, we place fallen leaves on top of the pool, thus permitting winter sun to shine still on the straight southern slope of the rock pile, while protecting the inside of the pile from moisture and cold, which comes from the top and three (north, west and east) sides.

Predators - The primary problem with this simple type of vivarium is predator control. The metal ring must be deep enough to keep out mice, rats, shrews, moles and voles. The looser the soil, the deeper the metal should be placed. Our rings average 20 inches (about 51 cm) deep.

Gravel is also useful for predator control; it should be at least one foot deep and should be placed at the base of the ring to discourage predators from digging into the vivarium.

Also, the metal ring should be free from trees, walls or other metal rings, to prevent predators from climbing into

Moroccan uromastyx will thrive and breed readily in outdoor vivaria. Photo by John Tashjian





Midlands dwarf chameleon (*Bradypodion thamnobates*), one of several S. African species bred and raised outdoors by Agama International.

vivaria. To keep birds out, we use a good UV-resistant netting on top. This netting should not touch vegetation which may grow within or outside of the vivarium. There are likely many companies selling such netting; I use a product from Cissel in New Jersey (1-800-631-2234).

Size - Huge vivaria may be constructed based on this design, using metal roofing pieces fixed together with rivets. In the Netherlands, I built a 6000-square foot outdoor vivarium in this way (complete with an 'old' ruin, built new by me with very old bricks) to give wall lizards a habitat. At that time, all herps native to Holland were protected and not allowed to be kept in captivity. My native lizards remained in the habitat even when I left the door open, so that technically the lizards were not in captivity. The lizards were only there to look at, for if found between shrubs, rocks, ruins and vegetation, they could not be handled as pets. Yet, they remained in the outdoor vivarium and over time a few learned to come out to me for food.

Here in Alabama, I've used random roofing pieces to fence in about an acre, surrounding all vivaria within the area. Figure 1 shows a square of this outdoor vivarium made of sheet metal and bird netting. The fence serves as a second barrier in case a lizard escapes from a vivarium. Also, the fence aids predator control. Inside the perimeter fence are populations of local lizards (*Sceloporus*, *Eumeces*, *Scincilla* and *Anolis*) that increase every year because the vivaria also provide shelter to these lizards. Within the fence, predators are lacking and there are many escaped crickets.

Advanced outdoor vivaria - The best type of outdoor vivarium is more difficult to construct. This vivarium is protected from excessive heat in summer, cold in winter and from extreme wind speeds. These vivaria even survive moderate hurricanes

and tornados.

Advanced outdoor vivaria are constructed under the surface of the ground. Begin with a hilly landscape that provides a southern or southeastern slope. A south-facing slope is critical if a warmer microclimate is desired.

Drainage - To begin, select a site where the lowest level inside the vivarium is higher than a site selected further downhill, where a PVC pipe will drain excess water. The drainage pipe is connected to the inside of U-blocks (upside down) placed in the lowest level of a concrete block retaining wall (Figure 2).

Between the U-blocks we leave a narrow space so that surplus rainwater runs from inside the vivarium to the tunnel created by the U-blocks. The width of these narrow openings depends on the size of lizards kept in the vivarium. If plans call for lizard eggs to hatch within vivaria, the size of neonates should be considered, too, to avoid loss of hatchlings through the drainage system.

At Agama International, I made batteries of about 15 of these vivaria, aligned in an east-west direction. These vivaria all slope gently down to the east (because our hill slopes south-easterly). Using the above drainage system, surplus water drains into the tunnel from each vivarium, with no cross-contamination between vivaria.

The longer the battery of vivaria, the more concern should be given to the foundation. Outdoor vivaria should be built on firm, stable soil. At Agama International, I dug all the trenches by hand and spade, because heavy digging equipment may destroy the structure of the soil. Also, with a long battery of vivaria, thicker reinforced steel bars should be used under the concrete walls, oriented in a longitudinal direction along the battery, within the concrete foundation.

Once the drainage system is designed, one builds a concrete or block surface inside the vivarium which is as big as possible, vertically and horizontally. Stone, soil, sand, and blocks — all of these materials have a heat capacity, by volume, close to that of water. So the bigger that capacity is and the bigger the surface of those materials, the more stable will be the temperature inside the vivarium. This type of vivarium will be cooler in summer and warmer in winter.

At Agama International I always use pressure-treated wood and since in hot summer weather nails push themselves



Above: Detail of the construction of partially buried vivaria. This is a major project involving careful consideration of the orientation of the vivaria and careful planning in the construction - the benefits will warrant the efforts.

Right: Outdoor vivaria with walkway under shade



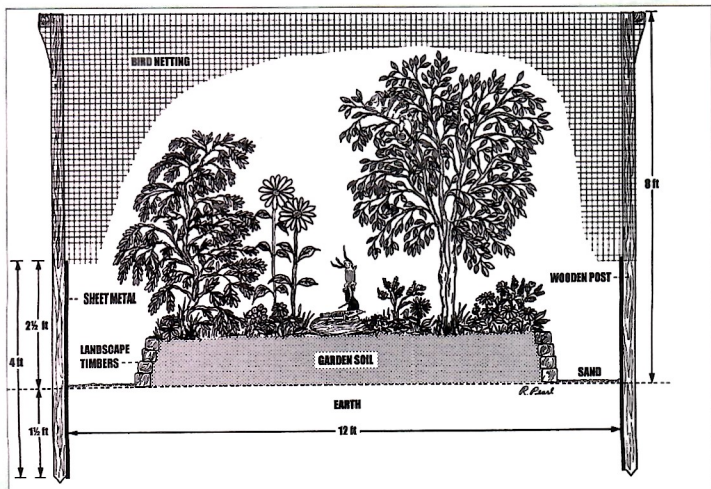


Figure 1.

out of the wood, I use wood screws. For a wire top I use half-inch (1.3 cm) and quarter-inch (0.6 cm) galvanized wiring. A wire screen should cover most of the top. The screen should be very strong, able to sustain a dog walking on it and hurricane-force winds. For smaller lizards there are two choices for wire screening: a) eighth-inch (0.3 cm) galvanized wire, which is expensive and hard to find (try McNichols, 800-237-3820); and b) aluminum insect screening (use charcoal color for better viewing) in combination with half-inch galvanized wire underneath. The wire needs to be secured to prevent smaller lizards from escaping between the layers. Aluminum screen used alone can be damaged by raccoons, cats, dogs, and rats. A door of glass or other material should occupy a small part of the surface, since UVB is filtered out by glass.

Overhanging concrete at the northern side of the vivarium creates a large shadowed area in summer and, if vegetation grows here too, also creates large gradients of temperature and humidity, especially in summer days when the sun is shining. Lizards then can choose their preferred spots. Furthermore, this overhanging part creates an area which is always dry, even during lengthy rainy spells. Overall, one must ensure that their outdoor vivaria is made for extreme weather conditions, because eventually, regardless of locale, extreme weather arrives.

Right outside the vivaria I made concrete walkways, so that mice and ants can be better controlled. If weeds grow right to the walls of the vivaria, a whole line of ants may be walking in and out without our knowledge, until we find an eaten lizard carcass.

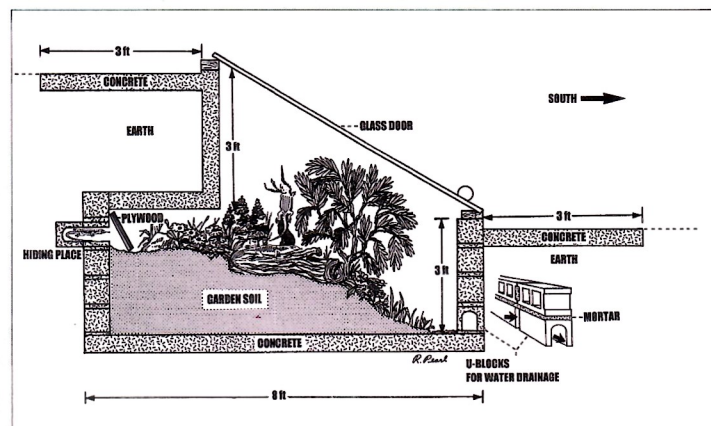


Figure 2.

In wintertime or during long rainy periods we roll transparent sheet-plastic over the vivaria. The plastic should be UV resistant or will require replacement about every three months. Ask a local nursery for sources of greenhouse plastic with a three-year guarantee. It is best if the plastic also lets through UVB light, but this is not absolutely essential if the plastic is left on only during winter or rainy days. Also, at Agama International, when we have time, we remove the plastic on sunny warm winter days.

When temperatures fall below 25° F (-4°C) the vivaria are covered with rugs and carpets, placed on top of the plastic. We use remnants which have been discarded from carpet outlets. Not only do our lizards stay warm, but we also grow grapes, pineapples, tomatoes, bougainvillea, elephant ear, lotus, and ginger with no problems in these vivaria.

In the cool temperatures of winter, the metabolism of lizards is low and, in our experience, rickets (vitamin D₃ deficiency; metabolic bone disease) is a problem only when soft tissue grows faster than bone. So avoid rapid growth when the vivaria are covered.

Conclusion - I have made even more complicated varieties of outdoor vivaria, with deep walkways surrounded by concrete. These walkways contain openings at eye level for observation of outdoor vivaria. But this type of vivarium is much more complicated and after using them, one feels more like a gopher than a human.

With outdoor vivaria, we utilize all means necessary to prevent lizards from escaping. We do this not only because we hate to lose a pet, but also because we want to avoid burdening nature and our neighborhood with animals that do not belong there. Escaped reptiles, especially large ones, give herpetoculturists a bad reputation. Escaped reptiles interfere with local herpetofauna if they choose to live in the same ecological niche or if they carry parasites and viruses to local reptiles.

In the simpler, sheet-metal outdoor vivaria we maintain year-round the following lizards with breeding success for most species: crag lizards (*Pseudocordylus melanotus*), sungazer (*Cordylus giganteus*), Grozny or Caucasian green lizards (*Lacerta strigata*), green lacerta (*L. viridis*), and jewelled lacerta (*L. lepida*).

In our advanced outdoor vivaria we keep year-round and reproduce the following species of lizards: spinytail lizard (*Cordylus vittifer*), Argentine black and white tegu (*Tupinambi meriani*), Chinese crocodile lizard (*Shinisaurus crocodilurus*), Australian water dragon (*Physignathus lesueurii*), Baja blue rock lizard (*Petrosaurus thalassinus*), Blanford's whipping frog (*Polypedates dennysii*), Natal midlands dwarf chameleon (*Bradypodion thamnobates*), Cape dwarf chameleon (*B. pumilum*), Kenyan dwarf chameleon (*B. damaranum*), Drakensberg dwarf chameleon (*B. dracomontanum*), and Moroccan uromastix (*Uromastix acanthinurus*).

About the author - Bert Langerwerf is owner of Agama International, 10514 Chilton Rd 73, Montevallo, AL 35115.

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A primitive ox-drawn cart was our salvation where modern four wheel drive technology failed in Madagascar.

Experiences of Travelling In Search of Herps

by Bill Love
Photos by Bill Love

Late Autumn in Paris is a lovely time to visit. May I also reserve a hotel for your stay?" offered the eager-to-please travel agent over the phone. Unfortunately, she didn't yet realize that my initial inquiry about going to the 'City of Lights' was merely the first step — a necessary delay — in reaching the object of my quest. I had no intention of amusing myself beyond the shops inside Charles de Gaulle airport while passing the wait for my connecting flight. A far more alluring destination was beckoning me onward to a little-known corner of the planet.

Born to Explore

Paris is undoubtedly the dream goal of countless millions, but the natural attraction of adventure and discovery on the world's less-beaten paths will always call out to some of us. It's been my experience that people who devote significant time and energy to some aspect of herpetology have already stepped apart from the crowd. Daring to be different requires certain unique personality traits to start with, and probably has a lot to do with being a *Type T* (*T* for thrill-seeking) personality. These are the mountain climbers, race car drivers, sky divers, gamblers — the risk-takers and novelty-seekers among us. They encompass a minority of mankind who thrive on facing the uncertainties of life, instead of never venturing far from the safety of the shallow end of the pool.

It was only demonstrated in 1996 that

a genetic link exists to cause exploratory behavior in humans. The actual gene was isolated by two separate researchers; it's believed to be the first gene ever discovered that controls human personality. Those of us possessing a

craving for seeking out new sensations and experiences apparently have a long form of this gene, while those with an adversity to risk have a shortened version. What this basically confirms is that some people are "born to explore." It may really be in our blood, literally.

Such motivation was most likely behind the arranging of my first trans-Atlantic crossing, by way of Paris, to far-off Madagascar, the trip that will forever be my most cherished and memorable. Nothing can compete with the rush of discovery I had on that journey. It made returning to the monotony of a cozy and predictable life 'on the farm' intolerable as a way to pass the rest of a lifetime. It literally changed my total outlook, permanently.

Breeding herps is still a strong and active interest, but I've now come to see that part of evolving into the third wave of herpetoculture includes getting to know herps in their native habitat. It's part of the strategy of good husbandry, and helps fill that void in our knowledge that often leaves us guessing what parameters of our propagation techniques could be altered to increase successes. It seems like an essential aspect of truly understanding a species' ecology and how it applies to the captive state.

Ecotravel

Getting out into the field brings the novelty of fresh challenges, and of acquiring exciting new knowledge and experiences. It's the chance to satisfy a curiosity and sense of adventure that's becoming increasingly harder to appease in our age of growing familiarity with, and resulting information overload about, our world. The financial rewards of modern herpetoculture have allowed some practitioners the opportunity to "reinvest their earnings while satisfying their yearnings." Travelling is a sure-fire way of broadening one's herpetological horizons, and expanding culturally and personally in the process.

This is certainly the route I now follow. I find ecotravel to be an invaluable adjunct to herp-keeping, and also a helluva lot of fun! I find myself planning my life around the next trip, and also make great efforts to assure that it's never too far in the future. The photographic and journalistic ops are bonuses, which only add to my reasons for going, but the sheer pleasure of these forays to strange lands, to experience the highs out on the frontiers of life, is the main draw.

Herp Horizons

It's with the above background in mind that I've chosen to create this new column in *The Vivarium*. If I can provide some information and advice, share stories (humorous and serious), suggest preparatory measures, discuss potential dangers, and maybe most importantly of all, instill new vacation ideas, it will be an interesting and appreciated bit of new spice for each issue. I feel that the time is ripe, and this publication's readership is of the enlightened audience who will glean valuable (and useable) tidbits from it regularly.

I plan to draw from my own experiences as well as that of friends and colleagues in the herp arena. Most of the folks I've spent time with afield tend to be of a special and/or unique calibre — truly a trip (in the figurative sense) to accompany into the ambiguity of regions-less-travelled. A herper hasn't really lived until he or she has slogged through Amazonian rainforests, dodging columns of army ants during a downpour while chasing huge hairy spiders and fer-de-lance with Bill Lamar. Memories don't get much better than having witnessed Philippe de Vosjoli quiver with delight as each step brought a strange new botanical curiosity into his view amidst the bizarre thorn forests of southern Madagascar. The company you're bound to find joining you on such trips is a huge part of the enjoyment.

I'll also encourage readers to submit accounts of their travel memoirs (funny, tragic, or whatever) to include and analyze, or questions/concerns to answer and discuss. By no means have I 'done it all' myself; I'll always welcome input from others who have interesting testimony to share that enhances everyone's wisdom of the world.

I most of all want it to contribute toward bringing fun and enjoyment to your future excursions, whether they be to local parks or little-known countries with barely pronounceable names. Remember back when you first got hooked on herps — when herping was purely for the fun of the hunt and seeing herps in nature? That childhood exhilaration can be rekindled again on an ecotour to a place



The author extracting an adult Madagascar ground boa *Acrantophis madagascariensis* from the "long walk hole."

you only thought you'd ever read about, or drool over on the Discovery Channel.

I like to cite a further quality of the successful ecotraveler that sets us apart from the other 'ordinary' thrillseekers alluded to earlier. I consider a hearty sense of humor paramount to beating the bushes miles (or oceans) away from home. In such places, the accustomed comforts and conveniences of civilization can become merely fond memories, useful only for wishful comparison to the rigors and uncertainties lying ahead in the remote backwater in which you've chosen to go herping. The following events may help illustrate what I'm talking about and "get the ball rolling" so this doesn't turn into purely one long introduction to the column.

Madagascar

November of 1992 found my wife, Kathy, and I bouncing along a dusty track way inland (east) of Mahajanga on the northwest coast of Madagascar. My old friend Olaf Pronk, and new acquaintance Nero Spannring, had chosen to explore an area that would be perfectly believable as the inspiration for the term *boondocks*. We felt lucky to have at our disposal such a sturdy and unstoppable-looking vehicle as Olaf's Nissan Patrol, a rugged four-wheel drive model not sold in the United States. I was quite impressed (and even more amazed) that so far he hadn't once opted to engage the front wheels to assure our passage through numerous sandy hellholes infesting the almost nonexistent overland route we were investigating.

We soon elected to take a "short hike"

in the broiling noon sun to see and maybe photograph a ground boa *Acrantophis madagascariensis* that a local passerby recalled seeing some days (weeks? months ???) prior. Setting off into the bush with him in the lead was the only alternative if I had any hope of seeing it. It was impossible to get an estimate of where we were headed, and how long it might take to get there with him, except for his simple gesture of "It's this way." Rural Malagasy live by their own biological clocks that don't usually correspond to our ordered sense of tracking things like time (hours) or distance (kilometers). Added to this was my genuine skepticism about the snake still being there at all.

An estimated four kilometers later, we were drenched in perspiration. My will to continue was being tested to the max as I pondered how I could possibly have been duped into this ridiculous trek, of who knew how many hours, to see a creature that was probably long gone. I was also silently cursing myself for neglecting to bring along drinking water.

Suddenly the man's spear pointed out the fabled snake hole under the base of a long dead stump. Sure enough, the snake was indeed still home, visible at arm's length down the six inch (2.4 cm) wide shaft. I decided it was a safe bet that nothing capable of chomping on my hand, in a manner any worse than the boa itself could inflict, was likely to be co-habiting the hole. The six to seven foot (1.8-2.1 m) serpent was carefully removed without a trace of protest, its demeanor as mellow as the proverbial kitten. I had to smile inwardly as my restored confidence taught me a valuable lesson in having patience and trust in other cultures' ways of doing things. The local mindset was a bit different than what I was used to, but nonetheless proved itself successful at yielding the desired results.

Hours later, our cheerful dispositions had evaporated as we watched the vehicle's tires spinning futilely. We were heaving against the bumper in ankle-deep sugar sand in the middle of a wide dry river bed. The mercury must have been in the low 100's° F (high 30's°C) there at midday as I stuffed palm fronds under the rear wheels trying to provide traction for the thoroughly stuck Nissan. Olaf was at the gas pedal rocking it back and forth, hoping to gain enough momentum to thrust ahead another foot before the axles bottomed out again. At our current rate of forward progress, it could take days of toil to creep the 40 feet (12 m) to the opposite bank, assuming we didn't succumb to thirst or heatstroke first. Kathy was no doubt asking herself if I had purposely saved all the 'fun' for this particular trip when she had decided to join me.

The obvious question of 'Why not just engage the four wheel drive and zip out of trouble?' is probably crossing your minds about now. My query of that exact nature was met with a matter-of-fact explanation from Olaf that "the 4WD hasn't been right ever since an employee rolled the car over several months ago."

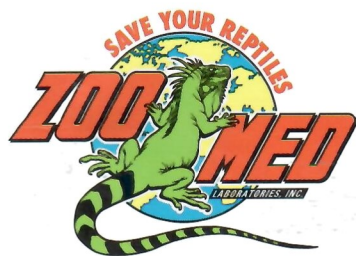
"You're saying that we had attempted to cross this xeric quagmire in the equivalent of a NORMAL 2WD vehicle !!! Are you nuts?" I was incredulous that we had even attempted any of the explorations of the past couple days without functional 4WD. This was the first inkling I had been given about the car's condition. It immediately became reasonable to assume that maybe in a decade, some scientist would discover our sun-bleached bones scattered around the Patrol's rusted frame, possibly piece together the situation, and return to the states with a great "How'd they die?" story of our demise.

At this point Olaf shut off the engine, calmly walked to the sparse shade along the riverbank, and plopped down on his butt. I was wondering if this was the spot he had chosen to shrivel up and die. Instead, he said that he'd wait there for help to happen along. I resigned myself to a long sweltering stay since, by then, it was too hot for herping or any other physical activity. And there simply weren't many people around in these parts who were likely to meander along and save us.

I hardly had time to conjure to mind the image of an extra-large, ice cold Slurpee® when some farmers in a creaky old wooden ox cart descended the far embankment toward us. Within minutes, Olaf and Nero made arrangements for it to be utilized in towing us to solid ground. I guess it was the Malagasy version of horsepower. It went quickly and smoothly, as did my absorption of one more of life's lessons in patience and seeking nonconventional solutions to tough dilemmas. I'll try to commit such incidents to memory and recall them when difficult situations eventually arise that appear to be similarly hopeless of solution. 

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About the Author: Bill Love is a photographer, writer, herpetoculturist, lecturer, and staunch enthusiast of and participant in ecotravel. With wife Kathy, he operates BLUE CHAMELEON VENTURES in Akva, Florida. He currently specializes in leading wildlife / photo tours to Madagascar, and frequently visits other exotic locales around the world. Bill always welcomes your comments and questions that pertain to the theme of this column. Please send them to Herp Horizons, c/o AFH, PO Box 300067, Escondido, CA 92030-0067.



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