PROCEEDINGS OF THE 26th INTERNATIONAL HERPETOLOGICAL SYMPOSIUM on CAPTIVE PROPAGATION and HUSBANDRY

Hosted by
The St. Louis Zoo
St. Louis, Missouri

July 18th - July 21st, 2002

International Herpetological Symposium

26th Annual Meeting

Hosted by

The St. Louis Zoo
St. Louis, Missouri USA

July 18 - July 21, 2002

Program and Abstracts

INTERNATIONAL HERPETOLOGICAL SYMPOSIUM
26TH ANNUAL MEETING

PROGRAM

Thursday, July 18th

5:00 - 8:00 p.m.	Registration – Sheraton West Port Hotel
7:00 p.m. - ?	Ice Breaker – Hospitality Room

Friday, July 19th

8:30 a.m. - 3:30 p.m.	Open Registration – Sheraton West Port Hotel
9:00 - 9:15 a.m.	Open Remarks and Introductions
9:15 - 10:00 a.m.	**Dr. Charles Daugherty** "The Fall and Rise of New Zealand Herpetofauna"
10:00 - 10:45 a.m.	**Dr. Nicola Nelson** "Temperature-dependent Sex Determination in Natural Nests of Tuatara"
10:45 - 11:00 a.m.	*Morning Break*
11:00 - 11:45 a.m.	**Dr. Jonathon Losos** "Diversity and Natural History of Caribbean Anolis Lizards"
11:45 a.m. - 12:30 p.m.	**Jon Coote** "Lies, Damned Lies and Statistics the Global Fight for the Reptile Industry"
12:30 - 2:00 p.m.	*Lunch Break*
2:00 - 2:45 p.m.	**Mark Mitchell, D.V.M.** "Arboviruses and the Reptile"
2:45 - 3:30 p.m.	**Dan Wentz, D.V.M.** "Adenovirus in Bearded Dragons an Emerging Threat"
3:30 – 3:45 p.m.	*Afternoon Break*

3:45 – 4:30 p.m.	**Charles Painter** "A Review of the Commercial Trade in the Western Diamondback Rattlesnake, *Crotalus atrox*. Are Rattlesnake Roundups as Bad as you Think – or Worse?"
4:30 – 5:30 p.m.	**WORKSHOPS** Open Forum "Ask The Vets" **Drs. Boyer, Mitchell and Wentz** " The Vipers a Pictorial Review" **John H. Tashjian**

Saturday, July 20th

9:00 a.m. - 3:30 p.m.	Open Registration – Sheraton West Port Hotel
9:00 - 9:15 a.m.	Remarks and Announcements
9:15 - 10:00 a.m.	**Dr. Robert Aldridge** "The Reproductive Cycle and Estrus in Colubrid Snakes of Temperate North America"
10:00 - 10:45 a.m.	**Dr. Robert Powell** "West Indian Lizards: Ecological Release, Melanism and Systematic Problems"
10:45 - 11:00 a.m.	*Morning Break*
11:00 - 11:45 a.m.	**Vicky Poole** "Proyecto Rana Dorado/Project Golden Toad"
11:45 a.m. - 12:30 p.m.	**Patrick Nabors** "The Strawberry Poison Dart Frog, *Dendrobates pumilio*: Observations on Care and Reproduction in Captivity"
12:30 - 2:00 p.m.	*Lunch Break*
2:00 - 2:45 p.m.	**Thomas Boyer, D.V.M.** "Paramyxovirus and Herpes Virus"
2:45 - 3:30 p.m.	**Mark Mitchell, D.V.M.** "Epidemiology of *Salmonella* at a commercial green iguana (*Iguana iguana*) farm in El Salvador"
3:30 - 3:45 p.m.	*Afternoon Break*

3:45 - 4:30 p.m.	**John Brueggen** "Crocodilians: Fact vs. Fiction"
5:30 p.m.	Shuttle Buses leave for **Field Trip to St. Louis Zoo and Hosted Dinner at the River Camp**
8:00-10:00 p.m.	**St Louis Zoo Reptile Department Open House**
10:00 p.m.	Shuttle Buses Return to Hotel

Sunday, July 21st

9:00 a.m. - 12:00 p.m.	Open Registration
9:00 - 9:15 a.m.	Remarks and Announcements
9:15 - 10:00 a.m.	**John Hollister** "The Trans-Pecos Region of Texas from a Herper's Perspective"
10:00 -10:45 a.m.	**Alan Kardon** "The Quest for Arboreal Alligator Lizards and Lance-headed Rattlesnakes"
10:45 – 11:00 a.m.	*Morning Break*
11:00 – 11:45 a.m.	**Dr. David Lazcano** "Rattlesnakes and Vegetation, Their Distribution in the State of Nuevo Leon, Mexico"
11:45 a.m. – 12:30 p.m.	**Adam Marfisi** "Management of Venomous Reptiles at the St. Louis Zoo"
12:30 – 2:00 p.m.	*Lunch Break*
2:00 – 2:45 p.m.	**Jon Coote** (presenting for Alan Botterman) "The Pet Industry and Herpetoculture"
2:45 – 3:30 p.m.	**Norman Haskell** "The Many Uses of Plastic in Herpetoculture"
3:30 – 3:45 p.m.	*Afternoon Break*
3:45 – 4:30 p.m.	**Richard Mastenbroek** "Captive Husbandry and Propagation of Elapid Snakes"

4:30 – 5:30 p.m.	**John Tashjian** "Herp Mystery Quiz"
6:30 p.m. - ?	Banquet Dinner – Sheraton West Port Hotel
	Banquet Speaker – **William W. Lamar** "Fangs for the Memories: Working with Pitvipers in the Americas"
	Presentation of the Joseph Laszlo Memorial Award
	Closing Remarks
	Auction (Proceeds benefit next year's IHS!)

ABSTRACTS

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The Reproductive Cycle and Estrus in Colubrid Snakes of Temperate North America

Snakes in the family Colubridae are diverse and widespread. In temperate North America, the reproductive cycle of both sexes is conserved. Females begin vitellogenesis in the spring and ovulate in late spring. In both oviparous or viviparous species, the young are hatched/born in the summer. In males, spermatogenesis occurs in the summer and sperm are stored in the vas deferens. Estrus, the period of time when females are sexually attractive and receptive, occurs in the summer/fall in some species and in the spring in all species. The age of the sperm at fertilization is identical in both mating patterns. The difference is where the sperm is stored during the winter, in the oviduct in summer/fall breeding snakes and in the vas deferens in spring breeding snakes. The renal segment of the kidney, a secretory structure which contributes to the ejaculate, is hypertrophied during the mating season. Elevated plasma testosterone levels coincide with the mating seasons. The terms post-nuptial spermatogenesis and dissociated reproductive cycle are synonymous and refer to species which have summer spermatogenesis and spring fertilization. The terms are independent of the mating season. Pre-nuptial spermatogenesis is synonymous with associated reproductive cycle and describes species in which spermatogenesis immediately precedes fertilization, a pattern not described for any North American colubrid.

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The Pet Industry and Herpetoculture

In the early 1990s, reptiles became very popular in the pet sector. Many pet shops jumped at the opportunity to increase their sales, even if they had no prior experience or knowledge of reptiles. On the rare occasion that a pet shop had trained staff and a legitimate reptile section in their store, there just weren't the products available on the market to support this fast-growing category.

In fact, in 1993, approximately 1,000,000 iguanas were imported for the pet trade into the United States alone; and there wasn't even a prepared diet for iguanas available on the market for pet shops to sell. With this obvious market demand facing the pet shops, as well as the lack of support products for a reptile hobbyist to succeed, I started T-Rex Products. I wasn't the only entrepreneur who recognized the potential market. By 1997, 15 companies produced an iguana diet for the pet trade. The pet industry had never seen such an explosion in a category before the reptile proliferation. At its peak in 1996, the frenzy for reptile products produced hundreds of companies worldwide who manufactured, re-packed, or somehow marketed products for reptiles to the pet trade.

Today, the pendulum has swung back toward the center line. There are a few core companies who have remained committed to the reptile market. With the market stabilized at approximately 3,000,000 households owning reptiles, it proves to be a very competitive category amongst the pet trade manufacturers.

It is my opinion however, that the so-called fad of keeping reptiles for pets has not pinnacled, but is experiencing a tremendous bottleneck in the availability of quality livestock. It is my contention, that with the development of the captive breeding of appropriate pet trade reptiles, we could be on the verge of another growth spurt in the reptile pet industry.

T-Rex is actively supporting the efforts of captive breeders to supply quality reptiles to pet shops. This strategy will ensure a sustainable reptile market for the pet industry.

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Paramyxovirus and Herpes Virus

Two major viral diseases of reptiles are paramyxovirus and herpes virus. Paramyxovirus was originally thought to be a viperid disease, but is now known to infect elapids, colubrids, boids, and even some lizards. Paramyxovirus should be suspected in any large dieoffs of snakes, outbreaks are more common in the first half of the year. Mortality usually peaks one month following the initial deaths, then declines over the next two to three months. Paramyxovirus primarily affects the lungs, liver and pancreas. Aerosol transmission is thought to be responsible for the large number of cases within a collection; virus may persist in water and be shed in feces (thus fomites may also be involved in transmission). Histopathology with experienced pathologists will often yield a diagnosis. Hemagglutination inhibition titers (through the University of Florida) are useful in screening for paramyxovirus during three to six months quarantine. No new snakes should be introduced in an active outbreak until two months after the last death. Clinically affected snakes should be isolated and air movement minimized.

Herpes virus is a relatively new contagious virus primarily affecting tortoises. The actual chelonian host spectrum remains unknown. Clinical signs can be confused with mycoplasmosis in that rhinitis and nasal discharge are often present. However, herpes virus typically causes necrotizing stomatitis, glossitis, and paryngitis. Small whitish plaques develop at the back of the mouth and quickly coalesce. Herpes virus attacks epithelial cells in the oral cavity, lower respiratory tract, liver, kidney and brain. Untreated animals often die, antiviral drugs, such as acyclovir, as well as antibiotics, may save some patients. Direct transmission between tortoises likely allows spread; environmental contamination is also possible. Diagnosis is via histopathology and/or serologic testing (University of Florida). Outbreaks are much more common in Europe than the United States, we must be vigilant to prevent herpes virus from becoming common in the U.S.. Dilute bleach is an effective disinfectant for both viruses.

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Crocodilians: Fact vs. Fiction

CROCODILIANS: FACT VS. FICTION This is a discussion of crocodilian behaviors witnessed at the St. Augustine Alligator Farm. There are four specific topics within the talk: Crocodilians have the ability to swallow prey underwater, crocodilians may eat more vegetable material than we are willing to admit (video), Siamese crocodiles as parents, and crocodilians feeding their young? (video).

Crocodilians have the ability to swallow prey under water: We have witnessed both *Crocodylus johnsoni* and *Tomistoma schlegelii* swallowing their food without coming to the surface.

Crocodilians eating their vegetables: It is possible that biologists have been assuming too much when doing stomach content surveys on crocodilians. We have compelling evidence that alligators, at least, seek out vegetation in their diet.

Siamese Crocodiles as parents: A two-year account of a pair of *Crocodylus siamensis* raising young on exhibit at the St. Augustine Alligator Farm.

Crocodilians feeding their young?: Video of *Crocodylus siamensis* allowing her young to feed from a piece of meat in her mouth.

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Lies, Damned Lies and Statistics, the Global Fight for the Reptile Industry

Recent statistically based reports from animal rights groups masquerading as animal welfare groups, both in the USA and Europe, call for a ban on reptiles in captivity. These reports have deliberately hijacked and mixed conservation, trade and wildlife management issues with animal welfare philosophy to both misinform, and gain credibility, with naïve legislators and the general public. These groups prey upon the publics, and governments, general ignorance about reptiles, conservation, and trade, to gain support for their misguided goals.

The realization that sustainable use can be a powerful conservation tool is being buried by biased misinformation posing as facts. Also ignored is the principle concern for wildlife, namely habitat loss due to development, unless it can be blamed on collectors. The considerable advances made in information, education, and the captive care and reproduction of reptiles are generally ignored, unless they can be twisted into negative welfare concerns. Any increase in the positive perception of reptiles by the general public is being systematically undermined. Proposals by these groups to adopt a policy of releasing captive reptiles back into the wild do not take account of the serious consequences of introducing pathogens, gene pool pollution and unknown ecological interactions. These groups are seemingly unaccountable for the misinformation that they publish or feed to the media. The reality of the reptile trade is a far cry from the sordid picture painted by them. Herpetoculture is facing its darkest hour. These reports, and associated unwarranted media exposure, give completely unbalanced views that are not supported by scientific fact.

The challenge for us all is to make the general public and politicians aware of the true situation if we are to ensure a future both for ourselves, and those who would follow us.

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The Fall and Rise of the New Zealand Herpetofauna

Pre-human New Zealand abounded with tuatara, lizards, primitive frogs, and giant flightless birds and insects. After New Zealand separated from Gondwana late in the Cretaceous, a highly distinctive and largely endemic fauna evolved in the absence of two types of terrestrial predators that shaped biotas elsewhere: mammals and snakes.

The arrival of humans with dogs and the Pacific rat about 1800 years ago ended 80 million years of evolutionary isolation and initiated an ecological catastrophe that was amplified by European colonisation in the nineteenth century, with many further introductions of mammalian predators. The consequences included extinction for many large indigenous species and range reductions for others. About 30% of lizard species, 50% of frogs, and all tuatara survive only on mammal-free offshore islands, many of which are small and vulnerable to rat invasion.

First efforts to protect the herpetofauna were mainly legislative and of limited effectiveness, but increasingly interventionist approaches in the past two decades offer new hope of turning the tide in favor of many threatened species. Mammal eradications, sometimes combined with captive propagation to bulk up numbers, have allowed establishment of new populations of rare species. A major landmark will be the re-colonisation of the mainland by tuatara when they are introduced to a secure mammal-free reserve adjacent to Wellington city in the near future.

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The Many Uses of Plastic in Herpetolculture

The term," *Plastics*", refers to an organic polymeric material consisting of giant organic molecules which can be formed into various shapes through extrusion, spinning, casting or molding. The molecular composition is either natural,(wax, cellulose, and natural rubber), or,synthetic,(polyethylene and nylon). The base materials consists of resins which are in the form of pellets,powders,or solutions and are used to form the finished products. Plastics were first developed in the mid 1800's. Since then plastics have improved in quality and variety and are now used in almost every household the world over. The herpetological community bas embraced the science of plastics and has made it their own. What I propose to show, is how plastics have been altered and adapted for use by the herpetological community. I will begin with the demonstration of an aquarium rack that I developed several years ago for use with our *Peltophryne lemur* and *Bufo baxteri* SSP projects. I will next show some of the other uses that I have found for plumbing PVC. We are all familiar with the many plastic household items that occur in all of our homes. I will try to show how we, (the herp community), have altered these to fit our special needs. I will then show some of the commercially produced plastic products that were developed specifically for our interests. I will finish by showing some products

modifications that were made to common items for various reasons such as safety, easy accessibility and practicality. Not all ideas are original, but may be found to be quite useful to those who have never seen them used before.

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The Trans-Pecos Region of Texas from a Herper's Perspective.

John Hollister first crossed the Pecos River in 1972 and fell in love with the area. He has since spent at least part of every year touring the area and looking for its herps. He has driven over 500,000 miles in the area and has many photographs of the area and its animals.

This tour will cover five counties of west Texas - an area of approximately 12,400 square miles. It is primarily Chihuahuan Desert scrub brush with elevations from under 1,000 feet to over 7,000 feet. It has a wealth of reptile and amphibian species. The talk will include pictures of the habitats in the five counties, but will concentrate on the reptile life, including variations across the range of the talk. Mr. Hollister is a life-long amateur naturalist who, for the last thirty-five years, has concentrated on reptiles.

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The Quest For Arboreal Alligator Lizards And Lance-Headed Rattlesnakes

San Antonio Zoo's herpetological staff began traveling and conducting fieldwork in Mexico in 1978. Mexico has one of the richest assemblages of herpetofauna in the world with 1000 ± species of reptiles and amphibians. The year, 1982, marked the beginning of a continuing collaboration between the San Antonio Zoo and the Universidad Autonoma de Nuevo Leon.

Husbandry and reproduction of endemic Mexican herpetofauna have become primary foci of the San Antonio Zoo's herpetological department. The San Antonio Zoo was granted a Mexican scientific collecting permit for the year 2001. Targeted species included plethodontid salamanders, anguid, phrynosomatid, helodermatid, xantusiid, and xenosaurid lizards, as well as select colubrid and viperid snakes.

This presentation will focus on the natural history, husbandry, and captive reproduction of three species of arboreal alligator lizards: *Abronia graminea*, *Abronia mixteca*, *Abronia taeniata*, and the lance-headed rattlesnake, *Crotalus polystictus*.

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Rattlesnakes and Vegetation, Their Distribution in the State of Nuevo Leon, Mexico

Even though the state of Nuevo Leon, located in the northeast corner of Mexico posseses only 5 species of rattlesnakes: *Crotalus atrox, C. lepidus* (*lepidus* and *morulus*), *C. molossus (molossus* and *nigrescens), Crotalus scutulatus,* and *Crotalus pricei miquihuanus* of the 29 or more species of rattlesnakes of Mexico, very few studies other then distribution information have been obtained. After the severe forest fires of 1998, intensive studies on the distribution and presences of plant communities in the state are being conducted. When traveling with plant experts our herpetological group has benefited. We now encounter more frequently rattlesnakes in areas that in the past had not been accessible.

We have noticed that there is an existing growing relationship with the presence of native plant communities and all herps in general. But montane rattlesnakes like *C. lepidus* (*lepidus* and *morulus*), *C. molossus (molossus* and *nigrescens),* and *Crotalus pricei miquihuanus* are sensitive to the presence of different plant elements or species within the plant communities. We are still not sure if the areas that we have had access to, have inadvertently affected the distribution of these species in a positive or negative order. If forest fires and droughts persist, as has been predicted by climatologists, undoubtedly monitoring these species will be of great value to continue understanding the biology of these Mexican Rattlesnakes. A subject that with decades has lost interest, within the international herpetological community.

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Ecological and Evolutionary Determinants of Anolis Lizard Biodiversity

Anolis lizards occur on almost any Caribbean island with vegetation, as well as throughout Central America and Amazonia. All told, nearly 400 species of anoles are known, with more being described yearly, which makes this genus the most speciesrich genus of reptile, larger than any mammalian or bird genus, and second to Eleutherodactylus among terrestrial vertebrates. On Caribbean islands, anoles are ubiquitous. As many as 11 species can occur at one locality and as many as 60 species exist on a single island (Cuba). Within a community, species differ in the ecological requirements, each occupying a distinct ecological niche. Comparisons among islands indicate that species have independently evolved the same adaptations to occupy the same habitats. Thus, for example, the twig specialists that occur on the four islands of the Greater Antilles (Cuba, Hispaniola, Jamaica, and Puerto Rico),are nearly identical morphologically, behaviorally, and ecologically, yet each has evolved independently. All told, six types of habitat specialists, termed ecomorphs, have evolved independently, making this the best known case of convergence of entire ecological communities.

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Management of Venomous Reptiles at the St. Louis Zoo

Well-written safety and husbandry protocols, with associated training, are of paramount importance to captive management of venomous reptiles in zoological institutions. The St. Louis Zoo has a large diverse collection of reptiles and amphibians. Of the 250+ herp species in the collection venomous reptiles make up 24% (7 elapids, 12 viperids and 2 helodermatids). This presentation will outline emergency preparedness, equipment, general working guidelines and an overview of the species comprising the collection. The techniques and safety issues outlined are applicable not only to zoological institutions, but to anyone who works with venomous reptiles.

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Care and Husbandry for Elapid snakes

Since the age of twelve I have kept a collection of Elapid snakes, many of which I have reproduced over the past 12 years. Currently I maintain a private collection of 38 species of Elapid snakes, with a special interest in the genera, *Naja* (cobras) and *Dendroaspis* (mambas).

I'm a student pursuing a degree in Wildlife Management. I'm also Curator of Reptiles at Pantera (http://www.pantera.nl) a big cat and reptile centre in the Netherlands. This centre is one of the largest in Holland. We have space for over a hundred big cats such as lions, tigers, and cougars but also have a large reptile exhibit with over 500 terrariums and an official reptile quarantine facility.

I have spent one whole year in Australia, where I had the opportunity to work in Venom Supplies Laboratories as one of the snake keepers.

Currently I'm working with the Dutch government to write a snakebite protocol, establish an antivenom bank and prepare a new law on the maintenance venomous snakes in the Netherlands. This law might be adopted for use by the entire European Union.

I will elaborate the husbandry and breeding methods used in my private collection emphasizing safety. The snakes are maintained in naturalistic enclosures which allow one to observe a variety of natural behaviours. To build these types of enclosures we need to look at lightning, heating, decoration and hiding places. All of these factors combined will aid in the successful reproduction of a variety of species. This talk will also focus on the special techniques used to breed the snakes, hatch the eggs and rear the offspring.

For additional information on husbandry and to view my facilities or specimens visit my website: http://www.kingsnake.com/elapids/index.htm

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Arboviruses and the Reptile

Eastern Equine Encephalitis is an arboviral disease endemic to North, South, and Central America. The eastern equine encephalitis virus (EEEV) is a new world alphavirus that is transmitted by mosquitoes. Epidemiological studies have demonstrated that birds, small mammals, and reptiles are susceptible to this virus with birds serving as the North American reservoir host. The role of reptiles in the epidemiology of EEEV is unclear. Experimental infection of two species of turtles resulted in seroconversion in one species. However, experimentally infected snakes and chelonians may remain viremic for periods up to 2-3 weeks, which is significantly longer than in other vertebrates. Reptiles have been implicated as a possible over-wintering reservoir for EEEV and western equine encephalitis virus, as they may remain viremic throughout hibernation. West Nile virus (WNV), a flavivirus, was apparently introduced into the United States in the late 1990's. An epizootic occurred in a population of birds in New York City during 1999. Since that time, the WNV has spread west through the United States. In 2001, the WNV was as far west as Illinois and as south as Louisiana. West Nile virus, like other arboviruses, can also affect humans, resulting in severe encephalitis and death. Other than occasional reports of WNV in snakes from the former Soviet Union, the role that reptiles play in the dissemination of this virus is unknown. This study was designed to determine the seroprevalence of EEEV and WNV in chelonians from Louisiana. Hemagglutination Inhibition Assay (HI) and Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) were used to determine exposure to or the presence of EEEV and WNV in a population of Louisiana chelonians captured for the pet trade.

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Epidemiology of *Salmonella* at a commercial green iguana (*Iguana iguana*) farm in El Salvador

Salmonella infection was first identified in snakes in 1944, and in turtles and lizards in 1946. Until the 1960's, reports of reptile-associated salmonellosis were rare. During the 1970's, approximately 4% of US households owned pet turtles and these animals accounted for 14% (280,000) of all reported cases of salmonellosis in children under ten years of age in the USA. In 1975, the US Food and Drug Agency implemented an interstate ban on commerce in turtles. This effectively halted the sale and ownership of turtles within the continental US and markedly reduced the number of turtle-associated cases of salmonellosis.

Recently, reports of salmonellosis from non-turtle reptile reservoirs have gained national attention. In most documented cases, the strain of *Salmonella* isolated from the patient was common to a pet reptile, confirming the source of infection. The US Center for Disease Control and Prevention has estimated that in 1996 there were over 50,000 cases of reptile-associated salmonellosis.

The increased popularity of the green iguana, with attendant risks of salmonellosis in owners and contacts of both clinically affected and normal green iguanas, merits study. There have been no documented epidemiological investigations to demonstrate when and how the commercial green iguana becomes infected with *Salmonella*.

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Observations on care and reproduction in captivity *Dendrobates pumilio* (Schmidt, 1857)

Dendrobates pumilio are found on the eastern watershed of Central America, in the lowland rainforest of the countries of Nicaragua, Costa Rica, and Panama. In Panama they also occur on a group of islands, the Bocas del Toros, located off the eastern coast. Over most of the mainland range of *D. pumilio*, populations consist of a bright red frog, with blue legs, but in the southern portion of their range they occur in a profusion of colors and patterns. In particular the insular forms show high levels of diversity in both size and colors.

For a variety of reasons this species is of particular interest, and has been heavily studied, in particular in the wild. It is also commonly seen in the pet trade, for which it is imported annually by the thousand. In spite of these facts, the breeding of this frog has remained rare in both hobbyist and institutional collections.

This presentation will discuss some of the experiences I have had while keeping this fascinating frog. I have used bits of information I picked up from other hobbyists, as well as information in print, to develop a method of breeding these frogs, which has been fairly successful. Frogs are paired in small terrariums, and with appropriate husbandry, produce between ten and twenty offspring a year. While initial results have been good, and some F-2 offspring have been produced, more work will be required to perfect husbandry of the offspring to adulthood. The captive-bred females produced here so far seem less inclined reproduce than the imported frogs, and there also seems to be a high ratio of male frogs produced.

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Temperature-dependent sex determination in natural nests of tuatara, *Sphenodon*

Tuatara (*Sphenodon punctatus*) are threatened New Zealand reptiles with temperature-dependent sex determination (TSD) when incubated at constant temperatures. We investigated the occurrence of TSD in natural nests on Stephens Island by recording natural nest characteristics, including temperature, and ascertaining the gonadal sex of all juveniles from those nests using laparoscopy. Twenty-five nests were selected to encompass the diversity of nest characteristics. Most nests had a northeasterly aspect, and mean depth from the top egg to the soil surface was 103 mm. Eggs were laid in clusters of between one and three layers; mean clutch size was 9.2 eggs. Mean number of days for incubation was 365, and hatching success was 65%. Incubation temperatures throughout the year ranged from 2.9 to 34.4° C, with daily fluctuations of between 0.5 and 15.6° C in summer (December to March). The overall proportion of male hatchlings was 0.64, and sex ratios varied significantly among nests. Sex ratios of nests were correlated with incubation temperature and nest depth, indicating that TSD occurs in nature. As this study represents data from only one nesting

season, future research will investigate whether female tuatara select nest sites according to environmental cues and whether global warming is likely to skew the hatchling sex ratio towards males.

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A Review of the Commercial Trade in the Western Diamondback Rattlesnake, *Crotalus atrox*. Are Rattlesnake Roundups as Bad as You Think or Worse?

While at least four species of rattlesnakes are commercially traded at Rattlesnake Roundups in North America, the Western Diamondback Rattlesnake represents over 95% of the total trade. These snakes are often locally abundant and are exploited to supply an international trade in skins, meat, gall bladders, and curios. This trade is linked to the unique social phenomenon of Rattlesnake Roundups, which often generate large amounts of money for the sponsoring organization and community. Because the commercial trade in rattlesnakes is largely unregulated and fluctuates widely according to the market demand for skins and meat, it is practically impossible to quantify. Data collected during the 1990's indicate that probably <125,000 rattlesnakes of all species entered the trade yearly.

Critical problems with Rattlesnake Roundups are the unethical and inhumane treatment of snakes, and snake shows that provide inaccurate information about the natural lives of these secretive and solitary predators. State wildlife agencies where Rattlesnake roundups are held should develop management strategies and monitoring programs to help address these problems.

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Project Golden Frog / Proyecto Rana Dorada

Project Golden Frog (PGF) is a comprehensive, multi-institutional conservation, research, and education initiative with strong range-country involvement. Simply stated, the primary goal of PGF is to ensure against the extinction of one of the world's most recognizable, culturally significant, and charismatic amphibians, the Panamanian golden frog, *Atelopus zeteki*. Once abundant, populations of this Panamanian endemic dwindled due to over-collection and deforestation. As a result, the golden frog was listed as an Appendix I species by C.I.T.E.S. on July 1, 1975, and as Endangered by the USFWS on June 14, 1976. It has also been protected under Panamanian law since 1967, but lack of enforcement continues to be a problem. Current trends in land use, illegal collection, and an incurable fungal disease (chytridiomycosis), seriously threaten the few remaining viable populations. The chytrid epizootic is presently 30-160 Km from the westernmost extent of the limited range of the golden frog. All available data from impacted amphibian populations in Costa Rica and western Panama indicate that this will result in the golden frog's extinction. Support has enabled the initiation of field studies, training, educational and captive propagation programs, a bilingual website (www.projectgoldenfrog.org), a Project Golden Frog Fund, and the purchase of a dedicated field vehicle. The continuance of these initiatives will not only help secure the golden frog's survival, it firmly

establishes a model program that benefits all conservationists dedicated to mitigating the global amphibian crisis.

For further information, please check out our website.

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West Indian Lizards: Ecological Release, Melanism, and Systematic Problems

Using a variety of West Indian lizards as models, I examine hypotheses suggesting that an anole exhibiting a particular ecomorph will experience ecological release in the absence of congeneric competitors, that a melanistic lizard on a small island will exhibit differences in thermal regimes when compared to a close relative with "normal" coloration, and that an isolated population of a widely distributed species might warrant full species status. If *Anolis monensis*, the only anole on Isla Mona and closely related to trunk-ground ecomorphs on nearby Puerto Rico, is capable of niche expansion it should: (1) exhibit characteristics of an ideal solitary anole, (2) exhibit less constraint in structural habitat use and thermal biology than its relatives, and (3) exhibit an ancestral display action pattern. Melanistic *Ameiva corax*, found only on Little Scrub Island off Anguilla, should exhibit differences in thermal biology in the field and different heating and cooling rates under controlled laboratory conditions than "normally" pigmented *A. plei* from Anguilla and adjacent Scrub Island. Iguanas from Isla Mona are closely related to *Cyclura cornuta* and have been subspecifically allied with Hispaniolan populations. Recent evidence based on mtDNA sequences reveals two distinct haplotypes among main-island populations, and indicates that the Isla Mona population clearly falls within one clade. Pertinent questions ask whether the isolated population warrants recognition as a full species and whether a "species" can evolve in what apparently was a relatively short period of time.

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Adenovirus in Bearded Dragons *(Pogona vitticeps)*

Little is known about the pathogenesis of adenovirus in the bearded dragon. Like other viral diseases in reptiles, adenoviral infection is difficult to diagnose antemortem. A better understanding of the disease process and its detection is necessary if we are to treat the animals affected and prevent this virus from spreading throughout the captive population. This discussion will examine the clinical presentation of the affected patient and my work on determining viral presence antemortem, as well as understanding its pathogenesis.

It is sometimes difficult to differentiate virally infected animals from animals suffering from calcium deficiency or coccidiosis. Fecal examination can rule out coccidiosis, and a thorough review of husbandry can rule out calcium deficiency. Diagnosis becomes complicated when multiple disorders present at the same time. While there are no specific signs of adenovirus infection, a good history, physical exam, and fecal can yield some strong suspicions.

Detection of viral presence in the patient while alive would be a useful tool for the veterinarian. Antemortem and postmortem histopathology and electron microscopy were performed on tissues taken from three symptomatic clutches of dragons including the mother. Samples were collected on random animals from ages one day old to one year old and the mother. Electron microscopy was also performed on fresh stool samples from this population. A review of these findings will be presented.

Detecting the presence of the virus is important, but preventing is spread is essential. By understanding the pathogenesis we can better accomplish this. Originally, it was believed that the virus was passed vertically. More recently, some have proposed that the virus is passed by the fecal-oral route. The goal of my work is to help better define this process.

Abstracts

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The Reproductive Cycle and Estrus in Colubrid Snakes of Temperate North America

Snakes in the family Colubridae are diverse and widespread. In temperate North America, the reproductive cycle of both sexes is conserved. Females begin vitellogenesis in the spring and ovulate in late spring. In both oviparous or viviparous species, the young are hatched/born in the summer. In males, spermatogenesis occurs in the summer and sperm are stored in the vas deferens. Estrus, the period of time when females are sexually attractive and receptive, occurs in the summer/fall in some species and in the spring in all species. The age of the sperm at fertilization is identical in both mating patterns. The difference is where the sperm is stored during the winter; in the oviduct in summer/fall breeding snakes and in the vas deferens in spring breeding snakes. The sexual segment of the kidney, a secretory structure which contributes to the ejaculate, is hypertrophied during the mating season. Elevated plasma testosterone levels coincide with the mating seasons. The terms post-nuptial spermatogenesis and dissociated reproductive cycle are synonymous and refer to species which have summer spermatogenesis and spring fertilization. The terms are independent of the mating season. Pre-nuptial spermatogenesis is synonymous with associated reproductive cycle and describes species in which spermatogenesis immediately precedes fertilization, a pattern not described for any North American colubrid.

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The Pet Industry and Herpetoculture

In the early 1990's, reptiles became very popular in the pet sector. Many pet shops jumped at the opportunity to increase their sales, even if they had no prior experience or knowledge of reptiles. On the rare occasion that a pet shop had trained staff and a legitimate reptile section in their store, there just weren't the products available on the market to support this fast-growing category.

In fact, in 1993, approximately 1,000,000 iguanas were imported for the pet trade into the United States alone; and there wasn't even a prepared diet for iguanas available on the market for pet shops to sell. With this obvious market demand facing the pet shops, as well as the lack of support products for a reptile hobbyist to succeed, I started T-Rex Products. I wasn't the only entrepreneur who recognized the potential market. By 1997, 15 companies produced an iguana diet for the pet trade. The pet industry had never seen such an explosion in a category before the reptile proliferation. At its peak in 1996, the frenzy for reptile products produced hundreds of companies worldwide who manufactured, re-packed, or somehow marketed products for reptiles to the pet trade.

Today, the pendulum has swung back toward the center line. There are a few core companies who have remained committed to the reptile market. With the market stabilized at approximately 3,000,000 households owning reptiles, it proves to be a very competitive category amongst the pet trade manufacturers.

It is in my opinion however, that the so-called fad of keeping reptiles for pets has not pinnacled, but is experiencing a tremendous bottleneck in the availability of quality livestock. It is my contention, that with the development of the captive breeding of appropriate pet trade reptiles, we could be on the verge of another growth spurt in the reptile pet industry.

T-Rex is actively supporting the efforts of captive breeders to supply quality reptiles to pet shops. This strategy will ensure a sustainable reptile market for the pet industry.

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Paramyxovirus and Herpes Virus

Two major viral diseases of reptiles are paramyxovirus and herpes virus. Paramyxovirus was originally thought to be a viperid disease, but is now known to infect elapids, colubrids, boids, and even some lizards. Paramyxovirus should be suspected in any large die-offs of snakes, outbreaks are more common in the first half of the year. Mortality usually peaks one month following the initial deaths, then declines over the next two to three months. Paramyxovirus primarily affects the lungs, liver and pancreas. Aerosol transmission is thought to be responsible for the large number of cases within a collection; virus may persist in water and be shed in feces (thus fomites may also be involved in transmission). Histopathology with experienced pathologists will often yield a diagnosis. Hemagglutination inhibition titers (through the University of Florida) are useful in screening for paramyxovirus during three to six months quarantine. No new snakes should be introduced in an active outbreak until two months after the last death. Clinically affected snakes should be isolated and air movement minimized.

Herpes virus is a relatively new contagious virus primarily affecting tortoises. The actual chelonian host spectrum remains unknown. Clinical signs can be confused with mycoplasmosis in that rhinitis and nasal discharge are often present. However, herpes virus typically causes necrotizing stomatitis, glossitis, and paryngitis. Small whitish plaques develop at the back of the mouth and quickly coalesce. Herpes virus attacks epithelial cells in the oral cavity, lower respiratory tract, liver, kidney and brain. Untreated animals often die, antiviral drugs, such as acyclovir, as well as antibiotics, may save some patients. Direct transmission between tortoises likely allows spread; environmental contamination is also possible. Diagnosis is via histopathology and/or serologic testing (University of Florida). Outbreaks are much more common in Europe than the United States, we must be vigilant to prevent herpes virus from becoming common in the U.S.. Dilute bleach is an effective disinfectant for both viruses.

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Crocodilians: Fact vs. Fiction

This is a discussion of crocodilian behaviors witnessed at the St. Augustine Alligator Farm. There are four specific topics within the talk: Crocodilians have the ability to swallow prey underwater, crocodilians may eat more vegetable material than we are willing to admit (video), Siamese crocodiles as parents, and crocodilians feeding their young? (video).

Crocodilians have the ability to swallow prey under water: We have witnessed both *Crocodylus johnsoni* and *Tomistoma schlegelii* swallowing their food without coming to the surface.

Crocodilians eating their vegetables: It is possible that biologists have been assuming too much when doing stomach content surveys on crocodilians. We have compelling evidence that alligators, at least, seek out vegetation in their diet.

Siamese Crocodiles as parents: A two-year account of a pair of *Crocodylus siamensis* raising young on exhibit at the St. Augustine Alligator Farm.

Crocodilians feeding their young?: Video of *Crocodylus siamensis* allowing her young to feed from a piece of meat in her mouth.

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Lies, Damned Lies and Statistics, the Global Fight for the Reptile Industry

Recent statistically based reports from animal rights groups masquerading as animal welfare groups, both in the USA and Europe, call for a ban on reptiles in captivity. These reports have deliberately hijacked and mixed conservation, trade and wildlife management issues with animal welfare philosophy to both misinform, and gain credibility, with naïve legislators and the general public. These groups prey upon the publics, and governments, general ignorance about reptiles, conservation, and trade, to gain support for their misguided goals. The realization that sustainable use can be a powerful conservation tool is being buried by biased misinformation posing as facts. Also ignored is the principle concern for wildlife, namely habitat loss due to development, unless it can be blamed on collectors. The considerable advances made in information, education, and the captive care and reproduction of reptiles are generally ignored, unless they can be twisted into negative welfare concerns. Any increase in the positive perception of reptiles by the general public is being systematically undermined. Proposals by these groups to adopt a policy of releasing captive reptiles back into the wild do not take account of the serious consequences of introducing pathogens, gene pool pollution and unknown ecological interactions. These groups are seemingly unaccountable for the misinformation that they publish or feed to the media. The reality of the reptile trade is a far cry from the sordid picture painted by them. Herpetoculture is facing its darkest hour. These reports, and associated unwarranted media exposure, give completely unbalanced views that are not supported by scientific fact. The challenge for us all is to make the general public and politicians aware of the true situation if we are to ensure a future both for ourselves, and those who would follow us.

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The Fall and Rise of the New Zealand Herpetofauna

Pre-human New Zealand abounded with tuatara, lizards, primitive frogs, and giant flightless birds and insects. After New Zealand separated from Gondwana late in the Cretaceous, a highly distinctive and largely endemic fauna evolved in the absence of two types of terrestrial predators that shaped biotas elsewhere: mammals and snakes.

The arrival of humans with dogs and the Pacific rat about 1800 years ago ended 80 million years of evolutionary isolation and initiated an ecological catastrophe that was amplified by European colonisation in the nineteenth century, with many further introductions of mammalian predators. The consequences included extinction for many large indigenous species and range reductions for others. About 30% of lizard species, 50% of frogs, and all tuatara survive only on mammal-free offshore islands, many of which are small and vulnerable to rat invasion.

First efforts to protect the herpetofauna were mainly legislative and of limited effectiveness, but increasingly interventionist approaches in the past two decades offer new hope of turning the tide in favor of many threatened species. Mammal eradications, sometimes combined with captive propagation to bulk up numbers, have allowed establishment of new populations of rare species. A major landmark will be the re-colonisation of the mainland by tuatara when they are introduced to a secure mammal-free reserve adjacent to Wellington city in the near future.

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The Many Uses of Plastic in Herpetolculture

The term," *Plastics*", refers to an organic polymeric material consisting of giant organic molecules which can be formed into various shapes through extrusion, spinning, casting or molding. The molecular composition is either natural,(wax, cellulose, and natural rubber), or,synthetic,(polyethylene and nylon). The base materials consists of resins which are in the form of pellets,powders,or solutions and are used to form the finished products. Plastics were first developed in the mid 1800's. Since then plastics have improved in quality and variety and are now used in almost every household the world over. The herpetological community has embraced the science of plastics and has made it their own. What I propose to show, is how plastics have been altered and adapted for use by the herpetological community. I will begin with the demonstration of an aquarium rack that I developed several years ago for use with our *Peltophryne lemur & Bufo baxteri* SSP projects. I will next show some of the other uses that I have found for plumbing PVC. We are all familiar with the many plastic household items that occur in all of our homes. I will try to show how we, (the herp community), have altered these to fit our special needs. I will then show some of the commercially produced plastic products that were developed specifically for our interests. I will finish by showing some products modifications that were made to common items for various reasons such as safety, easy accessibility and practicality. Not all ideas are original, but may be found to be quite useful to those who have never seen them used before.

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The Trans-Pecos Region of Texas from a Herper's Perspective.

John Hollister first crossed the Pecos River in 1972 and fell in love with the area. He has since spent at least part of every year touring the area and looking for its herps. He has driven over 500,000 miles in the area and has many photographs of the area and its animals.

This tour will cover five counties of west Texas - an area of approximately 12,400 square miles. It is primarily Chihuahuan Desert scrub brush with elevations from under 1,000 feet to over 7,000 feet. It has a wealth of reptile and amphibian species. The talk will include pictures of the habitats in the five counties, but will concentrate on the reptile life, including variations across the range of the talk. Mr. Hollister is a life-long amateur naturalist who, for the last thirty-five years, has concentrated on reptiles.

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The Quest For Arboreal Alligator Lizards And Lance-Headed Rattlesnakes

San Antonio Zoo's herpetological staff began traveling and conducting fieldwork in Mexico in 1978. Mexico has one of the richest assemblages of herpetofauna in the world with 1000 ± species of reptiles and amphibians. The year, 1982, marked the beginning of a continuing collaboration between the San Antonio Zoo and the Universidad Autonoma de Nuevo Leon.

Husbandry and reproduction of endemic Mexican herpetofauna have become primary foci of the San Antonio Zoo's herpetological department. The San Antonio Zoo was granted a Mexican scientific collecting permit for the year 2001. Targeted species included plethodontid

salamanders, anguid, phrynosomatid, helodermatid, xantusid, and xenosaurid lizards, as well as select colubrid and viperid snakes.

This presentation will focus on the natural history, husbandry, and captive reproduction of three species of arboreal alligator lizards: *Abronia graminea*, *Abronia mixteca*, *Abronia taeniata*, and the lance-headed rattlesnake, *Crotalus polystictus*.

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Rattlesnakes and Vegetation, Their Distribution in the State of Nuevo Leon, Mexico

Even though the state of Nuevo Leon, located in the northeast corner of Mexico posseses only 5 species of rattlesnakes: *Crotalus atrox, C. lepidus* (*lepidus* and *morulus*), *C. molossus (molossus* and *nigrescens), Crotalus scutulatus,* and *Crotalus pricei miquihuanus* of the 29 or more species of rattlesnakes of Mexico, very few studies other then distribution information have been obtained. After the severe forest fires of 1998, intensive studies on the distribution and presences of plant communities in the state are being conducted. When traveling with plant experts our herpetological group has benefited. We now encounter more frequently rattlesnakes in areas that in the past had not been accessible.

We have noticed that there is an existing growing relationship with the presence of native plant communities and all herps in general. But montane rattlesnakes like *C. lepidus* (*lepidus* and *morulus*), *C. molossus (molossus* and *nigrescens),* and *Crotalus pricei miquihuanus* are sensitive to the presence of different plant elements or species within the plant communities. We are still not sure if the areas that we have had access to, have inadvertently affected the distribution of these species in a positive or negative order. If forest fires and droughts persist, as has been predicted by climatologists, undoubtedly monitoring these species will be of great value to continue understanding the biology of these Mexican Rattlesnakes. A subject that with decades has lost interest, within the international herpetological community.

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Ecological and Evolutionary Determinants of Anolis Lizard Biodiversity

Anolis lizards occur on almost any Caribbean island with vegetation, as well as throughout Central America and Amazonia. All told, nearly 400 species of anoles are known, with more being described yearly, which makes this genus the most species -rich genus of reptile, larger than any mammalian or bird genus, and second to Eleutherodactylus among terrestrial vertebrates. On Caribbean islands, anoles are ubiquitous. As many as 11 species can occur at one locality and as many as 60 species exist on a single island (Cuba). Within a community, species differ in the ecological requirements, each occupying a distinct ecological niche. Comparisons among islands indicate that species have independently evolved the same adaptations to occupy the same habitats. Thus, for example, the twig specialists that occur on the four islands of the Greater Antilles (Cuba, Hispaniola, Jamaica, and Puerto Rico) ,are nearly identical morphologically, behaviorally, and ecologically, yet each has evolved independently. All told, six types of habitat specialists, termed ecomorphs, have evolved independently, making this the best known case of convergence of entire ecological communities.

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Management of Venomous Reptiles at the St. Louis Zoo

Well-written safety and husbandry protocols, with associated training, are of paramount importance to captive management of venomous reptiles in zoological institutions. The St. Louis Zoo has a large diverse collection of reptiles and amphibians. Of the 250+ herp species in the collection venomous reptiles make up 24% (7 elapids, 52 viperids and 2 helodermatids). This presentation will outline emergency preparedness, equipment, general working guidelines and an overview of the species comprising the collection. The techniques and safety issues outlined are applicable not only to zoological institutions, but to anyone who works with venomous reptiles.

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Care and Husbandry for Elapid snakes

Since the age of twelve I have kept a collection of Elapid snakes, many of which I have reproduced over the past 12 years. Currently I maintain a private collection of 38 species of Elapid snakes, with a special interest in the genera, *Naja* (cobras) and *Dendroaspis* (mambas).

I'm a student pursuing a degree in Wildlife Management. I'm also curator of reptiles at Pantera (http://www.pantera.nl) a big cat and reptile centre, in the Netherlands. This centre is one of the largest in Holland. We have space for over a hundred big cats such as lions, tigers and cougars but also have a large reptile exhibit with over 500 terrariums and an official reptile quarantine facility.

In the past I have spent one whole year in Australia, where I had the opportunity to work Venom Supplies Laboratories as one of the snake keepers.
Currently I'm working with the Dutch government to write a snakebite protocol, establish antivenom bank and prepare a new law on the maintenance venomous snakes in the Netherlands. This law might be adopted for use by the entire European Union.

I will elaborate the husbandry and breeding methods used in my private collection emphasising safety. The snakes are maintained in naturalistic enclosures, which allow one to observe a variety of natural behaviours. To build these types of enclosures we need to look at lightning, heating, decoration and hiding places. All of these factors combined will aid in the successful reproduction of a variety of species. This talk will also focus on the varied techniques used to breed, hatch the eggs and rear the offspring. For additional information on husbandry and to view my facilities or specimens visit my website: http://www.kingsnake.com/elapids/index.htm

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Arboviruses and the Reptile

Eastern Equine Encephalitis is an arboviral disease endemic to North, South, and Central America. The eastern equine encephalitis virus (EEEV) is a new world alphavirus that is transmitted by mosquitoes. Epidemiological studies have demonstrated that birds, small mammals, and reptiles are susceptible to this virus with birds serving as the North American reservoir host. The role of reptiles in the epidemiology of EEEV is unclear. Experimental infection of two species of turtles resulted in seroconversion in one species. However, experimentally infected snakes and chelonians may remain viremic for periods up to 2-3 weeks, which is significantly longer than in other vertebrates. Reptiles have been implicated as a possible over-wintering reservoir for EEEV and western equine encephalitis virus, as they may remain viremic throughout hibernation. West Nile virus (WNV), a flavivirus, was apparently introduced into the United States in the late 1990's. An epizootic occurred in a population of birds in New

York City during 1999. Since that time, the WNV has spread west through the United States. In 2001, the WNV was as far west as Illinois and as south as Louisiana. West Nile virus, like other arboviruses, can also affect humans, resulting in severe encephalitis and death. Other than occasional reports of WNV in snakes from the former Soviet Union, the role that reptiles play in the dissemination of this virus is unknown. This study was designed to determine the seroprevalence of EEEV and WNV in chelonians from Louisiana. Hemagglutination Inhibition Assay (HI) and Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) were used to determine exposure to or the presence of EEEV and WNV in a population of Louisiana chelonians captured for the pet trade.

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Epidemiology of *Salmonella* at a commercial green iguana (*Iguana iguana*) farm in El Salvador

Salmonella infection was first identified in snakes in 1944, and in turtles and lizards in 1946. Until the 1960's, reports of reptile-associated salmonellosis were rare. During the 1970's, approximately 4% of US households owned pet turtles and these animals accounted for 14% (280,000) of all reported cases of salmonellosis in children under ten years of age in the USA. In 1975, the US Food and Drug Agency implemented an interstate ban on commerce in turtles. This effectively halted the sale and ownership of turtles within the continental US and markedly reduced the number of turtle-associated cases of salmonellosis.

Recently, reports of salmonellosis from non-turtle reptile reservoirs have gained national attention. In most documented cases, the strain of *Salmonella* isolated from the patient was common to a pet reptile, confirming the source of infection. The US Center for Disease Control and Prevention has estimated that in 1996 there were over 50,000 cases of reptile-associated salmonellosis.

The increased popularity of the green iguana, with attendant risks of salmonellosis in owners and contacts of both clinically affected and normal green iguanas, merits study. There have been no documented epidemiological investigations to demonstrate when and how the commercial green iguana becomes infected with *Salmonella*.

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Observations on care and reproduction in captivity *Dendrobates pumilio* (Schmidt, 1857)

Dendrobates pumilio are found on the eastern watershed of Central America, in the lowland rainforest of the countries of Nicaragua, Costa Rica, and Panama. In Panama they also occur on a group of islands, the Bocas del Toros, located off the eastern coast. Over most of the mainland range of *D. pumilio*, populations consist of a bright red frog, with blue legs, but in the southern portion of their range they occur in a profusion of colors and patterns. In particular the insular forms show high levels of diversity in both size and colors.

For a variety of reasons this species is of particular interest, and has been heavily studied, in particular in the wild. It is also commonly seen in the pet trade, for which it is imported annually by the thousand. In spite of these facts, the breeding of this frog has remained rare in both hobbyist and institutional collections.

This presentation will discuss some of the experiences I have had while keeping this fascinating frog. I have used bits of information I picked up from other hobbyists, as well as information in print, to develop a method of breeding these frogs, which has been fairly successful. Frogs are paired in small terrariums, and with appropriate husbandry, produce between ten and twenty offspring a year. While initial results have been good, and some F-2 offspring have been produced, more work will be required to perfect husbandry of the offspring

to adulthood. The captive-bred females produced here so far seem less inclined reproduce than the imported frogs, and there also seems to be a high ratio of male frogs produced.

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*Speaker

Temperature-dependent sex determination in natural nests of tuatara,*Sphenodon*

Tuatara (*Sphenodon punctatus*) are threatened New Zealand reptiles with temperature-dependent sex determination (TSD) when incubated at constant temperatures. We investigated the occurrence of TSD in natural nests on Stephens Island by recording natural nest characteristics, including temperature, and ascertaining the gonadal sex of all juveniles from those nests using laparoscopy. Twenty-five nests were selected to encompass the diversity of nest characteristics. Most nests had a northeasterly aspect, and mean depth from the top egg to the soil surface was 103 mm. Eggs were laid in clusters of between one and three layers; mean clutch size was 9.2 eggs. Mean number of days for incubation was 365, and hatching success was 65%. Incubation temperatures throughout the year ranged from 2.9 to 34.4°C, with daily fluctuations of between 0.5 and 15.6°C in summer (December to March). The overall proportion of male hatchlings was 0.64, and sex ratios varied significantly among nests. Sex ratios of nests were correlated with incubation temperature and nest depth, indicating that TSD occurs in nature. As this study represents data from only one nesting season, future research will investigate whether female tuatara select nest sites according to environmental cues and whether global warming is likely to skew the hatchling sex ratio towards males.

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A Review of the Commercial Trade in the Western Diamondback Rattlesnake,*Crotalus atrox*. Are Rattlesnake Roundups as Bad as You Think-- or Worse??

While at least four species of rattlesnakes are commercially traded at Rattlesnake Roundups in North America, the Western Diamondback Rattlesnake represents over 95% of the total trade. These snakes are often locally abundant and are exploited to supply an international trade in skins, meat, gall bladders, and curios. This trade is linked to the unique social phenomenon of Rattlesnake Roundups, which often generate large amounts of money for the sponsoring organization and community. Because the commercial trade in rattlesnakes is largely unregulated and fluctuates widely according to the market demand for skins and meat, it is practically impossible to quantify. Data collected during the 1990's indicate that probably <125,000 rattlesnakes of all species entered the trade yearly.

Critical problems with Rattlesnake Roundups are the unethical and inhumane treatment of snakes, and snake shows that provide inaccurate information about the natural lives of these secretive and solitary predators. State wildlife agencies where Rattlesnake roundups are held should develop management strategies and monitoring programs to help address these problems.

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Project Golden Frog/Proyecto Rana Dorada

Project Golden Frog (PGF) is a comprehensive, multi-institutional conservation, research, and education initiative with strong range-country involvement. Simply stated, the primary goal of PGF is to ensure against the extinction of one of the world's most recognizable, culturally significant, and charismatic amphibians, the Panamanian golden frog, *Atelopus zeteki*. Once abundant, populations of this Panamanian endemic dwindled due to over-collection and deforestation. As a result, the golden frog was listed as an Appendix I species by C.I.T.E.S. on July 1, 1975, and as Endangered by the USFWS on June 14, 1976. It has also been protected under Panamanian law since 1967, but lack of enforcement continues to be a problem. Current trends in land use, illegal collection, and an incurable fungal disease (chytridiomycosis), seriously threaten the few remaining viable populations. The chytrid epizootic is presently 30-160 Km from the westernmost extent of the limited range of the golden frog. All available data from impacted amphibian populations in Costa Rica and western Panama indicate that this will result in the golden frog's extinction. Support has enabled the initiation of field studies, training, educational and captive propagation programs, a bilingual website (www.projectgoldenfrog.org), a Project Golden Frog Fund, and the purchase of a dedicated field vehicle. The continuance of these initiatives will not only help secure the golden frog's survival, it firmly establishes a model program that benefits all conservationists dedicated to mitigating the global amphibian crisis.

For further information, please check out our website.

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West Indian Lizards: Ecological Release, Melanism, and Systematic Problems

Using a variety of West Indian lizards as models, I examine hypotheses suggesting that an anole exhibiting a particular ecomorph will experience ecological release in the absence of congeneric competitors, that a melanistic lizard on a small island will exhibit differences in thermal regimes when compared to a close relative with "normal" coloration, and that an isolated population of a widely distributed species might warrant full species status. If *Anolis monensis*, the only anole on Isla Mona and closely related to trunk-ground ecomorphs on nearby Puerto Rico, is capable of niche expansion it should: (1) exhibit characteristics of an ideal solitary anole, (2) exhibit less constraint in structural habitat use and thermal biology than its relatives, and (3) exhibit an ancestral display action pattern. Melanistic *Ameiva corax*, found only on Little Scrub Island off Anguilla, should exhibit differences in thermal biology in the field and different heating and cooling rates under controlled laboratory conditions than "normally" pigmented *A. plei* from Anguilla and adjacent Scrub Island. Iguanas from Isla Mona are closely related to *Cyclura cornuta* and have been subspecifically allied with Hispaniolan populations. Recent evidence based on mtDNA sequences reveals two distinct haplotypes among main-island populations, and indicates that the Isla Mona population clearly falls within one clade. Pertinent questions ask whether the isolated population warrants recognition as a full species and whether a "species" can evolve in what apparently was a relatively short period of time.

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Adenovirus in Bearded Dragons *(Pogona vitticeps)*

Little is known about the pathogenesis of adenovirus in the bearded dragon. Like other viral diseases in reptiles, adenoviral infection is difficult to diagnose antemortem. A better understanding of the disease process and its detection is necessary if we are to treat the animals affected and prevent this virus from spreading throughout the captive population. This discussion will examine the clinical presentation of the affected patient and my work on determining viral presence antemortem, as well as understanding its pathogenesis.

It is sometimes difficult to differentiate virally infected animals from animals suffering from calcium deficiency or coccidiosis. Fecal examination can rule out coccidiosis, and a thorough review of husbandry can rule out calcium deficiency. Diagnosis becomes complicated when multiple disorders present at the same time. While there are no specific signs of adenovirus infection, a good history, physical exam, and fecal can yield some strong suspicions.

Detection of viral presence in the patient while alive would be a useful tool for the veterinarian. Antemortem and postmortem histopathology and electron microscopy were performed on tissues taken from three symptomatic clutches of dragons including the mother. Samples were collected on random animals from ages one day old to one year old and the mother. Electron microscopy was also performed on fresh stool samples from this population. A review of these findings will be presented.

Detecting the presence of the virus is important, but preventing is spread is essential. By understanding the pathogenesis we can better accomplish this. Originally, it was believed that the virus was passed vertically. More recently, some have proposed that the virus is passed by the fecal-oral route. The goal of my work is to help better define this process.

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Dendrobates pumilio (Schmidt, 1857): Observations on care and reproduction in captivity.

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Dendrobates pumilio are found on the eastern watershed of Central America, in the lowland rainforest of the countries of Nicaragua, Costa Rica, and Panama. In Panama they also occur on a group of islands, the Bocas del Toro, located off the eastern coast. Over most of the mainland range of *D. pumilio*, populations consist of bright red frog, with blue legs, but in the southern portion of their range they occur in a profusion of colors and patterns. In particular the insular forms show high levels of diversity in both size and colors.

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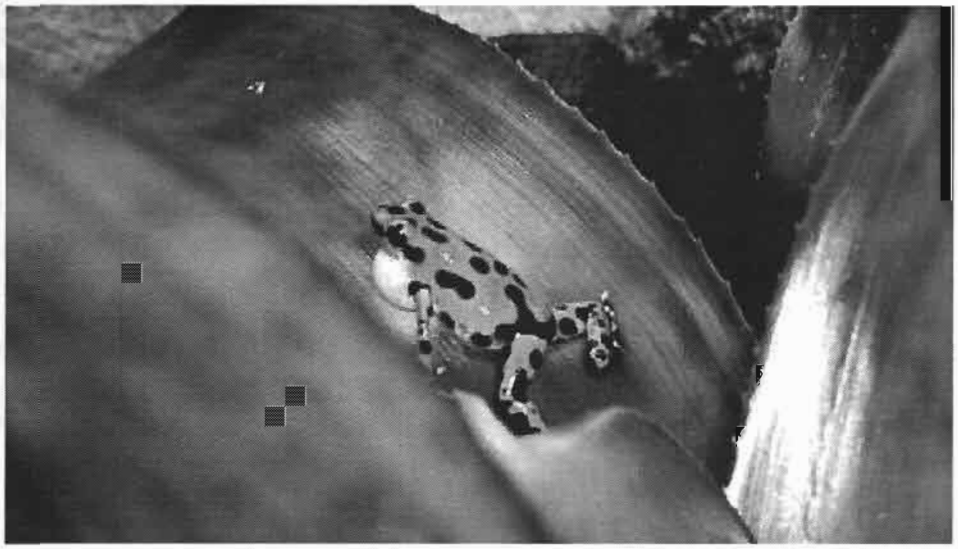
This presentation will discuss some of the experiences I have had while keeping this fascinating frog. I have used bits of information I picked up from other hobbyists, as well as information in print, to develop a method of breeding these frogs, which has been fairly successful. Frogs are paired in small terrariums, and with appropriate husbandry, often produce between ten and twenty offspring a year. While initial results have been good, and some F-2 offspring have been produced, more work may be required to fully understand the factors, which trigger the reproductive cycles of these animals. The captive-bred females produced here seem to be less inclined to reproduce than the imported frogs, and there also seems to be a high ratio of male offspring produced.

Distribution and Habitat

Dendrobates pumilio are found in Central America, from Nicaragua south through Panama, in the eastern watershed of these countries. They are primarily found in low-elevation, transition zones between forest and open, disturbed habitats near human settlements. They are also found on the Bocas Del Toro island group, off the northwestern coast of Panama. These frogs are diurnal, and very active.



Male *Dendrobates pumilio* calling from a bromeliad leaf. Photo by Patrick Nabors.

In many areas the population densities are very high, and the constant calling of the males is practically all you can hear.

Description

Dendrobates pumilio are small frogs, ranging in size from about five eighths of an inch, to close to an inch. The most common color form is one with blue legs, and a red back. These frogs occur in Nicaragua and Costa Rica, and in most of this range, this is the only *D. pumilio* form. However in Panama, and particularly on the Bocas del Tora archipelago, they occur in a profusion of different color forms and sizes.

Natural History

Dendrobates pumilio is a very active diurnal species, which expend a considerable amount of its time and energy reproducing. Males call for hours daily, and engage in territorial battles with rival males. Both the male and female will tend the clutch of eggs, often laid on a bromeliad leaf, or a sheltered spot on the ground. The tadpoles erupt around ten days later, and the female will carry the tadpoles individually to spots in her territory. Often used sites include bromeliads, the axils of other plants, and debris such as coconut shells or empty tin cans. The female then visits these sites every few days, and lays food eggs for the tadpoles. Each tadpole lives in its own little pond of water, and several weeks later emerges as a tiny frog. Apparently the food eggs laid by the female are critical for the tadpoles development, for in captivity, the tadpoles have proven to be impossible to raise without the females care. There is a report of using chicken egg yolk by the German hobbyist, Elke Zimmerman, but it has not been duplicated in the US, to my knowledge.

Specimen Acquisition and Acclimation

These frogs are currently regularly imported, in particular the blue jean form. Wild caught *D. pumilio* often suffer high mortality rates. Shipments to the United States often seem to arrive in fair condition, as far as appearance goes, but many of the frogs die within a few weeks of arrival. Much of the founding stock here at my facility have been wild caught animals. Wild caught *D. pumilio* brought here are quarantined to separate plastic boxes, generally six quart Sterilite or similar plastic storage box. The boxes are translucent. There are no ventilation holes provided, and the substrate consists of about an inch of good quality mulch such as hardwood mulch. Do not use cypress, pine or other conifer based types of mulch. The mulch is dampened thoroughly with water, and some leaf litter or other hide spots are placed in the box. The frog is introduced and observed for a few months. Prophylactic treatment of these frogs with antibiotics has been very helpful in keeping losses to a minimum. Baytril (Enrofloxacin) 2.27% has been used with good results here, mixed in water and sprayed over the frog daily. (One cc to a quart of water.)

Food must be regularly supplied, and appropriately sized. Termites or the larvae of wax moths are excellent while attempting to acclimatize these frogs, but crickets and fruit flies will also be taken readily by most frogs. Feed at least five times a week while the frogs are getting settled in. Frogs which appear to have trouble gaining or holding weight, are treated with Panacur (fenbenzadole) granules and Flagyl (metronidizole). This drug combination is ground to a fine powder , and mixed in equal parts with the calcium and vitamin supplement. It is used to dust the food items, on a single day's feeding, then re-administered in two weeks. This drug combination is both effective and lacks negative side effects, in my experience.

Captive bred specimens are also available on a limited basis. These represent a considerable improvement in health and condition over wild caught specimens. In addition there is often a larger variety of color forms available as captive bred frogs.

Determination of Sex

Dendrobates pumilio have long been popular in the pet hobby, and are much studied in the wild by the scientific community. Despite this fact there has been very little breeding of this frog in either hobbyist or institutional collections. In the pet hobby they are usually inexpensive, and the typical approach to keeping the species in the past has been to take several specimens and put them all into a large terrarium, and see what happens. Since *Dendrobates pumilio* are a very territorial frog, this generally does not have good results. Although the groups will often reach equilibrium and co-exist, egg predation and general fighting tend to make successful clutches of eggs a rarity. Based on discussions with other hobbyists, and the work of Ellen Zimmerman, together with my own experience with other types of dart frogs, it was obvious to me that the key to breeding these frogs in captivity with any regularity was keeping them in pairs.

The first, and primary hurdle here is to determine the sex of the frogs you are working with. These can be difficult frogs to sex by appearance alone. A process of discovery is used for both wild caught adults and captive-bred sub adults to determine the sex of the animals. First look at the throat of the frog. Males will sometimes have a spot of gray or black in the skin of the throat, created by the stretching of the throat from calling. This is fairly reliable, if present. However, lack of this spot is in no way conclusive. Also, while many specimens show the usual size difference in sexes, with the males being smaller, and the females stouter and longer, it is not that unusual to find *D. pumilio* which do not follow this guideline. Also, different forms of *D. pumilio* are more or less difficult to sex. The green form is an example of an easily sexed form, almost all males are small, significantly smaller than females. However many other forms are not so straightforward.

The next step would be to place the unknown sex frog in a small tank, which is furnished with plants, and well lit. The frog is set up alone in this fashion for several days, and observed for calling. If no calling is seen within a few days, the frog is considered a probable female, and returned to the quarantine container. If you put two or more frogs in a tank, you may not get accurate results. I have observed males to not call if they are housed with a calling male, or if you put two unknown sex frogs in a smaller tank, only one will call in my experience. My tanks are much too small for the second male to feel comfortable even trying to establish its own territory, apparently.

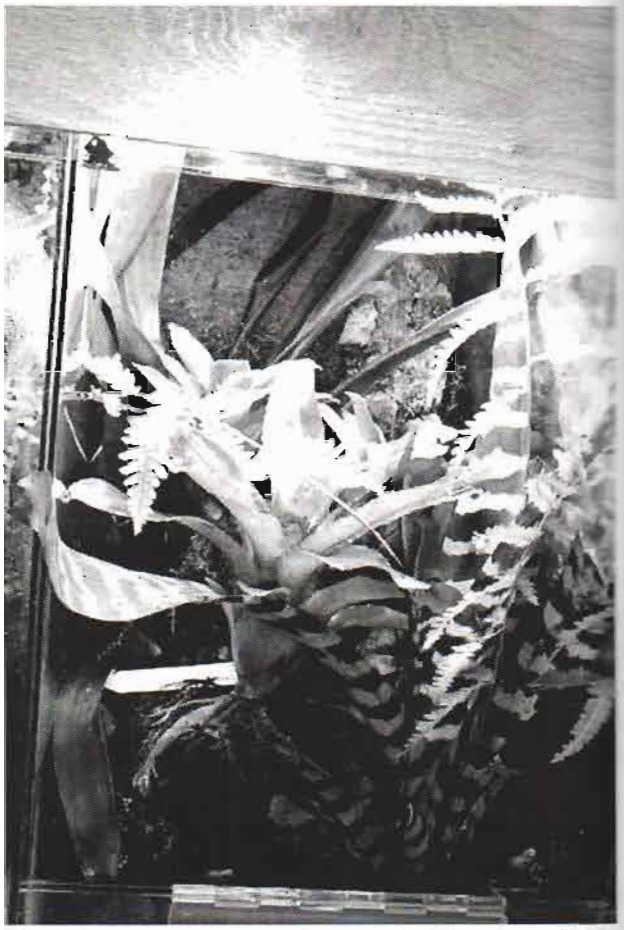
Tank Design and Construction

Two different designs of tanks have been used here for breeding these frogs. The most used is a glass tank built on the bottom frame of a ten gallon aquarium, about ten inches by twenty. The tank is seventeen inches high, with a door in the front, set at an angle, so you can very easily see into the tank. The interior of the tanks are set up with a piece of cork bark leaned against the back wall, onto which are mounted bromeliads. Small aquarium gravel is the substrate, with dead leaves placed about the floor of the tank which offer hiding areas. The tanks have ventilation holes, one in the back, and one or two in the lid. The remainder of the lid is glass. The holes are roughly 2 inches in diameter. The tanks are also fitted with a misting nozzle in the top, and drain in the floor of the tank. The misting system is typically run for three or four minutes at a time, three or four times a day. I doubt that this is critical, but I do find the automation offered by a misting system quite helpful with keeping the bromeliads full of clean water. These frogs do not seem to require the very high humidity, which some Dendrobatid frogs seem to require, and will remain active in the full sun, or light, during the relatively dry times of day.

The second design is similar to the first, but the tanks are slightly larger. They are slightly taller, and the tank have a flat front, instead of the slant front on the previous design. These tanks incorporate a fan to add

ventilation. These fans run several times through the day for a few moments, which both cools the tanks, and dries them.

Both standard forty watt four-foot fluorescents, and compact fluorescent lamps have been used here, with the best results being obtained with the brighter compact fluorescents. The intense light produced by the compact fluorescent lights is beneficial in particular to the bromeliads, and as stated earlier, these frogs seem quite happy to be out and active no matter how bright the light.



Dendrobatid frog enclosure with a variety of live plants. Photo by Patrick Nabors.

Reproduction in Captivity

Sexed pairs of *D. pumilio* are placed in these tanks, and in many cases breeding begins almost immediately. Courtship occurs throughout the day, with the males calling nearly incessantly. Both frogs are often visible throughout the courting process, and in some cases they may be observed actually laying and fertilizing the eggs. Eggs are typically laid in a couple of spots in the terrarium, mainly the bromeliad leaves, and the leaf litter. Some clutches are laid in very visible locations, and the entire process of development of the eggs can be observed. The eggs take about ten to fourteen days to fully develop. The tadpoles are smaller than most dendrobatid frog tadpoles when they hatch. They are carried one at a time, to bromeliad axils, by the female. If offered, the females will also deposit the tadpole in other water reservoirs, such as film vials. The female returns every few days to feed the tadpoles, which wriggle eagerly around the females' vent, to stimulate her to lay the eggs apparently.

The female often lays several clutches of eggs within a short time, and in some cases they may all develop, but the female will only attempt to raise a few at one time, leaving ten or twenty tadpoles to dry out on a leaf. The most tadpoles I have ever seen a female try to raise is eight, all of which made it to full term froglets, but some had spindly leg syndrome, and others were too small to be viable. A much more typical number would be three to five tadpoles carried to water and cared for by the female.

The tadpoles may be observed if one is persistent, however they can be quite elusive, and seem to disappear into the depths of the bromeliad at the slightest disturbance. The slant front tank design makes observing the tadpoles much easier. As the tadpoles' hind legs become fully developed, the skin begins to take on the color of the eventual frog. Next, the front legs erupt, and the tail is absorbed. There is a moderate incidence of "spindly leg syndrome"(SLS) in the froglets which emerge here. Spindly leg syndrome appears in a variety of frog species, and is characterized by thin, rigid useless front legs. The condition is irreversible, and fatal. While there are some specific causes, this syndromes' exact causes are not known in many cases. The health of the adult frogs, and the frequency with which food is offered to the adults during the tadpoles development seem to be factors in this problem, at least as far as *Dendrobates pumilio* is concerned.

Development seems to take about forty five days from the time the tadpoles are transported to the water, until they emerge.

When there is a distinct cycle in the tank, and several froglets will emerge over a few days. Just prior to the emergence of the froglets, the parents will often begin to court again. During the period the female is feeding the tadpoles, there is generally no breeding. The male still spends several hours a day calling, but no eggs are laid. *Finding eggs in the tank after not seeing any for six weeks is a good reason to begin looking closely* for tiny froglets.

The froglets will first be seen lurking at the water line in their little pond, and at this point they often still have their tail. After a few days of lingering close to their home, the froglet will leave the bromeliad, and begin exploring the tank.

One note is worth making here: the bromeliads often have a fairly short life span, either due to their life cycle, or in some cases due to poor light. It is a good idea to check the bromeliads from time to time. For example if a bromeliad which is beginning to go bad has tadpoles deposited in it, then as the bromeliad goes bad, the tadpoles will die from the waste produced by the rotting bromeliad. The best time to check the bromeliads is after a group of froglets has emerged. The bromeliads also benefit from a wash, so they are dumped into a plastic container, and rinsed under tap water. If the bromeliad shows any sign of rot, then it is discarded. If by some chance there are tadpoles in the bromeliad, then they are put back into the bromeliad, which is then replaced in the tank, in the same place it was removed from. While there would seem to be some risk that the female might abandon the tadpoles in a case like this, I have observed froglets emerging from bromeliads which had been disturbed in this manner. In some cases I have even replaced the old bromeliad with a new one, and placed the tadpoles in the new bromeliad, without inducing the female to abandon the tadpole.

Offspring Care

The froglets are captured and placed in similar boxes to the quarantine boxes described earlier. Some keepers have left the frogs in the tank with the parents, and that has happened on occasion here, but in general I prefer to have better control over the feeding of the froglets. As many as three froglets, all siblings, might be set up in a single box. However, over time it has become apparent that the best results are obtained by housing the froglets individually. The main hurdle in raising the tiny frogs to adulthood is providing a good supply of appropriate food. The froglets are too small in most cases to eat any but the tiniest of foods. Three foods are used here, the primary one being freshly hatched crickets. Another food item is a tiny wasp, (*Trichogramma nitripennis*) which are fly parasites cultured for fly control. These are offered in the form of parasitized fly pupae, and may be obtained from some biological supply houses. These are first allowed to emerge from the fly pupae, and then fed to the frogs. The third commonly offered food item is an arthropod which is obtained from the cage furniture of my leopard gecko breeding colonies. This is primarily composed of springtails, (order Collembela), and other tiny leaf litter dwellers. There is a range in sizes of the offspring, and the smallest seem to have a low survival rate here. The middle sized to large froglets put on size fairly quickly, and within a couple of weeks or less may be able to eat fruit flies.

At this point the husbandry is fairly simple, the frogs are fed daily to every other day with both fruit flies and small crickets, all dusted with Rep-Cal brand calcium supplement and Herptivite vitamin supplement at each feeding. Once or twice a week paprika is added to this mix. In the past froglets of the red forms, which always emerged brightly colored, would fade to a very pale color by a year of age. The paprika seems to eliminate this problem. This supplementation is continued throughout the frog's life.

The frogs grow rapidly, with some males calling by four months of age. At this age the frogs are not at full adult size, generally about half the size of adults. Offspring may begin to reproduce at six to eight months of age.

Problems and Challenges

Several areas are of interest, and will continue to be explored here at my facility. Some frogs seem to be interested in breeding year round, without taking a break. Other frogs seem to cease reproduction during the winter here, or after producing a few groups of offspring. Getting these pairs to begin reproducing again is sometimes difficult. Also, captive-produced females seem less inclined to reproduce than healthy acclimated wild-caught individuals.

Study and experiments involving manipulating the misting, feeding and other environmental factors which affect the frogs captive care are planned for the future, and hopefully these will allow a more complete understanding of the reproductive biology of *Dendrobates pumilio.*

Recommended Reading

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CROCODILIANS: FACT VS. FICTION

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This is a discussion of crocodilian behaviors witnessed at the St. Augustine Alligator Farm. There are four specific topics within the talk:

Crocodilians have the ability to swallow prey under water: We have witnessed *Crocodylus johnsoni, Crocodylus porosus,* and *Tomistoma schlegelii* swallowing their food without coming to the surface.

Crocodilians eating their vegetables: Is it possible that biologists have been assuming too much when doing stomach content surveys on crocodilians? We have compelling evidence that alligators in captivity, at least, may seek out vegetation in their diet.

Siamese Crocodiles as parents: A two-year account of a pair of *Crocodylus siamensis* raising young on exhibit at the St. Augustine Alligator Farm.

Crocodilians feeding their young?: Observations of *Crocodylus siamensis* allowing her young to feed from a piece of meat in her mouth.

INTRODUCTION

The St. Augustine Alligator Farm has been in existence for almost 110 years. It is not a true alligator farm. There is no production of skins or meat at the facility, and there never has been. It is a zoological park, accredited with the American Zoo and Aquarium Association (AZA). The facility started in 1893 by displaying American Alligators, *Alligator mississippiensis*. It has now grown to include other reptiles, birds, small primates, and the world's only complete collection of all 23 species of crocodilians. The following are four accounts of observations of crocodilian behavior that tend to go against the current literature or common thought.

Crocodilians have the ability to swallow prey under water: The palatal valve, in the back of a crocodilian's mouth, is a unique adaptation that seals the throat off from both air and water. With the palatal valve shut a crocodilian can grasp food underwater and not have the water flood past into the esophagus or glottis. Essentially the inside of a crocodilian's mouth is outside its body. Crocodilians obviously prefer to keep this palatal valve closed while submerged, and come to the surface to swallow their prey. It is often assumed that crocodilians are unable to swallow food underwater, because of the overwhelming flood of water that would flow into their body. However, we have witnessed three species of crocodilian swallowing their food underwater. The first is a female Freshwater crocodile, *Crocodylus johnsoni,* housed alone. On several occasions she has picked up pieces of meat from the bottom of the pool and proceeded to eat them without surfacing.

The second observation is of a female saltwater crocodile, *Crocodylus porosus*, housed with its mate. This female swallows both above the water and below, seeming to not have any preference for one over the other.

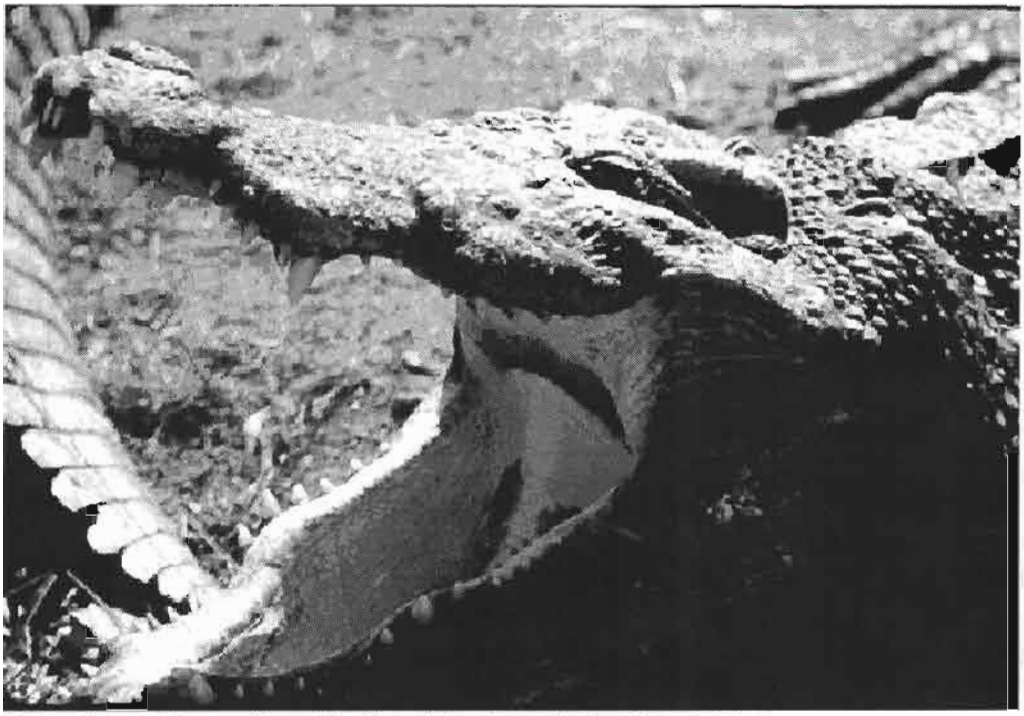

Figure 1: Male Siamese Crocodile, *Crocodylus siamensis*, showing palatal valve.

The most convincing observation has been a female false gavial, *Tomistoma schlegelii*. She is currently housed in a large exhibit with another female and a male. This exhibit affords visitors a complete underwater view of the entire pool though four glass panels. Soon after moving the female to this exhibit, I witnessed her taking a piece of meat to the bottom of the pool and holding it. After about five minutes, she very deliberately partially opened her mouth, then opened her palatal valve, and quickly moved her head forward and swallowed the meat. She remained in a resting position on the bottom of the pool for another ten minutes. Since she had recently come to us from Audubon zoo, I called the reptile staff there and asked if they had witnessed this behavior. They said that they had. Apparently the male *Tomistoma* at this facility was in the habit of stealing her food if she surfaced with it. I have witnessed her swallowing underwater on one other occasion. I believe the behavior is being extinguished by our training efforts, as our male does not have an opportunity to steal meat from the females.

Crocodilians eating their vegetables: Scientific literature is filled with research regarding the stomach contents of crocodilians. Almost all of them refer to the plant material found in the animals' stomachs as either an accident (i.e., the crocodilian got leaves in its mouth while trying to swallow a prey item), or secondary (i.e., the crocodilian swallowed a prey item that had grass or leaves in its stomach). One such article lists plants as a "nonfood item", but notes that the plants were found in ninety percent of the animals sampled. In the summer of 2000, some of our keepers said that they had been seeing American alligators eating fruit from the elderberry plants in the swamp exhibit. Of course I wanted to blame this on the fact that the alligator must have seen an anole or some other animal in the plants and lunged for it. The keepers were fairly persistent, saying that the alligator had gotten a mouth full of elderberry, swallowed, and then gone back for more. Reports of the alligators eating elderberry as well as wild grape from plants in the swamp exhibit happened several more times that year and have continued over the following years.

In May of 2001, we began a mixed species exhibit which includes: American alligators, Chinese alligators (*Alligator sinensis*), brown caiman (*Caiman crocodilus*), dwarf caiman (*Paleosuchus palpebrosus*), dwarf crocodiles (*Osteolaemus tetraspis*), mugger crocodiles (*Crocodylus palustris*), *and* red-foot tortoises, (*Geochelone carbonaria*). The keepers reported observing American and Chinese alligators eating out of the tortoises' dishes. Again, I was inclined to explain this away by saying that the alligators must have been

attracted to the food dishes by the movement of the tortoises, and just accidentally eaten some lettuce. However, it is now a common sight to see the alligators at the tortoise bowls eating romaine lettuce and yellow squash. Sometimes the alligators even beat the tortoises to the dishes. We have had plenty of opportunity to record this behavior on videotape.

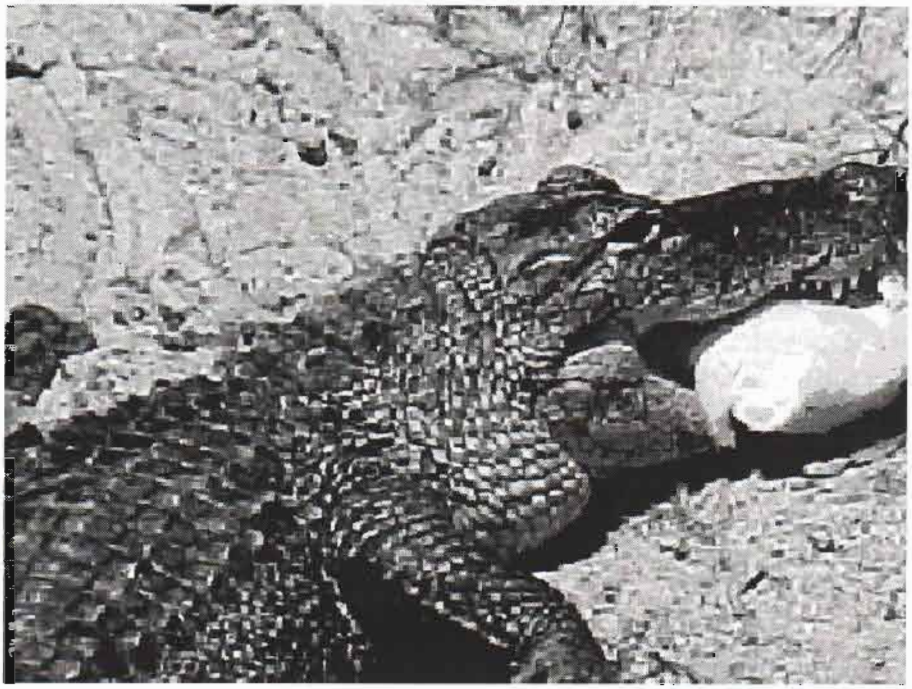

Figure 2: American Alligator, *Alligator mississippiensis* eating a lemon from a tree in its exhibit.

There are several citrus trees in this mixed species exhibit. Occasionally, we have witnessed alligators running around with an orange or lemon in their mouth, trying to keep it away from the other animals. It eventually gets chewed up or torn by other animals and swallowed. In March of this year, we watched as an American alligator raised itself into the lower parts of a small kumquat tree and grabbed fruit directly from the tree. In the course of a few minutes, we observed this same individual swallowing the fruit and going back for more.

We are not exactly sure why alligators in our park are eating their vegetables. It is possible that our animals, in captivity, are lacking something in their diet that makes them seek out vegetation. Or, is it possible that crocodilians deliberately consume vegetation as part of their normal diet?

Siamese Crocodiles as parents: In May of 2000 the St. Augustine Alligator Farm decided to do things a little differently. Typically, when the alligators or crocodiles lay eggs the keepers collect the eggs and put them in an incubator. There are several reasons for this. The success rate of artificially incubated eggs is usually higher, the sex of the animals can be controlled by the temperature at which they are incubated, and it keeps the larger animals in the enclosure from eating the hatchlings.

Though mother alligators are usually very good parents, some literature implies that male American Alligators tend to be unconcerned with their offspring, or worse yet, have been known to eat the hatchlings. This may be due to multiple paternity. It is possible the males don't even know which hatchlings are theirs.

Information about American Alligator behavior is fairly well-documented, but the same information for crocodile species is often a complete unknown.

Sometimes we assume that alligators and crocodiles, or even different species of crocodiles, have the same habits and behaviors. However, our recent experience with a pair of Siamese Crocodiles has opened our eyes to Siamese crocodile parenting.

On May 21, 2000 our female Siamese crocodile built a beautiful nest right in the front of her exhibit. We decided to leave the nest alone for all of the visitors to see. We had no idea what would happen. There were

any number of things that could have gone wrong. The nest could have been too dry, fire ants could have claimed the eggs, or the male could have eaten all of the young as they came out of the nest. We just had to wait patiently. It turns out the nest was built over a sprinkler head which kept the inside of the nest quite moist. Ants were seen several times at the nest, but were controlled. And when it came time to prove the male's intentions, he performed admirably.

Figure 3: Male Siamese Crocodile, *Crocodylus siamensis*, allowing the young to bask with him.

We are unsure exactly when the female actually laid the eggs in the nest mound. One week after the mound was built, we gently opened the top of the nest and removed the top three eggs. They were nicely banded and we put them in our incubator, just to make sure some of the clutch would survive.

At 7:30 am, on August 13, 2000, the female was seen lying on the nest mound with her head cocked sideways appearing as though she were listening to the nest. By 8:30 am eight hatchlings were out of the nest and eggshells were noticed floating, or laying on the bottom of the pool. As we watched, the female slowly used her front legs to pull dirt away from the top of the nest. When she uncovered a hatchling, she gently picked it up in her mouth and carried it to the water. If she uncovered an egg that was not yet hatched, she gently broke the egg with her mouth, scooped up the baby and again carried it to the water. Sometimes the hatchlings were still attached to the egg by their yolk and both baby and egg would be carried to the water. One little guy had quite a struggle as the egg he was attached to started to fill up with water and began to drag him under. He was pulled partly under water before he managed to wiggle his way free.

By 12:30pm the female got out of the pool and started to bask. There were seventeen hatchlings all huddled together at the edge of the pool, and it was assumed that this would be all that would hatch. But, at 2:45 the female returned to the nest and removed four more hatchlings.

The adult male stayed in the water during this entire process, and was quite curious as the female brought the babies to the pool. He swam over to almost every new release and watched as things went on. He never made an aggressive move toward any of the hatchlings.

On several occasions the female brought whole, unopened eggs to the water and released them. The eggs floated, and she left them, with no apparent interest in their future. The adult male bumped into one of these eggs as he was patrolling the pool. He gently picked it up in his mouth. At first, it looked as though he swallowed it, but he rolled it around on his tongue for almost a minute, and then gently broke it open. He then rinsed the shell out of his mouth, but the egg was infertile. There is no way of knowing for sure, but it

appeared that he was trying to open the egg and release a baby, just as the female had done. After opening the first egg, he seemed to patrol the pool more diligently, even diving to the bottom of the pool and gently breaking open what was left of hatched eggs. The male never went to the nest to retrieve eggs or young, but did open several of these infertile eggs. His basking site is near the nest mound, and twice during the day he crawled out and basked near the nest.

One week after hatching, the baby crocodiles started chasing and eating crickets and mealworms that were tossed into the exhibit. They are fed worms, crickets, and gator chow every two or three days. On August 25, 2000, twelve days after hatching, many of the babies were seen basking on the back of the parent crocodiles. This has been a common sight on warm afternoons ever since. When in the water, babies tend to congregate around the parents' heads, some even resting on the adults' heads as if they were a floating island.

The goal of leaving the nest alone was to allow our visitors be able to see the nest, the hatching, and now a family unit of crocodilians on display. It has been a great success. Visitors who take the time to look carefully can see many of the baby crocodiles usually, lined up at the edge of the pool. This is not the first time that the St. Augustine Alligator Farm has hatched Siamese Crocodiles, but it is the first time that we have allowed the parents to do all of the work. The three eggs that we put in the incubator from the nest hatched three days after the eggs in the exhibit hatched. We have since introduced these three babies back to the exhibit and they have been accepted into the family unit.

As long as we had this unique setup, we decided to try a couple of experiments. First, three yearling crocodiles were added to the exhibit to see how the parents reacted. These yearling crocodiles were offspring from the adults, but had never seen their parents, as they were artificially incubated and raised separate from the adults. The adults accepted these juveniles in the exhibit as well, and all are living comfortably together.

Secondly, we introduced a couple of American alligator hatchlings. This introduction was very interesting as well. The alligators did not seem to mind being with the crocodiles their own size, but were intimidated by the adults. While the juvenile Siamese crocodiles would congregate around the adults (even the yearlings), the juvenile alligators would swim away from them. Early on, there were several occasions that the alligators were seen around the adult crocodiles, but the alligators seemed shocked when the adults moved, and they swam away quickly. This test was performed to see if the parent crocodiles could distinguish between hatchling species. It is generally accepted that some crocodilian species will guard their offspring in nurseries. In other words, one female may guard offspring from several females in the area. One of the hatchling alligators did not survive in the exhibit. It appeared to have been accidentally crushed by a basking adult. However, one American alligator can still be seen, almost two years later, swimming, feeding, and basking with its surrogate family.

Crocodilians feeding their young?: More and more we are realizing how closely birds and crocodilians are related. They have many similar adaptations and behaviors. However, one distinct difference is that crocodilians do not seem to feed their young. Unlike most birds, hatchling crocodiles are ready to feed on their own soon after hatching. In spite of this, there have been occasional observations that may suggest otherwise.

Mulherny, in his 1935 book, claimed to have seen American Alligators feeding their young on eight different occasions. A private individual in Florida claims to have seen his broad-snouted caiman, *Caiman latirostris*, tearing pieces of meat from a large feeder rat and feeding the smaller pieces to their hatchlings. Blom, in 1982, said that he witnessed an adult Orinoco crocodile, *Crocodylus intermedius*, offering food to hatchling animals.

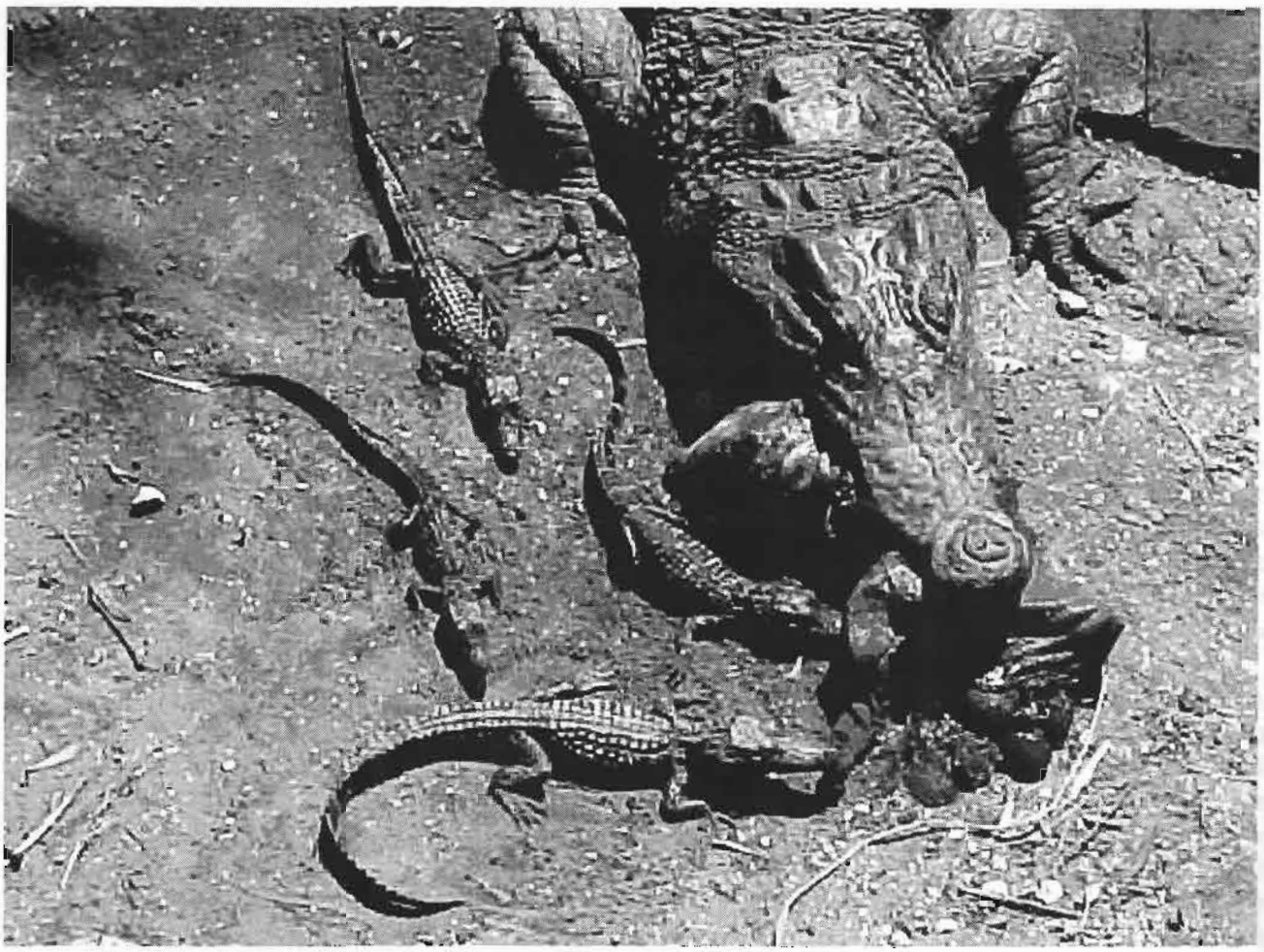

Figure 4: Female Siamese Crocodile, *Crocodylus siamensis,* allowing her young and one adopted American Alligator, *Alligator mississippiensis,* (closest to the adult) to eat some of her meal.

On two occasions we have witnessed our adult female Siamese crocodile allowing her hatchlings to eat meat from her mouth. This has only happened twice in almost two years, and did not occur until the hatchlings were more than a year old. The adult Siamese crocodiles are shifted off exhibit when they are fed. This gives the keepers a chance to count the hatchlings, clean the exhibit, and trim the plants. Both adults usually swallow their food almost immediately. However, on these two occasions the female still had a large piece of nutria in her mouth when she was released from the shift cage. The female sat for more than an hour with the meat protruding out of her mouth, allowing the hatchlings to tear off small pieces of meat. The adult male attempted to take the meat away from the female, but she just got up and walked away. Once, she even got in the pool to avoid the male's attempts, but she crawled right back on the bank and held the meat in her jaws until the hatchlings began feeding again.

Many people have read my account of this event, and there are many skeptics that think I might be exaggerating what I saw. However, once they see the event captured on video, there is no doubt that the female allowed the hatchlings to feed from the meat in her mouth. I do not pretend to know what this means. I am not assuming that all crocodilians feed their young, or even that this particular female intended to feed her young. I can only say that she did not mind the hatchlings eating her meal. It is entirely possible that she was just not hungry, and decided to hold the meat for later.

The adult male in this exhibit has been a great father to the hatchlings; he is protective and cautious around them. He is also very food motivated and has never been seen attempting to share his meals with the

hatchlings. In addition to attempting to steal meals from the female, I have even seen him try to take the occasional large piece of meat from the hatchlings. He is very gentle about it; trying to only get a hold of the meat without touching a hatchling, even to the point of quickly pulling his head back if a hatchling was accidentally in the way. To prove his good intentions, I have seen him basking with his mouth open just after eating. Hatchlings have crawled in his mouth looking for the meat that they can still smell. One even tried to bite his tongue. The male is very patient, but really does not like the young crocodiles in his mouth, and he gently turns his head and shakes them out.

CONCLUSION

Crocodilian behavior is often overlooked because we tend to think of them as prehistoric, and therefore too primitive to have complicated behavior. We have also been quick to dismiss all of a particular author's writings, because they were not completely accurate in everything they wrote. I am not the first to suggest that crocodilians swallow under water or that they may feed their young, but other authors have often been ignored because of errors elsewhere in their observations or because so few others have witnessed these behaviors for themselves. It is my assertion that crocodilian behavior deserves a more in depth look, as I am confident they have much more to teach us.

ACKNOWLEDGMENTS

I am very grateful to the animal staff at the St. Augustine Alligator Farm for being so observant. This paper is made up of observations that could have very easily been overlooked if it were not for their diligence and dedication. Thanks to the Reptile department: Shannon Chapman, Jim Darlington, David Kledzik, Thomas Kenrod, and Shelly Triplett. I would also like to thank David Drysdale for his continued support of our efforts. Lastly, I would like to thank my mentor, Dr. Kent Vliet for his knowledge, insight, and encouragement.

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Adenovirus in Bearded Dragons (*Pogona vitticeps)*

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ABSTRACT

Little is known about the pathogenesis of adenovirus in the bearded dragon. Like other viral diseases in reptiles, adenoviral infection is difficult to diagnose ante mortem (before death). A better understanding of the disease process and its detection is necessary if we are to treat the animals affected with the virus and prevent this virus from spreading throughout the captive population. This discussion will examine the clinical presentation of the affected patient and my work on determining viral presence ante mortem, as well as understanding its pathogenesis. Detecting the presence of the virus is important, but preventing its spread is essential. By understanding the pathogenesis we can better accomplish this. Originally, it was believed that the virus was passed vertically. More recently, some have proposed that the fecal-oral route or an intermediate host passes on the virus. The goal of my work is to help better define this process

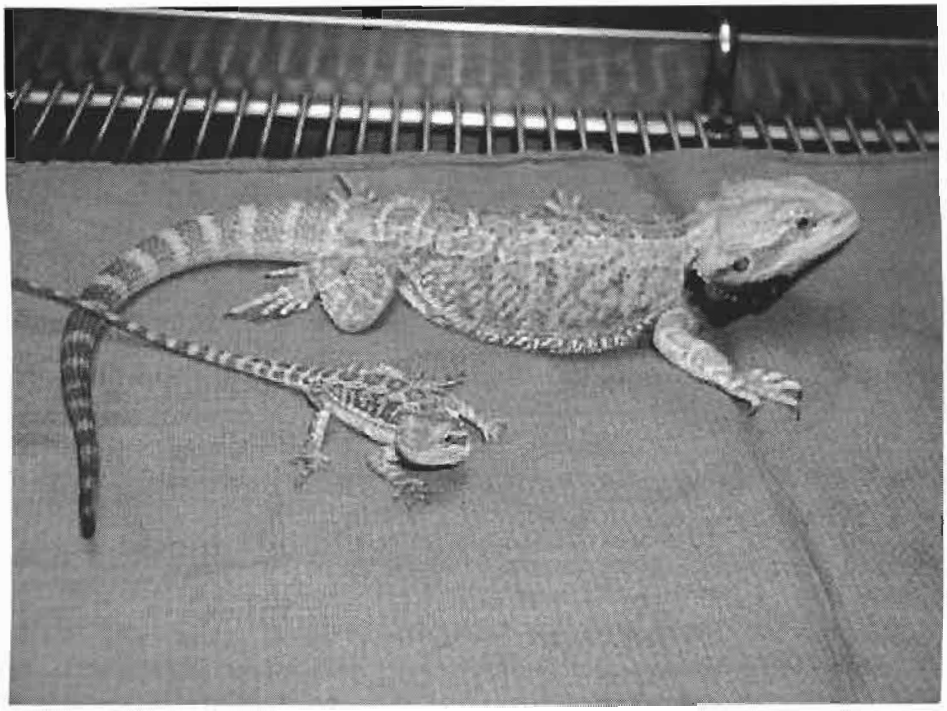
It is sometimes difficult to differentiate virally infected animals from animals suffering from calcium deficiency or coccidiosis. Fecal examination can rule out coccidiosis, and a thorough review of husbandry can rule out calcium deficiency. Diagnosis becomes complicated when multiple disorders are present at the same time. While there are no specific signs of adenovirus infection, a good history, physical exam and fecal can yield some strong suspicions. Detection of viral presence in the patient while alive would be a useful tool for the veterinarian.

Ante mortem and postmortem histopathology and electron microscopy were performed on tissues taken from three symptomatic clutches of dragons including the mother. Tissue samples were collected on random animals from ages one-day-old to one-year-old and the mother. Electron microscopy was also performed on fresh stool samples from this population. A review of these findings will be presented.

INTRODUCTION

Since their introduction into the USA pet trade in the early 80's, the Inland Bearded Dragon (*Pogona vitticeps)* has grown in popularity and is now estimated to outnumber the green iguana. It is the most popular reptile species kept as a pet in the United States and it is estimated that over 500,000 captive bred babies are produced each year in the USA. Adenovirus is a relatively new disease. The first reported case in the USA inland bearded dragon (*Pogona vitticeps)* was in 1996. There have been only 3 reported cases of adenovirus in bearded dragons. The first was by Julian, A. & Durham, and P. 1990 in a female *Amphibolurus barbatus* at the Auckland Zoological Park in Australia. The second was by Frye, F. et. al. 1994 in Rankin's Dragons (*Pogona henrylawsoni*) at a private breeder in Illinois, USA. The third was Jacobson, E. et. al. 1996 in *Pogona vitticeps* with animals from Iowa and California USA mentioned. My first case was in 1997 in a clutch of one month old *Pogona vitticeps* from Illinois USA. Since that time there have been many cases

diagnosed all over the country. An exponential increase in the cases in the past three years has been noted. Because to this point we have only been able to detect this disease after death using postmortem pathology, little is known about the pathogenesis of the adenovirus in the bearded dragon. My work has focused on detecting the virus in the live animal and getting a better understanding of its pathogenesis.



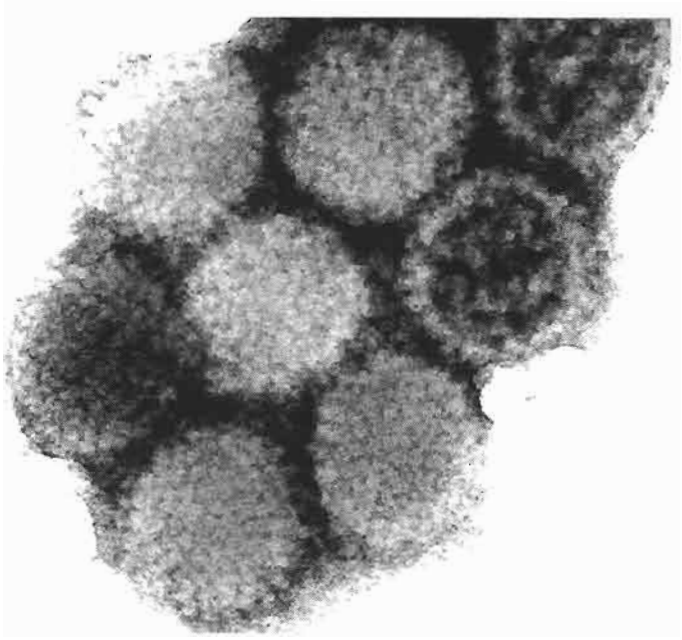
This photo shows two dragons that are clutch mates and show how growth is retarded in some animals and not in others. Both dragons have the virus.

DISCUSSION

Accurate diagnosis is the key to containing this disease's spread throughout the entire population of bearded dragons. History, physical exam, histopathology, fecal stool exam, and fecal stool EM negative staining are the tools I use to diagnose the presence of adenovirus.

History and **physical exam** are essential in identifying potentially affected animals. This disease presents itself differently in different age groups. The age groups can be divided into three ranges, 0 to 4 weeks, 5 weeks to 12 weeks, and greater than 13 weeks. In all groups it is essential to determine if proper husbandry is utilized. It is important to determine if proper UVB lighting, day and night temperature, diet, and supplementation are being provided. In cases where there are husbandry short-falls, they should be corrected and the animals reassessed in 4 weeks. Parasitism should be eliminated by running a fecal floatation on all suspect animals. Clutches that incubate normally but have poor hatchability or have more than 10% death before 4 weeks should be suspect. Affected animals that are between 5 weeks and 12 weeks may appear week, have diarrhea, poor appetite, failure to thrive, have seizures and death. Dragons over 12 weeks that grow at a slower rate than expected while appearing normal in all other ways should be suspect. If two or more clutchmates are kept together and one is much smaller, suspicion should be high. Also, some animals can carry the adenovirus and have no clinical signs. These are the hardest to identify. If any animals are determined to have the virus, their parents should be suspected to be carriers and proper tests for viral presence should be done.

Histopathology and **fecal stool exam** can be run either ante mortem or postmortem. The virus has been found in all types of tissue but is consistently found only the liver and small intestine. The problem with these tissues is that they are not always positive in affected animals. An ante mortem liver biopsy can be collected safely by an experienced reptile veterinarian. However, negative liver biopsies can occur in affected animals. Post mortem, liver and small intestine samples should be collected at a minimum, but all other tissues should also be taken. Intestinal parasitism with pinworms, Coccidia or bacterial overgrowth can mimic the viral disease. In some cases, both intestinal parasitism and virus are present. It is essential the run a fecal stool exam on all suspected cases, and if parasitism is detected administer proper treatment. Parasit-



Adeno Virus in the stool of a Bearded Dragon. Imaged by Negative fecal staining on an electron microscope.

mal animals should be then be re-evaluated in 4 weeks for proper growth. If growth is still retarded, further tests should be run.

Fecal EM **Negative Staining** is where I have concentrated my work. Feces are placed in a special fixative and sent to a university that has an electron microscope where the virus particles can be detected in the sample. In 100% of affected animals, this test has been positive and 100% of unaffected samples have tested negative. After a number of trials using known virally infected feces, it has been determined that the stool sample must be put in the fixative within 90 minutes of being voided. After that time, the test is less accurate. If it is not possible to submit the sample within that time, the sample can be frozen and later thawed and fixed. Known positive samples that have been frozen for up to 46 days have had 100% positive results. The importance of this work is that this test can be run ante mortem and without the risk of anesthesia or surgery and is much less costly.

Little is known about the pathogenesis of adenovirus in the bearded dragon. Possible modes of transmission are vertical, fecal-oral, and through an intermediate host. Vertical transmission is when the virus is passed directly from the parents to the offspring. In order to test this method, two virally positive symptomatic normal size adults were bred together. The eggs were laid in a 50% play sand and 50% coconut fiber mixture sterilized by autoclave and mixed with distilled water. The mother's ventral surface was washed daily with Lemon Quat (a viracidal disinfectant) for the last week prior to laying the eggs. The eggs where then incubated in the sterilized coconut fiber moistened with distilled water and incubated at 84 degrees Fahrenheit until hatching. The hatchlings were then put into a new 10 gallon glass tank that was disinfected with the Lemon Quat and lined with sterilized surgical drapes. They were fed Rep-Cal juvenile bearded dragon pellets moistened with distilled water. At 4 weeks old freshly voided stool was submitted for fecal EM negative staining. All of the hatchlings were positive for adenovirus. These results show that the virus is transmitted from mother to offspring. It does not determine if the virus came from the ovaries or from stool as the eggs passed through the cloaca— (the common area that stool, urine and eggs pass through before leaving the body). Surgical removal of the eggs at the time the positive female indicates she is ready to lay should determine the point of infection. If the hatchlings are negative, the virus is acquired from the stool in the cloaca. If they are positive, transmission is from the ovary.

In order to fully understand the pathogenesis of the adenovirus, we must test the other possible modes of transmission. Future work will test the fecal-oral mode by force-feeding virally infected stool to negative animals and running fecal EM negative staining. To test the intermediate host hypothesis, virally infected stool will be fed to crickets and in turn, the crickets will be fed to negative animals which will ultimately be tested with fecal EM negative staining for diagnosis. When these modes are defined, we will have a complete understanding of the pathogenesis of the virus. When we understand the modes of transmission, we can define a plan for prevention.

CONCLUSION

Until we fully understand the pathogenesis of the adenovirus, we should take all the precautions possible to prevent its introduction into our collections or spread to others. For this reason, I recommend following these precautionary steps. Fecal EM test ALL breeder animals. This will allow for clean breedings and production of virally free offspring. Quarantine ALL new introductions until fecal EM tests are run. This will prevent introduction of the virus into your collection. Feed only commercially processed foods. Until it is determined that crickets are not a vector, play it safe. Feeding commercial foods also prevents Bearded Dragons from contracting pinworms and Coccidia. Finally, always maintain proper disinfection and hygiene. Animals that are proven virally free or are the offspring of them should be sold at a premium—this will more than offset the added cost of testing.

The potential for this disease to devastate your collection is high. If it continues to spread throughout the industry, it could ruin the market. For these reasons, ethical considerations should always be considered if an animal is diagnosed with adenovirus. The main question is should any animal suspected of or diagnosed with Adenoviral infection be sold or bred? At this time, this author believes the answer is no. Since many of the asymptomatic carriers can live a long and natural life, they can be kept separate. Precautions must be taken to prevent the accidental spread of the virus if one chooses to keep positive animals.

The Viper

John H. Tashjian

Program for the San Diego Herpetological Society 28 June 01

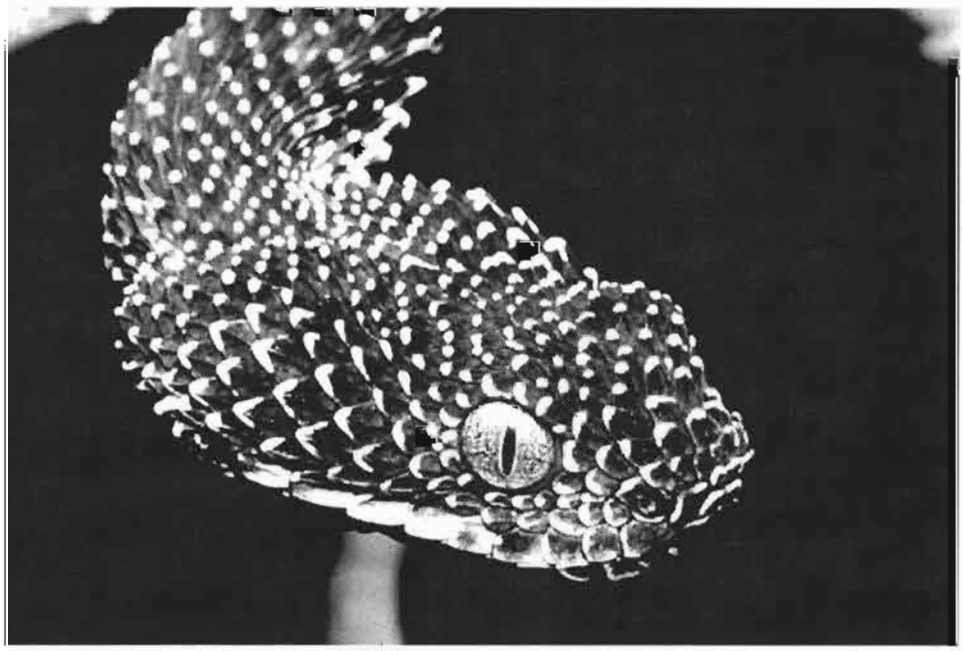
The vipers are a specialized group of snakes that have evolved apparatus and methods to deliver complex agents to their prey for two main purposes. (1) To immobilize; (2) To start digestion immediately inside the prey's body as the snake's stomach fluids will do after the prey is swallowed. Other snakes (Elapids and some Colubrids) and a genus of lizard (Heloderma) can do this also but theirs is a simpler and, in some cases, less efficient method of delivery. Vipers have relatively longer fangs for deeper penetration of their venoms. To accommodate these longer fangs a mechanism has evolved to store them along the roof of the mouth when not in immediate use. To deliver the venom the maxillary bone, which bears the fang, is swung forward so the fang stands perpendicular to the upper jaw, the jaws open wide and the paired fangs stab the victim. The jaws close, pressure is exerted on the venom glands forcing venom through the venom ducts and the hypodermic needlelike fangs deep into the victim.

Venomous snakes that have large fangs that are stored flat against the roof of the mouth when not being used to deliver venom to prey, we call vipers. The vipers are divided into two main groups. One group lacking heatsensing pits has been called "true" vipers or "old world" vipers. As we have seen, all venomous snakes having this particular method of storing long fangs are truly vipers and, as we shall see, many species of pit vipers are also native to the old world so, here, we will call nonpit vipers Basic vipers. Those with heat-sensing pits on the side of the head, between and slightly below the eye and the nostril are called Pit vipers.

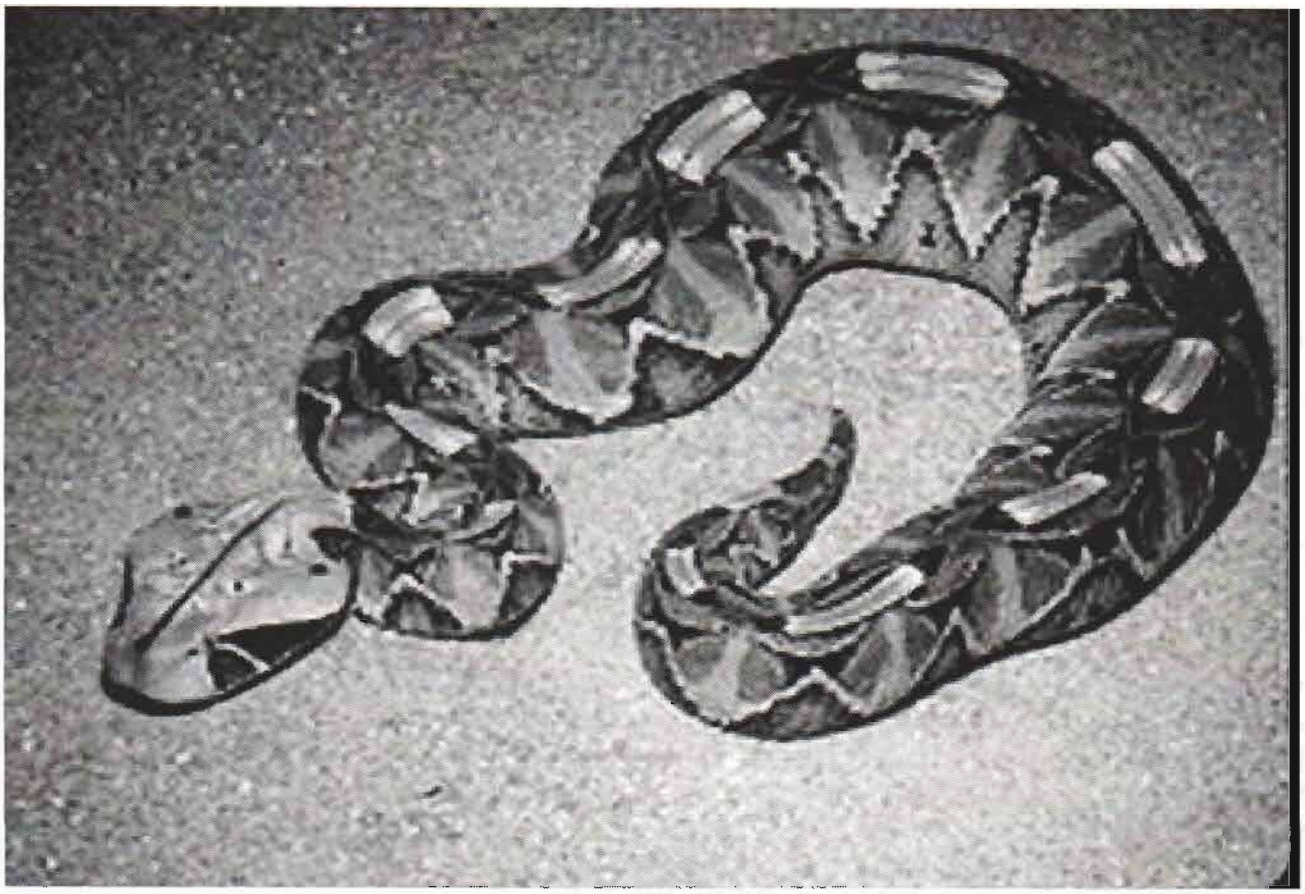
The vipers are found on all continents except Australia and Antarctica.

The Basic Vipers

The basic vipers are native to Eurasia and Africa and are grouped in about a dozen genera. The monotypic genus, said to be the most primitive viper, is represented by *Atheriops feae*, a medium sized species found in southern China and adjacent Burma. The genus Vipera consists of 20 small to medium sized species. Some of the larger species have been split off into the genera Daboia and *Macrovipera*. They are found in Europe, North Africa and the Middle



Atheris desaixi, a rare montane viper from Africa. Photo by John Tashjian.



Bitis gabonica, the Gaboon Viper, a large, robust viper from Africa. Photo by John Tashjian.

East with one species found as far east as Indonesia.

Four genera of sidewinders are small natives of the deserts of North Africa and the Middle East. They are Cerastes with three species found from Mauritania to Iran, *Pseudocerastes* with two species from Sinai to Pakistan, the monotypic *Eristocophis* from southern Afghanistan and adjacent Iran to Pakistan and *Echis* with six species of small vipers with potent venoms found from Senegal to Sri Lanka.

Six species of small frog-eating Night Adders in the genus *Causus* are found in east and central Africa from Ethiopia to the Cape.

Nine species of arboreal bush vipers genus *Atheris* are native to the rain forests of Central Africa from Guinea to Kenya to Malawi. These are all small snakes, usually under 1 meter in length. They correspond roughly to the pit viper genus *Bothriechis* of Central America.

Adenorhinos, a rare, monotypic genus has been found on two mountains in Tanzania.

The Pit Vipers

The 30 species of rattlesnakes, genera *Crotalus* and *Sistrurus* are found throughout the temperate and most of the tropical parts of the western hemisphere. Species may be from $1^1/_2$ ft. to 7 ft. long.

The largest, not the longest but the bulkiest, venomous snake in the world is the monotypic bushmaster, *Lachesis muta* of Central and South America, which grows up; to 12 foot. The 31 species of lanceheads *Bothrops* such as the fer de lance, *B. caribbaeus* and the urutu, *B. alternatus* along with the neotropical rattlesnake *C. durissus are* the next largest venomous snakes of the American tropics. Six genera have, in recent decades been split off from the genus *Bothrops*, some may grow to as much as 6 ft. or a little more. They are mostly terrestrial and occur from Mexico to Argentina. The next largest may be some of the seven species of *Bothriopsis*, some of which may exceed 5 ft. in length. They are rather slender and are at least partially arboreal. The arboreal genus *Bothriechis* includes the eyelash vipers (*B. schlegelii)* and six other small to medium-sized, mostly green species from Mexico, Central America to extreme northern Ecuador. The three species of *Atropoides* are the small, stout "jumping" vipers of southern Mexico and Central America. Eight species of hog-nosed vipers of the genus *Porthidium* occur from Southern Mexico to northern and western South America. They are all small and have a ridge around the top of the snout. The three species of montane pit vipers, genus *Cerrophidian,* are from southern Mexico and northern Central America. The monotypic horned pit viper, *Ophryacus unclulates*, is a semi-arboreal species of southern Mexico that rarely reaches two feet in length.

The Great Basin Rattlesnake, *Crotalus viridis lutosus*, is a species that is variable in color and pattern. Photo by Bill Love.

The *Agkistrodon* complex as designated by Gloyd and Conant (1996) includes 11 species of *Agkistrodon* in the southeastern US, Mexico and across central Asia from the Caspian Sea to Japan. These are generally medium-sized, terrestrial, and, in at least one case (A. *piscivorus)*, semiaquatic. Three other genera, *Hypnale* with three species and two monotypic genera, *Calloselasma* and *Deinagkistrodon* occur in more southerly parts of Asia.

The taxonomy of the 41 species of *Trimeresurus, of* southern and eastern Asia and its offshore islands, has begun to crumble. The first to be separated was *Tropidolaemus,* the temple viper; then *Ovophis*, the egg vipers and, more recently, *Ermia*, a large pit viper from China. The various species of this genus show some strong differences and the genus may be divided to more genera with further study.

Further Reading

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Captive Husbandry and Propagation of Elapid Snakes

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Introduction

I'm a 24 year old Elapid breeder from the Netherlands. I have a part time job as the Head Reptile Keeper of a big cat and reptile reception centre named Pantera. I also give CITES determination and Venomous snake training courses for the Dutch customs service and police. My main specialization is the keeping and breeding of cobras (*Naja*) and mambas *(Dendroaspis)* species. I also keep some other Elapids from Australia and Papua New Guinea.

A Natural Looking Setup

The natural looking terrarium is an important part of the hobby in Europe, with many breeders trying to setup their enclosures like a small piece of nature. To build a cage and make it like a piece of rainforest is not the hardest thing to do. A few things are needed to know before we can start building a natural looking setup for a particular snake. Is the snake a arboreal or terrestrial snake? In what habitat does the snake occur? How large does the snake grow that needs to live in the enclosure?

First we start with the back wall of the enclosure. We have a wide selection of products we can use with which we can create our own back wall, which is much cheaper than purchasing one. We can use chicken wire which we arrange like a rock formation and we can use plaster or cement to cover the chicken wire. After it has dried (usually after 24 hours) we can paint it in the colour we like. I often use on those backgrounds a layer of fluorescent paint, which gives a nice glowing effect after the lights in the enclosures are shut down. As a background we can also use cork or fern root plates which work fantastically when we want to grow sphagnum, Tillandsia, ferns, or another types of vegetation on it. The big problem with these kinds of backgrounds is that it is a good place to grow bacteria and mites. (Cleaning of this kind of backgrounds is not that simple.)

After we have made the background in the enclosure we need to make a choice from a wide variety of substrates we can use. Again we have to look at the species which will live in the enclosure before we choose a substrate. I use many different substrates in all my enclosures.

The desert terrariums are filled with river sand and gravel and my forest and tropical enclosures have a substrate mixture of potting soil, peat, coco bark, and coarse tree bark to give more oxygen to the bottom. This mixture works fantastically because it keeps the humidity stable and feces and other fluids will be absorbed well.

When this is finally done we can make a choice of further decoration. We can use plants (live or fake) which give some colour to the enclosure but also provide the snakes some hiding places. When we use live plants we need to consider a few points:

Is the light enough for the plants to survive?
Can the plants handle the heat in the enclosure?
The snakes that need to be housed in the enclosure are not able to break the plants?
Do the plants need a lot of care (water and food)?

These points need to be considered before we use them. When those points are impossible to do in the enclosure of your choice, you would be better off using artificial plants. They generally cost more but are easy to clean, don't need extra care, are much stronger and when bought in a good quality are hard to distinguish from the real thing. Depending on the snake's habits (terrestrial or arboreal) we can make a choice from of rocks, branches, tree roots/logs, lianas, or other materials that expand the movement space for the snakes. Hide spots can be created with the decoration but we can also make a hide box out of a hollow tree log.

To create a natural-looking setup for snakes. There are many different advantages and disadvantages to consider:

Advantages
More secure surrounding for the snakes
The snakes show a better natural behavior
Better humidity control
Looks better
Less stress for the snakes
More activity for the snakes
More space to move

Disadvantages
Hard to clean
Can be a good host for disease and parasites
Expensive
More space to hide, so the snakes are seen less
More work on the enclosure
Many hide spots for prey items fed alive
More risks when getting the snakes out of their enclosure(s)

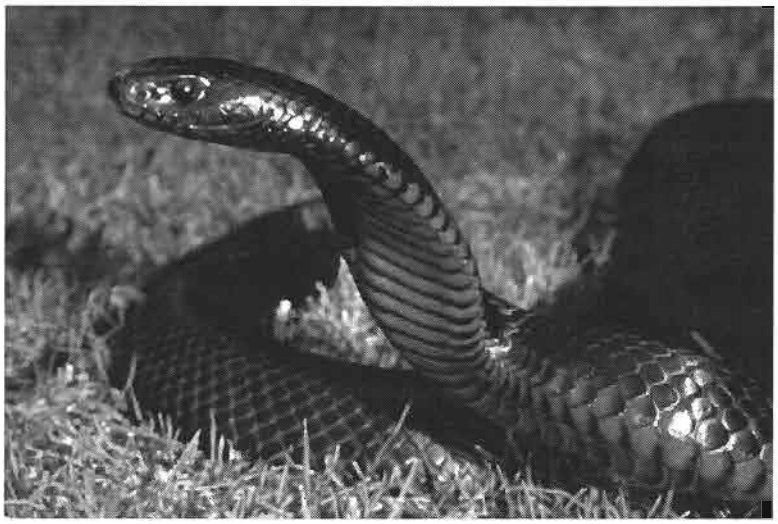
Breeding Elapids

Through the years I have bred many different species of Elapid snakes. Many different ways of breeding them have been tried and provided luck, both good and bad. For several years I have used one way to get my snakes to breed and this works perfectly for me.

I keep my snakes in different types of enclosures. The larger Elapids like the mambas, taipans, and larger cobras are kept in enclosures that measure a size of 175 x 60 x 70 cm (length x wide x height). These enclosures are heated by a 100 watt spotlight and floor heating. Lighting is done with a 120 cm long fluorescent lighting. The smaller Elapids (up to 140 cm) are kept in enclosures of 120 x 50 x. 50 cm and 100 x 50 x 50 cm. These enclosures also have a 75 watt spotlight and floor heating. The spotlight will also provide the light in the enclosure. The smaller Elapids and young snakes (up to 90 cm) are kept in enclosures of 60 x 50 x 50 cm. These small enclosures

The Common Death Adder, *Acanthophis antarcticus*, from Australia. Photo by Bill Love.

are heated by a 40 watt spotlight and the floor is heated by the lights in the cages below. The black mambas live in a enclosure of 175 x 120 x 180 cm. The lighting is done by a 120 cm long fluorescent lights. Heating is by floor heating and two 100 watt spotlights. The average temperature in the snake room is around 25° C. All enclosures are made out of plasticized chip wood, all seams are closed with aquarium silicone sealant so fluids cannot drain into the chip wood.



The Red-bellied Black Snake, *Pseudechis porphyriacus*, is a large venomous species from eastern and southeastern Australia. It gives birth to 10 to 15 live young. Photo by Tell Hicks.

I feed my snakes on a weekly basis and juveniles are fed twice a week. I feed this often because I only like to breed with strong, large adult animals. It has been proven to me over the years that big snakes give stronger eggs and hatchlings. I have seen it many times that people try to breed with under-aged or under-sized snakes. The litters of those snakes are small, not that strong, and juveniles are also born smaller than the average size of my hatchlings. I prefer to feed dead prey items to my snakes but some will not accept dead prey items so I will fed them live prey. I mainly feed dwarf hamsters, rats, and chicks. The snake-eating snakes and Elapids which have a smaller head are fed with mice. Certain species are also fed with freshwater fish.

Around the end of October I start to prepare the species that come out of a colder winter climate (Rinkhals and Cape cobras) for their brumation period. I start with shutting down the floor heating at night and around two weeks later I will do the same in daytime. Also daylight will be gradually changed from 14 hours a day to 8 hours a day over a period of two weeks. This will also mean that they only can heat up under the spotlight for 8 hours a day. The snakes will not be fed anymore in this month of preparing them on the brumation. After one month I will pack the snakes in plastic boxes which I stack in the basement of my house. This brumation period lasts for two and a half months and the temperature in the basement is quite variable, depending on the outside temperature. The temperature will go down from 14° to 18° C depending on the time of the day. After the 2.5 months in the basement, the snakes are moved back to their enclosures and the same ritual will be done the other way around. The first week I don't try to feed the snakes, and I start the second week with the snakes that are actively searching for food. After the snakes have shed for the first time after hibernation they will be put together for mating and then I wait for the eggs. I keep the snakes the whole year together until the next brumation period.

The snakes that are not going into brumation are provided with a sort of rainy season, which I will start in the same period as I start preparing the others for hibernation. I spray the enclosures twice a day once in the morning before the lights go on and once in the early evening a hour before the lights go off. I spray the snakes with hot distilled water. The water has a temperature of 50° C, but will come out of the waterspout at 28° C. Spraying the snakes with hot water protects them against pneumonia or other lung infections. In this period of a fake rainy season I will also play with the temperature. I will cool them down a bit more at night and raise the temperature by day. By doing this I stimulate the snakes to mate.

When I notice that the female snakes come up for a shed prior to laying their eggs I will provide them with a dark plastic box which is filled with a mixture of river sand, cocobark and peat. This mixture is disinfected

by steaming it and heating it in the oven at 250° C for over 120 minutes. After the eggs are laid, the box is removed from the enclosure. All the eggs are given a number and are measured and weighed before being put in the incubator. The incubator I use is a dry incubator. When the humidity level drops, I need to spray the eggs with a spray bottle. The temperature in the incubator varies from 26° to 30° C and the humidity is around 60 to 80%. The wide variation in temperature and humidity is intentional. This is because most of the clutches in the wild also have different weather influences. After 40 days I measure and weigh the eggs again.

When the eggs are hatched the hatchlings placed in separate plastic boxes. The boxes have paper towel for substrate, a little water bowl, and a piece of cork to hide under. The boxes measure 30 x 20 x 15 cm (length x width x height) and are stacked in a rack. For heating I use a heating cable that is placed under the back of the boxes. I feed the hatchlings for the first time after their first shed. Most of my juvenile Asian cobras will only start to eat after a baby mouse is scented with a frog. The Africans will eat most of the time on un-scented mice, except for the Forest cobras *(Naja melanoleuca)* that are fed as juveniles with pieces of fish. Baby kingbrowns *(Pseudechis australis)* and the arboreal mamba species are often fed with common house geckos *(Hemidactylusftenatus)*.

The only two species of live-bearing snakes I keep are the Deathadders (*Acanthophis* ssp.) and the rinkhals spitting cobras *(Hemachatus haemachatus)*. The newborns from these species are first tried to be fed with crickets which most of them will eat. Others need to be force-fed for a while with strips of cow heart. Strips of cow heart will also be used for force-feeding of other specimens that don't want to eat.

From my hatchlings I will always pick out the most beautiful ones to keep in my own collection. All the other hatchlings will go to friends and other collectors.

The Trans-Pecos Region of Texas from A Herper's Perspective

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Trans Pecos literally translates as "across the Pecos", referring to the Pecos River. It is not a specific area but can be expanded or contracted to meet the situation. In this instance it could probably also be called "alterna country" since it was a desire to find these beautiful snakes which initially brought many herpers to the area.

For the purpose of this talk I will include a five county area of West Texas ranging from Val Verde County in the east through the Big Bend and Davis Mountains regions. The combined areas of these counties are [illegible] square miles. As a point of reference, Brewster County alone is 6,204 square miles, which is about the same as Connecticut and Rhode Island combined, and has a population of approximately 11,000. The area is basically the Chihuahuan desert area of Texas. I consider it to start around Del Rio.

The Trans-Pecos is an area with a good selection of herpetofauna. There are, counting subspecies, around forty-four colubrid snakes, one coral snake, one or two copperheads, six rattlesnakes, one salamander, ten turtles, and thirty lizards to be found in the area. Some are commonly seen, some are very difficult to find.

From the Blair's kingsnake, now the gray-banded kingsnake, which brought many herpers to the area in the 60's and 70's. Most of us started out in Val Verde County, especially in the Langtry area. We would hunt from sunset to sunrise, then find a rock cut to shield us from the morning sun and sleep as long as we could. Many of us took our morning ablutions in three small pools of water in the rocks above Eagle's Nest Canyon outside Langtry. Many of us would kill the afternoon in Del Rio, sleeping through a $1.00 matinee or cooling off in San Felipe Springs.

While it may have been the snakes which brought many of us into the area, it was the stark beauty and solitude of the area which kept many of us coming back year after year.

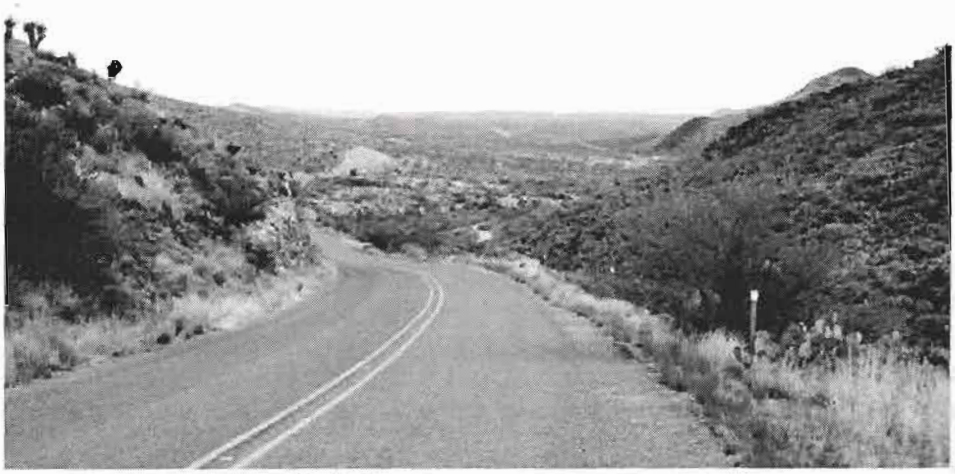
Some species such as the western indigo snake and the Texas tortoise barely range into Val Verde County. The coral snake is found occasionally throughout Val Verde County and slightly into Terrell County to the west.

From Del Rio, the closest good herping area is to the north on Hwy. 277. Here you can find species which are found throughout the entire Trans-Pecos region, such as gray- banded kingsnakes, Trans-Pecos ratsnakes, mottled rock rattlesnakes, blacktail rattlesnakes, western diamondbacks, and Baird's ratsnakes. Eastern blackneck gartersnakes are also found in eastern Val Verde County.

Some herpers prefer to head west to Comstock and then north up Juno Rd. Baker's Crossing on the Devil's River is a nice spot with clear water. The Trans-Pecos copperhead may be found in the eastern part of the county. The Texas horned lizard is also found throughout the area, but in the eastern portion they are getting hard to find, possibly because of the influx of fire ants which are pushing out the harvester ants which are the normal diet of these lizards.

From Alpine we head north on Hwy. 118 into Jeff Davis County and through Musquiz Canyon. This is a good area for *lepidus*, *molossus* and occasionally some other species. Notice that the *lepidus* in the western counties tend to be darker and more varied in color than the ones in the eastern part of the range, where they

are all light gray. North of Musquiz Canyon we level off for a while and arrive in Fort Davis. Going north out of Fort Davis we can go two ways. We can stay on Hwy. 118 and drive up toward the McDonald Observatory, which is situated at 6,880 feet elevation. Or we can head north on Hwy. 17 through Limpia Canyon and then, 25 miles north of Ft. Davis, we can turn onto the Boy Scout Road.



The famous stretch of Black Gap in West Texas. Photo by John Hollister.

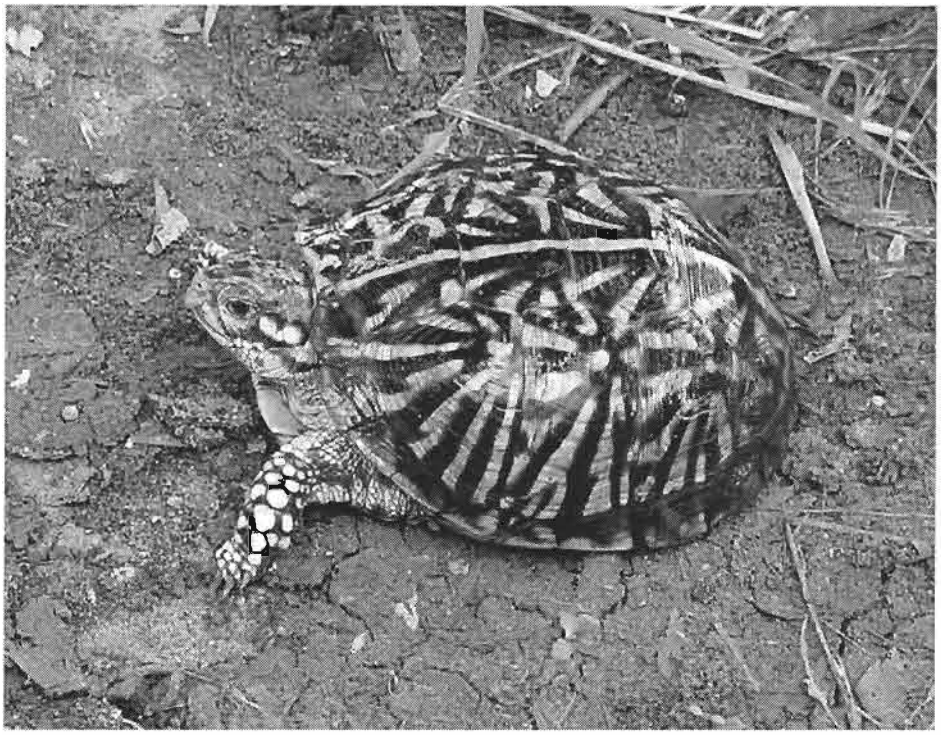
The Boy Scout Road isn't a high production area, but has some interesting snakes. The *alterna* from the Davis Mts. tend to be darker than from other areas and some of the subocs are a nice orangeish color. When there is water in the canyon, I sometimes find western blackneck garter snakes swimming after tadpoles. The canyon tree frog is found in the Davis Mts. and is very common in the Boy Scout Rd. canyon when there have been decent rains. Some of the other animals encountered in the area are the night snakes, regal ringneck snakes, ground snakes, bullsnakes, Great Plains ratsnakes, glossy snakes, and hooknose snakes.

The eastern ornate box turtle is also found throughout the area. In Culberson County it starts getting into the Western subspecies. Texas alligator lizards are also found throughout much of the area into the Big Bend, but are more common from Val Verde county east through the Hill Country. The Rio Grande cooter is found in the drainage of the Rio Grande River to Comstock and then up the Devil's River. It is also found in disjunct areas in the Guadalupe Mountains.

From Sanderson we head west toward Brewster County, The largest county in Texas. The first town is Marathon. From Marathon you can head south toward the Big Bend National Park. Just before reaching the park you can turn left onto Black Gap Rd. This is a nice tranquil road, since the bridge to Mexico has been closed off and the mine at the end is closed. *Alterna*, subocs, longnose and glossy snakes are the most common snakes found here. It is also a good area to find the Big Bend gecko. The elevation drops around 800 feet from the outer end of the road to the Rio Grande. As you can see, the mighty Rio Grande has been turned into a trickle. Following rains, this is also a good area to find the western green toad.

From Black Gap Road you then head south and then west through the Big Bend National Park. On the western side of the park you enter the "twin cities" of Study Butte and Terlingua Terlingua used to be a mercury mining and production town. It is now best known for the great Chili Cookoff. The first "blonde" Trans-Pecos ratsnakes were found just west of Terlingua around the Pepper's Hill area. This is also a good area for some beautiful New Mexico milksnakes. From here we continue to head west on the River Road toward Lajitas. Lajitas was built in the early 80's by Walter Mischer. It can be seen in several movies, including "Young Guns II." A couple years ago it was sold at auction and the new owners hope to turn it into a sort of "Palm Springs at the end of nowhere."

West of Lajitas we cross into Presidio County. The Teepees are a landmark to herpers in the area. They are also a good place to sleep for the night. Just past the Teepees is the Big Hill, a good spot for *lepidus*, *alterna* and *celaenops*. In the eastern counties the blair's morph is the more common form of *alterna*; in the western counties the *alterna* morph is more common. It is a breathtaking view to look down from the Big Hill, a drop of around 800 feet. A snake which is found in the Big Bend area is the banded ground snake. The Texas lyre snake is also found in the area in a narrow band along the Rio Grande. At first glance they can easily be mistaken for an *alterna*.



The striking Desert Box Turtle, *Terrapene ornata luteola*. Photo by John Hollister.

Back into Brewster County, we head north from Terlingua on Hwy. 118 into the Christmas Mountains. This is some beautiful area for a variety of snakes. We continue north to Alpine, elevation around 4,400 feet. It is home to Sul Ross State University, a great school for herpers.

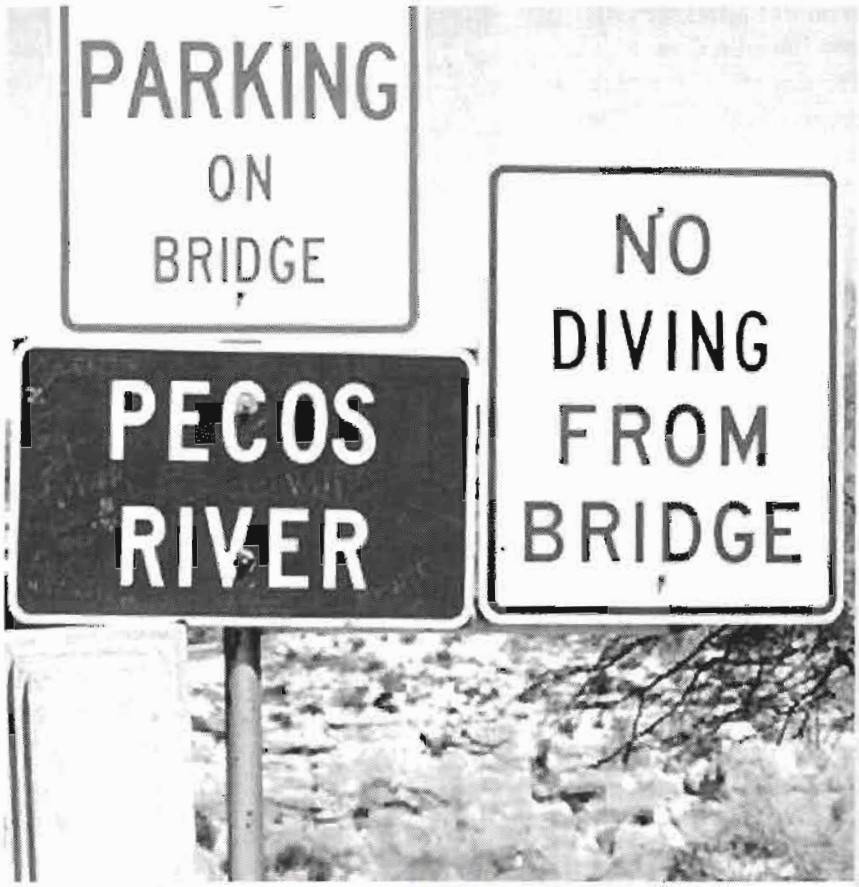
The Mojave rattlesnakes are found from Brewster County west. This southern plains lizard was found between Alpine and Marathon. The round-tailed horned lizard is also found throughout most of the area. Most of them are small and gray, but now and then intergrade with the broad-banded copperheads there. Lane Road I consider the best easterly locality for finding pure *pictigaster*.

Mexican milksnakes are also found in Val Verde county, although not commonly.

We then head west back to Langtry on Hwy. 90. On the way we cross the Pecos River. This used to be a great place to launch a boat and cruise with canyon walls rising around 300 feet. Now it is silted up and is not navigable except by canoe or other small boats. The Pecos River flows into the Rio Grande just south of the highway.

The elevation in Del Rio is around 990 feet. In Langtry it is around 1250 feet. Some herpers will brave the bouncing and dust of Pandale Rd. for some herping. In the late afternoon Mexican hognose snakes can be found here. There are also ornate whipsnakes and bullsnakes to be found, as well as several other species. At the north end of the Pandale road loop is another crossing on the Pecos River. This is a nice area to camp, fish, and swim. However, I've seen a flashflood around thirty feet high come down the river, covering the area where the vehicles are parked.

Heading west on Hwy. 90 we pass through many good rock cuts. These cuts could be considered the land form of artificial reefs, and many reptiles and other animals have made them home. Snakes can be found on rock cuts ranging from a couple feet high to over sixty feet high. About fourteen miles west of Langtry we cross into Terrell County. We go down a long hill toward Lozier Canyon and Palma Draw, which is a good area for *alterna*, Trans-Pecos ratsnakes and Trans-Pecos copperheads. *Alterna* are one of the more commonly found snakes in the area. The Rio Grande leopard frog is found throughout the Trans-Pecos. I am constantly amazed to find them surviving in pools of water which may have been dry for two years or more.



Some signs point to one of the most exciting herp meccas in the United States. Photo by John Hollister.

We then pick up speed and head west through Dryden. About 8.9 miles west of Dryden is the holotype locality for *Lampropeltis blairi*.

West of Dryden we go through some fairly flat area in which the most frequently seen species will be longnose snakes and an occasional desert kingsnake. Both of these species are found throughout the Trans-Pecos.

About ten miles east of Sanderson we get into hillier area with some very good rock cuts. Sanderson is a dying town but has several reasonable motels and 24 hour gas stations. It doesn't have a restaurant I'd call decent. By the time we get to Sanderson we have climbed to around 3,200 feet. About 7 miles north of Sanderson is the Big Hill, a favorite spot of herpers. You can find *alterna*, subocs, *pictigaster* and *lepidus* there. Sanderson is also the more easterly portion of the range for the New Mexico milksnake.

Another interesting snake of the eastern portion is the Devil's River black-headed snake. I have found these ranging from 17 inches to 27.5 inches. Their primary food is the giant centipede, and watching them feeding is an interesting sight. I also have what I believe to be the only captive breeding on this species.

A review of the RSPCA's report on "Morbidity and Mortality in Private Husbandry of Reptiles". A report by Pro Wildlife to the RSPCA May 2001

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What is scientific truth? Academics have debated the issue for decades. It is an argument without end. Some scientists have argued that any quest for truth or objectivity is pointless. In their view conclusions based on scientifically derived data are still no more than an expression of opinion, dependant on the personal perspectives and approach of the authors. If this is the case then we need to know if the opinions, of the authors of a scientific report, are biased towards a particular agenda that is divergent from the generally accepted approximation of the scientific truth. This why peer reviewed reports are generally accepted as the truth. It is vital that if the use of a report's sources are suspected to be tendentious, that is that it is suspected that a report is weighted consistently towards a particular interpretation, and deliberately omitting or distorting data or evidence, which runs counter to a more generally accepted conclusion, those sources are carefully examined. It is important to both understand and accept that there is such a thing as scientific untruth. It is the purpose of this presentation to establish if a recent report calling for the private keeping of reptiles to be seriously restricted is tendentious, and if so, that it's literature sources should be examined in greater detail.

Let us first examine the publishing organization of the report in question, "Morbidity and Mortality in Private Husbandry of Reptiles", a report by Pro Wildlife to the RSPCA. The Royal Society for the Prevention of Cruelty to Animals is a long established UK charity that as its name suggests enjoys royal patronage. It is currently well perceived by the general public in the UK. However the RSPCA is actually three organizations. It is a private law enforcement agency operating under statutory authority, though not accountable like the police to an independent complaints authority, and not controlled by the Human Rights Act 1998, that came into force in the UK on 2nd October 2000. Though there are many complaints, the RSPCA continues to audit itself. It is also a political campaigning organization, on the extreme edge of the politically correct animal rights ideology, allied with the UK government in pursuit of a 'hunting with dogs ban' and more recently with an 'animal bill of rights' (to be enforced by its own unaccountable law enforcement officers). And it is a charity, its original function, collecting public and private money for animal welfare and operating a vast network of shelters, kennels, incinerators, etc, where politically correct criteria decide who can have a stray cat or dog, or which of these animals will live or die. Last year the RSPCA killed and incinerated over 90,000 dogs. This genocide of pets by the RSPCA is under reported. The RSPCA has serious conflicts of interest, yet is self-righteous beyond belief, and staffed by bullies. The political activists control their own police. This is sinister. And these are not simply my personal opinions, they are the publicly published comments of Jonathan Miller, a well respected columnist in the UK's Sunday Times newspaper, the premier UK Sunday newspaper title, that have not been effectively refuted by the RSPCA, despite their attempts to apply pressure to the editor.

Pro Wildlife, the persons commissioned by the RSPCA to produce this report, appears to be a typical animal rights extremist organization based in Munich in Germany. Check out their website www.prowildlife.de, which will confirm this assumption. In the past the RSPCA has commissioned reports from serious academ-

ics from recognized institutions, such as Andrew Smart and Ian Bride, of the Durrell Institute of Conservation Ecology, University of Kent at Canterbury. In 1993 they produced a report titled 'The UK trade in live reptiles and amphibians – a report to the RSPCA on the nature and status of the reptile and amphibian trade between 1980 and 1992'. Interestingly this report, although widely referenced in anti-reptile keeping reports, including the one under consideration, has never been published by the RSPCA, perhaps because its conclusions where in general in favor of the trade, based on the authors research. I have a copy. In particular they criticized many of the quoted scientific papers, which called for a ban on the trade, in their report, on the basis that the data collection methods used included no controls to allow for a considered scientific conclusion, and were simply the authors strongly held opinions masquerading as facts.

The current report under consideration, by Pro Wildlife, considers only the German market. It states that it is a representative study, because Germany imports the most CITES-listed reptile species of any EU country and German reptile publications are considered to be more numerous, though in fact far more are of course published in English. It is therefore not surprising that over 80% of the references used are German. The fact that these are relatively inaccessible to UK or USA herpetologists may or may not have been a consideration. The reason why the RSPCA, a UK organization, commissioned this report on the German reptile trade is therefore open to speculation. One sinister fact is that in their précis of this report, called 'Far from Home', the RSPCA make no mention of the fact that the report is almost exclusively concerned with the reptile keeping in Germany. It is only this précis of their report that the RSPCA has placed into wide circulation.

Having examined the credentials of both the authors and the publisher of this report it is not too speculative to consider that a report produced by these two organizations is likely to be biased away from the median of any generally recognized approximation of the scientific truth. But let us look at the body of the report for further confirmation of this initial conclusion.

The title of the report, "Morbidity and Mortality in Private Husbandry of Reptiles", suggests it is primarily concerned with the premature deaths of captive reptiles due to capture, transport and long-term care. The main thrust of the report is to exploit the provision provided under Article 4.6.c of the European Community's regulation 338/97 concerning reptiles that are listed in Annex B. This Article allows for import restrictions to be imposed of live specimens of Annex B listed species that suffer a high mortality during transport, or in captivity, and are unlikely to survive in captivity for a considerable portion of their potential life-span. The report seeks to encourage the EU to impose many more of these import restrictions, by proving that these problems apply to the majority of the more than 400 species of reptiles listed on Annex B. In addition they conclude that all other reptile species should now also be listed on Annex B, presumably to seek similar import restrictions on all reptiles at some point in the future. To date the EU has only restricted the importation of wild specimens of 17 species of tortoise under Article 4.6.c.

The report considers that transport itself has a strong impact on eventual survivability and that the most important criteria impacting on mortality, during international transport of reptiles, is their condition before transport. References are cited to prove debilitating conditions during collection and holding in the country of origin, but on examination these references are based on anecdotal opinions rather than scientifically collected data. The report does not expend much effort on pre-collection mortality, perhaps because it is not a consideration under Article 4.6.c. If pre-export conditions are so bad then we should expect to see high mortality in transit, as the report concludes, and again references are cited to support that this is what occurs.

However it is quite simple, certainly within the UK, to quickly and accurately establish the level of transit mortality. Simply ask the head of the Animal Reception Centre at Heathrow Airport, Rob Quest, what levels of transit mortality he sees. On a daily basis at the airport, he is responsible for the checking of every single reptile transit shipment, including many for Germany, and every UK import. His estimate, at a meeting that I had with him on 21st June 2002, is that the mortality of reptiles in transit is less than 0.1%. In addition what

mortality in transit he does see is almost invariably a result of the airline freezing the shipment. It is probably safe to assume the same situation is true in other parts of Europe, including Germany, as the international reptile suppliers supply everyone. So perhaps we can assume from the reports own conclusion, that as transit mortality is practically zero, the condition of reptile prior to export must be quite good. In addition because transit mortality is clearly so low we can conclude that not a single additional reptile species should be restricted from import into the EU under Article 4.6.c. because of transit mortality.

If we consider that a wild specimen's most important function in the wild is to successfully replace itself with another reproducing individual, to ensure survival of the species, but not over populate its habitat, perhaps we can conclude that if a species completes the same task in captivity, it can be considered to have lived a considerable portion of its life-span, an thus successfully fulfills the second criteria for consideration for import restrictions under Article 4.6.c. Any species for which private individuals have regularly achieved this situation with an Annex B species should be sufficient reason to reject its consideration for all time from any considered import restrictions.

Exactly 100 species of Annex B reptile are documented in the report as considered to be difficult to breed in captivity. The scientific data referenced in the report needs to be examined carefully, for this 100 species, to determine if this is actually the case and compared with the more comprehensive English language references, to establish the scientific truth of these conclusions. 'Difficult to captive breed' has not proved to be a serious restriction to an enormous number of private reptile keepers, as is well documented in the literature. In fact private breeders are well documented as consistently being more successful than either scientific institutions or zoos, particularly with difficult to breed species. We can, in any case, conclude that 75% of the reptiles listed under Annex B in this report should have no import restrictions directed against them on the basis of this reports own conclusions that they are not listed as difficult to breed in captivity.

The report seeks to establish criteria to assess the suitability of all Annex B reptile species as pets by assigning each to one of four categories.

Category 1. Species not suitable for private husbandry
Category 2. Species suitable only for qualified keepers
Category 3. species conditionally suitable for knowledgeable private individuals
Category 4. Data deficient

The report primarily, but not exclusively, recommends that all species that it classifies as Category 1 and Category 2 should be restricted according to Article 4.6.c. Category 1 species include the chameleons (*Chamaeleonidae*), the larger growing monitors (*Varanus spp.*), and several boids (*Boidae spp.*), crocodilians (*Crocodylia*), venomous reptiles (e.g. *Viperidae, Heloderma spp.*), several *Teiidae,* and certain chelonians.

This is where this report expands its original remit and you could be forgiven for asking why the title was chosen. Perhaps this is the reason why the RSPCA's published précis of the report is titled 'Far from Home'. Incidentally it is only this précis that the RSPCA has widely circulated to politicians and others. The report establishes the following list of criteria that it considers leads to increased morbidity and mortality in captivity.

A. Inhabitants of climates which are difficult to simulate (e.g. deserts, or mountains with widely varying temperatures, rainforests with constant humidity)
B. Special nutritional requirements
C. Seasonal activity patterns
D. Timid species with large flight distance
E. Particularly active species (e.g. agile, digging, swimming, climbing)

F. Large adult size
G. Dangerous species
H. Species with insufficiently known needs (e.g. species is new to trade, rare in captivity, has a wide distribution but specific adaptation to different microclimates
I. 'High transport mortality' or 'poor condition of imported specimens' reported
J. Reported as 'difficult to keep' or with 'high mortality in captivity'
K. Reported as 'difficult to breed'

Let us now consider each of these criteria in turn. The report informs us that it considers that 'Keepers and traders do not always take into account the fact that reptiles of several genera, and within one genus, live in different habitats and have specific climatic requirements', and 'subspecies or populations belonging to one species can be adapted to different environments'. Elsewhere the report seeks import restrictions for data deficient species identified within the same genus, with similar biological requirements, and of similar size potential to a Category 1 or 2 species. It would appear that the authors, on those occasions that suit them, wish to emphasize the similarity of species to encourage import restrictions but then elsewhere dissimilarities are emphasized to indicate husbandry difficulties. Is this what is called a win, win situation?

Captive microclimates for reptiles are in fact widely understood and implemented as even the most cursory glance at the literature will confirm. Today we all have easy access, from the international pet industry, to a multiplicity of equipment to control and achieve almost any climatic conditions that could perceivably ever be required. In particular the desert environment is amongst the most easy to accomplish as is clearly demonstrated by the World's million or more private and commercial individuals successfully maintaining and breeding the Inland Bearded Dragon (*Pogona vitticeps*), a desert species of lizard originally from Australia, over many generations. Today's sophisticated thermostats and heating devices provide for the opportunity to vary temperatures by the simple touch of a few buttons or turn dials. Humidifiers and their control are widely used, particularly for those maintaining and breeding Poison Dart Frogs (*Dendrobatid spp.*). The most successful exponents of this aspect of the hobby are the Dutch and Germans. Interestingly the report also informs us that metabolic bone disease is exacerbated by low humidity. I had always understood that this condition was nutritional rather than climatic. Poor air circulation is reported as one of the main problems in chameleon husbandry. They fail to mention that it is for this reason that specialist screen cages are widely available to house them in.

An interesting, and repeated, method of presenting evidence in this report is illustrated by the following example. '*If the preferred optimum temperature zone is exceeded by only a few degrees a critical level is reached than can be fatal (Kimair 1994; Stallmann 1996). This is illustrated by the digestion process in snakes. If the temperature is too high, decomposition starts in the intestines before digestion can occur. On the other hand, a cold environment brings digestion to a standstill and the food in the intestine starts to rot (D. Schmidt 1995)*'. Note that the middle statements are not supported by references but the leading and following statement both are. Interesting. Let's us generously consider the fact that the use of the term 'intestines', rather than 'stomach', is most likely a corruption by the translator. The use of the terms 'decomposition' and 'rot' in the above statements is really the same process. It is not made clear however in what way we are to accept that this process occurs both if a reptile is too warm or too cold, and we have no references to examine these statements further. It would appear that we are dammed if we keep our snakes too warm and dammed if we keep them too cold. The fact that the concept of thermal gradients is well understood and practiced probably means that we are unlikely to ever find out. This concept of 'damned if we do and damned if we don't' is a recurring technique in these kinds of report.

The report tells us that 'most mistakes in husbandry concern the feeding of reptiles'. We are then told that 'most lizards and snakes are overfed', soon followed by 'In a veterinary clinic..... 15%, that means

almost every sixth lizard, suffered from extreme malnutrition'. We can't get it right can we? The report then goes on to mention 'a case in which adult specimens of *Phelsuma madagascariensis grandis*, which normally feed on insects and plants, were fed only on fruit yoghurt, supplemented with vitamins and minerals, over a period of four years'. Within a four-year period this species could potentially reproduce to several generations, so this proves, based on our previous established criteria, that these lizards are likely 'to survive in captivity for a considerable portion of their potential life-span'. The statement is however presented in the report as a negative rather than a positive statement.

The authors clearly do not understand classic vitamin D_3 deficiency systems as they consider that a 'deficiency of vitamin B leads to immobilization of the hind legs or trembling'.

With regard to seasonal activity patterns the report is only able to provide scant historical references to hibernation problems in the past involving captive tortoises. The most recent of these references is from 1986, sixteen years in the past, when wild tortoise importations where not controlled, and husbandry techniques unrefined, compared to the situation as it is today.

Timid species and flight distance are considered using the Water Dragon, *Physignatus cocincinus*, as the prime example. This is a species that I have kept and bred. It frequently rubs its snout on glass barriers when it has reached sexual maturity; juveniles rarely ever indulge in this behavior. It does not do this as a result of being frightened but rather indulges in this undesirable habit when no one is near simply because it does not then recognize glass as a barrier. It is easily and successfully kept in enclosures without glass barriers. Zoos would do well to learn this simple fact. The references in this report attributed to Clifford Warwick, supporting damage as a result of panic flight from perceived predators, should be discounted on the basis of his publications confusing his opinions with scientific fact. In the RSPCA report by Andrew Smart and Ian Bride, Warwick is criticized for failing to define, in either a qualitative or quantitative form, hyperactive escape behavior. In particular Warwick demonstrates no knowledge of the 'normal' behavior pattern of reptiles in the wild and simply states, from captive observations only, that either escape behavior (hyperactivity) or waiting strategy (hypoactivity) both indicate that the captive reptile is suffering from stress. Another example of dammed if it does and dammed if it doesn't? There is no acknowledgment in the report of the wide availability and use of hides for captive reptiles to reduce stress.

As examples of very active species, a factor we are expected to understand could lead to increased morbidity and mortality, the report informs us that *Bradypodium tavetanum*, a chameleon species, 'will climb across its enclosure throughout the day', and that '*Trachemys scripta*, a freshwater turtle, is a very good swimmer'. Now I'm sure that we all already know that turtles are good swimmers, and probably that tortoises are not. Apparently the RSPCA does not know this. Recently they drowned a pet tortoise believing it to be a turtle!

This report fails to understand the whole strategy of being a reptile. It is to survive and reproduce on relatively little food, compared to mammals and birds, and to expend as little energy as possible on the pursuit of this food. If food is plentiful and mates close at hand the need to range very far and wide is simply removed.

Digging and burrowing species often spend protracted periods of their lives in very close self-imposed confinement. As a result in captivity they frequently thrive better in cages that may appear to be too small, but more accurately simulate such a burrowing existence. Leopard Geckos, *Eublepharis macularius*, and Ball Pythons, *Python regius*, are both good examples that thrive in smaller cages.

Large adult size is considered in some detail with regard to the potential for these species to harm their keepers. Only one example of potential morbidity is cited; that of an Anaconda, *Eunectes murinus*, confiscated from unsuitable housing. The link of large adult size to increased captive morbidity is simply not proven.

The same is true with regard to venomous species, though the report does confirm "that the danger posed by venomous reptiles is generally overestimated'. It then speculates however that keepers may be afraid to properly service these types of reptiles, but provides no scientific data on the subject. Venomoid specimens (those that have had their venom glands removed surgically) are discussed on the basis that they will suffer chronic digestive problems, but the only reference cited is speculative on the subject. My experience of venomoid specimens indicates that they thrive and reproduce as if they where normal. Food digestion is as rapid and uncomplicated as compared to intact specimens. The venomous lizards of the Heloderm family are reported to be able to spit their venom, which was a surprising revelation to me, as I have never known one to ever do this.

Private keepers of reptiles, as with other exotic species, have an almost innate ability to establish the captive needs and breeding criteria of unfamiliar species. As stated previously private keepers are successful with more species in terms of captive care and breeding than any of the world's scientific institutions or zoos. If restrictions on new species in trade are to be made it would be most logical, based on the scientific evidence, to impose these restrictions on zoos, etc, rather than private keepers. Whilst this may seem a radical proposal it is confirmed by the facts, as even a cursory glance at the literature will confirm.

It is interesting that in analyzing this report in detail, and examining the criteria that the authors wish to be considered in establishing which reptiles on Appendix B should have import restrictions imposed upon them, there is virtually no peer reviewed scientific evidence presented that supports any significant morbidity and mortality in captive reptiles. We have a lot of detail concerning how reptiles should be kept, and these proposals from authors and a publisher who are unable to demonstrate any real knowledge of caring for captive reptiles.

The RSPCA claims that its report contains evidence in the form of a comprehensive review of the literature relating to welfare problems in reptile husbandry. If that is the case then can they explain why over 80% of this literature is published in German? Does this mean that welfare problems are practically unknown in the English-speaking world, or is this subject simply grossly under reported here? They also claim that their report documents the causes of morbidity and mortality during transport, capture, transportation and while kept in captivity. In this endeavor they have clearly failed, as discussed in detail above.

Although the main thrust of this report is to have additional Annex B reptile species banned from import under Article 4.6.c it also has an additional agenda. The report self-righteously purports to demonstrate expertise on establishing which Annex B species it considers make good pets from a basis of no perceptible academic knowledge of the subject at all. This level of imposed arrogance almost beggars belief, but is perhaps typical of the rabid organization that I believe the RSPCA has sadly become.

In support of this reports conclusions as to what species make good pets they make extensive use of the Association of German Pet Shops recommendations for their members. The report acknowledges that this organization admits that 'most reptiles are not purchased in pet shops but at special reptile fairs that are booming in Europe'. The animal welfare rules of the Association of German Pet Shops are referenced in the report as ZZF (the Zentralverband Zoologischer Fachbetriebe). The report uses these rules extensively, obviously hoping that readers, including Government decision makers will see this as inferring that trade organizations support their contentions with regard to suitability, or lack thereof, for keeping certain species in captivity. It is firstly important to note that this trade organization is very much for "pet shops" and not specialist reptile suppliers. Secondly, a great number of pet shops are not affiliated to this organization and their standpoint is not necessarily supported by other trade organizations; in particular the Pet Care Trust in the UK. Thirdly, what they have is a list of species in two categories, Annex A and Annex B. The report uses these categorizations throughout in supporting their demands for banning the species usually under the annotation ZZF (1996), as 'not suitable for private keeping'. I would have to suggest that this is either

misleading or is misrepresentative due to the authors' incompetence at report writing and/or translation. Listing on ZZF's Annex A, which the report incessantly quotes as meaning "not suitable for private husbandry", means nothing of the sort. It means not suitable as a normal 'pet' species, and should not be sold by ZZF members from their members' pet shops to the general public. The ZZF wording does not preclude private ownership of such species by specialist keepers.

Time for the RSPCA and other extreme animal rights organizations to stop peddling scientific untruths and accept the scientific truth of keeping reptiles in captivity, though they do need to be able to recognize the truth first, and this may take a protracted period of time.

For the rest of us, and particularly our politicians, we all need to refute these kinds of extreme opinions and recommendations, that are not based on scientific truth, as has recently been confirmed and endorsed by our Prime Minister, Mr. Tony Blair, when he gave animal rights campaigners short shrift, in a major speech at London's Royal Society. He said, "Academics abroad see us as completely overrun by protesters and pressure groups who use emotion to drive out reason. I believe that if we don't get a better understanding of science and its role, they may be proved right. We need to go further in our drive for successful knowledge transfer. Let the debate be one between open minds, not a retreat into a culture of unreason. Science is just knowledge. And knowledge can be used by evil people for evil ends. Science doesn't replace moral judgement. It just extends the context of knowledge within which moral judgements are made. It allows us to do more, but it doesn't tell us whether doing more is right or wrong. The fundamental distinction is between a process where science tells us the facts and we make a judgement; a process where *a priori* judgements effectively constrain scientific research. We have the right to judge but we also have the right to know. *A* prior judgement branded Darwin a heretic; science proved his tremendous insight. So let us know the facts; then make a judgement as to how to use or act upon them. None of this should diminish the precautionary principle. But that principle should make us proceed with care on the basis of fact; not fail to proceed at all on the basis of prejudice."

The Many Uses of Plastic in Herpetoculture

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ABSTRACT

The term, *"Plastics"*, refers to an organic polymeric material consisting of giant organic molecules which can be formed into various shapes through extrusion, spinning, casting or molding. The molecular composition is either natural, (wax, cellulose, and natural rubber), or synthetic, (polyethylene and nylon). The base materials consists of resins which are in the form of pellets, powders or solutions and are used to form the finished products. Plastics were first developed in the mid 1800's. Since then plastics have improved in quality and variety and are now used in almost every household the world over. The herpetological community has embraced the science of plastics and has made it their own. What I propose to show, is how plastics have been altered and adapted for use by the herpetological community. I will begin with the demonstration of an aquarium rack that I developed several years ago for use with our Puerto Rican Crested Toad (*Peltophryne lemur*) and Wyoming Toad (*Bufo baxteri*)SSP projects. I will next show some of the other uses that I have found for plumbing PVC. We are all familiar with the many plastic household items that occur in all of our homes. I will try to show how we, (the herp community), have altered these to fit our special needs. I will then show some of the commercially produced plastic products that were developed specifically for our interests. I will finish by showing some Modifications that were made to common items for various reasons such as safety, easy accessibility and practicality. Not all ideas are original, but may be found to be quite useful to those who have never seen them used before.

History

Plastics has been a familiar word to most of us all of our lives. Some of us may even remember the scientist who visited us in our grade schools to explain and demonstrate to us how it was made and tell us of all the possible uses that the future would hold. He never, in his wildest imagination had a clue.

Plastic was first developed around 1860 by inventor John Wesley Hyatt, who developed a method for pressure working pyroxlin, a cellulose nitrate of low nitration that had been plasticized with camphor and a minimum of alcohol solvent. He did this in hopes of winning the $ 10,000 prize being offered by Phelan and Collander for the first one who could find a suitable substitute for the ivory billiard balls which they produced. It seems that they were prone to chipping and breaking after some use. Mr. Hyatt did not win the prize, but he did win the patent. (Apparently, celluloid can be unstable and prone to easily catch fire or sometimes explode and was thus not suitable for billiard balls). It wasn't noted who won but the plastic industry was off and running.

Advances through several decades have brought us to today's uses for the modem household. The two largest influences on the herping world have been "Tupperware", and, "Rubbermaid". I'm sure that when they first conceived the ideas for their numerous products to make our mothers' jobs easier, that they would be embraced and converted over to another use. I don't know who was the first to throw away the leftovers to house their pet snake, but that is by far the most common use by the herping community for these products. First it started with placing the various boxes on top of bedroom dressers, tables and shelves; then racks

developed by some to house them in an easily accessed yet spacious friendly arrangement. There are several modern companies who now make or used to make these rack systems. Neodesha, Habitat Systems Limited, Vision Cages and Damke Rack Systems. I too, have developed a rack system, that unlike the others, holds aquariums for aquatic applications. I have also found other useful conversions for already existing plastic products that are commonly found in our households. I will try to explain some of these in the *Methods & Materials* section. Please feel free to utilize anything that was demonstrated in the contents of my presentation. Due to space constraints, not all of the ideas that were shown in my slide presentation are explained in this article. I would also like to state that I am making no claims of original thought and only hope that anything I demonstrate to you does not turn into a new closet industry to be hawked on the internet.

Methods & Materials

Aquarium Rack System The rack that I developed was for use with our Puerto Rican Crested Toad (*Peltophryne lemur*) and Wyoming Toad (*Bufo baxteri*) SSP (Species Survival Plan) projects. Both of these species are currently being reproduced in captivity for release back into their original or restored habitats. To accomplish this it meant having rows of 15 gallon aquariums which had to be individually carried to the nearest drain or sink for cleaning. When our aquarium supply place informed us that they could drill drain holes into the bottoms of our aquariums (I prefer the holes to be drilled in the corner of the tank), that took care the next step; letting the tanks hang over the edge of the table and onto the floor. This meant that each time they were cleaned it became necessary to clean the floor. It was because of this, that I decided to try something a little different. I remembered a talk that I had heard from someone at the Baltimore Aquarium about a hard lined drainage system that they used for their *Dendrobates* collection in which they had used PVC plumbing to attach a drainage system to their tanks that sat on a separate rack array. (I have only heard of this system, so I hope that I am describing it correctly.) The talk was about the problems they were having with the glue fumes having an effect on their frogs. Inspired by this presentation I preceded to come up with a way to make a rack out of PVC that could act as both a place to set my aquariums and have a separate drainage system. In the rack that I developed, the aquariums sit independently on top of the rack/drainage system allowing them to be put into service soon after the rack is finished, (48 hrs.), with seemingly no ill effect on my animals. I have since found that this rack array is suitable for most aquarium/terrarium setups using the 15 long drilled tanks. The rack I will present here sits on an 8 ft. by 30 inch countertop and will hold six 15 gallon drilled aquariums. The tanks in this system sit approximately 2" apart. The first thing you need to determine is what arrangement you want to use. This is decided by the number of tanks you want to use, countertop space availability, the distance of clearance between your tanks, and the drainage direction.

Materials:

Part	Qty.
2" O.D. 10 ft. PVC Pipe	3
2" I.D Pressure T's	10
2" I.D Directional T's	4
2" I.D 90 degree Elbows	3
PVC Primer	1 sm. can
PVC glue W/Applicator	1 sm. can
2" Diameter Plastic Bulkhead Fittings	6

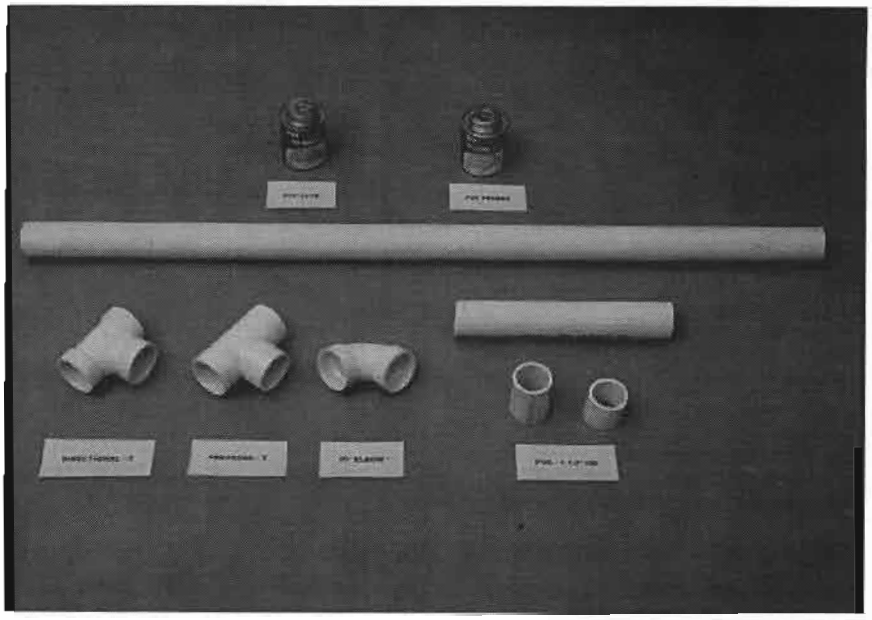

Fig. 1: Component parts used to construct the aquarium rack system.

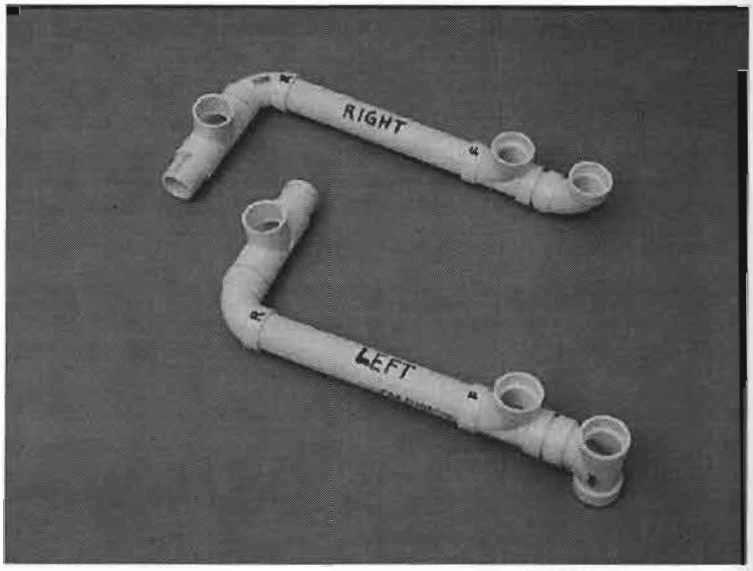

Fig. 2: Side Rail Assemblies – showing proper placement to insure correct construction.

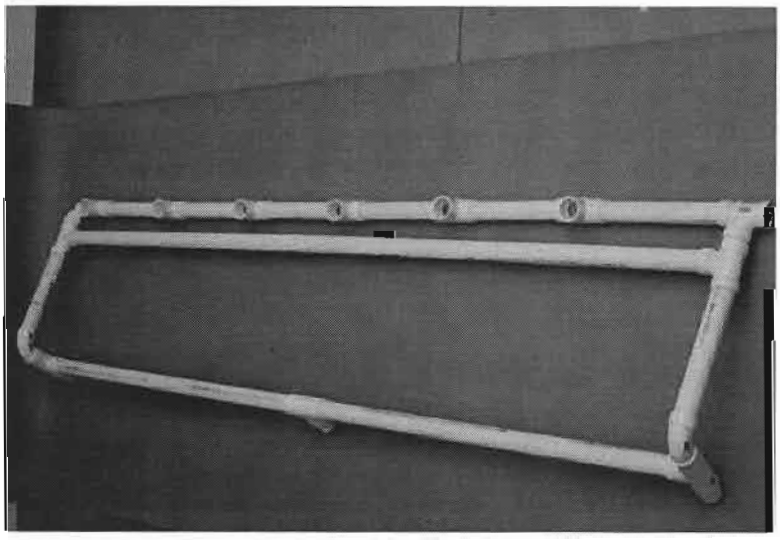

Fig. 3: Completed rack system – showing the four main components of the Rack = Front drainage array, Middle support rail, Rear support rail and Side rail assemblies.

Step 1.

- Place your aquarium tanks on your countertop or table at the desirable distance between each tank.
- Next, determine which direction you want the tanks to drain.
- Place the pressure T's under the bulkhead fittings of each tank allowing the tanks to rest centered in the middle hole of the fitting.

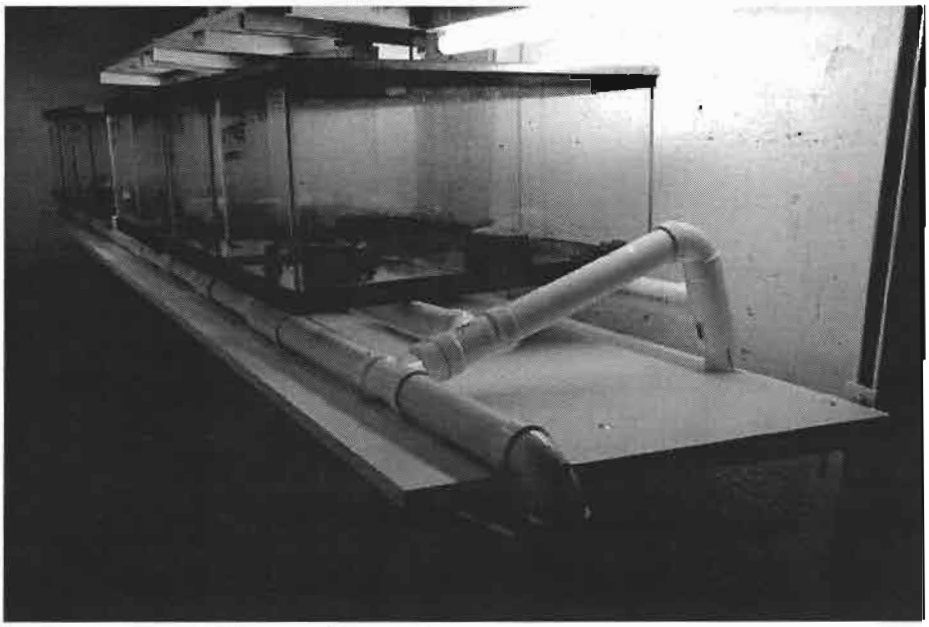

Fig. 4: Completed rack system with aquariums.

- Measure the distance between the pressure T's being sure to allow for the distance the pipe will fit into each fitting. This will be the length of your connecting pipes on your front drain array and will determine the total length of your rack system. Before you glue the front array, make sure the connecting pipes are snug and the pressure T's are in alignment with each other. Your tanks will rest on these.
- Cut a $1^1/_2$" piece of $1^1/_2$" OD PVC pipe and attach it to one end of the 90 degree elbow.
- Attach the 90 degree elbow to the end of the array opposite of the drain end.
- Attach a directional T to the drain end with the middle curving to meet the side rail.

Step 2.

- Next assemble the two side rails.
- Cut 2 – $11^1/_2$" pieces $1^1/_2$" OD PVC pipe. Lay these flat on the your work table.
- Attach one 90 degree elbow to each pipe. Turn one elbow to the left and one to the right.
- Next attach one directional T to the opposite end. Rotate the directional T's so that the middle holes are at the top while making sure that elbows are still facing in opposite directions and lying flat on the table .
- Cut 2 – $1^1/_2$" pieces of $1^1/_2$" OD PVC pipe.
- Attach one piece to the end of each directional T making sure that the directional T's middle holes are still facing directly up and empty.

Step 3.

- Attach the side rail assemblies to the front drainage array, making sure that both of the directional T's middles now face each other.
- Measure the distance between the two directional T's, allowing for proper insertion into the two fittings.
- Install the appropriate sized PVC pipe length between the two side rail assemblies. This creates your support rail and should be the same length as the front array.

Step 4.

- Cut 2 – 1 ft pieces of $1^1/_2$" OD PVC pipe.
- Lay these two pieces flat on the table.
- Attach one pressure T to each pipe with the middle holes facing in opposite directions.
- Cut 2 – 2" pieces of $1^1/_2$" OD PVC pipe.
- Attach one piece to each pressure T on the end opposite of the pipe. These serve as the rack's rear feet.
- Attach the long pipe end of these two assemblies to the elbow end of the side rail assemblies making sure that the middle holes of the pressure T's are facing each other.
- Measure the distance between the two pressure T's center holes being sure to make allowances for inserting the pipe into the fittings. This is the back support rail assembly.
- At this time your rack should be complete.
- If your rack assembly is more than four tanks wide you may need to make bottom supports for your two support rails. You can accomplish this by cutting pressure fittings into the middle of the support rails being sure to include the appropriate sized feet.

Snake Barrel w/plexiglass lid

My favorite trash barrel to use for this application is *Rubbermaid's* 44 gal. "Brute" model. I've found it to be a very sturdy barrel that is easy to alter for this purpose.

Materials:

Part	**Qty.**
Rubbermaid Brute trash can (44 gal.)	1
Plexiglas or Acrylic $^1/_2$" thick 19" dia. circle	1
Cabinet handle w/ 2 machine screws & nuts	1
$6^1/_2$" x 1"x $^3/_8$" thick Aluminum flat stock	4
1" long x $^1/_4$" (sized) bolts	8
$^1/_4$" (sized) nuts	12
$^1/_4$" (sized) 1" dia. washers	8

- Cut a 17" hole out of the trash can lid. You can easily accomplish this by measuring across the diameter of the lid to find dead center. Insert a nail at the center. Tie a string to the nail and a felt marker to the other end, with a string distance of 8 1/2" between the two. Draw your circle on the lid and use a sharp knife to cut out the middle.

Fig. 5: Normal Rubbermaid 44 gal. Brute trash can next to completed "Snake Barrel w/ plexiglas, lid" conversion.

- The easiest way to get the plexiglas/acrylic lid is to purchase the 19" dia. x 1/2" thick circle from your local hardware store. If you have to cut your own circle, you can accomplish this by using the same method as listed above. Just remember that you want a 19" diameter circle this time. You will also need to use a jig saw or saber saw to cut the circle.

- Attach the cabinet handle to the center of the plexiglas/acrylic circle. The easiest way to accomplish this is to place the clear lid inside the trash can lid. By lining up the handle to the middle of the trash can lid ears, you should be able to just visualize it into the correct position.

- Drill a 1/4" dia. hole into each of the aluminum stock pieces approx. 1" from one of the ends.

- Drill one 1/4" hole at the four compass points of the trash lid about 1/2" from the inside of the trash can lid.

- Attach the four aluminum stock pieces to the trash can lid using the appropriate nuts, bolts and washers. The aluminum stock pieces should be able to rotate easily in order to hold down the plexiglas/acrylic lid. I've found that the best order to attach the bolts is follows: bolt...washer ... lid...washer...nut...nut.

- Attach the lid assembly to the trash barrel. Drill four 1/4" dia. Holes around the top of the barrel rim making sure that the holes are centered so they will be centered with the rim's bottom ridge supports. The easiest way to do this is to turn the barrel upside down. Next drill your holes at the four compass points around the inside of the rim between the barrel and that ridge.

Plastic Guard Paddle

I have been using various types of shields for years. Most of those were made of wood and metal and also doubled as shovels or spoons. You could block something off but, you couldn't see what they were doing. I developed this paddle for my use while participating in a doctoral study of the reproduction cycles of Brazilian Rainbow Boas *Epicrates cenchria and* Ball Pythons *Pythons regius*. It was my job to capture and handle these animals while the graduate student anesthetized, withdrew blood samples and ultrasounded them. Trying to pin these animals down during their capture was both stressful for the animals and resulted in bites

for yours truly. I found that by using the paddle, the animals did not stress out nearly as often and my hands didn't hurt as much. By positioning the paddle gently over the animal I was able to see the animal clearly and safely pick it up. I do not recommend its use for venomous snakes but, it works well on non -venomous animals.

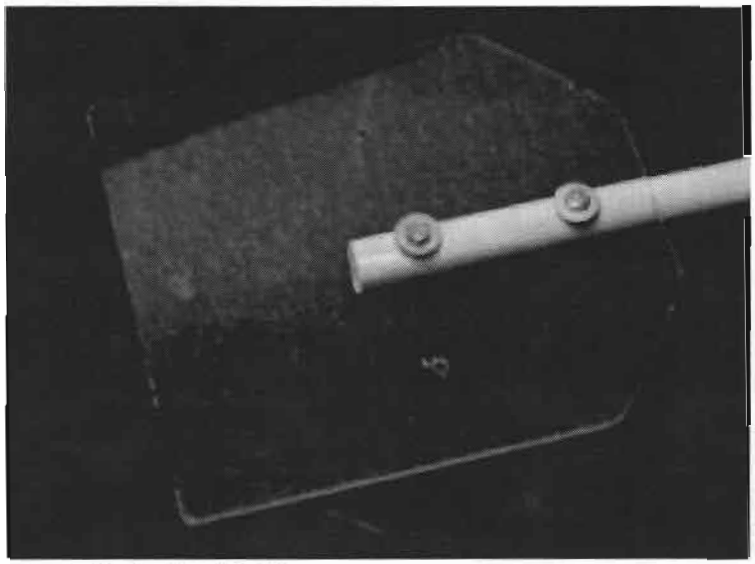

Fig. 6: Plastic Guard Paddle

Materials

Part	Qty.
10" x 10" plexiglas/acrylic $^1/_8$" thick	1
28" long x 1" dia. wooden rod	1
$1^1/_2$" $^1/_4$" sized bolts	2
$^1/_4$" sized nuts	2
$^1/_4$" sized fender washers	

- Drill two $^1/_4$" holes down the center axis of the plastic; one 2" from the top and the other 2" from the bottom.

- Lay the shield on top of the center axis of the wooden rod and using the existing holes mark the spot for the handle holes, making sure that everything is in proper alignment. Remove the shield and drill the holes.

- Attach the shield to the handle making sure that washers are placed between the shield and the nut.

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