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PROGRAM AND ABSTRACTS

ABSTRACTS

HERPETOFAUNAL CONSERVATION: THE THREATENED SPECIES TREADMILL

Hal Cogger, Australian Museum, Sydney

ABSTRACT: Populations of very many reptiles and amphibians throughout the world have seriously declined in the past 50 years and these declines continue, often at an accelerating rate. It is almost universally acknowledged that loss of habitat is by far the major cause of these declines.

Yet both internationally and nationally, a high proportion of limited conservation resources have been directed primarily t threatened species. Vast sums are being spent on policing trade in threatened species, or in developing and implementin recovery plans for a relatively small number of species on th brink of extinction.

The financial costs and conservation benefits of these activities are examined and found wanting. Indeed, it is suggested that current conservation priorities are actually contributing to an overall decline in global biodiversity. Because the alternative strategies are more difficult to implement than the present ones does not mean that they shoul be assigned a lesser priority by conservation agencies.

THE NATURAL HISTORY OF SOME UNUSUAL AMPHIBIANS AND REPTILES FR SOUTHERN AFRICA

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Southern Africa, at least in this presentation, encompasses the countries of Namib Zimbabwe, Botswana, the southern half of Mocambique, Swaziland, plus the Republic South Africa. It would be a monumental undertaking to discuss each and every species t comprises the rich herpetofauna of the aforementioned region, hence selecting a chosen f that exemplify the term "unusual."

One of the amphibian species that enters this region from the north is the Grey Tree Fr or Foam Nest Frog, Chiromantis xerampelina. It ranges from Hluhluwe in Zulula through the Transvaal lowveld of South Africa, then north into Kenya. Adults reach maximum length of 10 cm, with males being proportionately smaller. During the breedi season, which occurs in the southern months, Chiromantis builds a foam nest around eggs. This is often a cooperative effort of several pairs of frogs in amplexus. The fem lays her eggs, as many as 150, in a mucous fluid which is then churned up into a mass white foam by the hindlegs of both sexes working together. Being able to survive the lo and hot droughts of the Africa bush is a real plus for the continued survival of a amphibian species, and in this respect the grey tree frog is an expert bar none. The fr excretes uric acid rather than urea, meaning that precious liquid is retained within the bo and not passed as urine.

South Africa is the stronghold of the genus Cordylus, commonly referred to as girdle-tailed or armadillo lizards. The largest of these is C. giganteus with a limital distribution in the Orange Free State. It boasts an impressive body covered with spines, excavates its own burrow, and often shares the underground abode with scorpions and such unlikely room mates as the dainty frog Cacosternum and the running frog Kassina. The venomous rinkhals, a spitting cobra, also frequents the same locale. One of the lizard's common names, sungazer, is derived from the reptile's habit of sitting in front of its burrow and intently staring into the sun.

Perhaps the most popular of this group is C. cataphractus, also endemic to South Africa, and restricted to the northwestern region of the Cape Province. It too boasts an impressive spinose body. For a suitable habitat the lizard prefers the deep crevices of rock outcroppings. During the summer months the daytime temparature may well reach the 40 C mark, while winter periods often fall below freezing. Needless to say, cataphractus is subjected to some very extreme climatological conditions. It's claim to fame, however, lies in the fact that newly captured specimens often bite their tail, then roll up into an almost perfect ball, exposing only the spinose exterior of head, body and tail. Cordylus bear living young and to the delight of the mother-to-be, these young leave the female's body with "soft and pliable" spines.

One of my favorite places to visit on the African continent is the Namib Desert that stretches along the Atlantic coast of Namibia, formerly known as South-West Africa. Here, where sand dunes reach the ocean's shore, where summer temparatures duplicate a hellish existence, and where fog and sand storms create some of the most trying conditions on earth, we find a reptile community that adapted well to the aforementioned climatic variances.

One of these is the Peringuey's viper or Namib side-winding adder, Bitis peringueyi. It is full grown at a mere 27 cm, making it one of the smallest vipers/adders on earth. I have spent many an hour looking for and photographing this serpent in the sand dune system that stretches from Swakopmund to Walvis Bay. During the day, and during foggy nights, it spends its time burried in the fine dune sand, and often in association with the shilling bush. It uses the sidewinding method of locomotion, feeds primarily on lizards, gives birth to living young, and more often than not demonstrates a rather nasty disposition.

From exactly the same locale, often from the identical shilling bush, comes a delicate lizard known as the Web-Footed Gecko, Palmatogecko rangei. It is strictly nocturnal, able to endure cold, foggy and windy conditions, and often falls prey to Bitis peringueyi. I have seen these geckos active at night, not far from the ocean's shore, when it was so cold that clutching a camera and flashlight with only partial control of the appendages, proved an excercise in futility. But the geckos kept moving nicely.

The Namaqua chameleon, Chamaeleo namaquensis, also frequents the habitat of Palmatogecko and B. peringueyi, but is not restricted to same. However, it is a genuine "desert denizen." Being active during the daylight hours it must surely cross the path of the occasional viper and I suspect that a full grown chameleon would have no difficulty in over powering a half-grown viper. On the other hand, a large viper could easily kill and swallow a neonate chameleon. Namaqua chameleons also frequent the gravel plains of the inner Namib, but to see one walking across the loose sand of a dune is definitely a sight to behold.

The smallest tortoise on earth, Homopus signatus, is endemic to Southern Africa, specifically the western Cape of South Africa and extreme southern Namibia. It is full grown at 6-8 cm with a maximum recorded length of 9.6 cm. Males are smaller than females and have a well developed concavity in the plastron plus an extremely long tail. During the summer months the rocky habitat is bombarded with the sun's vengeance and winter brings with it temperatures well below freezing. In the Springbok area this tortoise species shares its domain with the Many-Horned Adder, Bitis cornuta.

Effects of habitat degradation and climatic change upon the behaviour of land tortoises in the arid regions of North Africa and the Middle East

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For 4 years the author has undertaken an ongoing study of tortoise distribution and behaviour in Morocco. It has become evident that behaviour patterns are different from that generally assumed. In addition, the specific threats to *T. g. graeca* have been studied and in this presentation brief details are given of these problems and of the steps which are being initiated to overcome them. Comparisons are made with similar tortoise habitats in Turkey and Tunisia, also studied by the author.

Aestivation in *Testudo graeca*

Aestivation within the *Testudo* complex has previously been reported in *Testudo kleinmanni*, where peak activity is recorded during the winter. In summer, *Testudo kleinmanni* retreats into rodent burrows and activity decreases as a heat avoidance strategy. Aestivation employing mammal burrows has also been reported in *Testudo horsfieldi.* This report provides evidence, for the first time, of identical behaviour in *Testudo graeca graeca* L. 1758 at various sites in Southern Morocco.

Distribution of *T. g. graeca* in Morocco

This tortoise was once found in abundance throughout the country, but many years of extensive trade collecting - now officially ended - plus the effects of habitat destruction, severe drought and desertification have dramatically reduced populations in recent years. The distribution of *T. g. g* in Morocco extends from the Northern borders with Algeria, to the pre-Saharan Anti-Atlas mountain range. This encompass a wide variety of habitats, from humid thick forest, through thinly spaced argon (*Argania spinosa*) woodland, to semi-arid desert-like regions. It would be fair to say that in general terms the tortoise population of Morocco was (and to a certain extent still is) denser in the Northern and Central coastal regions than in the arid Southern region. Historically, the most extreme southerly records for *T. g. g.* in Morocco occur in the region of Goulimime and were made some 20 years ago. The vegetation in this region is very sparse and conditions are desert-like. In the years since, desertification has continued apace and it is not known if tortoises are still to be found there.

In the Autumn of 1992, I surveyed the Taroudannt valley in Southern Morocco (having previously carried out similar surveys in the North of the country) and visited many of the localities in that region where tortoises had previously been recorded. The region under examination may be summarised as consisting of a triangle of territory between Essaouira in the North, Aoulouz (which is located on the mountainous road to Marrakech) and Tiznit in the extreme South. The Taroudannt valley sites were of particular interest as throughout the 1950's and 60's this was one of the most important trade-collecting areas in Morocco, with hundreds of thousands of tortoises being taken from here for export to Europe. Further surveys of this region were conducted in 1993 and these results are compared with previous findings.

Climatic factors influencing behaviour

Tortoises in the North of the country are subjected to mean minimum monthly temperatures in winter of 9.6°C (Tangier) in the coastal region, and as low as -4.5°C at higher altitudes in the Middle Atlas. Tortoises in these regions hibernate to escape the cold - and often very wet - winter months. The period of hibernation can last up to 5 months in high altitude localities (e.g. Ifrane in the Middle Atlas), but shorter periods of circa 3 months are more typical in lower altitude and coastal regions. Tortoises usually 'dig in' for hibernation under the roots of trees or under large rocks.

In the South of the country the picture is entirely different. Winter temperatures in the coastal resort of Agadir, for example, are sufficiently warm to render it a popular winter holiday resort. In summer and autumn however, temperatures are unpleasantly high (38–40°C is not unusual), although persistent sea mists result in reduced sun-light and temperatures along the edges of the coast. This dramatic climatic contrast between the north and south results in diametrically opposite behaviour between southern and northern tortoises. When northern populations are hibernating, southern tortoises are enjoying their peak activity. The peak activity period for northern tortoises is typically parallelled in the south by tortoises aestivating to avoid the extreme heat.

The impact of human activity

The Mediterranean of today is very different from that of only a few thousand years ago. Deforestation caused by felling of trees for building and firewood is one major cause. Overgrazing by sheep, goats and cattle another. With decreasing forest cover, climatic conditions have deteriorated, with progressively less rainfall and increased (severe) soil erosion. These effects have accelerated markedly within the last 50 years. Today, many areas of prime 'natural' habitat are now devoid of wildlife.

In terms of conservation, these problems must be addressed if viable habitats are to be preserved and this author is working on a new program (in co-operation with geographers and rural environment specialists) to bring about changes in local agricultural practices which will allow tortoises (and other wildlife) to co-exist with the human population.

The impact of tourists on conservation is also discussed in this context. Tourists often purchase 'souvenir' objects made from reptiles: Tortoise 'banjos', fire-bellows and snake-skin products are a particular problem. An education campaign aimed at tourists is being undertaken. 'Reptile-friendly' alternative products are being investigated.

ELAPID HUSBANDRY

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The keeping of elapids in a zoo situation involves frequent contact between the keepers and the snakes. Due to the dangers inherent in working with these active, highly venomous snakes, the handling techniques that work with other types of venomous snakes may not be adequate to protect both the keeper and the snake from injury.

At Reptile Gardens, the development of new types of handling equipment has been essential in order to efficiently and safely maintain the large quantity of elapids in the collection. By using clear plastic tubes, plexiglass sheets, plastic Rubbermaid cans, and trap boxes any species of elapid can be safely handled, sexed, or bagged. In addition, cultures can be taken, shedding can be assisted, and eye caps can be removed with little danger to the keeper or snake.

GARTER SNAKE SYSTEMATICS: A LIGHT AT THE END OF THE TUNNEL?

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In as wide-ranging and highly speciose a group as the garter snakes--a group in whic scale variations, pattern polymorphism, and sexual dimorphism abound--it is a sma wonder that Ruthven (1908) opened his classic monograph on Thamnophis by stating th "this genus has long stood in the minds of herpetologists as a synonym for chaos...." O should bear in mind, however, that Ruthven's comment was at least in part the reactio of one inclined toward "lumping" taxa to what he saw was the excessive "splitting" indulge in by some of his predecessors, most notably Cope (who, in his final publication in 190 recognized 25 species of Thamnophis and an additional 21 subspecies...as opposed to t 12 species with an additional 7 subspecies subsequently recognized by Ruthven).

Because Ruthven systematically and graphically presented geographic variation i meristic characters, thoughtfully discussed character variation, and objectively postulate the origin and evolution of the four species groups he erected, his book is recognized as landmark in snake systematics generally. Nonetheless, subsequent studies by othe herpetologists have revealed that Ruthven seriously underestimated the number of specie with which he was dealing. In fact, most of the papers on Thamnophis systematics th have appeared in the past 86 years have been involved in sorting out one or more Ruthven's catchall taxa.

Although de Quiroz and Lawson (in press) have challanged the validity of Ruthven species groups on the basis of biochemical data, these groups do provide a convenie means of organizing the taxa in order to summarize their systematic status.

The semiarboreal ribbon snakes, long recognized as being distinct from othe Thamnophis, comprised Ruthven's Sauritus group. Rossman (1962) resurrected T proximus as a distinct species, and Rossman, Rossman, and Keith (1982) demonstrated tha many of the visceral organs of ribbon snakes differ in position from those of othe Thamnophis.

Ruthven's Radix group is comprised of T. eques (which he called megalops), T marcianus, T. radix, T. butleri, and T. brachystoma, (which Ruthven did not distinguis from butleri). Each of the first two species has had several subspecies recognized (Conant 1963; Rossman, 1971, respectively), but the latter three taxa have variously been treate as synonyms, subspecies of radix, or separate species (see especially Smith, 1949; Conant 1950).

Ruthven's Elegans group included a number of species that probably are not closel related, as well as a group that are.
The latter cluster (now known as ordinoides, elegans, atratus, couchii, gigas, hammondii was slowly teased apart over a period
of more than 50 years by Fitch (1940, 1948), Fox (1948, 1951), Lawson and Dessaue (1979), Rossman (1979), Rossman and Stewart (1987), and McGuire and Grismer (1993) The unrelated taxa included T. rufipunctatus and its subsequently described
sister- species T. nigronuchalis (see Thompson, 1957; Tanner, 1985; Rossman, 1993), T melanogaster (see Smith, 1942; Conant, 1963),

T. scalaris and its sister-species T. scaliger (Rossman and Lara-Gongora, 1991), and T. phenax (=T. sumichrasti) and its subsequently described sister-species T. mendax (Rossman, 1965 and 1992b). Other subsequently described species that have at one time or another been associated with one of the species in the Elegans group include T. errans (see Webb, 1976; Fitch, 1980) and T. exsul (see Rossman, 1969; Rossman et al., 1989).

Finally, Ruthven's Sirtalis group included, in addition to T. sirtalis (of which he recognized only three subspecies: sirtalis, parietalis, concinnus), T. cyrtopsis (then called T. eques), T. chrysocephalus, T. godmani, T. fulvus, T. pulchrilatus, and the subsequently described T. postremus. Smith (1942) considered T. godmani to be a subspecies of T. scalaris, but Rossman (1992b) demonstrated that the two taxa are not conspecific. Webb (1982) showed that T. fulvus is distinct from T. cyrtopsis, as are T. postremus and T. pulchrilatus (Rossman, 1992a).

Lawson (1987), on the basis of allozyme frequency data, transferred Nerodia valida to the genus Thamnophis. Several morphological characters contradict this allocation, and the problem requires more extensive examination.

Beginning with Cope in 1892, a number of herpetologists have attempted to graphically represent the relationship of one or more species clusters within Thamnophis, but only recently have these "family trees" been both inclusive and objective. De Quiroz and Lawson (in press) present two phylogenies, one based on sequence analysis of mitochondrial DNA and the other on allozyme data. There are significant points of agreement and disagreement between these phylogenies and, in an attempt to resolve this difficulty, the authors analyzed the combined data sets as well. De Quiroz and Lawson acknowledge potential problems with this methodology, too, and called for further studies based on other kinds of characters in order to see how the results compare with their work. A cladistic analysis based on a broad suite of morphological characters is well under way (Rossman, Boundy, and Good, in progress).

THE LIZARD ADVISORY GROUP'S PROGRAM FOR THE LESSER ANTILLEAN IGUANA, *IGUANA DELICATISSIMA*

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A CBSG Lizard Advisory Group mandate to initiate captive management plans for threatened West Indian saurians prompted the development of a pilot program for the Lesser Antillean iguana, *Iguana delicatissima*. *I.delicatissima* is a poorly-known taxon. In contrast to its wide ranging congener, *I. delicatissima* has been the subject of few investigations, and its captive history is brief. The species' obscurity is attributable to its very restricted distribution (historically encompassing fifteen islands in the Lesser Antilles), its scarcity on some of these islands, and the relative inaccessibility of many of the locations where it is most abundant. Its superficial resemblance to *I. iguana* may also help explain why it has been overlooked by zoological parks.

Iguana delicatissima is no longer found on many of the islands of its historic range. Within recent times, it occurred on Anguilla, St. Marten, St. Eustatius, Antigua, Ile Fourchue, Les Iles Fregate (2 islets), Ile Chevreau, St. Barthelemy, Guadeloupe (Grand Terre), La Desirade, Les Iles des Saintes (Terre de Bas and Terre de Haut), Dominica, and Martinique. Field surveys by Mark Day, University of Aberdeen, indicate that the species has been extirpated from perhaps as many as eight of these islands, and populations are critically low on several others.

The Lizard Advisory Group's program for *I. delicatissima* encompasses two components: captive-breeding and in situ research. In 1992, the Ministry of Agriculture of the Commonwealth of Dominica (Division of Forestry and Wildlife) granted permission to collect and export three (1.2) iguanas to the Memphis Zoo. These specimens were viewed as the start of a pilot breeding program, and brought the worldwide captive population to five (two are held at the Jersey Wildlife Preservation Trust). The following year, two additional pairs were collected, with one pair joining the trio at Memphis and the second pair going to the Center for Reproduction of Endangered Species at the San Diego Zoo.

There are four contributions that this small captive population can make towards the better management of wild populations: 1) Produce data on dietary, environmental, social, and caging requirements and develop sound husbandry practices that will form an information resource to Antillean conservation agencies when in situ programs call for captive or semi-captive maintenance of iguanas, 2) Determine the best method of artificial egg incubation and rearing juveniles, which would be invaluable to in situ programs by reducing egg and juvenile mortality when working with endangered wild populations, 3) Answer the question: can *I. delicatissima* be bred and reared successfully under artificial captive conditions? The answer will be essential for Caribbean wildlife managers to know when planning iguana recovery programs, because it would tell them if they had the option of utilizing captive facilities to hold and raise surplus offspring prior to release into protected areas (as is being contemplated with the Jamaican iguana), 4) Provide basic life history data on growth, fecundity, and social behavior that would augment field studies such as Mark Day's.

The Memphis Zoological Society, along with the Jersey Wildlife Preservation Trust, have provided funding for Mark Day's study of interisland genetic diversity, reproductive biology, and island-by-island population structure and density. When completed, this work will be invaluable to both the in situ and ex situ components of the LAG *I. delicatissima* project. Already, the island surveys have discovered a previously unknown population on an uninhabited islet that is now under consideration as a nature reserve.

The *I. delicatissima* project has become part of a larger plan for all West Indian iguanines, and a IUCN Conservation and Action Plan for West Indian Iguanas is being compiled by Dr. Allison Alberts, San Diego Zoological Society (CRES).

The Memphis Zoological Society hosted Mr. Arlington James, Director of the Division of Forestry and Wildlife (Dominica), on a visit to Memphis. During his visit, discussions were held concerning the future direction of conservation efforts for *I. delicatissima*. As the partnership between the government of Dominica and the Memphis Zoo continues to strengthen, we expect the cooperative agreement between our two agencies to produce actions that will benefit the Lesser Antillean iguana on its native islands.

Lampropeltis triangulum: SOME TAXONOMIC PROBLEMS

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Lampropeltis triangulum has one of the largest distributions of any snake. It is also one of the most variable of all snake species. This is evidenced by the recognition (by some) of 25 subspecies. Virtually no one would argue that this is one of the most variable snake species. How this variation is to be interpreted has been discussed and "cussed" in numerous papers. Part of this disagreement is the usefulness of the subspecies category; many feel that it obscures rather than illuminating variation. Other criticisms involve levels of differentiation within the 25 subspecies; for example that the subspecies triangulum and elapsoides are more distinct than hondurensis and stuarti. My viewpoint (i.e., recognition of 25 subspecies) is beginning to erode especially concerning some of the populations in central and southern México and Central America. I will review the populations of these areas and indicate other possibilities as to their interpretation. The populations I will primarily deal with are: abnorma, arcifera, blanchardi, campbelli, conanti, dixoni, hondurensis, nelsoni, oligozona, polyzona, sinaloae, smithi, and stuarti. Time permiting I will briefly look at evolutionary relationships in the species.

THE HERPETOFAUNA OF NUEVO LEóN, MÉXICO: A PRELIMINARY REPORT

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México is the 14th largest country in the world and ranks 3rd in biological diversity and the herpetofauna is a significant part. Nuevo León is the 12th in size of the 32 states of México having a land mass of 40, 112.5 mi² (64, 555 km²) or 3.27% 0f the total land mass of México and extends for 378.4 mi (509 km) N-S and and 167.1 mi (269 km) E-W at the widest point. Nuevo León borders on the United States to the north, Tamaulipas to the east, San Luis Potosí to the south and Coahuila to the west. Three Biotic Provinces are found in the state, to the east the Tamaulipan Lowlands, in the center the Sierra Madre Oriental, and to the west the Chihuahuan Desert. The state is comprissed of a large variety of habitats within these Biotic Provinces: rivers and streams (some dry during most of the year), springs, waterfalls, mesquite flatlands, grasslands, desert, yucca flats, canyons, forests, llanos, and alpine meadows to mention a few. The area north of Monterrey is hot, dry, and has limited rainfall

mostly confined to the northeastern sector influenced by the Gulf of México. The northwestern sector is influenced by the Chihuahuan Desert. The area from Monterrey southeastward is influenced by the Sierra Madre Oriental with its higher elevations. The western flanks of the Sierra Madre Oriental are still influenced by the Chihuahuan Desert, particularly at the lower elevations. Precipitation in the southeastern and central sectors is greater than north of Montwerrey and is influenced by the higher elevations acting as a barrier and by cloud formations that blanket the higher elevations almost daily. The diversity of habitats greatly influences the herpetofauna to be found in them. The highest points are Cerro Potosí at 12,500 ft (3810.9 m) and Peña Nevada at 11, 808 ft (3600 m). Of México's known herpetofauna of 1539 taxa, Nuevo León has 145 (9.42%) broken down as 3 Caudata (2.75%), 21 Anura (9.77%), 7 Testudines (10.77%), 50 Sauria (8.68%), and 64 Serpentes (11.32%), with no Gymnophiona, Crocodilia, or Amphisbaena. There are 206 genera in México and Nuevo León has 70 (44.13%). One taxon, a lizard, **Hemidactylus turcicus turcicus** is an introduction (0.68%) and 5 (3.44%) taxa are endemic as presently known: **Elgaria parva, Sceloporus chaneyi, Sceloporus jarrovi cyaneus, Sceloporus torquatus binocularis** and **Rhadinaea montana.** Twenty-six taxa were first described from the state between 1854 and 1992, and of these 16 (61.53%) are still recognized today. The earliest collection from the state was that of Lt. Darius Nash Couch in 1853. Edward W. Nelson and Edward A. Goldman, noted mammalogists and ornithologists, collected herpetological specimens in México incidental to their main interests and collected in the state in 1898 and 1902. Harry Hoogstral collected herpetological specimens in 1938-40 in the state (as reported by Hobart M. Smith). A collection by the noted malacologist Henry A. Pilsbry added a few significant specimens, which were reported by Emmett R. Dunn. Rafael Martín del Campo made a major contribution to Nuevo León herpetology in 1953. Hobart M. Smith and Edward H. Taylor also contributed significantly to the state herpetofauna. Most other collections by herpetologists in the state usually were made while passing through to more southerly areas or heading home. Several students from the Universidad de Nuevo León have made significant collections in various parts of the state.

My work in the state started on my first collecting trip to México in November. 1950, and over the intervening years 35 trips to the state were made at various times of the year but mostly during July (the last was in May, 1988). Some trips were made alone and others with varying numbers of field companions. Every effort was made to sample as many localities as possible, especially when remote areas became accessible.

SUBSTRATE SELECTION IN CAPTIVE SNAKES

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and

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Lance-headed rattlesnakes (Crotalus polystictus) and Aruba Island rattlesnakes (Crotalus durissus unicolor) were tested for preference between a naturalistic substrate (pine bark mulch in C. polystictus; sand in C. d. unicolor) and an artificial substrate (newspaper in both species). C. polystictus exhibited a preference ($P < 0.02$) for pine bark mulch substrate, and C. d. unicolor exhibited a preference ($P < 0.02$) for newspaper substrate. Hypotheses for the exhibited preferences and implications for captive reproduction/release programs will be discussed.

Husbandry and Research of the Bushmaster Lachesis muta at the Dallas Zoo, Department of Herpetology by Donal M.Boyer

The staff began working with Lachesis in the late 1960s. From 1967-1981 the efforts were directed toward the Costa Rican subspecies L. m. stenophrys. Although we successfully maintained this subspecies for 13 years they never reproduced in captivity. In 1982 with the loss of L. m. stenophrys, a group of 3.2 wild caught subadult L. m. muta were obtained from the same geographic area in Surinam. This group formed the initial breeding nucleus, with the first reproduction in 1987. Since that time two unrelated pairs have reproduced six times resulting in 55 offspring. Reproductive data and husbandry techniques used to successfully maintain this subspecies are discussed. Many of the surplus offspring were distributed to other zoos working with bushmasters or desiring to start a program with them. Eighteen U.S. zoos and several private collectors are working with about 65 specimens of three subspecies, L. m. muta, L. m. stenophrys, and L. m. melanocephala. A studbook is currently being prepared for bushmasters.

Dallas Zoo research with Lachesis began in 1987 with a preliminary investigation of predatory behavior, focusing primarily on prey handling and strike induced chemosensory searching (SICS). The project was a collaborative effort involving Dr. D. Chiszar and H. M. Smith, University of Colorado at Boulder; Dr. C. W. Radcliff, San Diego Zoo; and Dr. J. B. Murphy, Dallas Zoo. Observations were made during feeding episodes. The results of this work were published and are discussed further. This project led to additional research on prey handling, SICS, and the ability of bushmasters to follow post strike prey trails, conducted by Dr. Chiszar and the Dallas Zoo staff. The results the results are in press and are discussed.

In 1988 the zoo assisted Dr. H. Greene, University of California at Berkley, in field work investigating the ecology of the vertebrate predator community in the lowland tropical wet forest of Finca La Selva, a biological reserve and field station in the north eastern Costa Rica. Dr. Greene's work involved data collection on a wide variety of vertebrate species, utilizing radio telemetric monitoring of Lachesis and Bothrops asper and mark/recapture. All snake species encountered were collected, weighed, measured and released at capture site. Although Dr. Greene has finished his work at La Selva, the zoo staff continues to do work on a long term mark/recapture studies utilizing passive integrated transponder tags. An endoparasite survey of herpetofauna was begun in 1993. A 35mm waterproof camera was donated to the station in 1993 to help establish a photo ID and location project for Lachesis when permanent station field assistants encounter specimens. Future research efforts will be directed toward learning how bushmasters select and utilize ambush sites. We will also try to determine the extent of maternal egg guarding behavior.

New Perspectives on Reptile Anthelmintics

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As the average herpetoculturalist becomes increasingly aware of parasites as a problem to be corrected, our awareness to problems with the treatments also increases. It is imperative that the user, whether veterinarian or lay person, know the indications and contra-indications of the common anthelmintics and insecticides available and in common usage.

Ivermectin is absolutely contra-indicated in chelonians due to the drugs ability to cross the blood brain barrier and affect the nervous system. However, early results from preliminary trials indicate that a related drug, Milbemycin (Ciba-Geigy) , provides a similar spectrum of activity against most nematode parasites (hookworms, roundworms,etc.) and filarial nematodes without serious side effects. Other contra-indications of ivermectin will be discussed.

Several cases of anaphylaxis and lethargy have been reported following the use of praziquantel (Droncit -Mobay) injectible as a treatment for cestode (tapeworms) parasites. In general this has been related to excessive dosage due to recommendations found in print. Corticosteroid usage has been helpful following these reactions.

The treatment of mites continues to create controversy from many quarters. Deaths have been documented with the use of pest strips, NIX, pyretrins, neguvon, and other products in their use as a mitacide. A rational treatment plan based on the actions of the drugs and the behavior of the mites will be presented with safety in mind.

THE ORIGINS OF TERRESTRIAL SNAKES OF THE GALAPAGOS ARCHIPELAGO

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The terrestrial snakes of the Galapagos Archipelago have received little attention since Merten's (1960) systematic analysis, in which he recognized three species: Dromicus biserialis, D. dorsalis, and D. slevini. Maglio (1970) referred them to the genus Alsophis.

The attitude of most researchers regarding their relationships is typified by Maglio's (1970) statement: "...they are clearly closer to each other, and represent products of speciation on the Galapagos" (the inference being a single invasion). Darlington (1957), however, thought of the species as "...possibly representing two different mainland stocks of the genus." He stated no reason for this comment, but it probably arose from Van den Burgh's (1912) notion that there were two species groups that were "...the decendants of two species which originally occupied the Galapagos."

My studies are based soley on scale counts, color patterns, and hemipenal morphology. Based on this investigation and my studies of mainland South American xenodontine snakes, I have the following opinions: 1) Alsophis biserialis is clearly a derivative of Philodryas chamissonis mainland stock (current distribution restricted to Chile). It may be argued, upon close examination, whether to recognize the taxa as subspecies of P. chamissonis or as distinct, full species. Due to their extreme isolation, I consider P. biserialis to be the only Galapagos species of Philodryas. 2) Alsophis dorsalis is obviously a derivative of the mainland Alsophis elegans. It is so close that one of the two syntypes of Dryophylax freminvillei Dumeril, Bibron, and Dumeril, a taxon long considered a synonym of A. elegans, was a specimen of A. dorsalis with incorrect locality data! 3) I do not yet know the ancestry of A. slevini, but I do not believe it is at all closely related to either A. dorsalis or P. biserialis. For the time being, I will retain it in the genus Alsophis, and speculate a Middle American or Caribbean origin.

My concept is that the only insular speciation that has occurred has been subspeciation, therefore there were three invasions.

CITES AND THE HERPETOLOGIST

Ernie Cooper

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Since 1973 the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has grown from an agreement between 21 countries to a major international trade convention with over 120 signatories. CITES operates through an import/export permit system that is stricter for more endangered species. Animals and plants that are deemed to require protection or regulation are classified into one of three appendices. Species from more than 100 different genera of amphibians and reptiles are presently listed by the CITES. As this list continues to grow, the convention will have increasing impact on herpetologists whether they are researchers, herpetoculturists, or simply pet owners. A discussion of the administration of CITES in Canada provides an understanding of the requirements for CITES compliance. However, different countries have different logistical approaches to CITES, and these differences may be significant to the importing/exporting herpetologist.

HERPETOFAUNA, HERPETOLOGY AND CONSERVATION IN ISRAEL, LAND BETWEEN THE CONTINENTS

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Israel, at the SW tip of Asia, between Europe and Africa, measures only ca. 400x50 km. Within it there meet the outposts of four biogeographical regions: the Palaearctic (1) Mediterranean (sensu stricto), relatively mesic, in Israel's north; (2) the Saharo-Arabian desert in Israel's south; and (3) an Irano-Turanian steppe belt intervenes between these two but in Israel is hardly expressed herpetologically; also (4) a Palaeotropical Sudanian intrusion area overlapping part of the SE desert.

Israel's herpetofauna comprises 6-7 amphibians, 6 marine turtles and 90+ terrestrial and freshwater reptiles. With few exceptions, these terrestrial reptiles are of heterogeneous biogeographical relations in accordance with the division above. A few species occur in both the mesic and desert zones but most of these comprise distinct subspecies respectively. Some genera are represented by vicariant species in the Mesic and Desert zones. These phenomena are interesting from the point of view of the evolution of ecological adaptations.

Some herp-based research is done at most of Israel's seven universities. Herpetofaunal research is centered in the HUJ (Hebrew University of Jerusalem) and the IHIC (Israel Herpetological Information Center) of the SPNI (Society for the protection of Nature in Israel).

Geopolitical isolation has hobbled the faunistic research. But examination of matrerial from adjacent countries, in European and U.S. museums, has enabled some advances in the knowledge of the herpetofauna of the Levant.

Israel has no natural history museum. Only HUJ and TAU (Tel Aviv University) have herpetological museum collections (approx. 20,000 items in each) and these cooperate within the the "National Collections of Natural History".

The major collection of live reptiles is at TAU. A gecko facility at HUJ serves varied research, recently - of captive longevity. The other main live reptile exhibits are maintained by NRA (Nature Reserves Authority) and by the SPNI. Problematic are snake menageries illegally amassed by youngsters who often lack a general interest in biology.

All herps are legally protected, as conservation issues are acute: Each ecosystem is vulnerable, existing only in a small area within Israel, and that at the most extreme acceptable conditions. Land is competed for by agricultural and urban development, roads and the army. Nature reserves are too small and some coincide with shelling ranges.

Basic herpetological and conservational education is

offered amateurs and the public by the SPNI through its IHIC (publisher of "Hardun"). An annual herp symposium is co-organized by IHIC with HUJ and NRA. General fauna courses are taught at some universities but only HUJ offers herpetology courses, undergraduate and graduate. Student projects in the graduate course often get published.

Some highlights of Israel's herpetofauna, with emphasis on recent advances, follow.

The six amphibian species are European-Mediterranean, each with its own southern limit towards the desert. Thanks to the work of Hans Schneider et al., our treefrog is now Hyla savignyi, not H. arborea, and our frog, Rana levantina, not R. ridibunda. A seventh species, Discoglossus nigriventer, was endemic and is almost certainly extinct.

The Mediterranean Sea and the Gulf of Elat of the Red Sea, flanking Israel, harbor six marine turtles which are cosmopolitan. The large Trionyx triunguis barely survives in some rivers. The above are the only reptiles closely monitored by the NRA. Mauremys caspica is spreading in polluted reservoirs. Testudo graeca, in the Mediterranean, is taxonomically problematical. T. kleinmanni, in desert sands, is endangered.

The Gekkoninae exemplify Israel's biogeography: The Mediterranean Cyrtodactylus kotschyi is restricted to the mesic north, C. amictopholis is endemic on Mt. Hermon, and C. scaber is a recent settler at Elat. Hemidactylus turcicus occurs country-wide but varies geographically. Stenodactylus sthenodactylus occurs throughout the desert while the Saharan S. petriii is restricted to the SW sands and the Arabian S. doriae and Bunopus blanfordii are restricted to the SE sands. The tiny Tropiocolotes of the desert is taxonomically problematical. Exceptional are the three parapatric Ptyodactylus spp. whose boundaries break the rules.

Among Agamidae, Agama stellio occurs country-wide but in two-plus sspp; three other Agama and two Uromastyx species occupy specific desert habitats. Ophisaurus apodus (Anguidae) and Chamaeleo chamaeleon recticrista live in the mesic north; C. c. musae and the Saharo-Sindian Varanus griseus - in sandy parts of the south. The eight Scincidae (half are viviparous) include a congener of U.S. reptiles - Eumeces schneideri (in mesic and desert sspp.) and two Saharan sandswimmers, Scincus scincus and Sphenops sepsoides. The Lacertidae include in the north Lacerta trilineata israelica, L. laevis and Ophisops elegans and in the south five Acanthodactylus spp. and two Mesalina spp. (formerly in Eremias).

Of primitive snakes Israel has only one Leptotyphlops, two Typhlops and one Eryx species. Among "aglyphous" Colubridae Coluber includes three Mediterranean and five desert species, including both C. elegantissimus and C. sinai; Eirenis (formerly in Contia) includes three Mediterranean and one desert species; Natrix tessellata and Rhynchocalamus melanocephalus occur in the north and Lytorhynchus diadema and Spalerosophis diadema in sandy desert.

Antibodies as Therapeutic Agents

As diagnostic agents, monoclonal antibodies are unparalleled. Because they all recognize the same part of the antigen, they are very specific. As therapeutic agents, however, they are less ideal. Because they recognize the same binding sites, very few, perhaps only one, can bind to each antigen molecule. This may have little effect on the antigen. Other major problems are the cost and the fact that monoclonal antibodies are usually IgG; thus, their antigenicity is high.

Digoxin Fab is an excellent example of how the relatively simple polyclonal Fab technology produces more useful and cost effective therapy. Digoxin Fab is produced by immunization of sheep with digoxin, harvesting of the blood and isolation of the IgG. The IgG is then digested to Fab. The Fab is purified to contain only Fab specific to digoxin. Finally, this is packaged and sold for the treatment of digoxin poisoning. Digoxin Fab quickly reverses digitalis toxicity as well as other cardiac glycosides. It causes extremely few allergic reactions, either ananaphylaxis or serum sickness.

Polyclonal Fab: The Future

Antivenoms are a natural choice for polyclonal Fab application. In reality antivenoms are simply impure IgG solutions. For example, the currently available rattlesnake antivenin is made by immunizing a horse with rattlesnake venom, harvesting the blood, partially purifying the serum and then administering the serum to snakebite victims. Because of the proteins present in addition to the IgG, it produces a high incidence of acute allergic reactions, including anaphylaxis, and also causes serum sickness. Other potential applications of this technology include black widow, coral snake and scorpion envenomation.

Clinical trials of the new antivenin, Polyvalent Crotalidae Antivenin, Ovine Fab (FabAV) are underway in the United States. FabAV is produced in sheep immunized with the venom from one of the following pit vipers: eastern diamondback (C. adamanteus), western diamondback (C. atrox), mojave rattlesnake (C. s. scutulatus), or cottonmouth (Agkistrodon piscivoris). The antibody containing fraction is isolated from each of the 4 monospecific antiserum pools by sodium sulfate precipitation. This is followed by papain digestion, which dissociates the venom binding moiety of the IgG (Fab) from the remainder of the antibody (Fc), with the Fc fragments then removed by cold precipitation. The resulting monospecific Fab fractions are refined further by affinity purification against the respective venoms, dialyzed, combined in equal proportions and lyophilized.

Preliminary research on FabAV has demonstrated a high efficacy and minimal adverse reactions. Furthermore, although the use of Fab antivenin is new, extensive clinical experience is available for digoxin-specific Fab fragments (Digibind), which is produced in a manner identical to FabAV. Digibind in sealed vials has been found to be stable at 45 degrees centigrade for at least 7 days. Digoxin-specific Fab is uniformly well tolerated, does not require skin testing, and in a series of 717 patients treated with Digibind, there was no evidence of anaphylaxis found in any patient.

In addition to improving the therapeutics available to a snake bite victim once he reaches a medical facility, FabAV may have valuable field applications. However, several factors must be investigated to determine if field use of this antivenin is safe and practical. These include 1) the stability of the antivenin in conditions likely to be encountered in the field, 2) an assessment of the adequacy of intramuscular or subcutaneous administration, and 3) continued assessment of ongoing human studies for any adverse reactions such as anaphylaxis which require medical care not available in the field.

Summary

Polyclonal antibodies have been slower to receive attention than monoclonal antibodies. Despite lack of attention relatively modest efforts are leading to striking successes in contrast to monoclonal antibodies. The future holds an explosion of application of this simple and relatively inexpensive technology.

THE HERPETOFAUNA OF BAJA CALIFORNIA AND THE SEA OF CORTÉS, MÉXICO

L. Lee Grismer

Baja California and the Sea of Cortés are two of the most environmentally diverse regions with North America. Much of this has to do with the unique tectonic origin of these areas, being torn away from the west coast of México over the last 4.5 to 5 million years. Northern Baja California alone supports cool coastal srcub habitats, coniferous forests reaching over 10,000 feet in elevation, and rainshadow deserts which have been considered to be one of the dryest and hottest places in the entire world. Central Baja California supports broad expanses of volcanic badlands interrupted by spring-fed oases as well as one of only three of the world's coastal fog deserts. The southern tip of Baja California extends below the tropic of cancer and much of this area is dominated by tropical deciduous forests. The Sea of Cortés is unique in that harbors 65 to 70 islands of varying sizes, shapes, and origins. Some are continental, some are landbridge, and still yet others are oceanic. This environmental diversity has had a rippling effect on the herpetofauna of these regions, promoting a broad array of adaptive types and endemics.

The Biology and Conservation of the Giant Geckos (genus Rhacodactylus) of New Caledonia

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The carphodactyline genus Rhacodactylus is represented in New Caledonia by six species of large to very large arboreal geckos. One of these, R. ciliatus, has not been seen alive since the 1880's, but the remaining taxa may be locally abundant in appropriate habitats. Species of Rhacodactylus are among the largest native predators in New Caledonia, and include some of the largest geckos in the world. Although little is known of the biology of these lizards in the wild, there is some evidence to suggest that habitat preference is correlated with body size, with the largest species, R. leachianus (to 250 mm SVL or more), preferentially occupying the canopy, whereas smaller forms are most often encountered at lower positions on smaller trees. The smallest species, R. auriculatus, although chiefly arboreal, may spend significant periods of time on the ground. At least in R. leachianus there appears to be intersexual differences in habitat preference and activity pattern.

The wild diet of most species is not known, but R. auriculatus takes other lizards (both geckos and skinks) as well as a variety of arthropod prey. It also apparently feeds on pollen, as has been previously reported for a number of other insular geckos. The dentition of this species is specialized for piercing large vertebrate prey. Other Rhacodactylus are chiefly insectivorous, although birds are also known to be taken as prey and all species appear to eat fruit when it is available. Reproduction of those species examined occurs throughout the year, although the greatest percentage of females are gravid in spring (September-November).

All Rhacodactylus species are limited in distribution to the humid forests of eastern and southern New Caledonia and the nearby Isle of Pines and Belep Isles. R. leachianus occupies nearly all of this area, but all other species are more restricted. R. auriculatus and R. sarasinorum are restricted to the souther ultramafic block of the main island of New Caledonia, whereas R. chahoua is found only along the central east coast. R. trachyrhynchus occupies both the south and central regions, but has not been found in the north of the island. As many as four species of Rhacodactylus may occur sympatrically, although this has only been documented in the vicinity of Yaté.

Threats to the New Caledonian herpetofauna, and Rhacodactylus in particular, come from a variety of sources. Agricultural clearing and burning and logging activities in the rainforests of the east coast and southern ultramafic block of the island are responsible for extensive habitat degradation that effectively results in local extinction. Mining activity and housing development, although less important, may also have a negative impact on the geckos. The introduction of non-volant mammals, including rats, to New Caledonia has also undoubtedly had an impact on the native lizards. The available fossil and sub-fossil evidence from New Caledonia suggests that several reptiles, possibly including species of Rhacodactylus, have become extinct since the arrival of man in the region. Conservation efforts should focus on habitat protection, public education, and the inclusion of reptiles in a broader campaign to preserve terrestrial biotic diversity in New Caledonia.

Infectious Diseases of Amphibians

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Infectious diseases are the main source of pathology of captive amphibians. Various helminths have been described as parasitizing amphibians, but the pathological and medical aspects of these parasites have been poorly studied. Anthelminthics that have been used without apparent adverse effects in amphibians include levamisole, fenbendazole, ivermectin, and praziquantel. Protozoal diseases of significance are usually ectoparasites, and the conditions usually respond to appropriate anti-protozoal baths as have been described for tropical fish. Fungal and bacterial infections are important causes of mortality in captive amphibian collections. Samples of skin lesions and other tissue samples should be collected to assist in the diagnosis of an illness. Proper diagnosis of the pathogenic agent responsible for a given illness may require specialized microbial culturing techniques. Antifungal baths and parenteral agents may be used to treat saprolegniasis, but some fungi (e.g., chromoblastomycetes) do not respond to treatment short of surgical excision. Aeromonas spp. are significant disease agents in amphibians, but many other Gram negative bacteria can cause clinical signs of "red leg". Antibiotics that have been used in the management of bacterial infections include tetracycline, doxycycline, amikacin, gentocin, pipracillin, and chloromycetin. Antibiotic of choice (pending culture results) for an isolated case of bacterial disease is amikacin +/- pipracillin where as outbreaks of disease may warrant treatment with tetracyclines. Viral infections of various types have been described from amphibians, but their clinical significance is poorly documented outside of Lucke's renal tumor/herpesvirus in leopard frogs. Since inappropriate husbandry may stress an amphibian and alter its immunocompetence, any diagnosis of infectious disease warrants review of the husbandry and quarantine protocol used within a collection.

Veterinary Management of Indoor Collections of Chameleons

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The captive management and breeding of chameleons -- Chameleoculture -- has always been a challenge. Although progress has been made over the last few years. chameleons often adjust poorly to life in captivity.

Chameleons tend to be easily stressed animals. Stress exacerbates both infectious and non-infectious disease. Minimizing stress is the first step in resolving many of the problems discussed in this presentation.

Of the non-infectious diseases, the most typical problems are nutritional-related disorders, including metabolic bone disease and over/under supplementation. Chameleons that are housed indoors typically lack exposure to natural sunlight, and must rely on artificial sources for vitamin D3. When used incorrectly, artificial light sources and nutritional supplementation can be detrimental to the chameleon's health. A proper balance must be maintained.

Other non-infectious problems include, dystocia (inability to lay eggs or give birth), trauma, and general husbandry practices.

Infectious diseases are also common in chameleons. Typical bacterial-related problems include pneumonia, mouth rot (infectious stomatitis) and abscesses. Bacteria cultured from these infections are usually gram negative bacteria, such as Pseudomonas, Aeromonas, Klebsiella, Proteus, and a host of others. Parasitic infections include, nematodes (round worms), cestodes (tape worms), coccidia, flagellates, and amoeba.

In addition to bacterial and parasitic problems, there may also be concurrent, unidentified viral infections that may complicate both infectious and non-infectious diseases. To minimize the spread of any disease, it is critical that new animals are quarantined for a minimum of sixty days.

Continued research into nutrition, disease management, and breeding is crucial if we are to solve the mystery of chameleoculture.

EXCITATORY AND INHIBITORY EFFECTS OF MALE COMBAT IN SNAKES: IMPLICATIONS FOR MANAGEMENT IN CAPTIVITY

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Combat behavior in snakes has been documented in a wide variety of species in all of the major lineages (Boidae, Colubridae, Elapidae, and Viperidae). As far is known, combat behavior is restricted to the male sex, and most evidence to date supports the intrasexual competition hypothesis (i.e. males compete with each other to gain priority access to mates). In pairwise contests, generally one male emerges as the winner and the other the loser. The distinction between these two behavioral categories can be pronounced, and whether an individual is a winner or loser can have significant effects on (i) ability to win in subsequent contests, and (ii) other fitness-related behaviors, such as courtship. My recent lab work on a large group of copperheads (Agkistrodon contortrix), a North American viperid, has demonstrated that post-fight behavioral effects differ dramatically between winners and losers: combat and courtship are negatively affected (i.e. inhibitory response) for 1-7 days or more in losers, and the converse is observed in winners, with neither combat nor courtship inhibited; in fact, they are affected positively (i.e. excitatory response). Further, my colleagues and I have recently discovered that plasma levels of one stress-related glucocorticoid hormone, corticosterone (CS), differ in winners and losers, with losers have significantly higher plasma levels of CS at 1-hour post-fight. This relationship may show that corticosterone mediates and/or controls inhibitory responses at the level of central nervous system (e.g. GABA) where regulation of sexual behaviors occurs. A general model for this inhibitory response will be presented. The types of data I will discuss have direct implications for captive management of snake species where combat is exhibited, and especially where fatal fighting can occur (e.g. in certain boids, such as Morelia viridis). I will discuss both the benefits and costs of using fighting behavior as an ethological tool to stimulate male sexual interest/activity (e.g. courtship). Further, I will suggest several possible non-injurious alternatives to fighting that utilize chemosensory and visual cues that may be equally effective in stimulating male sexual behavior.

HUSBANDRY AND NATURAL HISTORY OF PHYLLOMEDUSINE FROGS WITH NOTES ON CAPTIVE REPRODUCTION

Michael Ready - Temple City, CA
Dante Fenolio - Saratoga, CA

The Phyllomedusine frogs are a unique sub-family of Hylidae whose range extends throughout most of Latin America. Photographic examples of Phyllomedusa, Pachymedusa, and Agalychnis are presented. Recent taxonomic revision has divided what was three genera into six: Phyllomedusa, Pachymedusa, Agalychnis, Phasmahyla, Hylomantis, and Phrynomedusa respectively (Duellman, 1993). Techniques for captive reproduction such as rain chamber design, temperature manipulation, and preconditioning of adult frogs are covered. All of the frogs of the sub-family Phyllomedusinae oviposit upon vegetation over either temporary or permanent bodies of water. Two methods of egg deposition are known; gelatinous masses of eggs deposited either on top of or underneath leaves, as in Agalychnis and Pachymedusa, or an actual leaf funnel is constructed around the eggs as they are deposited, as in Phyllomedusa. Representative photographs of both egg deposition and styles are shown. Raising larvae through metamorphosis with discussion of specific dietary formulas and required water quality parameters is included. Successful methodology developed by the presenters for rearing problematic froglets, and maintenance of adult animals (vivarium design & methods of food administration) are presented. Agalychnis callidryas and P. hypochondrialis both demonstrate at least two different types of vocalizations: territorial and reproductive. Auditory examples depicting differences between mating and territorial calls of these two exemplary species are included. Observations of new reproductive/territorial behaviors among male frogs of the genus Agalychnis are described.

REPTILE RANCHING

RON & MARILYN TREMPER, CENTER FOR REPTILE & AMPHIBIAN PROPAGATION
BOERNE, TEXAS

THE REPTILE HOBBY HAS NOW GROWN INTO THE REPTILE INDUSTRY. LARGE-SCALE BREEDING OPERATIONS THAT INCLUDE OUTDOOR SYSTEMS ARE NOT ONLY BEING ESTABLISHED IN THE '90's BUT ARE NECESSARY FOR NEWLY EXPANDED LIZARD KEEPING EFFORTS AND INTEREST.

IN OCTOBER 1993, CENTER'S NEWLY BUILT STATE-OF-THE-ART 9,200 sq. ft. FACILITY WAS COMPLETED IN BOERNE, TEXAS, LOCATED SOME 30 MILES NORTHWEST OF SAN ANTONIO.

FEATURES OF THE FACILITY:

3 - 10' x 80' INDOOR TEMPERATUE CONTROLLED ANIMAL HALLS, EACH WITH FOUR 16' WIDE R-17 INSULATED AUTOMATIC DOORS FACING SOUTH TO ALLOW DIRECT U.V. IRRADIATION ON CAPTIVES.

3 - 15' x 80' OUTDOOR COURTYARDS CONTAINING TWO 6' x 27' BREEDING AREAS.

1 - 12' x 50' INDOOR FOOD ROOM USED TO HOUSE AND RAISE RODENTS AND INSECTS.

1 - 12' x 25' INDOOR CHELONIAN ROOM WITH ATTACHED 9' x 37' OUTDOOR EXERCI
PEN AND EGG-LAYING SITE.

1 - 20' x 30' SHIPMENT PACKING AND WORK ROOM.

1 - 10' x 30' OFFICE, RECEPTION AND RESTROOMS AREA.

1 - 45' X 30' LIVING QUARTERS.

OUR TARGET SPECIES:	CURRENT # BREEDERS	YOUNG PRODUCED ANNUALLY
GEOCHELONE SULCATA	2.2	100
POGANA VITTICEPS	10.30	1200
EUBLEPHARIS MACULARIUS	30.300	2000
CHAMAELEO CALYPTRATUS	14.50	3000

WE ARE EXPANDING THESE FOUR SPECIES GROUPS MONTHLY AND EXPECT TO SURPASS 10,000 CAPTIVE-BRED REPTILES IN 1995.

FIRE ANTS ARE A MAJOR CONCERN. A 30-FOOT WIDE CLEAR SAFETY ZONE SURROUNDS THE BUILDING SO THAT NEWLY FORMED NESTS CAN BE TREATED WITH POISON GRANULES WEEKLY. TO DATE, NO LOOSES HAVE OCCURRED FROM THESE ANTS.

BECAUSE OF THE SURROUNDING CONFIGURATION OF THE INDOOR ROOMS THE OUTDOOR COURTYARDS ARE AFFORDED FULL SECURITY FROM VERTEBRATE PREDATORS.

A MONITORED BURGLAR ALARM SYSTEM IS PRESENT FOR TWO-LEGGED PREDATORS.

REPTILE RANCHING IS HERE TO STAY.

HUSBANDRY OF LAMPROPELTIS

Ronald G. Markel

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A slide presentation on the genus species and subspecies of Lampropeltis. Included are all known morphisms, wild caught as well as captive bred. Particular attention will be the maintenance, rearing, and selective breeding of kingsnakes and milksnakes. Also included are cage designs, thermoregulation, diet hibernation, and pre-breeding requirements. The next area is selective breeding, egg disposition, incubation and rearing juveniles and problems associated with same.

RATTLESNAKE RELOCATION AT THE ARIZONA-SONORA DESERT MUSEUM:
Results of a Three-Year Study

By
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The Arizona-Sonora Desert Museum (ASDM) is located 24 kilometers west of Tucson, Arizona in Tucson Mountain Park. The habitat surrounding the Museum is defined as the Arizona-Upland subdivision of Sonoran Desertscrub and is characterized by low, rugged mountains with associated basins or flatlands.

Since its opening in 1952, free-ranging wildlife, including mammals, birds, numerous arthropods, amphibians and reptiles, have been commonly encountered. In 1967, a Rattlesnake Removal Program was initiated. The rattlesnakes found on the grounds were captured and relocated off grounds. The intent of this program was to prevent accidental bites to the visiting public and/or staff. The numbers of rattlesnakes collected over the years has varied from a low of 4 in 1974 to a high of 79 in 1989. Five species have been observed: Western Diamondback Rattlesnakes (*Crotalus atrox*), Tiger Rattlesnakes (*Crotalus tigris*), Black-tailed Rattlesnakes (*Crotalus molossus*), Mohave Rattlesnakes (*Crotalus scutulatus*) and the Sidewinder (*Crotalus cerastes*).

Beginning in 1991, data on each individual snake such as species, sex, approximate length, and notable physical characteristics were recorded. All snakes were individually marked by ventral scale clip prior to release at one of five sites. In 1992 two additional release sites were added.

Over the past three years there have been 84 snake captures; 79 *Crotalus atrox*, 9 *Crotalus tigris*, and 1 *Crotalus molossus*. *Crotalus atrox* have been collected between March and November with males peaking in the summer months, while females are more common in late spring. Male *Crotalus tigris* have been found from May through September while the only female occurred in September. Historically, *Crotalus molossus* have occurred in late summer while the one collected during this study was found in July.

Of the 84 snake captures, 22 have been recaptures. Recapture frequency correlates positively with distance from the Museum grounds, with the most snakes returning to the Museum grounds from the release sites closest to the museum. One individual has been removed on five separate occasions, has twice returned from 1.5 km away.

While the data are interesting, at the very least several more years of data will be necessary to evaluate their significance.

BREEDING THE KOMODO MONITOR AT THE NATIONAL ZOOLOGICAL PARK

Trooper Walsh & Roger Rosscoe

National Zoological Park, Smithsonian Institution, Washington, D.C. 20008-2598

During the National Zoo's 105 year history a total of seven adult Komodo dragons (Varanus komodoensis) have been exhibited. Most of these animals lived for less than five years, and although eggs were laid none of them appeared to be fertile. In 1988 NZP received a pair of young animals as a state gift from the people of Indonesia. These dragons first bred in 1991 and in January of 1992 eggs were recovered. Since then the female has bred three times with two males. Two of these breedings were at the Cincinnati Zoo and involved one of their males. Forty-five young dragons have resulted from these breedings.

This paper will describe aspects relevant to the breeding of Komodo dragons. We will discuss environmental factors in the breeding enclosures, the behaviors of the males and female prior to, during, and after courtship and egg laying, nest characteristics, incubation techniques, the characteristics of the young, and rearing techniques.

In conclusion we will discuss the future of dragons in zoos.

FEDERAL LAW ENFORCEMENT'S CHANGING ROLE IN THE PROTECTION OF NATIVE HERPETOFAUNA

Len Jones

USFWS

The significance and responsibility of law enforcement in wildlife management has changed dramatically in recent years. The United States Fish and Wildlife Service (USFWS) has three separate positions which deal exclusively with the enforcement of federal wildlife laws:

(1) Wildlife Inspectors
(2) Special Agents
(3) Refuge Officers

The wildlife inspector program is designed primarily to address international import and export issues. Special agents and refuge officers, however, are becoming increasingly involved in herpetological issues here in the United States.

Historically, reptiles and amphibians have been excluded from mainstream wildlife management objectives and subsequent conservation laws. The lucrative commercial trade in skins, meat and live native herpetofauna has benefited tremendously from this lack of interest. Likewise, wildlife law enforcement has suffered from a similar disdain for this resource as well as from a lack of knowledgeable personnel.

Recognizing these factors, in 1990 the Federal Law Enforcement Training Center in Glynco, Georgia initiated a series of training regimens designed to foster a new appreciation of the herpetological resource. These first sessions addressed primarily the broad spectrum of reptile and amphibian commercialization. Today expanded USFWS required curriculums include species identification, product recognition, handling of potentially dangerous species, herpetological case histories and practical exercises designed to place the student in simulated "real life" scenarios. These scenarios have included alligator poaching, skin and sea turtle part smuggling, snake den gassing, malicious snake killing and commercial collecting on federal properties. Exercises such as these have greatly enhanced the future officers ability to recognize specific violations. In addition, students have expressed a far greater appreciation of the herpetological resource after undergoing these training programs. The USFWS has offered this instruction to many other federal, state and local agencies, as well as in local academic curriculums and conservation group presentations.

The creation of sound state conservation law is arguably a critical component of responsible resource management. These laws must be biologically sensible as well as enforceable by appropriate law enforcement agencies. Subsequently, the consultation of both the scientific and law enforcement communities is necessary in the birth of viable herpetological resource laws.

It is frequently the violation of a single state law which initiates a federal investigation by the USFWS. Once such a law has been violated and the object of the violation (ie. product, live animal, etc.) has been transported across state lines (via person, mail, air freight, etc.) the offender is subject to investigation and possible prosecution under the Lacey Act (16USC 3371-3378). While the applications of the Lacey Act are diverse and understandably complex, it has been the backbone of successful wildlife offense prosecutions. One such significant herpetological case in point is a timber rattlesnake (Crotalus horridus horridus) investigation of 1993 which resulted in successful felony convictions under the Lacey Act. This case revolved around the mass collection of endangered northeastern timber rattlesnakes by a single collector and interstate sales of the captives. He was assisted in his endeavors by an accomplice who was also successfully prosecuted. These convictions were very significant for several reasons:

(1) They represented federal felony convictions initiated by multiple violations of state law.
(2) They involved a violator whose detrimental impact on a herpetological resource had been historically documented.
(3) The case clearly demonstrates the federal government's willingness to prosecute a venomous reptile case with successful results.
(4) The scientific community assisted the USFWS in making the investigation and prosecution possible.

It is my sincere hope that our native pit vipers will continue to experience attention from federal law enforcement investigations.

Illicit activity with native herpetofauna includes a multitude of offenses. These offenses range from the single malicious killing of a live animal on a national wildlife refuge, to the unlawful take of sea turtles or their eggs, to interstate transport of protected species to sell, to commercial collection of live reptiles and amphibians on federal properties.

Enforcement of conservation laws is vital to the survival of our wild herpetological resources. Given the poor track record for captive produced reintroductions to the wild, protection of remaining habitats and native populations must be paramount. As so many species are decimated prior to the scientific evaluation of life history data, these protected areas should be utilized for such study. The responsibilities of wildlife law enforcement are increasingly complex and we need the assistance and support of those who value our herpetological resources.

METABOLIC BONE DISEASE IN REPTILES

Thomas H. Boyer, D.V.M.

Deer Crest Animal Hospital, 10148 West Chatfield Avenue, Littleton, CO 80127.

Metabolic bone disease (MBD) is a common disease of rapidly growing reptiles, but is less common once normal bone formation occurs. MBD is the long term result of insufficient dietary calcium (Ca) or vitamin D, excessive dietary phosphorous (P), a negative dietary Ca to P ratio, and/or inadequate ultraviolet (UV) light. MBD is diagnosed from dietary history, clinical signs, radiographs and serum Ca and P levels. Two distinct forms of MBD are present in lizards. The first, more prevalent in growing lizards, is classic MBD, with most symptoms referable to the skeletal system. The second, more prevalent in adult iguanas, has symptoms secondary to hypocalcemia, such as paresis and muscle fasiculations. In classic MBD symptoms include poor truncal lifting, pliable mandibule or maxilla, a rounded infantile skull, fractures, fibrous osteodystrophy, spinal deviations, rear limb paresis, decreased appetite or no weight gain. Radiographically there is decreased bone density, increased cortical width and fractures. Serum Ca may be decreased and P elevated or they may be normal. In chelonians, if the shell never calcified, the shell feels soft and there may be other shell and skull abnormalities. In turtles that developed a normal shell before a calcium deficient diet was instituted, the shell feels firm but looks too small for the turtle. Treatment consists of good nursing care, improved diet with calcium and vitamin D supplementation, calcium and calcitonin injections, (if the patient is normocalcemic), and fracture management. The prognosis for recovery is good to excellent with aggressive veterinary treatment.

TROPICAL DISCOVERY: A NEW FACILITY AT THE DENVER ZOO

Rick Haeffner

Curator of Reptiles/Fish, Denver Zoo, 2300 Steele Street, City Park, Denver, CO

In November of 1993 the Denver Zoo opened a new 41, 600 sq. foot, $10 million dollar facility called Tropical Discovery. This building houses some 1900 specimens represented by 330 species. The theme of the building is to show tropical diversity and we have specimens from the following taxa: mammals, insects, arachnids, reptiles, amphibians, freshwater fish and marine aquatic invertebrates.

This talk will highlight the various displays, the layout of the building, and show representative species displayed. In addition, there will be an emphasis on the 89 different amphibian and reptile species, their displays, holding facilities, and our department's future plans for research and reproduction.

THE STATUS OF SELECTED THAI SNAKES

Merel Cox
Bangkok, Thailand

The history and present status of Herpetology in Thailand, including the contributions of Malcom Smith, Boonsong-Lekagul, Edward H. Taylor, and that of current workers is presented. The status of the genus Naja (N. kaouthia, N. siamensis, and N. sumatrana) is discussed, pointing out that the confusion which has long been associated with this group of snakes finally appears to be settled. The status of the genus Trimeresurus (T. albolabris, T. hageni, T. kanburiensis, T. macrops, T. popeorum, T. puniceus, T. purpureomaculatus, T. stejnegeri, T. sumatranus, and T. venustus) is discussed; confusion abounds. The status of the genus Oligodon (O. barroni, O. cinereus, O. dorsalis, O. fasciolatus, O. inornatus, O. joynsoni, O. mouhoti, O. purpurascens, and O. taeniatus) is reviewed. Years of confusion surrounding O. cinereus and O. cyclurus have ended.

SNAKES OF ECUADOR: MY PERSONAL EXPERIENCES IN CAPTIVE BREEDING

Jean Marc Touzet

Quito, Ecuador

Comprising about 200 taxons, the fauna of Ecuador's snakes is one of the world's richest. It is also one of the less known. Since the beginning of our work in the country, we have been able to get important data on the biology and behaviour of the local species. With the help of numerous slides, we will show the feeding, breeding, character, etc... of the fauna's representants that we could observe in the open and in captivity. We will present the technical conditions of our breeding and the difficulties that we have to face.

THE VIVARIUM OF THE GUSTAVO ORCES HERPETOLOGICAL FOUNDATION: NEW GOALS IN SOUTH AMERICA

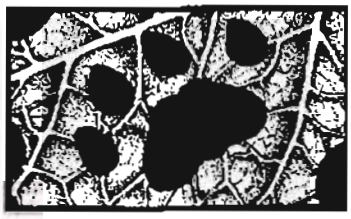
Jean Marc Touzet

Quito, Ecuador

The Gustavo Orces Herpetological Foundation (FHGO) has been created on July 1989. On December of the same year, the FHGO started the project "Vivarium", wich is a permanent public exhibition of herpetological fauna.
In contrast with the deplorable situation of the fauna collections, improperly called "zoos" in Ecuador, the Vivarium of the FHGO has demonstrated to be an adequate instrument for the fulfillment of the four principal objectives of every modern fauna collection: Education, Research, Species Protection and Entertainment.
The following goals have been achieved:
- First legal center of captive fauna in the country;
- Good national and international fame;
- Long-lived fauna collection, demonstrative of a successfull professional management;
- Direct information about reptile and amphibian biology brought to more than 26.000 scholars and students in Ecuador;
- Finding of acceptable solutions for 600 animals saved from illegal animal trade.

These innovations arise from various actions:
- Permanent staff formation and qualification;
- Implementation of file and control systems that allows a transparency on the captive fauna management;
- Concrete educational statements;
- Educational programs for trainees on captive fauna management;
- Joint actions with the Authorities and NGOs in campaigns against illegal species trade;
- General fauna management advise;
- Information exchange with national and international research institutions, etc.
The achieved goals have permitted that the Vivarium' public image reached a South-American level.

GREAT NEWS from



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THE AMAZON with JOHN WORTMAN AND BILL LAMAR ..... 20-27 AUGUST
(with optional 1-week extension)
THE AMAZON with BILL CHRISTIE ..... 17-24 SEPTEMBER
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PROGRAM

WEDNESDAY, JUNE 15

7:00 pm - 10:00 pm Registration - Lobby, The Clarion Hotel

THURSDAY, JUNE 16

8:00 am - 5:00 pm Registration - Lobby, The Clarion Hotel
Paper Sessions & Workshops - Tulane Ballroom

8:00 am - 8:15 am Opening Remarks
Richard A. Ross, M.D., President
International Herpetological Symposium, Inc.

8:15 am - 9:00 am Herpetofauna Conservation: The Threatened Species Treadmill
Keynote Address
Harold G. Cogger, Ph.D., Deputy Director
Australian National Museum
Sydney, Australia

9:00 am - 9:30 am The Natural History of Some Unusual Amphibians and Reptiles from Southern Africa
Karl H. Switak, Wildlife Photographer
Santa Rosa, CA

9:30 am - 10:00 am Effects of Habitat Degradation and Climatic Change Upon the Behaviour of Land Tortoises in the Arid Regions of North Africa and the Middle East
A. C. Highfield
The Tortoise Trust
London, England

10:00 am - 10:30 am Elapid Husbandry
Don Middaugh, Curator of Reptiles
Black Hills Reptile Garden
Rapid City, SD

10:30 am - 11:00 am Garter Snake Systematics: A Light at the End of the Tunnel?
Douglas A. Rossman, Ph.D.
Museum of Science
Louisiana State University
Baton Rouge, LA

11:00 am - 12:00 pm Venomous Reptile Management
Workshop
Don Middaugh
Donal M. Boyer
Winston Card

12:00 pm - 1:00 pm	LUNCH
1:00 pm - 1:30 pm	The Lizard Advisory Group's Program for the Lesser Antillean Iguana, Iquana delicatissima Steven B. Reichling, Assistant Curator of Reptiles Memphis Zoo and Aquarium Memphis, TN
1:30 pm - 2:00 pm	Lampropeltis triangulum: Some Taxonomic Problems Kenneth L. Williams, Ph.D. Department of Life Science Northwestern State University of Louisiana Natchitoches, LA
2:00 pm - 2:30 pm	The Herpetofauna of Nuevo León, México: A Preliminary Report Ernest A. Liner Houma, LA
2:30 pm - 3:00 pm	Substrate Selection in Captive Snakes Karl H. Peterson, Curator of Herpetology Houston Zoological Gardens Houston, TX David Lazcano, Curator Museo de Historia Natural Universidad Autónoma de Nuevo León Monterrey, Nuevo León, México
3:00 pm - 3:30 pm	Husbandry and Research of the Bushmaster Lachesis muta at the Dallas Zoo Donal M. Boyer, Supervisor Herpetology Department Dallas Zoo Dallas, TX
3:30 pm - 4:00 pm	New Perspectives on Reptile Anthelmintics Roger J. Klingenberg, D.V.M. Sheep Draw Veterinary Hospital Greeley, CO
4:00 pm - 5:00 pm *Workshop*	Legislative Issues Curt Harbsmeier Len Jones Ernie Cooper
5:00 pm - 7:00 pm	AQUARIUM OF THE AMERICAS

FRIDAY, JUNE 17

8:00 am - 5:00 pm	Registration - Lobby, The Clarion Hotel Paper Sessions and Workshops - Tulane Ballroom
8:30 am - 9:00 am	Dinosaurs and Callisaurs - Slide Presentation John Tashjian, Wildlife Photographer San Marcos, CA
9:00 am - 9:30 am	The Origins of Terrestrial Snakes of the Galapagos Archipelago Robert Thomas, Ph.D., Director Louisiana Nature and Science Center New Orleans, LA
9:30 am - 10:00 am	CITES and the Herpetologist Ernie Cooper, Wildlife Inspector Canadian Wildlife Service Delta, BC, Canada
10:00 am - 10:30 am	Herpetofauna, Herpetology and Conservation in Israel, Land Between the Continents Yehudah L. Werner, Ph.D. Department of Evolution, Systematics and Ecology Hebrew University of Jerusalem Jerusalem, Israel
10:30 am - 11:00 am	Snakes of Ecuador: My Personal Experiences with Captive Breeding Jean Marc Touzet Gustavo Orces Herpetological Foundation Quito, Ecuador
11:00 am - 12:00 pm	Chelonian Husbandry Brett Stearns, L.L.B. A. C. Highfield
12:00 pm - 1:00 pm	LUNCH
1:00 pm - 1:30 pm	Allometric Scaling of Drugs in Reptiles and Amphibians Barbara Bonner, D.V.M. Upton, MA
1:30 pm - 2:00 pm	Regional Diversity and Variation in Pacific Sea Kraits (SERPENTES:LATICAUDIDAE) Harold G. Cogger, Deputy Director Australian National Museum Sydney, Australia

2:00 pm - 2:30 pm	Polyclonal Antibodies - An Emerging Therapy for Snake Venom Poisoning Richard C. Dart, M.D., Ph.D. Rocky Mountain Poison Center Denver, CO
2:30 pm - 3:00 pm	The Herpetofauna of Baja California and the Sea of Cortéz, México L. Lee Grismer, Ph.D. Department of Biology San Diego State University San Diego, CA
3:00 pm - 3:30 pm	The Biology and Conservation of the Giant Geckos (genus Rhacodactylus) of New Caledonia Aaron M. Bauer, Ph.D. Biology Department Villanova University Villanova, PA
3:30 - 4:00 *Workshop*	Veterinary Medicine Tom Boyer, D.V.M. Roger Klingenberg, D.V.M. Scott Stahl, D.V.M. Kevin Wright, D.V.M. Barbara Bonner, D.V.M.
5:00 pm	BUSES GO TO ZOO
5:30 pm	DINNER AT ZOO

SATURDAY, JUNE 18

8:00 am - 12:00 pm	Registration - Lobby, The Clarion Hotel Paper Sessions & Workshops - Tulane Ballroom
8:30 am - 9:00 am	Infectious Diseases of Amphibians Kevin Wright, D.V.M. Curator of Amphibians and Reptiles Philadelphia Zoological Garden Philadelphia, PA
9:00 am - 9:30 am	Veterinary Management of Indoor Collections of Chameleons Scott J. Stahl, D.V.M. Pender Veterinary Clinic Fairfax, VA

9:30 am - 10:00 am	Excitatory and Inhibitory Effects of Male Combat in Snakes: Implications for Management in Captivity Gordon W. Schuett, Ph.D. Life Science Program Arizona State University West Phoenix, AZ
10:00 am - 10:30 am	The Vivarium of the Gustavo Orces Herpetological Foundation: New Goals in South America Jean Marc Touzet Gustavo Orces Herpetological Foundation Quito, Ecuador
10:30 am - 11:00 am	Husbandry and Natural History of Phyllomedusine Frogs with Notes on Captive Reproduction Michael Ready Temple City, CA Dante Fenolio Saratoga, CA
11:00 am - 11:30 am	Reptile Ranching Ron & Marilyn Tremper Center for Reptile and Amphibian Propagation Boerne, TX
11:30 am - 12:00 pm	Husbandry of Lampropeltis Ronald G. Markel Arlington, TX
12:00 pm - 1:00 pm	LUNCH
1:00 pm - 1:30 pm	Rattlesnake Relocation at the Arizona-Sonora Desert Museum: Results of a Three Year Study Janice Perry-Richardson Craig Ivanyi Arizona-Sonora Desert Museum Tucson, AZ
1:30 pm - 2:00 pm	Breeding the Komodo Monitor at the National Zoological Gardens Trooper Walsh, Head Keeper Roger Rosscoe, Animal Keeper National Zoological Gardens Washington, D.C.
2:00 pm - 2:30 pm	Federal Law Enforcement's Role in the Protection of Native Herpetofauna Len Jones Department of Refuges U.S. Fish and Wildlife Service Naples, FL

2:30 pm - 3:00 pm	Metabolic Bone Disease in Reptiles Thomas H. Boyer, D.V.M. Deer Creek Animal Hospital Littleton, CO
3:00 pm - 3:30 pm	The Status of Selected Thai Snakes Merel Cox Bangkok, Thailand
3:30 pm - 4:00 pm	Tropical Discovery: A New Facility at the Denver Zoo Rick Haeffner, Curator of Reptiles/Fish Denver Zoo Denver, CO
4:00 pm - 5:00 pm *Workshop*	Lizard Husbandry Ron Tremper Tim Tytle, M.D. Winston Card Ernst Hoffman
7:00 pm	DINNER
8:00 pm *Banquet Speaker*	Francis Rose, Ph.D. Department of Biology Southwest Texas State University San Marcos, TX "My Life as a Herpetologist, or What is Half of Nothing?"
	ANNOUNCEMENTS PRESENTATION OF JOSEF LASZLO MEMORIAL AWARD AUCTION

SUNDAY, JUNE 19

9:00 - 12:00	Informal Sessions - Tulane Ballroom
9:00 - 10:00	Introduction to Herp Net
10:00 - 11:00	Husbandry and Breeding of the Chinese Giant Treefrog Polypedates (=Racophorus) dennysi Bert Langerwerf Agama International, Inc. Montevallo, AL Followed by: "bring your own slide(s)" (open to anyone)
11:00 - 12:00	Forum on Legislative Issues Len Jones Ernie Cooper Curt Harbsmeier