PURE WHITE RATTLESNAKE

An aberrant female specimen of Eastern Diamondback Rattlesnake, *Crotalus adamanteus* was collected as a 20" juvenile, displaying only the first button, crossing a road approx. 3 miles N. W. of Palm City, Martin County, Florida, on September 19, 1975. She was given to the authors and raised by them since. Nearing 4 years of age, she measures 55" and is still in perfect health.

"Snowflake" apparently lacks all pigment, though the iridophores probably account for the bluish-grey color surrounding the iris and the prismatic luster of her scales after a shed. As a juvenile, she had a pinkish cast due to the somewhat transparent scales and skin, but now she looks pearl white since the scales have enlarged and thickened. No trace of pattern is visible. Blood vessels can clearly be seen below the skin when a meal distends her.

Two other specimens exhibiting this type of aberrancy have been seen by the authors; a Texas Rat Snake, *Elaphe o. lindheimeri*, at the Houston Zoo, Texas, and a Cobra, *Naja naja*, at the Black Hills Reptile Gardens, South Dakota. Plans are to breed "Snowflake" in an attempt to learn how this aberration is inherited.

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NOTES ON THE SEXUAL BEHAVIOR AND THE REPRODUCTION OF *TEIUS TEYOU* (LACERTILIA: TEIIDAE)

Teius teyou is a common Uruguayan species found not only in rocky areas but in sandy zones as well. As the sexual behavior of teiids is poorly known, and as little information is available on the reproduction of this species, the following notes may be of interest.

These observations were made on December 12, 1977, in a sandy area with shrubby vegetation (*Acacia longifolia*) at Canelones Department, Uruguay. A big male was observed walking slowly among the shrubs. Tongue flicks were occasionally directed at the ground. Minutes later, the male started to follow a nearby female. She attempted to move away, but the male pursued, biting her on the dorsum, sides and extremities. The female would free herself, and again retreat. I observed a repeated succession of retreats by the female, accompanied by pursuit and biting by the male. The couple moved several meters during this activity.

The male on one occasion mounted the female and bit her behind the neck. The female remained motionless, and the male bit her dorso-lateral zone, ahead of one of her hind legs. The male moved his trunk and kept his body close to the female's. His cloacal region was in a vertical position. The female moved her body so her cloaca was near the male's, and copulation commenced. The male everted both hemipenes, although only one was utilized. As copulation concluded, the female moved away.

The male then started some post-copulatory activities. He stretched his hind legs, so his cloaca was elevated above the ground. He then retracted his hemipenes, and dragged his cloacal zone on the ground; he also rubbed his lips against the ground and the nearby vegetation. He remained motionless for some minutes, basking, and then walked slowly between the shrubs to about 100 m from the place where copulation took place.

Carpenter (1962) and Müller (1971) described the sexual behavior of *Cnemidophorus sexlineatus* and *C. lemniscatus* respectively. Their observations are similar to these on *T. teyou*. The male I observed did not do any pre-copulatory rubbing. The walking and the exploration of the ground displayed by this male just before copulation has been observed in this species only in this case. This suggests that this behavioral unit is related to sexual behavior. The mount also present in *C. sexlineatus* and *C. lemniscatus* (Carpenter, 1962; Müller, 1971) could be the unit necessary to go from the reiterated pre-copulatory phase to the copulatory one.

Copulations were observed from late October to early December. In November, eggs have been found in *Acromyrmex* ant hills (Vaz-Ferreira, *et al.*, 1970). I have observed a clutch of 8 eggs under a rock (49 x 26 cm, and 15 cm high) at Valle Edén, Tacuarembó Department. The eggs were buried, and only one was visible. A complicated channel system was found under the rocks around the nest. In seven measured eggs, the long axis ranged from 20.0 to 16.9 mm ($\bar{x}$ = 10.3 mm), and the short axis from 12.0 to 14.1 mm ($\bar{x}$ = 13.2 mm). These values are different from those reported by Vaz-Ferreira, *et al.* (1970), who found that 21.4 mm was the minimum long axis and 13.3 mm was the minimum short axis observed. Eight is also a new maximum record of eggs in a clutch.

T. teyou is unique among the lizards of Uruguay as it optionally lays eggs in ant hills or under rocks. It is also apparently a K-strategist species: it is a large, long lived lizard, and a presumed single-brooded species. The eggs laid in ant hills are in a favorable environment, with fairly constant temperature, high humidity and the absence of harmful fungus. The eggs under rocks are affected by the great variations of temperature and rain of the Uruguayan summer. There is no data on nest predators.

It could be assumed that those genotypes that lay their eggs in ant hills could be favored over those that lay their eggs under rocks. This duality in nest site appears to be an interesting topic for future research.

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LITERATURE CITED

Carpenter, C. C. 1962. Patterns of behavior in two Oklahoma lizards. Am. Midl. Nat. 67: 132-151.

Müller, H. 1971. Oekophysiologische and oekethologische Untersuchungen an *Cnemidophorus lemniscatus* L. (Reptilia: Tejidae) in Kolumbien. Forma et Functio 4:189-224.

Vas-Ferreira, R., L. C. de Zolessi and F. Achaval. 1970. Oviposicion y desarrollo de Ofidios y Lacertilios en hormigueros de *Acromyrmex*. Physis (Buenos Aires) 29:431-459.

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HERPETOLOGICAL HUSBANDRY

SUGGESTIONS FOR THE *POST-MORTEM* EXAMINATION OF REPTILES

Collections of living reptiles are unique and valuable biological resources. The purpose of this paper is to encourage herpetologists to enhance the value of this resource by obtaining useful data following the death of any specimen.

Why perform necropsies or "What can be learned from a dead snake?"

Death is the inevitable outcome of life. Too often, we use this truth as an excuse for failing to derive any information from specimens in reptile collections "after the fact." A careful *post-mortem* examination (necropsy) can provide the interested curator and herpetologist, as well as the scientific community at large, with valuable data, much of which is immediately applicable to the living collection. Among other things, a necropsy may provide data on:

1) The cause of death;

2) The existence of infectious diseases which may threaten other specimens;

3) The existence of intercurrent or clinically silent diseases which may not be fatal, but which sap vitality, reduce the fecundity and otherwise, affect the health, value and appearance of specimens;

4) Correlation of clinical signs and tissue changes—Adequate clinical care of ill animals simply cannot be provided if no one knows, for example, what the possible causes of abdominal distension in snakes are; how rapidly each may progress; which occur most frequently; what the effects of the treatment were, etc.;

5) Efficacy of treatment—If we treat an animal for some clinical condition and it dies, the treatment was obviously no good and should not be used again - or should it? Did the specimen die of the condition for which it was being treated? Was the clinical diagnosis both correct and complete? Necropsy may provide at least partial answers to these and similar questions;

6) Incidence of various types of diseases in captive reptile collections—This endeavor is no less important than the short-term studies, but requires the help and cooperation of many collections to compile adequate statistics. One current effort in this area is the Registry of Tumors in Lower Animals at the Smithsonian Institution. Help yourself and help your colleagues by contributing to these collections.

One final plea for the necropsy: it provides us all an opportunity to refresh and add to our knowledge of normal anatomy and even to determine what "normal" anatomy is in some of the more exotic specimens. All too often, normal tissues are submitted to laboratories identified as "worms," "tumors," etc. It is appalling to think how many lesions may be dismissed as "normal"!

What are the objectives? or "I cut up the carcass just like you said and I didn't learn anything!"

The necropsy can provide reams of valuable and useful information, but not without a little foresight. Before anything at all is done with the animal, the investigator must decide what goals are to be achieved by the necropsy and how these goals rank in importance. The goals cannot be achieved without adequate advance preparation. The following table provides some examples.

PROBLEM OR QUESTION	GOAL	BE PREPARED TO
Infectious disease suspected	Identify causative agent.	Collect samples aseptically; provide samples to lab and/or identify agent(s); provide appropriate storage if necessary.
Chemical agent suspected	Identify causative chemical.	Collect proper fluids or tissue in appropriate containers; provide means to identify suspected chemical; store sample properly.
Confirm clinical interpretation	Account for each major clinical sign; assess effects of treatment; render diagnosis.	Examine each organ systematically; collect appropriate specimens for more detailed study (e.g. - fixed tissue for histopathology).

If a suspected disease is under study by a central registry, provide specimens and other documentation adequate for the purposes of the registry collection. Give detailed descriptions of autopsy findings. Document with photographs. Collect specialized materials, (*e.g.* fix tissues for electron microscopy; collect living cells for tissue culture).

If the dead animal is unusual enough to warrant further taxonomic study, preserve the specimen so that accurate taxonomic data can be obtained. Identify and preserve key organs or tissues required for accurate taxonomic classification. Accurately record findings which cannot be preserved.

Some Suggested Techniques or "There's More Than One Way To Shell a Turtle."

A necropsy is a systematic examination of body organs and tissues following death. A little attention to technique will make the whole thing go smoother and easier. Some suggestions for performing a necropsy follow. Obviously, the goals of the necropsy may dictate some changes in the approach. These suggestions provide a starting point.

Some cardinal necropsy rules are:

1. DON'T WAIT - Spoiled tissues are no help to anyone.
2. BE PREPARED - Sterile equipment, culture media, preservatives, arrangements with consultants, etc. all require forethought. Do it now.
3. FREEZING RUINS TISSUES for microscopic study. Hold dead animals at refrigerator temperatures. Do the necropsy promptly. A frozen carcass *may* be acceptable for preservation of infectious or chemical agents of disease. Check with your lab or an appropriate reference to confirm this for the agents you suspect.
4. PICK and RANK the GOALS.
5. HAVE A PLAN - Why are you doing the necropsy? Which goal is the primary one and which are secondary ones? You can usually achieve more than one objective -especially with a little foresight.
6. Take notes and write it all down.
7. Save samples of ALL major organs and tissues.
8. Use sharp instruments.
9. Cut thin (2-4 mm) pieces of tissue with a SHARP BLADE (not scissors) for fixation.
10. Use 10 to 20 times as much formalin as you have tissue. Use neutral buffered formalin if at all possible.
11. Label and date ALL containers.
12. Store properly.

The Basic Necropsy Procedure may be performed as follows:

1) Examine the entire body, this includes all body openings, body coverings, eyes, oral cavity (be careful with the fangs of venomous snakes), cloaca, penis, etc. Look into and under scales, skin folds, shell crevices, eyelids, etc. Look for blood, discharges, foreign bodies, parasites, food, wounds, etc. The shell of turtles should be specifically examined for cracks, separations and other evidence of injury.

2) Lay the body on its back and make a midline incision through the skin from the end of the lower jaw all the way to the posterior end of the body cavity. If a specimen is to be saved for museum study, cut at juncture of ventrals with dorsals. Carefully remove the skin from the ventral and lateral body walls. Carefully describe any lesions associated with the skin or shell and remove those lesions along with the skin. Observe the condition of the muscle and subcutaneous tissue. Now cut through the ventral body wall itself and expose the body cavity. The plastron and carapace of turtles should be separated at the bridge with a butcher saw, coarse bladed hacksaw or bone cutters. The plastron is then removed by cutting the underlying muscle to reveal the pleuro-peritoneal space. Cut the sternum at the costochondral junctions and sever the pectoral and pelvic girdles.

3) The usual time for collecting samples for microbiology, chemistry, hematology, etc. is now. Collect the specimens for microbiology carefully. Choose both obviously abnormal and normal areas of the organ(s) being sampled and collect the "cleanest" organ system first (e.g.-collect a specimen of lung before collecting intestine).

4) During the entire necropsy, look for changes in: anatomic position, sizes of organs and tissues, shape, color and consistency of organs and tissues. Look for the presence of exudates, excessive fluid, hemorrhage, discharges, foreign materials, parasites, etc.

5) Identify and remove the thyroid, parathyroid and thymus glands. Some review of normal anatomy will be helpful since there are often marked differences in location among various species of reptiles.

6) Start with the larynx and remove the cardiopulmonary system in one unit by dissecting away the soft tissue of the pharynx, tongue and esophagus. Examine the tissues. Open the lungs by opening the major bronchi with scissors. Open and examine the heart chambers and great vessels.

7) Identify the liver and gall bladder. Before removing, open the segment of intestine into which the bile duct drains and put slight pressure on the gall bladder. Free flow of bile indicates an open bile duct. Remove liver and gall bladder. Make multiple slices through the liver and look at the cut surfaces.

8) Remove and examine the spleen. Make multiple incisions through the organ and examine the cut surfaces. (If the spleen and pancreas are intimately attached defer and remove both together in step 10.)

9) Identify, remove and examine the genital system.

10) Remove the digestive system by dissecting the tongue free of its muscular and fascial attachments and remove tongue, esophagus, stomach and intestine to the cloaca. Observe the pancreas and dissect it free of the intestine after probing the pancreatic duct. Open the gastrointestinal tract and observe the contents and the mucosal surfaces at all levels.

11) Identify and remove the adrenals.

12) Remove the kidneys, ureters and cloaca. Probe the ureters for patency and make multiple incisions through the kidneys.

13) Examine the body cavity and remove segments of muscle covered with mesothelium (the lining of the cavity).

14) Open and explore the nasal cavity and sinuses.

15) Lay the body on the ventral surface and

remove the rest of the skin. Save a portion of skin (save it all if rare).

16) Remove both eyes and orbital contents. Dissect the globes free of muscle, fat, glands, etc. but do not open them.

17) Cut through the dorsal vertebral arches and the skull. Remove the brain, pituitary and spinal column. Do not slice these tissues until they have fixed 24-48 hours.

18) Open and examine the marrow cavity of at least one long bone. Save at least one bone with marrow and a joint surface still attached.

19) Incise the skeletal muscles and open at least some major joints. Examine the vertebral column and the appendicular skeleton.

CONCLUSION

Necropsy of specimens is a highly rewarding activity with many immediate and long term benefits. Foresight, a plan and some practice will result in a high yield of valuable data and deep personal satisfaction.

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CAPTIVE REPRODUCTION IN THE SCARLET KINGSNAKE, *LAMPROPELTIS TRIANGULUM ELAPSOIDES* (HOLBROOK)

Data on the eggs and young of the scarlet kingsnake, *Lampropeltis triangulum elapsoides* (Holbrook), have been provided by Allen (1932), Duellman and Schwartz (1957), Wright and Wright (1957), Palmer (1961), Groves and Sachs (1973), Mount (1975), and Groves and Assetto (1976). This information, however, is restricted to either eggs found in nature or eggs and young from wild-caught gravid females. Dates of copulation, egg-laying, and hatching in captivity were presented by Williams (1978), but no measurements were provided for eggs and young.

A female *L. t. elapsoides* (572 mm total length) collected 25 March 1971, 2.2 km SW Tillman, Jasper Co., South Carolina and a male (483 mm total length) were housed in separate 38 liter (10 gal.) aquaria with paper towel substrates and pine bark for hiding. Fresh water was provided daily and each snake was fed two ground skinks, *Leiolopisma laterale*, or green anoles, *Anolis carolinensis*, weekly. Ambient cage temperature varied between 21-28° C. Windows with a southern exposure provided a natural photoperiod. The male was placed with the female on 15 April 1971.

Copulation was already in progress when observed on 27 April 1971 at 0115. Intromission and coitus were similar to that observed by Gillingham, *et al.* (1977) and Murphy, *et al.* (1978). The male was observed pressing the female down middorsally with four body loops. The female's venter rested upon the substratum with her tail slightly raised. The male's tail was in a ventrolateral position and under the female's tail without encircling it. The male rubbed his chin lightly along the female's neck for 3.5 minutes; tongue flicks occurred at 4-6 second intervals for 2 minutes. After *ca.* 30 minutes, the male relaxed, moved slightly forward, and retracted his hemipenis. The snakes slowly crawled away from each other with their tails raised to a 40-45° angle from the no substratum. The tails were lowered slowly, after 2 minutes, as they crawled about the cage.

The female's appetite thereafter decreased and her girth increased rapidly; bulges appeared along the posterior one-third of her body by 14 May 1971. The pair was separated on 19 May 1971.

On 6 June 1971 at 1125, four eggs were found under a piece of pine bark in the cage. The eggs were soft and adherent. Length and diameter were measured with a vernier caliper; weights were taken. The range in variation was: length, 19.0-31.7 mm (mean 23.7) and diameter, 9.3-12.1 mm (mean 10.4).

The eggs were incubated between layers of dampened paper towels in a .943 liter (1 qt.) plastic freezer container sealed with clear plastic wrap and maintained at 25-31° C. The eggs were checked at weekly intervals for desiccation and fungal infection.

At 1540 on 11 August 1971 the heads of the neonates protruded from longitudinal dorsal slits in two eggs. The remaining two eggs began to hatch at 1610 the same day. All four snakes had completely freed themselves from the shells by 0825 on 12 August 1971. The hatchlings behaved defensively and struck at objects moved near them. Juvenile coloration differed from the adults; the light body rings were white instead of yellow. The lengths were measured by gently stretching each hatchling along a metric rule. The range in length was: 139.7-177.8 mm total length (mean 152.4). No weights were recorded.

After ecdysis on 20 August 1971, the hatchlings were offered the amputated tails of ground skinks, which were eagerly accepted. Each juvenile ate two adult ground skinks weekly until the snakes were released 24 October 1971.

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LITERATURE CITED

Allen, M. J. 1932. A survey of the amphibians and reptiles of Harrison county, Mississippi. Amer. Mus. Novitates (542):1-20.

Duellman, W. E. and A. Schwartz. 1957. Amphibians and reptiles of southern Florida. Bull. Florida State Mus. 3(5):181-324.

Gillingham, J. C., C .C. Carpenter, B. J. Brecke, and J. B. Murphy. 1977. Courtship and copulatory behavior of the Mexican milk snake, *Lampropeltis triangulum sinaloae* (Colubridae). Southwest. Nat. 22(2): 187-194.

Groves, J. D. and R. J. Assetto. 1976. *Lampropeltis triangulum elapsoides*. Herp. Rev. 7(3):114.

Groves, J. D. and P. S. Sachs. 1973. Eggs and young of the scarlet king snake, *Lampropeltis triangulum elapsoides*. J. Herpetol. 7:389-390.

Mount, R. H. 1975. The reptiles and amphibians of Alabama. Auburn Univ., Auburn, Alabama, 347 pp.

Murphy, J. B., B. W. Tryon, and B. J. Brecke. 1978. An inventory of reproduction and social behavior in captive gray-banded kingsnakes, *Lampropeltis mexicana alterna* (Brown). Herpetologica 34:84-93.

Palmer, W. M. 1961. Notes on eggs and young of the scarlet kingsnake, *Lampropeltis doliata doliata*. Herpetologica 17:65.

Williams, K. L. 1978. Systematics and natural history of the American milk snake, *Lampropeltis triangulum*. Milwaukee Pub. Mus. Publ. Biol. Geol., 2:1-258.

Wright, A. H. and A. A. Wright. 1957. Handbook of snakes of the United States and Canada. Comstock Publ. Assoc. Ithaca, New York, vol. 1, 564 pp.

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NEW BOOKS

The Royal Zoological Society of South Australia announces the publication of THE STATUS OF ENDANGERED AUSTRALASIAN WILDLIFE, a 220 page book containing seventeen chapters on the wildlife of Australia, New Zealand and New Guinea. Endorsed by the IUCN, this book attempts to establish which animals are genuinely endangered in the area covered. Available from: The Curator, Royal Zoological Society of South Australia, Frome Road, Adelaide, South Australia 5000, Australia. Price: $8.15 postpaid (Australian currency).

Smithsonian Institution Press has recently published two books that are of considerable interest to herpetologists. The COMPOSITION OF SCIENTIFIC WORDS (882 pages, 6 x 9", cloth, $12.50) is a reprint of Roland W. Brown's 1956 classic dictionary. The first part of the book offers a brief discussion on the elementary structure of English, Greek, and Latin with a guide to the formulation of technical terms and scientific names. The majority of the volume is an alphabetical list of key words giving their synonyms and cognates in English, Greek, and Latin with occasional additions from thirty-eight other languages or dialects. THE ENGLISH-RUSSIAN: RUSSIAN-ENGLISH DICTIONARY OF VERTEBRATE ZOOLOGY by George J. Jacobs (48 pages, 9 x 10" paper, $4.25) provides a list of terms of special interest to vertebrate systematists and anatomists with a strong emphasis on amphibians and reptiles. Of particular interest will be the "root" words for anatomical terms and the matching Russian common names for herps with their Latin taxonomic equivalents and vice versa. Both books are available for purchase from the Smithsonian Institution Press, P.O. Box 1579, Washington, D. C. 20013.