Cobra

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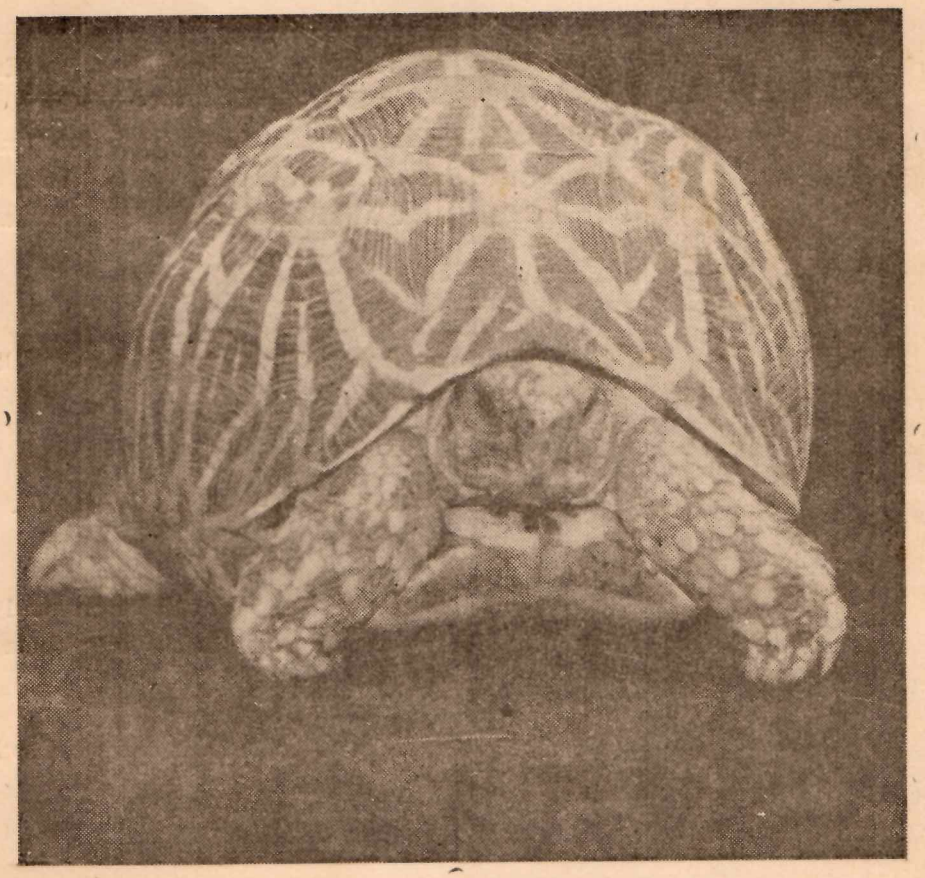
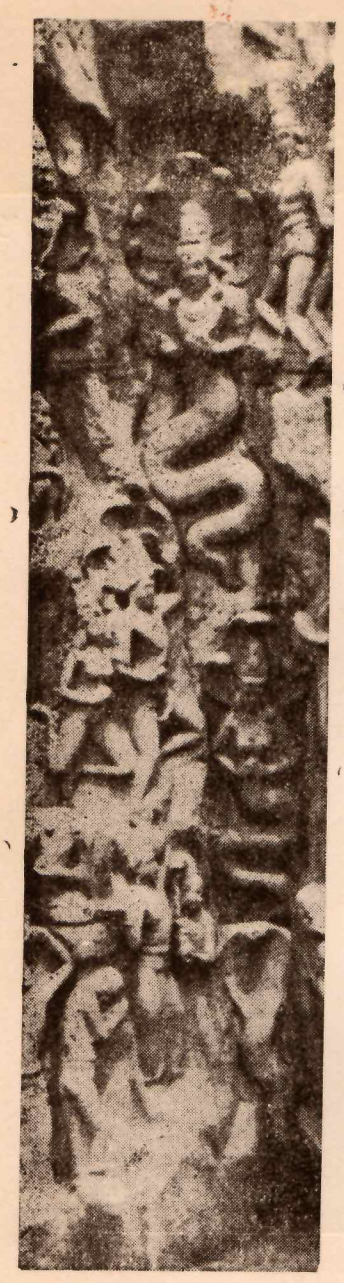


Star Tortoise (*Geochelone elegans*)

— *Photo by :* M. KRISHNAN.

Madras Snake Park Trust
Guindy National Park – Guindy
Madras - 600 022. - India



WELCOME TO MADRAS SNAKE PARK TRUST

* The Madras Snake Park Trust was established in 1971 on a one-acre plot of forest land leased by the Govt. of Tamil Nadu at Guindy, Madras. Managed by a Trust, the MSPT is a centre for Education, Tourism, Conservation, Service and Research on Reptiles.

* A variety of live Reptiles, both Indigenous and Exotic are displayed which include Marsh Crocodile, Giant Tortoise, Reticulated Python, South American Iguana and other species of Snakes, Lizards and Turtles. Besides, a Snake Lore Centre and a Museum of Reptile specimens are maintained.

* The Park is open from 8-30 a.m. to 5.30 p.m. on all days of the year.

* **Entrance fee :** Adult Re. 1/- and Child Re. 0.50.

* Photography charges are Rs. 5 for still cameras and Rs. 50/- for Video Cameras. For commercial Video contact office.

* Hourly Demonstration of a few kinds of live Reptiles with commentaries is conducted.

* Nearly 12 lakh persons visit MSPT in a year.

COBRA

Quarterly Newsletter of the Madras Snake Park Trust

CONTENTS

Annual Subscription for 4 issues of COBRA commencing from the date of Subscription	Rs. 75/- Inland US $ 10/- Overseas (including postage)

MADRAS SNAKE PARK TRUST PROGRAMME FOR INDIA TOURISM YEAR 1991 - '94

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1. Special pamphlets on common poisonous snakes and non-poisonous snakes with special legends about them to be issued.

2. The regular hourly demonstration of reptiles now being conducted in Hindi / Tamil / English will also be extended with special tapes in several Indian languages like Kannada Telugu, Malayalam, Bengali, Oriya, Marathi, Punjabi, Gujarati, Goanese, Urdu, etc. and Foreign languages like Russian, Japanese, Spanish, German, French, Chinese, Italian etc.

Tourist groups could avail of these special demonstration at Rs. 50/- Indian and Rs. 100 or US $ 5 for Foreign languages.

3. Opening of the Exhibition Building displaying—

--Reptile lore around the world.

—Myth, Mythology, Worship and other interesting facets of Reptile-lore in our Indian Culture to commemorate the India Tourism year 1991 — 1994.

ON TURTLES & TORTOISES

(Testudines : Reptilia)

DR. K.V. LAKSHMINARAYANA,

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and

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INTRODUCTION

The turtles, tortoises and terrapins have been ruthlessly exploited chiefly for food, shell, and to some extent for skin (leather). Some species have become extinct, while others became vulnerable due to human indulgence. For example, it has been estimated that 10,000,000 giant land tortoises were taken off from Galapagos Islands for supply of food for early European settlers! Therefore, Scientists, Field Naturalists, and Conservationists expressed deep concern and are trying to save the remaining species. They are now included in the Red Data Book of the IUCN, or in Schedules of CITES, and the Wild Life (Protection) Act, 1972. Turtle census surveys, and conservation programmes are now taken up around the World, including India. It is gratifying to note that some local non-Governmental Organizations in Madras also are taking part in this endeavour.

In this paper, we present some little known facts on the group, including information on fossils, mythology, religion, and folk lore in our country. At this stage it may be worth while to mention that the term tortoise is generally used to all members of the group except some marine species in the United Kingdom, while the term turtle is much more broadly applied with addition of terrapins for some edible land box-turtles in the United States.

The turtles, tortoises, and terrapins belong to a geologically old group of Reptiles of cosmopolitan distribution inhabiting the seas, estuaries, marshes, rivers, lakes, ponds, and on land. Scientifically often popularly called Chelonians, they are placed in the Order Testudines (Chelonia), in the Class Reptilia along with extinct dinosaurs, crocodilians, snakes, etc. They have a long palaeontological history from Triassic (@ 215 million years ago), but undoubtedly must have originated even earlier in Permian (another 45.90 m.y.a.) from Cotylosaurian ancestors.

Pritchard (1979) broadly recognized the following families of modern or living species: the sea-turtles (Cheloniidae, Dermochelyidae) the side-necked turtles (Pelomedusidae, Cheliidae), the mus and musk turtles (Kinosternidae), Central American River turtle (Dermatemyidae), the snapping turtles (Chelydridae), big-headed turtle (Platysternidae), land tortoises (Testudinidae), fresh water and semi-terrestrial turtles

(Emydidae), soft-shelled turtles (Trionychidae), and the Fly-river turtle (Carettochelyidae).

The Order Testudines is divided into three suborders of both the extinct and extant species : the totally extinct suborder and known only by fossils, the Amphichelydia (familes Archaeochelydiidae (?), Proganochelyidae and Proterochersidae (super family Proagnochelyoidea), Pleurosternoidae, Plesiochelyidae, Thalassemydidae, and Apterotemporalidae (superfamily Pleurosternoidea), Baenidae, Glyptopsidae, Macrobaenidae, and Meiolaniidae (Superfamily Baenoidea), the Suborder Cryptodira (families Platysternidae, Chelydridae, Kinosternidaem, Dermatemyidae, Emydidae, Testudinidae, Trionychidae, Carettochelyidae, Cheloniidae, Dermochelyidae, and the extinct families of Sinemydidae, Ptychogastridae, Chelycarapookidae, Nanhsiungchelyidae, Toxochelidae, and Protostegidae), and Pleurodira (Chelidae, and Pelomedusidae with both living and fossil species). The testudines are unique and remarkable and relict species of a very archaic group. They are unique because, all their vital organs are encased in a box-like shell comprising a carapace and a plastron, and both meeting marginally at the bridge.

SHELL

The shell as already stated is made up of a carapace, and plastron both meeting at the bridge giving a tough protective cover to the animal.

The carapace consists of a large polygonal median plate, the proneural or nuchal bone to which the cervical or neck muscles are attached. The nuchal plate is followed by eight neural plates which are joined by the neural arches of the trunk vertebrae. The last plate is followed by two suprapygals, and a median pygal bones. On either side of the neural plates, two series of narrow pleural or costals are present. Each pleural bone is formed around a rib, and therefore their number is constant as eight. The pleurals have alternative wide and narrow proximal ends corresponding to the alternative octogonal or square neurals in case of tortoises. Where they are wide at the anterior end, the posterior end will be narrow and *vice versa*. If viewed from the inner side, it appears that the head of each rib articulates with the vertebra. In older specimens the gap is filled by the bone. The distal portion of the ribs do not curve round as in other vertebrates, but may project a little beyond the pleural bones. The rib tips are pointed and are inserted in pits of the so-called peripheral or marginal bones on either side. The anterior and the posteriormost pairs are in contact with nuchal and pygal bones. In the mud turtles, soft-shelled turtles, and terrapin, some neural bones are lost so that the posteriormost and occasionally the anteriormost pleurals may meet in the middle. In the soft shells, the peripheral bones, also are altogether missing and, therefore, the free ends of the ribs are simply embedded in the cartilaginous shell flap. In certain genera like *Lepidochelys*, the neural bones are increased by longitudinal or transverse divisions of each neural secondarily, or they may be lost altogether as in certain genera of the side-necked turtles (Chelidae).

The plastron is the ventral counterpart of the dorsal convex carapace of the rigid shell. It is made up of epi-,hyo-,hypo-,and xiphiplastra. A diamond shaped median bone, the entoplastron is located at the junction of epi-,and hyoplastra. The former (Epiplastra) are derived from the clavicles and the entoplastron is from the inter clavicle of the pectoral girdle. The other plastral bones are modified abdominal ribs. The ribs of the trunk except the first as already stated are incorporated in the carapace. In the *Terrapene*, the plsatron is composed of two moveable lobes with a

hinge between the hyo-and hypoplastra (Pritchard, 1979). In the predatory forms, the ventral armature is not that important, and hence, the plastron is reduced to a cross-like structure, but maintains the connection with the carapace and also provide base for muscular attachments. Pritchard (*op.cit.*) further states that in mud turtle *Kinosternon*, and the musk-turtle *Sternotherus*, the entoplastron disappears and both the front and rear parts of the plastron get attached by flexible hinges to the middle part of the plastron (combined hyo- and hypoplastra). In the related mud-turtle *Claudius*, the entoplastron is however, present, the hinges are absent, and the paired bony elements of the plastron are reduced to three on either side replacing the hyo- and hypoplastra by the middle pair. In the extinct genera one or two extra pairs of bones, the meso plastra were intercalated between the hyo-and hypoplastra. In the living genera, as in the African *Pelusios* the mesoplastra are very large and retained the connection, but in the side-necked turtle *Podocnemis*, and *Pelomedusa* they are small and separated. In certain Cryptodires like the Ridley *Lepidochelys* and the African pancake tortoise *Malacochersus* the mesoplastra are modified. In *Malacochersus tornieri* the shell is extremely flat and smooth, so that it can be squeezed through the thumb and the finger! In all the soft-shells (Trionychidae) the entoplastron is absent, and the epiplastra are fused and certain neomorphic structures like the preplastra are present.

Both the carapace and plastron are covered by horny scutes, otherwise called as scales, or shields. Typically, there is a median row of five large scutes known as vertebrals or centrals, flanked by two rows of costals or laterals. The edge scutes are known as marginals with a small anterior nuchal, and a large some times longitudinally divided posterior supracaudal. The scutes grow with age by the deposition of new horny material secreted by Malpigian cells present on the surface of the bone in seasonal cycles. Hence, counting rings indicate the age. Variations are also known in the scutes. The pigmentation of the turtles is due to the deposition of melanin and the deposition pattern may be ornamental and specific to each species.

APPENDICULAR SKELETON

The two limb girdles viz., pectoral, and pelvic are housed in the rib cage. In the Pleurodires, the pelvis is firmly fused to both the carapace and plastron, but in others there may be a little movement. In most tortoises the wrist bones (carpals) show some degree of fusion The metacarpals or bones of the palm may be fused to the proximal phalanges of the fingers, or the medialia may fuse together. Carpal fusion is very much advanced in the extinct *Geochelone grandieri* of Madagascar. The hind foot has a simpler structure. Typically six ankle bones (tarsals) are present. Each has a single metatarsal in the sole. The first and fifth toes have two and the others three phalamges each. Most turtles have pentadactyl limbs. Normally, the fore limb has five well developed claw bearing digits, while the hind limb has four well developed claw bearing and a fifth clawless digit. In some tortoises, however, one of the digits in the fore limb is lost, but in the side-necked turtles like *Pelomedusa* five claws are provided in both the limbs. In the soft shells only three claws are provided to both the limbs, but in the marine turtles only one claw with or without a small or rudimentary claw is present. In the leather back, *Dermachelys* claws are totally absent. Most turtles have the phalanges in the first and fifth digits and the rest have three, but in tortoises only two are present in each digit. Different tortoises walk on different parts of the limb. Either the gait is plantigrade as in *Geochelone*, digitigrade as in African hinge-back tortoise *Kinixys*, or unguligrade

as in the burrowing tortoises like *Gopherus* when the front foot is rigid with spoke-like claws for digging. The terrestrial tortoises have stumpy feet and in marine turtles they are flippery or paddle like for swimming.

RESPIRATION

Respiration in Testudines is also unique. Unlike in other Vertebrates, the presence of a rigid shell and the appendicular structures pose special problems for a normal respiration. Pritchard (1979) gave a vivid account on respiration. However, briefly the peculiarities are stated here under: The shell which encircles the visceral mass naturally prevents the inspiration and expiration by lungs through the usual chest movements except where the muscularis striatum pulmonare muscle is provided as in *Lissemys punctata*. The lungs get filled in or emptied by activities like withdrawal of the head and limbs which are totally unconnected with respiration. When the latter organs are withdrawn in to the shell, the air is expelled by pressure to make room, and in this condition the animal may have to spend quite a long time with lungs almost empty. Most vertebrates cannot tolerate the presence of excessive Carbon dioxide (CO_2) either in lungs or in blood. Fortunately, the turtles have circumvented this problem by evolving certain physiological mechanisms to meet the adversities. When higher CO_2 is present the acidity in the blood increases and the pH level is decreased. Turtles developed a mechanism to buffer the blood with bicarbonate ions, haemoglobin, and the serum proteins which resist the pH change so that they can tolerate a higher CO_2 per unit volume than in other vertebrates. The other modifications include a more complete filling or emptying of lungs; presence of higher myoglobin for storing more oxygen (and this make the meat often deep red); when more oxygen is required most vertebrates breathe rapidly and deeply, and panting for some rest. This is possible by an energy-producing reaction in the muscle by which glycogen is converted in to lactic acid without involving oxygen. Since lactic acid is toxic, it should be burnt off before long by rest and hyper ventilation. Turtles were found to tolerate a higher lactic acid level; further slowing of the heart beat or bradycardia (not tachycardia as stated in Pritchard) occurs during the diving phase which reduces further the oxygen demand; Many turtles can extract oxygen from water by the thin papillose skin as in the mud-and musk turtles (Kinosternida), and the snapping turtles (Chelydridae), and the buccal lining of emydids or fresh water and semi-terrestrial turtles, soft-shelled turtles (Trionychidae), American River turtles (Dermatemydidae), and in Sea turtles. The highly vascular thin-walled sacs in the cloaca of aquatic turtles serve as a sort of cloacal gills when the animals are submerged. This phenomenon coupled with the urinary bladder which serves as reservoir for reabsorbed water observed by ancient Indians, perhaps made them, to coin a name 'Kacchup' meaning in Sanskrit the animal which drinks the water by tail end! Pritchard (1979) excellently described the respiration in giant tortoises in Madagascar. Here the active respiration is carried by means of a membraneous sling across the rear part of the shell. This sling when pulled forward compressing the lungs cause exhalation by means of transverse abdominal muscles which enclose the posterior end of the viscera. The sling when pulled back expanding the lungs causing inhalation by means of other muscles known *oblique abdominalis*. These movements also result in pumping in and out, the soft skin around the base of the hind limbs. The diaphragm also is used in exhalation, and the *testocoracoidalis* are used in inhalation. The latter are attached to coracoids and therefore they produce a swinging movement of the pectoral girdle when they contract. When the turtles

are on land the inhalation is carried by the weight of the relaxed drooping visceral mass and limb muscles which produce a slight negative pressure on lungs. Likewise, when the turtle with submerged shell keeps its nostrils above the water and can exhale passively under hydrostatic pressure and inactively inhale the air. These mechanisms lower the muscular exertion in breathing there by reducing the Oxygen demand. The respiration in sea-turtles is very little studied. In them, the extremities are non-retractile, though the chest is slightly expandable, with bridges flexible, with a partially flexible plastron in the middle. The turtles can breathe actively for some time, and suspend it for a considerable time. Though the thoracic movements are not actively engaged in respiration, pumping of the air over the olfactory surface may help in sampling air and quality of the environment. Experimentally, it was proved, that turtles can survive even in an atmosphere containing more Nitrogen.

SOME ASPECTS OF BIOLOGY

For a detailed information on the way of life of turtles, one should consult Pritchard (1979); however some interesting information can be summarized below :

The New Encyclopaedia Brittanica (1973) states that the emydid box turtle *Terrapene* (4—7" in modern and 10" in fossils) can support a weight of 200 times of its own weight. The Atlantic Leatherback (*Dermochelys coriacea*) one of the largest living species around six feet (though stated to be 8–9ft) weighs around 800–1300 lbs (Pritchard, 1979) in contrast to *The New Encyclopaedia Britannica* where the length is given as 12ft (3—7m) and a weight of 1500 lbs (680 kg). The shells of the most adult species measure around 5–15" and a specimen with 5" shell may weigh a pound (16 Ozs) or slightly less. The two fossil specimens of *Stupendemys geographicus* from Venezuela is one of the largest turtle so far known have shell lengths of 7' 2"-7' 6½" (218-230cm) and is definitely larger than in the living leather back which may be around 6' (183 cm). Another fossil species, *Archelon ischyros* measures 6' 4" (193cm), but with its elongate skull may be around 9' in life (Pritchard, 1979). The Indian fossil *Geochelone* (*Megalochelys*) *atlas* (*Colossochelys atlas*) had a shell length of 7' (2.1 m) which together with its skull may be around 10'. The largest living Testudine may in general weigh more than 225 kg (1500 lbs). One of the largest modern tortoise from Chagos Archipelago of 55" weighed 560 lbs.

The New Encyclopaedia Brittanica (op. cit.) states that the terrapin, *Terpene carolina* the Eastern box turtle survived 158 years in the Wild. Pritchard (1975) however states that the dates mentioned on the shells may not be taken too much for granted. A recent newspaper report quoted that a turtle of 200 years age is now available in the Alipore Zoological garden, Calcutta.

The general size of both the sexes are almost identical, except in some cases. For example, the Alligator snapping turtle (*Macroclemys temmincki*) of U.S.A., and in the giant tortoises the males are larger than the female. In some extreme cases as in the map turtles (*Graptemys barbouri* &

G. pulchra) and the saw-back (*G. oculifera*) the females may be around one foot, while the male may be around $4\frac{1}{2}$" in the case of the former, and $8\frac{1}{2}$" in female and 4" in male in case of the latter species. Accessory supporting structures may help holding the female, or aid in mating. Sexual rituals may or may not be marked. They seldom emit sounds, except in mating or in harness. They can breed very long time after a single mating. For example, the American diamond-back terrapin (*Malaclemys*) is known to lay viable eggs even after 4 years after a single mating. The marine green turtle lays around 226-242 eggs in a single clutch, while African pan-cake tortoise (*Malacochersus*) and the American *Rhinoclemys* lays a single large egg at a time.

Though the famous proverb "Slow and steady wins the race" attributed to a tortoise is true with some land forms, the aquatic genus *Gopherus* (U.S.A.) has a speed of 0.21—0.48 km (0.13-03 miles)/hr. The aquatic *Pseudemys floridana* was recorded at 1.7 km/hr (1.07 miles/hr), and the marine green turtle *Chelonia mydas* can swim 480 km (300 miles) in 10 days according to the *New Encyclopaedia Brittanica* (op. cit.)

FOSSIL HISTORY

For a detailed fossil history and phylogeny attention is invited to Pritchard (1979), and Tikader & Sharma (1986). However, briefly to state they evolved undoubtedly in Triassic (@ 225 million years ago), and had a grand geological past. They not only remained much the same since ages, but the fossils exhibit that even in very early period of their evolution many advanced adaptations have already appeared in them. Therefore, they might have evolved even in Permian (a period of another 45-90 m.y.a.). Inspite of this, still the known fossils shed very little on the exact mode of evolution. Although, *Ecnotosaurus africanus* is believed for long as a missing link between the Testudines and the Cotylosaurian reptiles, the recent view is that *Eunotosaurus* may be a side line species. The various suborders and families of the extinct and extant members has already been given in the introduction. So far 244 fossil genera are known (of Pritchard, 1975 list), some of still exist now. From Pritchard (1975) and Tikader and Sharma (1985) we can tabulate the World genera *et* species *vis-a-vis* India as follows :

MISCELLANEOUS NOTES

COBRA invites contributions under "Miscellaneous Notes". Short notes and interesting personal observations on Reptiles and Amphibians are invited for publication. Myths, lores and beliefs which highlight these animals from the cultural and traditional point of view are also welcome.

GENERA ET SPECIES/SUBSPECIES OF MODERN TURTLES FROM THE WORLD AND INDIA (EXCLUDING 244 FOSSIL GENERA)

	WORLD		INDIA	
	Genera	Species/S. Subspecies	Genera	Species/S. Species
SUBORDER : CRYPTODIRA				
Family				
Carettochelyidae	1	1		
Cheloniidae	4	8	4	4
Chelydridae	2	5		
Dermatemyidae	1	1		
Dermochelyidae	1	1	1	1
Emyidae				
Emydinae	9	44		
Batagurinae	22	64	7	17
Kinosternidae	4	33		
Platysternidae	1	3		
Testudinidae	10	66 (*9)	1	4
Trionychidae				
Cyclanorbinae	3	7	1	2
Trionychinae	3	25	2	4
SUBORDER : PLEURODIRA				
Chelidae	8	36		
Pelomedusidae	5	24		
Total	74	318	16	32

*Recently extinct

Pascoe (1973) listed the following fossil turtles from India, Pakistan, and Burma:

SUBORDER : CRYPTODIRA

Family : Testudinidae

Colossochelys atlas Falc. & Caut. (now *Geochelone* (*Megalochelys*) *atlas*) : Siwaliks, Middle-Upper Pleistocene (1 m.y.a.)

Family : Emydidae

Bellia sivalensis Theob. (now *Siebenrockiella sivalensis*)—Siwaliks, M. U. Pleistocene.

B. theobaldi Lyd. (now *S. theobaldi*)—Siwaliks, M.U. Pleistocene

Damonia hamiltani (now *Malaemys hamiltoni*)—Siwaliks, U. Pleistocene

Pangshura tecta Bell. (now *Kachuga tecta*)—Narbada Valley, M. Pleistocene

P. lineata (now *K. lineata*)—Narbada Valley & Siwaliks, M. Pleistocene.

P. flaviventris Theob. (now *K. tecta*)—Narbada Valley, M. Pleistocene

Emys namadicus Theob.—Narbada Valley, M. Pleistocene

Batagur of *dhongoka* Gray (*Kachuga dhongoka*), Narbada Valley, M. Pleistocene

Hardella thurgii (Gray)—Siwaliks, Pleistocene.

Family : Trionychidae

Emyda lineata Lyd. (now *Lissemys lineata*) Siwaliks, Pleistocene

E. sivalensis Lyd. (now *L. sivalensis*), Siwaliks. Pleistocene

E. palaeindica Lyd. (now *L. palaeindicus*)—Siwaliks, Pleistocene

E. vittata Peters (now *L. vittata*) Siwaliks, Pleistocene

Chira indica Gray (now *Chitra indica*)—Siwaliks, Pleistocene

Trionyx sp.—Siwaliks, Pleistocene

T. cf. *gangeticus* Cuv.—Siwaliks & Narbada Valley, Pleistocene

Family : Cheloniidae

Chelonia sp.—Siwaliks, Pleistocene.

In addition to the above, Williams (1953) reported "*Hydraspis leithi*" (now *Carteremys leithi*) from Eocene of India, incidentally the earliest so far known fossil from our country, Pritchard (1979) reported *Shweboemys pilgrimi* (Pliocene or Pleistocene of Burma) and *S. gaffneyi* from Miocene of Pakistan, and *Podocnemis indica*? from Eocene of India, a doutful species (all belonging to the Pleurodira : Pelomedusidae), and Tewari & Badam (1969) *Geoclemys sivalensis* (Cryptodira : Enydidae) from Pinjore, Upper Siwaliks, Pleistocene.

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UPDATED CITES LIST

The U.S. Fish & Wildlife Service, Department of the Interior, has released an updated list of the plants and animals subject to regulation under CITES, the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Dated September 30, 1992, this list includes all plants, arthropods, molluscs, fishes, amphibians, reptiles, birds and mammals protected under Appendices I, II, or III of the treaty. It also lists all 119 party nations and their date of entry; Nations which entered the Convention within the last year are: Barbados, Czech Republic, Equatorial Guinea, Estonia, Greece, and Slovakia.

Appendix I includes species presently threatened with extinction. The Convenvention's most stringent controls are directed at activities involving these animals and plants. All shipments of such species, their parts and derivatives (including manufactured products), require two permits—one from the importing country (obtained first) and another from the exporting country. Such permits will be issued only when the purpose for import is not primarily commercial and will not be detrimental to the survival of the species. Permit applications should be submitted to the Management (permit issuing) Authority of both countries.

Appendix II species are not presently threatened with extinction but may become so unless their trade is regulated. CITES controls are less stringent for Appendix II species than Appendix I. Import permits are not needed for Appendix II species, but an export permit or reexport certificate must accompany each shipment. Export permits can be issued for any purpose as long as the export will not be detrimental to the survival of the species. Reexport certificates are required for items previously imported, including items subsequently converted to manufactured goods. Some Appendix II species are also covered under the Endangered Species Act (ESA) and its regulations must also be complied with.

A "Letter of Authorization" (LOA) system has been implemented in the U.S. to facilitate the issuance of Appendix II export permits for shipments of skins..or products of..American alligator and for reexport of all Appendix II or III species. This system reduces the amount of paperwork for the exporter and expedites the issuance of an original permit for each shipment. LOA's may be valid for two years and are renewable.

Appendix III includes species which do not fall in the Appendix I or II categories, but are regulated for conservation purposes by a Party nation. International shipment of these species requires either an export permit from the country that listed the species or a reexport certificate or certificate of origin from any other country. No import permit is necessary.

Certificates of exception may be issued by the country of export for artificially propagated plants, captive-bred animals, items acquired before the Convention applied to them and non-commercial exchanges between registered scientific institutions. Wildlife and plants exempted under these certificates may be traded internationally without being subject to the strict permit requirements of the Convention. The certificates must be displayed, but are not collected, at U.S. ports of entry or exit.

For further information, contact: Federal Wildlife Permit Office, Fish and Wildlife Service, U.S. Dept. of the Interior, Washington, D.C. 20240.

AMPHIBIANS

CAUDATA	**SALAMANDERS**	
Ambystoma dumerilli	Lake Patzcuaro salamander	II
A. mexicanum	Axolotl	II
Andrias davidianus	Chinese giant salamander	I
A. japonicus	Japanese giant salamander	I
ANURA	**FROGS & TOADS**	
Atelopus varius zeteki	Panamanian golden frog	I
Buto periglenes	Monte Verde toad	III
B. retiformis	Sonoran green toad	II
B. superciliaris	Cameroon toad	I
Dendrobates spp.	Poison dart frogs, Poison arrow frogs	II
Dyscophus antongilii	Tomato frog	I
Nectophrynoides spp.	African viviparous toads	I
Phyllobates spp.	Poison arrow frogs	II
Rana hexadactyla	Asian bullfrog	II
Rana tigerina	Indian bullfrog	II
Rheobatrachus spp.	Platypus frog	II

REPTILES

CROCODYLIA	**CROCODILES, ALLIGATORS, CAIMANS, GAVIAL**	
Alligatoridae spp. (all species in family except those in Appendix I or with earlier date in App. II)	**Alligators, Caimans**	II
Alligator mississippiensis	American alligator	II
A. Sinensis	Chinese alligator	II
Caiman crocodilus apaporiensis	Apaporis River caiman	I
C. crocodilus crocodilus	Common caiman	II
C. crocodilus fuscus (including *C. crocodilus chiapasius*)	Brown caiman	II
C. crocodilus yacare (= *C. yacare*)	Yacare	II
C. latirostris	Broad-snouted caiman	I
Crocodylidae spp. (all species in family except those in App. I or with earlier date in App. II).	**Crocodiles**	II
Crocodylus acutus	American crocodile	I

C. cataphractus	African slender-snouted crocodile	I
C. intermedius	Orinoco crocodile	I
C. johnsoni	Johnson's crocodile	II
C. moreletii	Morelet's crocodile	I
C. niloticus (except those populations in App. II)	Nile crocodile	I
C. niloticus (populations in Madagascar, Somalia, South Africa, and Uganda subject to export quotas described by the Secretariat).		II
C. niloticus (populations of Botswana, Ethiopia, Kenya, Malawi, Mozambique, Tanzania, Zambia, and Zimbabwe subject to ranching).		II
C. novaeguineae (except subspecies listed below).	New Guinea crocodile, Freshwater corcodile	II
C. novaeguineae mindorensis	Philippine crocodile	I
C. palustris kimbula	Ceylon mugger crocodile	I
C. palustris palustris	Mugger crocodile	I
C. porosus (except the population of Papua New Guinea, the Australian population subject to ranching, and Indonesian population subject to export quotas).	Saltwater crocodile	I
C. porosus (Papua New Guinea population, the Australian population subject to ranching, and the Indonesian population subject to export quotas described by the Secretariat).	Saltwater crocodile	II
C. rhombifer	Cuban crocodile	I
C. siamensis	Siamese crocodile	I
Gavialis gangeticus	Gavial, Gharial	I
Melanosuchus niger	Black caiman	I
Osteolaemus tetraspis (except subspecies listed below).	Dwarf crocodile	I
O. tetraspis osborni	Dwarf crocodile	I
O. tetraspis tetraspis	Dwarf crocodile	I
Paleosuchus trigonatus	Smooth-fronted caiman	II
Tomistoma schiegelii	Tomistoma, False gavial	I

TESTUDINATA	TURTLES, TORTOISES	
Batagur baska	River terrapin, Tuntong	I
Cheloniidae spp. (all species in family)	**Sea turtles**	I
Chersina (= *Testudo*) spp.	Bow-sprit tortoises	II
Clemmys insculpta	Wood turtle	II
C. muhlenbergii	Bog turtle	I
Dermatemys mawii	Central American river turtle	II
Dermochelys coriacea	Leatherback sea turtle	I
Erymnochelys madagascariensis	Madagascar turtle	II
Geochelone (except species listed below)	Land tortoises	II
G. (= *Testudo*) elephantopus	Galapagos tortoises	I
G. (= *Testudo*) *radiata*	Madagascar radiated tortoises	I
G. (= *Testudo yniphora*	Angulated tortoises	I
Geoclemys (= *Demonia*) *hamiltoni*	Sported pond turtle	I
Gopherus spp, (except species listed below)	Gopher tortoises	II
G. flavomarginatus	Bolson tortoise	I
Homopus spp.	African parrot-beaked tortoises	II
Kachuga tecta tecta	Indian saw-back turtle	II
Kinixys spp.	Hinged-back tortoise	
Lissemys punctata punctata	Indian flap-shell tortoise	I
Malacochersus ssp.	Pancake tortoises	II
Mejanochelys (= *Geoemyda*) *tricarinata*	Three-keeled Asian turtle	I
Morenia ocellata	Burmese peacock turtle	I
Pelomedusa subrufa	Helmeted terrapin	III Ghana
Peltocephalus dumerliana	Big-headed Amazon River Turtle	II
Pelusios adansonii	Adanson's hinged terrapin	III Ghana
P. castaneus	Brown hinged terrapin, Swamp hinged terrapin	III Ghana
P. gabonensis	Gabon hinged terrapin	III Ghana
P. niger	Black hinged terrapin	III Ghana
Podocnemis spp.	South American turtles	II

Psammobates (= Testudo) geometricus	Geometric turtle	I
Pseudemydura umbrina	Short-necked swamp turtle	I
Pyxis spp.	Madagascar spider tortoises	II
Terrapene coahuila	Aquatic box turtle	I
Testudinidae spp. (all species except those in App. I or with earlier date in App. II).	Land tortoises	II
Testudo spp.	Land tortoises	II
Trionyx ater	Cuatro Cienegas softshell turtle	I
T. gangeticus	Indian softshell turtle	I
T. hurum	Peacock softshell turtle	I
T. nigricans	Black softshell turtle	I
T. triunguis	Three-clawed turtle	III Ghana
RHYNCHOCEPHALIA	**TUATARA**	
Sphenodon punctatus	Tuatara	I
SQUAMATA	**LIZARDS, SNAKES**	
Acrantophis spp.	Madagascar boas	I
Agkistrodon bilineatus	Cantil	III Hondurus
Amblyrhynchus cristatus	Galapagos marine iguana	II
Atretium schistosum	Olive keelback water snake	III India
Boa (= *Constrictor*) *constrictor*	Boa constrictor	II
Boa constrictor occidentalis	Argentine boa constrictor	I
Boidae spp. (all species except those in App. I) or with earlier date in App. I	Boa constrictors, pythons	II
Bolyeria multocarinata	Round Island boa	I
Bothrops asper	Terciopelo	III Hondurus
B. nasutus	Rainforest hog-nosed pit viper	III Hondurus
B. nummiter	Jumping pit-viper	III Hondurus
B. ophryomegas	Slender hog-nosed pit viper	III Hondurus
B. schlegelii	Eyelash palm pit-viper	III Hondurus
Brachylophus spp.	Fiji iguanas	I
Bradypodion spp.	Chameleons	II
Casarea dussumieri	Round Island boa	I

Cerberus rhynchops	Dog-faced water snake	III India
Chamaeleo spp.	Chameleons	II
Clelia (= *Pseudoboa*) *clelia*	Mussurana snake	II
Cnemidophorus hyperythrus	Orange-throated whiptail lizard	II
Conolophus spp. (except species listed below)	Land lizards	II
C. pallidus	Barrington Island land lizard	II
C. subcristatus	Galapagos land iguana	II
Cordylus spp.	Girdled lizards	II
Corucia zebrata	Prehensile-tailed skink	II
Crocodilurus lacertinus	Dragon lizardet (*sic*)	
Crotalus durissus	Tropical rattlesnake, Cascabel	III Honduras
Cyclagras (= *Hydrodynastes*) *gigas*	South American false water cobra	II
Cyclura spp.	Ground iguanas	I
Cyrtodactylus serpensinsula	Serpent Island gecko	II
Dracaena guianensis	Caiman lizard	II
D. paraquayensis	Caiman lizard	II
Elachistodon westermanni	Indian egg-eating snake	II
Epicrates cenchris cenchris	Rainbow boa	II
E. inornatus	Puerto Rican boa	I
E. monensis	Mona boa	I
E. subflavus	Jamaican boa	I
Eunectes notaeus	Yellow anaconda	II
Gallotia simonyi	Hierro giant lizard	I
Heloderma spp	Beaded lizards, Gila monster	II
Hoplocephalus bungaroides	Broad-headed snake	II
Iguana spp.	Iguanas	II
Micrurus diastema	Atlanta coral snake	III Honduras
M. nigrocinctus	Black-banded coral snake	III Honduras
Naja naja	Indian cobra	II
Ophiophagus hannah	King cobra	II
Phelsuma spp.	Day geckos	II

Phrynosoma coronatum (except subspecies with earlier date in App. II)	Coastal horned lizards	II
P. coronatum blainvillei	San Diego horned lizard	II
Podarcis liifordi	Lilfords' wall lizard	II
P. pityusensis	Ibiza wall lizard	II
Pseudocordylus spp.	Crag lizards	II
Pytas mucosus	Oriental rat snake, Whipsnake	II
Python spp. (except subspecies listed below)	Pythons	II
P. molurus molurus	Indian python	I
Sanzinia madagascariensis	Trea boa	I
Sauromalus varius	San Esteban Island chuckwalla	I
Shinisaurus crocodilurus	Chinese crocodile lizard	II
Tupinambis spp.	Tegu lizards	II
Uromastyx spp.	Spiny-tailed lizards	II
Varanus spp. (all species except those in App. I)	Montor lizards	II
V. bengalensis	Indian monitor, Bengal monitor	I
V. flavescens	Yellow monitor	I
V. griseus	Desert monitor	I
V. komodoensis	Komodo Island monitor, Komodo dragon	I
Vipera russellii	Russell's viper	III India
V. ursinii (except USSR populations)	Orsini's viper	I
V. wagneri	Wagner's viper	II
Xenochrophis (= *Natrix*) *piscator piscator*	Checkered keelback water snake	III India

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Notes from Noah XXI (1), 1993

AN EXPERIMENT ON THE EFFICACY OF THREE SNAKES,

Eryx conicus, *Eryx johni* and *Ptyas mucosus* in the control of the field rat *Bandicoota bengalensis*

ARUNA DEVARAJ

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ABSTRACT :

Eryx conicus, *Eryx johni* and *Ptyas mucosus* with a food preference for rats could easily be domesticated and introduced into fields to check the rat population. Rat menace is an ever growing problem in Agriculture. These snakes exhibit social behaviour like competitive interaction. Territorial behaviour exhibited by rat snakes prevents the entry of other animals into their territory. The feeding behaviour of rat snakes show a remarkable chase and strike phenomenon, which is reported in this study.

The foraging behaviour and feed efficiency of the rat snake *Ptyas mucosus* is compared with the data of twenty *Eryx conicus* and twenty *Eryx johni* which are ovoviviparous. Mass domestication of these snakes could go a long way in checking the rat population effectively. Area specific study of the above snakes is a need of the day.

Introduction :

The domesticated snakes have a heterogeneous food preference from lizards to rats. Of the common Indian snakes, *Eryx conicus*, *Eryx johni*, the sand boas and *Ptyas mucosus*, the rat snake, prefer the field rats *Bandicoota bengalensis* to the house rats. An attempt is made to study the efficacy of these three snakes in the control of the field rats. Snakes eat nothing but animal foods, and snakes living under natural conditions always capture their prey alive (Rajendran, 1973) Calculating the net food value E, the time cost h, the time taken to subdue and consume, one item of prey with a higher E / h value is definitely profitable for these snakes. Hence these snakes have a natural preference to *Bandicoota*.

The function of the predator may change as the ratio of the predator and prey changes and its effectiveness as an agent of control will be given by adding the functional response of the predator (Solomon, 1949). Sense of smell is the most valuable help for locating food. Work on Prey-Predator relationship of these three domesticated snakes is the first of its kind and the results are rewarding too.

Materials and *methods* : Five snakes in each species of *Eryx conicus*, *Eryx johni* and *Ptyas mucosus* were collected and domesticated at home by constant handling. All the snakes were collected, starved for fifteen days and a variety of animals like frogs, toads and lizards were given adlibitum. Rodents were supplied after five days along with the frogs, toads and lizards, all the three animals had a preference for the field rat *Bandicoota bengalensis* which is causing a menace to paddy in Periyakulam fields.

All the domesticated caged animals of 200 gms weight were brought to seminatural

field conditions and their predatory behaviour was studied. Concept of hunger was studied based on Holling's (1963) model. Influence of size of prey, starvation & feeding pattern, killing efficiency were analysed for the three sets of snakes.

The sand boas were specially studied for their coiling and strangling technique and the rat snake was studied for its stike and chase technique of food catching. The study was carried out for 45 days with a regular five days feeding schedule. The efficacy of control was calculated and the results were treated statistically.

RESULTS AND DISCUSSION :

Ptyas was found to be more successful in chase & strike and in the process of chasing *Bandicoota* take refuge in their own dwelling. This results in easy catch of nearly 7 to 12 younggones available inside.

With its peculiar territorial behaviour *Ptyas* does not allow other wild species & other types of snakes. If properly manned, Rat snakes could effectively check the rat menace & population of Bandicoota can be decimated too. The ratfree fields with 98% yield is in the near future, if proper steps are taken to domesticate and to leave the rat snakes in the peripheral areas of the paddy field.

Eryx conicus and *Eryx johni* prefer dry fields rather than the wet paddy fields, and the dry land cultivators could very well employ these harmless sandboas to watch and kill the rodent pests. The muscular strength and agility to overpower the animals they wish to eat is used by the Pythons, Anacondas, Bull snakes, King snakes and many small constrictors (Sherman, 1964). This is very true of the sand boas like *Eryx conicus* and *Eryx johni*.

Hollings model (1963) shows the interrelationship of various fragments of components of predation as well as the specific way of action of these fragments as Awareness, Attack, Killing and Engulfing. The investigator suggests the model of Awareness, Chase, Strike and strangling as the effective components, during which swallowing of necessary numbers takes place. This Model definitely shows an advantage to the control scientists.

The foraging strategy, and the aggressive behaviour exhibited by *Ptyas*, clearly shows that the report of Andrews and Pough (1985) regarding the metabolic rate being influenced by foraging strategy might not be true of rat snakes. In the months of August and September, lactating female rats are found to be more than 40% and this is the ideal time for introducing the domesticated snakes in the field. Area-wise field trials could go a long way in improving the economy of india.

Trapping methods adapted in different field studies have shown the highest trapping success in July, ie. 39.8%. No significant correlation between monthly rainfall and monthly trapping percentages was found. (Farhang—Azad, and Charles H. Southwick, 1979). Wounding and cannibalism are rare in the fields and therefore predation is the only alternate method of control of rats. Similarly studies on wounding due cannibalism is also very rare, since *Bandicoota* has a habit of dragging the dead rats into the burrows, the only predator that can make a free entry into the deep dwellings of field rats is snake. The best control technique suggested is to apply natural biological control techniques, since interfering with mother nature with toxic chemicals and biocides have only brought in negative effects. Proper recruitment of the right type of snake in the right season accompanied by other control measures taken could definitely yield better results.

Acknowledgements

The investigator thanks Dr. M.V. Rajendran, Director, Nellai Snake Park & Founder Trustee, Madras Snake Park for the inspiration, Guidance and steady support. I greatfully acknowledge the financial assistance and moral support extended by my husband Er. Devaraj.

OBSERVATION :

Table I

Nature of feeding on ad libitum food supply

Predator	*Prey*	*Time taken for killing the prey*
E. conicus. (Coiling & striking)	Lizard	Refused
	Frog	20 minutes
	Toad	25 minutes
	Calotes	15 minutes
	Bandicoot	9 minutes
E. johni (Coiling & Strangling)	Lizard	Refused
	Frog	30 minutes
	Toad	25 minutes
	Calotes	20 minutes
	Bandicoot	8 minutes
Ptyas. (Chasing & Striking)	Lizard	———
	Frog	15 minutes
	Toad	15 minutes
	Calotes	20 minutes
	Bandicoot	5 minutes
		Ready for 3 more.

TABLE — 2

KILLING RATES OF THE THREE TEST SNAKES PER FEED IN THE MONTHS JANUARY, FEBRUARY, AUGUST and OCTOBER

Values are mean ± SD of sets of five samples

Experimental month	*No. of animals killed per feed*		
	Eryx conicus	*Eryx johni*	*Ptyas mucosus*
JANUARY	4.20 ± 0.04	3.40 ± 0.05	6.20 ± 0.04
FEBRUARY	3.80 ± 0.04	2.80 ± 0.04	5.60 ± 0.05
AUGUST	4.40 ± 0.05	2.80 ± 0.04	5.80 ± 0.05
OCTOBER	4.40 ± 0.05	3.02 ± 0.04	6.60 ± 0.05

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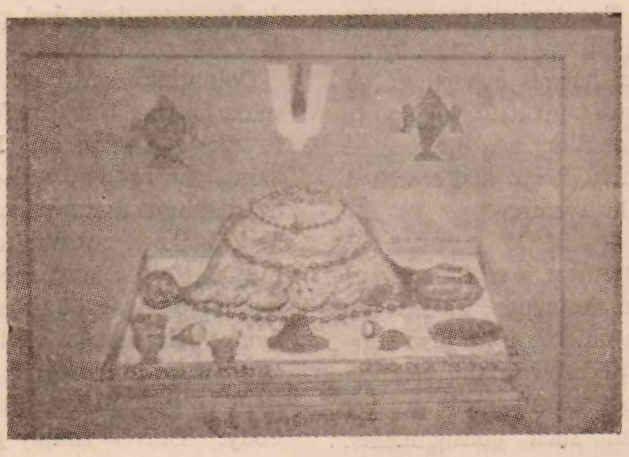
TURTLE LORE

MYTHOLOGY, RELIGION & FOLK—LORE

One of the ten incarnations of Lord *Vishnu* is *Kurma Avatara*. Here the Lord, at the request of both the Suras (Devas) and Asuras (Rakshas) during the churning of the ocean for the Divine nectar or *Amrita*, assumed the form of a turtle and supported the *Mandhara* mountain which was used as the churning rod, This story has been depicted well in *Vishnu Purana* and *Srimad Bhagavata Purana*. It is said that during this incarnation Lord *Vishnu* described various incarnations of Lord *Siva*, and advocated His Worship and this formed the basis of *Kurma Puranam*.

bians arose the reptiles to which group the dinosaurs, testudines, crocodilians, snakes, and lizards, etc. belong. The turtles are either aquatic, semi-aquatic, or terrestrial. Even the aquatic species come to land during the breeding period thus leading a true amphibious life. Surprisingly, the Divine turtle *Avatar* or *Sri Kurma* follows that of the *Matsya Avatar*.

Long before the 20th Century Naturalists who are now pleading for the conservation of the Testudines, the ancient Indians perhaps felt the need for Turtle conservation



The Second incarnation of Lord *Vishnu* is the aforesaid *Kurma Avatar*. The Indian Zoologists and philosophists consider the *Dasavatara* concept as an evolutionary theory proposed long before Darwin & Wallace. The Chordate life began as a fish in the Seas, later the early chordates entered freshwaters, and then came the Amphibians to which frogs, salamanders and caecilians belong. From the amphi-

and therefore revered it so that the code of conduct is strictly followed. Perhaps, India is the only country where turtle is worshipped, even to-day. In Srikakulam District in the town of *Sri Kurmam*, Lord *Vishnu* is worshiped in the form of Turtle known as *Sri Kurma Natha* (see picture).

By Dr. K.V. LAKSHMINARAYANA and Km. PURNA SAI

THE HINDU 1-10-93

Rs. 50 LAKH WORTH SNAKE SKINS SEIZED

Forty-five gunny bags containing 31,500 snake skins valued around Rs. 50 lakhs in the international market have been seized by the Madras Customs at the port.

Giving details of the seizure, the Additional Collector of Customs (Appraising), Mr. J. Gopinath, said that vigil was stepped up the docks after intelligence reports that there were illegal export of snake skins, sandalwood, and red sanders.

He said the special watch kept on export consignments on Tuesday night yielded results. A shipping bill was presented by an exporter stating that he was exporting 700 blocks of granite consignment to Singapore. On suspicion, the container was intercepted by a team of customs officials and searched which resulted in the seizure.

During investigation, it was found that the address given in the export invoice bill was fictitious. The officials have also started conducting enquires with the clearing agent of the export consignment to get more details about such consignments. A special team has been formed to nab the exporter, who was now at large.

THE HINDU 16-10-1993

WONDERS OF NATURE : THE SLITHERY TERROR

MOST of the snakes in our country are harmless and useful as destroyers of rats. The blind snake which is a harmless variety is diminutive, and worm-like. It eats termites and other soilliving arthropods. Two kinds of sand boas—the Red Sand Boa and the Common Sand Boa are found in India. They prowl at night when they prey upon rats and other rodents.

The Indian Python, despite its enormous size and coiling powers, is not likely to swallow an adult human. Probably given a chance, the snake might be able to kill a man by crushing him under its coils. The Reticulated Python is confined to the Nicobar Island. Rivalled only by the Anaconda, the water boa of South America, this python reaches a record length of 10m for a non-venomous snake. For all its fearsome length, it requires a diet consisting of fowls, ducks, cats, dogs and pigs.

Colubrids constitute the bulk of our snake fauna. They are found on the ground, in trees and in water. Despite its common name, the rat snake also feeds upon frogs, lizards, birds and even snakes. The Golden Tree Snake is not only one of the prettiest, but is also the most spectacular among the reptiles because of its so-called powers of flying. It can take off from one branch to another by jumping in space, at the same time spreading its ribs and flattening its body. Thus it simply glides across a distance of four feet between branches it is active during the day and hunts for its prey consisting mostly of sleeping bats, small birds and lizards hovering about trees.

The Checkered Keelback is the commonest water snake of India. It has a thick-set body with black spots arranged on the pattern of a chessboard. The Wolf Snake is a small, slender reptile which is seen only at night in outhouses, ceilings.

A few venomous snakes are responsible for giving the entire clan a bad name. In India, these are the Cobra, the Common Krait and the two vipers—the Russell's Viper and the Saw-scaled Viper.

Cobra is the only snake that can dilate its neck to form a "hood" with a pattern. The Common Krait is a bluish-black snake with white bands. The Banded Krait has alternate bands of golden yellow and blue on the back. The coral snakes are slender, small-sized poisonous snakes. They are rare, being found in the forested and hilly areas. The venom of the cobras and kraits is neurotoxic, affecting the nervous system of the victim. It is said to be the most toxic snake in India.

The characteristic chain-like markings of the Russell's viper establishes its identity. It hissess loudly when annoyed and prior to striking. With its long and movable viperine fangs, it can inject a large amount of venom. The Saw-scaled Viper is small but very aggressive, striking quickly at the lightest provocation. The viperine venom affects the blood of the victim. Pit-vipers found in the hills have a deep facial depression on each side of the head between the eye and the nose. The pit is a sensory organ that helps the snake to locate its warm-blooded prey. Any snake with a pit is poisonous. The snakes in the sea are venomous though they seldom bite.

The world's most venomous and dangerous reptile is the King Cobra. A grown adult can be 4.5 metres. It is the only snake that takes care of the young by building a crude nest of twigs and leaves. Its lethal venom is sufficient to kill an elephant. However, it is a rare snake in India and its confrontation with man in an encounter is occasional.

T.S.N. MURTHY

THE HINDU 1-12-93

DRUGS FROM FROGS

Drugs derived from the secretions of frogs will soon be commonplace in chemists shops, according to Michael Tyler, a herpetologist from the University of Adelaide. He said compounds extracted from glands on frogs' skin showed promise in treating a vast range of health problems, from schizophrenia to bacterial infections.

"We have hardly scratched the surface of this huge natural resource and there is a very real danger we could lose many of our frogs before we even find out how they can benefit us." Scientists have recently been alarmed at a sudden drop in the numbers of frogs worldwide. He said 29 of Australia's 204 species of frog are in danger.

Tyler stressed that the medicinal value of frogs has been known in many cultures for thousands of years. In Nigeria and Patagonia, for example, warts are treated by strapping frogs upside down on them. But Western scientists have only recently appreciated the potential of the secretions.

Some researchers skin the frogs and boil the skin in acetic acid for several hours. Tyler, however, has developed an electrical stimulation technique based on acupuncture, which relaxes the frogs and encourages secretion. The frogs are not killed.

Tyler and his group has filed patents on a new class of peptides discovered in the skin of *Litoria caerulea*, the common green tree frog. The compounds, named caerions and caeridins, have been shown to act as antibiotics. According to Tyler, one appears to act against *Staphylococcus aureus*, a bacterium that can cause serious infection, including septicaemia.

But Australia is not the only country exploiting frogs for medicinal purposes.

Japanese researchers, said Tyler, have recently injected caerulein, another compound derived from the Australian tree frog, into chronic schizophrenics. For a month afterwards, the patients were symptom free. The same compound has also been used in Germany to treat atonic gut, a condition in which the muscles of the gut collapse.

In the U.S. Magainins Pharmaceuticals, a company in Philadelphia, had found antimicrobial activity in a peptide from the skin of *Zenopus laevis*, the African clawed frog, said Tyler. And John Daly, a researcher at the National Institutes of Health in Maryland, has found an alkaloid in a South American frog that carries a painkiller 200 times as powerful as morphine.

"But the alkaloid is not a narcotic and it is not a drug of addiction," said Tyler.

A burrowing desert frog produces a natural glue that could replace stitches after surgery, said Tyler. "It is not toxic and it is very strong. Hydrofluoric acid is the only way it could be removed in the laboratory."

But he warned that the substances amphibians offer are not always health giving. A medical student in Sydney recently ate the ovaries of a cane toad. "It was a bet. The ovaries look like caviar." The student spent six weeks in intensive care and had three heart attacks.

IAN ANDERSON

in New Scientist

THE HINDU 4-12-93

CHANGING COLOURS

NATURE has many wonderful things in its ecological balance. The life-support systems are the ecological processes that shape climate, cleanse air and water, recycle essential elements, create and regenerate soil, and keep the animals and plants fit for life. These are 5,000 known species of reptiles today which include lizards, snakes, turtles and crocodiles.

Among the reptiles, the chameleon has many interesting features. It is an arboreal lizard of Africa, Madagascar and Europe. Chameleon is also found in parts of South India and Sri Lanka. The species found in India is Chameleon zeylanicus Laurenti which is 15 inches long. Its movements are deliberate and slow.

The sticky tongue is long and sometimes it extends to the size of its body while catching insects. The limbs are used for grasping twigs.

Chameleons have a remarkable power to change colour and this is controlled by an automatic nervous system. Basically the colour of chameleon is green to which patterns of yellow and black are added in the form of bands and spots. They can change their colour almost instantly. The change of colour may be in response to light, heat or emotion. When necessary, it can also use its tail as support. A major hunting aid is its amazing ability to change its body colour, but chameleons do not assume the colours of the surroundings.

S. DAMODARAN

THE HINDU 7-11-93

NATURE WATCH
A MATTER OF TASTE

In man the tongue is the organ of taste. It also helps in chewing, swallowing and speaking.

Some animals like the frog and the chameleon use the tongue to catch prey. The chameleon's tongue is so long that the

lizard keeps it folded in its mouth—but it can flick it in and out at lightning speed.

The anteater is another animal that uses its tongue to catch food. Its tongue is long and sticky. The animal sticks its tongue deep into the nests of termites and when it withdraws it there are scores of ants stuck to it.

The reptile flickers its tongue in and out, each time carrying scent molecules from its surroundings to an organ called Jacobsen's organ in the roof of its mouth.

The aardwolf, like the cat uses its long tongue to keep itself clean. Its tongue can reach as far as its eyes.

The okapi's tongue is far longer. This animal, found in Africa, uses its long tongue to clean the whole body, including the insides of its ears!

The blue whale has the largest tongue. The tongue can weigh as much as an elephant!

THE HINDU 5-12-93

ON THE CROC TRAIL

"Spot de light, dere!", sang out Dama suddenly, his voice knifing through the still night in its unexpected loudness. We had been speaking in whispers, a mite overwhelmed with the night, the water, the dark shapes of the trees all around us, the general air of mystery. And till now, the only sounds louder than our occasional whispers had been the regular splashes of our oars in the water, paddling across the still lagoon. Now we were close to the banks, floating along with an occasional nudge from Dama's oar.

And with no warning, Dama's instruction to "spot de light". We all shone our torches at the spot lit up by his. Our reward? Two orange spots, close together. Even though we were on this late night adventure specifically to look for crocodiles, I did not realise those were the eyes of one such. Till they disappeared, without so much as a sound or a ripple in the water. How on earth did a crocodile manage to slip into the water without a ripple ?

It was all a little fantastic; searching for crocodiles late at night, surrounded by the vaguely threatening shapes of the forest, the stars, Dama's torch and the occasional pair of orange spots being the only visible light in sight. And no doubt it was all old hat to Dama. But I think it was while "spotting de light" that I realised that even if I had not known it, this was why I had really come to Costa Rica: for this kind of mildly fantastic experience.

As the night wore on, it only got more so. We missed that crocodile and the next in the same silent, ripple-less way. But we drew closer and closer to the third, to those strange orange spots, without a sound, closer and closer...suddenly, so quickly that I can't say I really saw it happen. Dama's hand moved, and he had the crocodile in his hand. We all let out a collective gasp, realising only then that we hadn't taken a breath in the past several minutes.

It was a baby, perhaps a foot long. The poor thing was terrifield; it let out feeble, regular squawks as Dama held it and then passed it on to us. Even though I felt for the little creature, I couldn't wait to hold it. I never got a chance. I was at the other end of the boat from Dama. The woman behind me was terrified as well when she got the crocodile. She let go, squawking vigorously herself, and the animal fell back into the water. Later, Dama similarly grabbed a frog that I got to hold. But I just knew my friends back home wouldn't

be quite as impressed by "I held a frog in my hands" as they would by "I held a crocodile in my hands."

We had spent most of the day on a noisy, noisome boat (our seats were next to the engine) getting here. "Here" was Tortuguero, the National Park on the Atlantic coast of Costa Rica. Named for the Volkswagen Beetle sized turtles ("tortuga" in Spanish) that come up out of the sea on to the beach here to lay their eggs, this Park can only be reached on a canal that runs the length of the coast. We didn't see the turtles since they nest in July and this was January, as if that's any excuse, but we did see a beetle. It landed on Zu's sleeve, and was about the largest beetle I had ever seen. If you don't count Beetles—the Volkswagen variety. Easily the size of my hand. Terrified of being nipped, I lifted it off as Zu shut her eyes. It crawled off placidly in search of more sleeves.

After the boat ride large beetle, a "swim" in the ocean which was really half an hour being battered by enormous waves, and grabbing at crocodiles, oh yes, reggae music was certainly what we needed. We danced the rest of the night away.

Morning came bright and clear and Zu suggested a walk through the forest that bordered the beach. We entered about a mile down the beach from the Cabinas. Within seconds the blue sea and bright sun were only a memory as we were enveloped in a dusky half light. Not forgetting, up to our knees in muddy pools that were the outstanding features of the "trail" we were following. And for me, up to my elbows as well, Zu had very wisely chosen to wear my slippers on this walk instead of her boots. Said slippers got stuck at least once in each pool. You guessed right, I was bending down to yank them out of the mud each time.

And if this was getting irritating, all hell broke loose above us as we rounded one turn in the trail, fraying my nerves some more. Howls that I could only conclude were threatening reverberated through the trees. My handy guidebook mentioned howler monkeys in this forest, so that's who must have responsible, even though there was no visible sign of them. They were warning us, I suddenly knew. Here was this invisible troop of monkeys, obviously angered by our presence, screaming for our blood possibly, and what was I doing? I was yanking a slipper out of the mud.

Two days later, we found ourselves in a Toyota driven by Tony, a cheery, burly Tico—Costa Rican—who spoke fluent, if ungrammatical English. It went well with our broken Spanish. As we zoomed down the highway, Tony stuck his head out and hailed pretty much everyone we passed ("Do you know everyone here, Tony?" asked Zu). We were well south along the coast from Tortuguero, heading for the home of the Talamanca Indians, a reservation on the border with Panama. More surreal experiences were nigh.

All around us were banana trees, thousands upon thousands of them in rows off into the distance.

Tony took us down Sixaola river which forms the border with Panama. We piled into a tiny canoe and were paddled across to Panama by a phlegmatic old man who didn't pay any attention to our squeals as the boat tipped first one way, nearly tossing us out, and then the other, nearly tossing us out. I felt like Columbus and Vasco Da Gama must have as I stepped onto Panamanian soil: weak at the knees, slightly nauseous, and anxious to check out the shop I saw in front of me.

Yes, for the benefit of Ticos in this remote corner of the country who were willing to

brave the trip across the Sixaola to buy cheaper in Panama, there was a mini-supermarket right here on the bank of the river. There were fans and TVs and cloths, including underwear (I checked). All on sale in this spot surrounded by forest, hills and the river, with no other building anywhere in sight either in Panama or in Costa Rica. Adding to the improbability of it all, the owner was a Spanish speaking Palestinian from Jordan sporting a PLO button. Others like him were running small businesses all over the world, he told us, sending money to the cause, to the PLO struggle.

Back in Costa Rica, Tony drove us into the Talamanca Indian reservation. There were small thatched houses, chickens running around, two boldly coloured goats fighting. But what struck us immediately was the obvuous fertility of the land. Trees everywhere, small fields bursting with crops, a pervasive air of lushness. What a contrast to the barren tracts on which native Americans have been deposited; or to the shabby treatment India metes out to its displaced tribals.

And that was a reminder of what was, finally, the best thing in a country of so many special things. As Tony explained, a special effort had been made to pick our choice land for Indian reservations such as Talamanca. This is just one of many progressive policies pursued by Costa Rica.

DILIP D' SOUZA

Sanctuary Features

Compared by

T. RAVEENDRA BABU

CONTRIBUTIONS ON REPTILES INVITED

COBRA solicits papers on snakes, lizards, turtles and crocodiles for *quick* publication.

Paper may be on any aspect : Ecology, Biology, Natural History or Conservation.

Faunal and Behavioural aspects are also welcome.

Snake-lore, Myths and interesting personal observations are also accepted for publication under Miscellaneous Notes.

Contributions may be sent to Dr. R.S. Pillai, Editor, COBRA, Madras Snake Park Trust, Guindy National Park, Madras-600 022.

PAPERS ON AMPHIBIA

In deference to the wishes of a number of herpetologists, it has been decided to enlarge the ambit of COBRA to incorporate articles and notes on Amphibia as well. Contributions on ecology, conservation, fauna, behaviour and other aspects on Amphibia may be sent to Dr. R.S. Pillai, Editor, COBRA, Madras Snake Park Trust, Guindy, Madras-600 022.

—Editor

NEWS FROM MADRAS SNAKE PARK TRUST

4th October '93

Hony Secretary Mr. A.N. Jagannatha Rao delivered a lecture on "Ecology of Reptiles" at Zoological Society, Govt. Arts College (Men) Nandanam, Madras-35.

11th — 14th October '93.

Hony Secretary Mr. A.N. Jagannatha Rao and Research Scholars attended Workshop on Lion-tailed Macaque PHVA organited by Arignar Anna Zoological Park, Zoo outreach organisation, Wildlife Institute of India, CBSG (India) at Arignar Anna Zoological Park, Vandalur, Madras-48.

28th November — 3rd December '93.

Mr. T. Raveendra Babu, Research Scholar attended the meeting on "Congress on Traditional Sciences and Technologies of India" organised by the Indian Institute of Technology, Bombay and presented a paper on "Biological control of Rodents by Harmles Snakes such as Rat Snake (*Ptyas mucosus*), Common Sand Boa (*Eryx conicus*) and Red Sand Boa (*Eryx johni*)".

21st — 23rd December '93.

Mr. V. Kalaiarasan, Research Scholar has attended the "Workshop on Biostatistics" organised by the Division of Post-graduate and Research Department of Zoology, A.V.C. College, Mayiladuthurai.

CURRENT RESEARCH PROJECTS AT MADRAS SNAKE PARK TRUST

1. "Ecology of Reptiles in scrub jungles of Tamil Nadu" by Mr. V. Kalaiarasan for his PhD. Programme under the guidance of Dr. R. Kanakasabai, Prof. and Head, Dept. of Zoology A.V.C. College, Mayiladuthurai. This project is being co-ordinated by Mr. A.N. Jagannatha Rao, Hony. Secretary and Dr. R.S. Pillai, Research Officer, Madras Snake Park Trust.

2. A research project on "Rodent control using harmless Reptiles" is being undertaken by Mr. T. Raveendra Babu for his Ph.D. Programme under the guidance of Dr. P. Vivek Raja, Lecturer in Zoology, Govt. Arts College, Madras-35 co-ordinated by Shri A.N. Jagannatha Rao, Hony. Secretary and Dr. R.S. Pillai, Research Officer Madras Snake Park Trust.

3. Mr. R. Aengals is working for his Ph.D. on "Studies on Iso-enzymes of Snakes" under the guidance of Dr. E. Prabhakaran Selection Grade Lecturer in Zoology, Presidency College (Autonomous) Madras-600 005. This project is being co-ordinated by Shri A.N. Jagannatha Rao, Hony. Secretary and Dr. R.S. Pillai, Research Officer, Madras Snake Park Trust.

4. The following Research programmes on captivity studies are being undertaken-

   a) Studies on Chamaeleon—R. Rajarathinam and R. Aengals.

   b) Studies on Turtles and Tortoises—R. Rajarathinam and V. Kalaiarasan

   c) Captive breeding in Green Iguana (*Iguana iguana*)—R. Rajarathinam and T. Raveendra Babu.

   d) Correlation between morphology and habits of Snakes—Mrs. R. Chitra.

SURPLUS REPTILES AVAILABLE AT MADRAS SNAKE PARK TRUST IN EXCHANGE

(Subject to approval by the Government)

WE OFFER

Snakes

1. Indian Python (*Python molurus*) (Babies and Sub-adults)
2. Reticulated Python (*Python reticulatus*) (Single specimen not pair)

Turtles, tortoises and Crocodiles

3. Pond turtle (*Melanochelys trijuga*)
4. Star Tortoise (*Geochelone elegans*)
5. Marsh Crocodile (*Crocodylus palustris*) (7 years old)

WE ARE LOOKING FOR

Snakes

1. Black Cobra (*Naja naja oxiana*)
2. King Cobra (*Ophiophagus*)
3. Banded Krait (*Bungarus fasciatus*)
4. The Indian Egg-Eating Snake (*Elachistodon westermanni*)
5. Flying Snake (*Chrysopelea ornata*)

Monitor Lizards

6. Desert Monitor (*Varanus griseus*)
7. Yellow Monitor (*Varanus flavescens*)
8. Water Monitor (*Varanus salvator*)
9. Common Indian Monitor (*Varanus bengalensis*)

Turtle

10. Fresh water turtles—any species.

Crocodile

11. Estuarine Crocodile (*Crocodylus porosus*) (Juveniles and sub-adults)
12. Preserved specimens of 5 species of Sea turtles
    - *a*) Leatherback turtle (*Dermochelys coriacea*)
    - *b*) Green turtle (*Chelonia mydas*)
    - *c*) Logger Head turtle (*Caretta caretta*)
    - *d*) Olive Ridley turtle (*Lepidochelys olivacea*)
    - *e*) Hawksbill (*Eretmochelys imbricata*)

An Appeal

The Madras Snake Park Trust has obtained, with the help of the Govt. of Tamil Nadu, 2.5. acres of land on the old Mahabalipuram Road on the outskirts of the city of Madras to establish an elaborate Reptilium on modern scientific lines to promote Tourism, Conservation, Education, Service and Research on Reptiles.

The proposed layout and estimates of the various units are shown on the next page. The total cost of the project is estimated around Rs. 180 lakhs or 6,00,000 $(US).

The MSPT now seeks financial contributions from various organisations and individuals to fulfil this ambitious future programme unit/block-wise.

Grants and donations are exempted by the Income Tax authorities under 80G vide Ref. No. DITE/1146/(34)/78 dated 1-4-89 to 31-3-92.

Generous contributions are solicited. Contributions may be sent to "The Madras Snake Park Trust" Guindy National Park—Guindy, Madras-600 022 India.

Trustees of the Madras Snake Park Trust, Madras-600 022.

DETAILS OF COST OF CONSTRUCTION AND DISPLAY

Building 1 and 2 (3 floor)

Each floor has 40' — 40' area and will house Rooms, Mess, Recreational area for Research students, each building 12 students.

Cost per floor Rs. 6 lakhs or $ 20000. Total cost of building 18 lakhs or $ 60000.

Building No. 3 and 4 (3 floor)

Each floor has 70' — 40' area and will house Research Division, i.e., Library, Laboratory etc.

Cost per floor Rs. 10 lakhs or $ 35000. Total cost of each building Rs. 30 lakhs or £ 105000.

Pit No. 5 and 6 (1000 sq. ft.)

Specially designed, natural setting with pond etc., to house 3 species of Indian Crocodiles

Cost Rs. 1,50,000 or $ 5000.

Pit No. 7

This will house exotic reptiles like Iguanas, etc., in 500 sq. ft. area.

Cost Rs. 75,000 or $ 2,500.

Pit No. 8 and 9 (area 1000 sq. ft.)

Skunks, Chamaeleons, Monitors etc., will be exhibited in these enclosures in specially designed habitats.

Cost Rs. 1,50,000 or $ 5000.

Pit No. 10 and 11 (area 1000 sq. ft.)

Specially landscaped to display land tortoises, marine turtles and fresh water terrapins.

Cost Rs. 1,50,000 or $ 5000.

Pit No. 12 (Area 500 sq. ft.)

Giant tortoise of Seychelles, Komodo dragon etc., will be displayed.

Cost Rs. 75,000 or $ 2500.

Building No. 13 and 14 (area 1000 sq. ft.)

Different poisonous and non-poisonous snakes of India will be exhibited in specially designed habitats. King Cobra will find a special habitat cooled by air cooler.

Cost Rs. 1,50,000 or $ 5000

Building No. 15 and 16.

Indian snake lore and myths which are in plenty will be elegantly brought out and made interesting and attractive for tourists. Simple hall 40' × 40' with a sloping roof.

Cost Rs. 6 lakhs or $ 20,000 — each building.

Building No. 17 (Demonstration shed— 3000 sq. ft.)

To educate the public on reptiles. Hourly display of live reptiles with commentaries in English, Tamil and Hindi. Tapes in 10 Indian languages and choice of 6 Foreign languages will be available for large groups for a special fee.

Cost Rs. 10,00,000 or £ 35,000.

Building No. 18 and 19.

40' × 40' to house preserved specimens of Indian and exotic reptiles for Research purposes. Sloping roof.

Cost Rs. 6 lakhs or $ 20,000 each building.

Building No. 20.

This is a storeyed building. The ground floor to be used by visitors as a Rest-shed. The second floor for the Administrative Office of the Madras Snake Park Trust. 3rd floor for Guest house.

Each floor is 70' × 40' Cost Rs. 10 lakhs or $ 35000. Total cost of the building would be 30 lakhs or £ 105000.

Building No. 21

3 floors each of 70' × 40'. To house an auditorium, a conference hall and a records room.

Each floor cost Rs. 10 lakhs or $ 35000 and the total cost of building Rs. 30 lakhs or $ 105000.

Building No. 22 and 23.

These are quarters for watchman, on either side with 300 sq. ft area.

Cost Rs. 1,00,000 or $ 3500. The 2 units cost Rs. 2,00,000 or $ 7,000.

Building No. 24 and 26

Open wells of 6' diameter each costing Rs. 37,000 or $ 1250. Together they cost Rs. 74,000 or $ 2500.

Building No. 25

General store Room of 20' × 10'. Costing Rs. 75,000 or $ 2500.

Building No. 27 and 31

Large underground storage tanks to hold water, each 15,000 litres capacity.

Cost Rs. 75,000 or $ 2500/- each 2 sumps together would be Rs. 1,50,000 or $ 5000.

Building No. 28 and 30

10' × 10' rooms for electric meters and water pumps, each room Rs. 37,000 or $ 1250.

Cost of 2 room Rs. 75,000 or £2500.

Building No. 29

10' × 10' Security room. Cost Rs. 37,500 or $ 1250.

No. 32 and 33

IN and OUT gates Each cost Rs. 15,000 or $ 500. Cost of 2 gates Rs. 30,000 or $ 1,000.

All costs are worked out on present exchange rate of US $ — 30.00 as on date March 1993.

ALL GRANTS WILL BE DISPLAYED ON A MARBLE SLAB ON THE RESPECTIVE FLOOR/BUILDING.

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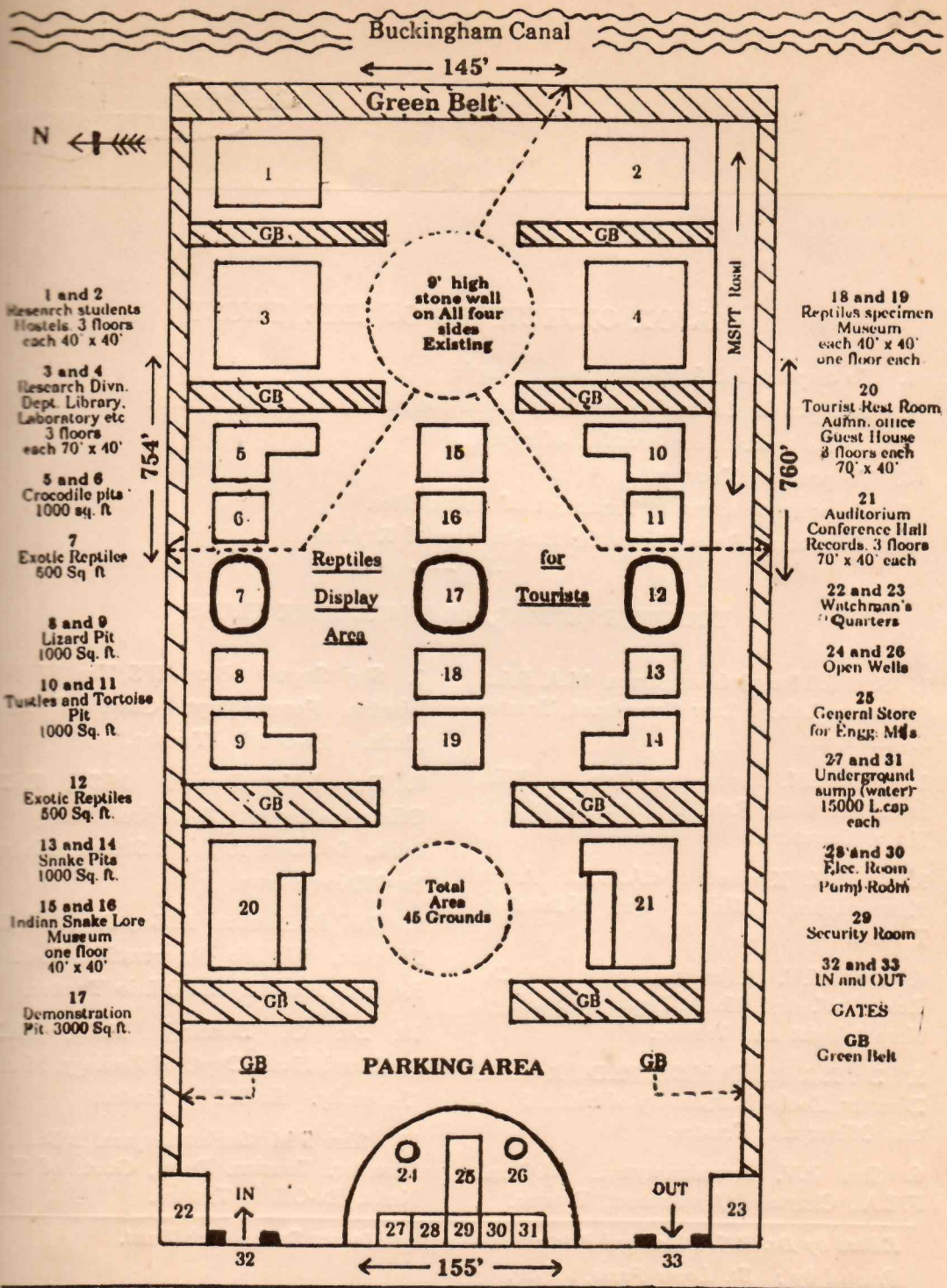
Proposed Layout of Madras Snake Park Trust at Kottivakkam, Madras



To Adyar Madras ← Old Mahabalipuram Road → To Mahabalipuram

(NOT TO SCALE) SEP 1990

MAJOR OBJECTIVES OF THE TRUST

1. To dispel blind fear of snakes in people
2. To highlight the usefulness of reptiles in controlling rodents and pests.
3. Efforts towards conservation of reptiles.
4. To promote Tourism.
5. To promote scientific Treatment of Snake bites.
6. To conduct Research on the Eco-biology of Reptiles.

TRUSTEES OF MADRAS SNAKE PARK TRUST

1. Shri S. Meenakshisundaram, M.A.,B.L., Advocate, Labour Law Consultant, Trustee & Chairman.

2. Shri A.N. Jagannatha Rao, B.E., Industrialist and Retd. Engineer, Trustee & Hony. Secretary.

3. Shri M. Krishnan, M.A.,B.L., Artist Photographer, Writer and Naturalist, Trustee.

4. Dr. M.V. Rajendran, M.A., Ph.D., Retd. Prof. and Head, Dept. of Zoology, Herpetologist and Trustee.

5. Dr. R.S. Pillai, M.Sc., Ph.D., Retd. Jt. Director, Zoological Survery of India, Scientific Officer and Trustee.

6. Shri P.V. Laxminarayana, B.Com., F.C.A., Chartered Accountant, Trustee.

7. Shri Sugato Dutt, IFS, The Wildlife Warden, Forest Dept. Govt. of Tamil Nadu, Ex-Officio Trustee.

8. Dr. P.T. Cherian, M.Sc., Ph.D., Officer-in-charge, Zoological Survey of India, Southern Regional Station, Madras. Ex-Officio Trustee.

9. Shri P. Kannan, M.Sc., Regional Dy. Director, Wildlife Preservation, Southern Region, Madras. Ex-Officio Trustee.

10. Dr. G. Durairaj, M.Sc., Ph.D., Prof. and Head, Dept. of Zoology, Madras University. Ex-Officio Trustee.

11 Shri S M Sankaralingam, B Sc., B.L. Director, Tourism Dept., Govt, of Tamil Nadu, Ex-Officio Trustee.

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