Human-crocodile conflict in Neyyar Wildlife Sanctuary, Thiruvananthapuram, Kerala.

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Neyyar Wildlife Sanctuary is situated in the Thiruvananthapuram District in Kerala State. The extent of the sanctuary is 128 km² and the major vegetation types are moist deciduous forest and tropical evergreen forest. A reservoir was built in the Neyyar River in the early forties for the purpose of irrigation in the States of Tamil Nadu and Kerala. The size of the Reservoir is 8.45 km². Thirty-six Mugger (Crocodylus palustris) crocodiles were introduced into the Reservoir in the year 1983, as a part of Crocodile Breeding and Management Programme executed with the assistance of F.A.O. Crocodiles were recorded in the wild, before the introduction also. Human-crocodile conflicts started to appear from 1985 onwards and further introduction of crocodiles from the captive breeding farm to the Reservoir was stopped. Humans and domestic animals like dog, cat, goat, domestic fowl and cattle were attacked in these incidents. Under the World Bank Forestry Projects, a study was initiated in the year 2000 to suggest suitable management measures to mitigate the human-crocodile conflict in Neyyar Wildlife Sanctuary. This article is based on the first years fieldwork.

Incidents in the last one-year (2000-2001)

More than fifteen fatal attacks on humans were recorded in the early period up to 2000. In the previous years, a lady was attacked twice causing severe injury to body and hand. She had lost one of her hands also. Similarly, many victims survived crocodile attacks and now lives with serious deformation to the body parts. In a gruesome incident that occurred in December 2000 near Pantha, a woman was attacked by an adult crocodile and her right hand was torn of from the knee onwards. Local people helped her to escape from the clutches of the crocodile after hearing her cries.

In the same locality, after a lapse of one month, an adult crocodile killed a lady (57 years) in the month of January 2001. This was the first casualty caused due to the crocodiles. The woman was washing her clothes alone on the banks of the reservoir. The crocodile approached the victim stealthily and caught hold of the lady from behind. She was pulled towards the middle of the reservoir and drowned. When the crocodile surfaced with the body of the victim, people gathered around the reservoir and the crocodile submergences into the water again. This process was continued for about 5 hours and police was called. They fired from the service revolver and when the animal was injured on the dorsal side of the mouth, it released the body of the victim (paper clipping). The crocodile escaped into the reservoir.

After the beginning of the human-crocodile conflicts, many people were molested and the crocodiles in the reservoir consumed numerous cattle and domestic animals. Most of the assaults on humans happened near the edge of water when the victims were washing clothes or taking bath. No specific time was observed in the pattern of attacks. Most of them were alone when they were attacked. The incidents of attacks were recorded from Kappukad to Amboori with in a stretch of 26 km. However, maximum people were hurted near the dam site and Pantha. No attacks were made on humans during night.

Status of crocodiles in the reservoir

In a census conducted in the reservoir, 12 crocodiles were recorded from the problem areas alone. The census was carried out with the aid of searchlights at night in rowing boats. The 12 crocodiles were sighted from the area starting from earthen dam to Amboori. It is estimated that crocodile population in the Reservoir will be less than 50. Nest of crocodiles with eggs were recorded from the wild during this period.

Reasons for the attack

The main reason for the attack of crocodiles on humans and livestock seems to be the scarcity of food in the reservoir and in the adjacent forests. Usually, when crocodiles attain bigger size, they look for mammals also as a source of food, apart from fish. Availability of mammals was very low on the banks of the reservoir. This was made evident in a survey carried out to assess the density of mammals near the Reservoir and adjacent areas. The method used for assessing mammals was based on indirect evidences. Line transects with a length of 10 m were laid all along the banks of the reservoir and searched for the indirect evidences of mammals. Only few sighting of indirect evidences of mammals were recorded in the survey. Presence of Sambar, Wildboar and Bonnet monkeys were recorded from the banks in the survey, even though their density was very low.

Population pressure near the Reservoir

Another major problem contributing to the human-crocodile conflict in the Neyyar Wildlife Sanctuary is the utilisation of reservoir by local people on banks, along a length of 26 km. They utilise the reservoir for various daily needs like washing, bathing, collecting drinking water and washing cattle. Number of houses recorded in the sample areas is given in the Table 1, which shows the high density of houses near the reservoir. These people have no other source of drinking wa-
Table 1. Number of houses recorded near the bank of Neyyar Reservoir starting from Kappukad to Amboori.

<table>
<thead>
<tr>
<th>Name of Area</th>
<th>100m</th>
<th>200m</th>
<th>300m</th>
<th>400m</th>
<th>Total houses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kappukad</td>
<td>Nil</td>
<td>Nil</td>
<td>6</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Malavatti</td>
<td>Nil</td>
<td>2</td>
<td>13</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Neyyar Dam</td>
<td>109</td>
<td>12</td>
<td>7</td>
<td>2</td>
<td>130</td>
</tr>
<tr>
<td>Marakunnann</td>
<td>132</td>
<td>30</td>
<td>Nil</td>
<td>12</td>
<td>162</td>
</tr>
<tr>
<td>South Pantha</td>
<td>73</td>
<td>23</td>
<td>6</td>
<td>6</td>
<td>108</td>
</tr>
<tr>
<td>Mayam</td>
<td>77</td>
<td>20</td>
<td>12</td>
<td>30</td>
<td>139</td>
</tr>
<tr>
<td>Parangi</td>
<td>48</td>
<td>22</td>
<td>2</td>
<td>4</td>
<td>76</td>
</tr>
<tr>
<td>Kumbichal</td>
<td>70</td>
<td>45</td>
<td>40</td>
<td>14</td>
<td>169</td>
</tr>
<tr>
<td>Near Dam</td>
<td>35</td>
<td>40</td>
<td>52</td>
<td>72</td>
<td>199</td>
</tr>
<tr>
<td>Puravi Malai</td>
<td>24</td>
<td>2</td>
<td>8</td>
<td>23</td>
<td>63</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>568</strong></td>
<td><strong>194</strong></td>
<td><strong>135</strong></td>
<td><strong>182</strong></td>
<td><strong>1073</strong></td>
</tr>
</tbody>
</table>

Solution to the problem

The conflict can be solved only through people’s participation. It is obvious that crocodile and people cannot stay together. One strategy adopted by the Forest Department is to get rid of the problem crocodiles from the problem areas. Two crocodiles were removed from the sanctuary in this way by the Department. Another solution is to provide piped drinking water to the local people. This can be done on long-term basis by digging wells and by commissioning a drinking water supply scheme. Providing protection with the use of fences in the bathing ghats is not practical due to the steep nature of banks. Level of water will also change drastically during summer and monsoon. Eviction of some of the families from the fringe areas of the Reservoir is another way to reduce the conflict between people and crocodile.

Acknowledgements

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Cobra vs. Cobra

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Snakes play an important role in control of rodents and other vermin, which are pests of agricultural crops. Their preferred food include small vertebrates (lizards, frogs, toads etc.), small mammals (chiefly rodents), small birds, their eggs and chicks. But, some snakes feed exclusively on snakes (The King Cobra, Ophiophagus hannah), while some others are facultative snake eaters which take other foods also. Although cannibalism is not a feature of snakes, it is seen on occasions (Curran & Kaufield, 1997). The Kerala Agricultural University (KAU) campus, Thrissur consists of plantations of coconut, arecanut and rubber with profuse natural cover. Human interaction is restricted in many places. The area is an abode to a wide array of insects, reptiles, birds and other animals.

There are many reports of ophiophagy in various snakes all over the world. Generally, snakes swallow the dead prey from the head portion. However, rarely two snakes may compete for the same meal leading to the larger snake swallowing the other (Curran & Kaufield, 1997).

Two Indian Cobras (Naja naja) entered a combat in the KAU Campus Thrissur. The weather was sunny, just after a good rain and time was 9:30 a.m. One of them was an adult and the other was a juvenile. The adult was 2.5m long and dark violet in colour and the juvenile was pale brown and about 1m long. Both of them coiled around the other trying to suffocate each other. They also attempted to fasten their jaws on the other while coiling. At times they struck each other with their raised hoods. In the encounter the juvenile was injured on the dorsal side of the belly - a small bite injury without any bleeding. The battle lasted for a long time until the weaker snake was caught by the head, for swallowing. It is reported that sometimes snakes devour other snakes of greater bulk and length also. The combat was stopped by the onlookers who attempted to kill both of them. The adult snake then left the weak juvenile and disappeared into the bushes. After some time the juvenile died although it was left unhurt by people, which may be due to the impact of poison of the other cobra or due to the injuries.

Kawamura and Sawai (1989) have reported the effect of Indian Cobra venom on man, which may be toxic to other cobras also.

References

Hunting methods adopted to capture Varanus bengalensis in Agra region
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Monitors are hunted for various reasons. Auffenberg (1989) reported about the illegal trade of oil of these lizards used as aphrodisiacs. Gupta et al. (1993) reported that it is primarily hunted for its skin, which is used for making musical instruments and other items. V. bengalensis is also used as a food source by some tribes and the leftover bones are supplied to biological suppliers, who in turn supply these to educational institutes where osteology of Varanus is a part of the curriculum.

In order to accommodate their (snake charmers) requirements this lizard is grossly hunted in different ways in different seasons. Some of these methods are discussed below:

1. By snake charmers: During winters when the monitors hibernate, they are caught and eaten almost every day by the tribals. The hunters search for live/active Varanus holes, used for hibernation. Active holes are identified by the presence of fresh claw marks or trails. Then, they insert a 3-4 feet long stick in the active hole to confirm the presence of monitors in it. If the hole is a tunnel type they start digging the hole, if it is a multituell type they first close all exit points. They dig the hole with the help of a sharp small spade to a depth of 2 feet and then remove the mud with hand, then slowly start digging again carefully. As soon as they see the monitor's tail the hunters slowly remove the mud and enlarge the hole by hand as the soil is loose and humid inside. When the tail is fully exposed they pull the Varanus out of the hole holding its tail. The moment the monitor is out, the animal catcher immediately breaks its vertebral column so as to make the animal immobile but alive. The other method employed to immobilize the animal is by twisting the hind limbs upwards and using its sharp claws they tear the metatarsals of the opposite hind foot to expose its nerve. When the nerve is exposed the claw is broken so that it looses strength and is inserted into the nerve of teased hind foot.

2. Hunting by dogs: Rainy season is also the active season of the monitors and foraging is at its peak (Auffenberg, 1994). During this time of the year, the Varanus rarely sits in burrows so it is very difficult to catch them. Therefore, snake charmers, who are the main source of monitor supply, rely on their trained hunter dogs -- 5-6 dogs, collectively hunt for their masters. When these snake charmers along with their trained dogs go to hunt in areas where the probability of finding monitors is more. On sighting the Varanus the hunters chase them and order their dogs to catch it by shouting “choo” “choo”. Immediately, all the dogs chase the monitor and within no time catch it firmly on the belly until their masters come. Special point to note here is that these dogs do not eat Varanus. One group traps around 15-20 animals per day.

3. Baiting: Generally this type of method is adopted by the snake charmers who are older and are not capable of moving long distances for hunting. Such hunters usually bait the monitors using poultry eggs. They place these eggs in an open area within Varanus habitat and hide. When the monitors come to feed on these eggs they chase and catch them.

References
Observations on the Travancore Tortoise (Indotestudo forstenii) in captivity

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The Travancore Tortoise (Indotestudo forstenii) is an endemic testudine inhabiting the moist evergreen and semi-evergreen forests of the Western Ghats of southwestern India (Das, 1991). Much of what is known about this species consists of anecdotal information and, taxonomically, it has led a chequered career (Frazier, 1989; Das, 1991; Pritchard 2000). A crepuscular and free-ranging species (Das, 1991), the Travancore Tortoise is thought to be mainly herbivorous (Auffenberg & Iverson, 1979; Vijaya, 1983; Das, 1991). But in captivity it has been known to feed on fish and meat apart from fruits and vegetables (Vijaya, 1983; Das, 1991) and in one instance the tortoises also scavenged on a dead parrot (Sane & Sane, 1988). It shows sexual dimorphism and during the mating season both sexes develop a bright pink colouration on some regions of the head (Auffenberg, 1964; Vijaya, 1983; Das, 1991). The main breeding season has been reported to extend from November to January (Auffenberg, 1964), but it is thought to breed at other times of the year as well (Moll, 1989; Vijaya, 1983; Das, 1991). The clutch size varies from 1-3 and the eggs are deposited on the ground surface or in small leaf litter mounds (Das, 1991).

A brief study on enclosure utilization and breeding behaviour in Travancore Tortoises was conducted at the Centre for Herpetology, MCBT, from May to December 1999. This note deals with the former while breeding behaviour will be discussed elsewhere. The study animals were a captive breeding group of nine (3 males, 6 females) (Andrews & Whitaker, 1993). They were housed in three interconnected outdoor enclosures (ca. 20.4m²). Vegetation in the enclosure consisted of Pongamia pinnata, Bambusa sp., Trapaflorus indicus and shrubs. Logs, rock caves and two pools of water (diameter 1m) were also provided. In summer (May-Aug) sprinklers were turned on every afternoon (1400-1500 hrs). Observations totaling 146 hrs were made with periods extending from 0600-0800 hrs and again from 1600-1800 hrs since the animals exhibited a bimodal pattern of activity.

The tortoises were crepuscular, and the number of active animals varied, but males were the first to emerge from shelter 68% of the time. During inactive periods, the tortoises either burrowed under the leaf litter (depth mean = 53.45mm), or hid under rocks. Hollow logs were also used as shelter. They were occasionally active during the day as well in cloudy weather or when it drizzled, but the sprinklers did not noticeably change their activity pattern. They became inactive in a heavy downpour, and though it is mentioned that they croak in a chorus during the rains (Das, 1991; Auffenberg, 1967), no such vocalization was heard during this study. Perhaps the report actually refers to Testudo heros (see Smith, 1931).

The tortoises were fed a diet of cabbage, carrot, cucumber, tomato, spinach, cashew fruit, banana, fish and beef. In addition, they were also seen feeding on green Pongamia pinnata leaves, mushrooms and snails. The snails were located by sniffing the leaf litter, uncovered by pushing it away with the forelegs, and eaten with the shell. 'Leaf tea' drinking was also observed for the first time in this species - 'leaf tea' is the sludge formed by leaves soaking in stagnant pools of water, and it is thought to aid digestion in the Star Tortoise (Geochelone elegans) (Frazier, 1987). It probably serves a similar purpose in I. forstenii.

The tortoises were also observed burrowing into the sludge until they were completely covered by it, with only the nostrils exposed for breathing. They seemed to prefer sludge to clear water because when one pond was cleaned and filled with clear water, they stopped using it.

Contrary to existing literature, hole nesting was observed during the study. Moreover, the nests were all located near the roots of trees and shrubs, perhaps since the soil is cooler in these regions (Andrews, pers. comm.).

Though the Travancore Tortoise has been placed in the Lower Risk near threatened category (Molur & Walker, 1998), even population estimates are not available and information on its natural history is scanty. Therefore, a detailed study on I. forstenii in the wild could yield valuable information.

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I would like to thank everyone at the Madras Crocodile Bank Trust, in particular Harry Andrews for his guidance and Romaine for her hospitality.

References
We then moved on to a summary of the King Cobra, which outlined the natural history of this species, its status in India and elsewhere, and its distribution.

Next, we tackled enclosure design, with reference to temperature and humidity maintenance. Designing enclosures for these delicate and highly venomous snakes is always a challenge. Attention should be primarily oriented towards allowing safe and efficient cleaning of the enclosure, and facilitate easy viewing by the public. The keeper of the snakes should be able to view the snakes position in the enclosure prior to entering it. The access door to the enclosure should be large enough for the keeper to enter without stooping, and wide enough to allow rapid maneuvering and exit if necessary. All snakes are excellent escape artists; meticulous evaluation of the enclosures ability to contain the snake should be made prior to its release in the enclosure.

Choice of substrate varies with different views on aesthetics. Primary focus should be placed on identifying easily changeable substrate, and one that does no harm to the snake. Suggested substrates are korean grass and fine sand. When cleaning faeces from these substrates, the entire faecal matter must be removed, not just the surface. Cage ornaments like stones and logs should be positioned solidly, so they do not fall on the snake. These ornaments will aide the snake in shedding its skin; surfaces of all cage ornaments should be rough, but not sharp.

Distance between the visitors and the snake should be at least 200cm; this is to prevent the snake from being stressed by people waving hands, towels, etc. This distance can be kept by erecting a stand-off barrier. A snake that is constantly being petrified into attaining defensive postures rarely does well in captivity. Keep the area around the enclosure free of large sticks and stones.

A water bowl large enough for the snake to soak itself fully should be provided. Providing drainage holes for these bowls are unnecessary, as they are a size that is easily cleaned and sterilized. In addition, people tend to forget to cork the drainage ports after cleaning the bowls. A recommended time interval for completely cleaning and sterilizing the bowl is a four-day interval.

As these snakes are a species found in mesic forests, humidity should duplicate that of their natural habitat, optimum at 80% relative humidity. Humidity can be measured with a hygrometer, an easily available, inexpensive instrument which can be purchased from a scientific supplies dealer. The importance of maintaining adequate humidity levels for this species can be reflected by compromises in health when it is not done. A visual sign is difficulty in shedding skin. To facilitate digestion, a heat pot at one end of the enclosure or access to sunlight, which is ideal is essential. Ambient temperature within the enclosure can range between 27-30°C, with a "heat sink", via either an air-conditioner or ventilation fan which keeps a small portion of the enclosure at 26-27°C.

Enclosure maintenance is an important aspect of management of the King Cobra. A regular, daily protocol should be established, with the keeper going in everyday to remove faeces and shed skin. Good communication is imperative between the veterinarian and the keeper. The veterinarian should get him/herself well aquainted with reptile veterinary care, and frequently examine the snake up close with the keeper to evaluate the presence of ticks, ulshed eye caps, lesions, etc. Regular inspections should be made for sharp objects (concrete and sticks) protruding from the substrate. Areas where rain leaks through the roof of the indoor enclosure should be sealed. Substrate utilized at the MCB is fine sea sand, a half-foot of which is removed and replaced once every two months.

King Cobras need water for two reasons; soaking and drinking. The bowl should be large enough to allow the snake to completely soak itself in. Water management is an important aspect of healthy King Cobra management. Water should be changed at least once every week, and the water bowl cleansed with an effective disinfectant -- Dettol™ is recommended. Only after thoroughly re-cleansing the bowl with fresh water should the bowl be set back in the enclosure. Aside from the general aesthetic advantages of providing a clean water source to King Cobras, there are many health benefits. Water that contains faeces, decaying organisms, or that has been allowed to become stagnant offers an ideal breeding ground for pathogenic bacteria. As this is the snake's sole water source, the animal has little choice but to be continually exposed to the contaminated water. Drinking and soaking in
contaminated water predisposes the King Cobra to bacterial infections such as infectious stomatitis and bacterial dermatitis. Utilizing tap water here at the MCB while maintaining frequent water changes has not had any untoward effects on the snakes. This may well vary in other areas though.

The King Cobra sub-adults and the adults that have produced them have been feeding on rats since their acquisition at the MCB. Initially, road-killed snakes were made into a soup, and dead rats were dipped in this broth and moved in jerky serpentine movements in front of the King Cobras. Now, it is not necessary to dip rats in the soup, rats are readily accepted. Rats for the King Cobras at the MCB are captured from agricultural lands nearby. Where this source is not an option, arrangements can be made to purchase lab rats or set up your own rat-breeding colony. Both these options have advantages in that rats can be kept parasite-free. Rats are not presented as is, the fur is clipped off the entire body of the rat, and both the front limbs are amputated with dissection scissors. A lateral incision is then made to the ventral surface of the rodent, and the entire digestive viscera are removed, inclusive of the colon, jejunum, ileum, and the stomach proper. Feeding frequency for sub-adults averages twice per week, each snake being fed 10-12 pinky rats of the species Rattus rattus. Each rat averages 6g in weight. Feeding at the MCB/CFH is done with large 15" forceps. Once the rat is accepted the snake is left alone to swallow the rat, after which the next rat is offered. Keepers must be wary whilst feeding since these snakes can be exceedingly fast and persceptive, especially when expecting feed. Never should a live rodent be left in an enclosure with the snake, if the snake is not interested in feeding, the rodent can cause serious injury or even death to the snake by repeatedly biting it. Snakes should never be handled for at least 3 days after feeding unless necessary. King Cobras need to be fed separately. Feeding King Cobras wild snakes is undesirable, as they are protected. In addition, the wild snakes would be introducing potentially pathogenic endo/ecto parasites. Treatment for King Cobras for parasites is useless if the snakes are continually being re-infected by parasites brought in from wild snakes. Feeding rats is easy and safe, once the King Cobra is acclimatized to eating them. In conclusion, the ideal situation would be to have your own rat breeding colony, whereby breeders are frequently screened and consequently treated for endo-parasites, thereby providing pathogen-free offspring. In addition, varieties of different sizes of rats are available then.

The second day, focal aspects of capture/transfer techniques and veterinary care were discussed. We started the first half of this day with extrapolating the differences in capture, which would be utilized when actual restraint is required for clinical examination, and transfer, when the snake has to be shifted to another enclosure. We stressed the need for focus on the safety of the keeper, and the quick, painless capture of the King Cobra. We demonstrated a proven effective method of capturing King Cobras utilized at the MCB/CFH, the bagging system that requires two persons. A large-sized bag, with ties around the mouth is attached to a bagger, which is a 4½-5’ pole with a rubber grip at one end, and a welded metal rim at the other. The rim of the bagger has blunt hooks, to which the ties from the mouth of the bag are fastened. One person controls the snake, while the other holds out the bag attached to the rim of the bagger, which should be held very steady. The snake is oriented towards the mouth of the bag, and once the snake is inside the person in control of the bagger must rapidly twist it several times thereby closing off the mouth of the bag. The snake can then be lightly touched through the bag to summon an alert posture, with head raised. Once the head is located, it is gently but firmly grasped. One hand is then put into the bag, and the snake is extracted from within, ready for examination.

We then examined techniques utilized to transfer King Cobras from one enclosure to another without having to actually restrain the snake. Hide boxes were constructed as part of a practical workshop, and the blue prints for construction were given to each of the participants. In theory, a hide box is placed in the enclosure where the snake to be transferred is currently housed, and after opening the small snake access door, the snake can be oriented towards the same with a snake hook, the snake should eventually crawl in. The small sliding door is then immediately fixed into place. If it is not necessary to transfer the snake immediately, the snake access door can be left open, and closed once the snake chooses to retire in the hide box. We emphasized the need to make sure that any part of the snake is not underneath the sliding door, and that the door is closed flush. Once transfer to the enclosure which the snake is to be kept for whatever period of time, the small sliding door can be opened with a snake hook and left in that position for the snake to come out in its own time. The channel that the small sliding door fits into must facilitate smooth closing and opening.

The second half of the day was devoted to veterinary care. It was agreed among all of the participants that any animal in captivity, avoidance of disease through rigorous maintenance is far better than having to put the animal under a treatment regime, this in itself introduces untoward stress. For this section, we analyzed our experience over the last 4½ year with the King Cobra, the topics relating to common problems encountered with King Cobras in captivity. Specific treatment regimes were described when maladies relating to the topics chosen were encountered at the MCB/CFH. Chapters on Therapeutics of Repetile Medicine, and Allometric Scaling were enclosed along with the other literature provided to participants, with a request to go through them carefully.

We addressed dermatology in snakes in general as the first topic for our section on veterinary care. The normal complete process of skin shedding in snakes takes 10-14 days. Initially, the skin becomes dull and the spectacles turn white or opaque. The skin and eyes then clear and become shiny; shedding takes place 3-4 days after this occurs. This is only a very general guideline; frequency of shedding can be affected by numerous parameters, namely, age, body condition, reproductive status, parasite load, hormonal balance, and ambient temperature and humidity. King Cobras in particular require high humidity conditions to successfully shed their skins. King Cobras like other snakes shed their skins in one piece unlike lizards and other reptiles. At the MCB/CFH, snakes having trouble shedding skin are placed in Luke warm water, or sprayed with a spray gun used in horticulture to aid in shedding. The latter technique is preferred, as the former requires capture of the snake. Retained eye shields are removed with a wet cotton swab, which is repeatedly applied around the eye to loosen the eye
shield. The eye shield is then gently removed with forceps, taking care not to damage the cornea.

We next addressed neoplasia. A neoplasm is a new, abnormal growth of tissue. There is an increased incidence of neoplasia in immunologically compromised snakes. To date, there has been no reports linking pollutants with reptilian neoplasms, however, fish and amphibians from highly polluted waters have been found with oral and skin neoplasms. A known approach in clinically assessing neoplasia in snakes is to evaluate masses from a body systems point of view, in addition to other conditions that may cause “lumps and bumps”. Rigorous management (ie. frequent removal of faeces and frequent water changes) and careful handling are factors that are known to prevent the occurrence of neoplasia.

Neoplasia in King Cobras has been encountered at the MCB/CFH, and successfully treated. A large female King Cobra measuring 2.8m total body length (TBL), which unfortunately died before necessary action could be taken to diagnose her, developed several fibroses on the ventral surface of her body. The exudate was sent for microbiological examination, antibiotic sensitivity tests revealed that the bacteria involved were sensitive to Gentamicin, (2-4 mg/kg IM every 72 hours), Neomycin (10 mg/kg administered intramuscularly, every 24 hours), and Chloramphenicol (50 mg/kg given administered orally every 24 hours). Following our experience with the adult female King Cobra, a sub-adult King Cobra was found to have similar fibroses development. Neomycin was utilized as the drug of choice, due to its local action effect. This individual was successfully treated, and fully recuperated. Despite exhaustive investigation to identify incorrect husbandry and management parameters, it was not possible to determine the causes of neoplasia in this snake.

The third topic of discussion was ophthalmology. In several respects, the diseases of the reptilian eye are comparable to those of the mammalian eye, and therefore treatment is similar (Mader, 1996). There are however differences in anatomic and physiologic features, such as the ophidian spectacle and the differences between mammalian and reptilian inflammatory processes. We concluded that no problems at the MCB/CFH had been encountered with respect to ophthalmology; snakes with retained spectacles had them removed immediately once they were noticed. Optimum humidity and temperature parameters are adhered to at the MCB/CFH, hence rarely have we had a case of retained spectacles.

The next topic we addressed was parasitology. It was acknowledged that all free-ranging reptiles, harbour both endo- and ecto-parasites. Parasites disperse frequently in wild reptiles thereby not causing any serious harm to the host. However, once in captivity, parasites can reach alarming numbers in a short period of time. Infestations in the captive situation become much worse than any experienced under wild conditions because the animals have a limited space to range. Within this limited space are higher concentrations of ecto-parasites that may result in anemia and dehydratation, thus placing stress on the animals and predisposing them to secondary pathogens.

At the MCB/CFH, no ecto-parasites have been found on King Cobras, primarily because the snakes are housed in sterile environments and in addition there are no snakes coming in from the wild which would harbor ecto-parasites. Endo-parasites that have been identified by one of three different techniques in use at the MCB/CFH, namely direct smears, zinc sulphate centrifugation technique, and the ethyl acetate sedimentation technique. These endo-parasites have been identified to Genus level of Ascaridia sp., Strongyloides sp., Monezia sp. and Gerraridia sp. Ascaridia sp. being by far the most virulent of the four.

Treatments have been described for ridding a collection of tick and mite infestations, as well as endo-parasites. Ivermectin is commonly used as it provides many advantages and conveniences. This drug has been administered in a variety of ways to treat ecto-parasite infestations. The recommended dosage is 0.2mg/kg administered intramuscularly once and then again in two weeks. An oral dose has also been used as it has been noticed that ivermectin passes into the host when given as a bolus by itself, or if necessary when it is injected into a prey item and then fed to the King Cobra. Oral administration is highly recommended for King Cobras 0.2mg/kg administered orally by injection into prey, repeated in 2 weeks as this would not involve capture of the animal. There has been a topical spray described for spray-on use. This solution is made by mixing 5mg ivermectin with one litre of water.

We then addressed anorexia, which seems to be a very common cause of morbidity and mortality in a large number of reptile collections within the country. Anorexia can be described as a lack of appetite. Often, it has its roots in a variety of infectious and metabolic disorders and husbandry conditions. Acquiring a good history is critical to evaluate the presence and cause of anorexia in any reptile patient. Some causes of anorexia are food offered at the wrong time of day (King Cobras are diurnal, or active in the day) and offering of food in the wrong location of the animals captive environment. Lights should never remain on 24 hours a day. A thorough examination of the enclosures is in order once a King Cobra has been diagnosed as anorexic. King Cobras are largely arboreal (dwelling in trees), so, is the cage furnished with appropriate furnishings (i.e. tree branches)? Lack of a secure hiding place may cause King Cobras not to feed; this is why a distance of at least 200cm between the public and enclosure glass is advised. Constant tapping and banging on the enclosure glass by people may create stressful conditions that cause anorexia. Handling a King Cobra too frequently, particularly if a feeding regime has not been established can cause anorexia. Improper temperatures are a frequent cause of anorexia; if a captive reptile cannot enter its preferred optimum temperature zone (POTZ), it may not feed. Keeping a reptile too cool often leads to anorexia, as can keeping it too hot without an opportunity to cool off or escape the heat. Optimal enclosures offer King Cobras the opportunity to thermoregulate. Social and reproductive factors may induce anorexia. Female King Cobras may go into self-induced anorexia during gestation, as may reproductivey active males.

A male King Cobra 3.0m in TBL was anorectic for a period of over two weeks at the MCB/CFH. Evaluation of the enclosure did not reveal any obvious faults, as did the results of temperature profiles recorded from different areas of the enclosure (the snake should have been able to successfully thermoregulate). As capture of this animal at this stage was not an option for
various reasons; it was decided to administer metronidazole at the recommended dosage of 250mg/kg, orally, repeated in two weeks. Metronidazole at the above mentioned dosage is known to anaerobically stimulate appetite and improve health in general. This is thought to be due to the drugs anti-protozoal and anaerobic antibacterial effects, in addition to its abilities to correct abnormalities in normal gut flora. The medication was injected into a rat, which the snake accepted after much prompting. Appetite recovered soon after the first dose of metronidazole was administered to the snake.

Day four of the workshop was a half-day program, at which we discussed breeding techniques utilized at the MCB/CFH, and management of eggs. This was a theoretical discussion.

The first requirement is a compatible male and female, the male being larger, of at least 4 years of age. The above notes on dimensions of enclosures and necessary requirements should be kept in mind. Disturbances must be minimal. Snakes need to have access to sunlight at least once a day, preferably in an outside, attached enclosure. The mating season for King Cobras is in February/March so the male and female should be kept separate for several months prior and then paired in February.

Nutrition plays a large role in successful mating, and the breeding pair should be well fed prior to the mating period. The female may become anorectic several days prior to egg laying.

Courtship in King Cobras is done mainly by the male. He may crawl on the female, poke or butt her with his nose, and finally mate, which may go on for an hour or more. During this period the King Cobras should be kept under observation so that the time of mating (or multiple matings) can be ascertainment. About 30 to 40 days after mating the female will become quite agitated, crawling all over the cage. At this time, or earlier, the male can be removed from the enclosure and transferred to another enclosure. The female should not be handled at all at this delicate stage.

Once deposited, the eggs should be removed to an artificial incubator, rarely would allowing eggs to incubate in the nest be fruitful. Topmost horizontal surfaces of eggs must be marked with a non-delible marker (Sharpie®) prior to removing them from the nest, and this position is to be maintained throughout the duration of incubation. One should record some non-obtrusive measurements for the sake of acquiring a scientific database on this poorly known species:

1. Nest length (edge to edge of the longest portion of the nest)
2. Nest width (edge to edge of the shortest portion of the nest)
3. Nest height (substrate to apex of nest)
4. 1st egg depth (depth of 1st egg from surface of nest apex)
5. Ambient temperature (air temperature)
6. Nest temperature (at mid clutch)

The eggs can be maintained at room temperature (27-28°C), within a large plastic bag, with moist cotton substratum. Eggs should not touch each other, or the bag. Temperature monitoring is important, and should be recorded from within the bag at least twice a day. The bag should be opened every 2 days, to facilitate gas exchange. Eggs that have signs of going rotten / spoiling should be removed from the main clutch and incubated separately. Clotrimazole, an anti-fungal/bacterial powder has been used at the MCB/CFH to deter fungal growth on King Cobra eggs with no ill effects.

At the conclusion of the workshop, we conducted an evaluation that involved acquiring feedback from all the participants on duration of the workshop, choice of topics for the workshop, among other factors.

Ultimately, what we wish is that the findings published herein improve the management and husbandry of this most magnificent of snakes. We know so little of the status of this species in the wild in our country, it is mandatory that this species does not end up being "recycled" in zoos that cannot care for them in a systematic and responsible manner. In conclusion, this workshop was a very good lesson for the attendals as well as the organizers. In the future we hope to organize more such workshops, the next of which would probably be related to the Management and Husbandry of Indian Testudines.

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