

# GUIDELINES FOR THE UPKEEP OF **REPTILES** IN ZOOS AND PARKS

Neelimkumar Khaire  
RAJIV GANDHI ZOOLOGICAL PARK



Central Zoo Authority  
(Ministry of Environment & Forests)





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FOR THE UPKEEP OF  
REPTILES  
IN ZOOS AND PARKS**

**Neelimkumar Khaire  
Ex-Director**

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**Rajiv Gandhi Zoological Park and Wildlife Research Centre**

Katraj, Pune 41104, India

Tel. No.: 020 24367712

Email: [rajivgandhizoo@punecorporation.org](mailto:rajivgandhizoo@punecorporation.org)

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Acknowledgment

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This project '**Guidelines for the Upkeep of Reptiles in Zoos and Parks**' has been taken up with a view to provide information and knowledge for management, maintenance of reptiles.

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Indian zoos are being modernised and upgraded thanks to the continuous efforts, of the Central Zoo Authority. Cages are being replaced by moats and animals that were previously kept in concrete cages are now being provided naturalistic enclosures. However, this change has not been reflected in the way Indian zoos and parks are housing, keeping and displaying reptiles. The Schedules 1 and 2 of the Wildlife Protection Act include a variety of reptiles, unfortunately they have never been given the same priority as their mammalian and avian counterparts by zoo personnel. Most reptilian collections in Indian zoos are not being managed scientifically and many a times they have been housed and exhibited in totally unnatural conditions, in contrast to their biological needs. In the past as well as now, many reptiles are exhibited just because the zoo has acquired them by coincidence. Sadly these are then housed in whatever kind of cage is available at the time of arrival. Recent surveys have shown that most reptilian exhibits in our zoos and reptile parks are a neglected lot. In India, we still use archaic methods of displaying crocodilians, chelonians, lizards and snakes on unnatural substrates without giving any thought to the animal's ecological and behavioural needs.

Today there are several options available in the local market to improve the way we keep our reptiles. These range from different substrates, to UV lamps and heaters, to specialized hook sticks and tongs. However, perhaps due to the lack of awareness these are not being used in many zoos around the country. It is therefore hoped that this small book will be of immense help to the directors and curators to upgrade their reptile sections, and make them at par with their moated, naturalistic, mammalian enclosures. Considering the scenario, it was most urgent that such a book was published and distributed across the zoos in the country, in order to upgrade the standards of reptile care. Full credit goes to the Central Zoo Authority for understanding the severity of the subject and coming to the aid of zoos once again.

In the making of these guidelines I have visited many reptile collections, in various parts of the country. My team and I photographed and studied them. Interactions with zoo directors, curators and keepers have provided valuable inputs to the kind of information that was required to upgrade their facilities. Based on this, I have attempted to provide guidelines on a variety of topics. As most collections were not being properly exhibited, the section on housing has been extensively covered. Insights and inputs on various other husbandry practices, disease and breeding have been provided. A separate chapter has been included on feeding. A section on education and conservation has also been included, keeping in mind that a modern zoo needs to educate its visitors as well as participate in captive breeding.

The making of this book has been an informative, interesting and educative journey. This book addresses the basic principles of scientific management of reptiles (in captivity). I hope that its readers will use these guidelines effectively and improve the way they take care of the reptiles in their custody. I await the day when Indian zoos and parks will give equal consideration to their reptiles, birds and mammals.

**Neelimkumar Khaire**

## List of scientific & common names of reptiles used in this book

	<b>Common Name</b>	<b>Scientific Name</b>
1	Elliot's Shield Tail Snake	<i>Uropeltis ellioti</i>
2	Buff-striped Keelback	<i>Amphiesma stolatum</i>
3	Common Trinket Snake	<i>Coelognathus helena helena</i>
4	Montane Trinket Snake	<i>Coelognathus helena monticollaris</i>
5	Gunther's Racer	<i>Coluber gracilis</i>
6	Banded Kukri Snake	<i>Oligodon arnensis</i>
7	Banded Krait	<i>Bungarus fasciatus</i>
8	Hump-nosed Pit Viper	<i>Hypnale hypnale</i>
9	Malabar Pit Viper	<i>Trimeresurus malabaricus</i>
10	Ornamental Flying Snake	<i>Chrysopelea ornata</i>
11	Bronzeback Tree Snake	<i>Dendrelaphis tristis</i>
12	Leith's Sand Snake	<i>Psammophis leithii</i>
13	Slender Coral Snake	<i>Calliophis melanurus</i>
14	Checkered Keelback Water Snake	<i>Xenochrophis piscator</i>
15	Common Vine Snake	<i>Ahaetulla nasuta</i>
16	Indian Smooth Snake	<i>Coronella brachyura</i>
17	Banded Racer	<i>Argyrogena fasciolata</i>
18	Indian Rat Snake	<i>Ptyas mucosa</i>
19	Spectacled Cobra	<i>Naja naja</i>
20	King Cobra	<i>Ophiophagus hannah</i>
21	Barred Wolf Snake	<i>Lycodon striatus</i>
22	Yellow-spotted Wolf Snake	<i>Lycodon flavomaculatus</i>
23	Common Wolf Snake	<i>Lycodon aulicus</i>
24	Common Krait	<i>Bungarus caeruleus</i>
25	Wall's Sind Krait	<i>Bungarus sindanus walli</i>
26	Forsten's Cat Snake	<i>Boiga forsteni</i>
27	Common Cat Snake	<i>Boiga trigonata</i>
28	Saw-scaled Viper	<i>Echis carinatus</i>
29	Common Sand Boa	<i>Gongylophis conicus</i>
30	Whitaker's Boa	<i>Eryx whitakeri</i>
31	Indian Rock Python	<i>Python molurus molurus</i>
32	Russell's Viper	<i>Daboia russelii</i>
33	Bamboo Pit Viper	<i>Trimeresurus gramineus</i>
34	Green Keelback	<i>Macropisthodon plumbicolor</i>
35	Dog-faced Water Snake	<i>Cerberus rynchops</i>
36	Starback Tortoise	<i>Geochelone elegans</i>
37	Travancore Tortoise	<i>Indotestudo travancorica</i>
38	Elongated Tortoise	<i>Indotestudo elongata</i>
39	Indian Softshell Turtle	<i>Aspideretes gangeticus</i>



## List of scientific & common names of reptiles used in this book

	<b>Common Name</b>	<b>Scientific Name</b>
40	Indian Flapshell Turtle	<i>Lissemys punctata</i>
41	Chitra Turtle	<i>Chitra indica</i>
42	Leith's Softshell Turtle	<i>Aspideretes leithii</i>
43	Tent Terrapin	<i>Kachuga tentoria</i>
44	Painted Roofed Turtle	<i>Kachuga kachuga</i>
45	Roofed Terrapin	<i>Kachuga tecta</i>
46	Indian Pond Terrapin/Black Turtle	<i>Melanochelys trijuga</i>
47	Olive Ridley Turtle	<i>Lepidochelys olivacea</i>
48	Green Turtle	<i>Chelonia mydas</i>
49	Common Indian Monitor	<i>Varanus bengalensis</i>
50	Yellow Monitor	<i>Varanus flavescens</i>
51	Water Monitor	<i>Varanus salvator</i>
52	Desert Monitor	<i>Varanus griseus</i>
53	Spiny-tailed Lizard	<i>Uromastix hardwickii</i>
54	Indian Garden Lizard	<i>Calotes versicolor</i>
55	Western Ghats Flying Lizard	<i>Draco dussumieri</i>
56	Fan-throated Lizard	<i>Sitana ponticeriana</i>
57	Little Skink	<i>Mabuya macularia</i>
58	Indian Chamaeleon	<i>Chamaeleon zeylanicus</i>
59	Mugger or Marsh Crocodile	<i>Crocodylus palustris</i>
60	Estuarine or Saltwater Crocodile	<i>Crocodylus porosus</i>
61	Gharial or Long-snouted Crocodile	<i>Gavialis gangeticus</i>
62	Green Iguana	<i>Iguana iguana</i>



A decorative graphic consisting of four vertical bars of varying heights and widths, located on the left side of the white header box. The bars are colored in shades of yellow and orange.

# **HOUSING**

## **Enclosure Design**



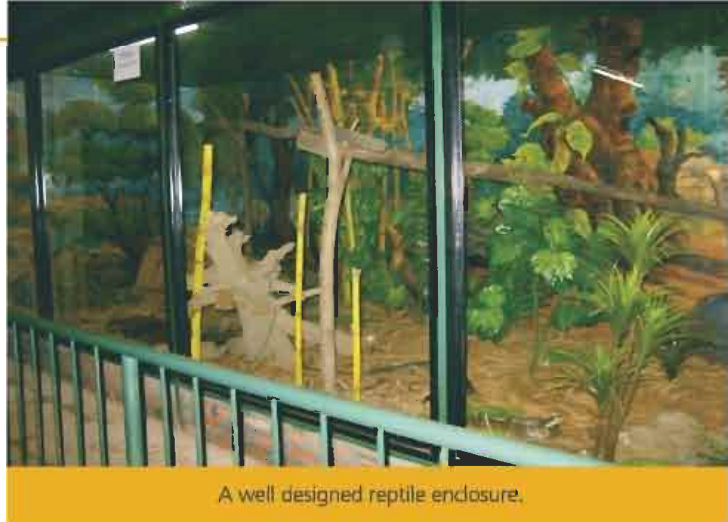
## Enclosure Design

Enclosure design depends on the type of environment the reptile needs. It is easier to manage reptiles if their captive habitat contains key features from the reptile's natural environment. Basically the enclosure should imitate the surroundings in which that particular reptile is found in, thus making life for the reptile and its manager easier.

Drainage, sanitation, heating, lighting and ventilation are very important parameters to be considered. The space of the enclosure must be large enough to permit a proper temperature gradient to be set up and maintained.

Furniture and substrate should be provided for the reptile to fulfill its behavioural and physiological activities like locomotion, swimming, thermo-regulation, feeding, drinking, basking, sleeping, nesting and hiding. Heating and lighting equipment such as submersible heaters, bulbs etc should be well shielded to avoid contact with the reptile. All furniture and fixtures should be fastened securely.

The enclosure design should allow keeper's activities like cleaning, washing and changing of water to be accomplished with ease. While constructing the enclosure, it is necessary to consider the size, shape and materials used.



A well designed reptile enclosure.

## Enclosures can be designed as per the following types of habitats:

### Aquatic



Sea snake

#### Sea Turtles, Sea Snakes

Aquatic reptiles need large bodies of water to swim and feed. To thermoregulate, the water body and land should be in the ratio of 60:40. The water body needs to be strong enough and waterproofed well to hold the water.

A radiant heat source should be installed over the land section. The reptiles should be able to get in and out of water with ease. There should be a shallow shore area with flat rocks, gravel or tree bark. The water can get badly polluted with feces. Frequent water change is essential. Furniture such as aquatic plants, rocks, branches should be kept. Sand and pebbles can be used as substrate.

### Semi-Aquatic

#### Checkered keelbacks, Terrapins, Crocodiles

Some reptiles spend considerable amounts of time in the water swimming, feeding, and sleeping, as well as basking on dry land. The ratio of land and water should be 70:30.

Furniture such as logs, sturdy branches and plantation like shrubs and bushes can be used. The water bodies should have islands with hiding places. The shore area should be covered with substrate arranged in the sequence of bigger pebbles followed by medium sized pebbles, sand and soil. This arrangement helps the water from the reptile bodies to drain off, without spoiling the sand and soil.



Gharial

## Fossorial

### Sand boas, Sandas, Geckos, Skinks

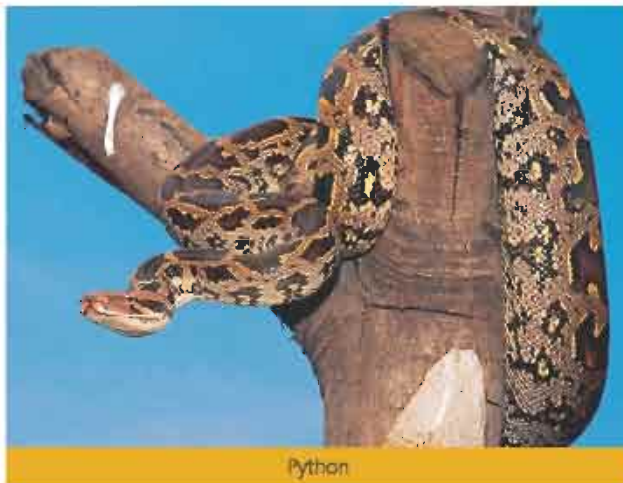
Appropriate substrate in which the reptiles can burrow (soil, pebbles, sand, etc.) should be used. The floor of the enclosures need to be strong enough to hold several inches of appropriate substrate. The ratio of land to water should be 90:10. Many snakes and lizards, and some chelonians, spend some or all of their time hidden under few inches or more of substrate. Some, like sand boas, are rarely seen above ground; others, like some skinks, burrow away to sleep and digest.

Furniture such as hollow wooden logs, artificial wooden logs, rocks with cavities should be used.



Sanda

## Arboreal



Python

### Pythons, Pit vipers, Whip snakes, Lizards

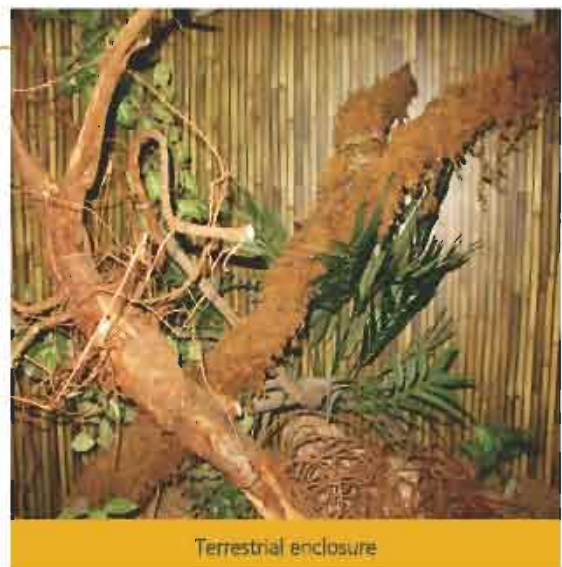
Many species of lizards and snakes spend most or all of their time in trees, including iguanas, geckos, boas and pythons. The ratio of land to water should be 90:10. These enclosures should have a good height. If live plants are used in these enclosures, they must be sturdy enough to withstand the weight of the animal as well as any other damage the animal can exert on it with its claws or movement. Partial or complete drainage is required to catch the run-off when the plants are watered. Artificial creepers made out of rope coated with epoxy material can be used. The water body should be shallow. Substrates such as soil, litter, moss should be used.

## Terrestrial

### Rat snakes, Cobras, Vipers

Terrestrial enclosures should have ample furniture like rocks, wooden logs, boulders with flat surfaces and an undulating substrate of hard soil. The enclosure should be large and ratio of land to water should be 80:20. The enclosure should have ample depth and width to ensure enough room for adequate thermo-regulation. Ratio of land to water should be 80:20

Small trees, bushes, and grasses can be planted in an open enclosure.

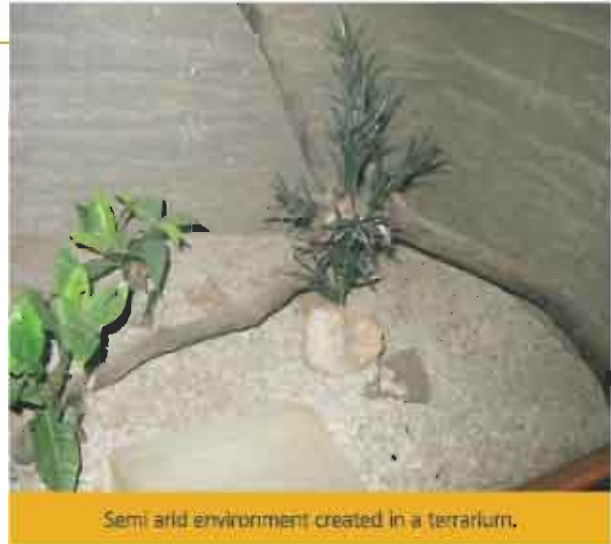


Terrestrial enclosure

## Desert / Semi arid

### Saw scaled Vipers, Tortoises, Lizards, Royal snakes

It is an arid or semi-arid environment. Ratio of land to water is 90:10. Furniture such as tree bark, branches, boulders with flat surfaces should be provided. Hollow tree logs, natural or artificial rocks with cavities can be used for hiding. Substrates like small pieces of tree bark are preferred.



Semi arid environment created in a terrarium.

## Special tips for commonly exhibited reptiles in Indian zoos

### Indian Rat snake

The enclosure should be large and have a arboreal and grassy habitat with branches and a large water body. There should be



boulders and roots of different trees. Soil with a thin layer of dry leaves should be used as a substrate.

### Python

The enclosure should have arboreal / forest habitat with a large water body and large sunlight sites for basking. There should be lots of branches, logs, boulders. Soil and sand substrate should be used.



### Tortoise

The enclosure should have a substrate of soil and sand. Adequate shrubs and grass, with patches of sunlight and shade should be provided. There should be a small water body with a gradual gradient on all sides.

### Hump nosed viper

The enclosure should have a tropical forest like habitat with damp patches and dry warm basking sites.



### Cat snake

They require a warm (well heated) enclosure during the day, which should cool down at night.



### Racer

Enclosures should be well heated, sunny and dry with adequate hiding places. They can be kept in secure outdoor enclosures with supplementary heating.

### Russell's viper

Russell's viper should be maintained in a spacious, well heated dry enclosure with a water body. Substrate of dry grass and leaves should be used.



### Bronze back tree snake

The enclosure should have a warm tropical forest environment with many plants, creepers, branches and a large water body.

### Spiny tailed lizard (Sanda)

The enclosure habitat should be fossorial, with a deep substrate layer for burrowing and a small water body. The enclosure should be partially exposed to the sun for basking.



**Elongated tortoise**

The enclosure should be warm and dry with a large water body. Provide adequate basking areas.



**Shield tailed snake**

The enclosure should have a substrate of loose flat rocks or pieces of tree bark. The soil should be moist and loose.

**Wolf snake**

The enclosure should be warm and dry with ample hiding places. The night temperature should be reduced. The habitat should be either grassy, rocky or rainforest with rocks and logs for hiding.



**Kukri snake**

The enclosure should be warm and dry with ample hiding places. Night temperature should be reduced.



**Sand snake**

The enclosure should be warm and dry with ample hiding places. The habitat could be desert or grassy. There should be ample sunlight and night temperature should be reduced. There should be lots of tree branches.



**Flying Snake**

Provide plenty of tree branches as they are arboreal. High humidity and weak sunlight works best for this species.

**Calotes**

These are arboreal and require lots of greenery and high humidity. Temperature should range from 25 to 32° C, with only minor reduction at night. A large water body is required.



**Cobra**

The enclosure should be warm and dry. A water body should be provided, as cobras love water.



**Monitor lizard**

They require spacious enclosures with hiding places, climbing branches and a large water bodies. Day temperature should be from 25-30°C and night temperature should be reduced by 10°C.

**King cobra**

The enclosure should have a large water body, branches, bamboo leaf litter and hiding places. It should have adequate heating.



**Chameleon**

They are strictly arboreal. The enclosures should have an arboreal habitat with branches for climbing. The enclosure should have partial exposure to the sun for basking.



**Pit Vipers**

Since these snakes are arboreal, plenty of creepers and branches should be provided. The enclosure should maintain 80 -90% humidity.





#### Fat tailed gecko

The enclosure temperature should have a wide range. Day temperatures should be 25-35 °C. Night temperatures should be 20°C or less. Part of the substrate should be kept damp.



#### Iguana

They are arboreal but need water bodies to swim. Generally they require a spacious enclosure with adequate climbing branches. Day temperature from 25-30°C are satisfactory with an incandescent lamp for sun bathing, night temperature can be reduced to 20-24°C. Humidity must be kept high by regular spraying of water.

#### Crocodiles

The enclosure should be semi aquatic with large water bodies with a depth of 1 meter. The land area should be large enough for nesting. The enclosure should have a substrate of sand and soil and damp straw for nesting. Furniture such as rocks, logs should be firmly cemented. The water section must have a drain that can be serviced from the outside so that the feces and left over food can be removed without danger.



#### Skink

The enclosure should be spacious with some rocks, pieces of tree barks, roots and branches and should have sunny sites. A section of the substrate must be kept damp. They need a day temperature of 25°-30°C with reduction in temperature at night to about 20°C.



## Housing Different Species Together

Keeping different species together is not recommended as :

- It increases the chances of exposing other species of reptiles to possibly fatal organisms that the host reptile may harbor and be naturally immune to.
- It may lead to stress if the species are not compatible
- It could lead to mating between different species



Cat snake and wolf snake mating together.

## Reptile enclosure dimensions

	REPTILES	Number of individuals (M+F)	Size of enclosure (m)	Proportion of the water body	Fogger system
1	Marsh Crocodile	5 + 15	38 x 19	1/3	
2	Saltwater Crocodile	2 + 8	38 x 19	1/3	
3	Gharial	4 + 6	38 x 19	1/3	
4	Indian Pond Terrapin	10 + 10	8 x 8	1/3	
5	Peninsular Mud Turtle	10 + 15	8 x 8	1/3	
6	Indian softshell Turtle	2 + 4	8 x 8	1/3	
7	Starback Tortoise	10 + 15	8 x 8	1/6	
8	Travancore Tortoise	2 + 4	8 x 8	1/6	
9	Elongated Tortoise	2 + 4	8 x 8	1/6	
10	Chameleon	3 + 3	5 x 2.5 x 3	1/6	✓
11	Desert/Yellow Monitor Lizard	2 + 2	12 x 6	1/4	
12	Monitor Lizard	2 + 10	12 x 6	1/4	
13	Water Monitor Lizard	2 + 2	12 x 6	1/3	
14	Indian Rock Python	2 + 8	19 x 6 x 3	1/4	✓
15	Reticulated Python	2 + 4	16 x 6 x 3	1/4	✓
16	Burmese Python	2 + 6	16 x 6 x 3	1/4	✓
17	Russell's Sand Boa	2 + 4	5 x 2.5 x 2	1/6	
18	John's Sand Boa	2 + 4	5 x 2.5 x 2	1/6	
19	Whitaker's Sand Boa	2 + 4	5 x 2.5 x 2	1/6	
20	Trinket Snake	3 + 7	5 x 2.5 x 2	1/5	
21	Montane Trinket	3 + 3	5 x 2.5 x 2	1/5	
22	Rat Snake	5 + 15	16 x 6 x 3	1/4	
23	Banded Racer	3 + 7	5 x 2.5 x 2	1/5	
24	Common Kukri Snake	2 + 2	2.5 x 2 x 2	1/5	
25	Painted Bronzeback	2 + 4	5 x 2 x 2	1/5	✓
26	Common Wolf Snake	4 + 6	2.5 x 2 x 2	1/5	
27	Checkered Keelback Water Snake	10 + 15	8 x 2.5 x 2	1/3	
28	Buff-striped Keelback	4 + 6	2.5 x 2 x 2	1/4	
29	Green Keelback	2 + 4	2.5 x 2 x 2	1/5	
30	Banded Krait	2 + 4	5 x 2.5 x 2	1/4	
31	Common Cat Snake	2 + 2	2.5 x 2 x 2	1/5	✓
32	Ceylon Cat Snake	2 + 2	2.5 x 2 x 2	1/5	✓
33	Forstern's Cat Snake	2 + 2	2.5 x 2 x 2	1/5	✓
34	Common vine snake	2 + 2	2.5 x 2 x 2	1/5	✓
35	Common Indian Krait	2 + 2	2.5 x 2 x 2	1/5	
36	Indian Cobra/ Monocellate Cobra	2 + 4	5 x 2.5 x 2	1/5	
37	Russell's Viper	4 + 6	5 x 2.5 x 2	1/5	
38	Sawscaled Viper	4 + 6	2.5 x 2 x 2	1/5	
39	Bamboo Pit Viper	2 + 6	2.5 x 2 x 2	1/5	✓
40	King Cobra	1 + 1	16 x 6 x 3	1/4	✓
41	Ornamental Flying Snake	2 + 2	5 x 2.5 x 3	1/4	✓

## Guidelines for enclosures with natural habitat

1. Enclosures should try to recreate the natural habitat as much as possible.
2. There should be adequate greenery, ventilation, water and sunlight.
3. The naturally recreated habitat should be kept clean. Plants should be watered and kept healthy. Regular pruning of bushes, shrubs should be done.
4. Artificial plants can also be used.
5. Ponds and water bodies should be free of algae.
6. Organic fertilizer or vermicompost should be used for plants.



Naturalistic looking enclosure with suitable vegetation planted in it.



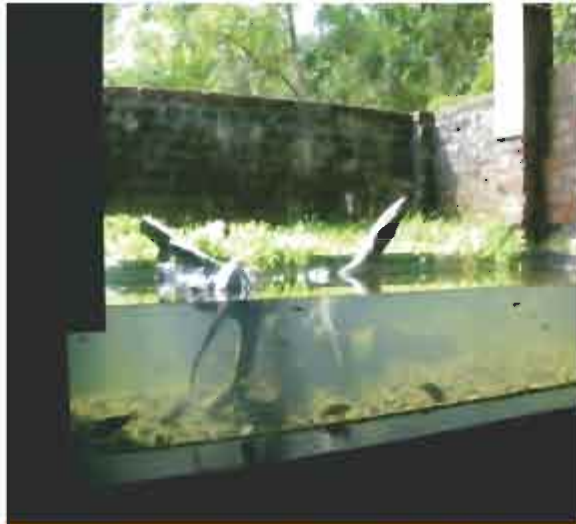
Excellent example of greenery planted atop the enclosure wall, allowing the greenery to trail down.



The habitat looks natural and pleasing to the eye.

## Modern Housing Designs

Traditionally reptiles were kept in pits and visitors would look down into the pits. Nowadays reptiles are kept in cages like terrariums which have glass barrier for better visibility. These glass enclosures and cages should be at eye level so that visitors can see them at a close range.



A good way to observe terrestrial as well as aquatic habitat.



Excellent way to observe gharials underwater.

## Guidelines for maintaining glass enclosures

- Glass cages should have excellent visibility.
- The glass should be kept clean at all times with proper cleaning accessories like sponge, newspaper, cloth and soap solution.
- Cracked or broken glass should be replaced immediately, as this is dangerous for the enclosed reptile and the keeper.
- Dirty and cracked glasses greatly hamper visibility as depicted in the photos below.





Glass enclosures and cages should be exhibited in a hall or covered with a shade to avoid reflection of light on the glass.



Water bodies should not be close to the glass because if a wet reptile attempts to climb on the glass, it would dirty the glass leading to poor visibility.

## Guidelines for crocodile enclosures

1. The water in the enclosure should be clear so that the reptile is visible.
2. The enclosure should have proportionate dry land and water bodies.
3. The enclosure should be designed in such a way that the visitors can view the animal at eye level.
4. Structures that aid the reptile to escape should be avoided.
5. The enclosure wall should be 2' in height. The entrance door for keepers should be above the wall.
6. Conceal any water pipes, extruding material, unnatural concrete tiles and blocks, etc that look unnatural to public eye.
7. Plantation of sturdy plants which can withstand the weight and movement of the animals should be carried out.
8. Use of pointed metal bars in the enclosure design should be avoided.



An excellent exhibit. The reptile is visible at eye level and its viewing is in darkness. The railing has been fixed at an appropriate distance.



An ideal naturalistic exhibit in which the proportion of land to water is appropriately maintained. Suitable substrate and furniture have been provided.



The Gharials have been exhibited correctly with a proper water and land ratio. The wall has been created aesthetically and good vegetation has been planted.



The water in the crocodile enclosure should always be kept clean, unlike as shown as above.



The size is not proportionate to the number of crocodiles exhibited.



The heavy metal bars give the enclosure the look of a jail barricade which should be avoided.



Steps in the enclosure wall can lead to an easy escape and should be avoided.



This crocodile enclosure can be made more aesthetic by planting some marshy plants and improving the substrate.



Unclean nets should be avoided as they decrease the aesthetics of the enclosure. It is also preferable to conceal the drainage chamber instead of keeping it exposed.



## Guidelines for Snakes enclosures

1. Snakes should be displayed as per the habitat they belong to and the number of snakes in that enclosure should be proportionate to the area of that particular enclosure.
2. Proper sex ratio should be maintained.
3. Individuals of cannibalistic snakes (king cobra, krait) should be housed separately, except during mating.
4. Freshly laid eggs should be removed immediately from the enclosures.
5. Reptile pits below ground level should be well protected from water seepage.
6. The water body should be of adequate size so that the snake can submerge itself in it.
7. Natural or artificial plants should preferably be planted in the cages.
8. Hiding places for reptiles should not be of a permanent structure as they are difficult to clean.
9. Enclosures should have proper visibility especially keeping in mind small venomous species.
10. Keeping different species together should be strictly avoided.
11. Glass terrariums should preferably be permanently fixed to the ground.
12. Enclosures for pythons and king cobras should preferably have provision for 2 locks.
13. Heating systems should be properly concealed to avoid any injury to the reptile.



An excellent enclosure that has appropriate substrate, natural and artificial plants, furniture, a water body, fogging system and heating elements.



The enclosure is an excellent example of terrestrial environment. There is adequate sunlight. Plantation and substrate is appropriate. The above is reflected in the health status of the snake.



Keeping various snake species together and material like chain link fencing which can cause injury to the snakes should be avoided.



Tiles should not be used to house snakes. Proper substrate, ventilation, furniture and keeper access should be provided.



Small sized snakes like saw scaled viper, boa should be exhibited in a small sized terrarium. The system of exhibiting a cage within a cage like depicted in the picture is wrong.



This system of keeping snakes should be used for off exhibit species and not for public exhibition.



Terrariums should be mounted on a permanent structure (platform) so that there is less chance of it falling or breaking due to vandalism.



An exposed light bulb can be fatal to the snake. All such electrical fittings should be covered.



A naturalistic enclosure with appropriate hiding places for snakes.



Information provided should be accurate and should not block the view of the reptile as depicted in the picture.



A damp substrate should be avoided as the snake can fall ill as a result.



An artificial ant hill has been created for snakes to hide, however it is difficult to clean the faeces and moults from such structures.

## Guidelines for Tortoise enclosures

1. The enclosure should have a substrate of soil and sand. Adequate shrubs and grass, with patches of sunlight and shade should be provided.
2. The enclosure should have a 6" layer of smooth sand.
3. The water pond should be shallow with a gradual slope.
4. The enclosure of the cage / site should allow stray birds to perch. The bird droppings contain calcium which are consumed by the tortoise.
5. Enclosure should be have adequate plants and adequate space for basking.
6. Proper male-female ratio (1M:5F) should be maintained.
7. The enclosure should not have any steep slopes to facilitate ease of movement for the tortoise.



Example of an appropriate enclosure having adequate sunlight, shade, plantation, feeding area, substrate and water body.



The enclosure for Elongated tortoises should be provided with a 40 W light bulb at a height of 20" from the ground to provide warmth and to attract insects which are a good animal protein source for the tortoises.



This steep incline is inappropriate for tortoises, and should be replaced with a gradual slope.



Plastic bags left in the enclosure are likely to be consumed by tortoises resulting in dangerous consequences. Such materials should not be used in the enclosure.

## Guidelines for exhibiting Turtles and Terrapins in enclosures / cages

1. Proper slope should be maintained for the water bodies for the easy movements of the turtles.
2. Proper sunlight and shade should be made available in the enclosure.
3. The water inlet should be attached to a clean water source while the water outlet should be attached to the drainage line.
4. In the enclosure land and water body ratio should be 60:40.
5. The enclosure should have adequate heating facilities like heating bulbs or thermostatic under gravel heating.
6. Keepers should disinfect themselves properly after working with terrapins as the excreta of the terrapins contains *Salmonella spp.*



The correct proportion of land to water along with adequate shade and green vegetation has been provided in this terrapin enclosure.



Too many terrapins have been kept in small tubs above. Try to avoid over crowding.



Turtles require to bask in the sunlight so turtles housed in aquaria should be provided dry areas along with appropriate artificial lighting for basking.





Do not place stones or tiles loosely in the enclosure as they might fall and result in injuries to the turtles or terrapins.



There is no gradual slope for the reptile to access the water body. As a result, once the reptile is inside the water it cannot come out.



Display of terrapins in the above manner is not suitable for the species and hence should be strictly avoided.

## Guidelines for lizards enclosures

1. As lizards are arboreal and terrestrial, there should be adequate furniture such as branches, hollowed out wooden logs, etc.
2. Sufficient hiding places should be provided compulsorily.
3. An area for the proper basking should be provided.
4. In northern India, underground heaters should be placed during winters.
5. A proper male-female ratio (1M:2F) should be maintained.



With no hiding place around, the lizard has sought to hide underneath the water body.



Enclosure design needs to consider the animal's welfare, so an artificial environment as depicted on the right should be avoided.



An MS sheet fixed as shown in the picture on the left can cause serious injury to the animal and should be used in a funnel shape as shown in the picture on the right.

## Guidelines for exhibiting Chameleons in enclosures / cages

1. Adequate climbing branches should be present in the enclosure.
2. Proper sunlight and hiding places should be provided in the enclosure.
3. The viewing side of the enclosure should preferably be of glass while for the other sides 6mm perforated MS sheets are preferred. The roof of the enclosure should be made of 1" x 1" weld mesh in order to allow the entry of insects.
4. Basking and heating facilities should be provided in the design for the reptile.
5. Chameleons do not drink water from bowls. Water should be sprayed with the spray pump on the branches and leaves for the chameleons to drink.
6. Feeding should be done on daily basis.



Water for drinking is sprayed on the branches and leaves.



A good way to exhibit chameleons.

## Guidelines for exhibiting Iguanas in enclosures / cages

1. Iguanas need to climb and perch, so one must provide them branches which are thicker than the animal in girth. This facilitates them to climb and rest on the branches. The bark of the branches should not be removed.
2. The enclosure should have adequate sunlight.
3. The feeding platform should be at an height of 1m from the ground.
4. Arrangement of the perches should be linked to the feeding platform.
5. Proper basking area should be provided.
6. Water pipes, drainage line, electrical wiring, etc. should be concealed.



One should avoid displaying material like water inlets and drainage pipes, etc in the enclosure.



An ideal enclosure for Iguanas with appropriate substrate, shade and perches.

The slide features a solid orange background. On the left side, there are three vertical bars of varying heights and shades of orange, stacked vertically. To the right of these bars is a white rectangular box containing the text.

## **HOUSING**

**Substrate, Heating  
and Lighting**



## Guidelines for Substrate

Substrate is material used to cover the bottom of the cage or enclosure. The substrate depends upon the natural habitat of the species. Substrate can be natural or artificial. Natural substrate can breed pests but are aesthetically pleasing. Artificial substrate are much easier to clean and can be maintained for longer time. Natural substrates can be discarded and easily be replaced. Natural substrates like sand and soil can be heated to make them sterile. The substrate also provides exercise and hiding places for snakes.

### Substrates that can be used in off exhibit cages



#### Newspaper

It is cheap, dust free, absorbent and easy to replace. It is ideal for large non-burrowing snakes. However it is unattractive and wrinkles when wet. Reptiles can get trapped underneath and is unsuitable for fossorial species. Reptiles tend to crumple it. Live food animals may hide underneath the paper sheets.



#### Carpets

They little more attractive than newspaper, can be easily cut to size of the cage and can be replaced when soiled. They are neat, washable and maintain temperature. Carpets however have unnatural appearance and are unsuitable for fossorial species. Carpets should be trimmed for loose threads which may choke or entangle reptiles.



#### Paddy straw

It is cheap, very absorbent, easy to clean and can be replaced regularly. Spot cleaning is convenient. It can be used for burrowing snakes.

### For Public exhibition



#### Gravel

It is most commonly used substrate and can be washed and re-used. It is non absorbent and need thorough sterilizing and rinsing before re-use. Various sized gravel can be used to suit the reptile and its habitat.



#### Sand

It is useful for fossorial species from arid areas. It is easy to clean and is pleasing to the eye. Avoid using sand as a substrate in cold regions. Sea sand has fine grains and is difficult to maintain when soiled. Nowadays there are aquarium sands that are available in various colours and can be used according to the species. Avoid sand that is used in construction.



#### Leaf litter

Leaves give the enclosure a natural appearance. They retain moisture, but too much of moisture may lead to pneumonia. Leaves need to be sterilized before use, using UV light. They are good at maintaining temperature and facilitate hiding.



**Chipped bark**

It looks attractive and has a pleasant smell. They may contain splinters and insects. It is not very absorbent and is difficult for spot cleaning. Not suitable for fossorial species.



**Hardwood chips**

It has an attractive appearance and is slightly absorbent. It may contain splinters or sharp pieces.



**Moss**

It is fairly absorbent and is harmless if ingested. It is easy to spot-clean. It crumbles when wet. However, It is expensive if used in large quantities. The moss can be wrapped around tree branches for arboreal species like pit vipers and vine snakes.



**Dust free wood shavings**

It has an attractive appearance, and a pleasant smell. It is quite absorbent and can be spot-cleaned. It maintains enclosure temperature and is good for burrowing reptiles.



**Coco Dust**

It is attractive in appearance. Good for borrowing snakes. It maintains temperature of the enclosure.



**Pebbles**

Mainly useful for aquatic reptiles. It is excellent for draining water in enclosures with water bodies. When the reptile emerges from water, on to the pebble substrate, the water drains, making them dry. It is ideal for pits in which water seeps in during monsoon.

Species	Type of substrate
<b>Terrestrial</b> Python, Russell's viper, Dhaman, Geckos, Common Skink, Cobra, Shield tail snake	Leaf / litter / moss / coco dust / wood shaving
<b>Fossorial</b> Tortoise, Sand boa, Earth boa, Monitor lizard, Spiny-tailed lizard, Skink, Yellow Monitor lizard, Gharial, Kukri, Krait	Wood chips / sand / small gravel / large rocks
<b>Semi aquatic</b> Turtles, Terrapins, Water Monitor lizard, Crocodile, Keel back, Sea snakes	Sand / gravel / rock / soil
<b>Arboreal / rainforest</b> King cobra, Pit viper, Vine snake, Flying snake, Cat snake, Draco, Forest calotes, Chameleon, Fan throated lizard	Moss / gravel / soil / leaf litter



## Guidelines for heating management

Being cold-blooded reptiles need a temperature controlled environment which is why it is very important to maintain the right temperature in cages and enclosures. The optimum temperature range for most reptiles is between 25-30°C. If the temperature falls way below 25°C then it could result in illness and even death of the reptile. The heat provided should be appropriate to the reptile, its habitat and seasonal weather changes. Heating can be done either by heating a large area or using spot heaters for localized heating.

### Different type of heaters

#### Ceramic heaters

These heaters provide infrared rays and do not emit light. They are useful for larger reptile pits and night-time heating.

#### Heating mats

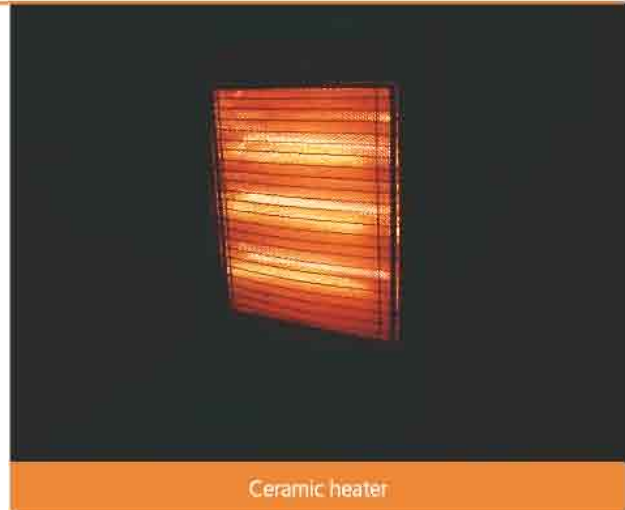
These heaters provide infrared rays and do not emit light. They are useful for heating at night and for providing heat to the abdominal area. However they are prone to be damaged by clawing.

#### Heater plates

They are similar to mats, usually screwed to the top of cage. They provide infrared rays and have insulation on one side.

#### Heating blankets / Pig blankets

They are similar to heater plates and are used on the floor.



Ceramic heater



In emergency situations when electricity is not available, hot water bags can be employed to provide heat to the animals.



Tubular heater



Fiber glass imitation rocks



Woollen blanket



Undergravel heater

### **Tubular heater**

They can get extremely hot and are more suitable for larger enclosure/pits. Several lengths or wattages are available.

### **Basking lamps / Carbon filament lamp**

They are the commonest, cheapest and most effective means of heating. They can be used in the day or at night and are available in various wattages.

### **Heat tapes**

They have low wattage and are often used for hatching snakes boxes or shelf/rack systems.

### **Hot rocks**

They are fiber glass imitation heating rocks with a thermostat. They are most useful in small and nocturnal reptiles. Wattage is as low as 4 watts.

### **Aquarium heater with thermostat**

It is mainly used for terrapin tanks if the basking light is insufficient to heat the water. It can be used to heat a pool of water. It needs some protection to prevent accident.

### **Woollen Blanket**

Use woollen blankets in open pits and enclosures in winters to cover small reptiles.

### **Under-gravel heaters**

The heater can be used with a timer to control heat. The heater should be covered with 2 inches of sand.

### **Bulkhead setting**

For heating lamps for lizards. These special type of heating lamps allow the animal to rest its belly to absorb heat.



Bulkhead setting

## Proportional temperature controller

To accurately control temperature without extensive operator involvement, a temperature control system relies upon a controller, which accepts a temperature sensor such as a thermocouple or resistive temperature detector (RTD) as input. It compares the actual temperature to the desired control temperature, or set point, and provides an output to a control element. The controller is one part of the entire control system, and the whole system should be analyzed in selecting the proper controller.

Proportional controls are designed to eliminate the cycling associated with on-off control. A proportional controller decreases the average power supplied to the heater as the temperature approaches set point. This has the effect of slowing down the heater so that it will not overshoot the set point, but will approach the set point and maintain a stable temperature.



Heating pad with thermostat.



Hygro-thermometer is used to monitor humidity and temperature.

## Guidelines for lighting in cages and enclosures

Lighting creates an ambience of a natural environment and is essential for the health and well being of reptiles. Lighting can be used to create effects such as a bright desert landscape or twilight in a jungle.

Lighting should be chosen appropriately. Diurnal reptiles utilize certain wavelengths of light in order to synthesize vitamin D3 for the utilization of calcium, essential for bone and shell construction. Reptiles while basking, absorb ultraviolet light. Nocturnal reptiles are active at night time. Their enclosures should have dim lighting.

Many tropical and subtropical reptiles can be kept temporarily outside during summers in an outdoor enclosure or at least be given some sun exposure for a few hours. However care should be taken that there is no over heating; some shade must always be accessible to the reptiles. If the animals cannot be exposed to direct sunlight then, they should be routinely exposed to UV radiation via special lamps once or twice a week.

### Sunlight

Outdoor pits and enclosures should have adequate sunlight for basking. The enclosure should be partially open to the sky. Shade should also be provided for reptiles to cool off.

### Artificial lighting

A variety of factors influence the selection of one or more lamp types. These are enclosure size and design, species, economics and light characteristics. Additional features of light output are intensity (total power output) and quality. Timers should be used to turn off lights at preset times.

### Fluorescent Tubes (UVB output) / UV lamp

UV radiation is the best and most natural substitute for sunlight. These are standard full spectrum lights, are long lasting and are proven to be safe. These lights should have good reflectors which should be replaced every year. This light prevents skin infection and is a source of vitamin D. The minimum distance from the light source should be 50 cm. Caution should be exercised with young reptiles. They should be exposed to UV radiation for shorter periods. Excessive exposure to UV lights is extremely dangerous. Keepers should wear proper goggles if attending to the reptile while the light is on.

### Mercury Vapor Bulbs

These are screw-in bulbs that emit light and look like flood lights. They should be used in open pits and enclosures.

### Heat Bulbs / Brooding lamps

Heat bulbs operate in much the same way as standard bulbs and produce heat as well as light, which radiates over a wide area. These lights should be used with a timer to avoid overheating of the enclosure.



Terrapins basking in sunlight



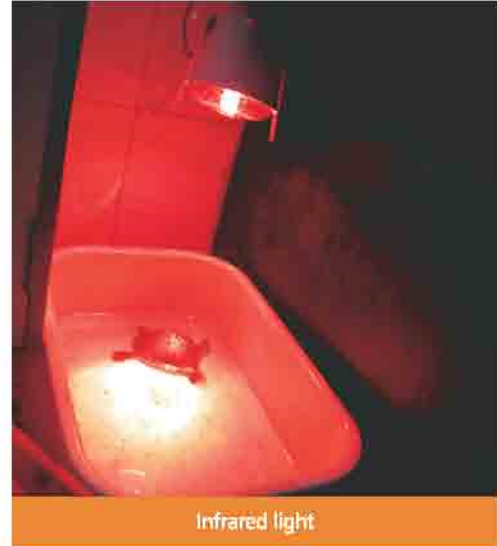
Ultra violet lighting



Mercury vapour lamp

**Infrared bulbs**

Infrared bulbs are used for nocturnal species. The light emitted by them does not disturb the reptile. Always use them with a timer.



Infrared light

**Proportional controller for lighting**

A proportional controller is also recommended for cage lighting. A light sensor like LDR or photo transistor can be used as light sensor. A fluorescent tube or CFL (compact fluorescent light) cannot be used in conjunction with such a controller because light intensity of these light sources cannot be varied. Incandescent bulb or newer halogen lamps can be used for this purpose. There are varieties of such lamps available in the market. The heating effect of these light sources should also be considered while illuminating cages.

This controller can be used to simulate the effect of dusk and dawn for the reptiles.



Sun gun / flood light being used in an open gharial enclosure in the winter, when the day light hours are short.

## Details of infra-red and ultra-violet lamps available in the market

### STANDARD RANGE OF SHORT WAVE IR MODULES

Module Code	Length	Width	Depth	Lamp Used	Heated Length	Watts	Volt
IR 500	310	80	55	SW 500	127	500	240
IR 1000	460	80	55	SW 1000	254	1000	240
IR 1600 S	610	80	55	SW 1600 S	406	1600	240
IR 2000 S	725	80	55	SW 2000 S	508	2000	240
IR 2500 D	825	80	55	SW 2500 D	635	2500	415
IR 3000 S	725	80	55	SW 3000 S	508	3000	240

Infrared modules are the ideal solution in the application of infrared heat technology. They save the user design costs and time, but are substantially less expensive than complete infrared systems.

### QUARTZ INFRARED LAMPS

Available in 500W, 1KW, 2KW, 3KW & other wattages.

#### APPLICATIONS :

- Heating of shrink fits. • Baking of lacquer on all kinds of material. • Heating of food and keeping it warm • Drying of printing inks. • Heat-sterilization.
- Softening of plastics. • Blowing of PETP bottles. • Research into materials at high temperature. • Grilling and toasting apparatus. • Pre-heating of wood prior to lacquering. • Melting of plastic powders, etc.



### ULTRA VIOLET TUBES & BULBS (ACTINIC & SUPER ACTINIC)

#### (a) 05 Series

The "05 Series" actinic tubes are highly efficient/ultra-violet radiation sources with a radiation peak at approximately 360 nm.

#### Application Fields

\* INSECT TRAPS \* DIAZO PRINTING MACHINES.  
(Available in 4W, 6W, 8W, 15W, 20W, 30W, 40W, 65/80W, 140W)

#### (b) 03 Series

The "03 SERIES" Super Actinic Tubes are very efficient ultra-Violet radiation sources with a radiation peak at 420nm.

#### Application Fields

\* Used in Diazo Printing Machines for drying of inks and curing of Lacqures  
Available in size of 11/2 ft to 5 ft.

#### THE MEDICAL SERIES (ULTRA VIOLET) UVA / UVB

09, 03, 52" CLEO", 10 R, Ultra Vitalux,  
Cleo Compact, Professional, Performance Effect  
Used for Treatment of skin diseases and in baby incubators for Treatment of Jaundice, Tanning and other disease.

### STANDARD RANGE OF SHORT WAVE IR LAMPS

Code	Heated Length HL (mm)	Overall Length OL (mm)	Wattage (W)	Voltage (V)
SW 500	127	212	500	240
SW 1000	254	348	1000	240
SW 1600 S	406	500	1600	240
SW 2000 S	508	626	2000	240
SW 2500 D	635	728	2500	415
SW 3000 S	508	626	3000	240

All the above lamps are with round cap and 100 mm long lead wire at both ends. For horizontal mounting application only.





# **HOUSING** Water Bodies





## Guidelines for Water body

1. Water is essential for the health and well being of reptiles. Reptiles use water not only for drinking, but also to submerge themselves, as well as for mating (all aquatic species). Therefore the water bodies should be of an appropriate size and designed to meet the physiological needs of the reptiles.
2. Reptiles also pass feces in water, therefore the water body has to be kept clean everyday.
3. Water bodies should have a gentle slope with a rough surface to facilitate easy access.
4. The depth of the water body should be such that the reptile can submerge itself.
5. For crocodiles the depth of the water body should be 1 meter.
6. The water should be potable. Store chlorinated water 24 hours before using it for reptiles.



An ideal water body for crocodiles: the proportion of land to water has been maintained. The depth of the water body is ideal for crocodiles. Sunlight, shade and tree plantations are excellent.



For small cages, a water bowl with a solid base should be used, to avoid toppling.



Avoid direct sunlight on the glass (in the above condition) because it results in algae development leading to increased maintenance.



Sharp edged stones may cause injuries to animals and hence should be avoided.



There is no gradual slope to this water body. As a result adult terrapin and the babies are unable to climb out of the water body on to the sandy area.



An appropriate water body for a python enclosure. There is a gradual slope to the water body.



The water body is very small in comparison to the size of the reptile. The reptile should be able to submerge in the water body.



The water body has been poorly maintained resulting in an overgrowth of floating water plants decreasing the visibility of the reptile.





## **HOUSING**

### **Railings, Keeper Access and Cleaning**



## Guidelines for Railings

1. The railings for enclosures/cages should be properly designed to prevent visitors from harming the reptiles.
2. The railing should be made of strong durable material. Material like bamboo, ropes and other non-permanent material should be avoided.
3. A minimum height of 1m should be maintained.
4. The railing should be erected at a minimum distance of 1.2 m from the enclosure.
5. The railing should be designed to prevent visitors from jumping across or going under the railing to access the glass or enclosure.



Railings should preferably have vertical bars (see picture on left) as against horizontal bars (right picture) so that visitors cannot climb on the railing.



One should provide a railing (like in the picture on the left) for all venomous snake enclosures to prevent vandalism and to safeguard the visitors from fatal accidents as against the picture on the right.



The height of the railing should preferably be around 1 m (left picture). The enclosure wall (right picture) is low enough for people to cross over and may lead to visitors harming the animals.

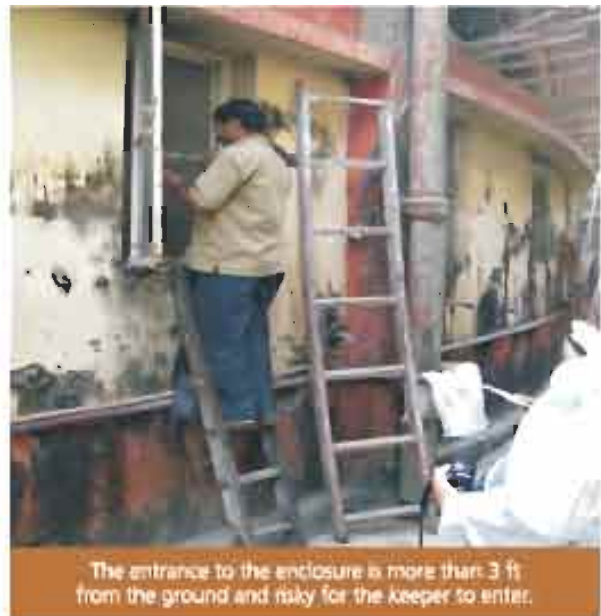
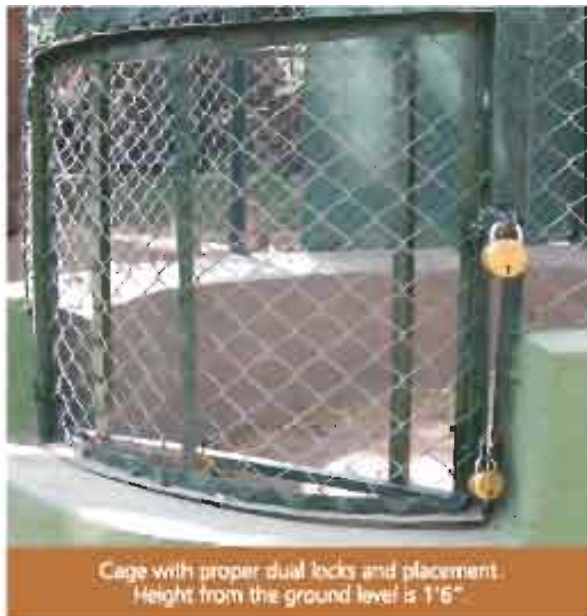


The above railing design provides adequate distance between the cage and the visitors.



## Guidelines for keepers entrance / access / doors for cages and enclosures

1. The entrance to the cage / enclosure should be designed well. It should allow easy access without risk of accidents.
2. The door should be 3ft high x 2ft wide and at a height of 1'6" above ground level.
3. There should be dual locking systems especially for Pythons, Crocodiles, Monitor Lizards and King Cobra.
4. Doors / entrances should be always locked. The keys should be kept in a secure place.
5. Door should be made of Mild steel (MS) or Marine ply of 19 mm.



## Guidelines for Enclosure cleaning

A very important aspect of reptile care is cleaning and disinfecting. Routine cleaning is necessary to keep the reptiles safe and healthy. For the visitors, cages and enclosures should appear clean, attractive and odor-free.

Reptiles are susceptible to bacterial infections of the skin and digestive tract so their cages and enclosures must be cleaned thoroughly and regularly.

Certain precautions need to be taken during cleaning, since fecal matter of reptiles may harbour harmful bacteria such as *Salmonella*. *Salmonella* is most commonly transmitted to keepers through oral ingestion after handling a reptile or contaminated equipment, through open cuts or sores during handling, or through contact with contaminated soil.

Keepers should wear protective gloves and wash their hands thoroughly with soap and water after handling reptiles, their cages and equipment and their faecal matter.

### Cleaning accessories

Scoopers, sponge, newspapers, water hose pipe attached to a pump with compressor, brushes, shovels, buckets, mugs, brooms, cotton rags, dustbins for fecal matter, moult and uneaten food.

### Keeper's accessories

Gloves, masks, gumboots, shin guards.



Compressor pump in use.



Cleaning of a snake enclosure in progress.



Shin guard

### Cleaning cage furniture

Cage and enclosure furniture should be cleaned well. Rocks, when introduced in the enclosure for the first time should be thoroughly cleaned and boiled in water for 30 minutes. Sand can be rinsed with large amounts of water to remove any particulate matter. Cages and enclosures with glass should be cleaned at all times with a cleaning agent and sponge or newspaper. Water bowls and dishes should also be routinely kept clean. Branches should also be regularly cleaned to keep out dust, faecal material, fungi, pieces of moult, etc.

Using a water hose pipe from a pressure pump is ideal to clean large surfaces and enclosures. In case of an infestation (ticks/mites), all furniture from the cage should be replaced and the infested wooden furniture should be burnt. If the cage or enclosure has unremovable (permanent) material, the reptile should be relocated to a spare enclosure. Wash all the material/furniture with the help of a pressure pump 2-3 times a week and keep it vacant for 8 days. Ensure that the enclosure is completely dry before introducing the reptile back to the enclosure.

## Cleaning Schedule

The frequency of cage cleaning varies from species to species depending on the size and habits of the reptile.

### Daily cleaning

Cages with reptiles consuming food everyday, need to be cleaned daily. Uneaten food, shed skin, faecal matter, spills, etc. need to be removed with a scoop. The substrate needs to be cleaned and replaced. Water bowls and food dishes should be washed well.

### Weekly Cleaning

Snake enclosures need cleaning once a week. During the cleaning period, snakes need to be temporarily relocated to a spare cage while cleaning the main cage.

### Monthly Cleaning

Big crocodile water bodies should be cleaned once a month. Crocodiles should be relocated to a temporary enclosure for the safety of any new personnel.

When it is impossible to relocate crocodiles in numbers, erect a temporary barrier in the enclosure and clean. Crocodiles also become familiar with their keepers. Such familiar keepers can carry out the cleaning of the enclosure without having to relocate the crocodiles.



Erected temporary barrier (left) to facilitate cleaning (right).





# HOUSING Enrichment



## Guidelines for Enrichment

Creating the appropriate environment is enrichment in itself and this facilitates good exhibits and husbandry practices. Reptiles are provided stimulation and activity that is conducive to their good health by providing the right environment.

### Exhibits

**Size** - The size of the cage should be proportionate to the size and number of reptiles. The cage should not be over populated.

**Substrate** - Use natural substrate like soil, wood chip, moss, leaf litter, sand, etc.

**Plants** - Use natural as well as artificial plants. The selection of the plants should imitate the natural habitat of the species.

**Hiding places** - Hollow logs or rocks made of FRP (fibre reinforced plastic) should be provided.

**Furniture** - Creepers, branches, vines for climbing should be made available.

**Moisture** - Automatic fogging system or spray pump can be used to provide moisture.

**Lighting** - Spot lights, CFL, tubelights, infrared lamps should be provided.



Enclosure with artificial plants



Food animal (cricket)

### Food Enrichment

The feeding strategy should be suitable for herbivores, insectivores, carnivores, frugivores, omnivores and piscivores respectively.

Scatter vegetables in various quantities. Place rotting wooden logs with insects to provide live prey. Unpeeled and uncut ripe to over ripe fruits should be strung on branches. Spray urine or feces of prey animal for scent trails. Keep live fish in water

### Social Enrichment

Sometimes different species like gharial and turtles live together in the same habitat harmoniously.



Multi species exhibit







## Feeding



## Feeding

Feeding is a very important aspect of captive reptile management. It is very important to understand the species and understand their natural feeding habits. Reptiles feed on a variety of food depending upon whether they are carnivores, herbivores, frugivores, insectivores or omnivores.

### Size

The size of food is important as too large a prey may result in injuries from swallowing and regurgitation. For snakes it should not be wider than the widest part of the snake's body. For lizards should be no bigger than two-thirds of the lizard's head.



Cobra feeding on a toad.

### Colour

Colour is an important factor as some reptiles are sensitive to colour and will only eat prey of certain hues. Many insectivorous reptiles prefer to eat green coloured invertebrates.

## Frequency of Feeding

The frequency of feeding reptiles should follow the reptile's natural rhythm. Reptiles feed at various times of the day; like some feed during the day, while some at sunset, while others feed at night. Smaller sized reptiles eat more frequently and younger reptiles eat more often than older ones. Insectivores need to eat more frequently than those eating vertebrates, and herbivores will need to eat more often than omnivores or carnivores. Reptiles that are preparing for breeding may also eat more as well as more frequently. Juvenile chelonians especially turtles and terrapins are piscivorous and later as adults are herbivores. Snakes in zoos should be feed every 8 to 10 days. Crocodiles and chelonians should be fed on alternate days.

## Live Prey vs Pre-killed prey

Captive reptiles should not be fed live prey like rodents which may gnaw on the reptile. If at all a live prey is fed, the reptile should not be left unattended. To know which prey the reptile will prefer one can leave both pre-killed and live prey at once and observe which one it feeds on. This can be done for several meals. If the reptile feeds on one particular prey then the other kind should never be offered, ever.

To simulate a live prey to the reptile one can hold the pre-killed prey with long forceps and move it across the animal. If a snake does not consume live prey in 10 -15 mins, it probably is not going to eat on that day.

Prey can be killed humanely by using carbon dioxide gas or stunning and can then be frozen. When feeding, ensure that the prey is thoroughly defrosted and offered to the reptile at room temperature. It is recommended to provide feed according to the age and length of the snake.



Co<sub>2</sub> chamber for food animal.



Prey stored in deep freezer.



Thawed prey offered.

## Basic guidelines for feeding reptiles

- Care should be taken that the vegetables are thoroughly washed and finely chopped.
- The feeding plate should be shallow (so that the reptile can see the food) or the food should be spread out evenly on the floor.
- Sometimes reptiles tend to fight amongst themselves. In such cases, they should be fed separately.
- Young ones of herbivorous reptiles should be fed every day while adults should be fed six days a week.
- Feed for land tortoise should contain 50% green leafy vegetables. Turtles and terrapins require vitamin A.
- Appropriately sized crickets are good primary food for most insectivorous reptiles. Giant (super) mealworm and regular mealworms should only be offered occasionally.
- In order to provide a balanced nutrition for the reptile, crickets should be fed on oats and alfalfa hay. Poultry feed and cereal are also recommended. Put insects in a clear plastic container. Add a pinch of a vitamin-mineral supplement. The container should be gently shaken so the insects get a light coating.
- Reptiles that do not feed on the whole vertebrate prey need vitamin-mineral supplement.
- For herbivorous reptiles, the diet should be a proper balance of proteins, carbohydrates, vitamins and minerals.
- For piscivorous reptiles (turtles, crocodiles, gharials, water snakes, etc) fresh fish should be fed instead of frozen fish to avoid thiamine deficiency.
- Earthworms and insects can also be used as a source of protein for small snakes, turtles, terrapins. If earthworms and insects are not available then 1/4th of the feed can be substituted with commercial dog food.

### Calcium requirement

Reptiles like lizards and tortoises which feed on insects need sufficient dose of calcium for their normal growth. To supplement that one can give lime water instead of plain drinking water. There are few snakes like pythons which feed on birds and mammals and therefore do not need calcium supplementation. For those snakes and tortoises that are force fed, one can mix dog food along with the feed. Fish eating reptiles can be provided with calcium by giving calcium carbonate tablets.

### Iodine requirement

Iodine has a great effect upon the health of the reptile. Deficiency of iodine in feed stuff can be found mostly in lizards and tortoises. To avoid the deficiency of iodine in small reptiles add iodide salt 0.5 gm for 100 gms of feed.

## Variety of food eaten by reptiles

### Raw vegetables and fruits

Beetroot, cabbage, green peas, corn, red and white pumpkin, ber, apple, pear, plum, bread, grains are examples of vegetables and fruits that can be fed to herbivorous reptiles.



### Fish

A variety of salt water or sweet water fish can be fed to piscivorous reptiles.



## Mealworms (Flour beetle)

Mealworms are bred in plastic containers of 30 x 20cms, filled with a mixture of wheat bran and oat meal. Food can be provided in the form of fresh vegetables with small pieces of yeast and fruits for vitamin enrichment. Avoid decay of food. A calcium lactate supplement improves the calcium balance. Since these beetles can fly, the plastic container must be covered with gauze lid.



## Crickets

They can be bred in gauze covered medium sized glass containers in 25-30 °C. A corrugated card board is placed inside the container (to provide hiding places) and a small dish filled with a 5-8 cm layer of damp sand soil mixture is provided for the crickets to deposit their eggs. Drinking water can be offered in a test tube plugged with cotton or wet sponge in a shallow dish. Food offered can be poultry feed, dog food, crushed mice feed pellets, whole wheat, powdered milk and dried minced beef. Grass or vegetables can be given once or twice a week.

## Mice

They can be easily bred in mice cages with wire mesh lids at 18-20 °C. In order to minimize offensive urine odor, a bedding of wood shaving, saw dust and paddy is placed inside the breeding cage. The mice should be fed with commercial mice pellets. They can also be given grains, dry breads and vegetables.

Please follow CPCSEA guidelines for breeding white mice, white rats, guinea pig, hamsters, rabbits.



## Cockroaches

They are eaten by lizards and geckos. Cockroaches should be bred in glass, plastic or metal containers that are tightly covered with gauze lids. Covering the upper inner rim of the container with petroleum jelly prevents cockroaches from escaping. Ideal temperature for breeding is 25-30 °C. Rodent pellets, food pellets, bread, oat meal, ground poultry feed, dog biscuits can be used as food. Water can be offered in a test tube plugged with cotton. Substrate should consist of a thin layer of a saw dust covered with a corrugated card board.

## Vermiculture

Earthworms can be bred through vermiculture process. It can be done in a concrete chamber, plastic tub or metal tins.



## Frogs

Frogs can be bred in captivity. A froggery should be semi aquatic. The water pool should be deep and should occupy half of the space. Live water plants with small fishes should be introduced to feed the frogs. Algae developed in the water pool are also a good source of food and therefore the pool need not be cleaned regularly. Shrubs should be planted in the ground along the water pond. An electric bulb can be switched on at night to attract insects, on which the frogs can feed.

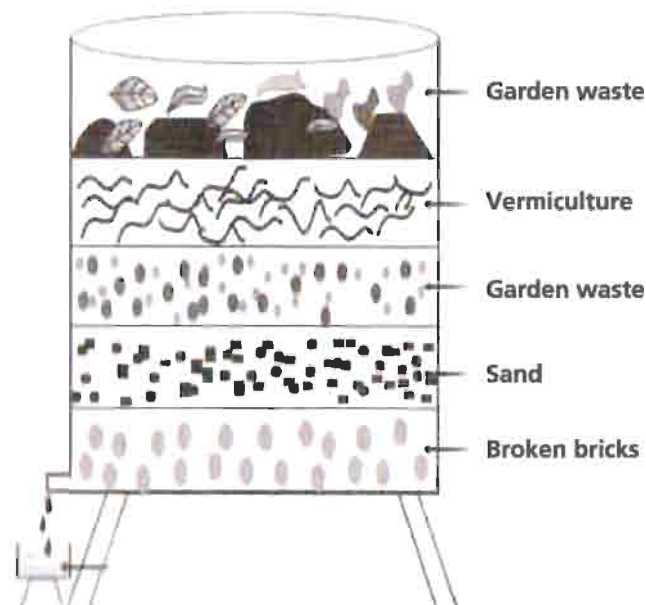
## Food chart for commonly exhibited reptiles

Common Name	Scientific Name	Food Item
Elliot's Shield Tail Snake	<i>Uropeltis ellioti</i>	Small arthropods/earthworm
Buff-striped Keelback	<i>Amphiesma stolatum</i>	Earthworms/fish/frogs
Common Trinket Snake	<i>Coelognathus helena helena</i>	Rats/lizards/mice
Montane Trinket Snake	<i>Coelognathus helena monticollaris</i>	Rats/lizards/mice
Günther's Racer	<i>Coluber gracilis</i>	Insects/worms/geckos/skinks
Banded Kukri Snake	<i>Oligodon arnensis</i>	Insects/worms/lizards and their eggs
Banded Krait	<i>Bungarus fasciatus</i>	Rats
Hump-nosed Pit Viper	<i>Hypnale hypnale</i>	Frogs/lizards/small mammals.
Malabar Pit Viper	<i>Trimeresurus malabaricus</i>	Frogs/lizards/small mammals.
Ornamental Flying Snake	<i>Chrysopelea ornata</i>	Frogs/lizards/small mammals/geckos
Bronzeback Tree Snake	<i>Dendrelaphis tristis</i>	Frogs/lizards/geckos
Leith's Sand Snake	<i>Psammophis leithii</i>	Mice/lizards
Slender Coral Snake	<i>Calliophis melanurus</i>	Geckos
Checked Keelback		
Water Snake	<i>Xenochrophis piscator</i>	Fish/frogs
Common Vine Snake	<i>Ahaetulla nasuta</i>	Frog/lizard/small mammals/gecko
Indian Smooth Snake	<i>Coronella brachyura</i>	Lizards/geckos
Banded Racer	<i>Argyrogena fasciolata</i>	Rats/mice
Indian Rat Snake	<i>Ptyas mucosa</i>	Grasshoppers/lizards/frogs/ snakes/rats/toads
Spectacled Cobra	<i>Naja naja</i>	Lizards/frogs/snakes/rats/toads
King Cobra	<i>Ophiophagus hannah</i>	Rats/venomous & non venomous snakes
Barred Wolf Snake	<i>Lycodon striatus</i>	Geckos/skinks
Yellow spotted Wolf Snake	<i>Lycodon flavomaculatus</i>	Geckos/skinks
Common Wolf Snake	<i>Lycodon aulicus</i>	Geckos/skinks
Common Krait	<i>Bungarus caeruleus</i>	Mice/lizards/frogs/fish
Wall's Sind Krait	<i>Bungarus sindanus walli</i>	Mice/geckos
Forsten's Cat Snake	<i>Boiga forsteni</i>	Mice/Birds/lizards/geckos
Common Cat Snake	<i>Boiga trigonata</i>	Lizards/geckos.
Saw-scaled Viper	<i>Echis carinatus</i>	Mice/geckos
Common Sand Boa	<i>Gongylophis conicus</i>	Mice/rats/skinks/lizards
Whitaker's Boa	<i>Eryx whitakeri</i>	Rats/lizards
Indian Rock Python	<i>Python molurus molurus</i>	Rats/guinea pigs/pigeon/rabbit
Russell's Viper	<i>Daboia russelii</i>	Rats/poultry chicks
Bamboo Pit Viper	<i>Trimeresurus gramineus</i>	Mice/birds/lizards/frogs
Green Keelback	<i>Macropisthodon plumbicolor</i>	Toads/fish/lizards/frogs
Dog-faced Water Snake	<i>Cerberus rynchops</i>	Fish/frogs/crabs
Starback Tortoise	<i>Geochelone elegans</i>	Omnivorous/bird excreta
Travancore/Elongated Tortoise	<i>Testudo spp.</i>	Insects/worms/fruits/lucerne grass/ vegetables/bird excreta/succulents/ snails

Common Name	Scientific Name	Food Item
Turtles	<i>Bataguridae</i>	Frogs/fish/snails/crustacean/plants
Turtle, Terrapin	<i>Chelonidae, Trionychidae</i>	Fish/algae/liver/minced meat
Tent Terrapin	<i>Kachuga tentoria</i>	Omnivorous/herbivorous
Roofed Terrapin	<i>Kachuga tecta</i>	Herbivorous diet
Indian Pond Terrapin	<i>Melanochelys trijuga</i>	Animal droppings/herbivorous diet
Olive Ridley Turtle	<i>Lepidochelys olivacea</i>	Fish/crabs/crustaceans/molluscs
Green Turtle	<i>Chelonia mydas</i>	Marine algae/sea grass
Monitor Lizards	<i>Varanus spp.</i>	Mice/beef/small mammal/eggs/ lizards/snakes/ fish/crabs
Garden Lizards	<i>Calotes spp.</i>	Insects/frogs/small birds/arthropods/ ants
Spiny-tailed Lizard	<i>Uromastyx hardwickii</i>	Flowers/fruits/grass/beans/ lettuce/grains
Skinks	<i>Scincidae</i>	Insects/small lizards
Indian Chameleon	<i>Chamaeleon zeylanicus</i>	Insects/meal worms/small frogs or mice
Crocodiles	<i>Crocodylus spp.</i>	Meat/chicken/beef/fish
Gharial	<i>Gavialis gangeticus</i>	Fish
Green Iguana	<i>Iguana iguana</i>	Green vegetables/sprouts/lettuce/ fruits/hibiscus flowers.

The arrangement of the vermiculture is as follows :

## Structure of vermiculture



## Food animals

Food animals ideally should not be exhibited. They should be kept in a separate animal house.

Guidelines for setting up an animal house has been provided by CPCSEA (Committee for the Purpose of Control and Supervision of Experiments on Animals, Chennai) and can be obtained from the following url:  
[http://www.envfor.nic.in/divisions/awd/cpcsea\\_laboratory.pdf](http://www.envfor.nic.in/divisions/awd/cpcsea_laboratory.pdf)







## Breeding and Egg Management



## Sex determination and reproduction

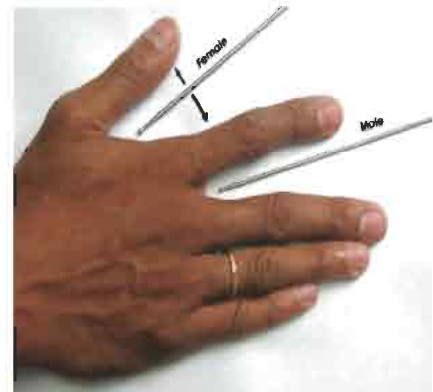
### Sex determination in reptiles

**Snakes:** The gender of an adult snake can be determined by introducing a smooth, blunt, lubricated slender probe into its cloaca, and pushing the probe against the posterior wall of the cloaca to see if it can be freely and gently pushed into the base of the tail. This is referred to as the "cloacal probing technique," or, more often, simply as "probing".

When "probing" a snake to determine gender a suitable sized stainless steel sexing probe should be selected. The largest probe that could be inserted into the hemipenes of a male should be used. The probe is inserted into the cloaca and directed against the posterior wall of the cloaca to determine if it can be passed into the tail, and if so, how far. This technique is based on the fact that a probe introduced into the cloaca can be slid a greater distance into the base of the tail of a male than into the tail of a female.



Cloacal probing in a rat snake.



The difference in feel between a male snake and a female snake when probed, is similar to the difference in the space between the thumb and index finger, and the index finger and middle finger respectively. The musk gland in females feels shallow and broad, and the hemipenes of the male feel long and narrow.



Pelvic spur in a male python.

**Anal spurs / anal claw** - Anal spurs / anal claw are external vestiges of the hind leg near the cloaca in boas and pythons (Boidae family). They are larger in males and are presumed to be a stimulatory organ used during courtship. They are also called as pelvic spurs.

### Everted hemipenes of different male snakes



Checked Keel back



Python



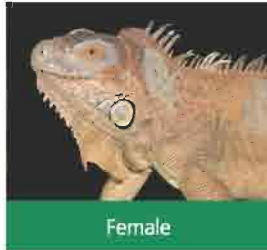
Rat snake

### Iguanas

Mature male iguanas have longer crests, larger dewlaps, and larger operculum scales than female and have bilateral hemipenes bulges at the base of tail.



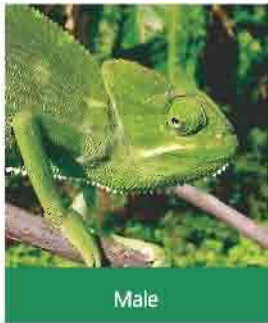
Male



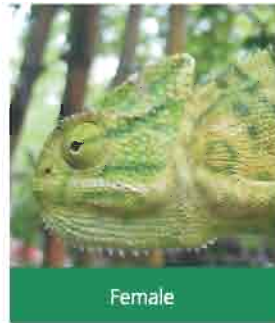
Female

### Chameleons

Males often have elaborate head ornamentation in the form of crests and plates that are lacking in females.



Male



Female

### Geckos

Male geckos have femoral pores on the underside of their thigh, noticeable V-shaped preanal pores and two hemipenal bulges on the base of their tails. In female geckos femoral pores and preanal pores are virtually non-existent and do not have two hemipenal bulges at the base of their tails.

### Others lizards

Males often have larger heads, bigger crests brighter colours, or erectable dewlaps or are larger than females.



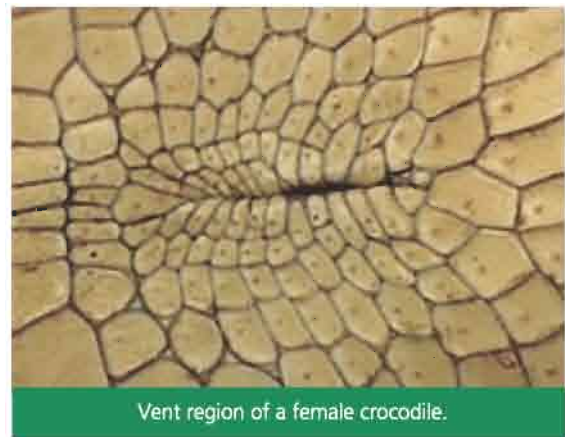
Male



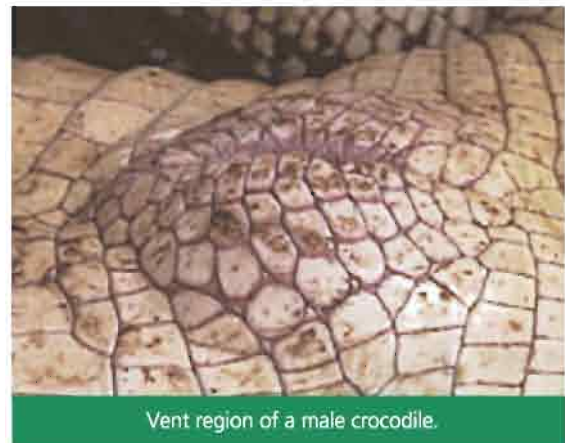
Female

### Crocodilians

Sexing of the reptile can be done by turning the reptile upside down. Females tend to have smaller, narrower and flatter vents whereas males have larger, wider, and more convex vents. If above method does not give clear idea of the reptile sex, one can insert clean well lubricated finger (size of finger approximated to the vent size) into the vent feeling for the sex organ. The male has a single, very obvious penis with a fleshy head and a cartilaginous shaft. It originates from the wall of the cloaca directly in front of the vent on the belly side, and curls backwards so the shaft and head lies directly beneath the vent opening. Females have a clitoris in the same location which is quite similar in shape to the male's penis, but it is much smaller and not cartilaginous.



Vent region of a female crocodile.



Vent region of a male crocodile.

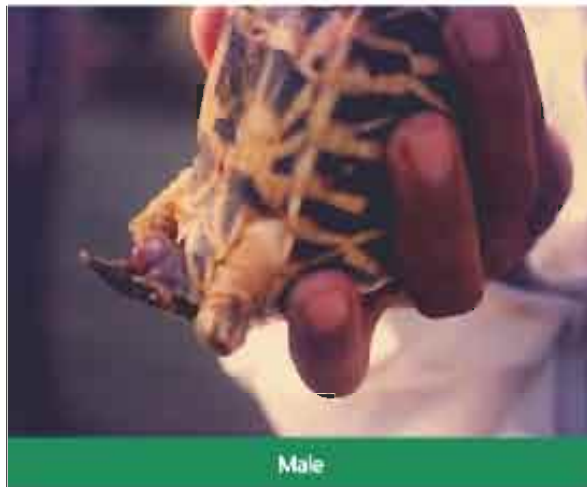
In endangered reptiles where one cannot identify the sex with above methods, endoscopic gender identification can be done, where the primary sex organs can be visualized directly with the help of endoscopic apparatus.



The male gharial (left) has a protrusion on the tip of his snout which is absent in the female (right).

### Tortoises, turtles and terrapins

Males are smaller in size with a concavity in the plastron and a longer tail in comparison to the females.



Male



Female



Male



Female

## Reproductive disorders

### Dystocia/ Egg binding

Dystocia or egg binding is the most common reproductive malady in reptiles. It can be classified in two broad groups:

**Obstructive dystocias** that are caused due to anatomical inability to pass one or more eggs or foetus through the oviduct and cloaca. Fetal abnormalities include oversized and malformed eggs or fetuses. Maternal abnormalities include misshapen pelvis, oviductal stricture, or non reproductive masses including abscesses and cystic calculi.

**Non obstructive dystocias** are mainly caused due to poor husbandry, improper nesting site, improper temperature, malnutrition and dehydration.



Ovi-position in a trinket snake.

### Diagnosis

**Snakes** - A history of recent oviposition and the visual presence of a caudally located mass make diagnosis of dystocia simple for most oviparous species. It is difficult to diagnose in viviparous snakes since the pliability of fetuses makes them less evident.

**Lizards and Chelonians** - Egg retention is nearly impossible to detect without radiographs.

### Treatment

One of the most common methods used for removal of retained eggs or fetuses in snakes is manual palpation. Hormonal stimulation can also be used to treat dystocia in order to stimulate oviductal contraction by using posterior pituitary hormones. Oxytocin has been routinely used intramuscularly or intra-coelomically at doses ranging from 5 to 30 IU/kg. Doses as low as 1 IU/kg have been effective in turtles. Another treatment for dystocia in oviparous snakes is to aspirate the contents of the retained eggs by inserting a sterile needle into the eggs through the ventrum of the snake. Surgery is the last resort if all earlier attempts fail.

### Oviductal and cloacal prolapse

Oviduct or cloacal prolapse can occur during normal oviposition or parturition. However, most cases are iatrogenic, resulting from keeper attempting to manually correct dystocias. Externalized tissues should be kept moist and clean. Treatment depends on the severity of the prolapse and the tissue involved. Most cloacal prolapse and mild oviductal prolapse can be replaced through the cloaca. Care must be used to avoid traumatizing the tissue and to assure proper replacement. Externalized tissue must be inverted and not simply placed back through the cloaca. If the tissue inverts back then purse string suture should not be placed. Inversion of tissue is best accomplished by placing a relatively blunt instrument through the exteriorized opening and carefully working the tissue back through the cloaca. This procedure should be repeated several times. Prolapse of larger lengths of oviduct are best treated by resection of the tissue after ligating both ends.

### Hemipenile and penile prolapse

Penile prolapse occurs as a result of trauma while the penis or hemipenis is everted for copulation. Traumatized tissue quickly swells making retracting back through the cloaca impossible. The exposed tissue is then subjected to further trauma with bleeding, sometimes substantial. Owing to the extensive trauma, desiccation and often necrosis, penile prolapse is best treated by amputation. Amputation of the penis does not affect excretion of urates, since the ureters empty into the cloaca. More so, the reproductive potential of squamates is unaffected, since they possess a second hemipenis. It is essential to ligate the base of hemipenis twice as it is highly vascular. Fluid therapy (e.g. saline or Ringer's) may be warranted if excessive bleeding occurs.



Penile prolapse in a star backed tortoise.

## Egg management

Most incubators are relatively simple in design. They should be well insulated to prevent loss of heat and humidity; the heat should be evenly dispensed throughout the incubator with no hot spots and the heat should be controlled with a reliable thermostat. Various substrates like vermiculite, potting soil, sand, sphagnum moss, and shredded paper can be used. The eggs should be monitored daily. A slight mottling on the surface of the egg may not be significant however marked changes in the color or texture, or growth of fuzzy mold usually indicates that the egg has either died or was infertile. The incubator should be set up and operated several days before the expected arrival of the eggs to allow for equilibration of the temperature within the entire system.



Rat snake laying eggs.



Brood care in python.

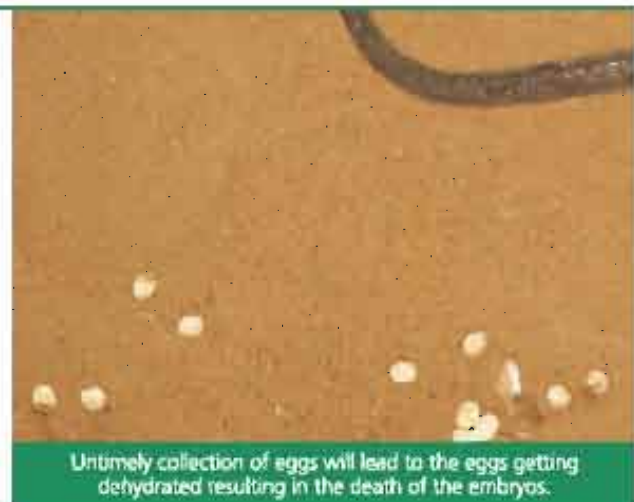
## Brood care

Most reptilian females do not incubate or look after their eggs once laid. However some reptiles show brooding behavior which facilitates protection, care, and viability of the eggs and young. Methods of brood care are rather diversified in these reptiles: it can extend from searching for a suitable site to deposit the eggs (as in turtles) and guarding the clutch (as in crocodile) to actual brooding of eggs as in all pythons, cobras and king-cobra.

## Incubation of eggs

The most favorable temperature is 25-30 °C. Night temperature can be reduced to about 20 °C. It is important that the substrate used is sufficiently loose for adequate ventilation and is always damp and as germ free as possible.

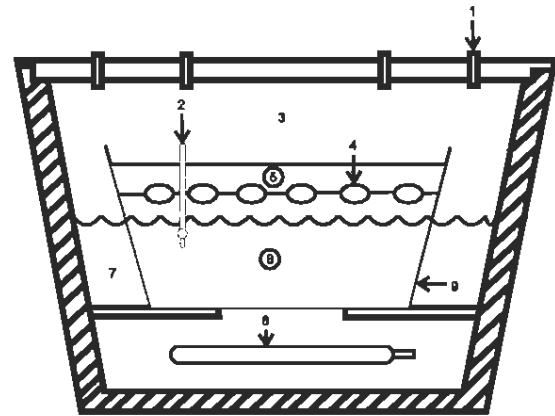
During incubation, the clutch is inspected regularly and decaying eggs are promptly removed. Unfertilized eggs usually collapse within a short period of time. Soft shelled (snakes and many lizards) take up a lot of water, therefore increasing in size quite substantially after laying and later in development. Thus appropriate humidity should be maintained. Reptiles laying hard shell eggs can be incubated on a bed of dry coarse sand, the eggs should never be turned throughout the incubation period.



Untimely collection of eggs will lead to the eggs getting dehydrated resulting in the death of the embryos.

## Specification for incubation chamber

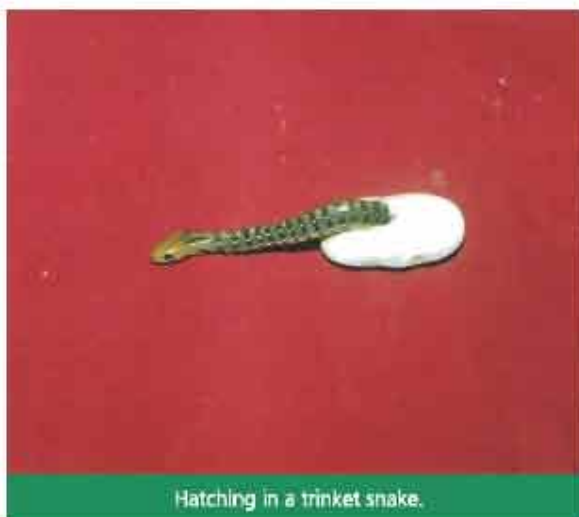
- Vertical aquarium: 1'x1'x2' (6mm thick glass).
- Brick crush / leaves / peat moss / vermiculture.
- Temperature control using carbon filament lamp on top (28 to 30 °C)
- Humidity control by occasional spraying (70%)
- Egg shells are permeable to allow water & oxygen exchange.
- Incubation period 60 to 70 days.
- 36 days for checkered keel back snake.
- 120 days for rat snake (open type).



Design of the standard reptile incubator.  
 1. Air vent 2. Thermometer 3. Air 4. Egg  
 5. Sphagnum moss 6. Moist Vermiculite 7. Spring water  
 8. Submersible heater 9. Plastic liner  
 Ref. *Reptile Medicine & Surgery*, by Douglas Mader,  
 (W.B. Saunders Co., London, 1996)



Positioning of eggs in coco-peat for artificial incubation.



Hatching in a trinket snake.



Baby grass snake seen hatching from its egg.





## **Disease and Treatment**



## Diseases of reptiles and their control measures:

### Symptoms of disease

Diagnosis of disease in reptiles can be made by closely watching the state of health in terms of abnormal sluggishness or restlessness, difficulties and irregularities in skin shedding and loss of the brilliance of natural colors. One of the most important point in attempting to diagnose the disease of any animal is to know its age, since advanced age itself would lead to many obvious diseases which may have a doubtful prognosis.

## Infectious diseases

### Bacterial diseases

Bacterial epizootics are a common occurrence in reptiles. They mainly appear in animals already weakened by other causes. The causative bacteria can be divided into two groups accordingly as primary agents (wherein they themselves cause the disease) and secondary agents (where they are merely found on or in the reptile and act as carrier). The *Salmonella* group of bacteria often comes under the second category. Commonly occurring bacteria in reptiles are *Aeromonas*, *Pseudomonas*, *Actinobacillus*, *Corynebacterium*, *Escherchia*, *Klebsiella*, *Neisseria*, *Pasteurella*, *Proteus*, *Serratia spp.*

Mouth Rot is an ulcerative inflammation of the oral cavity in snakes caused by few of the bacteria mentioned above. The above bacteria are also found in lizards housed in zoological gardens. Mouth rot starts with oedema and inflammation of the oral mucosa which swells so much that the animal can no longer close the mouth and is unable to feed. Mouth rot is thought to have more than one causative agent and it can also be treated successfully with vitamin supplementation.

*Pseudomonas* are the most common agents to cause symptoms of typhoid. *Pasteurella haemolytica* is also found in ulcerative stomatitis. One of the commonest bacteria, always threatening reptile & amphibian collections, is *Aeromonas hydrophila* which causes "Red leg" in frogs. *Aeromonas* can be transmitted by the mite *Ophionyssus serpentinum*. The occurrence of the genus *Salmonella* in reptiles is of the greatest importance as they cause variable symptoms like peritonitis, gastric and intestinal inflammation, liver oedema, and renal degeneration. The agent has reported to cause dysentery in children. The clinical picture is that of atypical tuberculosis with pulmonary tubercles (tortoise, turtles) and analogous lesions in skin, liver, and spleen (snakes and crocodiles) caused by the *Mycobacterium spp.*

*Spirochetes* have on several occasions been found both in snakes and lizards but it is still doubtful whether they should be regarded as pathogenic for the host.

### Tuberculosis (TB)

Tuberculosis also occurs in reptiles which is generally caused by *Mycobacterium spp.*

Following symptoms are observed in TB:

- |                            |                       |                                |
|----------------------------|-----------------------|--------------------------------|
| 1. Tubercles in intestines | 2. Tubercles in lungs | 3. Ulcerating wounds and boils |
| 4. Allergic rash on skin   | 5. Reduced weight     |                                |

*Mycobacterium spp.* can also be transmitted from reptiles to humans therefore the handler should take utmost precaution. These organisms multiply slowly making their treatment a cumbersome task. These organisms produce tubercles/granulomas on the skin which contains mucoid fluid. The symptoms are only visible on the skin. The skin scraping or biopsy of the skin should be sent for laboratory analysis and the treatment should be started with the following antibiotics on the advice of the veterinarian:

- Isoniazid, Streptomycin, Ethambutol.

### Salmonellosis

*Salmonella sp.* is the causative organism for typhoid. The disease is common in captive reptiles in zoological parks.

Symptoms of this disease are:

1. Greenish color diarrhea
2. Wasting of reptile (loss of proteins)
3. Anorexia
4. Lethargy

### Treatment

Tetracycline and Chloramphenicol are the antibiotics of choice.

Caution: Since the disease is zoonotic the veterinarian and the keeper should wash hands thoroughly after handling the reptile.

### Pneumonia

There are number of pathogens that cause this disease.

#### Symptoms:

1. Sneezing
2. Mucous discharge from nose and mouth
3. In chronic cases the nostrils shut due to discharge and the forked tongue gets stuck
4. Breathing from the mouth

#### Treatment:

Snake should be kept in a warm room or cage. Prevent cold draft of air from entering the cage but maintain proper ventilation. The disease can be contagious and even fatal. Oxytetracycline may be used at the rate of 50 mg/kg orally once daily.



A cobra showing signs of pneumonia.



Stomatitis

### Infectious stomatitis

It is a common disease in snakes. First symptom shown by the snake is anorexia, followed by sticky mucoid discharge in mouth cavity. Cyanotic gums with occasional bleeding is also observed. Gums are inflamed with mucoid discharge accumulating around the gums. The snake breathes from the mouth and becomes lethargic. Deficiency of calcium, vitamin A and vitamin K may also cause this disease. Secondary bacterial infection may take an upper hand once the disease sets in.

#### Treatment:

Swabs from the oral cavity and gums can be taken and sent to a laboratory for antibiotic sensitivity testing for appropriate antibiotic therapy. Following antibiotic can be sprayed or painted on the gums

Gentamicin 2.5mg /kg once a day every 72 hrs for 3 occasions.

Chloramphenicol, kanamycin, neomycin, cephalothin, streptomycin, ampicillin, tetracycline can also be used.

It is recommended to supplement ascorbic acid (vitamin C, Celin Tab) 10-50 mg total dose orally or along with the feed . Most important aspect is to maintain the right temperature in the cage, as temperature variation can boost up or decrease the snake's immunity. The oral cavity should be cleaned using hydrogen peroxide or chlorhexidine on a cotton swab. In drinking water, add sulfadiazine at the rate of 30g in 4 litres of water.

### Abscesses

This is a very common infection in snakes. It can occur anywhere on the body of the snake and is flabby to touch.

#### Treatment:

Lancing of the abscess with abscess knife and clearing the abscess cavity, cleaned the cavity with saline or Lugol's solution. Prepare a seton/gauze by smearing it in silver sulphadiazine cream or Savlon/Betadine solution and insert it in the cavity. One should take care to keep one end of the gauze outside for easy removal. This should be continued till the wound heals up.



An abscess (lump) seen in the body of a rat snake.

### Fungal diseases

In reptiles, fungal diseases are not as commonly observed as in mammals. If the reptile is not kept properly in its cage then dermatophytosis can set in. Prolonged antibiotics therapy in reptiles can cause fungal infections due to super infection.

#### Treatment:

Lugol's solution or antifungal ointment e.g. Povidine iodine solution or Tolnaftate solution can be used. The dull scaly patch on the skin can be removed and the reptile should be kept for basking in sunlight for 2 -3 hours every day which will help in faster healing.

## Reptilian parasites

The parasites can be divided into two groups:

1. Ectoparasites
2. Endoparasites

### Ectoparasites

Ectoparasites include a variety of arthropods such as ticks, mites and occasionally larval flies that live in tissue and result in myiasis.

### Ticks

The ticks are hematophagous so they may induce blood loss and transmit other etiological agents. There are two main groups of ticks: hard ticks (Ixodidae) and soft ticks (Argasidae). The Ixodidae ticks are more commonly seen on reptiles. Some of the genera of ticks that commonly feed on reptiles include *Amblyomma*, *Aponomma*, *Haemophysalis*, *Hyalomma* and *Ixodes*. The argasids include species of *Ornithodoros* and *Argas*. Ticks are visible to the naked eye. They appear reddish brown in color. They are about the size of a snake's scale. They adhere to the snake with their mouth parts.

So once the snake is brought to the center it should be thoroughly examined and part where the tick is attached should be dipped in alcohol and pulled out using tweezers. The site where the tick was attached may get infected as it remains as an open wound.



A tick observed to be lodged between the scales of a rat snake.



A soft tick pulled out from a snake.

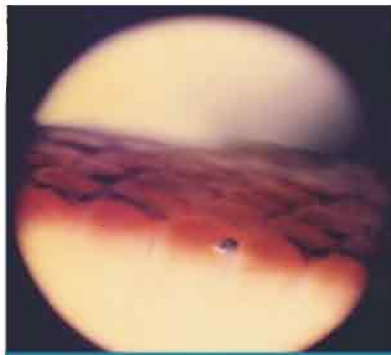


Photo of a mite (*Ophionyssus natricis*) as seen under compound microscope.

### Mites:

Mite infestation is very common in most of the snakes in the world.

The most commonly found mite on reptiles is *Ophionyssus natricis*.

It is commonly found on the captive reptiles. Sometimes *Sarcoptes* and *Psoroptes spp.* may be found accidentally. The mites lodge in between the scales of the whole body, scales of the lower jaw and orbital cavity of the eye. These organisms reproduce very rapidly. The mite-infested snakes show white powdery scales as if some powder is dusted on the snake. The white powder is nothing but the faeces of the mites. The mites feed on the blood of the host through skin. The mites transmit different diseases; thus infested snakes should be isolated and kept separately for further treatment.

### Treatment:

Apply 'No Pest' that comes in tape form on the cage for 24 to 48 hours which will kill almost all the mites. The treatment should be repeated after a week to kill the nymphs that hatch out from the eggs. Silica gel powder should be dusted on the snakes judiciously and in the cage environment. In smaller snakes the gel has some adverse effects; thus should not be used in them. Soak the snakes in warm water at least two hours.

### Myiasis

This condition is observed in captive tortoises and crocodiles kept outside or in free-ranging individuals. The female fly deposits larvae into open wounds. The larvae begin to grow and molt two times before they mature. These larvae leave the host and pupate on the ground. The area around becomes swollen from the mass of maggots under the skin and possibly secondary invaders cause severe infection. The most common flies that cause myiasis include *Dipterans* larvae.

## Endoparasites

Endoparasites live throughout the body of the reptiles. Each has its particular aspects of its life cycle, physiology, behavior, and anatomy to assist in its success as a parasite. Because of some the needs of many life cycles, the infections may be self limiting, although some parasites appear to be long lived.

### Nematodes (Round worms)

Though endoparasites are not always fatal to reptiles, their excess load can cause severe adverse effects on the health of the reptile. The parasite invades other body systems of the reptile and replicates there to cause systemic diseases. They can even form lumps under the skin as seen the photo on right (below):

#### Treatment:

Fenbendazole @ 50 mg/kg body weight should be administered orally.

It should be repeated after 15 days.

Piperazine citrate @5mg/100 g orally in water once a week for three weeks.

### Strongyloides worms

These are tiny worms found in the gut and their eggs can be isolated from their feces.

Treatment: Administer Mebex (Mebendazole) 15 to 20 mg /100gm orally in water with the help of feeding gun.

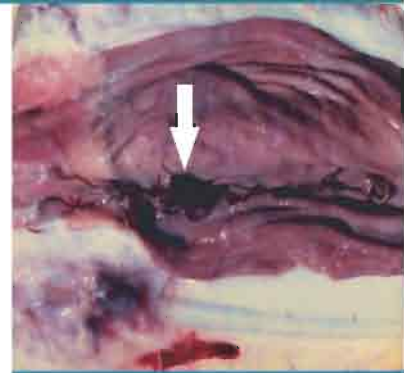
### Cestodes (tape worms)

These are tapeworms commonly seen excreted in their feces. The mode of transmission of these worms is normally through the ingested prey.

Treatment: Niclosamide 135- 200 mg/kg

Bunamidine 25 to 50 mg/kg

New snakes to be introduced in the cages should be thoroughly examined and quarantined before keeping it in a common cage with other reptiles.



Round worms seen on postmortem.



Round worms seen under the scales of a cobra.

### Anti-parasitic agents used in reptiles against endo-parasites:

No.	Drugs	Dose and route	Comment
1	Albendazole	50 mg /kg PO once	Ascarids
2	Doxycycline	10 mg /kg PO q24h *7-10d	Balantidium in snakes and tortoises
3	Febendazole (Panacur)	50-100 mg/kg PO once, repeat in 2 weeks 100 mg/kg PO q48h 3 *, repeat in 3 weeks	Nematodes Ascarids in box turtles can cause anorexia
4	Febentel/praziquantel	580 mg/kg PO q24h * 3 d 0.3 ml/kg PO q24h * 3d repeat in 2 weeks	Chelonian anthelmintic
5	Ivermectin (ivomec)	0.2 mg/kg IM once, repeat in 2 weeks 0.025 mg/kg IM once 0.5 ml of 100% solution/qt water, use as a topical spray q7 -10 d	Snakes Turtles- do not give to box turtles or tortoises Never give within 10 d of diazepam Ectoparasites
6	Levamisole	5-10 mg/kg Ice once repeat in 2 wks	Lungworm in snakes, careful in tortoises
7	Mebendazole	20-25 mg/kg PO once repeat in 2 wks 100 mg/kg PO once	Strongyles and ascarids Ascarids in snakes and lizards
8	Metronadazole	250 mg /kg PO once repeat in 2 wks 100 mg/kg PO once repeat in 2 wks and 4 wks	Falgellates, appetite stimulation Protozoans
9	Niclosamide	150-200 mg/kg once, repeat in 2 wks	Cestodes
10	Piperazine	40 -60 mg/kg PO once repeat in 2 wks	Ascarids
11	Praziquantel	8 mg/kg IM,PO once repeat in 2 and 4 wks 20 -30 mg /kg PO once	Cestodes and trematodes Cestodes in snakes and lizards
12	Pyrantel pamoate	2.2 ml/kg PO once, repeat in 2 wks	Nematodes

*Douglas Mader, Reptile Medicine & Surgery, (W.B. Saunders Co., London, 1996)*

## Protozoa

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Amoebiasis caused by the *Entamoeba invadens*, in reptiles is an important disease in captive snakes and crocodiles. This is a protozoa that moves and feeds by forming pseudopodia thus changing shape while in the trophozoid stage. The cyst is the resting stage in which a wall is produced by the trophozoids to encapsulate and protect the parasite while it is in the abiotic environment. This cyst is the infective stage and enters the host via ingestion. Signs of amoebiasis include anorexia, dehydration and wasting. Ulcerative gastritis develops, as does colitis, inducing dysentery with mucus and blood. The liver and kidney may be reached via trophozoids in the blood. The parasite then colonizes in these organs, and further damage is done, leading to necrosis and abscesses formation. Diagnosis may be aided with the direct smear of feces but the best method is examination of histological section of the gut and liver at necropsy. The sections should be stained with trichrome or iron hematoxyline stain for better demonstration of the vesicular nucleus in the trophozoids than with the standard hematoxyline and eosin (H&E) stains.

Ciliated protozoa are more commonly found in herbivorous reptiles such as tortoises. The more common genera are *Balantidium* and *Nyctotherus*. These are large ciliates, usually more than 60 microns in length, uniformly covered with cilia. The trophozoids are hard to miss on the direct smear, and the sites are the means of transmission to the next host via fecal oral contamination.

## Coccidiosis

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The protozoa that cause this disease produce oocysts in the endothelial cell that line the gut. Not all coccidians cause disease, and this condition is called coccidiasis. This is opposed to coccidiosis, in which the parasite causes diseases. In many cases in which coccidian oocysts are seen in the feces, it could be case of coccidiasis or coccidiosis. Some coccidians (species of *Isopora*, *Emeria* and *Cryptosporidium*) have direct lifecycle with single host with the oocysts produced and passed in the feces.

### Treatment and control:

All wild reptiles have a normal parasite burden. Some are truly parasitic, some are commensals. In the balance of nature, these organisms co-exist. In captivity, however, when stress, poor nutrition, crowding, and other problems exists for reptile, even a normal parasite load can be a serious problem. Some apparent parasites should not be treated because they are as much a part of the digestive process as the flora in a hindgut. However, others, because of complication of biological concentration, and stress must be treated or the death of the host might result. Reptiles found in wild are infested with a number of ectoparasites and they are responsible for transmission of many diseases mainly bacterial and viral. A layman can't detect mites infested snakes as they are lodged between the scales. Newly rescued snakes should be thoroughly examined and should be kept for quarantine in isolation cages for three day to prevent infestation of other reptiles. To examine for infestation of mites one should have a magnifying lens and sufficient light. The mites can be observed and identified under compound microscope. Ticks, mites and blowflies can be identified using compound microscope.

Reptiles infested with ecto-parasites show following symptoms: anorexia or inappetance and abnormal skin and scales, lethargy, loss of weight and should also be symptomatically treated for the same.

Snakes, lizards, tortoise and crocodiles have different species of ectoparasites and are host specific. Other animals can get infested by the feed stuff provided to the reptiles. Water snakes that feed on frogs and toads have high prevalence of tapeworm infestation. Snakes fed on mice and rats have high incidence of other tapeworms and round worms.



## Vitamins

### Vitamin Deficiencies

Deficiency of various vitamins can cause immuno-suppression in the reptiles which leads to invasion of various pathogenic organisms.

#### Vitamin A

Though the deficiency of this vitamin found in all reptiles it is mostly seen in chelonians (tortoise, terrapin and turtles). Symptoms seen are swollen eyes, puffed body, rough skin coat and discoloration at head region. Excess feeding of lettuce, cabbage and beef can cause this disease.

**Treatment:** Commercially available food for reptiles which contain 4850 IU of Vitamin A should be given. Cod liver oil (1-3 drops) can be given along with the feed. Once symptoms are alleviated, one can provide multivitamin supplements available for human purpose.

#### Vitamin K

Due to deficiency of this vitamin, reptiles like snakes and monitor lizards develop stomatitis with ulceration, coagulation disorders and can lead to secondary bacterial infections.

**Treatment:** Vitamin K can be administered at the rate of 0.25- 0.50 mg/kg intramuscularly.

#### Vitamin D

Due to deficiency of vitamin D all reptiles develop rickets.

**Symptoms:** Lethargy, loss of control of motion and eventually loss of balance, anorexia, arthritis, deformed limbs, soft shell and deformed shell in Chelonians (tortoise, terrapin and turtles).

**Treatment:** 608 IU of vitamin D should be supplemented in feed.

Excess of vitamin D in body can occur when fish and eggs are overfed. Calcium and phosphorus levels elevate in blood. Due to accumulation of calcium in blood the elasticity of blood vessels decreases and become stiff. Radiographically the accumulated calcium is visible. The animal becomes dull, listless and anorexic.

#### Vitamin E

Deficiency of vitamin E occurs in all reptiles but mostly are found in mackerel eating crocodiles and snakes fed on laboratory grown animals (guinea pig, rats and mice).

**Symptoms:** Anorexia, lumps in skin, diarrhea and myopathy.

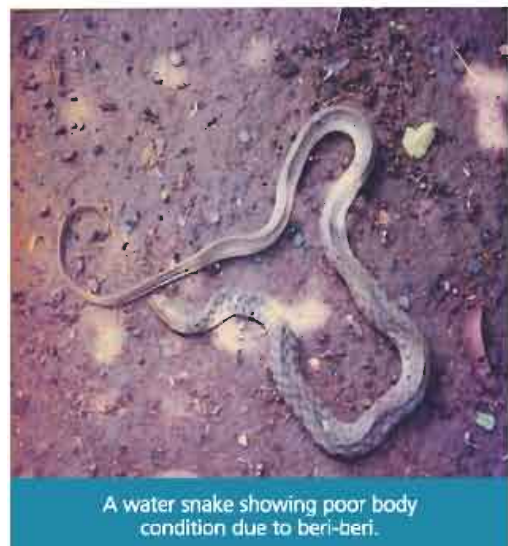
**Treatment:** Vitamin E can be given parentally or orally. Diet should be balanced and patients can be fed involuntarily if anorexia persists.

### Beri Beri (Thiamine deficiency) Vitamin B1

Deficiency of thiamine is seen in almost all reptiles. This disease occurs in reptiles which feed only on fish or meat or only vegetables. Since fish like goldfish and smelt (have low levels of thiamine) the disease is more prevalent in reptiles fed on those fish.

**Symptoms:** Loss of body weight is the most common symptom along with weakness and diarrhea.

**Treatment:** Thiamine injection @ 25-100 mg to be given intraceolamic route(I/c). Improvement in condition can be seen as early as 24 hours after injection. 5-10 mg of Vitamin B1 can be given through feed. 30 mg/kg thiamine can be added to the feed if the reptile is being fed with smelt fish. Reptiles which feed on mammals usually will not suffer from beri-beri.



A water snake showing poor body condition due to beri-beri.

### Treatment for Vitamin Deficiencies

Vitamin	Dosage	Species/Comments
Vitamin A	2000 IU/Kg PO,SC, IM q7-14 day x 2-4 treatments	Most Species
	1000-5000 IU/kg IM q7-10 d x 4 treatments	Most Species
	2000 IU/30 g PO once repeat in 7 days	Chameleons
	200 IU/kg SC, IM	Turtles/ hypovitaminosis A, give in conjunction with PO vitamin A(2000-10,000 IU/kg feed DM)
Vitamin A, D3, E	0.15 ml/kg IM, repeat in 3 weeks	Most species
Vitamin B complex	5-10 mg/kg SC, IM	Most species
Vitamin B1(Thiamine)	25 mg/Kg PO q 24 h	Thiamine Deficiency (Mostly for piscivorous species)
	30 g/kg feed fish PO	Crocodilians
Vitamin B12	0.05 mg/kg SC,IM	Lizards, snakes
Vitamin C	10-20 mg/kg SC,IM q 24 h	All species
Vitamin D	100-250 mg/kg PO q 24 h	Most species/ infectious stomatitis
	200 IU/kg IM q 4 wk	Most species
Vitamin E	1 IU/kg	Most species
	25 mg/kg IM	Lizards
Vitamin K1	0.25 -.0.50 mg/kg IM	Most species

*Douglas Mader, Reptile Medicine & Surgery, (W.B. Saunders Co., London, 1996)*

## Common problems

### Inappetance

The reasons of inappetance could be:

- Extreme temperatures
- Obesity
- Moulting phase (when there is an opaque layer on the eye of the snake)
- When laying eggs and hatching
- Cold temperature
- Suffering from stomatitis or gastrointestinal diseases
- Increased worm load

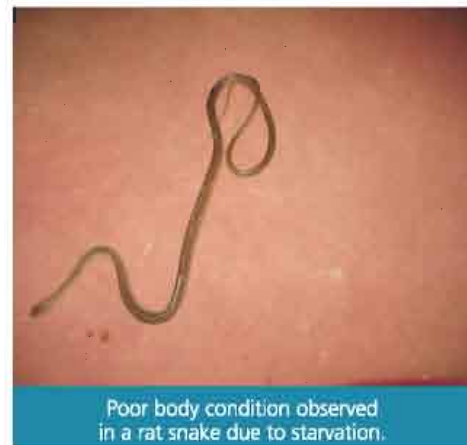
The probable reasons for inappetance in snakes are extreme temperatures and/or variable temperatures. An obese or fat snake may refuse to feed at times. Snakes may refuse to feed during moulting. Female snakes when laying and incubating eggs don't feed for weeks together. Snakes also don't feed during cooler temperatures like in winter. The environmental temperature alters the activity of digestive system since the reptiles are cold blooded animals. When the snake is affected by stomatitis or gastrointestinal diseases then they refuse food.

Reptiles kept at zoos are often fed with the best food available like healthy laboratory animals and become obese. These reptiles loose the capacity to tolerate excess environmental temperature and their masculine characters diminish and eventually develop into hermaphrodites. The environmental temperature alters the activity of digestive system since the reptiles are cold blooded animals.

If the reptile does not feed regularly and in balanced proportion its immunity decreases and it may succumb to death. An eight feet long python can tolerate 100 days of starvation and its body weight can decrease upto 10% of its body weight. If snakes are not feed individually, they can turn into cannibals.

Digestion is temperature dependent and time taken for an Indian python (8 feet long) to digest the same meal at different temperatures is given below:

Temperature	Period required for digestion
28°C	4-5 days
22°C	7 days
18°C	More than 15 days.



Force feeding is the last option in these cases. Most of the time, snakes die due to stress of force feeding. To avoid death due to force feeding one should make an effort to improve appetite of the snake and avoid force feeding till the snake appears healthy. If the period of inappetance is prolonged, then force feeding is the last resort.

Following care should be taken to avoid problems while treating reptiles:

- 1) One should take care that the snake should not vomit after given oral medication.
- 2) For a snake of four feet one should have stomach tube of at least 1 foot long.
- 3) While weighing the snakes use a cloth bag to confine the snakes.
- 4) In chelonians though the weight of carapace and plastron is 1/3 of the total body weight, the total weight of the animal is to be considered and the weight of the shell is not to be deducted.

## Improving the appetite in snakes

If a snake is not feeding for a long period, its appetite could be improved by increasing the humidity in the cage. Before feeding sprinkle water in the enclosure and put a plastic sheet on the enclosure. Due to increased humidity the snake becomes active and aggressive thus attacking the prey. Once the snake feeds on the prey, the sheet should be removed and the snake should be left undisturbed. In spite of all above efforts, if the snake refuses to feed, it is advised to dry and ventilate the cage.

## Force feeding in snakes

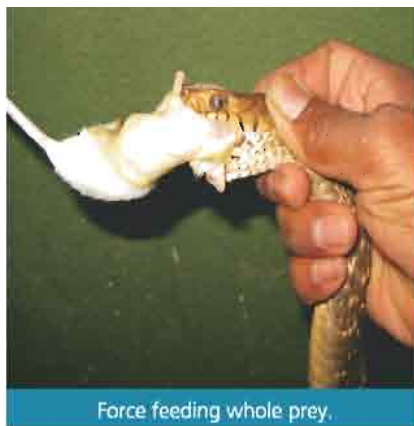
Snakes should be force fed only if the snake has not consumed food for more than 45 days.

Blunt forceps (12 -14 inches long) or custom made syringe specially designed can be used. Forceps are used to feed whole prey (mice) to snakes. The feed can be smeared with egg white to act as a lubricant so that the food enters the gullet easily. Avoid using egg yolk. The thumb of the handler should be placed on the neck and remaining fingers should be placed at the side of the mouth to keep it open. The snake may wriggle so it is advisable to have another keeper hold the snake.

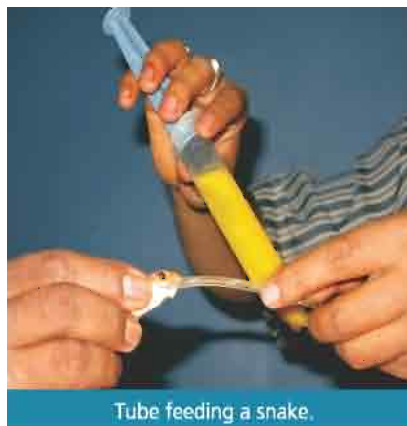
The keeper holding the snake's mouth should hold the prey in the forceps and slowly push the prey in the esophagus. The snake bites into the prey and eventually swallows it. Gently massage the food from the gullet downwards towards the stomach (one-third of the body length) with the fingers and release the snake into its enclosure. Darken the cage and leave the snake undisturbed.

Make sure that the forceps do not hurt the snake. Be cautious while feeding venomous snakes. While holding the mouth of the snake, be careful not to hold too close to the lower jaw, as there is a risk that the upper jaw would clamp down resulting in a bite.

A feeding gun can also be used to feed snakes. The rubber tube should be smooth and soft with a length of 8-10 inches. The tube should be smeared with cod liver oil for easy passage. Different types of feed can be administered to a snake through a syringe, including milk, eggs, liver, dog food and multivitamins. While withdrawing the tube care should be taken that the fangs do not get stuck in the tube.



Force feeding whole prey.

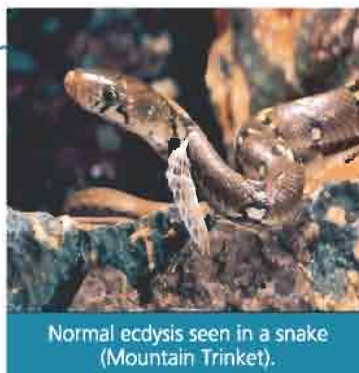


Tube feeding a snake.



Massaging the gullet.

## Shedding Problems



Normal ecdysis seen in a snake (Mountain Trinket).



Removal of the unshed moul with a forceps.

Sometimes snakes don't shed the complete moult. In this situation the moult should be removed manually. Unmoulted snakes are vulnerable to diseases. If the moult is not peeling off easily, one can soak the snake in water to soften the moult and then it can be peeled off easily. For this, one can use a wet cotton bag or the snake can be kept in a wide mouthed, flat bodied, lidded plastic box filled with water up to the level of 2 inches. The lid should be perforated to provide ventilation. The snake should be soaked overnight. The moult on the eyes should be removed using tweezers but one should hold the head firmly. The moult should be peeled off by pulling the molt towards the tail. This work should be carried out by an experienced handler.

## Snout scraping

Rat snake being an agile snake scrapes its snout on the cage when housed in cages having weld mesh as cage walls. This can cause serious injuries to the snake. These snakes should be kept in larger cages. The cage should be well ventilated. In due course, the snout scraping behavior shown by the snake will diminish. It can take months or even years for this wound to heal depending on the damage to the snout.



## Hypoglycemia

Hypoglycemia is most common in crocodiles. If many crocodiles are kept in one cage then there is competition for food and for reptiles that do not get any food, there is a profound effect on liver which in turn reduces the glycogen level.

### Symptoms of hypoglycemia

The orbits are swollen, shivering, lighting reflex is diminished, stargazing and lethargy are common symptoms in crocodiles. For crocodiles from 5' to 18', this disease is common. If a new crocodile is introduced in a group of crocodiles, the first symptoms to appear will be orbital inflammation that can remain for many weeks. Once the new reptile is settled in the group, the symptoms disappear. If the unsettled crocodiles are disturbed further they will develop other symptoms, like torticollis, muscle-stiffness and eventually will drown to death. In these crocodiles the sugar level is as low as 5 milligram/dl. There is normally a variation in the range of sugar levels season wise: in winter the level is at about 50 milligram/dl and in summer it rises to 100 milligram/dl, The crocodilians can manage this physiological variation, however crocodiles if disturbed in winter during their hibernation period, then their adrenaline level in blood increases, adversely reducing the sugar level in blood.

### Treatment and control

Put the patient separately in the isolation ward and force feed it 3 grams of glucose powder for every 1 kilo body weight of the animal. The incidence of hypoglycemia can be reduced by reducing the number of animals in the enclosure.

## Gout

In reptiles gout is seen mostly in articular form rather than the visceral form and the arthritis caused by gout can be diagnosed by physical examination. The visceral form can be diagnosed only on post mortem examination. Gout can affect all the reptiles in nature and the main reason can be excess of protein in the diet, Vitamin A deficiency and dehydration.

### Treatment

Correction of fluid imbalance in body and reducing the protein levels in feed but these are only palliative remedies. Allopurinol can be given orally @ 10mg/kg body weight once daily till symptoms disappear.

## Bites from other animals

It is believed that reptiles particularly snakes can eat only live prey. However, reptiles in captivity can be converted to feed on pre-killed prey. It is safer, since live prey, when attacked can harm the reptile causing serious injuries to the eye, jaws and body. Sometimes live prey like rats, mealworms and crickets can also cause harm to the animals by feeding on the predator instead.

Treatment of bite wounds in reptiles – All wound should be washed with copious amount of normal saline as they are contaminated. For tongue and mouth injuries one can apply antibiotic + steroidal ophthalmic ointment to the tongue sheath 2-3 times a day. Snakes who lose their tongue should be hand fed throughout their life. Snakes can be housed in dry plastic containers till their wounds heal. Topical and systemic antibiotics are indicated for contaminated bite wounds. Silver sulphadiazine 1% is an excellent ointment. Neosporin and povidine-iodine are other good choices for topical therapy. Systemic, parental bactericidal like enrofloxacin/amikacin should be used to prevent and treat infection and septicemia. Healing by granulation can take as little as a few months to over a year.

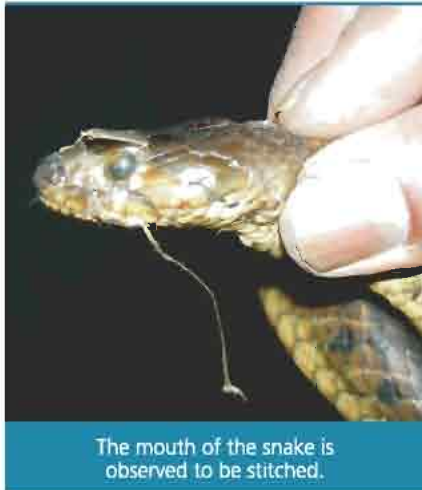


A dog bite wound on the carapace of a juvenile star back tortoise.



A prey bite that has healed through granulation.

## Wounds caused by snake charmers



The mouth of the snake is observed to be stitched.

In some cases where snakes are confiscated during Nagpanchami, the mouth of the snake is stitched, to prevent it from biting the handler. In such a case, the stitches should be carefully removed and the wound dressed. The snakes should be kept in isolation cages. The snakes should be offered only water if required and food should only be offered after healing of the wound is evident. The cage temperature should be higher than that used regularly for other snake enclosures.

## Other diseases

Due to some other pathogens the organs like liver, lungs and kidney of the snakes are affected that cannot be detected when the snake is alive. A post mortem examination of can reveal a lot about the condition of its organs. The general symptoms of disease are anorexia, diarrhea, vomiting, dehydration, loss of weight and respiration through the mouth.

Treatment - Gentamicin @ 2.5 mg/kg body weight along with Dextrose 5% in 0.5% saline. Increase the temperature of the cage. Utmost care should be taken of the snake as above symptoms indicate the disease is in its advanced stages.

### Precautions to be taken to avoid zoonotic diseases

Encephalitis caused by viruses can be transmitted from reptiles to humans. Salmonella spp. is an important organism which can cause typhoid and is a common resident of some turtles and terrapins. In many countries turtles/terrapins harboring *Salmonella spp.* are banned as pets and for importing into the country. TB and fungal diseases can also be transmitted between man and reptiles.

## Venipuncture for intravenous injections and collection of blood

In choosing the method and sites of venipuncture, one must consider the disposition of the animal, the drug, the volume and nature of medication to be administered or the volume of blood to be withdrawn, and the method with which the samples will be evaluated. Reptile blood is easily hemolyzed, so the samples should be sent as urgently as possible to the laboratory for analysis.

### Chelonians

Several sites and techniques are available for chelonians depending on the nature of the patient and the volume to be injected or collected. Most commonly used site is the jugular vein. Jugular venipuncture requires a cooperative patient or chemical restraint. The jugular vein lies on the lateral side of the neck, just under the skin and runs in a line from below the dorsal limit of the lateralmost point of the neck where it meets the body at 2 o'clock and 10 o'clock position.

The dorsal tail vein can be used to collect blood from tortoises. With tail extended, introduce a 25 gauge needle at the dorsal midline close to the base of the tail. Apply suction and advance the needle until it pops the vein and blood gets in the needle hub. Large quality of blood can be collected with slow withdrawal.

In specimens that are very small or uncooperative or those that are unsafe to immobilize, there may be no choice but to clip a nail. For the nail clipping technique the nail should be cleaned before collecting. Cut one or more toenails with a sharp guillotine type nail clipper and allow the blood to flow freely into the tube rather than milking the foot or toe.

### Snakes

Blood sample can be obtained from variety of locations. Cardiocentesis has produced best sample (size and quality). Ventral caudal vein and the palatine vein have also been used. For cardiocentesis, lay the snake on its dorsum and observe the abdominal scutes for movement of a heart. Direct a 23 to 25 gauge needle from under the scales and into the heart and aspirate. Blood is withdrawn slowly and will fill the syringe in bursts with the ventricular filling. In order to collect blood from the tail vein, lay the snake on its dorsum and insert a 23 to 25 gauge needle perpendicular to the vertebra and advance at point caudal to the vent in female and caudal to hemipenes in male snakes.

### Lizards

The caudal tail vein is the best choice for collection of blood from the vast majority of lizard species. Restrain the animal in dorsal recumbency with the tail on a solid surface. Insert the small gauge needle perpendicular to tail and advance it until it comes in contact with the caudal vertebrae in the ventral midline, between the vent and the tail tip, in the first one third area.



### Crocodilians

Blood samples from large crocodile specimens are often obtained from the super-vertebral vessel located just caudal to the occiput and just dorsal to the spinal cord. Once restrained the area on the midline and just caudal to the occiput is prepared as for surgery. A 21 gauge needle of appropriate length to reach the spinal cord is chosen and passed perpendicular through the skin. Apply suction and advance the needle until it enters the sinus and blood appears in the syringe.

## Microchip implantation

As per the international norms, the sites for insertion of transponders (microchip) is as follows in different reptiles:

Chelonians: left hind limb socket.

Crocodylians: anterior to nuchal cluster.

Lizards (large >12.5cm snout to vent): left inguinal region.

Lizards (small < 12.5cm snout to vent ): intercoelomic cavity

Snakes: left nape of neck subcutaneously placed at twice the length of the head from the tip of the nose, or left side in the distal third of the body in between ventral and dorsal scales.

It is recommended that tissue glue is placed over the needle entry site in all reptiles.



Insertion of transponder (microchip) in king cobra.

## General Anesthesia

### Injectable anesthesia

Injectable anesthesia can be achieved for surgical procedure by using very low dose of drugs like ketamine hydrochloride and xylazine. Ketamine HCl @ 44mg /kg (20mg /Lbs) can be used in small snakes, lizards and crocodiles. With this dosage minor procedures like lancing abscesses and minor surgical interventions can be carried out. Ketamine HCl @ 66 to 88mg /kg (30 to 40 mg/LBS) can be used for major surgical procedures .If a dose of 132mg/kg is to be used then the snake should be put on ventilator. For anesthesia in larger tortoise a dose of 88mg/kg (44mg/LBS) can be used. Etorphine (M99) has been successfully used in all reptiles. To achieve a stable state of anesthesia (about 50 % more effectively) one can give injection intra peritoneal. Dosage for less than 4 feet should be 1µgm/9 inch. 0.05 to 0.67 µgm/9 inch for snakes of more then 4 feet. The anesthetic will take 10 to 30 minutes to act and the effect can last from 20 to 180 minutes. In tortoise a dose of 0.25 to 1.25 µgm/ 1 Lbs will last for 45 to 100 minutes. For juvenile crocodile a dose of 0.05 to 2 µgm can last for 60 minutes. Isoflurane is used nowadays to induce as well as anaesthetize reptiles. It is inducted at the rate of 3-5% while the maintenance dose is around 2-4%. Propofol has also been used successfully in reptiles for anesthesia for short durations however its drawback is that it needs to be administered only by the intravenous route.



<b>Anesthetics and sedatives</b>			
<b>No.</b>	<b>Drugs</b>	<b>Dose and route</b>	<b>Comment</b>
1	Acepromazine	0.1 -0.5 mg/kg IM	Preanesthetic (give 1 h before anesthetic)
2	Atropine	0.01 -0.02 mg/kg IM , SC	Pre-anesthetic
3	Diazepam	0.22 – 0.62 mg/kg IM	
4	Halothane	3-5% induction, 1-3 % maintenance	Gas anesthesia
5	Isoflurane	3-5% induction, 2-4 % maintenance	Gas anesthesia
6	Ketamine	20-60 mg/kg IM (higher dose range for larger animals)  60-100 mg /kg IM  12-25 mg/kg IM  50-70 mg/kg Ice  20-40 mg/kg IM,SC	  Crocodilians  Crocodilians  Rapid but short acting  Aquatic turtles
7	Ketamine/acepromazine (10:1 in volume)	40-60 mg/kg ketamine portion IM	Tortoise and snakes (especially juveniles)
8	Ketamine/midazolam	40 mg/kg ketamine, 2 mg/kg midazolam IM	Turtles
9	Ketamine/xylazine	20 mg/kg ketamine IM, 1 mg /kg xylazine IM ( given ½ h before ketamine)	Large crocodilians
10	Meperidine	20 mg/kg IM q24h bid	Analgesia
11	Midazolam	2mg/kg IM	Preanesthetic for ketamine
12	Morphine	0.5 -2 mg/kg IM, SC q12-48 h	Analgesia
13	Oxymorphone	0.025 -0.1 mg/kg IV 0.5- 1.5 mg/kg IM	Analgesia/anesthetic Does not work well in snakes
14	Nitrous oxide	1:1- 1:3 NO <sub>2</sub> :O <sub>2</sub>	Use with volatile anesthetics
15	Thiopental	15-30 mg/kg Ice	Variable results
16	Tiletamine/zolazepam	10 mg/kg IM  15-30 mg/kg IM  1-2 mg/kg IM  1-1.5 mg/kg IM	Tortoise , iguana  Snakes and lizards  Crocodilians  Monitors
17	Xylazine	0.1 1mg IM,SC	Variable results

*Douglas Mader, Reptile Medicine & Surgery, (W.B. Saunders Co., London, 1996)*

## Guidelines for isolation or quarantine facility

- A separate quarantine facility, with the ability to accommodate reptiles should exist. If a specific quarantine facility is not present, then newly acquired reptiles should be isolated from the established collection in such a manner as to prohibit physical contact, to prevent disease transmission and avoid spread by aerosol. The facility should be minimum 50 meters away from the exhibit area.
- Equipment used to feed and clean reptiles in quarantine should be used only with these reptiles. If this is not possible, then equipment must be cleaned with an appropriate disinfectant (as designated by the veterinarian supervising quarantine) before use with post-quarantine reptiles.
- The isolation ward should not be seen by the visitors and should have proper barrier to avoid contact. There should be a separate keeper appointed to look after the isolation ward.
- There should be a very high level of hygiene. Zoos must take precautions to minimize the risk of exposure of reptile care personnel to zoonotic diseases that may be present in newly acquired reptiles. These precautions should include the use of disinfectant foot baths, wearing of appropriate protective clothing and masks.
- No other person (staff/zoo guest/VIP) should be allowed to visit the quarantine facility.
- All new animals should be kept under quarantine for a minimum period of 30 days.
- It is strongly recommended that a veterinary examination should be carried out along with CBC/blood chemistries for all animals at the time of coming and after being in quarantine for 30 days.
- A full post-mortem examination and histopathology on all specimens dying while in quarantine, should be carried out.
- During PAQ (Post arrival Quarantine) the reptile(s) should be monitored daily for signs of illness and, if necessary, be subjected to a clinical examination.
- Complete medical records should be maintained and available for all animals during the quarantine period. Animals that die during quarantine should have a necropsy performed under the supervision of a veterinarian and representative tissues submitted for histopathologic examination.
- Quarantine cages should be separate for desert, aquatic, semi aquatic, terrestrial and arboreal reptiles.



Quarantine facility (exterior)



Quarantine facility (interior)

## Guidelines for laboratory and veterinary facility

- The facility should be air conditioned and have modern equipment like microscope, anesthesia machine with corresponding masks and endo-tracheal tubes.
- The facility should be stock appropriate medicines.
- It should not be accessible to unauthorized people.
- Reptile Identification - When working in the field, it is imperative to correctly identify genus and species of all reptiles. To facilitate proper identification, several field guides should be provided in the facility.
- Computers - The computers in the facility are not for unauthorized persons. Folders and files on the computer should be named appropriately to keep an easy track of file, locations, etc.
- Larger tissue samples should be taken from dead reptiles.
- Gravid snake: If the snake brought into the lab is a female, check to see whether she is gravid (i.e., with eggs or developing young). This is done by palpating the snake anterior to the cloaca and feeling for several round objects (the eggs or embryos).
- Sometimes a wild caught snake could be brought back to lab soon after eating a meal. If the snake has a large bulge toward the middle of its body, it probably has recently eaten. Feeling the snake's belly will allow you to feel the bulge and discern the outline of a prey item in the stomach. Recording what the snake has eaten gives us valuable information about its ecology. To determine what the snake has ingested, palpating the snake's belly will force it to regurgitate its prey. At that point, the prey can be identified and recorded.



Laboratory facility



A decorative graphic consisting of four vertical bars of varying heights and shades of orange, positioned to the left of the title.

## Handling and Transportation



## Handling

All reptiles must be handled with care. They are to be handled according to their size. Keepers should take utmost precaution as sometimes bad handling can result in nasty bites. Even non-venomous reptiles can inflict septic bites and have anticoagulants in their saliva, so care should be taken when handling or working around them.

### Handling equipment

- Kevlar gloves
- Tongs
- Cotton bags
- Snares
- Hook stick
- Gloves
- Ropes
- Gunny bags.

## Handling snakes

**Snake Hook Stick** - The snake hook stick is one of the best tools to handle snakes. Using the hook stick is a skill that comes with experience. There are a variety of hook sticks used by handlers and keepers. G shaped, L shaped, collapsible hook stick, pen sized hook stick (to carry in small bags), wooden hook stick, hook stick with attached torch, etc.

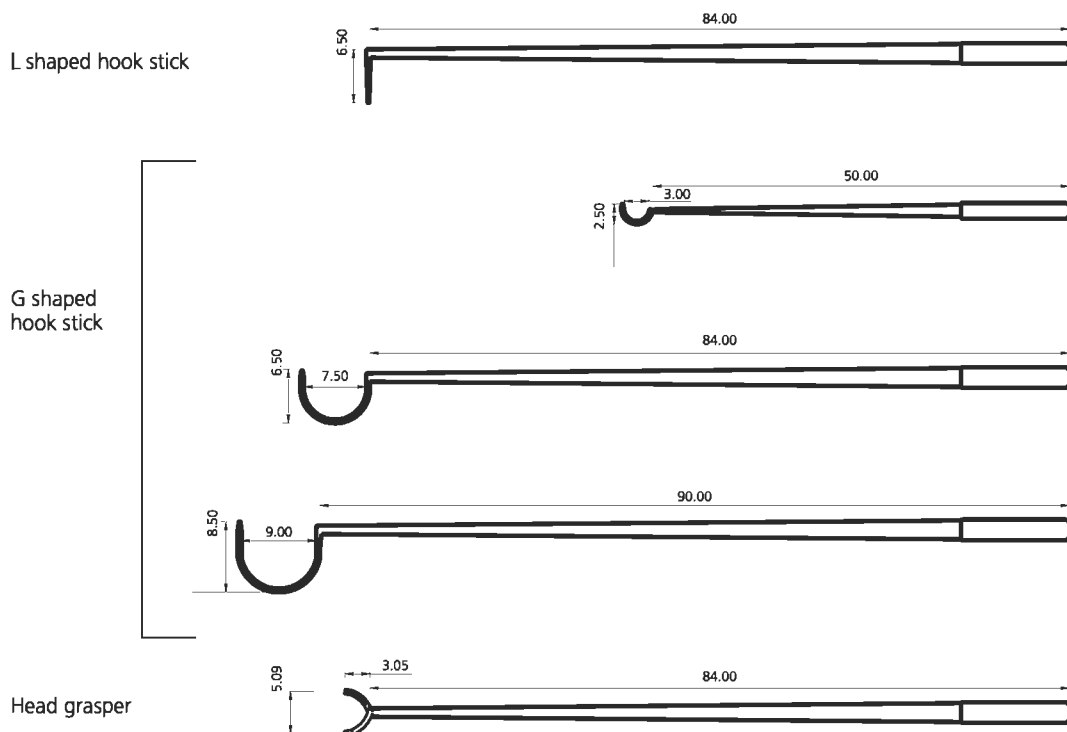
An indigenous hook stick can be made with a used golf club (stick) by removing the metal head and inserting a hook in its place.

A smaller sized hook stick can be used for snakes kept in small cages. For larger and thicker snakes, the stick should be long.



Hook the snake around the middle or one-third away from the head. Lift it gently while holding its tail with the other hand. The snake is thus restrained.

### Different types of hook sticks (unit of measurement - cm)





Head grasper

### Head grasper

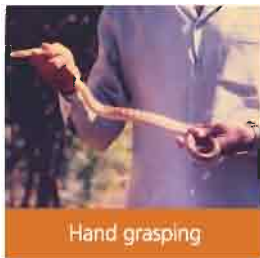
A specially designed stick with a semicircular arc lined with sponge is useful for catching venomous snakes by the head. This stick is pressed on the neck of the snake, rendering it immobile. The snake can thus be caught safely.

### Snake Tongs

Snake tongs should be used by newcomers. However care should be taken to monitor the grip. A hard grip can cause injury to the snake. Tongs are more useful for thinner and smaller snakes.



Snake tongs



Hand grasping

### Hand grasping

The surest and easiest way is to grasp the reptile by hand. However this technique is risky and a wrong grasp can lead to a vicious bite. Only experienced professionals should attempt to do this.

### Transparent plastic tubes

Plastic tubes can also be used to capture snakes. Tube diameters can differ according to the girth of the snake. The tube is kept on the floor and the snake is inserted slowly. The tube diameter should be such that the snake should fit in exactly so that it cannot turn back and come out.



Transparent plastic tube can be used to restrain venomous snakes.



Snake bag: Plastic tube is attached to the mouth of the bag through which a venomous snake can be guided easily in to the bag.

## Handling Crocodiles

Small size crocodile (up to 3 feet) can be handled by single individual. One hand can grasp forelegs around the neck and shoulders. The thumb and index finger should be just caudal to the head to prevent bites and base of tail by other hand. In larger crocodiles, trapping cages should be used. Crocodiles can also be caught by using snares of ropes made of cotton, jute or nylon. Various sizes of snares can be used depending upon the size of reptile.



Catching



Ready to be transported

## Handling Lizards/Iguana

Lizards can be restrained by the same method for small sized crocodiles.



## Handling Turtles/Tortoise/Terrapins

The chelonian should be held upright using hand gloves, with one hand on centre of carapace and other at centre of plastron or the turtle could be grasped in the middle with both hands, between the fore and hind limbs (as shown in pictures below).





## Transportation

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Transportation of reptiles becomes necessary when they need to be shifted from one facility to another either from a zoo to zoo, or from a rescue facility to the wild or during rescue from someone's house or fields to the forest department office.

### Permits

It is of utmost priority that permission and permits from relevant authorities should be acquired for transporting or release

- Local Governing body of the zoo
- The Principal Chief Conservator of Forests / Deputy Conservator of Forests
- Veterinarian (health certificate)
- The Central Zoo Authority

### Release into the wild

All releases should be done as per the IUCN guidelines. According to the Wildlife Protection Act, the reptile can be released only in the presence of a forest officer. A panchanama should be obtained from the concerned forest officer. There should also be photographic documentation of the release.

Schedule I & II reptiles should be micro chipped.

## Reptile Transportation Guidelines

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- Only reptiles in good health should be transported.
- Reptiles should not be sedated.
- Reptiles of different species should not be transported in the same compartment or bag.
- Unless reptiles of the same species are known to be compatible with one another, they should not be transported in the same compartment or bag.
- Reptiles should be left undisturbed during transport.
- Reptiles that have become sick or that have been injured during transport should receive veterinary treatment as soon as possible. A record of any such occurrences should be kept.
- Do not feed the reptiles before or during transport except for young tortoises and iguanas.
- The container should be constructed of wood or hardboard.
- To ensure an adequate flow of air at all times, ventilation holes should be provided in all walls and the lid of the container but should be of a suitable size to prevent animal escape.
- There should be no sharp edges or projections on the inner surfaces of the container.
- Containers should be secured to the aircraft, rail wagon, lorry or ship to avoid any possible movement and should at all times be maintained in a horizontal position.
- If any wood preservative or paint is used on the container, care should be taken to ensure that this is not toxic or a skin irritant.

## Labeling and documentation

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1. The transport boxes should be labelled properly and correctly with the caption "LIVE REPTILES! DO NOT TIP!" on all sides and top.
2. The box can also be labelled with the caption "THIS WAY UP" with arrows indicating the top on all sides.
3. The box should always contain the consignor's and consignee's name, address and telephone number.

## Transportation equipment

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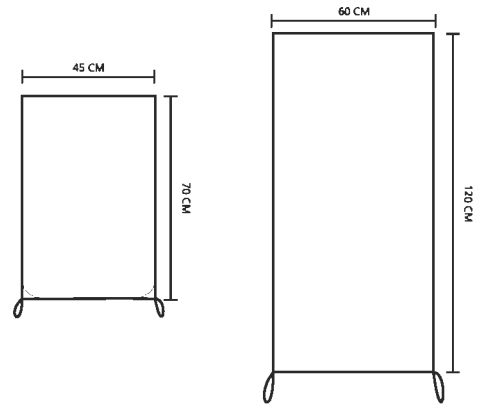
- |          |                               |                     |
|----------|-------------------------------|---------------------|
| ● Cages  | ● Cotton bags                 | ● Metal boxes       |
| ● Boxes  | ● Strings (to tie snake bags) | ● Ropes             |
| ● Towels | ● Cardboard boxes             | ● Waterproof marker |

## Snakes

Snakes should always be transported in bags made of casement cotton. Red colour bags should be used for venomous snakes and green colour bags for non venomous snakes. These bags should be packed in well ventilated cardboard boxes. The boxes should have markings to identify the species and quantity. If the travel time is more than 24 hours, green leaves should be put into the bags to hold moisture.



Transportation Bags for (L) non-venomous and (R) venomous snakes.



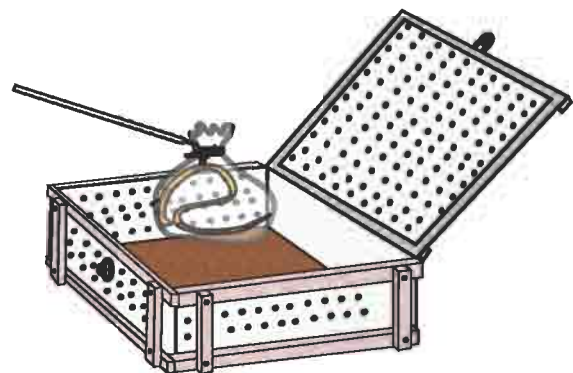
Bag dimensions for (L) small and (R) big snakes.



Transportation box for baby snakes.



Transportation box for (L) medium sized and (R) big snakes.



## Tortoises

Tortoises should be transported in boxes. The size of the box should be according to the size of the shell. Boxes should be made of water proof plywood with holes drilled for ventilation. If there is large number of tortoises, then boxes with drawers should be made.



Transport box for turtles.



Transport box for tortoises.

## Turtles

Turtles should be transported in marine ply boxes. During summer, there should be damp towel inside the box to avoid dehydration of the shell especially for soft shell turtles.

## Crocodiles / iguanas / monitor lizard

They should be transported in a strong, water-proof, well ventilated, wooden box or a box made from a perforated metal sheet (see picture). The size of the box should be according to the length of the reptile.



Transport box for crocodiles.



A decorative graphic consisting of four vertical bars of varying heights and shades of yellow and orange, positioned to the left of the title.

## Record Keeping and Safety Measures



## Importance of Record Keeping

Record keeping is an integral part of reptile zoo management. Good records maintain and transmit accurate information about the reptile collection. It documents a complete history of each reptile owned by or kept at the facility. It provides meaningful archival material. It provides legal documentation, reports for permits. It also provides genetic history and basic demographic information used in local and global species management. Record keeping helps maintain data for research and husbandry. Research depends on data, and the records-keeper's files can provide necessary information.

**Animal inventory, daily report register, history sheets, stud book information and post mortem reports should be kept as per the proformas specified by Central Zoo Authority.**

The conditions, health and behavior of all reptiles are checked at least twice daily by the keeper or head keeper of that particular section and it should be noted in keeper's diary. Any reptiles which give cause for concern must be thoroughly assessed as to whether they are unduly distressed, sick, or injured. Wherever necessary they must receive immediate attention and treatment. A daily record must be kept by the veterinarian and daily observation charts by the keeper, indicating changes to the prescribed, health checks carried out, any unusual behavior or activity or other problems and remedial action taken.

## Guidelines for emergencies and disaster management

### Reptile escape

**There is every chance of reptiles escaping from the zoo or park either due to human error, faulty cage design or natural disasters.**

In the likelihood of a reptile escape, consider the possible or likely attempted route that the reptile may have taken. Every effort must be made to recover the reptile dead or alive. The zoo staff should be familiar with procedures to be adopted in case of a reptile escape. Procedure should include reporting of the escape by the quickest possible means to the most senior member of staff. In the event of an escape, recapturing the reptile, protecting visitors, alerting the police and the forest department, etc. will be needed to be done on an urgent basis. Controlling visitors, ushering them into safer locations, evacuating the zoo, securing the perimeter boundary including closure of all points of entry and exit from the zoo should be done as fast as possible. In case of extreme emergency the use of darting equipment or fire-arms may be necessary.

### Escaped Snake

1. Begin by narrowing down the options. Isolate the areas where snake is likely to be hidden. Most probably it will be in warm dark place like under a lamp or near a water body.
2. Therefore, place heating lamps and blankets near likely areas. This will mostly attract the snake during nights. Check these spots at night.
3. If there is fine sand, check for any marks that is left by the moving snake.
4. Place a bowl of water and a frozen rodent (if it is known that the snake has not eaten recently) in the area that's illuminated by light. The bowl should be surrounded with fine sand.
5. Check in warm areas or near other heaters inside. The snake will be naturally attracted to these areas. Turn off all other lights in that area & leave the heating lamp on. Check every few hours. Wireless IR CCTV cameras can be placed.
6. Look out for bird alarm calls of crows, mynahs, babblers, bulbul, etc which start making noise if a traveling reptile appears in open places.

During summer the escaped snake is likely to move near water bodies or moist places like underneath nearby bushes. It can often take a few days or more until the missing reptile makes an appearance.

### Escaped crocodiles & gharials

All crocodiles & gharials need water. A crocodile can smell water and is likely to be attracted to water. Therefore, check all water bodies (tanks, ponds, lakes) in and around the zoo. They like heat and need regular basking. A crocodile trapping cage with bait can be placed near water bodies.

## Other likely emergencies



**Fire** - Dry grass placed directly under a heating lamp is a potential hazard for fire.



### Electrical Shock

Exposed cables are dangerous for the reptile and the keeper. All cables and wires should be properly sealed and hidden.



### Off-site emergency

More than 25 aquatic snakes were trapped in unmanned fishing nets. The fishermen need to be educated to discontinue such a practice.

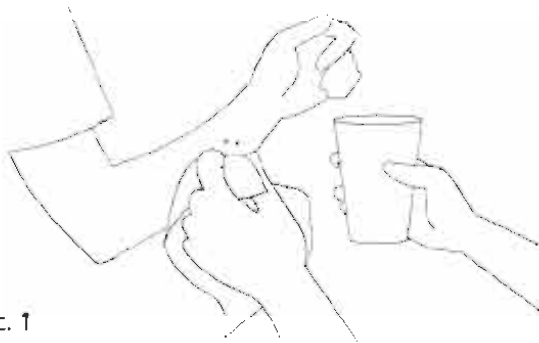


## Non-venomous Snake, Crocodile, Monitor Lizard, Iguana, Turtle bites

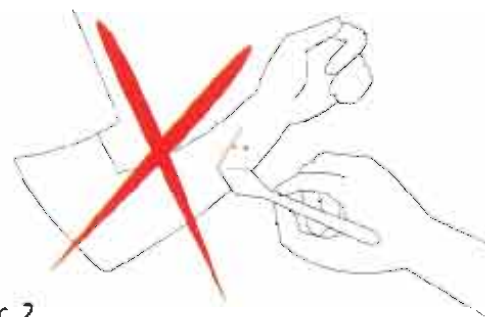
Though these bites are non venomous, antibiotic therapy should be administered for any kind of bite (big or small, deep or superficial) to prevent sepsis. If the injury is deep, it can result in heavy blood loss. In such a case apply a tourniquet to prevent blood loss and move the patient immediately to the nearest hospital.

## Venomous snake bite

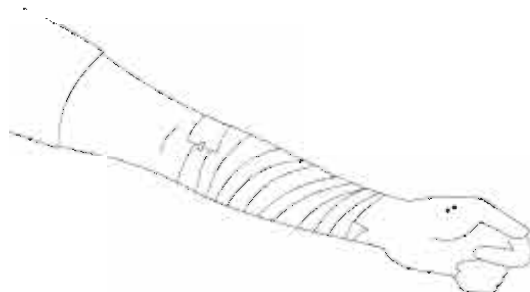
1. Do not panic. Remain calm. Remember that the person may have been bitten but no venom might have been injected.
2. Remove all jewelry from the bitten limb.
3. Call an ambulance to take the patient to a government hospital. If possible, carry the patient or assist him in such a way that movement is reduced. Ensure that the patient lies down while waiting.
4. During transportation, it is necessary to restrict movement. Inactivity slows down the circulation of the venom through the body.
5. Wash and cleanse the wound with antiseptic solution (see pic 1).
6. Apply a tourniquet (see pic 3 & 4).
7. Always seek medical attention. Never apply ice, cut the bite area or apply suction (see pic 2).
8. Never try to catch or kill the snake as it is dangerous and illegal to do so.



Pic. 1



Pic. 2



Pic. 3



Pic. 4

First-aid measures to be taken in case of a snake bite.

### Anti snake venom

Anti-snake venom (ASV) is a polyvalent antidote for most of the venomous snakes. ASV should be administered by an experienced physician only. ASV can cause hypersensitivity in the patient when injected, so it should be administered with caution. A person can need 5 to 30 vials depending on the severity of symptoms of toxicity.

Pinak tablet, an Ayurvedic antivenin remedy recently developed has proven exceptional results in government hospital in Pune district. It can be administered sublingual as a preliminary treatment and as well as adjuvant to ASV treatment. The tablet can be ground into powder and kept under the tongue. It gives effective results within minutes that last for 6-12 hours. The patient may require a dose of 1 to 10 tablets depending upon the severity of the bite. It can be taken immediately after any snake bite. It is recommended to keep Pinak tablets for any snake bite emergencies.

### How to avoid snake bites

- Be sure to wear proper foot gear. Exercise caution around fallen trees and logs.
- Snakes should not be handled without proper formal training.
- Most experts advise against trying to handle even a freshly killed snake as the nervous system may be still active and as it can still deliver a bite! Exercise caution while handling a dead snake as even an accidental scratch of the fangs can still inject venom. Even a cut-off head can cause a severe bite.
- The best action to take if one comes across a snake is to slowly and quietly move away leaving a passage for it to escape.
- Keepers should take good care in snake pits. Snakes hide beneath logs and rocks during daytime. While lifting rocks or logs, roll them with long stick before lifting it. Avoid putting your hand underneath them.
- Don't touch any snake, even if it seems dead, as some of them can remain very still and yet are very agile to deliver a bite.
- Snakes do not always warn with a hissing sound. Most snakes give no warning at all before attacking.
- Wear boots and long pants when hiking in snake territory and better still wear long sleeves.
- Always work with a companion while handling venomous snakes or constrictors like pythons.



Available treatments for venomous snake bites

## Safety Management

### Keeper safety

- Keepers should be very careful when handling reptiles.
- Non venomous species can inflict septic bites and have anticoagulants in their saliva.
- Keepers should wear protective footwear (gumboots or boots).
- Strictly no slippers or chappals should be allowed.
- Thick pants (jeans) and a full sleeved shirt should be worn.
- Employees should eat only in designated clean areas.
- Train employees to recognize zoonotic infection risks as well as to implement the necessary control measures.
- While cleaning enclosures, use a hook stick to rummage through dry leaves.
- Be careful of cage furniture like logs and boulders. The reptiles could be hiding behind or beneath them.
- Night duty keepers should always carry a head torch or a bright torch light.



Keeper safety should be given priority when dealing with reptiles.

## Personal hygiene

**To reduce the risk of zoonotic infections it is recommended the keepers observe the following guidelines:**

1. Maintain short hair.
2. Remove loose wristwatches, necklaces, locket, strings, beads or bangles at the start of work.
3. Maintain short nails.
4. Strictly avoid consumption of liquor, tobacco and cigarettes during working hours.
5. Maintain good standards of hygiene in animal enclosures avoiding contamination of the drinking water with the animal's feces.
6. Adequate washing facilities like running hot and cold or warm water, soap and towels should be provided to the staff so that they can maintain personal hygiene.
7. Cuts and abrasions to be washed immediately with soap and water.
8. Existing cuts, abrasions and open sores should be covered with a waterproof dressing.
9. Wash hands regularly.
10. Clean or change footwear before leaving animal areas.
11. Disinfect footwear if necessary and wash hands after handling contaminated clothing.
12. Avoid any face-to-face contact with animals.
13. Keep hands away from the face, in particular the mouth, nose and eyes.





**Public Education  
and Conservation**



## Guidelines for Information boards

1. Information boards should be of a minimum size of 3 ft x 2 ft.
2. The information should be scientifically correct.
3. Information boards should be sized properly and proportionately to the size of the enclosure.
4. Materials used should be durable, weather proof and have good print quality. Modern techniques like eco-solvent printing, lamination on foam sheet, etc could be used.
5. Standardize fonts and colours and use creative graphics.
6. The information should be readable and should be placed at a proper angle for viewing.
7. Information boards should not be placed inside cages or enclosures.
8. The information should be in Hindi, English and the local language.
9. Boards should be placed away from the reach of visitors to avoid vandalism.



Use of standard material will make the information boards more durable and vandal proof.

## Guidelines for Signs/ Symbols

### Signs and way finding systems

For good crowd management it is very necessary to have clear signs and way finding systems. They should be in the local language and English.

An adequate number of clearly visible safety signs providing warning by means of a symbol or words, or a combination of symbol and words, should be displayed at each enclosure containing any species of reptiles.

### Warning signs

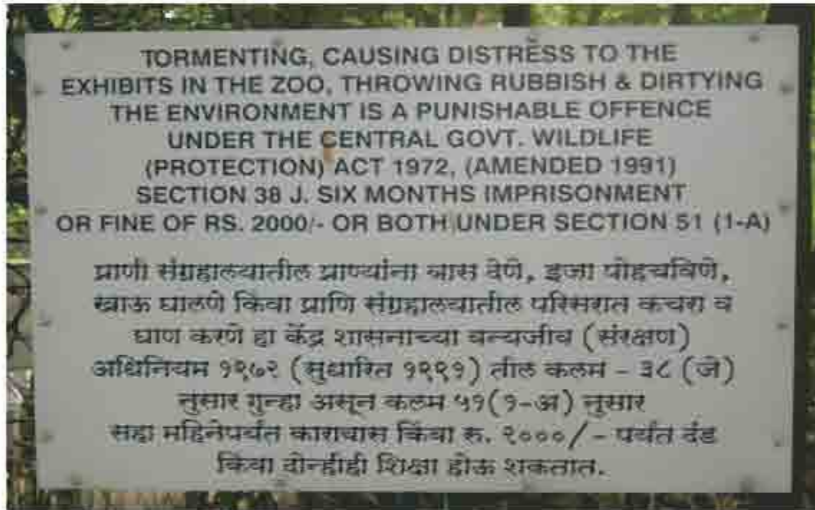
Warning boards should be well designed and placed prominently for the viewers. They should be attractive and easily visible to the viewer.

Warning signs need to be placed at appropriate locations:

- Where reptile and visitors are likely to come in contact.
- At edges where there may be a sharp fall.
- In areas which are unsafe or where hazards exist.

### Directional signs

Use of arrows, identification of designated public areas and functions like toilets, drinking water, picnic zones, etc. all come under directional signage.



Warning sign boards

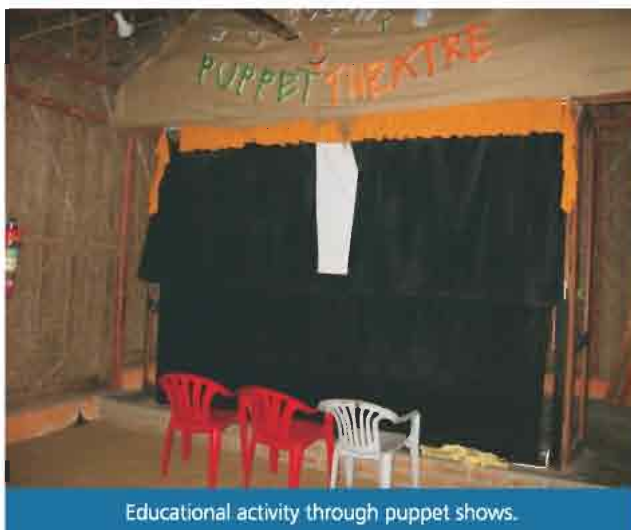


## Guidelines for Education and Training Facility

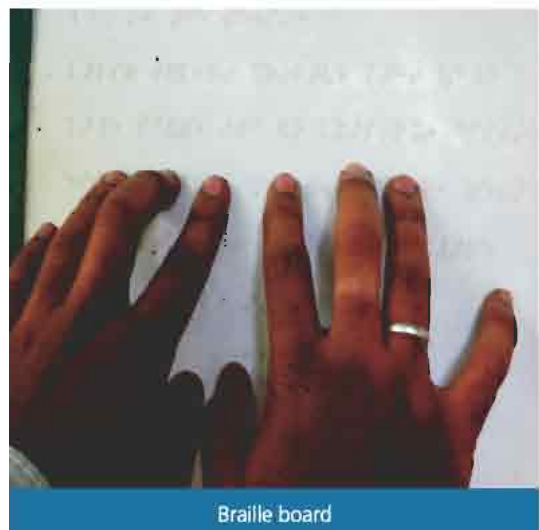
1. There should be a designated area for demonstration and training. The area could have class room or amphitheater style seating for 100 people.
2. White boards, LCD projectors and other educational facilitation tools should be available.
3. Proper information charts should be in English, Hindi and the local language should be put on display.
4. An educational officer should be appointed.
5. Access for handicapped visitors in the form of ramps and braille boards should be made available.
6. Live demonstration should be carried out by professionally trained staff and reptiles should not be given to zoo visitors for handling to prevent stress and trauma to the reptiles. Instead hands-on training programmes should be organized for people interested in learning about snake and reptile handling.



Amphitheater style seating.



Educational activity through puppet shows.



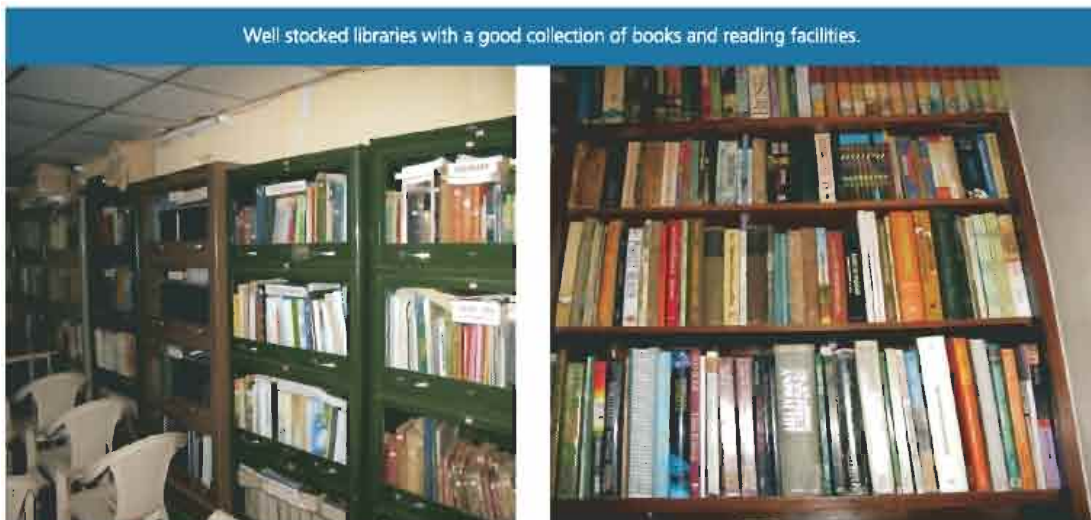
Braille board

Live demonstration of reptiles by professionals in progress.



## Guidelines for a library

1. A library contributes in educating people and aids in the studies of wild life conservation. It provides access to research material, scientific text, ready reference materials, books, periodicals and global information resources.
2. The library should be located in a quiet place, away from hustle and bustle of zoo activity. It should have proper ventilation and should be well lit.
3. A reading area should be provided.
4. The books and journals on herpetology should be kept in the library. They should be in English, Hindi and the local language.
5. Books should be accessible to visitors, NGOs, students, nature lovers etc.
6. The library should have digital resources like e-guide, CDs, DVDs etc.
7. A librarian should be appointed to look after the library.
8. There should be a budget allocation annually.
9. A computer with internet facilities should be provided.



## Conservation

Today, there is an increasing awareness about conservation of reptiles. Zoos and parks are playing a very important role in educating and imparting information. However, the challenges are daunting. Snakes are still hunted for their skin and venom. Monitor lizards and crocodiles are captured for their flesh and skin. Turtles are hunted for their eggs.

Various species of reptiles are reducing in numbers. A number of snakes and chameleons are killed on roads that go through sanctuaries and national parks. The local forest department should put up warning signs in Hindi, English and the local language. Local and regional zoos should promote the conservation of reptiles found in their region.

Various initiatives should be taken up, which can go a long way in facilitating conservation. Special breed-for-release programs of native species, should be taken up, involving local herpetological groups.



Instead of live snake demonstrations, the snake moult can be laminated and can be handled by visitors displayed for identification.



Snakes are kept as pets. Sometimes, these pets could be rare species like an albino cobra. Very often, rare species are captured from the wild and sold illegally at a very high price. Zoos should educate and discourage people about adopting this practice.

Snakes are killed in large numbers for making trophies and their skin has been used for making wallets, belts and other pieces of decoration. This has resulted in the decline of certain species. Similarly monitor lizards are killed in large numbers as their skins are used for making drums called "ghumats" which has resulted in their decline.



Python skin mounted for display.



Wallet made from snake skin.



Rattle-snake trophy used as a show piece.



A ghumat

According to the Indian government, around 80,000 snakes die on Nagpanchami day. As devotees pray to snakes, snake charmers stitch the mouth of the snake, rendering the snake decapacitated resulting in its death.

This practice can be avoided by using snake replicas instead of live snakes. Participation of local volunteer groups can be sought in distributing these snake idols (replicas) in their localities.



Snake charmers using live snakes.



FRP idols of cobras.



A lady worshipping a snake idol.



Spiny tail lizards are caught in large numbers to prepare a certain kind of an oil.



Conservation of native species can be taken up with breed-to-relocate program. Breeding reptiles in captivity also fosters and encourages research.



Hundreds of star back tortoises confiscated by the Customs department.

The limbs of spiny tail lizards are broken and entire lizards are put into boiling oil. Such lizards are brought to the rescue center or zoo in a very pitiable condition. These reptiles can be rehabilitated gradually with physiotherapy (creating a swimming pool in their enclosures). These reptiles can be used for breeding, and their progeny can be released in the wild. Rare species can be saved only through captive breeding. Zoos and rescue centers should adopt such programs.

The international pet trade will thrive as long as people long for exotic reptiles as pets. Customs and forest authorities have seized boxes carrying large numbers of tortoises, terrapins and turtles. Often these tortoises are packed tightly in boxes without any food or water. Many of them die as a result.

In India, there are only one or two places who have a proper scientific chelonian breeding program. Zoos, rescue centres, and reptile parks must take up the challenge of initiating these projects by creating a micro habitat in their premises and adopting conservation measures like preserving their habitat, stopping illegal poaching and controlling the pet trade.





## List of Zoos and Parks with reptile collection visited during the study

National Zoological Park, Delhi  
Kamala Nehru Zoological Garden, Ahmedabad  
Sundervan Nature Discovery Centre, Ahmedabad  
National Park, Banerghatta Zoological Garden, Banerghatta  
Pilikulla Wildlife Safari, Mangalore  
Sri Chamarajendra Zoological Garden, Mysore  
Parasnikadavu Snake Park  
Arignar Anna Zoological Park, Chennai  
Chennai Snake Park Trust, Chennai  
Irula Snake Catchers Industrial Cooperative Society Limited  
Madras Crocodile Bank Trust, Mahabalipuram  
Alipore Zoological Garden, Kolkata  
Calcutta Snake Park, Kolkata  
West Bengal Snake Park and Laboratory, Badu  
Nehru Zoological Park, Hyderabad  
Sakkarbaug Zoo, Junagadh  
Siddhartha Zoo, Aurangabad  
Sri Venkateswara Zoological Park, Tirupati

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## Handling

All reptiles must be handled with care. They are to be handled according to their size. Keepers should take utmost precaution as sometimes bad handling can result in nasty bites. Even non-venomous reptiles can inflict septic bites and have anticoagulants in their saliva, so care should be taken when handling or working around them.

### Handling equipment

- Kevlar gloves
- Tongs
- Cotton bags
- Snakes
- Hook stick
- Gloves
- Ropes
- Gunny bags.

## Handling snakes

**Snake Hook Stick** - The snake hook stick is one of the best tools to handle snakes. Using the hook stick is a skill that comes with experience. There are a variety of hook sticks used by handlers and keepers. G shaped, L shaped, collapsible hook stick, pen sized hook stick (to carry in small bags), wooden hook stick, hook stick with attached torch, etc.

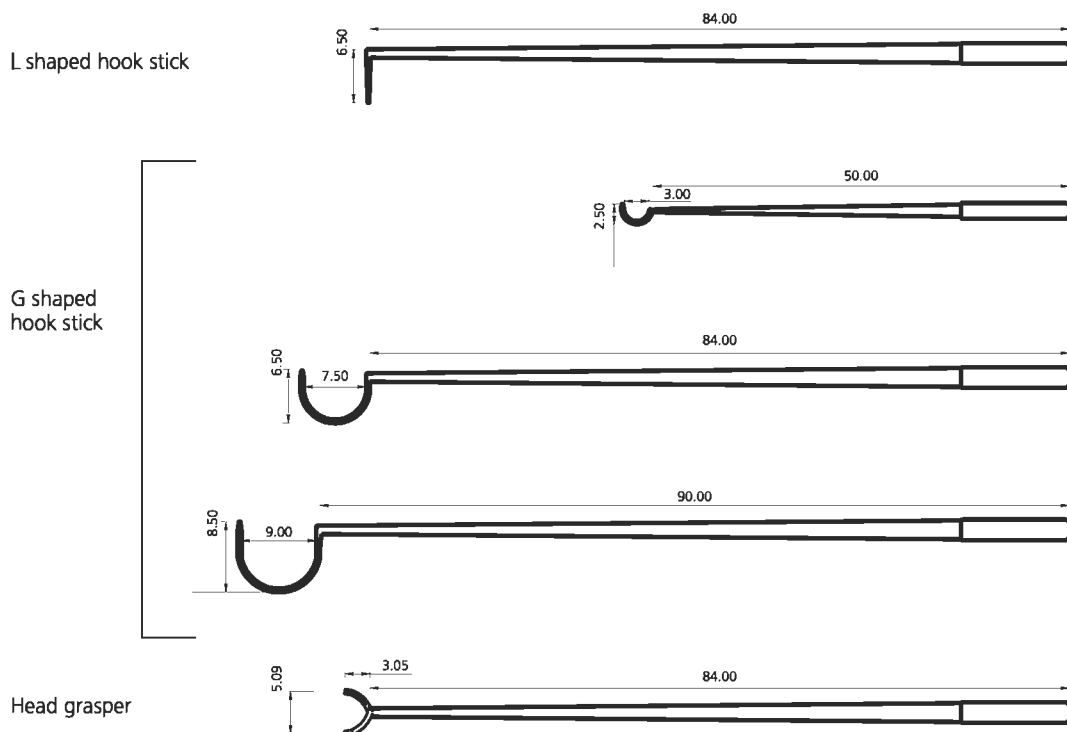
An indigenous hook stick can be made with a used golf club (stick) by removing the metal head and inserting a hook in its place.

A smaller sized hook stick can be used for snakes kept in small cages. For larger and thicker snakes, the stick should be long.



Hook the snake around the middle or one-third away from the head. Lift it gently while holding its tail with the other hand. The snake is thus restrained.

### Different types of hook sticks (unit of measurement - cm)





Head grasper

### Head grasper

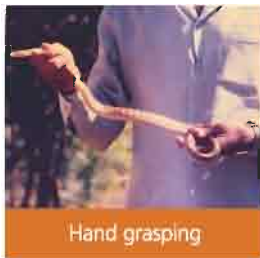
A specially designed stick with a semicircular arc lined with sponge is useful for catching venomous snakes by the head. This stick is pressed on the neck of the snake, rendering it immobile. The snake can thus be caught safely.

### Snake Tongs

Snake tongs should be used by newcomers. However care should be taken to monitor the grip. A hard grip can cause injury to the snake. Tongs are more useful for thinner and smaller snakes.



Snake tongs



Hand grasping

### Hand grasping

The surest and easiest way is to grasp the reptile by hand. However this technique is risky and a wrong grasp can lead to a vicious bite. Only experienced professionals should attempt to do this.

### Transparent plastic tubes

Plastic tubes can also be used to capture snakes. Tube diameters can differ according to the girth of the snake. The tube is kept on the floor and the snake is inserted slowly. The tube diameter should be such that the snake should fit in exactly so that it cannot turn back and come out.



Transparent plastic tube can be used to restrain venomous snakes.



Snake bag: Plastic tube is attached to the mouth of the bag through which a venomous snake can be guided easily in to the bag.

## Handling Crocodiles

Small size crocodile (up to 3 feet) can be handled by single individual. One hand can grasp forelegs around the neck and shoulders. The thumb and index finger should be just caudal to the head to prevent bites and base of tail by other hand. In larger crocodiles, trapping cages should be used. Crocodiles can also be caught by using snares of ropes made of cotton, jute or nylon. Various sizes of snares can be used depending upon the size of reptile.



Catching



Ready to be transported

## Handling Lizards/Iguana

Lizards can be restrained by the same method for small sized crocodiles.



## Handling Turtles/Tortoise/Terrapins

The chelonian should be held upright using hand gloves, with one hand on centre of carapace and other at centre of plastron or the turtle could be grasped in the middle with both hands, between the fore and hind limbs (as shown in pictures below).



## Transportation

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Transportation of reptiles becomes necessary when they need to be shifted from one facility to another either from a zoo to zoo, or from a rescue facility to the wild or during rescue from someone's house or fields to the forest department office.

### Permits

It is of utmost priority that permission and permits from relevant authorities should be acquired for transporting or release

- Local Governing body of the zoo
- The Principal Chief Conservator of Forests / Deputy Conservator of Forests
- Veterinarian (health certificate)
- The Central Zoo Authority

### Release into the wild

All releases should be done as per the IUCN guidelines. According to the Wildlife Protection Act, the reptile can be released only in the presence of a forest officer. A panchanama should be obtained from the concerned forest officer. There should also be photographic documentation of the release.

Schedule I & II reptiles should be micro chipped.

## Reptile Transportation Guidelines

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- Only reptiles in good health should be transported.
- Reptiles should not be sedated.
- Reptiles of different species should not be transported in the same compartment or bag.
- Unless reptiles of the same species are known to be compatible with one another, they should not be transported in the same compartment or bag.
- Reptiles should be left undisturbed during transport.
- Reptiles that have become sick or that have been injured during transport should receive veterinary treatment as soon as possible. A record of any such occurrences should be kept.
- Do not feed the reptiles before or during transport except for young tortoises and iguanas.
- The container should be constructed of wood or hardboard.
- To ensure an adequate flow of air at all times, ventilation holes should be provided in all walls and the lid of the container but should be of a suitable size to prevent animal escape.
- There should be no sharp edges or projections on the inner surfaces of the container.
- Containers should be secured to the aircraft, rail wagon, lorry or ship to avoid any possible movement and should at all times be maintained in a horizontal position.
- If any wood preservative or paint is used on the container, care should be taken to ensure that this is not toxic or a skin irritant.

## Labeling and documentation

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1. The transport boxes should be labelled properly and correctly with the caption "LIVE REPTILES! DO NOT TIP!" on all sides and top.
2. The box can also be labelled with the caption "THIS WAY UP" with arrows indicating the top on all sides.
3. The box should always contain the consignor's and consignee's name, address and telephone number.

## Transportation equipment

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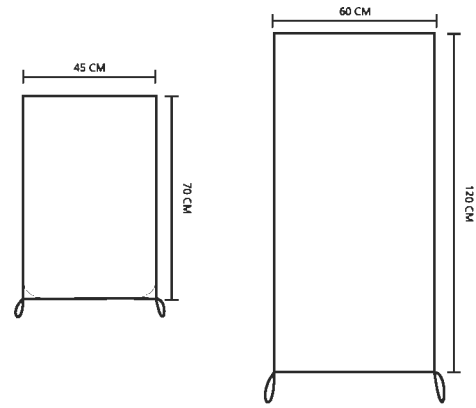
- |          |                               |                     |
|----------|-------------------------------|---------------------|
| ● Cages  | ● Cotton bags                 | ● Metal boxes       |
| ● Boxes  | ● Strings (to tie snake bags) | ● Ropes             |
| ● Towels | ● Cardboard boxes             | ● Waterproof marker |

## Snakes

Snakes should always be transported in bags made of casement cotton. Red colour bags should be used for venomous snakes and green colour bags for non venomous snakes. These bags should be packed in well ventilated cardboard boxes. The boxes should have markings to identify the species and quantity. If the travel time is more than 24 hours, green leaves should be put into the bags to hold moisture.



Transportation Bags for (L) non-venomous and (R) venomous snakes.



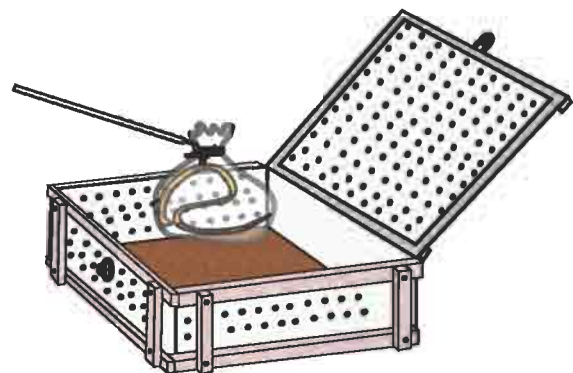
Bag dimensions for (L) small and (R) big snakes.



Transportation box for baby snakes.



Transportation box for (L) medium sized and (R) big snakes.



## Tortoises

Tortoises should be transported in boxes. The size of the box should be according to the size of the shell. Boxes should be made of water proof plywood with holes drilled for ventilation. If there is large number of tortoises, then boxes with drawers should be made.



Transport box for turtles.



Transport box for tortoises.

## Turtles

Turtles should be transported in marine ply boxes. During summer, there should be damp towel inside the box to avoid dehydration of the shell especially for soft shell turtles.

## Crocodiles / iguanas / monitor lizard

They should be transported in a strong, water-proof, well ventilated, wooden box or a box made from a perforated metal sheet (see picture). The size of the box should be according to the length of the reptile.



Transport box for crocodiles.





A decorative graphic consisting of four vertical bars of varying heights and widths, colored in shades of yellow and orange, positioned to the left of the title.

## Record Keeping and Safety Measures



## Importance of Record Keeping

Record keeping is an integral part of reptile zoo management. Good records maintain and transmit accurate information about the reptile collection. It documents a complete history of each reptile owned by or kept at the facility. It provides meaningful archival material. It provides legal documentation, reports for permits. It also provides genetic history and basic demographic information used in local and global species management. Record keeping helps maintain data for research and husbandry. Research depends on data, and the records-keeper's files can provide necessary information.

**Animal inventory, daily report register, history sheets, stud book information and post mortem reports should be kept as per the proformas specified by Central Zoo Authority.**

The conditions, health and behavior of all reptiles are checked at least twice daily by the keeper or head keeper of that particular section and it should be noted in keeper's diary. Any reptiles which give cause for concern must be thoroughly assessed as to whether they are unduly distressed, sick, or injured. Wherever necessary they must receive immediate attention and treatment. A daily record must be kept by the veterinarian and daily observation charts by the keeper, indicating changes to the prescribed, health checks carried out, any unusual behavior or activity or other problems and remedial action taken.

## Guidelines for emergencies and disaster management

### Reptile escape

**There is every chance of reptiles escaping from the zoo or park either due to human error, faulty cage design or natural disasters.**

In the likelihood of a reptile escape, consider the possible or likely attempted route that the reptile may have taken. Every effort must be made to recover the reptile dead or alive. The zoo staff should be familiar with procedures to be adopted in case of a reptile escape. Procedure should include reporting of the escape by the quickest possible means to the most senior member of staff. In the event of an escape, recapturing the reptile, protecting visitors, alerting the police and the forest department, etc. will be needed to be done on an urgent basis. Controlling visitors, ushering them into safer locations, evacuating the zoo, securing the perimeter boundary including closure of all points of entry and exit from the zoo should be done as fast as possible. In case of extreme emergency the use of darting equipment or fire-arms may be necessary.

### Escaped Snake

1. Begin by narrowing down the options. Isolate the areas where snake is likely to be hidden. Most probably it will be in warm dark place like under a lamp or near a water body.
2. Therefore, place heating lamps and blankets near likely areas. This will mostly attract the snake during nights. Check these spots at night.
3. If there is fine sand, check for any marks that is left by the moving snake.
4. Place a bowl of water and a frozen rodent (if it is known that the snake has not eaten recently) in the area that's illuminated by light. The bowl should be surrounded with fine sand.
5. Check in warm areas or near other heaters inside. The snake will be naturally attracted to these areas. Turn off all other lights in that area & leave the heating lamp on. Check every few hours. Wireless IR CCTV cameras can be placed.
6. Look out for bird alarm calls of crows, mynahs, babblers, bulbul, etc which start making noise if a traveling reptile appears in open places.

During summer the escaped snake is likely to move near water bodies or moist places like underneath nearby bushes. It can often take a few days or more until the missing reptile makes an appearance.

### Escaped crocodiles & gharials

All crocodiles & gharials need water. A crocodile can smell water and is likely to be attracted to water. Therefore, check all water bodies (tanks, ponds, lakes) in and around the zoo. They like heat and need regular basking. A crocodile trapping cage with bait can be placed near water bodies.

## Other likely emergencies



**Fire** - Dry grass placed directly under a heating lamp is a potential hazard for fire.



### Electrical Shock

Exposed cables are dangerous for the reptile and the keeper. All cables and wires should be properly sealed and hidden.



### Off-site emergency

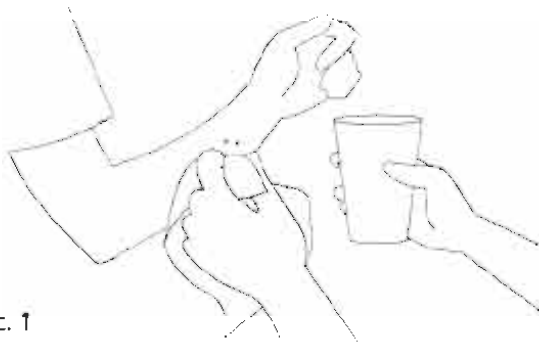
More than 25 aquatic snakes were trapped in unmanned fishing nets. The fishermen need to be educated to discontinue such a practice.

## Non-venomous Snake, Crocodile, Monitor Lizard, Iguana, Turtle bites

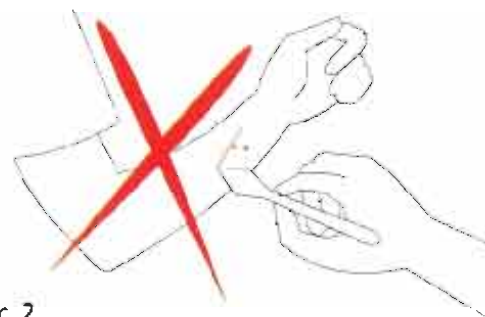
Though these bites are non venomous, antibiotic therapy should be administered for any kind of bite (big or small, deep or superficial) to prevent sepsis. If the injury is deep, it can result in heavy blood loss. In such a case apply a tourniquet to prevent blood loss and move the patient immediately to the nearest hospital.

## Venomous snake bite

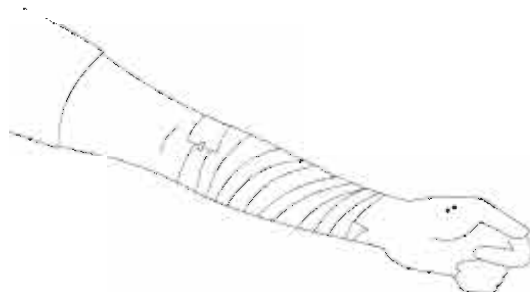
1. Do not panic. Remain calm. Remember that the person may have been bitten but no venom might have been injected.
2. Remove all jewelry from the bitten limb.
3. Call an ambulance to take the patient to a government hospital. If possible, carry the patient or assist him in such a way that movement is reduced. Ensure that the patient lies down while waiting.
4. During transportation, it is necessary to restrict movement. Inactivity slows down the circulation of the venom through the body.
5. Wash and cleanse the wound with antiseptic solution (see pic 1).
6. Apply a tourniquet (see pic 3 & 4).
7. Always seek medical attention. Never apply ice, cut the bite area or apply suction (see pic 2).
8. Never try to catch or kill the snake as it is dangerous and illegal to do so.



Pic. 1



Pic. 2



Pic. 3



Pic. 4

First-aid measures to be taken in case of a snake bite.

### Anti snake venom

Anti-snake venom (ASV) is a polyvalent antidote for most of the venomous snakes. ASV should be administered by an experienced physician only. ASV can cause hypersensitivity in the patient when injected, so it should be administered with caution. A person can need 5 to 30 vials depending on the severity of symptoms of toxicity.

Pinak tablet, an Ayurvedic antivenin remedy recently developed has proven exceptional results in government hospital in Pune district. It can be administered sublingual as a preliminary treatment and as well as adjuvant to ASV treatment. The tablet can be ground into powder and kept under the tongue. It gives effective results within minutes that last for 6-12 hours. The patient may require a dose of 1 to 10 tablets depending upon the severity of the bite. It can be taken immediately after any snake bite. It is recommended to keep Pinak tablets for any snake bite emergencies.

### How to avoid snake bites

- Be sure to wear proper foot gear. Exercise caution around fallen trees and logs.
- Snakes should not be handled without proper formal training.
- Most experts advise against trying to handle even a freshly killed snake as the nervous system may be still active and as it can still deliver a bite! Exercise caution while handling a dead snake as even an accidental scratch of the fangs can still inject venom. Even a cut-off head can cause a severe bite.
- The best action to take if one comes across a snake is to slowly and quietly move away leaving a passage for it to escape.
- Keepers should take good care in snake pits. Snakes hide beneath logs and rocks during daytime. While lifting rocks or logs, roll them with long stick before lifting it. Avoid putting your hand underneath them.
- Don't touch any snake, even if it seems dead, as some of them can remain very still and yet are very agile to deliver a bite.
- Snakes do not always warn with a hissing sound. Most snakes give no warning at all before attacking.
- Wear boots and long pants when hiking in snake territory and better still wear long sleeves.
- Always work with a companion while handling venomous snakes or constrictors like pythons.

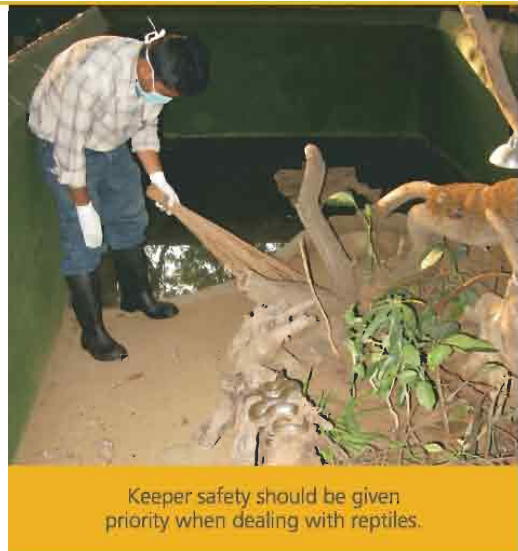


Available treatments for venomous snake bites

## Safety Management

### Keeper safety

- Keepers should be very careful when handling reptiles.
- Non venomous species can inflict septic bites and have anticoagulants in their saliva.
- Keepers should wear protective footwear (gumboots or boots).
- Strictly no slippers or chappals should be allowed.
- Thick pants (jeans) and a full sleeved shirt should be worn.
- Employees should eat only in designated clean areas.
- Train employees to recognize zoonotic infection risks as well as to implement the necessary control measures.
- While cleaning enclosures, use a hook stick to rummage through dry leaves.
- Be careful of cage furniture like logs and boulders. The reptiles could be hiding behind or beneath them.
- Night duty keepers should always carry a head torch or a bright torch light.



Keeper safety should be given priority when dealing with reptiles.

## Personal hygiene

**To reduce the risk of zoonotic infections it is recommended the keepers observe the following guidelines:**

1. Maintain short hair.
2. Remove loose wristwatches, necklaces, locket, strings, beads or bangles at the start of work.
3. Maintain short nails.
4. Strictly avoid consumption of liquor, tobacco and cigarettes during working hours.
5. Maintain good standards of hygiene in animal enclosures avoiding contamination of the drinking water with the animal's feces.
6. Adequate washing facilities like running hot and cold or warm water, soap and towels should be provided to the staff so that they can maintain personal hygiene.
7. Cuts and abrasions to be washed immediately with soap and water.
8. Existing cuts, abrasions and open sores should be covered with a waterproof dressing.
9. Wash hands regularly.
10. Clean or change footwear before leaving animal areas.
11. Disinfect footwear if necessary and wash hands after handling contaminated clothing.
12. Avoid any face-to-face contact with animals.
13. Keep hands away from the face, in particular the mouth, nose and eyes.







**Public Education  
and Conservation**



## Guidelines for Information boards

1. Information boards should be of a minimum size of 3 ft x 2 ft.
2. The information should be scientifically correct.
3. Information boards should be sized properly and proportionately to the size of the enclosure.
4. Materials used should be durable, weather proof and have good print quality. Modern techniques like eco-solvent printing, lamination on foam sheet, etc could be used.
5. Standardize fonts and colours and use creative graphics.
6. The information should be readable and should be placed at a proper angle for viewing.
7. Information boards should not be placed inside cages or enclosures.
8. The information should be in Hindi, English and the local language.
9. Boards should be placed away from the reach of visitors to avoid vandalism.



Use of standard material will make the information boards more durable and vandal proof.

## Guidelines for Signs/ Symbols

### Signs and way finding systems

For good crowd management it is very necessary to have clear signs and way finding systems. They should be in the local language and English.

An adequate number of clearly visible safety signs providing warning by means of a symbol or words, or a combination of symbol and words, should be displayed at each enclosure containing any species of reptiles.

### Warning signs

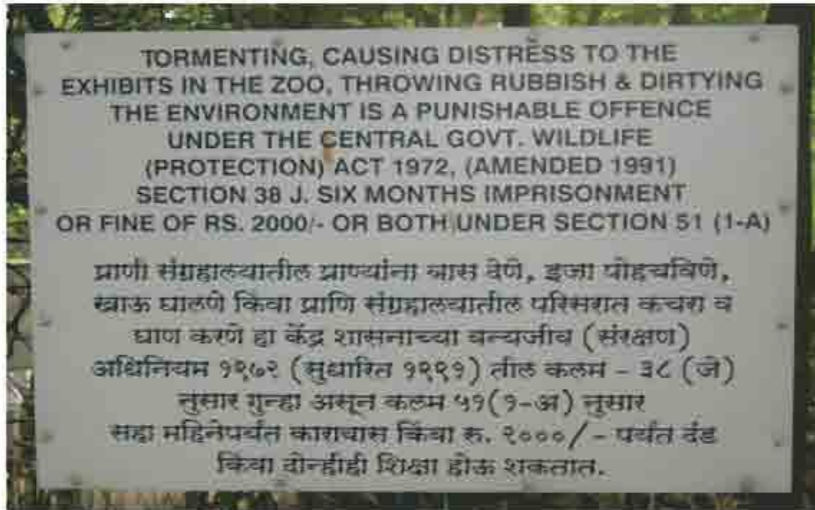
Warning boards should be well designed and placed prominently for the viewers. They should be attractive and easily visible to the viewer.

Warning signs need to be placed at appropriate locations:

- Where reptile and visitors are likely to come in contact.
- At edges where there may be a sharp fall.
- In areas which are unsafe or where hazards exist.

### Directional signs

Use of arrows, identification of designated public areas and functions like toilets, drinking water, picnic zones, etc. all come under directional signage.



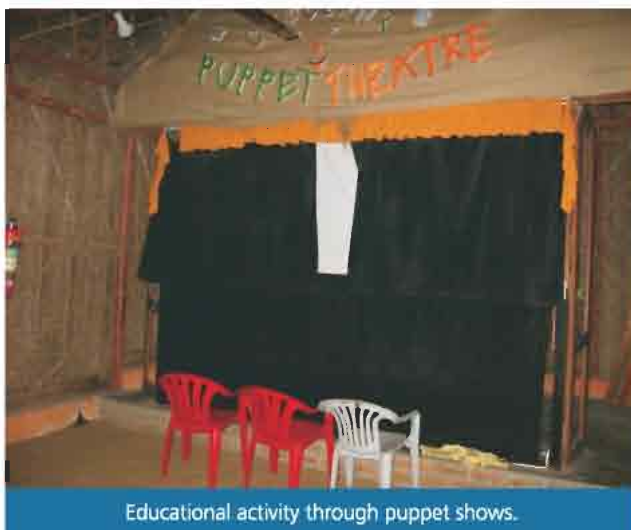
Warning sign boards

## Guidelines for Education and Training Facility

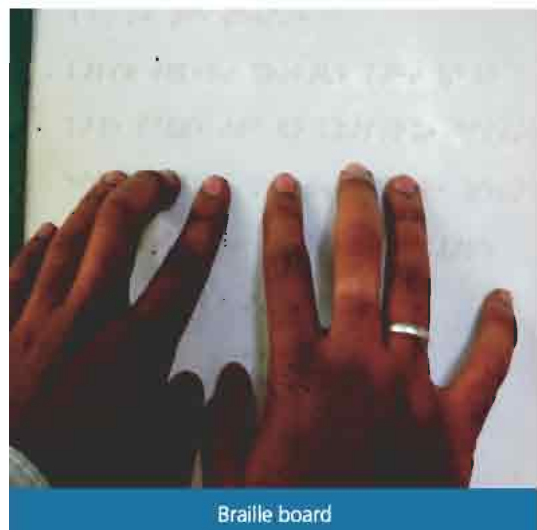
1. There should be a designated area for demonstration and training. The area could have class room or amphitheater style seating for 100 people.
2. White boards, LCD projectors and other educational facilitation tools should be available.
3. Proper information charts should be in English, Hindi and the local language should be put on display.
4. An educational officer should be appointed.
5. Access for handicapped visitors in the form of ramps and braille boards should be made available.
6. Live demonstration should be carried out by professionally trained staff and reptiles should not be given to zoo visitors for handling to prevent stress and trauma to the reptiles. Instead hands-on training programmes should be organized for people interested in learning about snake and reptile handling.



Amphitheater style seating.



Educational activity through puppet shows.



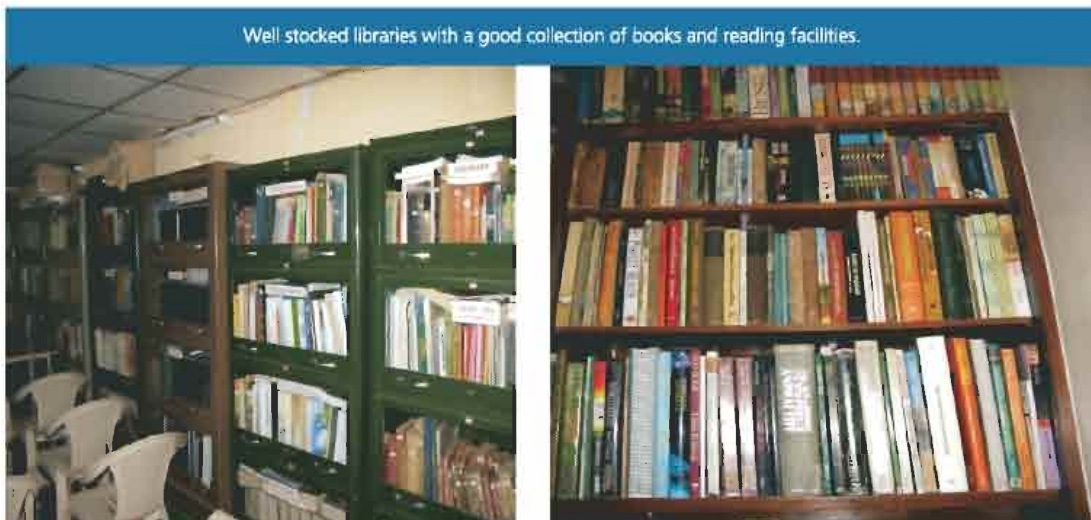
Braille board

Live demonstration of reptiles by professionals in progress.



## Guidelines for a library

1. A library contributes in educating people and aids in the studies of wild life conservation. It provides access to research material, scientific text, ready reference materials, books, periodicals and global information resources.
2. The library should be located in a quiet place, away from hustle and bustle of zoo activity. It should have proper ventilation and should be well lit.
3. A reading area should be provided.
4. The books and journals on herpetology should be kept in the library. They should be in English, Hindi and the local language.
5. Books should be accessible to visitors, NGOs, students, nature lovers etc.
6. The library should have digital resources like e-guide, CDs, DVDs etc.
7. A librarian should be appointed to look after the library.
8. There should be a budget allocation annually.
9. A computer with internet facilities should be provided.



## Conservation

Today, there is an increasing awareness about conservation of reptiles. Zoos and parks are playing a very important role in educating and imparting information. However, the challenges are daunting. Snakes are still hunted for their skin and venom. Monitor lizards and crocodiles are captured for their flesh and skin. Turtles are hunted for their eggs.

Various species of reptiles are reducing in numbers. A number of snakes and chameleons are killed on roads that go through sanctuaries and national parks. The local forest department should put up warning signs in Hindi, English and the local language. Local and regional zoos should promote the conservation of reptiles found in their region.

Various initiatives should be taken up, which can go a long way in facilitating conservation. Special breed-for-release programs of native species, should be taken up, involving local herpetological groups.



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Python skin mounted for display.



Wallet made from snake skin.



Rattle-snake trophy used as a show piece.



A ghumat

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Snake charmers using live snakes.



FRP idols of cobras.



A lady worshipping a snake idol.



Spiny tail lizards are caught in large numbers to prepare a certain kind of an oil.



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Hundreds of star back tortoises confiscated by the Customs department.

The limbs of spiny tail lizards are broken and entire lizards are put into boiling oil. Such lizards are brought to the rescue center or zoo in a very pitiable condition. These reptiles can be rehabilitated gradually with physiotherapy (creating a swimming pool in their enclosures). These reptiles can be used for breeding, and their progeny can be released in the wild. Rare species can be saved only through captive breeding. Zoos and rescue centers should adopt such programs.

The international pet trade will thrive as long as people long for exotic reptiles as pets. Customs and forest authorities have seized boxes carrying large numbers of tortoises, terrapins and turtles. Often these tortoises are packed tightly in boxes without any food or water. Many of them die as a result.

In India, there are only one or two places who have a proper scientific chelonian breeding program. Zoos, rescue centres, and reptile parks must take up the challenge of initiating these projects by creating a micro habitat in their premises and adopting conservation measures like preserving their habitat, stopping illegal poaching and controlling the pet trade.



## List of Zoos and Parks with reptile collection visited during the study

National Zoological Park, Delhi  
Kamala Nehru Zoological Garden, Ahmedabad  
Sundervan Nature Discovery Centre, Ahmedabad  
National Park, Banerghatta Zoological Garden, Banerghatta  
Pilikulla Wildlife Safari, Mangalore  
Sri Chamarajendra Zoological Garden, Mysore  
Parasnikadavu Snake Park  
Arignar Anna Zoological Park, Chennai  
Chennai Snake Park Trust, Chennai  
Irula Snake Catchers Industrial Cooperative Society Limited  
Madras Crocodile Bank Trust, Mahabalipuram  
Alipore Zoological Garden, Kolkata  
Calcutta Snake Park, Kolkata  
West Bengal Snake Park and Laboratory, Badu  
Nehru Zoological Park, Hyderabad  
Sakkarbaug Zoo, Junagadh  
Siddhartha Zoo, Aurangabad  
Sri Venkateswara Zoological Park, Tirupati

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(Ministry of Environment & Forests)**