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Cover

Gharial (*Gavialis gangeticus*). A critically endangered crocodilian native to the rivers of northern India and adjoining territories and an important species on display to visitors at the Chennai Snake Park.

- Photo: Dr. S.R. Ganesh

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**RESCUE AND REHABILITATION OF A STRAY JUVENILE INDIAN ROCK PYTHON (*PYTHON MOLURUS*) FROM THE OUTSKIRTS OF CHENNAI, INDIA WITH NATURAL HISTORY NOTES
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MANAGEMENT INTERVENTIONS FOR PROPER UPKEEP OF CAPTIVE REPTILES DURING AND AFTER THE DEPRESSION BOB-05 2021 CYCLONIC RAINFALL IN CHENNAI SNAKE PARK

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Introduction

Animals living in the wild are vulnerable to natural disasters. Volcanoes, storms, and floods can kill marine animals directly, or cause long-term problems by depositing debris and affecting the temperature and salinity of water (Cronin et al., 2003). All of this contributes to health problems for marine animals, while changing the circulation of water, which further affects nutrient availability and water temperature (Khosla et al., 2018; Tiemensma, 2019). For example, one study focussed on vulture mortality in India, due to such disastrous events (Paital, 2016). So much so that during natural disaster events, the veterinarians have a predominant and vital role (Moore et al. 1991).

A disaster is defined in human terms as a catastrophic event that exceeds a community's capacity to respond without external assistance (Pelling, 2003). Small animals can drown more easily, have their burrows inundated by floods or heavy rains, or be crushed or burned when they are trapped with no way to escape (Day, 2017; Travers et al., 2017). Animals may be displaced, either because they moved to safer places or because they were swept away by high winds or rushing flood waters. If displaced animals are crowded together in a small area, they risk major outbreaks of disease and parasite infestations (White, 2012). Malnutrition and starvation due to limited food supplies also become major risks (Every et al., 2016). Saving animals during disasters also benefits human health (Thompson, 2018).

The animals might also be affected by exposure to sun, cold, or wind if they do not have adequate shelter (Kenny, 1999). The wind, rain, and debris from storms



injure and kill animals and cause a lot of damage to their habitats, including destroying shelters and contaminating food and water sources (Wickins-Dražilová, 2006). Smaller animals are more vulnerable to drowning or dying in resulting floods and mudslides. Burrowing animals may be safe from smaller disturbances, but torrential rains can collapse their burrows or block the entrances, trapping them or leaving them without shelter. Burrow entrances can be blocked by branches, leaves, stones and other debris moved around by water or wind. Leaves and debris can also harm marine animals, blocking sunlight, reducing oxygen levels as they rot and suffocating fishes by blocking their gills. Reptiles are especially cumbersome during temperature fluctuations (Oonincx & van Leeuwen, 2017).

Viewing animals is usually the main reason for the zoo visit (Roe & McConney 2015, 879.). Zoos have a very long history: keeping wild and/or exotic animals' captive was already known in ancient Greek and Roman times (e.g., Barantay and Hardouin-Fugier 2003; Kisling 2000; Miller 2013). Modern zoos have a variety of functions both relative to the species exhibited and the conservation of wildlife in general. According to the Association of Zoos and Aquariums (AZA), some of these goals are: (1) the care and welfare of the animals they exhibit; (2) educating and engaging public, professional, and government audiences; (3) species/habitat conservation; and (4) internal and academic research that increases our knowledge of animals and promotes AZA's other goals (Reade and Waran, 1996; Fernandez et al., 2009; Association of Zoos and Aquariums, 2013). Zoos can be seen as choreographed and constructed places for controlled interaction between human and non-human animals, guiding the interaction between the visitors and the captive animals in many concrete, subtle and practical ways (e.g. Braverman 2011). Approximately 700 million people visit zoos and aquariums worldwide annually (Moss et al., 2014). In addition, zoos have a legacy of being a form of entertainment and are primarily a destination for visitors to attend in their leisure time (Carr and Cohen, 2011)

The success or failure of any risk assessment and disaster prevention program would technically or scientifically depend upon the management staff and involvement of all types of employees in that zoological park. Critical reviewing, identifying any weakness, and regular updating of the program would bring betterment of the proposed disaster management plan (Kumar, 2009). Maintenance is so important in case of animals being in a captive condition. Attempts to develop and successfully operate facilities that commercially exploit crocodylians have always faced considerable challenges. Huge ongoing

investments in money, time, and labour are required with scant returns for several years (Elsey et al. 1994; Lever 1994).

Zoos have begun to make significant contributions as genetic refuges and reservoirs, especially for large vertebrate species threatened with extinction. In developing this capacity zoos have fostered investigations into several facts of small population biology. These have extended to simulation modelling to help predict the outcome of various combinations of ecological, genetic, and demographic factors on the viability of populations in captivity and the wild. Because resources of zoos are limited in aspect to their enlarged functions in conservation and research, they are encouraging development of criteria to help prioritize actions for the conservation of biodiversity (George, 1994). Zoological gardens also provide an opportunity for the conservation of the endangered or threatened species and possible breeding from captivity to repopulate the natural environment. Zoos also provide opportunities for studying the best practices in conservation, animal management and genetic resources of the threatened populations (Zhao et al. 2014; Adeniyi et al. 2015).

Effects of cyclones on the structure and production of zoos are often species-specific. Species may vary in their capacity to resist wind (resistance), offset the effects of injury (tolerance), and recover from injury (resilience). It is unlikely that any one taxon will display all three of these characteristics (resistance, resilience, tolerance). This is because of the site- and habitat-specific resource limitations which will force a trade-off among them (Sundarapandian et al., 2014). Reports of high mortality in zoos and free-living wild animals have alarmed conservationists, as zoos are intended to play a pivotal role in their protection (Russel, 2006).

Review of literature:

Zoos in India are vulnerable to a number of natural risk factors like floods, cyclones, earthquakes, landslides, etc. as well as human induced disasters like fire, epidemics, animal escapes, animal attacks, civil disturbances etc. These devastating events significantly affect lives of the captive species and their respective enclosures up to a great extent (Kumar, 2009). Reports of high mortality in zoos and free-living wild animals have often caused serious concern among conservationists since zoos are meant to play a major role in their conservation (Russel, 2006). During Hurricane Dorian in 2019, winds reached 295 km per hour. Strong winds and rain can cause broken limbs, head trauma, as well as breathing problems and infections from getting water into the lungs. Animals

are displaced and orphaned. Most of these issues would not be deadly if the animals were able to receive treatment, but this is not the case in most situations. A few lucky mammals and birds get care if they are blown into urban areas and are found disoriented on someone's lawn.

It can be seen that the research that has been done previously states about the maintenance of Turtles, Tortoises and Lizards (Mautino & Page, 1993; Highfield, 1994; Bartlett & Bartlett, 1995, 2008; Donoghue & McKeown, 1999; Stahl, 2003; Passos et al., 2014). On 17 June 2015, a tiger escaped from the Tbilisi Zoo when an unprecedented series of rain events caused a wall of water to tear through an affluent Georgian neighborhood & destroyed the Soviet-era Tbilisi zoo (Swann-Quinn, 2019). These devastating events significantly affect the lives of the captive species and their respective enclosures up to a great extent (Kumar, 2009).

In the development of a crisis management plan in a zoo, the following considerations are to be made and few steps a must be undertaken in advance to reduce the vulnerabilities in a zoo (Underwood, 2016): (i). Evaluate the specific risks and vulnerabilities of the zoo, (ii). Identify the personnel and resources required for an effective response and (iii). Creating an effective communication and warning system and testing the plan (iv). Have in place the actions to be taken during the recovery phase (Izadkhahet *et al.*, 2016). Zoonotic diseases are infectious diseases that can infect both people and animals. During cyclones, the risk of zoonotic diseases may increase and reasonable actions must be taken to control that risk (Izadkhahet *et al.*, 2016). There are some crucial aspects that a captive environment/enclosure should have for the healthy maintenance of snakes, as well as some preparations that should be made ahead of time to keep them safe during cyclonic rain. In addition, one of the important issues that can be considered by the zoo managers is the unusual behaviour of some animals.

Justification For Study

Reptiles generally are subjected to many misconceptions and underestimations regarding both their lives in nature and their needs in captivity, sometimes leading to existence in captivity of frequent deprivation, even in a few zoo facilities. The thermoregulatory behaviour of captive reptiles is sufficiently documented. However, our understanding of such behaviours of captive reptiles, while being exposed to natural calamities is mainly fragmentary and anecdotal. (Berger *et al.*, 2017). Different types of heaters are Ceramic heaters, Heating mats, Heater plates, Heating blankets, Tubular heaters, Basking lamps, Heat tapes, Hot rocks (fiberglass imitation heating rocks with a thermostat), Aquarium heaters with

thermostat, and Under-gravel heaters (Khaire,2009).The shape and size of the enclosure for a snake should be selected based on the snake's biology. A fossorial species should be housed in an enclosure that is provided with enough depth of soil substrate. In contrast, an arboreal species should be housed in a tall enclosure to ensure that ample foliage can be placed in the enclosure. The enclosure should also be large enough to provide an appropriate environmental temperature range, including partially shady and partially sun-lit areas (Khaire, 2009). It is important to know how reptile enclosures are made, and how it is maintained, especially during unfavourable times faced by zookeepers to maintain the animal normally under such abnormal circumstances.

The Chennai snake park has 35 different species of snakes, which are displayed in separate enclosures. Snakes are kept in captivity in a variety of situations, including zoo exhibits; laboratories; culinary, skin, and curio producers; various pet industry facilities; and private homes. Maintaining snakes in captivity involves capture, infrastructure investments, management techniques, and appropriately qualified personnel. Many species of snakes are rather demanding in their requirements. This includes their routine needs for behavioural normality, exercise, avoidance of stress, and andisease called a variation of physical discomfort, all of which are significant factors that contribute to their welfare in captivity. Captive environments for snakes commonly involve small enclosures with dimensions, in particular, the commercial, hobby, and pet sectors roututilizesmall vivarria and racking systems, and other facilities also commonly maintain at least some snakes under broadly similar conditions.The commercial, hobby, and pet sectors frequently recommend and utilize vivaria and racking systems for snakes in small and restrictive enclosure dimensions(Warwick, 2019).

It is easier to maintain snakes if their captive habitat contains key features from the snake's natural environment. The enclosure should imitate the surroundings in which that particular snake is found, thus making life for the snake, 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 to fulfill behavioural and physiological activities like locomotion, swimming, thermo-regulation, feeding, drinking, basking, sleeping, nesting, and hiding. Also, heating and lighting equipment such as bulbs, etc., should be well shielded(Warwick, 2019). The enclosure design should allow the keeper's activities like cleaning, washing, and changing of water



to be accomplished with ease. While constructing the enclosure, it's necessary to consider the size, shape, and materials used (Khaire, 2009)

The previous researches state more on how a reptiles' enclosure should be built, the design, and some important factors that an enclosure should possess. There are not many details provided about the maintenance of the enclosure and the animal, especially during the cyclonic rainfall disaster. The purpose of this report is to summarise the various aspects of the maintenance of snakes and their physical and behavioural characteristics in the captive environment, during and after the depression BOB-05-2021 cyclonic rainfall.

Crocodiles being large-bodied, top predators of the reptilians alive today, are not the simplest of animals to keep in captivity (Huchzermeyer, 2003). Attempts to develop and successfully operate facilities that maintain captive crocodilians have always faced considerable challenges. Huge ongoing investments in money, time, and labor are required with scant returns for several years (Elsley et al. 1994; Lever 1994). The difficulties in running a crocodilian facility are further compounded in developing countries where the basics, like reliable sources of electricity, running water, appropriate land and cheap, fresh crocodile food are difficult to obtain (Child 1987; Cox and Rahman 1994). In developing countries, inability to acquire the appropriate technology and licenses to propagate intensively and market crocodilians are also prohibitive factors to success (Magnusson 1984; Cox and Rahman 1994).

All of these aspects have led to a misleading notion that crocodiles are rather simple to keep in captivity especially in the developing world (Mazzotti 1987; David 1994). Constructed wetlands are becoming more popular in recent years due to aesthetic benefits and the maintenance ease. Depending on the size of the wetland, the treatment can reach very high levels (Cooper, 2009). It can be seen that the research that has been done previously states about the maintenance of crocodiles, essentials required for the management of crocodiles and how captive environment for crocodiles is created. A spate of research has been done on captive regimes of crocodilians in zoos (see Huchzermeyer, 2003 and references therein).

Materials and Methods

Chennai Snake Park is home to 35 different reptile species, mostly native and a few exotics. Glass enclosures are popular because of their ready availability, ease

of maintenance, reasonable cost, and the ability to view the animal (Khaire, 2009). When correctly set up, these can be suitable for smaller species. Some species need larger spaces than stock aquaria can accommodate. Although minimum cage requirements vary by species, the idea is that the animal needs space to move around, thermoregulate, feed, and use multiple hiding places. It is much easier to provide all these things-particularly the necessary gradients of heat, light, and humidity in a larger enclosure. Many species will need even bigger enclosures. For arboreal species, height is usually more important than floor space, and gradients can be vertical as well as horizontal (Khaire, 2009).

Snakes are incredibly diverse (Whitaker & Captain, 2004). Their enclosure should reflect this diversity. Python species such as Reticulated Python, Indian Python, and Albino Python of all stages of maturity are housed in mesh top enclosures & closed roof enclosures. All other species such as Indian Trinket Snake, Indian Rat Snake, Whitaker's Boa, Bronze Back Tree Snake, Green Vine Snake, Olive Keelback Snake, Banded Kukri Snake, Striped KeelBack Snake, Common Sand Boa, Red Sand Boa, Checkered KeelBack Snake, Common Wolf Snake, Indian Cobra, Common Krait, Russell's Viper, Saw Scaled Viper, Green Pit Viper, Spitting Cobra, Indian Cat Snake is housed in a closed roof enclosure.

There are 10 enclosures for different types of Turtles, Tortoise and Lizards. These species, which are housed in this zoo, are as follows:

- Indian Black Turtle (*Melanochelys trijuga*) – Open moat enclosure
- Indian Flapshell Turtle (*Lissemys punctata*) – Open moat enclosure
- American Slider Turtle (*Trachemys scripta*) – Open moat enclosure
- Star Tortoise (*Geochelone elegans*) – Open moat enclosure
- Indian Chameleon (*Chamaeleo zeylanicus*) – Roof top enclosure
- Rock gecko (*Hemidactylus graniticolous*) – Roof top enclosure
- Indian rock agama (*Psammophilus blanfordanus*) – Roof top enclosure
- American Green Iguana (*Iguana iguana*) – Roof top enclosure
- Indian Monitor Lizard (*Varanus bengalensis*) – Open moat enclosure

Five species of crocodiles are present here. The captive environment of crocodiles is made up in such a way that the different species of crocodiles adapt to the set up easily. The Chennai Snake Park Trust has 9 enclosures for different types of crocodiles. The types of crocodiles are as follows:

Gharial *Gavialis gangeticus* (adult & young)
Mugger crocodile *Crocodylus palustris*
Saltwater crocodile *Crocodylus porosus*
Siamese crocodile *Crocodylus siamensis* (exotic)
Nile crocodile *Crocodylus niloticus* (exotic)

Temperature During Rainfall: Cold blooded animals include turtles, tortoises, and lizards. In captivity, turtles, tortoises, and lizards find it difficult to move around during rainstorms. The ability of an organism to maintain a consistent body temperature despite extreme temperature differences in the environment. Turtles are cold-blooded, which means their body temperature varies with the ambient temperature. They regulate their body temperature by controlling blood flow in their skin and fins. A layer of blubber protects them from cold water, and they can warm up by sunbathing on the surface. Tortoises must roam around their habitat to warm up or cool down in order to maintain a consistent body temperature. As the tortoise is warm, it becomes more active, and when it cools, it becomes less active.

Stagnation of Water: There is usually no stagnation of water inside the enclosure after mild rainfall since it goes away through the canal. However, when it rains heavily, the water inside the cage becomes stagnant. As a result, the zookeeper enters the enclosure to build a new canal way because the canal's path has been blocked by heavy rain.

Clearance of Pool: The pools within the enclosure cannot be cleaned during the rainy season because the water is stagnant. The pool is cleaned every two days, or the day after the Turtles, Tortoises, and Lizards are fed.

Rainfall events in November 2021: Chennai city is situated in an area highly prone to cyclone flood disasters (Natarajan *et al.*, 2021). A Deep Depression named BOB-05-2021 (i.e. Bay of Bengal) was formed out of cyclogenesis as a tropical cyclone near Banda Aceh province of Sumatra in Indonesia on 7th November 2021. BOB-05 was characterized by a wind speed of 55 mph, a gust of 70 kmph, and pressure area 00MB/hPa. The cyclone made landfall and dissipated on the Tamil Nadu-Karnataka border on 13th November 2021 at 03:00 PM BST (+6 GMT). The rainfall lasted over a week and was heavy during the second week that is from 6th to 11th November due to the depression formed in the Bay of Bengal.

Later another depression formed during the last week of November 2021. A low-pressure area developed over the southwestern part of the Bay of Bengal. Consequently, the rainfall was very heavy from 26th to 29th November. The heavy rainfall caused flooding in many parts of the city. Though this did not intensify into a deep depression, a very heavy rainfall alert (orange category) was issued in and around Chennai.

Cumulatively, due to these two major rainfall events, a disproportionately large amount of 148.5cm of rainfall was received in November 2021, as opposed to the normal monthly mean of 80 cm. This means the November 2021 rainfall experienced by the Chennai region was 57% over the normal value. This value of total cm of rainfall was just 0.5 cm less than the disastrous 2015 Chennai flood rainfall. Chennai received 23 'rainy days' (i.e. wherein it rained > 0.25 cm per day), as opposed to the normal mean monthly value of 11 days. The Chennai Snake Park was also partially flooded as the enclosures had a lot of stagnant water.

Results

Measures were taken to keep the enclosure and the animal safe during and after the cyclone. Medical attention is offered to the affected individual if it is required. However, clearing the enclosure and the campus after the cyclone is a difficult chore for the zoo keepers. During the severe rains, the enclosure and snakes at the Chennai Snake Park were not that affected compared to the other species.

How the enclosure is maintained during the monsoon season?

- The fallen trees surrounding the cage enclosures are cleaned.
- cracked or broken glass is replaced immediately to prevent the water from flowing into it.
- Drains across the campus are cleaned.
- Water suction motors were kept ready to clear the stagnation of water.
- The veterinarians kept a continuous check on the animals.
- Sandbags were kept outside the animal enclosure which protects water from flowing into it.
- An artificial heating system is been created inside the enclosure



Snakes: Because most snakes were maintained and cared for in a secure roof-top enclosure, they were rarely exposed to the elements. Snakes, however, encountered difficulties with thermoregulation and feeding during the cyclone because they are cold-blooded animals (unable to create body heat internally). Artificial heating has been installed in the enclosures, and when the heating systems were unavailable due to a power outage during the hurricane, the animal was allowed to bask for thermoregulation. The heating system for the snakes is one of the most important aspects during monsoon. being cold-blooded animals, need a temperature-controlled environment which is why it is very important in enclosures. The optimum temperature range for most snakes is between 25-30 degrees celsius. If the temperature falls way below 25 degrees celsius, then it could result in illness and even the death of the animal.

The heat provided should be appropriate to the snakes, their habitat, and seasonal weather changes. heating can be done either by heating a large area or by using spot heaters for localized heating. Of all thermoregulatory behaviours, 'basking' is the most conspicuous, wherein the animal exposes whole or at least a part of their body to thermal radiation while being immobile. Some reptiles spend up to 80% of their time inside their burrows or other microrefugia in cold climates, which is also a thermoregulatory behaviour where the primary function is avoiding critically low body temperatures. Upon favourable ambient conditions, the reptiles then emerge from their burrows and spend long and frequent basking periods acquiring appropriate body temperatures.

Feeding is a very important aspect of captive reptile management. Anorexia (loss of appetite or refusal to eat) is usually very commonly seen in snakes during monsoon. The probable reasons for appetite loss in snakes are extreme temperatures or variable temperatures. Snakes don't feed during the cooler temperatures like in monsoon. The environmental temperature alters the activity of the digestive system since they are cold-blooded animals. If a snake is not feeding for a long period, its appetite could be because of increased humidity, and a drop in temperature thus the snake becomes inactive thus ignores the prey. Snakes should be force-fed only if they snake has not consumed food for more than 45 days.

Normally, Indian Rock Python (adult) and Reticulated Python (adult) eat 1 chicken/ week, Reticulated Python (sub-adult) eats 10 chicks/ week, Common Sand Boa, Red Sand Boa, and Whitaker's Boa eat 3 rats/ week, Common Cat

Snake eats 5 mice/ week, Russell's Viper eats 5 rats/ week but there was no feeding during the cyclone. There was no change in feeding habits of Saw Scaled Viper, Checkered KeelBack, OliveKeelBack& Striped KeelBack. Common Vine Snake and Common Bronze Back ate 5 lizards/ week but during the cyclone, they ate only 0-1 lizards l/ week. Spectacled Cobra and Indian Rat Snake normally eat 5 rats or chickens/ week but during the cyclone, they ate only 0-1 rat or chicken/ week. Common Krait normally eats 10 mice/ week but during the cyclone, it ate 5-7 mice/ week. Common Wolf and Common Kukri Snake normally eat 5mice/ week but during the cyclone, they ate only 1-2 mice/ week. Common Trinket Snake normally eats 3 rats/ week but during cyclones, it ate only 1-2 rats/ week. Indian Rock Python (sub-adult) normally eats 10 chicks/ week but ate only 5-6 chicks/ week during the cyclone.

Lizards & Chelonians

Changes in ambient humidity and temperature impact Turtles, Tortoises, and Lizards' thermoregulation, resulting in changes in feeding habits and locomotion. During rain, turtles, tortoises, and lizards are unable to bask. This causes a lot of problems. Zookeepers have reduced the food in order to deal with the situation. Food is reduced, allowing Turtles, Tortoises, and Lizards to digest food more readily and avoid obesity. Low food, on the other hand, will lead to malnutrition.

The only thing that can be done is to keep the enclosure water-free by removing stagnant water so that the Turtles, Tortoises, and Lizards can freely roam. This is the responsibility of the zookeepers, and all zoo management must follow their lead. They go to great lengths to ensure that creatures do not become rare.

Crocodiles

During rainfall the crocodile in the captive environment finds it difficult for thermoregulation that is the ability of an organism to keep its body temperature within certain boundaries by shifting its microhabitats to those experience suitable temperature bands. Crocodiles usually maintain their temperature by basking as crocodiles raise the temperature of the body by resting in the sun-lit areas and also by opening its mouth. This helps crocodiles to maintain their body temperature which in return makes the crocodile body healthy and normal. During the cyclonic rainfall crocodiles could not bask as there was a paucity of adequate direct sunlight. The sky was gloomy and heavily overcast due to DOB-05-2021. The temperature was also low. So without adequate basking the crocodiles temperature and activities dropped down. The temperature during rainfall was

about 22°-26°C. Though this is the suitable temperature for crocodiles they found it difficult without any opportunity for basking or access to direct sun light.

Usually during moderate rainfall there is no stagnation of water inside the enclosure as any such rain water moves away through the canal. But during this heavy cyclonic rainfall the water got stagnant inside the enclosure. So the zookeepers entered inside the enclosure to dig a path again for the canal as there is heavy rainfall pouring down which blocks the way of the canal. Holes measuring 2-3 inches diameter were drilled at the base of the walls of the crocodile enclosures to help drain excess stagnant water that got inundated by heavy and prolonged rainfalls.

In the rainy season the pools present inside the enclosure cannot be easily cleaned as excess water gets stagnant. Usually the pool is cleaned every two days or the next day after providing feed to the crocodiles (since the feed items like meat, organs and bones comes into contact with the pool water). The movement of crocodiles during rainfall was low or sometimes nil as the water was stagnant inside the enclosure. As mentioned in the enclosure details, the crocodiles moved to higher parts of the enclosure when the water got stagnant. But sometimes the enclosures are fully flooded with water and therefore crocodiles found it difficult to bask. As they could not bask there was a high risk of being ill (low body temperature and lack of appetite).

Crocodiles usually eat a reasonably good amount of feed in captivity. The crocodiles except Gharials are given both meat and fish as Gharials are only given fish. Many types of crocodiles take a huge bite once to get enough feed. In the rainy season the feed quantity was reduced to only half the amount as crocodiles could not bask and hence have low rate of movements. If the same amount of food is given, crocodiles find it difficult to digest as the metabolism is less which increases the risk of obesity. So the food was reduced to maintain normal health of the crocodiles. The crocodiles become sick as they cannot bask, this shows how important basking is for the crocodiles as Thermoregulation is an important phenomenon in crocodiles. 4-5 crocodiles happened to be sick during this rainfall. The crocodiles show no movement as this is a sign that the crocodile's health is affected. When the crocodiles are ill they don't eat food. The aftermath of the heavy rainfall were that many of the crocodiles got sick (low metabolism, loss of appetite), the branches were broken from the trees and had fallen into the enclosure. The thatched roof-top shed got damaged due to heavy rainfall. The

stagnant water is getting increased more and more inside the enclosure. The concrete wall of the crocodile enclosure and the wire fence above the wall were damaged and bent due to the broken and fallen branches over the fence.

Measures taken by the Snake Park

1. After the rainfall the broken branches from the trees that fell into enclosures were fully cleaned by the zookeeper.
2. Stagnant water was removed from the enclosure through the canal, or drain holes on the walls, or motor pumping outside the pool, or even manual labour.
3. Enclosure walls that got damaged was between two enclosures of crocodiles. Since this situation was dangerous, that wall was repaired within a few days.
4. During heavy rainfall the shed was damaged and got broken into pieces that fell into the enclosure are removed and cleaned by the zookeepers.
5. Medical care (oral de-worming medicine) was given to the zoo animals when they became affected by loss of appetite during the rainfall.

Discussion

In the previous studies, there is not much information that states how an animal and its enclosure are maintained especially during natural calamities. Here are some important steps and methods followed in Chennai snake park during and after rainfall. During flood-like situations, in the captive conditions, the flood might increase and alter the quantity & quality of water supply which results in the spread of water-borne diseases along with poor hygiene and sanitation. It is therefore needed to imply effective measures like vector control and waste disposal to maintain good hygiene for the protection of the health of zoo animals (Kumar, 2009). On much rarer occasions, blockage of sewage lines and pipes causes sewage-contaminated water that may result in common illness and food poisoning in animals. Pathogenic viruses, bacteria, and other dreadful organisms in the contaminated flood water affect zoo managers as well as captive animals. Poor sanitation and unhygienic conditions can lead to zoonotic and parasitic prevalence, which can cause further risk to other captive animals (Singh et al., 2017). There are some crucial aspects that a captive environment/enclosure should have for the healthy maintenance of snakes, as well as some preparations that should be made ahead of time to keep them safe during cyclonic rain.

Disastrous Incidents of the Past: The most devastating incidents which have happened in the past 20 years in NZ have been taken into account. Reasons

behind their occurrence and measures taken by the zoo authorities were described and a gap analysis has been taken. From 1964 to 2017, the highest number of incidents were reported during the year 1999, all the cases of animal escape design, negligence in the maintenance of chain-linked fences, and other structures of the enclosure along with width, depth, and height of moat, and lack of closed-circuit television surveillance. It is needed that zoos must have appropriate measures or techniques for preventing the escape of animals from their respective enclosure. Otherwise, this might result in the destruction caused by the escaped animals in terms of damage or fatalities to the other captive animals and zoo staff, which would ultimately lead to the loss of significant wild species. Among the disastrous incidents happening in the NZP, a higher future possibility of the snake bite cases (44%) and disease outbreaks like rabies outbreak, avian influenza, canine distemper, and tuberculosis (32%) have been shown, followed by the other incidents. (Kumar, 2009).

Table 2. Technical interventions required during cyclonic disasters

Measures to be taken	Technical intervention required	The suggested role of zoo management
Animal control	Sealing crevices/holes/cracks inside the arena, installing a snake-proof fence, removal of grasses, shrubs, and trees, priming overgrown bushes, installation of perch poles to provide residence to snake predators such as hawks and owls; use of anti-snake retardants	Keeping enclosures and surroundings free of rodents.

Measures Taken In Chennai Snake Park During Bob-05-2021 Cyclone

During the specific two-week period of unfavourable conditions (BOB-05-2021) involving a reduction in temperature, rise in humidity, over rainfall, and floodwater stagnating on the ground, we investigated the maintenance procedures and improvisations made on the captive regime of snakes. There were prolonged power outages as a result of the rains (crippling heating systems were not available and pumping of water from the ground surface stopped). Certain snake species' diet and feeding intake decreased, and others were completely absent. Measures such as rewiring of heat bulb set-up, manual water removal, tuning of enclosure roofs to seal water seepage, and so on were taken during and after the

cyclonic rains. To prevent water seepage within snake enclosures, water-proof covers such as plastic sheets were used to cover the mesh tops.

As the crocodiles are huge there is difficulty in maintaining them (Huchzermeyer, 2003). But they always make sure they maintain crocodiles with care during rainfall and provide every necessary measure for crocodile's health. The previous research says that the management of species in captivity requires a huge amount of investment of money, labor and time as this was true as managing animals in zoos is still a struggle until there is enough resources present for the management of the zoo (Elsey *et al* 1994; Lever 1994). In this study it can be seen that the crocodiles are maintained properly during disasters like floods.

Previous researchers said the need for adequate amounts of electricity, water, land and food and the struggles to acquire licenses for a crocodylian facility is difficult but then just getting them is not enough as the proper maintenance is the key to run a zoo successfully (Child, 1987; Cox & Rahman, 1994). A previous research speaks about the construction of wetlands helps in maintenance (Cooper, 2009). This can be a drawback in some zoos as the Chennai Snake Park does not have wetland. It can be reconstructed in a way that during flood the excess water runoff to the artificial wetlands. The main goals of the zoos in previous researches were seen as to reduce the mortality rate of the species that die during the disaster such as flood, cyclones and landslides (Russel, 2006).

Conclusion

After interacting with the experienced zookeepers at Chennai snake park, we would like to conclude that, during and after the cyclonic rainfall, compared to the maintenance of other species, snakes and their enclosure are easier to maintain if proper measures are taken prior, for example, arrangement for basking and artificial heating systems, etc. Continued involvement in making further improvisations and tweaks in the maintenance protocol on a case-by-case basis depending on the problem faced, will best serve to keep the captive reptiles the healthiest, during such unforeseen climatic disasters.

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RESCUE AND REHABILITATION OF A STRAY JUVENILE INDIAN

**ROCK PYTHON (*PYTHON MOLURUS*) FROM THE OUTSKIRTS OF
CHENNAI, INDIA WITH NATURAL HISTORY NOTES**

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The Indian rock python (*Python molurus*) is a large bodied, non-venomous, constrictor snake of the family Pythonidae that has a wide geographical distribution across India, Pakistan, Nepal, Bhutan, Bangladesh and Sri Lanka (Vyas and Patel 2020; Smith 1943). It is found in diverse habitats such as arid scrub forests, deciduous forests, rainforests, riverine habitat, estuarine mangrove forests, grasslands (Whitaker and Captain 2004). It is primarily a nocturnal species though they can be seen at day time. Like most snakes they are excellent swimmers and can climb trees. Though they are found throughout India, this species is included in the Near Threatened category of IUCN red list of species as their population has declined in recent decades due to habitat loss (Aengals et al. 2021). It is protected under the Schedule I of Indian Wildlife (Protection) Act (IWPA), 1972, the highest level of protection.

The city of Chennai lying on the Coromandel Coast is one of the major metropolitan cities in India and the capital of Tamil Nadu state. With an increasing population of over 4.9 million and rapid developmental activities taking place, the city is subjected to loss of its existing natural habitat and related species (Bindu 2017; Satish and Satish 2021). Despite the habitat loss and pressure on its natural resources, the city and the surrounding districts of Chengalpattu, Kancheepuram, and Tiruvallur provide a refuge to the remaining native plants and animals that had escaped the urban sprawl engulfing the city skirts rapidly. Snakes are among those animals of this region which have been reported to be persisting in this region over the past (Janani et al. 2016). Here we describe the first incident of an Indian Rock Python *Python molurus* (Linnaeus, 1758) rescued from a house in the outskirts of Chennai, rehabilitated and released into a nearest python habitat with some of its natural history notes.

On 12th November 2019, a local resident from Sathananthapuram (12.89897° N, 80.10603° E), Perungalathur town, Chengalpattu district called the first author over phone at 9:40 p.m. requesting for a snake rescue in the vicinity of their house. Upon arrival, we were surprised to find a juvenile Indian rock python in a resting position along the compound wall of the house. The snake was found to have consumed a prey, guessed by the girth size of its abdomen. The snake was carefully transferred to a gunny sack to be carried to the forest department animal facility at Advanced Institute for Wildlife Conservation (AIWC) at Vandalur, Chengalpattu. The possession of a Schedule-I animal was reported to the Chief Wildlife Warden of the state forest department as per the protocol and a request was made to release the snake in a suitable habitat following scientific consultation with expert herpetologists. The permission was received for its rehabilitation and release (WL1/55195/2019) after a two weeks period during which the following observations were made.

The following morning the snake was examined by two forest department veterinary doctors (author 2&3) for vital signs and biometrics such as length, scale pattern, weight and sex. The individual was determined to be a female snake based on its relative tail length and cloacal probing by the veterinarian. Snout-to-Vent length 102.8 cm; Tail length 14.1 cm; Head length 3.7 cm; width 2.1 cm;

height 1cm. The scalation as follow: mid-body scales in 70 rows; ventral 257; anal undivided; subcaudals 63 paired; rostral and first two supra-labials with pits; supra-labials 12. The python was kept under observation for the next 19 days in a separate room with proper ventilation, infrared lighting for heat, an enclosure furnished with tree branches, earthen pot and bowl of water to resemble its natural habitat. Every day the snake was exposed to sunlight for a period of 15 minutes for thermoregulation and then left in its closed roof enclosure with artificial light. The snake was fed with live rats thrice during the nineteen days of captivity; once on 8th day (19th Nov 2019), 10th day (21st November 2019) and 17th day (28th Nov 2019). By the end of rehabilitation period the snake was found to have gained weight as compared to its first day in captivity (Figure. 2) while the length of the snake was found to be, understandably, unchanged at 116.9 cm. The python was first offered a live common Asian toad *Duttaphrynus melanostictus* (Schneider 1799) but it refused to feed on the toad for nearly two days after which it was removed from its enclosure.

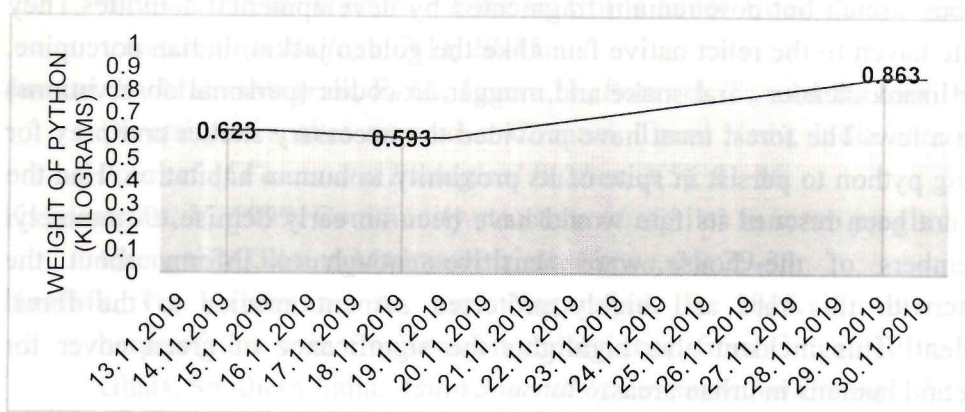


Figure 2: Body weight of rescued Indian Python during captive period

After 18 days of captivity, permission was granted to release the python in Gingee hills, Villupuram district, as it is the nearest habitat with a viable population of Indian rock pythons (Ganesh et al. 2018; Karthik et al. 2018). The Gingee hills reach an altitude of 700m, consists of five reserve forests of scrub forests and dry evergreen forests interspersed with rocky hillocks in the Eastern Ghats of Tamil Nadu (Karthik et al. 2018). The snake was released inside Siruvadi Reserve

Forest (1441 hectare), in the presence of the Forest Range officer, Forester and Veterinarians.

The apparent occurrence of a wild juvenile Indian rock python (*Python molurus*) in close proximity to the Chennai city (~25 airline kms) is still not clearly established. Therefore, it is speculated that this young python might have been carried away from any of the nearby native range by waterways, or by other means as there has been no record of Indian python from this region for decades now (Aengals 1999; Kalaiarasan 1999; Subramanean 2001; Ganesh and Chandramouli 2005; Tsetan and Ramanibai 2011; Ramesh et al. 2013; Janani et al. 2016). Surprisingly, there was a reference to the presence of Indian python from the campus of Madras Christian College (Amirthalingam 2005) but this claim does not have any valid proof. The rescued individual was able to survive in this urban area as this particular location is bounded by the last patch of natural forests of Madras Christian College, Perungalathur-Vandalur Reserve Forest and Arignar Anna Zoological Park. Once these forest patches must have been a continuous stretch but now remain fragmented by developmental activities. They are a safe haven to the relict native faunalike the golden jackal, Indian porcupine, monitor lizard, slender coral snake and mugger crocodile (personal observations) to name a few. The forest must have provided the necessary shelter and prey for the young python to persist in spite of its proximity to human habitation. Had the python not been rescued its fate would have been an early demise. Fortunately, the members of the house were sensitive enough to inform about the encounter with this rare and highly protected serpent species to the forest department. This incident also highlights the significance of green cover for wildlife and humans in urban areas.

Acknowledgements

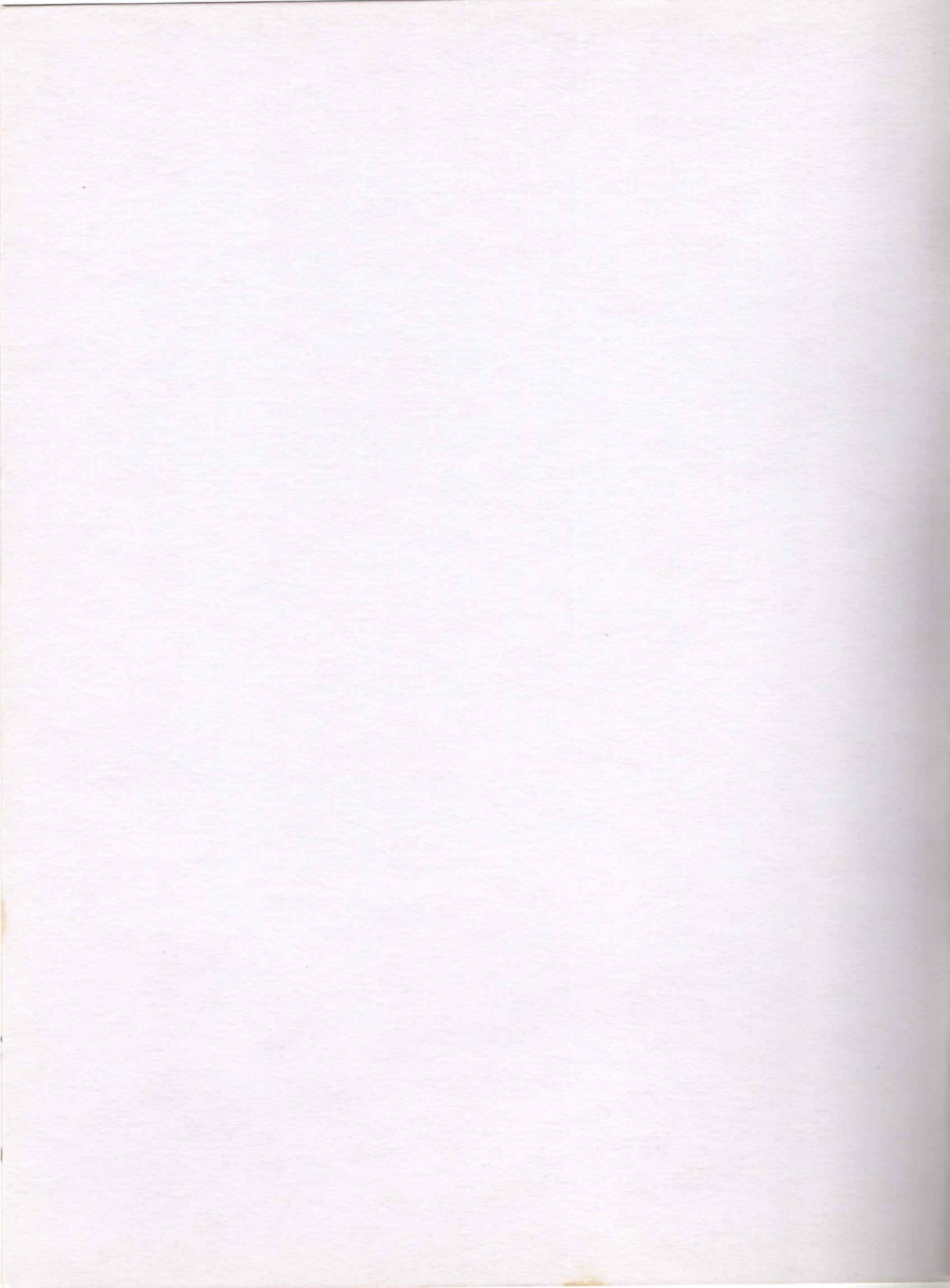
We thank the Principal Chief Conservator of Forests (Chief Wildlife Warden) of Tamil Nadu for granting permission to carry out this rescue and rehabilitation process. We thank Dr Shekar Kumar Niraj IFS, (former Director), Advanced Institute for Wildlife Conservation (AIWC), Vandalur, for providing the facilities for this rescue and rehabilitation process. We also thank the present Director and Deputy Director of AIWC, Vandalur for their support in making this article.

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