

FINAL REPORT

September-November 2016

SURVEY TO ASSESS
HUMAN-SNAKE CONFLICT
AT TATA CHEMICALS'
CAMPUS, MITHAPUR,
GUJARAT

Report submitted to



TATA CHEMICALS LIMITED

Report submitted by



This report has been prepared for TATA Chemicals Limited by IndianSnakes at the Tropical Institute of Ecological Sciences, to submit the findings of the first phase (survey) of the two part project sanctioned to assess and mitigate human-snake conflict at the Mithapur Campus of TATA Chemicals Limited

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Executive Summary

As conservationists and researchers, who are working on mitigating snake bite deaths, the opportunity to conduct such a study has to a certain extent enhanced our understanding of human-snake conflict. Snake bite is the biggest human-wildlife conflict in the country, where our understanding of precipitating factors and ways to mitigate them are scant. Each area- township, forest, village- has an ecosystem of its own and it becomes imperative to understand the individual dynamics to be able to come up with long term solutions that are beneficial to both the snakes as well as the humans in the area.

For IndianSnakes, conducting a thorough study in the first phase of the project was vital to suggest Mithapur specific recommendations for a better coexistence of the serpents and human beings, after concerns had been flagged off about increase in sightings of snakes in human habitation. The entire campus was studied to determine the species of snakes predominantly found, the favourable conditions that supported a snake population and the reasons behind an increase in sightings. The main aspects studied included usage of drainage system by snakes for breeding, waste disposal methods and locations, rodent population in the campus and past rescue data. The study found that the major factors that impacted snake population in the campus were the invasion of snake species from neighbouring township and adjoining forest, habitat modification and alteration offering more hiding places for the snakes, scarcity of active predators and natural enemies, and lack of knowledge on snakes.

The findings of the first phase will be used to implement the mitigation program in the second phase to mitigate human-snake conflict at TATA Chemicals Limited campus.

INTRODUCTION

India is home to about 300 snake species and hundreds of subspecies, who play a crucial role in the ecosystem. The conflict between humans and snakes is the most prominent, but widely ignored form of human-wildlife conflict. While an estimated 45,000 - 50,000 deaths occur every year across India, the innate fear of snakes makes the belief “the only good snake is a dead snake” has led to countless serpents being killed mostly in retaliation and fear, which largely arise due to ignorance and lack of awareness. Snakes form some of the primary predators of rodents in sensitive habitats like agricultural lands; hence, a decline in their numbers may have wider ecological and economic consequences. Land-use changes which may ultimately lead to the habitat destruction and fragmentation, have made many habitat specialist species like rat snake (*Ptyas mucosa*) and Indian spectacled cobra (*Naja naja*) persist and thrive in human dominated locations, where they are often killed as people cannot differentiate between a non-venomous species or a venomous one, with myths abound for both. It is therefore imperative to undertake necessary measures to mitigate human-snake conflict to save the lives of both snakes and humans.



Need of the Project

Mithapur Township was established by TATA Chemicals PVT LTD in 1939 to provide housing to employees working in TATA Chemicals. The township lies in the Okhamandal coast of Dwarka district, in the extreme tip of the lower jaw of Gujarat, with a geographical area of 22.1 km². Being situated at a coastal line, the area has an oceanic climate and is known for scarcity of fresh water supply in both open and underground reservoirs. The landmass supports a vegetation type that grows in typical semi-deserts with abundant bushy thorny vegetation. The fauna that inhabits the area is that of desert and semi-desert type, with animals that rely on ocean often sited near the coast.

Over the past decade, it was reported by the locals and the permanent residents of the area that there is a significant increase in snake sightings, in and around human habitation which included medically significant species like spectacled cobra, saw-scaled viper and common krait. The management authority of the township commissioned this project to IndianSnakes with the aim of finding the reasons behind increased snake sightings in human habitation and to come up with a mitigation plan for the same.



The IndianSnakes team proposed a two phase project. As part of the first phase, a survey was conducted to determine snake density as well as possible contributing factors towards increased sightings of snakes and proposed mitigation solutions for the same at the TATA Chemicals' Mithapur Campus. A full time Field Surveyor, Mr. Chandan Kurmi, and a Consultant Biologist, Mr. Vivek Sharma were assigned to gather data and make observations in scientific way. The project duration was of three months starting from 1 September, 2016 to 30 November, 2016. The mentioned surveyors conducted their field study across the Mithapur campus and the surrounding regions, in which they attempted to compare the cluster habitats with its environment of unused thorny forest, open rocky plains, marine coast and saline water bodies.

METHODOLOGY

The surveyors collected previous snake rescue data from Mr. Trivedi as a baseline to start the survey, after which the clusters of area were divided into categories based on the frequency of reported snake sightings in the area. Primary and secondary evidence was collected to establish the accuracy of reported sightings and the reasons behind snake abundance in the area. Random sampling was also preferred for several sites to gather thorough spatial and temporal data on the presence of snakes and prey species. Historical data was also referred to, to support the hypothesis established during the survey.

The survey team spent three months in the campus conducting systematic examination of snake prone areas and also attended rescue calls during those three months within the campus. During these exercises, they interacted with the people to understand their perceptions about snakes, presence of snakes in their surroundings and past instances of snake sightings within the campus.

Prey species of lizards and amphibians, which are not protected under the Wildlife (Protection) Act, 1972, were humanely captured and photographed to facilitate precise species level identification, post which they were released back at the location from where they have been captured. All snakes (and other protected species under the WPA 1972) photographed were wild and none of them were captured or harmed for any purpose during the survey.

FINDINGS AND INTERPRETATIONS

Through the study conducted at Mithapur Township, forest and adjacent township, Surajkaradi, the following observations were recorded.

a. Species in the township and adjoining forest

Findings: The presence of 12 snake species was confirmed in the township and adjoining forest (Table 1). The list of lizard and amphibian species was submitted in the preliminary report. The presence of rat snake (*Ptyas mucosa*) and Russell's viper (*Daboia russelii*) could not be verified in and around the area. The sighted ones were observed in the areas where imported goods were unloaded, indicating high chances of being transported from elsewhere along with the goods.

Table 1: Snake species observed in Mithapur

S.No.	Common Name	Scientific name	Venomous (V), Mildly venomous (MV) Non-venomous (NV)	Main prey*	Hiding habit	Population status**
1	Brahminy Blind Snake	<i>Indotyphlops brahminus</i>	NV	Insect eggs, soft-bodied insects	Self-made cavities in loose soil and vegetation roots	Uncommon
2	Common Cat Snake	<i>Boiga trigonata</i>	MV	Lizards, Small rodents	Tree cavities and rocks at height	Rare
3	Common	<i>Bungarus</i>	V	Other Snakes,	Mounds, cracks,	Uncommon

	Krait	<i>caeruleus</i>		Rodents	foundations	
4	Common Kukri	<i>Oligodon arnensis</i>	NV	Reptile egg- yolk, Amphibians, Lizards	Mounds, Self- made cavities in loose soil and vegetation roots	Uncommon
5	Common Trinket	<i>Coelognathus helena helena</i>	NV	Rodents, Lizards	Mounds, cracks, foundations	Common
6	Common Wolf Snake	<i>Lycodon auleus</i>	NV	Lizards, Small Rodents	Cracks and gaps mainly at heights	Common
7	Leith's Sand Snake	<i>Psammophis leithi</i>	NV	Lizards, Small Rodents	Thick thorny vegetation, between rocks	Common
8	Red Sand Boa	<i>Eryx johnii</i>	NV	Rodents, Lizards	Mounds, Self- made cavities in loose soil and vegetation roots	Uncommon
9	Russell's Kukri	<i>Oligodon taeniolatus</i>	NV	Reptile egg yolk, Amphibians and Lizards	Mounds, Self- made cavities in loose soil and vegetation roots	Uncommon

10	Sochurek's Saw Scaled Viper	<i>Echiscarinatus sochureki</i>	V	Lizards, Small Rodents, Arachnids	Cracks, foundations	Common
11	Spectacled Cobra	<i>Naja naja</i>	V	Rodents, Amphibians	Mounds, cracks, foundations	Common
12	Thread Snake	<i>Myriopholis sp.)</i>	NV	Insect eggs and soft bodied insects	Own made hole in loose soil or vegetation roots	Rare

* In the order of preference

** Based on the frequency of sighting in the study area

Interpretation: From the above listed species, two rare species (common cat snake and thread snake) were seen only once. The five uncommon species were not uniformly spotted in the township and the sightings were infrequent. The remaining five species were common in the township and were sighted very frequently. The largest among the above 12 species were spectacled cobra and common trinket; causing panic among people when sighted. Among the twelve, spectacled cobra, saw-scaled viper and common krait are the medically significant species present in the project site.

Sand snakes are not habituated to habitat modification and hence, will keep moving away from urban settlement. In the case of cobra, viper, trinket and wolf snake, the reasons of preference of urban settlement are attributed to their prey and hiding patterns. These species are the most widely distributed snake species in the Indian subcontinent and are found in multiple habitat and forest types. They are capable of adapting to habitat alterations and can perform better in modified habitats as they easily adapt to feed on the prey animals of new environments.

Among the uncommon ones, krait and boa might be sighted frequently if the degradation of housing and gardens and piling of construction material increases. The recorded absence of some very common species can also prove to be a contributing factor to the increasing abundance of the others. Two species of keelbacks and rat snake, which are heavily dependent on amphibians and rodents for food and were expected to be found in the area, were entirely absent in and around the township. On the other hand, these species are very common in other parts of the Indian subcontinent and are considered as a mandatory reptile component of healthy fresh water ecosystems.

Image Gallery 1- Some of the species photographed during the survey



Leith sand snake (*Psammophis leithi*)



Leith sand snake rescued from J series of Cluster B of township



Sochurek's saw-scaled viper (*Echis carinatus sochureki*)



Saw scaled viper found in TATA Solar Plant



Saw scaled viper spotted in TATA Solar Plant



One of the Saw scaled vipers spotted in Janbai Lake of township outskirts



Spectacled cobra (*Naja naja*) rescued from a house compound of Cluster B



Common krait (*Bungarus caeruleus*) skin found in outskirts of Mithapur in an area piled with discarded concrete



Common trinket (*Coelognathus helena* Helena) rescued from Cluster D of township



Common wolf snake (*Lycodon aulicus*) rescued from Golden Jubilee of Cluster C of township



Red sand boa (*Eryx johnii*) spotted in TATA Solar Plant



A gecko of genus *Hemidactylus*

b. Habitat modification leading to rise in breeding areas for snakes

Findings: The township has been going through several anthropogenic changes, while trying to improve the standard of living for the residents. Old settlements are being frequently demolished and the discarded concrete is piled around in the forested areas of the township and peripheries of urban settlement. Even though the overall township is maintained for cleanliness, piles of materials were found in many places. Piles of concrete, rock, brick, junk and cement sheets were seen in the peripheries (Cluster B and C) and piles of wood, plastic material and personal junk were seen in the house compounds (Cluster C and D), for which

the residents are presumably responsible. Holes, cracks and gaps were observed on workman quarters and old housings. Broken or misplaced manhole openings of old and new drainage systems were spotted. Some snake rescues were done at such manhole openings. These openings were either wrongly filled with concrete or rock pieces or were just wide cavities which can be seen from distance. Many of the rescue calls were from such places that serve as vast hiding places, such as Golden Jubilee, SSV of Cluster B etc.

Interpretation: While the main infrastructure in the township has less hiding places for small animals because of limited narrow places (cracks, gaps, cavities etc.), the increasing piles of unused materials is providing animals like snakes and rodents more spaces for hiding and breeding. The observation was verified on many occasions as snakes were found hiding within the material and on one occasion, a significantly high population of 40 vipers were seen in the material around Janbai Lake (reference picture in Image Gallery 1). A high number of vipers, cobras, kraits and boas were generally recorded from sites which had ongoing construction and piles of discarded material. Vipers were spotted from construction spots in beach areas where they could hide in openings in the concrete construction inside the canteen room, temple etc. This shows the direct impact of increasing habitat modification on increase in number of snake population in the township.

The main hiding places of snakes were heaps of concrete, rock, brick, wood, junk, cement sheet, plastic materials, mixed non-degradable garbage etc. Hiding spots were also found in old tree cavities at trunk base and roots of deciduous trees. Similarly, there are cement platforms and perforated round walls for old deciduous trees on roadsides. These were constructed to improve the aesthetics of the area, but piles of garbage and other degradable or non-degradable materials were found inside these structures.

All these hiding spots provide shelter for many prey animals such as lizards and rodents, also making them ideal temporary and permanent shelters for snakes for their unhindered growth and breeding. Abundant hiding places and the surplus availability of prey animals in these spots has lead to the proliferation of snake population in the area. For instance, during a routine field investigation in a randomly selected concrete pile, four viper individuals were found within a three feet diameter.

Image Gallery 2- Preferred Shelter and Breeding Places of Snakes and their Prey



Unused culvert in front of school (Cl. A/D)



Poorly arranged pile of sheets (Cl. A)



Unused open house with no gate (Cl. A)



Cavity made with time in foundations (Cl. A)



Brick pile in open places (Cl. A)



Constructions having pores and gaps (Cl. A)



Untidy backyard between apartments (Cl. B)



Unused concrete piles around township (Cl. B)



Poorly piled firewood and junk (Cl. C)



Poor filling of rocks in foundation cavity (Cl. C)



Rock wall and wood standings in houses (Cl. C)



Concrete pile and dense vegetation between houses (Cl. C)



Pile of occasionally used items (Cl. D)



Pile of broken concrete (Cl. D)



Non-plastered thick wall of rocks (Cl. D)



Tree guard/foundation with gaps (Cl. D)

c. Population pressure in neighbourhood:

Findings: The township has a limited population comprising of TATA Chemicals Limited employees. But the neighbouring town of Surajkaradi had a population growth rate of over 25-30% in the last two decades. The increasing development has attracted more people from outside communities to the township, which in general is poorly maintained and lack of hygiene and cleanliness is evident. Few snake rescues occurred at Surajkaradi during which increased sighting of large snakes was recorded.

Interpretation: The unhygienic environment in the Surakkaradi Township provides enough support for survival of rodents and hence, promotes survival of predators depending on

them. According to the snake rescue data gathered from Surajkaradi, it was found that snakes were located at sites with poor management of solid-liquid waste, piles of old raw construction materials, storage of food and other items. When the species population burgeons in one area, large snakes like cobras, trinkets and kraits migrate to places within a few kilometres of their home range in search of food and shelter. Therefore, it could be inferred that a significant part of the snake population in Mithapur Township constitute the individuals migrated from neighbouring townships for their survival.

Image Gallery 3- Snake Entry and Migration Points



Gap between well plastered wall (Cl. A)



Metal net and hole in boundary wall (Cl. A)



Vegetation on the level of boundary (Cl. A)



Vegetation climbing with walls (Cl. B)



Main gate having space on lower side (Cl. D)

d. Apparent scarcity of active predators and natural enemies of snakes

Finding: Several carnivorous birds, mongooses, wild cats, jackals etc. were sighted in the forest areas and around open saltwater bodies. These animals often feed on snakes. However, many of them were not found in urban settlement despite the abundance of hiding and roosting places in selected places of the township. Furthermore, street dogs and domestic cats are also considered as natural enemy of snakes, but they were not located in the surroundings of the township. Instead, they were clustered around and dependent on local fishermen and residents for the leftover food and remnants of fish catch.

Interpretation: Lack of natural predators and enemies causes an imbalance in an urban ecosystem. In a healthy urban ecosystem, selective wild species with higher adaptability rate will survive well with new set of life resources. Not only there will be new sets of prey species but natural predators and enemies will also invade such spaces. In urban areas, predators and habitual enemies of reptiles and rodents are mostly street dogs, cats, some carnivorous birds and other reptiles. As street dogs and domestic cats in this township are entirely dependent on humans, they are seldom found actively hunting for food or scavenging on their own, which can be a causal factor in the rise of rodents. Their lack of presence in areas which has recorded a higher abundance of snakes also lessens their rate of interaction, therefore minimising the chances of them engaging and killing snakes in their

territory. Lack of participation of predators in the higher strata food chain leads to the proliferation of animals in the lower strata.

e. Knowledge of snakes and present status of snake removal:

Finding: A random preliminary survey of approximately 150 people of Mithapur, private security and select people of Surajkaradi was conducted. It was seen that a local's identification skills and knowledge on location names, folklore, venom property etc. of snakes was very poor. Even few renowned snake rescuers of Surajkaradi who perform maximum snake rescues (jointly in the township and Surajkaradi) were found to have low knowledge in basic information like robust identification skills, species specifications, local diversity, snake bite first aid protocols etc. Only some of the older residents of the township were able to describe the characteristics of some common species up to an acceptable level. They should also be updated with consistent scientific information in regional language.

Wrong information provided in the folklores, myths etc. threatens humans and snake population as they create unnecessary fear among people and directly leads to the loss of local wildlife. Spreading scientific knowledge in regional language can help mitigate this threat.

SOLUTIONS AND RECOMMENDATIONS

By analyzing the above findings, solutions and recommendations made from the point view of biologists and herpetologists at IndianSnakes are given below.

- 1. Constant education and awareness:** Education is the primary tool to inform the local community about the regional snakes and other reptiles. This will help during situations of conflicts and snake bites, and will definitely reduce people's fear of snakes. To create awareness, posters, booklets and biodiversity manuals will be provided. Education institutes can be used as a permanent media to distribute and spread awareness through different education materials.
- 2. Waste and construction residue management:** Presently all building scrap, which is primarily non-biodegradable, is heavily piled around the town periphery and forest areas. Such piles should be completely removed and thus, free the area from hiding places. The materials that are not used by TATA Chemicals should be transported to other urban settlements for ground levelling. Also, items that can be recycled should be collected periodically and measures for proper recycling should be adopted. Wood that is stored at houses for household use should be kept at heights on hanging racks.

Garbage and other waste emanating from households should not be left lying around under any circumstance as they attract rodents for scavenging and give them ample food to feed on. Waste management can be looked at an individual household, as well as at a cluster level where for at least the biodegradable waste can be put in compost pits to ensure safe, hygienic and ecological friendly disposal. The result can be used as manure for the grounds later.

- 3. Filling of gaps, holes, cracks and cavities:** Management needs to assign responsible individuals to renovate selective housing areas and check for low height gaps, cracks and cavities on walls, ground and manmade holes. These holes should be fixed with materials that cannot be removed by rodents or termites. The materials that can be used for filling are mixture of glass pieces, fine sand etc. Non-plastered walls and flooring should be plastered with durable construction material.

Boundary walls made with rock boulders which are lacking proper cementing should either be replaced with standard plastered walls or completely demolished because, having no wall is better than these type of raw walls which will only serve the purpose of attracting snakes. Old tree trunks, foundations, platforms and perforated walls should also be checked and annually or quarterly monitored. Items like flowerpots placed in house gardens should be arranged in such a way that do not leave any dark and narrow corner which can attract snakes. Unused old buildings are considered as safer places for snake hiding. Such buildings if not demolished in the near future, should be thoroughly sealed.

- 4. Prevention of entry and migration:** To actively prevent migration of snakes, all unused holes, metal nets and gaps between boundary walls should be packed temporarily or permanently depending on their role in resident's daily activities. Also, vegetation reaching the height of boundary walls should be regularly trimmed. Any such object at heights that can work as a ladder to enter inside the boundary or windows should be removed. Necessary entrances like main gates should be bordered with flexible hard net materials which can be easily replaced when it gets old or loses quality. The drainage system has to be sealed in ground opening points to restrict the use of underground drainage tunnels by snakes as a refuge and breeding ground. Preventing and restricting the entry and migration will direct the snakes to stay in small areas. Hence it will prevent their breeding and it will become easy to spot them.
- 5. Rodent and other prey animal control:** Rodents are the biggest threat to any snake control attempt. Increase in snake population is directly related to urban rodent population and therefore traps need to be set in present areas of rodent infestation. Careful and secure storing of edible items will help in controlling them slowly but effectively in the long term. Releasing rodents in open within the periphery of residential areas is not recommended, especially if preventative measures are not carried out as they will return upon finding food easily available again in the houses and at garbage collection points near the residential areas. To control them and other prey animals like geckos, no hiding places inside or outside the house should be left, including drainage systems and waste and hygiene management needs to be given a serious look.

- 6. Reviving local natural ecosystem:** By carefully reintroducing native vegetation in gardens and forest area, natural wild predators of snakes can be repopulated throughout the township and their number can be slowly increased by supporting their life. For instance, feeding and maintenance of a vaccinated and sterilised population of feral cats and dogs in the areas that they are currently absent can also be looked at as a viable solution, since they are natural enemies of snakes and prey species. However, such sensitive biological control programmes are successful only when long term ecological study is conducted.
- 7. Snake Species to be aware:** The campus unquestionably has a healthy population of saw-scaled vipers because of their regional distribution, presence of a number of above mentioned favourable conditions within the campus. Being a medically important snake (*which can cause human death*), the systematic management of this species within the campus must be the priority. During multiple surveys in the periphery of the township, snakes of this species were regularly encountered and the chances of them moving into the residential areas are always there. The presence of common cobra is not very common but there is a small population that exists in and around the campus and them using the underground drainage system as a breeding and dispersal route is a serious matter of concern. During the survey, large specimens were caught and considering the fact that large female cobras can lay large clutches of eggs (40+) could result in sudden spike in population of snakes within the campus. Common Krait is rare and Russell's viper is absent and both may not be considered as imminent threat at this point of time.
- 8. Specific Preventive measures to be undertaken:** As there are snakes, preventive measures will be the best to be implemented. Creation of an absolutely snake free campus is nearly impossible considering the practical difficulties, pre-cautionary measures hold the key to avoid damage to human life within or around the campus. Systematic and regular snake removal using traps, checking of snake hiding places should be undertaken to keep the population under control. All the security personal should be provided first aid training on snake bite management and also place posters within the campus on venomous snakes and snake bite first aid. The township hospital should stock sufficient vials (minimum 50 vials) of high quality ASV at all points of time to deal with an emergency.

- 9. Deploying a resident snake rescuer for one to two year period:** A full-time rescue expert(s) to deal with snake related issues will be helpful in dealing with the problem faced by the management and residents. Such human resource can be used to achieve the objectives of education and awareness as mentioned in **(1)** and will work according to standard rescue and monitoring protocols. Having an expert in any area reduces the hazards of conflicts and dilutes the fear and worries. He also will help in implementing the above mentioned recommendations and keep the snake movement under check. A spatial and temporal map of snake rescue / removal across the campus to be maintained to understand the yearly habitat usage of snakes / occurrence of snakes within the campus for effective mitigation measures.

GLOSSARY OF TERMS

Terminology	Explanation
Blind Snake	Brahminy blind snake(<i>Indotyphlops brahminus</i>)
Boa	Red sand boa(<i>Eryx johnii</i>)
Cat Snake	Common cat snake (<i>Boiga trigonata</i>)
Cobra	Spectacled cobra(<i>Naja naja</i>)
Drainage	Underground drainage system of the whole Township
Forest	Continuous and discontinuous forest cover of approximately 2km from the actual urban settlement
Township	Urban area of Mithapur Township which ends with the railway track. Continuous forest cover and TATA Chemicals plant is not included.
Gecko	All geckos of genus <i>Hemidactylus</i>
Lacerta	All Lacerta species of genus <i>Acanthodactylus</i> and <i>Ophisops</i>
Lizard	Common garden lizard (<i>Calotes versicolor</i>)
Krait	Common krait(<i>Bungarus caeruleus</i>)
Sand Snake	Leith's sand snake (<i>Psammophis leithii</i>)
Skinks	All Skink species of genus <i>Eutropis</i> and <i>Lygosoma</i>
Trinket	Common trinket (<i>Coelognathus helena helena</i>)
Viper	Saw-scaled viper (<i>Echis carinatus sochureki</i>)
Wolf Snake	Common wolf snake(<i>Lycodon aulicus</i>)



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