REPORT
ON
"MAPPING OF WILD ANIMAL RESCUE AND ROAD KILL DATA WITHIN THE MMR USING THE PRAANI MITRA SOFTWARE APP OF THE THANE VAN VIBHAG"

Submitted by:

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1. Introduction

Urban biodiversity has almost universally been a victim to developmental activities, and human activities have led to alteration and loss of habitat and biodiversity. However, enhancement of biodiversity in urban ecosystems can be quite important as some evidences suggest that personal exposure to natural things in everyday life is a major determinant of sensitivity to environmental issues. There are increasing demands on biological resources due to population growth and economic development. The result is a continuing loss and degradation of habitats or their conversion to other uses, the overexploitation of biological resources, loss of species and genetic diversity, and pollution and climatic change.

Biodiversity concerns related to urban ecosystems can be divided into three major groups:

1. those related to the impact of the city itself on adjacent ecosystems;
2. those dealing with how to maximize biodiversity within the urban ecosystem
3. those related to the management of those species within the ecosystem which may be unsuitable (from the anthropogenic point of view) for the urban ecosystem but are nevertheless present there.

In a recent study conducted by Rudd, H et al (2002), he mentioned that the chances of world population to increase by 2050 is estimated to be 10 billion, mostly in the urban region. Also, many urban regions are part of biologically sensitive regions. Many human activities lead to habitat loss and among them urban development leads to increase in local extinction rates and elimation of native species. Also, urbanization is often more lasting than other types of habitat loss (McKinney, M. L. 2002).

Most of the urbanization in developing countries being unplanned or poorly planned, biodiversity concerns do not get included. Animal loss to road-kills, birds dashing on to glass facades, trapping of snakes in gutters, trapping of birds and bats in transmission lines, trapping of species in high-rise buildings and illegal trade of live animals and dead animal parts through city railway stations and ports are some of the examples of how urban biodiversity is negatively impacted by urbanization. Also, poor social awareness regarding urban biodiversity concerns can lead to human-biodiversity conflict and loss of the latter.

The major reason behind increase in human-animal conflict is more people crowding on less land. If the two are to co-exist, conflicts must be minimized by decreasing the costs and increasing the benefits that come to the local communities as they interact with wildlife.

To better manage this aspect of urban life, detailed data analysis is necessary to understand –

a) Which are the city locations where road-kills/incidents of trapping are most commonly observed?
b) Are some species or taxonomic groups more at risk than others?
c) Is the incident of road-kill or trapping more frequent during a certain season?
d) Is there any other trend to be observed?

The task of rescuing wild animals trapped in city premises lies in the purview of the State Forest Department. In this task, the State Forest Department may be assisted by several local Non-Government Organizations (NGOs) and individuals. The Forest Department requires relevant information regarding the rescue operation to be filled into forms and formally submitted – this

information include name of the species, its condition at the time of rescue, time and location of rescue and the rescuer's name and organization. However, none of this data is in the digital form and most of the times, is maintained in a single copy only. Hence, it is of the utmost importance to create a digital back-up of this data and mapping the locations where the rescue operations were carried out prior to analysing it.

The mapping of the data will highlight areas majorly prone to conflicts/ road kill and this will help to further generate a database for creating awareness activities and proposing mitigation measures.

2. Scope of Work and Timeline

TerraEnviro Foundation was granted the prestigious project by Mumbai Metropolitan Region's Environment Improvement Society (MMR-EIS) to collate the wild animal rescue data from the entire MMR, to put this data on MS Excel sheet and map the locations where these operations were conducted – followed by its analysis to obtain meaningful conclusions. Our detailed scope of work is given below and timeline of the project is given in **Table 1.**

Scope of Work:

- **Data Collection**: Data will be collected from various NGOs and Maharashtra State Forest Department on rescue and road-kill within the Mumbai Metropolitan Region. Data will be collected for past 5 years i.e. 2012-17. For the same period, newspaper records will also be checked.
- **Digitization of Data**: Data collected will be converted into excel sheet records providing region-specific details of kill and rescue with the number of occurrences in a particular year.
- **Data Feeding into the Forest Dept App**: The data obtained from various NGOs within the MMR will be fed into the app prepared by the Maharashtra State Forest Dept. This app is expected to directly give a map output.
- **Report preparation**: Based on this analysis, a report will be prepared on the potential causes leading to animals being injured or trapped (hence, requiring rescuing) and killed, highlighting the current scenario and gaps that need to be plugged

Table 1: Timeline of the Project

Activity	Months				
	1	2	3	4	5
Data Collection	**	**	**	**	
Digitization of data	**	**	**	**	**
Data entry in the app	**	**	**	**	**
Report Preparation				**	**

3. Literature Review

A brief literature review of research papers stating issues of Human-Wildlife conflicts, reasons for its existence, contributors in conservation and mitigation through use of various technologies and other factors contributing to various accidents and injury to wild animals is given in **Table 2.**

Table 2: Literature Review

Sr. No.	Journal and Year	Volume	Issue	DOI	Title	Authors	KW1	KW2	KW3	KW4	KW5	KW6	Scope of paper	Study site
1	Biosphere Conservation (2000)	3	1		Road kills of wild fauna in Indira Gandhi Wildlife Sanctuary, Western Ghats, India: Implications for management	Honnavalli Nagaraj Kumara, Anantha Krishna Sharma	Road kills	Mammals	Snakes	Western Ghats			The study was conducted on the deaths of mammals and reptiles caused by vehicular traffic on a road in Indira Gandhi Wild life Sanctuary, Annamalai Hills, Western Ghats, India. In order to reduce this impact, it was suggested that at night and also during rainy season tourist traffic should be minimised. Alos, necessary steps to mintain corridors near roads sholud be taken. When constructing any further roads within the sanctuary, the sensitive rain forecaste areas must be avoided.	Western Ghats
2	Urban Ecosystems (2005)	8			Urban wildlife ecology and conservation: A brief history of the discipline	LOWELL W. ADAMS	Urban	Wildlife	Ecology	Conservation			The subject Urban wildlife ecology and is in scope worldwide. Most of the studies in this field Information gained through Urban Wildlife research on wildlife and plants in urban ecosystem will help in better understanding and help in sustaining the urban ecosystem.	United Kingdom.
3	Environmental Modelling with CIS and Remote Sens (2002)	53			Applications of Remote Sensing and Geographic Information Systems in Wildlife mapping and modelling.	Jan de Leeuw							To apply Wildlife management in a particular area the details such as abundance, habitat and distribution of speciesas well as threat is necessary. The study provides CIS and CIS techniques in mapping and modelling of wildlife distribution.	Kenya.

4	Ecological Engineering (2013)				Evaluation of the effectiveness of a wildlife roadkill mitigation system in wetland habitat	Alex Bager	Wildlife mortality	Fence	Mitigation	Roadkill	Wetlands		A Wildlife Protectecion system was installed along 15.7 km section of federal highway located in Brazil which is a crossing through the protected area and its effectiveness was studies. In this study analysis of road kill rate and impact on the vertebrates by the WPS was analysed.	Brazil.
5	Avian Ecology and Conservation in an Urbanizing World (2001)				Human perception and appreciation of birds: A motivation for wildlife conservation in urban environments of France.	Phillipe Clergeau , Gwanaelle Mennechez , Andre Sauvage.	Avian diversity	France	urban ecology	wildlife management			To conserve biodiversity in urban areason needs scientific justification as well as public interest. The density of birds was highest in urban areas because of the abundance of some species, including Rock Doves (Columba livia) and Swifts (Apus apus) and lowest in the rural sector.According to the results, efforts to increase or maintain avian biodiversity in cities appears to be justified in terms the perceived benefit to humans, both in terms of the perceived. Environmental and personal benefits to humans.	Renne, France.
6	Journal of the Bombay Natural History Society (2006)	103	1		FORAGING AND HABITAT USE BY GOLDEN JACKALS (CANIS AUREUS) IN THE BHAL REGION, GUJARAT, INDIA.	AMBIKA AIYADURAI, AND YADVENRADEV V. JHALA.	Home range	Golden Jackal	Radio Telemetry	Habitat use	Ranging pattern.	Food habits.	Home ranges of six Golden Jackals (Canis aureus) were estimated in and around Velavadar National Park, Gujarat using radio-telemetry, between November 2000 and December 2001. They often visited outskirts of villages to scavenge on livestock carcasses and garbage piles. This study highlights the importance of human generated resources for carnivores like Golden Jackals.	Velavadar National Park, Gujarat.

7	International Journal of Remote Sensing and GIS (2012)	1	2		Land Use Land Cover Mapping, Change Detection and Conflict Analysis of Nagzira-Navegaon Corridor, Central India Using Geospatial Technology.	P. K. Yadav, Mohnish Kapoor, Kiranmay Sarma.	corridor	change detection	deforestation	conflict	GIS	Remote sensing	Degradation of forest connectivity in between landscapes occurs due to fragmentation and anthropogenic activity, which causes biodiversity decline. Conservation of wildlife corridors requires complete knowledge of species habitat requirements. Information of land use/cover and conflicts supports the assessment of wildlife habitat and identification of corridor status. Due to high frequency of traffic on roads/railway, wild animals often divert from their original dispersal route and enter these hamlets leading to conflict situations.	Nagzira- Navegaon, India.
8	Human Dimensions of Wildlife: An International Journal (2004)	9			Creating Coexistence between Humans and Wildlife: Global Perspectives on Local Efforts to Address Human–Wildlife Conflict.	FRANCINE MADDEN	human wildlife conflict	global					The article is provided by " Creating Coexistence" workshop. It provides helping to demonstrate the depth and breadth of the knowledge and diversity of experiences.	USA
9	Journal for Nature Conservation (2007)	15			Monitoring the Chilla–Motichur wildlife corridor using geospatial tools.	S. Nandy, S.P.S. Kushwaha, S. Mukhopadhyay	corridor	GIS	Habitat	Remote sensing	wildlife		An assessment using temporary satellite of Chilla- Motichur wildlife coriddor ofRajaji National Park that is located in uttaranchal. satellite imagery. The study highlights about depletion of the corridors in a particular time span. It also states that remote sensing and GIS provide a great potential in corridor assessment and monitoring.	Rajaji National Park, Uttarakhand, India.

10	Biological Conservation (2001)	102			Snakes in the garden: an analysis of reptiles ''rescued'' by community-based wildlife carers.	Richard Shine, Jennifer Koenig	snake	mortality	lizard	relocation			Communiiity programmes conducted to rescue urban wildlife generate various inetractions among human and animals. Such activities have different impacts such as modifying mortality pattern, geographical distribution and can also provides data on locally available species, abundance and different taxa, type of treats to urban ecology. The increase in resuce activites indicate increase in ecological impact and rescue communnities can plan an important role to provide such information to wildlife communities.	Australia.
11	Human Dimensions of Wildlife: An International Journal (2008)			10.1080/10871200009359180	The role of wildlife rescue groups in the care and rehabilitation of Australian fauna.	Mr. Andrew Tribe & Mr. Peter R. Brown.	wildlife rehabilitation	relocation	urban wildlife	conservation	wildlife carers		This paper provides a review of the role of "wildlife rescue groups" in the care and rehabilitation of Australian fauna, and makes recommendations regarding future policy and practice. Fate of animals, survival after release,death during rehabilitation should be considered by ecologists.	Australia.
	URBAN HABITATS	4			Space for Urban Wildlife: Designing Green Roofs as Habitats in Switzerland	Stephan Brenneisen	Biodiversity	Urban ecology	Land- use regulation	Green roof			Switzerland	

13	Reptile Rap (2013)	15			Snake diversity and voluntary rescue practice in the cities of Gujarat State, India: an evaluation	Raju Vyas							The snakes rescue practices run by NGOs in urban areas of the state are not only one of the best voluntary services to the society but also an aid in the mission of snake fauna conservation. But, on the other side these NGOs lack scientific guidance by any professionals. Therefore, the maintenance of proper scientific documentation/database regarding the snake rescues and their release shows some lacuna.	Gujarat.
14	Proceedings of the National Conference on Modern Trends in Zoological Research (2014)				A BASELINE STUDY OF HABITAT AND ABUNDANCE OF LESSER FLAMINGO (PHOENICONAIAS MINOR) IN SEWRI MUDFLATS, MUMBAI, INDIA	Akshay Nachane, Amit Patil, Shashank More, Prachi Salunke and Madhavi Indap							Coastal wetlands are continuously under the influence of hydrological fluctuation yet they are known to congregate large number of migratory and resident species of birds. Birds use these coastal wetlands as their breeding, foraging and roosting sites.	Mumbai.
15	Hamadryad (2013)	36			A preliminary study on translocation of “rescued” King Cobras (Ophiophagus hannah)	Sahas Barve, P. Gowri Shankar, Romulus Whitaker, Ajay Giri.	Translocation	snake rescue	king cobra	spacial ecology			Animal translocation used as management of wildlife rescued from human habitations, without scientific evidences.	Western Ghats, Karnataka
16	Hamadryad (2013)	36			Factors influencing human hostility to King Cobras (Ophiophagus hannah) in the Western Ghats of India.	P. Gowri Shankar, Romulus Whitaker, Aditya Singh	ARRS	King cobra	Agumbe				This paper investigates people’s perceptions toward King Cobras in the tropical rainforests of the Western Ghats ecoregion of southern India.	Agumbe, India.

17	Indian Journal of Marine Science (2005)	34	3		Mangrove mapping and change detection around Mumbai (Bombay) using remotely sensed data.	V. Vijaya, R. S. Biradara, Inamdarb, G. Deshmukhea, S. Bajib & Madhavi Pikle.	mangroves	mapping	remote sensing	change detection			In this study remote sensing played a major role in detecting chances in the mangrove habitat that is located in Mumbai suburban region.	Mumbai.
18	Indian Forester (2017)	143	10		A REVIEW ON WILDLIFE RESCUE ACTIVITIES IN NORTH KERALA, INDIA	R. ROSHNATH AND D. JAYAPRASAD	Rescue	rehabilitation	wildlife interactions	awarness			This data explains the present situation of rescue activities in North Kerala. The rescue team of each district were visited and data on rescues such as number of rescues, species of animal rescued, date of rescue etc were collected, complied and interpreted. It also describes the limitation and include recommendations for better rescue and rehabilitation activities in the area.	Kerala.
19	Marine Mammal Science (2011)				The application of GIS and spatiotemporal analyses to investigations of unusual marine mammal strandings and mortality events	JOHN CALAMBOKIDIS, JOSEPH K. GAYDOS, M. BRADLEY HANSON, DEBORAH A. DUFFIELD, SANDRA DUBPERNELL,	porpoise	spatial	stranding				This article describes the spatial analytical tools applied in this study and how they can help identify root cause of marine animal deaths.	Washington

20	Kongunadu Arts and Science College, Coimbatore (2017)				SNAKE RESCUES; A CONSERVATION EFFORT IN KANNUR DISTRICT	Roshnath, R.	snake	awarness programmes	conservation				Knowledge of activity pattern of the snake in the district can be used for successful management and conservational plans. Waste management, rodent control, reducing hideout places etc were suggested to decrease the number of snakes entering into house compound. Promoting awareness about the local snake among the public is as important as rescue activities.	Kannur, Kerala.
21	Biological Conservation (2003)	115			An assessment of the olive ridley turtle (Lepidochelys olivacea) nesting population in Orissa, India	Kartik Shankera, Bivash Pandavb, C. Choudhury	Olive ridley	turtle	fishery	conservation			Turtle nest monitoring, conservation of turtles, use of GIS and mapping for better turtle management practices.	Odissa
22	Mamm Res (2016)				High resource availability and lack of competition have increased population of a meso-carnivore—a case study of Golden Jackal in Keoladeo National Park, India	Aakriti Singh & Aditi Mukherjee & Sumit Dookia & Honnavalli Nagaraj Kumara	Canis aureus	density	diet				According to this study highest number of golden jackals in the study area ever reported globally. The reasons being lack of any competitor and high food security.	Keloladeo National Park,

23	International Urban Wildlife Symposium (2004)				Urban wildlife issues in Australia	Ian D. Temby							Wiiillldlife species are seen in Human residents due to garderns or getting attracted towards food. A diverse rnge of problems are caused by wildlife making government wildlife agencies to take actions. Problems may also impact or threten Human health and safetly. This becomes a challenge for the wildlife managmers as support of people depends on the situation to tackle such problems.	Australia.
24	Kachhapa	9			Showing The Way: Mass hatching of olive ridleys in Rushikulya, Orissa	Belinda Wright & Biswajit Mohanty							Turtle nesting and care.	Odisha.
25	Online International Interdisciplinary Research Journal (2014)	4	1		Conservation of Olive Ridley through community participation: A Case Study of Velas, Ratnagiri District	Priya Parkar	Olive ridley	community	Ex-situ	turtle festival	velas		The study explains how local community can help in conservation of turtles, through awareness, patrolling and nest monitoring.	Velas, Maharashtra, India.
26	Wildlife society bulletin (1997)	25	2		Wildlife management by meteropolitian residents in the United States: practices, perceptions, costs and values.	Michael R. Conover	human wildlife intercatio n	metropoliti an wildlife	urban wildlife	wildlife damage	wildlif e econo mics		Cost, economics, values and perceptions involved under wildlife management in urban/ metropolitan areas.	USA

27	Herpetologists' League (2012)	47	3		Relocation, Repatriation, and Translocation of Amphibians and Reptiles: Are They Conservation Strategies That Work?	C. KENNETH DODD, AND RICHARD A. SEIGEL	amphibians	reptiles	relocation	translocation	conservation	management	Rescue , release, translocation programs may work under certain circumstances, they should not be used unless all parties involved are prepared to make the necessary commitment for collecting baseline data, releasing animals under appropriate circumstances, providing for follow-up studies at periodic intervals, and publishing the methodology and results of the program regardless of whether the outcome is positive or negative.	USA
28	Conservation evidence (2010)	10			An education programme and establishment of a citizen scientist network to reduce killing of non-venomous snakes in Malappuram district, Kerala, India	Peroth Balakrishnan							The conservation education programme resulted in positive attitudinal changes among local people towards the conservation of snakes and general biodiversity of the region.	Kerala, India.
29	Journal of experimental science (2011)	2	10		Species diversity of birds in mangroves of Uran (Raigad), Navi Mumbai, Maharashtra, West coast of India.	Prabhakar R. Pawar	species diversity	mangroves	birds	uran	navi mumbai		At present, ecological conditions in mangroves of Uran supports moderate density of birds but due to intense industrialization and urbanization, pollution of Uran coast cannot be ignored. Therefore, data presented in this paper can be taken as a base line data.	Uran, India.

30	Ecology and Society	16	3		Local Community Attitudes toward Forests Outside Protected Areas in India. Impact of Legal Awareness, Trust, and Participation.	Biljana Macura , Francisco Zorondo-Rodríguez, Mar Grau-Satorras, Kathryn Demps, Marie Laval , Claude A. Garcia, and Victoria Reyes-García.	anthropology	attitude	forest dwellers				This study explains how awareness about endemic species of the forest, to the people can help in conservation. These wild kinds can be present in fields, farms, coffee plantations etc. where there is high rate of human- wildlife encounter.	India.
31	Urban wildlife				MANAGING URBAN HABITATS AND WILDLIFE	Lowell W. Adams, Larry W. VanDruff, and Maciej Luniak	urban	wildlife	management				This chapter introduces the occurrence and attributes of wildlife and ecosystems across a landscape dominated by intensive human settlement. Wildlife biologists working in the urban environment, and students planning to become urban biologists, should be knowledgeable of techniques in wildlife field research and monitoring, habitat restoration and management, habitat conservation planning, human dimensions research and management, and management of nuisance situations and problem animals, relative to the metropolitan environment.	USA

32	Human Dimensions of Wildlife: An International Journal (2008)				Strengthening Partnerships for Effective wildlife rescue in the Panama Canal Area.	Nestor J. Correa , Andrew D. Carver & Roberto Master.							This paper focuses on how partnerships between wildlife rescue groups, government and workers can help in conserving local species by RRT (rescue, rehabilitation, and translocation).	Panama.
33	Journal of Entomology and Zoology Studies (2018)	6	4		Snake species diversity and their distribution in and around Nanded city, Maharashtra, India.	Pavan Laxmanrao Jadhav, Shivaji P Chavan and Harshad Sudarshan Trimukhe.	Snakes	Distribution	Nanded	Venomous			Snake species distribution was found out based on data recorded by wildlife rescue groups.	Nanded
34	Geoforum (2008)	39			Human–wildlife conflict and gender in protected area borderlands: A case study of costs, perceptions, and vulnerabilities from Uttarakhand (Uttaranchal), India	Monica V. Ogra	Human wildlife	conflict	Uttarakhand				There are some ways in which park managers, policy- makers, and the conservationists with whom they work can begin to address the hidden costs of HWC described in this paper.	Uttarakhand.
35	Landscape and Urban Planning (2006)	77			Ecological diversity of birds in relation to the structure of urban green space	U.G. Sandstro¨ma, P. Angelstama, G. Mikusin´ski	urban	birds	urban biodiversity	birds in cities			Sufficient amounts of natural vegetation such as large trees and a multi-layered vegetation structure are important components for maintaining high bird species diversity in urban green spaces.	

36	Center for Biological Diversity (2003)				Principles of Wildlife Corridor Design	Monica Bond							It is estimated that wildlife corridor with careful planning and design can help reduce the negative effects of habitat fragmentation by providing passage between large patches of habitats.	
37	Ocean and Coastal management (2018)	153			Using social media to strengthen public awareness of wildlife conservation	Yinglin Wua, Ling Xiea, Shiang-Lin Huanga, Ping Lia, Zengwei Yuanb, Wenhua Liu	public awarness	social media					More deeper studies are required to depict and provide conservation knowledge and negative impact on wildlife due to human behaviour and to generate public awareness to reduce public misunderstanding of policymakers and experts.	

4. Study Area

The project is being carried out in the complete Mumbai Metropolitan Region (MMR) comprising of Mumbai City, Mumbai Suburban, Kalyan Tehsil, Ambernath Tehsil, Pen Tehsil, Panvel Tehsil, Uran Tehsil, Karjat Tehsil, Ulhasnagar Tehsil, Bhiwandi Tehsil, Alibag Tehsil, Thane Tehsil, Khalapur Tehsil and Vasai Tehsil.

Google Earth imagery of the location is given in **Fig. 1.**

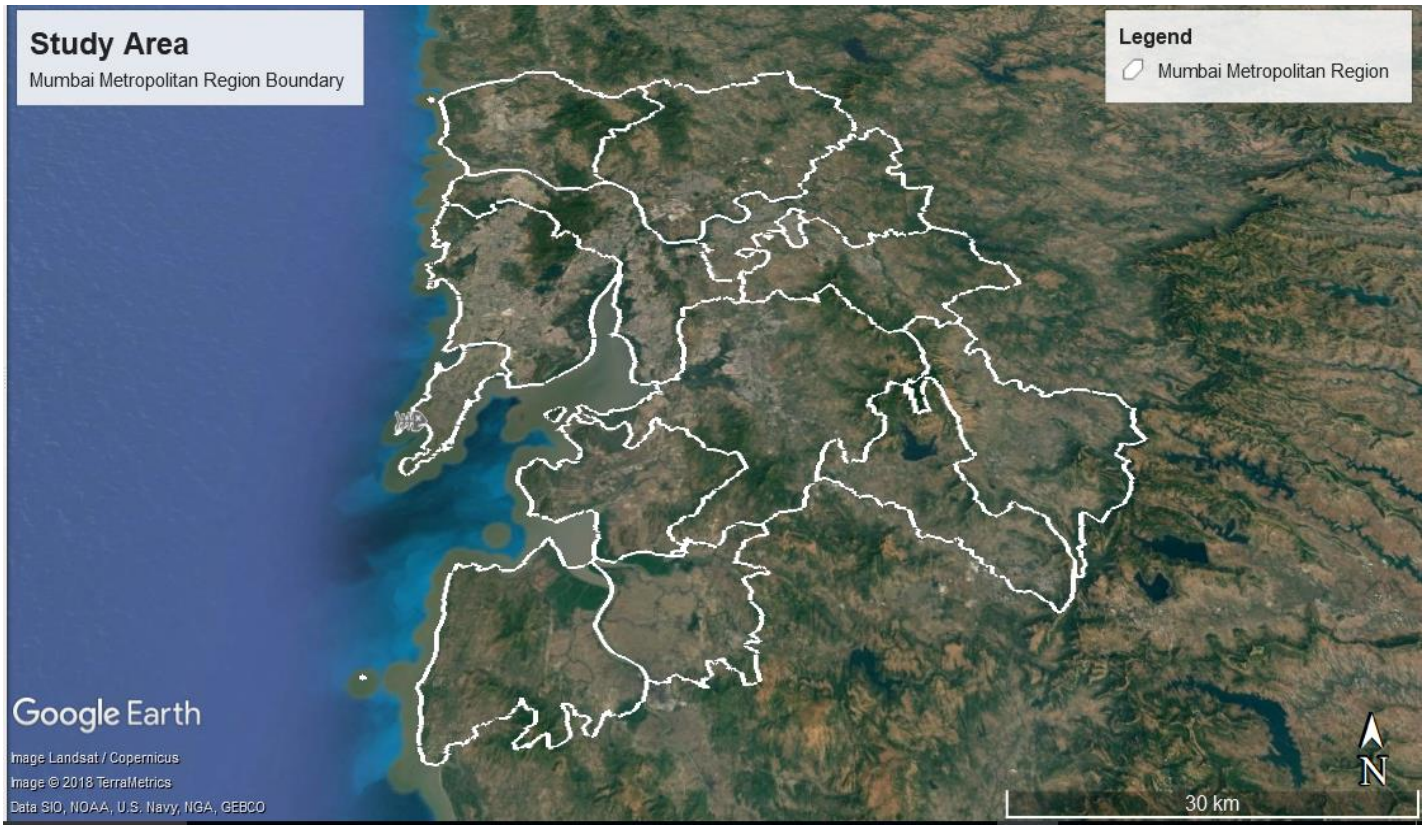


Fig. 1 : Google Earth Imagery of the Study Area

5. Methodology

5.1: Identification of NGOs and Individual Rescuers

NGOs and individual Rescuers in the MMR region, who are working in close association with the forest department were identified and they were interacted for obtaining data with consultation of the Forest Department.

5.2 Data Collection

Data was collected from various NGOs and Maharashtra State Forest from year 2014-2017. The data was collected by visiting the individuals and NGOs and explaining them about the need of data. For the same period, newspaper records were also checked.

5.3 Digitization of Data

Data collected will was converted into excel sheet records providing region-specific details of kill and rescue with the number of occurrences in a particular year.

5.4 Data Feeding into the Forest Department App

The data obtained from various NGOs within the MMR was provided to the Forest Department for feeding into the 'Prani Mitra App' prepared by the Maharashtra State Forest Dept. This app is expected to directly give a map output.

5.5 Report preparation

Based on this analysis, a report will be prepared on the potential causes leading to animals being injured or trapped (hence, requiring rescuing) and killed, highlighting the current scenario and gaps that need to be plugged.

The flow of the work to be conducted has been presented in **Fig 2** below:

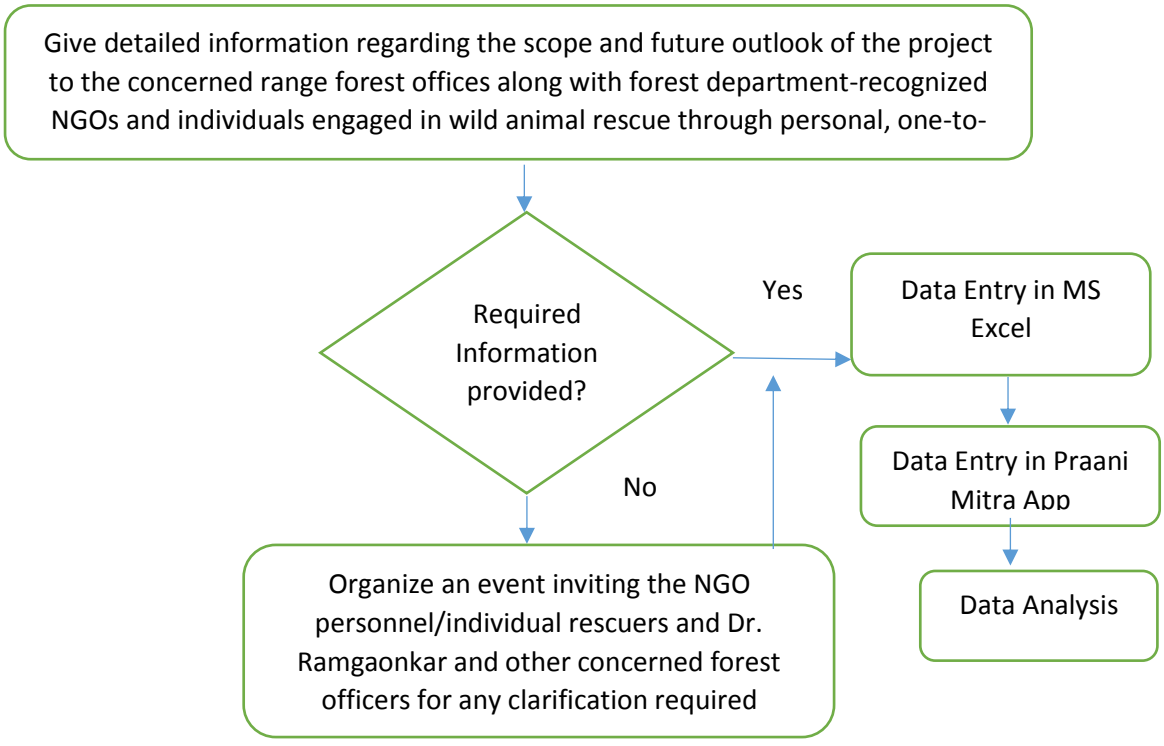


Fig 2: Flowchart of Work Schedule

6. Sources of Data

6.1 NGOs and Individual (Non –Governmental Sources)

About 14 NGOs and 5 individuals were contacted. A format for data entry, which was provided by the forest department, was forwarded to the NGOs and they were asked to submit the data in the given format. A few NGOs did not have the technical knowhow and/or required manpower to provide data in the format; in these cases, team TerraEnviro requested for their raw data, which was digitized.

A list of NGOs and individual rescuers contacted is given in **Table 3**

Table 3: List of NGOs and Individuals Contacted

Sr. no.	Area	Name of Organisation	Contact Person	Details of Data
1	Mumbai	Resqink Association for Wildlife Wellfare (RAWW)	Pawan Sharma :- 986978202	Data of 2014-17
		Spreading Awareness on Reptile and Rehabilitation Programme (SAARP)	1) Santosh Shinde:- 9769335531 2) Saket :- 9821134056	Data of 2017
		Plant & Animals Welfare Society (PAWS - Mumbai)	Sunish Subramania Kunj:- 9833480388	No data provided
2	Thane	Trust For rescue afforestration conservation and knowledge (TRACK)	1) Nitesh Pancholi :- 9920747818 2) Chandrakant :- 9869409946	No data provided
		Wildlife Welfare Association (WWA)	1) Aditya Patil :- 8080612930 2) Rohit Mohite :- 8452964788	Data of 2017
3	Kalyan	Kalyan Saarp Seva	1) Suhas Pawar :- 8850585854 2) Datta Bombe:- 9220468991	Incomplete data
		Plant & Animals Welfare Society (PAWS - Dombivli)	1) Nilesh :- 9820161114	No data provided
4	Raigad	Owls	1) Kunal Salunkhe:- 9011484969	Data not maintained

		Friends of Nature, Uran	1)Anuj Patil :- 8451030484 2) Jaywant Thakur:- 9594969747	Data not maintained
		Snake and Reptile Protection (SARP), Raigad	1) Pradeep Kulkarni:- 9766393198 2) Aniruddha Joshi :- 9960662329	Data not provided
		Sarp Vishva, Karjat	1) Nandkumar Tandel:- 7276809509	Data of 2018
		Care of Nature Samjik Satha Veshvi, Uran	1) Raju Mumbaikar:- 9819198947	Data not maintained
		Punarvasu	1) Shashank Padale:- 9664520880	Data of 2018
1	Raigad	Kapil Dev and Family (individual) Pen	1) Kapil Dev:- 9175026663	No data provided
		Mandar Gadkari (Individual) Alibaug	1) Mandar Gadkari:- 9423381465	No data maintained
		Rohan Nimbalkar (Individual. Turbe)	1) Rohan :- 9819099929	No data maintained
2	Vasai	Suraj Pandy (Individual)	1) Suraj Pandy :- 7666577293	No data provided
		Ashutosh Randive (Individual)	Ashutosh :- 937001001	No data provided

6.2 Forest Departments (Governmental Sources)

Forest range offices falling in the MMR were connected asking for the available rescue data and connecting various NGOs working in association with them. 6 forest offices were contacted.

A list of forest offices which have been approached is provided in **Table 4**, whereas scanned copies of our letters (requesting for the said information and describing the project scope) acknowledged by the forest department is presented in **Annexure I.**

Data has been received from Alibag DCF office and Kalyan range office. However, the data provided has no specific details of species and hence, cannot be used for digitization. Sample copy of the same is provided in **Annexure II.**

Table 4: List of Forest Departments Approached

Sr. No.	Name of Organisation	Contact Person	Details of Data
1	Office of Deputy Conservator Forests ,Thane Forest Division Lal Bahadur Shashtri Mark, Marathor Circle, Naupada Thane- 400062	Dr. Jitendar Ramgaokar (Deputy Conservator of Forests,)	Hardcopy in files (they are still searching for 2016 files)
2	Forest Department Office Mahatma Phule Chowk, Murbad Road, Kalyan, Thane Mumbai 421301	Mr Jadhav (Forester) 9773333472 Shri. Waghire (Range Forest officer, Kalyan) +91-9421050323	Hardcopy in files (they are still searching for 2017 files)
3	Office of the Deputy Conservator of Forests (Territorial) Alibag Near Collector Office, At. Po. Tal. Alibag Dist. Raigad Pin 402 201	Maneesh Kumar (Deputy Conservator of Forests,) +91-2141222016	Hardcopy in files only of last year (Gave references of local rescuers from their office)
4	Forest Colony Takka Village, Panvel, Navi Mumbai, Maharashtra 410206	Shri. Kupte Nandkumar Nanasaheb (Assistant Conservator of Forests Territorial and Campa) +91-9270056613	They will have to check for the data (Gave References of local rescuers from their office)
5	Township Hall JNPT township, Uran. 400707	Shri.Shashank Kadam (Range Forest officer, Uran) +91-9657488966	Contact concerned person and revert
6	Near Pen, Tahsildar office	Shri. Gaikwad (Range Forest officer, Pen) +91-9423936827	Contact concerned person and revert

7	Near Badlapur Station	Shri. Chandrakant Shelke (Range Forest officer, Badlapur) +91-2512674290	Contact concerned person and revert

Road Killed Data

Road Killed data was not available with individual rescuers as well the local NGOs for this data, Deputy conservator of forest of Thane, Alibag and Dahanu was approached ,road kill data from year 2012 to 2019 was available with Thane and Dahanu.

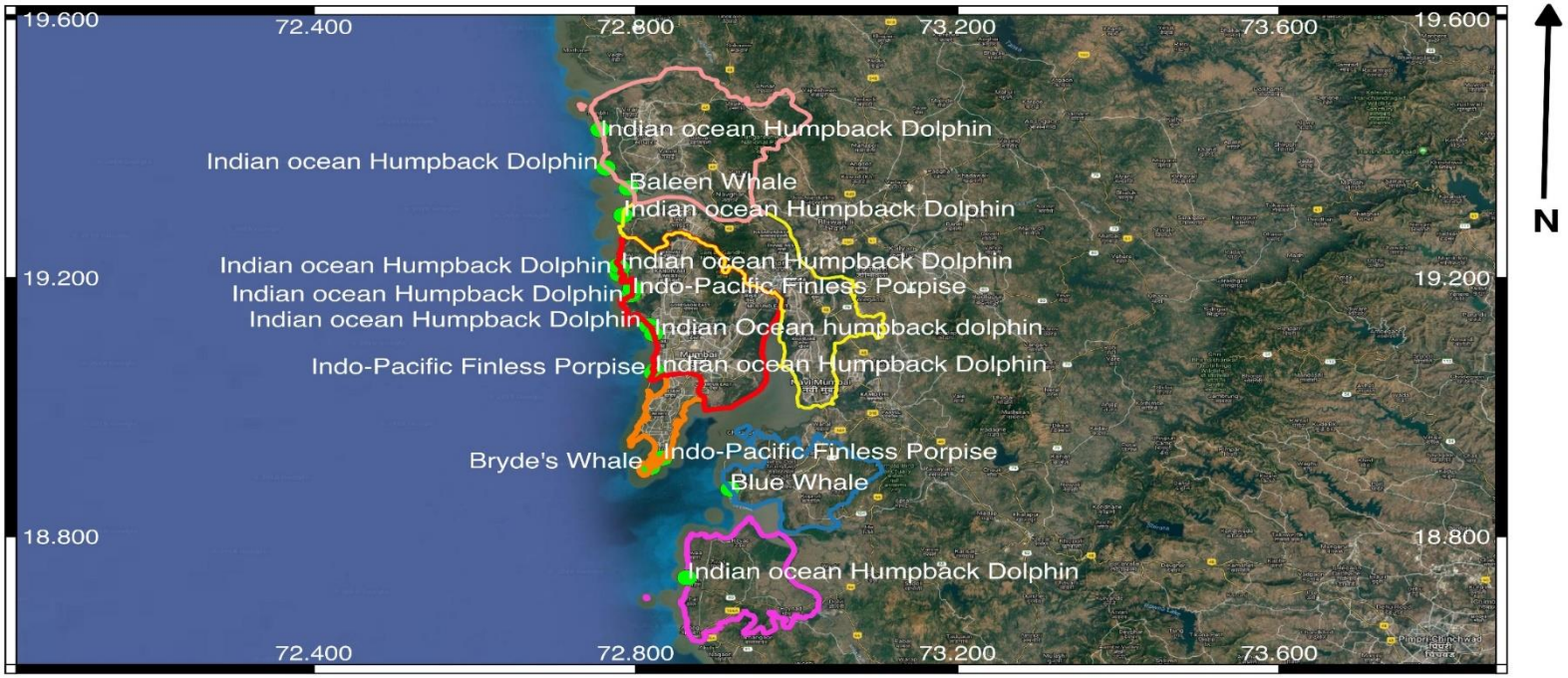
In Dahanu region three road accident are registered for Leopard in year 2013 ,2018 and 2019. Wheras in thane region two road kill/accident are registered for jackal and Leopard in 2017 and 2012 and Nilgai in 2016.

Data shared by the DCF office of Thane and Dahanu i is attached Annexure 1 and 2 at the end of the report.

***Data Entry*:**

A format in the form of excel sheet was provided by Mr. Chetan Vengurlekar (Prani Mitra App developer). All the available data was entered into the given format of the forest department. The Data was also generated into a map format. The map output of the data obtained is given in Fig.

Marine Mammal Strandings in MMR Region (2015-2018)



Legend

- Vasai Tehsil Boundary.
- Uran Tehsl Boundary.
- Thane Tehsil Boundary.
- Mumbai Suburban Tehsil Boundary.
- Mumbai Tehsil Boundary.
- Marine Mammal Strandings.
- Alibaug Tehsil Boundary.
- Google Satellite Hybrid Imagery.

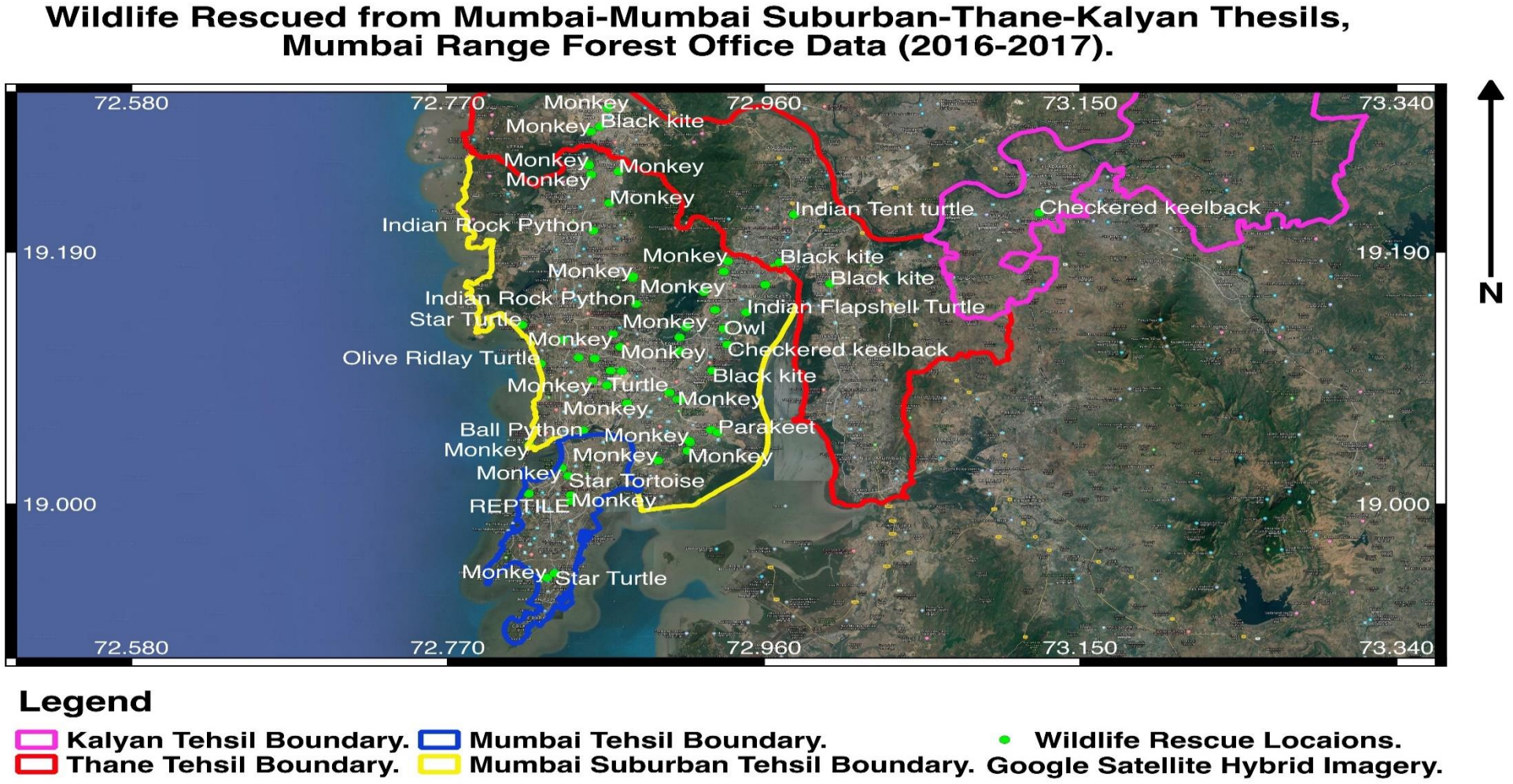


Fig.4 : Wildlife Rescued from Mumbai- Mumbai Suburbans- Thane –Kalyan Tehsil

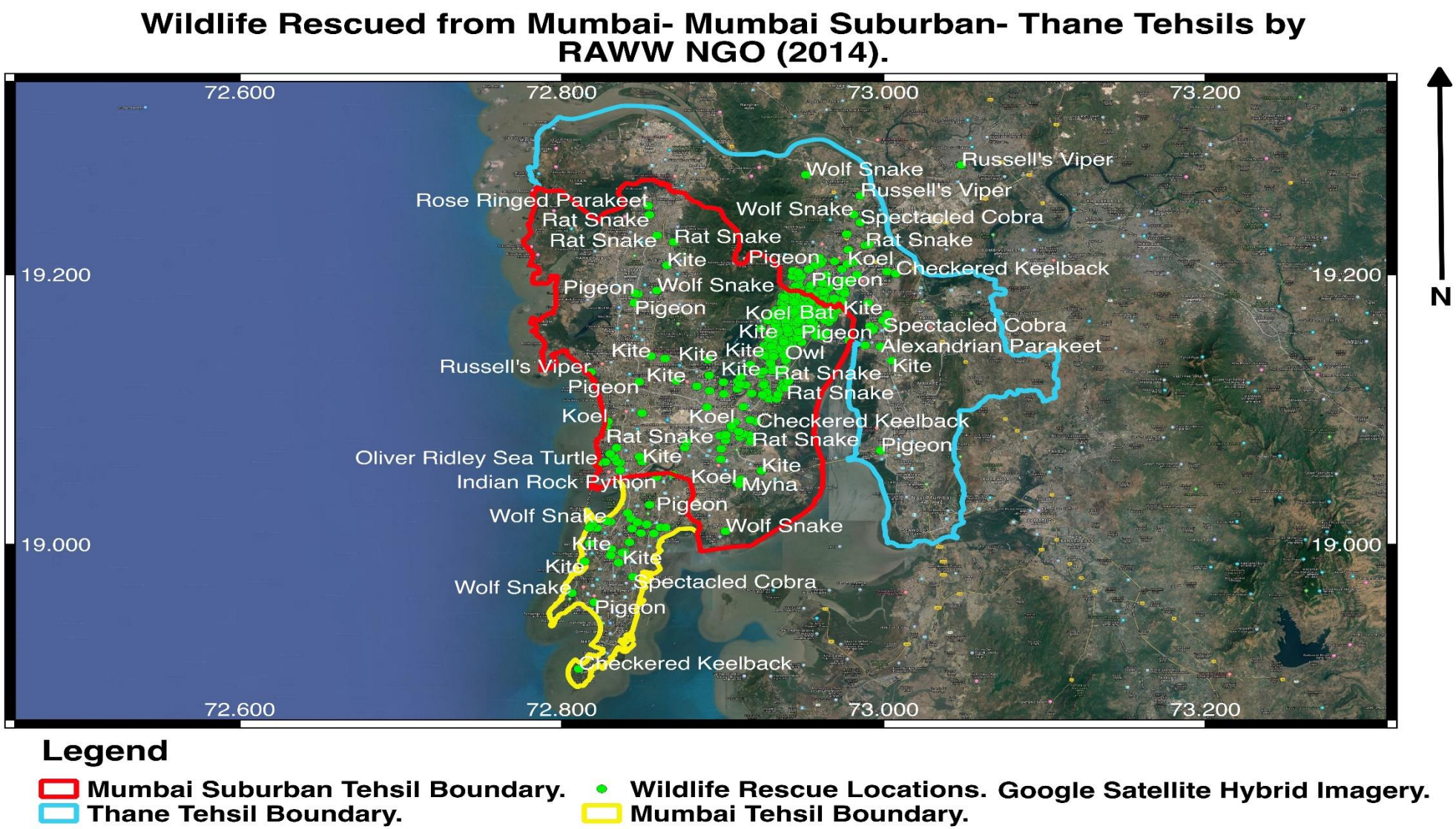


Fig. 5: Wildlife Rescued by RAWW NGO in 2014

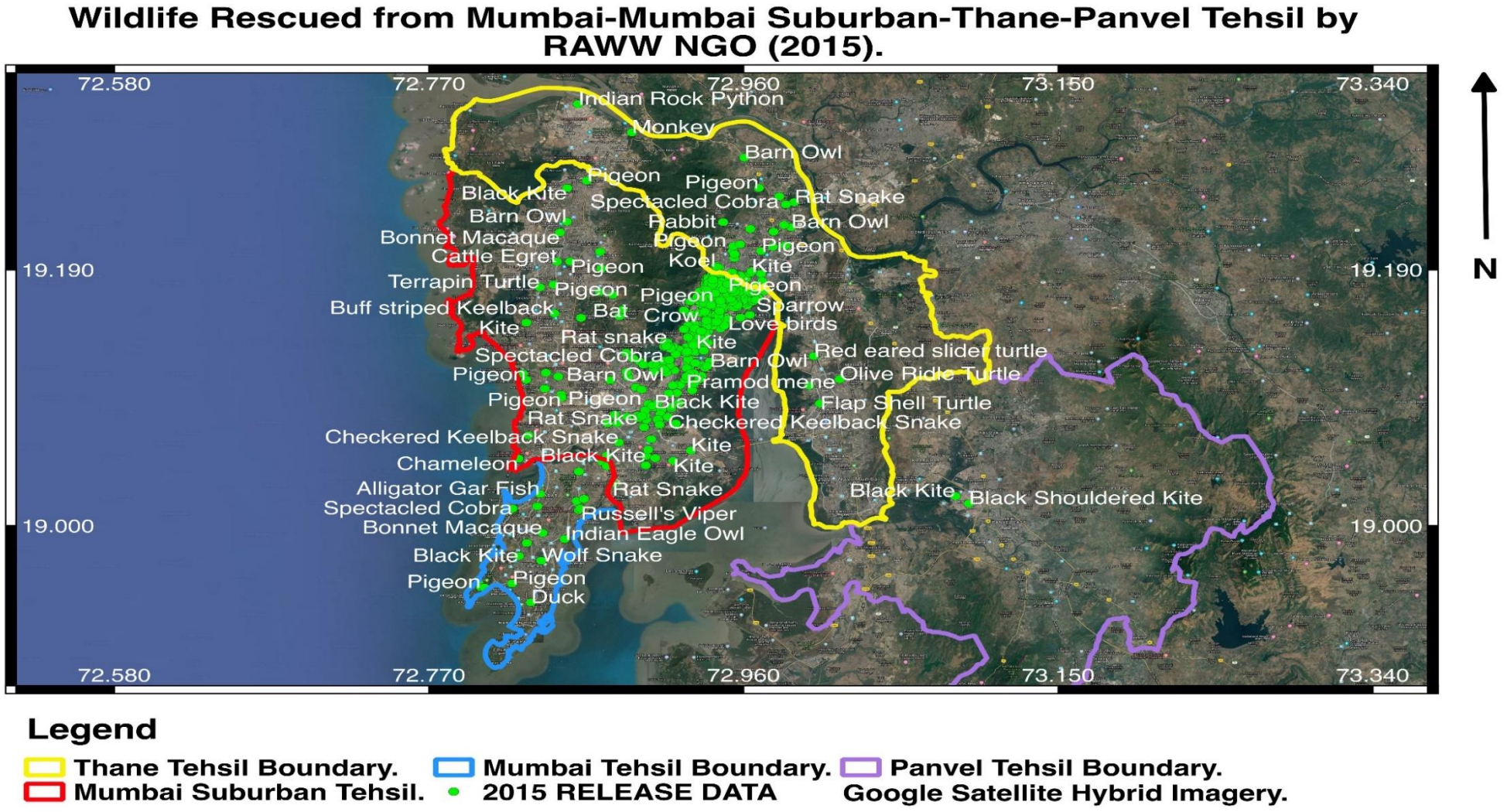
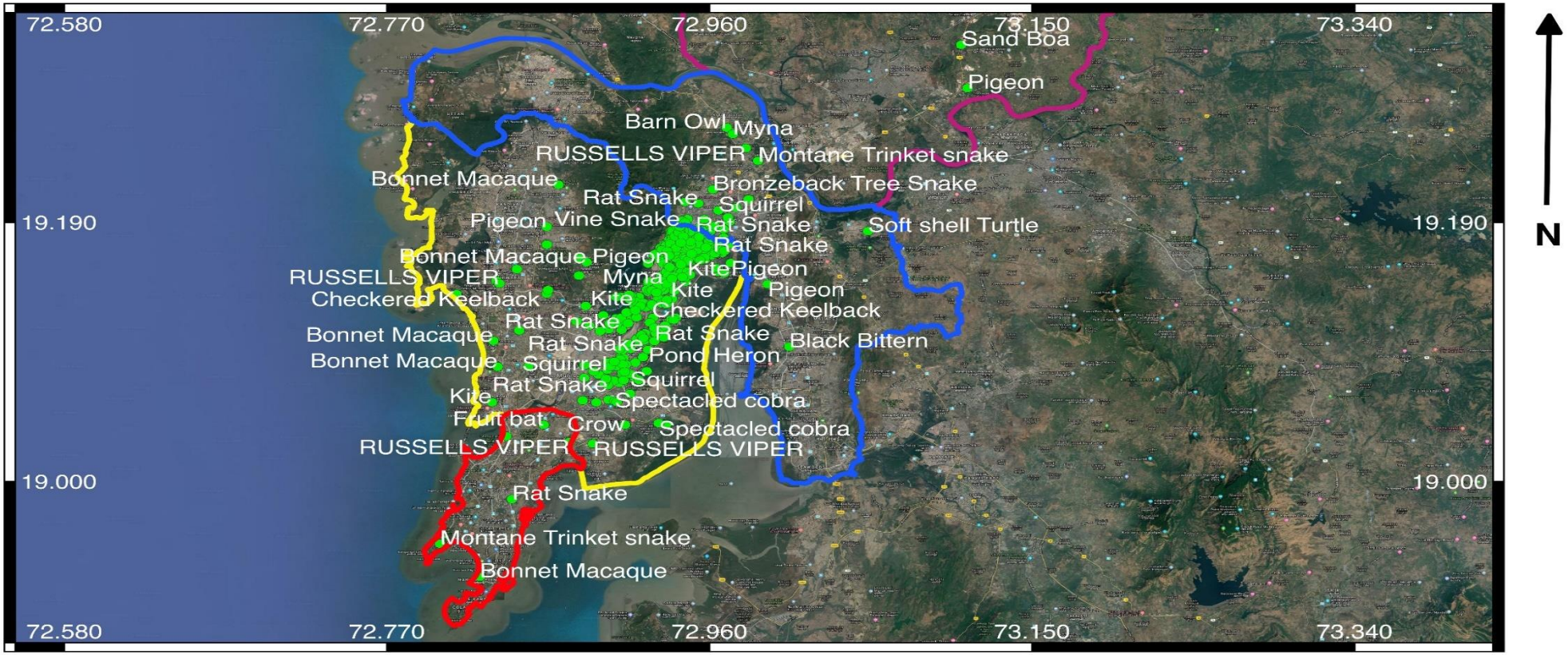


Fig. 6: Wildlife Rescued by RAWW NGO in 2015

Wildlife Rescued from Mumbai-Mumbai Suburban- Thane-Bhiwandi Tehsils by RAWW NGO (2016).



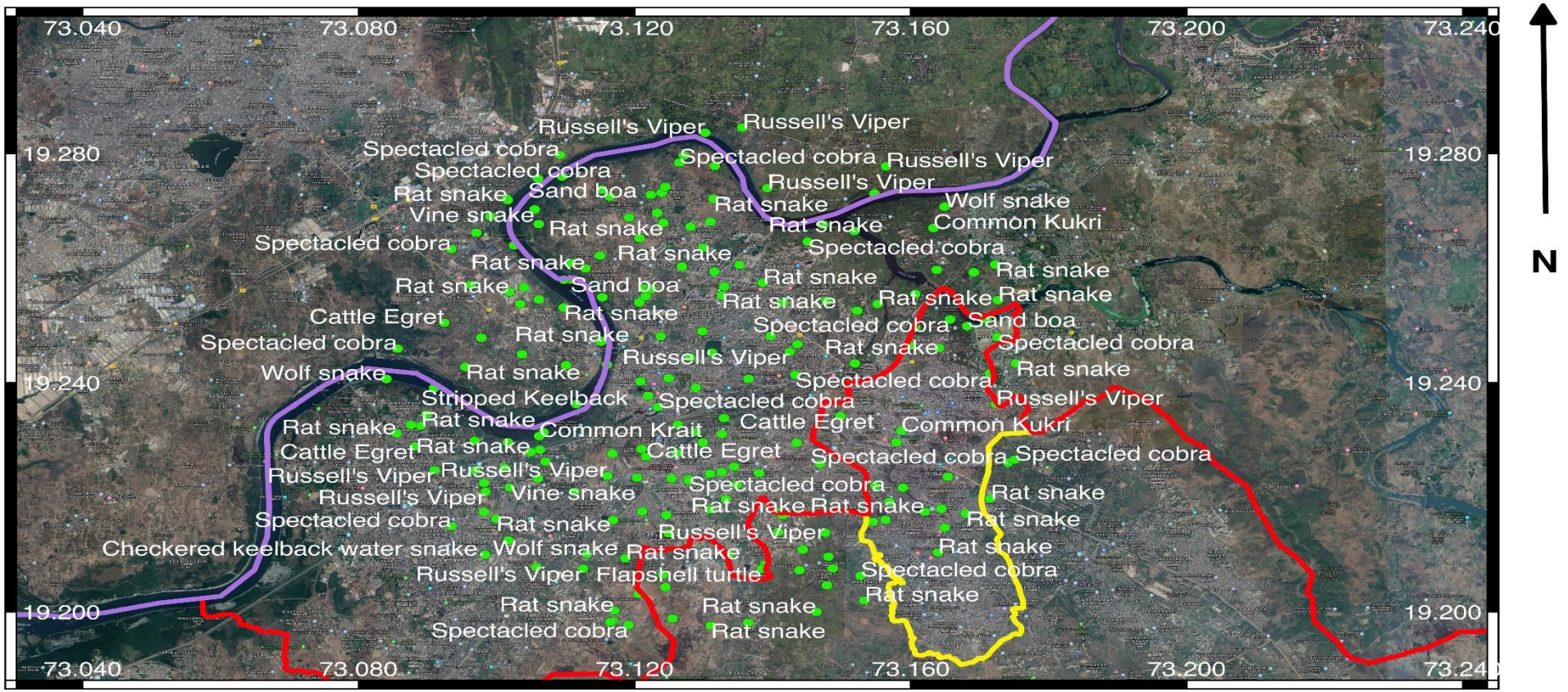
Legend

- Thane Tehsil Boundary.
- Mumbai Tehsil Boundary.
- Mumbai Suburban Tehsil Boundary.
- Bhiwandi Thesil Boundary.
- Wildlife Rescue Loactions.

Google Satellite Hybrid Imagery.

Fig.7: Wildlife Rescued by RAWW NGO in 2016

Wildlife Rescued from Kalyan-Bhiwandi-Ulhasnagar Tehsils by Datta Bombe.

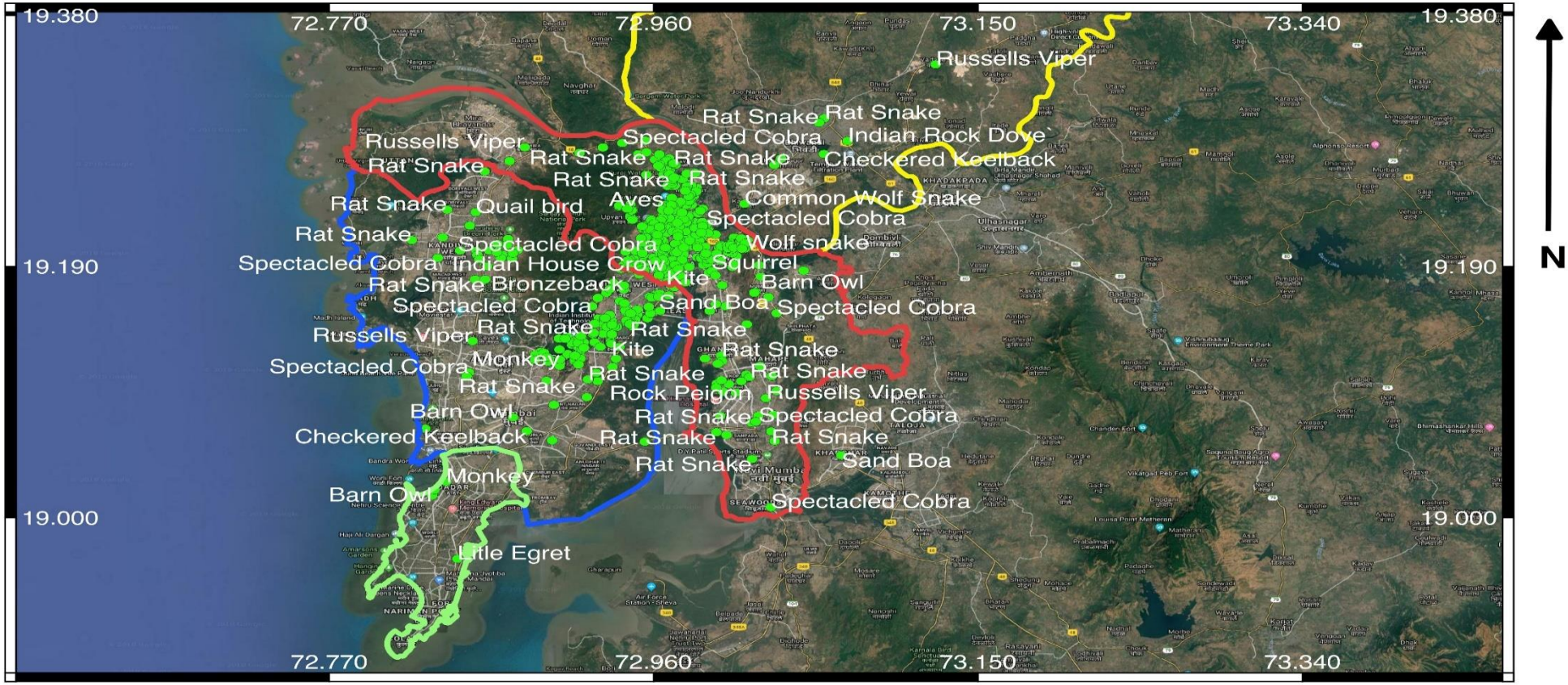


Legend

Bhiwandi Tehsil Boundary.
Kalyan Tehsil Boundary.
Ulhasnagar Tehsil Boundary.
Wildlife Rescue Locations.
Google Satellite Hybrid Imagery.

Fig.8: Wildlife Rescued by Kalyan Sarp Seva

Wildlife Rescued from Mumbai-Mumbai Suburban-Thane-Bhiwandi Tehsils by WWA NGO (2017).



Legend

Mumbai Tehsil Boundary | Mumbai Suburban Boundary. | Wildlife Rescue Locations.
Thane Tehsil Boundary | Bhiwandi Tehsil Boundary. | Google Satellite Hybrid

Fig.9: Wildlife Rescued by WWA NGO

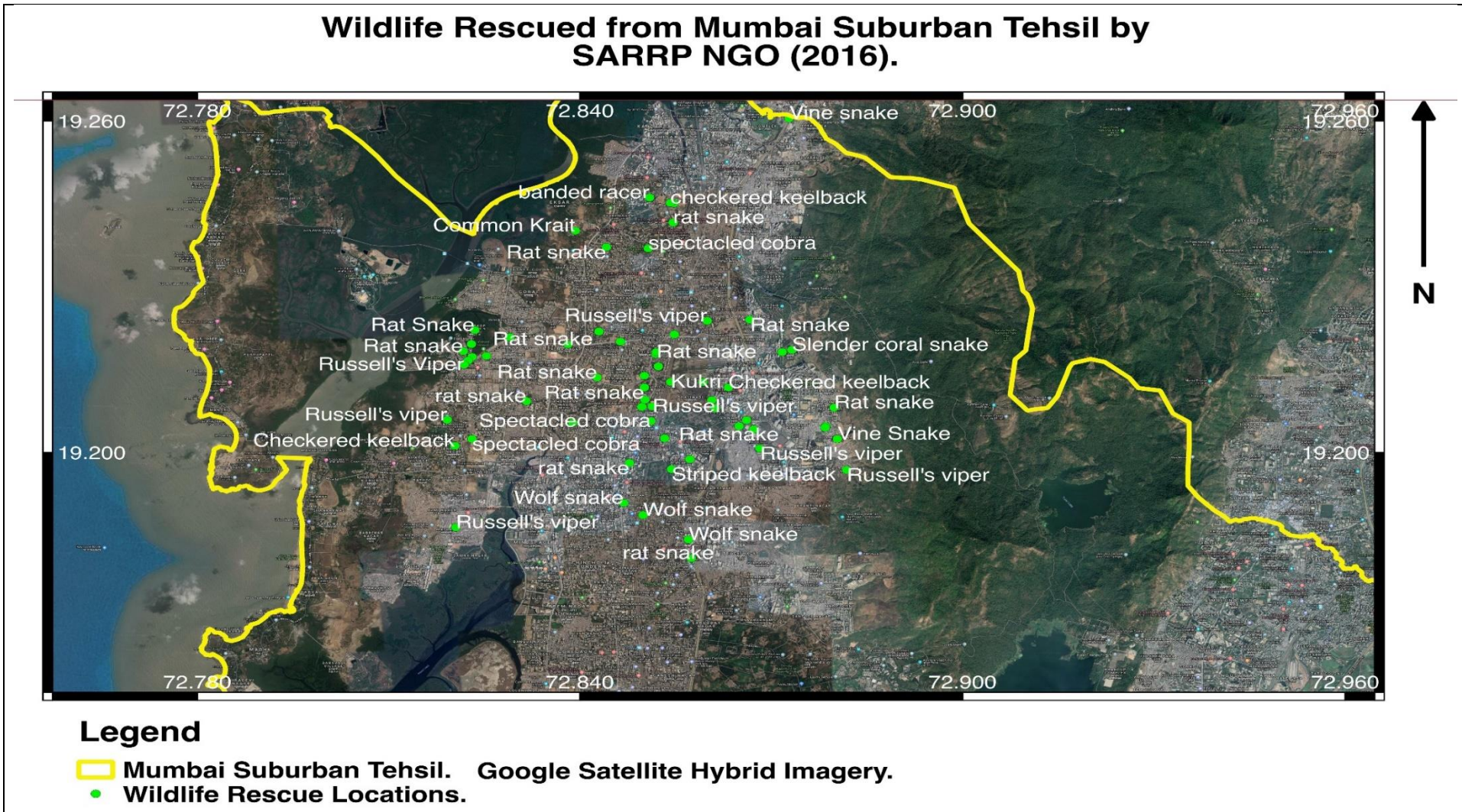


Fig. 10: Wildlife Rescued by SARRP NGO

7. Findings

7.1 Vulnerable Fauna

On the basis of the study it was found that reptiles are more prone to Human Wildlife Conflicts. Rescue data with respect to birds, reptiles and mammals for the years 2015, 2016 and 2017 is presented in Fig. 11, Fig. 12 and Fig.13 respectively. According to the data, more than 60% reptiles, majorly snakes, have been rescued from the MMR region, followed by birds and mammals.

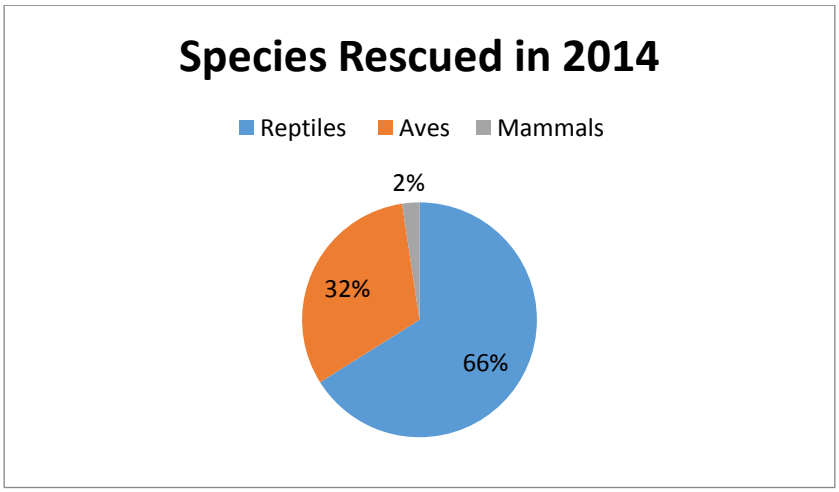


Fig.11: Species Rescued in 2014

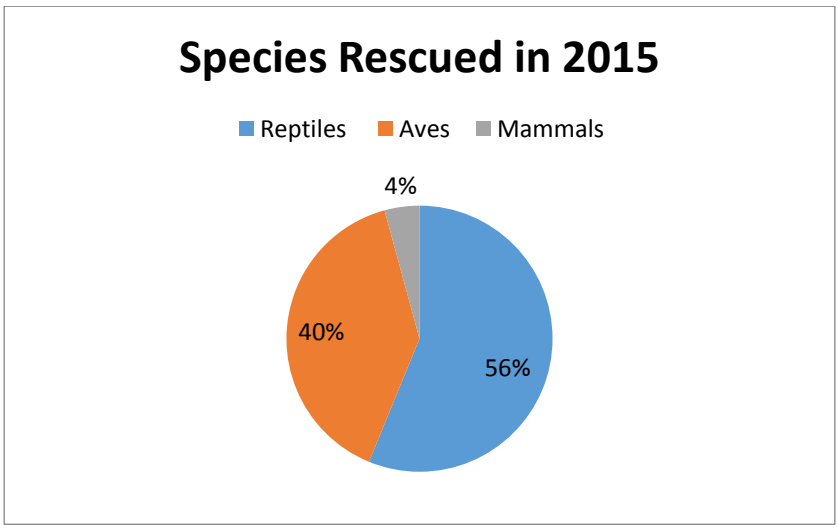


Fig.12: Species Rescued in 2015

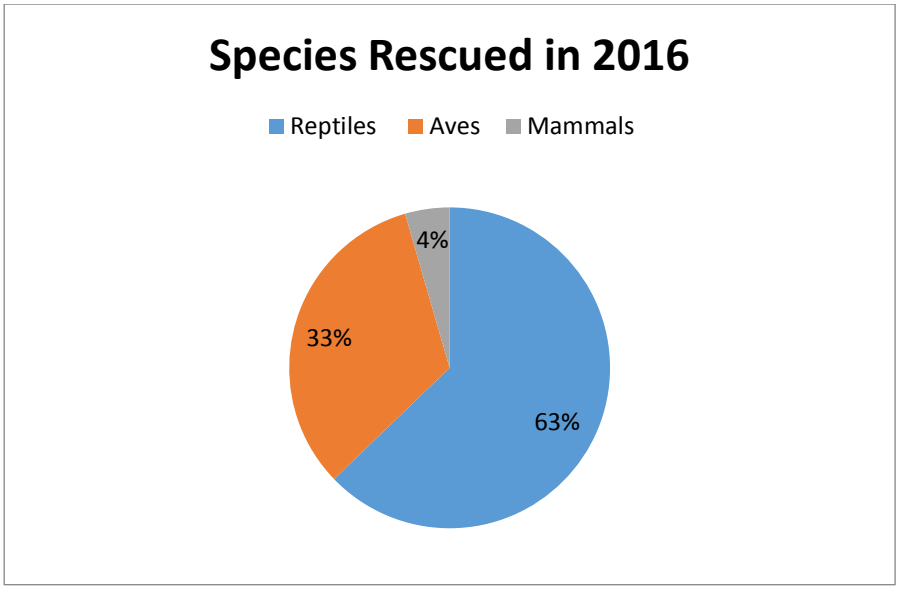


Fig.13: Species Rescued in 2016

7.2 Vulnerable Regions

According to the study the most vulnerable regions to Human-animal conflicts are Mulund, Bhnadup, Thane, Powai, Vikhroli, Bandra, Ghatkopar, Dharavi, Airoli, Chandivali, Worli, Kanjurmarg, Andheri, Marol, Parel, Khar, Juhu, Wadala, Colaba, Chichpokali, Dadar, Mankhurd, Kurla, Chembur and Sion. Mulund area showed maximum rescues. A diagrammatic presentation of the data for year 2015, 2016 and 2017 is given in **Fig. 14, Fig.16** and **Fig.17** respectively.

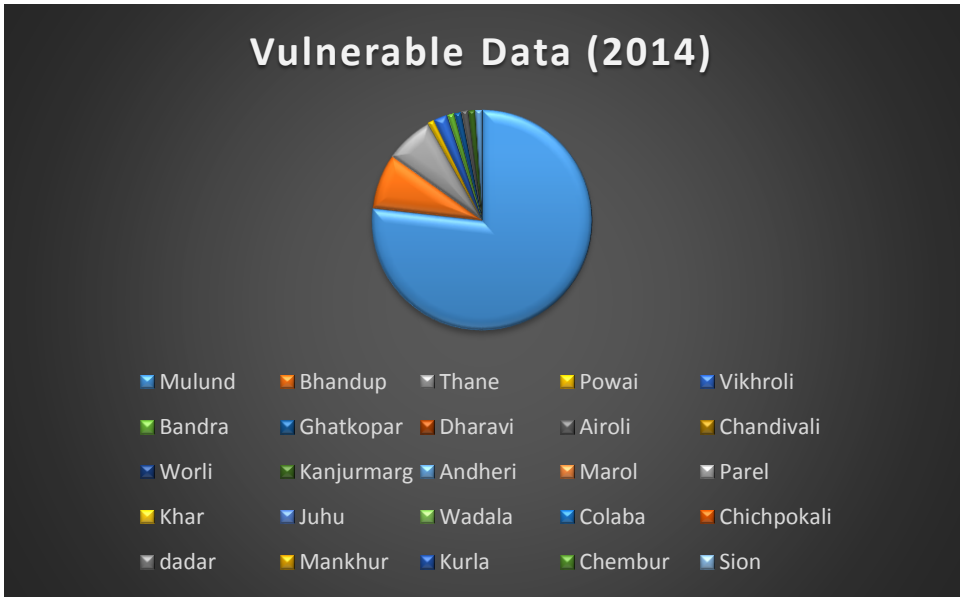


Fig. 14: Vulnerable Region (2014)

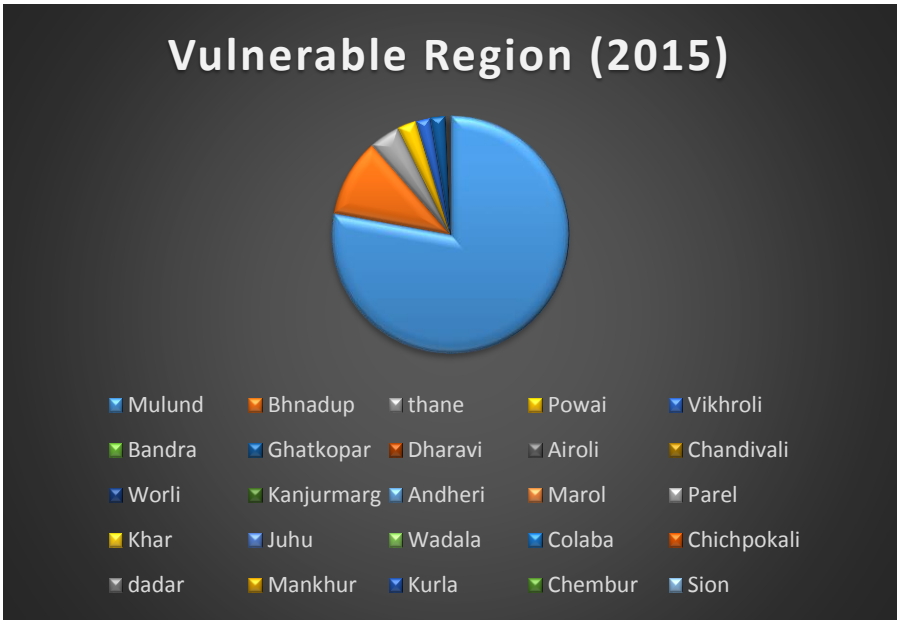


Fig. 15: Vulnerable Region (2015)

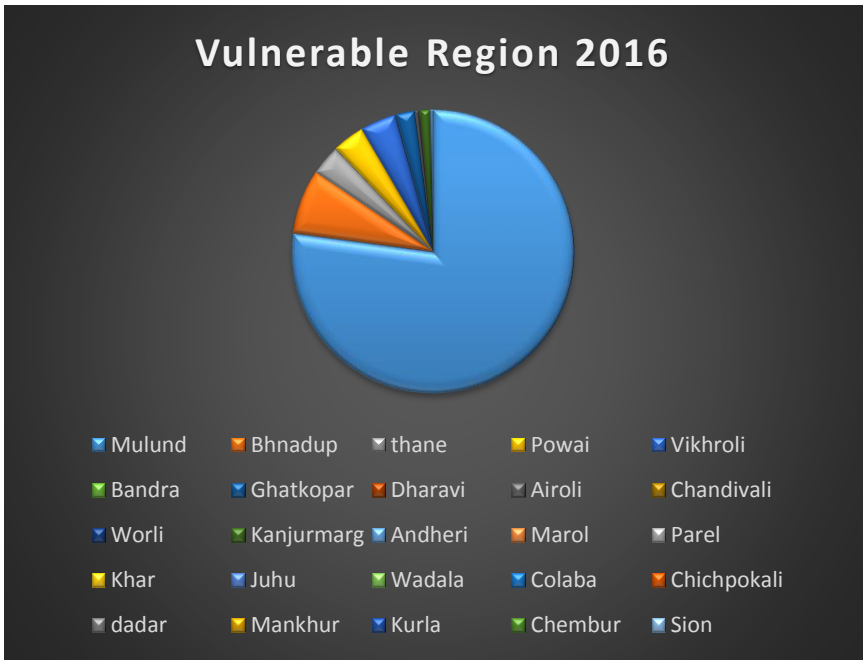


Fig. 16: Vulnerable Region (2016)

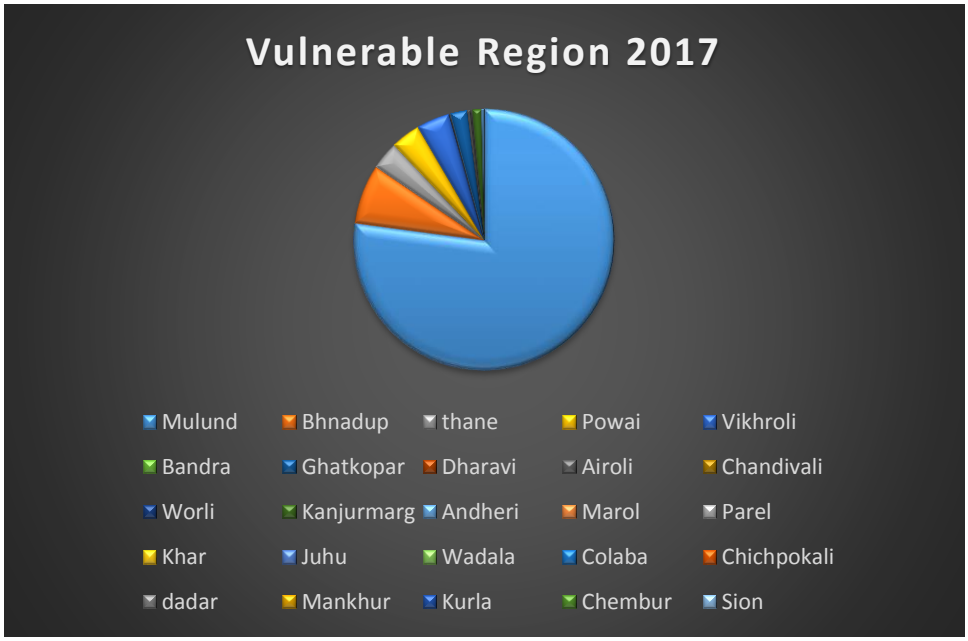


Fig. 17: Vulnerable Region (2017)

Mulund is found to be the most vulnerable region compared to other parts of the MMR followed by Bhandup. Other locations such as Vikroli, Thane Ghatkopar are also prone to Human – Wildlife Conflicts.

7.3 Causes of the Human- Animal Conflict

1. Encroachment:

According to one of the research, humans have affected about 75% of the land surface on the complete globe. The animals have been living and are adapted to a certain kind of habitat and any change in it leads to destruction of the population of several species. Increase in population have led to increase in the number of urban development impacting the biodiversity due to encroachment into the forest. The location where major issues of human animal conflict are observed is in Mulund near the boundaries of Sanjay Gandhi National Park. This location is highly prone to encroachment since years. This has led to destruction of forest by removal of floral species that serves as habitat for the wild animals by forcing them to migration from the location or death due to altered habitat. Due to stress on the habitat the animals move towards the nearby urban areas from the forest.

2. Infrastructure development-

Infrastructure development leads to alteration of several factors such as urban settlement structures, road, landscape, vegetation cover, hydrology, topography, wind patterns, etc. Development of structures near the forest has created a barrier effect for the wild animals. It not only leads to loss of

their habitat and resources but also restricts them to a set location making it difficult for them to move around for their food or shelter. Infrastructure also leads to increase in physical, chemical and biological pollution during the construction and operation phase. Also, the level of toxin and noise in the surrounding increases leading to movement of the animals.

Eastern Express Highway in Mulund is one of the major infrastructures that has been developed in the region making it susceptible to collision of vehicles and animals. The Eastern Express highway is surrounded by Thane creek on Eastern side and Yehoor hills on Western side. Hence, large-scale and dedicated measures need to be taken to reduce the impact of the highway on fauna.

3. Lack of Biodiversity Depots:

The hills of Sanjay Gandhi national park have no other biodiversity depot in the near vicinity as it is completely covered by city on three sides and only one biodiversity depot is located on either side of the Vasai creek but there is no connectivity over the creek. The nearest biodiversity depot is Thane creek that is located at more than 5 km from the said location. Also, the patch between the hills and Thane creek is a large patch of urban settlement. The movement of animal gets restricted due to absence of biodiversity corridors between the two locations. This leads to movement of animals in urban environment especially during nights and lack of green corridor diverts them towards human settlements.

4. Adaptation to Human Environment

Human encroachment has led to habitat destruction of many species, which has made them invade urban regions and live as a part of urban environment. Species of snakes have adapted to urban environment and are commonly seen in areas such as gardens, roofed houses, backyards, open sewages, etc. providing them shelter. Besides, they feed upon the amply available rodents, also an inevitable part of the urban environment due to poor garbage disposal and management. Stray dogs as a prey species after which leopards get lured has been highlighted in the leopard attacks of Mumbai. Also, human beings squatting for open defecation makes them vulnerable to leopard attack.

8. Conclusion and Recommendations

8.1 Conclusion

The study covered complete MMR region to detect various locations that are prone to Human- Wildlife Conflicts. All NGOs, individuals and Forest Department Offices in the region were contacted to obtain data related to conflicts. It was found the bodies working in recuing of animals are active all over the MMR but, very few maintain proper data of the recued animals.

Also, very few individuals are aware of the data management and 'Prani Mitra Application'. Also, the data stored by NGOs and forest department are stored in a crude format.

The study showed that location such as Mulund is more vulnerable to animal hazards, also reptile species were more vulnerable in the area to Human- Wildlife Conflicts.

However, the conclusions of this study may suffer from some limitations inherent with the study:

Limitations of the Study:

- In spite of the study being conducted in complete MMR region, data covering all locations could not be obtained.
- Very little data was formally maintained by the individual rescuers, making it unavailable for further processing
- Data obtained from few rescuers was not scientifically maintained, hence very less information was obtained. This unbalance data leads to a bias towards drawing conclusions regarding species-specific threats and conservation plan.
- In spite of a large volume of data collected by some NGOs related to natural history and conflicts of the animal without scientific guidance makes the data unavailable for scientific use
- All active NGOs and individuals were approached but data was not provided by few NGOs
- Also, data obtained might be specific to only those species which are considered as harmful by people (such as snakes), and for rescuing other species, people would avoid connecting with the NGOs.

8.2 Recommendations

a. Scientific Way of Data Management: It is recommended that all the organisations and individuals should be trained in proper data management in a scientific manner. This can be done by conducting training sessions for the active members along with forest department, wherein they can be made aware about the 'Prani Mitra Application', need for data management and scientific manner of data management.

b. Soft Engineering Structures: Crossing structures need to be constructed for birds across roads at several locations in city areas. The crossing are made of simple structures like rope ladders. This can connect two either sides of the roads providing a cross for the bird reducing chances of avifaunal kill.

Fig.18 : Crossing for Birds

c. Underpass for reptiles:

To mitigate the impact of roads an under pass can be constructed under large roads where the traffic movement is more. The underpass will facilitate safe passing of the reptile.

Fig. 19 and 20: Structure of Underpass

To create such structures a behavioural study is needed to understand the choice of the reptile for selecting an underpass for passing. Factors such as substrate type, aperture diameter, length, light permeability, temperature, etc. are few of the attributes that needs to be considered when creating an underpass.

d. Overpass:

In area where the conflicts are high, a wildlife corridor can contribute in conservation of species and act as a green corridor in urban environment.

Wildlife corridor can be defined as a link of wildlife habitat, with native vegetation, which joins two or more larger areas of similar wildlife habitat. Corridors are critical for the maintenance of ecological processes. It can comprise of level grounds dedicated to wildlife movement, with overpasses and underpasses to go across man-made barriers like roads and railways or natural ones like rivers or valleys.

Fig. 21 and 22: Pictorial/Diagrammatic Representation of Overpasses

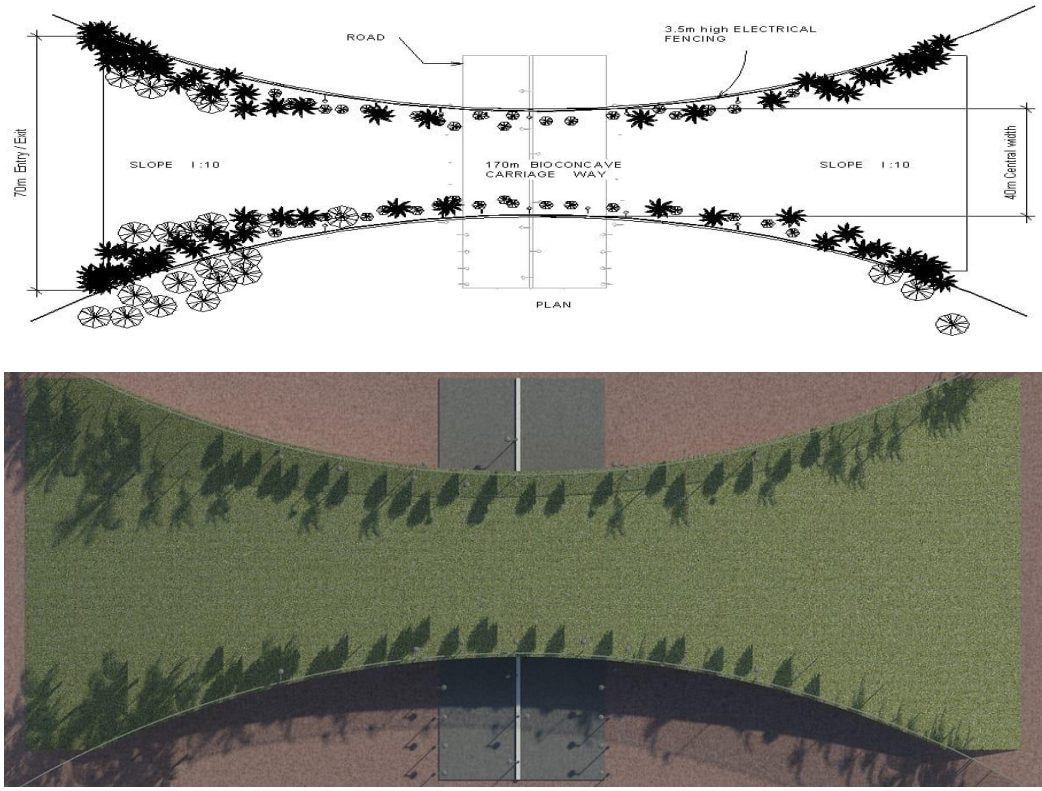


Fig.23 and 24: Tentative Design for Ecological Corridor

Wildlife corridors are significant from the point of view of –

a) Reduced loss of animal life due to road and rail accidents

b) Prevention of gene pool isolation

c) The wildlife corridor, along with its underpasses and overpasses is actually a natural habitat by itself, and while larger mammals will use it transiently, smaller creatures can complete their life-cycle therein!

Important design criteria of over-passes –

e) Very gentle slope/incline at both ends (10:1)

f) A bi-concave shape from top-view, with broader entry and exit points

g) Side boundaries of the structure to be bounded with local, native trees so that the underlying disturbance (rail/road) is not obvious and preferably, the noise is filtered out

h) There may be mild electric shock-giving fencing to the sides so as to prevent animal from jumping over

i) Attracting the wild animal towards the overpass with dung/urine/feed

8.3 Future Perspective

Scientifically maintained rescued data can be used for several studies such as local biodiversity of the region, distribution of species, abundance, diversity of species, factors affecting their population and threat to such species. Also, rescue data helps in designing and proposing various species-specific conservation plans by studying locations where the specie has been more prone to conflicts. On the basis of the study it was understood that the rescuers are working only due to their enthusiasm in their work and no scientific data management of the rescue is maintained by them. The rescuers need proper scientific guidance by any professional. Hence, it is suggested that several training sessions need to be conducted for individual rescuers and NGOs wherein proper guidance needs to be provided to them on data management of rescued species. Also, the complete data stored by the NGOs needs to be processed and managed by one single party, either the forest department or any one NGO, to ensure easy availability of all the data.

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Annexure 1

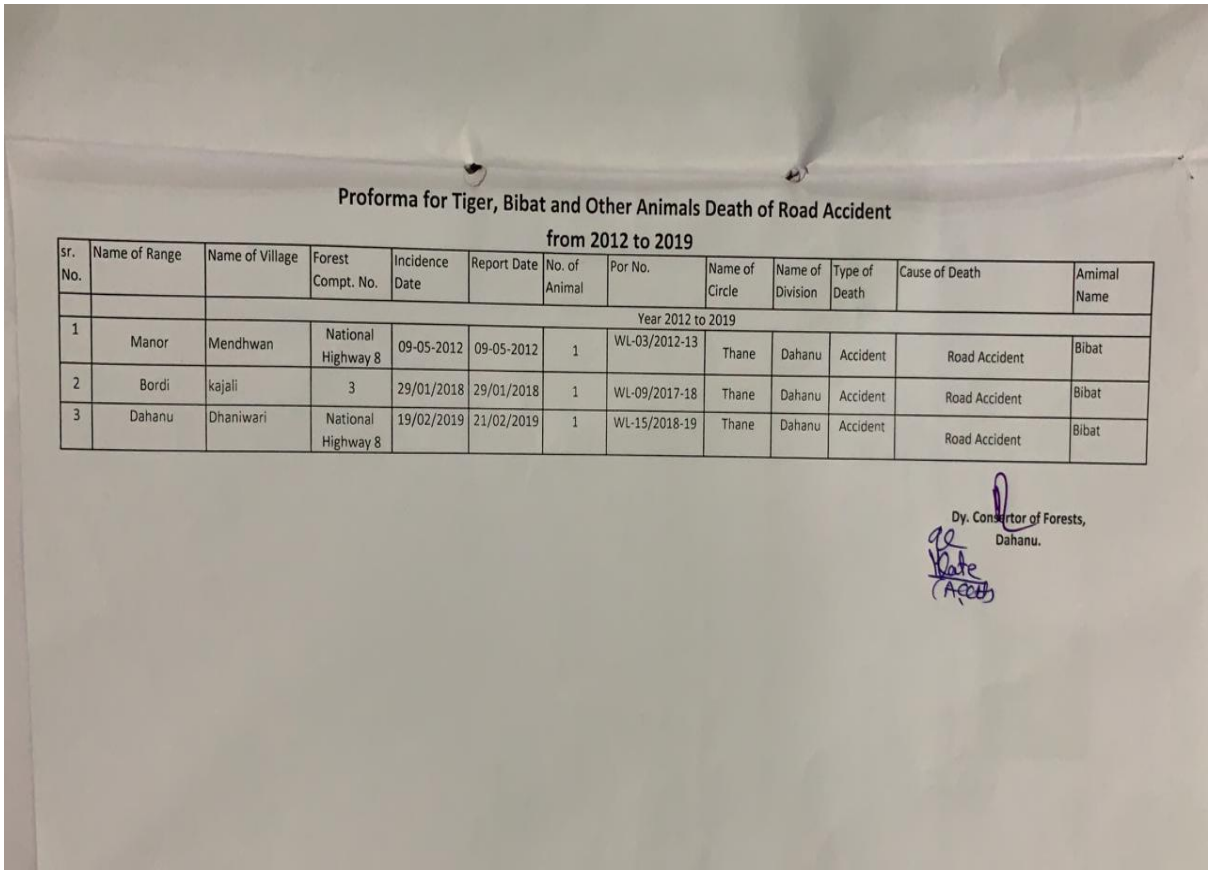
Road Kill data received from Thane Division.

Road Killing Data _POR 2012 to 2019								
Sr.No	**Date.**	**Range office**	**Latitude**	**Longitude**	**Species**	**Caller Name**	**Caller Number**	**Address**
1	16.11.2017	Thane	19 01 15.58 N	73 00 30.34 E	Jackal	Shri. Bupesh Shri. Shrikant Raskar	9820947443	Sanpada, Navi Mumbai
2	08.05.2012	Mumbai	-	-	Leopard	-	-	aare colony Unit No.13
3	11.02.2016	Tokawade North	19 30 52.06	73 64 58.13	Boselaphus	-	-	-
4		Tokawade south			Nil			
5		kalyan						
6		Murbad West						
7		Murbad East						
8		Badlapur						
9		Bhiwandi						
10		Mandvi						
11		Padgha						

Deputy Conservator of Forests
Thane Division Thane

Annexure 2

Data received from Dahanu Division.



Proforma for Tiger, Bibat and Other Animals Death of Road Accident from 2012 to 2019

sr. No.	Name of Range	Name of Village	Forest Compt. No.	Incidence Date	Report Date	No. of Animal	Por No.	Name of Circle	Name of Division	Type of Death	Cause of Death	Amimal Name
		Year 2012 to 2019										
1	Manor	Mendhwan	National Highway 8	09-05-2012	09-05-2012	1	WL-03/2012-13	Thane	Dahanu	Accident	Road Accident	Bibat
2	Bordi	kajali	3	29/01/2018	29/01/2018	1	WL-09/2017-18	Thane	Dahanu	Accident	Road Accident	Bibat
3	Dahanu	Dhaniwari	National Highway 8	19/02/2019	21/02/2019	1	WL-15/2018-19	Thane	Dahanu	Accident	Road Accident	Bibat

Dy. Conservator of Forests,
Dahanu.