

22 - 23 February, 2019

A report on Vishwamitri Vadodara Crocodile Count 2019

With an aim of Wildlife Conservation

Organized by



In Association with



Technical Partners



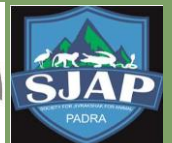
1. Vishwamitri is a unique riverine ecosystem that has a healthy, self-sustaining and breeding population of mugger crocodiles.
2. Research papers, monographs, popular articles, books, etc. published on Vishwamitri riverine habitat and the resident Crocodiles provide ample testimony to the importance of this unique ecosystem.
3. In Vadodara, crocodiles occasionally come in interaction with the locals especially during monsoon season.
4. Population density and geographical preferences of crocodiles can be known by conducting census at various time intervals.
5. Census is key for wildlife management and yearly population estimation of crocodiles will help in generating a database that can be vital for their conservation in Vishwamitri River.
6. Long term studies can provide insights on seasonal movements, range extension, reproductive success and overall breeding biology of crocodiles.
7. Therefore, it is the prime duty of Barodians to conserve the natural heritage of our city and the resident of urban wildlife.

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Report on Mugger Crocodile Count at Vishwamitri, Vadodara, Gujarat, India: With an aim of Wildlife Conservation



Picture Credit: Hashshiv Solanki



Organized by Pagdand, Vadodara, Gujarat, India

Team Members



Mr. Nishith Dand, Crocodile Project In-Charge,

Managing Director of Sure Safety & PagDand, He was Former Chairman of Confederation of Indian Industry (CII) for Central Gujarat Zonal Council and the Managing Director of Sure Safety (India) Pvt Ltd., He is fondly known as the “Space Suit Man”, as sure safety is the first to manufacture the “Astronaut Crew Escape Suit” for ISRO. He is also credited with many a first’s for the Industry to ensure Safety of the Industrial personnel especially in the fields of Respiratory and Body protection. Beside his entrepreneurial endeavours. Mr. Dand is passionate about biodiversity conservation and environmentalism. This passion led him to form the foundation of ‘Pagdand’, an NGO, based in Vadodara, along with likeminded people working in the area of biodiversity conservation.



Mr. Raju Vyas, Crocodile Project Chairman

Regional vice Chair of the IUCN/SSC crocodile specialist group. He is now retired after 30+ years of service as a Zoo Inspector, at the Sayaji Baug Zoo, Vadodara, India. He is the Regional Vice Chair of the IUCN/ SSC Crocodile Specialist Group (South Asia and Iran), and also a member of IUCN/SSC’s South Asian Amphibian and Reptile Specialist Group, Conservation Breeding Specialist Group and Reintroduction



Dr. R.V. Devkar, Crocodile Project Chairman

Professor at Faculty of Zoology, M.S. University He is an expert in zoology with 15 years’ worth of research experience under his belt. His research interests include micro chiropteran ecology, conservation breeding & reproductive biology of birds, ethno biology and Nano biology. He has been teaching for 20years.



Mr. Dhaval Patel, Crocodile Project Leader


Founder and fulltime trustee of VNC. He looks after all day to day activities. He is also co-opted Member: Animal Welfare Board of India. Honorary wildlife Warden: Anand district, by Govt. of Gujarat. Secretary: Bhaikaka Foundation, Trustee Sardar Vallabhbhai trust.



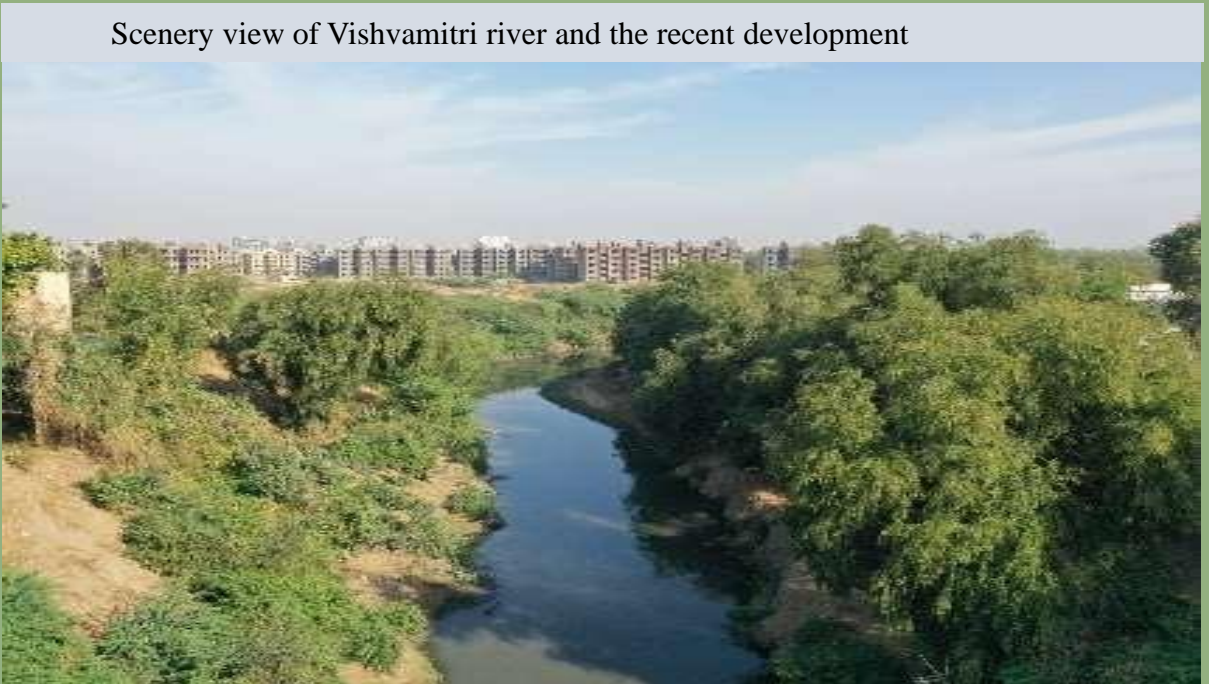
Mr. Kartik Upadhyay, Crocodile Project Leader

Businessman and wildlife photographer. He is businessman as well as wildlife photographer. He is involved in wildlife conservation and photography. He believes wildlife conservation as one of the responsibility of humans and is working hard to achieve it. He is expert in breeding behaviours.

Team Members

	<p>Mr. Anirudh Vasava, Crocodile Project Leader</p> <p>Research Coordinator at VNC. He is a conservation ecologist, he focuses on planning and implementing various research and conservation projects, which involve wolf monitoring in Kutch, crocodiles in central Gujarat and forest owlets in Dang forest. In 2013, he received the Duleep Matthai Nature Conservation Fellowship for contributing towards conservation of crocodiles in Charotar region in Gujarat, India. He is also a member of the IUCN-SSC Crocodile Specialist Group.</p>
	<p>Mr. Manoj Thaker, Crocodile Project Leader</p> <p>Entrepreneur and Wildlife Photographer. He owns Maruti authorized service centre. He is mindful entrepreneur with more than 20 years of experience in his field. He is passionate about studying and involving in wildlife and has interest in wildlife photography.</p>

Scenery view of Vishvamitri river and the recent development



Team of The Forest Department & Members **Supports & Acknowledgement**



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Team of Forest Department & Members



Shri S. K. Srivastava, IFS
Chief Conservator of Forest, Vadodara Circle.

The Principal Chief Conservator of Forests is an officer belonging to the Indian Forest Service (IFS). The Principal Chief Conservator of Forest is equivalent in rank with the Director General of Police and Chief Secretary to the State Government. We are thankful to Mr. Srivastava for his continuous guidance and mentorship which helped us in completing our research successfully. Your knowledge and guidance were a blessing for us.

Smt. Aradhana Sahu, IFS
Conservator of Forest, Vadodara Circle, Vadodara.

The Conservator of Forests is an officer belonging to the elite Indian Forest Service. Mrs. Aradhana helped us in finalizing the report. It could be very difficult to show research on papers without the guidance of Mrs. Aradhana. We are lucky enough to work under your guidance and supervision.



Mr K.J. Maharaja, GFS
Dy. Conservator of Forest, Social Forestry, Vadodara

The Deputy Conservator of Forests is responsible for managing the forests, Environment and wildlife related issues of a Forest Division of a state or union territory of India. Mr. Kartik Maharaja actively participated in the event and with the help of him and the forest department we successfully conducted our research study.



A large size animal basking on the river banks

Glimpses of The Events



Welcome speech by Mr. Nishith Dand



Aim and objectives of croc count speech by Dr. R. Devkar



Glimpses of The Events



Over all view of mugger crocodiles in India



The forest staffs and researcher team at the field sessions



Field training to all participates by researcher team

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Glimpses of The Events



Participates in field training



The forest staffs and researcher team at the field sessions



Final instruction from Mr. Kartik Maharaja, Dy Conservator of Forest

Preface

Vadodara is known as a “cultural city” in INDIA. The city has a unique and a glorious history.

We Barodians are also proud to co-exist with “MUGGER”, Crocodiles are the charismatic mega fauna and keystone species of freshwater ecosystem in India.

Vishwamitri is a unique riverine ecosystem that has a healthy, self- sustaining and breeding population of mugger crocodiles.

We at PAGDAND NGO, have wildlife conservation as a core agenda amongst our larger goal of biodiversity conservation.

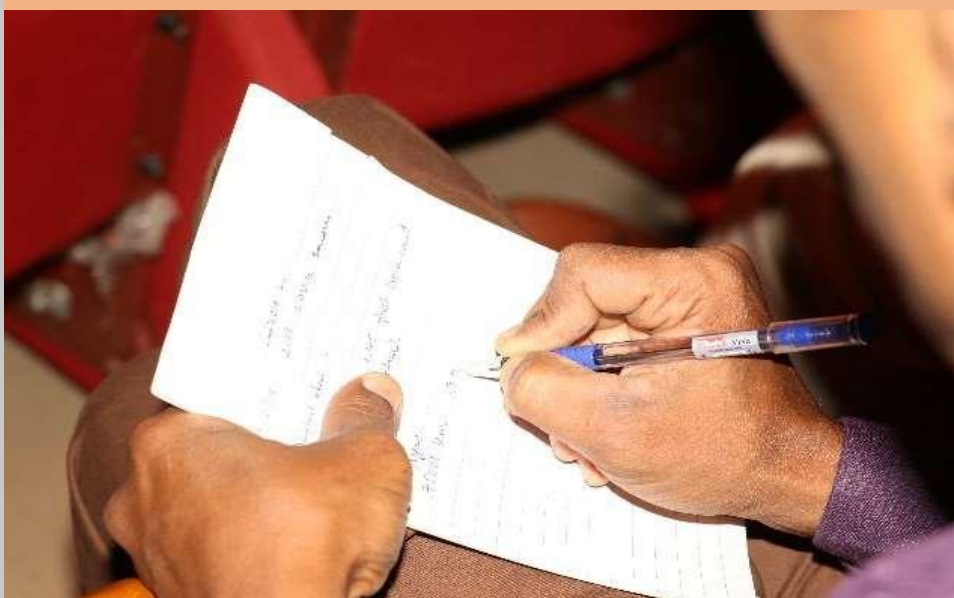
- Vadodara has witnessed a healthy growth of mugger in the past few years, the city is also grappling with issues around Vishwamitri River for sewage and encroachment issues, the mugger habitat is fairly disturbed and an evident change in behaviour is also noted. With these thoughts we decided to initiate this unique study with the forest department.
- Vadodara Vishwamitri Vadodara Crocodile Count Report held on 22nd and 23rd with an aim of wildlife conservation, Day time ground survey method, Citizens based count, Statistical analysis was very successfully carried out with the support of various organisations .
- We are very happy at pagdand , that we were successfully able to achieve our goal on the crocodile count with quantifiable results and meaningful recommendations
- We also sincerely hope and also commit to pursue that the recommendations are implemented



Glimpses of The Events



Team arrangement and area allocation



Data card filing practice by participate



Data sheet collection after the counts

Executive Summary

One day crocodile count event was carried out with the support of over one hundred participants from various wildlife enthusiasts, schools and colleges students, conservationists and volunteers of various organizations, along with the blessing of forest departments and its field staffs (guards, foresters and range forest officers) as the use of 'citizen science' tool. Total 169 individual animals from all sizes/age groups counted with density 6.25 muggers/km recorded in river stretch from Dena village to Talsat village of River Vishwamitri. This 27 km long river stretch flows through highly human populated urban city Vadodara, Gujarat. Of these, 169 muggers were further identified 18 juveniles below one meter (10.65%), 76 sub-adults between length of two meters (44.97%) and 71 adults above two meters long (42%), and remain four were noted as unknown size (2.36%) muggers, along with excluding of few water bodies of city, namely Lalbaug, Vadsar, Talsat and Kalali village ponds. The total crocodiles count on that day reached up to 170 muggers, within city limits.



Glimpses of The Events



Large mugger basking on banks of



Mugger basking on river banks at Bimnath , Vadodara



Mugger and solid west at the river

1. Introduction

1. Why this Event?

Mugger Crocodiles are the charismatic megafauna and keystone species of freshwater ecosystem in India. Vishwamitri is a unique riverine ecosystem that has a healthy, self- sustaining and breeding population of mugger crocodiles. Coexistence of mugger with humans in Vadodara is quite intriguing. Research papers, monographs, popular articles, books, etc. published on Vishwamitri riverine habitat and the resident Crocodiles provide ample testimony to the importance of this unique ecosystem. Census is key for wildlife management and regular population estimation of crocodiles will help in generating a database that can be vital for their conservation in Vishwamitri River. It was important to conserve crocodiles and to know the figure of crocodiles living in the banks of Vishwamitri River. This event will help to know the existing problem faced by crocodiles and changes need to address for the betterment of river. The need of the event in brief are as follows:

1. To count number of big and small Crocodiles with in city of Vadodara.
2. To identify the level of pollution in the banks of Vishwamitri river.
3. To observe, interpret, conclude and to give further recommendations to the problem.
4. The research carried out with an aim to observe the problems faced in Vishwamitri River and by its habitant.
5. To interpret the data and to further give conclusion and recommendation in order to improve the current situation.

2. Study Area

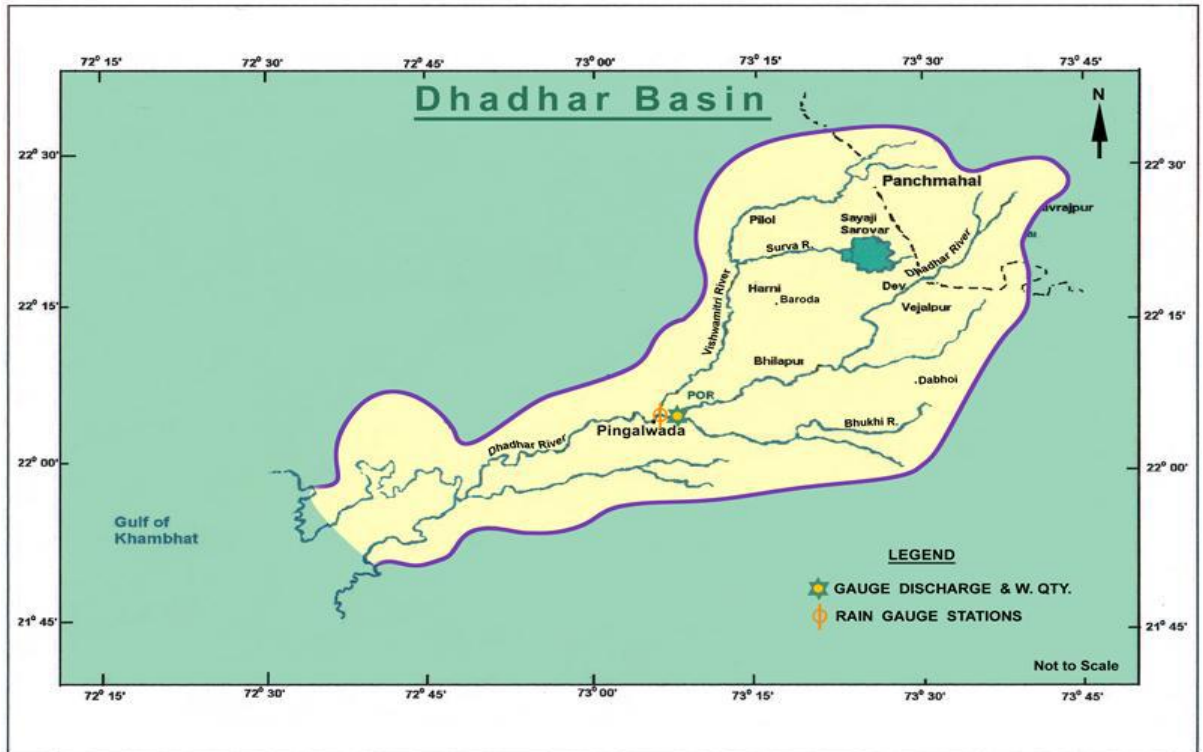
The study area is the small river stretch of Vishwamitri River, which is flows through the human landscape of urban city of Vadodara, Gujarat, India, including few water bodies of the city being part of the river systems.

2.1. Over View of Vadodara City



Baroda (now known as Vadodara) was an erstwhile princely state of the Gaekwads with Sir Sayajirao Gaekwad III being the architect of modern Baroda. This city is the Third Most-Populated City in the Indian State of Gujarat with population close to two million. Some areas of the city are highly crowded with more than 10000 people / sq.km. The city is also known as the ‘Cultural Capital of Gujarat’ due the people known for their literacy, scholarly pursuits, tolerance and emotional maturity. Rivers are the indispensable feature of urban history wherein; civilizations have flourished for ages on their banks and later metamorphosed into modern day cities.

2.2. Vishwamitri River: History & Geology



The 'Vishwamitri' is a seasonal river which originates in the Pavagadh Hills and flows east to west between the Mahi and Narmada rivers in Gujarat. Today, Vishwamitri flows through the highly populated and clustered urban areas of Vadodara city and joins the Dhadhar River and Khanpur River before emptying into the Gulf of Khambhat near Khanpur village. This river system includes the Sayaji Sarovar on the Vishwamitri River near Ajwa, and the Dev Dam on the Dhadhar Branch.



High numbers of muggers found within human dominant landscape

It flows westward through the city of Vadodara, further downstream it is linked with two other tributaries Dhadhar and Jambuva and finally culminates in the Gulf of Kambhat. As it flows through Vadodara, the Vishwamitri River receives the city's sewage and effluent from nearby industries.

2.3. Problem Related with the River



Picture shows current status of crocodile surrounded with pollution and plastic waste

Over the years of its course within the city of Vadodara, the river has been subject to severe abuse as a consequence of rapid urbanization and neglect towards water systems within the city and its outskirts. It has also suffered relentless ecological damage by way of sewage, contaminated storm water outfalls, industrial effluents drained in the river and several other point and non-point sources of pollution.

Problems faced during floods and monsoon season

During monsoons, residents of the industrial city of Vadodara face a strange problem. As the rains swell the Vishwamitri river, which passes through the heart of the city, crocodiles pop up at the most unlikely places—roads, rail tracks and parks. Travelling through the sewer line, baby crocodiles have sometimes even appeared in bathrooms.



River pollution and plastic wastage everywhere in Vishwamitri river bank

2.4. Mugger Crocodile: Present Status

The Mugger Crocodile (*Crocodylus palustris*) is distributed in Persia, Iran, Pakistan, India Bangladesh, Bhutan, Nepal and Sri Lanka. The mugger is the most adeptly species which is found in various types of habitat ranging from river to large lake and up to small puddles to village tanks and road side ditches, too. The Mugger Crocodiles is one of the threatened reptiles in India and legally protected under Schedule-I animals, under the Indian Wildlife (Protection) Act. In late sixties, the species has depleted from its entire distribution range due to illegal hunting, fishing and habitat loss which brings muggers at the edge of extinction but had recovered due to “Indian Crocodile Conservation Project”. This species is reported from over 10 states in India and an estimated population of over 2,500 to 3,500 in the wild.

The notable mugger population is recorded in Indian states of Tamil Nadu, Kerala, Maharashtra, Goa, Uttar Pradesh, Orissa, Gujarat and Rajasthan. In Gujarat, the mugger population is estimated to be about 1700 and is found in all parts of the state including Kutch, Saurashtra and Central Gujarat with congregations in Vishwamitri river, Vadodara and wetlands of Charotar being noteworthy.

THE TIMES OF INDIA, AHMEDABAD/BARODA
MONDAY, FEBRUARY 18, 2015

Wildlife activist to conduct census of Vishwamitri crocs

Report Of This 1st Pvt Count To Be Made Public In 10 Days

Tushar.Tew@timesgroup.com

RAPID RISE

Year	Crocs
2001	70
2007	100
2011	205
2015	260



Vadodara: In what could be a first-of-its-kind initiative by a private citizen, a Baroda-ian will take up count of crocodiles living in Vishwamitri River.

Nashir Dand, a businessman and environment activist, has decided to take up the cause of crocodiles that have been living in the river for more than a century now. Dand said that the comprehensive report will be submitted to the state government. The census will be done for two days beginning February 22 and the report will be prepared within 10 days.

"Crocodiles living in Vishwamitri have been such an important part of our ecosystem. It is due to these reptiles that the river and its biodiversity has survived, but there has never been a comprehensive study of this river. So, we decided to conduct a census of the crocodiles living in Vishwamitri," said Dand, the founding trustee of Pagdand, a NGO that works for environment conservation.

The last census conducted in 2015 had put the number of crocodiles in the river at 260. They had also covered 10 lakes in Vadodara where crocodiles had been spotted. No fresh census of crocodiles has been done since then.

"A team of 60 persons including the experts will conduct the census and study the other aspects of the river too. Apart from the number of crocodiles, we will be studying their behaviour, size, food habits and breeding. The focus will also be on other living creatures in the river," Dand told TOI.

When asked why a separate census was required when the forest department already does the count regularly, Dand said that the reports prepared by them are not available in public. "We haven't come across any detailed study done by the forest department about the crocodiles and biodiversity in Vishwamitri River. Our idea is to publish a report so that people too can understand the importance of crocodiles and this river," Dand said.

Vishwamitri River has been home to hundreds of crocodiles and turtles apart from the migratory birds that nest along the riverbank during winters every year. "Millions of litres of sewage water is released in this river by the Vadodara Municipal Corporation (VMC), some of which is treated. The study will also cover the impact such water has on the reptiles and how they have adapted to it," Dand added.

The study will cover the river stretch between Dens village on the northern end of the city to Talasra on the southern side. The human-crocodile interface will be one of the key aspects of the report.

"Every monsoon, several crocodiles are rescued from this river and rehabilitated to other places. It is necessary to study how and where they are rehabilitated," Dand added. The seven lakes in the city where crocodiles have been spotted will also be covered in the study.

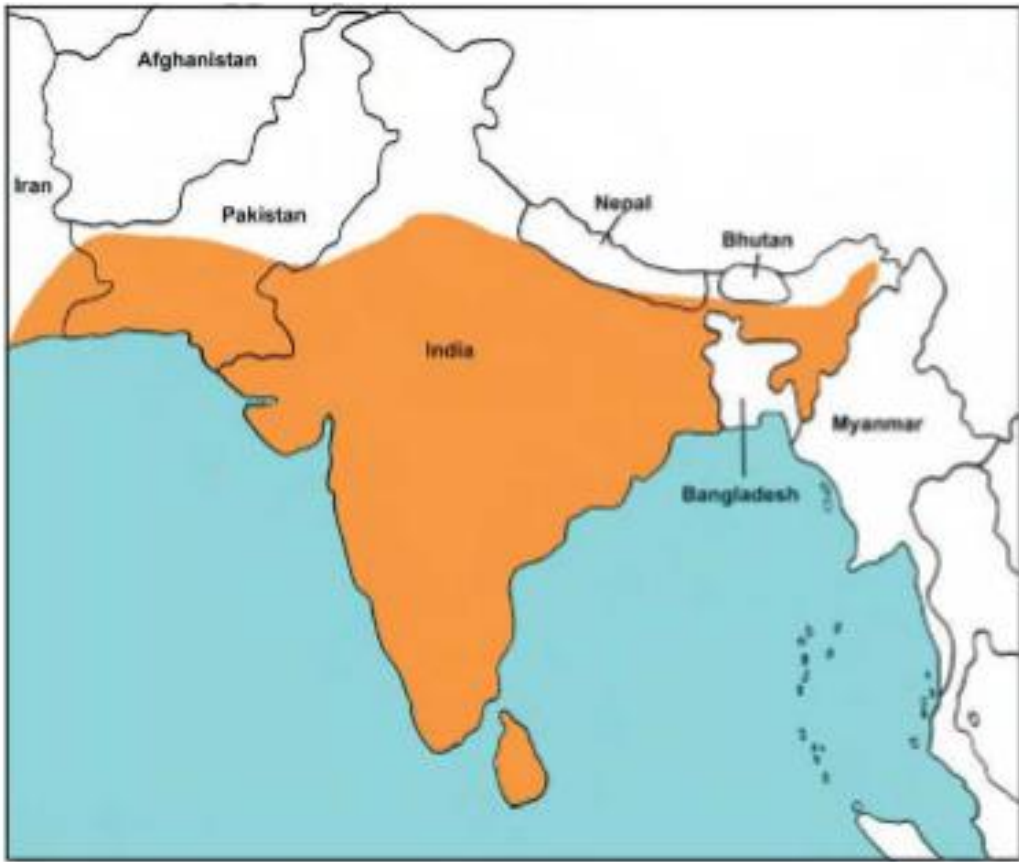
2.5 Mugger Crocodile in India

This species is reported from over 12 states in India and an estimated population of over 8,500 to 9,500 in the wild. The notable mugger population is recorded in following Indian states, Tamil Nadu, Kerala, Maharashtra, Goa, Uttarakhand, Uttar Pradesh, Orissa, Chhattisgarh, Gujarat and Rajasthan. In Gujarat, the mugger population in the state is estimated to be about 1700 and is found in all parts of the state including Kutch, Saurashtra and Central Gujarat with congregations in Vishwamitri River Vadodara and wetlands of Charotar being noteworthy.

2.6. Mugger Crocodile in Vishwamitri

Mugger Crocodiles are the charismatic megafauna and keystone species of freshwater ecosystem in India. In the past, erstwhile Baroda had about 50 mugger crocodiles reported to inhabit Sayaji (Ajwa) Sarovar during the early 70's but their population might have migrated to the down streams of Vishwamitri river due to various natural and anthropogenic pressures. Today, the Vishwamitri forms a unique riverine ecosystem that has a healthy, self-sustaining and breeding population of mugger crocodiles. This ecosystem includes, the natural meanders of the river, oxbows, associated lakes, ponds, drains (Kaas) and rivulets. The urban landscape of Vadodara city has undergone several anthropogenic changes but the crocodiles have been able to thrive all the years. Research papers, monographs, popular articles, books, etc. published on Vishwamitri riverine habitat and the resident Crocodiles provide ample testimony to the importance of this unique ecosystem. In Vadodara, crocodiles also occasionally come in interaction with the locals especially during monsoon season.

Crocodiles of India



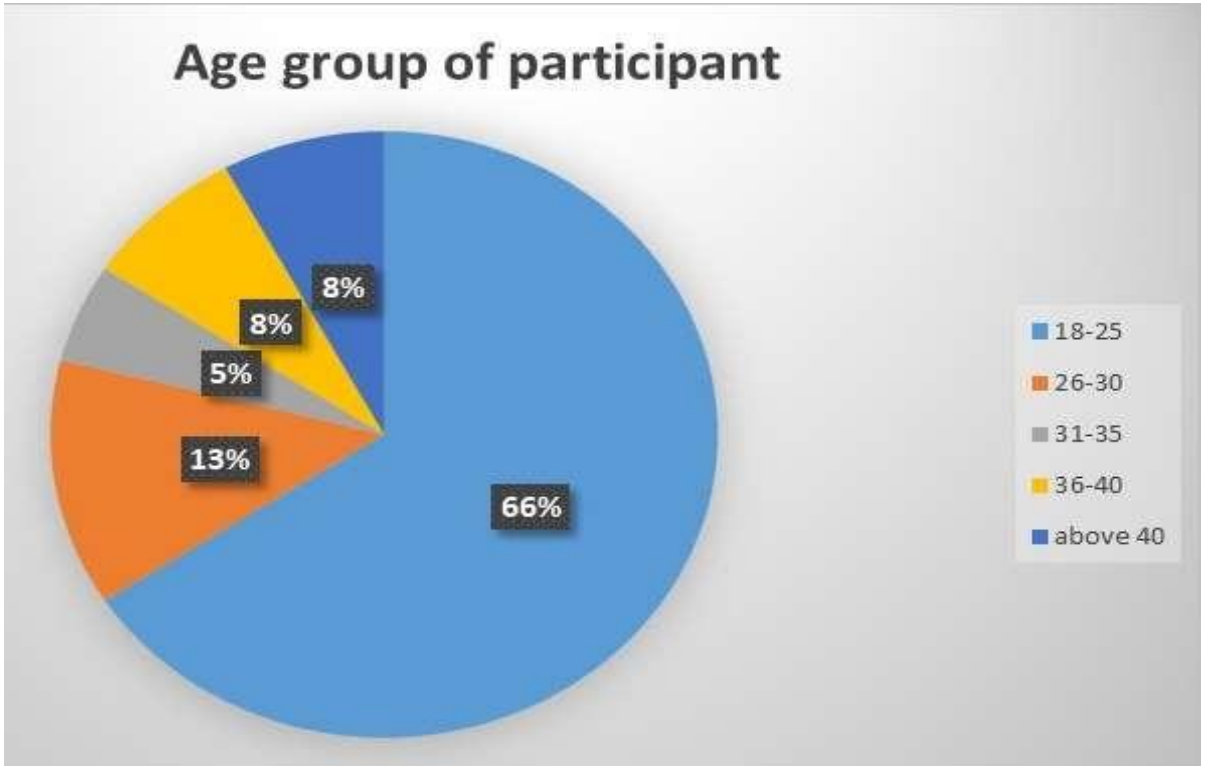
Geographical Distribution Range of Mugger Crocodile *Crocodylus palustris*

Species of Crocodilians' in India

1. **Gharial or Long Snouted Crocodile** *Gavialis gangeticus*: One of the Critical Endangered fish eating crocodiles, found only large rivers; the river systems of Ganga and Brahmaputra Rivers
2. **Salty or Estuarine Crocodile** *Crocodylus porosus*: Most largest crocodiles, Last Concern, aggressive and widely distributed from coastal Orrisa to Sundervan, Andaman & Nicobar Island and up to north sea coast of Australia.
3. **Mugger or Marsh Crocodile** *Crocodylus palustris*: One of common crocodile widely distributed in Indian Sub-continent and Vulnerable crocodilian species.

3. Methodology

We used an approach called “Citizen Science” to count crocodiles in Vishwamitri River. Citizen science is an exciting, multifaceted way to bring people from all walks of life together for research and conservation. We deployed about 55 voluntary participants of various age-groups for the survey crocodile count, excluding forest officials, researchers and subject experts (Appendix 1).



Pie chart describing age group of volunteers and other institution participated in the event

3.1 Approach to the Study Area

All participants were trained in classroom by guides and technical members, prior to actual field counts. Proved the methodology of the survey of crocodiles in various parts of globe and same as in the India. Provide information on code of conduct (Appendix 2) in local Gujarati language, data card (Appendix 3) about the importance of the species and its over all scenarios in its distribution range.

Table 1: The River zonation and Survey Team leaders in different river zones.

Name of team leader and its' allotted various river stretch area at Vishwamitri River, Vadodara City.				
#	River Zone	Team Number	Team leader	Area/River section
1	New Zone	1	Nilesh Bhavsar	Dena village to NH-8
2	I	2	Hemant Vadhvana	NH-8 To Sama Bridge.
3	II	3	Pratik Lakdawala	Sama Bridge to Vuda Bridge
4	III	4	Anil Gohil	Vuda to Narhari Bridge
5	IV	5	Rocky Maharaj	Narhari house to Kalaghoda Bridge
6	V	6	Raj Bhavsar	Kalaghoda to Munjmahuda Bridge
7	VI	7	Pravin Maharaj	Munjmahuda to Vadsar Bridge
8	VII	8	Rahul Bhatt	Vadsar bridge to Talsat Village
9	VIII	9	Karik Upadhayay	Wetland within the city: Lalbaug, Vadsar, Talsat, Kalali

3.2. Scientific Methodology

Day time ground survey method: The urban stretch of river (Dena village to Talsat village) will be arbitrarily divided into eight zones (Map 1). Lalbaug and other water bodies with crocodile population will form the 8th zone. After familiarizing the participants with the habitat during the training session, the count will be initiated from at 0930 h to 1300 h and the daytime basking crocodiles will be manually counted and



Body size estimates: Crocodile size classes based on total length (TL) classified as $TL < 1$ m as juveniles, between 1.1 and 2 m as sub-adults, and > 2 m as adults. Use of 8x40 binoculars will be done to execute this task.

Citizens based count: Public volunteers shall be used for counting crocodiles, a team of 10 volunteers and a team leader will be assigned a stretch of river and data will be collected through methodologies as well with information from the locals. All necessary information were fill-ups in prescribed data-forms (See: Appendix 3).



Statistical analysis: Descriptive statistics will be used to summarize crocodile population, encounter rates and abundance (number/km of river) will be calculated as per Vyas et al (2013).

Nocturnal spot light survey: Not to be used due to river access difficulties.





4. Result

4.1. Data & Interpretations

Total 169 mugger of varying sizes / age groups were counted in the stretch of river Vishwamitri from Dena village to Talsat village. An average of 6.25 muggers per kilometer. This 27 km long river stretch flows though highly human populated and fast developing city Vadodara, Gujarat. Of these, 169 muggers were further identified as 18 juveniles (less than 1m; 10.65%), 76 sub-adults (1-2 m; 44.97%) and 71 adults (bigger than 2m; 42%), and remain four (2.36%) were counted as being of unknown length. The total crocodiles count (diurnal only) on that day was 170 muggers (Figure 1), that included the Vishwamitri river and associated water bodies, viz. Lalbaug, Vadsar, Talsat and Kalali village ponds falling within the city limits area.

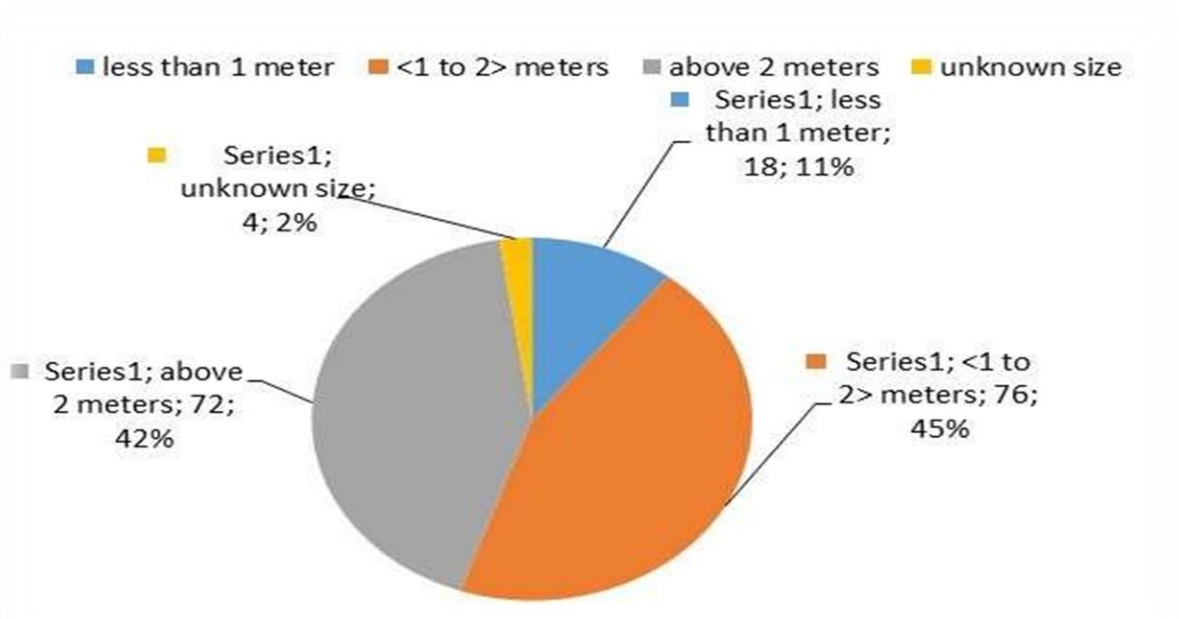


Figure 1: Pie Chart showing Crocodiles (based on size) counted in the study

The highest numbers of 54 crocodiles were noted in river stretch area between VUDA Bridge to Kalaghoda Bridge, followed by 48 crocodiles between Kalaghoda Bridge to Munjmahuda Bridge and 39 crocodiles between Vadsar Bridge to Talsat village

The highest numbers of 54 crocodiles were noted in river stretch area between VUDA Bridge to Kalaghoda Bridge, followed by 48 crocodiles between Kalaghoda Bridge to Munjmahuda Bridge and 39 crocodiles between Vadsar Bridge to Talsat village. Zones with maximum Crocodile concentration / numbers are situated in center of the city. Whereas, the lower and upper stretches of river (situated outskirts to the city) had recorded relatively less number of crocodiles. The results of the number of sightings of crocodiles in various zones are shown in Table 1 & Figure 2.

Further scrutiny of the data reveals that the smallest individual crocodile recorded was 60 cm (approx-total body length=a-tbl) whereas; the largest was 4 m (a-tbl). The rest of the crocodiles fall in the range of 0.60 m to 4 m size. It is interesting to note that 87% of larger crocodiles (bigger than 1 m) and 10.65% smaller ones (less than 1 m) were recorded in the riverine stretch passing through the center of Vadodara city (zones V and VI).

This needs further investigation and monitoring on the population especially on the number of females that are actively nesting in the said zones.

During the count, the volunteers had counted 22 active dens / burrows in various zones mentioned herein with the highest number of 8 dens recorded in the stretch between VUDA Bridge and Kalaghoda Bridge. This was followed by 5 ‘mugger den’ counted between Kalaghoda Bridge to Munjmahuda Bridge and 4 den noted in upper Sama Bridge to VUDA Bridge and lower Munjmauda to Vadsar Bridge river stretches respectively. The records of dens recorded in various zones of the river is shown in Table 2.

Digging activity and making of den/burrow is of ecological significance for *Crocodylus palustris*. These crocodile’s dens form a safe retreat or provide a refuge to this species under unfavorable conditions, severely high temperatures especially in summer and during periods of water scarcity and drought. These dens are occasionally used for nesting.

Table 1: Summary of Crocodile count within the study area.

	River Zone*	Team No.	Area/River Section (Approx stretch length in km)	Total Crocs Count
A	New	1	Dena Village & Village Ponds (3k)	01
	I	2	NH-8 to Sama Bridge (4k)	00
	II	3	Sama Bridge to VUDA Bridge (3k)	03
	III	4	VUDA to Narhari Hospital Bridge (1.5)	09
		5	Narhari Hospital Bridge to Kalaghoda (2.5)	45
	IV	6	Kalaghoda to Munjmahuda Bridge (4k)	48
	V	7	Munjmauda to Vadsar Bridge (3k)	24
	VI	8	Vadsar Bridge to Talsat Vilage (5.2)	39
			Sub Total	169
B		9	Village (Lalbaug, Vadsar, Talsat, Kalali)	01
		10	Sama, Chhani, Harni, Dena, Bhimnath	Not Surveyed
A+B			Total	170

Data generated in our study strongly implies towards a positive correlation between the total number of dens and the density of crocodiles within the study area. Also, the river zones; viz. VUDA Bridge to Kalaghoda Bridge and Kalaghoda Bridge to Munjmahuda Bridge emerge as the prime areas in providing refuge to the crocodiles in Vishwamitri river. The key credentials of these zones being relatively undisturbed and a healthy habitat for sustenance of the said species.

The results of the count depicted herein does not reflect the actual scenario as the total count is likely to be much higher as the nocturnal count was not conducted due to the inaccessibility of river banks. Also, many small habitat pockets (within river stretch) such as oxbows (in Sama, Vadsar and river stretch behind Laxmi Vilas Palace) and some water bodies (in Chhani, Sama and Harni) could not be included in this count although, the same were a part of the previous crocodile count.

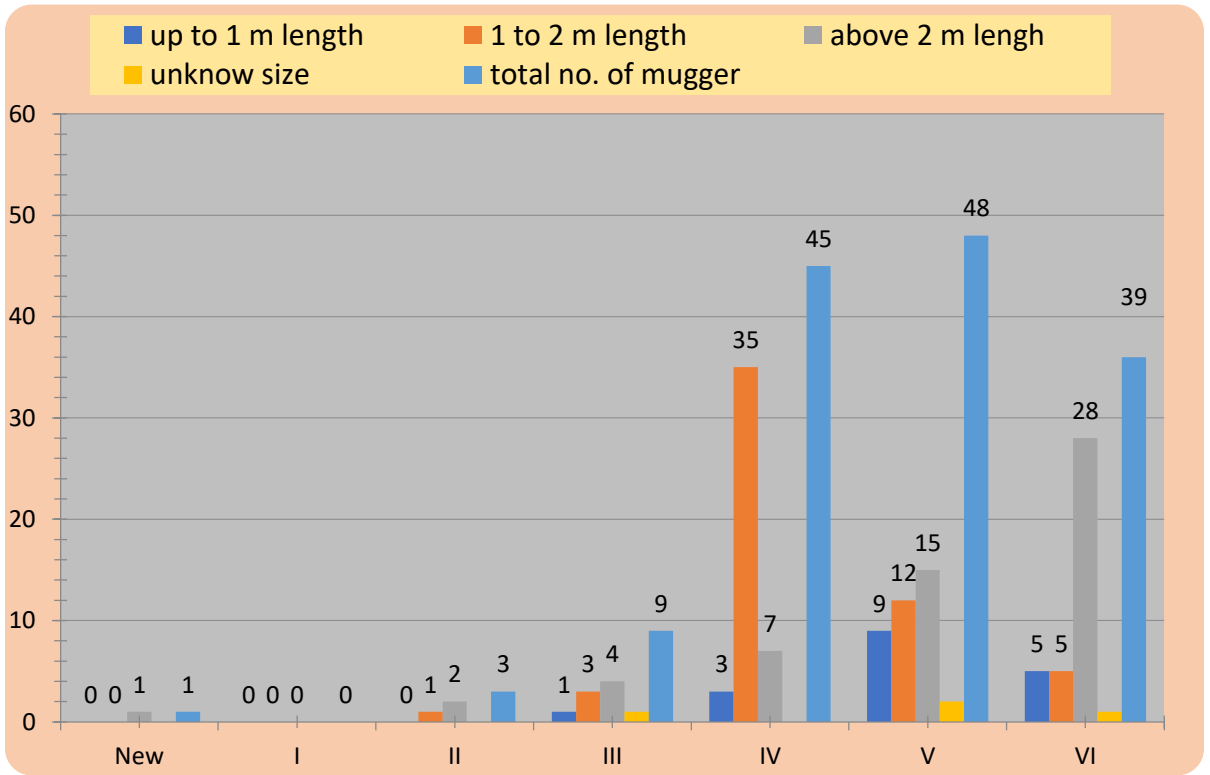


Figure 2: Pictograph shows mugger records in each zone of Vishwamitri River

5. Discussion and Conclusion

Results obtained showed presence of 170 mugger crocodile in the area studied herein. This count is less than the ‘January 2015’ count for two major reasons. The 2015 count was done by two methods viz. day time basking and night count methods. Here, we had employed only day time basking count. Also, weather is warmer in the later part of February and rise in temperature marks the beginning of breeding activity for mugger crocodiles. The activities include pairing, courtship and selection of nesting site. Ideally, the day-time count should be employed in cooler season (peak winter) as maximum numbers of muggers can be seen on the river banks for the purpose of basking. Though, the day time basking count is also useful for assessment of habitat and to know the population structure of species, the night count method is more precise and comparatively less error prone. However, use of various census techniques is dependent on availability of time, funds and type of habitat.

Presence of Crocodiles raises an immediate need to conserve the riparian habitat of this unique Vishwamitri riverine eco-system. It can be concluded from this study that, River Vishwamitri is one of the most significant habitats for *Crocodylus palustris* and a unique and noteworthy example for co-existence of man and mugger. Higher numbers of den/burrows along with muggers in zones III and IV sends a message for the administrative authorities and the people of Vadodara city that, this habitat is most crucial for conservation of the said species. Special care should be taken to conserve the meanders, oxbows ponds/lakes and other lesser known waterbodies that are directly or discretely associated with Vishwamitri riverine ecosystem. This unique ecosystem is also a natural heritage of Barodians' and efforts should be made to save the habitat from pseudo-urban development and negative anthropogenic activities.

6. Recommendations

Recent scenario of brisk urbanization of Vadodara city and related anthropogenic pressures is the prime cause of concern and raises a major challenge to conserve Vishwamitri riverine ecosystem and the inhabitant flora and fauna. Following are some important recommendations in favor of conservation of the species and its habitat based on the outcome of the results of crocodile count. Recommendations and suggestion emphasized in the study, if implemented in totality, can lead to revival of this unique habitat. Immediate action by the administrative authorities in implementing the recommendation can be the first step towards conservation of this species and to improve the riverine habitat.

1. River Vishwamitri should be free from pollution and untreated sewage water should not be discharged in the river.
2. The mugger population of in entire Vishwamitri River should be monitored, regularly. Annual mugger count should be carried out within the city limits.
3. Once in every five years, a detail survey of resident flora and fauna of Vishwamitri river should be carried out in the entire riverine system.
4. Regular awareness programs for Barodians to conserve Vishwamitri river and its crocodiles is imperative.

5. Encroachments on the river banks and in form of huts or urban development should be discouraged and dealt with immediately.
6. Standard manuals for 'Rescued and Released Muggers' should be maintained. Tagging or unique marking will help in future identification. In this way, seasonal or local movements of muggers can be monitored.
7. Only notorious and culprit large-sized muggers should be trapped or captured and kept in captive facilities or zoos. Rescue and rehabilitation center as per guide line of Central Zoo Authority (CZA) should be created for such crocodiles.
8. Local authorities should propose for a new state level action plan on conservation of mugger crocodile and its habitat should be made.
9. More effective and meaningful coordination amongst the State forest department, Zoo, NGOs and local wildlife enthusiasts is required. Forest Department should act as a mediator for a better coordination and for execution of the roadmap for crocodile conservation.
10. There is no clarity of authority with whom to be contacted and who is responsible for maintenance and preservation of Vishwamitri River and its habitat. There is an immediate need to identify a clear authority with reference to the river boundary, also a firm mandate should be given to the forest department to supervise the as there is existence of Schedule 1 animal residing. Various instructions and policy to Municipal Corporation has also to be laid down. As Mugger is listed in Schedule 1 in Indian Wildlife Protection Act-1972 and it is considered as highly protected wild animal. The control over property must be given to forest department for efficient monitoring and to avoid encroachment, there should be demarcations and proper boundary to avoid any such activities in future.

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Appendix 1

List of participated in the count (including forest staffs) : Croc Count February 2019

1	Shah Nilesh N	34	Mali Sanny
2	Patel Mehul A	35	Bhattacharya Yuyutshu
3	Patel Heris V	36	Chaudhari Chandrika
4	Mori Sharan N	37	Amin Sidharth
5	Surana Anushka J	38	Vyas Sunita
6	Panchal N.M. (Forest)	38	Ambadkar Tanya
7	Chaudhari R.N. (Forest)	40	Tadavi Nirav
8	Tariya R.B. (Forest)	41	Tadavi G.P.
9	Vadhavana Hemant R.	42	Thakor Rajrajeshwar
10	Gohil Sujitsinh M	42	Arya Rocky
11	Gujjar Gaurang P	43	Kothari Mohit
12	Yogi Ketan	44	Patel Anu
13	Sharma Amisha	45	Patel Shrayesh
14	Parmar Vanrajsinh	46	Talati Neel
15	Mistry Vishal	47	Arya Pravin M.
16	Lakadawala Pratik	48	Soman Mrunal S.
17	Patel Het	49	Deshmukh Ravin K.
18	Patel Miti	50	Diwaker Vidhi
19	Kaur Dilpreet	51	Rana Chaitan
20	Patel Geeta	52	Ghadhavi V.G. (Forest)
21	Shah Tapas	53	Bodana K.V. (Forest)
22	Patel Nitin (Forest)	54	Makwana K.G. (Forest)
23	Bariya Mukesh	55	Katariya Rajesh
24	Gohil M. M	56	Gareja Nikhil
25	Parmar V.K.	57	Bhardwaj Vaibhav
26	Bariya V.M.	58	Katara Jessica
27	Gohil Anil	59	Fanre Drushti
28	Bal Aditi	60	D Sonal
29	Vyas Vikrant	61	Jadav R.R. (Forest)
30	Vasava Nikunj	62	Patel D.C. (Forest)
31	Talpada Shailesh (Forest)	63	Karandikar
32	Nizama H.D. (Forest)	64	Sabaval Avi
33	Vasava Sarlaben (Forest)	65	

Appendix 2

Appendix 2: Code of Conduct.

મગર (CROCODYLUS PALUSTRIS) અથવા માર્શ ક્રોકોડાઈલ ગણતરી: ૨૨ - ૨૩ ફેબ્રુવારી ૨૦૧૯

આપણે, આ બંને દિવસો દરમિયાન "વડોદરા શહેર" માં મગર ની ગણતરી કરવા અત્રે હાજર થયા છો. આ દિવસો દરમિયાન આપણે મગરની ગણતરી કરવાનો પ્રયાસ કરીને વડોદરા શહેરની વિશ્વામિત્રી નદી તેમજ તળાવો અને જલપ્લાવિત વિસ્તારોમાં જોવા મળતી મગર તેમજ તેમા નિવસ્થાનો અને આવાસોનો અભ્યાસ કરી મગરની વસ્તી અંગેનો અંદાજ મેળવાનો છે.

"મગર" કે જે "વન્ય પ્રાણી સરસંરૂ ૧૯૭૨" કાયદા હેઠળ શિષ્ટક્રમ -૧ માં પ્રોટેક્ટેડ જાહેર કરેલ છે, અને છેલ્લાં ઘણાં વર્ષથી માનવી સાથેના અથડામણ/સંઘર્ષના બનાવો વધી રહેલ છે, તેવા આ સરિસૃપ જીવ અંગેની જરૂરી તમામ માહિતી એકત્રિત કરી આપણે આ અનેરા વન્ય પ્રાણીની એક નીતિ યોજના ઘડવા સહયોગી/ભાગીદાર થવા પ્રયત્ન કરવાનો છે.

"મગર" કે જે જંગલમાં કે માનવ-વસાહતની આજુબાજુ માં જોવા મળતા, કે પછી માનવ જોડે થતી અથડામણ નિવારવા માટે આ વન્ય પ્રાણીઓની સંખ્યા અને તેની પર્યાવરણીય પરિસ્થિતીનો તાગ કે કયાસ મેળવવો ખુબ જરૂરી જણાય છે. આ મુશ્કેલીઓને સમજવા કે તે ને હલ કરવા કે પછી તે બાબતના ચોકસ દિશામાં જરૂરી પગલા ભરવા માટે તે પ્રાણીઓની ગણતરી કરી તે અંગેના વિશિષ્ટ સાંઠટિક્કિ અભિગમ કેળવવો ખુબજ જરૂરી છે, માટે આપ સર્વેનો સહયોગ ખુબજ જરૂરી છે. આશા છે કે તમે સર્વે 'મગર બચાવો' અભિયાનમાં સાથ-સહકાર આપશો, ને વન્ય પ્રાણીઓ બચાવવાની ઉમદા કાર્ય-પ્રવૃત્તિમાં સહભાગી થશો. આપનો સહકાર ને આપની ભાગીદારી વગર 'મગર'નું જતન કરવું મુશ્કેલ છે,

આપણે, આ દિવસો દરમિયાન મગરની ગણતરી કરીશું, તે બાબતની નોંધ અત્રેથી મેળવેલ માહિતીપત્રકમાં (Data Sheet) તેમાં જણાવ્યા મુજબની માહિતી

Appendix 2: Continue....

મેળવશુ. મગરની ગણતરી અને તે બાબતની અન્ય માહિતીઓ મેળવવાનો પ્રયત્ન કરવાનો છે.

આપને આપેલ માહિતીપત્રકમાં (Data Sheet) જણાવેલ તમામ જરૂરી માહિતી ભરવાનો પ્રયત્ન કરશો. આપનો મારફતે મેળવેલ અવલોકનો (Observations) અત્રેથી આપેલ પત્રકમાં નોંધી, પરત આપવા વિનંતિ છે. આ દિવસોમાં આપણને આપેલ ફાળવેલ વિસ્તારમાં ફરી-ફરી/મુલાકાત કરી તમામ માહિતી મેળવવી તે પત્રકોમાં નોંધી અમોને પોહચતી કરવા વિનંતિ છે.

તમો જ્યારે ફિલ્ડમાં વિશ્વામિત્રી નદી કિનારે "મગર" અંગે માહિતી મેળવવા જાવ ત્યારે મુલાકાત સમયે નિચે જણાવેલ બાબતનું ધ્યાન રાખવા નમ્ર વિનંતિ છે.

૧. અત્રે તમારી ઉપસ્થિતિની ની હાજરી માટે 'રજીસ્ટ્રેશન' કરવું જરૂરી છે.
૨. 'મગર-ગણતરી' માટેના તમામ ચીજ-વસ્તુઓ, સાધનો અને પત્રકો મેળવી લેવા વિનંતિ છે.
૩. 'મગર સર્વે' વિસ્તારની મુલાકાત સમયે, તે વખતે સ્થળ પર શાંત, સુમેળ ભર્યું વર્તન રાખશો. શિસ્તપૂર્વક એક-બીજા જોડે વર્તન કરવા નમ્ર વિનંતિ છે.
૪. વિસ્તારમાં મળતા તમામ વ્યક્તિઓ/મુલાકાતીઓ સાથે સુમેળથી નમ્ર-મુલાકાત મેળવી મગર અંગેની તમામ માહિતી મેળવી, નોંધ કરવા વિનંતિ છે.
૫. કિનાર પરની કે પાણીમાં જોવા મળતી 'મગર' કે અન્ય વન્ય પ્રાણીઓને ખલેલના પોચાડતા કે પથ્થર કે કાંકરી ચળો ન કરવો.
૬. પાણી-કાંઠા પર ફરતા હો ત્યારે મગરથી અંતર રાખશો, ને તેનાથી યોગ્ય અંતર બનાવી તેના અવલોકનો મેળવવા પ્રયત્ન કરશો.
૭. નદી કિનારા પર તમો ખુબ સાવચેતી પૂર્વક ભ્રમણ કરી વધારે ને વધારે માહિતી મેળવવા પ્રયત્ન કરશો.
૮. દૃશ્યમાન 'મગર' ની આશરે ચોકસ લંબાઈ મેળવવી તે બાબતની નોંધ મેળવશો
૯. આપને અત્રે થી આપેલ/ શોપેલ કિંમતી સાધનો પરત કરવા નમ્ર વિનંતિ છે.
૧૦. ફિલ્ડમાં નદી કિનારે અવલોકન મેળવવા જાવ ત્યારે તમે બૂટ, પેન્ટ અને ફૂલ સ્લીવનો પેરવેશ પોશાક ધારણ કરવાનો આગ્રહ રાખજો.

Glimpses of The Events



The active den of mugger



The brows help to survive of animal in unfavorable



Large den of the mugger

Glimpses of The Events



One of the largest animals sighted in the river



Final Ceremony: Certificate Distribution

Note



Thankyou every one who participated !