

**ACTION HISTORY OF RTI REQUEST No.WLIOI/R/E/21/00046****Applicant Name** Ishan**Text of Application**

Kindly provide the following information under the RTI Act, 2005 1. The Wildlife Institute of India has assisted the Ministry of Environment, Forest and Climate Change and the Gujarat state government in creating the Lion Project. Please provide all documents and correspondences between the Wildlife Institute of India and the Ministry of Environment, Forest and Climate Change and Gujarat state regarding the project.

**Reply of Application**

kindly see the cover letter and Annexure I-III is being sent to you in registered email ID: ikukreti@gmail.com due to large side of information/ documents to be provided you under RTI Act, 2005

SN.	Action Taken	Date of Action	Action Taken By	Remarks
1	RTI REQUEST RECEIVED	05/07/2021	Nodal Officer	
2	REQUEST FORWARDED TO CPIO	06/07/2021	Nodal Officer	Forwarded to CPIO(s) : (1) P.K.Aggarwal
3	REQUEST DISPOSED OF	23/07/2021	P.K.Aggarwal- (CPIO)	

[Print](#)

[Print](#)

**Government of India  
Wildlife Institute of India, Dehradun  
Wildlife Institute of India  
P.O.Box-18, Chandrabani, Dehradun, Uttarakhand,**

Dated: 23/07/2021

To

Shri Ishan  
370, Top Floor,  
Sant Nagar,  
Delhi  
110065

**Registration Number : WLIOI/R/E/21/00046**

Dear Sir/Madam

I am to refer to your Request for Information under RTI Act 2005, received vide letter dated 05/07/2021 and to say that *kindly see the cover letter and Annexure I-III is being sent to you in registered email ID: ikukreti@gmail.com due to large side of information/ documents to be provided you under RTI Act, 2005.*

In case, you want to go for an appeal in connection with the information provided, you may appeal to the Appellate Authority indicated below within **thirty days** from the date of receipt of this letter.

**Director, WII**

FAA & Director

Address: Wildlife Institute of India Chandrabani Dehradun

Phone No.: 01352646101

**Yours faithfully**

**( P.K.Aggarwal)**

**CPIO & Deputy Registrar**

**Phone No.: 01352646110**

**Email : pka@wii.gov.in**

No. WII/RTI/CPIO/2021-22 (Qtr-II)/24

Date: 23 July, 2021

To,

Shri Ishan  
370, Top Floor, Sant Nagar,  
Delhi, Pin:110065  
Email: ikukreti@gmail.com

Sub.: Information under RTI Act, 2005-reg.

Ref.: Your Online RTI No. WLIOI/R/E/21/00046 dated 05/07/2021

Dear Shri Ishan,

Please refer to your application cited above under RTI Act, 2005. In this context, point-wise response to your queries is given below:

Information Sought under RTI	Reply
1. The Wildlife Institute of India has assisted the Ministry of Environment, Forest and Climate Change and the Gujarat state government in creating the Lion Project. Please provide all documents and correspondences between the Wildlife Institute of India and the Ministry of Environment, Forest and Climate Change and Gujarat state regarding the project.	Information attached as below:  1. <b>Annexure-I:</b> Correspondence documents/ letters. 2. <b>Annexure-II:</b> Project Proposal report 3. <b>Annexure-III:</b> Project Lion Report

If you are not satisfied with the aforesaid reply, you may appeal to the **Appellate Authority** i.e. "Director, Wildlife Institute of India, Post Box 18, Chandrabani, Dehradun – 248 001, Ph. 0135-2640910".

Thanking you,

Yours faithfully,

  
NO & CPIO (RTI)

Encl.: as above.



Government of India  
Ministry of Environment, Forest and Climate Change  
Wildlife Division

First Floor, Agni Wing,  
Indira Paryavaran Bhawan,  
Jor Bagh Road, Aliganj,  
New Delhi - 110003.

F. No. 34-3/2020 WL (Part-3)

Dated: 27<sup>th</sup> April 2021

The Director  
Wildlife Institute of India  
Dehradun.

Sub: Assessment of additional sites for lion conservation in Gujarat - Reg.

Sir,

Kindly refer to the discussions held during the online meeting held on 22<sup>nd</sup> April 2021 under the chairmanship of the Director General of Forests & Special Secretary, on matters pertaining to 'Project Lion'. During the said meeting, it was agreed that the Wildlife Institute of India would undertake an assessment of the Banni Grasslands, Gujarat and Dangs Forests, Gujarat, for considering the feasibility as potential habitats for Asiatic Lions.

In view of the above, the undersigned is directed to request the Wildlife Institute of India to take up the assessment study of Banni Grasslands, Gujarat and Dangs Forests, Gujarat, in consultation with the Gujarat State Forest Department, and submit a feasibility report to this Ministry at the earliest.

Yours faithfully,

INFORMATION PROVIDED  
UNDER RTI

(Rakesh Kumar Jagenia)  
Deputy Inspector General of Forests (WL)  
Email: digwl-mefcc@gov.in

Copy to:

- i. Chief Wild Life Warden, Government of Gujarat, Gandhinagar with a request to provide all necessary assistance to Wildlife Institute of India, Dehradun.
- ii. PSO to Addl. DGF(WL), MoEFCC
- iii. PPS to IGF(WL), MoEFCC
- iv. PS to JD(WL), MoEFCC.

Validity unknown

Digitally signed by RAKESH  
KUMAR JAGENIA  
Date: 2021.04.27 09:57:59 IST

ATTESTED  
  
CPJO, Wildlife Institute of India, Dehradun



Government of India  
Ministry of Environment, Forest and Climate Change  
Wildlife Division

6<sup>th</sup> Floor, Vayu Wing,  
Indira Paryavaran Bhawan  
Jor Bagh Road  
New Delhi.

F. No 1-63/2007 WL (part)

Dated: 18<sup>th</sup> August 2020

The Director  
Wildlife Institute of India  
Dehradun.

Sub: Preparation of Detailed Project Document for "Project Lion" - Reg.

Sir,

Conservation of Asiatic Lion has been accorded due priority by Government of India. During his address to the nation on 15<sup>th</sup> August 2020, on the occasion of the Independence Day, Hon'ble Prime Minister has also mentioned initiation of a Project for Conservation of Lions in the country.

In this context, the undersigned is directed to request that the Wildlife Institute of India to kindly prepare a detailed 'Project Lion' Document, which would encompass conservation of the species on a Project mode in the entire country, with inclusion of adequate budgetary provisions. While preparing the said Project Document, experts, including those from State of Gujarat, may also be consulted.

It is also requested that the detailed Project Document may kindly be submitted to this Ministry, by 15<sup>th</sup> September, 2020.

INFORMATION PROVIDED  
UNDER RTI

Yours faithfully,

(Rakesh Kumar Jagenia)  
Deputy Inspector General of Forests (WL)  
E.mail: digwl-mefcc@gov.in

Copy to: Sr. PPS to Addl. DGF(WL)/Sr. PPS to IGF(WL), MoEFCC

Validity unknown

Digitally signed by RAKESH  
KUMAR JAGENIA  
Date: 2020.08.19 12:46:22 IST

ATTESTED  
  
CPIO, Wildlife Institute of India, Dehradun

(2)

Government of India  
Ministry of Environment, Forest and Climate Change  
Wildlife Division

6<sup>th</sup> Floor, Vayu Wing,  
Indira Paryavaran Bhawan,  
Jor Bagh Road, Aliganj,  
New Delhi – 110003.

F. No 34-3/2020 WL (pt)  
Dated: 29<sup>th</sup> October 2020

The Director,  
Wildlife Institute of India,  
Dehradun.

Sub: Preparation and submission of Detailed Project Documents for 'Project Lion' and 'Project Dolphin'. -Reg.

Sir,

Reference is invited to this Ministry's letter of even no. dated 6<sup>th</sup> July 2020, subsequent reminders dated 10<sup>th</sup> August 2020 and 18<sup>th</sup> August 2020, and also the video conference meeting held on 21<sup>st</sup> September 2020, in connection with preparation and submission of a detailed 'Project Lion' and 'Project Dolphin' documents.

In this context, the undersigned is directed to once again request the Wildlife Institute of India to kindly submit the detailed 'Project Lion' and the 'Project Dolphin' documents to this Ministry, latest by 5th November, 2020.

Yours faithfully,

INFORMATION PROVIDED  
UNDER RTI

(Rakesh Kumar Jagenia)  
Deputy Inspector General of Forests (WL)  
E.mail: digwl-mefcc@gov.in

Copy to: Sr. PPS to Addl. DGF(WL)/Sr. PPS to IGF(WL), MoEFCC

Validity unknown

Digitally signed by RAKESH  
KUMAR JAGENIA  
Date: 2020.10.29 11:53:42 IST

ATTESTED  
*Rakesh Kumar Jagenia*  
CPIO, Wild Life Institute of India, Dehradun

(3)



Government of India  
Ministry of Environment, Forest and Climate Change  
Wildlife Division

First Floor, Agni Wing,  
Indira Paryavaran Bhawan,  
Jor Bhag Road, Aliganj,  
New Delhi - 110003.

F. No. 34-12/2020 WL

Dated: 16<sup>th</sup> February 2021

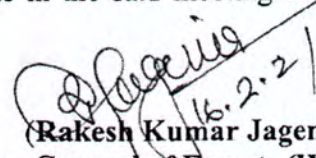
**MEETING NOTICE**

**Sub: Meeting to discuss the 'Project Lion'- Reg.**

It has been decided to convene a meeting to discuss the 'Project Lion' on 25<sup>th</sup> February 2021 at 1:00 p.m. at 'Krishna Hall' 4<sup>th</sup> Floor, Jal Wing, Paryavaran Bhawan, Jor Bhag Road, New Delhi. The meeting will be held under the chairmanship of the Director General of Forests & Special Secretary, MoEFCC.

It is requested to kindly make it convenient to participate in the said meeting at the above cited venue.

**INFORMATION PROVIDED  
UNDER RTI**

  
(Rakesh Kumar Jagenia)  
Deputy Inspector General of Forests (WL)  
Email: digwl-mefcc@gov.in

**Distribution:**

1. The Principal Chief Conservator of Forests & HoFF, Government of Gujarat, Gandhinagar
2. The Chief Wild Life Warden, Government of Gujarat, Gandhinagar.
3. The Addl. Director General of Forests (WL), MoEFCC, New Delhi
4. The Director, Wildlife Institute of India, Dehradun.
5. The Inspector General of Forest (WL), MoEFCC, New Delhi
6. The Joint Director (WL), MoEFCC, New Delhi.

**Copy to:** Sr. PPS to DGF&SS, MoEFCC, New Delhi.

**ATTESTED**  
  
CPIO, Wild Life Institute of India, Dehradun



**Government of India**  
**Ministry of Environment, Forest and Climate Change**  
**Wildlife Division**

6<sup>th</sup> Floor, Vayu Wing,  
Indira Paryavaran Bhawan  
Jorbagh Road, Aliganj  
New Delhi-110003

F. No. 34-3/2020 WL (pt)  
Dated: 20<sup>th</sup> November 2020

The Director  
Wildlife Institute of India  
P O Box 18, Chandrabani  
Dehradun.

**Sub: Preparation of full sized Project Documents for Project Lion and Project Dolphin.**

Sir,

Reference is invited to this Ministry's letter of even no. dated 6th July 2020, in connection with preparation and submission of a detailed 'Project Lion' and 'Project Dolphin' documents.

In continuation to the said letter, the undersigned is directed to request that the components indicated as per **Annexure** to this letter may also kindly be incorporated in the Project documents.

Further, it is also requested that the Project Documents may be suitably framed so as to incorporate the following as well, in a sequential form, apart from the other details:

- a. Overall objectives of the Projects;
- b. Listing and detailing of activities to be undertaken with specific action points;
- c. Specific targets;
- d. Timelines for implementation for each activity;
- e. Budgetary requirement;
- f. Details of consultation with experts; and
- g. Study practices followed in other countries, if any.

**INFORMATION PROVIDED  
UNDER RTI**

**ATTESTED**  
*[Signature]*  
CPIO, Wildlife Institute of India, Dehradun

Yours faithfully,  
*[Signature]*  
( Dr. R. Gopinath )  
Joint Director (WL)  
E.mail: jd-wl@nic.in

Encl: As above.

Copy to: Sr. PPS to ADGF(WL), MoEFCC/Sr. PPS to IGF(WL), MoEFCC

**Components for incorporation**

**Project Lion:**

- i. Establishment of All India Wildlife Disease Diagnostic Centre in Gujarat
- ii. Enumeration monitoring of Lion and associated species
- iii. Promoting local cultural handicrafts
- iv. Cultural Tourism
- v. Training and capacity building to local community members in livelihood enhancement activities.
- vi. Equipping field functionaries for strengthening infrastructure
- vii. Boundary demarcation
- viii. Staff welfare measures

**Project Dolphin:**

- i. Trans national cooperation and protocols
- ii. Monitoring populations of Dolphins
- iii. Developing shore-based/boat based Dolphin tourism
- iv. Snorkelling/SCUBA diving programmes
- v. Identification and development of new aquatic ecotourism centres and conservation of aquatic habitats
- vi. Alternate & additional livelihood options (e.g., Aquaculture, Pisciculture, oyster farming, etc.)

\*\*\*

INFORMATION PROVIDED  
UNDER RTI

ATTESTED  
*[Signature]*  
CPIO, Wild Life Institute of India, Dehradun



**Project Proposal**

**Title** : **ASSESSMENT OF BANNI GRASSLAND DANGS FORESTS & OTHER SITES OF GUJARAT FOR THEIR POTENTIAL TO SUPPORT ASIATIC LION (*Panthera leo leo*) POPULATION.**

**Agencies Undertaking the Project** : Wildlife Institute of India (WII), Dehradun & Gujarat Forest Department

**INFORMATION PROVIDED  
UNDER RTI**

**Principal Investigators** : Dr. Y.V. Jhala (Dean, WII) & Sh. Shyamal Tikadar, Chief Wildlife Warden, Gujarat  
Co-PI: Prof. Qamar Qureshi (Scientist-G, WII) and Dr. Kausik Banerjee (Project Scientist, NTCA-WII Tiger Cell,)

**Project Duration** : One Year (September 2021 – October 2022)

**Total Budget Cost (in Indian Rupees)** : **Rs. 114 LAKHS**

**ATTESTED**  
  
CPIO, Wild Life Institute of India, Dehradun



## Table of Contents:

	Page no
1 Abstract	1
2 Introduction	2
3 Study Area	
Banni Grasslands	4
Dang Forersts	4
4 Objectives of the study	5
5 Methodology	
Prey abundance estimation	6
Assessment of status and abundance of co-predators	6
Quantifying human impacts	6
Quantifying local people's attitudes for lion introduction	7
6 Proposed work calendar	7
7 Budget	8
8 Budget justification	9
9 References	10

INFORMATION PROVIDED  
UNDER RTI

## ABSTRACT

The conservation success of the Gir lions so far has been attributed to the timely actions and intrinsic management interventions taken by various agencies since the pre-independence era. At present the single most wild population of the Asiatic lions exemplifies all the typical impediments of carnivore conservation. Therefore, to ensure the long-term survival and better management of the species the Honorable Prime Minister of India announced to launch a national level Project Lion. One of the major objectives of the project is to create separate populations of Asiatic lions away from the Gir landscape to minimize the extinction probability from any probable future stochastic event like a disease epidemic. In this context the Ministry of Environment Forest and Climate Change, Government of India has mandated Wildlife Institute of India to assess the feasibility of Banni Grasslands, Dangs Forests and other potential sites within Gujarat for introduction of Asiatic lions with all necessary support and collaboration from Gujarat Forest Department. Therefore, in this project we propose to evaluate the habitat, status of prey, predators, human impacts and people's perceptions towards the introduction of lions in the proposed areas. Prey density will be estimated by Distance sampling. Livestock population will be estimated by total counts. Status and distribution of co-predators will be assessed by camera traps. Human disturbance parameters will be evaluated on line transects. Local people will be informally interviewed with a semi-structured open and closed questionnaire survey to get an overview of their socio-economic conditions, attitudes towards lion reintroduction and willingness to relocate with incentives. The proposed study will estimate prey abundance which in turn can be used to compute biological carrying capacity to support lions and to plan lion introduction. Information generated from questionnaire survey will be of importance for planning translocation and mitigating post-release conflicts with local communities. The report will assess the possibility of the proposed areas to sustain lions and suggest strategies and investments required if found suitable.



## INTRODUCTION:

The Asiatic Lion (*Panthera leo leo*) once roamed across Mediterranean coasts of Africa into Europe, the Middle East and upto eastern India had a vast historical range. However, the species has been wiped out from all of its former range due to indiscriminate hunting and habitat loss and at the onset of 19<sup>th</sup> century they were restricted into a single population in and around the Gir Protected Area of Saurashtra peninsula of Gujarat State, India. In the early 19<sup>th</sup> century, their number declined to as low as 20-50 individuals in the Gir Forests (Edwards and Fraser 1907; Kinnear 1920; Pocock 1930). The Nawabs of Junagadh at that time imposed strict restrictions on hunting and issued many orders to protect the declining population of lions within their territory and subsequently post-Independence due to the habitat management measures taken up by the Gujarat Forest Department, lions survived and increased in their numbers (Singh and Kamboj 1996; Jhala et al. 2019). It illustrates a great conservation success story of modern times. Currently their population is ranging across multi-used human dominated landscapes, including protected forests, agro-pastoral landscapes, industrial areas, townships and coastal forests. Currently their population is claimed to be around 674 individuals, ranging over 30,000 km<sup>2</sup> in the districts of Junagadh, Rajkot, Gir Somnath, Amreli, Bhavnagar and Botad (Gujarat Forest Department 2020).

Currently, lions outside the designated boundary of protected forests are thriving in areas which are not natural as per the species ecology, making them more susceptible to epidemics and conflict with human. Such small population with less genetic heterogeneity (O'Brien 2003) are also prone to extinction due to environmental stochastic factors (Gilpin and Soulé 1986). Catastrophes such as an epidemic, an unexpected decline in prey, natural calamities or retaliatory killings could result in the extinction of a threatened species when it is restricted to a single site. The outbreak of canine distemper in the lions of the Serengeti National Park, Tanzania, in 1994 killed an estimated 33% of the population (Roelke-Parker et al. 1996). The lion population in the Serengeti-Mara ecosystem is large, with about 3,000 individuals (Bauer and Van der Merwe 2004). In the year 2018-2019 due to the outbreak of Canine Distemper Virus in the Gir landscape about 92 lions are reported to have succumbed to the disease ([www.downtoearth.org.in/news/wildlife-biodiversity/12-06-2020](http://www.downtoearth.org.in/news/wildlife-biodiversity/12-06-2020)). Besides, a sum of 313 lions of various age classes are reported to have died due to various causes since January 2019 to December 2020



(<https://science.thewire.in/environment/06/03/2021>). Therefore, a high risk of extinction looms on the last wild population of Asiatic lions due to its single geographical location.

In order to minimize the extinction probability and to better manage the species, the Honorable Prime Minister of India on 15<sup>th</sup> August 2020 announced the commencement of “Project Lion” at the national level with similar framework of Project Tiger ([www.jagranjosh.com/current-affairs/17/8/2020](http://www.jagranjosh.com/current-affairs/17/8/2020)). A proposal on that matter has been prepared by Gujarat Forest Department and submitted to the Ministry of Environment Forest and Climate Change, Government of India. One of the major objectives proposed in the project is to assess additional sites for creating separate populations of Asiatic lions to safeguard them from extinction. The Ministry of Environment Forest and Climate Change has mandated Wildlife Institute of India to assess “The Banni Grassland” and “Dang Forest” and other potential sites present within the Gujarat State, for their feasibility as potential habitats for Asiatic lion, with all necessary consultation and assistance from Gujarat Forest Department (F. No. 34-3/2020 WL (Part-3); 27/4/2021). Earlier in the year 2013-14 in collaboration with Gujarat Forest Department, Wildlife Institute of India had also assessed Barda Wildlife Sanctuary, in the district of Porbandar of Gujarat for the feasibility of lion translocation and submitted the report to the Forest Department of Gujarat (Jhala et al. 2014).

The primary determinants of success of such translocations have been identified as logical processes from initial concept to design, feasibility and risk assessment, decision-making, implementation, monitoring, adjustment and evaluation (IUCN 2012). Failure of the first attempt of the Asiatic lion reintroduction in India (Chandraprabha Wildlife Sanctuary) in 1960s has been unanimously ascribed to the lack of an *a priori* scientific study on lion prey base, habitat requirements, local people’s attitude and a post-release monitoring program (Negi 1969). With this context the proposed research project aims to evaluate the status of prey, other co-predators, human impacts and people’s perceptions about lion reintroduction in Banni Grasslands and Dang Forests of Gujarat. The ecological and social information generated herein will be an important tool for the wildlife managers to understand the feasibility of lion introduction in those areas.

INFORMATION PROVIDED  
UNDER RTI



## STUDY AREA:

### 1. Banni Grasslands:

Banni Grassland is a tectonically raised mudflat (Basu et al., 2019) situated at the northern border of Kutch district of Gujarat from 23°19'–23°52'N, to 68°56'–70°32'E, covering an area of about 2500 km<sup>2</sup> (Jayadevan et al. 2018). It falls within the semi-arid biogeographic region with an annual rainfall of ~300 mm and temperature varies from 47° C in summer to below 7° C in winter (Misher & Vanak 2021). Banni is one of the world's largest hypersaline marshy area (Basu et al., 2019). The landscape is physiognomically classified as *Dichanthium–Cenchrus–Lasiurus* type of grassland (Dabadghao and Shankarnarayan 1973). The common grasses found in this region are, *Dichanthium annulatum*, *Cenchrus setigerus*, *Cenchrus ciliaris* and *Desmostachya bipinnata* (Joshi et al. 2009). Areas with high salinity is inhabited by perennial grasses such as *Aeluropus lagopoides* and *Urochondra sp.* Trees includes *Acacia nilotica*, *Capparis decidua*, *Ziziphus sp.*, *Salvadora persica* and *Salvadora oleoides*. Due to the extensive introduction of *Prosopis juliflora* in the 1960s, more than 50% of the Banni has been transformed into stable woody vegetation (Vaibhav et al. 2012). *Prosopis juliflora* is also used by the local community for charcoal production (Misher & Vanak 2021). A total of 12 species of mammals belonging to 9 families were recorded in Banni area. They include 6 species of carnivores and 2 species of herbivores. The species recorded are *Gazella bennetti* (Chinkara or Indian gazelle), *Canis lupus* (Indian wolf), *Canis aureus* (Jackal), *Boselaphus tragocamelus* (Nilgai), *Hyaena hyaena* (Striped hyena) and *Vulpes bengalensis* (Indian fox) (Kumar et al. 2015).

### 2. Dang Forests:

The Dang Forests lies on the border of Gujarat and Maharashtra lie between 20.16° - 21.19°N and 73.18°-73.93°E. The forest is continuous with the Western Ghats hill ranges. The area has two wildlife sanctuaries, Purna Wildlife Sanctuary in the Dang district, and Vansda National Park in Navsari district (Bhatt et al. 2014). The forest type of Dang falls under southern moist mixed deciduous forests-3B/C2, Bamboo brakes-5/E9 and tropical riverine forest-5/IS1 (Champion and Seth 1968). The region shows a typical sub-humid to humid climate. The annual temperature ranges between 46°C in summer to 22°C in winter. Purna WS has moist and dry deciduous forests



with bamboo brakes and extensive teak, 'khair' *Acacia catechu* and bamboo *Dendrocalamus strictus* and *Bambusa arundinacea* plantations (Worah 1991). The present mammalian fauna of Purna includes leopard (*Panthera pardus*), striped hyena (*Hyaena hyaena*), small Indian civet (*Viverricula indica*), lesser cats, and mongooses (*Herpestes edwardsii* and *H. smithi*). Other mammals include bonnet macaque (*Macaca radiata*), rhesus macaque (*M. mulatta*), common langur (*Presbytis sp.*), barking deer (*Muntiacus vaginalis*), four-horned antelope (*Tetracerus quadricornis*), hare (*Lepus nigricollis*) and Indian flying fox (*Pteropus giganteus*) (Trivedi 2006). However, Purna WS has witnessed recent local extinctions of the Surat-Dangs race of the Indian Giant Squirrel (*Ratufa indica dealbata*), tiger (*Panthera tigris*). Mammals such as sloth bear (*Melursus ursinus*), dhole (*Cuon alpinus*), smooth-coated otter (*Lutra perspicillata*) and possibly gaur (*Bos gaurus*) were exterminated from the Dangs much earlier (Singh et al. 2000).

#### Other Sites:

Any other site within Gujarat that has had historical distribution of lions and currently holds potential to house > 20 lions would be assessed for reintroduction and subsequent maintenance as a managed-metapopulation with Gir landscape.

## OBJECTIVES OF THE STUDY

The proposed study aims to assess the potential of establishing a lion population in Banni Grasslands, Dang Forests and other possible sites. The specific sub-objectives are:

- i) Assessment of habitat, status and distribution of prey species.
- ii) Assessment of the status and distribution of predators.
- iii) Quantifying human impacts, and assessing community attitudes towards lion introduction.



## **METHODOLOGY**

### **i) Prey abundance estimation**

Understanding the habitat suitability and availability has been identified as one of the key components of carnivore reintroduction (IUCN 2012). Prey abundance on the other hand is an important tool to measure biological carrying capacity of different habitat types for reintroduced carnivores (Hayward et al. 2007a). Distance sampling method based on line transects (Buckland et al. 2001) or camera traps (Howe et al., 2017) will be used. Density of species will be calculated using program Distance (Thomas et al. 2010). Density estimates will be used to calculate the biomass of prey species in the study area. Vehicle transects (of varying lengths) will be done in areas where prey base is extremely low and terrain is suitable (e.g. Banni).

Livestock total head counts will be done at each nest or villages within the sanctuary. Livestock will be counted during evening hours when all the livestock are corralled for nights. We will attempt to collect data on livestock holding and demography of each family within and around the sanctuaries.

### **ii) Assessment of status and abundance of co-predators**

To estimate co-predator population, camera traps will be systematically deployed within the study area by superimposing a suitable grid and deploying at least one double sided camera unit within each grid (Jhala et al. 2010). Density and abundance will be estimated by using mark-recapture method or random encounter method (Rowcliffe et al., 2008).

### **iii) Quantifying human impacts**

Data will also be collected during line transect walks on disturbances in the study area due to humans and livestock. Several anthropogenic disturbance parameter indices such as signs of logging, wood cutting, grass cutting, livestock trails, people and livestock seen on the line transects will be recorded (Jhala et al. 2017). The data will be used to determine the habitat patches (inviolate areas within forests) suitable for lion reintroduction.



**iv) Quantifying local people's attitudes for lion introduction**

Identifying the socio-economic circumstances and community attitudes has been identified by IUCN as one of the primary pre-requisites for any translocation program. A closed and open ended structured questionnaire (Bath 1987) will be designed to get an overview of the socio-economic conditions of the local people, occupational patterns in the area and the attitudes and support of local communities towards wildlife in general and lion translocation in particular. The households will be sampled at random. All respondents will be above 18 years and will be questioned only if they agree to answer the questions and participate in the survey. Interviews will be conducted in an informal way of conversation by memorizing the questions leading the discussion to acquire the desired information. The questionnaire survey will primarily be carried out by the same research team members so as to maintain the uniformity in the scoring. Responses from the questionnaire survey will be analyzed to arrive at economic well-being index, primary source of livelihood in the area and the attitudes and perceptions of people towards lion reintroduction.

**PROPOSED WORK CALENDAR**

**(September 2021 – October 2022)**

Activities	September 2021	October-December 2021	January 2022-August 2022	September-October 2022
Recruitment, purchase of equipment, training of staff, literature survey and compilation				
Reconnaissance				
Field data collection				
Data Analysis				
Synthesis of research findings, final report writing & submission				



**BUDGET:**

Budget Head	Details	Total Amount (Rs.)
Researchers	(One senior researcher @ Rs. 35,000/- and three junior researchers @ Rs. 31,000/- per person per month) + 16% HRA for one year	₹1,781,760
Technical Assistants	Four technical assistants @Rs. 12,000/month for one year	₹576,000
Field Assistants & Daily Wages	Four FAs/labors @Rs. 300/day for one year	₹432,000
Fuel & Vehicle Maintenance	Rs. 5,000/- per day for two vehicles for one year	₹1,800,000
Travel & Accommodations	Principal Investigator's & four researchers' to & fro visit in between Gujarat & WII, Dehradun + accommodation for the research team @ Rs. 10,000/month	₹270,000
Camera traps 100	@ RS. 40000 per Camera (Reconyx for REM estimation)	₹4,000,000
Camera Trap Accessories	Batteries, SD cards & accessories	₹300,000
Field equipments	Laser range finders, sunnto compasses, binoculars, digital cameras, GPS units, computer	₹400,000
Field Expenses	stationary, medical kits, casual labour, Transect cutting, etc	₹150,000
Publications		₹150,000
<b>Total Cost (A)</b>		₹9,859,760
Institutional Overhead Charge @15% of the total cost (B)		₹1,478,964
<b>TOTAL BUDGET (A+B)</b>		₹11,338,724

INFORMATION PROVIDED  
UNDER RTI



## **BUDGET JUSTIFICATION:**

**Salaries & Wages:** The research team has to conduct extensive and intensive work in the stipulated time duration of three months. Considering the short time duration and diversity of field works (line transect, camera trap, socio-economic surveys) at least three research fellows (Technical Assistants) and a minimum of four field assistants/daily wage labors are required. Fellowships are requested as per WII's norms while wages are in accordance with the daily labor's wage rate for Gujarat state.

**Fuel & vehicle maintenance:** Vehicles will be required to conduct field works and will be hired.

**Travel & Accommodation:** The PI will visit the field 1-2 times during the field work. His travel costs include two-way air fare in between WII Dehradun and field sites and accommodation charges. Four researchers would travel in between Gujarat and Dehradun 1-2 times during the project tenure. Since the research team (comprising of the researchers and field assistants) does not have any research base in the area, a house has to be rented or rooms need to be arranged in some low-cost hotel/lodge or forest guest house for one year. So minimum required fare charges & other costs are requested in this component of the budget.

**Camera trap accessories:** 100 Reconyx cameras will be purchased for the project. This camera is required for estimating density from Camera trap data as it is sufficiently fast to record images without delay with IR flash conducive for analysis using Random Encounter models that require estimating movement speeds of animals (Rowcliffe et al., 2008). Other necessary equipment like laser range finders, sunnto compasses, binoculars, digital cameras, GPS units, computer worth about Rs. 4 lakhs to be purchased as well as batteries & other necessary accessories for camera traps need to be purchased. Considering the energy requirement of a camera trap unit and market price of an alkaline D sized battery unit, a minimum amount is requested under this budget head.

**Other budget requirements:** Funds for contingency are kept at the minimum considering items viz. stationery, communication charges, photocopying and printing cost of the final project report. The institutional charges include the charges for using the institute facilities viz. Computer, GIS, Library, Internet, Scanner, Fax, Xerox, accounting and audit charges and other administrative costs during the project tenure. Institutional charges are mandatory for all externally funded projects.



## REFERENCES:

- Banerjee, K. and Jhala, Y.V. 2012. Demographic parameters of endangered Asiatic lions (*Panthera leo persica*) in Gir forests, India. *Journal of Mammalogy*, 93: 1420 – 1430.
- Banerjee, K., Jhala, Y.V., Chauhan, K.S. and Dave, C.V. 2013. Living with lions: economics of coexistence in the Gir forests, India. *PLoS ONE*, 8(1): e49457.  
[doi:10.1371/journal.pone.0049457](https://doi.org/10.1371/journal.pone.0049457).
- Basu, A., Jhala, Y.V. and Qureshi, Q. 2012. A report on population and density estimation of leopards in Girnar Wildlife Sanctuary, Gujarat 2012. Technical report of the Wildlife Institute of India submitted to Gujarat Forest Department.
- Basu, S., Sanyal, P., Pillai, A. A. S., & Ambili, A. (2019). Response of grassland ecosystem to monsoonal precipitation variability during the Mid-Late Holocene: Inferences based on molecular isotopic records from Banni grassland, western India. *PLoS ONE*, 14(4), e0212743.  
<https://doi.org/10.1371/journal.pone.0212743>
- Bath, A.J. 1987. Attitudes of various interest groups in Wyoming toward wolf reintroduction in Yellowstone National Park. MA Thesis, University of Wyoming, Laramie, 124 pp.
- Bauer, H. and Van Der Merwe, S. 2004. Inventory of free-ranging lion *Panthera leo* in Africa. *Oryx*, 38:26-31.
- Brook, B.W., Tonkyn, D.W., O'Grady, J.J. and Frankham, R. 2002. Contribution of inbreeding to extinction risk in threatened species. *Conservation Ecology*, 6: 16.
- Buckland, S.T., Anderson, D.R. Burnham, K.P., Laake, J.L., Borchers, D.L. and Thomas, L. 2001. An introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, Oxford, 432 pp.
- Carbone, C., Christie, S., Coulson, T., Franklin, N., Ginsberg, J.R., Griffiths, M., Holden, J., Kawanishi, K., Kinnaid, M.F., Laidlaw, R., Lynam, A., Macdonald, D.W., Martyr, D., McDougal, C., Nath, L., Obrien, T., Seidensticker, J., Smith, D.J.L., Sunquist, M., Tilson,



- R. and Wan Shahrudin, W. N. 2001. The use of photographic rates to estimate densities of tigers and other cryptic mammals. *Animal Conservation*, 4: 75–79.
- Champion, H. and Seth, S. 1968. A revised study of the forest types of India. Government of India Press, New Delhi, 404 pp.
- Chellam, R., Joshua, J., Williams, C.A. and Johnsingh, A.J.T. 1995. Survey of potential sites for reintroduction of Asiatic lions. Unpublished report, Wildlife Institute of India, Dehra Dun, India.
- Dabadghao, P. M. and Shankarnarayan, K. A. 1973. The grass cover of India. – Indian Council of Agriculture Research, New Delhi.
- Dave, C. and Jhala, Y. 2011. Is competition with livestock detrimental for native wild ungulates? - A case study of chital (*Axis axis*) in Gir forest, India. *Journal of Tropical Ecology*, 27: 239-247.
- Divyabhanusinh, C. 2005. The story of Asia's lions. Marg Publication, Mumbai, India, 259 pp.
- Edwards, S. M. and Fraser, L.G. 1907. The Gir forests and its lions. In *The Ruling Princes of India, Junagadh; Being a Historical, Archeological, Political and Statistical Account of the Premier State of Kathiawar*, Bombay. Times of India Press.
- Efford M.G. 2009. DENSITY 4.4: software for spatially explicit capture–recapture. Department of Zoology, University of Otago, Dunedin, New Zealand.
- Foster, R. J. and Harmsen, B. J. 2012. A critique of density estimation from camera-trap data. *The Journal of Wildlife Management*, 76: 224–236.
- Gilpin, M.E. and Soulé, M.E. 1986. Minimum viable populations: processes of species extinction, 19-34: In *Conservation Biology: the science of scarcity and diversity*, Soulé, M.E. (ed.), Sinauer, Sunderland, MA.
- Gujarat Forest Department. 2020. Report on Poonam Avlokan (Full Moon Observations) of Asiatic Lions in the Asiatic Lion Landscape: June, 2020. Wildlife Division, Sasan-Gir.



- Hayward, M.W., Adendorff, J., O'Brien, J., Sholto-Douglas, A., Bissett, C., Moolman, L.C., Bean, P., Fogarty, A., Howarth, D., Slater, R. and Kerley, G.I.H. 2007b. Practical considerations for the reintroduction of large, terrestrial, mammalian predators based on reintroductions to South Africa's Eastern Cape Province. *The Open Conservation Biology Journal*, 1:1-11.
- Hayward, M.W., O'Brien, J. and Kerley, G.I.H. 2007a. Carrying capacity of large African predators: predictions and tests. *Biological Conservation*, 139: 219–229.
- <https://www.jagranjosh.com/current-affairs/central-government-to-launch-projects-for-lion-dolphin-conservation-1597562257-1>.
- <https://www.downtoearth.org.in/news/wildlife-biodiversity/92-lions-already-dead-in-gir-this-year-report-flags-71721>
- IUCN 2012. Guidelines for reintroductions and other conservation translocations. Species Survival Commission, IUCN, August 2012.
- Jayadevan, A. et al. 2018. Bush encroachment influences nocturnal rodent community and behaviour in a semi-arid grassland in Gujarat, India. – *J. Arid Environ.* 153: 32–38.
- Joshi, P. N., Kumar, V., Koladiya, M., Patel, Y. S., & Karthik, T. (2009). Local perceptions of grassland change and priorities for conservation of natural resources of Banni, Gujarat, India. *Frontiers of Biology in China*, 4(4), 549–556. <https://doi.org/10.1007/s11515-009-0041-6>
- Jhala, Y.V., Qureshi, Q., Gopal, R. and Amin, R. 2009. Field guide: monitoring tigers, co-predators, prey and their habitats. Third edition. Technical publication of National Tiger Conservation Authority, New Delhi and Wildlife Institute of India, Dehradun.
- Jhala, Y.V., Qureshi, Q., Gopal, R. and Sinha, P. (eds.). 2010. Status of the tigers, co-predators and prey in India, 2010. National Tiger Conservation Authority, Government of India, New Delhi, and Wildlife Institute of India, Dehra Dun. TR2011/003, 302 pp.
- Karanth, K.U. 1995. Estimating tiger (*Panther tigris*) populations from cameras trap data using capture–recapture models. *Biological Conservation*, 71: 333–338.
- Kumar, V. V., Mahato, A. K. R., & Patel, R. (2015). Ecology and management of Banni Grassland



- of Kachchh Gujarat. *Ecology and Management of Grassland Habitats in India, ENVIS Bulletin Wildlife and Protected Areas, Wildlife Institute of India, Dehradun*, 17, 42-53.
- Kinnear, N. B. 1920. The past and present distribution of the lion in south eastern Asia. *Journal of the Bombay Natural History Society*, 27: 34-39.
- Misher, C., & Vanak, A. T. (2021). Occupancy and diet of the Indian desert fox *Vulpes vulpes pusilla* in a *Prosopis juliflora* invaded semi-arid grassland. *Wildlife Biology*, 2021(1), wlb.00781. <https://doi.org/10.2981/wlb.00781>
- Negi, S.S. 1969. Transplanting of Indian lion in Uttar Pradesh state. *Cheetal*, 12:98-101.
- O'Brien S. J. 2003. Tears of the cheetah and other tales from the genetic frontier: the genetic secrets of our animal ancestors. Thomas Dunne Books, New York.
- Parmar, M.V. 2005. Working plan for Junagadh forest division and Porbandar forest sub division, Volume I, Junagadh Circle, Gujarat state. Gujarat Forest Department, Gandhinagar, Gujarat, India, 210 pp.
- Pocock, R.I. 1930. Lions of Asia. *Journal of the Bombay Natural History Society*, 34: 638-665.
- Rexstad, E.A. and Burnham, K.P. 1991. User's guide for interactive Program CAPTURE. Colorado Cooperative Wildlife Research Unit, Colorado State University, Fort Collins Co., USA, 29 pp.
- Roelke-Parker, M. E., Munson, L., Packer, C., Kock, R., Cleveland S., Carpenter, M., O'Brian, S. J., Pospischil, A., Hoffman-Lehmann, R., Lutz, H., Mwamengele, G. L. M., Mgasia, M. N., Machange, G. A., Summers, B. A. and Appel, M. G. J. 1996. A canine distemper virus epidemic in Serengeti lions. *Nature*, 379: 411-445.
- Rowcliffe, J.M., Field, J., Turvey, S.T. and Carbone, C. 2008. Estimating animal density using camera traps without the need for individual recognition. *Journal of Applied Ecology*, 45: 1228-1236.
- Schaller, G. 1967. The deer and the tiger. University of Chicago Press, Chicago, USA, 370 pp.



- Singh, H. S., Raval, B. R., Patel, B. H., Tatu, K., Patel, D., Vyas, R. and Patel, B. H. 2000. Biodiversity study on Vansda National Park. A comprehensive ecological and socio-economic study. GEER Foundation, Gandhinagar.
- Singh, H.S. 2007. The Gir lion *Panthera leo persica*- a natural history, conservation status and future prospect. Pugmark Qumulus Consortium, Ahmedabad, India, 320 pp.
- Singh, H.S. and Gibson, L.A. 2011. A conservation success story in the otherwise dire megafauna extinction crisis: the Asiatic lion (*Panthera leo persica*) of Gir forest. *Biological Conservation*, 144: 1753-1757.
- Singh, H.S. and Kamboj, R.D. 1996. Biodiversity conservation plan for Gir (a management plan for Gir Sanctuary and National Park), Volume I. Sasan Gir Wildlife Division, Gujarat Forest Department, Sasan Gir, Junagadh, India, 242 pp.
- Thomas, L., Buckland, S. T., Rexstad, E. A., Laake, J. L., Strindberg, S., Hedley, S. L., Bishop, J. R., Marques, T. A. and Burnham, K. P. 2010. Distance software: design and analysis of distance sampling surveys for estimating population size. *Journal of Applied Ecology*, 47: 5-14.
- Trivedi, P. (2006). *Ecology and Conservation of Avifauna of Some Forested Areas in Gujarat, India Wildlife Science*.
- Worah, S. (1991) The ecology and management of a fragmented forest in south Gujarat India: the Dangs. Ph.D. thesis, University of Poona, Pune, India.

INFORMATION PROVIDED  
UNDER RTI



# Project Lion



Government of Rajasthan  
FOREST DEPARTMENT



भारतीय वन्यजीव संस्थान  
Wildlife Institute of India





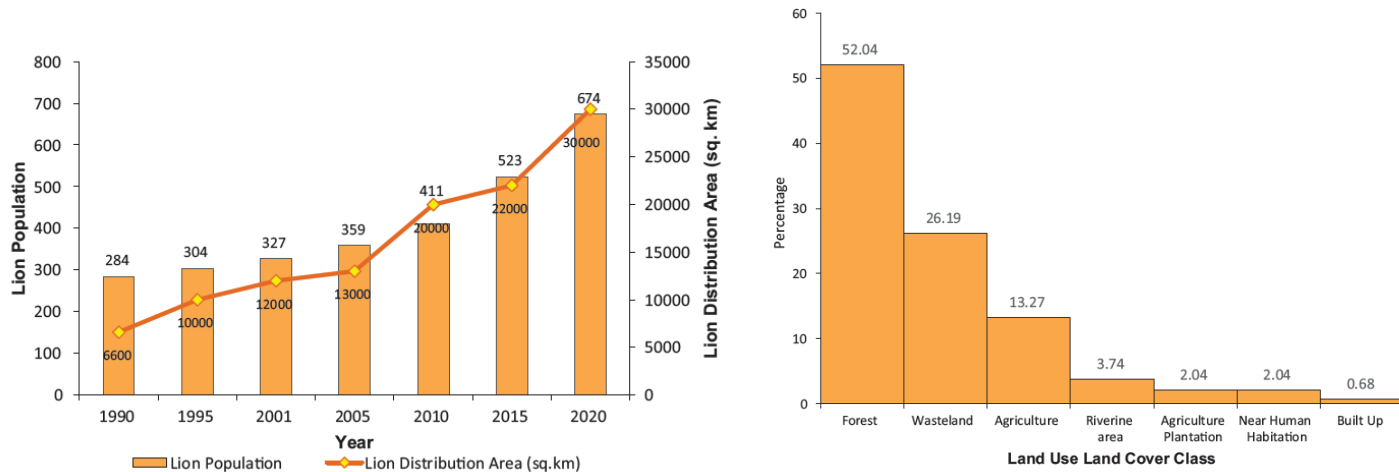
# Project Lion

## (Draft Proposal by Gujarat Forest Department & Wildlife Institute of India)

### Introduction & overall project objectives

India is the last home of the Asiatic lion (*Panthera leo persica*). After the initial efforts of the erstwhile rulers of Junagadh prior to India's independence the last 50 odd wild lions were saved from trophy hunting in the Gir Forests of Saurashtra. Lions were initially made the National animal of India after independence, the status which they subsequently lost to the tiger in 1973. Subsequently with the efforts of the government of Gujarat State and the Gujarat Forest Department, lions have since increased to around 674 occupying cumulatively about ~30,000 km<sup>2</sup> of human dominated landscape in Kathiawar peninsula (with sightings and kill recorded in areas spanning 9 districts over the years) (Figure 1). Honorable Prime Minister Shri Narendra Modi led celebrations when it was announced in June 2020 that Asiatic lion population in Gujarat had grown by almost 29% over the last five years. The Prime Minister himself shared this news with the nation and tweeted, "Over the last several years, the Lion population in Gujarat has been steadily rising. This is powered by community participation, emphasis on technology, wildlife healthcare, proper habitat management and steps to minimize human-lion conflict. Hope this positive trend continues!"

**Figure 1: Growth of Asiatic lion populations during past 30 years & different land use land cover classes of Saurashtra landscape being currently used by lions (Source: Gujarat Forest Department)**





The conservation of the Asiatic lion in the greater Gir ecosystem is a conservation success story and largely the credit can be attributed to the people of Saurashtra who have a special cultural bond and extreme tolerance toward this large carnivore. However, with an increase in lion abundance and density and spread of lion occupied areas in the landscape, unique problems that were hitherto not experienced by conservation practitioners have emerged. A fresh approach that imbibes a thorough understanding of lion ecology, socio-economics of the local communities, and the development agenda of the region is required to ensure the continued persistence of the Asiatic lions in India.

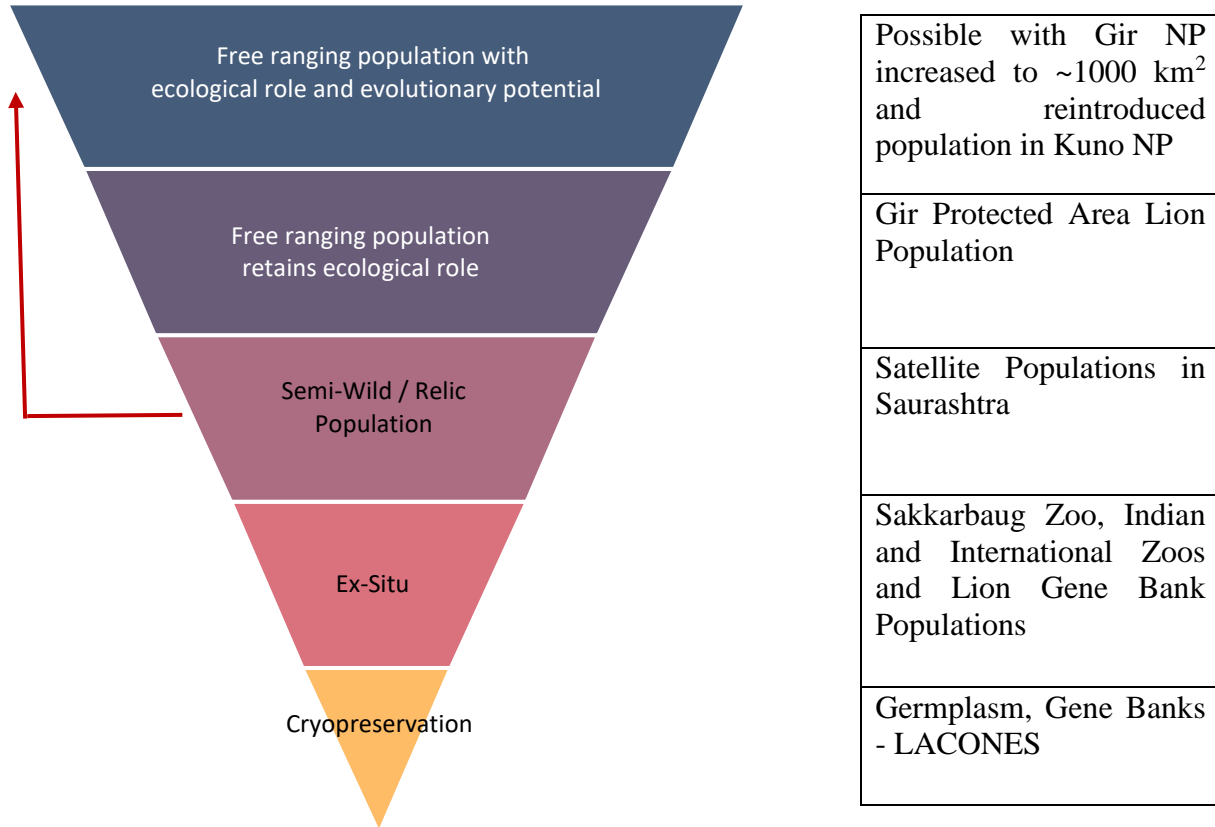
### **Need and Rationale: Best Interest of the Species**

Honorable Prime Minister, recognizing the best interest of Asiatic lions shared the Government's resolve and commitment to work for the long-term conservation from the ramparts of Red Fort in his speech on 74<sup>th</sup> Independence Day. The Prime Minister announced Project Lion for securing the future of Asiatic lions in the country.

The evolving scenario calls for even greater involvement of local communities in a range of activities including habitat augmentation and improvement, lion monitoring, shared usage of resources, man-animal conflict mitigation etc. for keeping this growing population healthy. The lions are now reaching in new areas where human settlements are predominant and the communities there, unlike peripheral areas of Gir forest, have not lived with lions in memorable past. In such a context, participatory management of the growing lion populations becomes imperative. Gujarat Forest Department has been seeking community participation in a big way in an attempt to reinforce a favorable perception towards lions and wildlife in general in minds of people in entire landscape. This is the primary aspect which is to be strengthened under the Lion Project over a period of time.

The ultimate goal of all species conservation projects including that of Project Lion should be to ensure that "Lions perform their ecological role in the ecosystem and retain their evolutionary potential". The ecological role of the Asiatic lion has been as an apex predator. Though this ultimate goal is what we should strive to achieve, it is often difficult to achieve in all scenarios and conservation goals have to be compromised to lower standards (Figure 2). All these lower conservation goals coalesce to prevent extinction of a species and are important cumulatively. The Gir Protected Area (PA) population and a reintroduced population in Kuno National Park (Madhya Pradesh) has the potential to achieve the ultimate goal, provided sufficient inviolate space is made available for lions in their protected habitat.

**Figure 2: Conservation objectives as an inverted pyramid signifying their relative importance. The ultimate conservation goal is to establish free ranging populations of lions that perform their ecological role as well as retain their evolutionary potential.**



For the first time, the entire genome of Asiatic lion has been sequenced by scientists from CSIR-Centre for Cellular and Molecular Biology, Hyderabad. The full genome sequencing of Gir lions has shown them to be lacking genetic diversity in comparison to other lion populations and historical samples of Asiatic lions <sup>1-4</sup>. The objectives of these studies are to understand the species at DNA level and study if there are any specific problems with regard to adaptability to environment or behavior vis-à-vis other big cats. It is a well-known principle of conservation biology that genetic diversity enhances adaptability to changing environmental (biotic and abiotic) conditions <sup>5</sup>. However, even genetically depauperate species can survive for the long-term (e.g. the cheetah <sup>6</sup> and the Gir lions). An essential element for the survival of inbred species is the mechanism of purging deleterious genes through natural selection <sup>7,8</sup>. It was suggested by several researchers time and again that the Asiatic lion may have low genetic diversity index and it is a concern in the long-term conservation of Gir lions <sup>9</sup>. Genetic studies and demographic management of populations may be guiding principle for further conservation of the Asiatic lion.



Further, in recent times, with increasing population, changing population dynamics and expansion of the territory, the overall health scenario of this population is also a cause of concern and science driven health management is needed. Susceptibility to diseases and chance of an epidemic type of outbreak is to be addressed through this project. This can and needs to be combated through demographic and genetic management of the lion population as a meta-population. Along with existing satellite populations, other free ranging populations need to be established. The gene exchange to enrich the existing genetic diversity among these population is to be taken up. The genepool program may offer solutions to infuse variations. Several populations will also act as a safety net against catastrophic events like epidemics or natural calamities that can wipe out single populations. Current lion population in Saurashtra is one big gene pool, with individuals exchanged between the Gir PA and satellite populations on a regular basis as shown by satellite-GPS-telemetry study <sup>10</sup>. The lion population of the Gir PA being the source population and the satellite populations being sinks. Immigration is an essential element for the survival of these satellite populations <sup>11</sup> (see Appendix 1 for Population Viability Analysis - PVA). With infrastructure, urban sprawl and industrialization on the increase, it is important to identify lion dispersal routes and ensure green norms for development projects traversing these corridors so as to safeguard the future of the satellite populations which cannot exist without immigrants. For satellite population viability immigration is an essential demographic process, but this makes the entire landscape susceptible to epidemics like Canine Distemper and Rabies. Since the intervening human dominated habitat matrix between lion satellite population teems with domestic and feral animal vectors for these diseases, the Saurashtra lion population would be vulnerable to epidemics that can cause catastrophic mortality and put the entire single Asiatic lion population at risk of extinction. This threat was recognized by the Gujarat Government through a PHVA analysis done under the leadership of the eminent conservation scientist Dr. Ulysses Seal, senior Forest Officials of Gujarat and wildlife biologists at Baroda in 1993 <sup>12</sup>. The Hon'ble Apex Court of India passed a land-mark judgement in 2013 mandating the Ministry of Environment Forests and Climate Change, GoI, Government of Gujarat and Government of Madhya Pradesh to work together and establish a reintroduced lion population in Kuno Wildlife Sanctuary, Madhya Pradesh. Progress towards this has been made on the principles laid down by the IUCN guidelines (2013) for reintroductions and the third draft action plan prepared by the expert panel appointed by the Hon'ble Supreme Court is under consideration by the three governments.

### **Goal of the Project Lion:**

*Asiatic Lions Should Play Their Ecological Role and Retain Their Evolutionary Potential. The Future Generation of Indians should be Proud of Their Natural Heritage which will be Preserved as Nature intended it to be.*

### **Objectives of Project Lion**

1. To manage growing lion populations in Gujarat.
2. To ensure that local communities, people of Saurashtra and of India are the main stakeholders and benefitted by Project Lion and Lion conservation

3. To secure and manage lion habitat and mitigate human-lion conflict
4. To avert any risk of extinction to Asiatic lions and ensure their perpetuation for generations to come



## Details of proposed activities with specific action points

### Specific Targets

#### A. Habitat and Population

- 1) **Creation of inviolate space for lions within Gir Protected Area:** Create inviolate space for lions within Gir PA. Large carnivores need vast areas for viable populations and for this reason they serve as umbrella species for biodiversity with the Protected Area designed for their conservation. For Tiger Conservation the mandate of National Tiger Conservation Authority is to have an inviolate space of 800-1000 km<sup>2</sup> as core area for a tiger reserve and with a buffer of another 800-1000 km<sup>2</sup>. It is within this human free core where tigers perform their ecological role. Currently, the only exclusive space for lions is the 250 km<sup>2</sup> of the Gir National Park. The rest of the range of the Asiatic lion is shared with people and the lion population subsists of human subsidies. It is important that Project Lion restores sufficient exclusive lion habitat of about 1000 km<sup>2</sup> through incentivized voluntary relocation of forest villages and Maldhari (local pastoral communities) settlements from within Gir Conservation Areas so that the only surviving Asiatic lion population gets the space it requires for performing its ecological role. The Maldharis living within Gir PA make a 75% higher profit compared to Maldharis living outside the PA due to free access to grazing, sale of manure with topsoil, and compensation for predated livestock <sup>13</sup>. Therefore, an appropriately lucrative rehabilitation package for incentivized relocation would need to be worked out and offered to all forest dwellers within the core zone to relocate outside with hand holding and additional perks which may be available from the Gujarat State Government.

***Time frame: 5-10 years; Responsibilities: Gujarat Forest Department, Madhya Pradesh Forest Department and Rajasthan Forest Department***

- 2) **Habitat management in Saurashtra landscape:** Habitat improvement and augmentation is crucial to manage the growing population in a variety of land use and land cover categories. Besides managing and augmenting the habitat in the protected areas as per management plan, restoration of grasslands (reserved and non-reserved), development of peripheral forests as ideal habitat, securing shelter belts and refuge patches, lion corridor development and incentive driven lion friendly management in eco-sensitive zone is the key to maintain the thriving population of Asiatic lions. This should be the focus of the Lion project in times to come. Due to overgrazing by livestock many of these habitats are degraded and infested with invasive weeds and shrubs like *Lantana camara*, *Cenchrus ciliaris*, and *Prosopis juliflora* <sup>14,15</sup>. The habitat improvement and augmentation efforts in areas other than protected areas must be dovetailed with direct and indirect benefits to the local communities by mechanisms such as sharing of proceeds, grass etc. Project Lion will address these management activities.

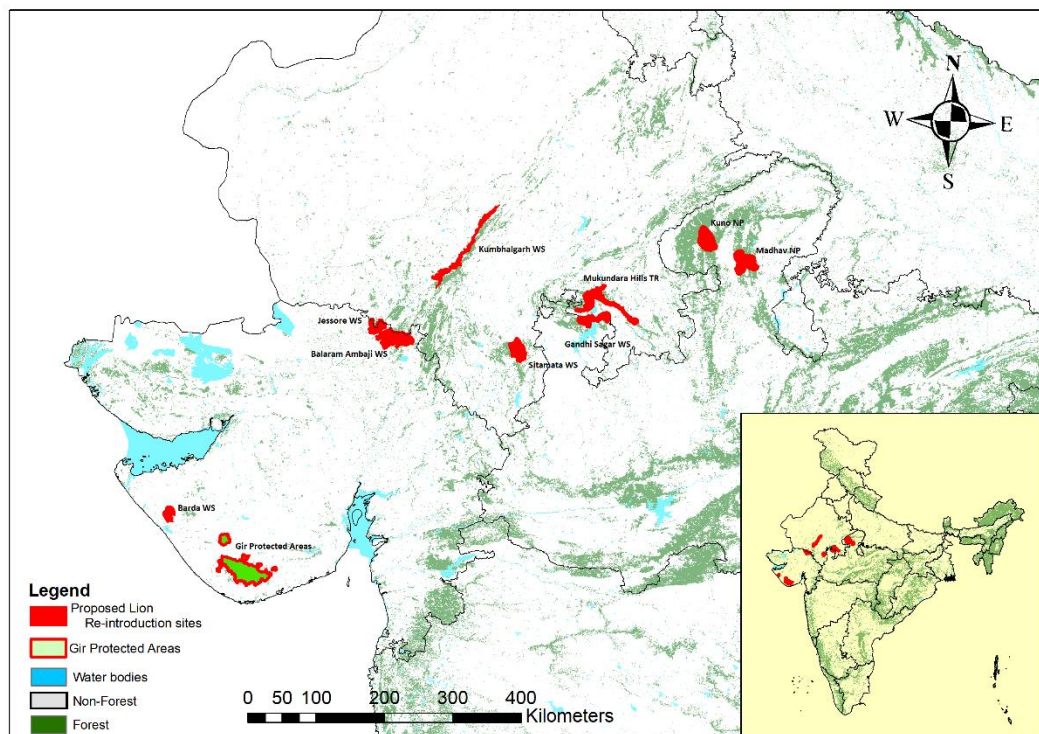
***Time frame: On a continuous basis. Responsibilities: Gujarat Forest Department, Madhya Pradesh Forest Department and Rajasthan Forest Department***

- 3) **Establishing additional populations for lions in Gujarat and India:** Create additional safety net free ranging populations within Gujarat and in India. The Barda Wildlife Sanctuary has been identified and assessed by the Wildlife Institute of India as a potential

site where a population of 40 lions can be accommodated in the larger landscape of Barda-Alech hills and coastal forests <sup>16</sup>. Investments for incentivized voluntary relocation of Maldhari families from within Barda WLS needs to be done under Project Lion. The Barda Maldharis are willing to relocate and a good incentive will free the wildlife sanctuary for lion reintroduction <sup>16</sup>. The other such potential sites may be further explored and progress may be made as per IUCN guidelines (Figure 3; see Appendix 2 for other sites within Gujarat and in other States). As per the Hon'ble Apex Court's order good progress has been made for reintroduction of lions to Kuno National Park, with Madhya Pradesh declaring the entire Kuno WLS and Wildlife Division as a National Park (750 km<sup>2</sup>) devoid of humans which is larger than the current Gir National Park (250 km<sup>2</sup>) (see Appendix 3 for a comparison between Gir and Kuno).

***Time frame: 5-10 years; Responsibility: Gujarat Forest Department, Madhya Pradesh Forest Department, Ministry of Environment Forest and Climate Change GOI, and Wildlife Institute of India.***

**Figure 3: Potential sites in Gujarat and elsewhere in India for establishing alternative populations of Gir lions**





- 4) **Management of alternate lion populations as metapopulations:** After establishing such lion populations these populations would be managed as a meta-population after disease and genetic studies of individuals to manage the demography in light of the lower genetic diversity in this subspecies of lions. With the current understanding based on full genome sequencing of all representative lions from across their range as well as historical samples<sup>3,4</sup>, the Gir lions along with Central and West African lions have been renamed as *Panthera leo leo*, while the east and southern African lions have been named as *Panthera leo melanochaita*<sup>17</sup>. The Asiatic lions have close genetic affinity with extant West African and Central African lions. However, these west and central African lion populations are under severe threat of extinction and the Gir lions can potentially play a significant role in rescuing these lion populations in the future. Genetic rescue has been successfully done in the Florida Puma (*Puma concolor coryi*,<sup>18</sup>) and is likely to be necessary for some lion populations across their range in Africa and India<sup>19</sup>.

**Time frame:** *On a continuous basis. Responsibility: Gujarat Forest Department, Madhya Pradesh Forest Department, Ministry of Environment Forest and Climate Change GOI, and Wildlife Institute of India.*

- 5) **Periodical enumeration of lion, co-predators, prey and habitat:** Traditional total count method is currently used to estimate status of Asiatic lions every five years by the Gujarat State Forest Department. Total counts are rarely possible in a free ranging population since not all animals are detected and often it is not possible to avoid double counts of the same individuals. These shortfalls of total counts are explicitly addressed by WII with a robust scientific approach to estimate abundance through individual animal identification<sup>20,21</sup> and technique such as spatially explicit capture recapture (SECR)<sup>22</sup>. The National Tiger Status evaluation carried out by the National Tiger Conservation Authority (NTCA)-WII in collaboration with State Forest Departments is a holistic assessment of prey, other carnivores, habitat and anthropogenic impacts along with tiger population estimation<sup>23</sup>. This exercise provides information that is useful for policy and management. Similar strategy should be adopted for evaluating the Status of Lions in Saurashtra Landscape at present and other landscapes in future.

**Time frame:** *On a continuous basis at an interval of every 4 years. Responsibility: Gujarat Forest Department, Madhya Pradesh Forest Department, Rajasthan Forest Department and Wildlife Institute of India.*

- 6) **Demarcation of boundaries of potential lion habitats:** Future of lions in Saurashtra will depend on how fast the potential lion habitats in the Gir landscape can be safeguarded against the odds of rapid change of land-use pattern and linear infrastructures<sup>10</sup>. However, there is little scope of further expanding the existing Protected Area network in the landscape. Therefore, the potential lion habitats, critical breeding and refuge patches and dispersal corridors should be urgently delineated and conserved as “Conservation Reserve”, “Eco-sensitive Zone” without compromising with local livelihood securities under the ambit of Project Lion. For other proposed sites for lion reintroduction in India, the boundaries of the Protected Areas should be appropriately demarcated in case there are ambiguities before the preparations for translocation begin.

*Time frame: 2-5 years. Responsibility: State Forest Departments.*

**B. Community participation**

- 1) **Eliciting public support for lion conservation:** Community participation and making them the stake holders is vital. The communities have a sense of pride and responsibility. This overarching sense needs to be converted into an information-sharing and monitoring mechanism. Public outreach is the key. Under its Vanyaprani Mitra (friends of wildlife) scheme, Gujarat Forest Department engages local youths who share intelligence about movement of wildlife and also act as a bridge between forest department and local communities. Currently, around 400 Vanyaprani Mitras are engaged and the Forest Department gives them honorarium. The scope of this scheme to more villages in lion landscapes of Gir and elsewhere may be expanded. Communities needs to be sensitized about the upcoming challenges of the growing lion population. The Project Lion will engage village Panchayats and encourage farmers to manage their land in a lion friendly manner to promote more space for wildlife in a rapidly developing landscape.

*Time frame: On a continuous basis. Responsibility: State Forest Departments.*

- 2) **Training and capacity building of local community members in livelihood enhancement activities:** Under this scheme, local communities around Gir Protected Area and other potential lion translocation sites should be trained in several aspects of alternate livelihood enhancement activities such as digital literacy, legal literacy, financial literacy, tailoring and embroidery, making articles out of waste, mushroom cultivation, poultry and goat farming, food processing, hospitality management etc. so as to build their capacity and reduce their dependence on forest resources.

*Time frame: On a continuous basis. Responsibility: State Forest Departments.*

- 3) **Developing additional eco-tourism infrastructure in Gujarat:** Supporting livelihoods is key element in winning community support. The proposed eco-tourism zones in the current Management Plan at Chikhalkuba and Girnar may be further developed so that local livelihoods from these regions can be benefitted. Similar eco-tourism as per prevailing guidelines and policy may also take up in newer areas.

*Time frame: On a continuous basis. Responsibility: Gujarat Forest Department.*

- 4) **Promoting cultural tourism and local handicrafts:** Policy for current eco-tourism in Gir should be amalgamated with local culture under the ambit of Project Lion. Homestays and local cuisines would be promoted to provide tourists with a flavor of local rich heritage. Maldharis and local villagers will be encouraged in preparing local ornaments, handicrafts and paintings which will be sold at local souvenir shops. Traditional local songs and dances by Siddhi (East African tribal descendants inhabiting in Gir landscape) and other local communities (like Charans) would be promoted as additional recreational activities for the tourists visiting Gir like being done in Kanha and other Tiger Reserves of the country.

*Time frame: On a continuous basis. Responsibility: Gujarat Forest Department.*



### **C. Management of Disease and Epidemics**

#### **1) Developing protocols and standard operating procedures for disease monitoring:**

Overall health and well-being of this endangered sub-species is crucial. Recent incidences of CDV and Babesiosis-related deaths of lions underline the gravity and urgency. Keeping in mind the natural processes of purging deleterious alleles, disease ecology and epidemiology; healthcare of lions will be very selective as per the advice provided by the best global experts from veterinary, genetics, and ecological fields to avoid any detrimental impacts on free ranging wild populations. A standard operating procedure (SOP) in the line of NTCA SOP on dealing with orphaned/abandoned tiger cubs and treating old/sick/injured individuals may also be developed for lions under Project Lion. The existing infrastructure and logistics need to be strengthened.

*Time frame: On a continuous basis. Responsibility: Gujarat Forest Department, Ministry of Environment Forest and Climate Change GOI, Wildlife Institute of India, Indian Veterinary Research Institute (IVRI) and International Experts.*

#### **2) Disease Profile and Ecology in the Greater Gir Landscape as well as in other reintroduction sites:**

Understanding the profile of all pathogens, their hosts and epidemiology in relation to wildlife and domestic livestock is essential for prophylactic management of potential epidemics. This study along with vaccination of domestic and feral animals will be undertaken within the Saurashtra landscape and other potential reintroduction sites. Further, disposal of cattle carcass must be streamlined with support from panchayats, panjrapols and gaushalas. Standard operating guidelines for the above aspects is the need of the day for containing the transfer of any pathogen/diseases from livestock or stray dogs to wild animals. This way of transfer of diseases and addition of pathogenic load in the wild needs to be checked. Interventions in the form of treatment to wildlife including lions will be kept to a minimum and only when required and advised by scientists.

*Time frame: On a continuous basis. Responsibility: IVRI, WII in collaboration with state forest departments.*

#### **3) Establishment of National Wildlife Disease Diagnostic Center in Gujarat:**

In order to investigate the causes of mortality events, especially large-scale die-offs or those that are otherwise unusual for lions and other wildlife, a National Disease Diagnostic Centre equipped with all modern facilities and infrastructure and manned by veterinary experts will be set up in Gujarat under the ambit of Project Lion. The center will be operating under the supervision of Ministry of Environment, Forest and Climate Change, GoI.

*Time frame: On a continuous basis. Responsibility: Ministry of Environment, Forest and Climate Change, GoI.*

### **D. Human-Wildlife Conflict**

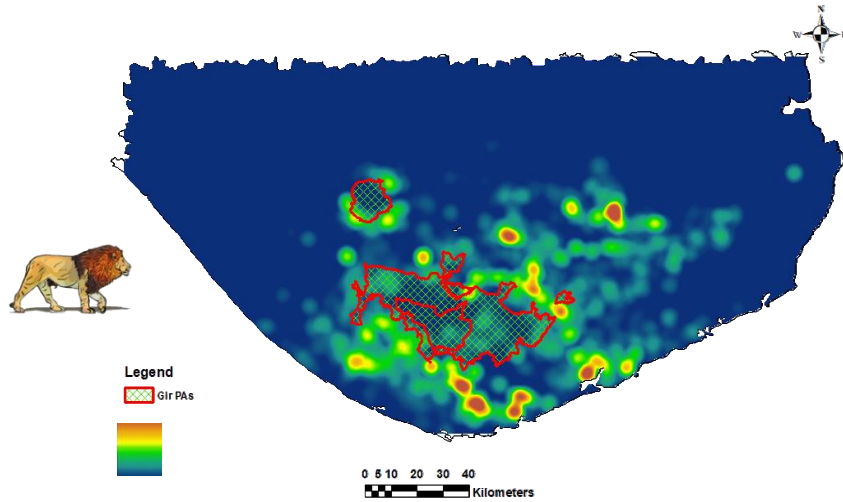
#### **1) Strengthening of infrastructures to mitigate conflict:**

Increase in number of lions also means increased human lion conflicts in addition to other human-wildlife conflicts (Figures 4 & 5). Besides effective compensation regime what is needed is extension of human-wildlife conflict mitigation measures. Especially with regards to farmers, the Forest

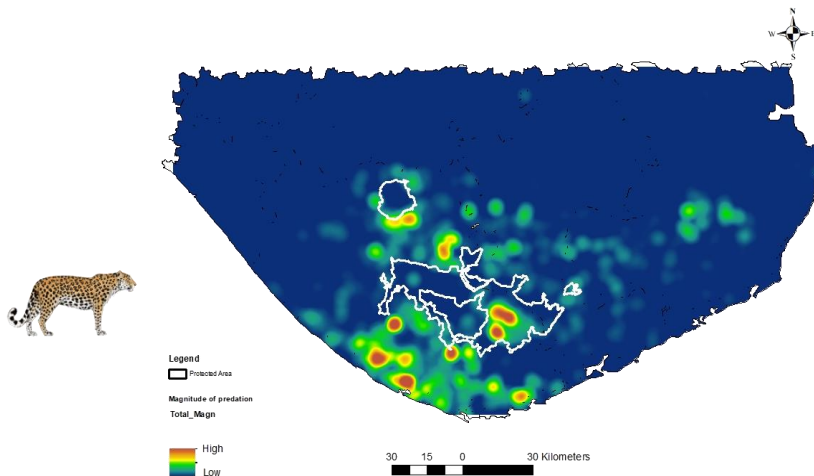
Department has started providing machans (watch stations for crop protection) which is a very welcome scheme among farmer communities. This along with other mitigation solutions like pulsating temporary power fencing, insurance schemes for crop and livestock damage, needs to be explored and extended under Project Lion. Crop raiding by wild ungulates is another equally important cause of wild animal conflict with local communities. Effective mitigation measures must be explored suitable for safe repulsion from farmlands and implemented.

***Time frame: 5 years and then on a continuous basis. Responsibility: Gujarat and other State Forest Departments***

**Figure 4: Intensity of livestock depredation by lions in the Saurashtra Landscape.**



**Figure 5: Intensity of leopard predation on livestock in Saurashtra Landscape.**





- 2) **Strengthening of rapid response units for mitigating conflict:** Strengthening of quick response teams for mitigating conflict across current and setting up new teams in potential lion habitat. Four-wheel drive vehicles equipped with darting and capture equipment, wildlife capture trained veterinary officer and his team will be deployed at strategic locations to address human-wildlife (lion/leopard) conflict and rescue.  
*Time frame: 1 year for strengthening and then on a continuous basis. Responsibility: State Forest Departments*
- 3) **Reproductive control of leopards & other agricultural pests:** Reproductive control of certain wildlife species like leopards in pockets where they are over abundant may be required to reduce their population growth and density. More human lives are lost to leopard attacks than tigers and lions combined in India. Many ungulate species like nilgai and wild pigs have become locally abundant and are responsible for large economic losses to farmers creating hostility towards Protected Areas. Immuno-contraception and chemical contraception options that are humane ways to reduce fecundity of these animals will be promoted on an experimental research basis by Project Lion in human dominated landscapes.  
*Time frame: On a continuous basis. Responsibility: Wildlife Institute of India, and subsequently State Forest Departments*

#### **E. Surveillance and monitoring**

- 1) **Smart monitoring and patrolling tools:** The Gujarat Forest Department aims to keep in line with the latest and state of the art technology. The Gir Hi-Tech Monitoring Unit, Sasan-Gir is one such of the many initiatives. The Gir Hi-Tech Monitoring Unit, Sasan-Gir was started on June 11, 2019 to continuously monitor the movement of radio-collared Asiatic Lions and field staff in the Asiatic Lion Landscape. The Gir Hi-Tech Monitoring Unit monitors various managerial segments in the Asiatic Lion Landscape 24\*7. A Forest Management Information System with an easy Graphical User Interface called e-GujForest has also been developed by the Gujarat Forest Department which helps in recording observations regarding wildlife protection and in mapping them for further use in devising management strategies. Virtual geo-fencing has also been established in probable conflict sensitive areas to monitor the movement of radio-collared Asiatic Lions in those areas. On ground patrols of staff and their live monitoring is also being done using technology. The existing software and hardware infrastructure is to be further strengthened and maintained. Implementation of MStrIPES, a program developed by WII in collaboration with NTCA for monitoring tiger reserves and landscapes of India, should be explored to other potential lion reintroduction sites. The program can be customized for particular sites by incorporating relevant points for lion conservation.  
*Time frame: On a continuous basis. Responsibility: WII & Gujarat Forest Department initially and then by other state forest departments*
- 2) **Developing a database for individual lion profiles:** Unlike tigers, lions do not have explicit body markings for individual identification. However, each lion has a unique

pattern of whisker spots <sup>20, 21</sup> and the WII has already developed a software “Program Lion” <sup>24</sup> that allows detailed history of each individual lion to be stored, compared, analyzed and used for population estimation, understanding long-term demographic parameters and for monitoring. A Lion database to store all relevant information related to population, movement, health etc. is a need of the day. The same will be developed under this Lion project.

***Time frame: 2 years and then on continuous basis. Responsibility: WII & Gujarat Forest Department initially and then by other state forest departments***

- 3) **Equipping field functionaries for strengthening infrastructure:** Continued efforts will be made to enhance infrastructure of the existing field functionaries by timely recruitment of staff, conducting regular training and capacity building for staff, increasing staff mobility, strengthening patrolling measures and using modern technologies for wildlife monitoring.

***Time frame: On continuous basis. Responsibility: Gujarat Forest Department initially and then by other state forest departments***

- 4) **Staff welfare measures:** The staff welfare fund will be continued to exist for Gir and other potential lion translocation Protected Areas. Such fund needs to be set up for the Protected Areas which do not have such facility till date. The Fund should support the frontline staff with accidental and death insurances, loans, medical expenses, educational and other financial supports.

***Time frame: On continuous basis. Responsibility: State forest departments***

## **F. Research**

Research into population genetics, population monitoring, human-wildlife conflict, disease dynamics and ecology of lions, co-predators, ungulates and socio-economies of local communities will be undertaken under the ambit of Project Lion. An understanding of ecological and social carrying capacity of the Saurashtra and other potential reintroduction sites will be obtained from this research for better management of lions and their ecosystem.

***Time frame: On a continuous basis. Responsibility: WII, IVRI, Other scientific institutions and universities in collaboration with the state forest departments.***

## **G. Information Education and Communication**

Regular press releases and reports would be made during the execution of the project at field sites of the project and also at regional and national level. An information cell will be developed. The official's in-charge of interaction with the media would be clearly identified, so that information flow may happen without any ambiguity. Every effort would be taken to ensure that the media gets an opportunity to understand the project and its



implementation with clarity. IEC material will also be developed for community sensitization and awareness.

***Time frame: On a continuous basis. Responsibility: MoEFCC, Gujarat Forest Department and State FDs***

#### **H. Manpower (Lion Cell)**

With an aim of providing technical assistance to MoEFCC to achieve the objectives of Project Lion at national scale, a Lion Cell in the line of NTCA Tiger Cell & MoEFCC Elephant Cell may be established based at MoEFCC, Delhi and WII, Dehradun. The Cell should be manned by scientists having expertise in wildlife biology, conservation ecology, GIS and veterinary science.

***Time frame: On a continuous basis. Responsibility: MoEFCC & WII***

#### **F. Monitoring and Advisory Committee**

Monitoring and stock taking is key to the project. A National Supervisory and Advisory Committee would be constituted chaired by Director General of Forests, members as CWLW's of Gujarat, Madhya Pradesh, and Rajasthan (added as required by potential reintroduction sites); Director WII, two lion biologist experts and one IVRI scientist, member secretary as Additional Director General (wildlife). A local monitoring committee is proposed for operationalizing state level management under the Chairmanship of Chief Wildlife Wardens of the respective States wherein Inspector General (Wildlife) MoEF&CC, Govt. of India, Representative of Wildlife Institute of India, Indian Veterinary Research Institute, National Institute of Virology, and local bodies such as those for Gujarat can be Gujarat Biotechnology Research Center, CCF-Wildlife Junagadh Circle, Deputy/Additional Secretary- Wildlife, Government of Gujarat will be the members. Other invited members may be taken aboard by the Chairman and committee. These committees will monitor and assess the deliverables under the Lion Project and will advise on related matters.

***Time frame: On a continuous basis. Responsibility: MoEFCC***

### Timelines for implementation for each proposed activity

<b>Proposed activity</b>	<b>Tentative proposed timeframe</b>
Creation of inviolate space for lions within Gir Protected Area	5-10 years
Habitat management in Saurashtra landscape	On a continuous basis
Establishing additional populations for lions in Gujarat and India	5-10 years
Management of alternate lion populations as metapopulations	On a continuous basis
Periodical enumeration of lion, co-predators, prey and habitat	On a continuous basis at an interval of 4 years
Demarcation of boundaries of potential lion habitats	2-5 years
Eliciting public support for lion conservation	On a continuous basis
Training and capacity building of local community members in livelihood enhancement activities	On a continuous basis
Developing additional eco-tourism infrastructure in Gujarat	On a continuous basis
Promoting cultural tourism and local handicrafts	On a continuous basis
Developing protocols and standard operating procedures for disease monitoring	On a continuous basis
Disease Profile and Ecology in the Greater Gir Landscape as well as in other reintroduction sites	On a continuous basis
Establishment of National Wildlife Disease Diagnostic Center in Gujarat	2-3 years for setting up the center. Support on a continuous basis
Strengthening of infrastructures to mitigate conflict	5 years and then on a continuous basis
Strengthening of rapid response units for mitigating conflict	1 year for strengthening and then support on a continuous basis
Reproductive control of leopards & other agricultural pests	On a continuous basis
Smart monitoring and patrolling tools	On a continuous basis
Developing a database for individual lion profiles	2 years and then on continuous basis
Equipping field functionaries for strengthening infrastructure	On a continuous basis
Staff welfare measures	On a continuous basis
Research	On a continuous basis
Information Education & Communication	On a continuous basis
Manpower (Lion Cell)	On a continuous basis
Monitoring and Advisory Committee	On a continuous basis



**Budgetary Requirement:** The budget estimates (in crores, Indian Rupees) are proposed for the **next 10 years**.

**Budget for Gujarat Forest Department**

Item	Activity	Unit	Rate	Amount (Rs. in Crore)											Remarks
				1st Year	2nd Year	3rd Year	4th Year	5th year	6th Year	7th Year	8th Year	9th Year	10th Year	Total	
<b>Habitat and Population</b>															
	A. Inviolat space for lions : relocation / resettlement of maldharis in existing PA (Gir and Barda)	2500 Families	20 Lakh per Family	100	100	100	100	100	-	-	-	-	-	500	Relocation process may spill over upto 10 years since process is time consuming
	B. Wildlife habitat rejuvenation / reclamation in relocated areas.	LS	LS	-	1	1	1	1	2.5	2.5	2.5	2.5	2.5	16.5	
	Habitat Improvement and augmentation (PA & outside PA) - Restoration of Grassland, Development of peripheral forests as ideal habitat, securing shelter belts & refuge patches	50000 Ha. 10000 Ha. Per year	Rs. 10000 Per Ha., 5000 Ha per year Maint. from Next Year	10	15	15	15	15	2.5	2.5	2.5	2.5	2.5	82.5	With maintenance works from 5th to 10th year

	Lion Corridor development, incentive driven lion friendly management in eco-sensitive zone (Development of Riverine / Non Riverine Corridor)	LS	LS	10	10	10	10	10	10	10	10	10	10	100	
	Vegetation manipulation (thinning / decongestion / pollarding etc.) in PA areas.	5000 Ha. 500 Ha. Per Year	Rs. 60000 per Ha.	3	3	3	3	3	3.25	3.25	3.50	3.50	3.50	32	
	Water augmentation in Lion habitat	LS	LS	2.5	2.5	2.5	2.5	2.5	3	3	3	3	3	27.5	
	Create additional safety net free ranging populations (Barda)	LS	LS	10	5	5	5	5	2.5	2.5	2.5	2.5	2.5	42.5	After relocation or establishment or dispersal of Lion to Barda PA
	Managing Meta-populations : other Sites (Study / preparatory works)	LS	LS	2	2	2	2	2	2	2	2	2	2	20	
	Infrastructure for field staff														
	Protection chowky/ Thana/ field staff quarters etc. & maintenance	LS	LS	10	10	10	10	10	5	5	5	5	5	75	



	Patrolling / protection infrastructure Maintenance & Development														
	Patrolling road maintenance / Development	LS	LS	10	10	10	10	10	10	10	10	10	10	100	
	Fire Control & related infrastructure	LS	LS	1	1	1	1	1	1.5	1.5	1.5	1.5	1.5	12.5	
<b>Communities</b>	Community Participation and making them stakeholders														
	Information sharing and monitoring mechanisms (Viz. Vanyaprani Mitra)	500 Persons	Rs. 2500 Per month Per person	1.5	1.65	1.82	2.00	2.20	2.42	2.66	2.92	3.22	3.54	23.91	With 10% increase in wages / stipend from 2nd year onwards
	Public outreach and sensitization programme	LS	LS	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	75	
	Engaging peoples to have lion friendly management of their land & securing / purchase private lands (Seed money)	LS	LS	75	50	30	30	30	30	30	30	30	30	365	
	local livelihoods through ecotourism and other allied activities	LS	LS	5	5	5	5	5	5	5	5	5	5	50	

	Entry point activities / Eco-development activities in new lion area	LS	LS	5	5	5	5	5	5	5	5	5	5	50	
<b>Lion Health Management</b>															
	A. Purchase of New Ambulance	10 Nos.	LS	5	-	-	-	-	-	-	-	-	-	5	
	B. Operation & Maintenance including old ones	LS	LS	-	1	1	1	1	1.5	1.5	1.5	1.5	1.5	11.5	
	strengthening of existing infrastructure and logistics & New treatment / transit facilities with maintenance	LS	LS	25	20	20	15	15	10	10	10	10	15	150	
<b>Human Wildlife Conflict</b>	Mitigation and adaptation measures														
	Manchan coverage in Lion / Leopard areas for farmers	35000 Manchan 3500 Beneficiaries per Year	Rs. 20000 Per Manchan	7	7	7	7	7	7	7	7	7	7	70	
	Protection / parapet wall for open well	15000 Nos. 1500 Well per year	Rs. 16000 Per well	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	24	
	Quick response teams	40 Teams													



	A. HR through outsourcing / Contract ( Trekkers, Labour, Animal keeper, Worker)	160 Labours	Rs. 13500 Per person per month	2.6	2.86	3.15	3.46	3.81	4.19	4.61	5.07	5.57	6.13	41.44	With 10% increase in wages / stipend from 2nd year onwards
	B. Driver through outsourcing / Contract for response team / Ambulances	50 Persons	Rs. 13500 Per person per month	0.81	0.891	0.98	1.08	1.19	1.30	1.43	1.58	1.74	1.91	12.91	With 10% increase in wages / stipend from 2nd year onwards
	C. Veterinary Officers	10 Persons	Rs. 50000 Per Person Per month	0.6	0.66	0.73	0.80	0.88	0.97	1.06	1.17	1.29	1.41	9.56	With 10% increase in wages / stipend from 2nd year onwards
	D. Engaging Livestock Inspector	10 Persons	Rs. 18000 Per Person Per month	0.216	0.2376	0.26	0.29	0.32	0.35	0.38	0.42	0.46	0.51	3.44	With 10% increase in wages / stipend from 2nd year onwards
	Other related Misc. Activities	LS	LS	5	5	5	5	5	5	5	5	5	5	50	For contingency population estimation and other related miscellaneous activities
<b>Surveillance and monitoring</b>	Strengthening of existing software and hardware infrastructure & maintenance there after	LS	LS	5	2.5	2.5	2.5	2.5	1.5	1.5	1.5	1.5	1.5	22.5	
	Engaging IT Engineers	4 Persons	Rs. 35000 Per Person Per month	0.168	0.185	0.20	0.22	0.25	0.27	0.30	0.33	0.36	0.40	2.68	With 10% increase in wages / stipend from 2nd year onwards
	GIS specialist	3 Persons	Rs. 45000 Per	0.162	0.178	0.20	0.22	0.24	0.26	0.29	0.32	0.35	0.38	2.58	With 10% increase in

			Person Per month												wages / stipend from 2nd year onwards
	Data Operator	10 Persons	Rs. 13500 Per person per month	0.162	0.178	0.20	0.22	0.24	0.26	0.29	0.32	0.35	0.38	2.58	With 10% increase in wages / stipend from 2nd year onwards
	Rescue Vehicle (Purchase / Contract) & maintenance charges of vehicles including fuel.	LS	LS	2	2	2	2	2	2	2	2	2	2	20	
	Lion Database	LS	LS	2.5	0.5	0.5	0.5	0.5	1	1	1	1	1	9.5	
Research	Population genetics, population monitoring, lion ecology, disease dynamics	LS	LS	1	1	1	1	1	1	1	1	1	1	10	
	Strengthening of Leo Gene Lab	LS	LS	3	2	2	2	2	2	2	2	2	2	21	
	Engaging JRF/ SRF/ TA/ Research Assistant / Biologist	5 Persons	Rs. 35000 Per Person Per month	0.21	0.23	0.25	0.28	0.31	0.34	0.37	0.41	0.45	0.50	3.35	With 10% increase in wages / stipend from 2nd year onwards
Information, Education and Communication	Regular press releases, reports & IEC material and training	LS	LS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	25	
	Information Cell	LS	LS	1	0.25	0.25	0.25	0.25	0.5	0.5	0.5	0.5	0.5	4.5	
				<b>318.83</b>	<b>280.22</b>	<b>260.93</b>	<b>256.71</b>	<b>257.56</b>	<b>136.50</b>	<b>137.54</b>	<b>138.93</b>	<b>140.18</b>	<b>146.56</b>	<b>2073.95</b>	

### Budgetary requirement for National Level Implementation of Project Lion

Component	Activity	Description	Amount (Rs. in Crore)											Agency to receive fund
			1st Year	2nd Year	3rd Year	4th Year	5th year	6th Year	7th Year	8th Year	9th Year	10th Year	Total	
<b>Preparation of sites for lion reintroduction</b>		Resettlement of human habitations to create inviolate space, habitat reclamation, grassland development, fencing, livestock vaccination, infrastructure and capacity building, awareness and community participation												
	Madhav NP		30	30	30	30	30						150	MPFD
	Sitamata WLS		36	36	36	36	36						180	RFD
	Mukundara Hills		65	65	65	65	65						325	RFD
	Gandhi Sagar WLS		30	30	30	30	30						150	MPFD
	Kumbhalgarh WLS		55	55	55	55	55						275	RFD
	Jessore Balaram Ambaji		66	66	66	66	66						330	GFD
<b>Lion reintroduction in Kuno NP</b>		Lion capture (drug, capture & immobilization equipment), lion transport cost, lion soft release facility at release site, additional compensation	15	15	10	10	10	10	10	10	10	10	110	MPFD



<b>Lion translocation cost for other sites</b>		Lion capture (drug, capture & immobilization equipment), lion transport cost, lion soft release facility at release site				10	10	15	20	25	25	25	130	GFD, MPFD, RFD, WII
<b>SECR based lion population estimation</b>		A quadrienal exercise initially for Gujarat & thereafter for other sites	7			8				10			25	WII
<b>Development &amp; customization of Program LION and database for Gir, Kuno and other sites</b>			1	1	1	2	2	2	2	3	3	3	20	WII
<b>Implementation of MStrIPES in Gir, Kuno &amp; other sites</b>		Customization of software, purchase of android phones, PC, laptops, server, training workshops	5	5	5	2	2	2	2	2	2	2	29	WII, State FDs
<b>Development of tourism zone in Kuno &amp; other sites</b>		Master Plan, tourism infrastructures & Interpretation Centres	5	5	5	5	5	8	8	8	8	8	65	State FDs
<b>Immunocontraception of leopards &amp; other wildlife to mitigate conflict</b>		Initially as a pilot project in Gujarat & subsequently in other states	5	5	5	5	5	8	8	8	8	8	65	WII, IVRI

<b>Establishment of National Wildlife Disease Diagnostic Center</b>		Initial set up cost in Gujarat and subsequently supporting cost	30	20	2	2	2	2	2	2	2	2	66	MoEFCC & GFD
<b>Research</b>														
	Saurashtra Landscape	Lion population genetics, population monitoring, human-wildlife conflict, disease dynamics and ecology of lions, co-predators, ungulates and socio-economies of local communities	2	2	2	2	2	2	2	2	2	2	20	WII
	Kuno	Ecological assessment & monitoring of Kuno Landscape as a potential site for lion reintroduction	2.5	2.5									5	WII
	Other potential sites	Ecological assessment of 6 sites for their potential for lion reintroduction	2	2	2								6	WII

<b>Lion Cell at MoEFCC &amp; WII</b>		Salaries & other statutory benefits of 5-6 personnel, equipment, office expenses, operational cost, travel, Institutional liabilities etc. (with increase of salaries @ 10% per annum)	2.00	2.20	2.42	2.66	2.93	3.22	3.54	3.90	4.29	4.72	32	MoEFCC, WII
<b>Information education and public outreach</b>		For Kuno & other potential lion reintroduction sites	5	5	5	5	5	5	5	5	5	5	50	State FDs
<b>Travel</b>		International & domestic travel by MoEFCC, WII, IVRI, Lion Cell officials and international experts	1	1	1	1	1	1	1	1	1	1	10	MoEFCC, WII, State FDs
			<b>365</b>	<b>348</b>	<b>322</b>	<b>337</b>	<b>329</b>	<b>58</b>	<b>64</b>	<b>80</b>	<b>70</b>	<b>71</b>	<b>2043</b>	

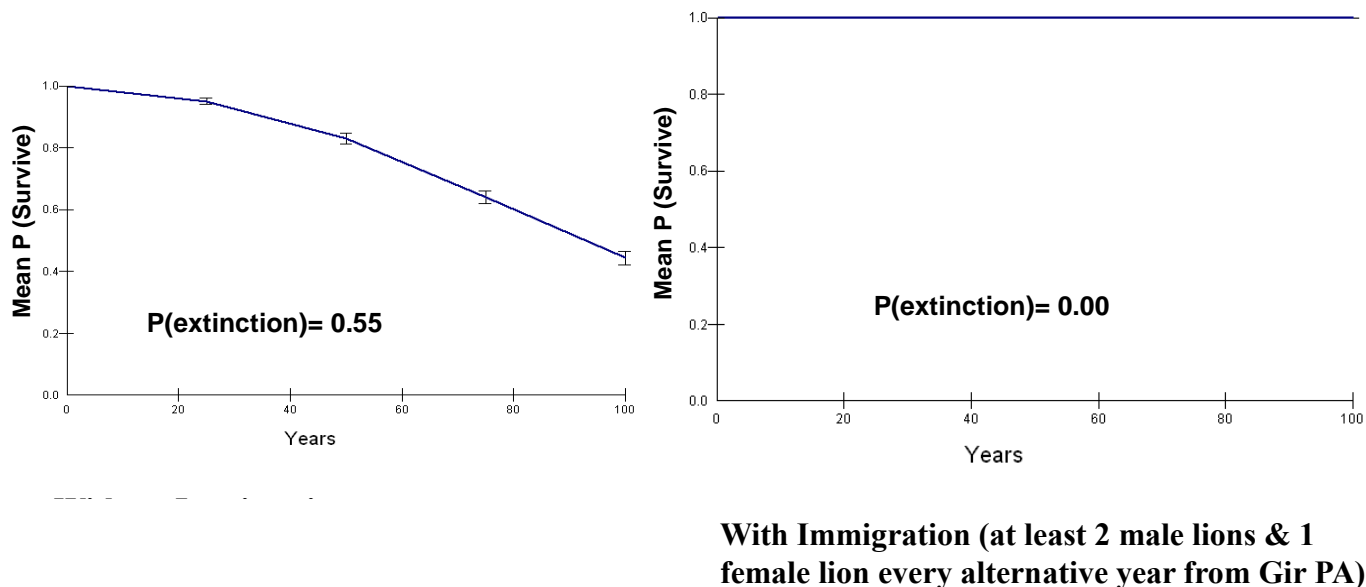


**Details of consultation with experts:** The current proposal has been prepared in consultation with the Gujarat Forest Department (Chief Wildlife Warden, Gujarat State and park managers of Gir Landscape).

## Appendix 1: Population Viability Analysis

Currently the only free ranging population of about 674 Asiatic lions (*Panthera leo persica*) exists in the Gir landscape (approximately 30,000 km<sup>2</sup>) comprising of the Gir Protected Area (PA), Girnar Sanctuary, coastal scrublands and human dominated landscapes of Saurashtra peninsula, Gujarat<sup>25</sup>. Lions are currently surviving in this landscape as a metapopulation wherein Gir PA acts as a ‘source’ and other satellite pockets act as ‘sinks’ and individual lions from different breeding populations can potentially disperse among these populations. A Population Viability Analysis (PVA) was performed for small, isolated Girnar lion population and the results suggest that the Girnar lion population could potentially survive for the short to medium term (25-50 years, probability of extinction 5-10%) without immigrants. However, for long term (100 years) persistence connectivity with the Gir PA is crucial<sup>11</sup>. Even if 1-2 lions immigrate from Gir to Girnar Sanctuary once in two years, extinction probabilities are reduced by 45% (Figure 1). Thus Girnar population of lions exists as a metapopulation sink in connection with the Gir PA and the corridor habitat should be restored and managed as ‘eco-sensitive’.

**Figure 1: Population Viability Analysis envisaging that for long term (100 years) persistence of Girnar lion population, habitat connectivity of Girnar Wildlife Sanctuary with the Gir Protected Area is crucial**



About 2,500 years ago, the Kathiawar peninsula was separated from the mainland India by rising sea level causing the first genetic bottleneck that isolated the founders of the present Asiatic lion population compelling them to inbreed for several generations<sup>9</sup>. A second less severe bottleneck happened at the onset of the nineteenth century when lions became restricted to the Gir forests and their number declined to around 50 individuals due to hunting and habitat loss<sup>26</sup>. Allozyme and microsatellite studies indicate that the Asiatic lion population is genetically monomorphic, attributed to an isolated inbred population with a small founder base<sup>9,27</sup>. Decreased heterozygosity likely diminishes reproductive vigor and survival and is believed to impair a population's long-term viability<sup>28, 29</sup>. Moreover, inbred carnivore populations restricted to single sites (such as Asiatic lions) face a variety of extinction threats from genetic and environmental stochastic factors<sup>30</sup>. Catastrophes such as an epidemic, an unexpected decline in prey, natural calamities or retaliatory killings could result in the extinction of a threatened species when it is restricted to a single site. It is worth recording that an epidemic caused by a morbillivirus closely related to Canine Distemper Virus (CDV) emerged abruptly in the lion population of the Serengeti National Park, Tanzania in early 1994 resulting in fatal neurological disease characterized by grand mal seizures and myoclonus; the lions that died had encephalitis and pneumonia<sup>31</sup>. Recent outbreak of Babesiosis and CDV in Gir has already resulted into mortality of at least more than 60 lions during past two years. As the world is currently witnessing the rapid spread of corona virus during COVID outbreak, similarly, the CDV can also spread very fast within the entire lion population of Gir especially when containment is not possible due to feral animal vectors in a landscape that remains connected for disease transmission. This necessitates urgency for establishing geographically distant and distinct populations of a minimum size and subsequently managed them as a metapopulation with Gir. *In-situ* lion conservation would benefit from as many such free ranging populations as possible.

One such potential site identified by the Wildlife Institute of India was Kuno Wildlife Sanctuary in Madhya Pradesh<sup>32</sup>. A population habitat viability workshop for the Asiatic lions held at Baroda in October 1993 also reiterated the need of a second home for the species in Kuno along with other sites such as Sitamata, Darrah-Jawahar Sagar and Kumbhalgarh in Rajasthan and Barda in Gujarat<sup>12</sup>. A PVA model was parameterized for Kuno by WII based on lion demographic data obtained from the Gir lion population<sup>33</sup>. With conservative and realistic lion population parameters, the PVA incorporating environmental, genetic and demographic stochasticity, suggests that the lions reintroduced in Kuno will have high probabilities of long-term population persistence. The salient features that permitted population persistence were a i) carrying capacity of over 45 lions, ii) introducing an initial population of a minimum of twelve individuals (5-7 breeding females and 2-3 breeding males) and iii) supplementation with a minimum of six individuals (two males and four females) every four year for the next 16 - 20 years. Even with this strategy long-term (> 200 years) lion persistence in Kuno requires a population of over 80 lions. This can be achieved by increasing the size of the Protected Area combined with an increase in prey abundance which will enhance the carrying capacity for the lions to the required level (20 – 25 years). The PVA models were extremely sensitive to loss of lions to human causes and therefore strict monitoring and protection



are required during the initial years of lion reintroduction in Kuno till the population size exceeds 60 lions.

## Appendix 2: Additional potential sites for lion re-introduction

### 1. Madhav National Park:

**Area:** 354.61 km<sup>2</sup>

**State:** Madhya Pradesh

**Biogeographic zone:** Semi-arid biogeographic zone, Gujarat-Rajputana biotic province 4B <sup>34</sup>

**Vegetation Type:** Tropical dry deciduous forest

**Geography:** Madhav National park is situated between 77° 15'to 78° 30' E and 24° 50' to 25° 55' N in the district of Shivpuri, Madhya Pradesh. The area of the National Park is 354.61 km<sup>2</sup> surrounded by the Vindhya range of mountains with an altitudinal difference of 360-490m from mean sea level <sup>35</sup>. The park is connected to Kuno-Palpur Sanctuary and serves as an important wildlife corridor in the landscape. The area falls under the semi-arid bio-geographic zone, Gujarat-Rajputana biotic province 4B <sup>34</sup> and Kathiarbar-Gir Dry Deciduous Forests eco-region <sup>37</sup>. Terrain is undulating and characterized by gentle slopes, small rocky hills multiple nallahs and contains artificial lake inside the National Park (<https://natureconservation.in/>). The dry deciduous vegetation of the park is mostly dominated by *Anogeissus pendula*, *Lannea coromandelica*, *Grewia tilifolia*, *Boswellia serrata*, *Sterculia eurens* and *Acacia catechu*. The park also comprises flat grasslands around the reservoirs<sup>38</sup>.

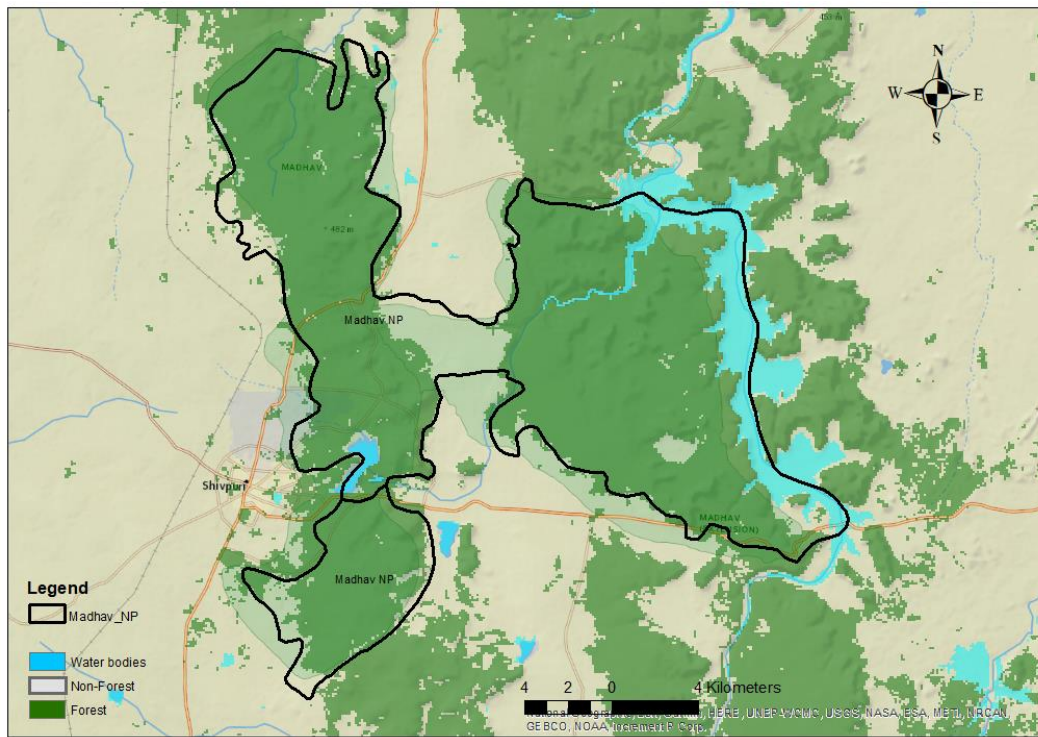
**Prey-predator diversity:** The major carnivore species includes Wolves (*Canis lupus*), Leopards (*Panthera pardus*), Sloth Bear (*Melursus ursinus*), Striped hyaenas (*Hyena hyena*), Golden jackal (*Canis aureus*), Indian fox (*Vulpes bengalensis*) and Wild Dog (Dhole) (*Cuon alpinus*). Among herbivores Sambar (*Rusa unicorn*), Spotted deer (*Axis axis*), Barking deer (*Muntiacus vaginalis*), Indian Gazelle (*Gazella bennettii*), Nilgai (*Boselaphus tragocamelus*) and Wild pig (*Sus scrofa*) are common <sup>35, 39</sup>.

**Climate:** The landscape experiences a sub-tropical climatic condition with extremely hot summer and relatively moderate winter. Winter ranges from November to February, summer ranges from March to June and rainy season starts from mid-June and continues up to September. The average annual temperature varies between 4°C in winter and 45°C in summer. The average annual rainfall in the landscape ranges between 1000 mm to 1250 mm <sup>38</sup>.

**Anthropogenic pressure:** About 130 villages surrounding with 10 km radius from the National Park and only one village is situated within. There is high pressure of both timber and non-timber forest product collection by the villagers <sup>35</sup>.

***Priority and immediate management interventions needed:***

The landscape of Madhav National park which have good connectivity with Kuno National Park creates an area of more than 3000 km<sup>2</sup> with good forest and less biotic pressure compared to other protected forests proposed herewith for lion re-introduction. There is ample space for lions to disperse from Kuno or vice-versa. Therefore, this landscape is on top of the priority list. However, to make it conducive for lion conservation some immediate management inventions need to be implemented, such as, resettlement of remaining villages from the protected area, habitat improvement, eradication of weeds, infrastructure development to reduce human-large carnivore conflict such as power-fencing and livestock vaccination to prevent disease spread from domestic animals.



*Figure 1: Madhav National Park, Madhya Pradesh*



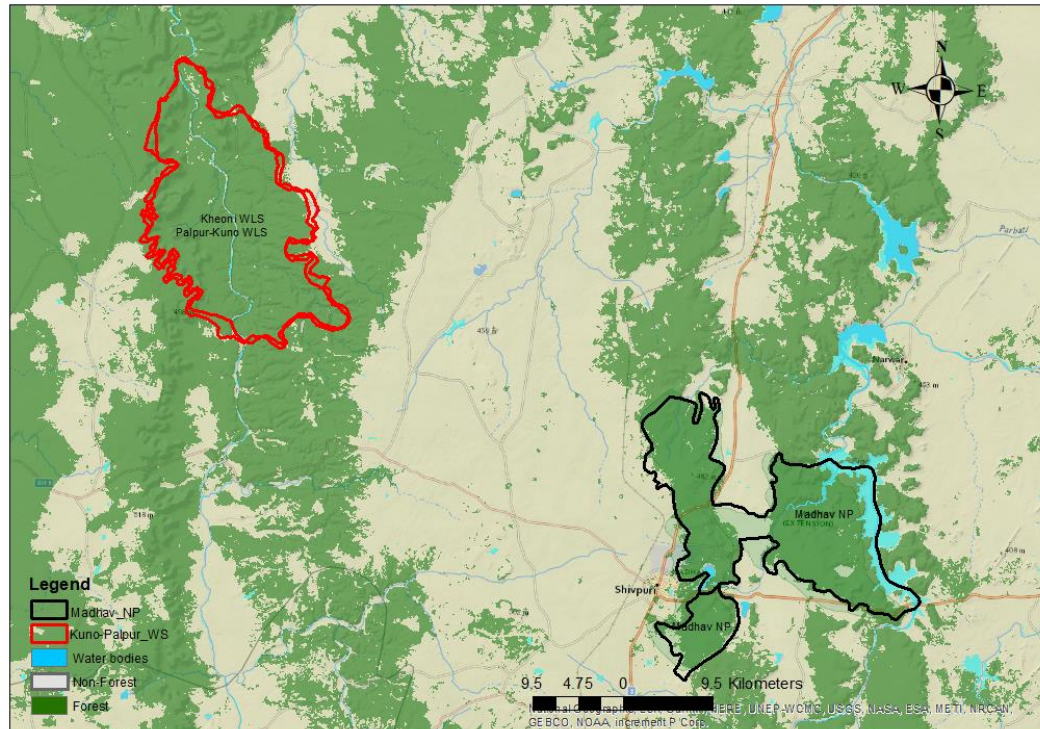


Figure 2: Madhav National Park and Kuno-Palpur Wildlife Sanctuary complex, Madhya Pradesh

## 2. Sitamata Wildlife Sanctuary:

**Area:** 422.95 km<sup>2</sup>

**State:** Rajasthan, India

**Biogeographic zone:** Semi-arid biogeographic zone, Gujarat-Rajputana biotic province 4B <sup>34</sup>

**Vegetation Type:** Tropical dry deciduous forest

**Geography:** Sitamata Wildlife Sanctuary is situated between 24° 04'-24° 23' N and 74° 25'-74° 40' E in the south-western part of Rajasthan State. It is spanning over an area of 422.95 km<sup>2</sup> in the districts of Pratapgarh and Chittaurgarh <sup>40</sup>. It falls under the “semi-arid bio-geographic zone; Gujarat-Rajputana biotic province 4B <sup>34</sup> and Kathiarbar-Gir Dry Deciduous Forests eco-region <sup>37</sup>. The strategic location of the sanctuary at the junction of the Aravalli, Vindyan hill ranges, and Malwa Plateau creates a unique ecosystem for many fauna and flora. The landscape is characterized by gentle slopes, rugged and hilly terrains interspersed with network of river and streams, wetlands, natural deep gorges and fine grooves of mixed woodlands. The altitude ranges from 280m to 600m above mean sea level.

**Prey-predator diversity:** The sanctuary forms the north-western most limit of Teak-bamboo mixed forest and distribution limits of many animal species <sup>41</sup>. The sanctuary is known to support a great diversity of mammalian fauna including many carnivorous species such as Wolves (*Canis lupus*), Leopards (*Panthera pardus*), Striped hyaenas (*Hyena hyena*), Golden jackal (*Canis aureus*), Jungle cat (*Felis chaus*), Indian fox (*Vulpes bengalensis*), Honey badger (*Melivora capensis*), Small Indian civet (*Viverricula indica*), Common palm civet (*Paradoxurus hermaphroditus*) and Grey mongoose (*Herpestes edwardsi*) and Ruddy mongoose (*Herpestes smithii*). Among herbivores Hanuman langur (*Semnopithecus entellus*), Sambar (*Rusa unicolor*), Spotted Deer (*Axis axis*), Nilgai (*Boselaphus tragocamelus*), Four horned antelope (*Teracerus quadricornis*) and Wild pig (*Sus scrofa*) <sup>40</sup>. Besides the sanctuary is rich with many other rare and endangered faunas such as Indian pangolin (*Manis crassicaudata*), Indian hedgehog (*Hemiechinus micropus*) and Indian Giant Flying Squirrel (*Petaurista ptilipensis*) etc.

**Climate:** The landscape experiences a sub-tropical climatic condition characterized by distinct winter, summer and monsoon season. Winter ranges from November to January, summer ranges from March to May and rainy season starts from mid-June and continues up to September. The average annual temperature varies between 6°C in winter and 45°C in summer and the average annual rainfall is about 756 mm with maximum up to 951 mm and minimum 517mm.

**Anthropogenic pressure:** There are about 193 villages and 14 Gram Panchayats inside the forest, mostly comprising of people from Meena and Bhil community. Of which about 8 Gram Panchayats comprising of 96 villages are within the core area. There are problems of encroachment, heavy grazing by domestic livestock, illicit cutting of wood, timber and bamboo along with other agricultural activities, <sup>41</sup>, heavy infestation of weeds, poor prey base, lack of antipoaching strategies, many linear infrastructures cutting across the tiger reserve and poorly trained frontier forest staff, etc. <sup>42</sup>.

***Priority and management interventions needed:***

The landscape of Sitamata Wildlife Sanctuary and adjoining forest patches with similar biotic and abiotic factors makes it a suitable for reintroduction of lions. However, at present the protected area experiences high anthropogenic pressure as mentioned above. About 11000 households are known to present within the sanctuary <sup>43</sup>. Therefore, to make the landscape conducive for lions we need to reduce anthropogenic pressure and create inviolate space by resettling villages from the park, create alternate livelihood opportunity for people, improve habitat quality, weed eradication, vaccination of livestock in the peripheral villages to stop disease spread to wild animals and infrastructure development for anti-poaching activities and to reduce human wildlife conflict.

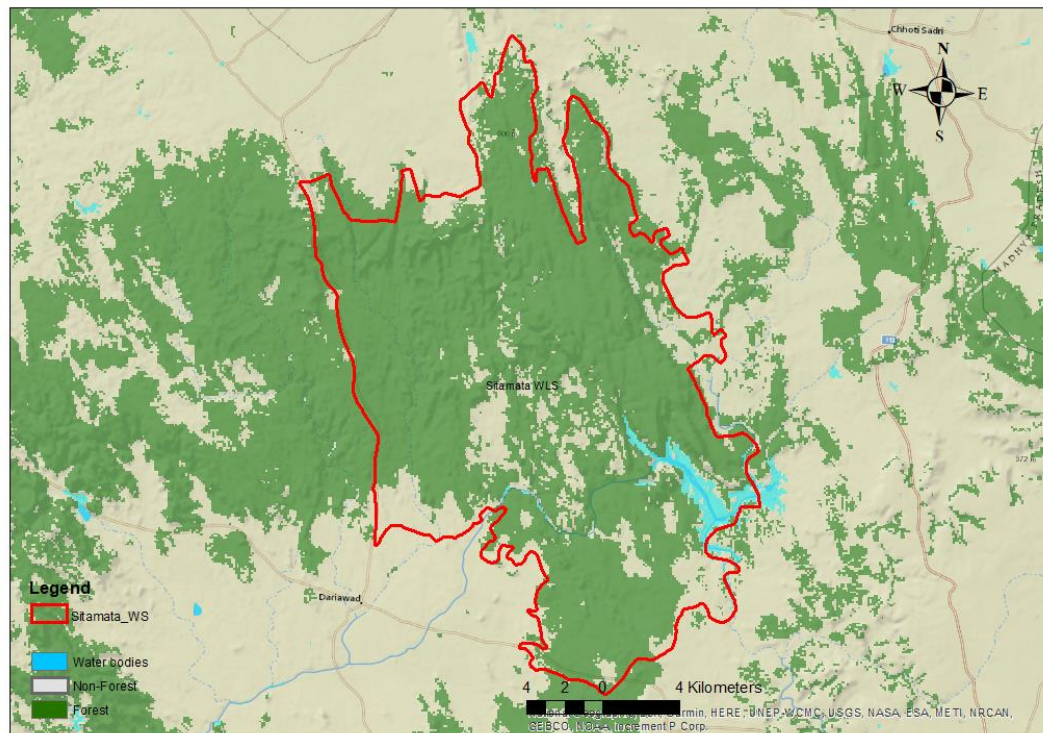


Figure 3: Sitamata Wildlife Sanctuary, Rajasthan



### 3. Mukundara Hills Tiger Reserve:

**Area:** 759.99 km<sup>2</sup>

**State:** Rajasthan, India

**Biogeographic zone:** Semi-arid biogeographic zone, Gujarat-Rajputana biotic province 4B <sup>34</sup>

**Vegetation Type:** Tropical dry deciduous forest

**Geography:** Mukundara hills tiger reserve lies between 24° 38' to 25° 7' N and 75° 26' to 76° 11' E across four districts of Rajasthan namely Kota, Bundi, Chittorgarh and Jhalawar. It covers an area of about 759.99 km<sup>2</sup> of which 417.17 km<sup>2</sup> is designated as core and 342.82 km<sup>2</sup> is designated as buffer <sup>44</sup>. Located in the eastern bank of river Chambal, the tiger reserve consists of three wildlife sanctuaries, Darrah National Park, Chambal Wildlife Sanctuary and Jaswant Sagar Wildlife Sanctuary. The tiger reserve has connectivity with Ranthambore tiger reserve, Ramgadh Vishdhari and Bhainsarogar wildlife sanctuary. Further, it is also connected to the Gandhi Sagar wildlife sanctuary in Madhya Pradesh <sup>23</sup>. The area falls under the semi-arid bio-geographic zone, Gujarat-Rajputana biotic province 4B <sup>34</sup> and Kathiarbar-Gir Dry Deciduous Forests eco-region <sup>37</sup>. The vegetation type is characterized by dry deciduous forest <sup>45</sup> dominated by *Anogeissus pendula*, *A. latifolia*, *Acacia catechu*, *Ziziphus mauritiana*, *Flacouritia indica*, and *Acacia leucifloea*.

**Prey-predator diversity:** Although there are no tigers in the reserve, it harbors a great variety of carnivorous and herbivorous species. Carnivore species includes Wolves (*Canis lupus*), Leopards (*Panthera pardus*), Sloth Bear (*Melursus ursinus*), Striped hyaenas (*Hyena hyena*), Golden jackal (*Canis aureus*), Jungle cat (*Felis chaus*), Desert cat (*Felis margarita*), Indian fox (*Vulpes bengalensis*), Honey badger (*Melivora capensis*), Small Indian civet (*Viverricula indica*), Common palm civet (*Paradoxurus hermaphroditus*), Grey mongoose (*Herpestes edwardsi*) and Small Indian mongoose (*Herpestes javanicus*). Among herbivores Hanuman langur (*Semnopithecus entellus*), Rhesus macaque (*Macaca mulatta*), Sambar (*Rusa unicolor*), Spotted deer (*Axis axis*), Indian Gazell (*Gazella bennettii*) Nilgai (*Boselaphus tragocamelus*), Indian crested porcupine (*Hystrix indica*) and Wild pig (*Sus scrofa*) <sup>23</sup>.

**Climate:** The landscape experiences a sub-tropical climatic condition with extremely hot summer and relatively moderate winter. Winter ranges from November to February, summer ranges from March to June and rainy season starts from mid-June and continues up to September. The average annual temperature varies between 6°C in winter and 45°C in summer and the average annual rainfall is about 795 mm ranges from 600 mm to 990 mm <sup>46</sup>.

**Anthropogenic pressure:** There are about 12 villages inside the park, dominant community is “Gurjars” whose principle occupation is livestock rearing and dependent on the forest for fuelwood and fodder <sup>44</sup>. The landscape experiences many threats due to deforestation, over-grazing, encroachment of forest land, exploitation of forests resources and uncontrolled quarrying <sup>47</sup>.

***Priority and management interventions needed:***

The complex of Mukundara Hills Tiger reserve and Gandhi Sagar Wildlife Sanctuary along with other adjoining forest creates an area of about 2000 km<sup>2</sup> which have great potential to develop it for lion conservation. At present, there are many villages inside the Mukundara Hills tiger reserve and have great anthropogenic impact on the ecosystem. Therefore, resettlement of villages from the park is of utmost necessity to create inviolate spaces for the lions to thrive. Further, to reduce the dependency of the villagers on the forest, it is important to create alternative livelihood opportunities. Intensive management interventions for habitat improvement, weed removal and anti-poaching activities are required. Strict law enforcement against illegal activities such as quarrying within the eco-sensitive zone of the PA need to be prohibited. Roughly there are more than 10,000 households within or in close proximity to the park <sup>43</sup>.

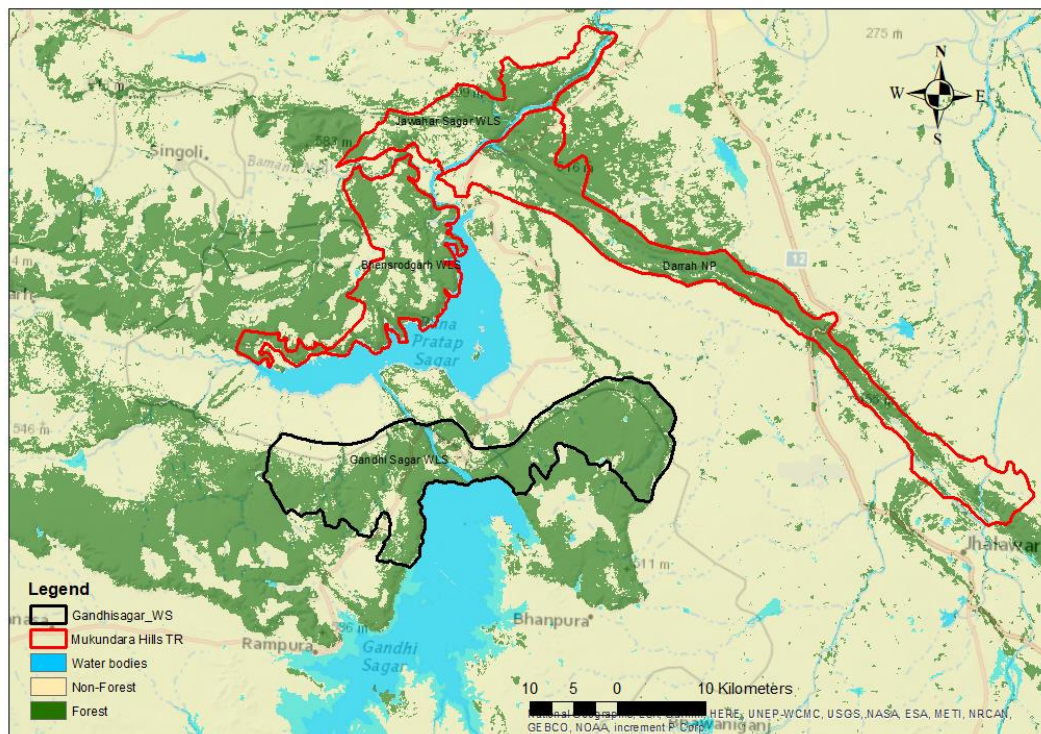


Figure 4: Mukundara Hills Tiger Reserve of Rajasthan and Gandhi Sagar Wildlife Sanctuary of Madhya Pradesh complex

#### 4. Gandhi Sagar Wildlife Sanctuary:

**Area:** 368.62 km<sup>2</sup>

**State:** Madhya Pradesh, India

**Biogeographic zone:** Semi-arid biogeographic zone, Gujarat-Rajputana biotic province 4B <sup>34</sup>

**Vegetation Type:** Tropical dry deciduous forest

**Geography:** Gandhi Sagar Wildlife Sanctuary is situated between 23° 45'-25° 2' N and 74° 42'-75° 50' E in the Malwa plateau of Madhya Pradesh. Spreading over an area of 368.62 km<sup>2</sup> the sanctuary is divided into two parts by the Chambal river running through it. The western part of the sanctuary falls in the district of Nimach while the eastern part is in Mandsaur district. The sanctuary is connected to Mukundara Hills Tiger Reserve of Rajasthan. The forests of the sanctuary can be broadly classified into (i) Northern tropical dry mixed deciduous forests [5B/C2]; (ii) Dry Deciduous Scrub Forests [5/DS1] and (iii) *Anogeissus pendula* forests [5/E1]<sup>45</sup>. The Gandhisagar dam is one of the largest inland reservoirs in the country with a submergence area of 650 km<sup>2</sup>, and there are good flat grasslands available around the submergence <sup>48</sup>.

**Prey-predator diversity:** Not much information available on the mammalian diversity of Gandhisagar Wildlife Sanctuary. However, there are reports in popular media about common sightings of Leopards (*Panthera pardus*), Striped hyenas (*Hyena hyena*) and Golden jackal (*Canis aureus*). Besides, the park also harbors Wolves (*Canis lupus*), and this sanctuary is known to be one of the strongholds of Indian Wild Dog (Dhole) (*Cuon alpinus*). The most commonly sighted wild herbivores include Hanuman langur (*Semnopithecus entellus*), Sambar (*Rusa unicolor*), Indian Gazell (*Gazella bennettii*) and Nilgai (*Boselaphus tragocamelus*) <sup>49</sup>.

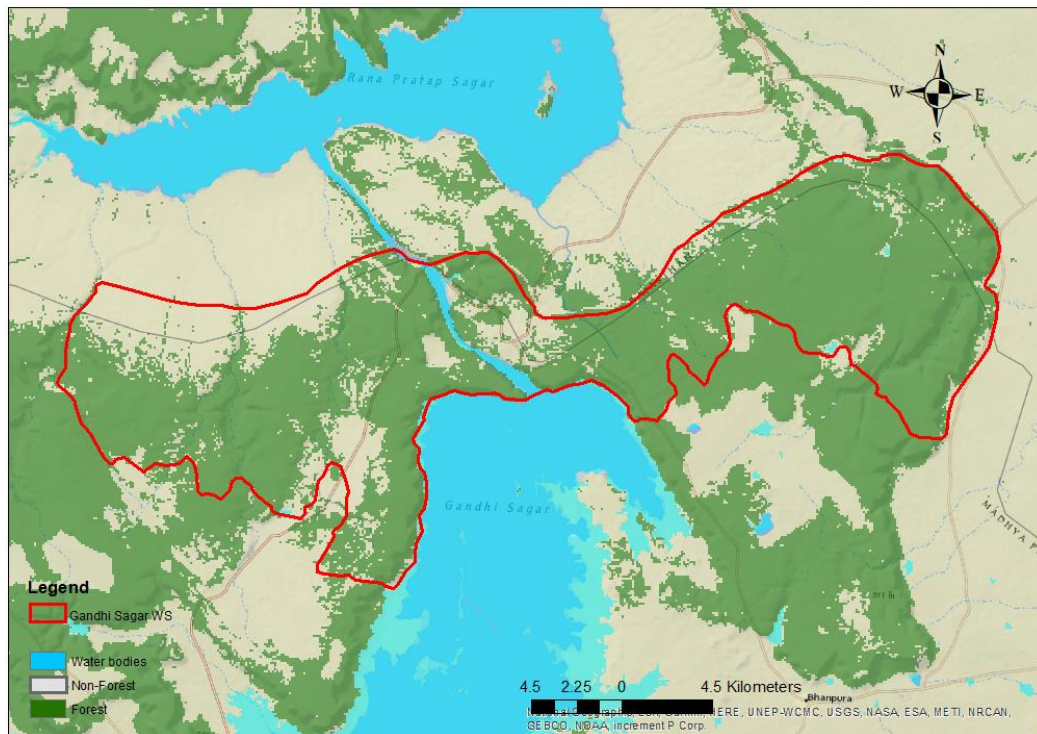
**Climate:** The landscape experiences a sub-tropical climatic condition with extremely hot summer and relatively moderate winter. Winter ranges from November to February, summer ranges from March to June and rainy season starts from mid-June and continues up to September. The average annual temperature varies between 10°C in winter and 43°C in summer and the average annual rainfall is about 795 mm ranges from 600 mm to 990 mm <sup>48</sup>.

**Anthropogenic pressure:** There are many religious tourism sites inside the wildlife sanctuary. Some of the famous attractions are Chaurasigarh, Chaturbhujnath temple, Bhadkaji rock paintings, Narsinghjar, Hinglajgarh Fort and Taxakeshwar temple <sup>50</sup>.



***Priority and management interventions needed:***

With good connectivity to Mukundara Hills Tiger Reserve in Rajasthan this landscape along with other adjoining forest patches creates an area of about 2000 km<sup>2</sup> of continuous forests and holds great potential for reintroduction of lion. There are about 530 households are known to be present within the sanctuary. Therefore, to reduce biotic pressure, religious tourisms needs to be regulated, mining or other development activities withing the eco-sensitive zone and along the habitat corridors need to be prevented. Habitat improvement, weed eradication, water management, grasslands management need to carryout. Vaccination of livestock around the park is important to prevent disease transmission to wild animals. Alternative livelihood opportunity creation is necessary to reduce dependency of villagers on forest product.



*Figure 5: Gandhi Sagar Wildlife Sanctuary of Madhya Pradesh*

## 5. Kumbhalgarh Wildlife Sanctuary:

**Area:** 610 km<sup>2</sup>

**State:** Rajasthan, India

**Biogeographic zone:** Semi-arid biogeographic zone, Gujarat-Rajputana biotic province 4B<sup>34</sup>

**Vegetation Type:** Tropical dry deciduous forest

**Geography:** Kumbhalgarh Wildlife Sanctuary is situated between 73°15' E, 25°00' N to 73°45' E, 25°30' N in the Rajsamand District of central-southern Rajasthan State and spanning over an area of 610 km<sup>2</sup> out of which 224.890 km<sup>2</sup> is designated as core zone and 385.638 km<sup>2</sup> area as buffer. It falls under the “semi-arid bio-geographic zone; Gujarat-Rajputana biotic province 4B<sup>34</sup> and Kathiarbar-Gir Dry Deciduous Forests eco-region<sup>37</sup>. The sanctuary forms the ecotone between the hilly forests of Aravallis and the Thar desert<sup>51</sup>. The vegetation is characterized by tropical dry deciduous forests with a mix of savanna grasslands, patchy riparian corridors of dense perennial canopy. The geography of the Sanctuary is characterized by highly eroded remnant of Precambrian uplift which follows the Aravali hill and covers the hill ranges of Kumbhalgarh, Sadri, Desuri and the Bokhada. The elevation varies from 275m to 1155 m from mean sea level<sup>52</sup>. Kumbhalgarh hills forms the catchment of many rivers and nallahs<sup>51</sup>.

**Prey-predator diversity:** The sanctuary is diverse in terms of carnivorous species and their prey. Carnivore species includes Wolves (*Canis lupus*), Leopards (*Panthera pardus*), Sloth Bear (*Melursus ursinus*), Striped hyaenas (*Hyena hyena*), Golden jackal (*Canis aureus*), Jungle cat (*Felis chaus*), Indian fox (*Vulpes bengalensis*), Small Indian civet (*Viverricula indica*), Common palm civet (*Paradoxurus hermaphroditus*), Grey mongoose (*Herpestes edwardsi*) and Small Indian mongoose (*Herpestes javanicus*). Among herbivores Hanuman langur (*Semnopithecus entellus*), Sambar (*Rusa unicolor*), Indian Gazell (*Gazella bennettii*) Nilgai (*Boselaphus tragocamelus*), Four horned antelope (*Teracerus quadricornis*), Indian crested porcupine (*Hystrix indica*) and Wild pig (*Sus scrofa*)<sup>51</sup>.

**Climate:** The landscape experiences a sub-tropical climatic condition with extremely hot summer and relatively moderate winter. Winter ranges from November to February, summer ranges from March to June and rainy season starts from mid-June and continues up to September<sup>51</sup>. The average annual temperature varies between 5°C in winter and 48°C in summer and the average annual rainfall is about 725 mm ranges from 403 mm to 950 mm<sup>52</sup>.

**Anthropogenic pressure:** There is no human settlement inside the sanctuary <sup>51</sup>. However, about 94,388 people are known to live within 5 km of the boundary of the sanctuary in about 33 settlements. The sanctuary experiences threats from over grazing by domestic livestock, illegal tree cutting, forest fire and invasive plants like *Lantana camara* and *Prosopis juliflora* <sup>52</sup>.

***Priority and management interventions needed:***

Although there are no human settlements within the protected area, biotic pressure from the peripheral villages are immense. Therefore, creating alternative livelihood opportunities for the villages around the sanctuary is necessary to reduce dependency of people on forest products. Habitat improvement to increase prey base density, weed eradication, water management, vaccination of livestock around the sanctuary boundary to prevent disease transmission to wild animals, and infrastructure development for anti-poaching activities and mitigate human-wildlife conflict needs to be carried out.

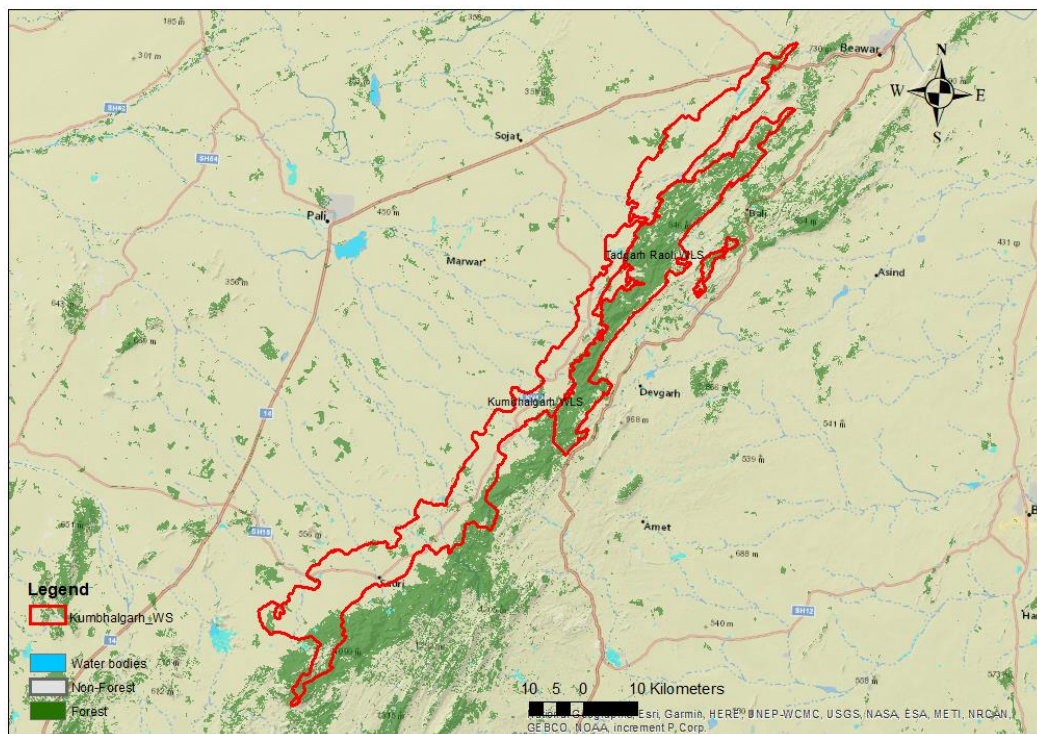


Figure 6: Kumbhalgarh Wildlife Sanctuary, Rajasthan



## 6. Jessore-Balaram Ambaji WLS and adjoining landscape:

**Area:** 542.08 km<sup>2</sup> (Balaram Ambaji WLS)

180 km<sup>2</sup> (Jessore Wildlife Sanctuary)

**State:** Gujarat, India

**Biogeographic zone:** Semi-arid biogeographic zone, Gujarat-Rajputana biotic province 4B <sup>34</sup>

**Vegetation Type:** Tropical dry deciduous forest

**Geography:** The areas of Jessore-Balaram Ambaji WLS comprises of Jessore Sloth Bear Sanctuary, Balaram-Ambaji WLS and adjoining forests in the north western part of Gujarat state. Both the sanctuaries are in the Aravali hill range and connected to the Mount Abu in Rajasthan through degraded forest corridors. The landscape is spanning between 23° 35' to 24° 43' N and 71° 0' to 73° 0' E in the district of Banaskantha, Gujarat. The total area of the Jessore Wildlife Sanctuary is 180 km<sup>2</sup> whereas the area of Balaram Ambaji Wildlife Sanctuary is 542.08 km<sup>2</sup>. The straight aerial distance between the protected areas are not more than 7 km and forms a complex of forested landscape which harbors many important flora and fauna. The landscape falls under the semi-arid bio-geographic zone, Gujarat-Rajputana biotic province 4B <sup>34</sup> and Kathiarbar-Gir Dry Deciduous Forests eco-region<sup>37</sup>. The terrain is characterized by rugged hills cutting through by few rivers and rivulets. The landscape has great ecological significance as it acts as a buffer between the desert eco-system and the dry deciduous type of forest ecosystem <sup>53</sup>. Elevation ranges from 10m to 1000m (Jessore peak) above mean sea level. The vegetation is characterized by dry deciduous forests with dominant trees of *Commiphora wightii*, *Bombaxceiba*, *Cassia auriculate*, *Cassia fistula*, *Diospyros melanoxylon*, *Ziziphus mauritiana* and *Butea monosperma*.

**Prey-predator diversity:** The landscape provides space for a great diversity of mammalian species. The major carnivorous species found in the landscape are Sloth Bear (*Melursus ursinus*), Indian leopards (*Panthera pardus*), Wolves (*Canis lupus*), Striped hyaenas (*Hyena hyena*), Golden jackal (*Canis aureus*), Jungle cat (*Felis chaus*), Indian fox (*Vulpes bengalensis*), Honey badger (*Melivora capensis*), Small Indian civet (*Viverricula indica*), Common palm civet (*Paradoxurus hermaphroditus*) and Grey mongoose (*Herpestes edwardsi*) and Ruddy mongoose (*Herpestes smithii*). Among herbivores Hanuman langur (*Semnopithecus entellus*), Rhesus macaque (*Macaca mulatta*) Sambar (*Rusa unicolor*), Spotted Deer (*Axis*

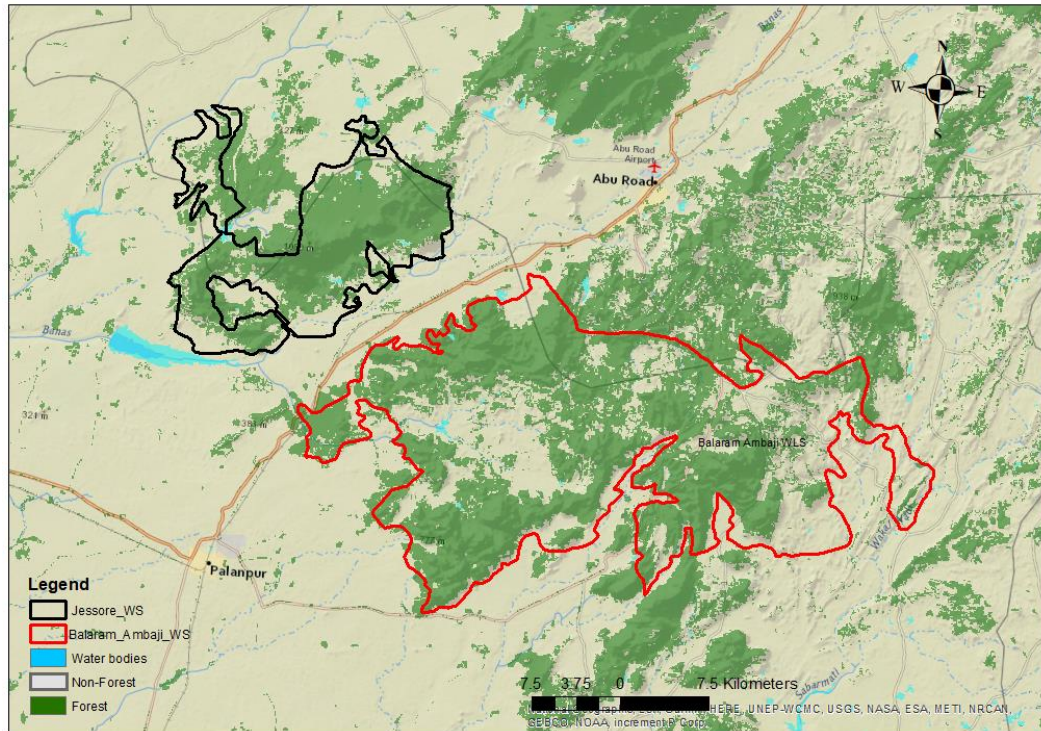
*axix*), Nilgai (*Boselaphus tragocamelus*), and Wild pig (*Sus scrofa*). Besides the sanctuary is rich with many other rare and endangered faunas such as Indian pangolin (*Manis crassicaudata*), Indian hedgehog (*Hemiechinus micropus*) and Indian Giant Flying Squirrel (*Petaurista ptilipensis*) etc. <sup>54</sup>.

***Climate:*** The landscape experiences a sub-tropical climatic condition with extremely hot summer and relatively moderate winter. Winter ranges from November to February, summer ranges from March to June and rainy season starts from mid-June and continues up to September. The average annual temperature varies between 5°C in winter and 46°C in summer. The average annual rainfall in the landscape 765mm<sup>55</sup>.

***Anthropogenic pressure:*** There are many temples in the landscape, besides the famous Balaram and Ambaji temples, which attracts millions of tourists. Average 5-6 lakh pilgrims are known to visit these temples every week. The landscape also experiences intensive mining for marbles, around the sanctuaries<sup>56</sup>.

***Priority and management interventions needed:***

This landscape with restoration of habitat corridors between the two protected areas forms a good area for re-introduction of lions within Gujarat. Unlike Barda this landscape does not have connectivity with the existing lion population in Gir, that ensures the isolation of the re-introduced population of the species. There are about 15523 households known to be present within the sanctuary<sup>43</sup>. Therefore, this landscape needs intensive management interventions to resettle villages from the protected areas, improve habitat quality, prey base, regulate mining activities within the eco-sensitive zone, vaccination of livestock in the peripheral villages and conflict mitigation strategies.





### Appendix 3: Comparison between Gir Protected Area and Kuno National Park

In order to minimize the extinction probability of Gir lions from any probable future stochastic event like a disease epidemic or a natural calamity, the Kuno Protected Area in Madhya Pradesh was identified 1995 as a potential site for establishing a second lion population. Substantial investments by the Government of India and Madhya Pradesh have been made to make Kuno ideal for receiving lions. Comparisons of the following parameters between Gir and Kuno explicate Kuno as being ready for receiving and nurturing a second population of Asiatic Lions in India:

Parameter	Gir Protected Area	Kuno Protected Area
<b>Size of the Protected Area &amp; human free area</b>	The total area of the Gir is 1,883 km <sup>2</sup> inclusive of a Gir Wildlife Sanctuary of 1,153 km <sup>2</sup> . The only area exclusively for Asiatic lions in the world is the Gir National Park of about 259 km <sup>2</sup> .	Total area of Kuno Wildlife Division is 1,235 km <sup>2</sup> . Human free Kuno National Park is about 748 km <sup>2</sup> . About 2.7 times larger than Gir National Park.
<b>Bio-geographic zone</b>	Semi-arid zone (4b), Gujarat-Rajputana biogeographic region <sup>34</sup>	Semi-arid zone (4b), Gujarat-Rajputana biogeographic region. The topography of Kuno is better suited for lions.
<b>Habitat and vegetation</b>	Dry deciduous teak forests in the western part of Gir PA and dry deciduous thorn forests, scrub forests and dry savannah forests in the eastern part of the PA.	Northern tropical dry deciduous forest. Under this type Southern tropical dry deciduous forest, <i>Anogeissus pendula</i> forest and scrub and <i>Boswellia</i> forest, <i>Butea</i> forest, dry savannah forest and grassland are predominant.
<b>Size of the forested landscape outside the PA where lions can potentially disperse and persist. Historical distribution.</b>	Currently lions occupy about 13,000 km <sup>2</sup> of Saurashtra landscape adjoining the Gir PA. This area is shared with intense agriculture, high density livestock and people. Forested areas & grasslands (Vidis) that are actual refuges for lions in this landscape are < 500 km <sup>2</sup> .	About 4,000 km <sup>2</sup> of contiguous forest patch surrounds Kuno PA. This area has low human and livestock density compared to the Saurashtra Landscape. It was occupied by lions in medieval times. Descriptions of lion hunts in this region are found in Mughal writings. The entire landscape is conducive for lions.

<b>Prey densities in Protected Area</b>	<p><b>Wild prey (#/km<sup>2</sup>)</b> Chital – 56.1 (8.3), Sambar – 2.4 (0.5), Nilgai – 0.3 (0.1), Wild pig – 3 (1.3), Chinkara – 0.6 (0.3), Chowsingha – 0.2 (0.1), Langur – 9.1 (2.2), Peafowl – 10 (2).</p> <p><b>Domestic prey</b> Cattle – 4.4 (4), Buffalo – 9.4 (3.4) [numbers within parentheses are Standard Errors]</p>	<p><b>Wild prey (#/km<sup>2</sup>)</b> Chital – 52.5 (8), Sambar – 6.6 (1), Nilgai – 3.5 (1), Wild pig – 4.3 (0.9), Chinkara – 0.6 (0.3), Chowsingha – 0.8 (0.3), Langur – 12.5 (3)</p> <p><b>Domestic prey</b> Feral Cattle – 1.4 (0.7)</p> <p>[numbers within parentheses are Standard Errors]</p> <p>In 2006 chital densities were as low as 5 per sq. km <sup>57</sup> but with good protection by 2014 they increased to &gt; 50 per sq. km <sup>58</sup>.</p>
<b>Investments made and impact on local livelihood</b>	<p>Communities in the Gir Landscape making direct or indirect profit from lions were more tolerant toward them. The two important economic benefits from lions were: (a) their propensity to predate nilgai and wild pigs, both considered as agricultural pests and (b) presence of lions offered an opportunity for tourism and employment.</p>	<p>Government of India and Madhya Pradesh Government have already spent approximately USD 3.4 million till 2007 for relocating 24 human settlements from Kuno WLS and for other habitat management interventions <sup>59</sup>. The local economy around Kuno is poor and would benefit from jobs and economies created by lion reintroduction.</p>

Furthermore, Madhya Pradesh Forest Department has an excellent track record of conserving and managing large carnivores such as tigers within the state since long. As per the recent all India tiger estimation report released by the Honorable Prime Minister, Madhya Pradesh bags the reputation of having the largest number of tigers and is the “tiger state” of the country with a population of 526 tigers. The state supports ~14% of tiger and ~23% of India's leopard population and has 15,156 km<sup>2</sup> of forests occupied by tigers <sup>36</sup>. Some of the Protected Areas in Madhya Pradesh like Bandhavgarh, Kanha Tiger Reserves have tiger population with more than 80 individuals, which serve as major source populations ensuring the persistence of other tiger metapopulations across the whole Central Indian Landscape <sup>23</sup>. Moreover, the state forest department also has the expertise and capacity of capturing, handling, translocating and radio-telemetry which all will be essential for managing the reintroduced lion population in Kuno.

## References

1. Tabasum, W., Ara, S., Rai, N., Thangaraj, K. & Gaur, A. Complete mitochondrial genome sequence of asiatic lion (*Panthera leo persica*). *Mitochondrial DNA Part B Resour.* **1**, 619–620 (2016).
2. Mitra, S. *et al.* De novo assembly and annotation of Asiatic lion ( *Panthera leo persica* ) genome. *bioRxiv* 549790 (2019). doi:10.1101/549790
3. Manuel, M. de *et al.* The evolutionary history of extinct and living lions. *PNAS USA* **117**, 10927–10934 (2020).
4. Armstrong, E. E. *et al.* Long live the king: chromosome-level assembly of the lion (*Panthera leo*) using linked-read, Hi-C, and long-read data. *BMC Biol.* (2020). doi:10.1186/s12915-019-0734-5
5. Figueiró, H. V. *et al.* Genome-wide signatures of complex introgression and adaptive evolution in the big cats. *Sci. Adv.* **3**, 20 (2017).
6. O'Brien, S. J., Roelke, M. E. & Marker, L. Genetic basis for species vulnerability in the cheetah. *Science* (80-. ). **227**, 1428–1434 (1985).
7. Keller, L. F., Arcese, P., Smith, J. N. M., Hochachka, W. M. & Stearns, S. C. Selection against inbred song sparrows during a natural population bottleneck. *Nature* **372**, 356–357 (1994).
8. Hedrick, P.W. & Garcia-Dorado, A. Understanding inbreeding depression, purging, and genetic rescue. *Trends. Ecol. Evol.* **31**, 940-952 (2016).
9. O'Brien, S.J. *Prides and prejudice, 35-55: In Tears of the cheetah and other tales from the genetic frontier: the genetic secrets of our animal ancestors.* O'Brien, S.J. Thomas Dunne Books, NY, USA. (2003).
10. Banerjee, K. *Ranging patterns, habitat use and food habits of the satellite lion populations (Panthera leo persica) in Gujarat, India* (Dissertation/Ph.D. thesis). India: Forest Research Institute Deemed University, Dehradun, India, pp 435. (2012).
11. Banerjee, K., Jhala, Y.V. & Pathak, B.J. Demographic structure and abundance of Asiatic lions (*Panthera leo persica*) in Girnar Wildlife Sanctuary, Gujarat, India. *Oryx* **44**, 248–251 (2010).
12. Ashraf, N. V. K., Chellam, R., Molur, S., Sharma, D. & Walker, S. *Population & Habitat Viability Assessment P.H.V.A. and Global Animal Survival Plan Workshops 18-21 October 1993, Baroda, India.* (1995).
13. Banerjee, K., Jhala, Y. V., Chauhan, K. S. & Dave, C. V. Living with Lions: The Economics of Coexistence in the Gir Forests, India. *PLoS One* **8**, 1–11 (2013).
14. Mungi, N. A., Qureshi, Q. & Jhala, Y. V. Expanding niche and degrading forests: Key to the successful global invasion of *Lantana camara* (sensu lato). *Glob. Ecol. Conserv.* **23**, e01080 (2020).
15. Dave, C. & Jhala, Y. Is competition with livestock detrimental for native wild ungulates? A case study of chital ( *Axis axis* ) in Gir Forest, India. *J. Trop. Ecol.* **27**, 239–247 (2011).
16. Jhala, Y.V., Banerjee, K., Basu, P., Chakrabarti, S. & Gayen, S. *Assessment of Barda landscape for reintroduction of Asiatic lions.* Technical Report, Wildlife Institute of India, Dehra Dun, India, pp xiii + 146. TR-2014/003. (2014).
17. Kitchener, A. C. *et al.* A revised taxonomy of the Felidae. The final report of the Cat Classification Task Force of the IUCN/ SSC Cat Specialist Group. *Cat News Special Issue* 11–80 (2017). Available at: [https://repository.si.edu/bitstream/handle/10088/32616/A\\_revised\\_Felidae\\_Taxonomy\\_CatNews.pdf?sequence=1&isAllowed=y](https://repository.si.edu/bitstream/handle/10088/32616/A_revised_Felidae_Taxonomy_CatNews.pdf?sequence=1&isAllowed=y). (Accessed: 9th September 2020)
18. Ochoa, A., Onorato, D. P., Fitak, R. R., Roelke-Parker, M. E. & Culver, M. De Novo Assembly and Annotation from Parental and F1 Puma Genomes of the Florida Panther Genetic Restoration Program. (2019). doi:10.1534/g3.119.400629



19. Saremi, N. F. *et al.* Puma genomes from North and South America provide insights into the genomic consequences of inbreeding. *Nat. Commun.* **10**, (2019).
20. Pennycuik, C. J. & Rudnai, J. A method of identifying individual lions with an analysis of the reliability of identification. *J. Zool. London* **160**, 497–508 (1970).
21. Jhala, Y. V., Qureshi, Q., Bhuvra, V., & Sharma, L. N. Population estimation of Asiatic lions. *J. Bombay Nat. Hist. Soc.* **96**, 3–15 (1999).
22. Gogoi, K., Kumar, U., Banerjee, K. & Jhala, Y.V. Spatially explicit density and its determinants for Asiatic lions in the Gir forests. *PLoS ONE* **15**(2), e0228374. (2020).
23. Jhala, Y.V., Qureshi, Q. & Nayak, A.K. (eds.). *Status of tigers, copredators and prey in India, 2018*. National Tiger Conservation Authority, Government of India, New Delhi, and Wildlife Institute of India, Dehradun. ISBN No. 81-85496-50-1. (2020).
24. Jhala, Y. V., Qureshi, Q., and De, P. (2005). *Lion: a Software to Identify Individual Lion and Database Management*, Wildlife Institute of India. Available online at: [http://wii.gov.in/lion\\_id](http://wii.gov.in/lion_id) (accessed September 11, 2020).
25. Gujarat Forest Department. *Report on Poonam Avlokan (Full Moon Observations) of Asiatic Lions in the Asiatic Lion Landscape: June, 2020*. Wildlife Division, Sasan-Gir. (2020).
26. Pocock, R.I. Lions of Asia. *J. Bombay Nat. Hist. Soc.* **34**, 638-665. (1930).
27. Wildt, D.E. et al. Reproductive and genetic consequences of founding isolated lion populations. *Nature* **329**, 328-331. (1987).
28. O'Brien, S.J., Wildt, D.E. & Bush, M. The African cheetah in genetic peril. *Sci. Am.* **254**, 84-92. (1986).
29. Packer, C. et al. Case study of a population bottleneck: lions of the Ngorongoro Crater. *Con. Biol.* **5**, 219 – 230. (1991).
30. Gilpin, M.E. & Soulé, M.E. *Minimum viable populations: processes of species extinction*, 19-34: In *Conservation Biology: the science of scarcity and diversity*, Soulé, M.E. (ed.), Sinauer, Sunderland, MA. (1986).
31. Roelke-Parker, M. E. et al. A canine distemper virus epidemic in Serengeti lions. *Nature* **379**, 411-445. (1996).
32. Chellam R., Joshua, J., Williams, C.A. & Johnsingh, A.J.T. *Survey of potential sites for reintroduction of Asiatic lions*. Unpublished Report, Wildlife Institute of India, Dehradun, 39 pp. (1995).
33. Banerjee, K. & Jhala, Y.V. Demographic parameters of endangered Asiatic lions (*Panthera leo persica*) in Gir forests, India. *J. Mammal.* **93**, 1420 – 1430.
34. Rodgers, W.A. & Panwar, H.S. *Planning a wildlife Protected Area network in India. Volume I*. Wildlife Institute of India, Dehra Dun, 339 pp. (1988).
35. Beazley, N. K. *Enclosing the pristine myth: the case of Madhav National Park, India*. Available at [https://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/592/Beazley\\_Kim.pdf?sequence=1](https://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/592/Beazley_Kim.pdf?sequence=1) (2006).
36. Jhala, Y.V. et al. *Status and Distribution of Major Mammalian Fauna in the State of Madhya Pradesh*. (Wildlife Institute of India, Dehradun. TR 2016/013, Pp 102, 2016).
37. WWF. Southern Asia: Northwestern India | Ecoregions | WWF. *World Wildlife Fund (WWF)* (2020). Available at: <https://www.worldwildlife.org/ecoregions/im0206>. (Accessed: 4th September 2020)
38. Chauhan, S. S., Tiwari, A., Sheikh, A. & Sharma, S. Study on biological spectrum of Madhav National Park, Shivpuri Madhya Pradesh India. *J. Bio. Env. Sci.* **2014**, 258–262 (2014).
39. <https://mpforest.gov.in/>. *Madhav National Park, Shivpuri*.

40. Bhatnagar, C., Koli, V. K. & Sharma, S. K. Sunbasking behaviour of elliot's giant flying squirrel *petaurista philippensis* (elliot) in sitamata wildlife sanctuary, Rajasthan, India. *J. Bom. Nat. Hist. Soc.* **109**, 196–197 (2012).
41. (FES), F. for E. S. Assessment of Biodiversity in Sitamata Wildlife Sanctuary : A Conservation Perspective Foundation for Ecological Security. *Found. Ecol. Secur. P.B. No. 29, Jahangirpura, P.O. Gopalpura, Vadod* 388 370, (2010).
42. Kumar, S. What went wrong with the tiger reintroduction programme at Mukudara Hills Tiger Reserve in Rajasthan? – Newsroom24x7. (2020). Available at: <https://newsroom24x7.com/2020/09/01/what-went-wrong-with-the-tiger-reintroduction-programme-at-mukudara-hills-tiger-reserve-in-rajasthan/>. (Accessed: 9th September 2020)
43. NASA Open Data, P. India Village-Level Geospatial Socio-Economic Data Set: 1991, 2001 | NASA Open Data Portal. (2001). Available at: <https://data.nasa.gov/dataset/India-Village-Level-Geospatial-Socio-Economic-Data/4ri6-783z>. (Accessed: 8th September 2020)
44. Sen, M. K. & Nama, K. S. Documentation of Ophiofauna of Mukundara Hills National Park , Kota , Rajasthan ( India ). **1**, 21–24 (2013).
45. Champion, H. & Seth, S. *A revised study of the forest types of India*. (Government of India Press, 1968).
46. Kumar, D., Chauhan, P. S., Bhatnagar, P. & Nagar, B. Phytodiversity Characterization of Mukundara Hills Tiger Reserve An overview on Inherent Potential of Underutilized Fruits View project PG teaching View project. *Artic. Int. J. Curr. Microbiol. Appl. Sci.* (2020). doi:10.20546/ijcmas.2020.907.235
47. Singh, P. & Reddy, G.V. *Lost Tigers Plundered Forests: A report tracing the decline of the tiger across the state of Rajasthan (1900 to present)*. WWF-India, New Delhi. (2016).
48. Tiwari, A. P., Khanna, K. K. & Dubey, P. C. Angiospermic diversity of Gandhi Sagar Wildlife Sanctuary , Madhya Pradesh , India. *Geophytology* **45**, 139–151 (2015).
49. Gandhi Sagar Wildlife Sanctuary | Wildlife in India Foundation. Available at: <https://wildlifeinindia.in/gandhi-sagar-wildlife-sanctuary/>. (Accessed: 9th September 2020)
50. Gandhi Sagar Wildlife Sanctuary - WildTrails Recent Sightings | The One-Stop Destination for all your Wildlife Travels. Available at: <https://wildtrails.in/gandhi-sagar-wildlife-sanctuary/>. (Accessed: 9th September 2020)
51. Bohra, P. *Faunal Exploration of Kumbhalgarh Wildlife Sanctuary Rajasthan Zoological Survey of India Kolkata. Conservation Area Series* (2013).
52. Chhangani, A. K. Avifauna of Kumbhalgarh Wildlife Sanctuary, in the Aravalli hills of Rajasthan. *Zoos' Print Journal* **17**, (2002).
53. Basu, P. *Assessment of landscape pattern for modelling habitat suitability for lions and prey species in Gir Protected Area, Gujarat*. PhD Thesis, FRI Deemed University, Dehradun, India (2013).
54. Balaram Ambaji Wildlife Sanctuary | Wildlife Sanctuaries | Available at: <https://forests.gujarat.gov.in/balaram-sanctuary.htm>. (Accessed: 9th September 2020)
55. Mewada, T. P., Tiwari, U. L. & Kotia, A. Fruiting species influence the seasonal use of the habitat by sloth bear in and around Balaram Ambaji Wildlife Sanctuary, Gujarat, India. *Not. Sci. Biol.* **11**, 183–190 (2019).
56. Rithe, K. & Madhusudan, M. *Site inspection report on proposal for rationalisation of boundaries of Balaram-Ambaji Wildlife Sanctuary (BAWS), Gujarat Submitted to the Standing Committee of the National Board for Wildlife A view of Balaram Ambaji Wildlife Sanctuary*. (2013).
57. Banerjee, K. *Estimating the ungulate abundance and developing the habitat specific effective strip width models in Kuno Wildlife Sanctuary, Madhya Pradesh*. M.Sc Theis, Forest Research Institute University, Dehradun, 170 pp. (2005).

58. Bipin, C.M., Patil, N.A., Prabhu, C.L., Sharma, U., Sharma, V.S., Mishra, R.K. & Jhala Y.V. *Status of predators and prey in Kuno Wildlife Sanctuary, Madhya Pradesh*. Wildlife Institute of India, Dehradun and Madhya Pradesh Forest Department. (2015).
59. Johnsingh, A.J.T., Goyal, S.P. & Qureshi, Q. Preparations for the reintroduction of Asiatic lion *Panthera leo persica* into Kuno Wildlife Sanctuary, Madhya Pradesh, India. *Oryx* **41**, 93 - 96. (2007).