भारतीय वन्यजीव संस्थान
Wildlife Institute of India

No: WII/KSIVA/IDWH/MOEFCC/2020/22

28 January, 2021

To,

The Additional Director General of Forests (Wildlife)
Ministry of Environment, Forests and Climate Change,
Government of India,
Indira Paryavaran Bhawan, Jor Bagh Road,
Aliganj, New Delhi – 110003
Email: adgwl-mef@nic.in

Sub: Pan India assessment and monitoring of endangered species covered under the 'Integrated Development of Wildlife Habitats' (IDWH) scheme of MoEF&CC, Government of India - reg.

Sir,

The National Wildlife Action Plan of India has emphasized to review and monitor the endangered endangered species of fauna and their habitats in India. In this context, the 'Integrated Development of Wildlife Habitats' (IDWH) is an on-going Centrally Sponsored Scheme of MoEF&CC, Government of India, which supports the state governments for the recovery of these endangered species. Besides immense environmental benefits and effective implementation of wildlife conservation inputs in Protected Areas & nearby areas under Development of Wildlife Habitats, the scheme has been strengthening/ consolidation of wildlife conservation in the country. However, significant gaps were seen in data pertaining to the population trends owing to lack of robust monitoring mechanism, which is required for evaluation of the effectiveness of this scheme, which is the need of the hour.

In this context, it is proposed to fill this data gap through a project titled 'Pan India assessment and monitoring of endangered species covered under the 'Integrated Development of Wildlife Habitats' (IDWH) scheme of MoEF&CC, Government of India' with active involvements of State Forest Departments and other relevant agencies.

In this regard, we have developed a conceptual proposal to assess and monitor all endangered species covered under the 'Integrated Development of Wildlife Habitats' (IDWH) scheme of MoEF&CC.

Submitted for your kind approval and support.

Thanking you,

Yours faithfully,

28/1/21

(Dr Dhananjai Mohan)
Director

Encld: As above

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सत्यमेव जयते

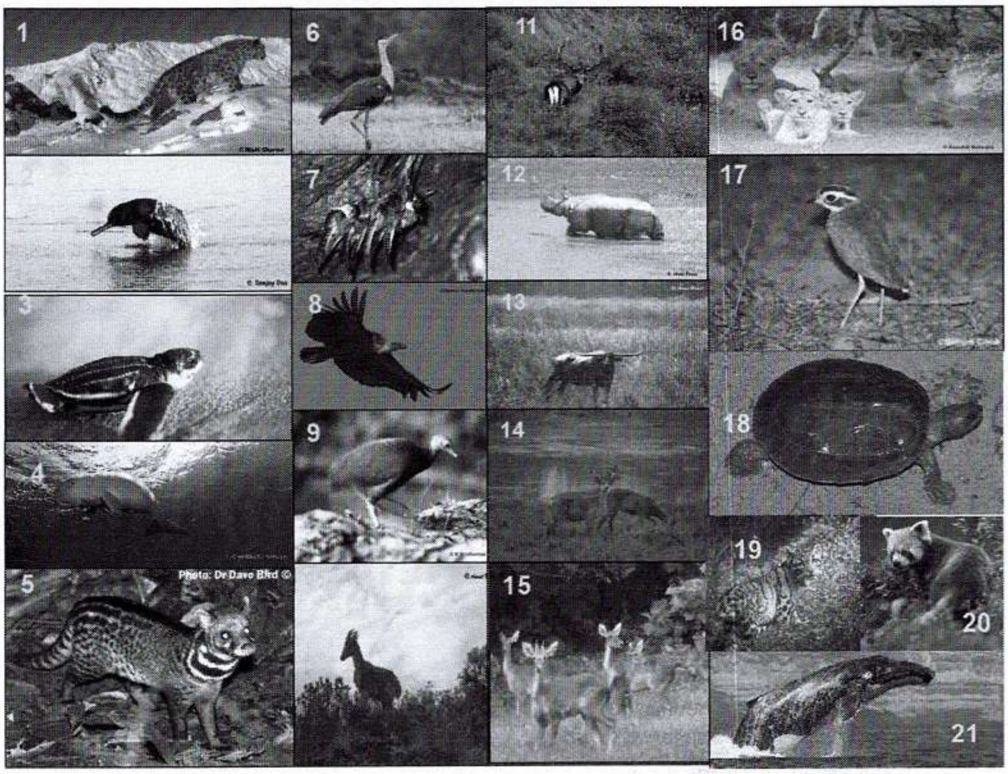
MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE
GOVERNMENT OF INDIA

Concept Proposal

Pan India assessment and monitoring of endangered species covered under the Integrated Development of Wildlife Habitats (IDWH)

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Endangered Species covered under IDWH



1. **Snow Leopard**
2. **Gangetic River Dolphin**
3. **Marine Turtles**
4. **Dugongs**
5. **Malabar Civet**
6. **Great Indian Bustard**
7. **Edible-nest Swiftlet**
8. **Vultures**
9. **Nicobar Megapode**
10. **Nilgiri Tahr**
11. **Hangul**
12. **Great One-horned Rhino**
13. **Asian Wild Buffalo**
14. **Swamp Deer**
15. **Manipur Brow-antlered Deer**
16. **Asiatic Lion**
17. **Jerdon's Courser**
18. **Northern River Terrapin**
19. **Clouded Leopard**
20. **Red Panda**
21. **Arabian Sea Humpbacked Whale**
22. **Caracal**

Content

Pan India assessment and monitoring of endangered species covered under the 'Integrated Development of Wildlife Habitats' (IDWH) scheme of MoEF&CC, Government of India

Background

The 'Integrated Development of Wildlife Habitats' (IDWH) is an on-going Centrally Sponsored Scheme, which has been made operational by adding more components and activities to the erstwhile Centrally Sponsored Scheme- 'Assistance for the Development of National Parks and Sanctuaries' during the 11th Plan Period. Under IDWH, the financial assistance is being provided to State/UT Governments for protection and conservation of wildlife and its habitats in Protected Areas (PAs) as well as outside PAs, and also for the recovery programmes of the critically endangered species. One of the three components of this scheme is 'Recovery programmes for saving critically endangered species and their habitats'. In all 22 endangered species have been covered under this scheme.

Besides immense environmental benefits and effective implementation of wildlife conservation inputs in Protected Areas & nearby areas under Development of Wildlife Habitats, the scheme has been strengthening/ consolidation of wildlife conservation in the country. The scheme has also been addressing the human wildlife conflict effectively and to generate employment opportunities resulting in economic upliftment of people in and around Protected Areas besides leading to reduction in natural resource dependency with substitution by clean energy use. Moreover, the scheme is helping in resource generation through tourist visits, thereby fostering in securing areas important for wildlife conservation, besides being helpful in sustaining life support systems as well as ensuring the food, water and livelihood security.

In this context, the Cabinet Committee on Economic Affairs, chaired by the Prime Minister had approved the continuation of the Centrally Sponsored Umbrella Scheme of Integrated Development of Wildlife Habitats (CSS-IDWH) beyond the 12thPlan period from 2017-18 to 2019-20.

Overall, the IDWH scheme of MoEF&CC has helped in conservation and improvement of habitats of nearly half of the endangered species covered under the scheme which include *inter alia* Asiatic lion, Rhino, sea turtles, dugong, Gangetic dolphins, Hangul, Nilgiri Tahr, Edible-nest Swiftlets and hard ground swamp deer. However, significant gaps were found in data pertaining to the population trends owing to lack of robust monitoring mechanism, which is required for evaluation of the effectiveness of this scheme, which is the need of the hour. Status and data gaps of all endangered species covered under IDWH has been provided in Table 1 and 2. In this context, this proposed monitoring program aimed to achieve the following objectives;

Objectives

1. Assess the current status of endangered species covered under IDWH Scheme

2. Development of long term monitoring protocols for populations and their habitats of endangered species covered under the IDWH Scheme

General Methodological Approach

1. **Population Assessment:** The status of the populations of both terrestrial and aquatic endangered species covered under IDWH would be assessed through appropriate scientific methods. Species specific estimation techniques are indicated in the Table 4. Initially, the surveys would be conducted by the Wildlife Institute of India with active involvement of Forest Departments which would empower them with adequate capacity to independently assess and monitor the populations of these species in future, with technical support from WII with respect to data analysis and reporting. Other partner institutions would also be involved in the assessment and monitoring programme.

2. **Digital App for Endangered Species Monitoring:** An user friendly 'Digital App, M-STrIPES has already been developed for the long term monitoring of 'Tiger and their co-predators and prey' in India. This App would be adopted to monitor the endangered species covered under IDWH scheme. Frontline staff of the Forest Department would be trianed to use this App for monitoring with respect to terrestrial species. A separate App would be developed for aquatic species monitoring so that that can be used by fishermen, etc.

3. **Habitat mapping and assessment:** Spatial surveys using advanced tools such as unmanned Aerial vehicles would be used for ground truthing of habitats of endangered species as per requirement that would be interpreted with high quality satellite imageries in GIS-Remote Sensing Platforms.

4. **Capacity Building**: The frontline forest, fisheries, coast guard, marine police staff would be trained in conducting surveys and monitoring endangered species. Local community will also be involved in the monitoring programme wherever feasible.

Table 4. Distribution range, fund sources, budget, periodicity and survey methods to assess and monitor all endangered species covered under the IDWH

	Species	Range States/UTs	Methods	Partner Agencies	Budget (Rs in Lakh)		Survey Timeline	Periodicity of Assessment (year)	WII Coordinating team
					Existing Fund Source	Additional Fund from MoEF&CC			
1	Snow Leopard	Jammu and Kashmir, Ladakh, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh	As per the national protocol 'Snow Leopard Population Assessment in India (SPAI)" Step 1 Occupancy surveys for SL & Prey, habitat status Step 2 SECR based on camera trapping and genetics	State Forest Departments, NCF, WWF-India, Snow Leopard Conservancy – India & others	Project Snow Leopard	IDWH 150.00	12 months	4	SSK
2	Great Indian Bustard, Lesser Florican and	Rajasthan, Gujarat, Maharashtra, Andhra	Double sampling, Occupancy Surveys,	State Forest Departments, NGOs (TCF, BNHS, etc)	CAMPA GIB Project	35 lakhs for Bengal Florican	1 year	3	SD, YVJ, QQ

	Bengal Florican	Pradesh, Madhya Pradesh, Karnataka, Uttar Pradesh, Assam, Arunachal Pradesh	Distance Sampling, Modelling,						
3	Gangetic River Dolphin	Uttar Pradesh, Bihar, West Bengal, Assam, MP, JHK, RJ	Boat survey for total country, Acoustic census	State Forest Departments, CIFRI, Aranyak, WWF, Bhagalpur & Patna Universities, etc	CAMPA Dolphin Project	20.00	12 months	4	VK, QQ
4	Hangul	Jammu and Kashmir	Line Transect, Block count (Area search method), occupancy modelling	State Forest Department		10.00	6 months	1	QQ, SSK, PN
5	Nilgiri Tahr	Tamil Nadu, Kerala	Occupancy Modelling, Double Observer surveys, scan counts	State Forest Department, KFRI, NCF & others		40.00	6 months	5	SSK
6	Marine Turtles	Andaman and Nicobar islands,	Nest count during peak	SFD ZSI NGOs		200.00	Six months	5 (But, assessment	KSK, RSK, GT

		Lakshadweep Island, West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Goa, Maharashtra, Gujarat, Daman & Diu	nesting period. Drone and Boat surveys during breeding congregation period along Odisha coast.			70.00		of mass nesting populations in every year)	
7	Dugong	Andaman and Nicobar islands, Tamil Nadu, , Gujarat	Aerial, drone, acoustic and boat surveys	SFD/SFishD Coast Guard Navy Marine Police CMLRE CMFRI	CAMPA Dugong Project and Aerial support from the Coast Guard and Navy	20.00	Six months	5	KSK, JAJ
8	Andaman Edible Swiftlet	Andaman and Nicobar Islands	Cave Surveys (total count)	SFD SACON ZSI		20.00	Six months	4	KSK, RSK, SACON
9	Wild Buffalo	Chattisgarh, Maharashtra, Assam	Camera Trap based Distance Sampling, Line transect, dung based DNA surveys, occupancy	SFD NGOs		30.00	6 months	4	YVJ, QQ, KSK, VK

			survey (Can be synchronized with AITM)						
10	Megapode	Andaman and Nicobar Islands	Nest surveys of coastal population using Belt transect. Line transect for deep forest population	SFD ZSI SACON		30.00	6 months	5	KSK, RSK
11	Manipur Brow-antlered Deer (Sangai)	Manipur	Total count, and Sample count with Line transects or block count	SFD	CAMPA Sangai Project	10.0	6 months	4	QQ
12	Vultures	All States & UTs	Spatially explicit encounter rates, Nest count at sample locations, Citizen Science, AITE survey	SFD SACON BNHS and Local institutions and NGOs	All India Tiger and Elephant Census Projects will supplement the data	25.00	12 months	4	YVJ
13	Malabar Civet	Kerala, Tamil Nadu and Karnataka	Possibly extinct but efforts would be put to			5.00			YVJ

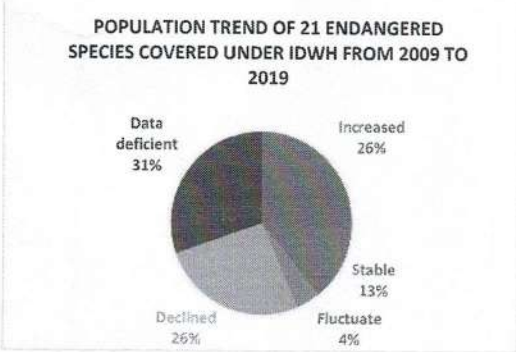
			search this species with help of Genetic tools and other techniques						
14	Great One-horned Rhino	Uttar Pradesh, Assam, WB	Total count and Block count or Line Transect with drone and elephants	SFD		20.00	6 months	4	QQ, YVJ, SM
15	Asiatic Lion	Gujarat	Individual Identification by Vibrissae or Scat-DNA followed by SECR	SFD		90.00	12 month	4	YVJ
16	Swamp Deer	Madhya Pradesh, Uttar Pradesh, Uttrakhand, Assam	Block count and Line transect	SFD		15.00	6 months	4	QQ
17	Jerdon's Courser	Andhra Pradesh	Occupancy survey using camera trap, tracking strip, remote sensing, and call plays, occupancy	SFD NCF & other NGOs		20.00	6 months	4	SD, YVJ, RSK

			survey, double sampling						
18	River Terrapin *Batagur baska*	West Bengal	occupancy survey, Block count, mark and recapture	SFD		50.00	6 months	5	AD
19	Clouded Leopard	Sikkim, West Bengal, Meghalaya, Tripura, Mizoram, Manipur, Assam, Nagaland and Arunachal Pradesh	Camera trap, occupancy survey, sign surveys	SFD, WWF		300.00	24 months	5	GGV, BH, SL
20	Arabian Sea Humpbacked Whale	Lakshadweep Island, Tamil Nadu, Kerala, Karnataka, Goa, Maharashtra, Gujarat, Daman & Diu	Acoustic surveys, boat surveys, mark and recapture using photo id, Interview based surveys with fishermen, etc	Coast Guard Navy CMFLRE CMFRI FSI	Proposed 'National Project Dolphin' will supplement the data	425.00	18 months	5	KSK, JAJ
21	Red Panda	Sikkim, West Bengal, Arunachal Pradesh, Meghalaya	Line transect, Camera trap, Occupancy Survey, Sign surveys, etc	SFD, WWF, ATREE		200.00	24 months	5	GGV, BH

22	Caracal	Rajasthan, Madhya Pradesh, Gujarat	Scat-DNA followed by SECR. Camera trap, Occupancy Survey, Sign surveys, etc	SFD		75.00	24	5	YVJ, VK, KSK

- **Current Status of endangered Species covered under IDWH**

India's impressive network of Protected Areas comprises more than 900 sites that spans over 5% of the geographical areas of the country. However, significant number of wildlife species that occur outside the PAs system have also require to be conserved, therefore, in 2006, MoEF&CC has rightfully felt the necessity of recovering endangered species and their habitats by adopting a *'landscape approach'*, which was an significant advancement over the *'protected area-centric'* approach under IDWH Scheme. This centrally sponsored scheme underscores the planning and implementation of *'Endangered Species Recovery Plan'* of wild animal species inhabiting terrestrial, inland aquatic, coastal and marine ecosystems. About 50% species covered under this scheme has already shown increasing trend in their populations.



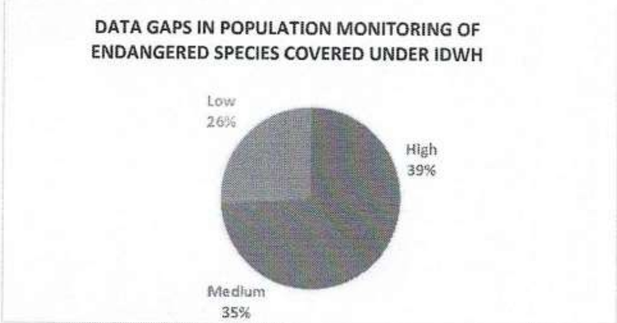


Table 1. Populations status of endangered species covered under IDWH, MoEF&CC

	Species	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Trend	Data Gap
1	Marine Turtles (4 species)	39730 739070	39730 - 739070	39730 - 739070	39730 - 739070	39730 - 739070	39730 - 739070	39730 - 739070	39730 - 739070	39730 - 739070	39730 - 739070	39730 - 739070	Fluctuate	Medium
2	Dugong	200-250	200-250	200-250	200-250	200-250	200-250	200-250	200-250	200-250	200-250	250-300	Stable	High
3	Andaman Swiftlet	3000									4200		Increase	High
4	Wild Buffalo (Central India)	70							<30		<30	<30	Decline	Low
5	Megapode	1600			1600						1300		Decline	Medium
6	Arabian sea Humpbacked Whale									50-100	50-100	50-100	Data deficient	High
7	Snow Leopard	400-700										516	Stable	Medium
8	Great Indian Bustards		300								150		Decline	Low
	Lesser Florican (Sightings)		200	220	262		200			340			Decline	Medium
	Bengal Florican (Sightings in UP)				8	34	22						Data deficient	High
9	Gangetic River Dolphin	3500						3200			3700		Stable	Medium
10	Hangul	175								182		214	Stable	Low
11	Nilgiri Tahr	<2000						3122					Increase	Medium
12	Manipur Brow-antlered Deer	92										76	Decline	Medium
13	Vultures (CR, 4 spp)	52500										52500	Decline	High
14	Malabar Civet												Data deficient	High
15	Great One-horned Rhino	2048			2290	2329		2400				3000	Increase	Low
16	Asiatic Lion	359	411					523			600		Increase	Low
17	Swamp Deer (*R. d. branderi)*	434						450				800	Increase	Medium
	Rucervus.d. ranjitsinhi	500							1148		907		Fluctuate	High
	R.d. duvauceli	1500											Data deficient	High
18	Jerdon's Courser	150											Data deficient	High
19	*Northern River Terrapin Batagur baska*											40	Data deficient	High
20	Clouded Leopard (Manas) (oer 100 sq.km)					0.58					4.2		Data deficient	High
21	Red Panda		300										Data deficient	High
22	Caracal												No Data	High

Table 2. Gaps in research and monitoring of endangered species covered under IDWH, MoEF&CC.

	Species	Initial Status	Year	Latest Status	Year	Trend	Data gap in Population Monitoring	Research Gap	Data from SFD
1	Marine Turtles (4 species)	39730 - 739070	2009	39730 - 739070	2019	Fluctuating	Medium	Medium	Required
2	Dugong	200-250	2009	250-300	2019	Stable	Medium	Low	Not Available
3	Andaman Swiftlet	3000	2009	4200	2018	Increase	Medium	Medium	Not Required
4	Wild Buffalo (Central Indian population)	70	2002	30	2018	Decline	Low	High	Required
5	Megapode	1600	2006	1300	2018	Decline	Low	High	Not Required
6	Arabian Sea Humpbacked Whale	50-100	2017			Data deficient	High	High	Not available
7	Snow Leopard	400-700	2009	516	2019	Stable	High	High	Required
8	Great Indian Bustard	300	2009	150	2018	Decline	Low	Low	Required
	Lesser Florican (No. of sightings)	200	2010	340	2017	Decline	Medium	High	Required
	Bengal Florican (No of sightings in UP)	8	2012	22	2014	Data deficient	High	High	Required
9	Gangetic River Dolphin	3500	2000	3700	2018	Stable	Medium	Medium	Not available
10	Hangul	197	2004	214	2019	Stable	Low	Medium	Required
11	Nilgiri Tahr	<2000	2009	3122	2015	Increase	Medium	High	Required
12	Manipur Brow-antlered Deer (Sangai)	92	2009	76	2019	Decline	Medium	Medium	Required
13	Vultures (CR, 4 sp.)	52500	?	52500	?	Decline	High	High	Required
14	Malabar Civet	?		?	?	Data deficient	High	High	Not available
15	Great Indian One-horned Rhinocerous	2050	2009	3000	2020	Increase	Low	Medium	Required
16	Asiatic Lion	359	2009	674	2018	Increase	Low	Medium	Required
17	Swamp Deer (Kanha)	400	2009	800	2019	Increase	Low	High	Required
18	Jerdon's Courser	150	2000	Undetected	2019	Data deficient	High	High	Required
19	River Terrapin (*Batagur baska*)	40	2019	40	2019	Data deficient	High	High	Not available
20	Clouded Leopard (Manas) (per 100 sq.km)	0.58	2013	4.2	2018	Data deficient	High	High	Not available
21	Red Panda	300	2009			Data deficient	High	High	Required
22	Caracal					No data	High	High	Not available

D.G.M high R.G high

Project Timeline:

First assessment will last for 18 months to standardize the survey techniques as different species required different survey techniques but with full involvement of the Forest departments. Later, the assessment would be completed within three to six months' period depending upon the species. Periodicity of the long term monitoring would also be decided based on the species characteristics. Indicative periodicity has been given in the table 4.

Agencies:

Overall Coordination and fund support: MoEF&CC

Technical Coordination: WII

Implementing Agencies:

1. State/UT Forest Departments
2. CMFRI
3. CMLRE
4. Coast Guard
5. Navy
6. ZSI
7. SACON
8. NGOs, etc.,

Team

Dr. Dhananjai Mohan (Project Lead), Dr YV Jhala, Dr S. Sathyakumar, Prof. Qamar Qureshi, Dr Prag Nigam, Dr Bilal Habib, Dr. Gautam Talukdar, Dr. J.A. Johnson, Dr. R Suresh Kumar, Dr Gopi, GV, Dr Abhijit Das, Dr Salvador Lyngdoh, Dr Sutirtha Dutta, Dr Vishnupriya K., and Dr K. Sivakumar (Project Coordinator).

(and)

Partner institutions such as SACON, BNHS, ZSI, CMLRE, CMFRI, etc

Budget:

Project Snow Leopard, CAMPA-Endangered Species Recovery Programme, All India Tiger Census and Project Dolphin are expected to support the assessment and monitoring of certain endangered species covered under the IDWH with approval of MoEF&CC. Additionally, Rs.19.45 crore (Rupees seventeen crore and forty-five lakh only) is required for the period of two years, to develop the methodological protocol, assess and monitor the populations of all the species. Cost will also include the capacity building of concerned frontline staff.

	Species	Budget (Rs in Lakh)		Periodicity of Assessment (year)	Coordinator*
		Existing Fund Source	Additional Fund from MoEF&CC		
1	Snow Leopard	Project Snow Leopard	IDWH 150.00	4	SSK
2	Bustards	CAMPA GIB Project	35.00	3	SD, YVJ, QQ
3	Gangetic River Dolphin	CAMPA Dolphin Project	20.00	4	VK, QQ
4	Hangul		10.00	1	QQ, SSK, PN
5	Nilgiri Tahr		40.00	2	SSK
6	Marine Turtles		200.00	5	KSK, RSK
7	Dugong	CAMPA Dugong Project	20.00	5	KSK, JAJ
8	Andaman Edible Swiftlet		20.00	4	KSK, RSK, SACON
9	Wild Buffalo		30.00	4	YVJ, QQ, KSK, VK
10	Megapode		30.00	5	KSK, RSK
11	Sangai	CAMPA Sangai Project	10.0	4	QQ, GGV
12	Vultures	All India Tiger and Elephant Census Projects	25.00	4	YVJ
13	Malabar civet	Genetic study	5.00		YVJ

14	Great Indian One-hroned Rhinoceros		20.00	4	QQ, YVJ
15	Asiatic Lion		90.00	4	YVJ
16	Swamp Deer		15.00	4	QQ
17	Jerdon's Courser		20.00	4	SD, YVJ, RSK
18	River Terrapin Batagur baska		50.00	5	AD
19	Clouded Leopard		300.00	5	GGV, BH, SL
20	Arabian Sea Humpbacked Whale	Proposed 'National Project Dolphin' will supplement the data	425.00	5	KSK CMLRE
21	Red Panda		200.00	5	GGV, BH
22	Caracal		75.00	5	YVJ, VK, SL
23	Select Habitat Monitoring of Critical IDWH Species		200.00	5	GT, NP, AK
Total			**1990.00**		

*Faculty Team: Dr. Dhananjai Mohan (Project Lead), Dr YV Jhala, Dr S. Sathyakumar, Prof. Qamar Qureshi, Dr Prag Nigam, Dr Bilal Habib, Dr. Gautam Talukdar, Dr. J.A. Johnson, Dr. R Suresh Kumar, Dr Gopi, GV, Dr Abhijit Das, Dr Salvador Lyngdoh, Dr Sutirtha Dutta, Dr Vishnupriya K., Dr Navendu Page, Dr Amit Kumar and Dr K. Sivakumar (Project Coordinator)

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Annexure I

Detailed Methodological Approaches

Snow Leopard *Panthera uncia*: The Snow leopard is the top carnivore of the high Himalayan regions (>3000m) and distributed in the states of Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh and the Union Territories of Jammu & Kashmir and Ladakh. Based on habitat quality and density estimation in a few intensive study areas, the population of snow leopard in India is estimated to be about 526 individuals (J&K + Ladakh – 285, Himachal Pradesh-90, Uttarakhand-86, Sikkim-13, Arunachal Pradesh-42). To monitor snow leopard, its prey and habitat, a national protocol "Snow Leopard Population Assessment in India (SPAI)" has been developed by the MoEFCC. This protocol involves two Steps, viz., Occupancy (Step 1) and Population estimation using camera traps (SECR) and genetic methods. The four states and two UTs would implement the protocol with technical support from research institutions and conservation organizations working on snow leopard in India.

Nilgiri tahr *Nilgiritragus hylocrius*: The endangered Nilgiri tahr has a patchy distribution in the states of Tamil Nadu and Kerala as it is restricted to the montane grasslands of the Western Ghats. The population size of Niligiri Tahr is estimated to be fewer than 2,500 mature individuals and there is an observed continuing decline in the number of mature individuals, and no subpopulation contains more than 250 mature individuals. The species current populations are distributed in Nilgiri hills (75-100), Silent Valley (30), Siruveni Hills (20), Elival Mala (60), Nelliampathi Hills (30), Top Slip and Parambikulam (120), Eastern Slopes of Ananmala (125), Grass Hills of Anamala (250), Swamaimala (130) Eravikulam National Park (760), High Range (30), Palani Hills (60), Highwavy mountains (100), Mudaliar oothu (70), Vellakaltheri (90), Ashambu Hills (70), and Thiruvannamalai peak (40). The tahr populations have been monitored by the concerned States, PA managers or researchers depending upon their requirements and availability of technical support and resources. The tahr populations are estimated based on visual encounter surveys in the surveyed blocks/grids in an area. It is now proposed that systematic population estimation and monitoring of Nilgiri tahr be carried out by both states using occupancy modelling and double observer surveys with technical support from research institutions and conservation organisations.

Asiatic Lions *Panthera leo leo*: The most reliable method for monitoring lion populations is based on a robust statistical approach of 1) individual identification of lions and subsequently 2) capture-mark-recapture (CMR) abundance estimation (Jhala et al. 1999). Individual identification of lions is usually done through the vibrissae (whisker spot) pattern (Penniquik and Rudnai). Whisker pattern along with gender, age of the lion, and permanent marks like notches on ears allow unique identification with a high level of certainty (miss identification probability is ~1 in 10,000). WII has developed Program "Lion" (Jhala et al 2005), a freely available software that allows for achieving identification information, photographs, and spatially explicit information on social and demographic structure (Jhala et al 2019). Alternatively, individual lions could be uniquely identified from a panel of highly polymorphic microsatellites (misidentification probability of ~1 in one million) amplified from scat-based DNA (Kolipakam and Jhala in Prep). Both methods of individual identification would allow the next step of abundance estimation through the powerful and scientifically robust capture-recapture approach. CMR abundance estimation of lions has been done in the Gir landscape (Jhala et al 1999, Banerjee et al. 2010) and in Africa (Elliot & Gopalaswamy 2017).

The mobile application of program "Lion" and/or "polygon search" in MSTrIPES would allow for spatially explicit capture-recapture (SECR) based analysis for estimating lion density and abundance in the Saurashtra landscape. Gogoi et al. (2020) demonstrate the practical application and use of this approach for managerial interventions in the western part of the Gir PA.

Hangul: Hangul population is stable but small and fawn: female ratio is low. There is an urgent need to ensure conservation breeding program for this species before its too late. Introduction of problem leopards and black bears need to be discouraged. The hangul population is small and needs annual monitoring. It is important to asses population during winter when population is confined using line transect method (Burnham et al 2008). This method has been used since 2004 (Qureshi et al 2009, Ahmad et al 2009, 2016,). It is important to buy appropriate equipment for line transect sampling like compass and range finders. Identify the area and keep transect permanent for monitoring over time.

Red Panda *Ailurus fulgens*: The species has a wide geographic range but is patchy and occur in very low densities (Thappa et al 2018). As the populations continue to decline, the IUCN has categorised the species under endangered category (Glaston et al 2015). In India, it is distributed only in 4 states of the northeast India i.e Sikkim, Meghalaya, West Bengal and Arunachal Pradesh. A total of 36 PAs (NP and WLS) will be surveyed comprising of 14 in Arunachal Pradesh, 5 in Meghalaya, 9 in north bengal, 8 in Sikkim. As the species is known to inhabit between 2500 and 4000 m, survey will not be conducted outside the elevation range as they are not potential habitats. After elimination of these areas, a 10 sq km grid will be laid across all these PAs and camera trap stations will be deployed in all the grids. In each grid, atleast 2 camera traps will be deployed (Bista et al, 2017). Multiple approaches will be followed for density estimation and occupancy analysis using occupancy models, distance sampling, Random Encounter Model and Distance based Camera trapping (MacKenzie et al., 2006, Noss et al. 2012, Howe, E. J. et al. 2017, Rowcliffe, J. M. et al. 2008). Survey methods and duration will be synchronised with clouded leopard surveys to utilise resources jointly. Monitoring will be carried out every five years by the state forest departments and WII.

Clouded leopards *Neofelis nebulosa*: The species is distributed in several protected areas and community forests in the NE India. In India, it has been reported from the northeastern states of Arunachal Pradesh, Assam, Meghalaya, Tripura, Mizoram, Manipur, Nagaland, Sikkim and in northern parts of West Bengal (Katti et al. 1990., Choudhury A.1993., Athreya.V and Johnsingh.A.J.T ., 1995., Dataa, 1998., Jesse Oak Taylor-Ide. 2000., Ghose.D. 2002). As the populations continue to decline, the IUCN has categorised the species under vulnerable category (Grassman et al., 2016). As the species is widely distributed, the population assessment will be prioritised to be carried out only in the PAs of the north eastern states. A total of 66 PAs (NP and WLS) will be surveyed comprising of 14 in Arunachal Pradesh, 5 in Meghalaya, 19 in Assam, 8 in Sikkim, 4 in Nagaland, 9 in Mizoram and 7 in Manipur. As the species is known to inhabit upto 3000 m, survey will not be conducted outside the elevation range as they are not potential habitats. After elimination of these areas, a 25 sq km grid will be laid across all these PAs and camera trap stations will be deployed in all the grids. In each grid, atleast 2 camera traps will be deployed (Penjor et al, 2018). Multiple approaches will be followed for density estimation and occupancy analysis using occupancy models, mark-recapture methods, Random Encounter Model and Distance based Camera trapping (MacKenzie et al., 2006, Noss et al. 2012, Howe, E. J. et al. 2017, Rowcliffe, J. M. et al. 2008). Survey methods and duration will be synchronised with red panda surveys to utilise resources jointly. Monitoring will be carried out every five years by the state forest departments and WII.

Nicobar Megapode: The Nicobar megapode is shy and cryptic birds and therefore difficult to see them in the forest whereas nesting mounds are stationary, inanimate and represent breeding signs, the easiest way to estimate and monitor a megapode population is by counting the number of active mounds (Sivakumar & Sankaran, 2003). The coastlines of the 15 islands of Nicobar on which the species was reported in will be surveyed for mounds using a standardized survey protocol (Sankaran, 1995). To estimate the total number of active mounds the coastline of each island will be divided into suitable and unsuitable coastal habitat for mound building. Coastal habitat suitable for mound building has a sandy-loam substratum and littoral forests (Sivakumar, 2000). The extent of these two coastal habitat types would be measured using satellite images (from 2006) and vegetation maps (Sankaran, 2005). Variable width transects of 10–600 m will be used to count all the mounds present within a surveyed area (the low lying coastal littoral forests are of varying width). Transect length and distance between transects will be determined by island size but it will be uniform for an island (Sivakumar, 2009). The mean length of a transect will be 2 km but in some islands, the entire coast will be surveyed if the total coastline is < 2 km. The census will be carried out with seven observers walking at 20-m intervals parallel to the shore; for transects > 140 m wide be walked the transect more than once to cover the entire width. The interior forests of Great Nicobar, Little Nicobar, Camorta, Katchal and Teressa islands will also be surveyed, with 1-km transects of 140 m width and 1 km long. The total number of active and abandoned mounds, mound size, green canopy cover over mound, and the distance between high tide mark and mounds will be recorded.

Dugong: CAMPA-Dugong Programe has already identified the critical dugong habitats of India. Intensive aerial/drone/boat surveys will be carried out using straight line transects. Number of individuals sighted, sighting distance and sighting angles will be measured to estimate the density of dugongs in Critical Dugong Habitats (CDHs). Extensive field data will be collected in the CDHs divided into grids mapped on a GIS domain before collecting the data. Sampling will be done using SCUBA diving/snorkelling during clear weather and low tide conditions. At each grid, vegetation plots will be established to assess the health of the seagrass beds. Data on species composition, shoot density, percent cover, blade/ leaf height, substrate, distribution etc. will be collected seasonally. Associated benthic fauna will also be quantified from these plots and data on species composition will be collated. Dugong feeding signs will be recorded as and when encountered. Along with the seagrass data other environmental and habitat variables like, depth, water temperature, nutrients, salinity, bed characters, human disturbance etc. will be recorded. National CAMPA-Dugong Recovery Project has already developed the dugong monitoring protocol that would be used for both assessment and monitoring of dugongs in partnership with State Forest, Fisheries and Marine Police, Indian Navy and Indian Coast Guard. CMLRE and CMFRI will also be involved in the monitoring programme.

Sea turtles: All important sea turtle nesting beaches identified in the National Turtle Action Plan would be monitored and surveyed with help of the frontline staff of the concerned Forest Department from November to March by launching national level coordinated turtle monitoring programme. Line transect method using both boats and drones will also be employed to estimate densities of the mating turtle populations especially in Odisha and Andaman islands during peak breeding season i.e. December and January.

Ganges River Dolphin: Ganges river dolphins inhabit the most threatened habitat in the world. In order to conserve the species in such a pressured habitat, it is important to have focussed conservation actions to ensure their long-term survival. Focused river management plans, that are currently almost non-existent, need to be developed along with funding for infrastructure and training, that will ensure the mitigation of threats. Important dolphin hotspots that have been identified (Qureshi et al., 2019), need to be the focus of conservation efforts. Large scale commercial boat traffic will negatively impact dolphin and it is important to adopt green technology and appropriate mitigation measures to reduce the impact. Unsustainable fishing practices, that affect the river ecosystem in general and more importantly, affect dolphin population (e.g. gill nets), and sensitisation of local communities against dolphin poaching and the use of dolphin oil are critical for conserving river dolphins.Other effects which modify and reduce the quality of river habitat are dams, sand mining and pollution and there is a need of holistic approach towards mitigating the threats. But for any conservation action to be successful, it is important to have a handle on population trends. For this, a robust scientific assessment is the need of the hour. Historically, river dolphin surveys were by visual observation by simply counting dolphins seen, estimation of encounter rates, and other estimation methods like distance sampling methods (Vidal et al 2002, Zhao et al 2008, Bashir et al 2012). All these methods suffer from confounding effects of complex river morphology, which violate the equal availability of habitat in sampling zone, and assumption that all animals are visible. Secondly, ability of individual observers to spot dolphins also differs. Because of the aforementioned reasons, one has to account for observer bias and unavailability bias. The observer bias is accounted for by dividing the observer platform into two decks; teams are separated and record data independently, so they are not influenced by each other's count (Smith et al 2001, Dawson et al 2008, Qureshi et al 2018). The unavailability bias is addressed by employing an acoustic device called A-tag (acoustic tag) along with the survey boat. Two acoustic devices are towed behind the boat carrying out the survey. These devices are built to identify and record dolphin vocalisations, called 'clicks', their direction and triangulate the dolphins position under water. Therefore, these acoustic detectors will help in accounting for the proportion of dolphins that have not surfaced during survey. The overall method will correct for both observer error, and non-surfacing dolphins. This method has been employed in Brahmaputra and Ganga (West Bengal) for estimating River Dolphin abundance (Qureshi et al., 2018). The visual-acoustic method is best and can only work in areas with good water depth where medium size boats can ply. For narrow rivers, where double observer method cannot be carried out, a Boat in tandem method using mark recapture analysis for observer bias can be used (Braulik et al 2012).

The current prevalent method of best count suffers due to inter-observer variability which makes comparison across years difficult, and this trend monitoring of endangered species extremely crucial. For assessing dolphin population estimates across the range, a combination of visual (double observer, boat in tandem) and acoustic surveys will be carried out. Visual surveys coupled with acoustic detectors will be carried out in certain stretches of rivers to address observer bias and availability bias (Akamatsu et al 2008; Braulik et al 2012, Qureshi et al 2018). Forest Department staff will be trained in doing double observer survey (Qureshi et al, 2018), where observer bias will be recorded and corrected for in the estimates. Observer bias is the inconsistent major bias, as there will be large inter-observer differences and it is very crucial to address these with appropriate method, and training of this will be imparted to survey teams. The unavailability bias correction factor needs to be checked by scientific institutions and improved upon with advances in technology over time. The correction factor developed for unavailability by WII, can be used to correct the visual survey and it is not necessary to do acoustics with all surveys.

Bustards: Status assessments of Great Indian Bustard and Lesser Florican will adopt methodologies developed by Dutta et al. (2016, 2018) and Dutta et al. (2017), respectively. The species' ranges will be sampled in systematic grid-based design in two-phases: vehicle based occupancy surveys in the first phase, to identify occupied grids (Mackenzie et al. 2002), and vehicle or foot based line transect distance sampling in the second phase, to estimate density in occupied grids (Buckland et al. 2001). Status assessment of Bengal Florican will adopt the methodology developed by Gray et al. (2009). The species' range (Jha et al. 2018) will be systematically sampled in grid-based design; along foot transects, to count displaying males. Multiple teams of researchers from WII and NGO partners, State Forest Departments' frontline staff and volunteers will be trained in these standard field methodologies. Surveys will be implemented in summer (March-May) for Great Indian Bustard and Bengal Florican, and monsoon (July-September) for Lesser Florican. Species' detections, habitat and threat status will be recorded, and analyzed to estimate occupancy, density, habitat relationships, and species' abundances at landscape and range levels. Bengal Florican population assessment methods will be refined based on the initial exercise. The method can be implemented by Forest department using MStRIPE android app, which need to be modified for bustard survey. The survey and analysis will be done in collaboration with WII. Workshops will be conducted for forest department staff and volunteers.

Malabar Civet: Extensive camera trapping across the Western Ghats has not yielded any photographic evidence of Malabar Civet. It would be advisable to use modern genetic tools to first ascertain the phylogeny of the Malabar Civet from putative museum specimens. Once confirmed as a distinct species all efforts with targeted camera trapping using lures and baits using arboreal camera trap settings should be attempted before declaring the species as extinct.

Wild Water Buffalo (*Bubalus arnee*): Wild water buffalo are found in in two distinct populations, the North Eastern population and the Central Indian population. The methods for assessing and monitoring the central Indian population are limited due to the buffalo habitats being strongholds for left wing militants. For buffalo populations of the North East, Distance sampling (Buckland, et al. 2015) on line transects ideally from elephant back work provide an assessment of buffalo density. Distance sampling (Howe, et al. 2017) and Random Encounter Method (Rowcliffe et al. 2013) based on camera traps would work well in both North East as well as Central India. However, it may not be possible to deploy camera traps in Naxel prone areas and therefore the only resort from such areas may be collection of dung samples using local people. DNA from dung would subsequently be extracted and confirmed to be wild water buffalo using Mt-DNA markers. Subsequently, individual identification of buffalos would be possible using a panel of microsatellites. Currently, work is ongoing at WII to develop markers that would identify wild buffalo from domestic buffalo. Once these markers are ready Central Indian population could be monitored effectively. Since wild water buffalo share their habitats with tigers, their populations could be monitored as part of the country wide tiger, co-predator, prey and habitat monitoring done by NTCA-WII every four years. A small additional budget would be required for developing genetic markers and subsequent monitoring in Central India.

Vultures: This is a multi-species complex and covers both resident (white rumped, long billed, slender billed, Himalayan griffon, Egyptian vulture, and red headed vulture) and migratory species (Eurasian griffon and cinerous vulture) of vultures. All vultures have significantly declined due to the use of veterinary diclofenac. A vulture sighting protocol has been implemented as part of the National Tiger Estimation done every four years since 2006 (Jhala et al 2005) across all tiger bearing states of India. Yet, this form is not addressed with the sincerity it deserves. Proper training and sensitization of staff collecting AITE data by senior officials will ensure that this basic data on vulture distribution across 20 states of India is collected ever four years as part of the AITE exercise of NTCA-WII. The MSTrIPES mobile Application with vulture sighting form is freely available on WII website. Citizen science can be utilized to collect opportunistic vulture sightings in the specified format for ready analysis using this APP. Additionally, it would be important to monitor breeding colonies and recruitment. This should be done by established protocols of using statistically rigorous approaches such as hierarchical multistage occupancy (Mackenzie et al. 2017) and nest survival approaches (White and Burnham 1999) based on sampling on an annual basis.

Swamp deer: Three distinct populations of swamp deer that occur in India (Madhya Pradesh, Uttrakhand-Uttar Pradesh and Assam) would be assessed and monitored through this programme. The method used for monitoring involves total count or block count, which are prone to error and data manipulations. Therefore, Point count (Burnham et al 1980) or Line transect based estimation will be used to assess the population status and monitoring during winter or summer months.

Arabian Sea Humpback Whale: There are challenges in estimating the abundance of whales to be completely precise. Therefore, as suggested by IWC, combination of fieldwork and computer modelling will be used to arrive the relative abundance of whales in Indian waters largely using the occupancy modelling. Vessel-based and aerial sighting surveys, acoustic monitoring, and analysis of individual animal markings (using camera trap or other telemetry technique or physical marking) are techniques will be used independently or in conjunction with each other to count whales. The information gathered from the fieldworks will be used as the basis for population modelling which could produce an abundance estimate.

Rhinoceros: The Greater One-horned Rhinoceros range once continuous across the flood plains of Indus, Ganges and the Brahmaputra from Pakistan to Indo-Myanmar borders during the 1600s, today is limited to small fragmented pockets in India and Nepal as a result of anthropogenic pressures. The methods for sampling rhino population involved total count, Distance sampling- both line transect and point count and genetic mark recapture. Distance sampling works with assumption that all animals will not be visible and addresses issues of habitat induced detection variability and observer bias. It is one of the most widely used method for monitoring wildlife in terrestrial and aquatic habitats. Its wider use has also tested its robustness. There are two types of sampling which is possible using distance sampling for rhinos, a) Elephant based line transect (Buckland et al 2001), b) Camera trap based point count (Howe et al, 2017) and modified version of point count c) Random encounter model (Rowcliff et. al., 2008). The data from 2006 to 2019 indicate population growth rate of 2.25/annum in Kaziranga, 2.0 in Pobitara, 3.93 in Orang, 3.04 in Jaldapara, 4.94 in Gorumara, and 3.47 in Dudhwa (Yadava, 2011; Sinha, 2013; Ellis et al. 2015).

Identity based method has been tried in Chitwan (Subedi et.al., 2013). It can be easily implemented with daily patrolling done by guards. Rhinos need to be individually identified. Most rhinoceroses can be identified individually from features such as horn shape, skin folds and body marks (Laurie, 1982; Conway & Goodman, 1989; Dinerstein & Price, 1991; Walpole et al.,2001; Amin et al., 2006, Malakkar et al, 2019). Few rhinos especially sub adult are not recognizable, constituting about 2-5% of population (Subedi et al., 2013). MsTRIPE software can be used for recording information (Jhala et. al., 2020). This method needs good training and continuous monitoring, which will be helpful in estimating survivorship, age of reproduction, maturity, inter-calf interval and protection. This should be done and managed at Range level. Elephant based line transect, camera trap based point count and identity based mark recapture will be suitable methods for population estimation and monitoring (Qureshi et al 2020). A combination of identity based method and point count by camera trap will be ideal for rhino monitoring.

Andaman Edible-nest Swiftlet: All the possible caves will be visited and surveyed for the abundance of nests and birds. The survey methods like nest count will be used to estimate the populations of the Edible-nest Swiftlet in different caves because counts of birds are too unreliable due to identification problems and the fact that many birds return to their caves only after dark.

A total count of the nests present was made in each cave, and each nest was assigned to a size class that ranged from foundation which were typically nests 1–3 days old, or nests which had very recently been removed to completed nests with young in them. Old nest marks were differentiated into those where traces of previous year(s) nests were present usually black or brown, and those where shallow indention in the cave wall shaped like the nest cup, and probably caused by repeated nesting by swiftlets at the same site over several decades or centuries. Old nest marks could have erroneously been counted as active nest sites.. Monitoring Cameras will also used certain important caves for continuous monitoring of birds and their nests. Trend in population would be estimated through changes in nest yields following Sankaran (2001).

Sangai: Sangai population is restricted to Kebul-lamjo Natioal Park. Population is declining and there is an urgent need to start captive breeding program and establish alternative site for their conservation (Angom et al 2020). Their habitat is highly endangered and stochastic in nature. The method used for monitoring involves total count, which is scientifically inaccurate and prone to error and data manipulations.Point count (Burnham et al 1980) based estimation has been done (Hussain et al 2006, Angom et al 2020) and is robust. It is suggested to follow same point count method as well as try Camera trap based Distance sampling and Random Encounter as more feasible options (, Howe et al 2017, Rowcliffe et al 2009).

Jerdon's Courser: Jerdon's Courser is a nocturnal cursorial bird last found in a small scrub jungle in Sri Lankamaleswara Wildlife Sanctuary, Andhra Pradesh in 2008. This exercise will attempt to survey this and other potential habitats especially in southern Andhra Pradesh (Jeganathan et al. 2004) to examine if the species persists and its distribution. The assessment will use camera traps and if necessary tracking strips (Jegannathan et al. 2002) and call playbacks. The method can be implemented by the frontline staff of State Forest Department with adequate training and routine monitoring of field activity by scientists from the WII, NCF and partner agencies (additional potential partners: BNHS and SACON). Data on the species' detections will be analysed to estimate the species' occupancy (Mackenzie et al. 2002) and encounter rate, once every four years. Additionally, changes in the species' suitable habitat (scrub jungle with low bush density) can be monitored using remote sensing and GIS tools to monitor its habitat trend, as a proxy for the species' population trend, given the apparent current low numbers of the species.

River Terrapin *Batagur baska*: E-DNA Survey to determine occupancy and presence of terrapin: eDNA sampling techniques has been popularized recently over traditional practices to detect the presence and abundance of freshwater rare and invasive species (Taberlet et al, 2018.). Therefore, water samples will be collected in plastic Nalgene/glass bottles (Smart, 2015) for eDNA sampling. Further, area search methods would be used to estimate the relative abundance of this species.

Caracal: The most reliable method for monitoring caracal populations is based on a robust statistical approach of 1) individual identification and subsequently 2) capture-mark-recapture (CMR) abundance estimation using scat DNA. Individual caracal could be uniquely identified from a panel of highly polymorphic microsatellites amplified from scat-based DNA. Both methods of individual identification would allow the next step of abundance estimation through the powerful and scientifically robust capture-recapture approach. The mobile application of program " "polygon search" in MSTrIPES would allow for spatially explicit capture-recapture (SECR) based analysis for estimating caracal density and abundance in the arid and semi-arid landscapes.

Habitat mapping and assessment:

Certain selected habitats of endangered species covered under IDWH would assessed and monitored intensively. Wild animals are difficult to survey at a population level because their widely spaced territories and nocturnal behaviour result in low detection probability and thus habitats available is a valuable surrogate to determine the status of the species. While occasionally conducted over small geographic areas (e.g., Radeloff et al., 1999; Lauver et al., 2002), wildlife surveys initiatives commonly require regional, or, increasingly, global perspectives that defy traditional field-based techniques (e.g., Skidmore and Gauld, 1996; Corsi et al., 1999; Osborne et al., 2001). In light of these challenges, remote sensing has often been identified as a key data source for supporting habitat mapping and other large-area ecological applications (Graetz, 1990; Roughgarden et al., 1991; Wickland, 1991). Recent advances in RS-GIS allows ecologists to map habitat (Recio et al., 2013) and assess habitat quality in much finer details and accuracy for a large/small scale analysis more preciously with ease. Also, it allows mapping of inaccessible areas (Vansteenvoort et al., 2003) and broader landscape for identifying critical habitat and threats, and predicting the impacts of environmental change. Hyperspectral imaging allows the recording of a precise spectral signature at each pixel, allowing identifying species level identification of plants and precise classification of habitats. Currently, very high spatial resolution satellite imagery provides spectral bands suitable for vegetation characterization, e.g., infrared bands (Chuvieco, 2006; Vas et al., 2005) and panchromatic bands with resolutions below 4 and 1 m, respectively (Recio et al., 2013). For this project, high resolution data will be acquired project to map habitat of the threatened species precisely, identify land-use patterns, and map different threats in the landscape for management intervention. These practices will be supported by use of unmanned-arial vehicles (UAV). Remotely piloted aircraft (RPA; commonly known as "drones," unmanned aerial systems or unmanned aerial vehicles) have seen a rapid uptake by ecologists for data collection. This surge in popularity has arisen largely due to their ability to carry remote sensing instruments that collect habitat data at scales highly suited to monitoring ecological phenomena (Hodgson et al, 2018; Anderson & Gaston, 2013). Drones are increasingly being used by ecologists to conduct habitat assessments (barnas et al., 2020). UAV's have recently emerged as a new tool for conducting population surveys on a wide variety of wildlife, eclipsing the effectiveness and even accuracy of traditional approaches (Bushaw et al., 2019). RPA as a powerful tool for wildlife ecology (Chabot & Bird, 2015; Christie et al, 2016; Jones, Pearlstine, & Percival, 2006; Linchant et al, 2015; Watts et al., 2010). There is clearly utility in obtaining high-resolution aerial imagery of wildlife for a variety of purposes. Equipping cameras that sense beyond the range of the visual light spectrum may further increase the utility of UAVs for conducting wildlife surveys. Whilst drones provide a means of collecting data efficiently over an extensive area, they are also likely to be useful when surveying sites where access on foot is problematic, e.g., bogs, watercourses, cliffs, intertidal habitats. Continued monitoring and assessments using UAV's to assess habitat damage is critical to management planning. Drones are increasingly being used by ecologists to address questions involving vegetation communities and habitat assessments. These platforms are able to rapidly collect high resolution imagery that can be easily archived for future analyses, and flight paths are highly repeatable over areas of interest which allows users to conduct repeated surveys with minimal variation (Barnas et al., 2019). Along with the habitat mapping of the select endangered species, UAV will be used for Population survey in inaccessible areas (Geoghegan et al., 2018), nest monitoring for species in nesting on cliffs or high canopy (Lyons et al., 2019). Satellite imagery along with UAV techniques can be used in conjunction for different types of applications, which includes modeling habitats of marine turtles (Rees et al, 2018, Ventura et al, 2018, Mateos-Molina et al, 2020); model elephant's habitat (Ashiagbor & Danquah, 2017, Huang et al, 2019), population survey (Duporge et al., 2020) or threat mapping (Beale et al., 2018); mapping marine mammals' habitat (Fiori et al., 2017, Landeo-Yauri et al., 2020, Ramos et al., 2018, Raoult et al., 2020), identifying dolphin's habitat for priority habitat for management and conservation (Hunt et al., 2020) etc.

Annexure II

Data sources for the current status, distribution and threats to certain endangered species covered under IDWH, MoEF&CC

Species	Population Status (Starting from 2009 to 2020)	Source	Range	State-wise Population Status	Threats	Important PAs where species occur
Marine Turtles (All)	39730 - 739070	Forest Department and Literature	Mass nesting at Odisha and Andaman and Nicobar islands, sporadic nesting along entire Coasts	Available	Fisheries bycatch, nest predation, habitat degradation, light and plastic pollution	Gahirmatha NP, Gulf of Mannar MNP, Gulf of Kutch MNP, Mahathma Gandhi MNP, Rani Jhansi MNP, Galathea Bay WLS, Pitti WLS, etc
Dugong	200 - 250	WII and GEER Foundation	Gulf of Kutch, Gulf of Mannar, Palk Bay and Andamana nd Nicobar Islands	10-15 Gujarat; 75 – 160 Tamil Nadu; 45-80 ANI	Fishing net entanglement, Boat strikes. Habitat loss. Pollution. High level of conflict with fishermen, Ghost nests	Gulf of Kutch MNP, Gulf of Mannar MNP, MGMNP, Rani Jhansi MNP
Ganges River Dolphin	3500- 3700	WII, Bhagalpur University, Patna University	Ganga, Brahmaputra rivers and their tributaries	Assam – 896, Main Ganga (Bihar and West Bengal) 1337 ± 43, Main Ganga (Uttar Pradesh) 310, Hooghly 236, Roopnarayan 25, Kosi 82 Chambal 86	Fishing net entanglement, ghost nets, poaching for oil, Habitat modification along with sand mining, dredging, noise pollution, water, pollution,	Dibru Saikhowa, Kaziranga, Orang, Sunderbans, Vikramshila, Mirzapur sanctuary, Katerniaghat, Valmiki, Kishenpur, Hastinapur WLS, Chambal WLS
Swiftlet	3000	SACON	ANI	NA	Nest collection	20+ PAs of ANI
Wild Buffalo	1000 - 1500	WII and WTI, WWF	CH, MH, AS	CH – 11 – 30 MH – 15 – 30 AS – 1000 - 1500	Habitat degradation, Hybridization	Udanti WLS, Indravati NP, Kazhiranga NP, etc
Megapode	1600	WII, SACON, ZSI	Nicobar Islands	NA	Habitat degradation, Hunting	Great Nicobar NP, Galathea NP, Tillanchang WLS
Arabian sea humpbacked Whale	50 - 100	IWC, IUCN	West coast of India and Gulf of Mannar	NA	Bycatch and noise pollution	? Malvan WLS, Gulf of Kutch NP, Gulf of Mannar NP
Great Indian Bustard	300-150	WII, SFD	Jaisalmer, Jodhpur, Bikaner, (Rajasthan), Kutch (Gujarat), Solapur, Osmanabad, , Chandrapur (Maharashtra), Bellary (Karnatka), Kurnool (Andhra Pradesh), Gwalior (Madhya Pradesh) districts	Rajasthan: 128 SE 19, Maharashtra: <8, Gujarat: 5, Karnataka: 10-12	Power-line collisions, nest/chick predators in breeding sites, habitat loss due to intensive agriculture and infrastructural development, shrub/tree plantations in PAs, livestock overgrazing, public antagonism due to large PA declaration,	Desert National Park, Lala Bustard Sanctuary, Nanaj Bustard Sanctuary, Rollapadu Wildlife Sanctuary, Ghatigaon Bustard Sanctuary

					wasteland policy	
Jerdon's Courser	250-150	BNHS, NCF	Eastern Ghats of Andhra Pradesh and extreme southern Madhya Pradesh	No records reported in last 5 yers	Habitat loss	Sri Lankamaleswara Wildlife Sanctuary
Sangai	100-75	WII	Manipur	76 in Manipur	Single isolated population, habitat fragmentation, poor water quality, climate change, changes in vegetation structure, anthropogenic pressure, poaching	Keibul Lamjao National Park
Clouded Leopard	Manas:16, DampaTR 10	WII & Literature	North-eastern States (Assam, Manipur, Meghalaya, Arunachal Pradesh, Nagaland, Tripura, Mizorum, Sikkim and Northern Parts of West Bengal)	**Assam:** Manas National Park: 4.73 (SE 1.43) per 100 sq. km., Dampa Tiger Reserve: 5.14 (SD 1.8) per 100 sq. km.,	**Habitat loss and habitat fragmentation and poaching**	Several PAs in the Range
Red Panda	6000- 3500	Jnawali et al. 2012	**Endemic to Eastern Himalaya**. Occurs in **three states of India: Sikkim, West Bengal, and Arunachal Pradesh**	55-60 in West Bengal, 250-300 in Sikkim, and 3,000 in Arunachal Pradesh	Habitat loss, feral dogs, climate change, anthropogenic preesure, poaching, tourism, natural disaster	**Sikkim**: Khangchendzonga Biosphere Reserve, Pangolakha Wildlife Sanctuary, Fambonglho Wildlife Sanctuary, Barsey Rhododendron Sanctuary, Kyongnosla Alpine Sanctuary. **West Bengal**: Singalila National Park, Neora Valley National Park. **Arunachal Pradesh**: Mouling National Park, Namdapha Tiger Reserve, Dibang, Eaglenest, Mehao, Sessa Orchid, and Kamlang Wildlife Santuaries, and also possibly in Taley Valley Wildlife Sanctuary **Meghalaya**: Early records from Nokrek and Balpakram National Parks