

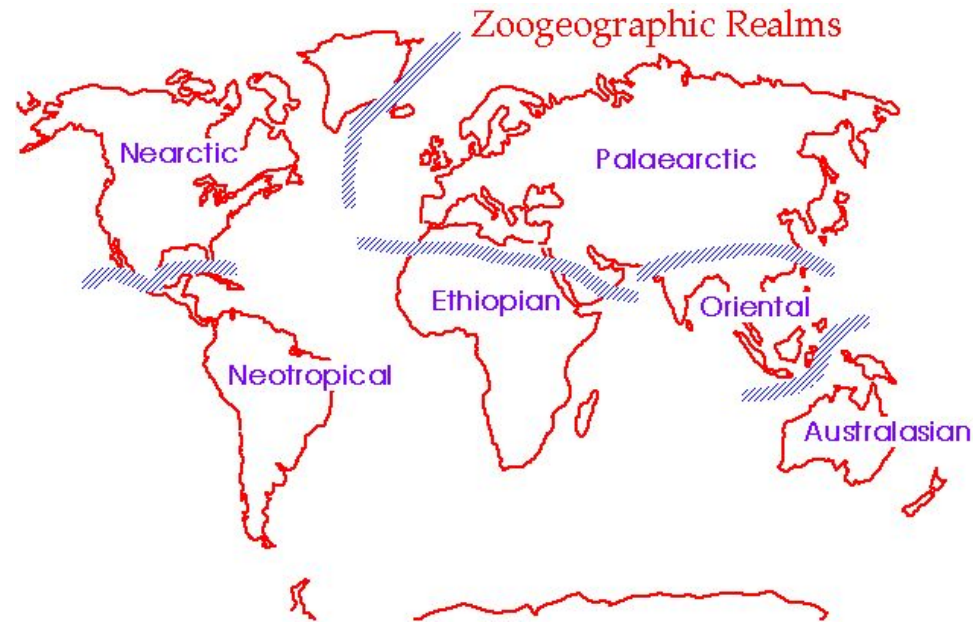
ZOOGEOGRAPHY OF INDIA – FOREST TYPES



Dr. K. Sivakumar
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Zoogeography of world

- Zoogeography is the study of the patterns of the past, present, and future distribution of animals in nature and the processes that regulate these distributions. It is the scientific analysis of the spatial patterns of biodiversity.



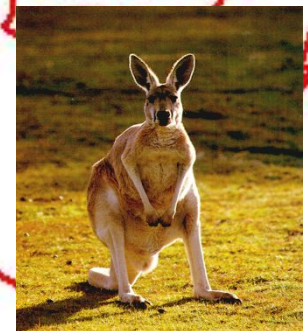
Nicobar megapode

- Oriental region: India, Indochina, and southern China, Malaya archipelago including Bali, Java, Sumatra and the Philippine islands.
- Primarily tropical with some exceptional areas having sub tropical to temperate (Himalayan region) and semi arid to arid (western region) conditions.
- The eastern parts are covered mostly with tropical rain forest and it shades into dry desert conditions as one moves westward.

Indigenous Peoples of the World



ZOOGEOGRAPHIC REALMS (WALLACE 1897)



Zoogeographic Realms

Nearctic

Palearctic

Ethiopian

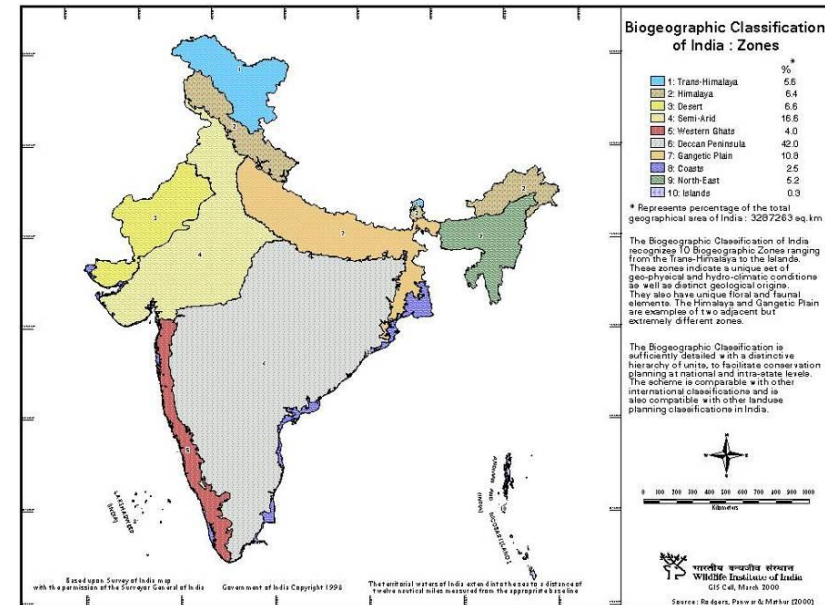
Oriental

Neotropical

Australasian

The Indian Zoogeography...

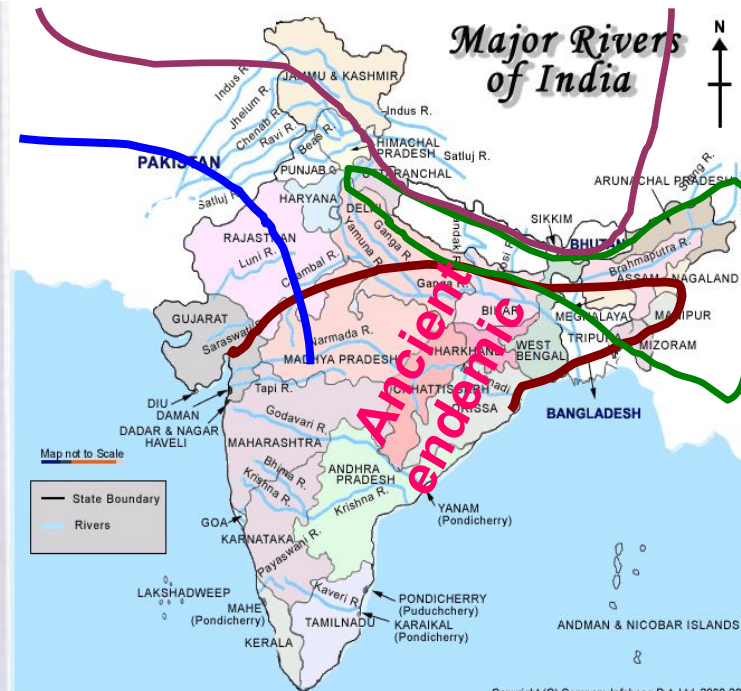
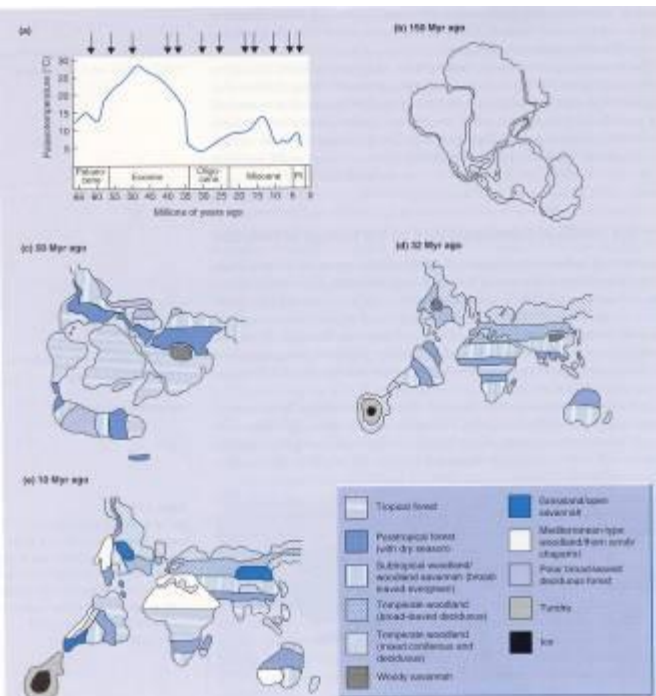
- 4 India has deep rooted ethos for nature and wildlife conservation
- 4 India is also amongst 17 '*mega-biodiverse*' countries and has 4 '*biodiversity hot-spots*'
- 4 India is amongst the few countries in the world that has developed a conservation planning framework on biogeographic basis
- 4 India conservation estate is ca. 21.34% of its total geographic area




more...

... unique biodiversity

- African element: Hyena and Gazelle
- European element: Wolf, Wild Goat, Hangul
- South east asian: Hoolock Gibbon and Elephant
- Hundreds of endemic species






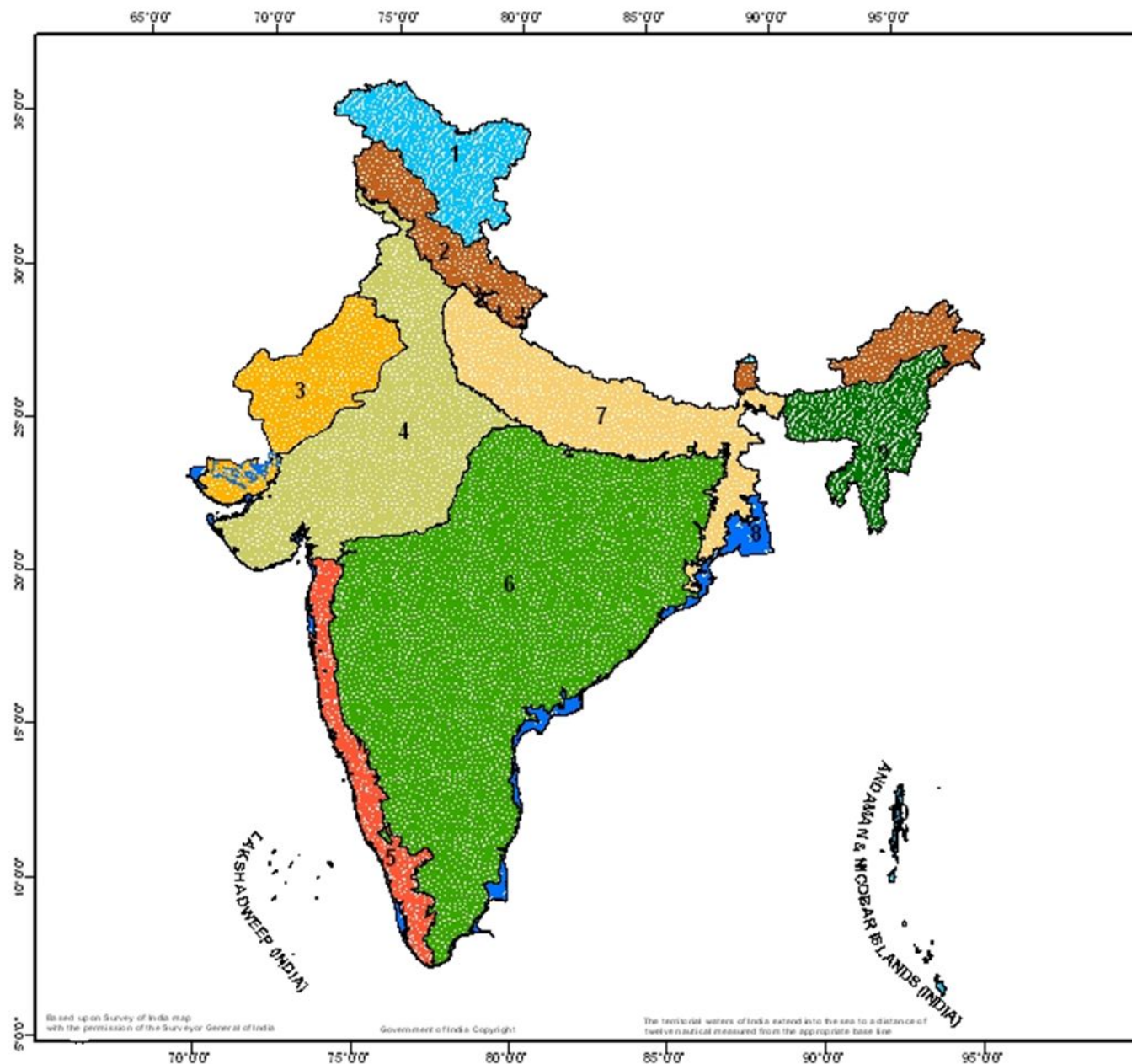
India is one of the select nations that have applied modern biogeographic knowledge and concepts for the planning of rational conservation strategies



In 1988, the Wildlife Institute of India (WII) prepared a Biogeographic Classification of India to facilitate rational conservation planning at the national and intra-state levels



Within India, this classification recognizes 10 Biogeographic Zones, which are further divided into 26 Biotic Provinces



Biogeographic Classification of India : Zones

	% *
1 : Trans - Himalaya	5.6
2 : Himalaya	6.4
3 : Desert	6.6
4 : Semi - Arid	16.6
5 : Western Ghats	4.0
6 : Deccan Peninsula	42.0
7 : Gangetic Plain	10.8
8 : Coasts	2.5
9 : North East	5.2
10 : Islands	0.3
Marine Influenced Area	10440 sq.km

* Represents percentage of the total geographical area of India : 3287263 sq.km



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The territorial waters of India extend into the sea to a distance of twelve nautical miles from the appropriate base line

BIOGEOGRAPHIC CLASSIFICATION

BIOGEOGRAPHIC ZONE Distinctive set of physical and Historical conditions.
e.g. Himalayas & desert

BIOTIC PROVINCE Further level of detail within zone.
Contains some distinctive species elements.
e.g. Western & Eastern Himalayas

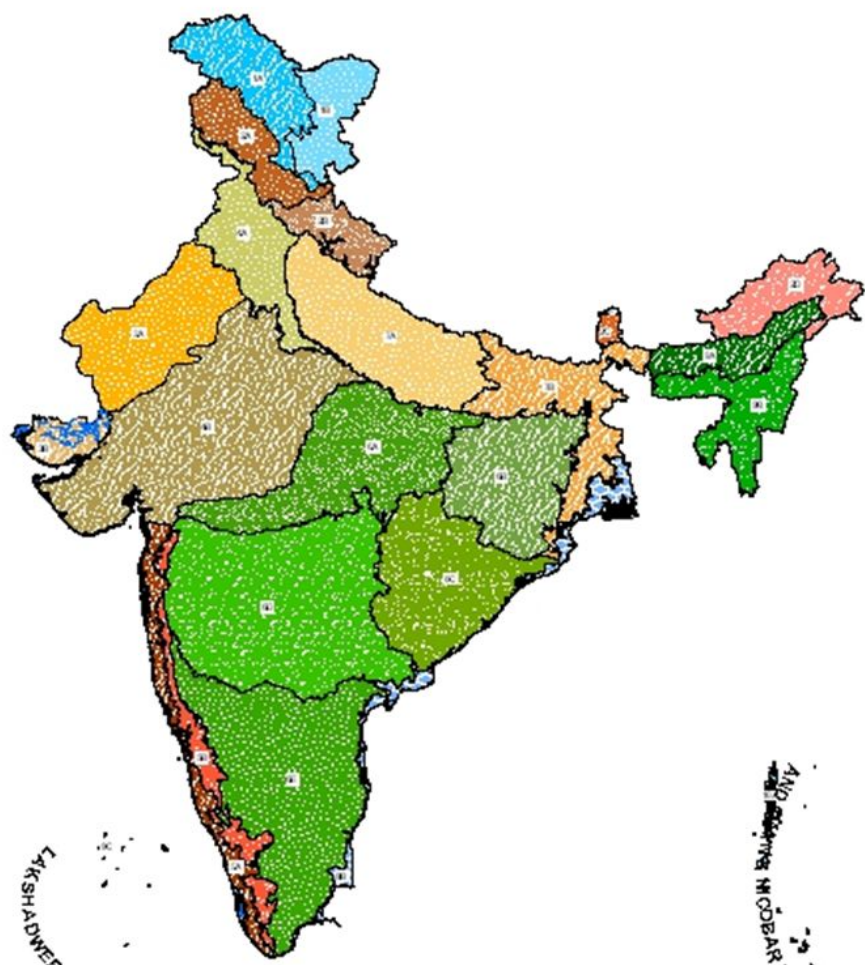
BIOGEOGRAPHIC REGION Distinctive geographic subdivision.
e.g. Garhwal & Kumaon in Western Himalayas

BIOMES Major ecosystem groupings found
Within each province and region.
e.g. Alpine, Subalpine, Temperate Conifer
Forest within Western Himalayas

60°00' 65°00' 70°00' 75°00' 80°00' 85°00' 90°00' 95°00'

Biogeographic Classification of India : Provinces

%^A



	1A:Himalaya - Ladakh Mtns	3.3
	1B:Himalaya - Tibetan Plateau	2.19
	1C:Trans - Himalaya - Sikkim	0.10
	2A:Himalaya - North - West Himalaya	2.1
	2B:Himalaya - West Himalaya	1.6
	2C:Himalaya - Central Himalaya	0.2
	2D:Himalaya - East Himalaya	2.5
	3A:Desert - Thar	5.4
	3B:Desert - Katchchh	1.1
	4A:Semi - Arid - Punjab Plains	3.7
	4B: Semi - Arid - Gujrat Rajputana	12.9
	5A:Western Ghats - Malabar Plains	2.0
	5B: Western Ghats - Western Ghats Mtns.	2.0
	6A:Deccan Peninsula - Central Highlands	7.3
	6B: Deccan Peninsula - Chotta - Nagpur	5.4
	6C: Deccan Peninsula - Eastern Highlands	6.3
	6D: Deccan Peninsula - Central Plateau	12.5
	6E:Deccan Peninsula - Deccan South	10.4
	7A:Gangetic Plain - Upper Gangetic Plain	6.3
	7B: Gangetic Plain - Lower Gangetic Plain	4.5
	8A:Coasts - West Coast	0.6
	8B: Coasts - East Coast	1.9
	8C:Coasts - Lakshadweep	0.1
	9A: North - East - Brahmaputra Valley	2.0
	9B: North - East - North - East Hills	3.2
	10A: Islands - Andamans	0.2
	10B: Islands - Nicobars	0.1
	Marine Influenced Area : 10440 sq.km	

^A Represents percentage of the total geographical area of India : 3287263 sq.km



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The territorial waters of India extend into the sea to a distance of twelve nautical miles from the appropriate base line

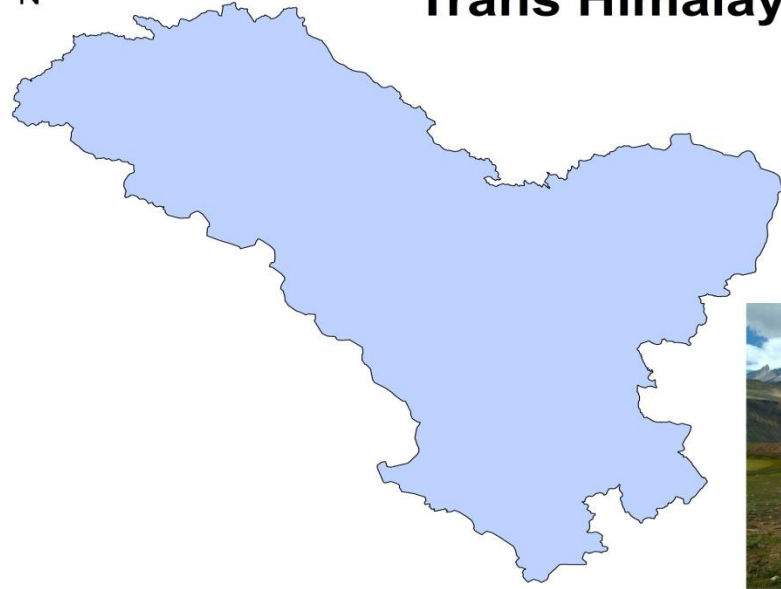
Biogeographic Zone:

Trans Himalayas



Zone Name	Zone Area (km ²)	% of India	No. of NPs	Area (km ²)	% of Zone	No. of WLS	Area (km ²)	% of Zone	No. of NPs + WLS	Area (km ²)	% of Zone
Trans Himalaya	184823	5.62	3	5809.00	3.14	4	11305.56	6.12	7	17114.56	9.26

Biogeographic Zone Trans Himalaya



Span:
Ladakh, Jammu & Kashmir, North Sikkim
Lahaul and Spiti areas of Himachal Pradesh
Vegetation Type
Sparse Alpine Steppe Vegetation



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Wildlife Institute of India

ENVIS-RP Wildlife and Protected Areas-2019

0 100 200 400 600 Km

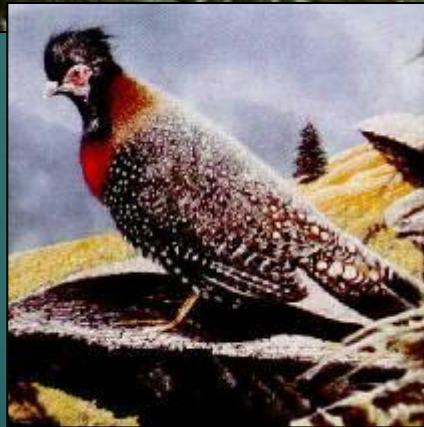
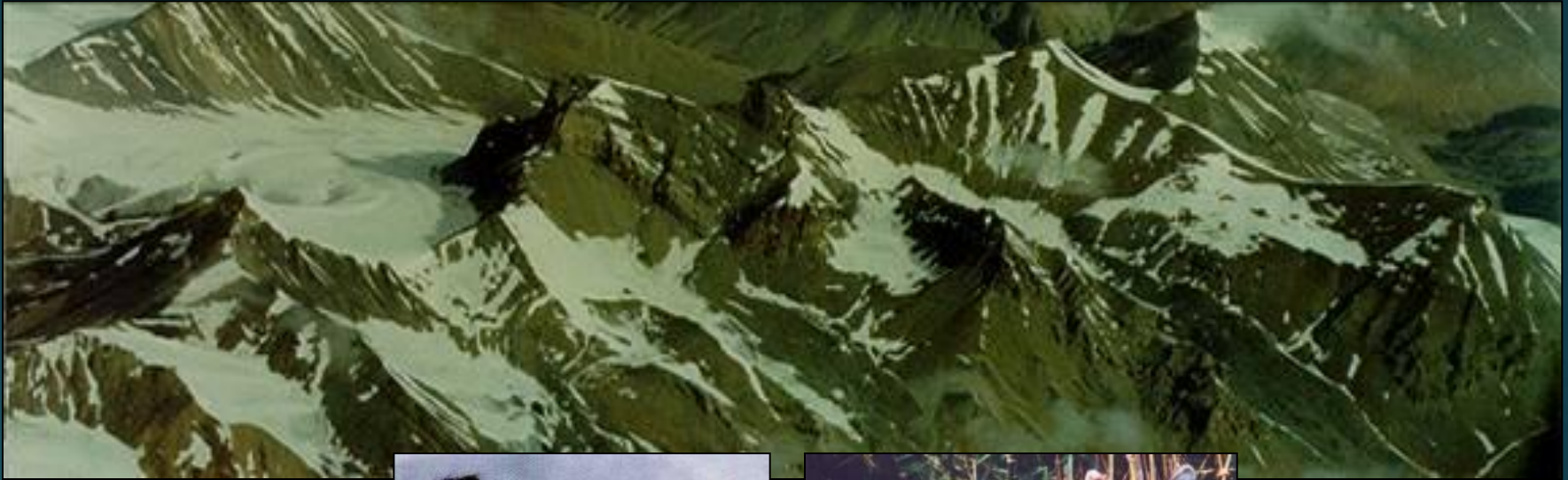


Trans Himalaya



Biogeographic Zone:

Himalayas



Zone Name	Zone Area (km ²)	% of India	No. of NPs	Area (km ²)	% of Zone	No. of WLS	Area (km ²)	% of Zone	No. of NPs + WLS	Area (km ²)	% of Zone
Himalaya	210673	6.41	15	8203.00	3.89	65	16850.10	8.00	80	25053.10	11.89

Himalayas





Biogeographic Zone The Himalaya



Biogeographic Provinces:

- 1: Himalaya - North West Himalaya
- 2: Himalaya - West Himalaya
- 3: Himalaya - Central Himalaya
- 4: Himalaya - East Himalaya

Vegetation Type:

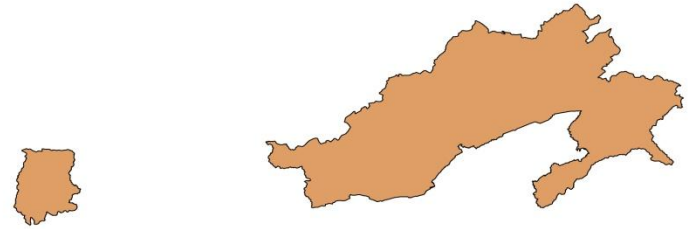
Alpine and Sub-Alpine Forests, Grassy Meadows and Moist Mixed Deciduous Forests



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ENVIS-RP Wildlife and Protected Areas-2019

0 100 200 400 600 800 1,000 Km



The Himalayas









Biogeographic Zone:

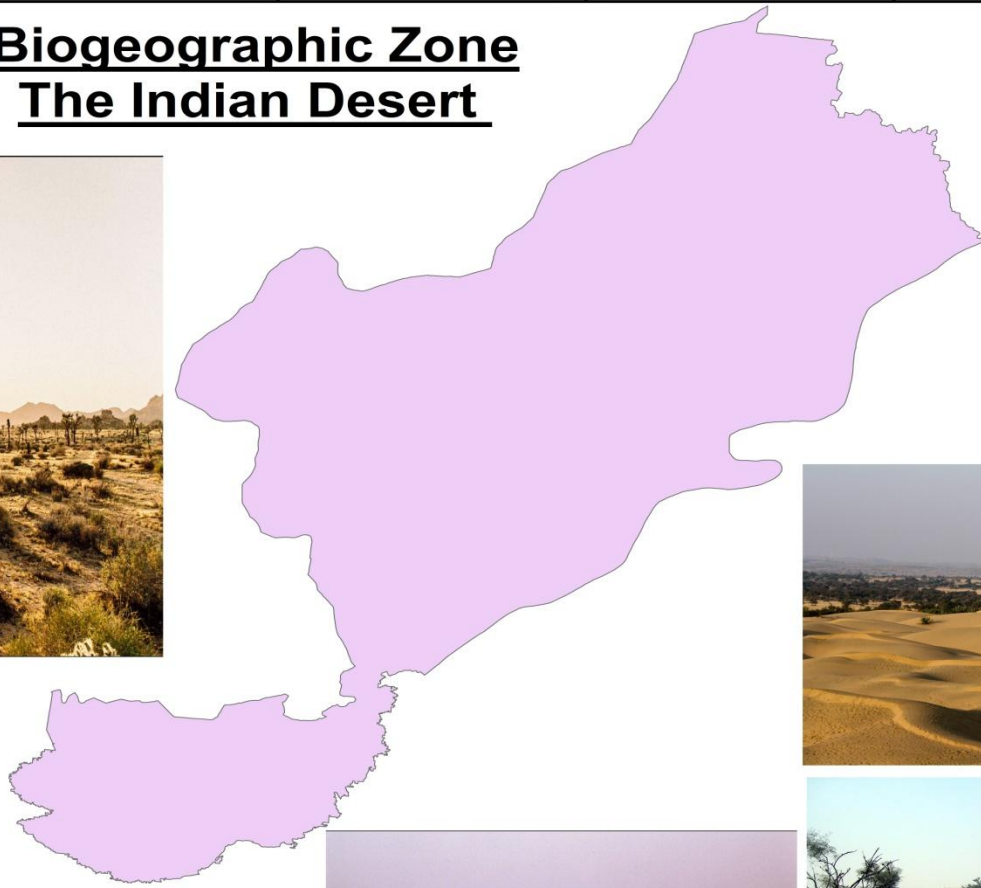
Desert



Zone Name	Zone Area (km ²)	% of India	No. of NPs	Area (km ²)	% of Zone	No. of WLS	Area (km ²)	% of Zone	No. of NPs + WLS	Area (km ²)	% of Zone
Desert	214014	6.51	1	3162.00	1.48	5	12913.38	6.03	6	16075.38	7.51



Biogeographic Zone The Indian Desert



Biogeographic Provinces:
1: Desert – Thar
2: Desert – Katchhh
Vegetation Type:
Tropical Thorn Forests and Grasslands



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Wildlife Institute of India

ENVIS-RP Wildlife and Protected Areas-2019

0 100 200 400 600 Km

65°0'0"E 67°30'0"E 70°0'0"E 72°30'0"E 75°0'0"E 77°30'0"E

27°30'0"N

25°0'0"N

22°30'0"N

30°0'0"N

27°30'0"N

25°0'0"N

22°30'0"N

The Indian Desert

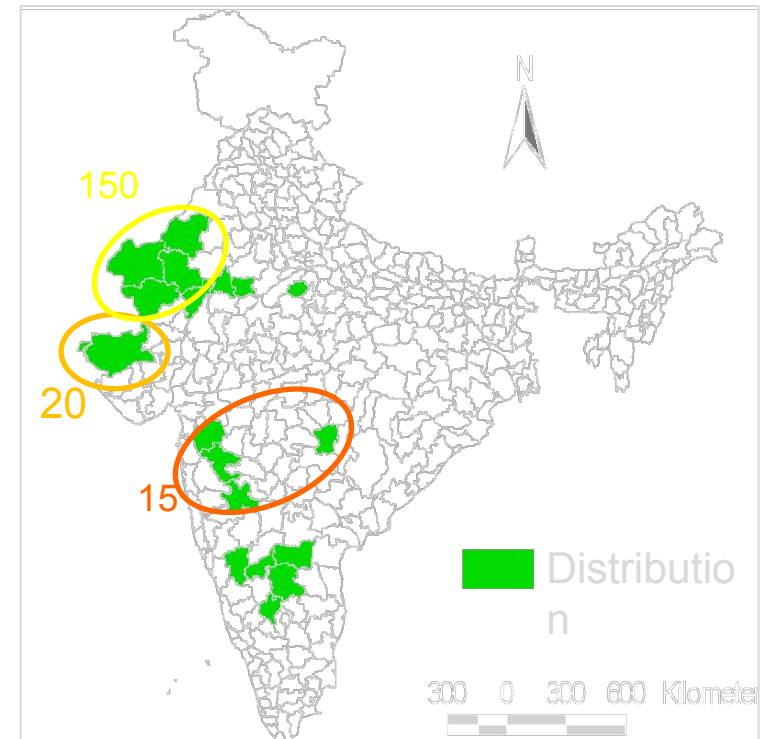
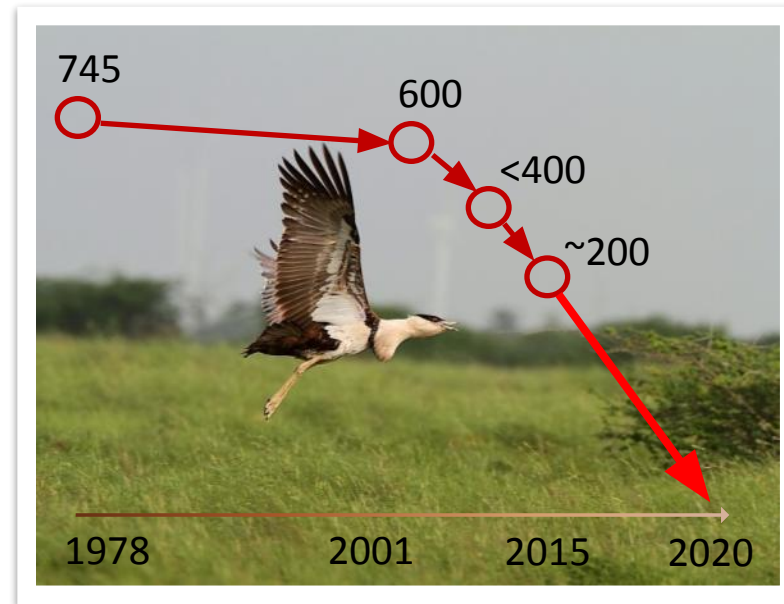


Great Indian Bustard

- Critically Endangered ~ 200 birds left
- Flagship & indicator of grasslands
- Threatened by hunting & hostile habitat
- Wide ranging nature in human-use areas; cannot be conserved only through PAs
- Needs integrated conservation approach involving research, management, protection & communities

Objectives

- Conservation Breeding Program
- Applied research
- Capacity building & awareness
- Pilot implementation of making habitat GIB friendly – Smart Green Infrastructure



Threats

Human induced mortality & Hostile Habitat

- Massive historical hunting – current
- Fatal bird collisions with power lines & other structures
- Nest damage – dogs, pigs, cattle & egg collection
- Agricultural expansion & mechanization, Pesticides ?
- Well intentioned but ill-informed management.
- Small population size



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Conservation Breeding Program

- Develop captive population from wild eggs/birds – artificial incubation, chick rearing & breeding
- Partnership between WII –Rajasthan and other State Governments – MoEFCC – International Bustard Breeding Facilities.
- Detailed Agreed upon action plan for the next 25-30 years



The UK great bustard *Otis tarda* reintroduction trial: a 5-year progress report

ROBERT J. BURNSIDE, IAN CARTER, ALASDAIR DAWES, DAVID WATERS
LEIGH LOCK, PAUL GORIUP and TAMÁS SZÉKELY

Abstract The great bustard *Otis tarda* became extinct in the UK during the 19th century due to a combination of factors, including hunting, egg collection and changes in agriculture. In 2003 a 10-year licence was granted to begin a trial to reintroduce the species back to the UK. Here we report on the first 5 years of the trial and assess the progress made towards establishing a founder population. From April 2004 to September 2009 a total of 102 great bustard chicks were imported from Russia and 86 released on Salisbury Plain. Monitoring showed that post-release survival was 10% in the first year following release, and that mortality of released bustards was mainly attributable to predation and collisions. Estimated adult survival was 7.6%, although the sample size was small. All known surviving great bustards are faithful to the surroundings of the release site, returning throughout the year. A lek has been established where males have been observed displaying to females. The first nesting attempt was in 2007, and in 2009 two females aged 3 and 4

(IUCN, 1998). However, when gaps in knowledge exist about the ecology of a species in an area from where it was extirpated, it is often difficult to determine the ability of that species to survive and persist once the original causes of extinction are removed. Consequently, trial reintroduction provides an opportunity to fill in the gaps in understanding and to assess the feasibility of a full-scale reintroduction project (Osborne, 2005).

Although the aim of a reintroduction is to establish a free-living, self-sustaining population, the progress of a reintroduction comprises a sequence of objectives, including the survival of released individuals, breeding by released individuals in the wild and then subsequent growth and persistence of the population (Seddon, 1999). Each of these stages must be assessed to identify the appropriate methodology and limitations (Seddon et al., 2007; Sutherland et al., 2010) and the importance of post-release monitoring has been increasingly emphasized in

Biogeographic Zone:

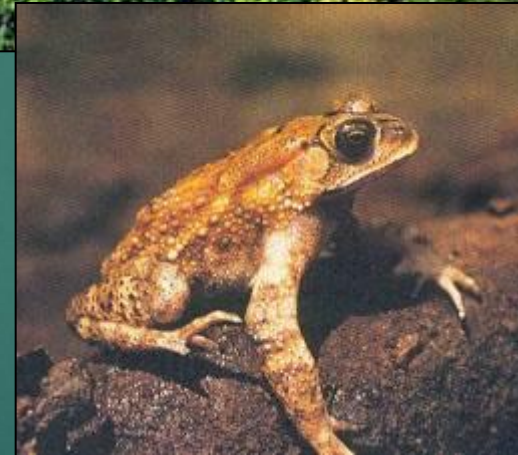
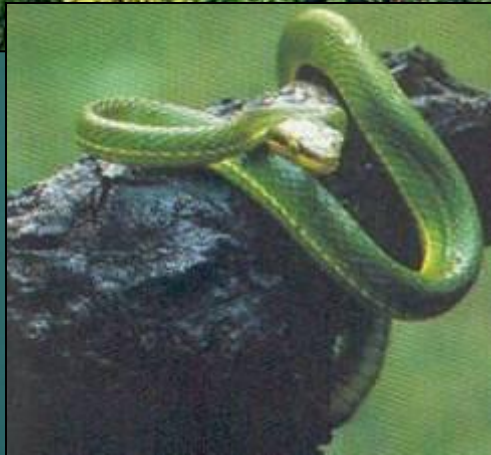
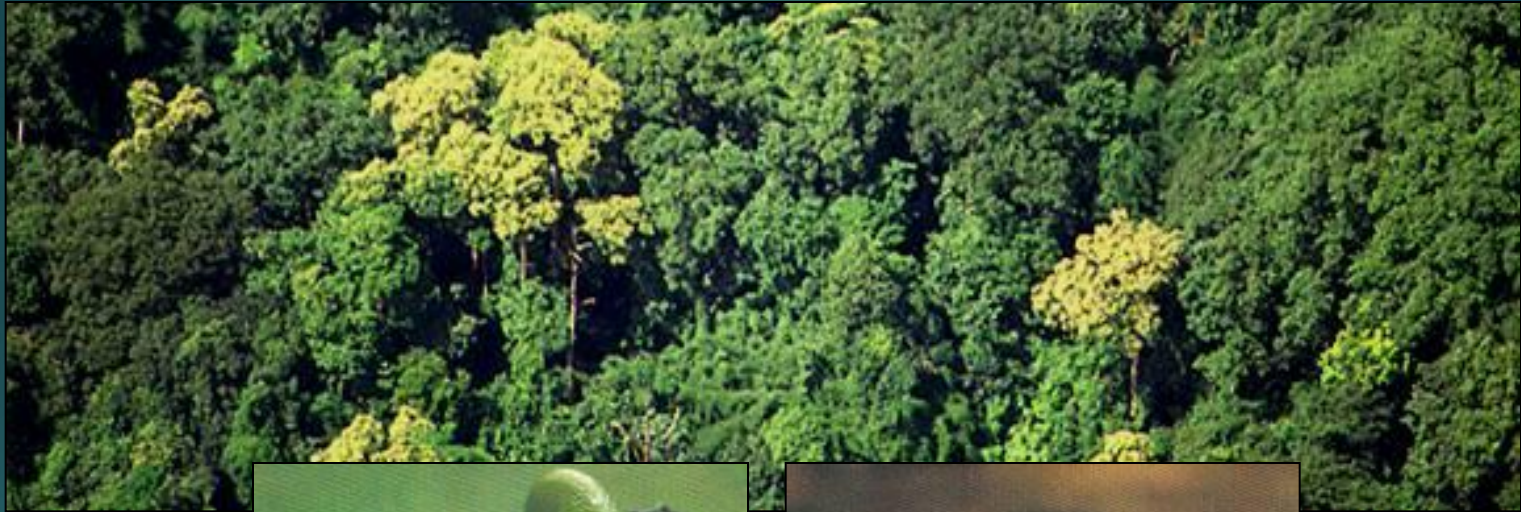
Semi-Arid



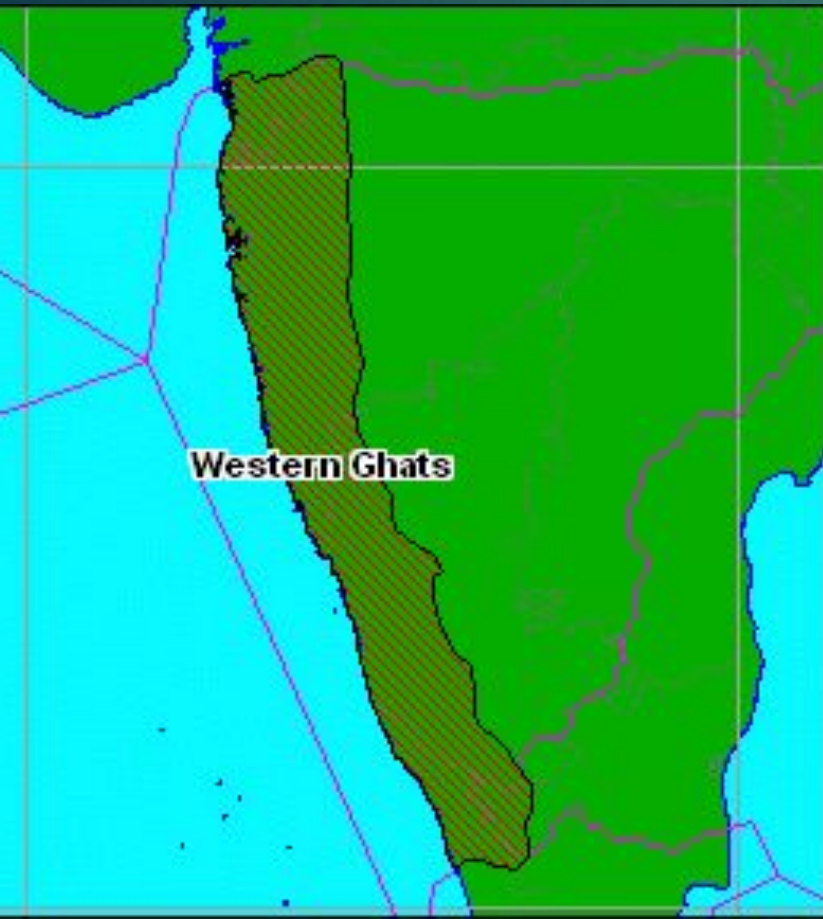
Zone Name	Zone Area (km ²)	% of India	No. of NPs	Area (km ²)	% of Zone	No. of WLS	Area (km ²)	% of Zone	No. of NPs + WLS	Area (km ²)	% of Zone
Semi-Arid	539479	16.41	10	1505.78	0.28	81	12690.54	2.35	91	14196.32	2.63

Biogeographic Zone:

Western Ghats



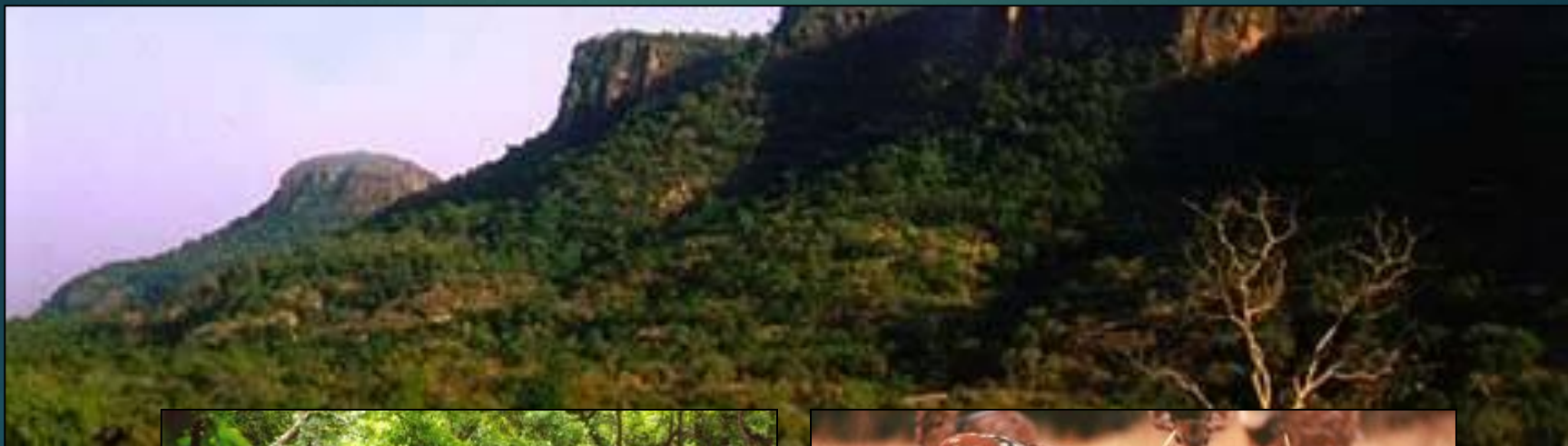
Zone Name	Zone Area (km ²)	% of India	No. of NPs	Area (km ²)	% of Zone	No. of WLS	Area (km ²)	% of Zone	No. of NPs + WLS	Area (km ²)	% of Zone
Western Ghats	132179	4.02	16	3673.52	2.78	50	10419.67	7.88	66	14093.19	10.66





Biogeographic Zone:

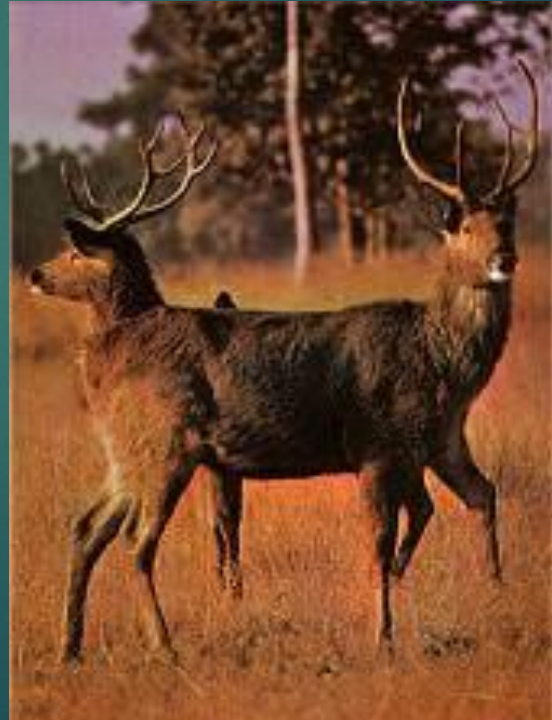
Deccan Peninsula



Zone Name	Zone Area (km ²)	% of India	No. of NPs	Area (km ²)	% of Zone	No. of WLS	Area (km ²)	% of Zone	No. of NPs + WLS	Area (km ²)	% of Zone
Deccan Peninsula	1380339	41.99	24	9798.91	0.71	130	46230.45	3.35	151	56029.36	4.06



Central Highlands, Eastern Ghats



Biogeographic Zone:

Gangetic Plains

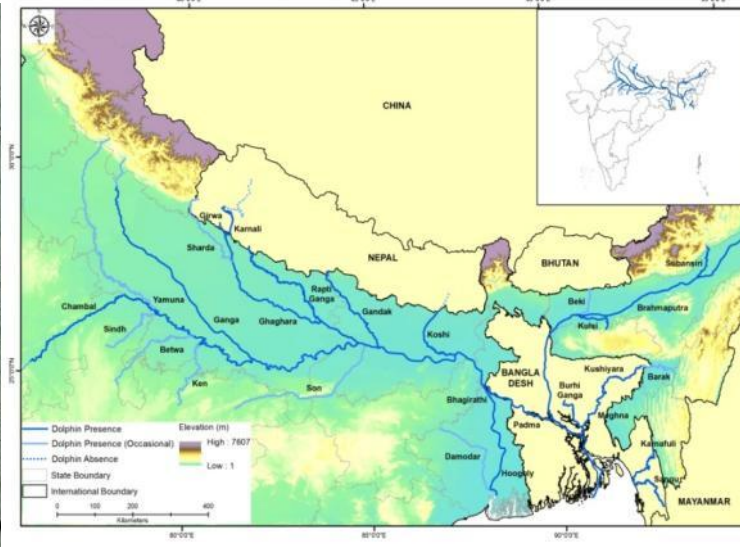


Zone Name	Zone Area (km ²)	% of India	No. of NPs	Area (km ²)	% of Zone	No. of WLS	Area (km ²)	% of Zone	No. of NPs + WLS	Area (km ²)	% of Zone
Gangetic Plain	354848	10.79	6	2363.44	0.67	32	5372.05	1.51	38	7735.49	2.18



Gangetic Dolphin

NOT EVALUATED	DATA DEFICIENT	LEAST CONCERN	NEAR THREATENED	VULNERABLE	<ENDANGERED>	CRITICALLY ENDANGERED	EXTINCT IN THE WILD	EXTINCT
NE	DD	LC	NT	VU	EN	CR	EW	EX



- ◆ A blind dolphin in one of the world's most populated areas
- ◆ Less than 2000 individuals and continuously declining
- ◆ Endangered and protected by the Government of India
- ◆ Threatened due to dams and barrages, poaching and pollution
- ◆ Identification of more critical of habitats of dolphin and prepare management plan for the same
- ◆ Awareness programme to protect the species from fisheries and pollution



Gharials





Gharials: Threatened by poaching/fisheries



planetwildlife
MAGAZINE



Ghariales: Threatened by pollution





Gharials: No place to go

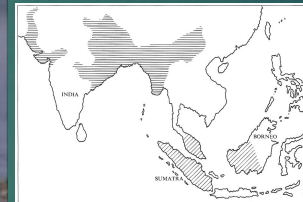




Gharials

Gavialis gangeticus

NOT EVALUATED	DATA DEFICIENT	LEAST CONCERN	NEAR THREATENED	VULNERABLE	ENDANGERED	< CRITICALLY ENDANGERED >	EXTINCT IN THE WILD	EXTINCT
NE	DD	LC	NT	VU	EN	CR		



- ◆ Less than 200 individuals in the world and most are in India
- ◆ Critically Endangered
- ◆ Extirpated from many places and continuously declining
- ◆ Protected and conservation breeding programs by the Governments
- ◆ But still declining due to change river flows, poaching and pollution
- ◆ About a 1000 juvenile sub adults and adults are in captivity but have no destination to be reintroduced in India
- ◆ Protection of river stretches, free from pollution, more artificial breeding centre etc

Biogeographic Zone:

Coasts



Zone Name	Zone Area (km ²)	% of India	No. of NPs	Area (km ²)	% of Zone	No. of WLS	Area (km ²)	% of Zone	No. of NPs + WLS	Area (km ²)	% of Zone
Coasts	91319	2.78	5	1731.18	1.90	20	2959.43	3.24	25	4690.61	5.14



Sea turtles



Whale Sharks



Biogeographic Zone:

North East



Zone Name	Zone Area (km ²)	% of India	No. of NPs	Area (km ²)	% of Zone	No. of WLS	Area (km ²)	% of Zone	No. of NPs + WLS	Area (km ²)	% of Zone
North East	171340	5.21	13	2674.00	1.56	37	3736.76	2.18	50	6410.76	3.74

North Eastern India

North-East India







Sangai *Rucervus eldii eldii*

- Single, isolated and small population ~100
- Found only in Keibul Lamjao NP, Manipur
- Endangered (IUCN), Schedule-I species (WPA)
- Globally threatened
- Highly inbred, low genetic diversity



Biogeographic Zone:

Islands



Zone Name	Zone Area (km ²)	% of India	No. of NPs	Area (km ²)	% of Zone	No. of WLS	Area (km ²)	% of Zone	No. of NPs + WLS	Area (km ²)	% of Zone
Island	8249	0.25	9	1153.94	13.99	96	389.39	4.72	105	1546.30	18.75





Action Plan for Mitigation of Human-Crocodile Conflicts in the Andaman and Nicobar Islands



Ministry of Environment, Forest
and Climate Change
Government of India



भारतीय वन्यजीव संस्थान
Wildlife Institute of India



Measures for mitigating HCC in Andaman & Nicobar Islands



2. **Human Crocodile Co-existence Zone (HCCZ)**- Include creeks and areas where crocodile habitat and human settlements are in close proximity and are known for occasional or regular conflicts. Management interventions are needed to mitigate the conflicts for peaceful co-existence of humans and saltwater crocodiles.
3. **Crocodile Free Zone (CFZ)**- Include areas important for livelihood of local communities. Activities like fishing, aquaculture, tourism etc are to be permitted.

This zone has to be kept '**Crocodile Free**' through all possible means.

Any crocodile that is sighted in CFZ would be declared as '**Problem Crocodile**', to be captured and translocated to the proposed '**Rescue and Rehabilitation Centre**'.

Contd...

DISTRIBUTION BY BIOGEOGRAPHIC ZONES

The existing distribution of NPs and PAs by Zones is as follows

Zone	Name	% as NPs	% as PAs
1.	Trans-Himalaya	3.55	9.20
2.	Himalayas	3.58	9.94
3.	Desert	1.48	7.51
4.	Semi-Arid	0.25	2.65
5.	Western Ghats	2.52	9.48
6.	Deccan	0.62	3.69
7.	Gangetic Plain	0.67	2.16
8.	Coasts	1.90	6.15
9.	North-East India	1.13	2.54
10.	Islands	10.92	15.43

DISTRIBUTION BY BIOTIC PROVINCE

Five provinces have a PA network totalling less than 2.0% of the province

These are:

3A	Thar Desert	1.78
4A	Punjab Plains	1.08
6E	South Deccan	1.32
7B	Lower Gangetic Plain	1.20
8A	West Coast	1.96

Note: In 1988 eleven provinces had a coverage below 2.0%

MAMMAL SPECIES OF CONSERVATION SIGNIFICANCE

12 Mammalian species have no or insignificant populations in a National Park. Species concerns are:

Indian Wild Ass 3A Kutchchh

Pharye's Leaf Monkey 8B Assam Hills-Tripura

Malabar Civet 5A+B? Western Ghats, Kerala

Malay Sun Bear 8B extinct in India

Markhor 2A N.W. Himalaya, J&K

Argali/Nayan 1A Ladakh

Pallas Cat 1A Ladakh

Rusty-spotted cat 5B+6B? Maharashtra & Gujarat

Tibetan Antelope 1A Ladakh

Tibetan Gazelle 1A Ladakh

Pig-tailed Macaque 8B Assam Hills

Stump-tailed Macaque 8B Assam Hills

Hangul, Sangai, Urial, Tibetan Ass, Dryland Swamp deer, Asiatic Lion, Golden Langur, Hispid Hare, Pygmy Hog are all dependent on the protection offered in a single NP.

THE CONSERVATION STATUS OF SPECIES

Viable population found in NO NP

- Crab-eating macaque 10B Two new NPs in Nicobar
- Indian Wild Ass 3B Upgrade WLS to NP in Gujarat
- Pharye's Leaf Monkey 9B Need for a park in Tripura
- Malabar Civet 5A/B Survey-possible in Annamalai
- Malay Sun Bear 9B ? EXTINCT IN INDIA-SURVEY
- Markhor 2A Possible in Pir Panjal WLS -
TRANSLOCATE to new home
- Argali/Nayan 1A/2C SURVEY(few in Hemis, few in North Sikkim)
- Pallas Cat 1A SURVEY
- Rusty-spotted cat 5A/B SURVEY
- Tibetan Antelope 1B SURVEY
- Tibetan Gazelle 1B SURVEY
- Pig-tailed Macaque 9B Possible WLS in Assam, Nagaland SURVEY
- Stump-tailed Macaque 9B Possible WLS in Assam, Nagaland SURVEY
- Grizzled Giant Squirrel 6E WLS in Tamil Nadu and Kerala

THE CONSERVATION STATUS OF SPECIES

Found in only ONE NP

Hangul **2A** TRANSLOCATE

Sangai **9B** TRANSLOCATE

Urial **1A** SURVEY

Tibetan Ass **1B** Rupshu NP in Ladakh (Proposed)

Rhinoceros **7A,B,9A** MORE TRANSLOCATION

Asiatic Lion **4B** TRANSLOCATE

Central Indian **6A** TRANSLOCATE

Swampdeer

THE CONSERVATION STATUS OF SPECIES

The following five species may not have a viable population in any NP

- Caracal
- Musk Deer
- Desert Cat
- Serow (possible in new areas for Arunachal)
- Lynx

PROTECTED AREA SUMMARY OF INDIA BY BIOGEOGRAPHIC ZONE

Biogeographic Zone	Area Existing in km ²	Area Protected in km ²	Existing PAs	% of Zone Area	Protected Areas
1- Trans Himalaya	184823	17002.5	7	9.20	
2- Himalaya	210673	20939.36	67	9.94	
3- Desert	214014	16076.08	6	7.51	
4- Semi-Arid	539479	14320.49	88	2.65	
5- Western Ghats	132179	13000.33	53	9.84	
6- Deccan Peninsula	1380339	50870.72	130	3.69	
7- Gangetic Plain	354848	7672.12	36	2.16	
8- Coasts	91319	5619.58	26	6.15	
9- North East	171340	4354.15	37	2.54	
10- Island	8249	1273.13	102	15.43	

Key Challenges for Wildlife Conservation

4 *At a glance...*

- ◆ Mitigation of Human-wildlife conflicts.
- ◆ Delineation of Eco-Sensitive Zones (ESZs).
- ◆ Management of Invasive Alien Species.
- ◆ Mainstreaming of wildlife conservation in development planning.



more...

NWAP (2017-2031): Highlights...

- ◆ The Plan is based on the premise that essential ecological processes that are governed or strongly moderated by ecosystems are essential for food production, health and other aspects of human survival and sustainable development.
- ◆ The Plan recognizes the intrinsic value of nature and its manifold components as '*Life Support Systems*', which are considered vital for all societies regardless of their stage of development.
- ◆ The Plan emphasizes the preservation of genetic diversity and sustainable utilization of species and ecosystems, which have a direct bearing on our scientific advancements and support to millions of rural communities.



NWAP (2017-2031): Highlights...

- ◆ The Plan advocates adopting a '*landscape approach*' for conservation of wildlife, which is a significant advancement over the '*protected area-centric*' approach of the earlier plan (2002-2016).
- ◆ The Plan underscores planning and implementation of '*Endangered Species Recovery Plan*' of wild animal species inhabiting terrestrial, inland aquatic, coastal and marine ecosystems.
- ◆ The Plan for the first time recognizes the concerns relating to climate change impacts on wildlife, by integrating actions that need to be taken for its mitigation and adaptation into wildlife management planning process.



NWAP (2017-2031): Highlights...

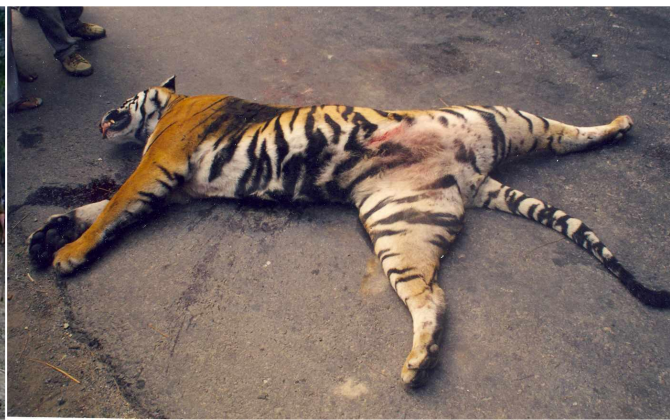
- ◆ The Plan takes into account the increasing need for people's support for conservation of wildlife and to this effect recommends strengthening of the '*core- buffer- multiple use surround*' structure with higher inputs for eco-development, education, innovation, training, extension, conservation awareness and outreach programmes.
- ◆ The Plan addresses the rising human animal conflict issues, owing to shrinkage, fragmentation and deterioration of habitats and generating animosity against wild animals and protected areas.



more...

NWAP (2017-2031): Highlights...

- ◆ The Plan recommends that the national planning processes have to take comprehensive cognizance of adverse ecological consequences of reduction and degradation of wilderness areas from the pressures of population, commercialization and development projects.



NWAP (2017-2031): Components...

Strengthening and Promoting the Integrated Management of Wildlife and their Habitats

Chapter	Theme	Actions	Projects
1	Strengthening and Improving the Protected Area Network	11	22
2	Landscape Level Approach for Wildlife Conservation	6	13
3	Conservation of Threatened Species	5	8
7	Control of Poaching and Illegal Trade in Wildlife	4	14
8	Wildlife Health	4	10
9	Mitigation of Human-Wildlife Conflict	6	11
	Total	36	78



more...

NWAP (2017-2031): Components...

Adaptation to Climate Change and Promoting the Integrated and Sustainable Management of Aquatic Biodiversity in India

Chapter	Theme	Actions	Projects
4	Conservation of Inland Aquatic Ecosystems	13	19
5	Conservation of Coastal and Marine Ecosystems	11	20
6	Integrating Climate Change in Wildlife Planning	7	11
	Total	31	50



more...

NWAP (2017-2031): Components...

Promoting Eco-tourism, Nature Education and Participatory Management

Chapter	Theme	Actions	Projects
10	Management of Tourism in Wildlife Areas	6	15
11	People's Participation in Wildlife Conservation	4	16
12	Conservation Awareness and Outreach	4	26
	Total	14	57



NWAP (2017-2031): Components...

Strengthening Wildlife Research and Monitoring and Development of Human Resources in Wildlife Conservation

Chapter	Theme	Actions	Projects
13	Development of Human Resources	7	16
14	Strengthening Research and Monitoring	4	17
	Total	11	33



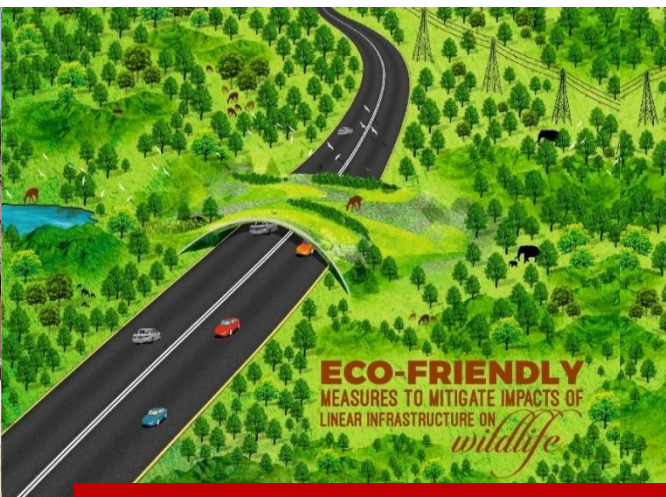
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NWAP (2017-2031): Components...

Enabling Policies and Resources for Conservation of Wildlife in India

Chapter	Theme	Actions	Projects
15	Improving compliances of Domestic Legislations and International Conventions	3	18
16	Ensuring Sustained Funding for Wildlife Sector	4	7
17	Integrating National Wildlife Action Plan with other Sectoral Programmes	3	6
	Total	10	31

In total, the Plan suggests 102 Conservation Actions with 249 Projects



These guidelines are an essential resource that can be used to ensure the new infrastructure that is built today is an environmentally friendly as possible. "Smart green infrastructure" has the potential to transform the way that infrastructure is planned, designed, constructed and managed, and these guidelines are a critical first step in that process. The guidelines address issues at all levels of a project, with particular emphasis on the design options to reduce and/or offset adverse impacts and wildlife and maintain the movement of wildlife across the infrastructure.

These are the first guidelines of this nature for south-east Asia and are here to help as an important guiding document for the region.

Robyn van der Ree
Deputy Director
Australia Research Centre for Urban Ecology
Biodiversity Conservation Program
University of Melbourne, Australia

This practice guideline gives detailed recommendations for the appropriate design of roads and railway lines, complemented with useful photographs and illustrations, apart from generic measures, specific sections of the document are dedicated to the design of linear infrastructure in steep and hilly habitats.

The guideline is designed to help address the unique issues to be addressed and the proposed mitigation measures should be both specific and cost-effective to implement. Of particular importance, it makes reference to emerging technologies and approaches which may become the norm in future planning practices by using planners and engineers.

It is hoped that the guideline will become standard good practice to linear infrastructure planning. Hoping to ensure that things better function and design, as well as stepping forward by doing, the future of India wildlife will be ensured while also ensuring environmental health and safety risks to people.

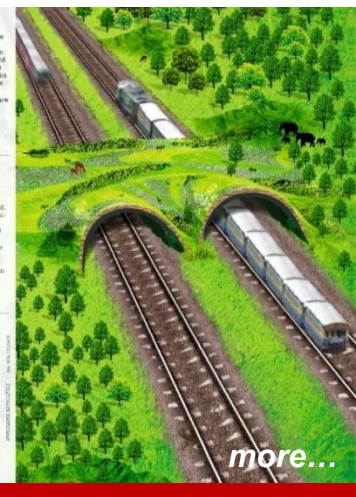
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(Biodiversity & Forest Specialist)

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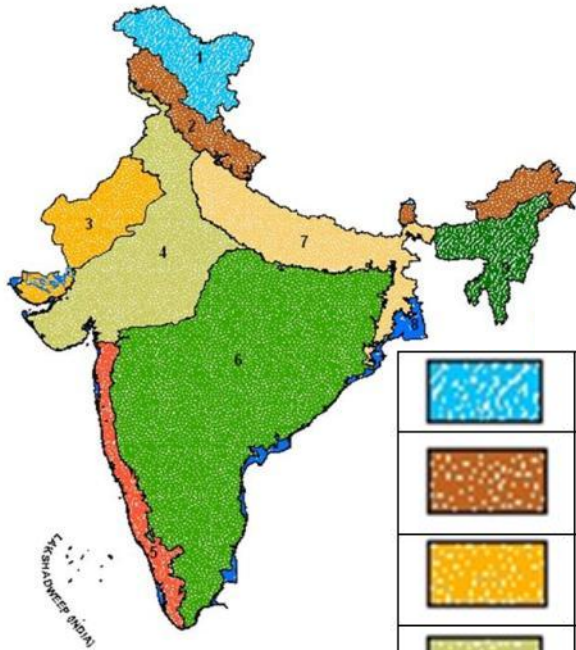









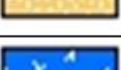
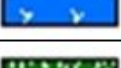

Ecology Invasive Animals and Forest Types



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Threats to Biodiversity



	1: Trans-Himalaya	Livestock pressure, Tourism, Exotic plantations, Medicinal plants & NTFP extraction, Poaching, Human-animal conflict, Border strife, Climate change.
	2: Himalaya	Climate change, Deforestation, Invasive species, Medicinal plants & NTFP extraction, Fire, Land use change, Development & urbanisation, Mining, Hydropower development, Tourism, Pollution & eutrophication.
	3: Desert	Invasive species, Land use change, Livestock pressure, Human population pressure, Mining, Border strife.
	4: Semi-Arid	Land use change, Mining, Livestock pressure, Poaching.
	5: Western Ghats	Deforestation, Invasive species, Exotic plantations, Encroachment, Mining, Medicinal plants & NTFP extraction, Livestock pressure, Poaching, Fire, Pathogen load & disease transmission, Climate change.
	6: Deccan Peninsula	Deforestation, Invasive species, Development & urbanisation, Mining, Conflict (insurgency), Pathogen load & disease transmission.
	7: Gangetic Plain	Deforestation, Invasive species, Development & urbanisation, Mining, Land use change, Pollution & eutrophication, Livestock pressure, Human population pressure.
	8: Coasts	Climate change, Pollution, Development & urbanisation, Mining, Tourism, Aquaculture, Invasive species.
	9: North East	Deforestation, Agriculture (shifting cultivation), Mining, Hydropower development, Hunting, Conflict (Border strife and insurgency), Climate change.
	10: Islands	Climate change, Invasive species, Development & urbanisation.

Chital in Andamans









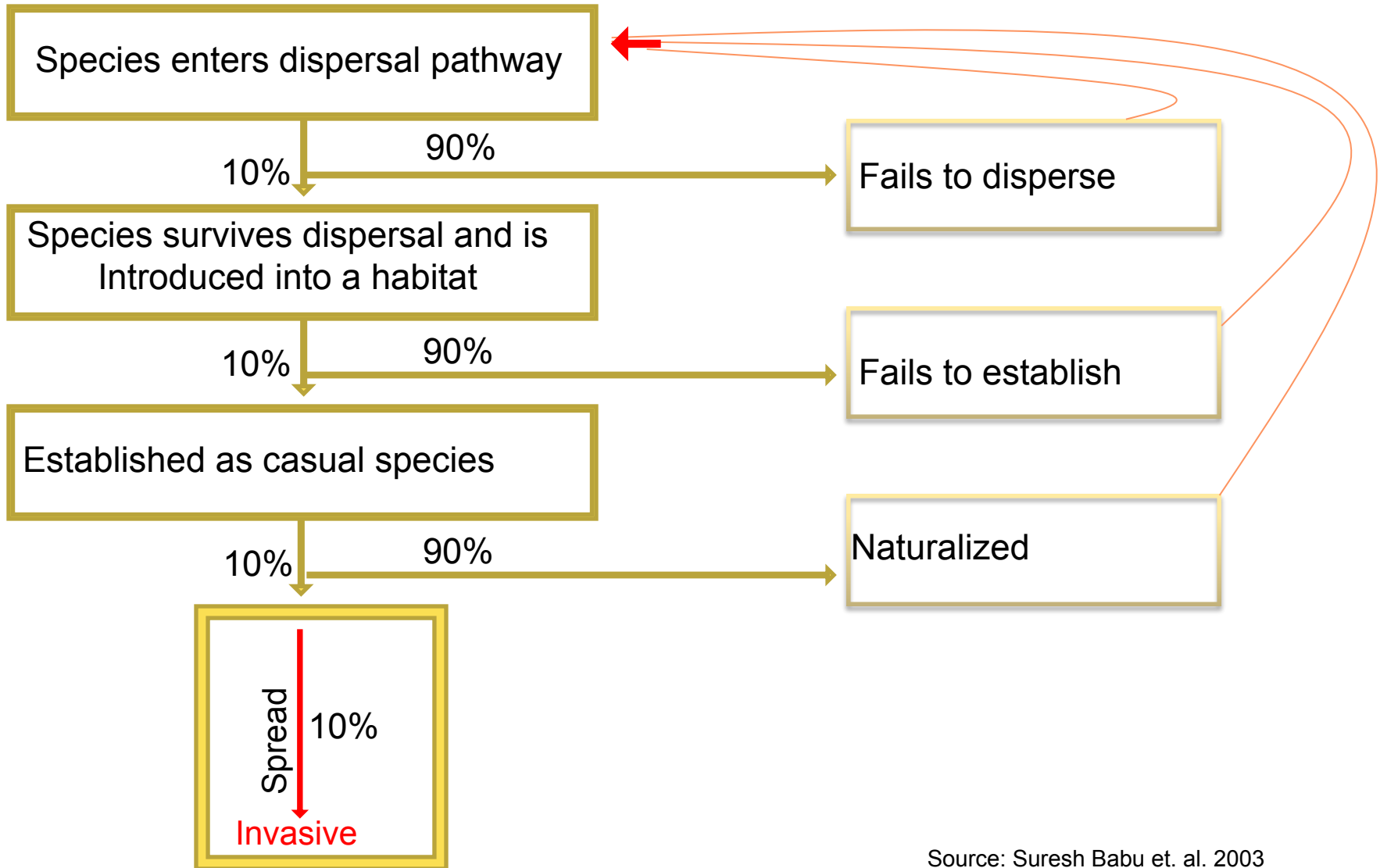
Invasive species

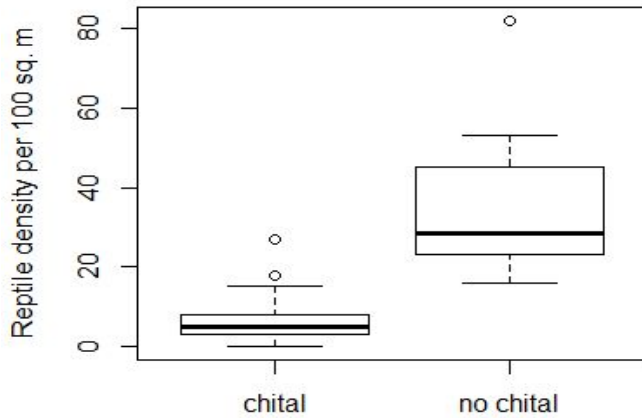
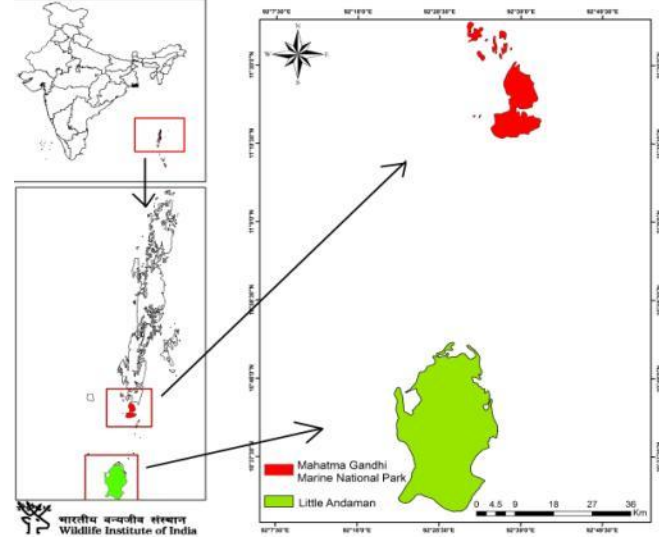


IAS are also commonly referred to as invasive, aliens, exotics or non indigenous species. IAS are species, native to one area or region, that have been introduced into an area outside their normal distribution, either by accident or on purpose, and which have colonized or invaded their new home, threatening biological diversity,

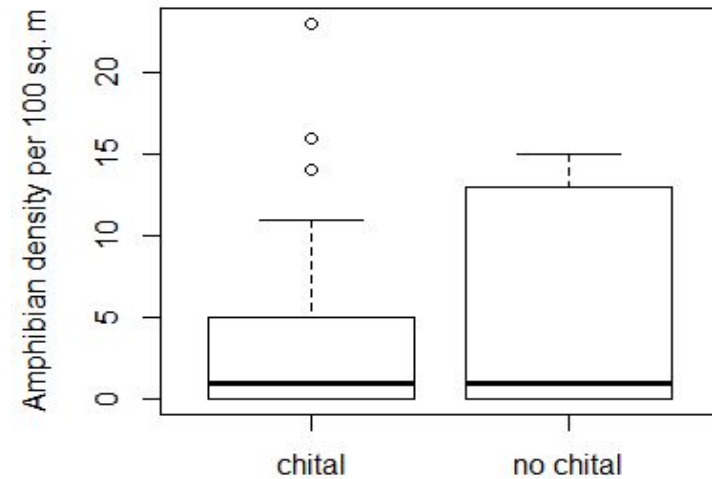


Are all Alien Species Invasive?





A box plot illustrating the difference in reptile density per bound plot between islands with and without chital ($F = 40.75$, $p < 0.001$ (significant), Effect size (η^2) = 0.58) in Andaman Islands. Island without chital showed higher reptile density per bound plot



A box plot illustrating amphibian density per bound plot in islands with and without chital in Andaman Islands. No difference between these two categories of islands was observed ($F = 0.35$, $p = 0.559$, Effect size (η^2) = 0.01).

Successful invaders

- **Large native range**
- **Abundant in native range (but not always)**
- **Broad diet (generalist, omnivore)**
- **prolific breeder**
- **associated with man**
- **successfully adaptable in a wide range of environmental conditions**



Impacts

- Next to the deforestation (habitat destruction), introduced species are the major threat to the preservation of biodiversity.
- It can profoundly alter ecosystem structure and function.
- E.g. in Western Ghats, Shola grasslands have been modified by with the invasion of aggressive black wattle (*Acacia mearnsii*, introduced here for tannin industry).
- Acceleration of soil erosion rate: Himalayan tahr in South Africa
- Alteration of hydrological cycles: Invasive fungus *Phytophthora cinnamomi* killing Eucalyptus in



Impact

- Large number of species extinct from Islands due to Invasive. In Islands, Amphibians, reptiles and birds are more vulnerable than mammals.
- Predation: e.g. Trout, Cat, Dog, brown tree snake etc.,
- Browsing and grazing: e.g. Goat, Spotted deer, elephant.,
- Hybridization (Genetic contamination): Turtle dove, Egret, pigs, carps,
- Food competition: exotic carp and native carp, sparrows, bulbuls.,
- Nest site competition: Parrot nest site encroached by introduced honeybee
- Introduction of disease: Avian malaria, cholera, pox.



Predation - Crown-of-Thorn Starfish

Acanthaster planci



Management

- **Mechanical control**
- **Chemical control**
- **Biological control**
- **Prevention**





Eradication and monitoring of invasive fishes

Invasive African cat fish *Clarias gariepinus* were posing threat to birds and other wildlife especially aquatics of the Park.

Park Management successfully initiated eradication of this species from the Park but it needs to be continued for longer period.



Management

- **Control of Invasive animals:**
 - Relocation
 - Fencing
 - Trapping
 - Shooting
 - Containing the population
 - Population control

- **National policy on the prevention of invasive animal species.**

- **IUCN Guidelines (www.issg.org)**



Nature Nurtures... Conserve Nature

Together we can build a frame work that
nourishes and not depletes our natural assets...

Thank You !
