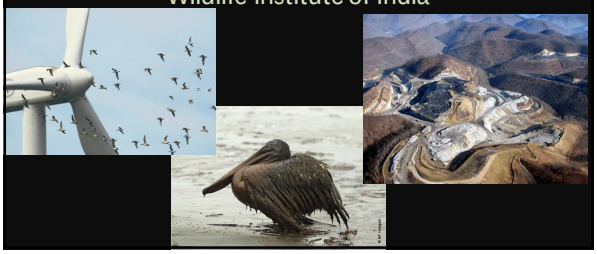
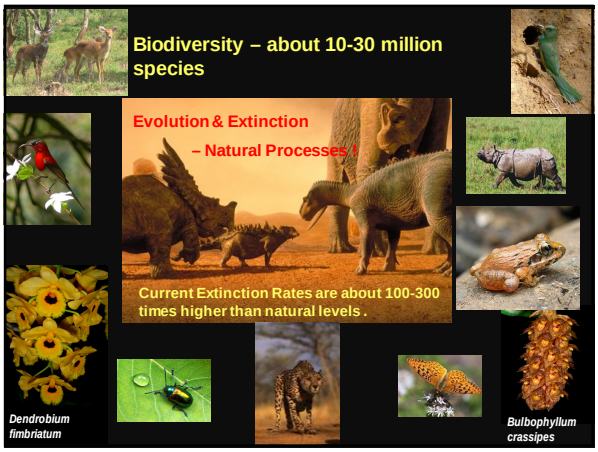
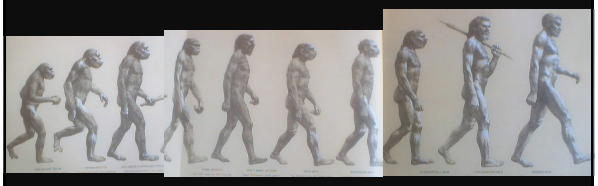
Ecological Perspective for the need for Mainstreaming Conservation with Development

Y. V. Jhala
Wildlife Institute of India





Humans Compete with other species since two million years



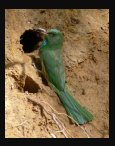
2,000,0000 Years

- Till 40 thousand years we barely managed to survive –
- Discovery of Fire was the turning point in Human Evolution
- Environment was no longer limiting
- Habitat modification to favour population explosion - Development

40,000 Y → 2,000 Y

Ecological Concepts – r & K selected Life History Strategies

- Fecundity
- Population Growth
- Parental Care
- Longevity
- Specialization
- Environment
- Susceptibility to Extinction



r- & *K*- selection

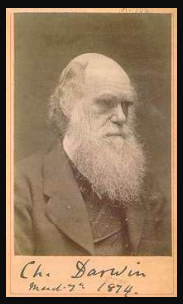
Verhulst equation : $dN/dt = rN(1 - N/K)$

Rodents ——— Whales

r-end ——— *K*-end

Correlates	*r*-selected species	*K*-selected species
Climate	Variable & unpredictable	Fairly constant or certain
Mortality	Density-independent; catastrophic	Density-dependent; directed
Survivorship	Low in young & adult ages	Age-constant *or* High
Population size	Time-variable & non-equilibrium Usually << Carrying Capacity	Time-constant & equilibrium Usually ~ Carrying Capacity
Competition	Usually low	Usually high
Life span	Short (<1 year)	Longer (>1 year)
Parental Care	Low	High
Selective pressure	High r_{max} ; rapid development; early reproduction; small size Leads to 'Productivity'	Low r_{max} ; slow development; late reproduction; large size Leads to 'Efficiency'

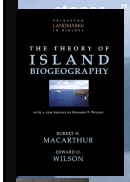
Darwin on Biogeography



"Neither the similarity or dissimilarity of the inhabitants of various regions can be wholly accounted for by climatic and other physical conditions."

"Barriers of any kind…are related in a close and important manner to the differences between the productions [organisms] of various regions."

"Theories, like islands, are often reached by stepping



MacArthur and Wilson (1967)

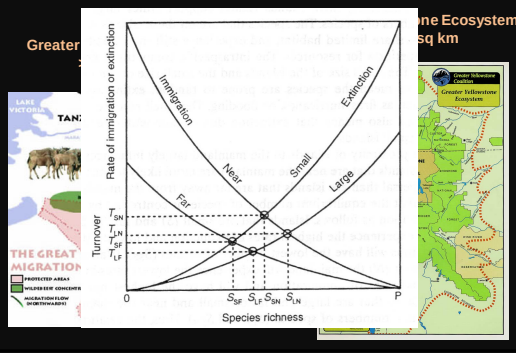
Theory of Island Bio-Geography

Island Biogeography

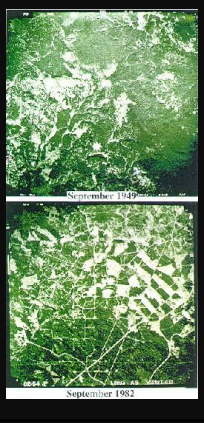
Definition: A subdivision of biogeography that relates the manner in which species distributions are influenced and restricted by "islands." The "island" is any area of habitat surrounded by an inhospitable matrix to the species occurring on that island.

Island Biogeography Theory
Extinction & Reserve size

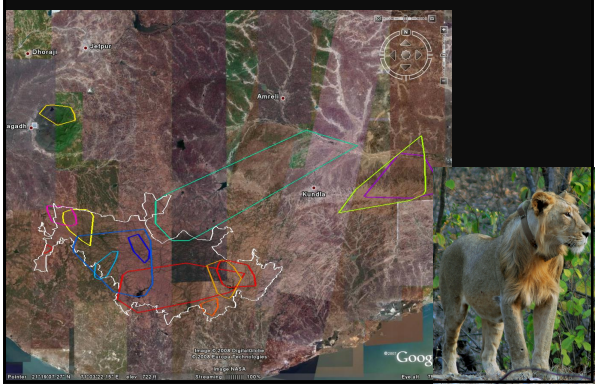
$S=cA^z$



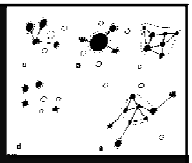
Island biogeography theory has had serious ramifications for conservation. One of the most significant anthropogenic influences on natural habitats has been the fragmentation of habitats into smaller and smaller "islands". These fragmented habitats often show relaxation effects like some islands.

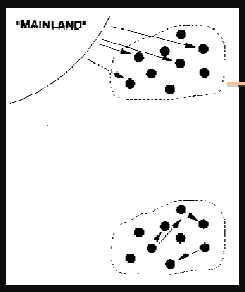


Home Range Size VS PA size



Meta-population Theory





Mainland-Island model

- Habitat islands suffer periodic predictable extinction
- Recolonized by dispersers from neighbouring islands
- If migration is greater than extinction population persists

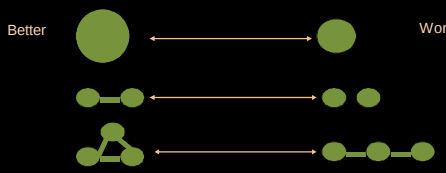
Levins, R. 1970. Some demographic and genetic consequences of heterogeneity for biological control. Bull. Ent. Soc. Am. 15:237-240

Habitat Fragmentation VS Patchy Habitat

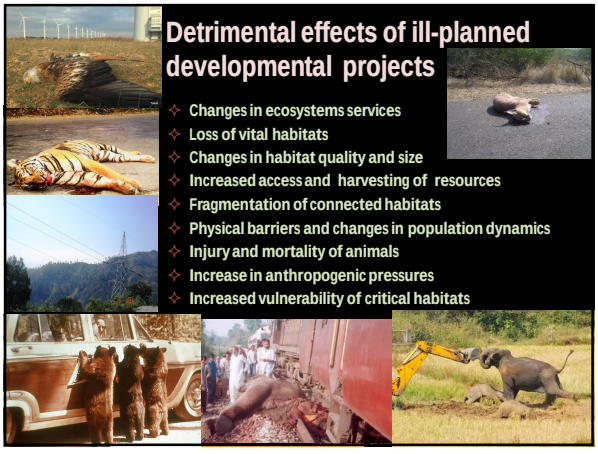
- There are differences between naturally patchy landscapes and fragmented ones
- Furthermore, the greater the differences, the greater the threat to species persistence in them
- Persistence in fragmented habitats is further compromised b barriers of infrastructure such as roads, urban sprawl, etc.

Shape, Size and Connectedness

- Often you simply buy what you can, but if there is a choice you should aim to optomise the site geometry.
- Consider edge effects – good or bad? (Good for UK insects, bad for deep rainforest species).
- Connectedness is always good



Detrimental effects of ill-planned developmental projects

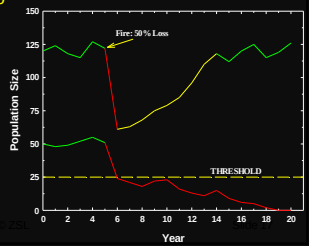


- Changes in ecosystems services
- Loss of vital habitats
- Changes in habitat quality and size
- Increased access and harvesting of resources
- Fragmentation of connected habitats
- Physical barriers and changes in population dynamics
- Injury and mortality of animals
- Increase in anthropogenic pressures
- Increased vulnerability of critical habitats

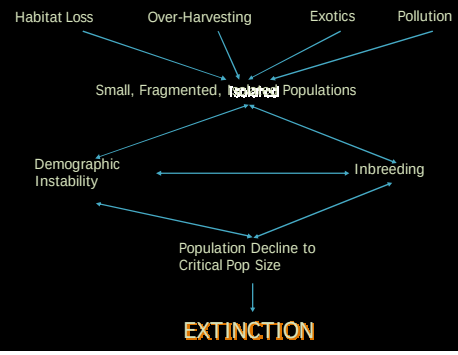
Dynamics of small populations

Why do small populations go extinct?

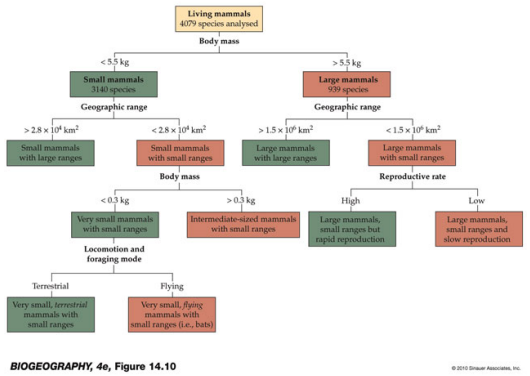
- Demographic stochasticity
  - Chance variation in individual birth & death
  - Chance variation in sex ratio
- Environmental stochasticity
- Genetic problems
  - Inbreeding depression
  - Genetic drift
  - Loss of heterozygosity
- Behavioural problems
  - Allee effects



Extinction vortex



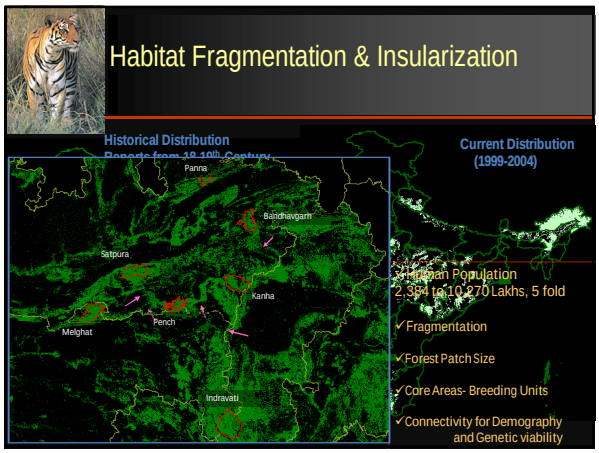
Selective nature of *extinction*

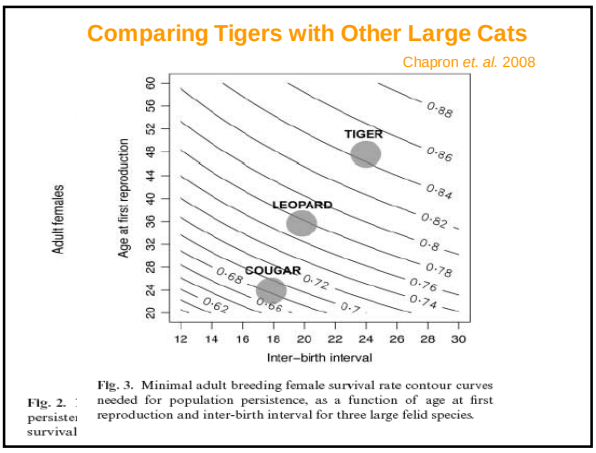


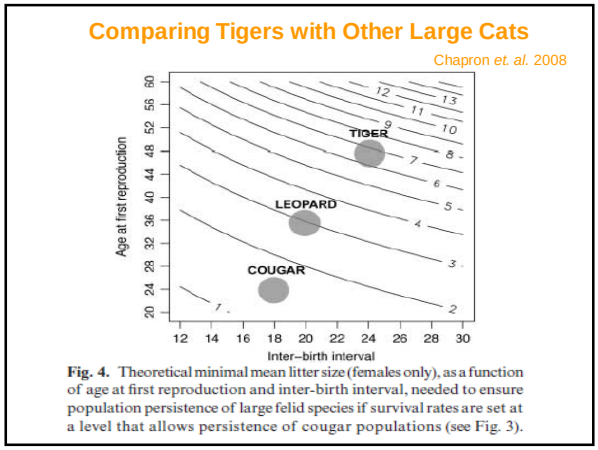
BIOGEOGRAPHY, 4e, Figure 14.10

Tigers Being Top Predators serve as a Umbrella species for Biodiversity Conservation – The Philosophy of Project Tiger

Monitoring Tigers is like Keeping the Pulse of the Ecosystem

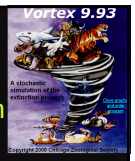

Habitat Fragmentation & Insularization
Historical Distribution
Current Distribution
(1999-2004)
Panna
Bandhavgarh
Satpura
Kanha
Pench
Melghat
Indravati
Tigers Population
2,334 to 10,270 Lakhs, 5 fold
✓Fragmentation
✓Forest Patch Size
✓Core Areas- Breeding Units
✓Connectivity for Demography
and Genetic viability


Comparing Tigers with Other Large Cats
Chapron et. al. 2008
Adult females
Age at first reproduction
Inter–birth interval
TIGER
LEOPARD
COUGAR
0·88
0·86
0·84
0·82
0·8
0·78
0·76
0·74
0·72
0·7
0·68
0·66
0·62
Fig. 3. Minimal adult breeding female survival rate contour curves needed for population persistence, as a function of age at first reproduction and inter-birth interval for three large felid species.


Comparing Tigers with Other Large Cats
Chapron et. al. 2008
Age at first reproduction
Inter–birth interval
TIGER
LEOPARD
COUGAR
Fig. 4. Theoretical minimal mean litter size (females only), as a function of age at first reproduction and inter-birth interval, needed to ensure population persistence of large felid species if survival rates are set at a level that allows persistence of cougar populations (see Fig. 3).


Trade of tiger parts
Costs
-Negligible
Demand
- Traditional Chinese Medicine
- Fashion

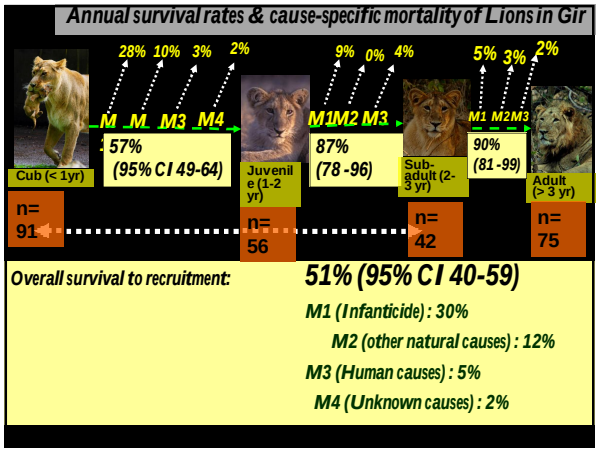
Program VORTEX



- Individual Animal Based Population Simulation Package
- Sophisticated tool for Population Habitat Viability Analysis
- Assists Conservation Management, Reintroductions, Harvest, Risk Assessment, etc.

Tools and Information Needed for Management of Endangered Species Populations

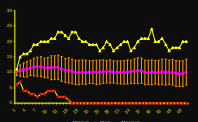
- Spatial Extent and Population Size
- Demographic Parameters
- Ecology (Spatial Dynamics)
- Population Models
- Landscape Characteristics / Land Use Matrix / Barriers to movement



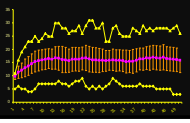
Show Simulations in Vortex

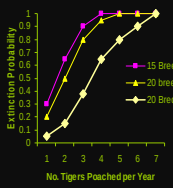
Population Viability Assessment

Fifteen Tigresses
Extinction Probability > 15%



Twenty Tigresses
Extinction probability < 5%





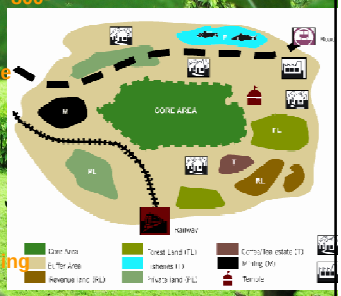
Inviolate Area

For 20 breeding tigresses -800-1000 km²

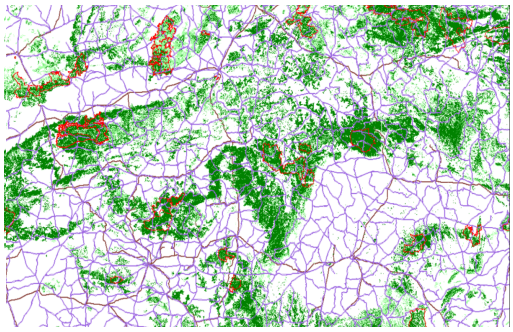
Total Population in the Core
Tigers = Male 8
Cubs < 1 Year = 10 -15
Cubs 1-2 Year = 10 -15

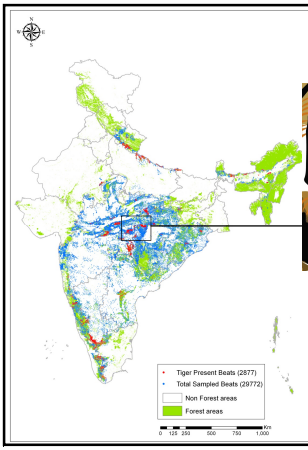
Buffer -- 1000-3000 km²
2-3 Year olds = 10 -15
3-4 Year olds = 10 -15
Old tigers & Surplus breeding age Tigers = 10-15

Tot Pop = 75 - 100 Tigers

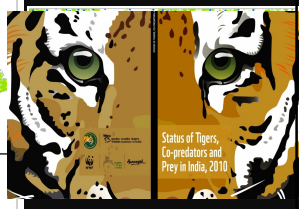


Infrastructure & Habitat Connectivity

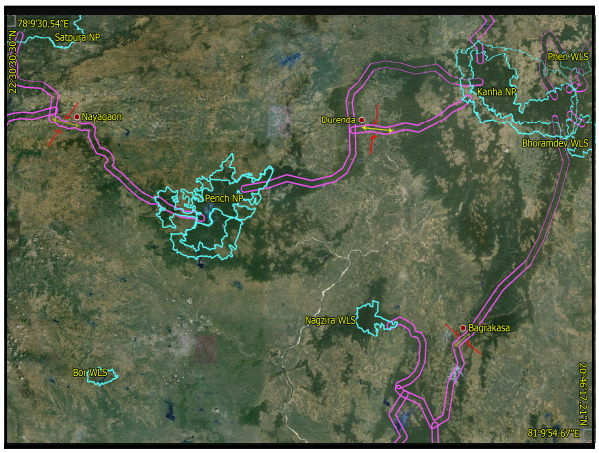


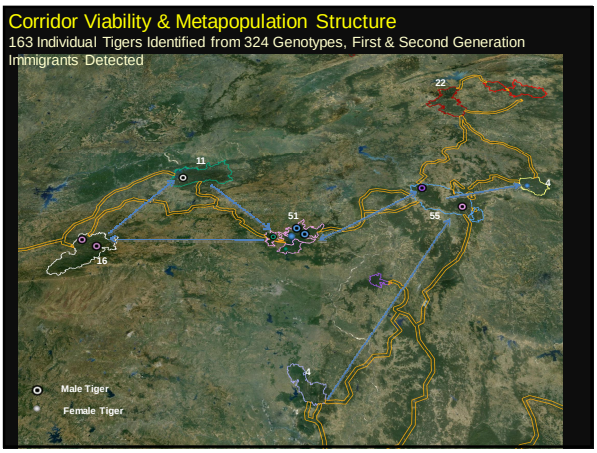


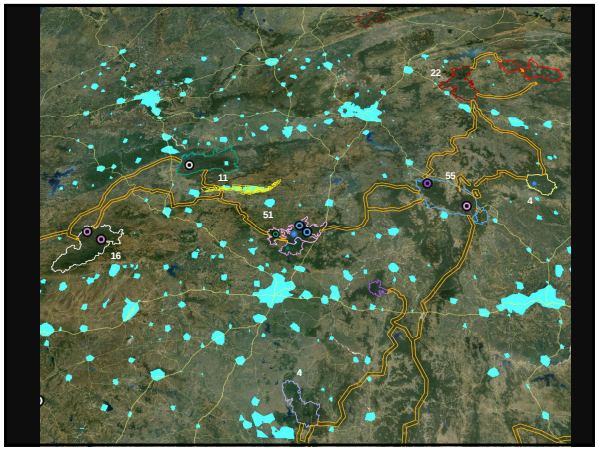
Phase I :Distribution of Sampled and Tiger Occupied Beats in India



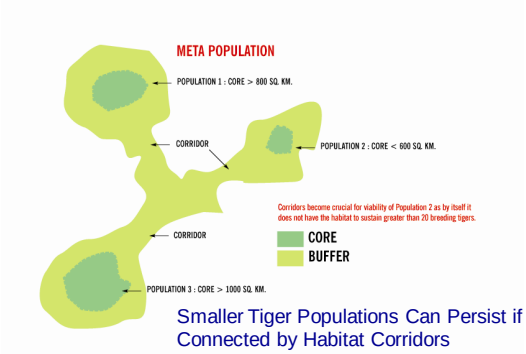
Total sampled beats – 29,867
Search paths (km) – 4,48,000
Transect (km) – 1,79,200
Total man-days – 4,77,000 (Forest Staff)
Total man-days – 37,000 (Biologists)
Total Area covered about 500,000 km²







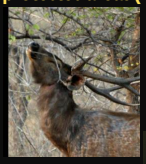
Relevance of Core Size and Corridors for Metapopulaton



Smaller Tiger Populations Can Persist if Connected by Habitat Corridors

Prey Depletion – Enhanced Conflict & Local Extinctions!

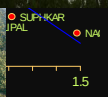
- Subsistence level poaching
- Local communities dependent on wildlife for proteins
- Chronic problem outside protected areas (Empty Forest Syndrome !)

Human Disturbances Tiger Occupancy & Density

Disturbance influence or



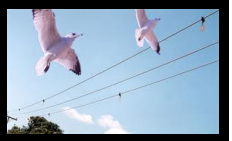



Conservation at Work
Chilla Range of Rajaji National Park

- Removal of Anthropogenic Pressures
- Tigers recolonise and breed within 1 year



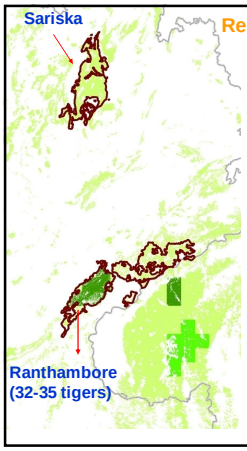

Inviolate Core Areas (No Go Areas) & Wildlife Friendly Infrastructure in Corridors and Buffers

Maintaining habitat linkages between source populations

- Policy (since outside the realm of Protected Areas) –Eco-sensitive Zone?
- Livelihood
  - Agro-forestry
  - Compensation for wildlife damage
  - Eco-development
  - Public-Private partnership
- Payment by global community and governments as ecosystem maintenance cost

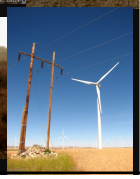
Reintroductions VS Natural Dispersal



Tiger as an Umbrella Spp. for Conservation of Biodiversity

Evolutionary Characteristics of Dispersers

Agricultural Encroachment & hostile Infrastructure in GIB habitats

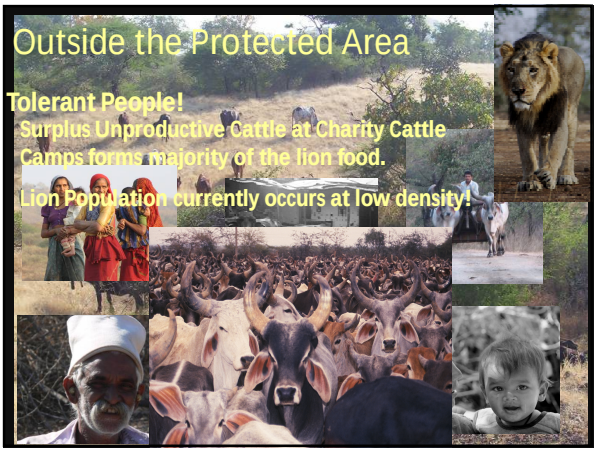


Outside the Protected Area

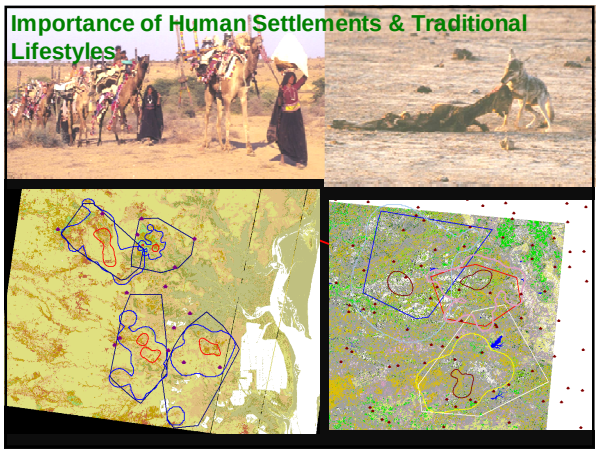
Tolerant People!

Surplus Unproductive Cattle at Charity Cattle Camps forms majority of the lion food.

Lion Population currently occurs at low density!



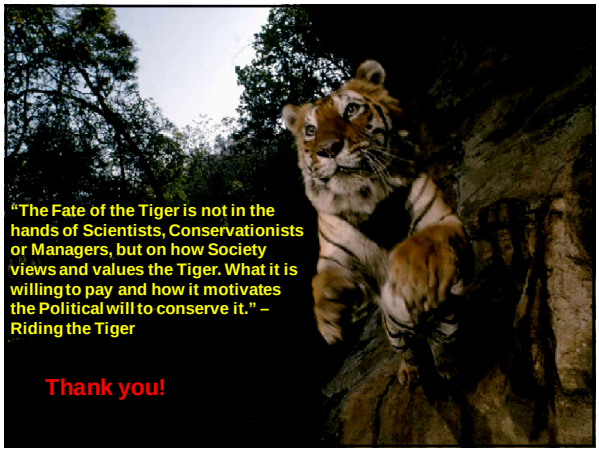
Importance of Human Settlements & Traditional Lifestyles



Conclusions

- Create Large Inviolate Spaces for Conservation.
- Maintain Habitat Connectivity between Sources and sinks to ensure Meta-Populations
- Avoid mixing people and wildlife ---- Zonation
- Control Problem animals immediately --- Backlash to populations and Species
- However, our PA ' s are too small for viable populations of most spp.
- Therefore Co-existence with Humans is an essential conservation strategy. Human welfare (development) needs to be sensitive to conservation concerns
- Understanding Landscape characteristics and ensuring wildlife movement corridors are a must for long term conservation goals
- Conflict is inevitable, managing conflict by mitigation, incentives, and awareness is the crux of successful conservation

Thank you !



"The Fate of the Tiger is not in the hands of Scientists, Conservationists or Managers, but on how Society views and values the Tiger. What it is willing to pay and how it motivates the Political will to conserve it." – Riding the Tiger

Thank you!