Population Viability Analysis (PVA):

Case Study of Panna

K. Ramesh, Ph.D.

Scientist
ramesh@wii.gov.in

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Population Viability Analysis (PVA)

- **What is PVA?**

  A structured, systematic and comprehensive examination of the interacting factors that place a population or species at risk of extinction.

- **Why do a PVA?**

  To assess the threats to a species survival in order to determine how best to intervene before significant population declines become inevitable.

Uses of PVAs

- **Assessment of extinction risk**
  - Single or multiple species assessments
  - Evaluate monitoring (time series) data

- **Guiding conservation and management**
  - Identifying key life-history stages
  - Determining reserve size and geometry
  - *Evaluating introductions and translocations*
  - *Setting limits to harvest*
  - Determining number of local populations needed

Types of PVA Models

- Count-based—times series of 'census' data
  - Count-based incorporating stochasticity and density dependence; non-spatial
- Demographic—explicitly considering population structure (age or stage); non-spatial
- Spatially structured — patch-based or metapopulation models
- Individual-based; spatially explicit

Components to Include in a PVA

- Basic population dynamics
- Demographic variation (for small populations)
- Environmental variation (time and space)
- Individual heterogeneity
- Genetic variation
- System dynamics (changing landscapes)
- Functions that link demography to habitat
- SPACE

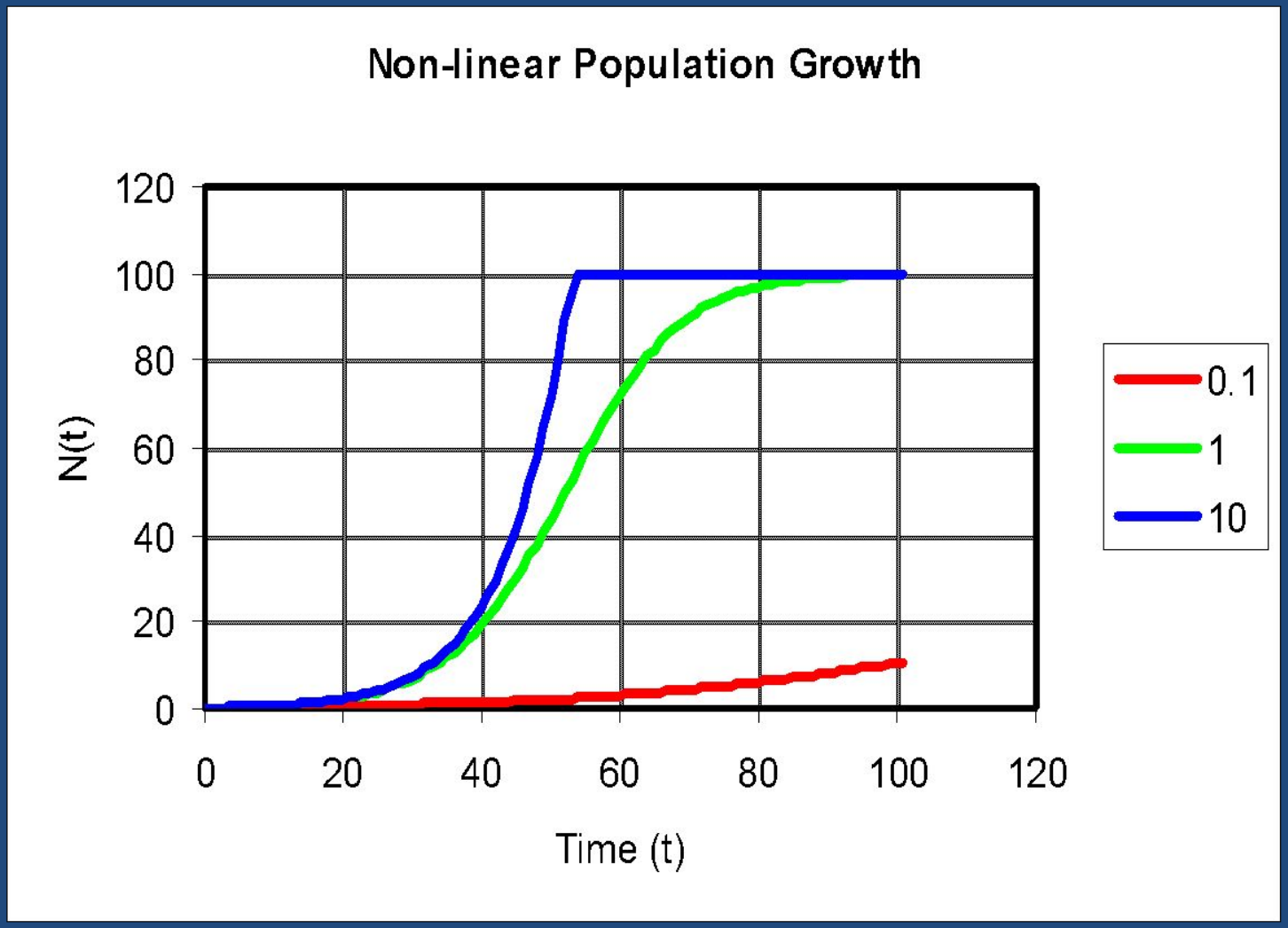
Sources of Process Variation

- Demographic
- Environmental
  - Spatial and Temporal
- Individual
  - Demography and Genetic
- System dynamics
  - “Natural” and Human-induced

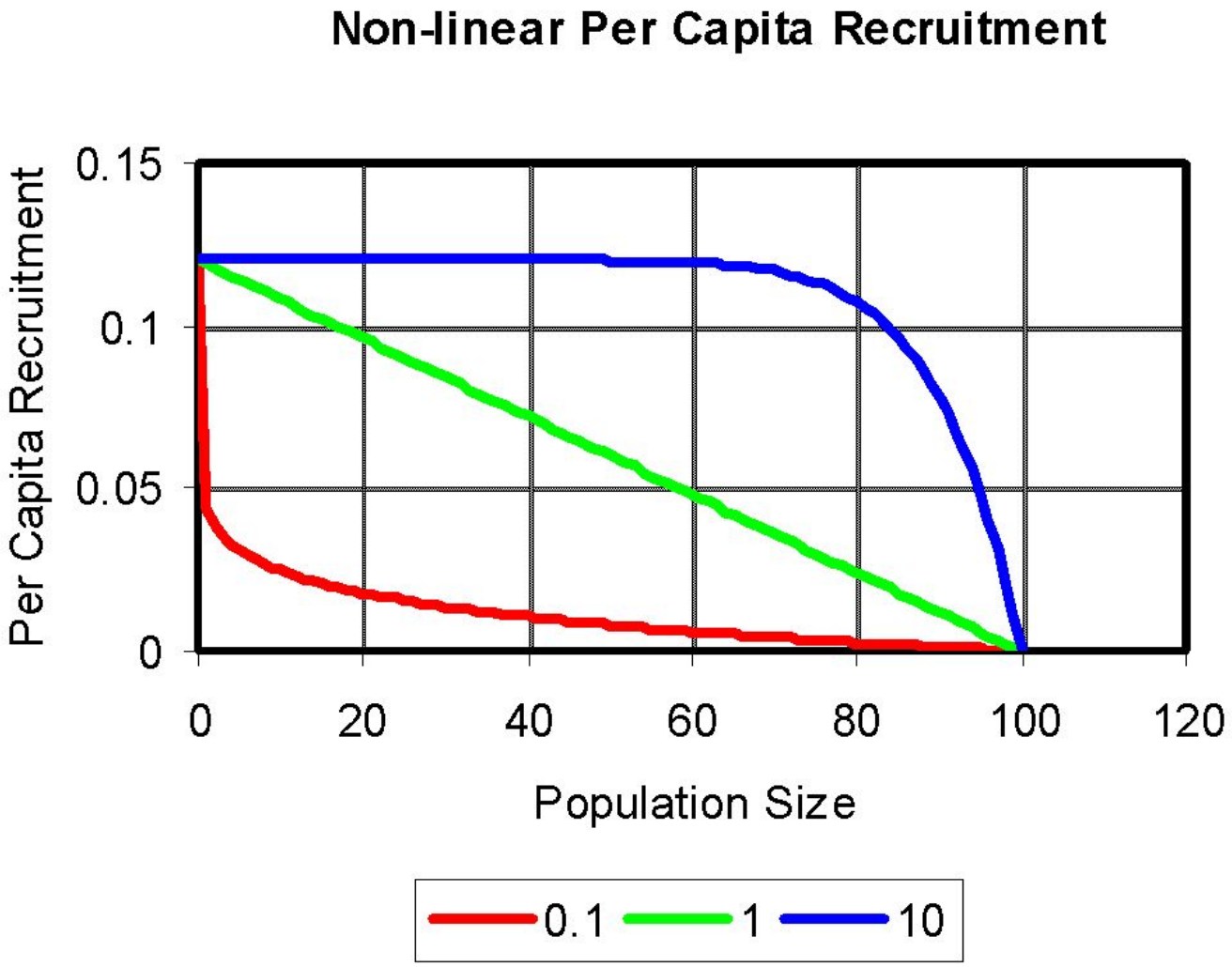
Structural Components of PVA Models

- **Stochasticity** (random or systematic variation in demographic rates)
- **Density dependence** (demographic rates are a function of population size)
- **Time lags** (delayed demographic response to changing resource/environment conditions)
- **Population structure** (demographic rates vary systematically *via* age or stage)
- **Geographic structure** (spatial distribution of populations across the landscape)

Density-Dependent Population Growth



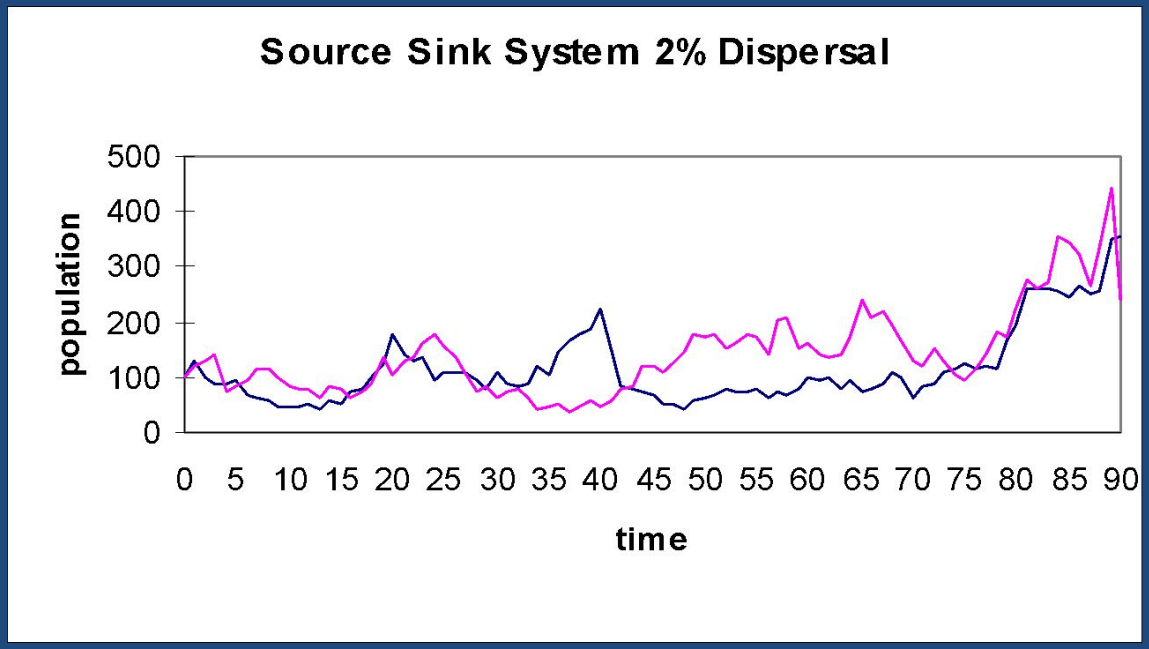
Density Dependence

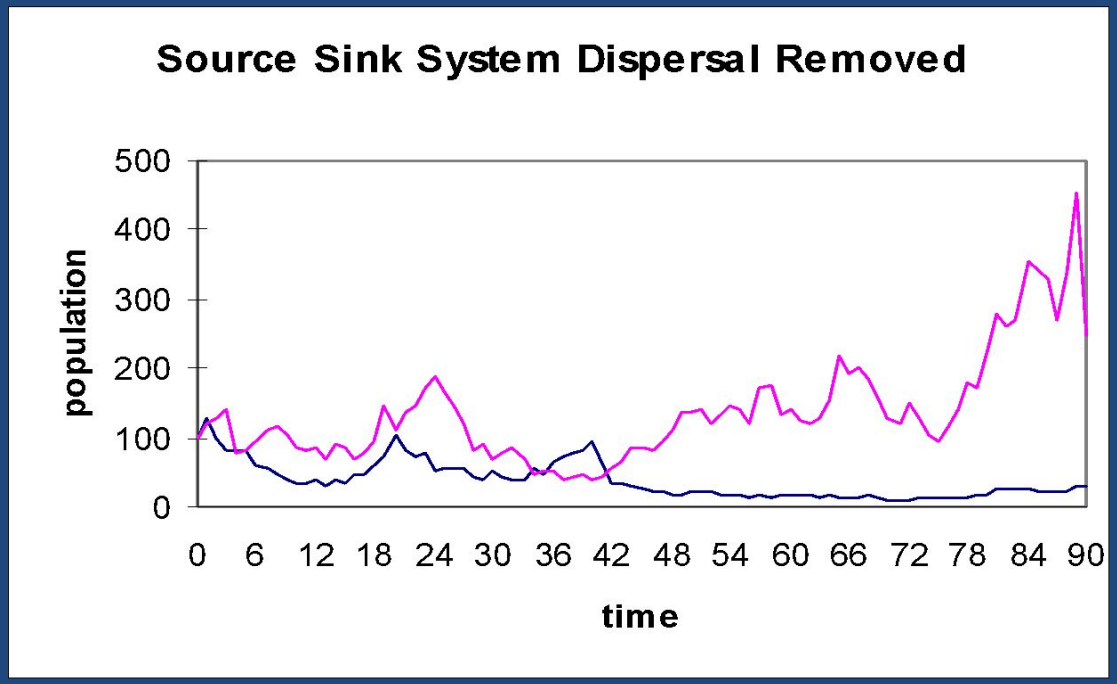


Genetic Considerations

- Migration
  - Dispersal among geographically distinct populations
- Inbreeding
  - Lowering of reproductive and/or survival rates
- Genetic Drift
  - Loss of genetic variability and adaptive potential
- Founder effects
  - Low genetic variability due to sampling effects
- Effective population size
  - Loss of genetic variability due to inequitable reproductive contributions

Connectivity among local populations





Setting Priorities for PVAs

- Rarity (local and regional population size)
- Degree of risk (threats based)
- Functional significance in ecological systems (keystone, engineer, food web dominant)
- Umbrella role for other species
- Legal status
- Public involvement and support
- Data availability

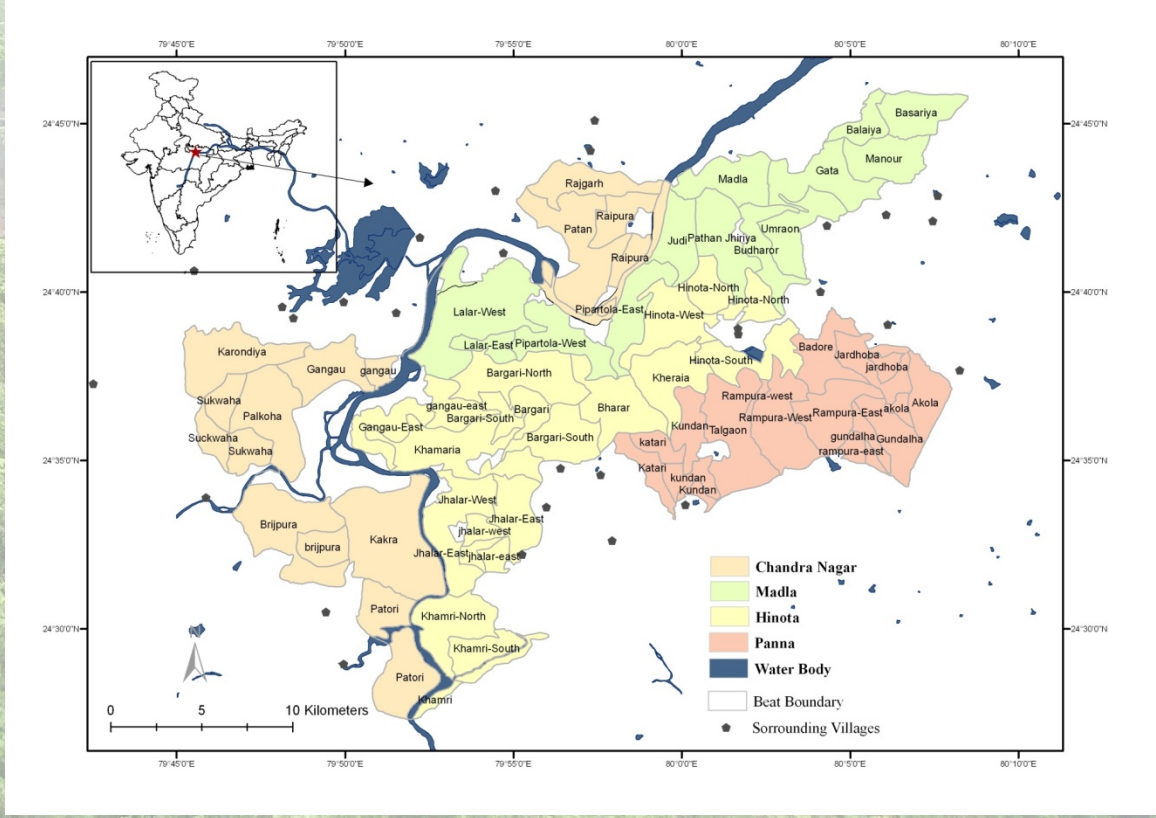
Small Population Attributes

- Number of local populations
- Size of local populations
- Geographic distribution of local populations
- Spatial-temporal covariance among populations
- Connectivity
- Movement rates
- Genetic interchange
- Genetic differentiation

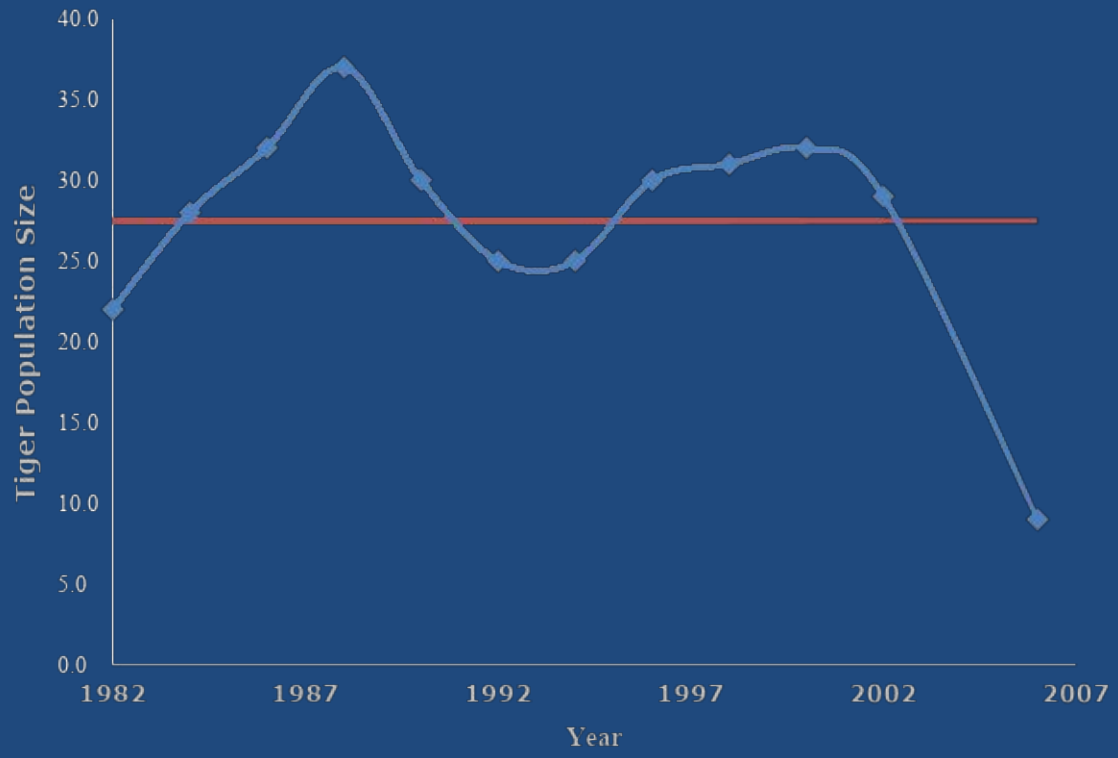
Extinction and Reintroduction of Tiger Population in Panna

> 35 in 2015

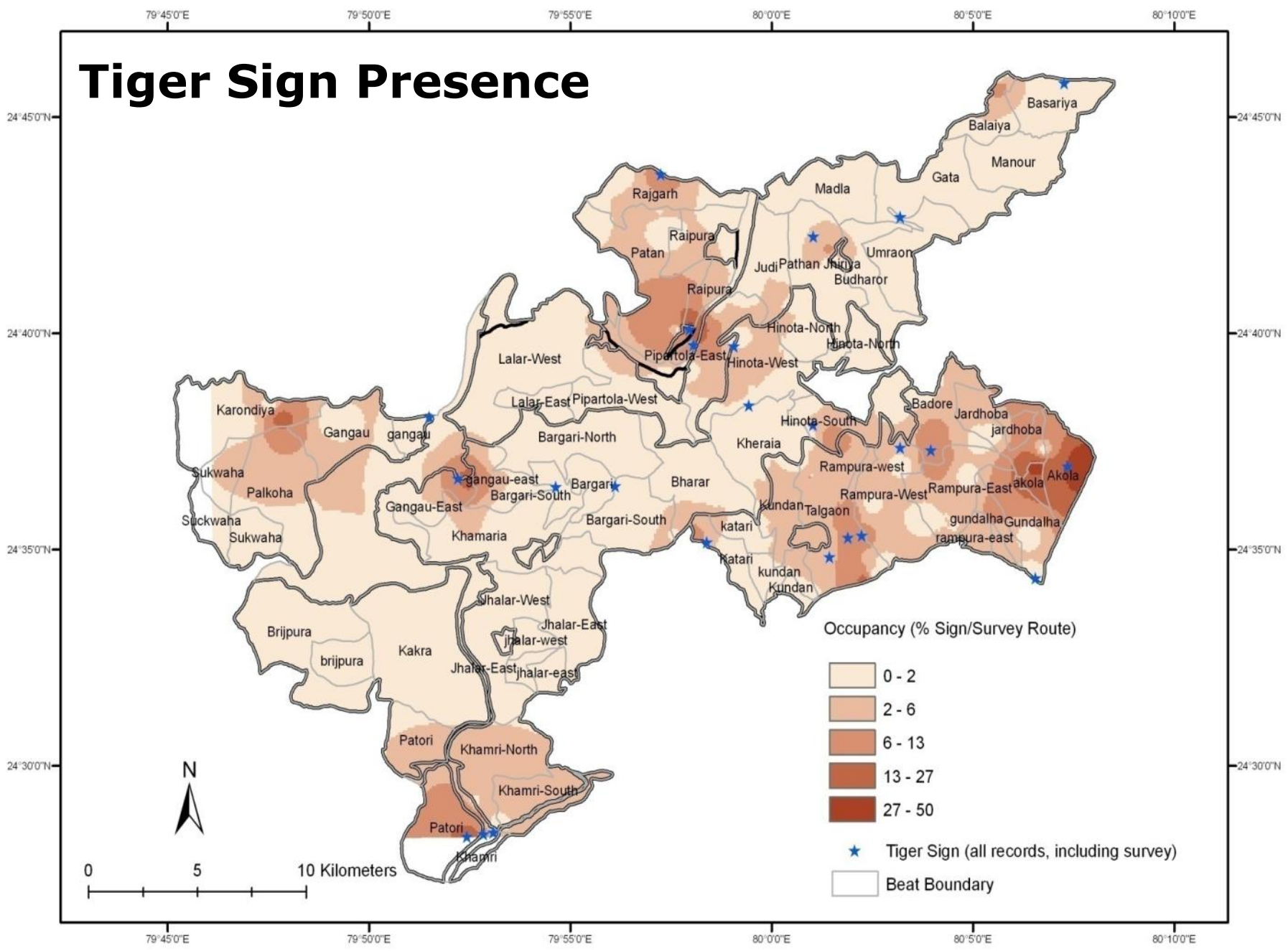
Extinct in 2009



Population Decline



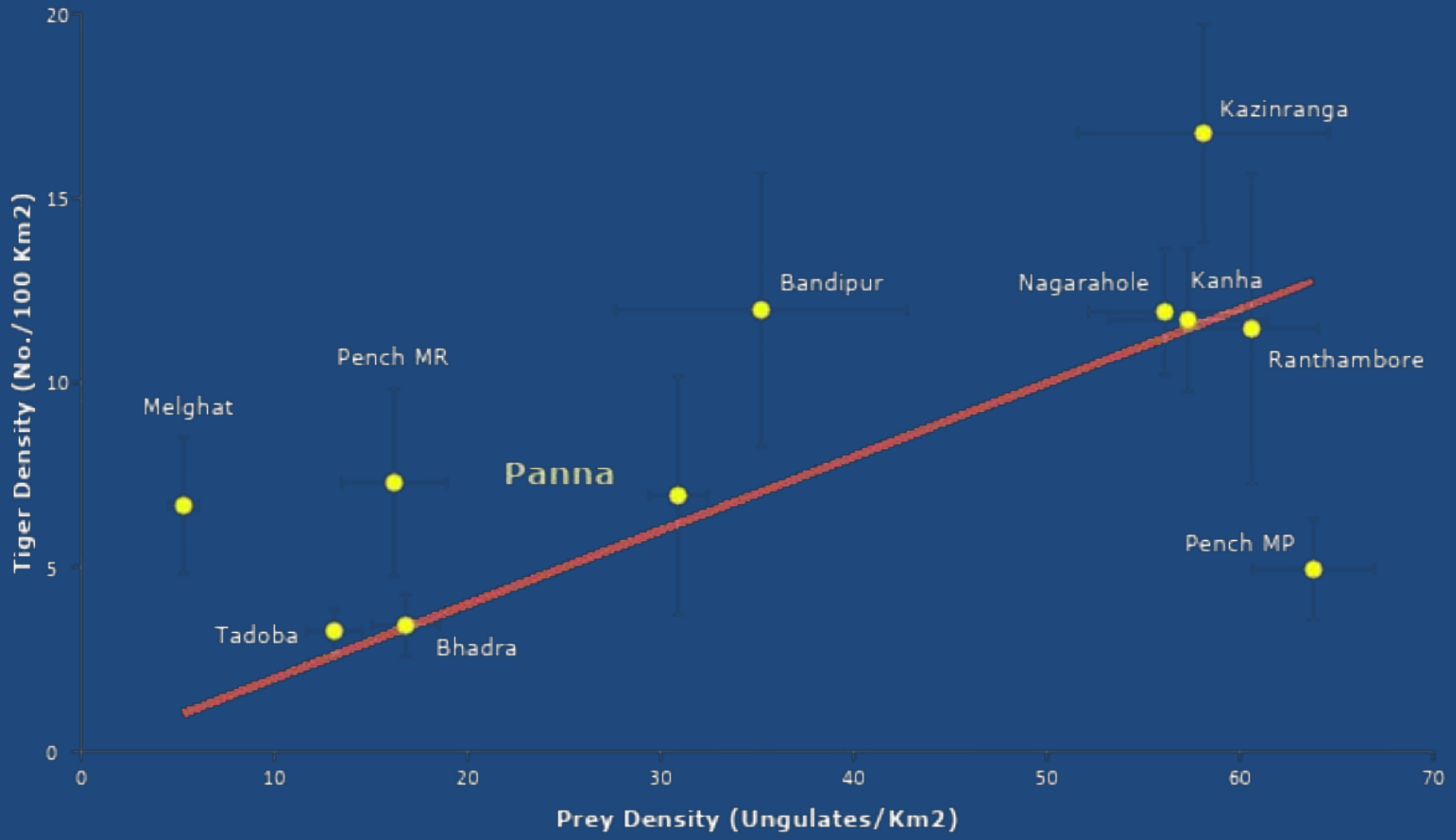
EXTINCTION
Occurred in February 2009


Tiger Sign Presence
79°45'0"E
79°50'0"E
79°55'0"E
80°0'0"E
80°5'0"E
80°10'0"E
24°45'0"N
24°40'0"N
24°35'0"N
24°30'0"N
Basariya
Balaiya
Manour
Gata
Madla
Rajgarh
Raipura
Patan
Judi
Pathan
Jhiriya
Umraon
Budharor
Raipura
Hinota-North
Hinota-North
Pipartola-East
Hinota-West
Lalar-West
Lalar-East
Pipartola-West
Karondiya
Gangau
gangau
Bargari-North
Hinota-South
Badore
Jardhoba
jardhoba
Kheraia
Rampura-west
Sukwaha
Palkoha
gangau-east
Bargari-South
Bargari
Bharar
Rampura-West
Rampura-East
akola
Akola
Gangau-East
kundan
Talgaon
Suckwaha
Sukwaha
Khamaria
Bargari-South
katari
gundalha
Gundalha
rampura-east
Katari
kundan
Kundan
Jhalar-West
Brijpura
Jhalar-East
jhalar-west
brijpura
Kakra
Jhalar-East
jhalar-east
Patori
Khamri-North
Khamri-South
Patori
Khamri
N
0
5
10 Kilometers
Occupancy (% Sign/Survey Route)
0 - 2
2 - 6
6 - 13
13 - 27
27 - 50
Tiger Sign (all records, including survey)
Beat Boundary

Never Ignore the Signals: Implicit and Explicit

You will save time, money and species population, and will avoid undue criticism and reinventing the wheel

How many could it support?



[Based on Karanth et al. 2004 b]

PVA for Tiger

SCENARIO 1: Base model, with only demography and does not include catastrophe, inbreeding, harvest (in this case, poaching) and supplement.

SCENARIO 2: Natural process model, with demography and includes catastrophe and inbreeding.

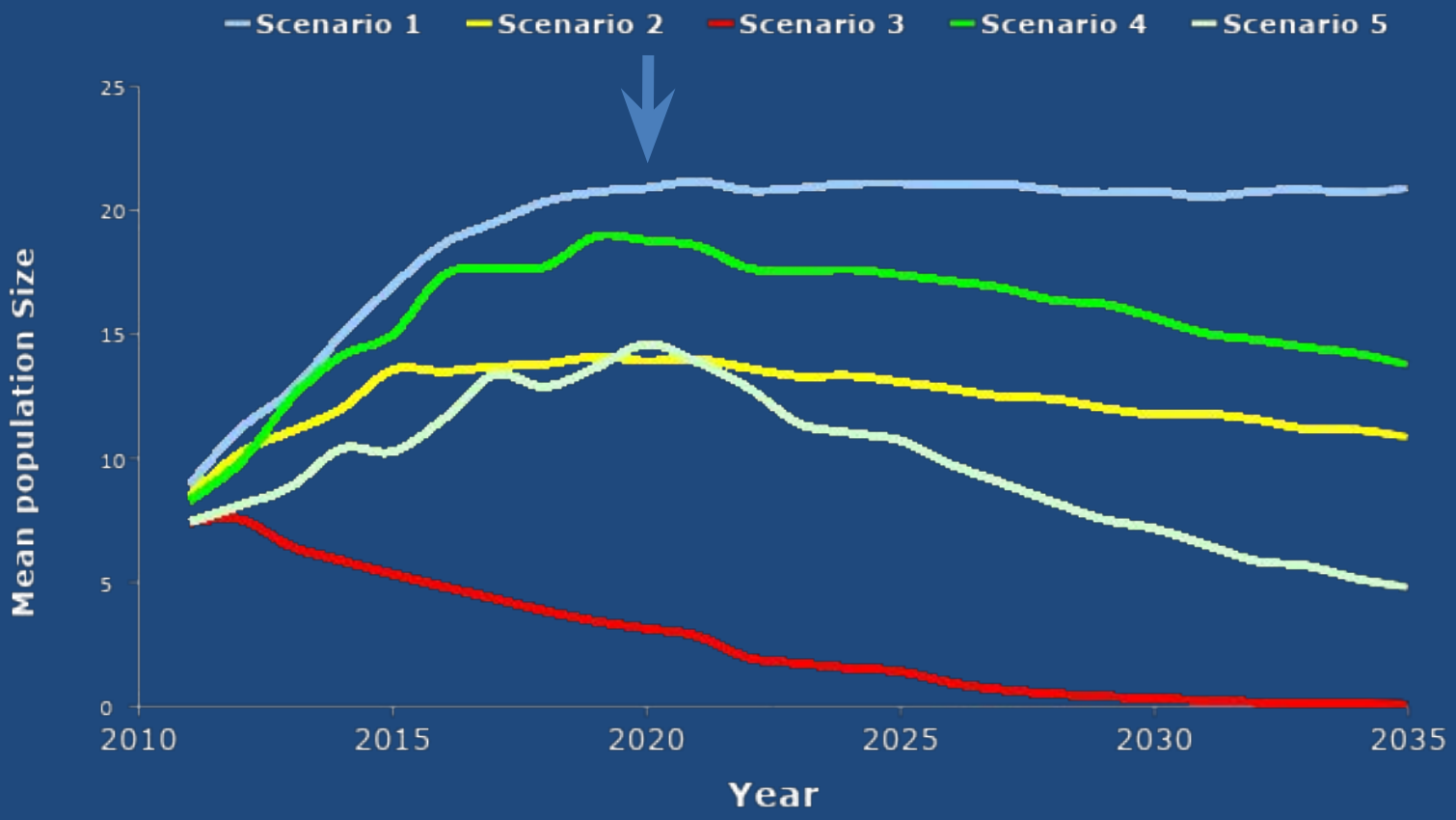
SCENARIO 3: Harvest model, with demography and include catastrophe, inbreeding and one poaching per year.

PVA for Tiger

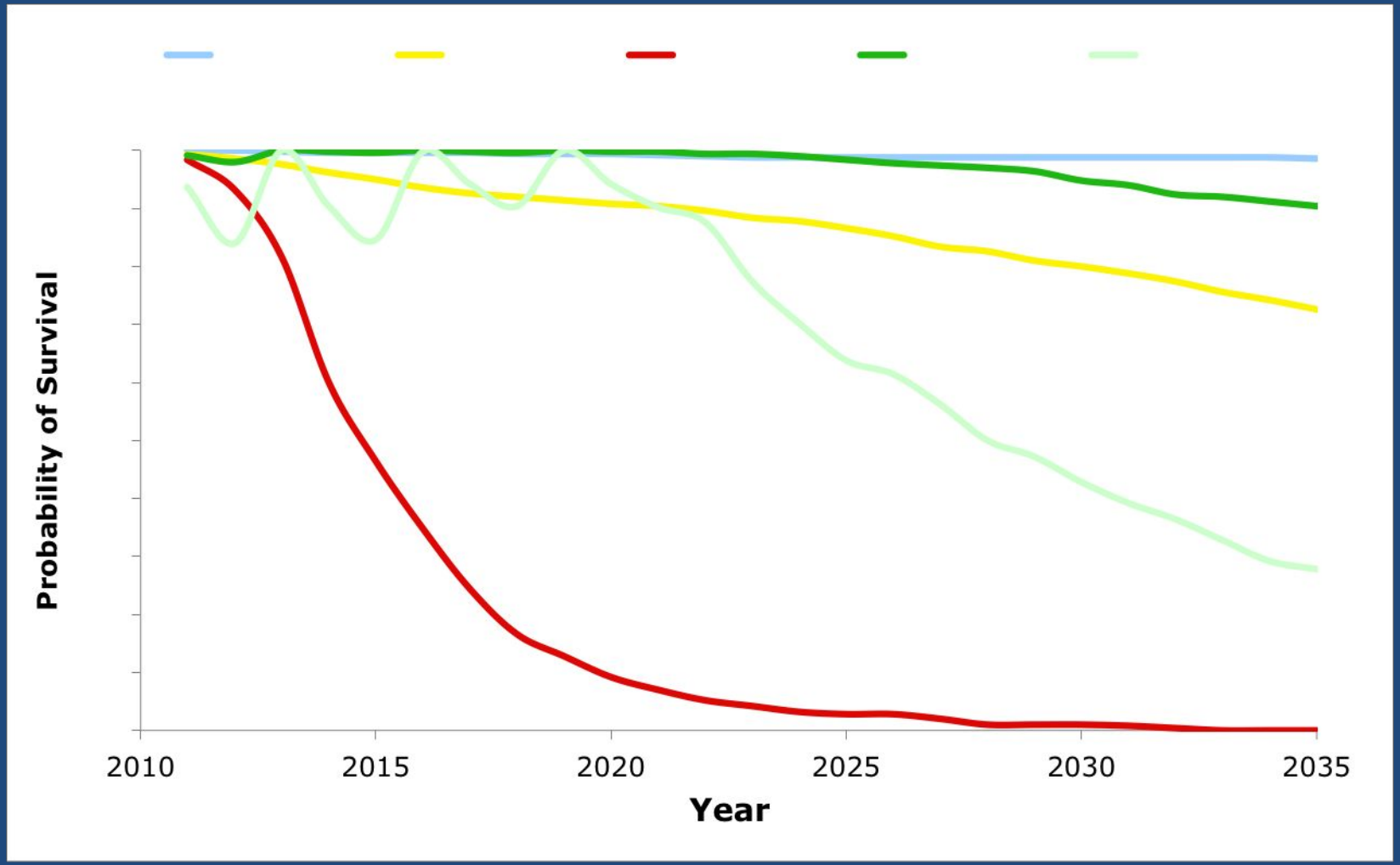
SCENARIO 4: Supplement model, with demography and include catastrophe, inbreeding, no poaching and supplement of 2 tigers every three year for three consecutive time scale.

SCENARIO 5: Supplement and harvest model, with demography and include catastrophe, inbreeding, supplement of 2 tigers every three years for three consecutive time scale, and 1 poaching per year.

PVA for Tiger



PVA for Tiger



PVA for Tiger

The scenario 4 (giving due consideration to all natural processes and supplementation of individuals) is a potential option for this reintroduction program.

The adjoining forest areas, though hostile, is part of tiger home range and offer dispersal opportunity, and therefore, at least a portion of these need to be brought under the PTR management.

Reintroduction of Tiger in Panna

Translocation from Wild Populations (in 2009)

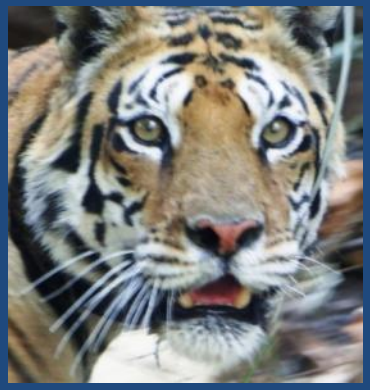
T1: Female
Bandhavgarh
TR

T2: Female
Kanha TR

T3: Male
Pench TR

Translocation of hand-reared / semi-wild tigresses (in 2011)

T4: Female
Kanha TR



T5: Female
Kanha TR

T6: Female
Pench TR (in 2014)

Rescued and Rehabilitated Orphaned Cubs

Rescued and Rehabilitated Orphaned Cubs

Three Cubs Rescued in June 2005 & Reared in Quarantine Facility

Shifted to Enclosure in February 2008

Male to Van Vihar in May 2008

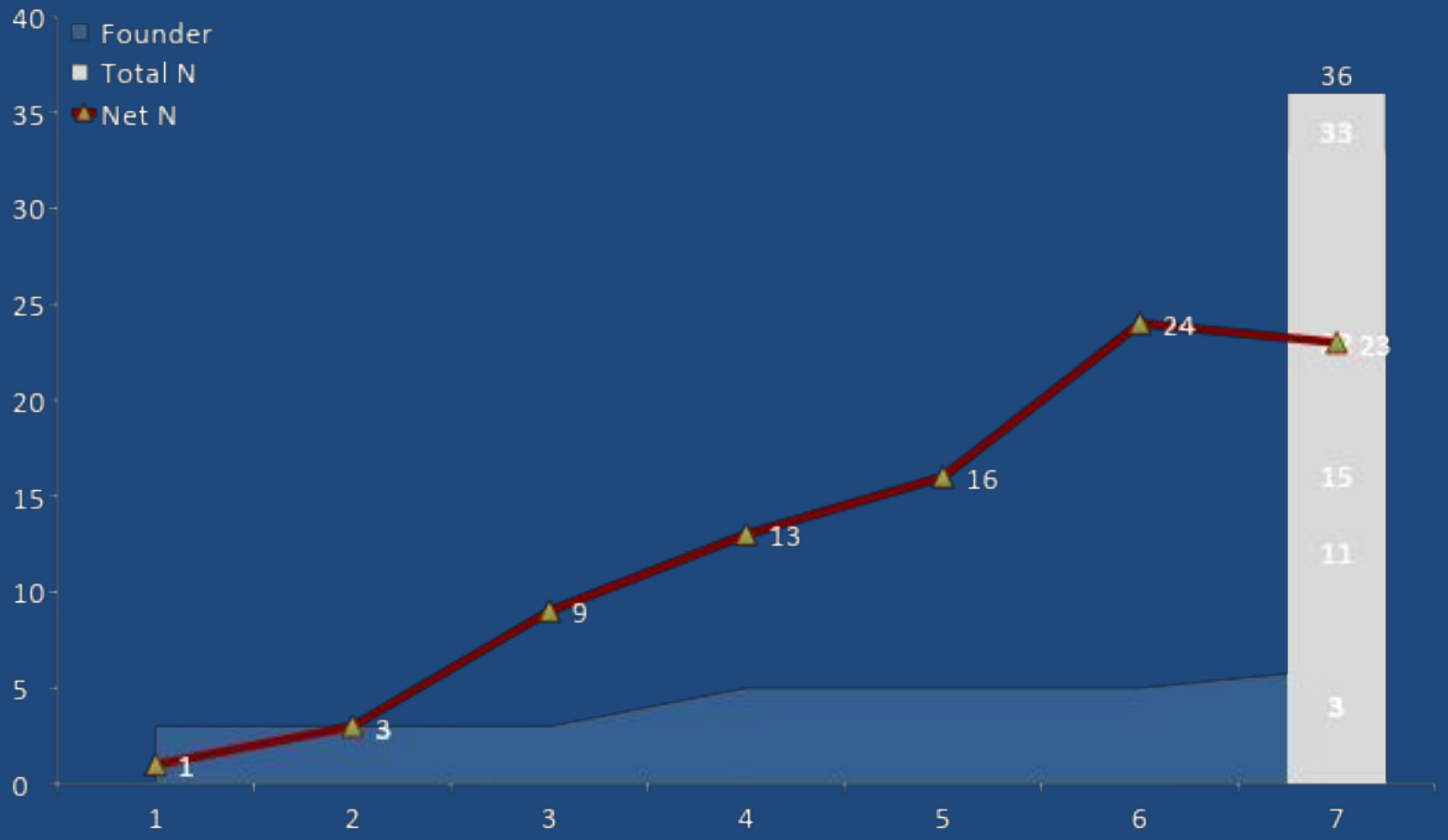
Females to Panna in 2011

Grown-up Brothers (T111 & T112)

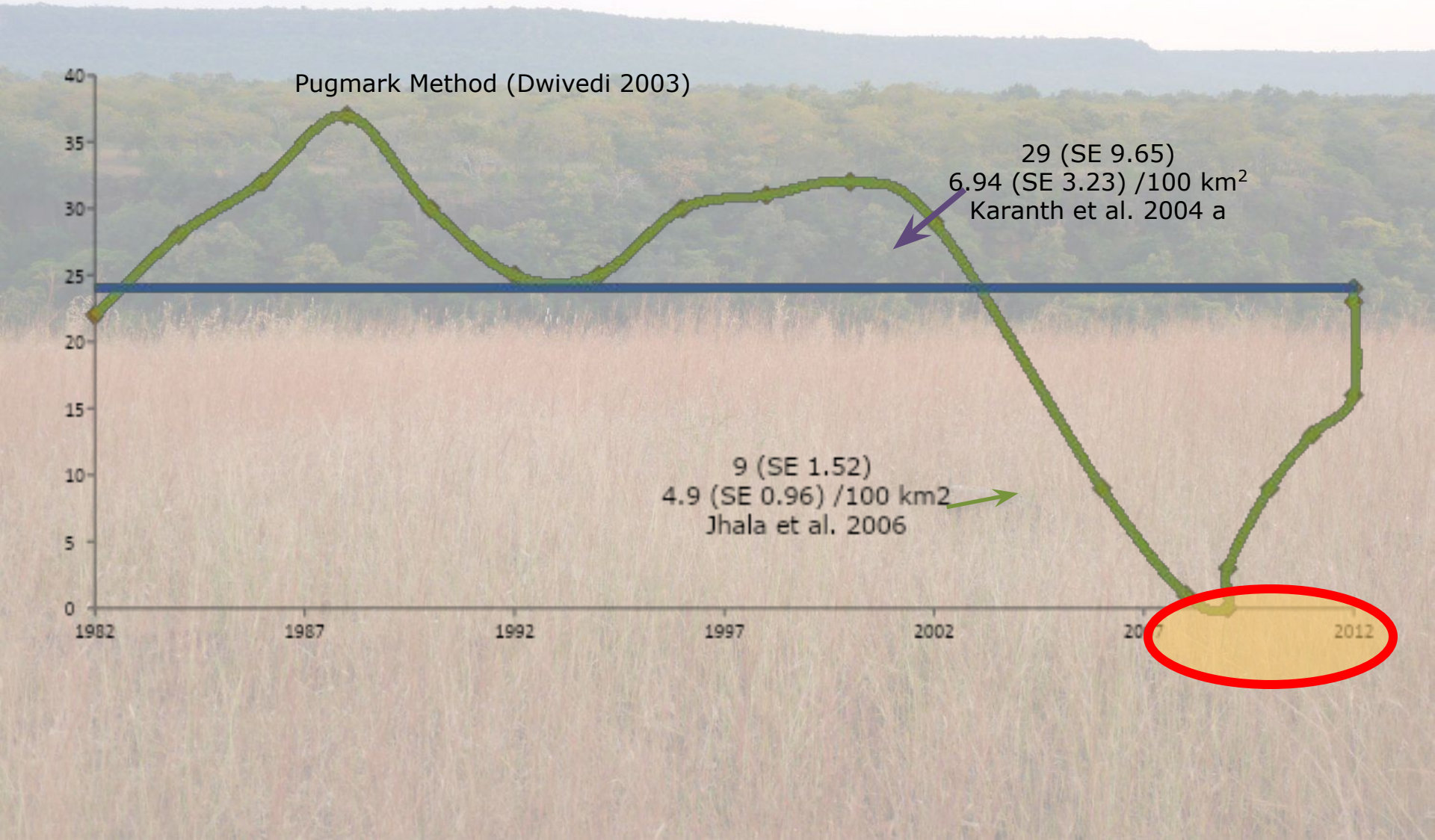
The Sisters in Captivity (T4 & T5)

T4 with T112 (F1 male)

Population Growth

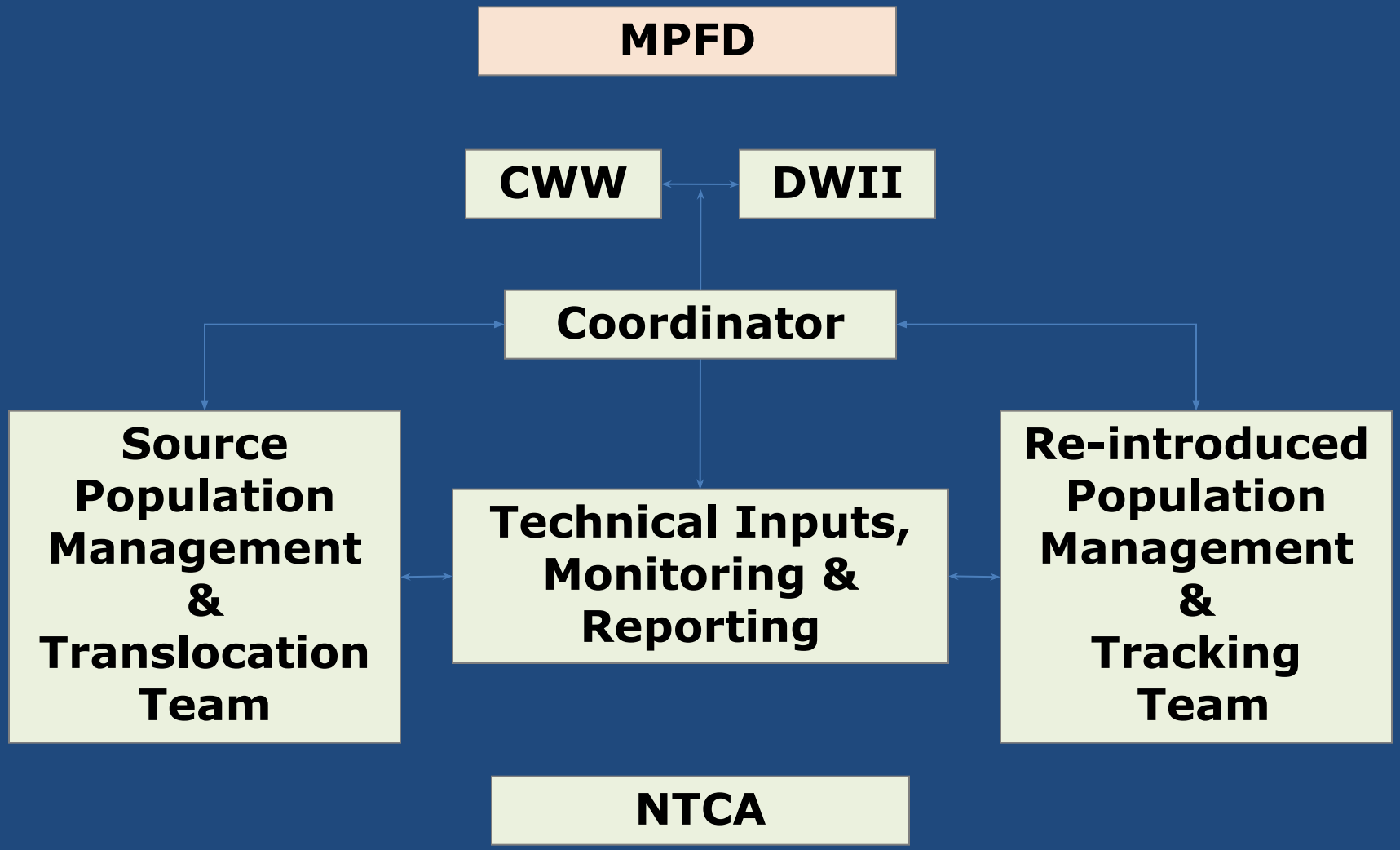


Tiger Population Trend in Panna



Strategies, Lessons and Implications

Institutional Mechanism



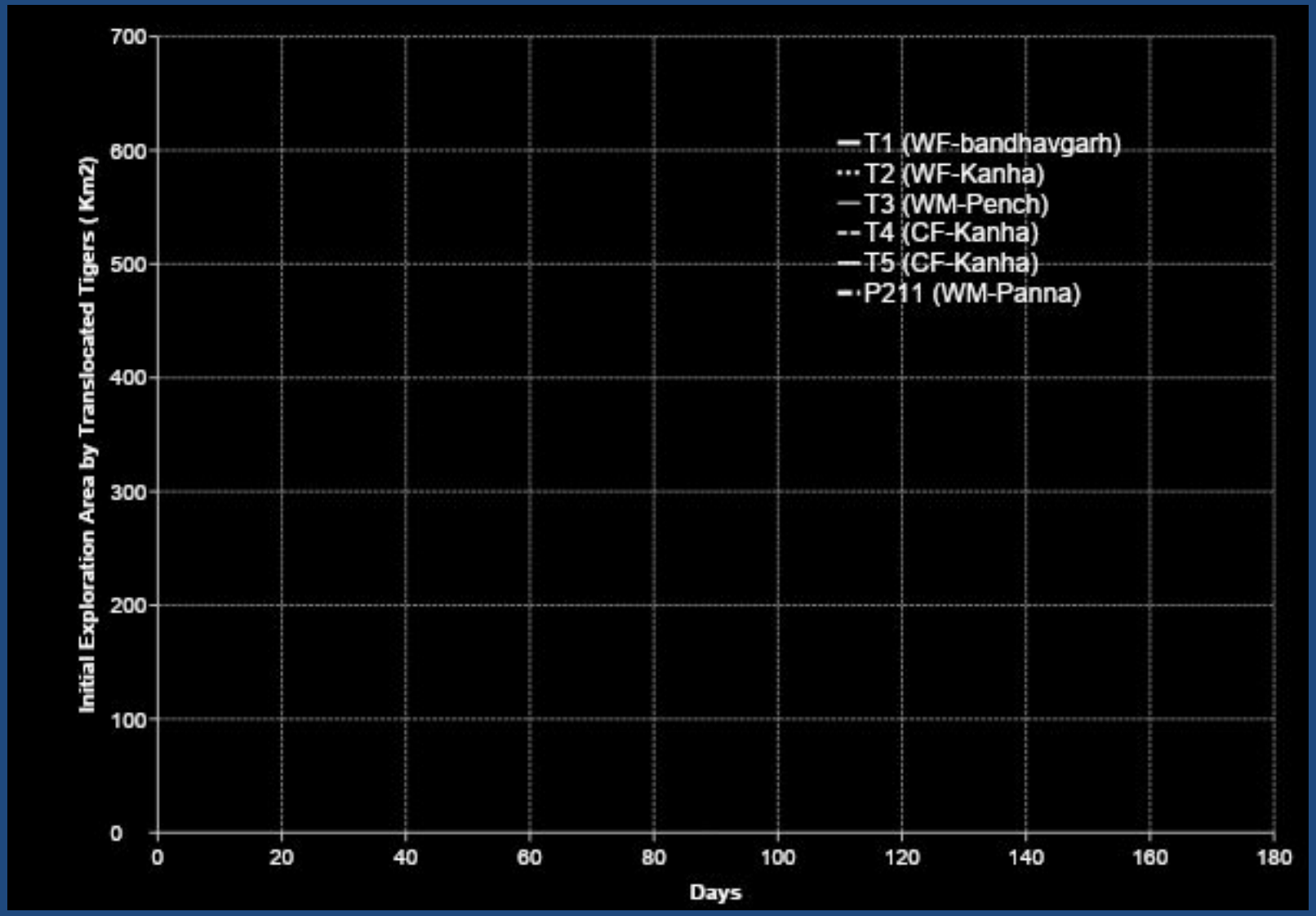
Intensive Monitoring and Interventions

Selection of Candidate Animals and Release Options

Although dispersing individuals are recommended to be ideal candidate for such restocking / reintroduction program, transient animals that are yet to establish constant home range may also be considered as it has certain edge over young dispersing ones, specifically in the challenging and human dominated environment.

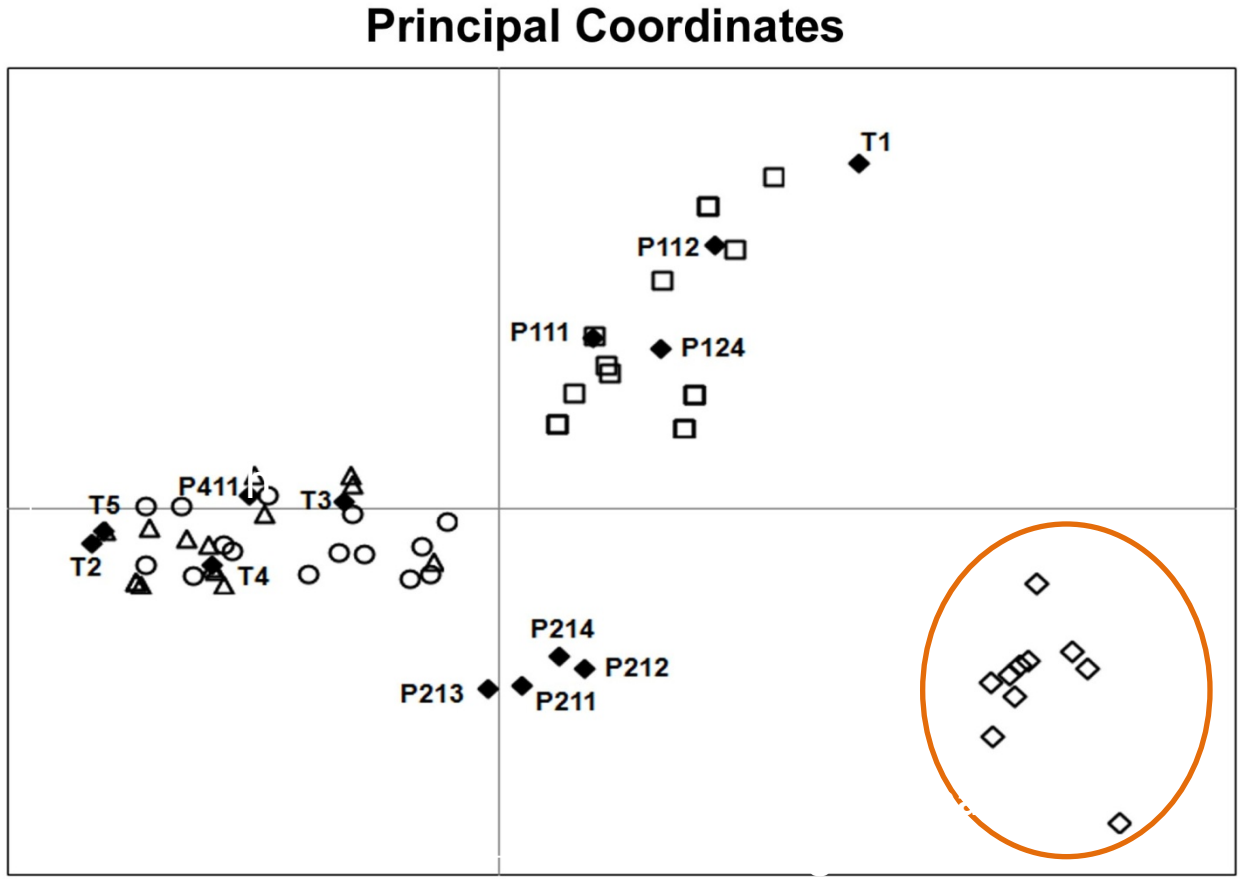
Soft-release and hard-release were possible, while hard-release appear to be less stressful, unless larger enclosure is planned.

Home Range (Initial Stage)



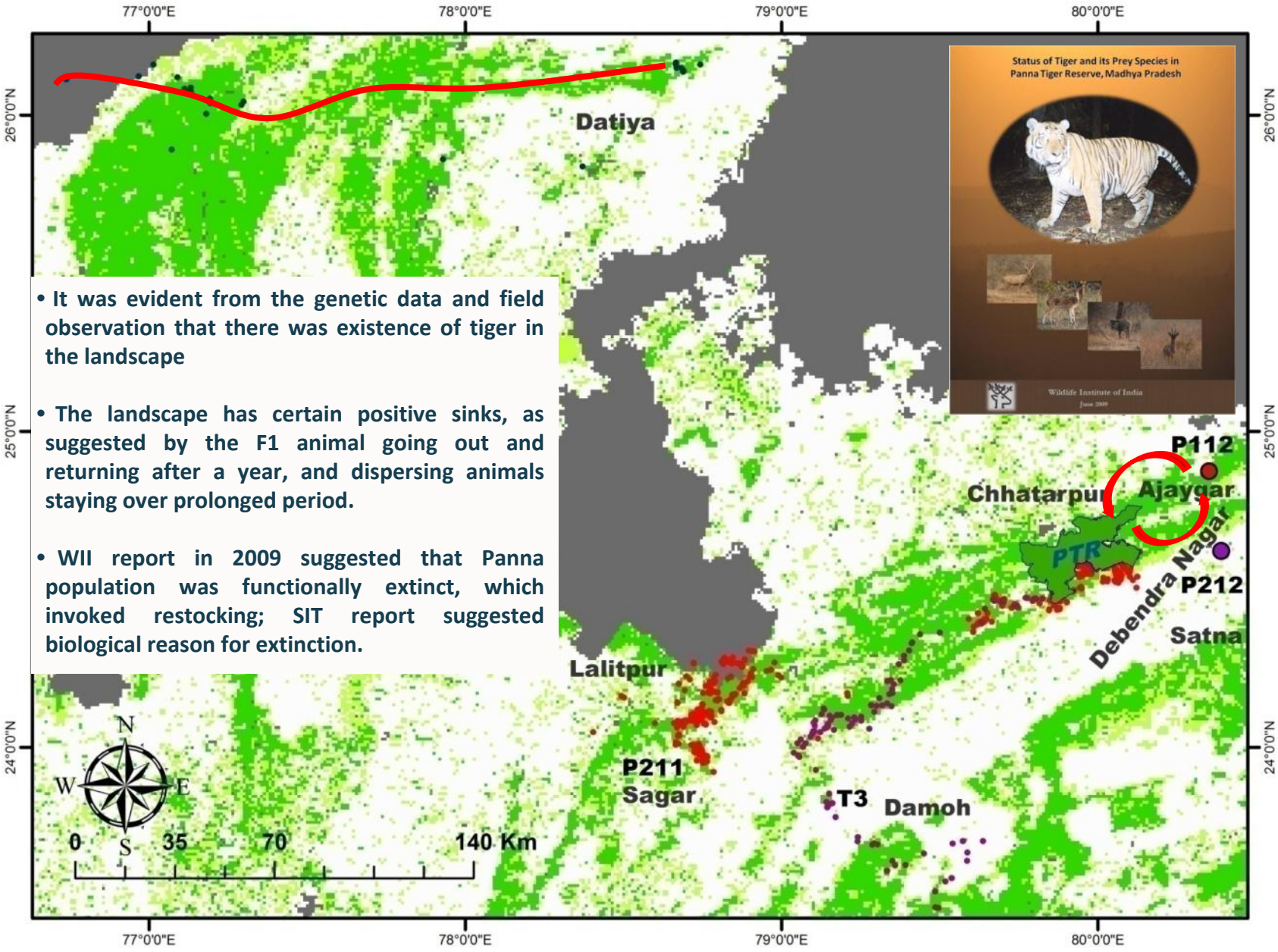
Relatedness

Software Used: GENELAX 6.41



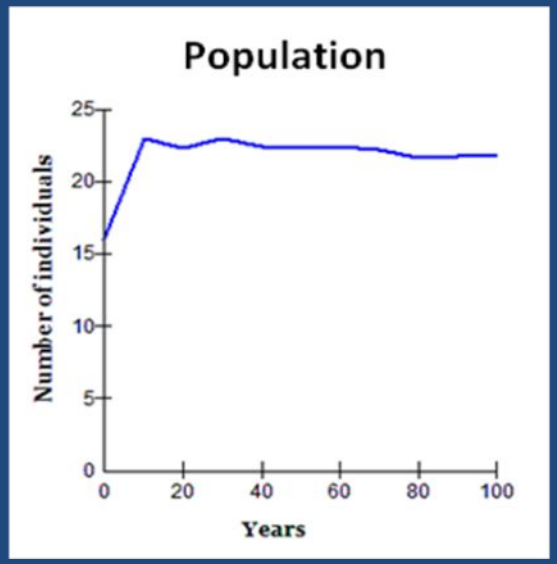
- PCA showed clustering of translocated animals and partial clustering of their offspring with their respective source populations .

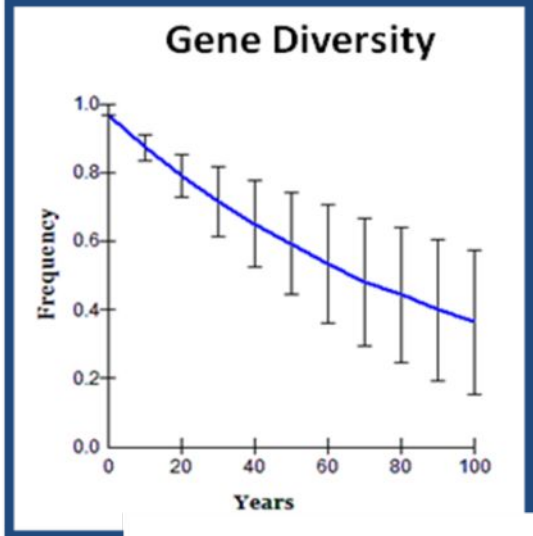
Source-Sink Landscape



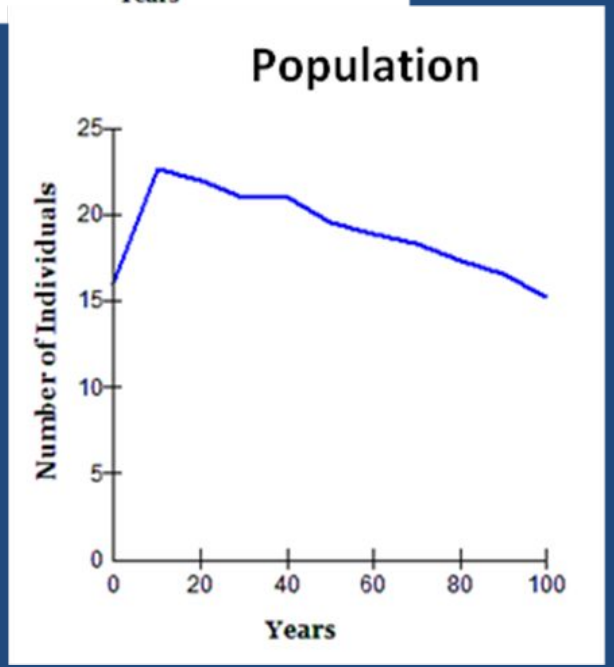
- It was evident from the genetic data and field observation that there was existence of tiger in the landscape
- The landscape has certain positive sinks, as suggested by the F1 animal going out and returning after a year, and dispersing animals staying over prolonged period.
- WII report in 2009 suggested that Panna population was functionally extinct, which invoked restocking; SIT report suggested biological reason for extinction.

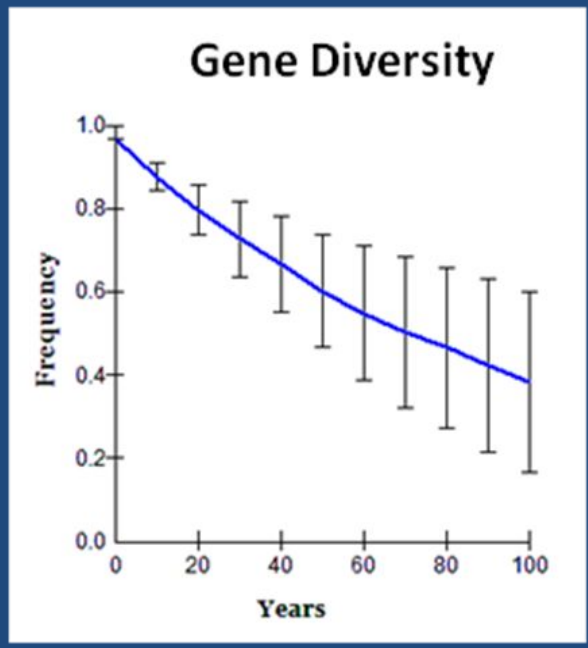
PVA (Current Status)





One Dispersing Male or Death

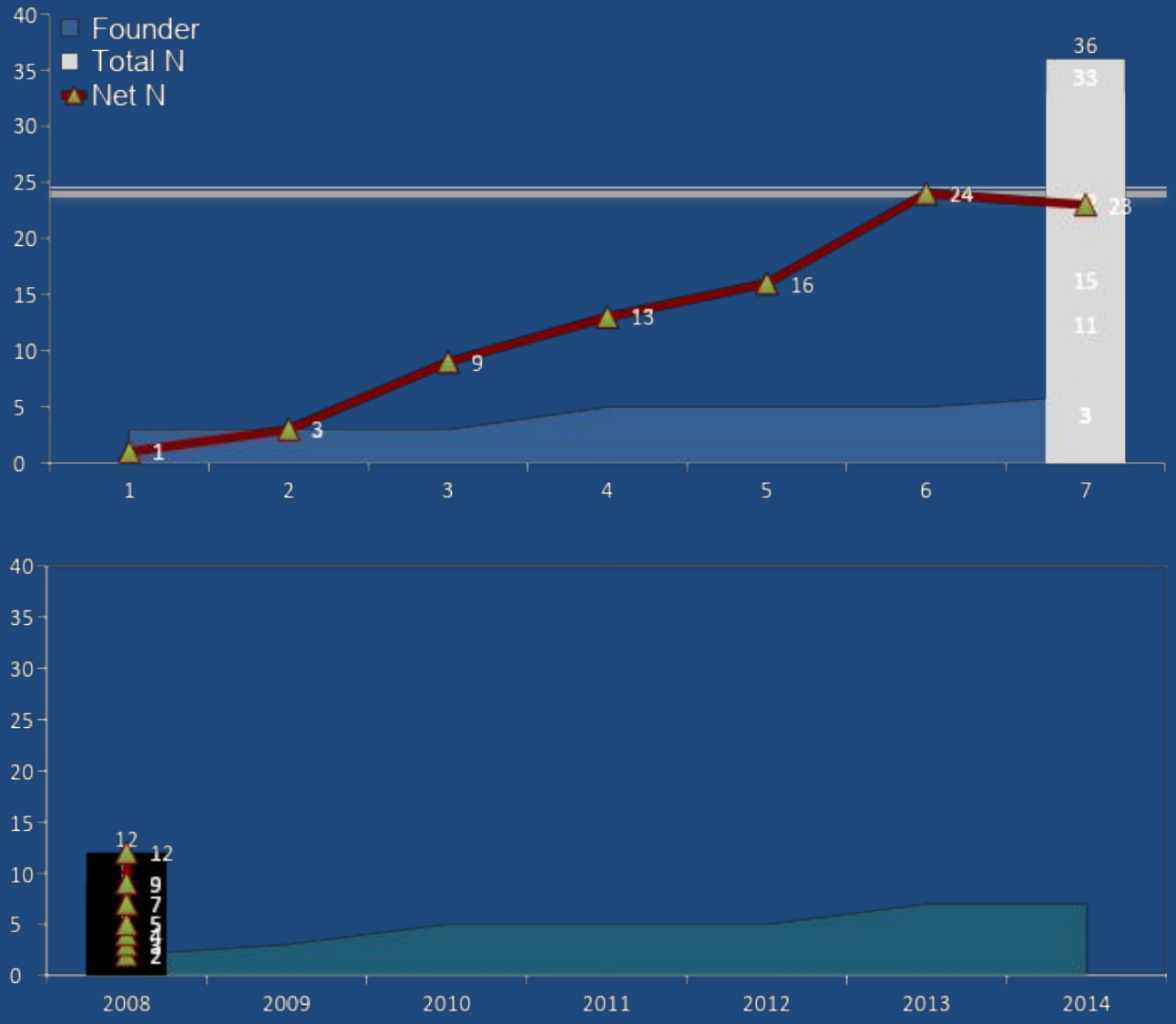




One Dispersing Female or Death

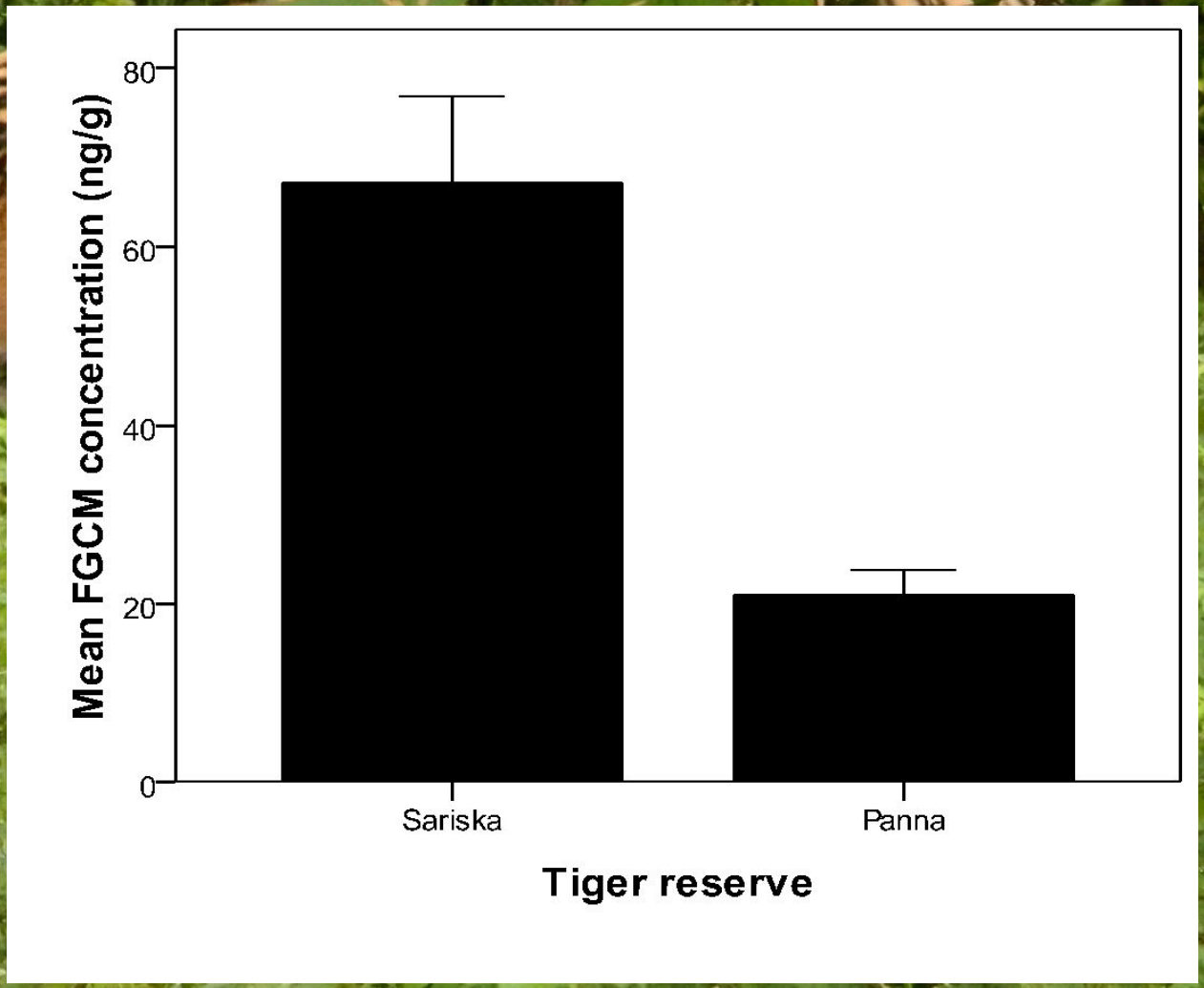
PVAs Are the Basis for Adaptive Management of Wildlife Populations

Population Growth in Panna and Sariska



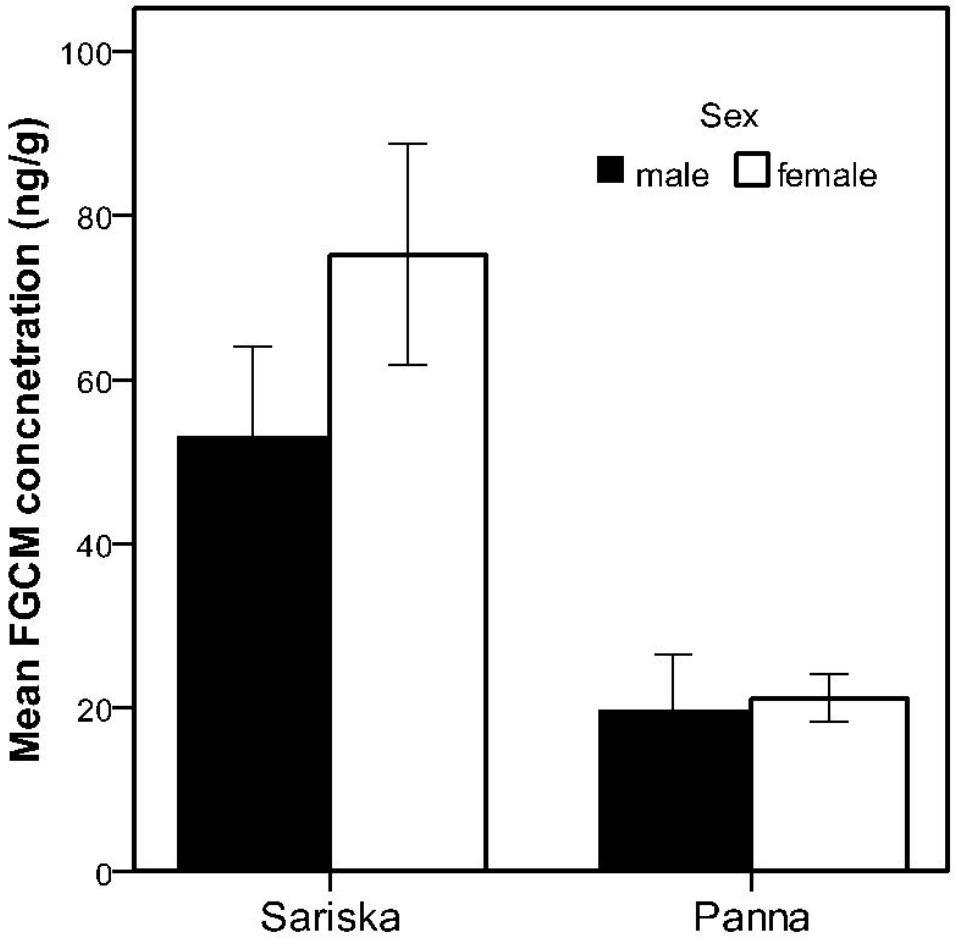
The Big Question…

Glucocorticoid Estimates



Sariska: n ind =6; n samples =202;
Panna : n indi =8; n samples =143 (2012-13)

Glucocorticoid Estimates



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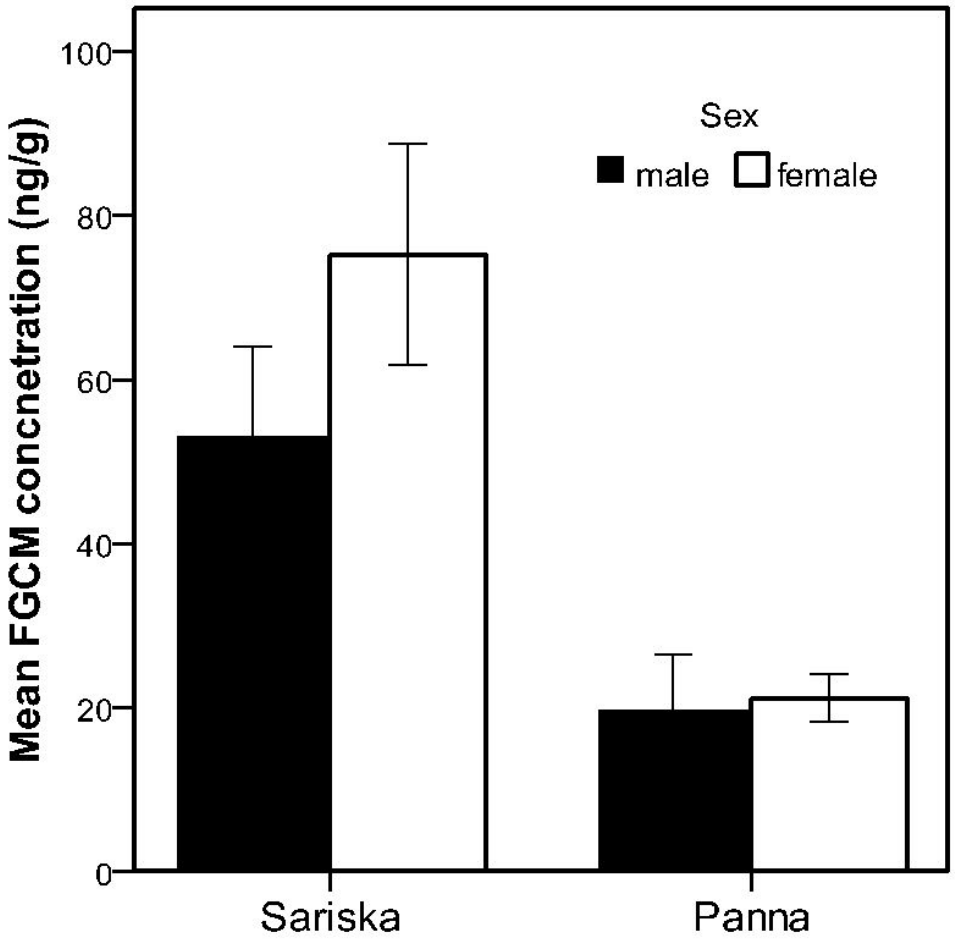
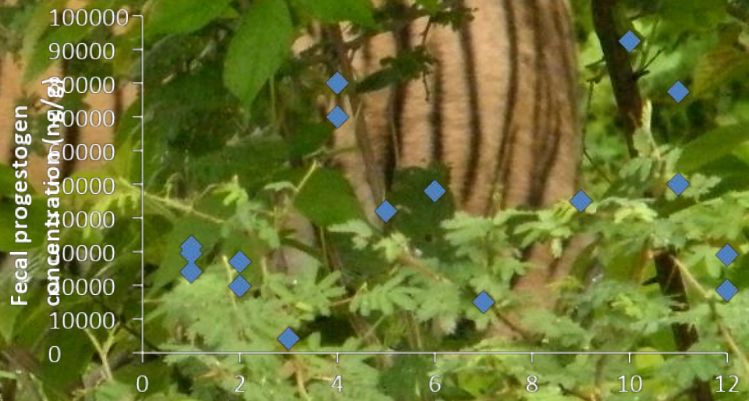
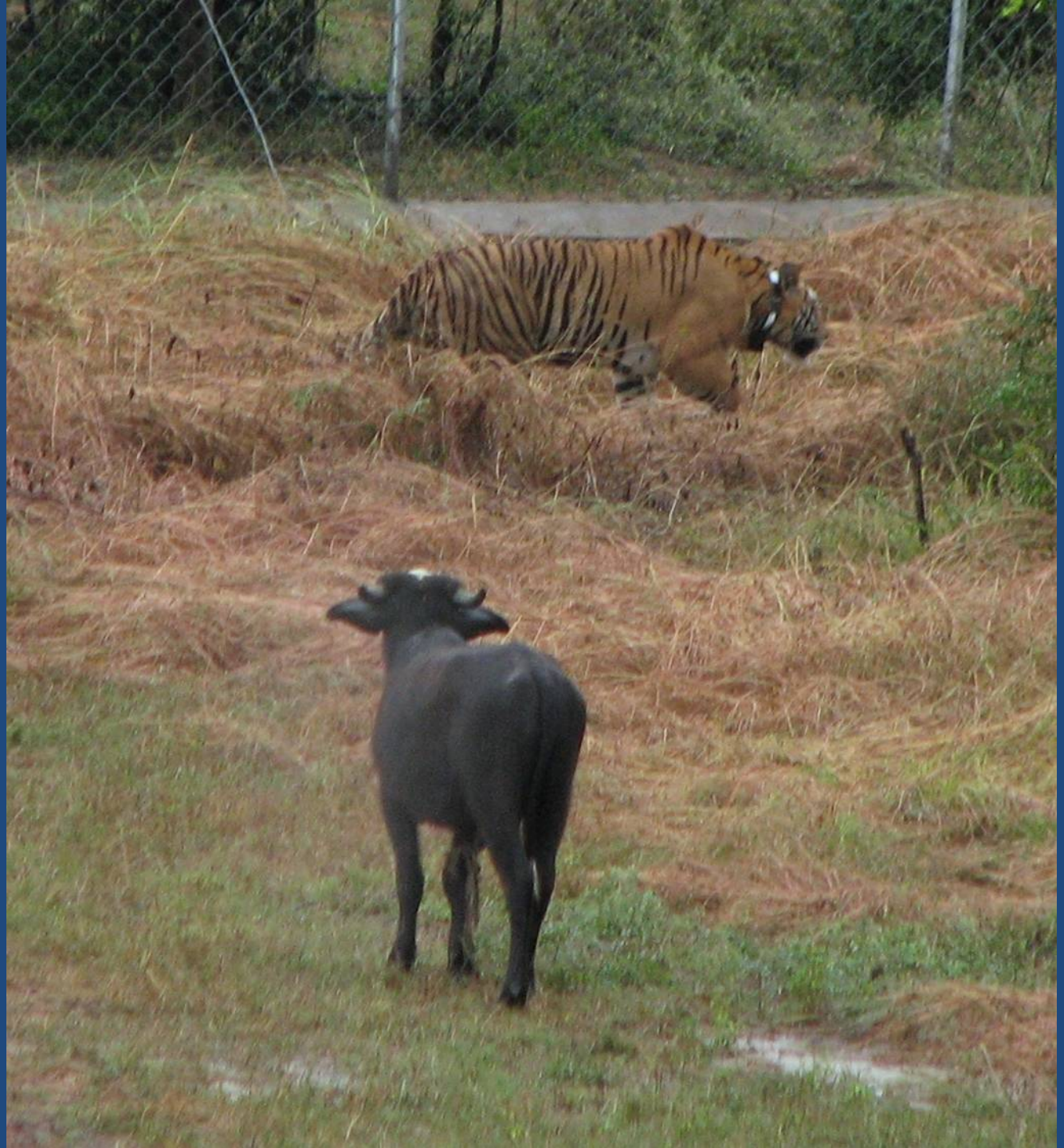


Progesterone Estimates

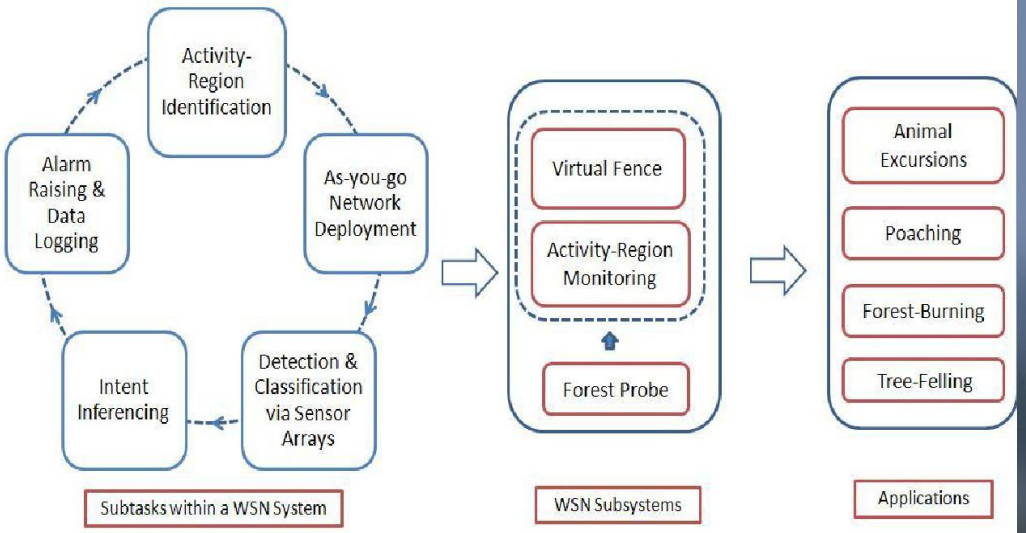


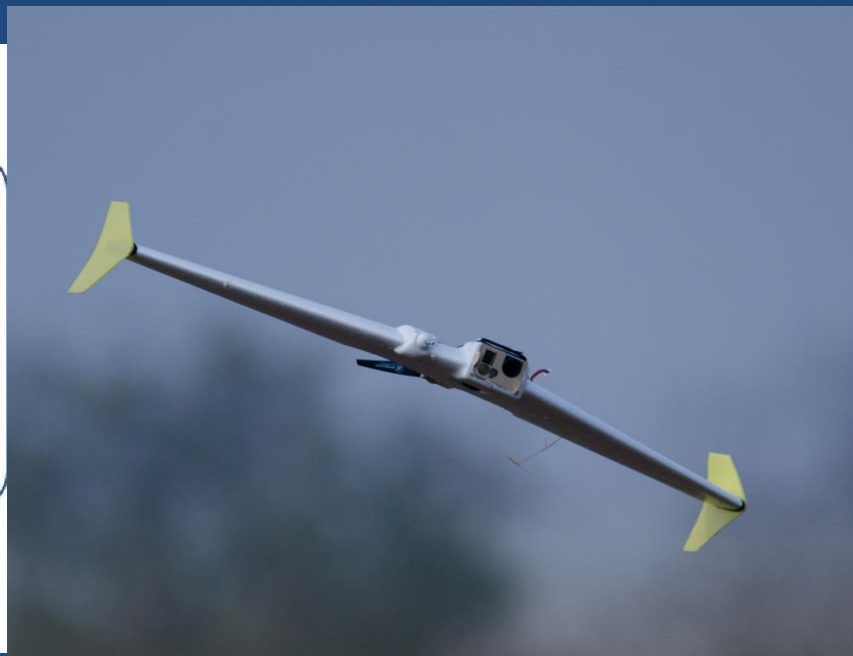
ST-2, ST-3 and ST 5 were found to be fertile and cyclic



Future…

- Individual based monitoring to population level monitoring
- Multidisciplinary research and management outlook
- Integration of advance technologies





Key Points

- **Tiger reintroduction in Panna has been successful, owing to combination of leadership, hard work of field staff, scientific support, proactive and intensive monitoring and resource base.**

- **Ownership and institutionalization of the activities, with scientific innovation and experience based convictions.**

- **Management and scientific lessons are helpful to have relook at available guidelines and protocols. It has been blessing in disguise in terms of science and management.**

- **There is still 'so much' to know about tigers and a good partnership between science and management is unlikely to fail.**