The performance of protected areas in fragmented landscapes

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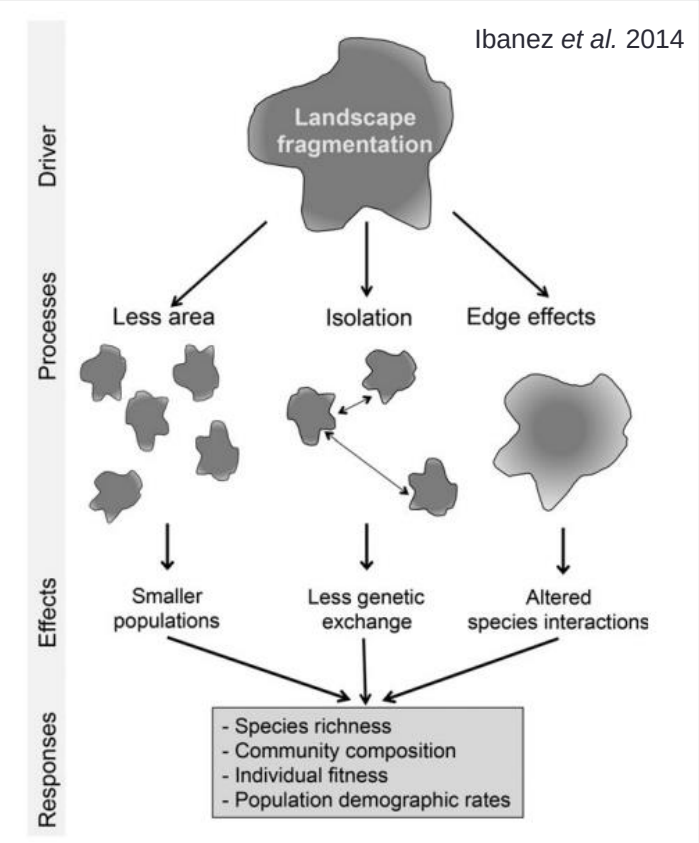
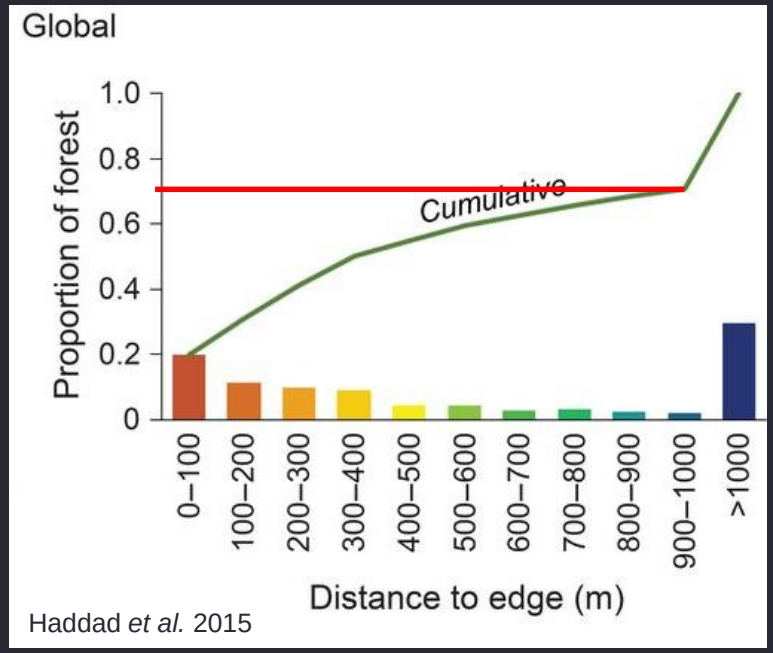
Forest Fragmentation



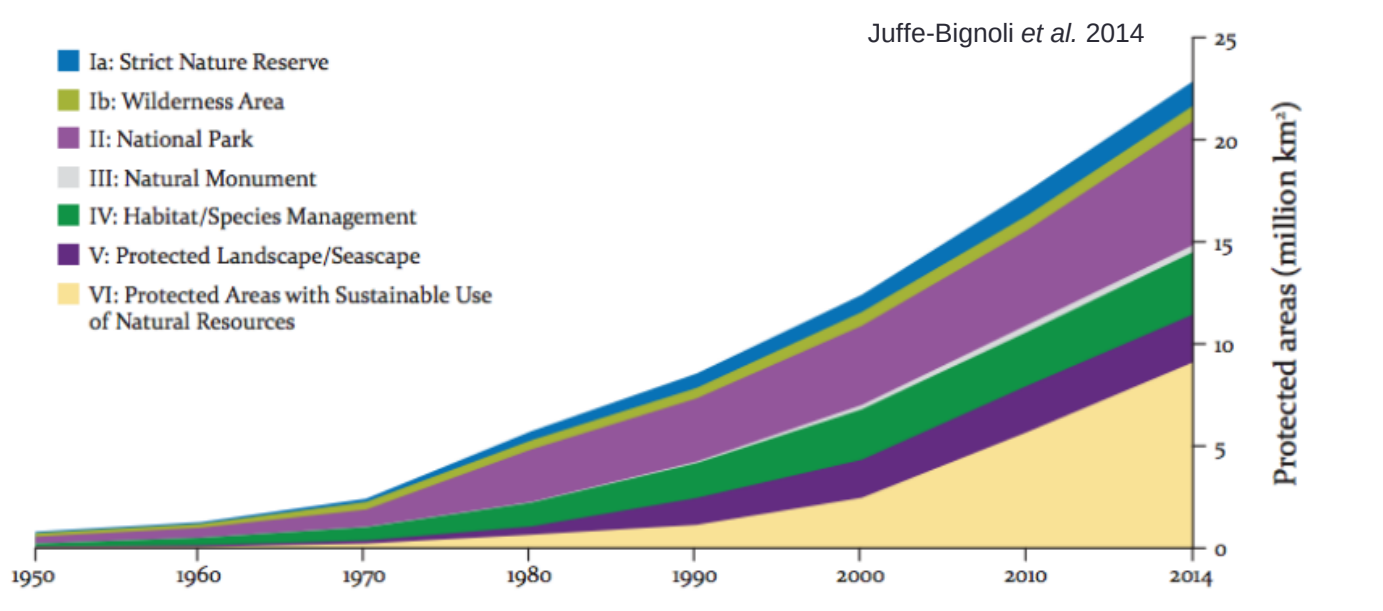


Isolation of PAs

- **Forest loss and degradation result in isolation of protected areas (PAs)** (Hansen & DeFries 2007)

Management Criteria

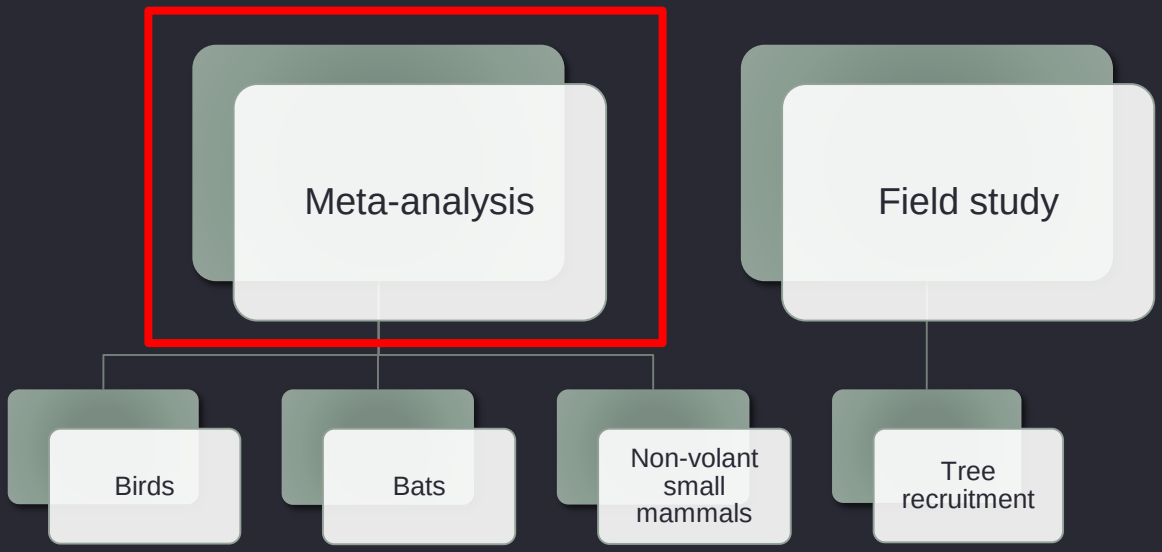
- Majority new PAs under less strict management ("sustainable use areas")



Aim & Approach

How large and how well-protected should forest fragments be to minimize species decline?

Global approach focussed on animals and plants



Meta-analysis Methods

- Species occurrence data from 315 forest fragments (0.1 - >5000 ha)
- 804 bird species, 103 bat species, and 28 non-volant small mammal species

Meta-analysis Methods

Protection type was categorized for each fragment

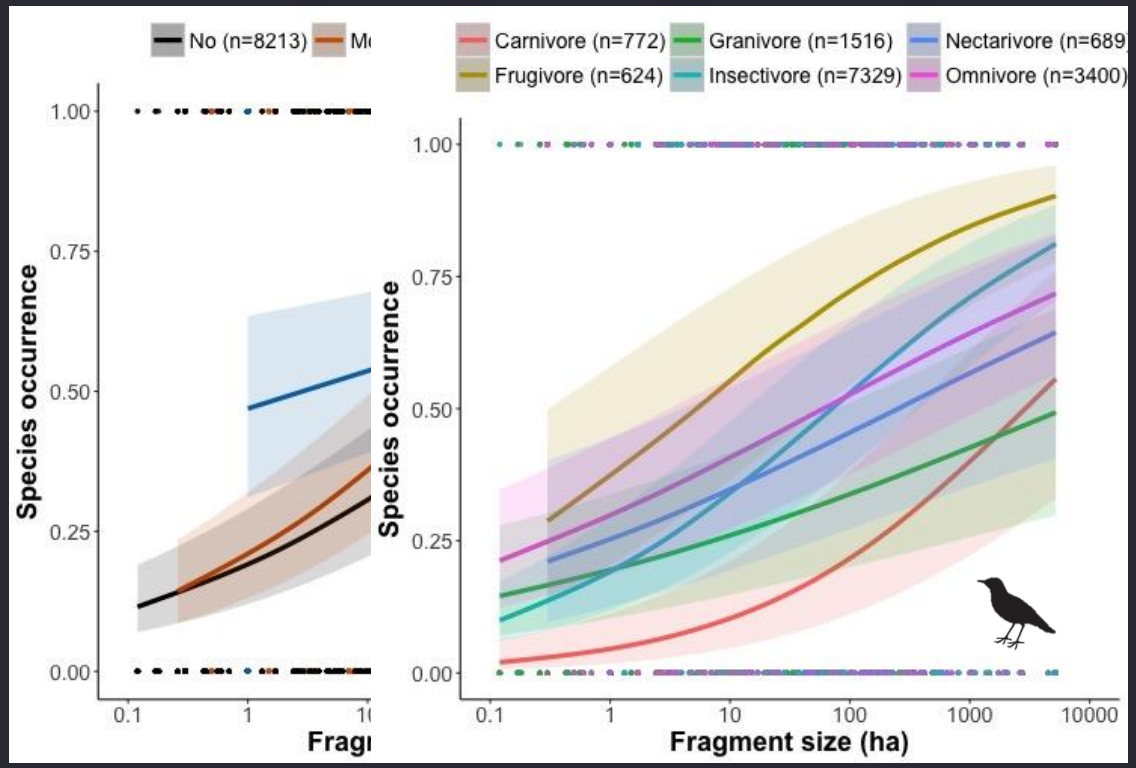
- **Strict**
- **Moderate**
- **No protection**

IUCN Management Categories

Category	Description
Ia	***Strict Nature Reserve***: Protected area managed mainly for science.
Ib	***Wilderness Area***: Protected area managed mainly for wilderness protection.
II	***National Park***: Protected area managed mainly for ecosystem protection and recreation.
III	***Natural Monument***: Protected area managed mainly for conservation of specific natural features.
IV	***Habitat/Species Management Area***: Protected area managed mainly for conservation through management intervention.
V	***Protected Landscape/Seascape***: Protected area managed mainly for landscape/ seascape conservation and recreation.
VI	***Managed Resource Protected Area***: Protected area managed mainly for the sustainable use of natural ecosystems.

Meta-analysis Results

1. All guilds and biomes need to exceed 5000 ha in order to prevent bird species loss
2. Insectivores and carnivores particularly sensitive
2. For fragments <5000 ha strict protection mitigates species decline

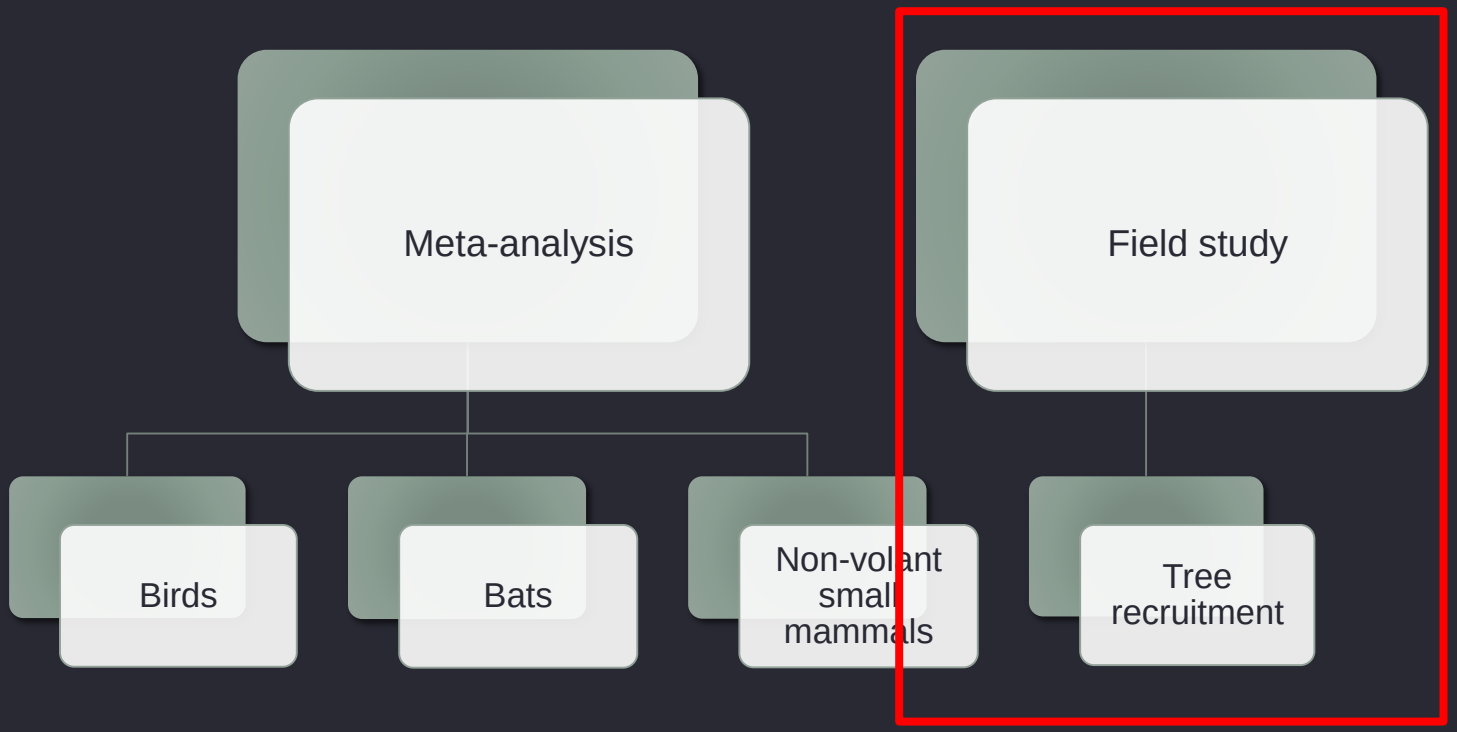


Timmers *et al.* (In prep.)

Meta-analysis Implications

What are the consequences for tree recruitment?

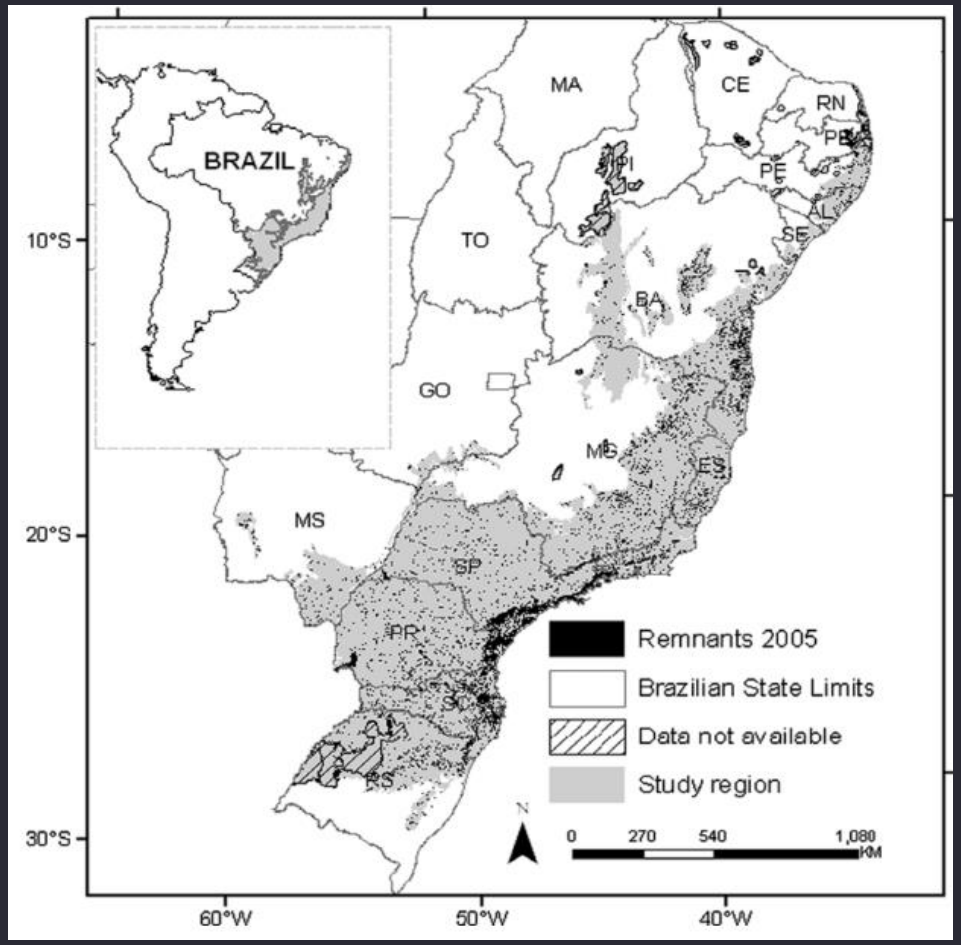
Field Study


Meta-analysis
Birds
Bats
Non-volant small mammals
Field study
Tree recruitment

Field Study Site selection

Atlantic Forest Brazil

- Global biodiversity hotspot
- 70% of the Brazilian population
- 7-16% of original forest remaining
- >200.000 fragments: 80% <50 ha
- Diverse range of management categories (I-VI)
- Extensive dataset on plant-frugivore interactions (Bello *et al.* 2017)
- WWF Priority Area



Field Study Research Questions

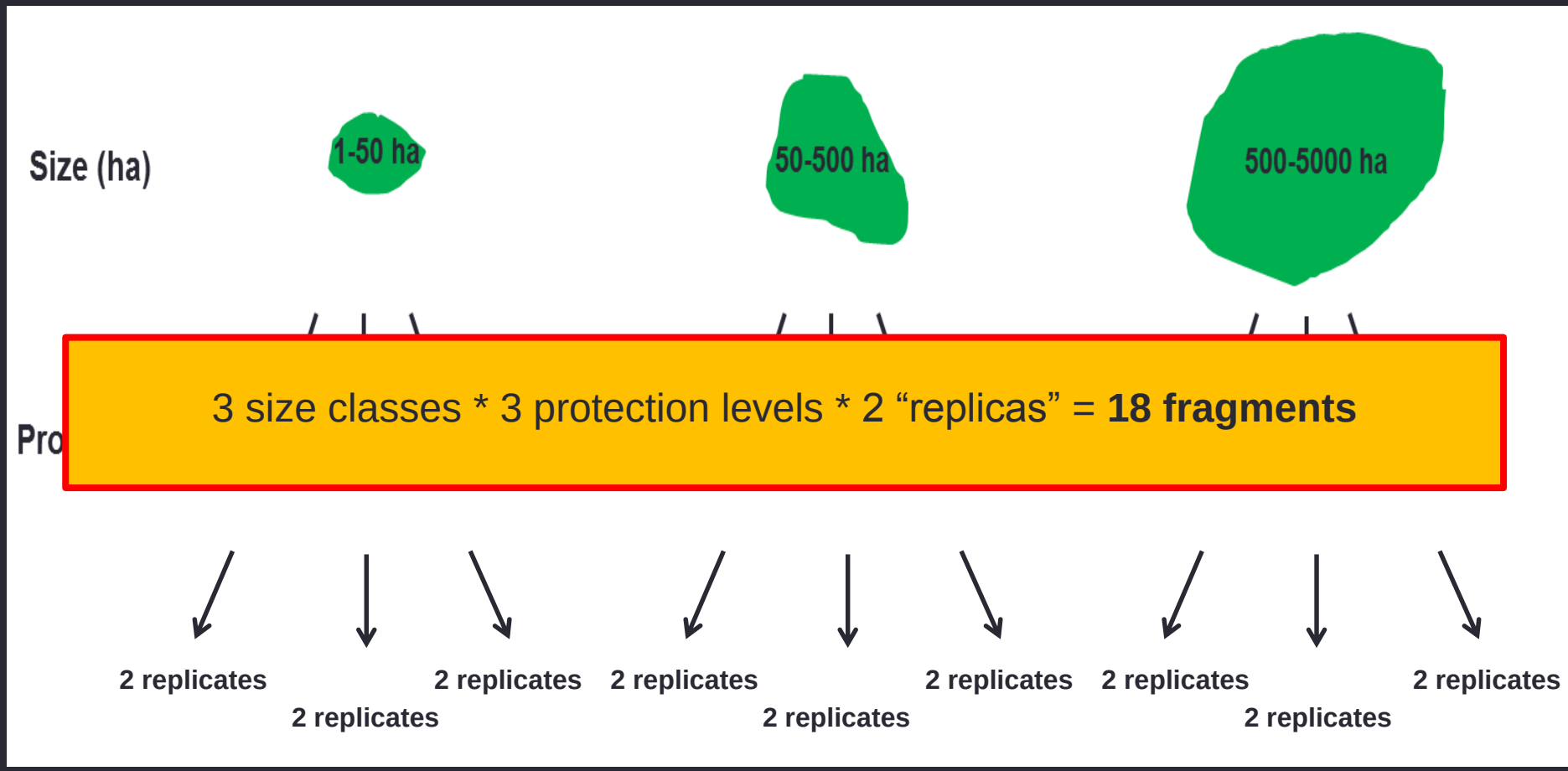
The process

- What is the relationship between forest fragment size and recruitment patterns of forest trees?
- Are these patterns species-specific and which traits are important predictors? (e.g.: dispersal vector, seed size or wood density)?
- Does protection of forest fragments have a positive effect on tree recruitment?

The mechanism

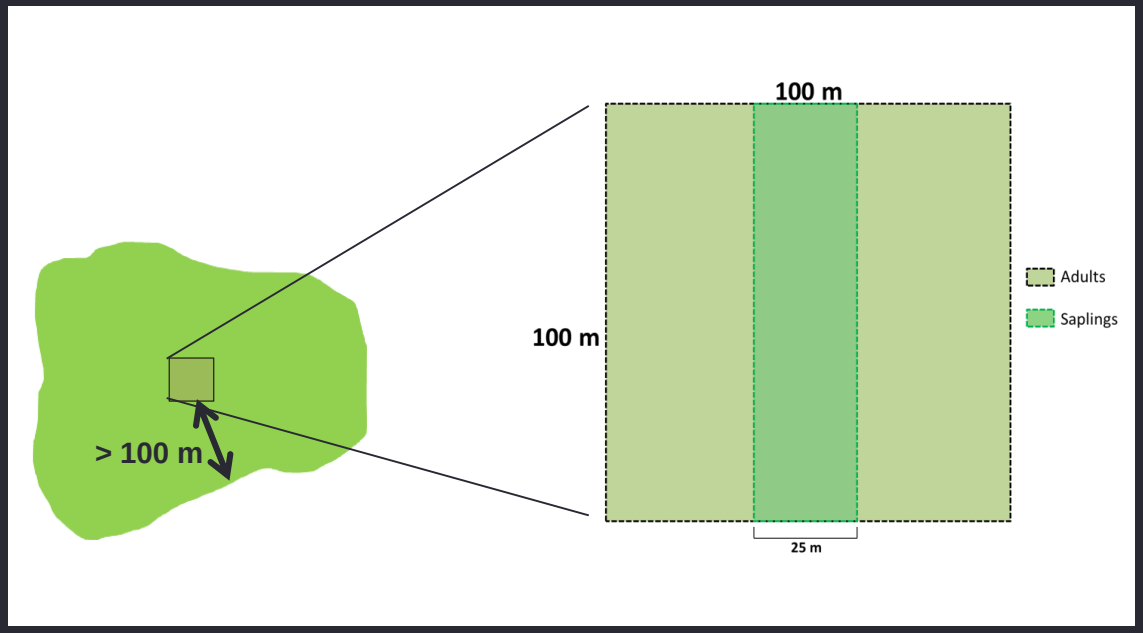
- Do recruitment shifts of animal-dispersed trees reflect changes in plant-frugivore interactions?

Field Study Design



Field Study Plot measurements

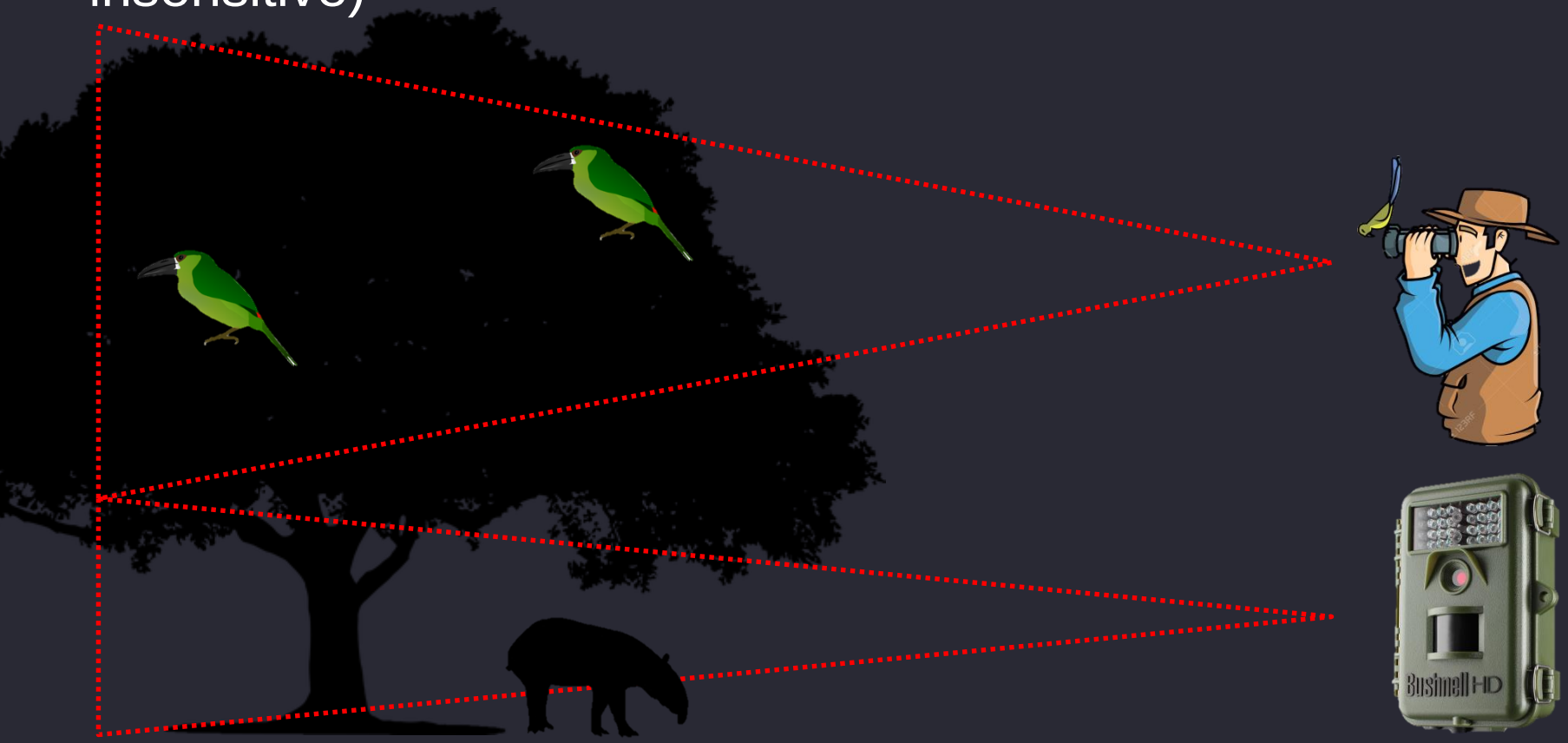
Species richness, eveness and densities of adults (DBH>20cm) and saplings (h>130 cm and <5cm DBH)



Additional fragment measurements	
Latitude/ longitude	Disturbance history
Forest type	Remoteness
Isolation	Fragment age
Surrounding land use	Soil type
Slope	Elevation

Field Study Plant-frugivore interactions

Measure **visitation rates** and **fruit removal** for selected animal-dispersed tree species (fragment sensitive *vs* insensitive)



Field Study Relevance

- Understand the combined effects of fragment size and protection on tree recruitment (and plant-frugivore interactions)
- Improve knowledge on PA management effectiveness
- Provide scientific basis for decisions on forest fragment management and conservation, including establishment of guidelines on minimum fragment size and optimal levels of protection.

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