

Habitat fragmentation disrupts ecosystem processes, with implications for restoration.

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Habitat Fragmentation and Loss



Declining

Diporiphora nobbi



Declining

Ctenotus schomburgkii



Declining

Simoselaps australis



Locally Extinct

Pygopus nigriceps



Locally Extinct *Ctenophorus pictus*



Proportion Declining	Taxon	Reference
26%	Reptiles	Driscoll (2004) Ecol. Applics.
27%	Birds	Saunders (1989) Biol. Conserv.
31%	Birds	Chamberlain et al. (2000) J. Appl. Ecol.
33%	Mammals	Nupp & Swihart (2000) J. Mammol.
19%	Mammals	Rosenblatt et al. (1999) Am. Midl. Nat.
21%	Beetles	Driscoll and Weir (2005) Cons Biol.
26%	Dung and Carrion Beetles	Klein (1989) Ecology
5%	Carabid Beetles	Halme and Niemela (1993) Ann. Zool. Fenn.
38% from 1 ha fragments 10% 100 ha fragments	Beetles	Didham et al. (1998) Ecol. Monogr.

Ecosystem Restoration

E.G. Gondwana link

'Reconnected country across south-western Australia.... in which ecosystem function and biodiversity are restored and maintained'



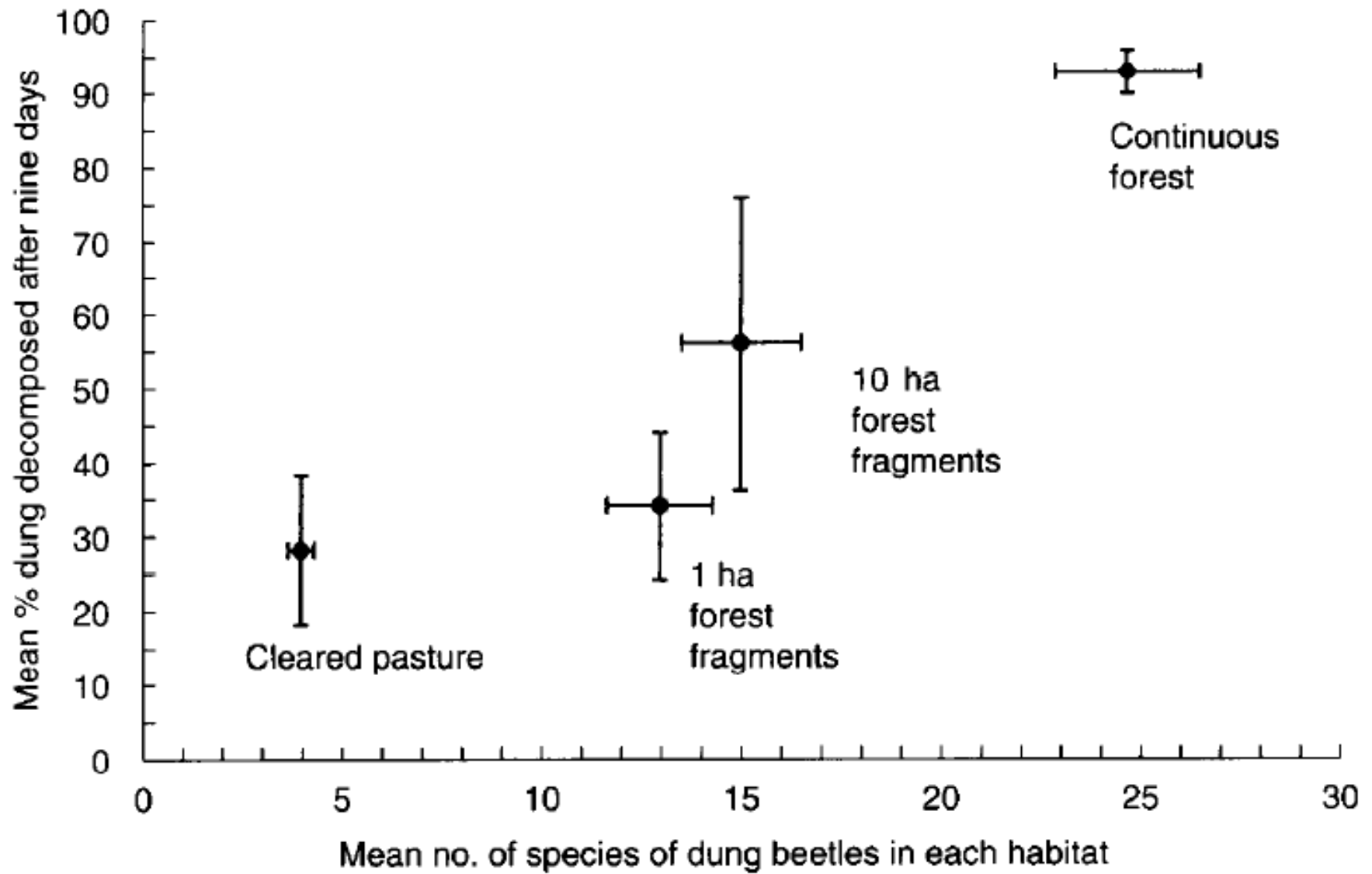
Ecosystem Processes

- Dig

- Eat



- Poo



Didham et al TREE 1996, after Klein Ecology 1989

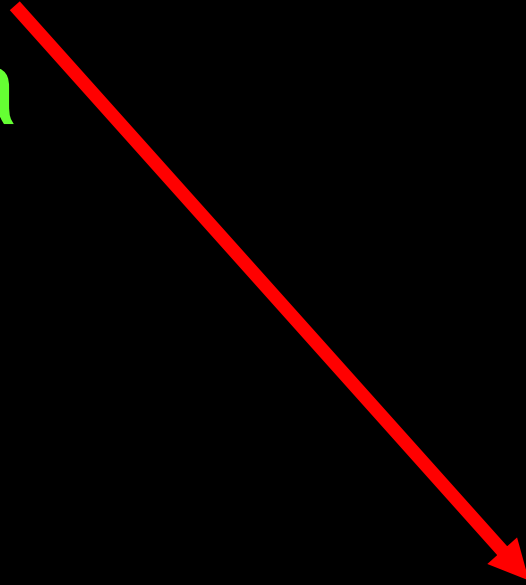
Above and below ground impacts of terrestrial mammals and birds in a tropical forest

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Oikos 117: 571-579, 2008

Ivory Coast
West Africa



Habitat fragmentation

Ivory Coast, West Africa

A photograph of a dense tropical forest with tall trees and a thick canopy. The forest is lush green and appears to be a primary forest. The text is overlaid on the top and bottom of the image.

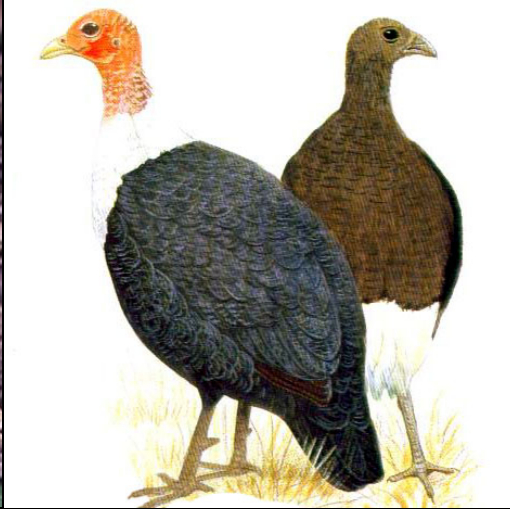
The palm oil company PALM-CI has just begun destroying this 6,000 hectare forest to convert it to oil palm plantations (to supply Unilever)

If the forest is destroyed, three primate species as well as many plant species will almost certainly become globally extinct.

Insectivorous birds and mammals decline after fragmentation



Buff-spotted fluff tail



White breasted Guinea-fowl



Latham's Francolin



Cusimanse Mongoose



Liberian Mongoose



White Toothed Shrew

Methods

- Tai" National Park
- Seven Sites (based on pilot study)
- Each with control and caged plot (3 x 3m)

- Measured macro and micro invertebrates before caging: treatments the same

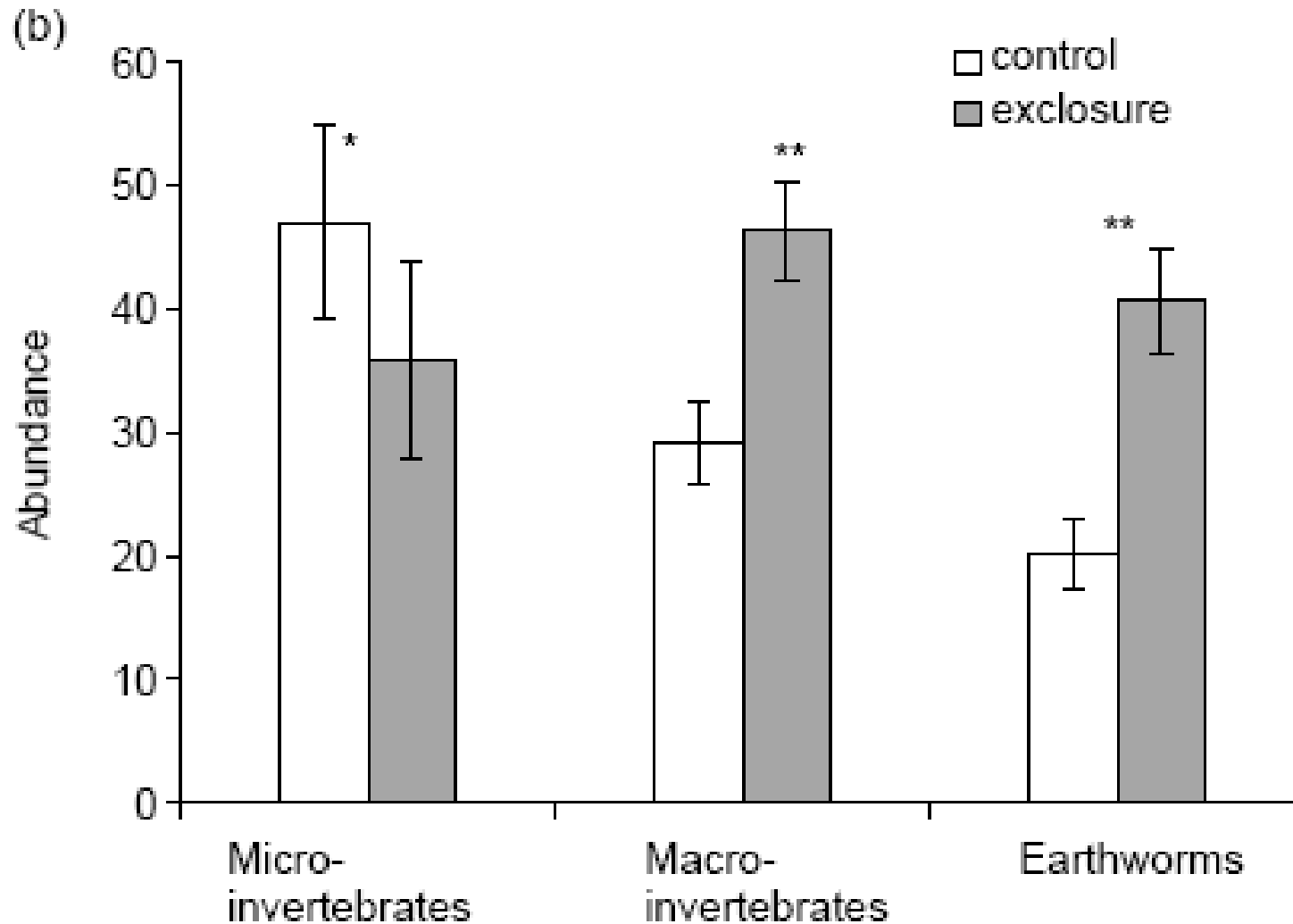


Measured (mostly after nine months):

- Macro-invertebrates (>5mm)
- Micro-invertebrates
- Earthworms
- Herbivory
- Litter consumption (NS)
- Nutrient Cycling

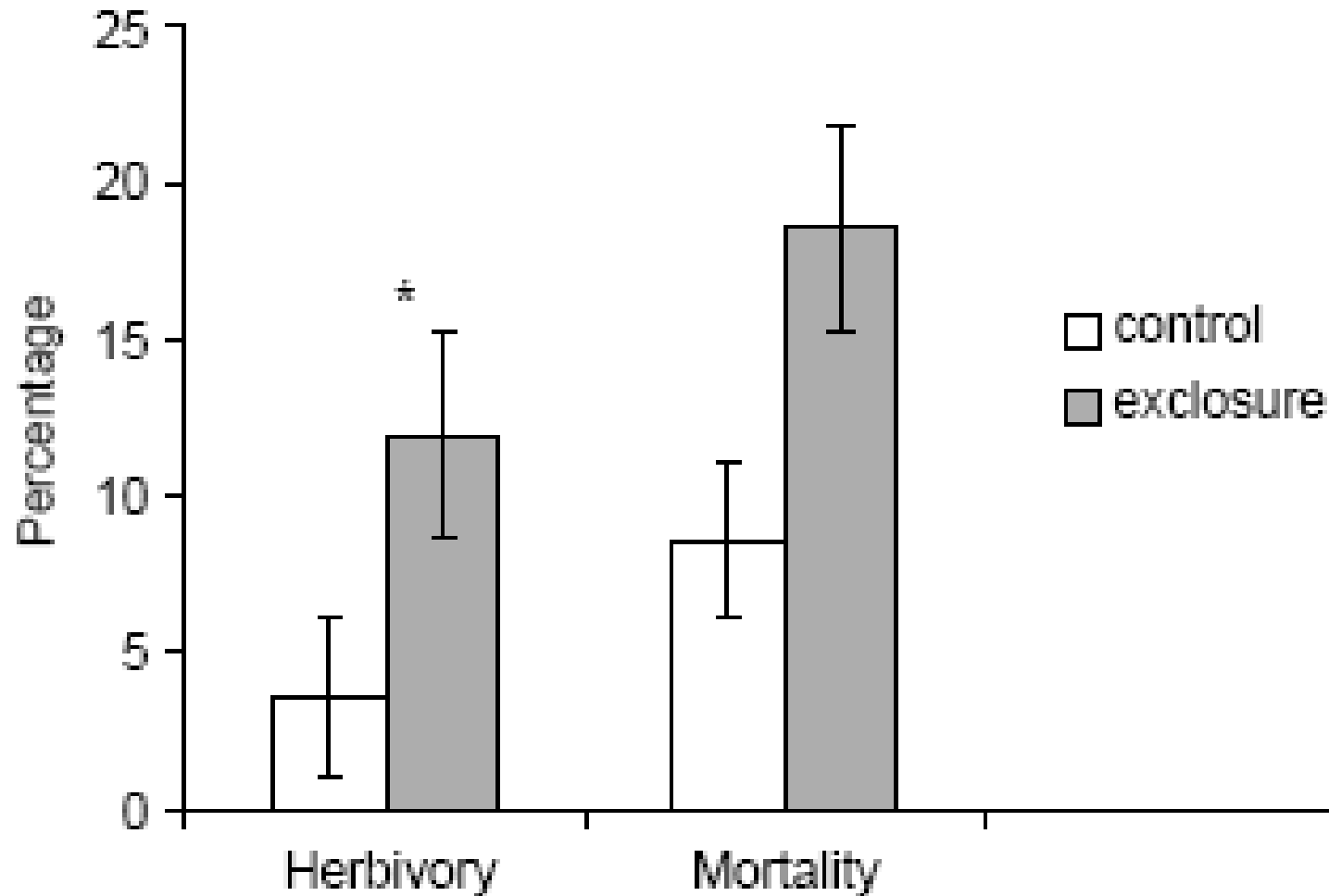


Invertebrate responses

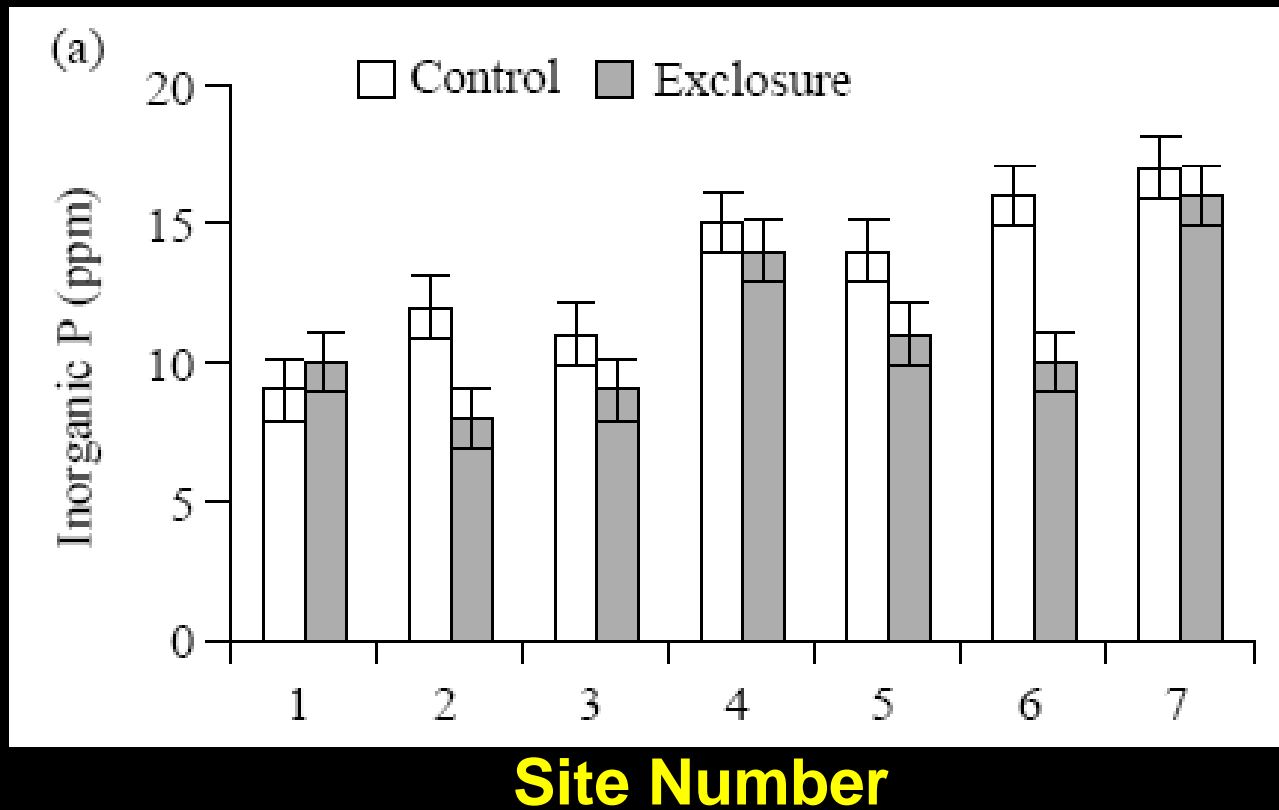


Error Bars = SE, * $P < 0.05$, ** $P < 0.01$

Herbivory



Phosphorus availability



Available Phosphorus 20% lower in exclosures

Path Analysis

Insectivore presence

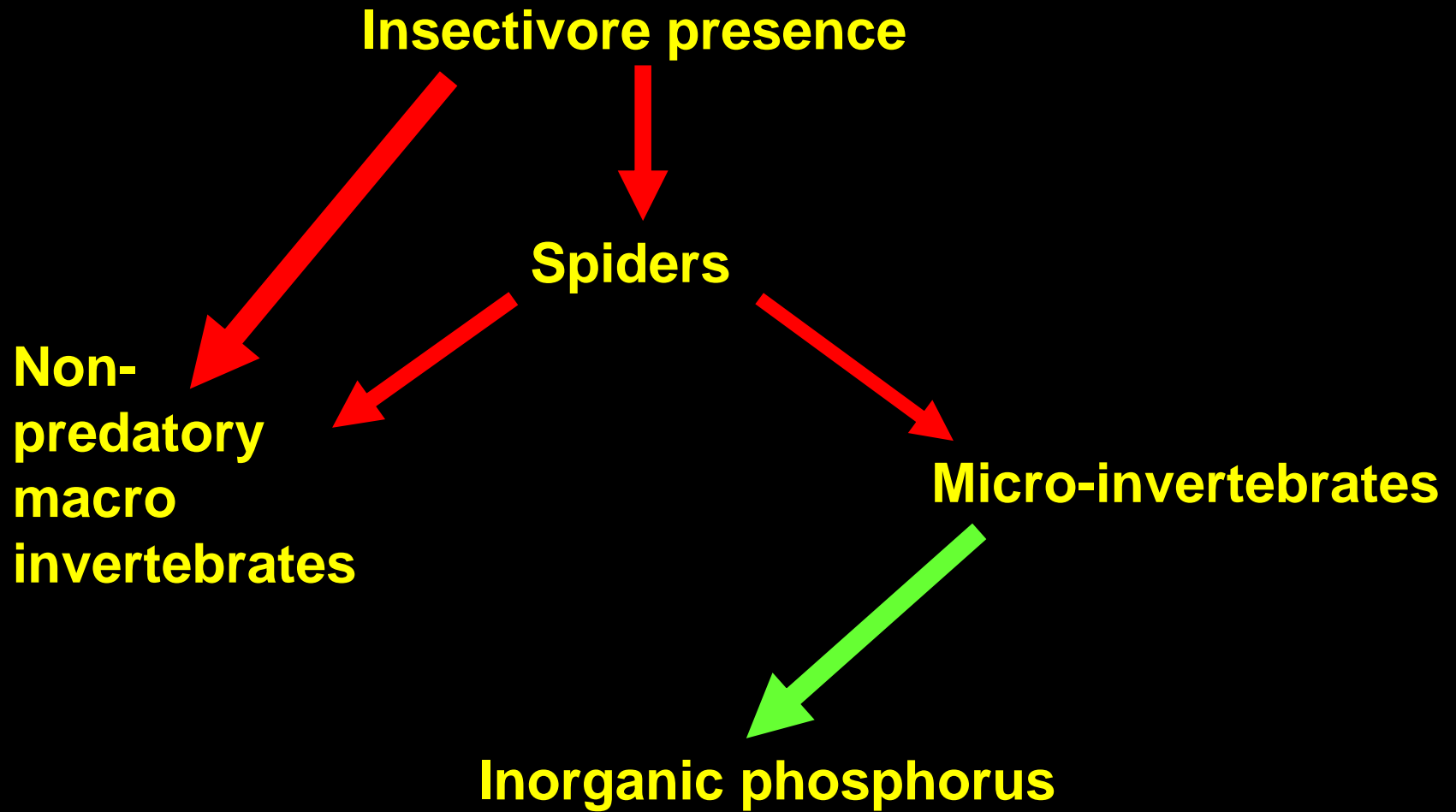
Spiders

**Non-
predatory
macro
invertebrates**

Micro-invertebrates

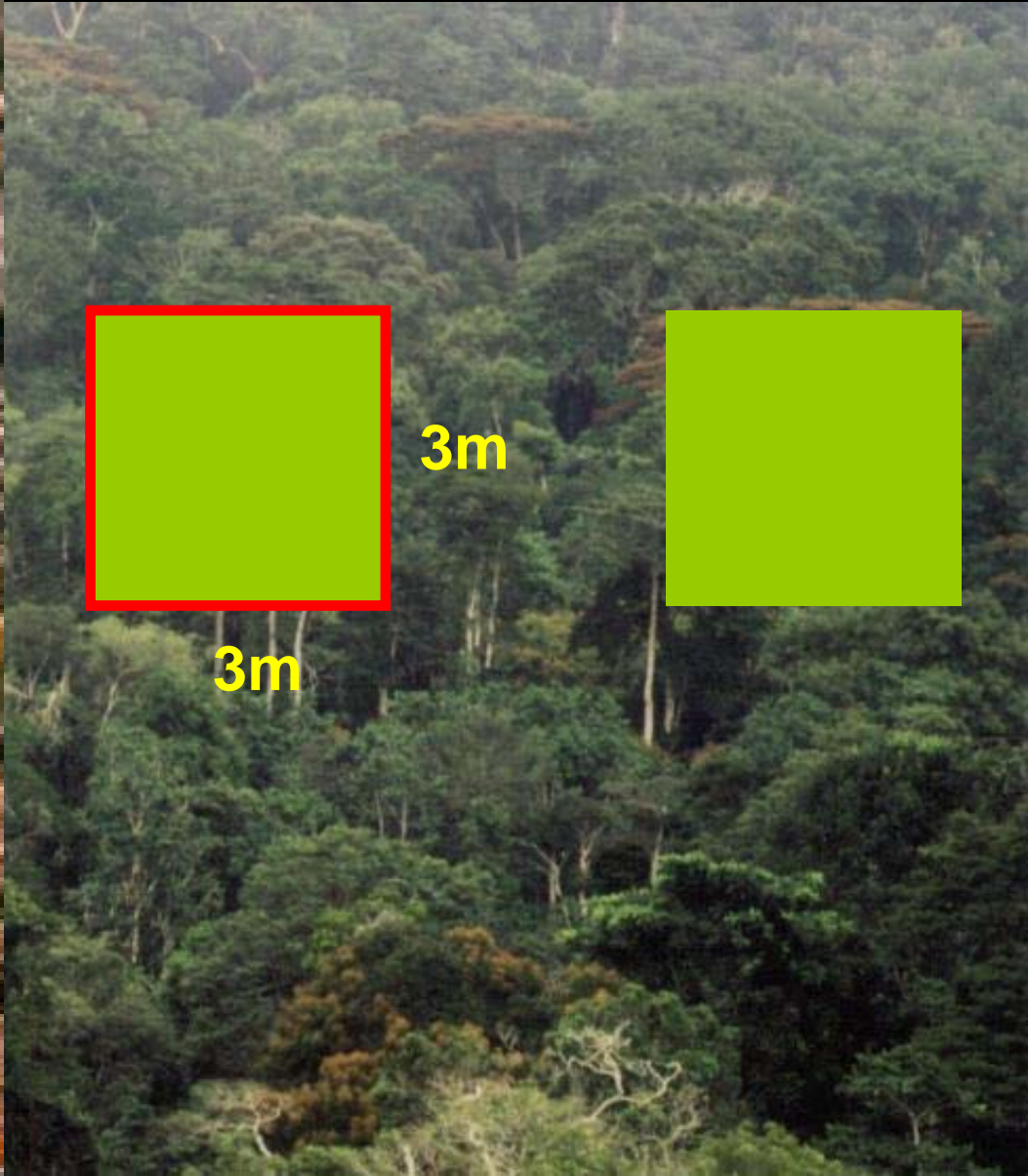
Inorganic phosphorus

Path Analysis



 **Negative impact**
 **Positive impact**

Caveat



Revegetation worst case scenario

- **High herbivory exterminates many species**
- **Some species fail to thrive due to low nutrients**
- **Revegetation remains in degraded state, unsuitable for vertebrate insectivores**

Future

- need to discover which species are missing from fragmented landscapes and plantings
- need to know how strongly those species interact with other species
- need to attempt to restore strongly interacting species to reduce impacts of habitat loss, and for restoration to be successful.

What's Important?

- Intellectually stimulating questions (food webs, redundancy) in an applied context
- Neat small-scale, tractable experiments provide clues as to what might happen in the system being modelled (but you also need to study the real thing).

Large messy tackle



Elephant shrew



Buff spotted fluff tail

Thanks to Amy Dunham for the photographs

- Ecological concepts
 - Redundancy/Resilience
 - Thresholds
 - Fragmentation
 - Food webs
 - Ecological processes
 - Restoration
- Science and Philosophy
 - Models vs real ecosystems
 - Advocacy
 - Interesting and important
 - Global issues vs national focus