

Biodiversity & Ecosystem Function in Tropical Agriculture (BEFTA): towards more biofriendly oil palm

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**Biodiversity &
Ecosystem
Function in
Tropical
Agriculture**



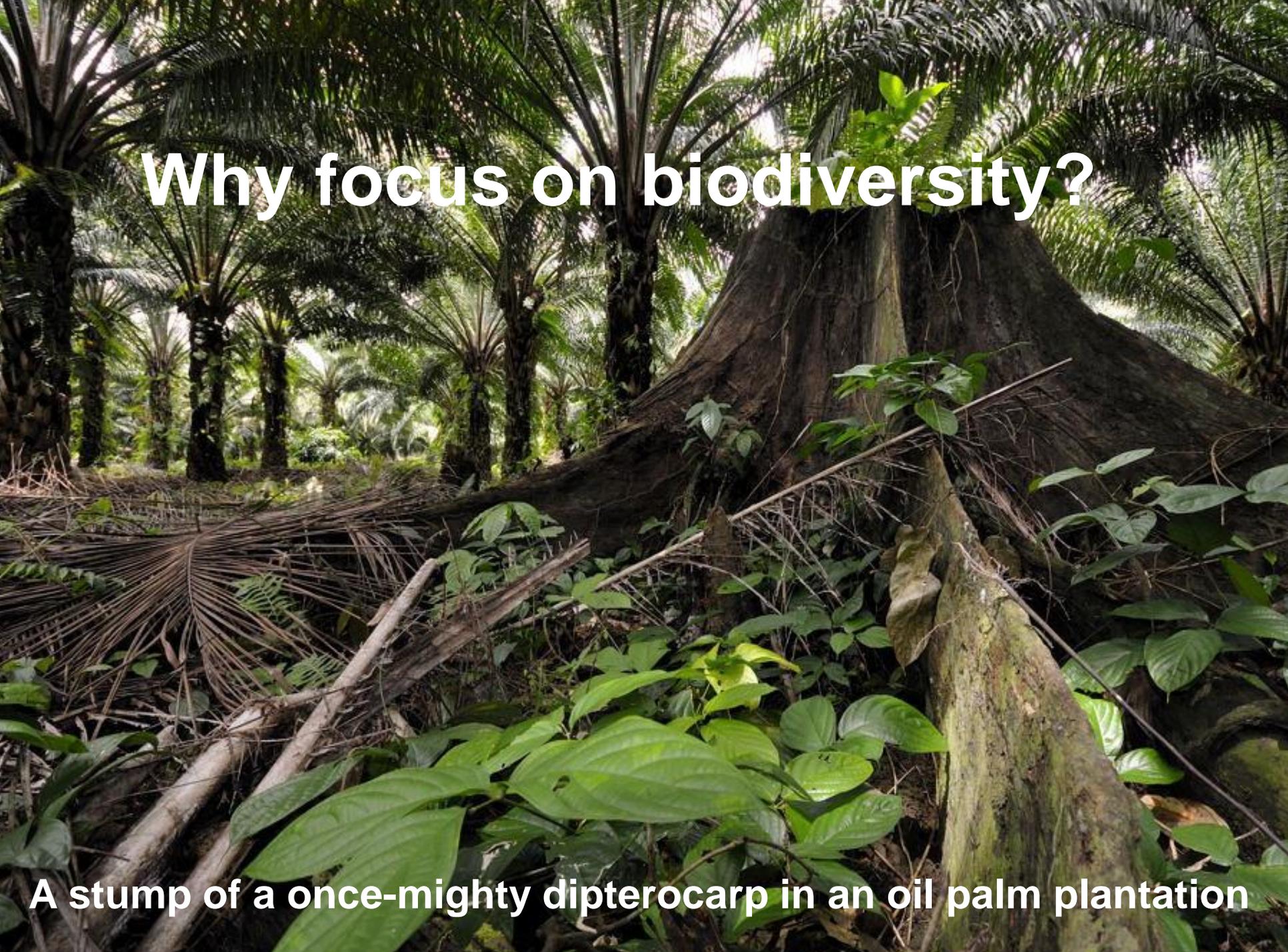
towards more biofriendly oil palm

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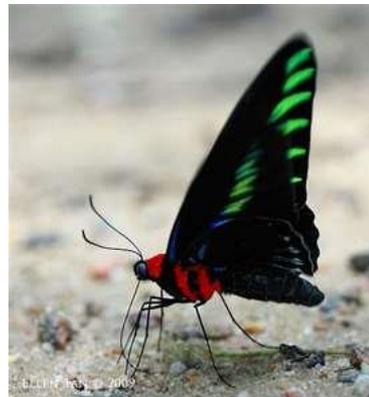


Why focus on biodiversity?

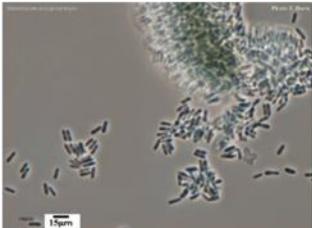
A photograph of a tropical forest. In the foreground, a large, hollowed-out tree stump of a dipterocarp tree is visible, surrounded by dense green vegetation and fallen branches. In the background, a plantation of oil palm trees is visible, with their characteristic fan-shaped fronds and straight trunks. The scene is brightly lit, suggesting a sunny day.

A stump of a once-mighty dipterocarp in an oil palm plantation

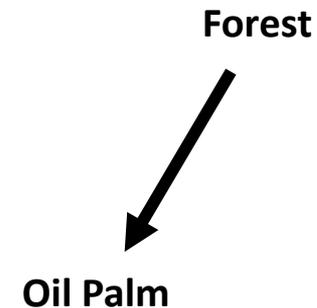
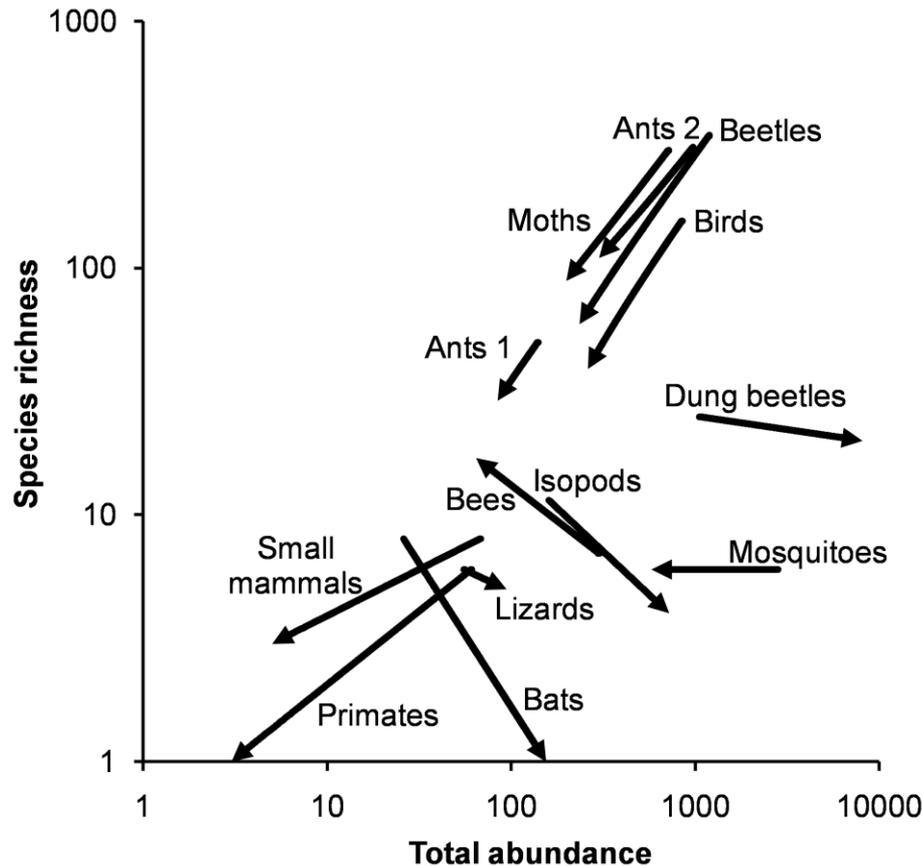
High Conservation Value Biodiversity



Useful Biodiversity



Effects on species richness and abundance of forest conversion to oil palm

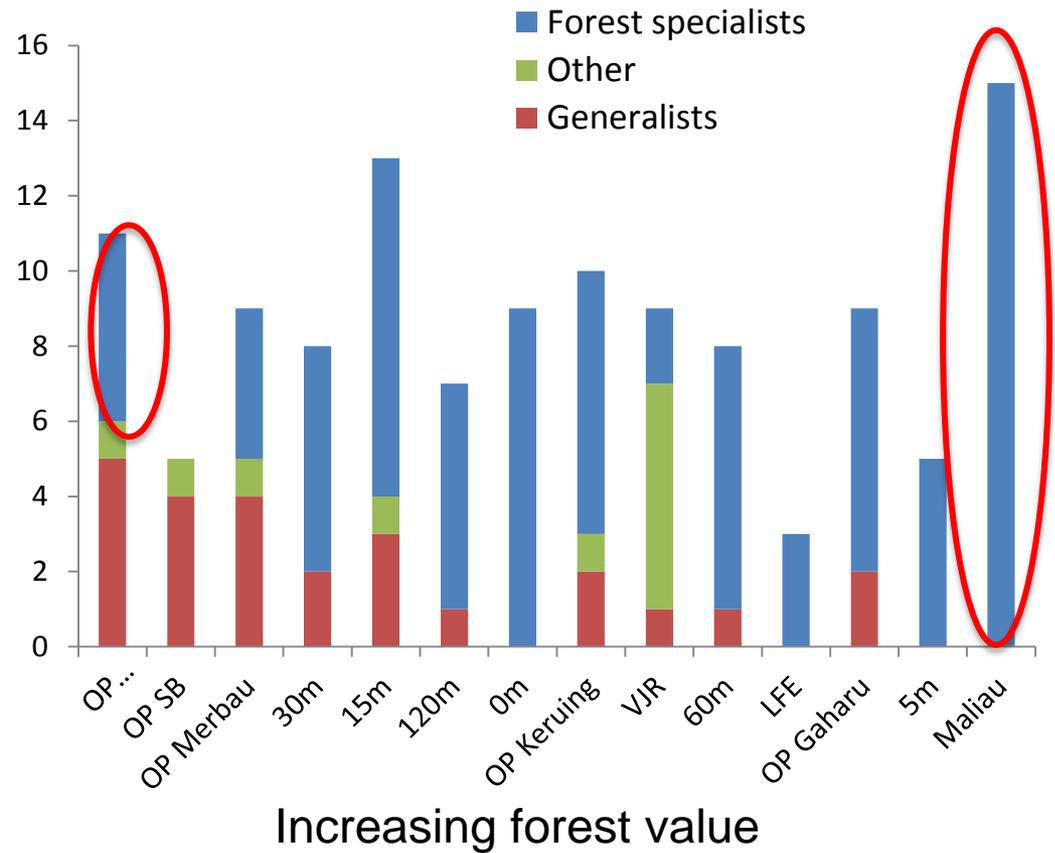


Even if species richness is conserved in oil palm, the species may be of lower conservation value

Dragonflies in Sabah Forests



No. of species



Oil palm



forest

Biodiversity in the oil palm landscape

High conservation value species



Big organisms: large range.

Large areas of forest needed

High-yielding nature of oil-palm makes this possible

Useful species



Small animals (insects etc)

Vital to **sustain ecosystem functions** in the crop



A collaborative research project between



and



A large-scale experimental study of the relationship between:

- habitat complexity
- biodiversity
- ecosystem function
- ecosystem service (yield)

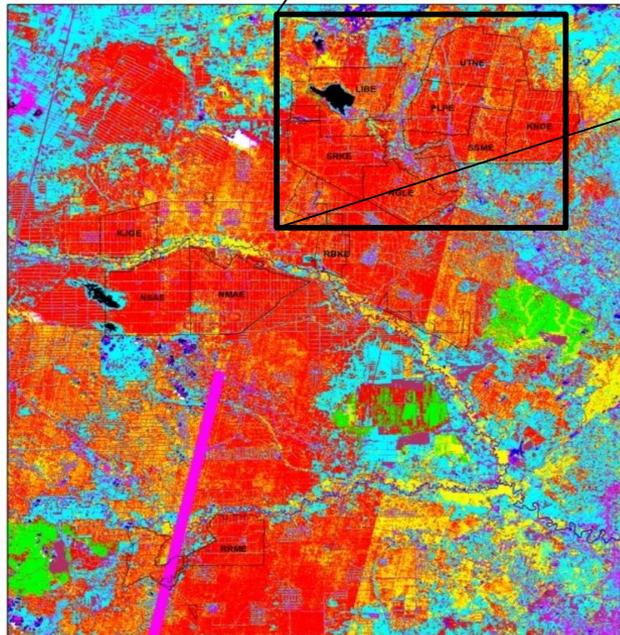
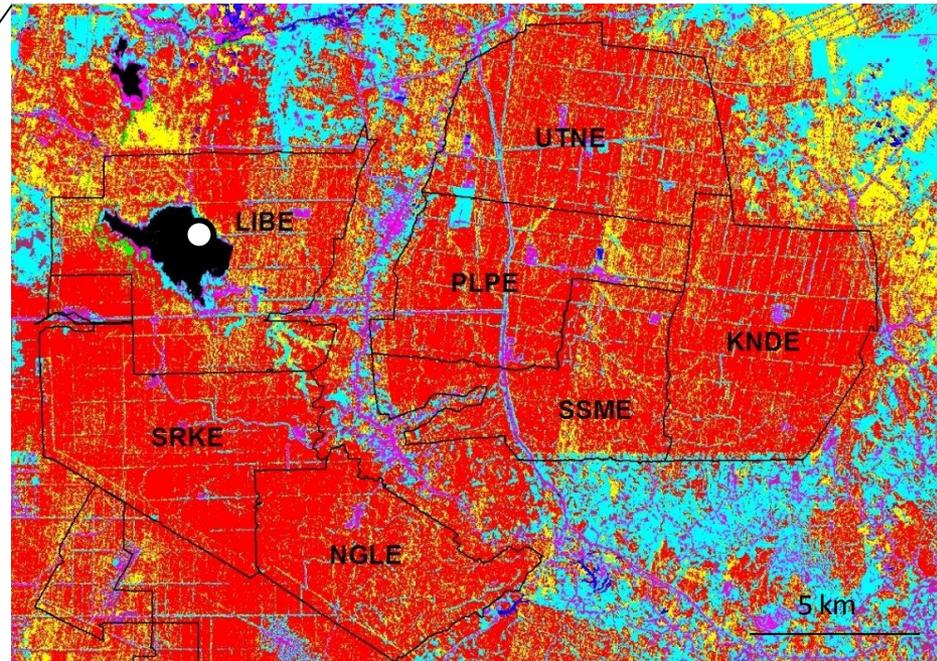
in the oil palm landscape



Questions

1. What levels of diversity can oil palm plantations support?
2. Can we show that habitat complexity enhances biodiversity and ecosystem function?
3. Can we show that this enhanced ecosystem function increases yield?

Location of BEFTA



- 1 Waterbodies
- 2 Palm
- 3 Secondary forest
- 4 Disturbed forest
- 5 Shrub
- 6 Built area
- 7 Bareland
- 8 Cloud
- 9 Shadow

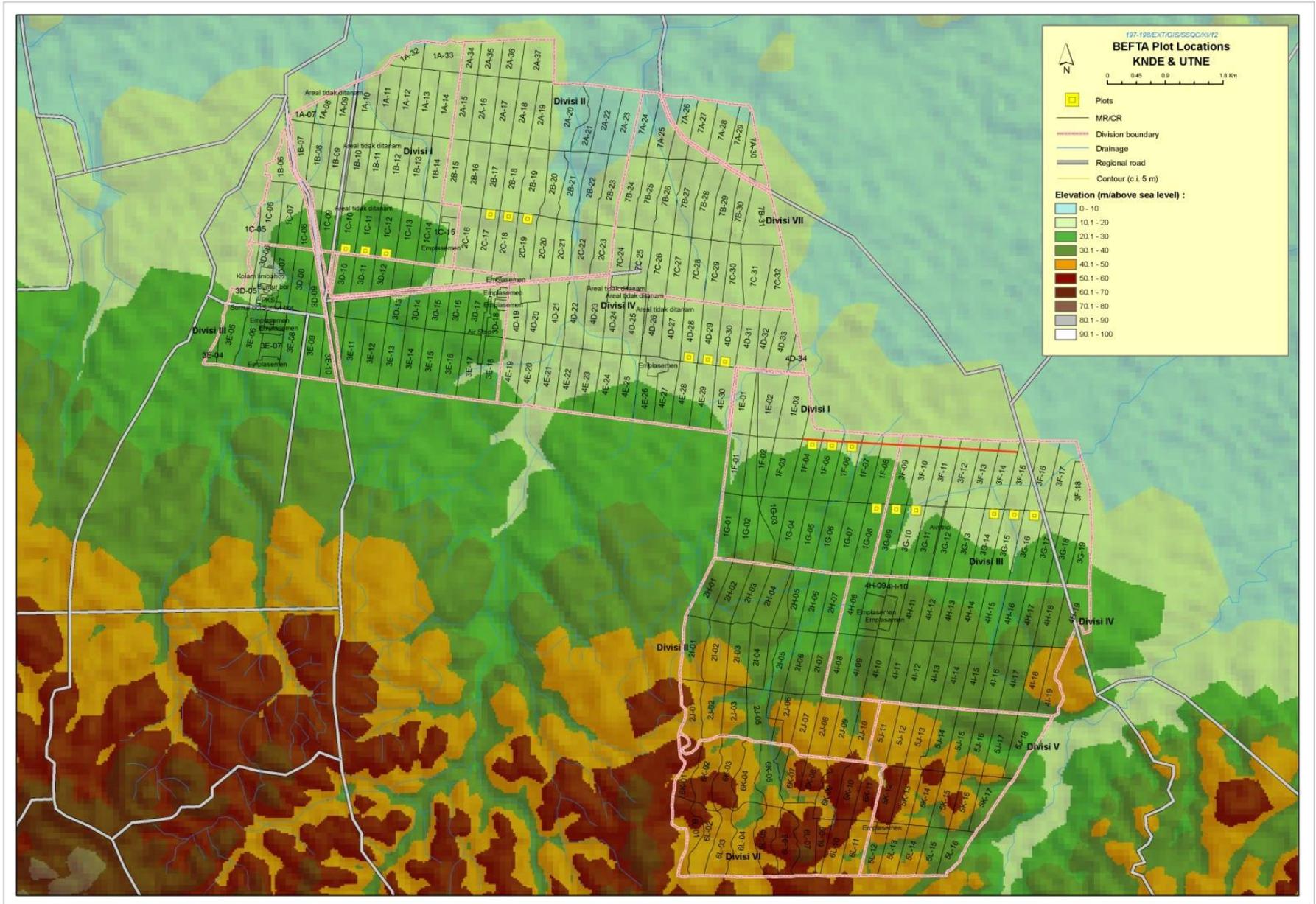


SMARTRI

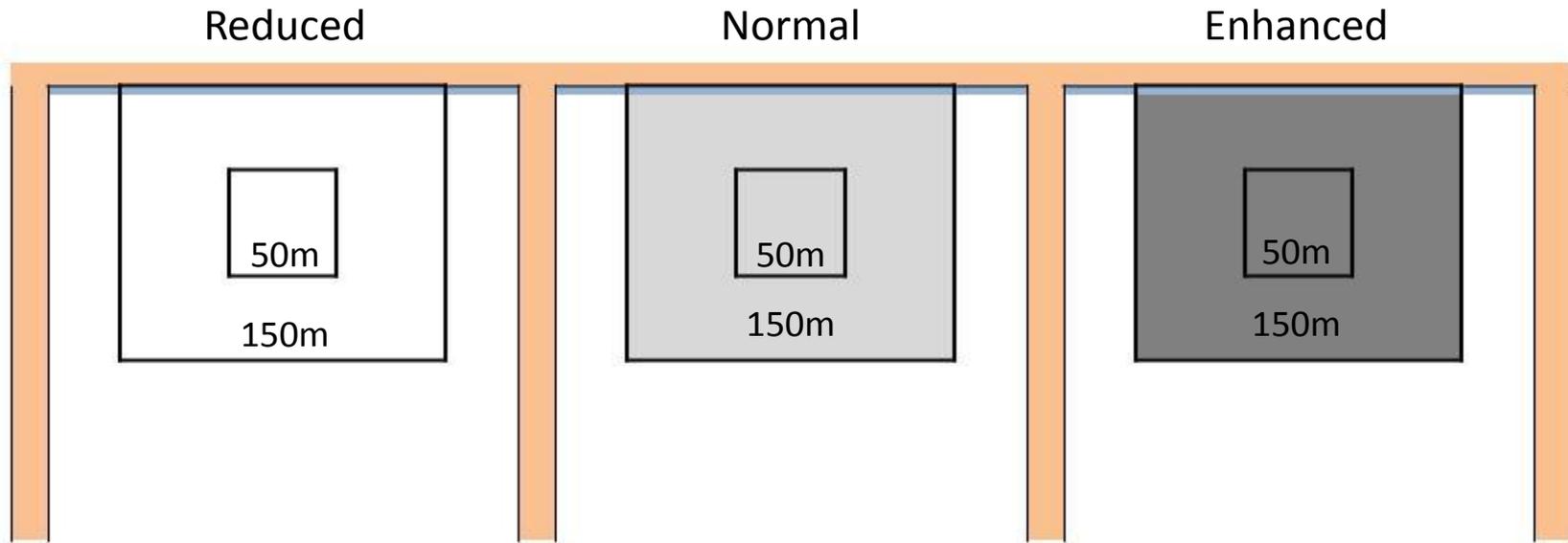


SMART Research Institute
Riau, Sumatra, Indonesia

Plot location

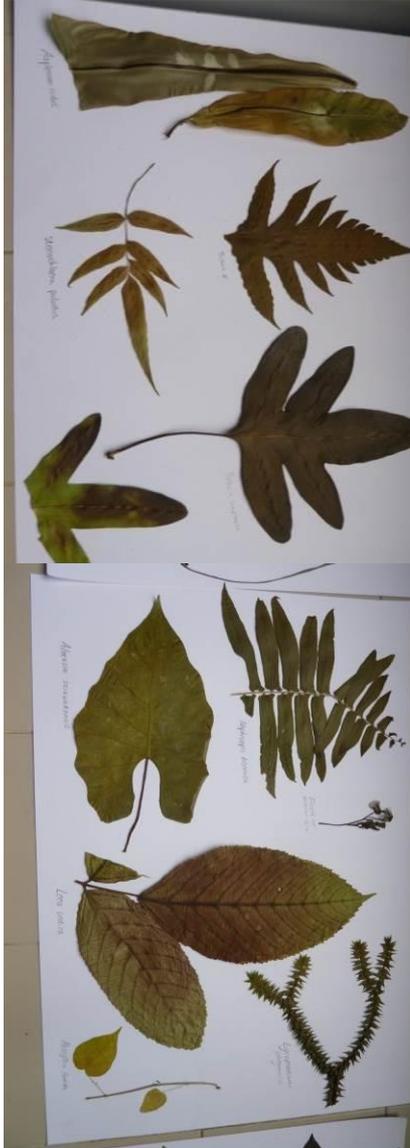


Experimental setup



- 1. REDUCED**
Removal of all ground vegetation
- 2. NORMAL**
Business as usual: managed levels of ground cover and of epiphytes
- 3. ENHANCED**
Ground cover allowed to grow unchecked (except for retention of pathways for access etc.)

BIODIVERSITY: Plants



BIODIVERSITY: Insects

- Combination insect trap
- Canopy fogging
- Dragonflies, butterflies, assassin bugs, dung beetles, ants



BIODIVERSITY: vertebrates

- **Rats:** baited traps
- **Large mammals:** camera traps, scats
- **Birds:** point counts
- **Frogs:** transects



ECOSYSTEM FUNCTIONS

- Soil physical and chemical properties
- Soil Biological activity:
bait lamina
- Herbivory



ECOSYSTEM FUNCTIONS

Leaf litter decomposition



ECOSYSTEM FUNCTIONS

Predation



ECOSYSTEM FUNCTIONS

Dung removal



ECOSYSTEM FUNCTIONS

Frog diets: stomach flushing



ECOSYSTEM SERVICE: PALM-OIL YIELD



Pre-treatment data collection: from Oct 2012
Treatment applied to plots: Feb 2014



Impacts of understory spraying



Ecosystem service



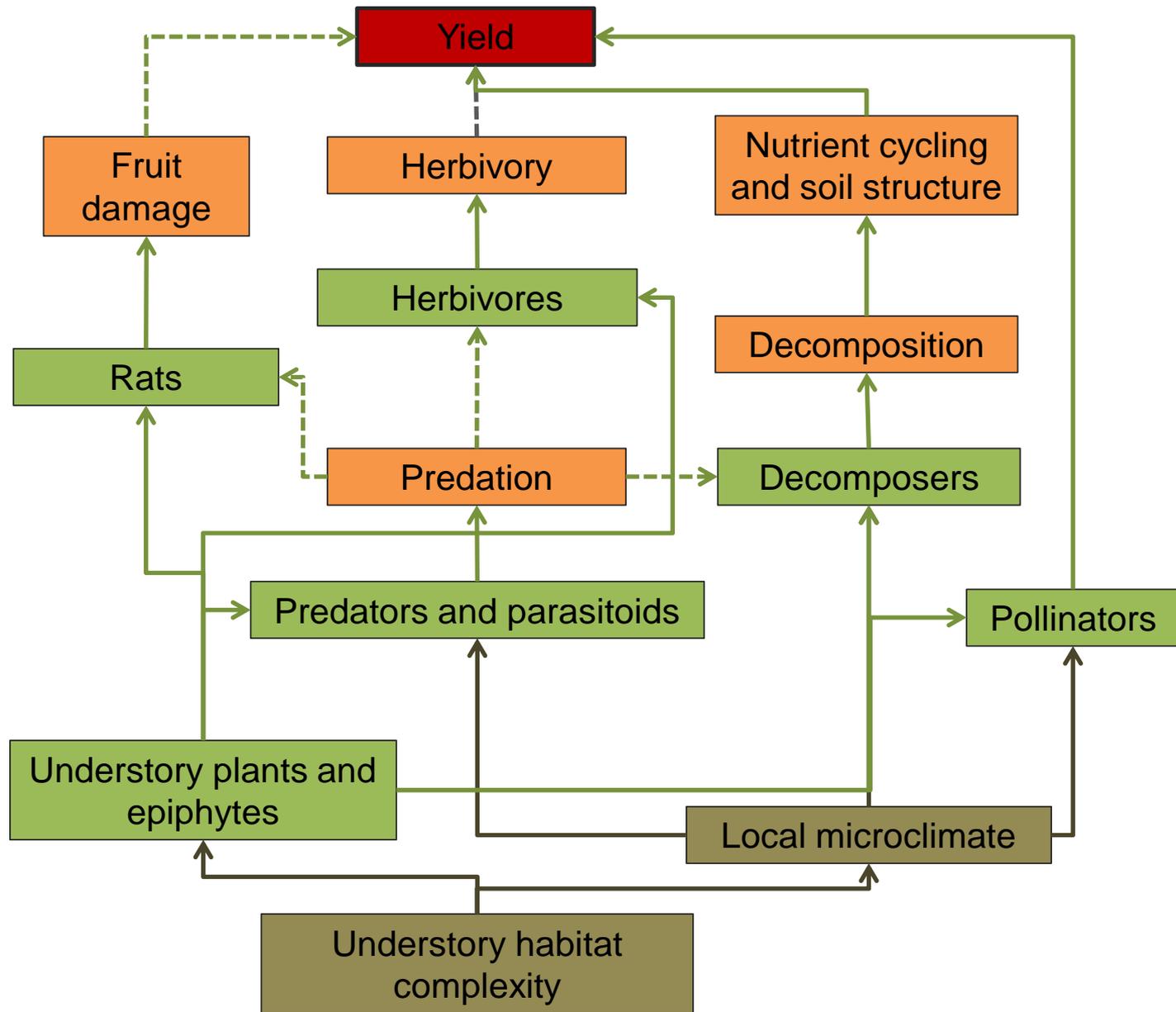
Ecosystem function



Biodiversity



Complexity



Impact of beneficial plants



Impact of two species of beneficial plants

- *Turnera ulmifolia*
 - *Antigonon leptopus*
- on:

- Insect abundance and diversity
- Parasitoid diversity
- Herbivory



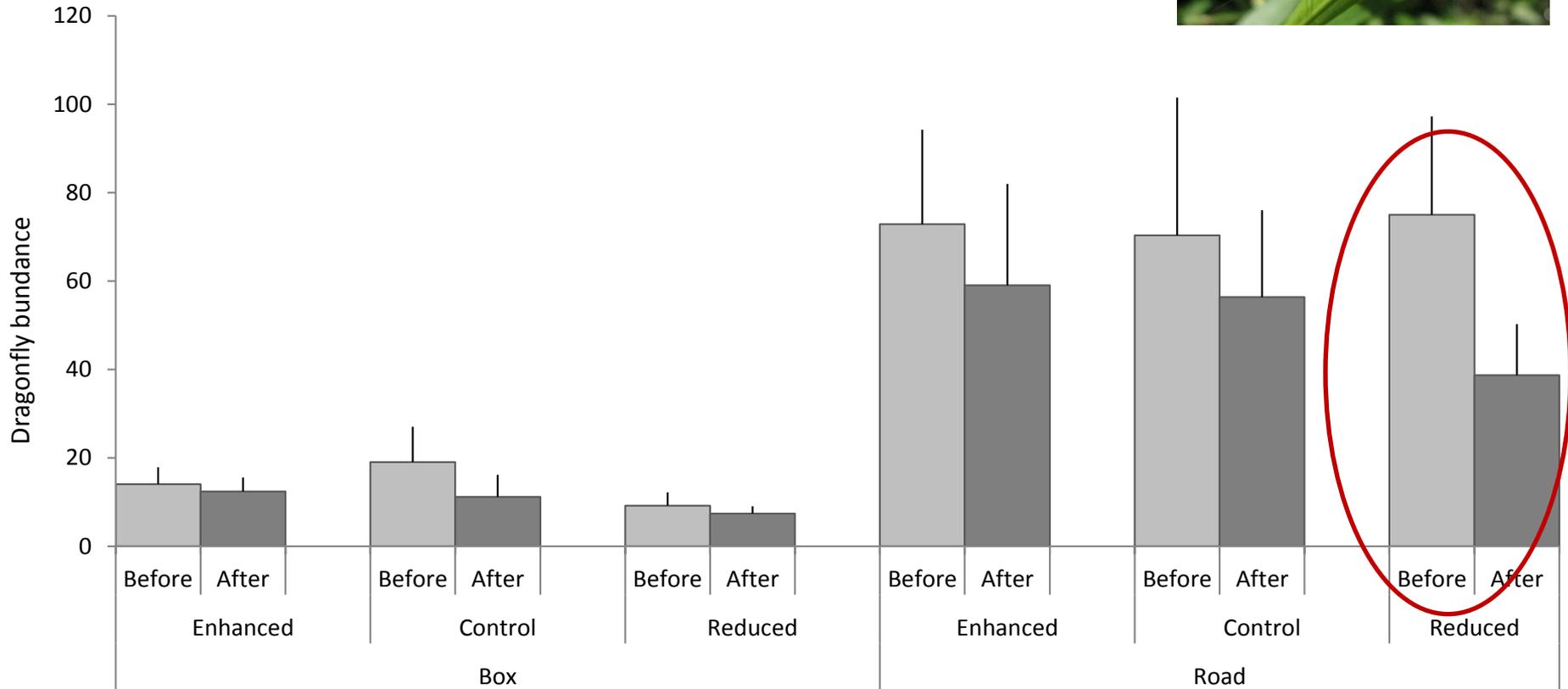
Results: Biodiversity

Dragonflies: Odonata

- 46 species identified from the BEFTA plots alone
- 86 from the whole SMARTRI area
- 51 new records for Riau
- 3 new records for Sumatra



Early effects of understory removal on dragonfly abundance?



Guide to dragonflies of oil palm in preparation



Family: Libellulidae

Species: *Brachydiplax chalybe*

Description: Powdery blue over thorax and abdomen, but black on last three segments. Yellow at base of wings.

Behaviour: Often along ditches perching on exposed vegetation. Distinctive chasing and hovering behaviour with two individuals frequently hovering in mid-air a few cm from each other

Body length: 32
Hind-wing length: 27



Family: Aeshnidae

Species: *Gynacantha subinterrupta*

Description: Large and predominantly brown with blue and green markings on top of thorax and apex of abdomen. Colour patterns on thorax distinct from *G. dohrni*.

Behaviour: Active flier, often inside plantation blocks, resting during day but easily disturbed

Body length:62
Hind-wing length:46



Family: Platycnemididae

Species: *Copera ciliata*

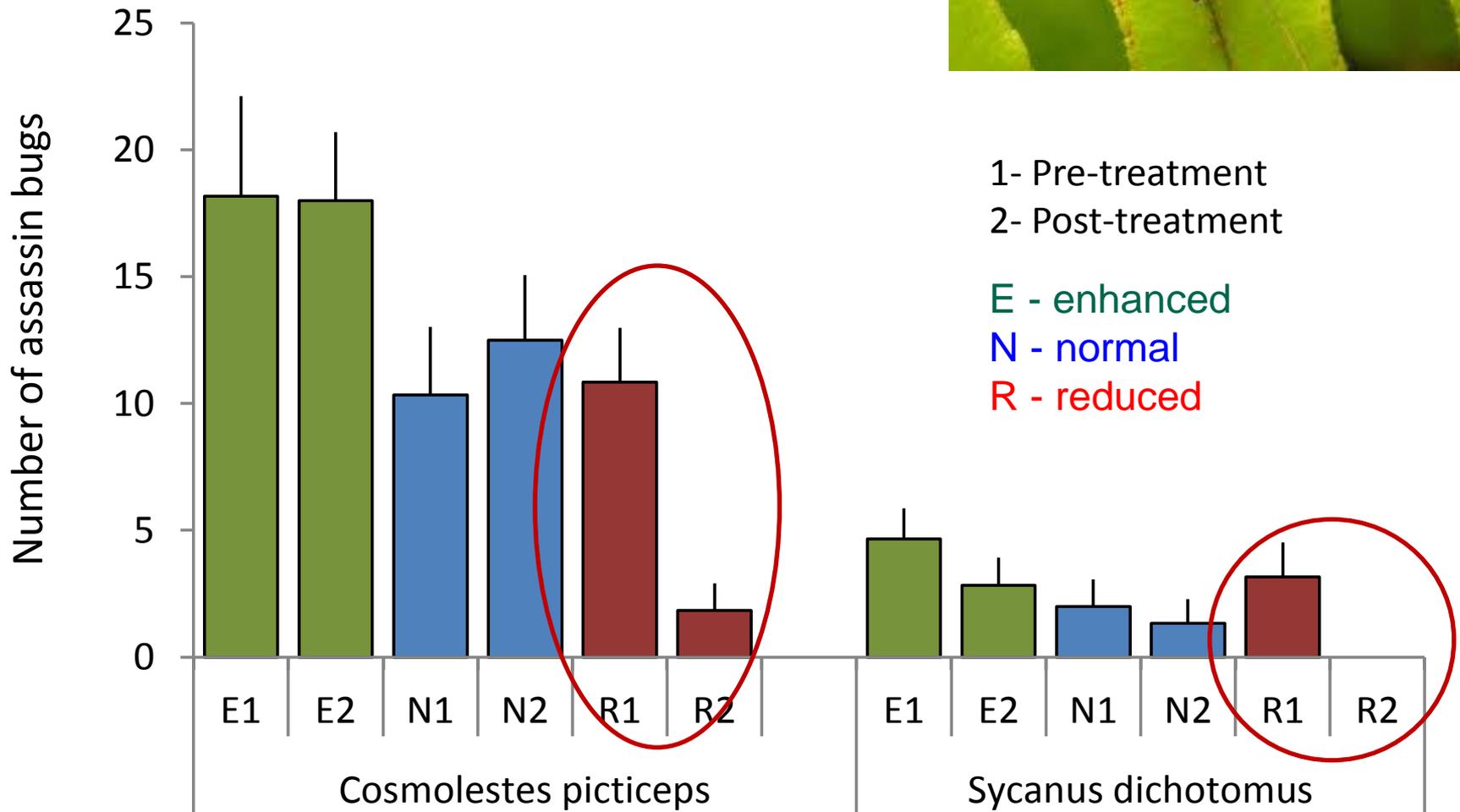
Description: Damselfly with very long white legs with black knees. Black abdomen with white joints and white at apex. blue/green white stripes on thorax. Newly emerged individuals (bottom) pinkish.

Behaviour: Resting in shady areas along ditches

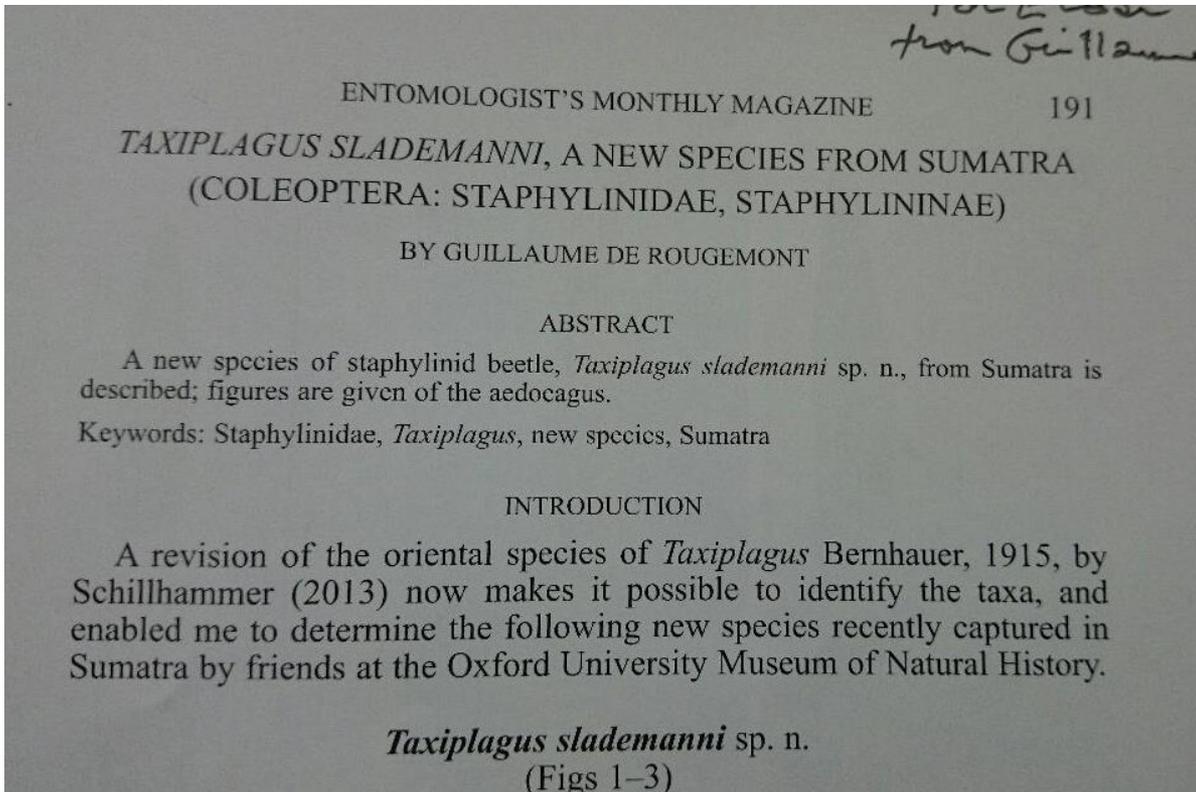
Body length: 41
Hind-wing length: 20



Assassin bug numbers lower after treatment

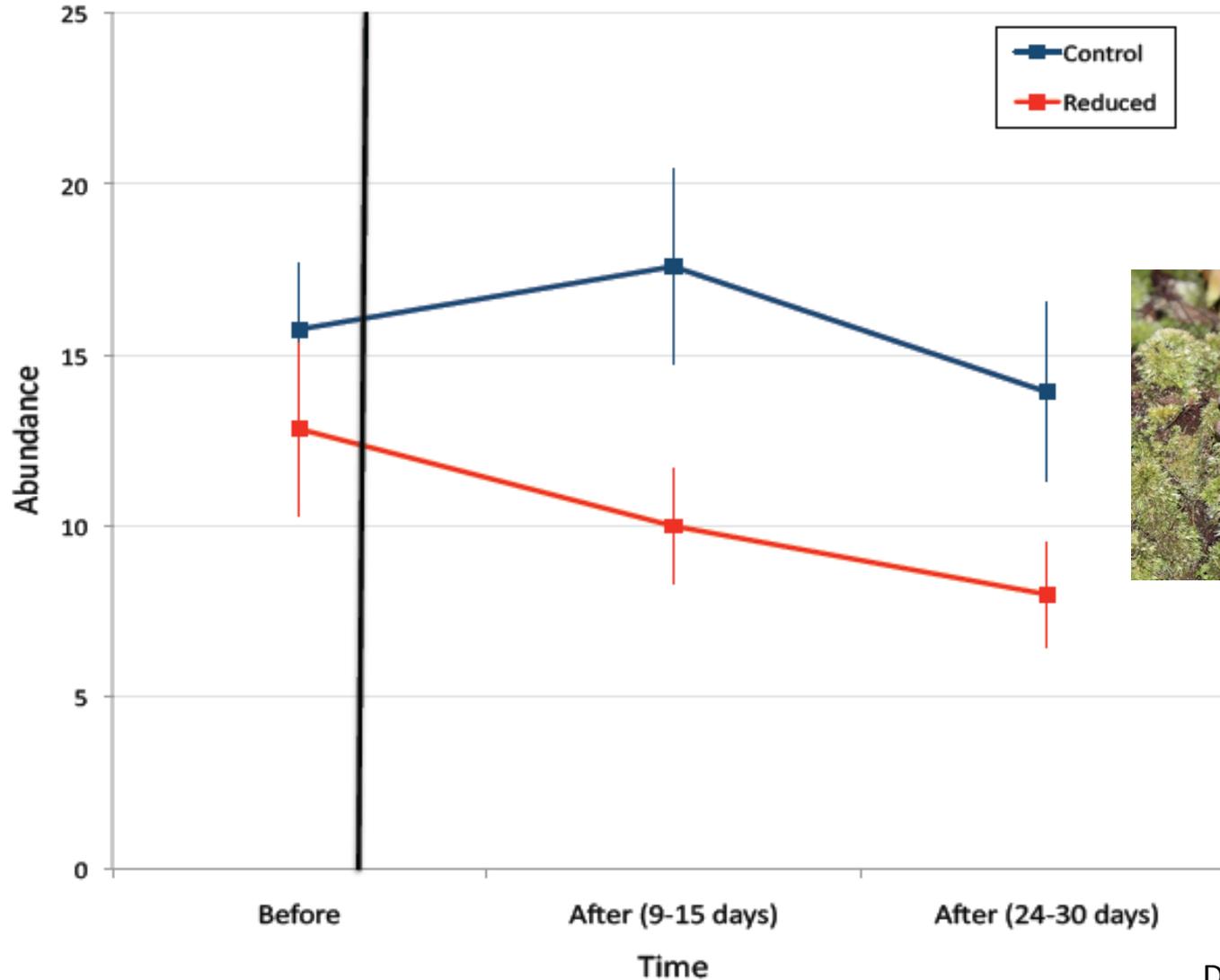


A new species of Staphylinid beetle discovered in the oil palm plantation

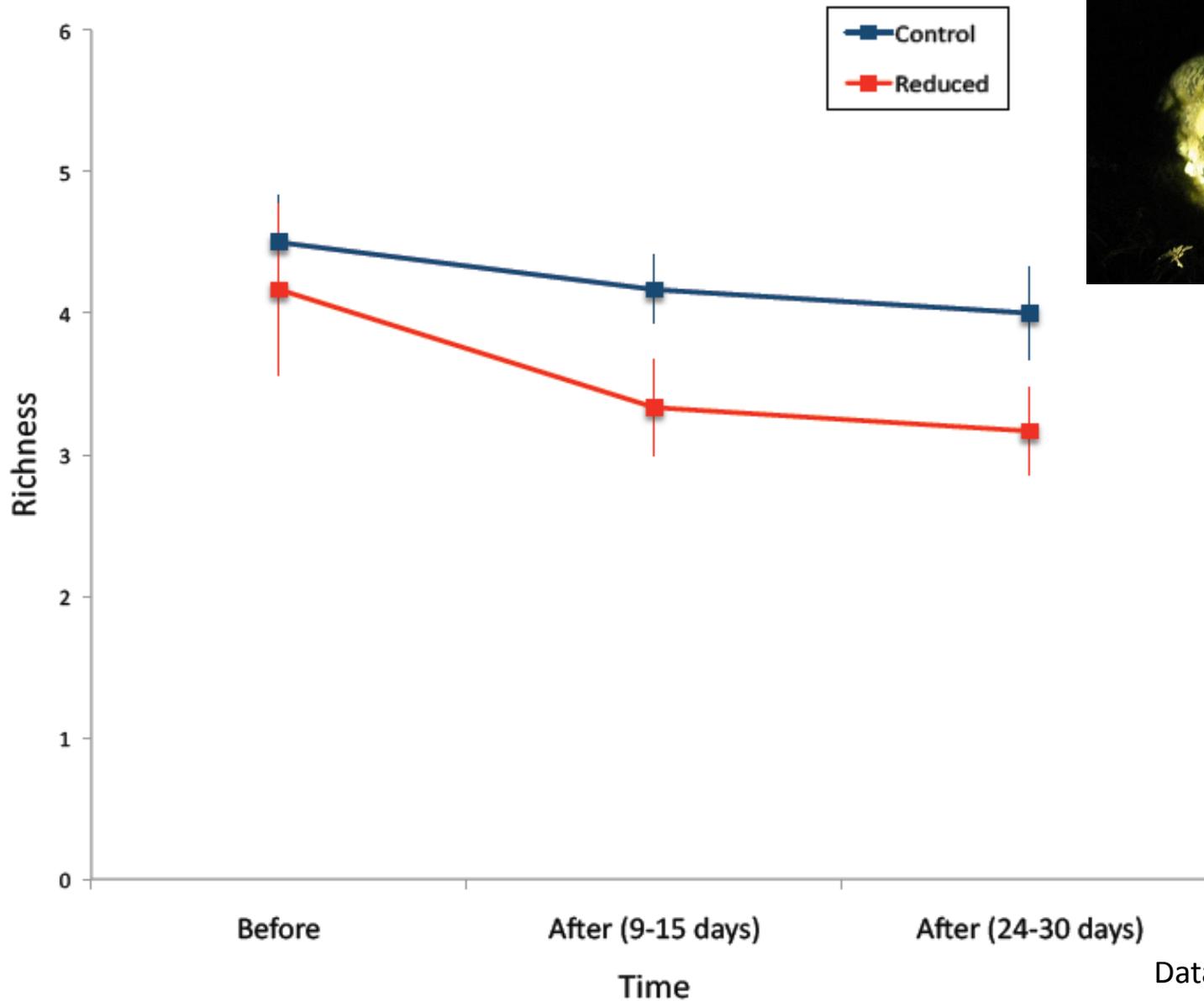


Taxiplagus slademanni de Rougement 2014

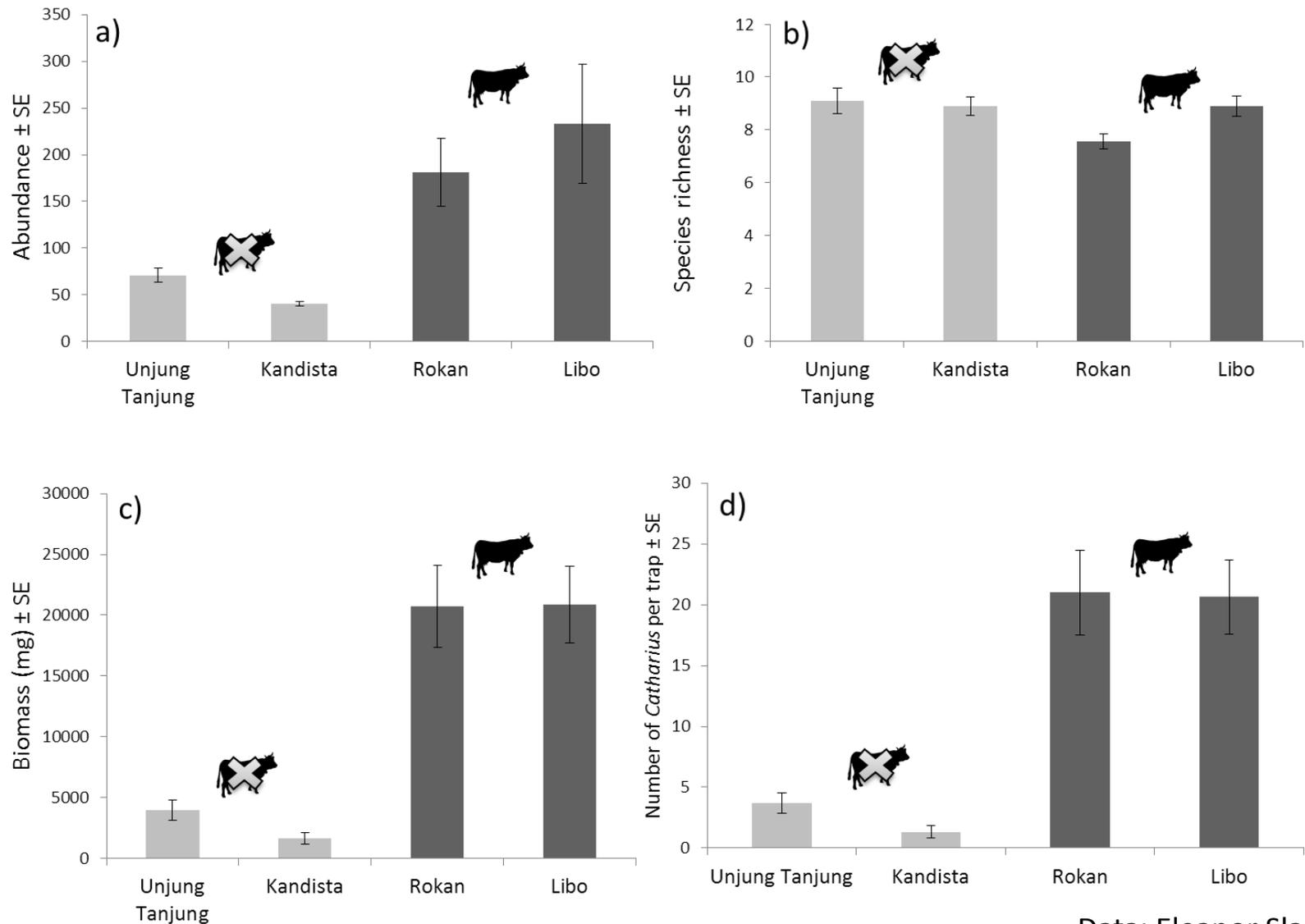
Frog abundance lower after treatment



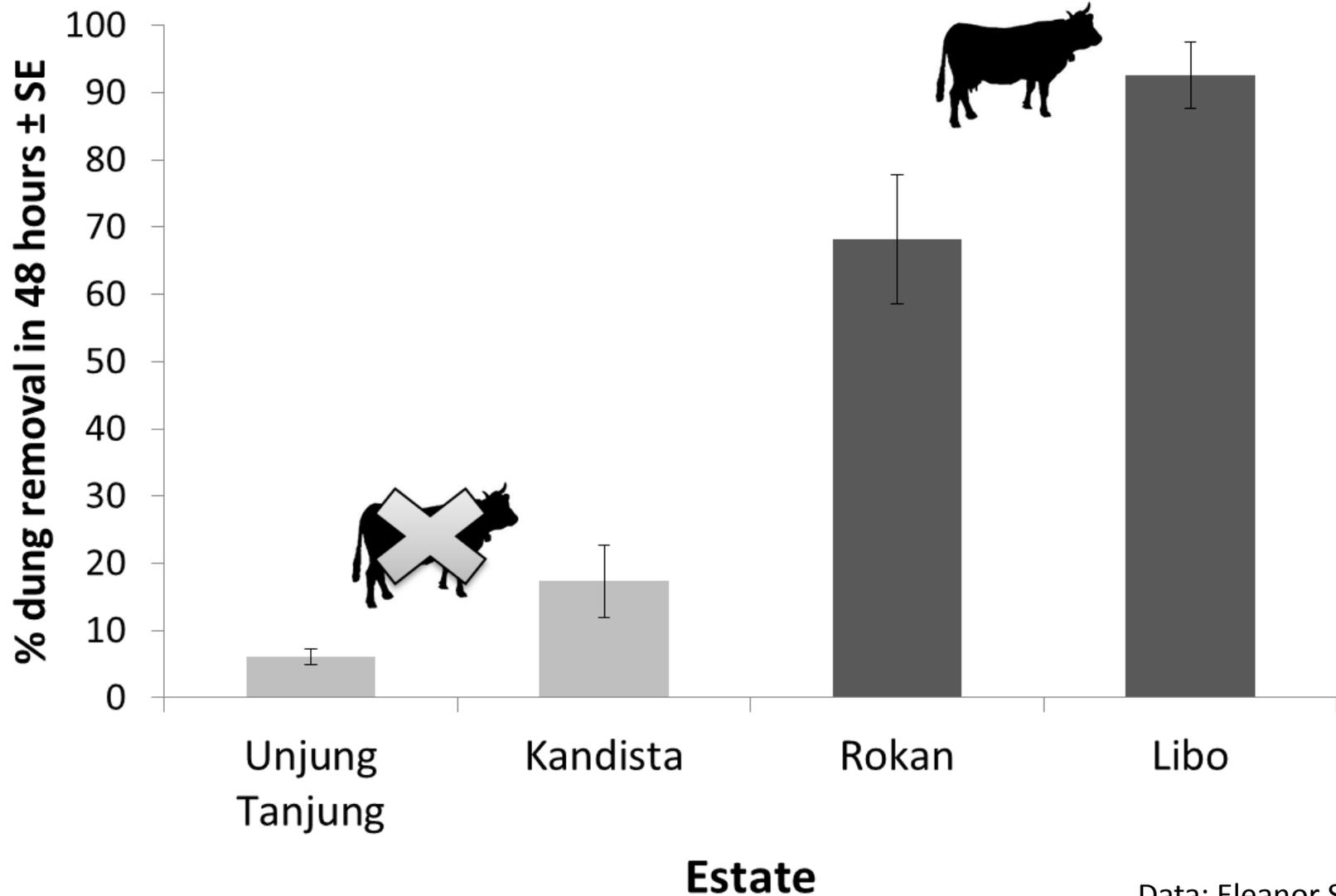
Frog species richness lower after treatment



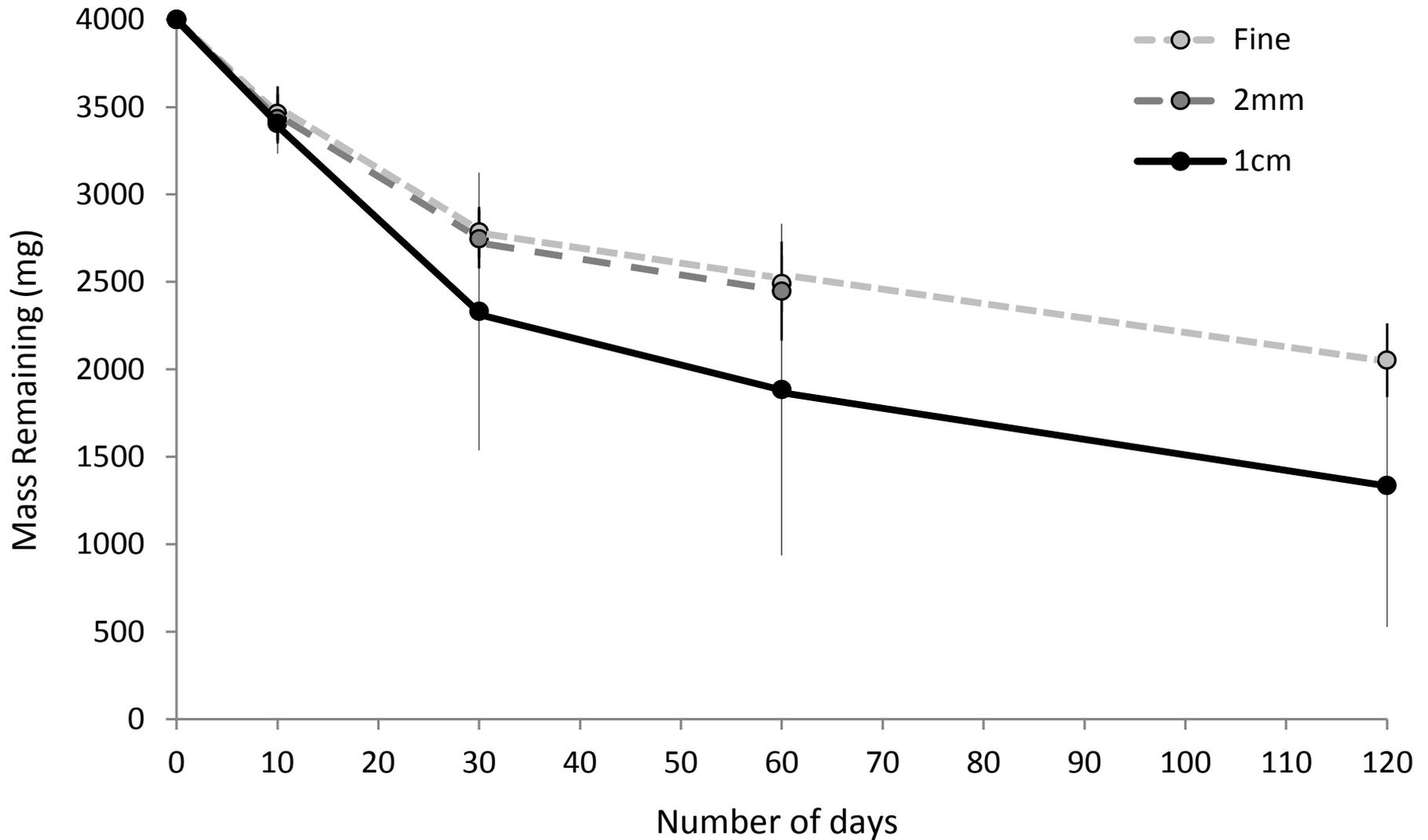
Abundance and biomass of dung beetles low in plantations, but higher where cattle present



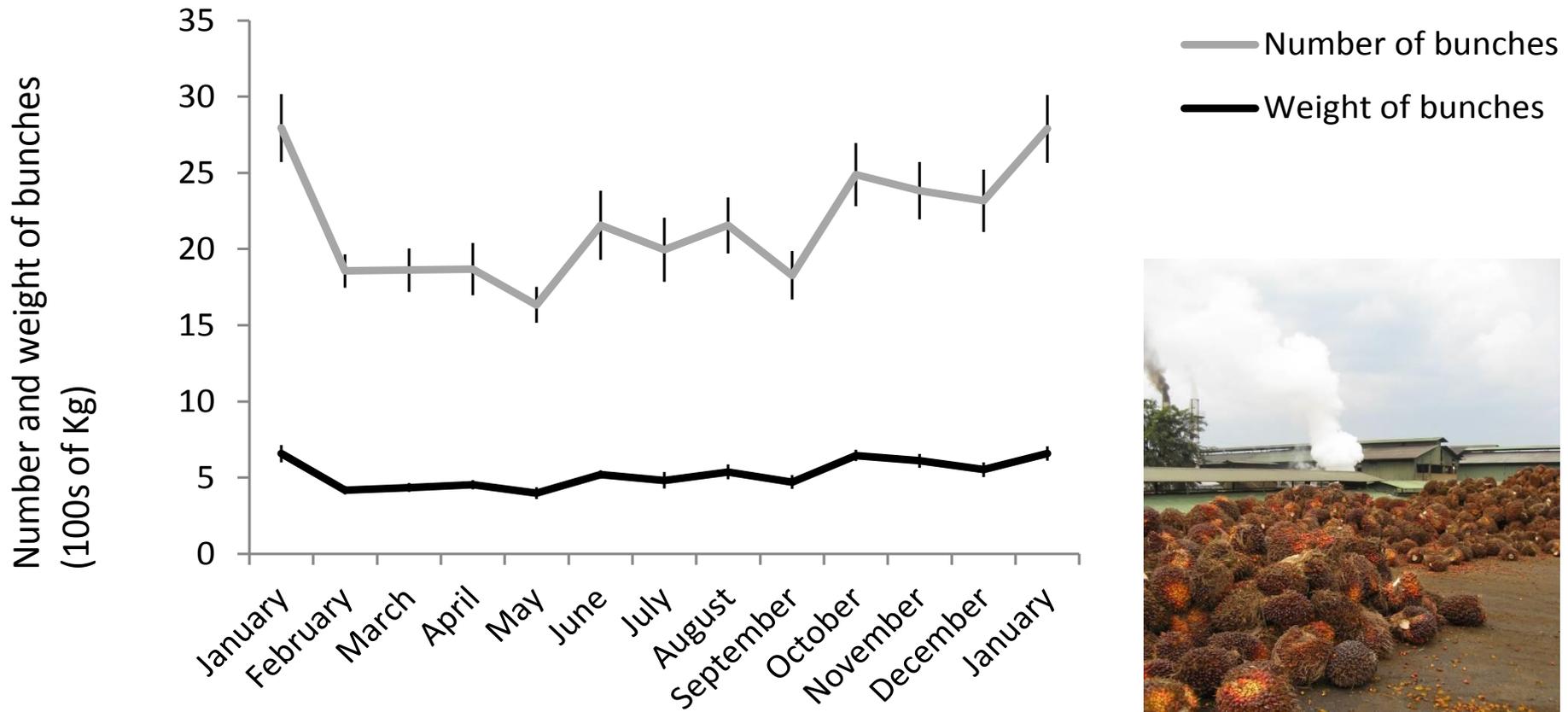
Dung removal low in plantations, but higher in areas with cattle



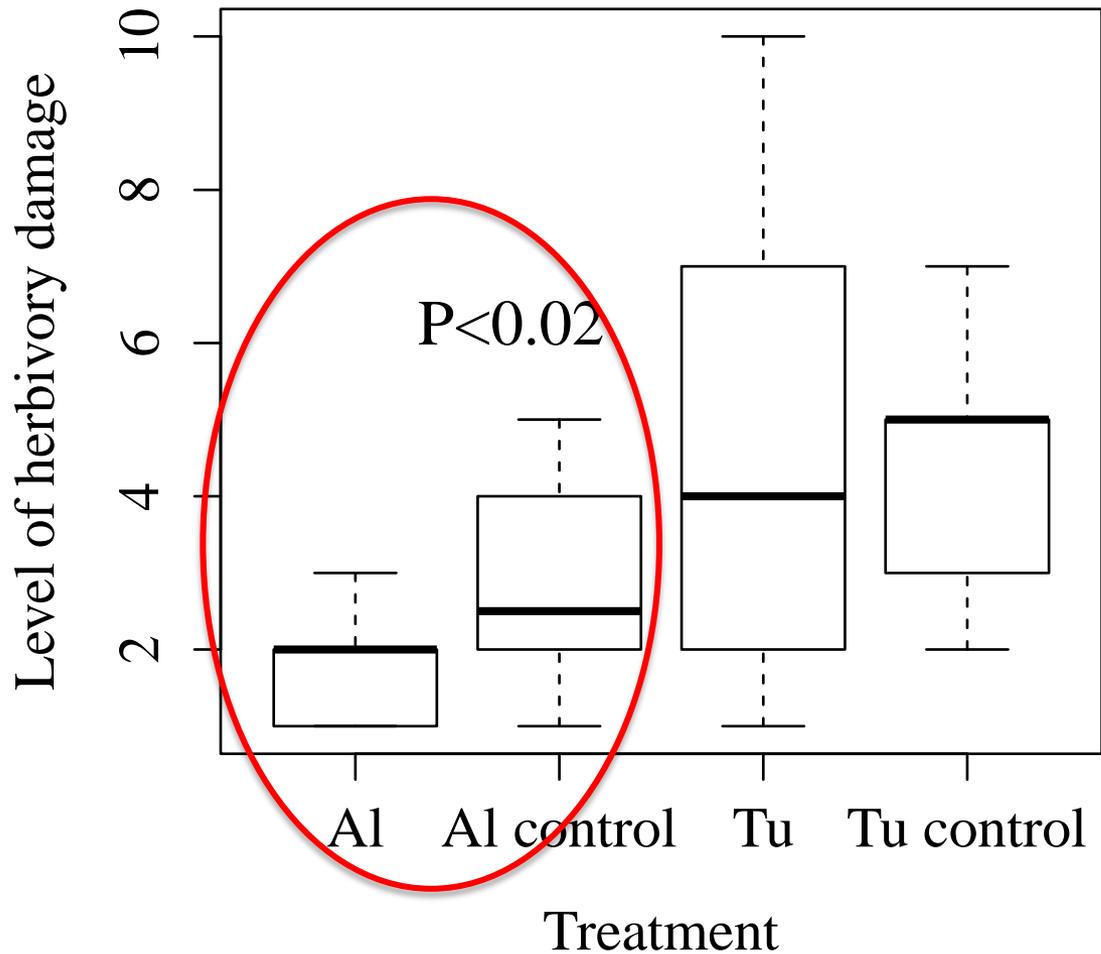
Faster rates of litter loss where large invertebrates can enter mesh bags



Yield of palms in plots recorded on a monthly basis since January 2013



Lower levels of herbivory where *Antigonon* present



Conclusions

- The BEFTA Project demonstrates the potential strength of research collaborations between industry and universities
- Such collaborations allow access to all aspects of a plantation's management
- Early results demonstrate:
 - High and variable levels of biodiversity within plantations
 - Potential impacts of understory management on:
 - BIODIVERSITY
 - ECOSYSTEM FUNCTIONS





Dr Edgar Turner



Acknowledgements

- The BEFTA Team
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