Beyond big mammals: How fire and herbivory affect savanna biodiversity broadly

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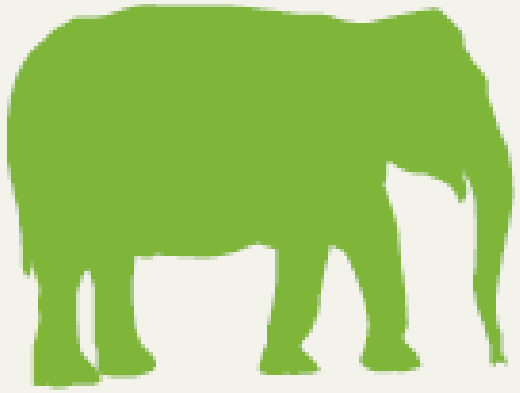
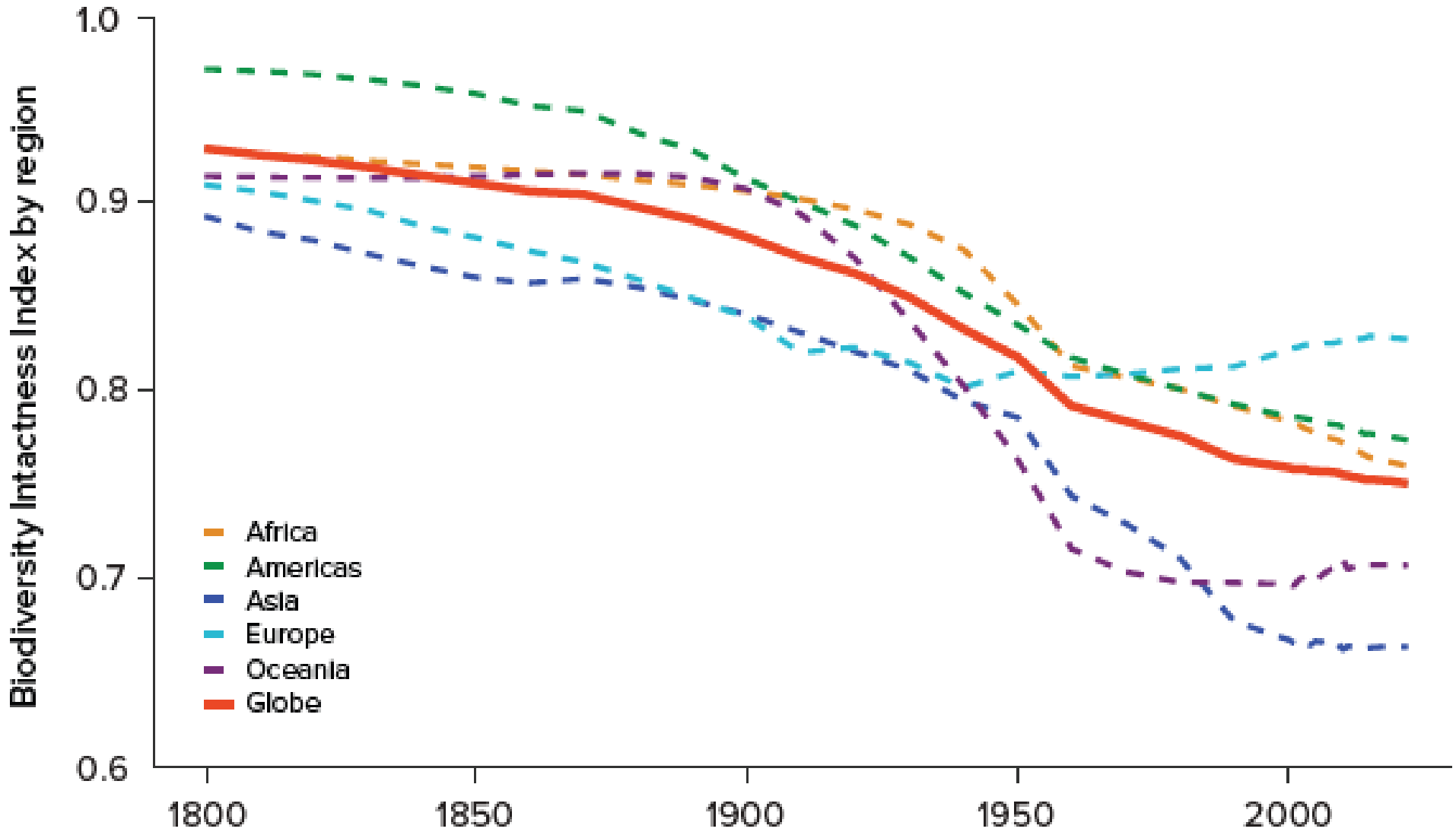
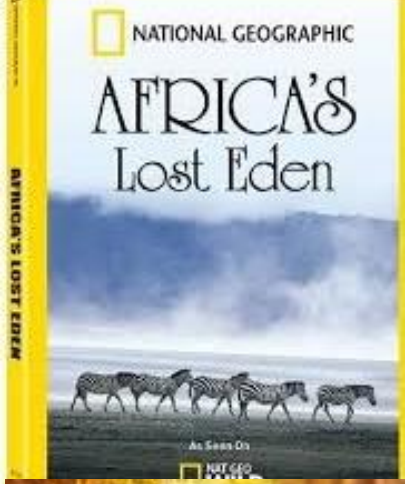
The Gorongosa Master's in Conservation Biology Program

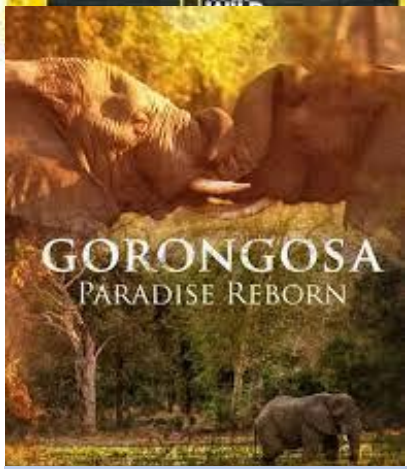
9,014

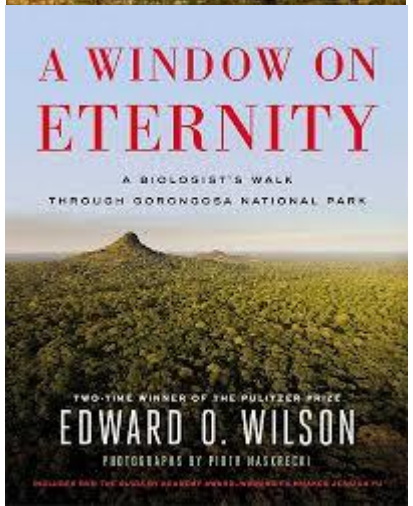
VERTEBRATE POPULATIONS ARE ON AVERAGE A THIRD SMALLER THAN THEY WERE 38 YEARS AGO

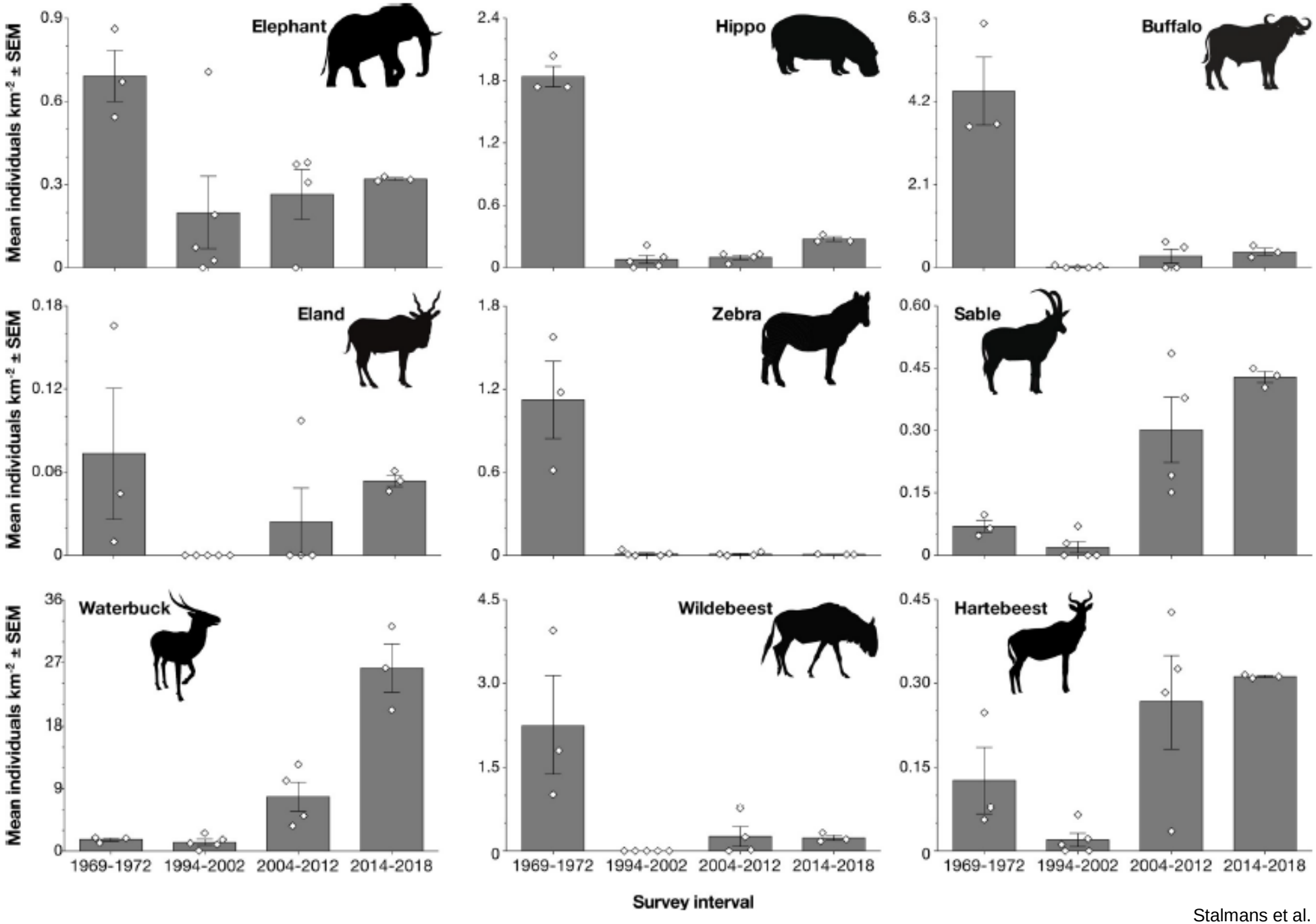






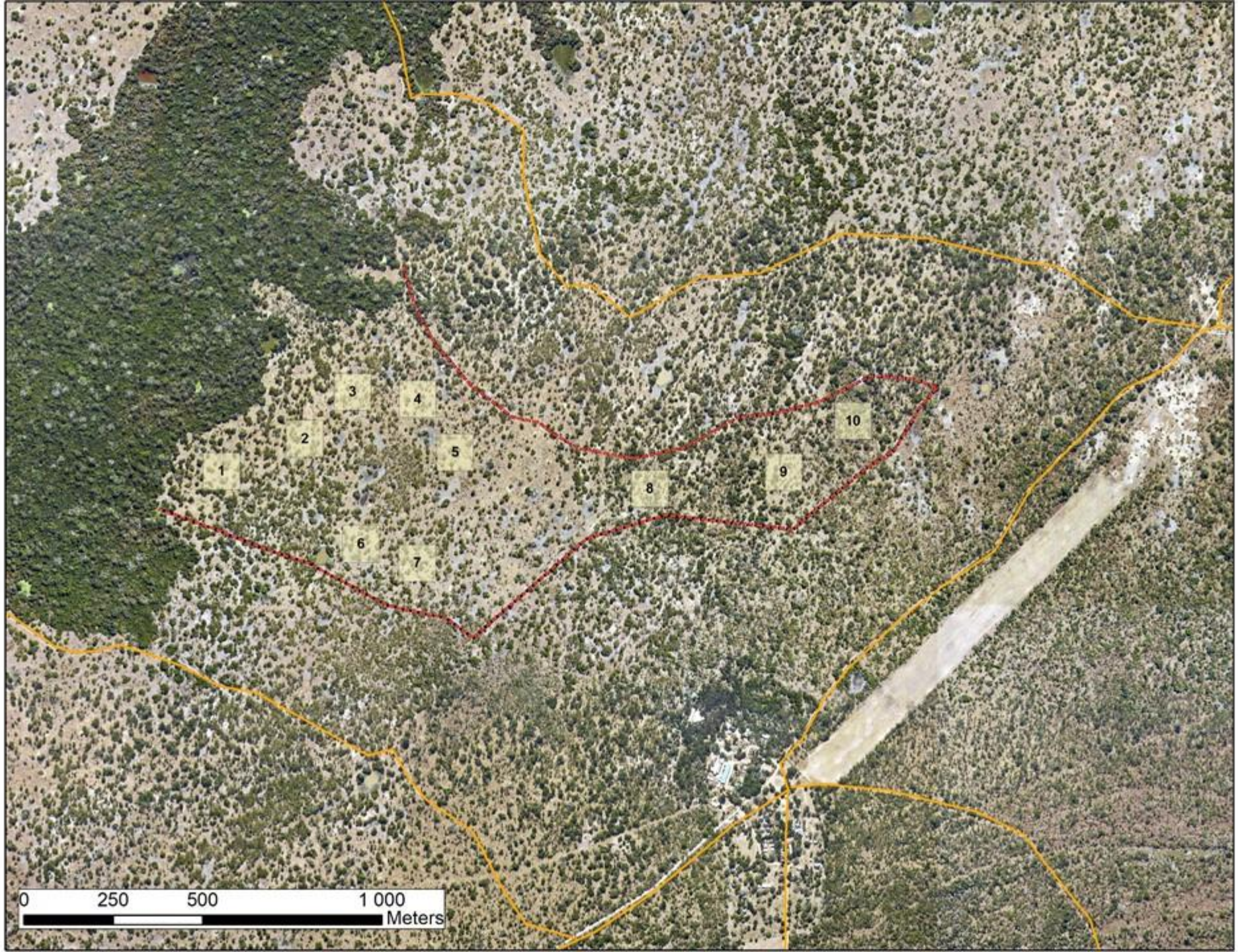






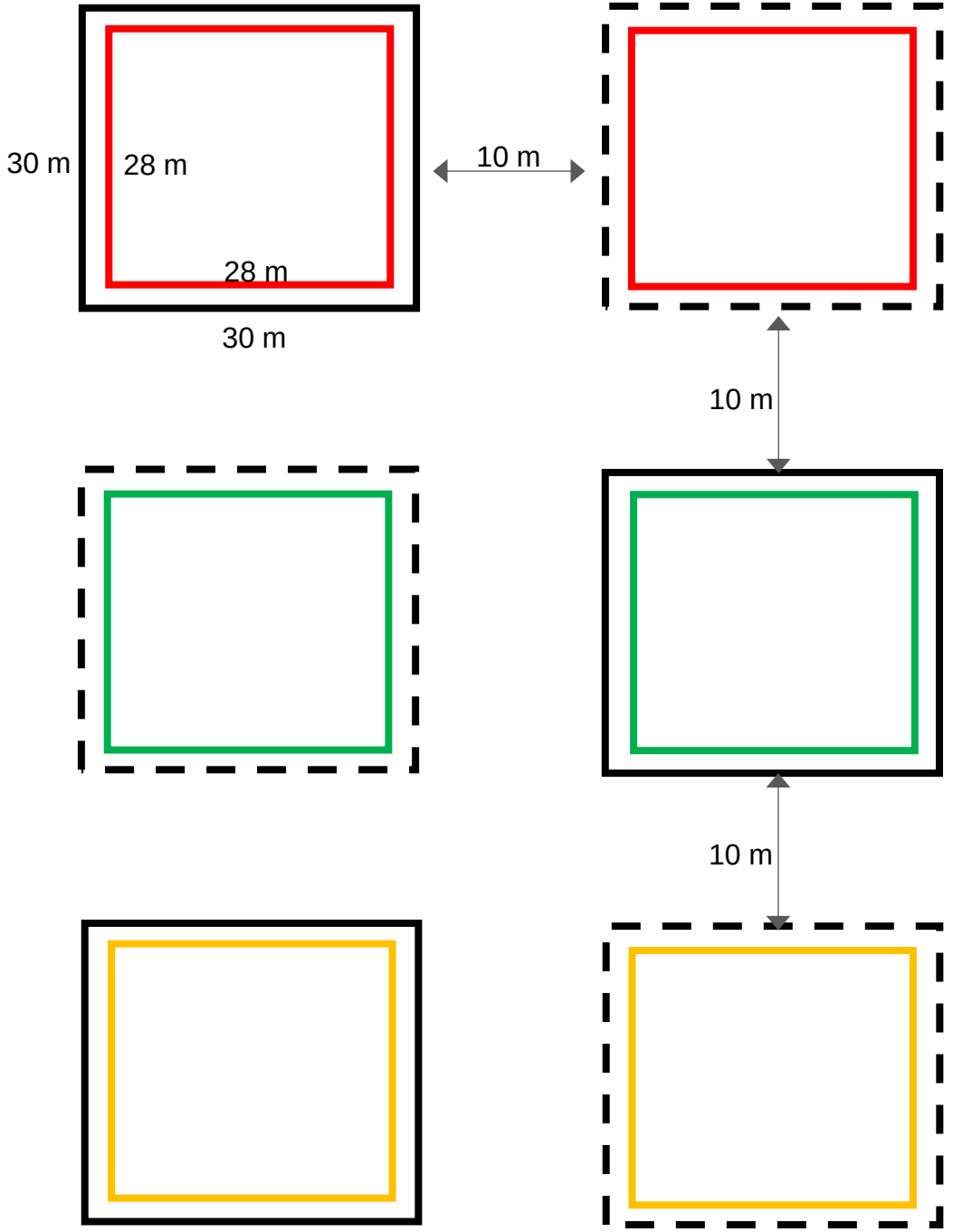
Stalmans et al. 2019

The landscape of the Gorongosa Savanna Ecology Experiment



GSSE experimental design

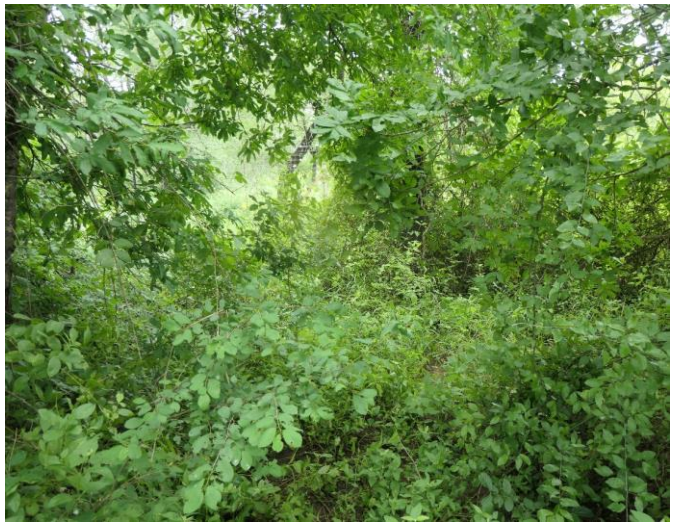
Photo: Marc Stalmans



Document changes in plant richness

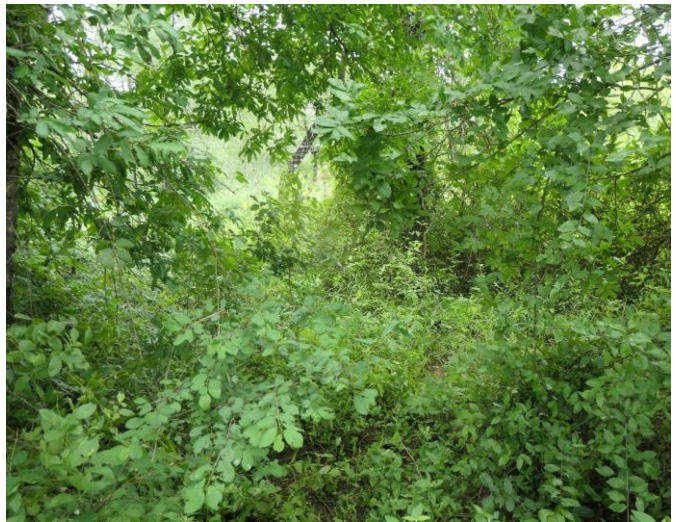
Cold burn

Hot burn



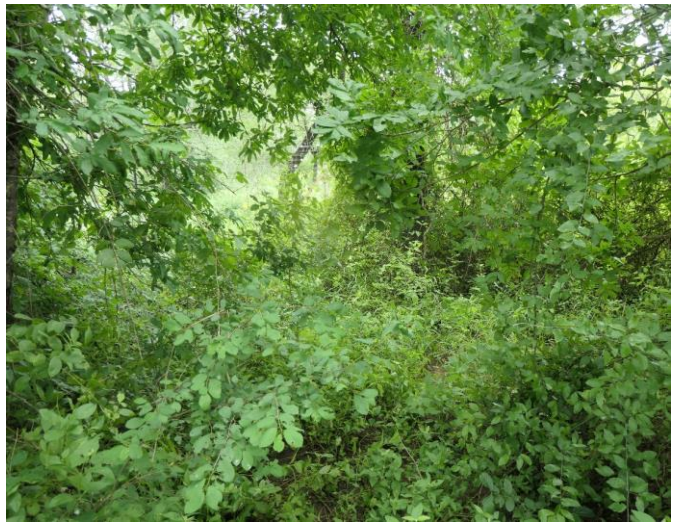
Document changes in plant richness

Grass richness may be higher in the presence of LMH and with cold burns.



Document changes in plant richness

Grass richness may be higher in the presence of LMH and with cold burns.



Document changes in plant richness

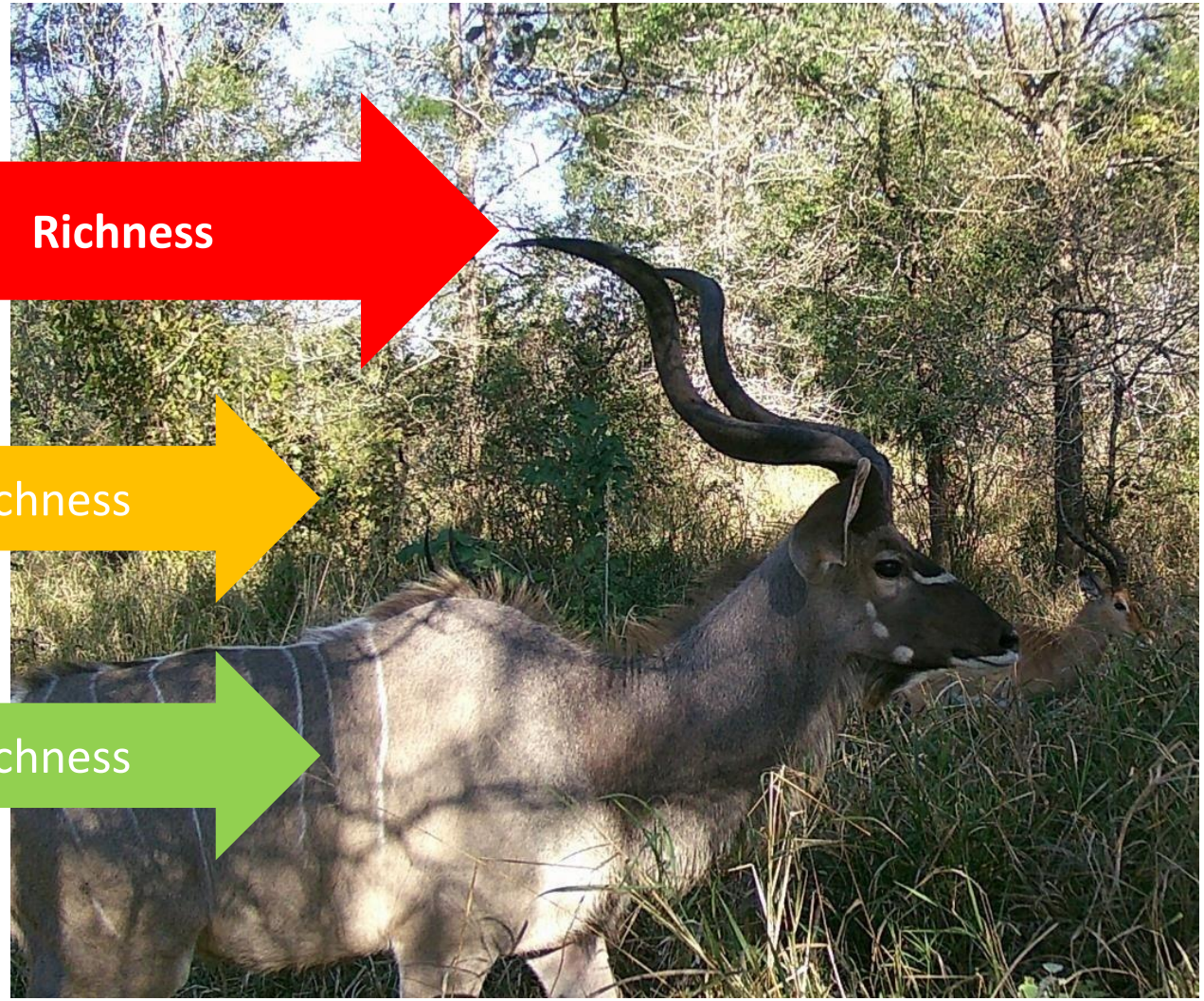
Cold burn

Hot burn

Grass richness may be higher in the presence of LMH and with cold burns.

Shrub richness may be higher in the absence of LMH and fire.

Determine the effects of fire on mammalian herbivore activity



Areas burned in the mid-late dry season (hot burns) may support a greater richness of herbivores.

Areas with cold burns and unburned areas may have similar herbivore richness because there will be more green biomass in the landscape at the time of cold burns.

Study the smaller majority…

Herbivore presence + Fire

Insects, amphibians, reptiles, birds, and small mammals may be more species rich in undisturbed areas, lacking fire and large mammals.

Richness

Fire

Hot burns may be more limiting than cold burns.

Norina Vicente

Methods

Install exclosures December 2020

Biennial burns

Vegetation monitoring

Focus on diverse taxa

Crickets & beetles
Beto Soares Tenente
Iolanda Greedes

Reptiles & amphibians
Acácio Chechene

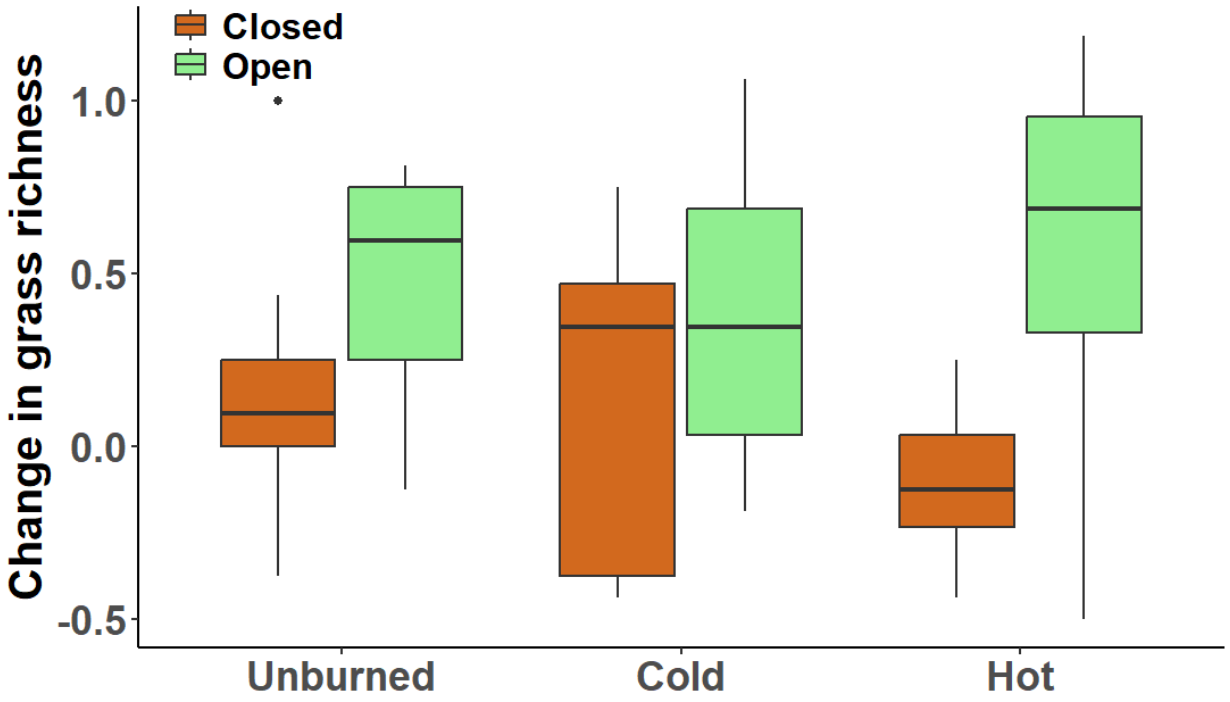
Birds
Jonatá Caminho

Small mammals
Hermínio António

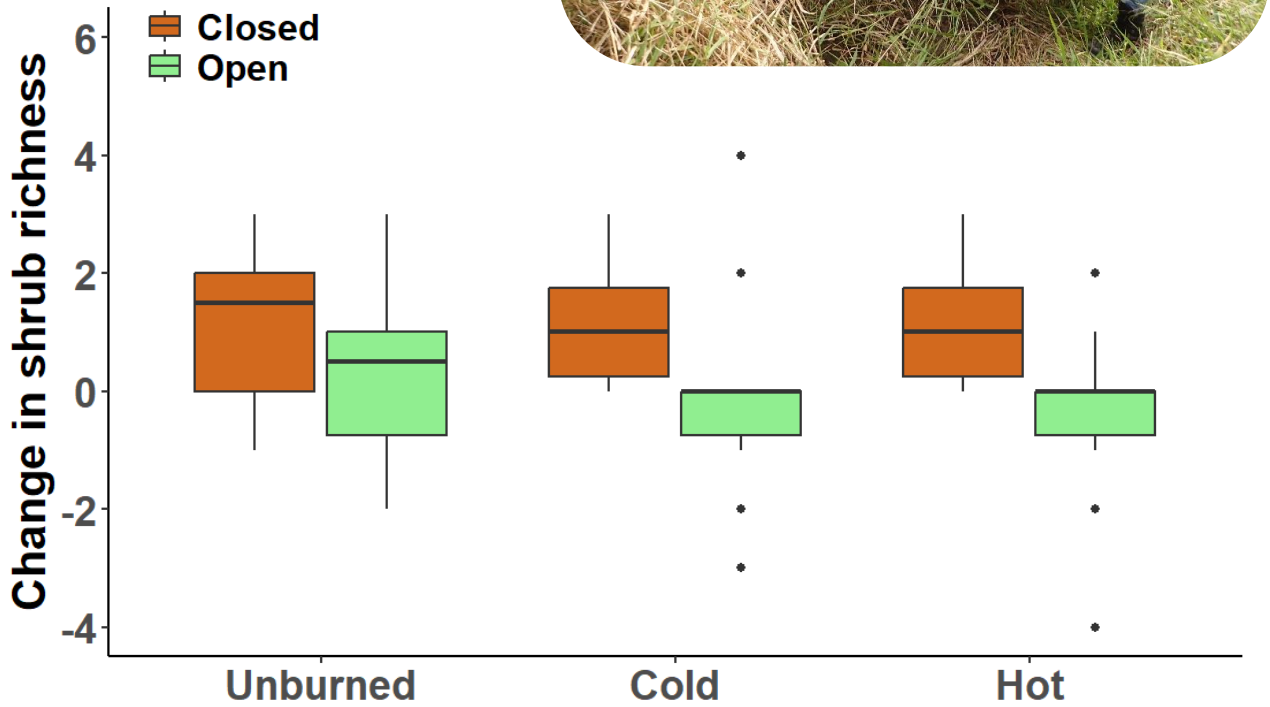
Large mammals
Osvaldo Abrão
Clementina Elias

Results

LMH promote **grass richness** and limit **shrub richness** over four years

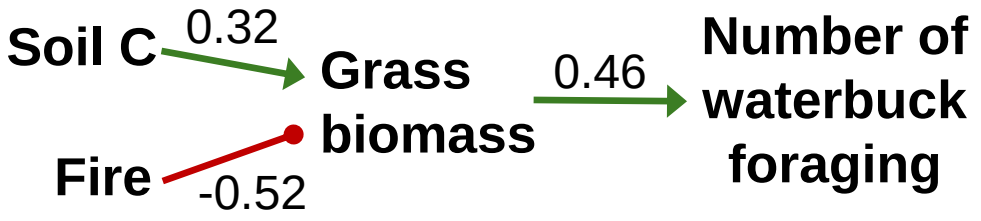


Exclosures: F = 16.7, 1, *P* = 0.001

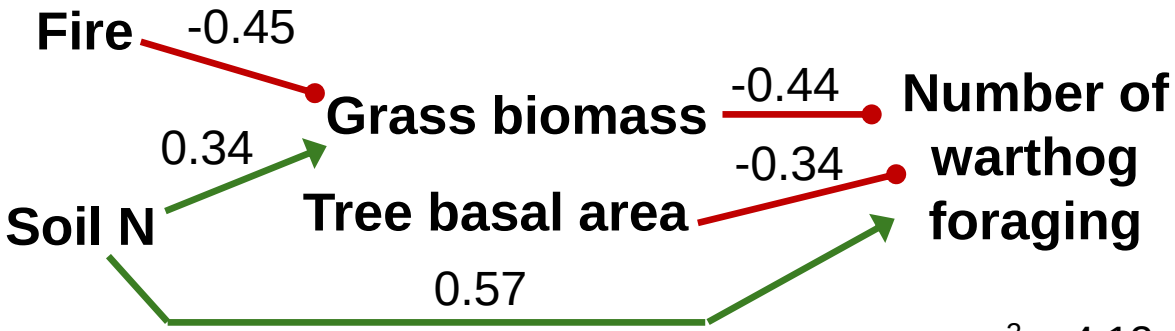


Exclosures: F = 9.5, 1, *P* = 0.003

Large mammal foraging was affected by environmental variation and fire (sometimes)



$\chi^2 = 0.85$, df = 3, $P = 0.84$

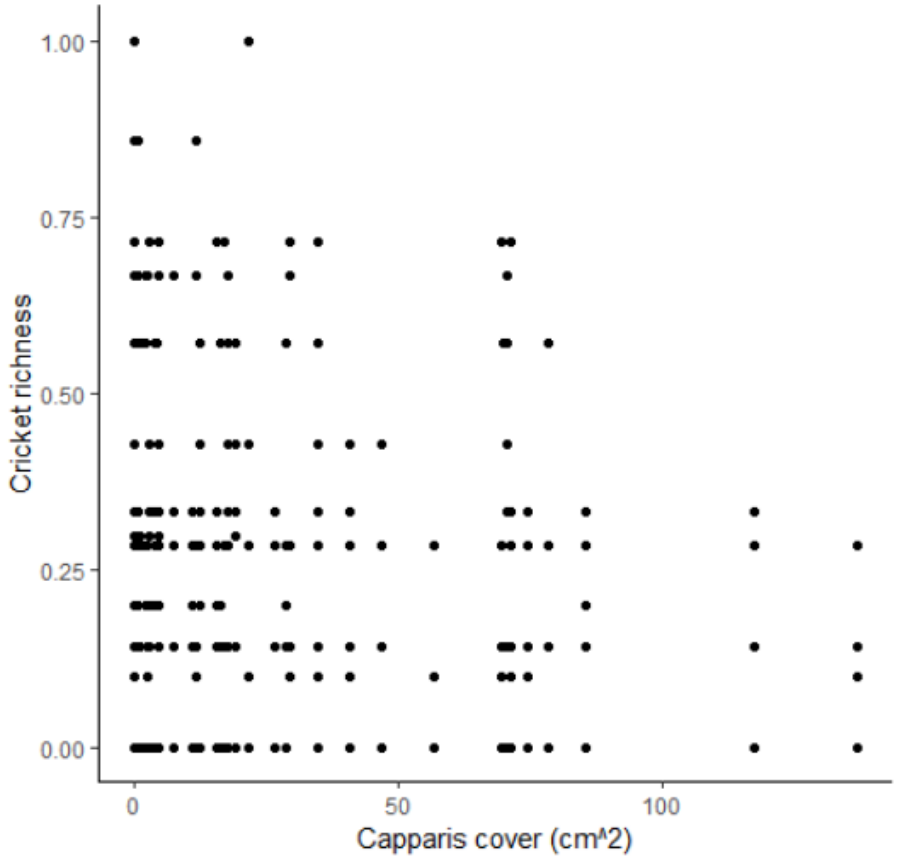


$\chi^2 = 4.12$, df = 5, $P = 0.53$

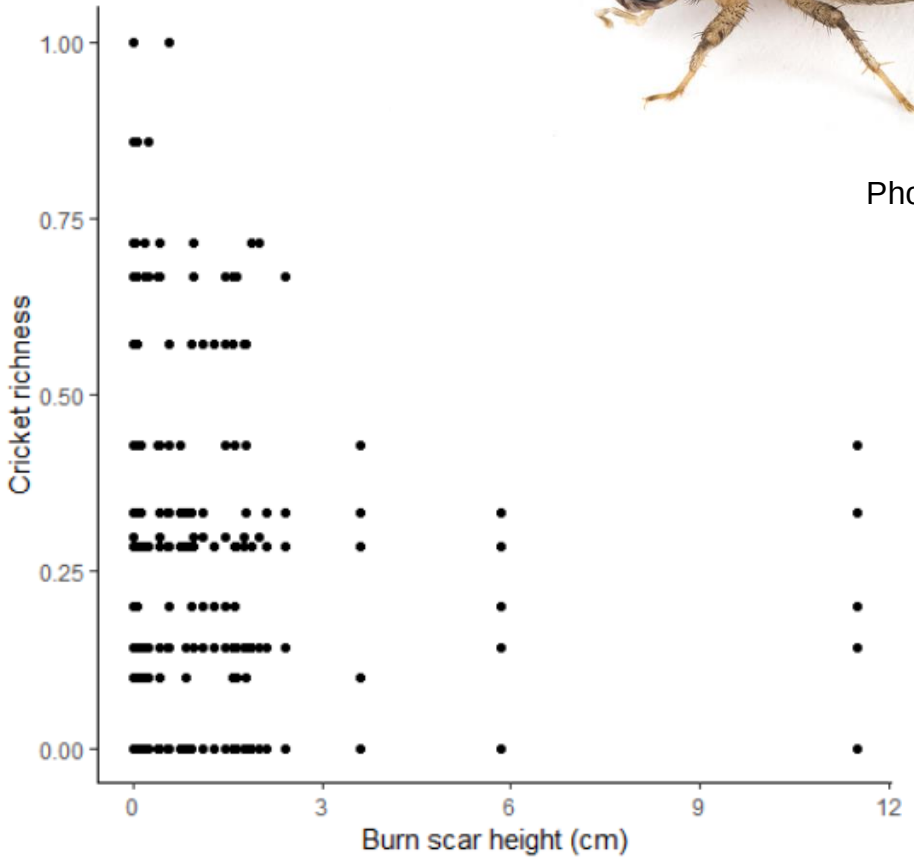
Cricket richness was 2x higher in the rainy vs. dry season

Richness decreased with shrub cover

Modicogryllus sp. 1
Photo: Piotr Naskrecki



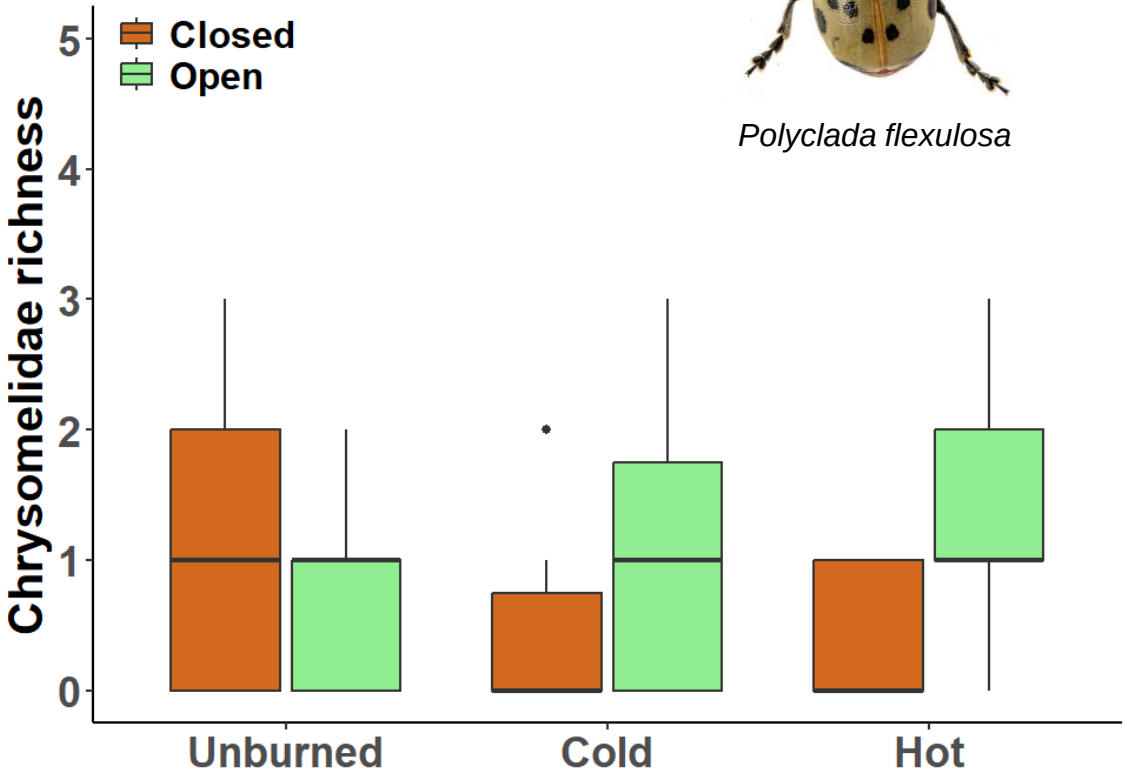
$X^2 = 18.8$, df = 1, $P < 0.0001$



$X^2 = 3.2$ df = 1, $P = 0.07$

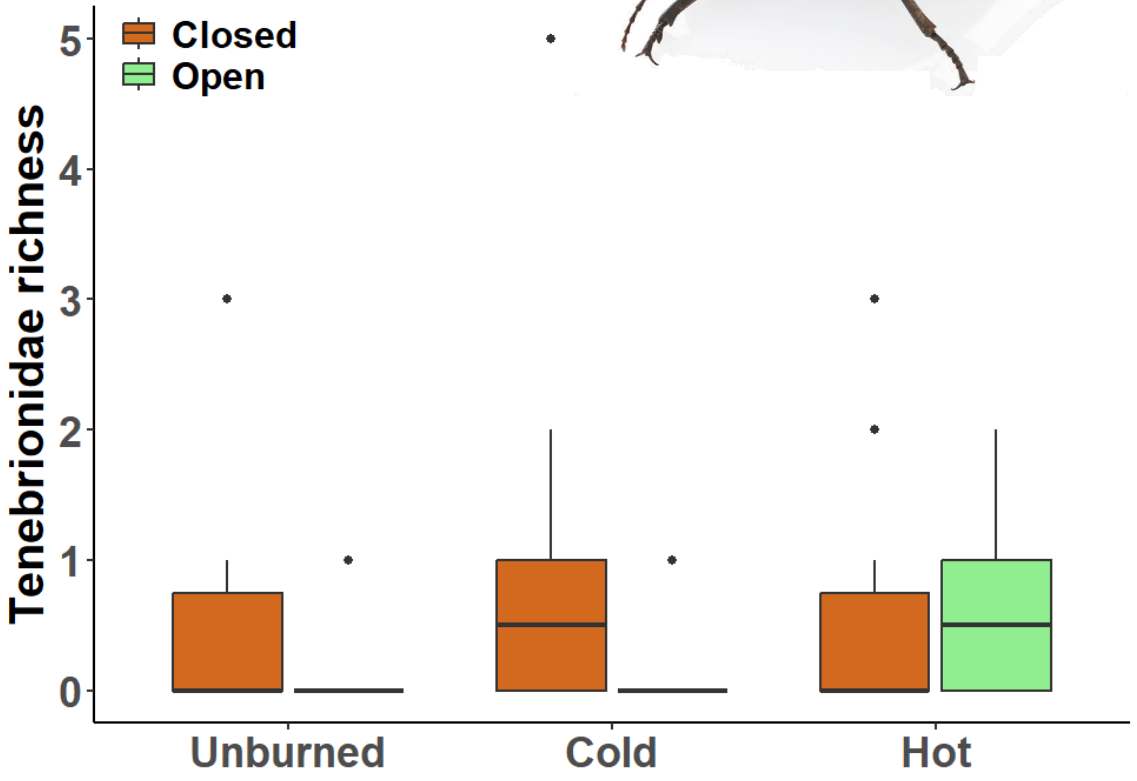
Beetle richness was higher in plots without LMH

Polyclada flexulosa



E: $X^2 = 8.7$, df = 1, P = 0.003

Phanerotomea arnoldi



E: $X^2 = 4.8$, df = 1, P = 0.03

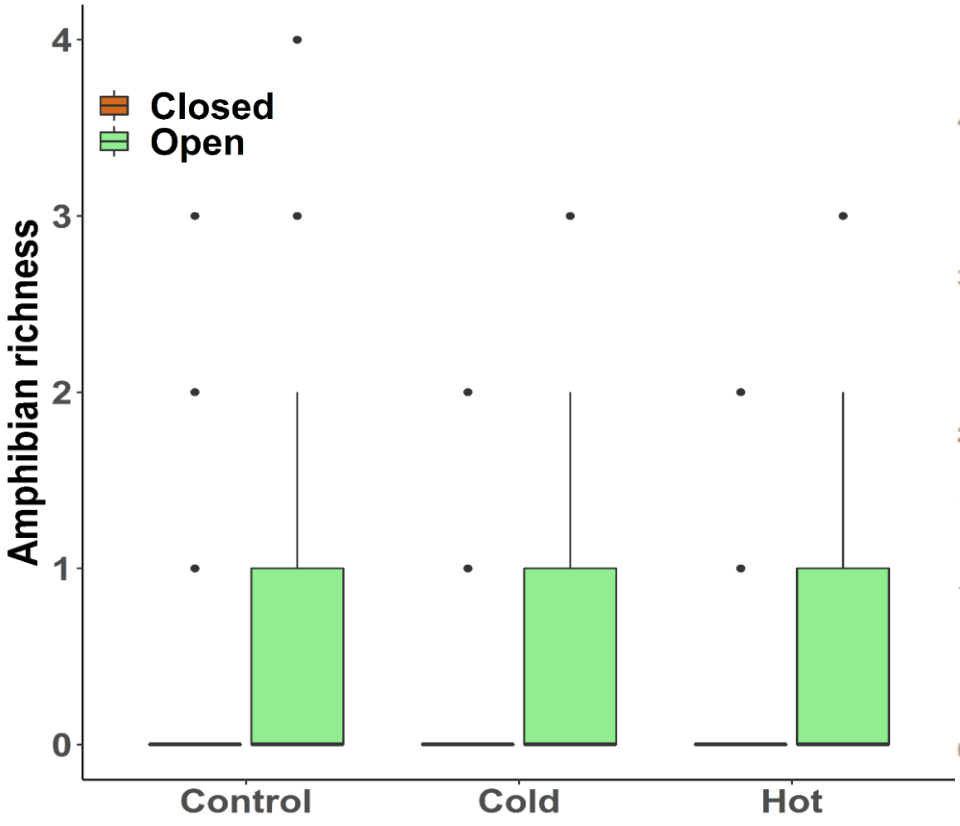
Photos: Piotr Naskrecki

Amphibian richness was ~16% higher in the wet season

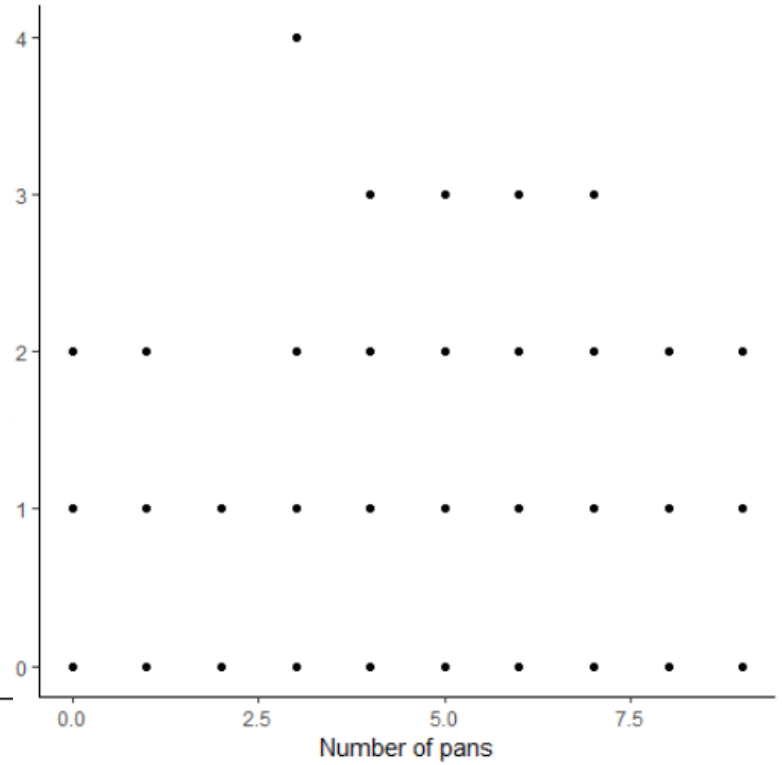
Richness increased in open plots and near pans

Richness was reduced in plots with more shrubs

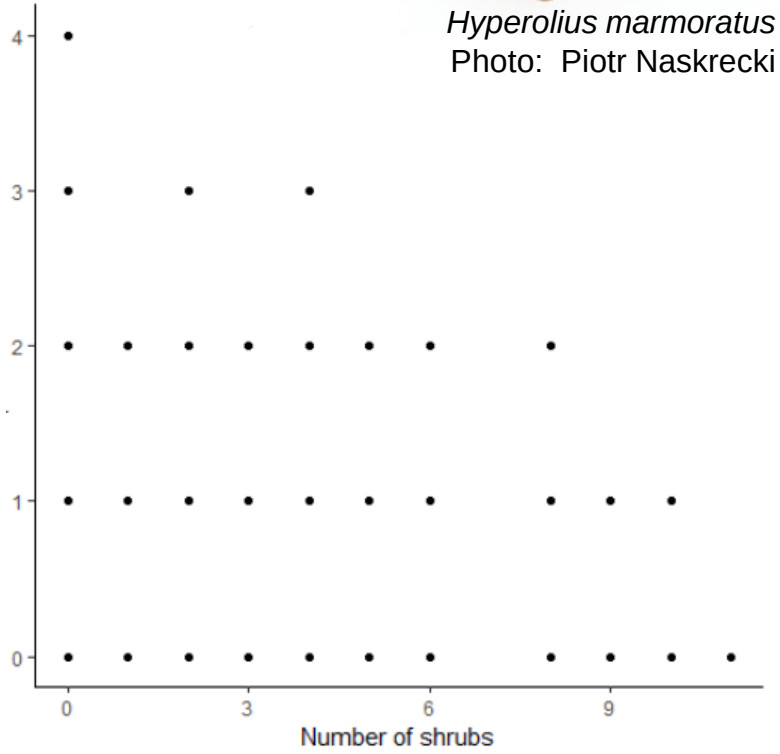
Hyperolius marmoratus
Photo: Piotr Naskrecki



E: $X^2 = 40.2$, df = 1, $P < 0.0001$



$X^2 = 4.0$, df = 1, $P = 0.04$

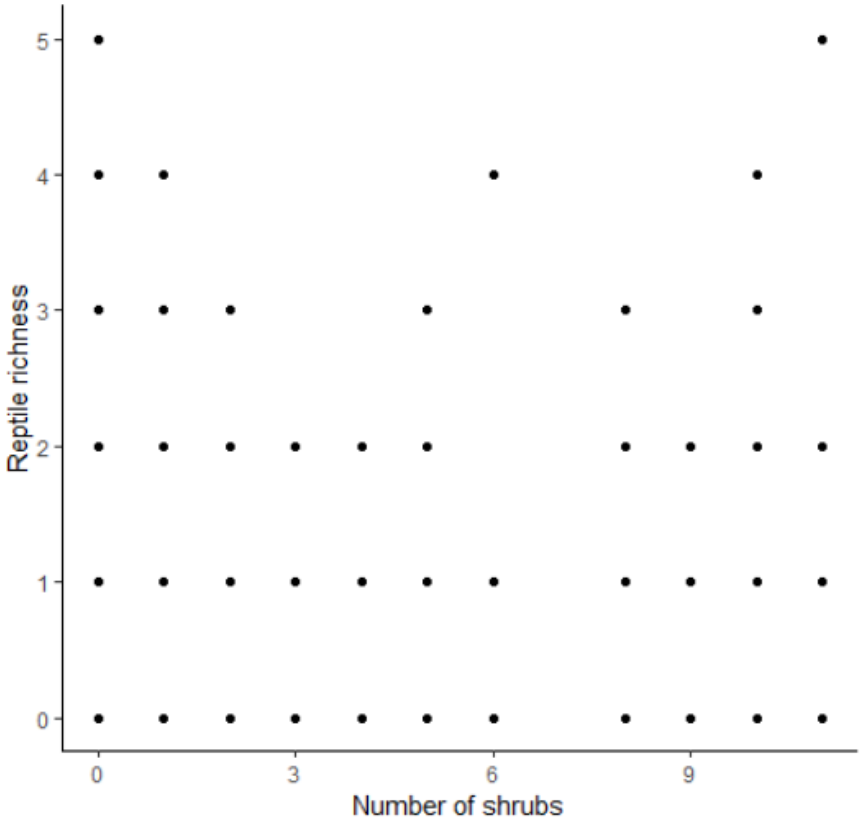


$X^2 = 5.0$, df = 1, $P = 0.03$

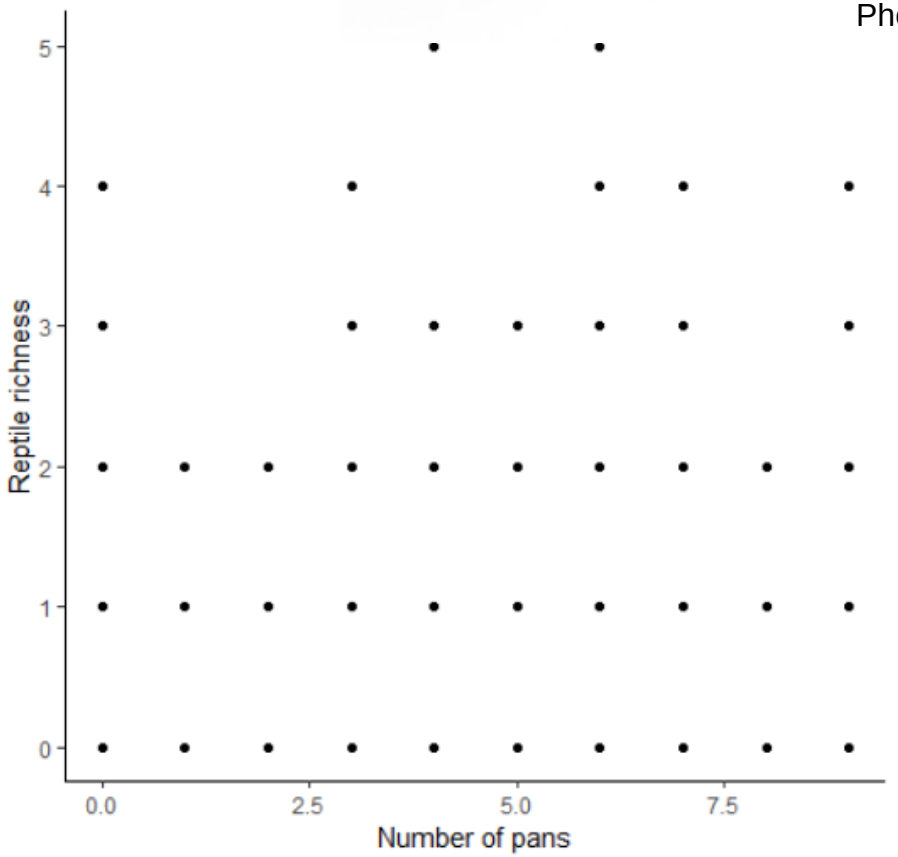
Reptile richness was about 66% higher in the dry vs. wet season

Richness increased with shrub abundance and the number of pans

Lygodactylus capensis
Photo: Piotr Naskrecki

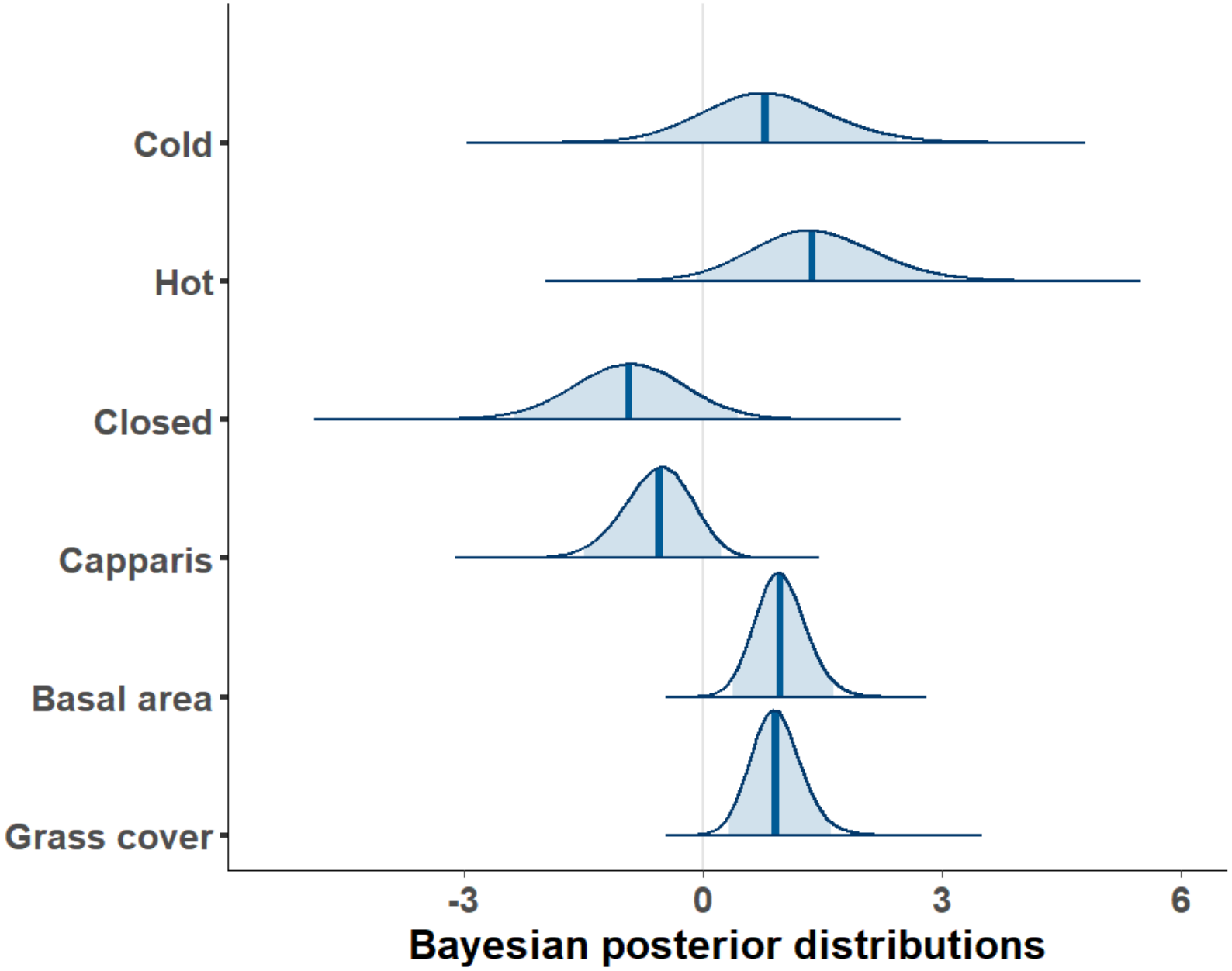


$X^2 = 5.6$, df = 1, $P = 0.02$



$X^2 = 3.8$, df = 1, $P = 0.05$

Granivorous bird richness increased with **fire** and **decreased** in the **absence** of **LMH**

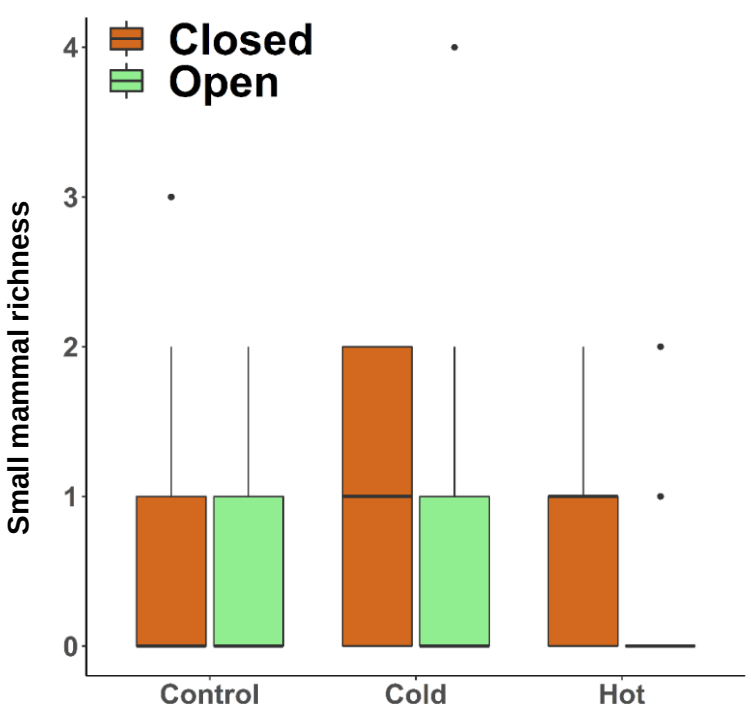


Estrilda astrild
Photo: Jonatá Caminho

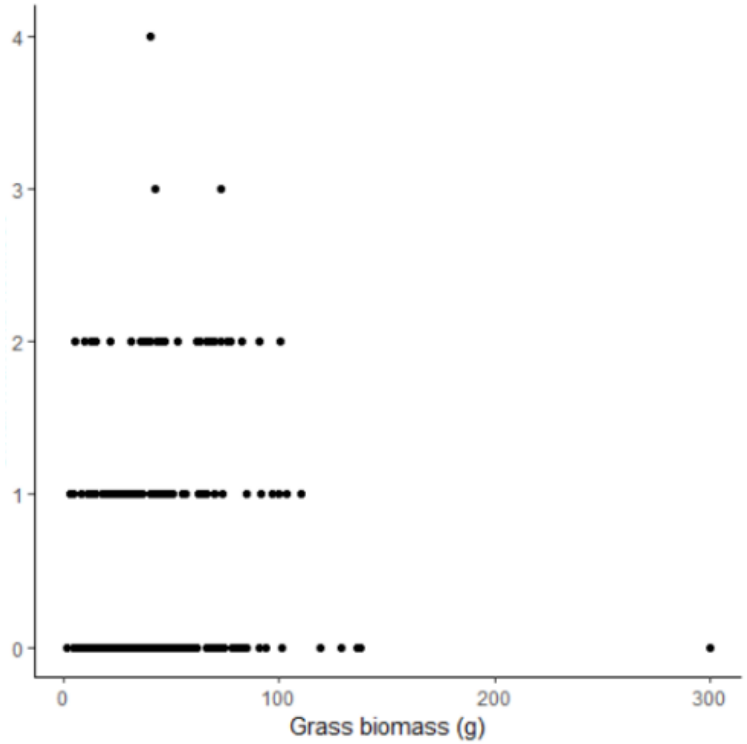
Small mammal richness was **higher without LMH**

Richness decreased with grass biomass and shrub abundance

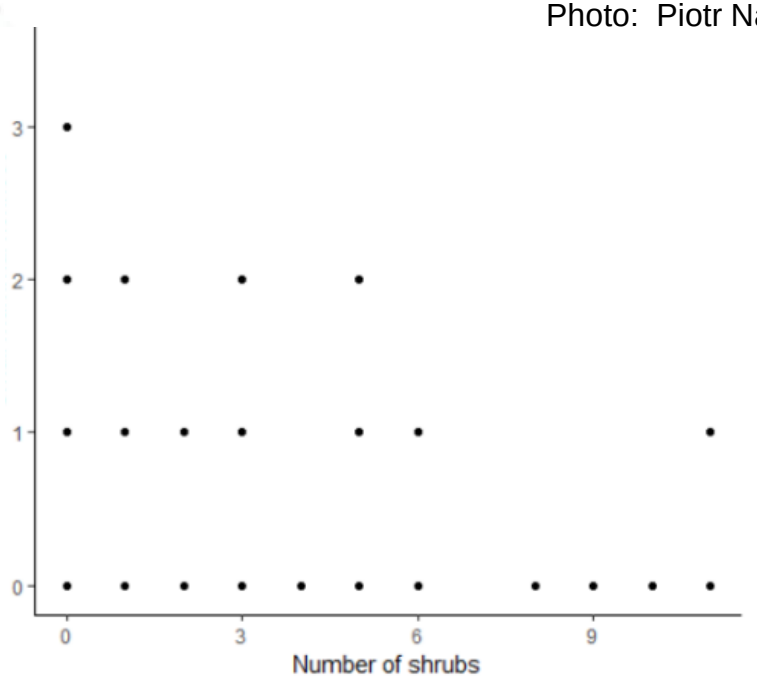
Mus minuties
Photo: Piotr Naskrecki



E: $X^2 = 8.9$, df = 1, $P = 0.003$



$X^2 = 3.9$, df = 1, $P = 0.049$



$X^2 = 4.3$, df = 1, $P = 0.04$

To wrap-up…

Fire indirectly promoted foraging of some species but limited foraging of others

Ground dwelling crickets were negatively related to shrub cover

Photos: Piotr Naskrecki

LMH limited beetle richness

Hispellinus sp.
Chrysomelidae: Cassidinae

Phanerotomea arnoldi
Tenebrionidae

Anthia burchelli
Carabidae

Polyclada flexuosa
Chrysomelidae: Alticinae

Photos: Piotr Naskrecki

Amphibian richness was positively affected by the presence of LMH directly

Richness was indirectly affected by fire and LMH (decrease with shrub abundance)

Hyperolius marmoratus
Photo: Piotr Naskrecki

Lygodactylus capensis
Photo: Piotr Naskrecki

Amphibian richness was positively affected by the presence of LMH directly

Richness was indirectly affected by fire and LMH (decrease with shrub abundance)

Reptile richness increased with shrub abundance

Hyperolius marmoratus
Photo: Piotr Naskrecki

Lygodactylus capensis
Photo: Piotr Naskrecki

Granivorous bird richness was higher with fire and LMH

Estrilda astrild
Photo: Jonatá Caminho

Small mammal richness increased in the absence of LMH

Photos: Piotr Naskrecki

In sum...

Conservation education can promote scientific research

A one size fits all fire regime may not support savanna biodiversity holistically

This experiment hints at what may happen if LM continue to decline

Please collaborate!

Acácio Chechene, Beto Tenente, Osvaldo Abrão, Hermínio António

Thank you...

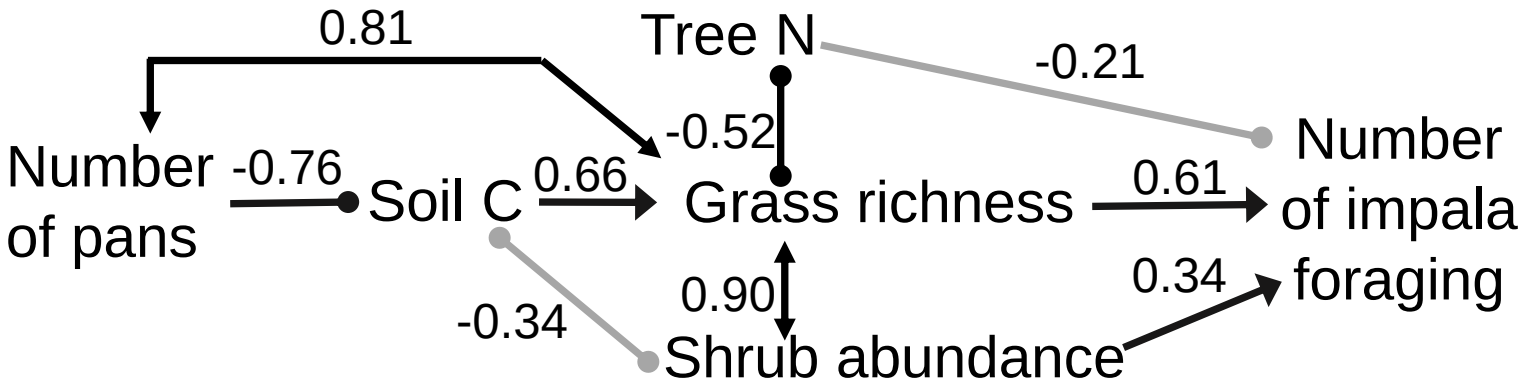
Marc Stalmans, Mark Oliver-Rödel, Ara Monadjem, Piotr Naskrecki, Luís Comissário

Diolinda Mundoza, Arquimedes André, Celina Dias, Dadzie Tarua

The Gorongosa Biodiveristy Interns

The Gorongosa Science, Conservation, and Operations Departments


PARQUE NACIONAL DA GORONGOSA
Questions?


0.81
Tree N
-0.21
-0.52
Number
of pans
-0.76
Soil C
0.66
Grass richness
0.61
Number
of impala
foraging
0.34
0.90
-0.34
Shrub abundance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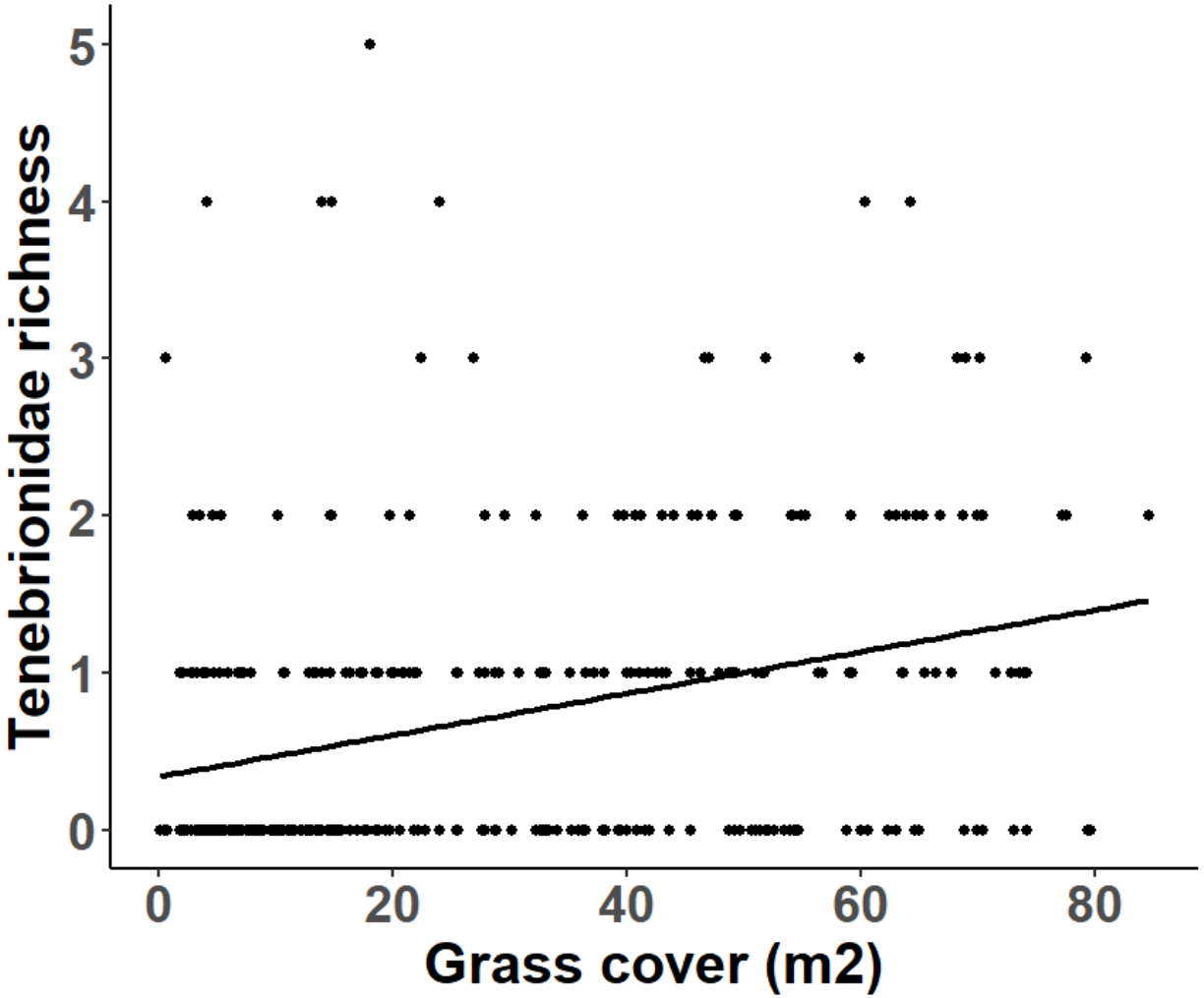
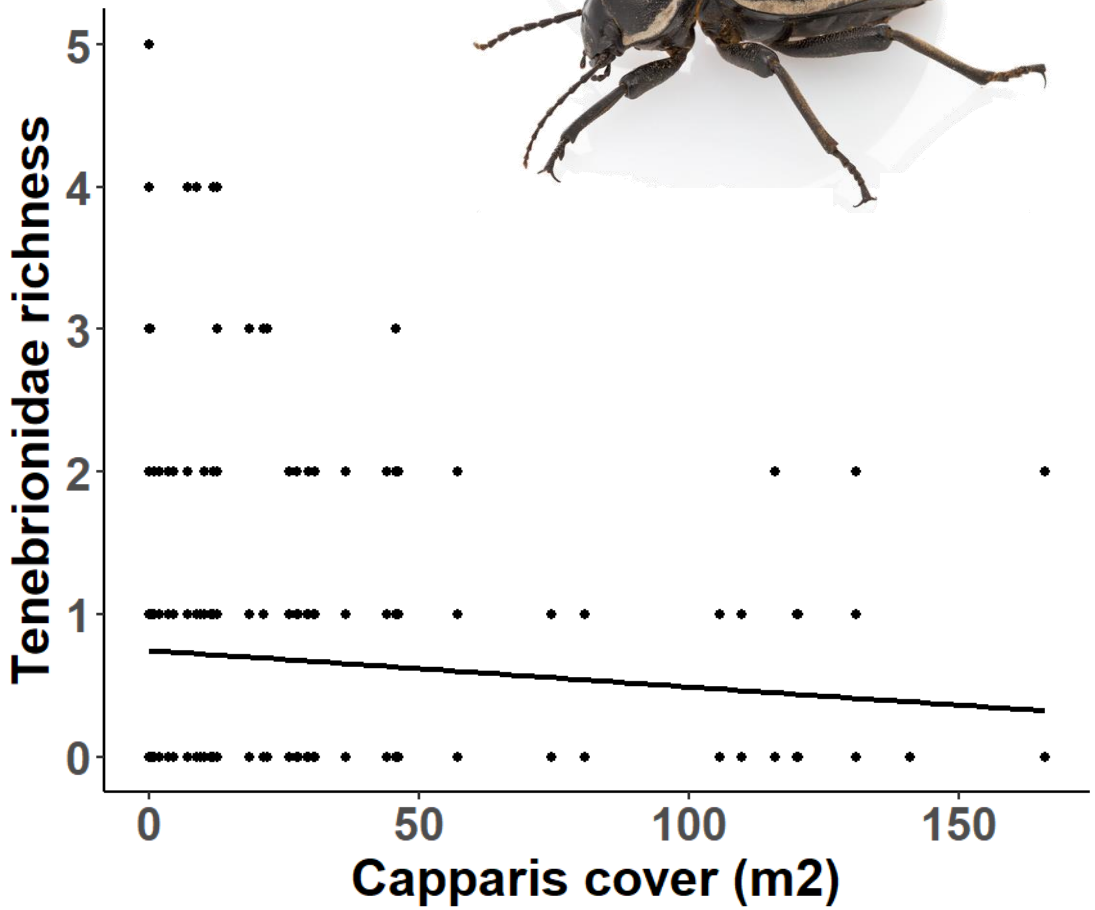


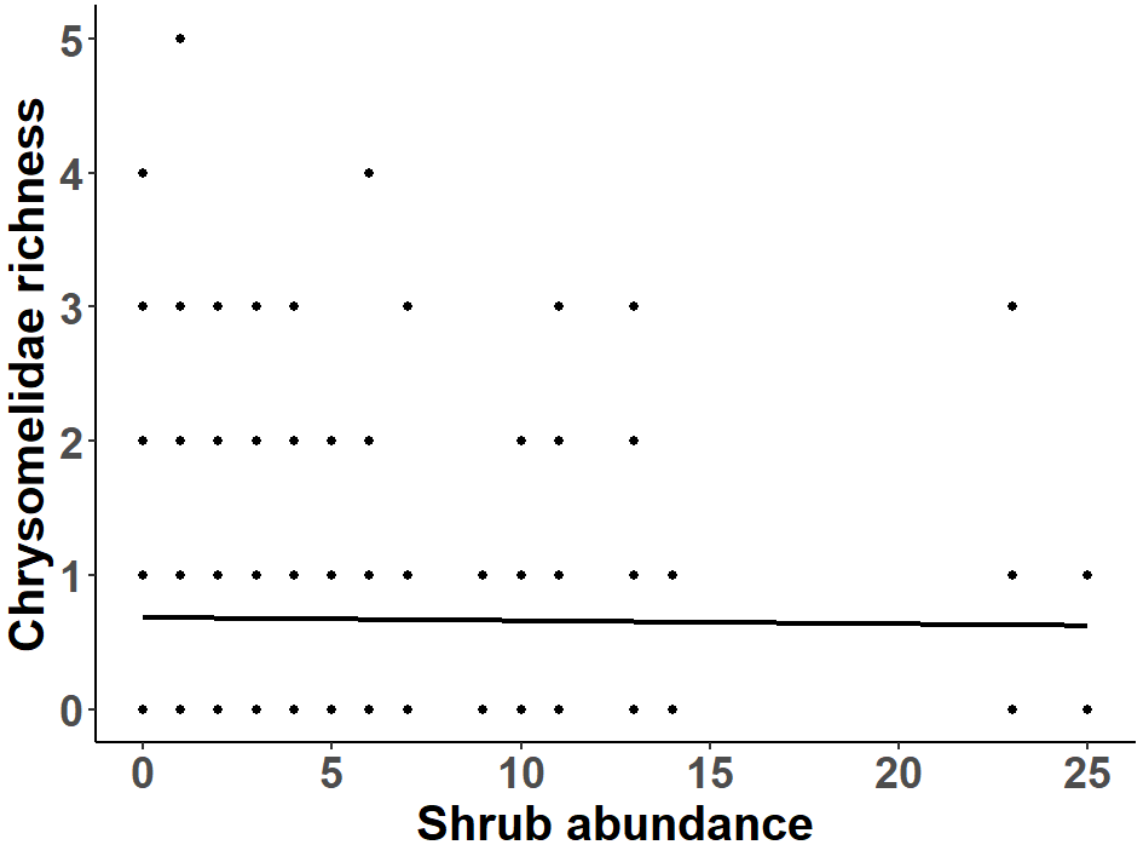
PE = 0.4, P = 0.003

Phanerotomea arnoldi

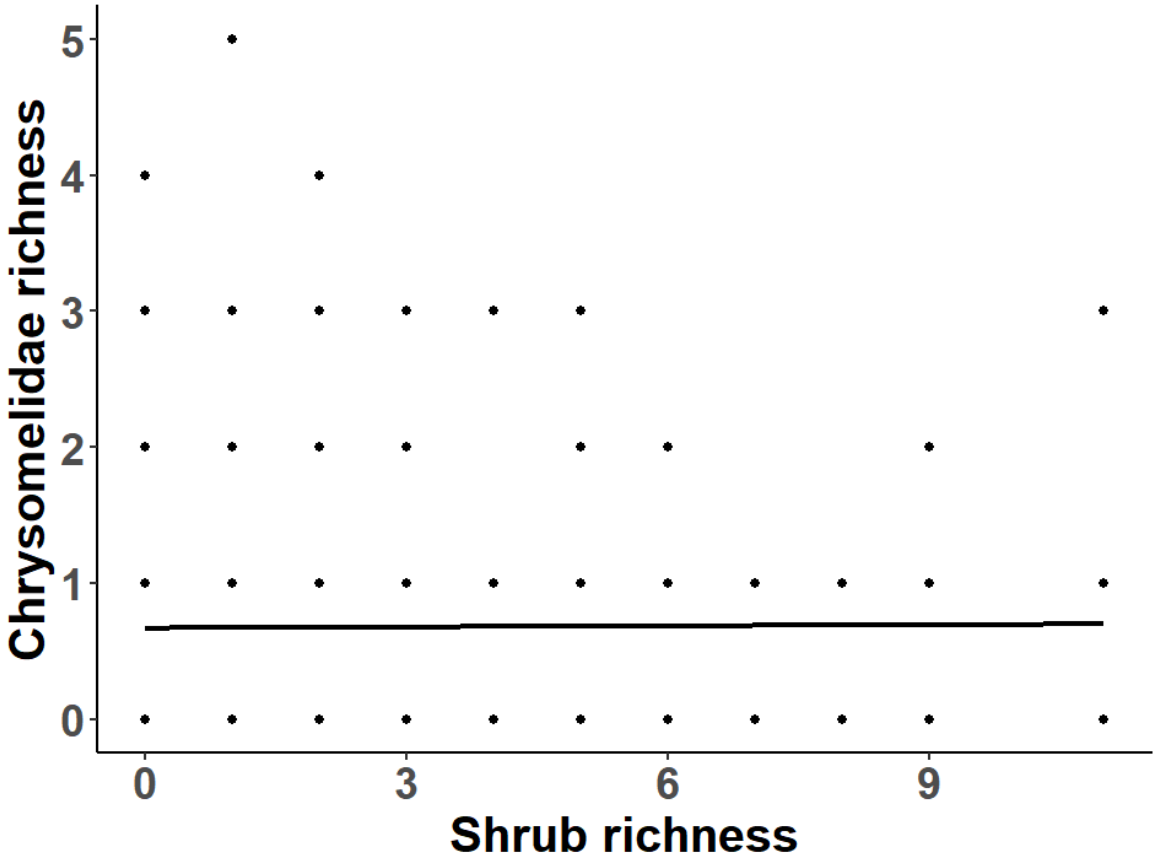


PE = -0.3, P = 0.009

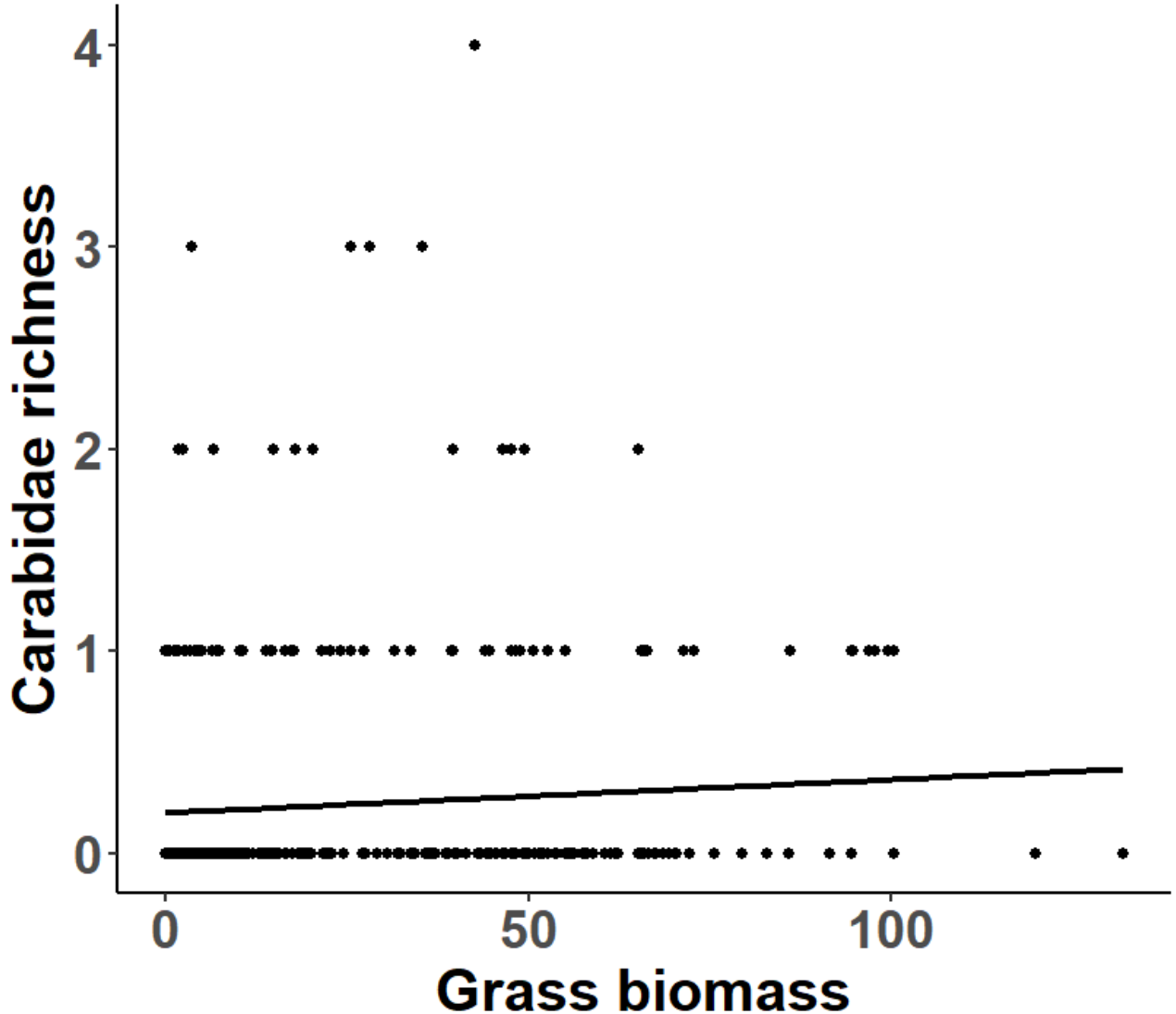
Photos: Piotr Naskrecki



PE = -0.4, P = 0.055



PE = 0.4, P = 0.046



PE = 0.4, P = 0.049