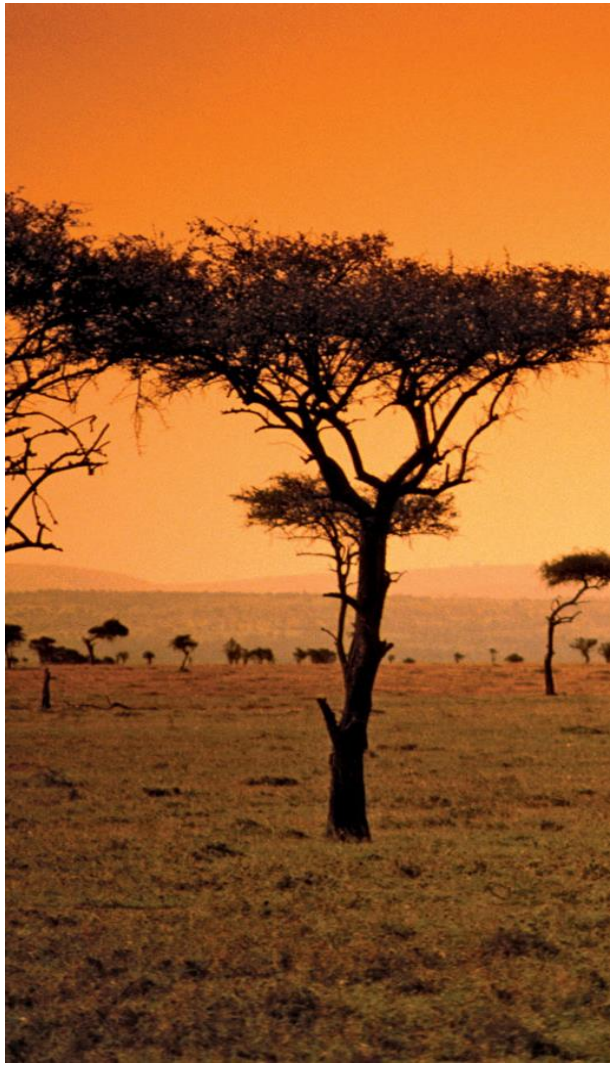
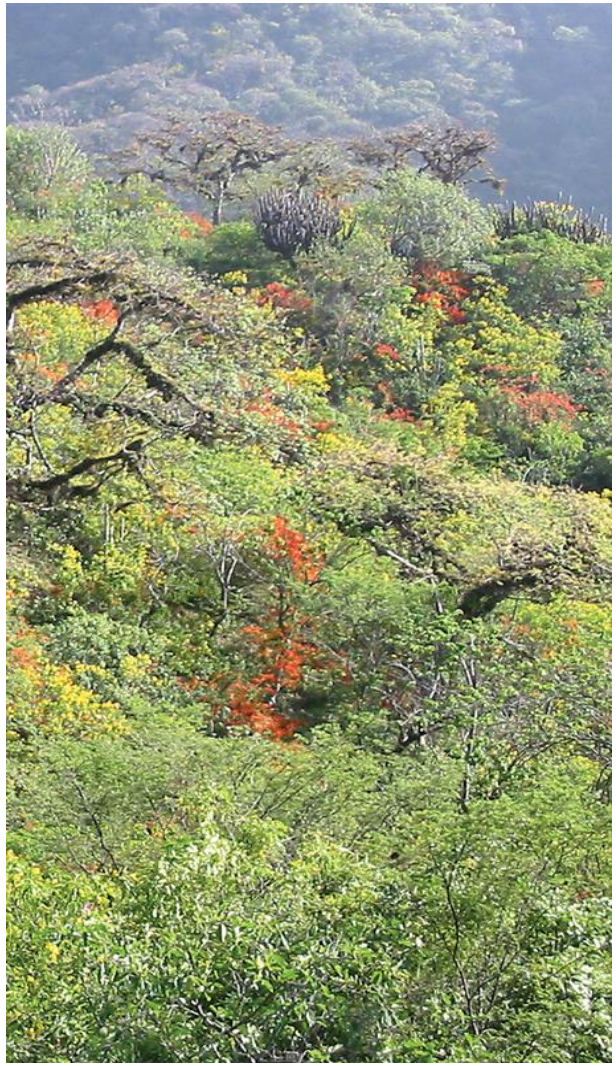
GRASSLANDS, SAVANNAS AND DRY FORESTS

GRASSLANDS, SAVANNAS AND DRY FORESTS





GRASSLANDS, SAVANNAS AND DRY FORESTS

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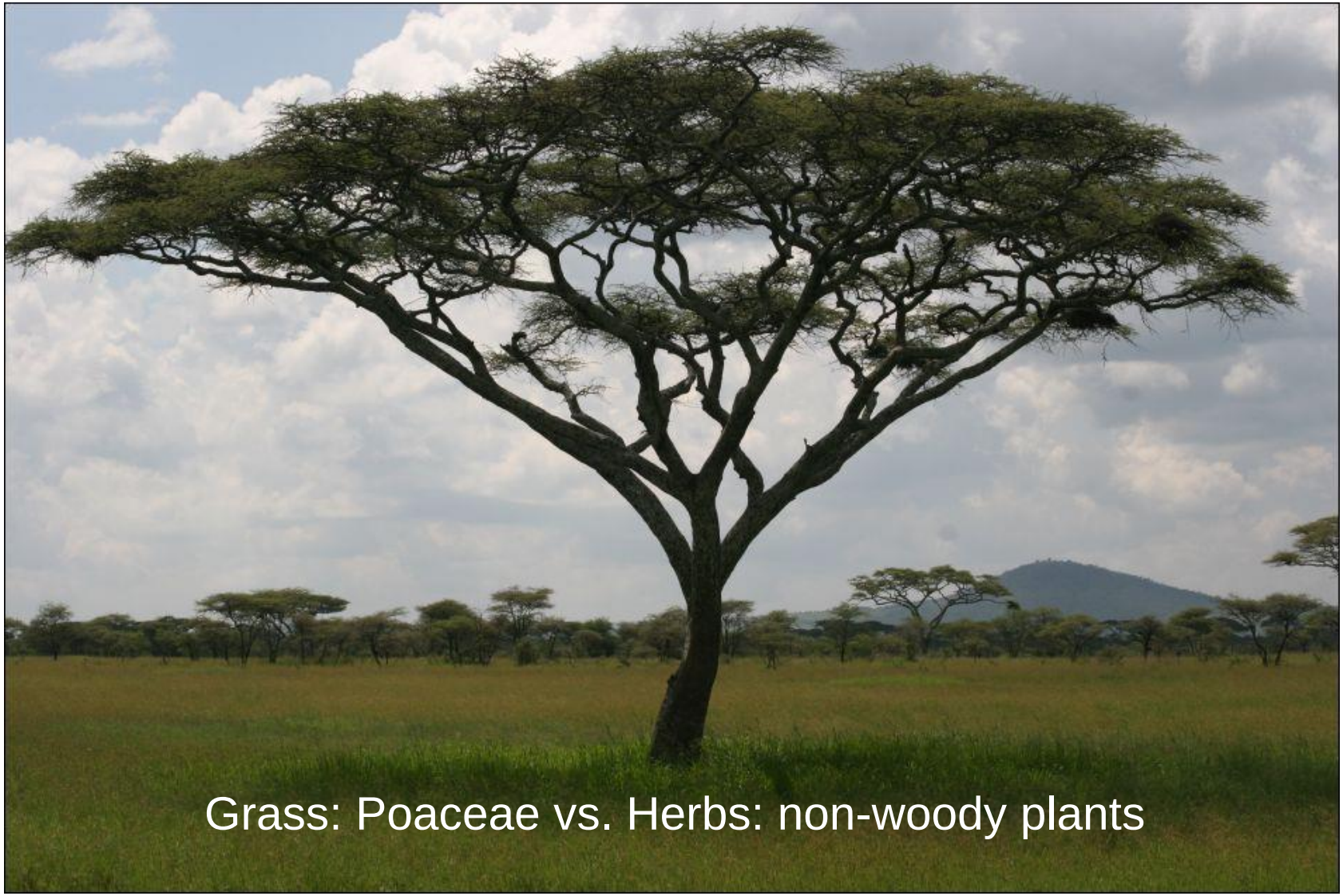
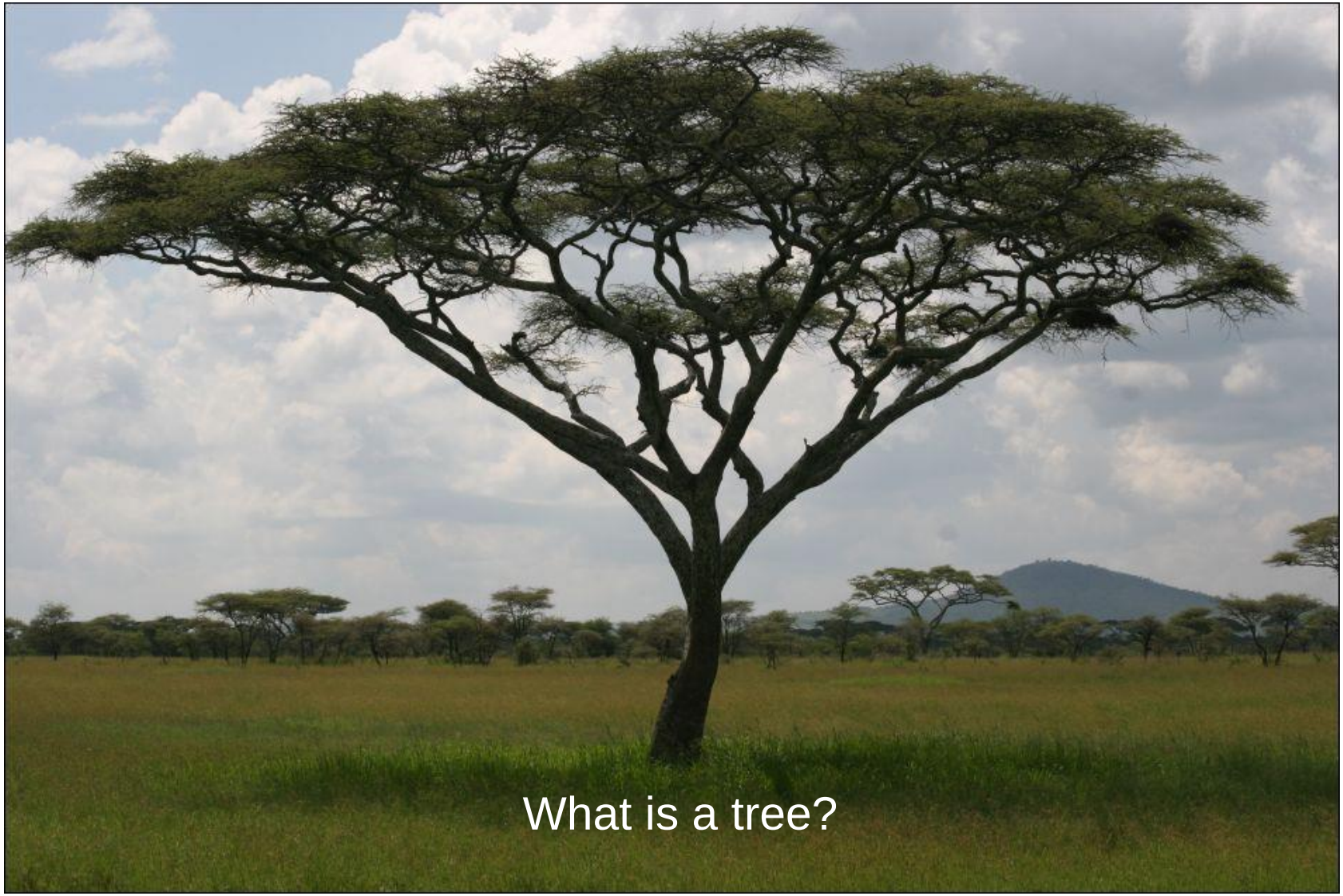


Grass: Poaceae vs. Herbs: non-woody plants

GRASSLANDS, SAVANNAS AND DRY FORESTS



GRASSLANDS, SAVANNAS AND DRY FORESTS

GRASSLANDS, SAVANNAS AND DRY FORESTS

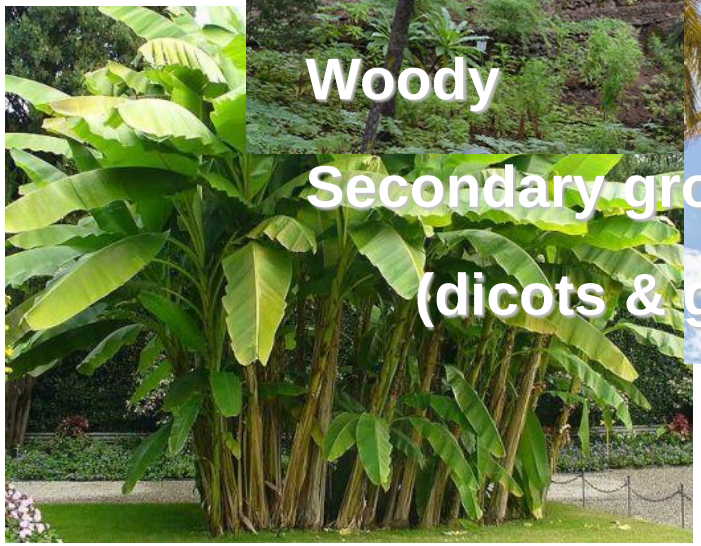
Perennial plant

Trunk

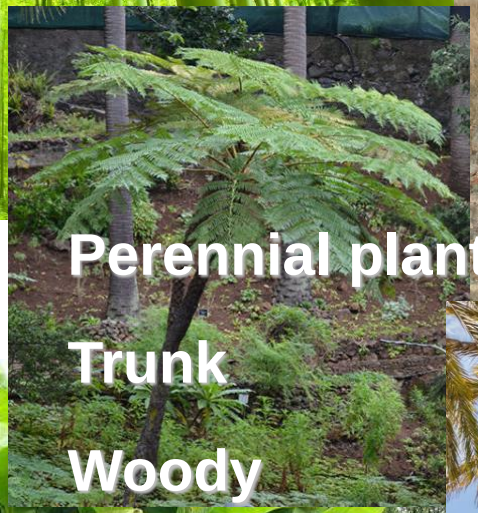
Woody

Secondary growth

(dicots & gymnosperms)



GRASSLANDS, SAVANNAS AND DRY FORESTS



Perennial plant

Trunk

Woody

Secondary growth

(dicots & gymnosperms)

GRASSLANDS, SAVANNAS AND DRY FORESTS

Perennial plant

Trunk

Woody

Secondary growth

(dicots & gymnosperms)

GRASSLANDS, SAVANNAS AND DRY FORESTS

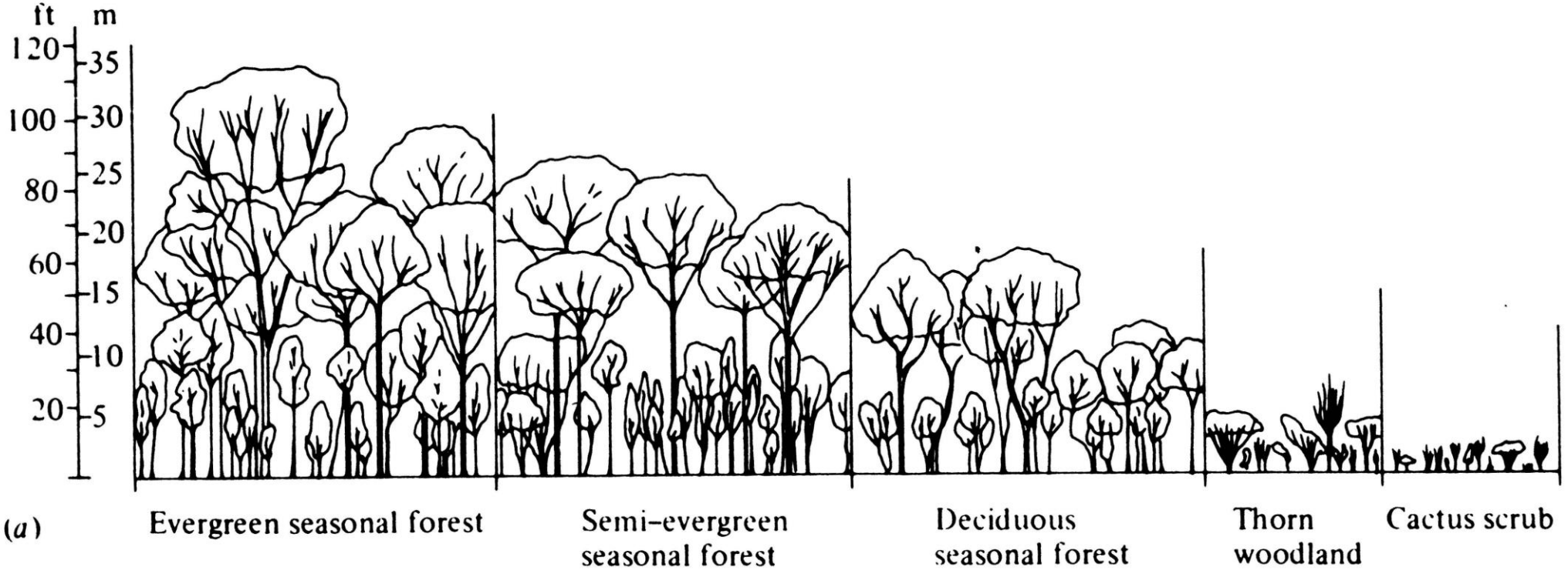
a. Forests have complete tree canopy cover and three or more overlapping vegetation strata;

b. Woodlands have 50-100% tree canopy cover by trees, and a sometimes sparse, but always significant gramineous layer;

c. Savannas have 10-50% cover by woody plants, and in the unexploited state, a well-developed grass layer;

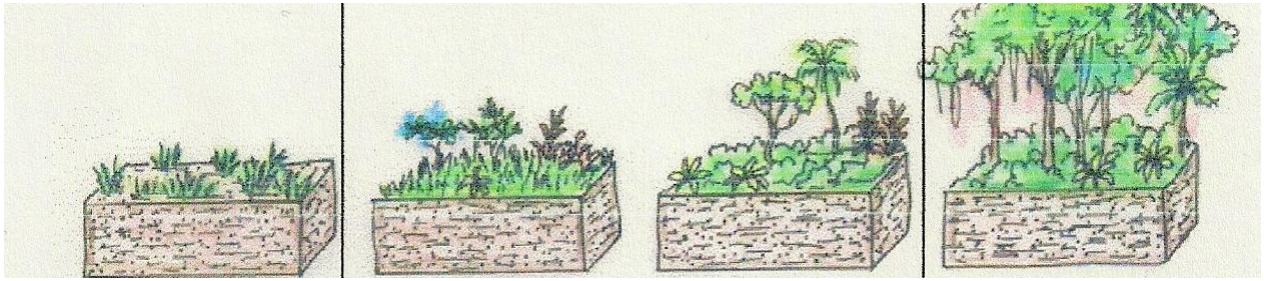
d. Grasslands have less than 10% tree cover.

GRASSLANDS, SAVANNAS AND DRY FORESTS



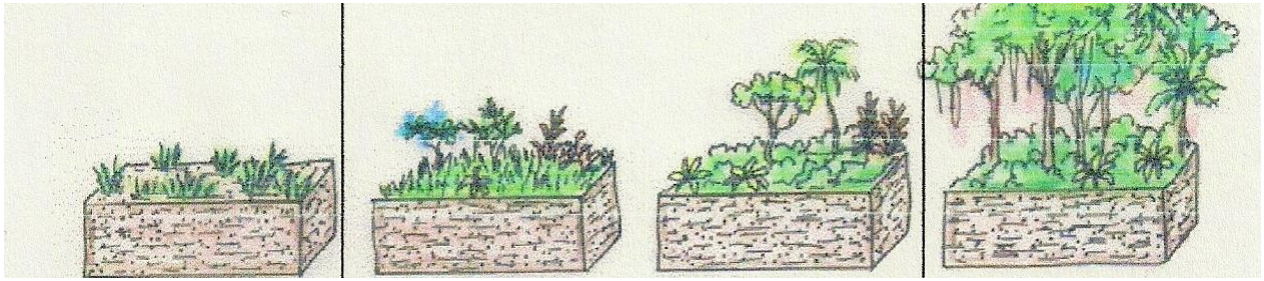
GRASSLANDS, SAVANNAS AND DRY FORESTS

Ecological gradient



GRASSLANDS, SAVANNAS AND DRY FORESTS

Ecological gradient vs. Ecological succession



GRASSLANDS, SAVANNAS AND DRY FORESTS

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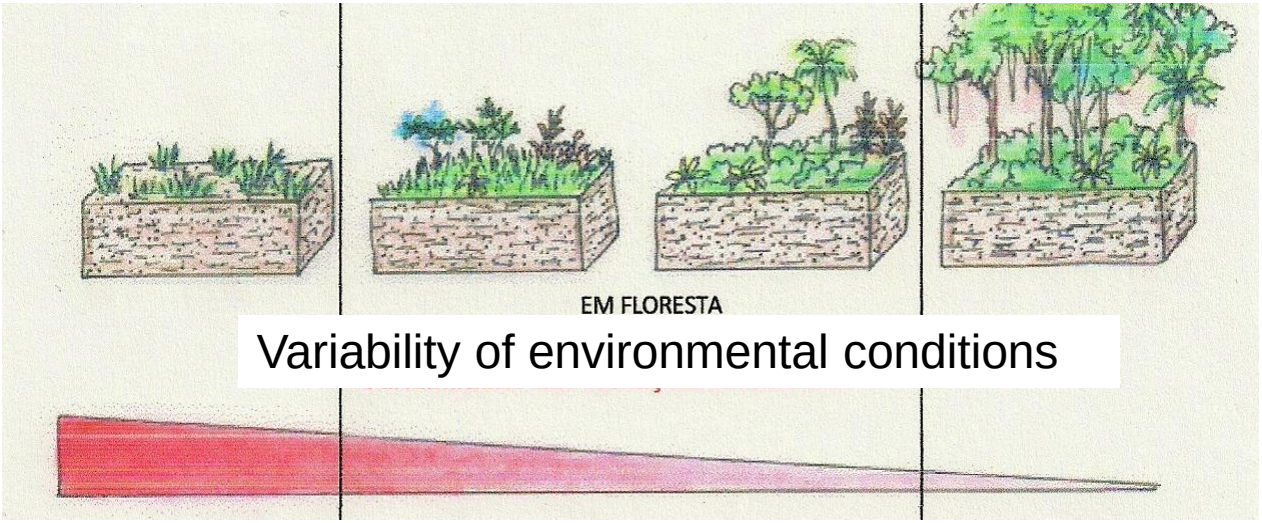
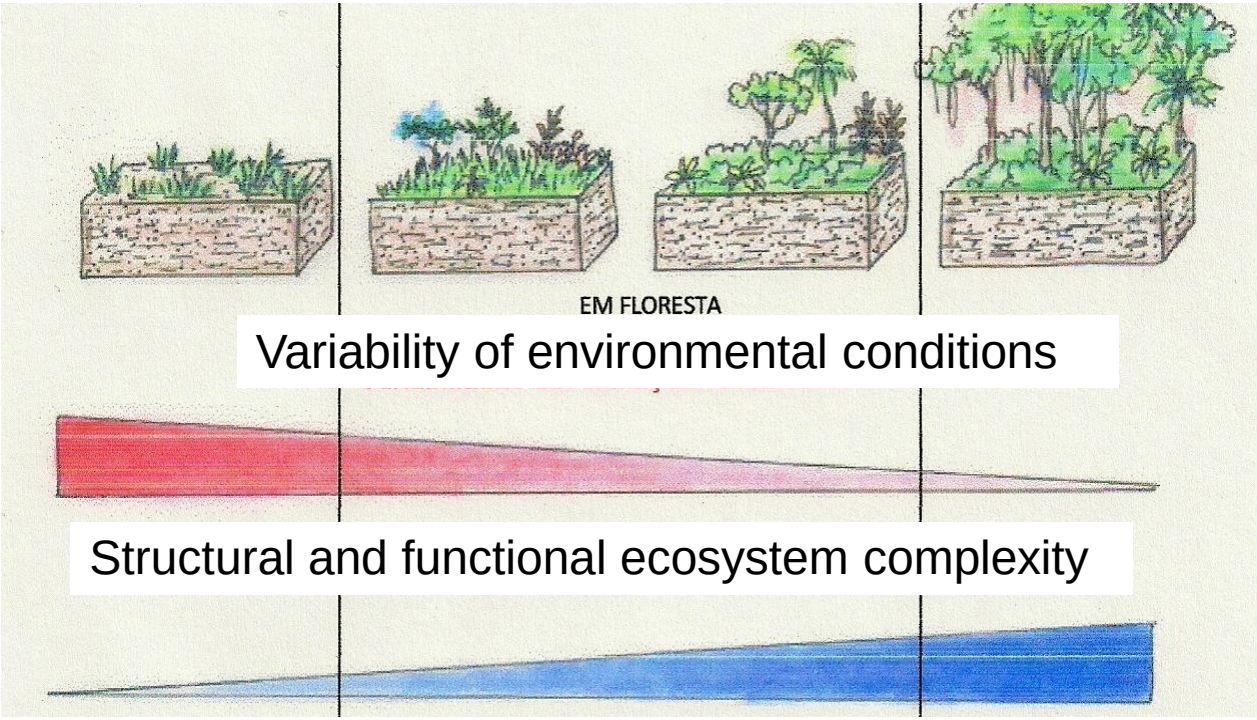


GRASSLANDS, SAVANNAS AND DRY FORESTS

Ecological gradient vs. Ecological succession



GRASSLANDS, SAVANNAS AND DRY FORESTS

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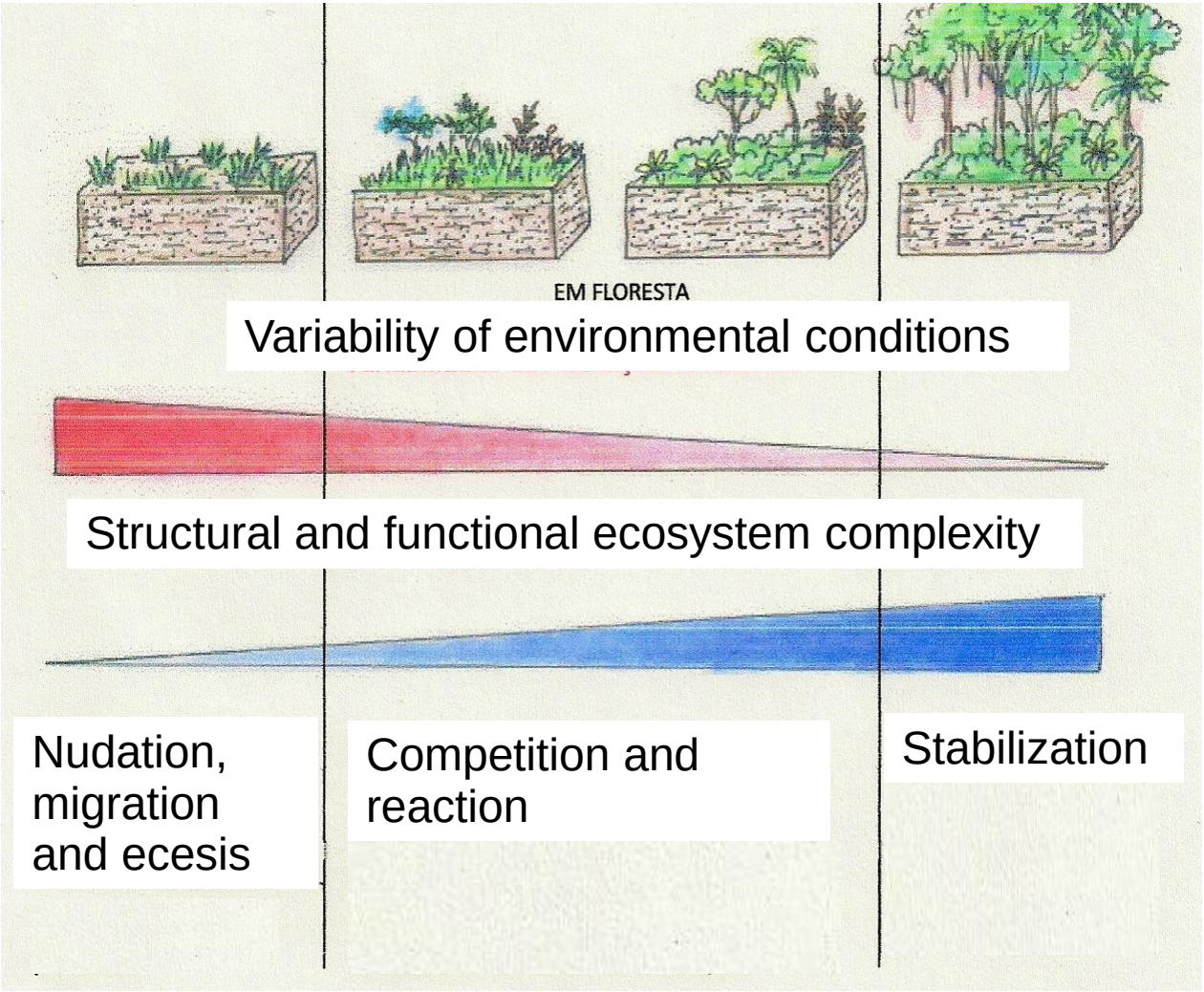
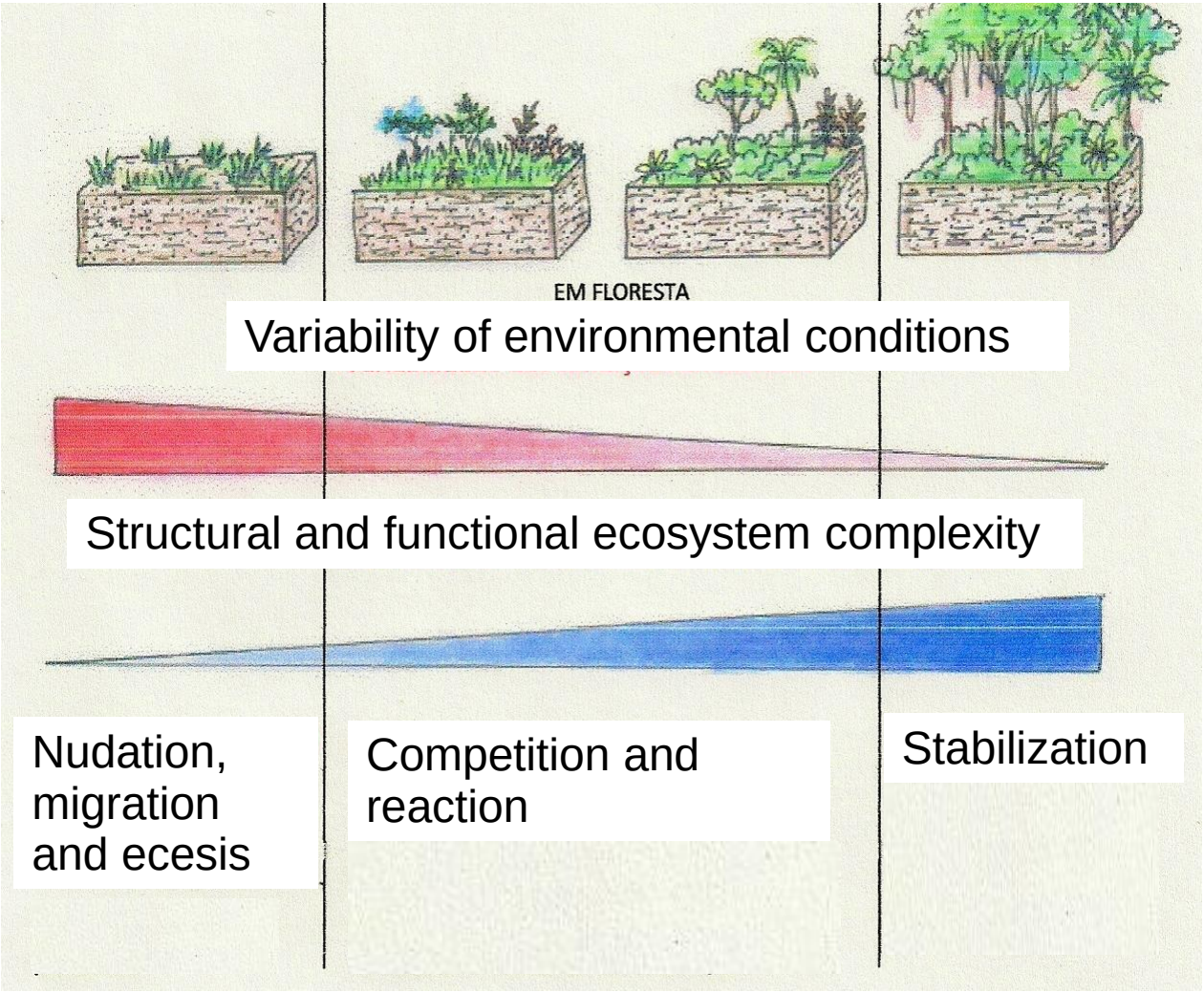


GRASSLANDS, SAVANNAS AND DRY FORESTS

Ecological gradient vs. Ecological succession

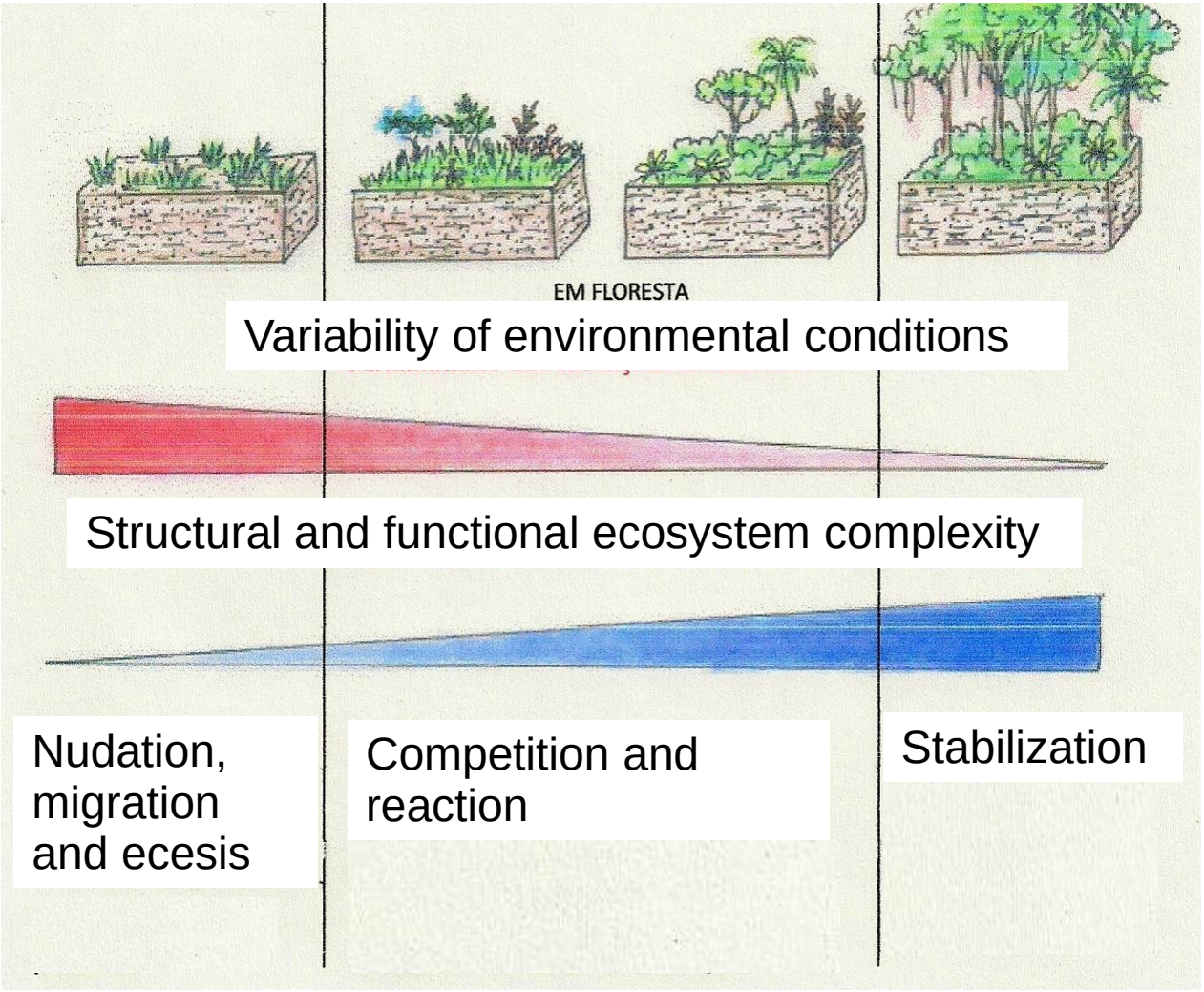


Nudation, migration and ecesis

Creation of new substract and setting of **pioneer species**

GRASSLANDS, SAVANNAS AND DRY FORESTS

Ecological gradient vs. Ecological succession

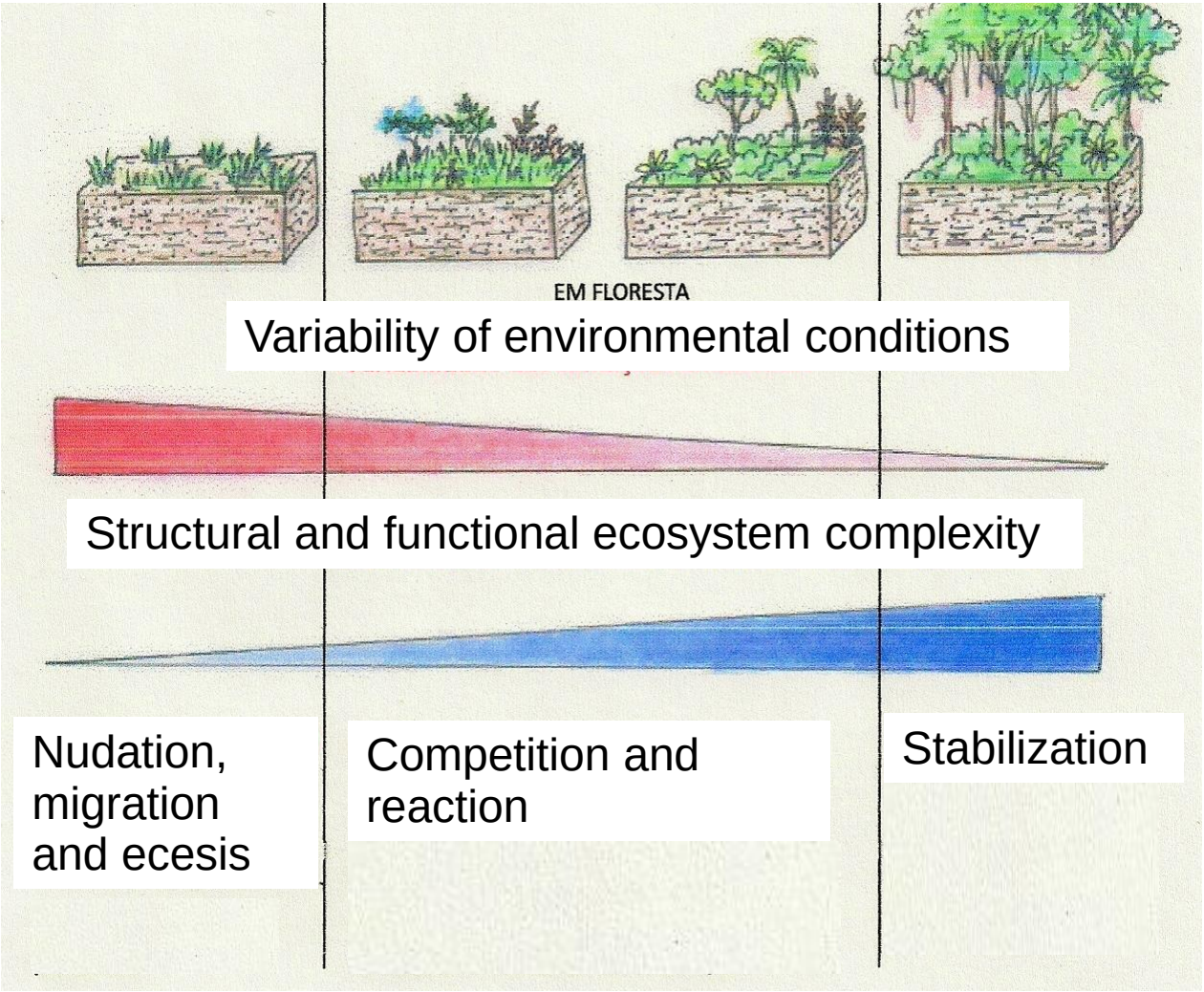


Competitions and reaction

Pioneer community is replaced by **intermediate species**, changing environmental conditions, which will create conditions for **late species**.

GRASSLANDS, SAVANNAS AND DRY FORESTS

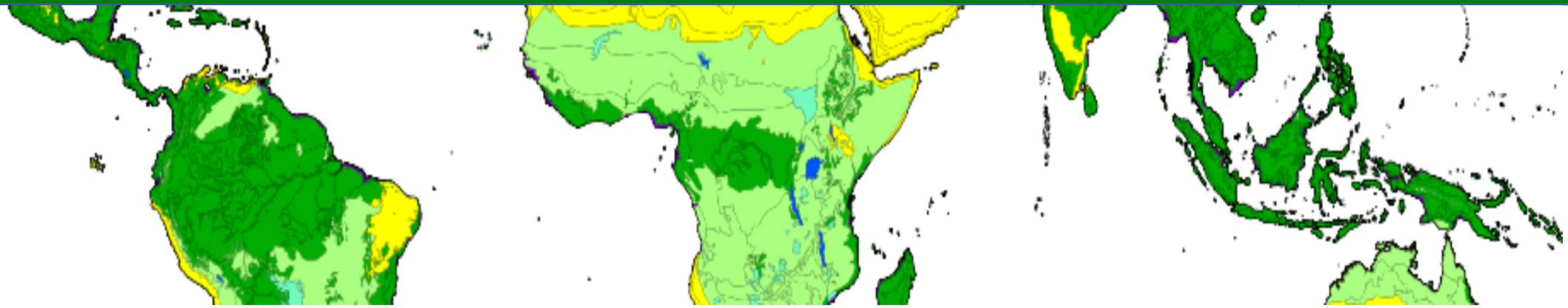
Ecological gradient vs. Ecological succession



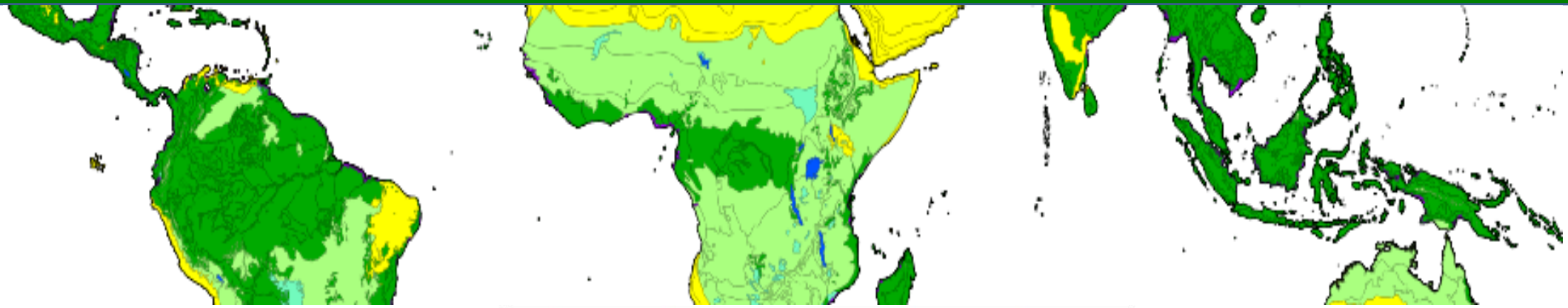
Stabilization

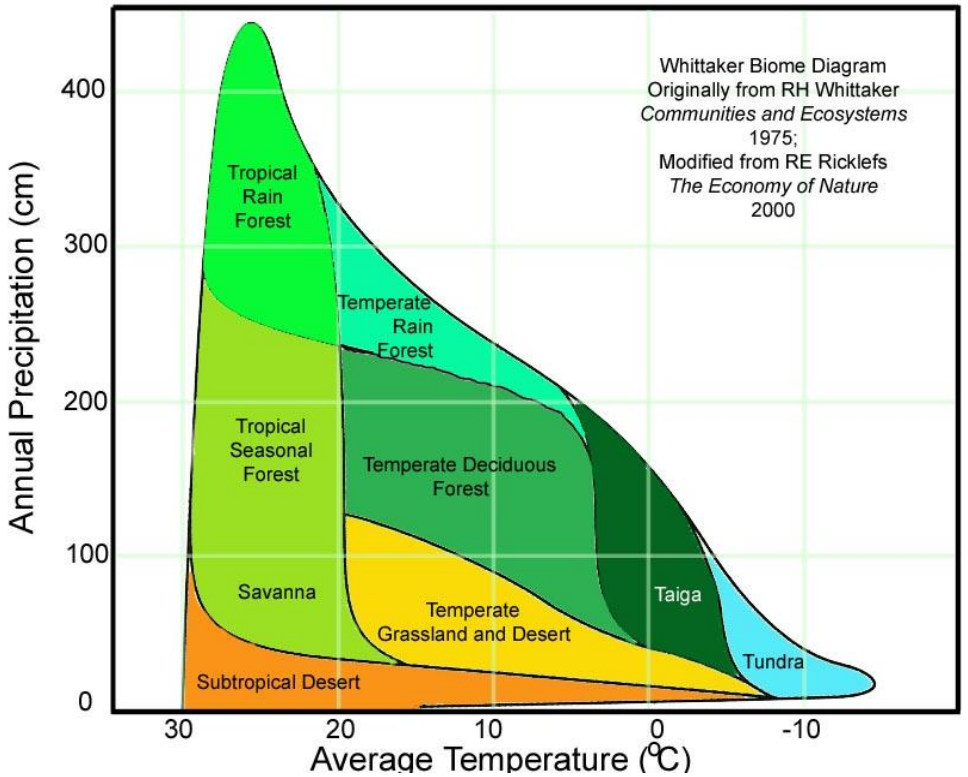
Appearance of a stable **climax community**

GRASSLANDS, SAVANNAS AND DRY FORESTS



GRASSLANDS, SAVANNAS AND DRY FORESTS





GRASSLANDS, SAVANNAS AND DRY FORESTS

GRASSLANDS, SAVANNAS AND DRY FORESTS

Coexistence of trees and herbs

GRASSLANDS, SAVANNAS AND DRY FORESTS

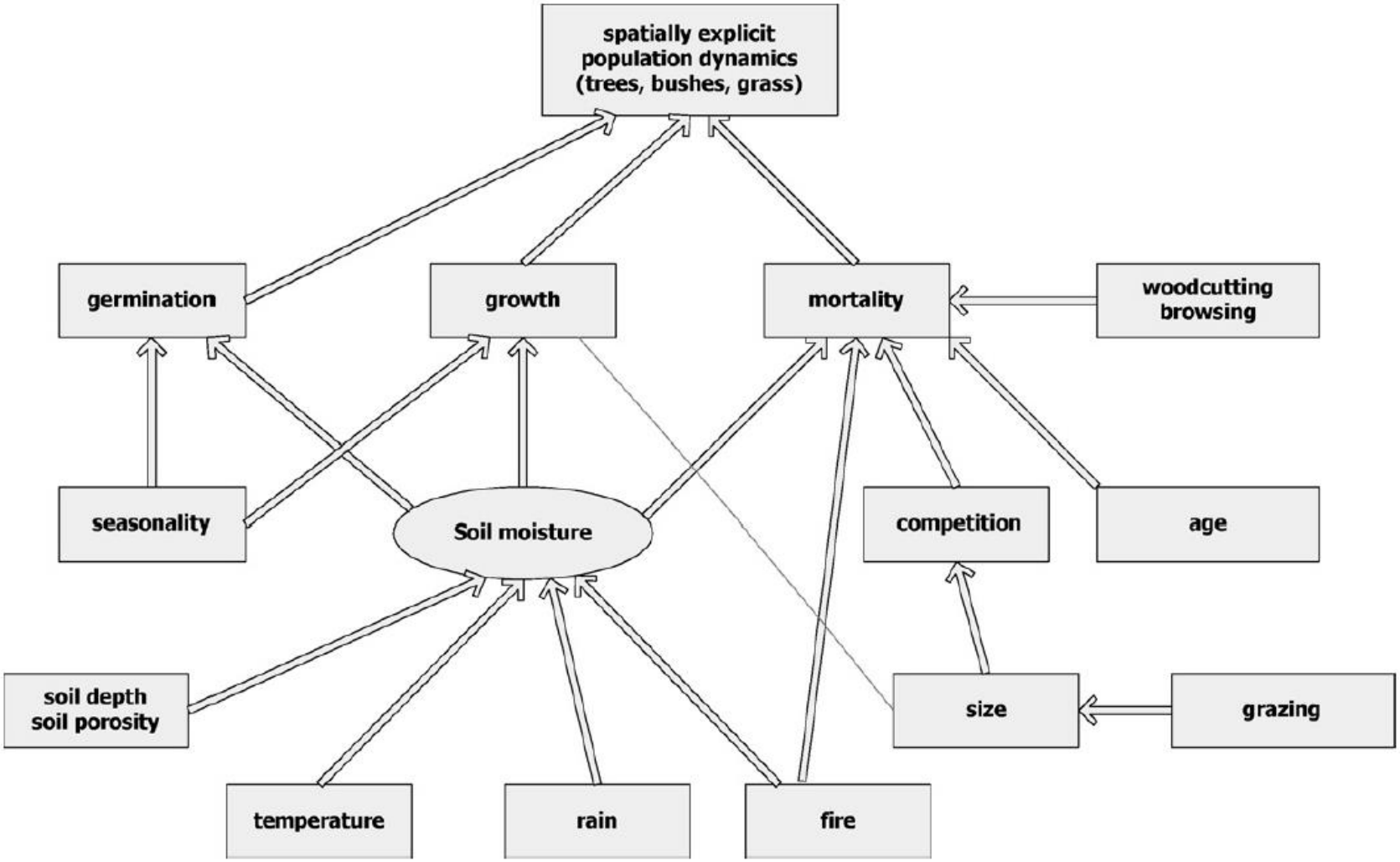


Fig. 1. Idealized spatially explicit savanna model along a soil and precipitation gradient. Size and growth are connected because they are interrelated. Arrows show influence of the starting process (box) to the one connected.

GRASSLANDS, SAVANNAS AND DRY FORESTS

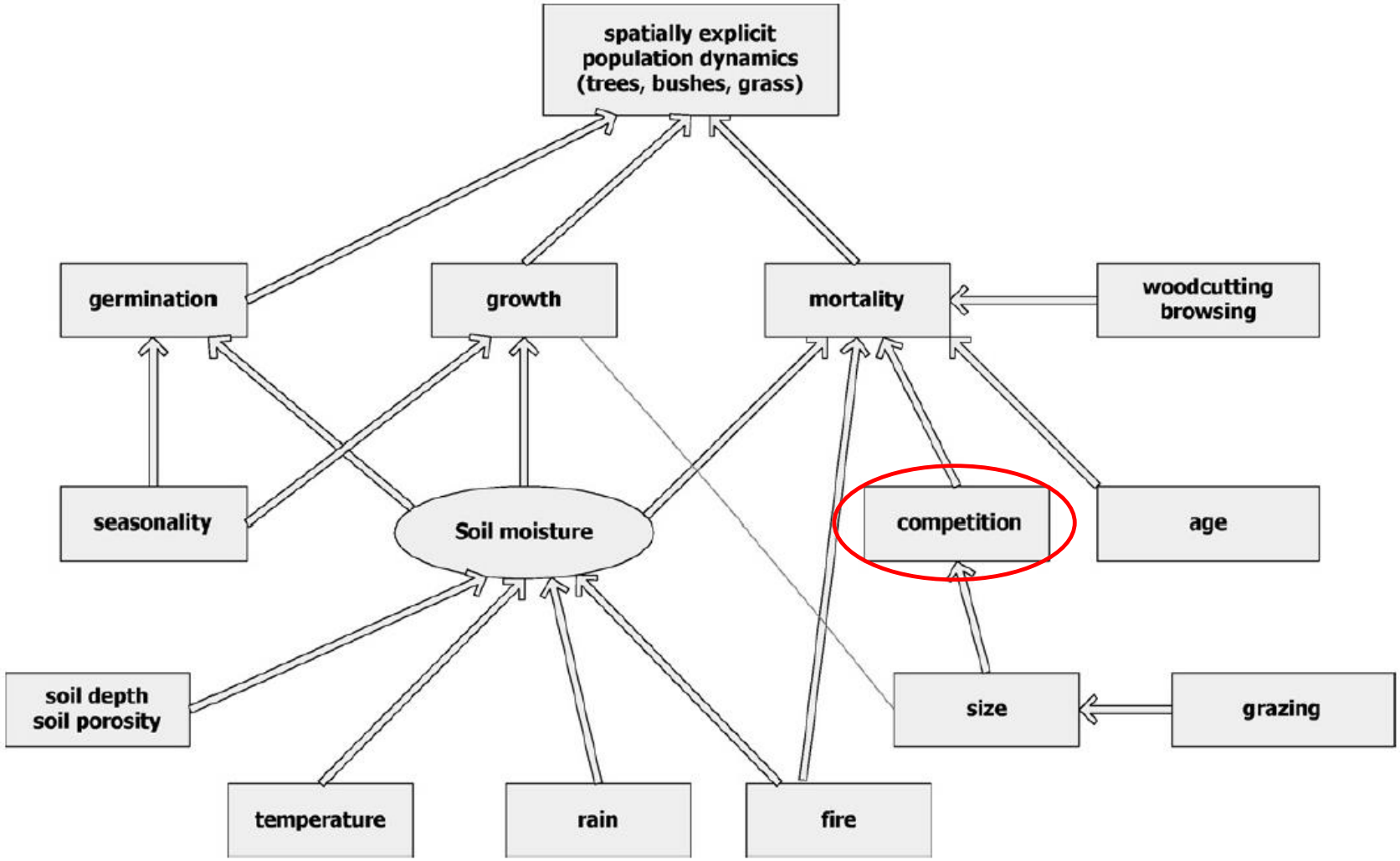


Fig. 1. Idealized spatially explicit savanna model along a soil and precipitation gradient. Size and growth are connected because they are interrelated. Arrows show influence of the starting process (box) to the one connected.

GRASSLANDS, SAVANNAS AND DRY FORESTS

Coexistence of trees and herbs

- Competition

GRASSLANDS, SAVANNAS AND DRY FORESTS

Coexistence of trees and herbs

- Competition

GRASSLANDS, SAVANNAS AND DRY FORESTS

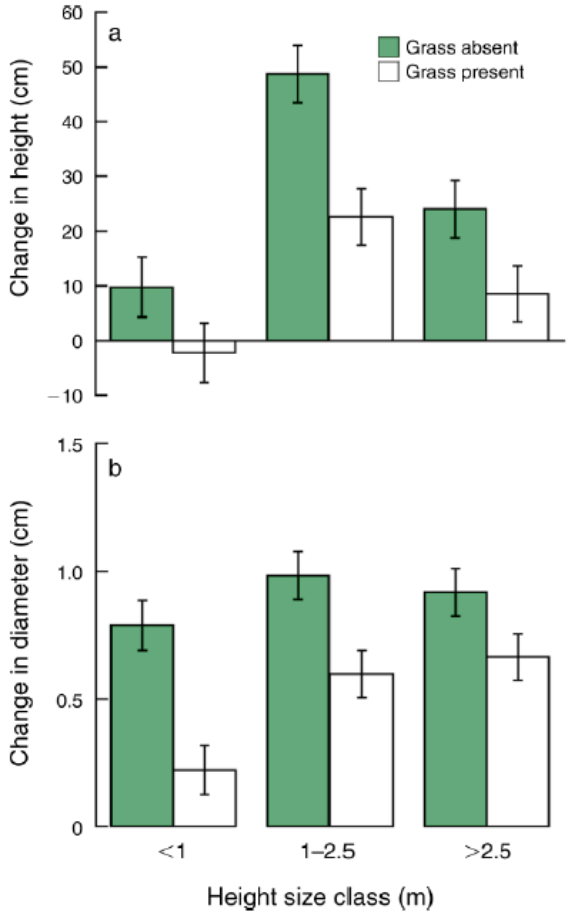


FIG. 2. Growth of *Acacia drepanolobium* trees (mean ± SE) over two years with and without the subcanopy grass removed. Growth is measured as (a) change in height and (b) change in stem diameter.

Coexistence of trees and herbs

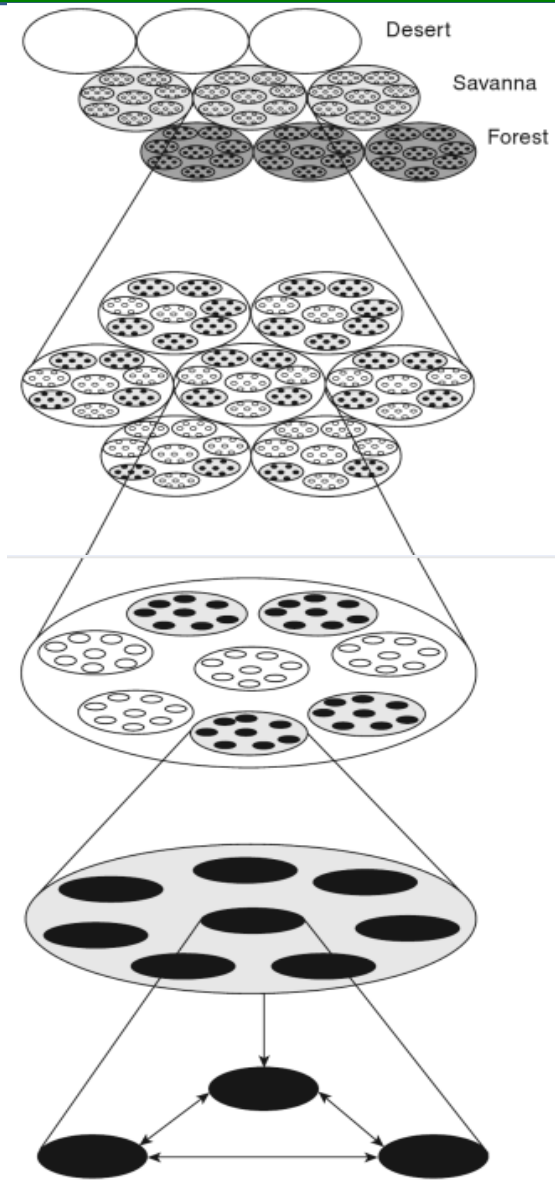
- Competition

GRASSLANDS, SAVANNAS AND DRY FORESTS

Coexistence of trees and herbs

- Competition
- Demographic mechanisms (germination, recruitment, maturity and mortality) – fire, herbivory, variability of water availability

GRASSLANDS, SAVANNAS AND DRY FORESTS



Macro scale

The limits of the savanna biome are defined by broad-scale climatic patterns.
Climatic change fire and arboriculture can all modigy the extent of savanna biome
(e.g., Ritchie & Haynes, 1987)

Regional scale

Within the savanna biome, regional changes in herbivore abundance (e.g., because of Rinderpest or hunting for ivory) can affect tree density
(e.g., Dublin, 1995)

Landscape scale

Within a savanna region, the type of savanna depends on:
Topography, hydrology, geology and rainfall
(e.g., Coughenour and Ellis, 1993)

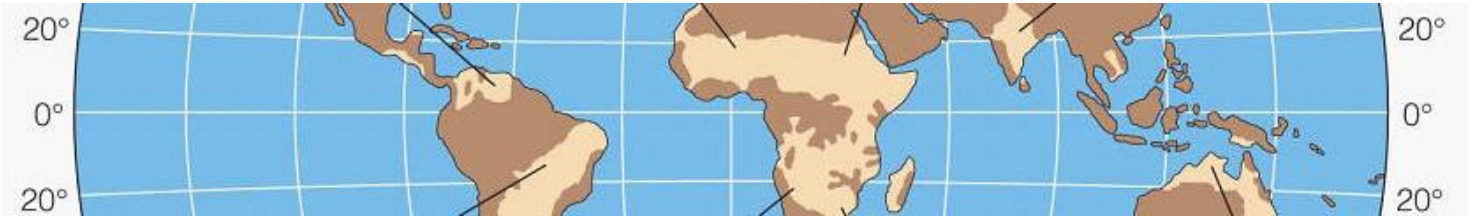
Local scale

Within savanna landscapes patchiness is determined by:
Local variations in soil and hydrology
disturbance e.g fire, herbivores
(e.g., Higgins et al. 2000)

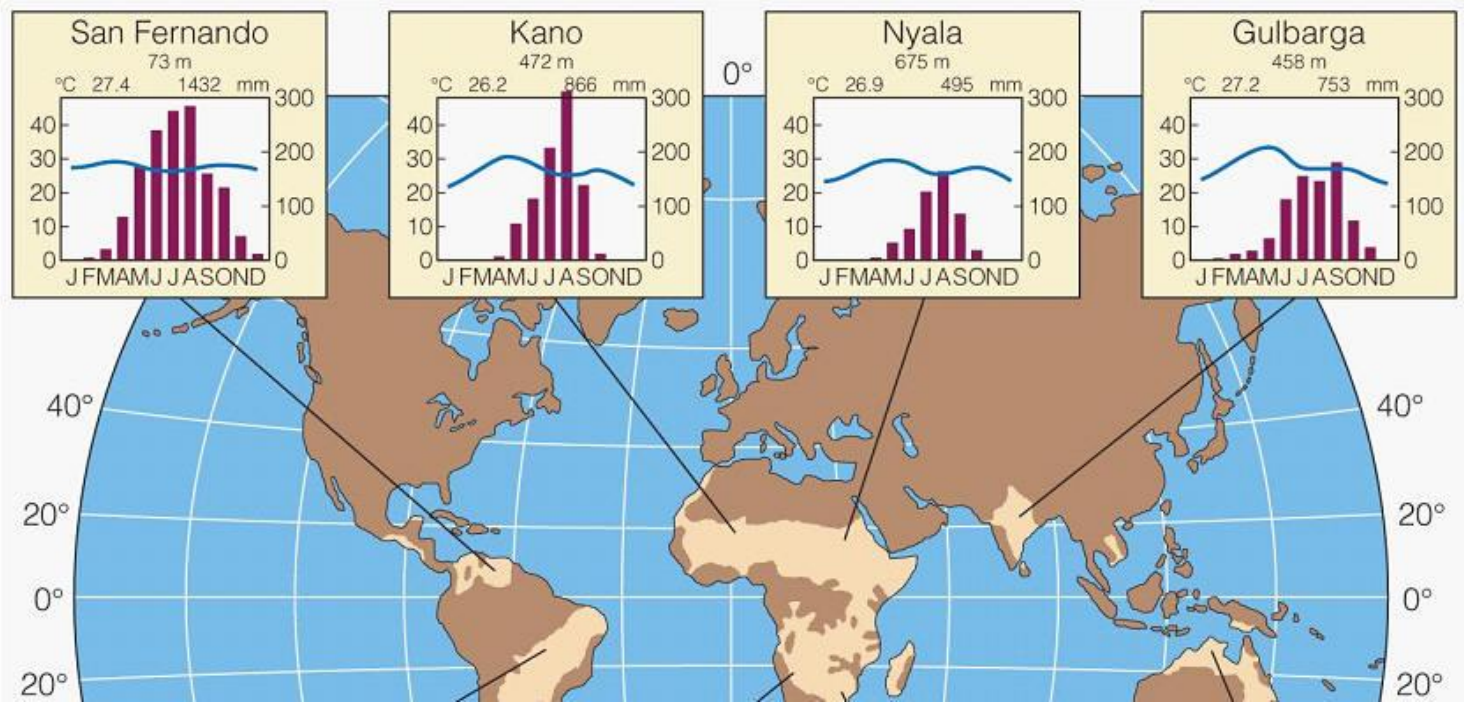
Micro scale

Within patches, tree density depends on micro-climate, selective herbivory and micro-disturbance plant-plant interactions (e.g., competition and facilitation) also occur at this scale (plant-plant interactions are represented by arrows)
(e.g., Coughenour and Ellis, 1993)

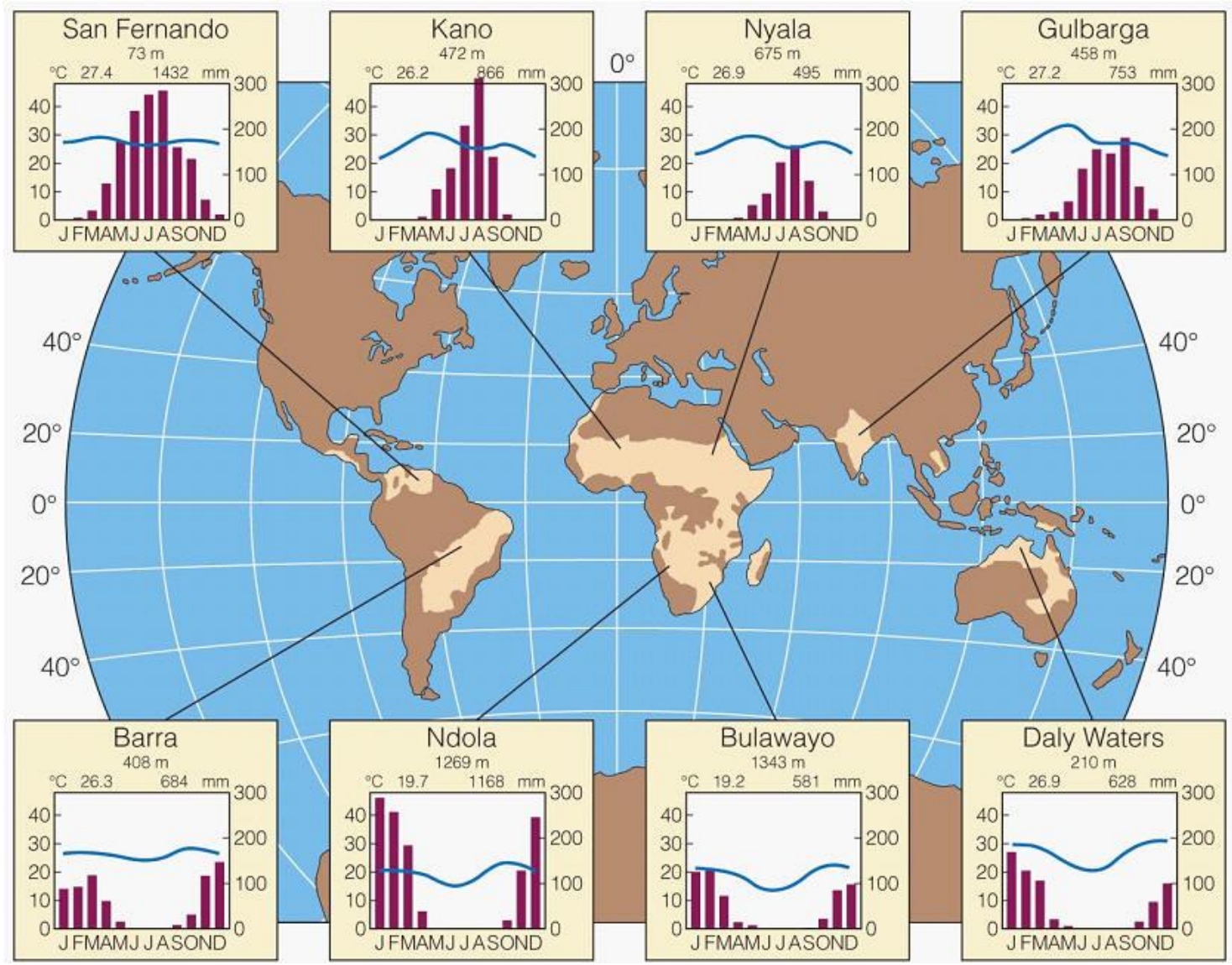
GRASSLANDS, SAVANNAS AND DRY FORESTS



GRASSLANDS, SAVANNAS AND DRY FORESTS



GRASSLANDS, SAVANNAS AND DRY FORESTS



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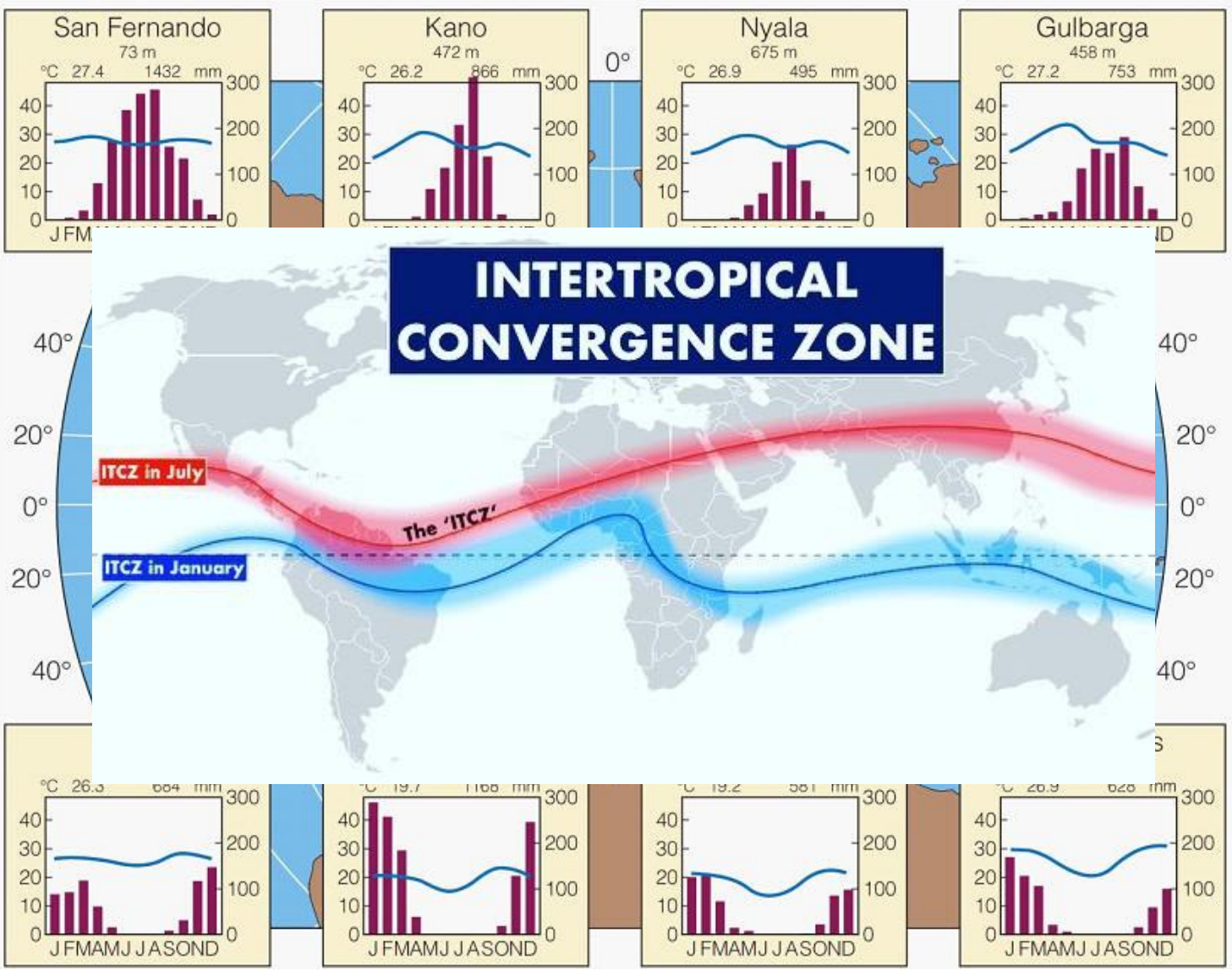

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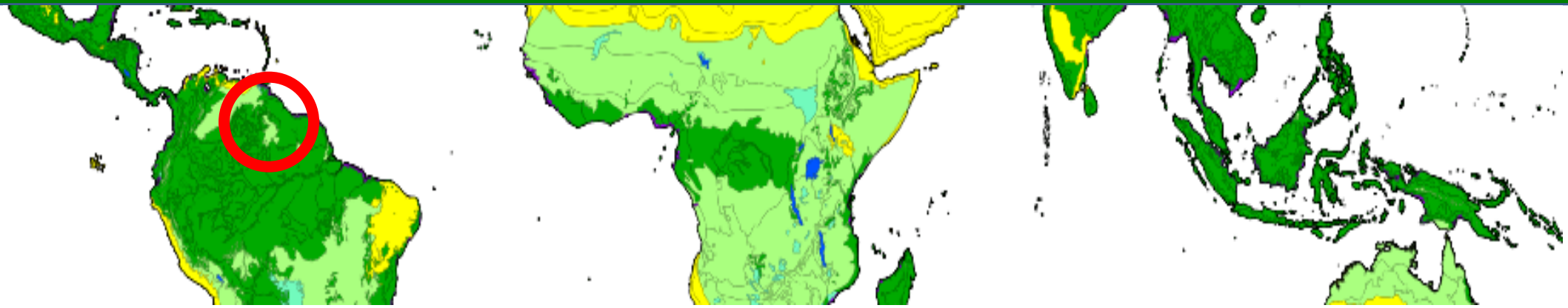
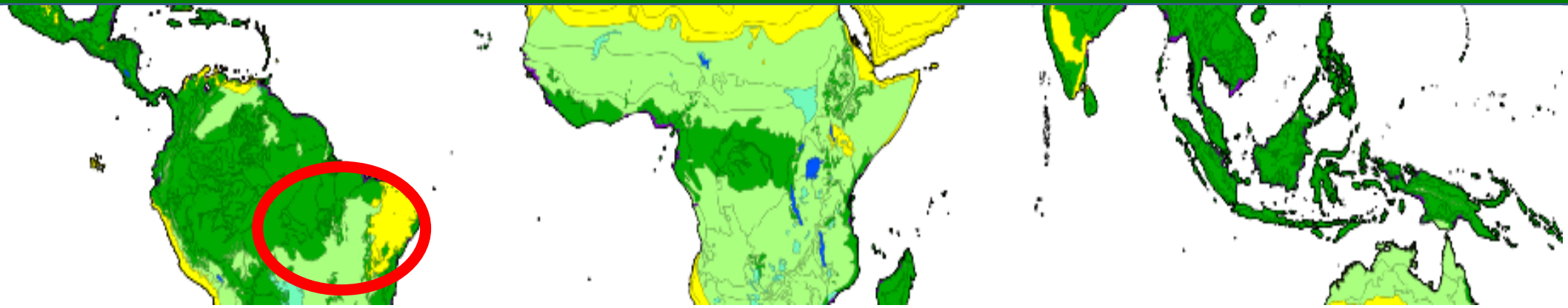
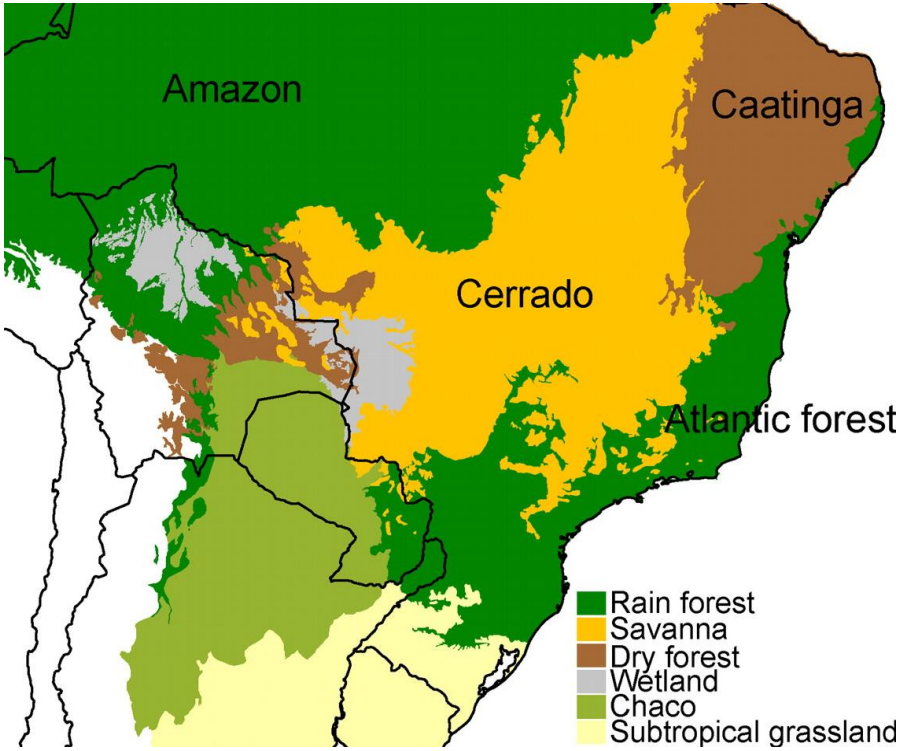


GRASSLANDS, SAVANNAS AND DRY FORESTS



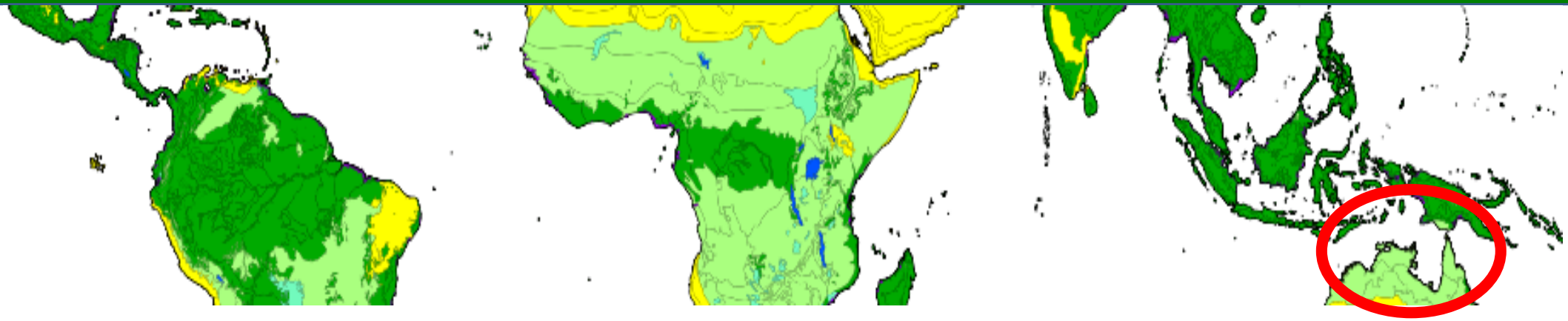


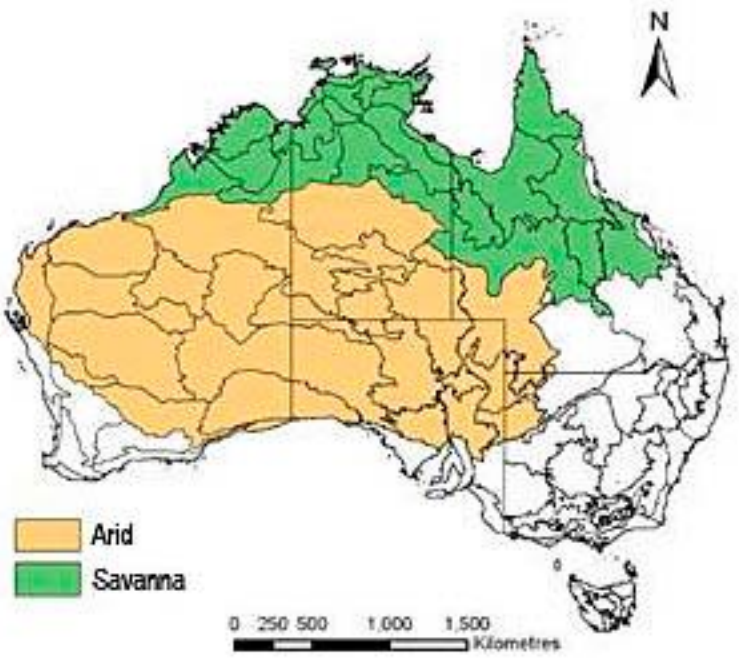
GRASSLANDS, SAVANNAS AND DRY FORESTS

Photo: Juan Millán

GRASSLANDS, SAVANNAS AND DRY FORESTS

GRASSLANDS, SAVANNAS AND DRY FORESTS

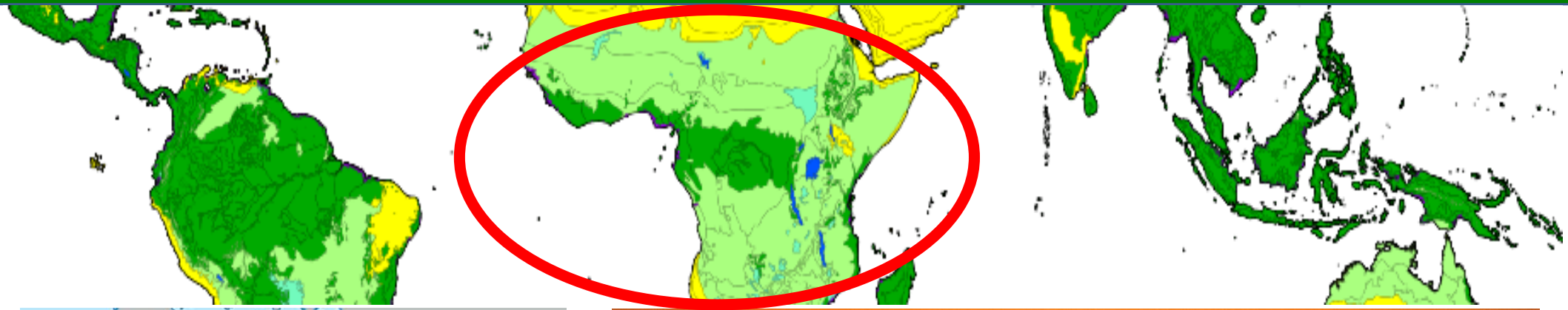


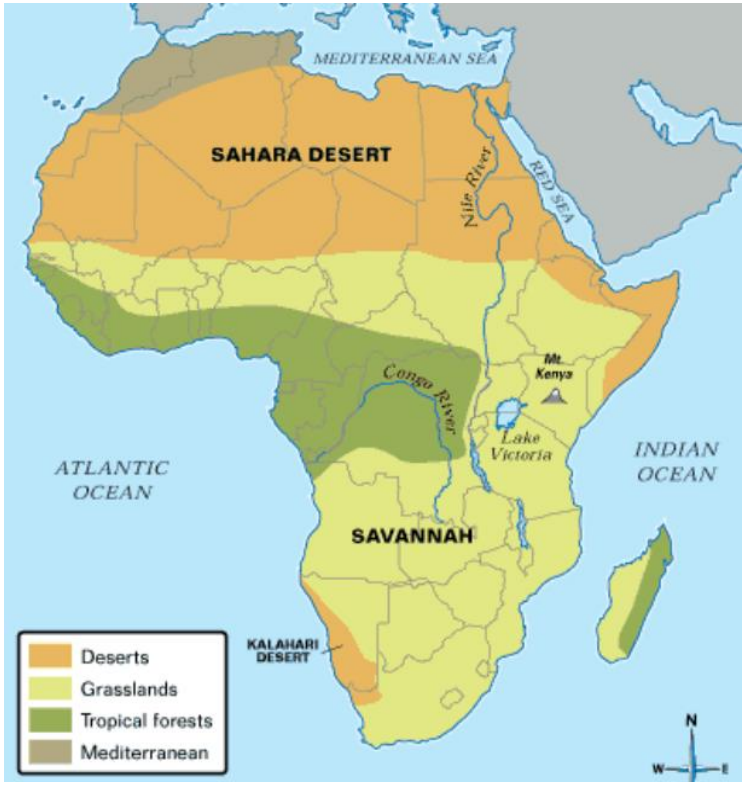


Australian savanna

GRASSLANDS, SAVANNAS AND DRY FORESTS

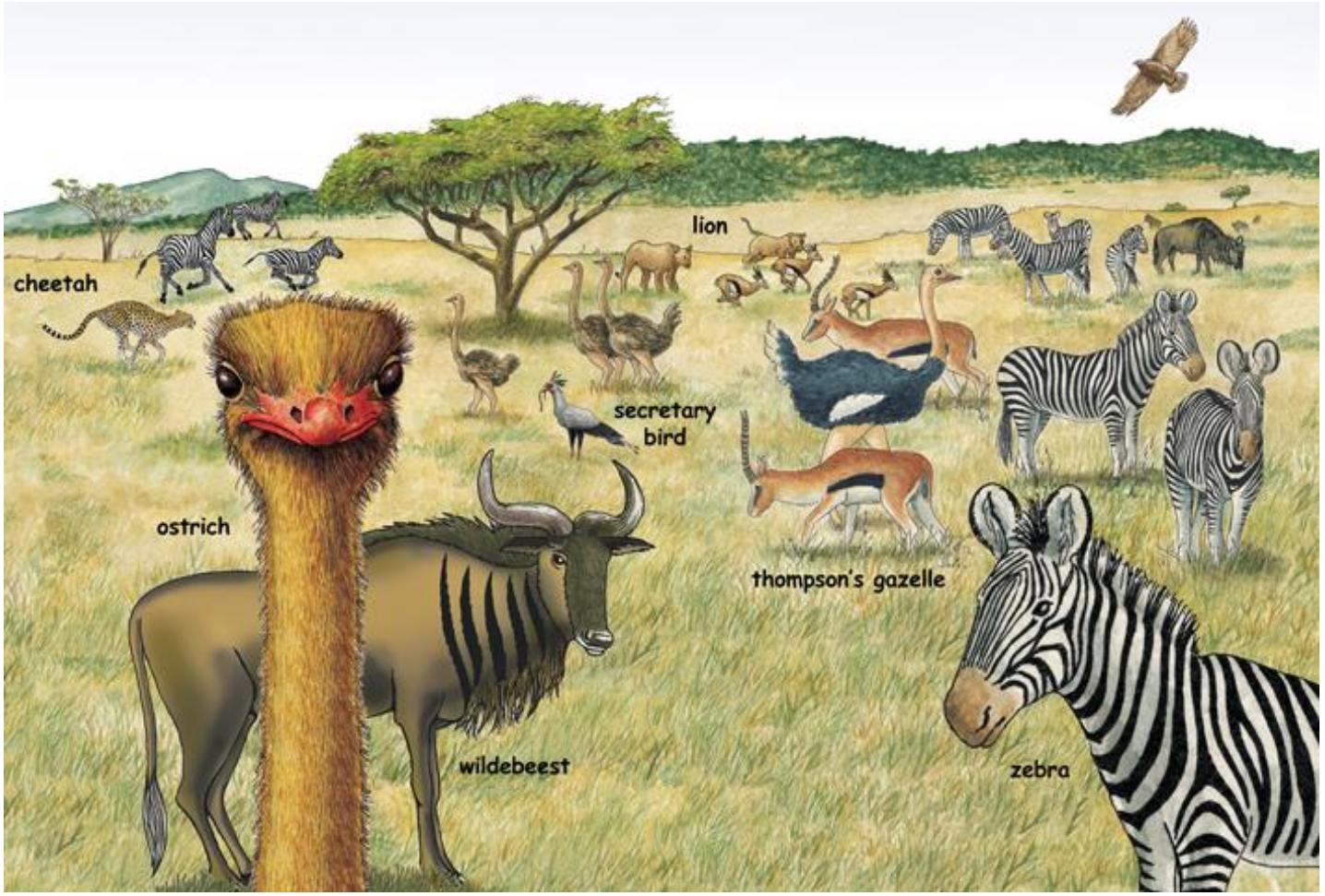
GRASSLANDS, SAVANNAS AND DRY FORESTS





African savannas

GRASSLANDS, SAVANNAS AND DRY FORESTS



GRASSLANDS, SAVANNAS AND DRY FORESTS

GRASSLANDS, SAVANNAS AND DRY FORESTS

Are African savannas that rich in megafauna?

GRASSLANDS, SAVANNAS AND DRY FORESTS

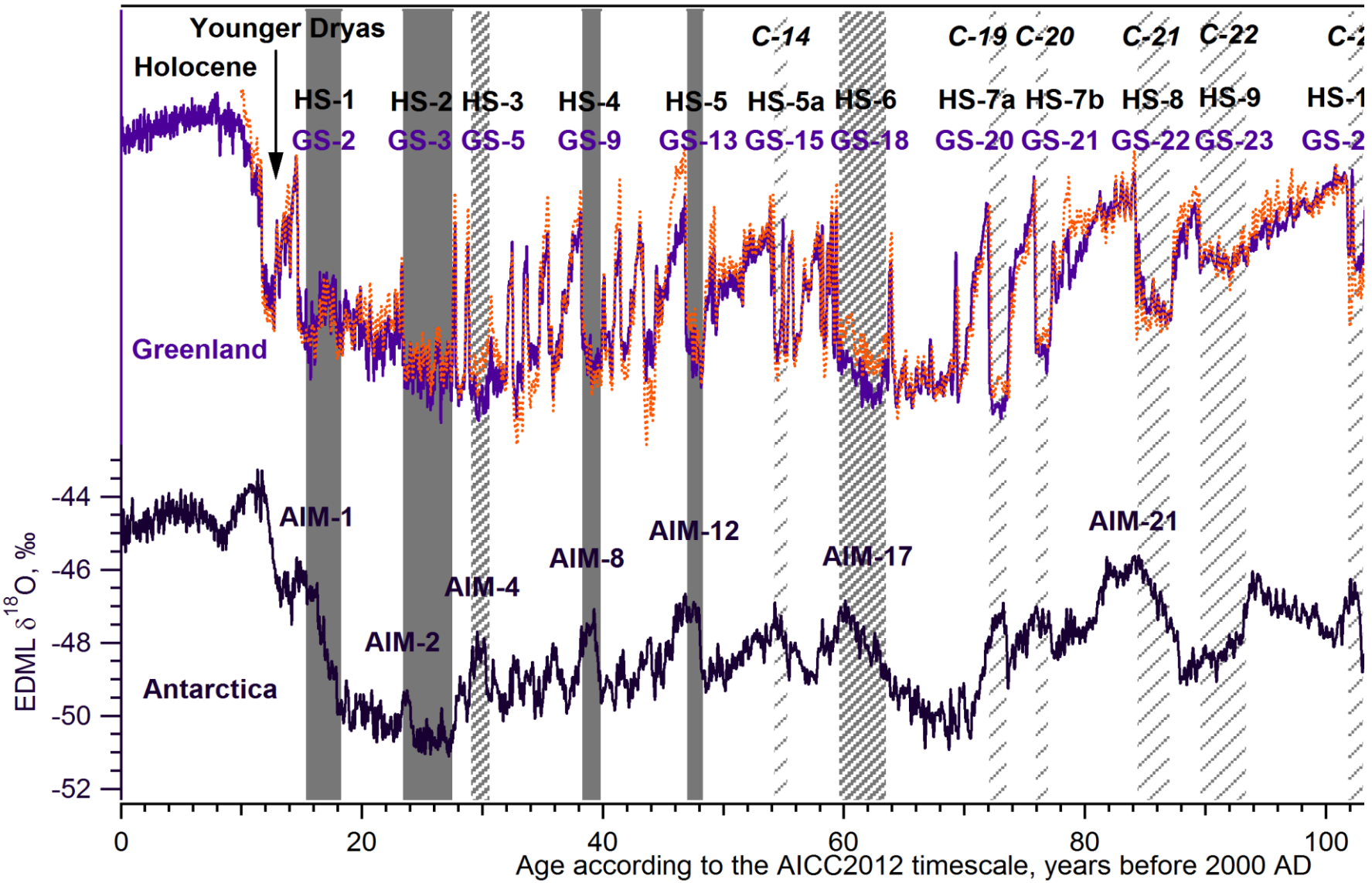
Megafauna (> 40 kg) has been disappearing since the end of the Pleistocene (c. 12,000 years)

GRASSLANDS, SAVANNAS AND DRY FORESTS

Megafauna (> 40 kg) has been disappearing since the end of the Pleistocene (c. 12,000 years)

- North America – 33/45 genera
- South America – 46/58
- Australia – 15/16
- Europe – 7/23
- Subsaharian Africa – 2/44

GRASSLANDS, SAVANNAS AND DRY FORESTS



GRASSLANDS, SAVANNAS AND DRY FORESTS

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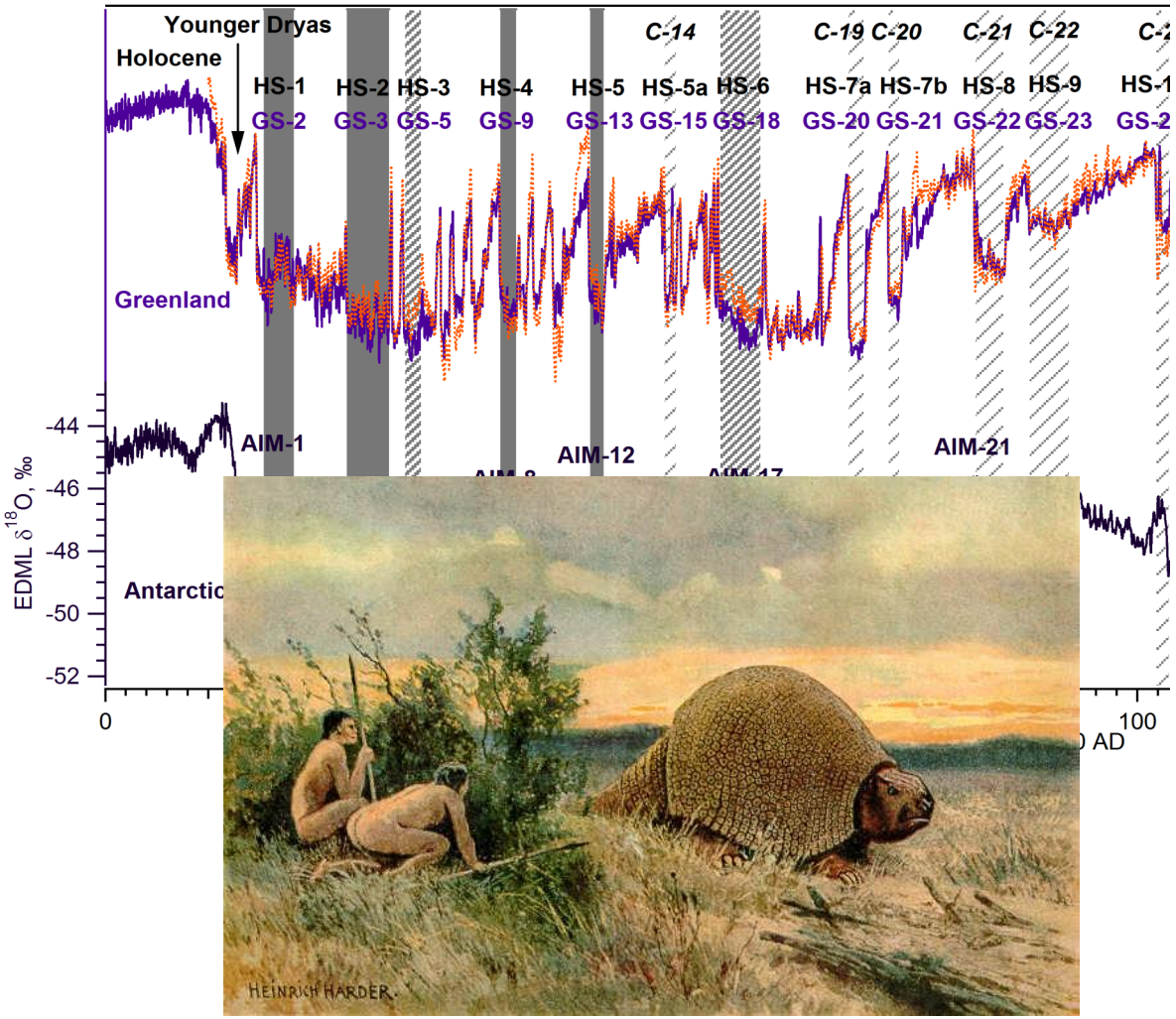
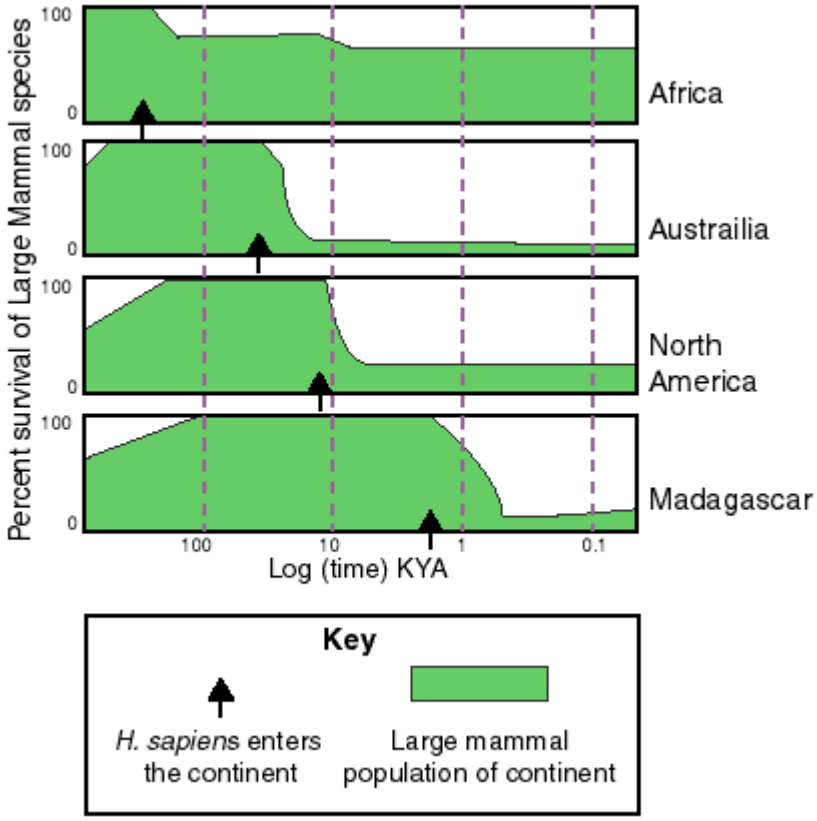




GRASSLANDS, SAVANNAS AND DRY FORESTS

GRASSLANDS, SAVANNAS AND DRY FORESTS

GRASSLANDS, SAVANNAS AND DRY FORESTS

Flora adaptations

GRASSLANDS, SAVANNAS AND DRY FORESTS

Flora adaptations

Deciduous leaves

Fast growth and reproduction

Seasonal primary productivity

GRASSLANDS, SAVANNAS AND DRY FORESTS

Flora adaptations

Deciduous leaves

Water storage in the trunk

Thick bark (fire and water loss)

GRASSLANDS, SAVANNAS AND DRY FORESTS

Flora adaptations

Thorns

Chemical defenses (sap)

Photosynthectic stalk

GRASSLANDS, SAVANNAS AND DRY FORESTS

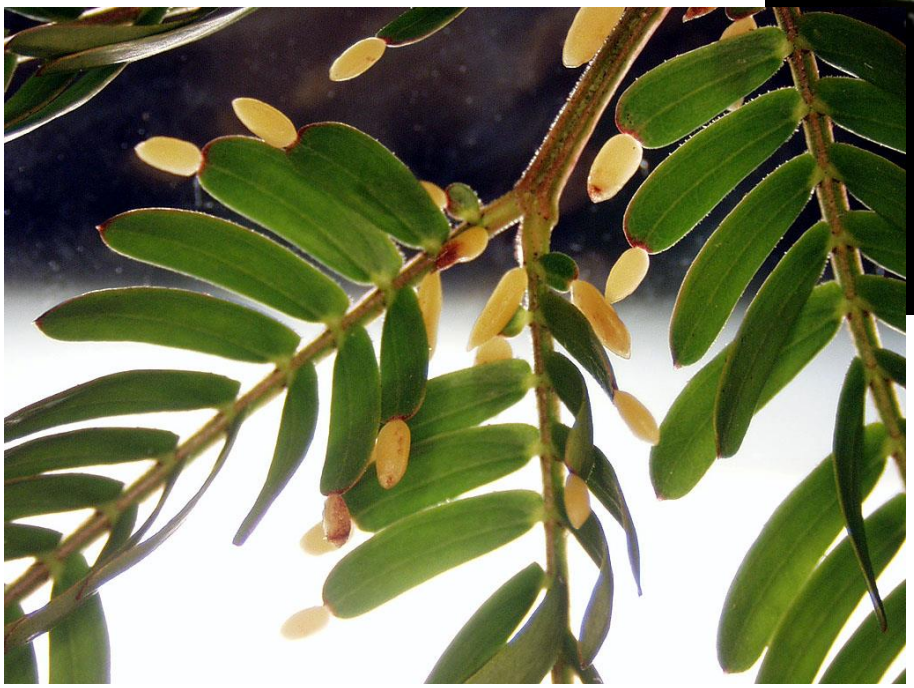
Flora adaptations

Small leaves (reduce predation and water loss)

Thorns (predation)

GRASSLANDS, SAVANNAS AND DRY FORESTS

Flora adaptations



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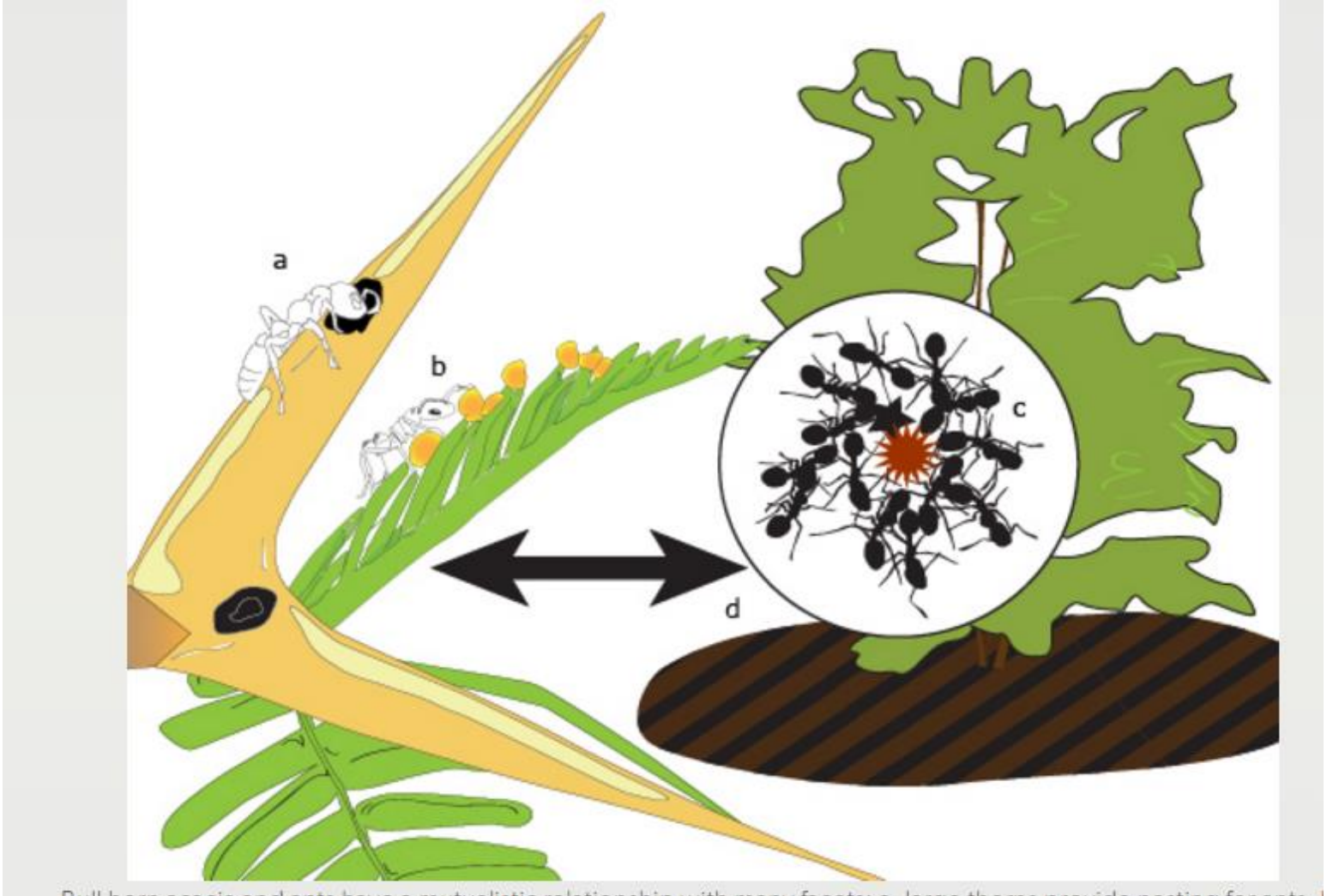


Bull horn acacia and ants have a mutualistic relationship with many facets: a. large thorns provide nesting for ants, b. Beltian bodies (and nectar) provide food for ants, c. ants swarm to defend anything eating the tree, and d. the ants a clear an area around the base of the tree to reduce competition for nutrients. Artist: Emily Harrington. Copyright: A rights reserved. See gallery for details.

GRASSLANDS, SAVANNAS AND DRY FORESTS

GRASSLANDS, SAVANNAS AND DRY FORESTS

Flora adaptations

Long small leaves

Deciduous or annual

Subterranean storage of nutrients

Fast growth

Subterranean stalk

GRASSLANDS, SAVANNAS AND DRY FORESTS

Flora adaptations

Reduced diversity

Biomass (carbon) largely subterranean

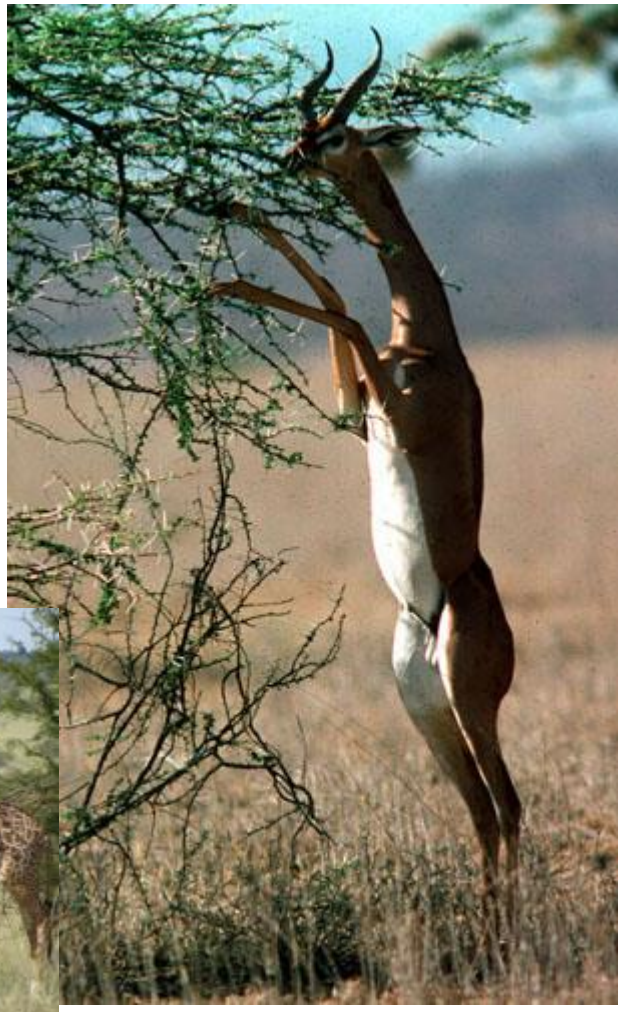
GRASSLANDS, SAVANNAS AND DRY FORESTS

Flora adaptations

Few annual species

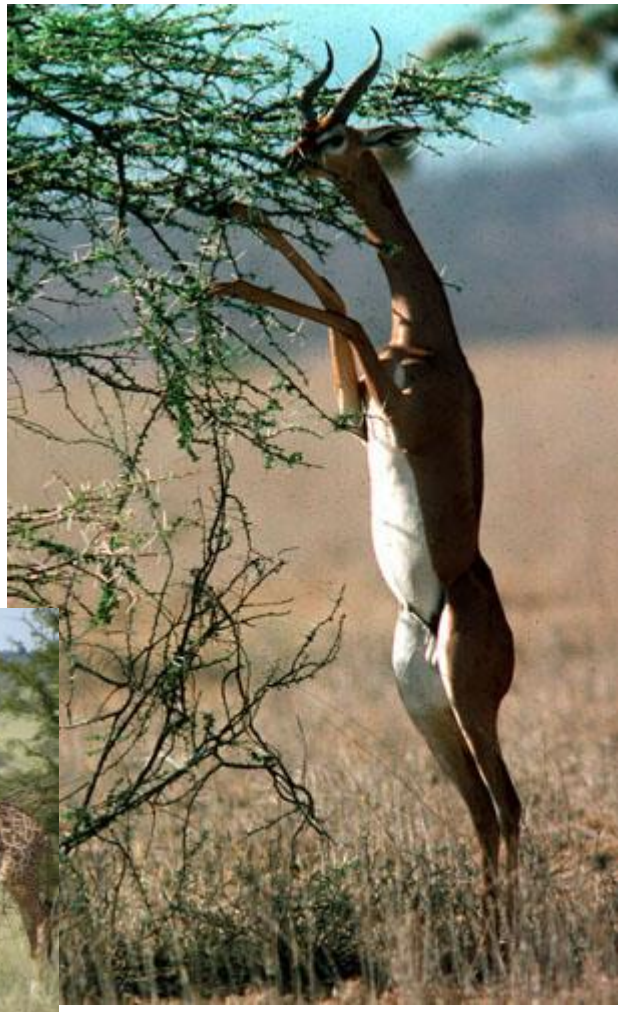
GRASSLANDS, SAVANNAS AND DRY FORESTS

Fauna adaptations



GRASSLANDS, SAVANNAS AND DRY FORESTS

Fauna adaptations



“Browsing & Grazing”

GRASSLANDS, SAVANNAS AND DRY FORESTS

Fauna adaptations

Aestivation

GRASSLANDS, SAVANNAS AND DRY FORESTS

Fauna adaptations

Seasonal breeding

Migration

GRASSLANDS, SAVANNAS AND DRY FORESTS

But the savana is not just made up of giants...

GRASSLANDS, SAVANNAS AND DRY FORESTS

GRASSLANDS, SAVANNAS AND DRY FORESTS

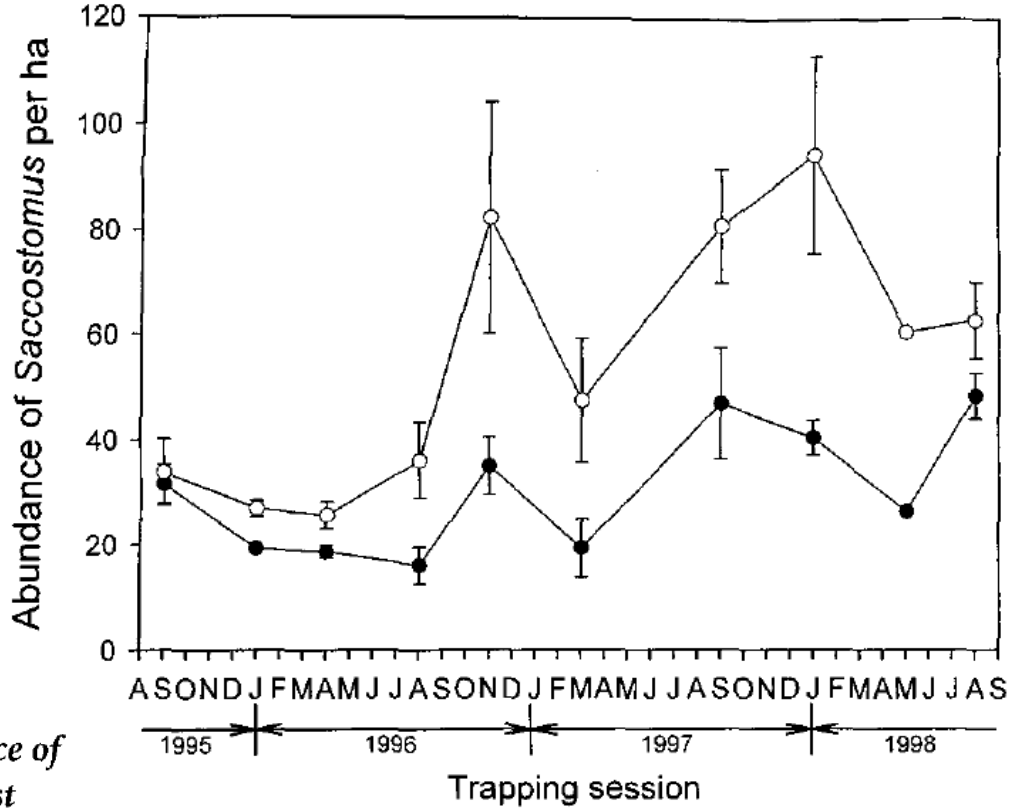


Figure 4. Abundance (individuals per ha) of the pouched mouse, Saccostomus mearnsi, *in the presence and absence of ungulates. Abundance was measured beginning in August 1995, when the large-mammal exclusion fences were installed. Differences in abundance between plots with (solid circles) and without (open circles) ungulates are statistically significant, based on a repeated-measures analysis of variance (treatment: $F_{1,4} = 13.97$; P = 0.02; treatment·time: $F_{8,32} = 2.38$; P = 0.07). Error bars represent standard errors.*

GRASSLANDS, SAVANNAS AND DRY FORESTS

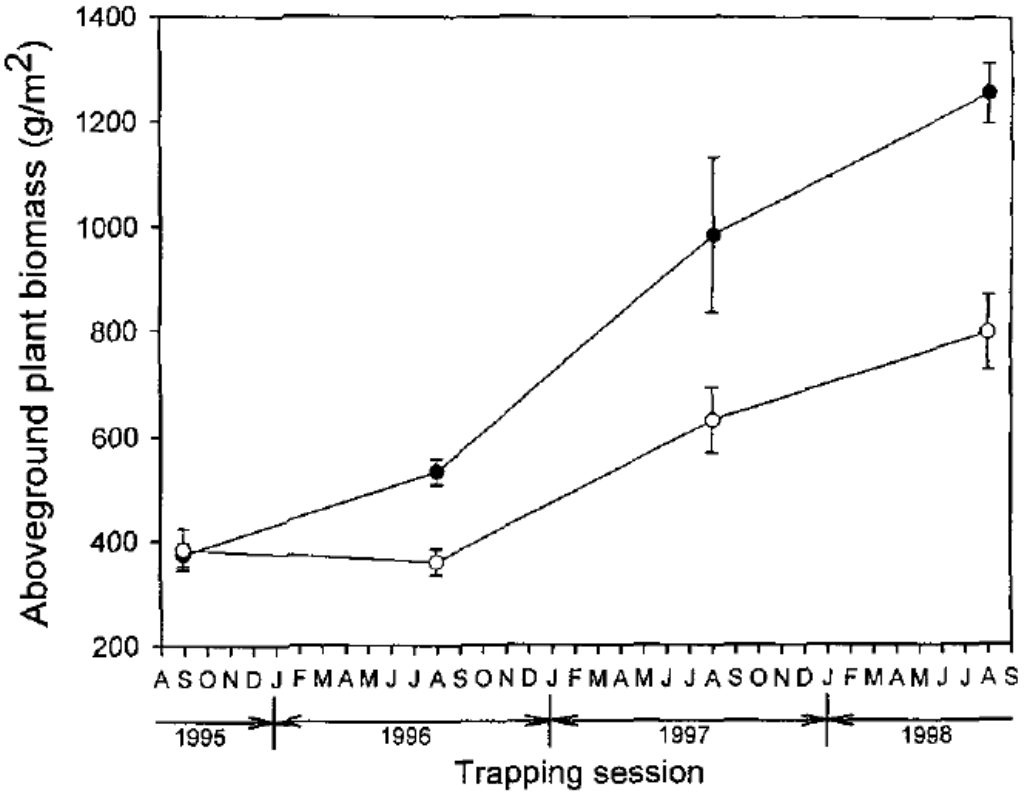
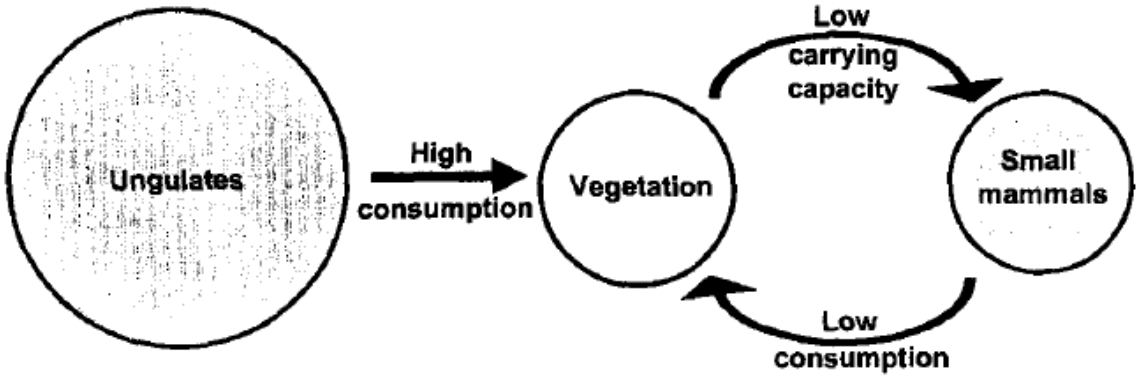
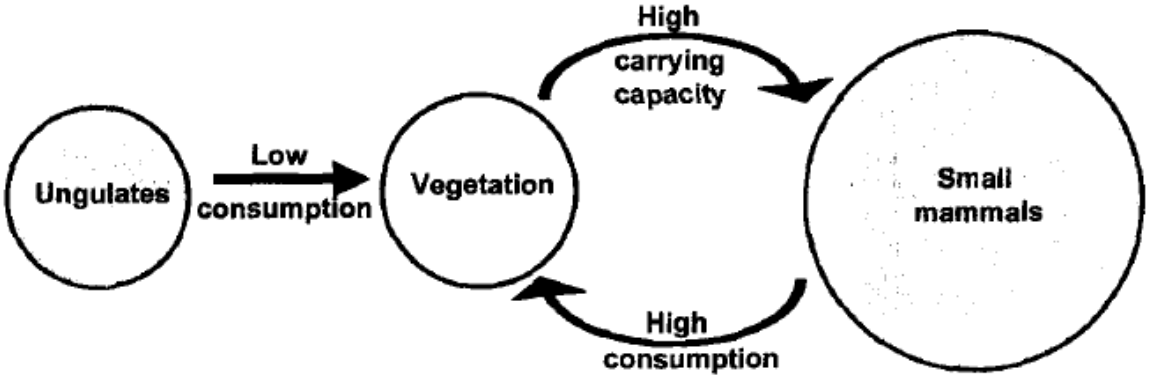


Figure 9. Effect of small mammals on aboveground plant biomass. Aboveground plant biomass, in g/m^2, was measured on 3 m × 7 m plots with (open circles) and without (solid circles) small mammals. The amount of aboveground plant biomass was, on average, approximately 50% higher on plots without small mammals than on plots with small mammals, and this difference was significant based on a repeated-measures analysis of variance (treatment: $F_{1,13} = 9.22$; P = 0.01; time·treatment: $F_{2,26} = 2.26$; P = 0.13). Higher-than-average rainfall in 1997 and 1998 resulted in an overall increase in plant biomass on all plots. Error bars represent standard errors.

GRASSLANDS, SAVANNAS AND DRY FORESTS





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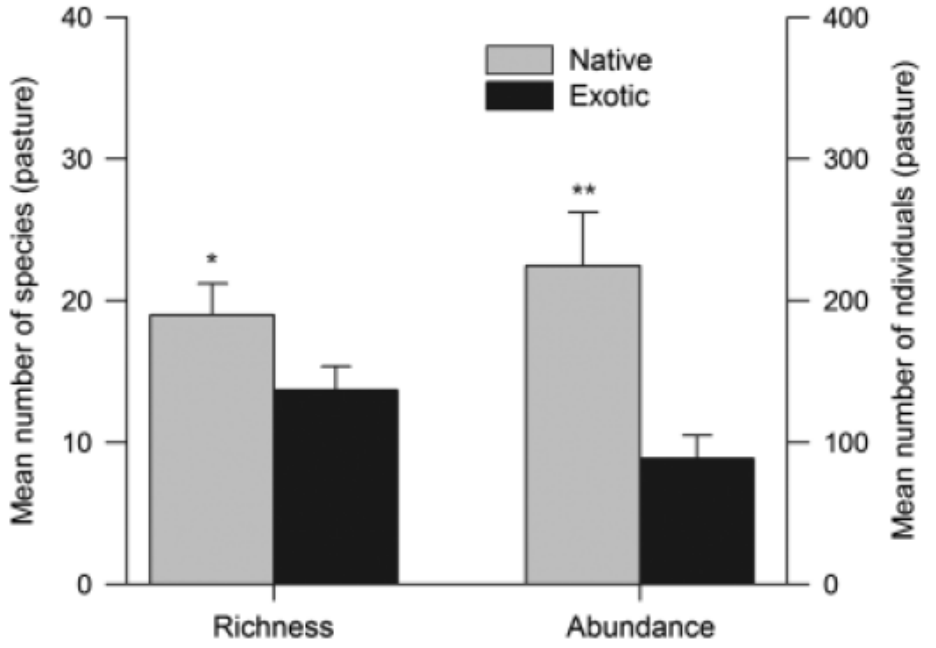

FIGURE 2. Observed mean richness and abundance of dung beetles (per pasture) in native ($N = 14$) and exotic ($N = 21$) pastures ($^{*}P < 0.05$, $^{**}P < 0.005$) based on Poisson's generalized linear model.

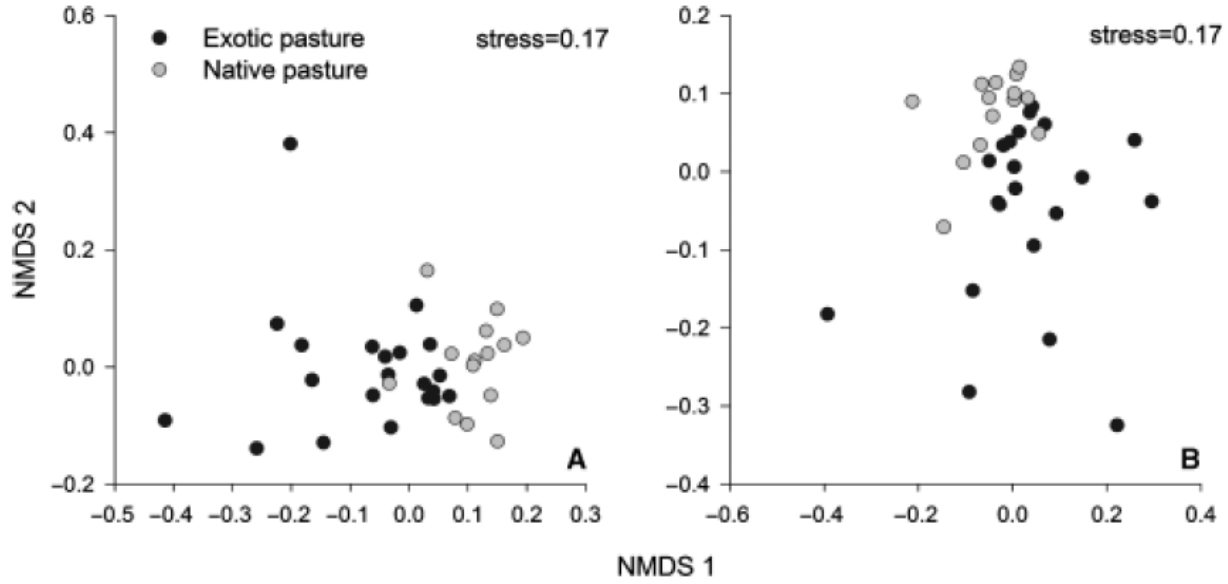

FIGURE 4. Nonmetric multidimensional scaling (NMDS) ordination based on a distance matrix computed with Bray-Curtis similarity index between pasture systems: native pasture and exotic pasture. NMDS (A) shows the difference in community composition (presence/absence species data) and NMDS (B) shows the difference based on community structure (abundance of individuals).

GRASSLANDS

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Cattle density map – 2005 *(census data)*

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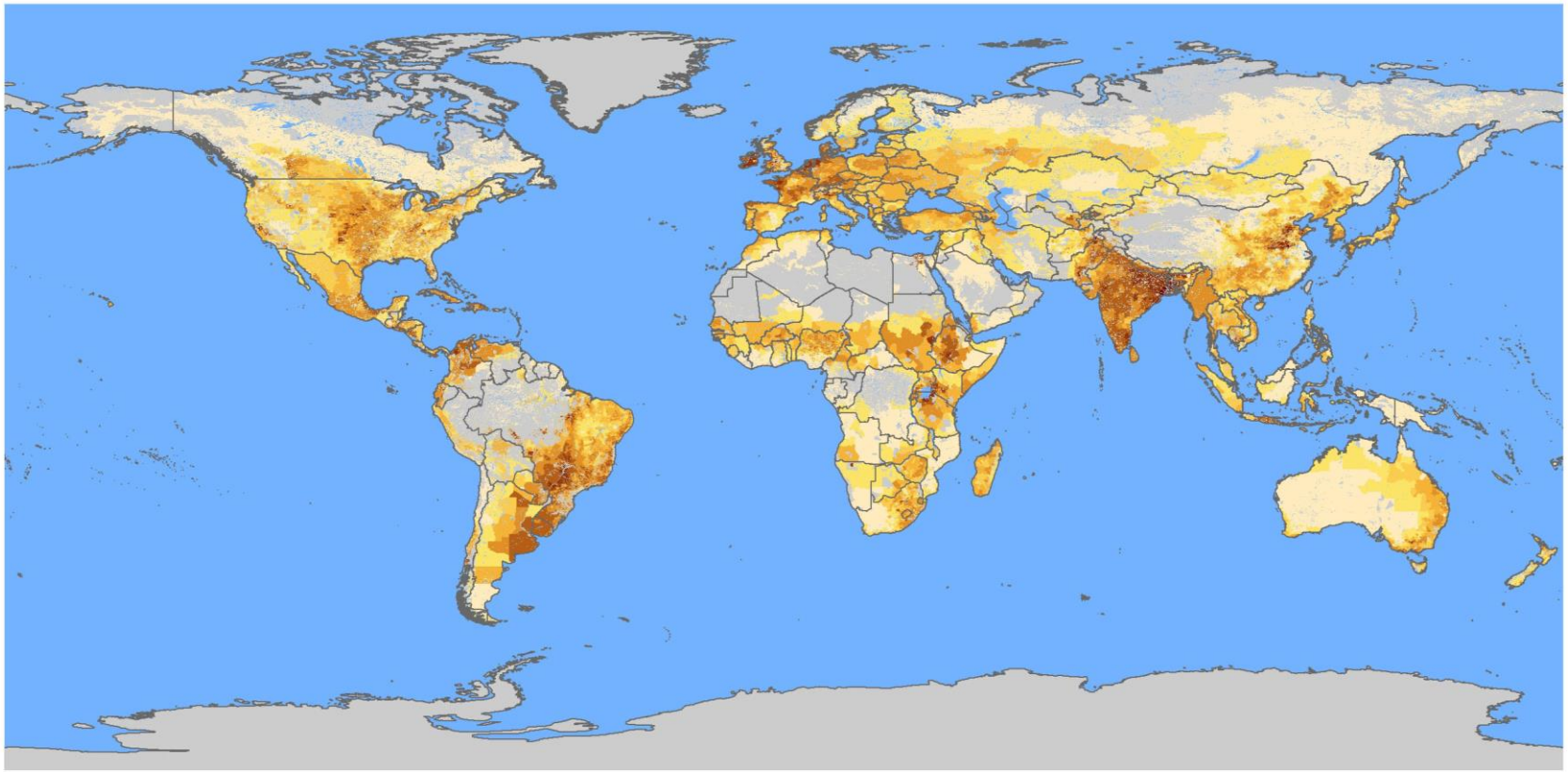
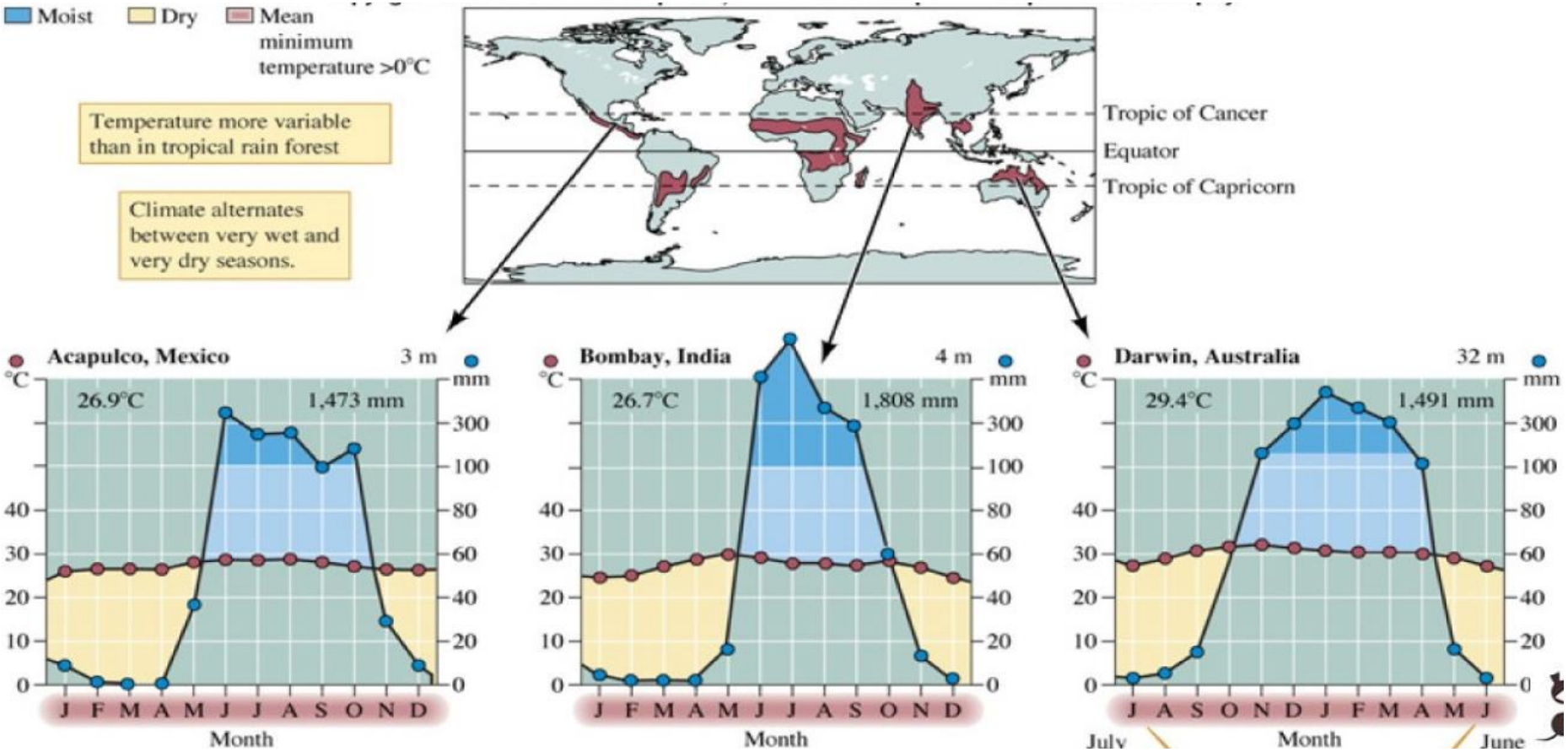


Number per square km

<1	5–10	20–50	100–250	Water
1–5	10–20	50–100	>250	Unsuitable for ruminat

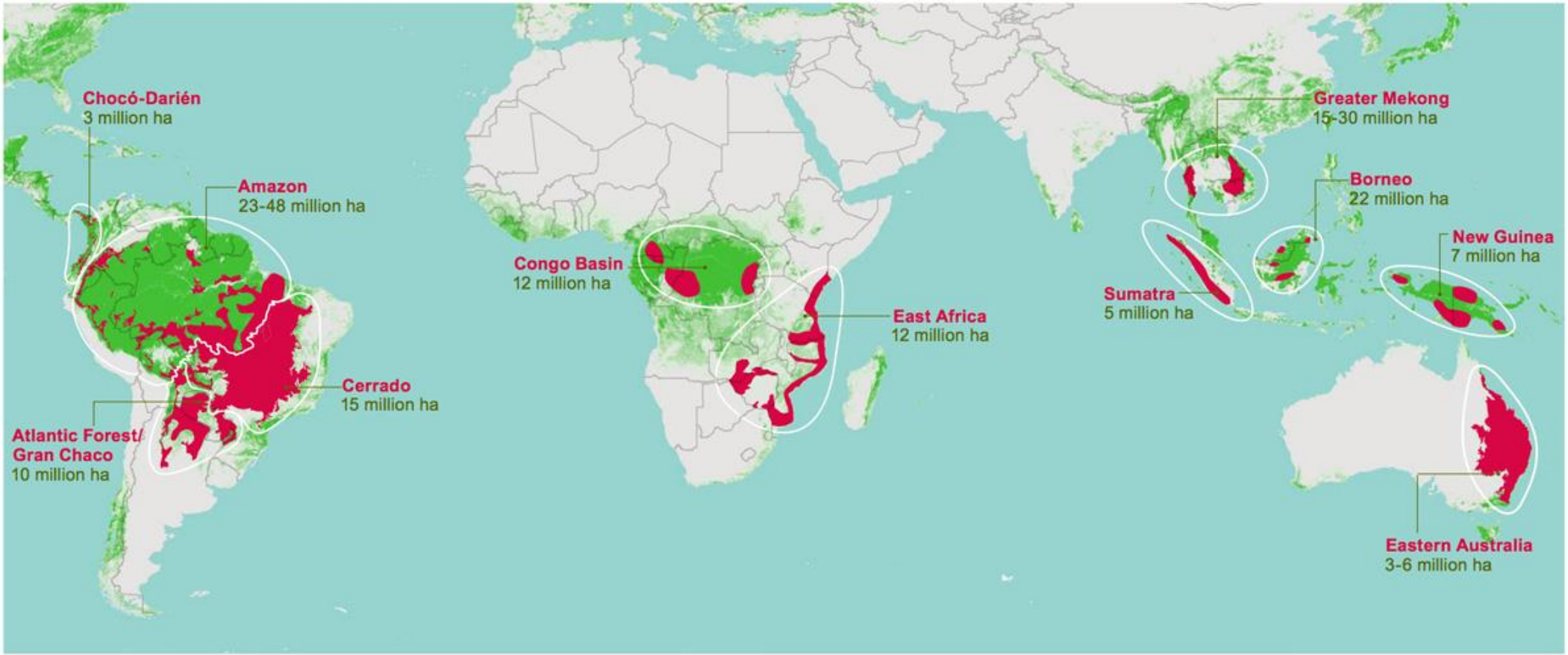
DRY FORESTS

DRY FORESTS


Moist
Dry
Mean minimum temperature >0°C
Temperature more variable than in tropical rain forest
Climate alternates between very wet and very dry seasons.
Tropic of Cancer
Equator
Tropic of Capricorn
Acapulco, Mexico
3 m
26.9°C
1,473 mm
Bombay, India
4 m
26.7°C
1,808 mm
Darwin, Australia
32 m
29.4°C
1,491 mm
°C
mm
J F M A M J J A S O N D
J A S O N D J F M A M J
July
June
Month

DRY FORESTS

MAP OF DEFORESTATION FRONTS



GRASSLANDS, SAVANNAS AND DRY FORESTS

Savanna classification, based on the key persistence factor (tree/herb ratio):

- Climatic
- Edaphic (submersion, excessive drainage, nutriente scarcity)
- Pirophile
- Alpine
- Anthropic
- ...

GRASSLANDS, SAVANNAS AND DRY FORESTS

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Ecology, 90(2), 2009, pp. 335–340

Grass competition suppresses savanna tree growth across multiple demographic stages

CORINNA RIGINOS[1,2,3]

Ecological Modelling 220 (2009) 3576–3588

Are savannas patch-dynamic systems? A landscape model

Aristides Moustakas[a,*], Konstantinos Sakkos[b], Kerstin Wiegand[a,1], David Ward[c], Katrin M. Meyer[a,1], Dirk Eisinger[d]

Symbiotic acacia ants drive nesting behavior by birds in an African savanna

Lujan, Ema[1†], Ryen Nielsen[1†], Zoe Short[1], Samuel Wicks[1], Wilson Nderitu Watetu[2], Leo M. Khasoha[1,2], Todd M. Palmer[2,4], Jacob R. Goheen[1,2], and Jesse M. Alston[3*]

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The distribution of tree and grass roots in savannas in relation to soil nitrogen and water

E.C. February [a,*], S.I. Higgins [b]

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Global Ecology and Biogeography, (Global Ecol. Biogeogr.) (2011) **20**, 653–660

ECOLOGICAL SOUNDING

When is a 'forest' a savanna, and why does it matter?

Jayashree Ratnam[1,2*], William J. Bond[3], Rod J. Fensham[4,5], William A. Hoffmann[6], Sally Archibald[7], Caroline E. R. Lehmann[8], Michael T. Anderson[9], Steven I. Higgins[10] and Mahesh Sankaran[1,11]

Journal of Biogeography (J. Biogeogr.) (2006) **33**, 491–505

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A global overview of the conservation status of tropical dry forests

Lera Miles[1*], Adrian C. Newton[2], Ruth S. DeFries[3], Corinna Ravilious[1], Ian May[1], Simon Blyth[1], Valerie Kapos[1] and James E. Gordon[4†]

BIOTROPICA 43(6): 704–710 2011 10.1111/j.1744-7429.2011.00751.x

Subtle Land-Use Change and Tropical Biodiversity: Dung Beetle Communities in Cerrado Grasslands and Exotic Pastures

Sabrina Almeida[1,5], Julio Louzada[2], Carlos Sperber[3], and Jos Barlow[4]