Grassy ecosystem conservation will protect biodiversity, human livelihoods and underground carbon

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Many native ecosystems are grassy
Grasses fuel fire and feed herbivores, limiting tree dominance
Savannas, woodlands and grasslands
Mosaics of grassy and woody vegetation

Brazil

Chaco, Paraguay

DR Congo

Australia
Native grassy ecosystems extend globally

NESCent Grasslands Working Group, unpublished
How old are these ecosystems?
Evidence from fossil teeth
Fossil teeth show grassy ecosystems are ancient

Cerling et al. (1997) Nature
Humans evolved in savannas

Carbon isotope ratios of fossil soils from African hominin sites (< 6myr) indicate majority are savannas (Cerling et al., 2011. Nature)
What’s the value of native grassy ecosystems compared with forests?
Carbon stocks in a typical Cerrado

Vegetation + soil (up to 1 m depth) = \(265.0 \text{ Mg C ha}^{-1}\)

- Woody biomass: \(42.5 \text{ Mg C ha}^{-1}\) (16%)
- Herbaceous biomass: \(28.5 \text{ Mg C ha}^{-1}\) (10.8%)
- Litter: \(28.5 \text{ Mg C ha}^{-1}\) (10.8%)
- Roots: \(185 \text{ Mg C ha}^{-1}\) (69.8%)

Soil organic matter
Water resources

Headwaters of important hydrological basins = water supply for millions of people:

River basin (% in Cerrado)
- 1. Araguaia- Tocantins (78%)
- 2. São Francisco (50%)
- 3. Paraná (48%)
Similar biodiversity to tropical wet forest

Searchinger et al. (2015) *Nature Climate Change*
Social and economic benefits

- Pasture for grazing domestic animals
- Firewood harvesting + charcoal production
- Charismatic animals bring tourism revenue
Deforestation can lead to degraded grassy vegetation
Degraded grassy vegetation can arise in other ways

Abandoned agriculture, old field, arrested succession
Photo: J. Veldmann

Secondary grasslands after removal of pine plantation
Photo: E. Buisson
Threats to native grassy ecosystems
History of agricultural conversion

Foley et al. (2011) Nature
Recent agricultural conversion

Main driver = agricultural expansion

Data: 3rd National Inventory of GHG, MCTI
Future agricultural conversion?
Native grassy ecosystems take centuries to recover from clearance

Old-growth pine savanna USA

Degraded savanna - 90 yr after agriculture
Afforestation: opportunity or threat?
A World of Opportunity
for Forest and Landscape Restoration

- restore 150 million hectares of deforested and degraded lands worldwide by 2020
- “20+20” initiative to restore 20 million hectares of degraded land in Latin America by 2020
Assessment of the
Atlas of Forest and Landscape Restoration Opportunities

9 million km$^2$ (40%) of “opportunities” correspond to grassy biomes

Veldman et al. (2015) Bioscience
New map suggests native grassy biomes extend further than in previous maps

NESCent Grasslands Working Group, unpublished
Afforestation of grassy biomes can degrade underground carbon stocks

Rio de la Plata grasslands, Uruguay (Berthrong et al. 2012 Ecol. Appl.)
Afforestation of grassy biomes compromises water resources

Clearing trees for water security

e.g. Working for Water programme in South Africa
Removal of alien tree species restores streamflow and groundwater recharge

Photos: Kowie Catchment Campaign
Grassland “restoration” after afforestation – no way back?

Forbs with underground storage organs have not come back 17 yrs after clearance of pine plantation (Zaloumis & Bond, 2011)
Our recommendations
Avoid afforestation or clearance of native grassy ecosystems

Value for carbon, water, biodiversity

Under greater threat than many forests
Target restoration or agriculture to degraded grassy ecosystems

Biodiversity low, underground carbon depleted
Need to assess natural regeneration and tailor restoration strategies to the system

Land-use History
level of degradation

Ecosystem Resilience
intrinsic rate of recovery

Landscape Context
surrounding matrix

Restoration strategy
Passive-----------------------------------------------Active

Goals
biodiversity, ecosystem services, human livelihoods

Resources
budget, labor availability, time frame

Holl and Aide 2011 *Forest Ecology and Management*
Recognizing native grassy ecosystems

1. Intact disturbance regimes
Recognizing native grassy ecosystems

2. High species diversity
Recognizing native grassy ecosystems

3. Underground storage, resprouting capacity
Recognizing native grassy ecosystems

4. Fire adaptations

- Resprouting from underground buds
- Fire-stimulated flowering
- Fire-insulated bark
Urgent need to identify and map native grassy ecosystems

- Native grassy ecosystems distinguished from degraded ones via well established criteria.
- Ground-based, local validation essential.
- Requires a global initiative with local experts in each region facilitating decision making.
- Global and fine-scale maps of areas suitable for reforestation.
Conserve native grassy ecosystems to protect livelihoods, water and carbon
Taita Hills project, Kenya

- Accounts for avoided conversion of grasslands.
- Generates REDD+ carbon offsets from protection of forest and savanna mosaic.
- Focus on soil carbon, conserving biodiversity, and sustainable charcoal production.
- Conservation within existing mechanisms.