Metadata - fire_effecs_invaded_cerrado

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About

This document details all data associated with the following study:

Title: Short-term effects of prescribed fires are modulated by invader's abundance in tropical savannas

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Projects and funding agencies:
* Neotropical Grassland Conservancy

- 'Invasions by African grasses and Cerrado restoration: an approach by state-and-transition models'. Funded by Fundação de Amparo à Pesquisa do Estado de São Paulo - FAPESP (Grant 2018/09054-0);

- 'How does fire season affect Cerrado vegetation?'. Funded by Fundação de Amparo à Pesquisa do Estado de São Paulo - FAPESP (Grant 2015/06743-0);

- 'Optimising the long-term management of invasive species affecting biodiversity and the rural economy using adaptive management'. Funded by Natural Environment Research Council - NERC, Newton Grant (Grant NE/S011641/1); and Fundação de Amparo à Pesquisa do Estado de São Paulo - FAPESP (Grant 2018/14995-8)

Data overview

All data presented here was sampled in March/April of 2019 (before the prescribed burnings) and 2021 (after the prescribed burnings) by Gabriella Damasceno together with fieldwork assistants for the second chapter of her PhD thesis available here.

Study areas

All data was sampled inside two areas in the Cerrado (Neotropical savanna) located inside protected areas: Estação Ecológica de Itirapina (EcEI; 700 meters a.s.l; 22º14'40"S 47º52'29"W, Southeastern Brazil) and Parque Nacional de Brasília (PNB; 100 meters a.s.l; 15º41'43"S 47º54'18"W, Central Brazil). In both areas, we chose non-converted landscapes invaded by Urochloa decumbens. Vegetation is characterized by a continuous herbaceous layer dominated by C4 grasses (Gymnopogon foliosus is the commonest species in EcEI and Arthropogon villosus in PNB) with scattered shrubs and small trees and locally known as campo sujo. At both sites, invasion started more than 30 years ago, during the 80's in EcEI and the 90's in PNB.

Experimental design

Our experimental design followed a BACI (Before-After, Control-Impact) type (Smith, 2014) and had the plot (5 x 5 m) as the sampling unit. In each area we established six invasion gradients based on the cover by the invasive alien species (IAS). Each gradient was composed by five plots representing 0, 25, 50, 75 and 100% ground cover by Urochloa decumbens. Every two gradients formed a block, one gradient to be left unmanaged (control) and one to be burned (fire treatment). In every area we had total of 30 plots divided into three blocks (5 plots x 6 gradients). Plots were established into independent invaded patches corresponding to the desired cover by the invasive species, from non-invaded (0% of cover by Urochloa decumbens) to totally invaded plots (100% cover by Urochloa decumbens). Blocks were at least 50 m apart while plots inside a gradient were 10 m apart. We collected vegetation data in the central portion of the plot (3 x 3 m) and destructive sampling, like biomass sampling, in remaining one-meter strip towards plot's borders. We conducted two experimental burnings in the middle of the dry season, in October in 2019 and in September in 2020. We opted for this fire season in order to maximize fire effects on reducing invader's biomass (Damasceno & Fidelis, 2020). Aiming to apply the same fire conditions to all plots within a gradient, we burned the entire gradient at once using head-fires lit during the day by PNB fire brigade.

Sampling effort

Microhabitat

We used data logger kits (composed by one HOBO Pendant and one HOBO Pro v2 sensors) to obtain hourly measurements of illuminance and temperature at the ground level. Because of the limitation in the numbers of kits (20 kits), we randomly selected two blocks to be sampled. To avoid biases in the location in which kits were left, we systematically placed one kit per plot at the same point in relation to its vertices. Kits remained in the field for at least 130 days, from the transition between the rainy-dry season (March/April) to the end of the dry season (August/September).

Vegetation

We assessed community composition by visual estimation of cover by every species present in the plots, including Urochloa decumbens. Due to the spatial heterogeneity of the herbaceous layer in tropical savannas (Augustine, 2003) and to follow the Braun-Blanquet method (Wikum & Shanholtzer, 1978), we divided the core zone of plots (9 m²) into nine 1 m² subplots where vegetation cover was always estimated by the same person. We visually estimated the cover by plant species using values of 0, 1, 5 and then every 10 up to 100% of cover from the projection of its canopy to the ground layer. Therefore, the total cover of a plot was allowed to surpass 100% due to the tridimensional organization of plant individuals. We also assessed the bare soil percentage and cover by dead biomass (standing + litter); the latter was estimated for the native and invasive biomass separately. We grouped native plant species according to their growth-form: grasses, forbs, and shrubs.

Specific leaf area

At the plant's individual level, we sampled the specific-leaf area of dominant species in the communities. These dominant species were selected based on their abundance: we ranked down all species by their cover and starting from the most abundant, we sampled additional species until they had represented at least 80% of cover in every community. Following Pérez-Harguindeguy and collaborators (2013), we collected three leaves/individual and ten individuals/species to account for trait plasticity. After collection, leaves were carefully stored in paper bags; at the laboratory they were rehydrated and had their area measured using a portable leaf area meter (LI-COR L3000C). Delicate leaflets were scanned using a scanner Epson V800 and had their area quantified using the P-trap software (Al-Tam et al., 2013). After measurements, all leaves were dried in a drying oven at 80ºC for 48 hours and weighted in an electronic scale with 0.1 mg precision.

Ecosystem properties

We randomly sampled plant aboveground biomass on the marginal zone of plots using 0.5 x 0.5 m quadrats. We sampled three subplots per plot to minimize the effects of spatial heterogeneity. We collected every sample by cutting all standing biomass at the ground level and by gathering the litter inside the subplot. At the laboratory, biomass was sorted out into Urochloa decumbens biomass (live or dead); native graminoids, forbs and shrubs (all live biomass); and native dead biomass. After that, biomass was dried in a drying oven at 80ºC for 48 hours and then weighted. We measured CO2 soil efflux by placing incubation chambers with soda lime (CaO/NaOH) in every plot following Keith & Wong (2006). We used 7 cm petri dishes with 25 mg of soda lime incubated for 24 hours inside opaque plastic chambers with a radius of 12 cm. The CO2 efflux was calculated from the difference in soda lime weight before and after incubation. We assessed decomposition rates using aluminum litter bags (20 cm x 20 cm) left on bare ground for 90, 120 and 160 days (Karberg et al., 2008) from April to August. We standardized parent material across the invasion gradient by using 5 g of Urochloa decumbens biomass in all bags.

Data structure

The data is composed of six distinct tables within the fire_effects_invaded_cerrado.RData file. The tables are:

- microhabitat, containing information about microhabitat conditions: illuminance, air temperature and humidity at ground level
- specific_leaf_area, containing information about specific leaf area of dominant species in the community
- ground_cover, containing information about plant cover in communities
- biomass, containing information about biomass sampling
- decomposition_rates, containing information about decomposition rates
- soil_co2_efflux, containing information about CO2 soil efflux

Microhabitat

Where the columns represent:

- year: The year in which the samples were taken (2019 or 2021)

- area: The conservation unit where the sample was collected (Brasilia or Itirapina)
- block: The block in which the sample was taken (B1, B2 and B3 for Brasilia and I1, I2 and I3 for Itirapina)
- treatment: The experimental treatment applied to the plot (burning or control)
- block_treatment: The combination of block and treatment
- plot: The combination of a letter indicating the treatment (Q for burning, C for control) and a number indicating the percentage of cover by Urochloa decumbens in the plot (0 for 0%, 2 for 25%, 5 for 50%, 7 for 75% and 1 for 100%)
- unit: The combination of block and plot
- invasion: The percentage of cover by Urochloa decumbens in the plot, expressed as a discrete gradient: 0 for 0%, 2 for 25%, 5 for 50%, 7 for 75% and 1 for 100%
- day: The day in which the samples were taken, in the format 'day/month/year hour/minute/second'
- illuminance: The daily mean illuminance as calculated from hourly sampling, in lux
- temp_range: The daily range of air temperature, calculated as maximum - minimum temperature in a day, in °C
- rh_range: The daily range of air temperature, calculated as maximum - minimum temperature in a day, in °C

Specific leaf area (SLA)

Where the columns represent:

- year: The year in which the samples were taken (2019 or 2021)

- area: The conservation unit where the sample was collected (Brasilia or Itirapina)
- block: The block in which the sample was taken (B1, B2 and B3 for Brasilia and I1, I2 and I3 for Itirapina)
- treatment: The experimental treatment applied to the plot (burning or control)
- block_treatment: The combination of block and treatment
- plot: The combination of a letter indicating the treatment (Q for burning, C for control) and a number indicating the percentage of cover by Urochloa decumbens in the plot (0 for 0%, 2 for 25%, 5 for 50%, 7 for 75% and 1 for 100%)
- unit: The combination of block and plot
- invasion: The percentage of cover by Urochloa decumbens in the plot, expressed as a discrete gradient: 0 for 0%, 2 for 25%, 5 for 50%, 7 for 75% and 1 for 100%
- species: The plant species for which the SLA was sampled
- individual: The number of the individual for which the SLA was sampled (from 1 to 10)
- leaf: The number of th leaf for which the SLA was sampled (from 1 to 3)
- sla: The SLA for the leaf, in mm2/mg

Ground cover

Where the columns represent

- year: The year in which the samples were taken (2019 or 2021)

- area: The conservation unit where the sample was collected (Brasilia or Itirapina)
- block: The block in which the sample was taken (B1, B2 and B3 for Brasilia and I1, I2 and I3 for Itirapina)
- treatment: The experimental treatment applied to the plot (burning or control)
- block_treatment: The combination of block and treatment
- plot: The combination of a letter indicating the treatment (Q for burning, C for control) and a number indicating the percentage of cover by Urochloa decumbens in the plot (0 for 0%, 2 for 25%, 5 for 50%, 7 for 75% and 1 for 100%)
- unit: The combination of block and plot
- invasion: The percentage of cover by Urochloa decumbens in the plot, expressed as a discrete gradient: 0 for 0%, 2 for 25%, 5 for 50%, 7 for 75% and 1 for 100%
- subplot: The subplot (1 x 1m) in which the cover was estimated (from 1 to 9)
- component: The component for which the cover was estimated - bare_soil, dead_biomass or plant species
- cover: The estimate of cover, in %
- height: Plant height, measured at the insertion of the highest vegetative structure, in cm
- group: The functional group to which the plant species belongs to (graminoid, forb, shrub), or alternatively bare_soil, dead_native, dead_urochloa or other invasive
- status: The origin of the plant species (native or invasive)

Biomass

Where the columns represent:

- year: The year in which the samples were taken (2019 or 2021)

- area: The conservation unit where the sample was collected (Brasilia or Itirapina)
- plot: The block in which the sample was taken (B1, B2 and B3 for Brasilia and I1, I2 and I3 for Itirapina)
- block: The experimental treatment applied to the plot (burning or control)
- treatment: The combination of block and treatment
- block_treatment: The combination of a letter indicating the treatment (Q for burning, C for control) and a number indicating the percentage of cover by Urochloa decumbens in the plot (0 for 0%, 2 for 25%, 5 for 50%, 7 for 75% and 1 for 100%)
- unit: The combination of block and plot
- invasion: The percentage of cover by Urochloa decumbens in the plot, expressed as a discrete gradient: 0 for 0%, 2 for 25%, 5 for 50%, 7 for 75% and 1 for 100%
- subplot: The subplot (0.5 x 0.5m) in which the biomass was sampled (from 1 to 3)
- functional_group: The functional group in which the biomass was sorted out (morta_nativa, graminea, herbacea, arbusto, melinis, urochloa_viva, urochloa_morta, total, native, native_live, urochloa_total, invasive_total)
- biomass: The measurement of biomass per area, in kg/m2

Decomposition rates

Where the columns represent:

- year: The year in which the samples were taken (2019 or 2021)

- area: The conservation unit where the sample was collected (Brasilia or Itirapina)
- block: The block in which the sample was taken (B1, B2 and B3 for Brasilia and I1, I2 and I3 for Itirapina)
- treatment: The experimental treatment applied to the plot (burning or control)
- block_treatment: The combination of block and treatment
- plot: The combination of a letter indicating the treatment (Q for burning, C for control) and a number indicating the percentage of cover by Urochloa decumbens in the plot (0 for 0%, 2 for 25%, 5 for 50%, 7 for 75% and 1 for 100%)
- unit: The combination of block and plot
- invasion: The percentage of cover by Urochloa decumbens in the plot, expressed as a discrete gradient: 0 for 0%, 2 for 25%, 5 for 50%, 7 for 75% and 1 for 100%
- k: The decomposition rate

Soil CO2 efflux

Where the columns represent:

- year: The year in which the samples were taken (2019 or 2021)

- area: The conservation unit where the sample was collected (Brasilia or Itirapina)
- block: The block in which the sample was taken (B1, B2 and B3 for Brasilia and I1, I2 and I3 for Itirapina)
- treatment: The experimental treatment applied to the plot (burning or control)
- block_treatment: The combination of block and treatment
- plot: The combination of a letter indicating the treatment (Q for burning, C for control) and a number indicating the percentage of cover by Urochloa decumbens in the plot (0 for 0%, 2 for 25%, 5 for 50%, 7 for 75% and 1 for 100%)

- unit: The combination of block and plot
- invasion: The percentage of cover by Urochloa decumbens in the plot, expressed as a discrete gradient: 0 for 0%, 2 for 25%, 5 for 50%, 7 for 75% and 1 for 100%
- efflux: The soil CO_2 efflux in (g C)/(m2 day), as calculated according to Keith and Wong (2006)

Reference list

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