NSFDEB-NERC: Elephant-mediated nutrient cycling in a dystrophic savanna-woodland ecosystem

A Data management plan created using the DMPTool

Creator(s): Johan du Toit

Affiliation: Utah State University

Last modified: July 28, 2015

NSFDEB-NERC: Elephant-mediated nutrient cycling in a dystrophic savanna-woodland ecosystem

Data Collected, Formats and Standards

Data and samples will be collected in Chobe National Park, northern Botswana.The research design involves ten sites in the study area, of which five sites will be <5 km (high browsing intensity) and five sites will be >5 km (lower browsing intensity) away from the Chobe River. At each site there will be three plots: dune ridge, mid-slope, and dune trough. A transect will run through the mid-point of each plot and sampling will be replicated. Data will be collected in a set of procedures labelled $_{P1 - P4}$ below:

$_{P1:}$ At each site, a transect will be positioned through each of the three sampling plots, running perpendicular to the catena and parallel to the dune ridge. In field seasons 1 and 2 (FS1 & FS2), starting from the sampling plot and heading in each direction, the first 50 woody plants encountered (>50 cm high) will be identified and measured. Browsing 'damage' to each entire canopy will be visually scored on a 7-point scale. In each canopy below 2 m a random sample of 10 twigs will be scored as recently browsed or not. The five most frequently occurring woody plant species in each of the three transect types (ridge, slope, trough), and the five most frequently browsed in relation to their occurrence in each transect type, will be examined for tolerance and resistance traits. Each species will be scored as evergreen or deciduous, and spinescent or non-spinescent. One randomly selected plant from each of those species at each sampling transect (30 plants of each species across all sites) will have 10 randomly selected shoots clipped and measured (length and dry mass) in FS1 and compensatory growth will be measured in FS2. When each plant is clipped in FS1, a paper bag of leaves will be filled by grabbing at random around the canopy and all bags will be air-dried for laboratory analysis of condensed tannin concentration.

$_{P2:}$ At each of the three sampling plots at each site, plant litter decomposition will be measured using steel-mesh litter bags containing site-specific leaf litter paired with bags containing leaf litter of one common and palatable woody species collected at one site and used in litter bags across all plots at all sites. Replicates of each bag type will be tethered with wire to the nearest tree stem at each plot; bags will be placed out in the mid-dry season and one of each will be collected in mid-wet, late-wet, and mid-dry seasons of the following cycle. The decomposition trial will be started in FS1 with 6 replicates of each bag type per plot and repeated in FS2 with 3 replicates of each bag type per plot. This will allow us to monitor decomposition over two seasonal cycles with replacement in the second cycle. Original litter and litter remaining in collected bags will be dried, weighed, and analysed for total C (%) and N (%) by combustion and gas chromatography using a COSTECH Analytical Element Combustion System 4010 (ESC 4010, Costech Analytical Technologies, Inc., Valencia, CA). Total P (%) will be measured by flow injection using a Lachat QuickChem 8500 Series 2 (Lachat Instruments, Hach Company, Loveland, Colorado). Fine root decomposition (fine roots from site-specific grass species and fine roots of one grass species common across habitats) will be measured using buried bags between 0-30 cm soil depths. Concentrations of bioavailable forms of key soil nutrients (i.e. NO_3, NH_4, PO_4) and ^{15}N will be measured at 0-30 cm (top-soils) and then at 100 cm soil depth in dry-season 1 and wet-seasons 1 and 2 across the three habitats along the catena using a Van Walt soil column cylinder auger. N isotopic ratios will be determined using a Costech model 4010 elemental analyzer (Costech Analytical Technologies, Valencia, CA), coupled to a mass spectrometer. Measuring changes in the natural abundance of ^{15}N in soils along the catena at different soil depths and across dry and wet seasons will help identify main sources (e.g.

dung vs. plant detritus) of inorganic N forms between dune ridges and troughs.

$_{P3:}$ Data sets will come from the browsing survey designed for testing $_{P1}$ and the decomposition trial designed for testing $_{P2}$. In addition, in FS1 and FS2, along 50 m transects in each direction through each sampling plot running parallel to the dune ridge and trough, a 1 m^2 quadrat will be thrown at random five times and all dung and leaf litter will be collected from the soil surface, dried and weighed. Elephant dung will be weighed separately from any other dung. Total N (% DM) and C (% DM) of elephant dung will be measured as well as potential net soil N mineralization rates at 0-30 cm soil depth (linked to P_2). Measuring net soil N mineralization rates provides an estimate of how rapidly inorganic forms of N become available for plant uptake, which we expect to vary among sites (across the browsing gradient) and plots (between dune ridges and troughs). Exploratory augering will also take place to locate the extent of the hard layer, expected to be a factor in linking leached nutrients between the two cycles. To monitor vertical seasonal flux of key nutrients (NO_3 and PO_4), modified resin-based solution-lysimeters containing triplicate flux-proportional passive samplers (Sorbisense^{TM}; de Jonge & Rothenberg 2005; Jordan et al. 2013) will be deployed in each transect at 1m depth. These will be manually deployed before the wet season in FS1 and retrieved at the start of the following dry season for analysis. The unconsolidated nature of the soil catenas facilitates this type of deployment and the buried lysimeter design will ensure temporary saturated conditions for the passive samplers during wet season vertical water flux periods.

$_{P4:}$ The browsing survey (see $_{P1}$) will provide plot-specific frequency distributions of plant species browsed, as well as an overall index of local browsing intensity. A standardized sample (250 g dry mass) of bulked elephant dung from each sampling plot at each site (see $_{P3}$) will be homogenized and woody plant species represented in the dung will be identified by micro-histological examination. Frequency distributions of species present in the dung and in the locally browsed plant community will be used to calculate a similarity index for each plot. Soil samples (three from each sampling plot; 90 in total across all sites) will be taken to determine organic matter content (linked to $_{P2}$). Total soil C (%) and N (%) and C isotopic ratios (^{13}C:^{12}C, to indicate the monocot:dicot ratio in the soil organic matter) will be determined simultaneously using a Costech model 4010 elemental analyzer (Costech Analytical Technologies, Valencia, CA), coupled to a mass spectrometer. Physical fractionation analyses of soil will be performed using a wet sieving protocol modified after Cambardella & Elliott (1993). By measuring the C and N content of different soil fractions we will be able to test whether sites with increased browsing intensity have larger C and N pools in the smaller soil fractions, indicating better structure and fertility for plant growth.

All data will be captured into Excel spreadsheets. Each Excel file will be labelled by procedure used (see above, $_{P1 - P4}$).

Each Excel file will be coded to relate to a metadata document, which will be a Word file describing the variable in each column of the relevant Excel spreadsheet, indicating the unit of measurement. If codes are used (e.g. for plant species) then these will be explained in a key in the metadata document referring to that Excel file. Contextual details will be provided to make the data meaningful to an ecologist working in this field of research.

Data Storage and Preservation

The data (Excel files) and metadata (Word files) will be digitally archived at USU in the DigitalCommons@USU repository (digitalcommons.usu.edu). The size of each individual file will be <4GB. The data will be preserved for as long as is mandated by NSF according to the protocols established by USU

for compliance with NSF or other federal regulations.

Dissemination Methods

All meaningful data, i.e. that which could be used by another researcher, will be made available together with explanatory metadata to any researcher who has access to the internet and can download the files from the Digital Commons repository at USU. The web link will be provided on all publications and will be made available upon request. The data will be available towards the end of FY4 of the project (2019), when data sets are complete and have been checked for errors.

Policies for Data Sharing and Public Access

The data will be available for use by non-group members under the following conditions:
all published work based on the data should acknowledge the source of the data;
users of the data should make every effort to contact the PI to indicate their intentions;
users of the data should consult the USU Office of Research and Graduate Studies (researchdata@usu.edu) to check that their intended use is consistent with USU policy.

Roles and Responsibilities

The PI (Johan du Toit) shall be responsible for data management and monitoring the data management plan. The PI will oversee the transfer of files to the Digital Common Repository and will check that each Excel file has a Word file of metadata that can be accurately interpreted.
Decisions for transferring responsibility of the data, once the PI is no longer available, will rest with the custodians of the Digital Commons repository at USU who will follow USU protocols.