SAFARI 2000 Stem and Canopy Characterization, Kalahari Transect, 1995-2000

Abstract

An international group of researchers completed an intensive field campaign at Kalahari Transect sites in Botswana and Zambia between February 28 and March 18, 2000 as part of the SAFARI 2000 program. The International Geosphere-Biosphere Programme (IGBP) has promoted the 'Kalahari Transect' as one of its global sets of 'mega transects', designed to explore continental-scale links between climate, biogeochemistry, and ecosystem structure and function.

This data set provides species distribution, basal area, height, and crown cover of woody stems at 10 sites along the Kalahari Transect. Some of the data were collected during earlier Kalahari Transect projects in 1995 and 1997 at Vastrap, South Africa; Sandveld and Sachinga, Namibia; and Maziba Bay, Senanga, and Lukulu, Zambia. The rest was collected at Mongu, Zambia and Pandamatenga, Maun, and Tshane, Botswana during the 2000 wet season field campaign of SAFARI 2000.

The purpose of the data collection was to document the species composition and structural characteristics of the woody vegetation at the sites, which are used for Earth Observing Satellite (EOS) validation as part of the Southern African Validation of EOS (SAVE) program and SAFARI 2000.

Background Information

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Project: SAFARI 2000
Southern African Validation of EOS (SAVE)

Data Set Title: SAFARI 2000 Stem and Canopy Characterization, Kalahari Transect, 1995-2000

Site: Kalahari Transect
Westernmost Longitude: 19.17
Easternmost Longitude: 25.50
Northernmost Latitude: -14.42
Southernmost Latitude: -27.75

Data Set Citation:

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Data File Information

The data files associated with this data set are listed below. The primary data file is the kt_stem_map_data_S2K.csv file, with the kt_species_list_S2K.csv file providing supplementary information.

kt_stem_map_data_2000.csv
kt_species_list_2000.csv

The primary data file, **kt_stem_map_data_2000.csv**, contains records of living, dead, and cut stem allometry, canopy geometry, and biomass at the SAFARI sites listed in the Site Summary table.

Stem Map File Column Descriptions

Data Type	Column Name	Description	Units/ Format
Site Information	SITE	Place name of the site.	ASCII
	SITE_NUM	Number of the site (increases from north to south).	numeric
	NUMBER	A number assigned to individual trees at a given site.	numeric
	X_METERS	X location in meters (from SW corner of plot).	meters
	Y_METERS	Y location in meters (from SW corner of plot).	meters
	SPECIES_CODE	Species code - corresponds to SPECIES (TRANSECT) in species_list file.	ASCII
Living Stems	L1NUM	L1NUM to L7NUM are the number of LIVING stems of a given size (L1DBH to L7DBH) for each individual tree.	numeric
	L1DBH	L1DBH to L7DBH are the sizes of LIVING stems measured as the diameter of the stem at breast height (~1.37 m).	cm
	TOTLDBH	Total DBH for all live stems (measured at top of basal swelling) for each tree.	cm
	TOTLSTEM	Total number of live stems for each tree.	numeric
	TOTLBA	Total living basal area for each tree.	cm^2
Dead Stems	D1NUM	D1NUM to D7NUM are the number of dead stems of a given size (D1DBH-D7DBH) for each individual tree.	numeric

	D1DBH	Diameter of dead stems (repeated for number of different sized stems - max is D7NUM & D7DBH).	cm
	TOTDDBH	Total DBH for all dead stems (measured at top of basal swelling) for each tree.	cm
	TOTDSTEM	Total number of dead stems for each tree.	numeric
	TOTDBA	Total dead basal area for each tree.	cm^2
Cut (or harvested) Stems	C1NUM	C1NUM to C7NUM are the number of cut stems (i.e., wood harvested) of size C1DBH-C3DBH for each individual tree. These occur primarily at the Maun site.	numeric
	C1DBH	Diameter of cut (harvested) stems (repeated for the number of stems of different sizes - max is C3NUM & C3DBH).	cm
	TOTCDBH	Total DBH for all cut (harvested) stems (measured at top of basal swelling).	cm
	TOTCSTEM	Total number of cut (harvested) stems.	numeric
	TOTCBA	Total basal area of the individual.	cm^2
Canopy Geometry	HEIGHT_1	Height to bottom of the tree canopy (where measurements were taken).	m
	HEIGHT_2	Height in to the top of tree canopy.	m
	CANOPY_M	Canopy width along X-dimension (E-W).	m
	CANOPY2_M	Canopy width along Y-dimension (N-S).	m
	AREAC	Area of canopy, assuming CANOPY_M and CANOPY2_M are axes of an ellipse.	m^2
Status Flags	COPICE	Flag (0/1) indicating presence of coppiced tree (regrowth from cut stem). These occur when harvesting or fire has cut back the tree from original growth.	0 - False 1 - True
	DEAD	Flag (0/1) to indicate tree is dead (may still be identified by species when possible), species code=99 is given if identification was not possible.	0 - False 1 - True
Biomass	TOT_BIOM	Total individual biomass for each tree based on allometric equations in Goodman 1990.	kg
	LEAF_BIOM	Leaf biomass based on allometric equations in Goodman 1990.	kg

Details regarding the species code column in the data file (described above) can be found in the **kt_species_list** file described below.

Species File Column Descriptions

Column	Definition
NAME	Latin genus, species name
SPECIES (TRANSECT)	Code corresponds to SPEC_CODE column in stem map data file
FAMILY	Latin plant family name
GENUS	Latin genus name
SPECIES	Latin species name
COMMON_NAME	Species common name in English
AFRICAANS	Species common name in Africaans

Study Sites

The sites were distributed as evenly as possible across a rainfall gradient from 200 to 1000 mm/yr, taking into account the difficulty of access to much of the area. Six sites were visited in 1995 and 1997 (Vastrap, Sandveld, Sachinga, Maziba, Liangati, and Lishuwa). One representative plot several ha in size was sampled at each site except at Vastrap, where two plots were used to capture variation in the landscape: a dune and a freely draining 'red' interdune. The other four sites (Kataba, Pandamatenga, Maun, and Tshane) were visited in March 2000. The sites are described in the table below.

The large gradient in both the mean and variation of annual rainfall results in dramatic changes in vegetation structure along the transect. Vegetation type ranges from partially closed woodlands in the north to open shrublands in the south. Throughout the transect, the mixed life-form composition characteristic of savanna communities is maintained. The consistency in geomorphology over the entire region (primarily deep Kalahari sands) allows for an analysis of vegetation structure and ecosystem processes independent of soil type (Thomas and Shaw, 1991a). Sand depth varies widely across the extent of the Kalahari sand sheet, from 10 to 100+ m (Thomas and Shaw, 1991a), and depth to bedrock has been shown to play an important role in controlling species distribution and vegetation structure (Moore and Attwell, 1999). In order to take these considerations into account, site locations were chosen to be in areas without access to shallow water tables or near-surface bedrock, making ground-water availability of secondary importance to rainfall when considering vegetation structure.

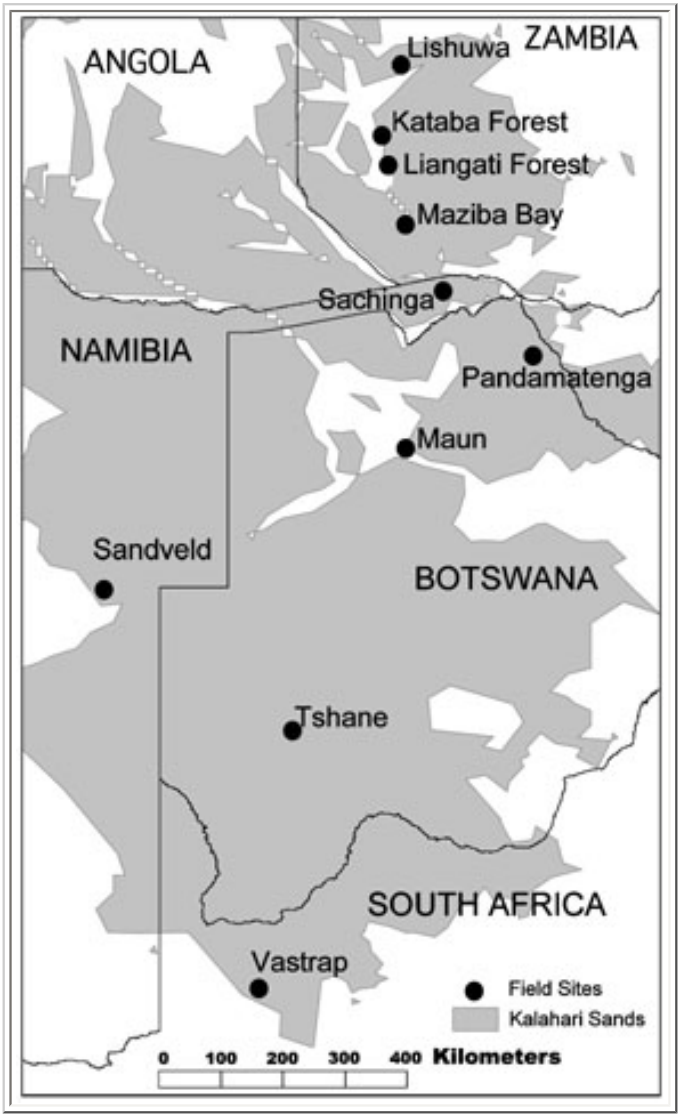
Site Summary Table

Site Name (S2K Site Name)	Location, Country	Latitude (SW corner of site)	Longitude (SW corner of site)	Plot Dimensions	Dominant Vegetation	Time Period Visited
Lishuwa Communal Forest (Lukulu)	**Lukulu**, Zambia	14.42 S	23.52 E	50m x 50m	Evergreen woodland *(Cryptosepalum)*	Feb-Mar 1997
Kataba Forest Reserve (**Mongu**)	**Mongu**, Zambia	15.44 S	23.25 E	50m x 50m	*Miombo* woodland *(Brachystegia)*	March 2000
Liangati Forest Reserve (**Senanga**)	**Senanga**, Zambia	15.86 S	23.34 E	50m x 100m	*Miombo* woodland *(Brachystegia)*	Feb-Mar 1997
Maziba Bay Forest (**Maziba**)	Sioma, Zambia	16.75 S	23.61 E	100m x 100m	*Miombo* woodland *(Brachystegia)*	Feb-Mar 1997
Sachinga Agricultural Station (**Sachinga**)	Katima Mulilo, Namibia	17.70 S	24.08 E	100m x 100m	Woodland *(Combretum)*	Feb-Mar 1995
Pandamatenga Agricultural Station (**Panda**)	Pandamatenga, Botswana	18.66 S	25.50 E	50m x 100m	Woodland *(Schinziophyton, Baikiaea)*	March 2000
Harry Oppenheimer Okavango Research Centre (**Maun**)	**Maun**, Botswana	19.93 S	23.59 E	50m x 50m	Woodland *(Colophospermum)*	March 2000
Sandveld Research Station (**Sandveld**)	Gobabis, Namibia	22.02 S	19.17 E	100m x 100m	Wooded grassland *(Terminalia)*	Feb-Mar 1995
Tshane (**Tshane**)	Tshane, Botswana	24.17 S	21.89 E	100m x 100m	Wooded grassland *(Acacia)*	March 2000

Vastrap Weapons Range (Vasred and Vasdune)	Upington, South Africa	27.75 S	21.42 E	100m x 100m	Shrubland *(Acacia)*	Feb-Mar 1995

Note: Relevant SAFARI 2000 site names used in data files are indicated in **BLUE**. At the Vastrap site, separate stem mapping was performed (~200 meters apart) in the interdune (vasred) and dune (vasdune) areas. These areas exhibited differences in species composition due to changes in the dune/ interdune hydrology and soil composition and thus the names **Vasred** and **Vasdune** are found within the data file instead of Vastrap.

Map of Kalahari Transect Sites



Selected Site Pictures

Mongu (Kataba Forest) from the tower

Maun from the tower

Tshane

Vastrap

Survey Methods

Stem maps were generated at ten sites along the Kalahari Transect. A variable-width belt-transect approach was used for stem mapping. Plot dimensions are provided in the site summary table, above. Tree location, species, diameter, height, and major and minor axis of crown dimensions were measured for each individual taller than 1.5 meters. For multi-stemmed individuals, the diameter of each stem was recorded separately. Individual locations were determined to be the center of the main stem, or the estimated center when multiple-stemmed individuals were sampled. Canopy area was calculated to be an ellipse defined by the two major axes of measurement. Canopy height was estimated using a clinometer.

One representative plot several ha in size was sampled at each site except at Vastrap, where two sites were used to capture variation in the landscape, a dune and a freely draining "red" interdune. At these sites the sub-canopy shrub layer was sampled only if it was a substantial component of the vegetation. Shrubs, defined as long-lived (> 2 yr) woody plants less than 2.5 m tall and typically multi-stemmed at the base, include many small individuals of the species forming the tree layer. The shrub category is included because basal area is an inefficient way of measuring multi-stemmed plants. There are typically thousands of stems per ha, but each is less than 2 cm in diameter; therefore the total contribution to the basal area is less than 1 m/ha. The shrub contribution to canopy cover, on the other hand, can be up to 25%.

The biomass allometry reference is Goodman (1990) as modified by Dowty (1999). The Dowty reference corrects a typo in the published equations found in Goodman.

Additional Sources of Information

Additional related data sets collected during the Kalahari Transect Wet Season Field Campaign are archived by ORNL DAAC. A list of these data sets is available at: http://www.daac.ornl.gov/S2K/safari.html.

References

Besag, J. E. and J. T. Gleaves. 1973. On the detection of spatial pattern in plant communities. Bull. Int. Stat. Inst., 45: 153-158.

Caylor, K., H. Shugart, and T. M. Smith. 2003. Tree spacing along the Kalahari Transect. Journal of Arid Environments, 54(2): 281-296.

Cox, T. F. 1976. The robust estimation of the density of a forest stand using a new conditioned distance method. Biometrika, 63: 493-499.

Diggle, P. J. 1977. The detection of random heterogeneity in plant populations. Biometrics, 33: 390-394.

Dowty, P. R. 1999. Modeling Biophysical Processes in the Savannas of Southern Africa. Ph D. dissertation. University of Virginia, Environmental Sciences, Charlottesville, Virginia, USA 228 pp.

Goodman, P. S. 1990. Soil, Vegetation and Large Hebivore Relations in Mkuzi Game Reserve, Natal. Ph D. dissertation. University of the Witwatersrand, Johannesburg, South Africa.

Moore, A. E. and C. A. M. Attwell. 1999. Geological controls on the distribution of woody vegetation in the central Kalahari, Botswana. S. Afr. J. Geol., 102(4): 350-362.

Scholes, R. J., P. R. Dowty, K. Caylor, P. G. H. Frost, D. A. B. Parsons, J. Ramontsho, and H. H. Shugart. 2002. Trends in savanna structure and composition on an aridity gradient in the Kalahari. Journal of Vegetation Science, 13(3): 419-428.

Thomas, D. S. G. and P. A. Shaw. 1991a. The Kalahari Environment. Cambridge U. Press, Cambridge.

Thomas, D. S. G. and P. A. Shaw. 1991b. "Relict" desert systems: interpretations and problems. Journal of Arid Environments, 20: 1-14.

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