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Research and Short Length Article:

Shrubs Associations in Relation to Ecology of Savannah Rangelands at El Suki Area, Sennar State, Sudan

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Received on: 20/10/2016
Accepted on: 12/03/2017

Abstract. Not all of the Sudan has been covered by post studies; and parts of it seemed more favoured research topic of the others. The first attempt to study the flora of the study area was in 1958, which included in the work of Harrison and Jackson about classification of the Sudan vegetation. The study area was very rich of plant diversity, especially trees and shrubs, because of the high rainfall and a good climate and rich soil. This study is an attempt to investigate and update the associations between the shrubs species to know their ecological positions among the vegetation cover of the Savannah range lands. A field survey was conducted in the two seasons of 2011-2012 and 2012 - 2013 at the south-eastern part of Sinnar State. Five major transects were taken, each of 3000 m length and 10 m width, in a total area of 150.000 m2. Results showed that *Acacia oerfota* is the dominant shrub species throughout the study area, with *Acacia mellifra* and *Combretum aculeatum* as ecological associates in relationship, because they were abundant, frequent and of high density, and less diversity in the Savannah Rangelands at El Suki Area, Sennar State, Sudan in the two seasons of survey.

Key words: *Acacia oerfota, Acacia mellifera, Combretum aculeatum,* El Suki

Introduction

The term of association was first coined by Alexander von Humboldtand formalized by the International Botanical Congress in 1910. (Barbour *et al.,* 1999; Willner, 2006). In community ecology and phytosociology an association is a type of ecological community with a predictable species composition; consistent physiognomy (structural appearance) which occurs in a particular habitat type (Barbour *et al.,* 1999).

There was no single researches studied shrubs only, always comes with trees, woody species or flora. An outstanding contribution is the well-documented classification of the Sudan vegetation by Harrison and Jackson (1958). Ramsay (1958) studied central Darfur, Recently, more comprehensive studies were undertaken. These include: Hassan (1974) who studied the flora of Erkouit. Gumma (1988) study was on Ingessana Hills, El Awad (1995) presented an eco-taxonomical study of the Red Sea Hills, Mohammed (2001) studied the ecology of Jebal AlFaw and surrounding area.

Old moribund trees have a more tree-like form because these lower branches die. A shallow but extensive root system radiates from the root crown (Fig. 1). Many of the roots extend 8-15 m from the stem, parallel to the surface and at a depth of 25 cm. The aerial parts are springy and, when a horizontal force is applied against them, will bend through 90° angle.

Acacia mellifera grows gregariously and forms impenetrable thickets. Consequently, the ground flora is sparse, consisting of scattered plants of *Aristida adscensionis* and occasional herbs, such as *Leonotis pallida*. The sparse ground flora is not sufficiently dense to carry fires into the thickets, and thus they are fireproof. Isolated bushes are also difficult to burn because the branches and leaves of a young or mature bush form a dense, hemispherical mass, touching the ground all around the stem (Adams, 1967).

In many cases the negative effects upon neighbours arise from competition for light, with larger plants shading smaller plants. In other cases, there may be competition below ground for water, nitrogen, or phosphorus (Keddy, 2001).

Frequency is usually expressed as a percentage and sometimes called a Frequency Index. The concept of frequency refers to the uniformity of a species in its distribution over an area. No counting is involved just a record of species present (Smith *et al.,* 1986).

This study is an attempt to study the association of the shrubs in El Suki area to know their ecological positions among the vegetation cover.

Materials and Methods

In the two consecutive seasons of 2011-2012 a field survey was conducted in the south-eastern part of Sinnar State, Sudan, to investigate the association between the shrubs species to know their ecological position among the vegetation cover. The study area (Fig. 2) is located at latitude N: 12°80' and longitude E: 34°26′ in the central clay plains of the Sudan.

It has a semi-arid tropical climate with high temperature during summer and relatively low temperature during winter. Relative humidity varies with maximum of 67% in winter, and minimum of 47% in summer. The soil was dark cracking with very high clay content, characterized by high swelling and shrinking characteristic (Abdelaziz, 2010).

Five major transects were taken, each of 3000m length, 10m width within a total area of 150m^2 (Fig. 2). Sampling precision was obtained by long narrow rectangles crossing contour lines, according to Barmann (1953). Four parameters were taken; density, abundance, frequency and diversity, to measure associations between shrubs

species, Analysis was done by using formulae of the above parameters.

Quantitative ecological parameters

Diversity Indices

The index used for measuring diversity is the index of Simpson's (1949). It is calculated as follows (Equation 1):

$$SiD = \frac{N(N-1)}{\sum n(n-1)} \quad \text{(Equation 1)}$$

Where:

SiD = Simpson's Index of diversity

N= Total number of individuals

n= Number of individuals of each species

Σ = Sum of

Density (D):

This is the number of individuals per unit area, and determined as follows (Equation 2):

$$D = \frac{\text{Total number of individuals}}{\text{Total number of quadrats}} \quad \text{(Eq. 2)}$$

Abundance (A):

This was determined as follows (Equation 3):

$$A = \frac{\text{Total number of individuals}}{\text{Number of occupied quadrats}} \quad \text{(Eq. 3)}$$

Frequency (F):

This is calculated as follows (Equation 4):

$$F = \frac{\text{Number of occupied quadrats} \times 100}{\text{Total number of quadrats}} \quad \text{(Eq. 4)}$$

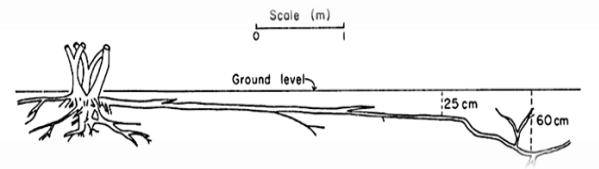

Fig. 1. The root system of *Acacia mellifera* (mature bush), Adams (1967)

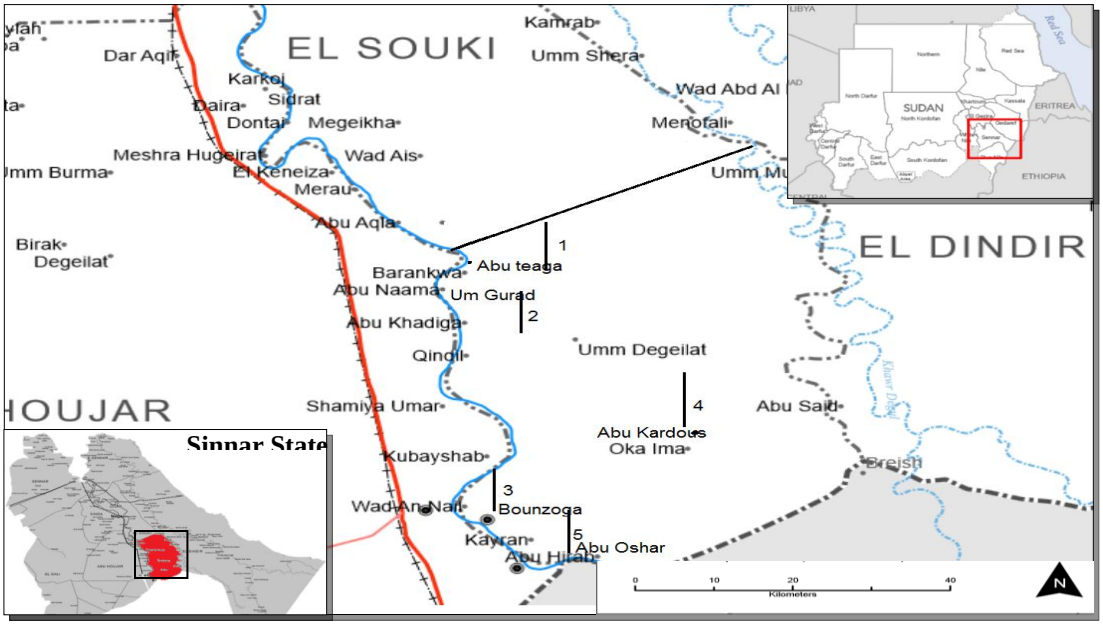

Fig. 2. Map of study area, south-eastern part of Sinnar State, Sudan, OCHA (2012)

Results and Discussions

Density

Results obtained in this study, as shown in Table 1 revealed that *Acacia oerfota* had a high density in all transects in the two seasons, while *Combretum aculeatum* had a high density in transects 4 in season 2011. While, in season 2012 *Acacia mellifera* had a high density in transects 4. This high density maybe due to their underground roots which extend 8-15 m from the stem and when a horizontal force is applied against them, will bend through 90°. This result in agreement with Adams (1967) who reported that many of the roots extend 8-15 m from the stem, parallel to the surface and at a depth of 25 cm. The

aerial parts are springy and, when a horizontal force is applied against them, will bend through 90°. It is also in agreement with Keddy (2001) who reported that; in other cases, there may be competition below ground for water, nitrogen, or phosphorus.

Table 1. Shrubs density of species 2011/ 2012

Species	2011					2012				
	TR 1	TR2	TR 3	TR 4	TR 5	TR 1	TR2	TR 3	TR 4	TR 5
Acacia oerfota	92.25	86.89	96.63	33.33	99.28	72.73	90.81	95.08	38.46	97.22
Acacia mellifera	6.68	10.78	0.48	31.91	0.36	21.21	8.46	2.84	48.95	
Combretum aculeatum	1.07	0.21		33.33	0.18				12.59	
Capparis decidua		0.42	1.69		0.18	6.06	0.37	0.76		
Grewia tenax			0.96				0.37	1.14		
Cadaba farinosa		1.69		0.71						
Calotropis procera			0.24					0.19		
Aerva javanica				0.71						
Stereospermum kunthianum										2.78

TR = Transect

Shrubs abundance, frequency, diversity and density

In season 2011-2012 and 2012-1013 at all of the study area *Acacia oerfota* had a high abundance, density and frequency with *Acacia mellifera* (Table 2). This result may be due their extended roots which make several new plants around the main plant. This result in agreement with Adams (1967) who reported that many of the roots extend 8-15 m from the stem, parallel to the surface and at a depth of 25 cm. The aerial parts are springy and, when a horizontal force is applied against them, will bend through 90°.

Table 2. Shrubs abundance, frequency and diversity 2011/2012

Species	2011				2012			
	Abundance	Frequency	Diversity	Density %	Abundance	Frequency	Diversity	Density %
Acacia oerfota	351.2	100	1.3	89.64	207.6	100	1.3	87.08
Acacia mellifera	25	100	247.5	6.38	23.00	100	108.3	9.65
Combretum aculeatum	13.3	80	1391.8	2.71	9.00	40	4639.5	1.51
Capparis decidua	3.3	60	42619.1	0.51	2.30	60	33801.7	0.59
Grewia tenax	4	20	319643.5	0.20	3.50	40	33801.7	0.59
Calotropis procera	1	20	0	0.05	1.00	20		0.08
Cadaba farinosa	4.5	40	53273.9	0.46				
Aerva jovanica	1	20	0	0.05				
Stereospermum kunthianum					6	20	47322.4	0.50

Conclusion

It was concluded that, *Acacia oerfota* is common throughout the study area with *Acacia mellifera* and *Combretum aculeatum* as ecological associates, because they showed high abundances, frequency and density in both seasons. It is to be recommended that further researches are needed in the study area to know the ecological relations between shrubs species.

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روابط اجتماعات بوته‌ها با مراتع ساوانا در منطقه El Suki، ایالت سنار کشور سودان

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تاریخ دریافت: ۱۳۹۵/۰۷/۲۹
تاریخ پذیرش: ۱۳۹۵/۱۲/۲۲

چکیده. جنوب شرقی ایالت سنار، سودان، غنی از تنوع گیاهی است، به خصوص درختان و بوته‌ها، به دلیل بارش زیاد و آب و هوای خوب و خاک غنی که دارد. این پژوهش به منظور بررسی و به روز رسانی جوامع بین گونه‌های بوته‌ای با موقعیت زیست محیطی آنها و با در نظر گرفتن پوشش گیاهی در مراتع ساوانا انجام شد. بررسی میدانی در فصول سال‌های ۲۰۱۱ الی ۲۰۱۲ و ۲۰۱۲ الی ۲۰۱۳ در منطقه مورد مطالعه انجام شد. پنج ترانسکت بزرگ هر کدام به طول ۳۰۰ متر و با ۱۰ متر فاصله از هم در کل منطقه مستقر شدند. نتایج تحقیقات نشان داد که گونه *Acacia oerfota*، بوته غالب در سراسر منطقه مورد مطالعه بود، و گونه‌های *Acacia mellifera* و *Combretum aculeatum* جزء جوامع اکولوژیکی و در ارتباط با آن بودند، زیرا این گیاهان نیز فراوان یافت می‌شدند و دارای تراکم زیادی بودند. از طرف دیگر این تحقیق نشان داد که تنوع گیاهی در مراتع منطقه El Suki در ایالت سنار سودان در دو فصل مورد مطالعه کم می‌باشد.

کلمات کلیدی: *Acacia oerfota*، *Acacia mellifera*، *Combretum aculeatum*، El Suki