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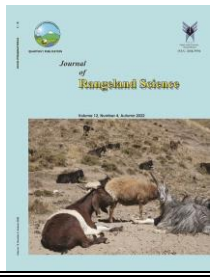

Research and Short Length Article:

Impacts of the Intensive Use of Rangeland on the Vegetation Attributes and Soil Seed Bank of Al-Baja Area, White Nile- Sudan

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Abstract. Al-Baja area, in White Nile State is considered one of the most important rangelands in Sudan as a rainy season grazing area, it used intensively by the herders. The study was conducted in the end of rainy season, November 2019. The study aimed to assess the impacts of intensive use of rangeland on the vegetation attributes and the soil seed bank of Al-Baja area. Parker loop and quadrate were used to determine the vegetation attributes. The number of samples was distributed systematically along line transects. Soil sample was taken from three depths (0-5, 6-10 and 11-15 cm) to assess soil seed bank. The data were analyzed using SAS statistical program, Duncan procedure for mean separation. There were significant differences between the ground cover components. The litters and bare soil recorded high percentage of 40 and 31%, respectively. The species *Schoenefeldia gracilis* recorded high plant composition 93% with density of 75 plant/m². The study showed that the biomass and carrying capacity of Al-Baja area was very low. The results found that *Schoenefeldia gracilis* recorded highest presence of seed in the soil (live 68.2% and dead 70.4%). The study revealed that the soil depth had a significant impact on the seed number and density in the study area and the highest values of both live and dead seed were observed in the upper soil layer (0-5 cm). The natural rangelands in Al-Baja area have been severely degraded as a result of intensive use by the herders and their animals.

Key words: Al-Baja area, Ground cover, Botanical composition, Biomass, Seed density

Introduction

Rangelands are uncultivated lands that are suitable of grazing and browsing animals, and consider the principal source of forage for livestock, (Getabalew and Alemneh, 2019). Rangelands all over the world are subjected to intensive use due to increasing animal and increasing human demands and high economic activities, which led to rangeland resource deterioration, (Salih *et al*., 2020; Abdelsalam, 2019). The Sudan rangelands are providing more than 80% of the total feed requirements of the national herd, in addition, protects the soil and watershed areas against erosion (Abusuwar, 2007). Despite of the importance of rangelands in Sudan, it suffers from several crises, the most significant of which are the lack of rainfall, expansion of agriculture, seasonal fire and overgrazing. Al-Baja area rangelands, in White Nile State are considered one of the most important rangelands in Sudan as a rainy season grazing area, but they were subjected to intensive use by the herders, which led to the deterioration of its resources. This study was aimed to study of the impacts of the intensive use of rangeland on the vegetation attributes and the soil seed bank in Al-Baja rangeland in White Nile, Sudan.

Materials and Methods

The study was conducted near the Habeela Village at Al-Baja area, White Nile State, which was located at latitude 14˚ 04' 19" N and longitude 032˚ 01' 45" E. The area is located in the semi-arid zone, with average rainfall between 150-300mm and the temperatures ranges between 16-36˚C, (Abdelsalam, 2008).

Vegetation attributes samples were distributed systematically across line transects of length 100m using distance tape. Parker loop method (Parker, 1951) was used to determine ground cover. Quadrate of size (1×1m) was placed along transect at 25 m interval between each other for biomass, density and frequency determination. The soil seed bank sampling was distributed according to quadrate distribution.

1- The ground cover and botanical composition were estimated along the line transect using the parker loop method, it expressed as a percentage, (Parker, 1951). These attributes were calculated using the following formulas:

$$\text{Percent of cover elements} = \frac{\text{Total hits cover elements}}{100} \times 100.$$

$$\text{Botanical composition} = \frac{\text{Total hits of each species}}{\text{Total hits of all species}} \times 100.$$

2- Frequency of the species was determined by recording the species names which appear in quadrates. The frequency was calculated by using the following formula:

$$\text{Frequency of the species} = \frac{\text{Number of the occurrence of the species}}{\text{Total number of sample}} \times 100,$$

(Muir, and McClaran, 1997).

3- Density is a number of individual plants per unit area expressed as (plant/unit). It determined by counting all plants rooted in quadrates.

4- Biomas was collected as total weight of the dry matter of vegetation present in the quadrate (1×1m), all plant materials were harvested above 3cm. The plant materials were collected in paper bags, and dried at 104ºC after that was weighted, (Abdelsalam *et al*, 2016). Biomass productivity was calculated by using the following formula:

$$\text{Biomass productivity} = \frac{\text{Average biomass (m2)} \times 10000 \times 0.5}{1000000} = \text{(ton/h/ year)},$$ (Abdelsalam *et al*, 2012).

5- Carrying capacity was determined by divided the biomass productivity by the Tropical Animal Unit (TAU) consumption, which was estimated, at about 2.7 tons/dry

matter/year. The tropical animal unit is an adult cow with its baby calf, which weighs about 250 kg.

6- The Soil Seed Bank was assessed using 9 soil samples (10×10cm) with depths 0-5, 6-10 and 11-15cm, were taken within each quadrate systematically. The soil was mixed and sub-sampled of 250 g, and then were prepared for washing and extraction. After seeds extraction, were floated into 250mm water for 45 minutes, until the dead seed float in the water surface, and then filtered using filter papers. The live seeds, which were sunk to the bottom of the beaker, were floated in Calcium Chloride $CaCl_2$ 12g/ml solution for live seed extraction, and were put in filter papers for drying. Seeds of the different species were identified under the magnifying glass, and comparing them with a seed collected from the plants of study sites, then the percentages of live and dead seeds and seed density were calculated according to the following equations:

$$\text{Percentage of live or dead seeds} = \frac{\text{The number of live or dead seeds}}{\text{All seeds number}} \times 100$$

$$\text{Seed bank composition} = \frac{\text{The number of seeds of plant species}}{\text{All seeds number}} \times 100$$

$$\text{Seed density} = \frac{\text{Number of seeds of depth} * 2 * 10000}{\text{Quadrate area} * \text{number of quadrate of soil depth}}$$

(seeds/m^2), (Abdallah, 2008).

The data were organized tabulated and analyzed using standard range measurements equation and SAS statistical software; ANOVA procedure and Duncan were used.

Results and Discussion

Ground Cover and Botanical composition

The results illustrate that there were significant differences among the ground cover. The litters and bare soil recorded high percentage 40 and 31%, respectively compared to plant cover (Fig. 1). These results clarify that the rangeland deterioration through the increasing bare soil and decreasing vegetation cover of Al-Baja area. There was a clear indicator of the intensive use of rangeland vegetation by the range animals such as the amount of plant litters about 40% of the ground cover components in this range site. Al-Baja area, consider as a rainy season grazing area, it subjected to the open grazing system which practiced by the nomads and other pastoralists. According to Abdelsalam *et al* (2017) the open grazing system affected negatively on vegetation cover and soil conservation.

The species composition the *Schoenefeldia gracilis* scored about 93%, while *Aristida spp*. scored just about 7% of the total botanical composition (Fig. 1). There were just two grass species contributed in the plant composition of the study area. This result explained the poor species diversity in this rangeland and there were no diverse plant types. The result indicated that the intensive use of rangeland resources had negative impacts on species diversity and botanical composition. The *Schoenefeldia gracilis*, was found the dominant plant in Al-Baja rangeland. This result agreed with Abdelsalam *et al*, (2016) who found that *Schoenefeldia gracilis* the dominant plant in Kadugli rangeland and it was considered as a key species. The two species found in study were annual grasses, indicated that the intensive and open grazing led to the disappearance of perennials and the predominance of annuals in the area.

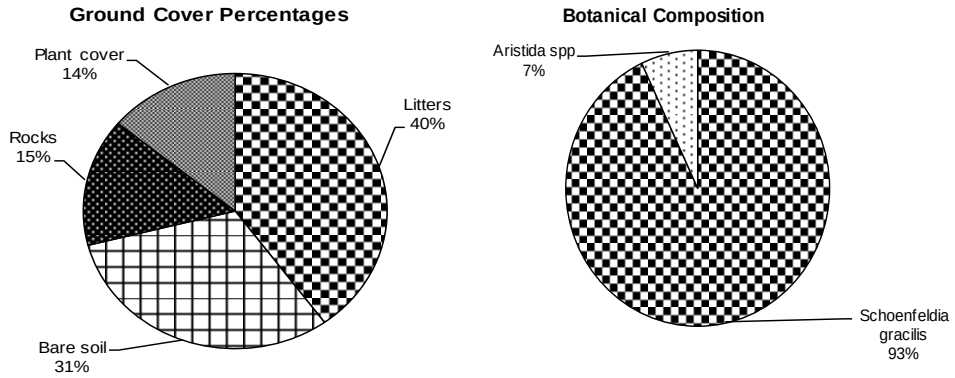

Fig. 1. The ground cover components and botanical composition of Al-Baja Rangeland

Plant Frequency and Density of plant speices

Three species appeared frequently in the range site namely *Schoenefeldia gracilis*, *Aristida spp.* and *Eragrostis spp.* with percentages 75, 15 and 5% respectively (Fig 2.). The species *Schoenefeldia gracilis* recorded high plant density reached about 75plant/m² compared to the other species. *Schoenefeldia gracilis*, has the highest density and frequency at the range site, which makes it more abundant and dominant (Fig. 2). This result reflects the plant's ability to adapt to an arid and semi-arid environment. Abdelsalam *et al*, (2012) found that the *Schoenefeldia gracilis* had a good distribution and more abundance in all rangeland types of Kadugli area. It was observed that the total plant density was low, and it was estimated about 81plants/m².

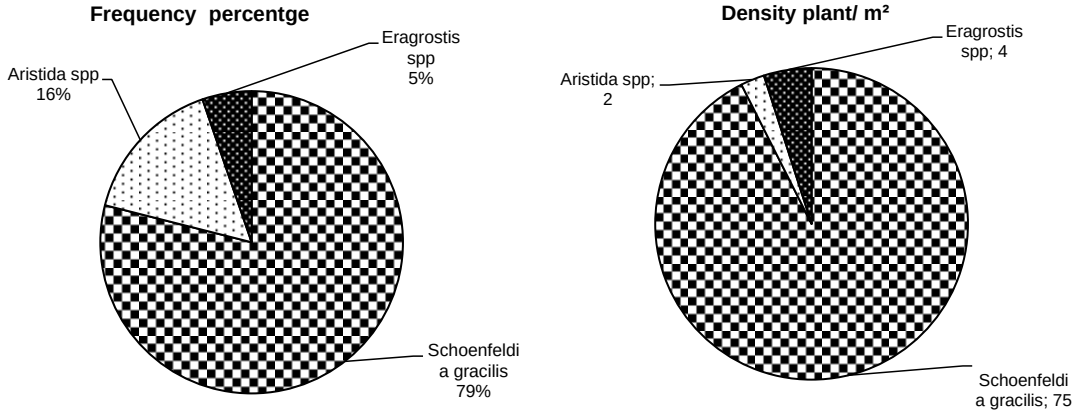

Fig. 2. Frequency and Density of three species *of Schoenefeldia gracilis, Aristida spp.* and *Eragrostis spp*. in Al-Baja area

Rangeland Productivity and Carrying Capacity

The result showed that the biomass productivity was very low, as it only reached 0.04 ton/ha/year. Based on this biomass productivity, the rangeland carrying capacity of Al-Baja area was reduced to 0.002 TAU/ha/year (TAU =Tropical Animal Unit). This result explained that the intensive use of the rangeland affected negatively the biomass production and carrying capacity. Ahmed *et al.* (2020) found that the above ground biomass was significantly decreased with an increasing grazing intensity.

Botanical Composition of Soil Seed Bank

The results shown in Table 1, there were significant differences among the botanical composition of the live and dead seeds in range site. The results showed that *Schoenefeldia gracilis* recorded the highest presence of seed (live 68.2% and dead 70.4%), while *Indogefera spp.* and *Cyprus rotandus* had the lowest presence of seed (live 4.5% and dead 3.7%), respectively. It observed that there were just four species contributed in species diversity in this range site, it may be attributed to the intensive use of rangelands by the grazing animals. Mohammed *et al*, (2020) reported that the misuse of rangeland resources affected negatively on species diversity of soil seeds bank.

Table 1. Botanical composition of soil seed bank

Species name	Live seeds		Dead seeds	
	Seed number	Percentage	Seed number	Percentage
Schoenefeldia gracilis	15 a	68.2	19 a	70.4
Eragrostis spp.	5 b	22.8	6 b	22.2
Indogefera spp.	1 b	4.5	1 b	3.7
Cyprus rotandus	1 b	4.5	1 b	3.7
Total	22	100	27	100
Pr > F	**		**	

*, **= significant at 5 and 1% probability levels, respectively

Means with the same letter are not significantly different at alpha 0.05.

Seeds Density in different soil Depths

The results showed that, the soil depth had a significant effect on the seed number and seed density in the study area of alive and dead seed (Table 2). The upper depth of 0-5 cm had the highest seed density with a value of 222 seed/m², while the lowers 11-15 cm depth recorded less seed density 44 seed/m² of live seeds. In the same line the density of deed seeds in the upper depth reached the higher values of 267 seed/m² as compared to other depths. According Frahaldour *et al*, (2019) the seed density decreases with the increasing soil depth. It was observed that the dead seed density was higher than that of the density of live seeds, which affected negatively on live seeds percentage 44.4% compared to the deed seeds percentage 55.6% (Table 2).

Table 2. Seeds density in different soil Depths

Soil Depths	Live seeds		Dead seeds	
	Seed number	Density (seeds/m²)	Seed number	Density (seeds/m²)
0-5 cm	10 a	222	12 a	267
6-10 cm	4 b	89	5 b	111
11-15 cm	2 b	44	3 b	67
Total (0-15cm)	16	355	20	445
Percentage	44.4%		55.6%	
P > F	*		**	

*, **= significant at 5 and 1% probability levels, respectively

Means with the same letter are not significantly different at alpha 0.05.

Conclusion

The rangelands in the Al- Baja area have been severely degraded as a result of intensive use by the herders and their animals. This deterioration is reflected in the increasing bare soil, declining in vegetation cover, and lack of productivity. The intensive use of rangeland resources led to a decrease in the density of the soil seed bank and an increase in the percentage of dead seeds.

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