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RAINFALL PATTERNS IN THE KRUGER NATIONAL PARK

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Abstract – The available rainfall data for all the recording stations in the Kruger National Park are presented. The average annual rainfall was calculated for each station and this served as basis for compiling a rainfall map for the region. The cyclic nature of the annual rainfall as well as the rainfall distribution within cycles were investigated and a prediction made of expected future rainfall.

Introduction

Rainfall data for the Kruger National Park (KNP) are available for varying lengths of time from scattered stations throughout the area. These data were, however, not consistently and conscientiously taken on the one hand and badly documented on the other. The purpose of this paper is therefore, to present the available rainfall data for the various stations as comprehensively as possible in a concise and readily available form.

A rainfall map for South Africa was published by the Weather Bureau in 1957. On the basis of rainfall data which have become available since 1957, it was apparent that the original map was in need of revision as far as the Lowveld and more specifically the KNP is concerned. Taking into consideration the importance of such a map for planning and interpreting vegetational phenomena, a revised rainfall map was compiled for the region (Fig. 1).

For long-term planning and the determination of management strategies such as a veldburning programme, an artificial water supply scheme and animal population levels, one often requires a prediction of what future rainfall patterns could be expected. Research into the cyclic nature of rainfall has been undertaken by Tidmarsh (1948), Dyer (1975), Tyson & Dyer (1975), Dyer (1976), Dyer & Tyson (1977), and Tyson & Dyer (1978). From an analysis of the KNP data it has also become apparent that periods of above and below the long-term average rainfall occur at regular intervals.

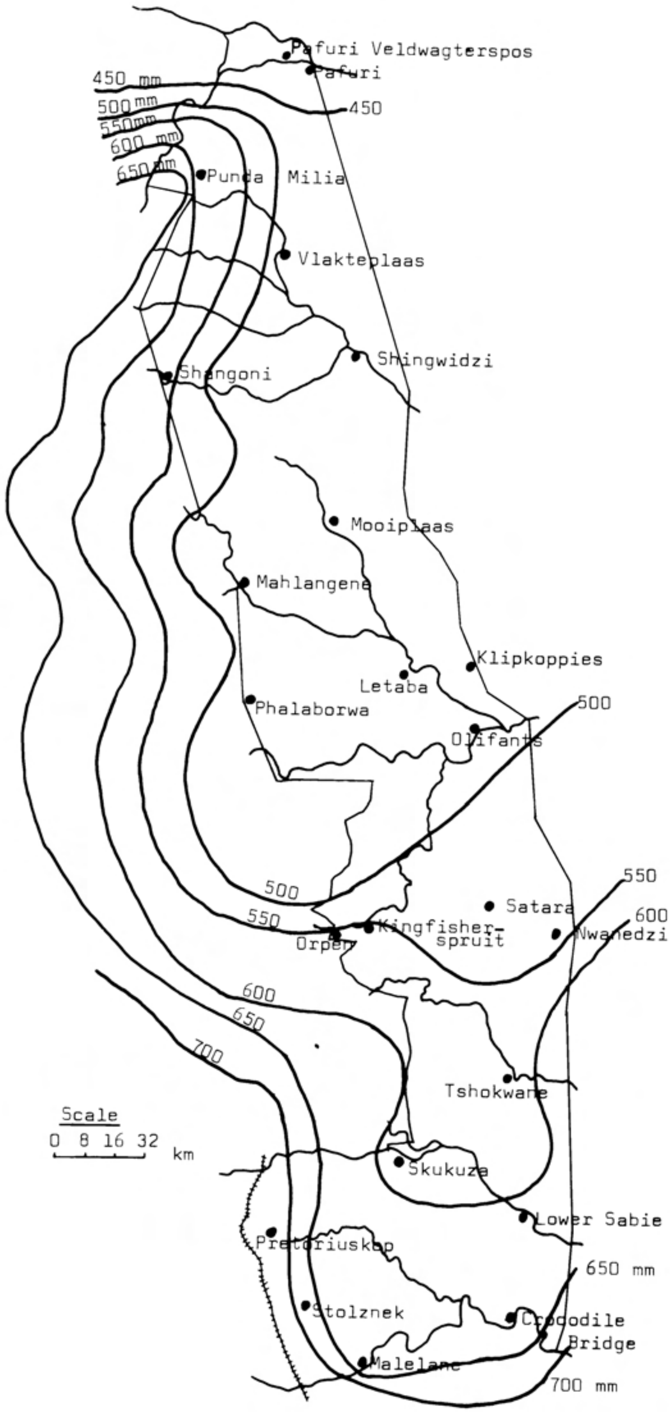

Fig. 1. Rainfall map of the Kruger National Park.

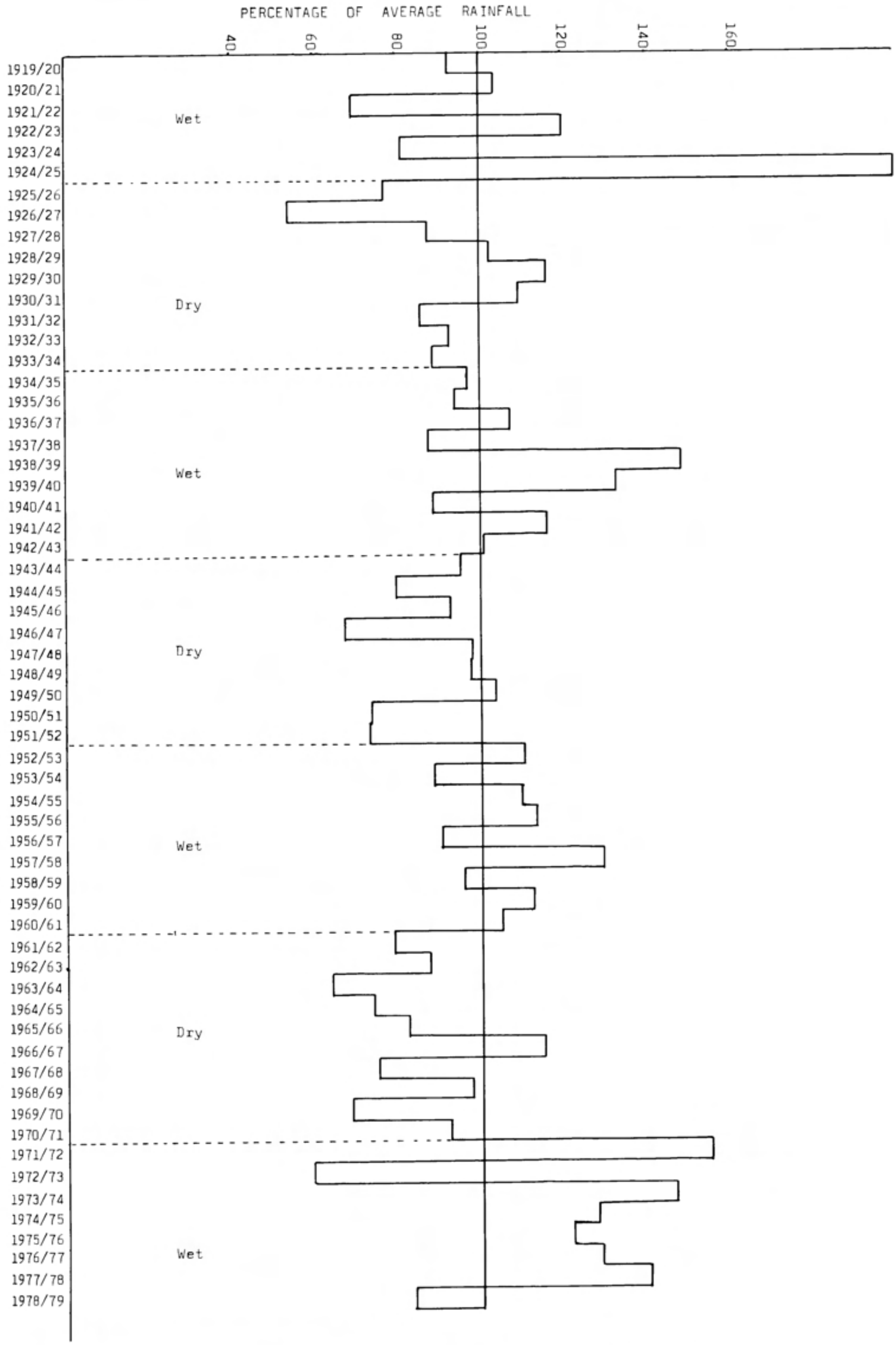

Fig. 2. Percentage annual rainfall of the Kruger National Park.

Methods

All available data for the stations in the KNP were obtained from the Weather Bureau. Where possible, these data were compared and supplemented with data obtained from the Annual Reports to the Board of Trustees for National Parks and from the diaries of rangers in the Park.

An average annual rainfall for each station was calculated. These averages were interpolated with reference to a topographic contour map, to compile a rainfall map of the Park. Use was also made of earlier rainfall maps for this area (Weather Bureau 1957; Dyer 1975; Webber 1979).

The annual rainfall for each station was calculated per season *i.e.* from 1 July to 30 June. This approach was adopted in preference to the custom of expressing annual rainfall in terms of calendar years (January to December). As rainfall is largely confined to the summer months (September to April) this seemed a more realistic approach. To obtain an idea of the annual precipitation for the KNP as a whole, the annual rainfall per station was expressed as a percentage of the average rainfal for that station. Percentage annual rainfall for the KNP (Fig. 2) was calculated as the mean of such percentages for all stations. This was used to examine the rainfall cycles.

Results

The monthly and annual rainfall for each station in the KNP is presented in Tables 1–18. During World War II no data were collected at Punda Milia and for the period 1942–1955 only annual rainfall (January-December) was obtainable for Letaba, Shangoni and Shingwidzi. It was also clear that data collected during the early stages of the KNP's existence are incomplete and unreliable. The altitude, position and average annual rainfall for all the stations in and around the KNP are presented in Table 19.

For determining the average annual rainfall, all available data were used. However, the periods for which data were available varied considerably from one station to another. Data for Skukuza were available for 60 years while data for Stolznek were available for only the last three years. The annual rainfall for Skukuza before 1919 is not presented in Table 11 but was recorded as follows:

Year	*Rainfall (mm)*
1908	315,5
1909	586,7
1910	730,3
1911	461,8
1912	513,1
1913	436,1
1914	No records

1915	No records
1916	No records
1917	853,4
1918	1 016,3

The acceptability of the average annual rainfall as presented for a particular station would therefore vary with the period for which rainfall data are available. Based on the acceptance of the recurrent nature of the rainfall pattern and the succession of above and below average rainfall cycles at 10 year intervals, it would appear that acceptable averages could only be expected with approximately 40 years of data *i.e.* a period representing two above and two below average rainfall cycles. It is therefore acknowledged that much of the data for the KNP is insufficient to be conclusive and should be re-evaluated at regular intervals.

In the KNP precipitation decreases from south to north, except for the area around Punda Milia which is situated at a higher altitude (Table 19). Cole (1961) states that rainfall is strongly controlled by relief and distance from the warm Indian Ocean, while Lilly (1977) claims that the precipitation progressively decreases inland from the escarpment and towards the east. The minor decrease in rainfall from west to east in the KNP is pointed out by Gertenbach (1978). The decrease in rainfall corresponds to a decrease in altitude from west to east and this becomes more pronounced towards the escarpment on the western boundary of the Park.

The boundaries of the different rainfall units as indicated in Fig. 1 are not necessarily accurate, due to the lack of sufficient stations in the Park. Differences due to local orographic influences were also ignored in compiling the map *e.g.* the average rainfall for Klipkoppies/Mooiplaas is above 500 mm, but it is not represented as such on the map. Data obtained from new stations give unrealistic higher averages due to the above normal rainfall during the past eight years.

According to Dyer (1975), Tyson & Dyer (1975), Dyer (1976), Dyer & Tyson (1977) and Tyson & Dyer (1978) there is a *quasi* 20 year rainfall oscillation in the summer rainfall areas of South Africa. The oscillation consists of 10 years of above and 10 years of below average rainfall. Hall (1976) suggests from dendroclimatological studies, that this 20 year oscillation was present as far back as 1750. Tyson & Dyer (1978) found that there was a change in phase around the turn of the century when a double dry spell occurred from 1897–1915.

The percentage average annual rainfall for the KNP is presented in Fig. 2. It corresponds to a large extent with the results obtained by the above mentioned workers. The period up to 1925 was a wet spell with stations like Punda Milia and Skukuza receiving respectively 290% and 204% of their annual rainfall in that season. During this period the KNP received 119,1% of its average rainfall. The average percentage annual rainfall for the different periods were as follows:

Period	*Average Percentage Annual Rainfall*
Up to 1925	119,1% – probably 10 wet years
1926–1933	90,3% – 8 dry years
1934–1942	108,1% – 9 wet years
1943–1951	86.8%– 9 dry years
1952–1960	106,0% – 9 wet years
1961–1970	83,4% – 10 dry years
1971–1978	120,4% – 8 wet years

The recent wet spell was the highest relative rainfall in the last 60 years. During 1979 a decrease in rainfall was detected which could be considered indicative of the initial stages of the dry cycle predicted for the 1980's.

On average the precipitation in wet and dry cycles in the KNP was 13% above and below normal. According to Tyson & Dyer (1975) this percentage varies from 20–30 with two to three years in a 10 year cycle not conforming to the general pattern. In spite of the wet spell of the seventies, the KNP experienced one of its driest seasons during 1972/73 receiving only 59% of its average annual rainfall. However, what seems to be most important ecologically is successive years of high or low rainfall and not an alternation from year to year. The oscillation in the KNP also seems to be shorter than 20 years.

The *quasi* 20 year oscillation will continue to operate if the aerial circulation over South Africa and the surrounding oceans continues to behave similarly to that over the past 60 years (Dyer 1976). However, Tyson & Dyer (1975) point out that it is difficult to predict how long a system known mainly for its irregularity, can maintain the present stable pattern of oscillatory changes.

December, January and February are on average the wettest months for the KNP, with July and August the driest (Table 19). In comparing the annual rainfall distribution in different cycles (Fig. 3), there appears to be a shift of the peak monthly precipitation towards the end of the rainy season in dry cycles. This, together with a relatively higher precipitation and a longer "dry" period during the winter months of a dry cycle, decrease the efficiency of the annual rainfall for plant growth, thus adding to the actual drought experienced.

Examples of the interaction between rainfall patterns and biological phenomena are common for the Park. According to Kloppers* (1979 *pers. comm.)* a large number of matume trees *(Breonadia microcephala)* in the Shipudza vicinity to the west of Punda Milia, collapsed as a result of the high rainfall during 1925. Also, a large number of knobthorn *(Acacia nigrescens)*, on the clayey soils to the north of Satara, died off during the severe droughts of 1961–1965. Game populations are also influenced by rainfall cycles. During the wet spell of 1934–1942, there was a remarkable decrease in the populations of blue wildebeest *Connochaetes taurinus* and Burchell's zebra *Equus burchelli antiquorum*, with the daily newspapers of the

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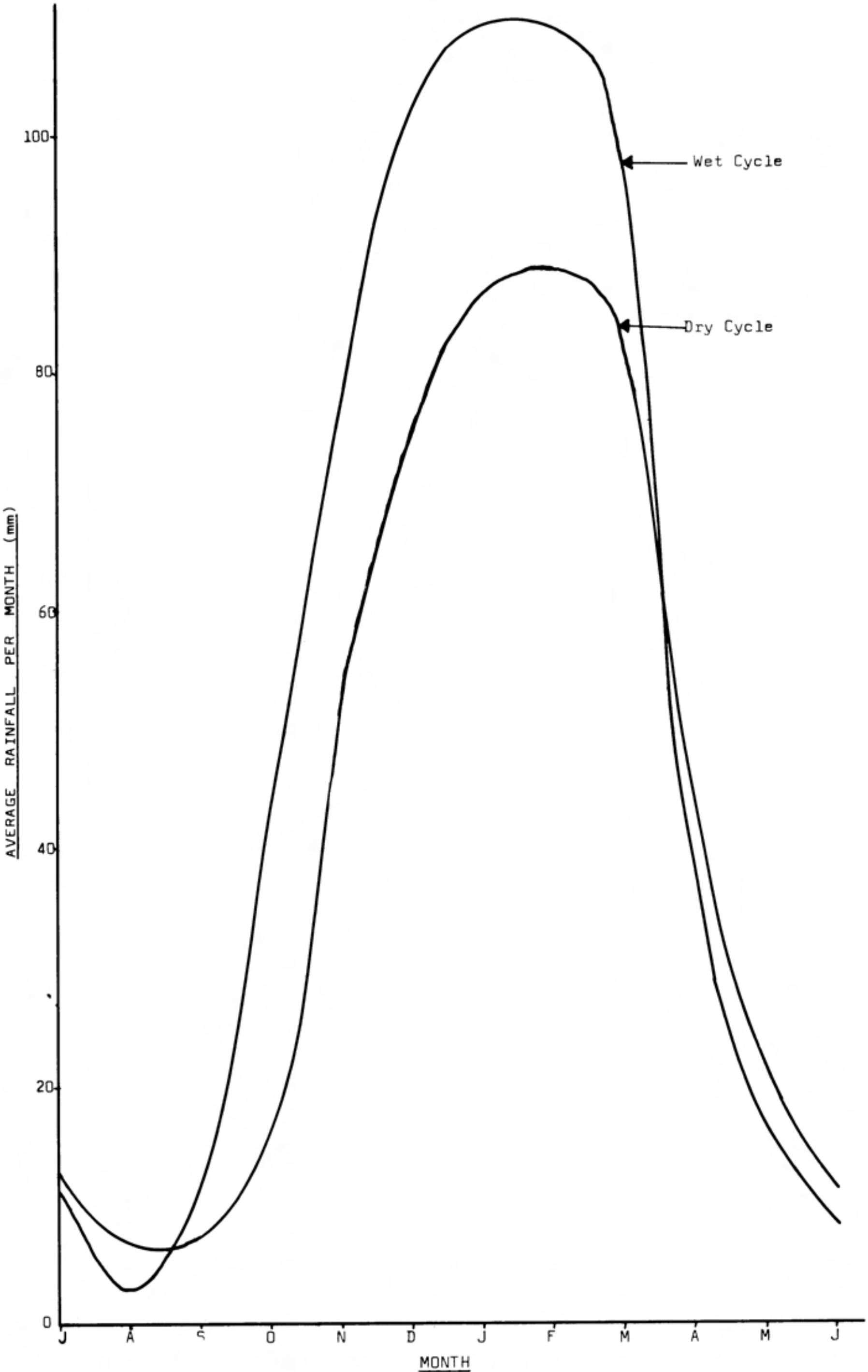

Fig. .3. Rainfall distribution in a dry and wet cycle.

time documenting controversial public interest *(Rand Daily Mail* 5th November 1938, *The Friend* 11th November 1938, *Natal Mercury* 18th November 1938, *Sunday Express* 4th December 1938). Lions *Panthera leo* were largely blamed for the decrease, but since 1971 (also in a wet spell) the numbers of the wildebeest and zebra again decreased. Once again lions were blamed but it became evident that the high rainfall and tall grass played a more important role in controlling these animal populations. The importance of these rainfall cycles and their associated effects have been overlooked and should be taken into account when attempting to explain and predict future events.

Conclusion

Inconclusive as the data may be, the rainfall statistics for the KNP confirm the recurrent, cyclic nature of the rainfall as expounded by Tyson & Dyer (1978). It has also been pointed out that the number and distribution of rainfall recording stations in the KNP are insufficient to enable the accurate plotting of rainfall isohyets.

Rainfall phenomena have a wide range of applicability in current and long-term planning for a variety of disciplines. In the field of nature conservation all biota respond to the pattern and distribution of rainfall on both the short-and long-term. Accurate rainfall statistics and their interpretation in terms of their influence on the environment therefore, form an integral part in the study and understanding of ecosystems. The continued monitoring of rainfall (and other components of the climate) and an increase in the number of recording stations within the Park is therefore of the utmost importance.

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