# Rainfall in the Namib Desert Park

by

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Received: 17 January 1980

CONTENTS

1 Introduction ..... 176
2 Data collection and analysis ..... 176
3 Results ..... 176
3.1 Individual storms ..... 176
3.2 Cumulative rainfall totals ..... 178
4 Discussion ..... 178
5 Conclusions ..... 178
6 Acknowledgements ..... 180
7 References ..... 180

ABSTRACT

Rainfall distribution during individual storms was monitored over a 100 km$^2$ area of the Namib Desert Park during 1974. Five of these storms and cumulative totals of precipitation are examined. The explanations for storm occurrence and for precipitation distribution within the study area are not obvious. The availability of additional data of this nature may assist with interpretation.

## 1 INTRODUCTION

The Desert Ecological Research Unit (DERU) at Gobabeb in the Namib Desert Park has an annual average precipitation of 24 mm (Schulze, 1969), although this amount may vary considerably annually. Between 1959 and 1969 the July–June annual totals averaged 16,8 mm, with a coefficient of variation of 54 % (Seely and Stuart, 1976). Most of the rain falls between January and April, on occasion during a single thunderstorm, prior to the onset of dry easterly Berg winds during May. The actual mechanisms causing storms (rainfalls) in this area are not well understood.

During 1974, a particularly wet season with 130 mm of precipitation recorded at Gobabeb, DERU undertook an intensive programme monitoring rainfall receipt. The area studied extends over 100 km$^2$ to the north-east of Gobabeb (Fig. 1). Five storms were monitored in detail as a preliminary attempt to explain the occurrence and distribution.

In the present paper a preliminary explanation of the five storms monitored and of selected cumulative rainfall totals is attempted. The explanation of local patterns from available data is not obvious, but may be more readily recognised with the availability of more observations.

## 2 DATA COLLECTION AND ANALYSIS

A network of rain-gauges was erected on a one-kilometre grid over an area of 100 km$^2$, centred on Mirabib (Fig. 1). Rainfall receipt at each station was recorded after individual storms, and isohyets plotted accordingly. Five individual storms and selected cumulative totals were examined in detail. Precipitation is also recorded at Gobabeb and at Ganab, outside the study area.

The total precipitation received at individual stations varied between storms from 0,0 to 47,5 mm. The five storms monitored in detail were of two distinct types (Table 1):

- those during which less than 7,5 mm of rain was received throughout the grid area (2 storms);
- those during which heavier rainfalls of between 7,5 and 47,5 mm were recorded at all stations (3 storms).

Although all the storms, except one during the afternoon, occurred in the early to mid-morning period, they were not associated with fog. Surface winds in all cases were light, not exceeding 5 m/s. Atmospheric circulation patterns, generally cyclonic (Table 1), were examined for each storm period; and the resultant rainfall distributions were compared with the topography of the area.

Relief of the area is slight (Fig. 1), with an average altitude of approximately 750 m, and a gradual slope towards the Atlantic coast to the west. Maximum relief in the study area occurs at Mirabib (840 m), while a more minor feature extends towards the south-east of the area (791 m). Small tributary valleys of the Kuiseb River are present throughout the area. Gobabeb, at 407 m, lies on the right bank of the Kuiseb River to the south-west, while Ganab is to the north-east of the area, at approximately 970 m (Fig. 1).

TABLE 1: Details of storms in the Namib Desert Park, 1974.

| Storm Type | r < 7,5 mm | | r > 7,5 mm | | |
|---|---|---|---|---|---|
| Date | 28,1 | 8,2 | 15,1 | 23,1 | 15,2 |
| Time | Early morning | | Early morning | | Afternoon |
| r (mm) | | | | | |
| Ganab | 0,6 | 0,0 | 0,0 | 0,0 | 3,0 |
| Gobabeb | 0,0 | 0,0 | 0,45 | 0,0 | 0,0 |
| Maxima | E-NE | W-NE | W-NE | SE-centre | NE |
| Wind | SW-NW | NW-NE | W-NW | SW-NW | SSW-NW |

## 3 RESULTS

The rainfall distribution for the Namib Desert Park grid area is considered for individual storms and for cumulative totals.

### 3.1 Individual storms

The two storm types monitored are considered separately.

Rainfalls less than 7,5 mm: The two storms (Fig. 2) which recorded very little precipitation are distinct from each other and from the heavier storms. In both cases, distribution is fairly uniform over the area, when related to the very low totals. The rainfall distribution for the storm on 28.1.1974 (Fig. 2a) displays a gradual increase from a trough of 0,0 mm in the south-west towards the east and north-east over the entire area. Gobabeb was correspondingly dry, while Ganab received 0,6 mm of rain. Such a distribution may possibly be associated with increased uplift as relief increases towards the east and north-east of the study area, in conjunction with a south-westerly to north-westerly wind. On 8.2.1974 (Fig. 2b) there is a general tendency towards increased rainfall in the south-east. Isolated areas of 0,0 mm towards the east may be associated with limited rain shadow effects of the relief obstacles.

In both instances, totals are very small, and consequently generalisations become difficult.

Rainfall exceeding 7,5 mm: The rainfall distribution during all three storms (Fig. 3) shows an increase in totals towards the east of the study area. On two occasions a maximum is reached in the north-east (Fig. 3a and 3c), and rain is recorded at Gobabeb or at Ganab (Table 1). As with the storm on 28.1.1974

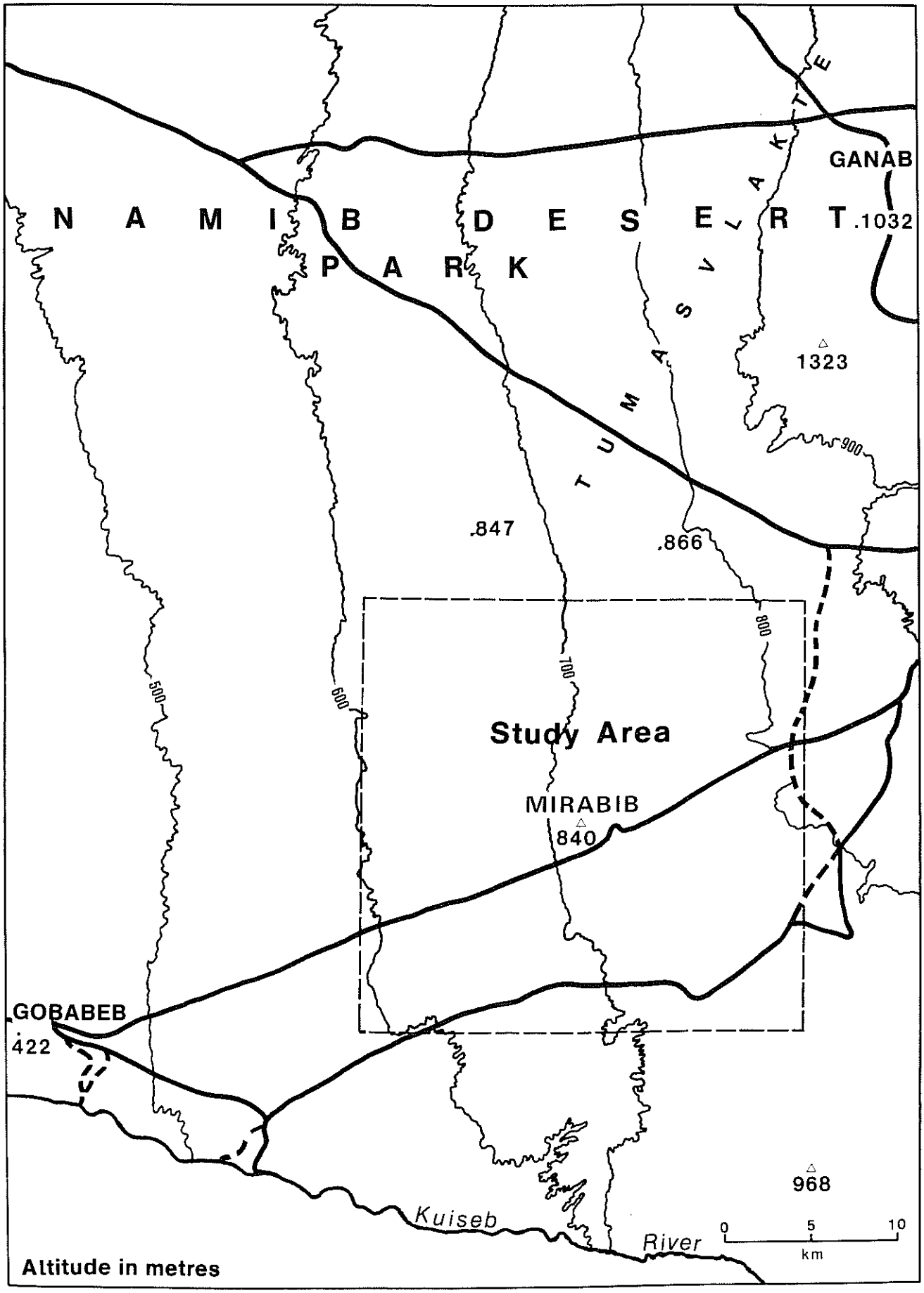


FIGURE 1: Location of the study area in the Namib Desert Park.

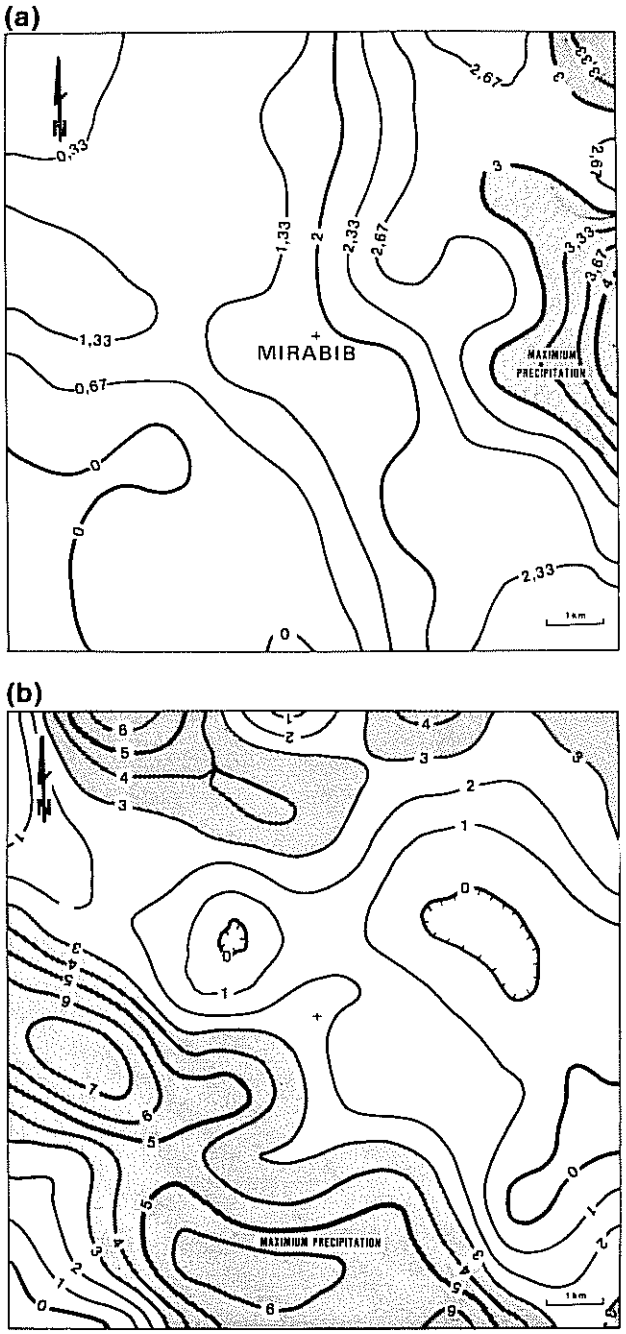


FIGURE 2: Distribution of rain during storms of less than 7,5 mm, (a) on 28.1.1974; and (b) on 8.2.1974.

(Fig. 2a), the distribution of precipitation during both these storms may possibly be ascribed to the general increase in altitude away from the Kuiseb River valley towards Ganab in the north-east. Maximum precipitation was received from the afternoon storm on 15.2.1974 (Fig. 3c), when it varied from 0,0 mm at Gobabeb to 3,0 mm at Ganab. On 23.1.1974 (Fig. 3b) a ridge of maximum precipitation extended from the centre to the south-east of the area, and was obviously a localised feature as neither of the two main stations recorded any rain (Table 1). In this instance, the distribution may be affected by the isolated relief features of the area.

### 3.2 Cumulative rainfall totals

The cumulative totals for storms over the grid area display an interesting pattern which has some correlation with the individual storms examined above. The January—February total (Fig. 4a) has a maximum in the north-east of the area, whereas the March total, at 25 % of that for January—February, has a ridge across the centre and south-west of the area (Fig. 4b). The 1974 January—June totals, however, are dominated by a ridge extending from the centre of the area towards the east and north-east (Fig. 4c). The dominant distribution, therefore, in both individual storms and cumulative totals would appear to be one of increasing precipitation towards the east and north-east in particular. A secondary maximum occurs to the south-west, in light storms, but is not evident in the annual cumulative totals.

## 4 DISCUSSION

The mechanisms involved in these occurrences of rain over the Namib Desert Park are uncertain. Taljaard (1979) has attributed the occurrence of afternoon storms, such as that on 15.2.1974, to the development and passage of a moisture front over the area. It would appear that the early to mid-morning rainfalls are also associated with such a moisture front as well as with convergence into the prevailing unstable low pressure centres. Nocturnal radiational cooling accentuates cloud development under these conditions, and hence storm occurrence during early hours.

The distribution of rainfall for both individual storms and cumulative totals appears to be correlated with relief to a limited extent throughout, particularly where rainfall totals exceed 7,5 mm. In all instances, however, there is no definite pattern, probably because actual totals are low.

One of the main problems in attempting to explain the occurrence and distribution of precipitation over the grid area is that the area is being considered almost in isolation with no data available for the surrounding area. It therefore becomes difficult to generalise.

## 5 CONCLUSIONS

Two types of storm, defined according to the amounts of precipitation received, have been identified in the Namib Desert Park. These are associated with cyclonic convergence, north-westerly winds, and generally occur during the early part of the day. A rainfall maximum in storms of more than 7,5 mm and in the cumulative precipitation totals occurs to the north-east of the grid area, corresponding with a gradual increase in altitude. A secondary maximum occurs to the south-west of the area. Storms appear to be local features, and to have some correlation with relief. However, with a small

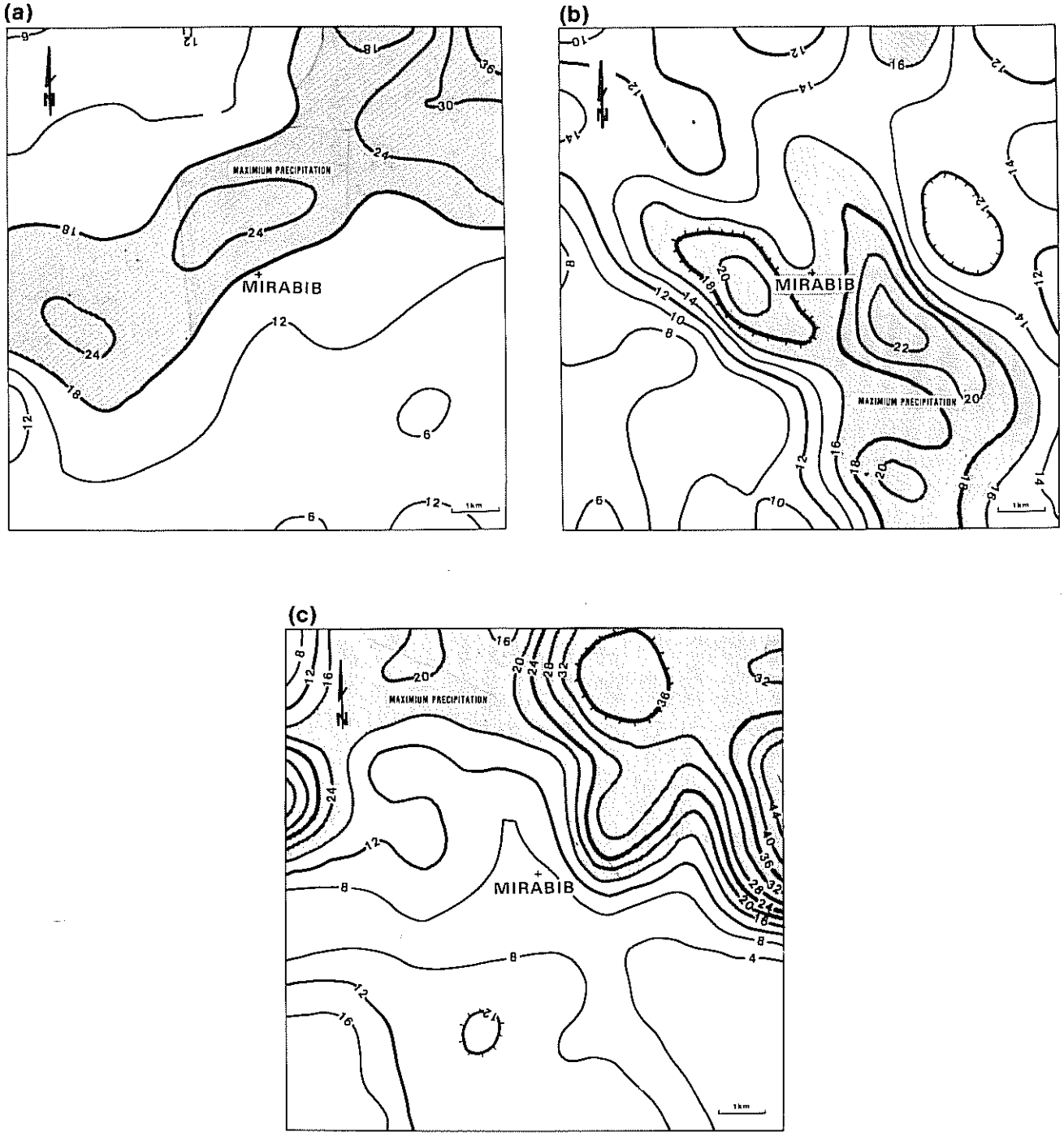


FIGURE 3: Distribution of rain during storms of more than 7,5 mm, (a) on 15.1.1974; (b) on 23.1.1974; and (c) on 15.2.1974.

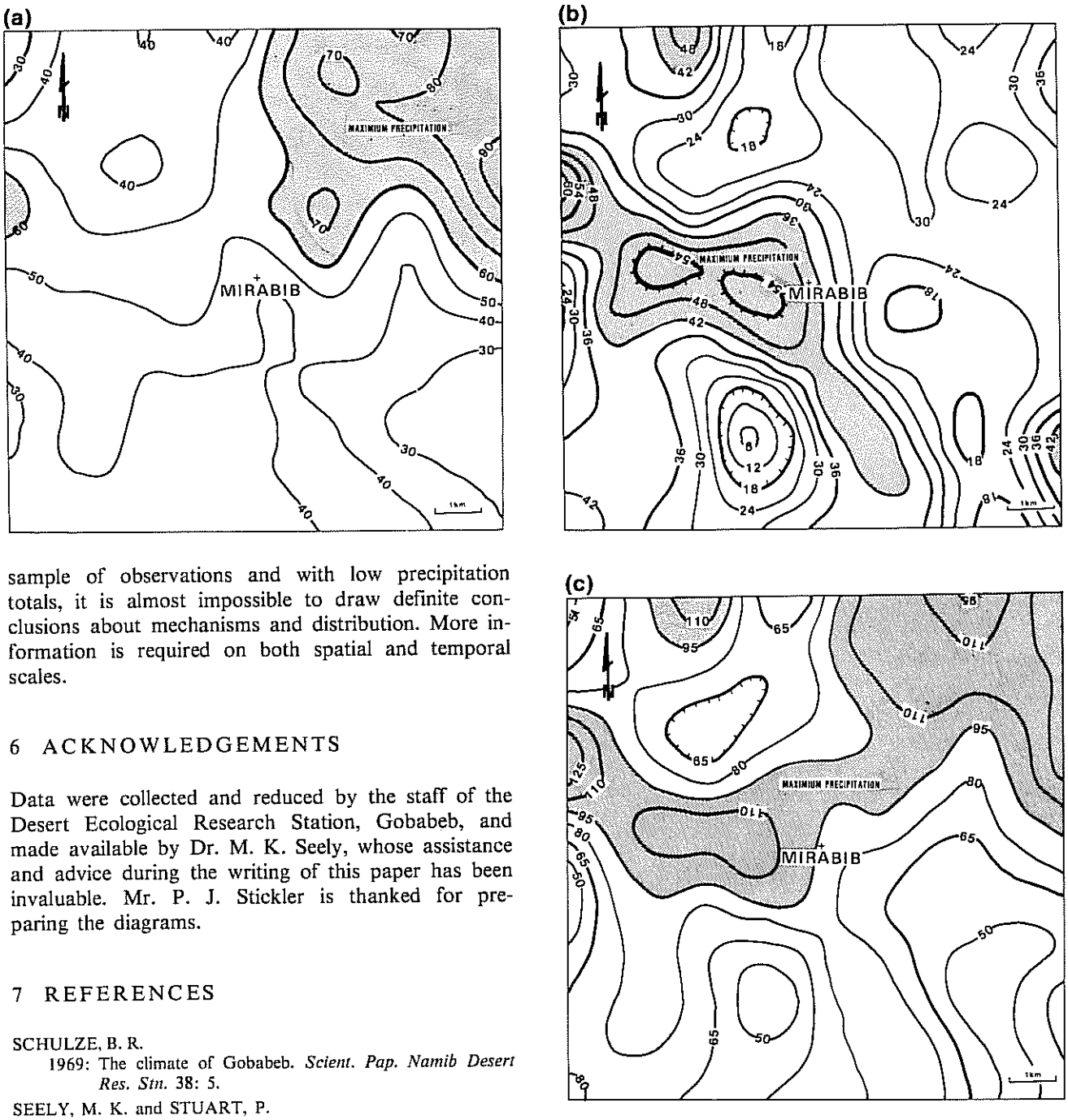


FIGURE 4: Cumulative totals of precipitation (mm) for the study area during (a) January–February, 1974; (b) March, 1974; and (c) January–June, 1974.

sample of observations and with low precipitation totals, it is almost impossible to draw definite conclusions about mechanisms and distribution. More information is required on both spatial and temporal scales.

## 6 ACKNOWLEDGEMENTS

Data were collected and reduced by the staff of the Desert Ecological Research Station, Gobabeb, and made available by Dr. M. K. Seely, whose assistance and advice during the writing of this paper has been invaluable. Mr. P. J. Stickler is thanked for preparing the diagrams.

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