Activity patterns shown by Hartmann Zebra *Equus zebra hartmannae* in South West Africa with reference to climatic factors

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CONTENTS

I. INTRODUCTION

The daily activity of mammals has, until lately, been somewhat neglected, their other behavioural aspects, such as social behaviour having attracted more of the researcher's attention. Recently however, the daily activity of the black rhinoceros *Diceros bicornis* was studied in detail in Kenya, (Schenkel & Schenkel, 1969) and in South West Africa (Joubert & Eloff, 1971). In addition three papers have appeared in the East African Wildlife Journal. In the first of these, Spinage (1968) advocates the standardization of procedures for the study of ungulates. In his study of the defassa waterbuck *Kobus defassa ugandae* he uses the same method for quantitative study of activity, used for zebu cattle *Bos indicus* by Rollinson, Harker & Taylor (1956). Clough and Hassam (1970) used the same method in their study of the daily activity of the warthog *Phacochoerus aethiopicus*. Both these papers (Spinage as well as Clough & Hassam) however, are based on short observation periods of two to three days and a very limited number of animals (one waterbuck and three warthogs). The third paper, however, by Owen (1970) on the sitatunga, *Tragelaphus spekei*, is based on the number of sightings recorded in each hour of the day during a sample of 284 days over 15 months. Elsewhere in his study on the Burchell's zebra Klingel (1967) spent eight days and five nights to work out their activity pattern over 24 hours. During this period he watched a large number of animals and every 15 minutes noted how many of the animals were grazing, standing, lying or walking.

This present paper forms part of a larger research project on the ecology and behaviour of the Hartmann zebra in South West Africa which was carried out from the latter half of 1968 until June, 1971. For the larger project various study areas throughout the Hartmann zebra range was used. Most of the information in this paper however was collected at the Daan Viljoen Game Reserve.

The Daan Viljoen Game Reserve is located just outside Windhoek, 28 km by road or 14 km as the crow flies. It is approximately 4 000 hectares in extent, but the area in which the Hartmann zebra are confined is just over 1 100 hectares. It lies on the eastern side of the Khomas Hochland and is severely dissected by the Augeigas River and tributaries which form a part of the upper reaches of the exoreic drainage system of the Swakop River. The Game Reserve is approximately 1 800 metres above sea level in extremely broken, hilly country. The hills are composed of wheathered mica-schists with steep slopes, especially on the eastern sides. The steepness of the slopes is mainly due to the geomorphological characteristics of the parent material. The drainage lines are very well marked and run in a series of parallel ravines in a northerly direction each with lesser side branches from east to west.

The vegetation may be classified as montane savanna (South West Africa vegetation map by W. Giess,

Herbarium, Windhoek). The vegetation on the hills are mostly open with scattered trees. Most of the tree growth is restricted to the drainage lines. On the hills the most prominent tree is *Acacia hereroensis*, averaging about 4 metres high. Most of these trees are stunted although in sheltered areas they grow higher. Other trees on the ridges are *Ozoroa crassinervis* and *Combretum apiculatum*. Both the *Acacia* and *Combretum* show a marked browse line as well as extensive damage caused by kudu *Tragelapus strepsiceros*. In the drainage lines the dominant tree growth is formed by *A. karroo*, *A. giraffae* and *Ziziphus mucronata*. The tall shrub layer is formed by *A. mellifera* var. *detinens*, *A. hebeclada*, *A. reficiens* and *Euclea undulata*. *Rhus lanceolata* frequents the drainage lines while on the slopes one finds *Rhus marlothii*. The dominant perennial grasses consists mainly of *Anthephora pubescens; Enneapogon cenchroides; Schmidtia* ssp.: *Stipagrostis uniplumis* and *Aristida meridionalis*.

The area has a strongly seasonal climate with regard to both temperature and precipitation. Winters are almost totally rainless and virtually cloudless, and with exceedingly low humidity. Precipitation occurs as summer convectional rainfall, with an annual mean of approximately 375 mm. During the summer months the relative humidity is extremely variable. Marked fluctuations in temperature, both daily and annual, occur. Summers have very high sun temperatures, but experience strong radiational cooling after sunset. Winter temperatures are fairly low (often near freezing) at dawn but rise rapidly after sunrise.

II. METHODS

The study area at the Daan Viljoen Game Reserve was visited monthly for periods of a week or longer. An attempt was made to visit the area always during the two middle weeks of each month. Observations were always made from a vehicle. The procedure normally followed, consisted of locating a group of zebras as shortly as possible after first light. These animals were then observed from the vehicle at distances that varied from approximately 50 to 200 metres until last light in the evenings. The observer always attempted to have a drainage line between himself and the hill or slope occupied by the zebras, as this seemed to make them more at ease.

Notes on their activities were jotted down at five minute intervals. At these times it was noted how many of the group of animals watched were actually grazing or performing other activities. At halfhour intervals the irritation caused by insects was measured. To do this the number of times an animal twitched its tail in one minute were counted. For accuracy a stopwatch and tally counter was used. This was done with three animals in a group and the average determined. Social behaviour was observed and noted down throughout the observation period. The various activities were then divided into either half-hour time intervals and the percentage of animals performing a certain activity determined. In other activities the number of observations during a one-hour time interval were determined. For the figures delineating grazing, only observations made during 1970 are used. Each figure is based on one day each month so that the specific activity, temperature and relative humidity for that particular day could be correlated.

III. GENERAL DAILY ACTIVITY PATTERN

a) Nutritional activities

Grazing: —

This behaviour pattern showed daily variations. It is, however, the activity that filled the best part of each day and when compared with other activities, is relatively stable. It was found that not all the animals were grazing at or shortly after first light. Normally, however, from within half an hour after first light the grazing activity intensified to become one of the major feeding periods of the daylight hours. After two to three hours the activity slowed down considerably, with some of the animals grazing while others rested or engaged in other activities.

Even during the rest periods of the day hardly any time passed without some of the animals starting to nibble for a few minutes. The grazing activity intensified again from about 15.00 hours and normally reached its highest intensity shortly before last night. During the rest of the day the grazing pattern was rather erratic with feeding activity taking place at a rather leisurely place.

From the grazing activity graphs (based on one average day for each month), it will be seen that it rarely happens that more than 90 per cent of the individuals in a family group graze together at any one time. This is due to the fact that the activity percentage is based on half-hour time intervals, each consisting of six observations. If, however, the five minute observation periods are analysed independently, it is found that one hundred per cent of the family groups were observed to be grazing together for 4.8 per cent of the total number of observations per day during February; for October this figure rose to 20,8 per cent. The reason for this dramatic increase during October will be discussed under seasonal variations. The periods when 100 per cent of the family group were grazing were normally during the early morning or late afternoons, viz. during the two major daylight grazing periods. The fact that these animals do not normally all graze together at any one time probably results in increased vigilance.

While the animals are busy grazing there is a slow but almost continual forward movement. This movement normally takes a zig-zag course. While

thus grazing the animal moves a considerable distance to left and right of its forward direction; the zig-zags may be anything up to 100 metres. As soon as the animals come across a patch where the grasses are more palatable, the legs of the zig-zag pattern may shorten to a few metres. Sometimes while grazing in this pattern, the animal moves back during the zag on nearly the same line taken during the zig part of the movement. This manoeuvre then brings them back to almost the same place were the zig-zag movement was initiated, sometimes as much as an hour earlier. This zig-zag mode of grazing nearly always follows the contours of the area in which the animals are grazing. Despite this, the animals sometimes stand grazing with head pointed down the slope or facing up the slope. While a family group is grazing it is notable how many of the animals are facing the same direction. According to field observations this occurs with an average of 62 per cent per family group under observation. The advantages if any, of this behaviour are not known.

Another very conspicious behavioural trait is the lack of synchronized grazing between the dominant male and the rest of the family group. Normally he only starts his grazing activities long after the females have started in the morning and always continues some time after they have lessened their grazing intensity. It is doubtful whether this behaviour can be attributed to vigilance on the male's part. During this period of inactivity he always assumes the posture of sleep. Where, on a number of occasions during these periods an alarm was given, it was noticed that it was nearly always done so by one of the females. It is of course possible that the male rests after having been vigilant throughout the night. Indications are, however, that the females have to feed longer owing to the drain of lactation. Some times a mare and her foul graze independently, away from the main concentration, sometimes as far as 200 — 300 metres distant, before moving back again.

Nutritional activities of foals: —

Foals start grazing within a few days of being born, although they remain dependent on their mothers until weaned. Figure 1 shows the daylight suckling pattern of Hartmann zebra foals. This shows clearly that although suckling occurs throughout the day, two peak periods exists. These are between 08.00 hours and 10.00 hours in the morning and then again from 14.00 hours onwards in the afternoon.

The two above-mentioned peaks coincide with the major feeding periods of the family group. The foals when desirous of suckling show a definite behavioural pattern. The foal approaches the female who normally is grazing and walks in under her neck rubbing its side against her shoulders (laterally and anteriorly). This normally forces the female to stop her forward movement while still grazing. The foal continues with this "crossing the bows" movement and ends up head to tail alongside the female and starts suckling. During the study period this movement by the foal was initiated in 49 per cent of the time from the right hand side and in 36 per cent of the time from the left side of the female. On 15 per cent of the occasions the foal tried suckling from behind between the hindlegs of the female. This latter approach was invariably unsuccessful, while the percentage of success with the former two approaches was quite high. The behaviour described above might be what Tinbergen (1951) called a social releaser. These are, according to Tinbergen, properties — either such of shape and/or colour, or special movements serving to elicit a response in another individual, usually a fellow member of the same species.

Newly born foals nurse with a very high frequency throughout the day. On the average about an hour passed between "feeds". The actual suckling lasts from 50 seconds to 75 seconds. The foal then waits approximately 10 seconds before nursing again for never longer then 15 seconds. While the foal is suckling the females sometimes sniff at the anogenital area of the foal. As the foals grow older the number of times they suckle during the day declines while the actual time spent suckling shortens to approximately five to 15 seconds. Their attemps to suckle also become less successful. This is especially noticeable from the time when they reach the age of approximately six months. This forces them to spend more time grazing. They are weaned when they reach the age of approximately 10 months.

Drinking: —

Where the zebra are hunted they normally come down to water during the night. Sometimes late evening, before 22.00 hours, but more likely during the early morning hours after 04.00 hours. In areas where they are protected or not disturbed, as at waterholes high in inaccessable mountains, they drink any time throughout the day. This behaviour was observed at the rainwater pans on the Naukluft Mountain plateau, and certain localities along the Kuiseb River, as well as in the Daan Viljoen Game Reserve. They may visit the water at any time throughout the daylight hours with peaks during the hours from approximately 07.00 hours to 09.00 hours and again from 19.00 hours. During the other hours of the day water is, however, also visited with a certain regularity. When water is available they may drink daily, sometimes even twice daily, viz., early morning and late afternoon. It is not certain how long they can remain without water during the hot day conditions but during the rainy season they might go two or more days without drinking (See figure 2).

b) Social activities

Hierarchy: —

Activities between the females of a family group to affirm social status occur throughout the day. These activities, however, reach a low point during the high intensity grazing activity of the two

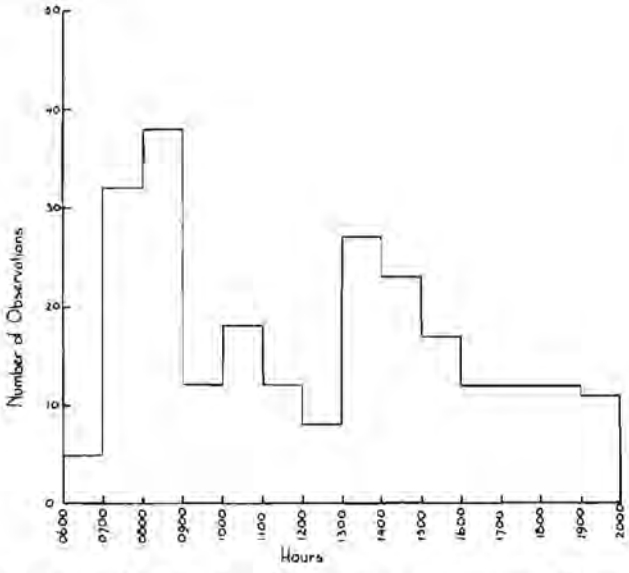

Figure 1: Daylight Suckling Pattern of Hartmann Zebra Foals.

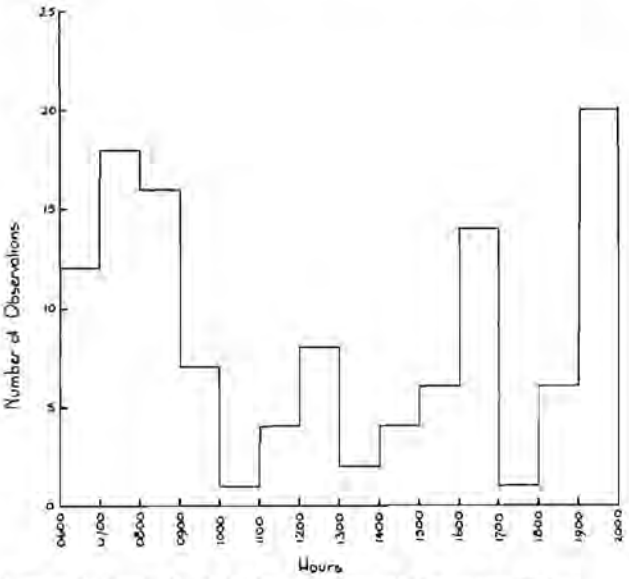

Figure 2: Daylight Drinking Pattern of Hartmann Zebra.

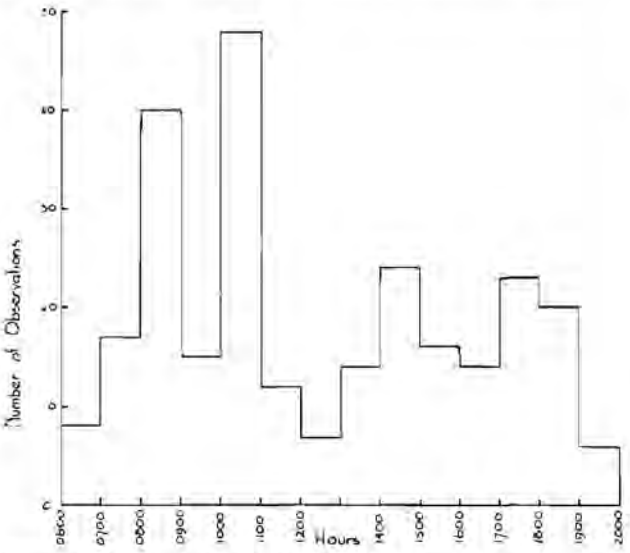

Figure 3: Hierarchal activities of Hartmann Zebra Females.

major grazing periods. Inversely, however, rivalry activities become more marked as the percentage of animals occupied with grazing activities decreases. Figure 3 shows a period of high intensity activity from approximately 09.00 hours. The other figures illustrating comfort movements viz. rubbing and rolling also show increased intensity from about the same time. This no doubt increases the competion for the best shade, rubbing posts and a better position in the dust-bathing sequence.

Playing: —

This activity is indulged in mainly by the foals in a family group and the immature animals in the bachelor groups. In the former, play consists mostly of the running/chasing variety while with the latter it becomes more serious and consists mainly of play fighting. Play occurs almost throughout the day as can be seen in figure 4, but with an apparent higher intensity during the morning hours. This high intensity playing from 07.00 hours to 10.00 hours coincides with the major morning activity period (See figure 4).

Mating: —

Mating activity occurs throughout the day as shown by figure 5. Unlike most other activities however it shows a higher intensity during the afternoon from 13.00 hours.

Greeting rituals: —

The rituals observed by dominant males whenever two family groups happen to meet do not vary at different times of the day. This behaviour is caused by the chance meeting of groups and no pattern is discernible.

c) Comfort activities:

Resting: —

This is a very noticeable or marked activity in the Hartmann zebra. While resting they invariably do so in the shade of a tree. Even during some of the relatively cooler winter months zebra indulge in this activities. As shown in figure 6 this happens from as early as 07.30 hours in the morning thus shortly after first light. No animals were ever recorded standing in the shade later than approximately 17.30 hours. No clear correlation can be found between the time most animals seek shelter in the shade and the peak of the temperature curve, apart from a small increase in this activity between 13.30 hours and 15.00 hours. A large percentage of the family groups under observation normally sought shelter in the shade. Usually, however, one or two individuals wil stay out in the sun, either resting or grazing.

When resting, these animals normally adopt the posture shown when in deep sleep. This is by hanging their heads low — below shoulder height — with the ears held at right angles with the rest

of the body and parallel to the ground. Depending on the amount of disturbance caused by insects the tail is switched in a regular rhythm.

Dust bathing: —

Zebra are compulsive dust-bathers. This activity is carried out with a very high frequence throughout the day and throughout the year. There is no clear indication of what advantage this is to the animal. One can only guess that it might be to lessen disturbance by insects. However, there is no decline in the rate at which this activity is performed during the winter months when the insects causing the disturbance are virtually absent. From figure 7 one may see that dust bathing shows a clear pattern with peaks after the morning's grazing activity declines and then again before the afternoon's grazing activity reaches its peak. Insect irritation cannot be shown to have any clear peaks. However, there can be no doubt that insects do cause certain amount of dust-bathing especially when the animals are resting in the immediate vicinity of dust bowls. It is thought however that dustbathing is mainly "maintainance of the hide" activity.

Dust bowls are normally located at predictable places, usually on saddlebacks or ridges on mountains or in the bottoms of the valleys that dissect the Khomas Hochland. They are usually situated in sandy or loamy soil and are aproximately 2 to 2½ metres across and anything up to 30 centimetres deep. Sometimes there are a few located close to one another. Newly graded roads are also used. To lie down, a zebra bends its forelimbs and stands on its knees. It then lowers the hindquarters to the ground. Getting up, it gets onto its knees and then with a jerk pulls the hindquarters onto its feet. While lying down in the dust-bowl it lies flat on its side, also resting the head on the ground. It then twitches the tail working dust in between the higher parts of the hindlegs. It will then roll onto its back and back to the original position — it never completely rolls over. Foals however, sometimes do. After doing this three or four times it will get up and then lie down on its other side. The whole performance is then repeated. Sometimes the animals lie in this position in the dust-bowl for a several minutes before getting up.

Lying down: —

Adults were seldom seen to lie down except when about to indulge in a dust-bath. On the only two occasions that adult animals were observed to lie down the animals concerned were pregnant mares, heavy in foal. In both instances they did not lie down for longer than 25 minutes. Foals however, lie down very often especially between 09.00 hours and 18.00 hours with peaks during 09.00 hours to 12.00 hours and 16.00 hours to 17.00 hours as illustrated by figure 8. The length of time spent lying down varies between 5 minutes and 35 minutes, with the average being 18,2 minutes (102 observations). One interesting aspect is that in all the above-mentioned cases of lying down the foals

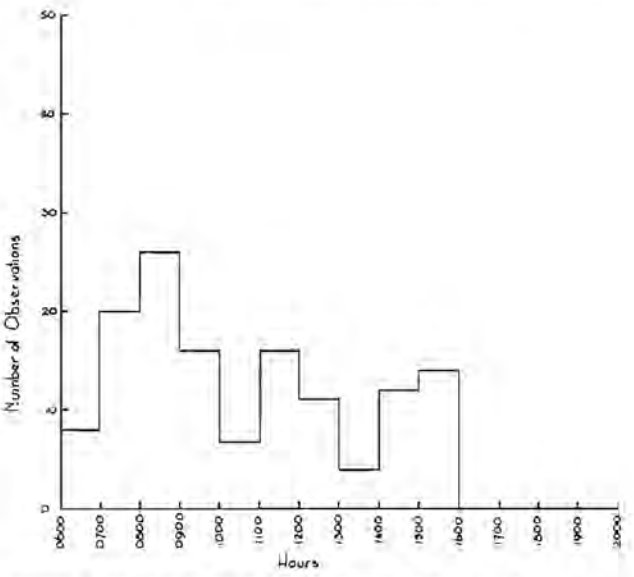

Figure 4: Playing Pattern of Hartmann Zebra Foals.

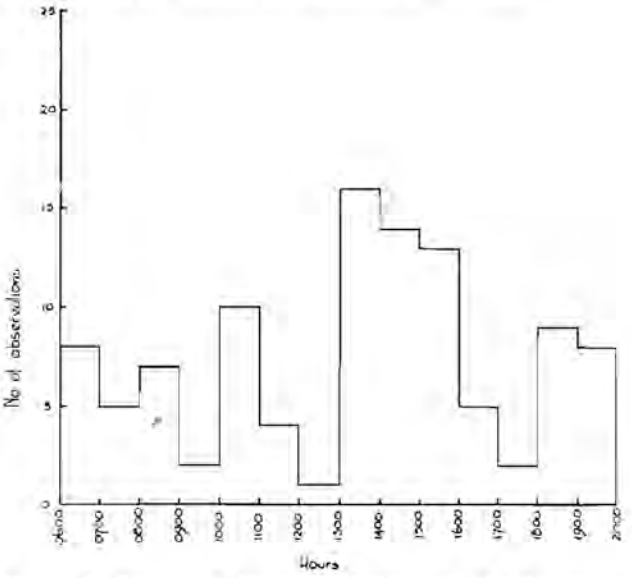

Figure 5: Pattern of Mating Behaviour in the Hartmann Zebra.

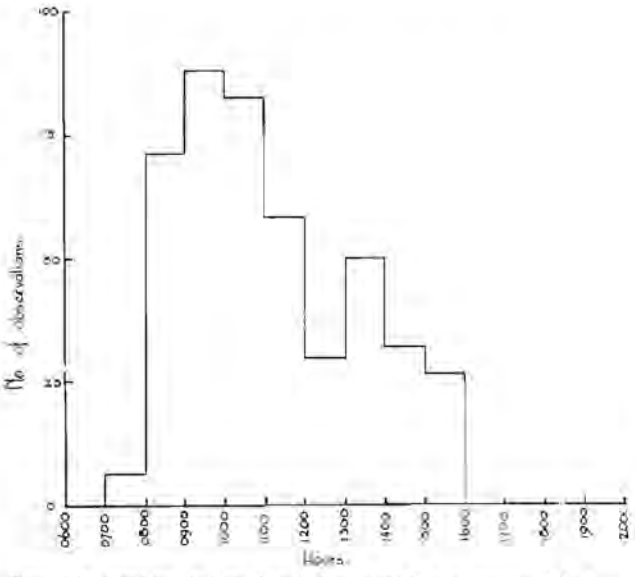

Figure 6: Resting in the Shade Pattern of Hartmann Zebra.

Plate 1. A Hartmann zebra rising with the front part of its body first.

Plate 2. A Hartmann zebra rubbing itself against a tree.

did so in direct sunlight. On no occasion was one of them observed to seek the shelter of a tree to lie down in the shade. When lying down they did so flat on their sides with their heads also resting on the ground.

Rubbing: -

This nearly always takes place while the animals are resting in the shade of a tree or under overhanging rocks. Animals were very seldom seen to interupt their grazing, just to rub themselves. The boles of trees were used to a very great extent in this activity although rocks were utilized sometimes. The brunt of this rubbing activity was normally directed at the neck and the side of the body. If the bole grew at an angle or if a rock was used the animal would try and straddle it to rub the insides of the hind legs and the rear part of the body. The face itself was very seldom attended to in comparison with the rest of the body. Only when a broken-off branch was available would this be used for scratching around the eyes and ears and sometimes the neck. They sometimes use the hooves on their hind feet to scratch their faces (See figure 9).

Grooming: —

No grooming between adults of a family group was ever noticed and only very seldom between mare and foal. Between foal and mare it was noticed with little more regularity. This amicable behaviour by the foal no doubt serve to promote the maternal instinct in the female and also as a mechanism inhibiting aggressive behaviour in the female. When observed between mare and foal as well as between foal and mare it normaly consisted of nibbling the neck and mane. No "licking" was ever seen such as is common with artiodactyls and certain carnivora. (See figure 10.)

Disturbance caused by insects: —

That Hartmann zebra are disturbed by insects is quite obvious from their behaviour in switching and twitching their tails extensively at certain times. Observations in the field first led me to believe that insect activity is closely correlated with temperature and not to light. This seemed to be confirmed by the fact that the zebra showed signs of disturbance by insects only an hour or more after first light (thus after the air had reached a certain temperature) and continued for a certain length of time after the sun had set (thus not limited by daylight or the lack of it). When the field data was processed and graphs drawn the picture did not seem so clear, especially when viewed on a daily basis. True, insect activity apparently only started after the environmental temperature had reached a certain level. However, instead of the insect disturbance intensifying with the rising

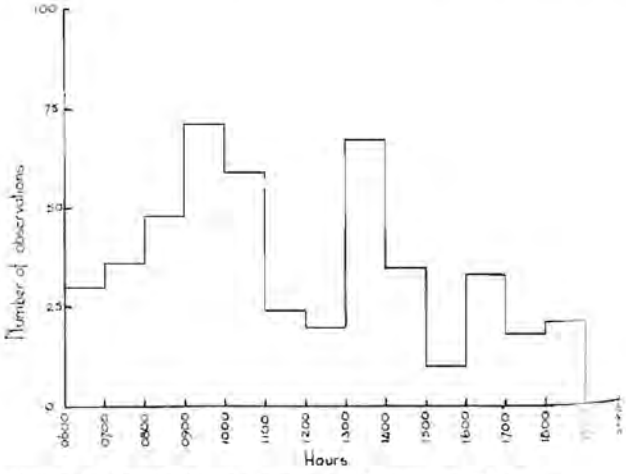

Figure 7: Dustbathing Pattern of Hartmann Zebra.

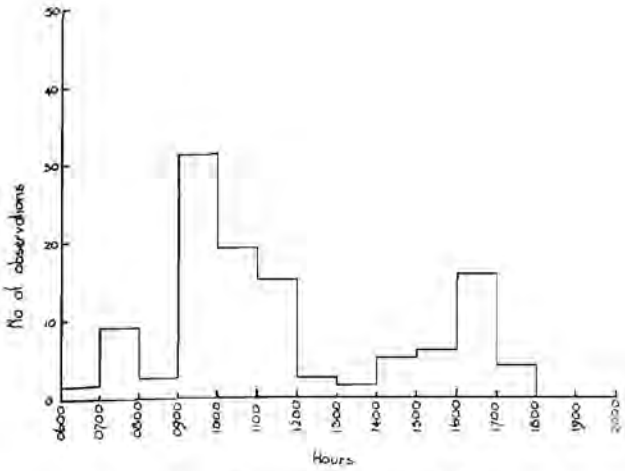

Figure 8: Lying down Pattern of Hartmann Zebra.

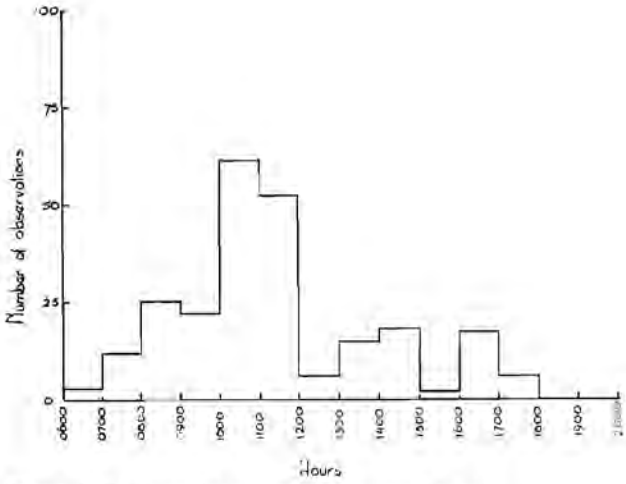

Figure 9: Rubbing Pattern of Hartmann Zebra.

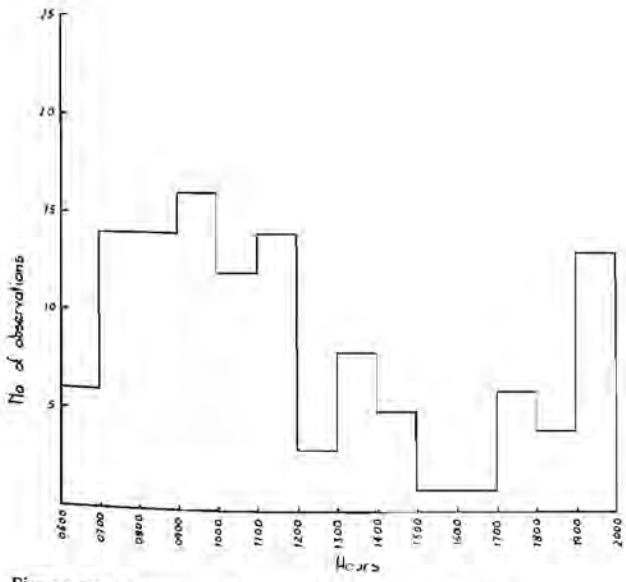

Figure 10: Grooming Pattern of Hartmann Zebra.

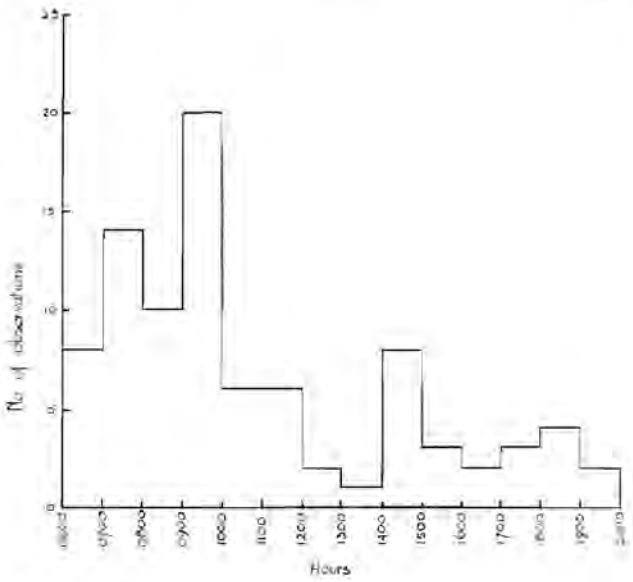

Figure 11: Defaecation Pattern of Hartmann Zebra.

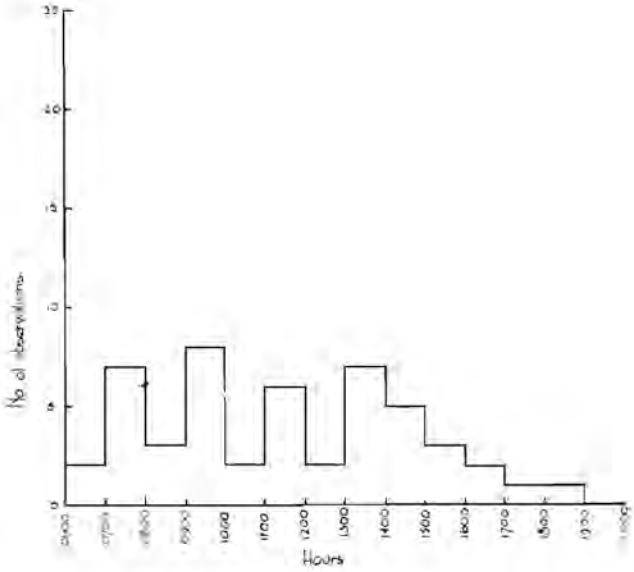

Figure 12: Urination Pattern of Hartmann Zebra.

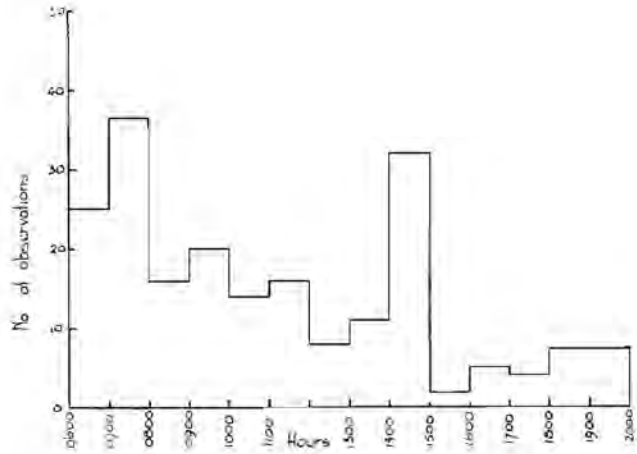

Figure 13: Walking without Grazing Pattern of Hartmann Zebra.

Plate 3. A Hartmann zebra male showing signs of irritation caused by insects – switching of the tail and stamping of the feet

in temperature it remained very erartic. This may be due to either of the following factors.

- certain microclimatic influences which could not be measured.
- insects are very localixed in their distribution and only irritate the animals as they move through these distribution areas.

This latter theory might be the reason why certain individuals are some times much more agitated by insect activity than individuals fifty metres away which showed hardly any sign of irritation.

d) Sanitary activities

Defaecation: –

In the field, animals defaecated any number of times, varying between three and eight times a day. Figure 11 shows clearly that although defaecation can take place at any time during the day, this activity reaches a peak during the morning high intensity grazing period. It was noticed sometimes that when one animal in a zebra group defaecated it acted as a expression movement and nearly all the other animals would then follow suit.

Urination: –

Urination does not take place simultaneously with defaecation although it can precede or follow it with only a short interval. Acording to figure 12 an animal urinates throughout the day, normally any number of times between five to thirteen, during daylight hours.

e) Other activities

Under this heading all the movements necessary for animals to fulfil their daily needs, additional to those dealt with above, will be discussed.

The major activity here consists of walking while not actively grazing. This takes place throughout the day. From figure 13 it may be seen that this activity starts in the morning with a high incidence. It then declines gradually; and it suddenly intensifies again dramatically to a high peak during the period 15.00 to 16.00 hours. Most of the other activities discussed elsewhere have a very low intensity during this time interval with the exception of grazing activity which shows a tendency to increase. It is possible that the peak shown on the figure, together with the peak between 07.00 to 08.00 hours, is caused by the animals moving into better areas for grazing. The high, early

morning, intensity could also be attributed partly to movement to, and from, water.

Klingel (1967) found that the Burchell's zebra have a specific sleeping place to which they retire every evening. In the morning they leave this sleeping place and walk to the grazing area, sometimes as far as 13 kilometres away. No such behaviour was ever noticed in the Hartmann zebra, in the Daan Viljoen Game Reserve or any other study area. They would spend their nights anywhere in the Game Reserve and start feeding at that particular place in the morning. The distance covered by day by the Hartmann zebra varies considerably and depends on such factors as condition of the grazing and season of the year. On the average they cover approximately one to three kilometres per day, grazing and at the most, five kilometres going to water. Even at the Naukluft Mountain Zebra Park and in the Khomas Hochland they would be remarkably sedentary.

Running caused by fright or other alarms happens throughout the day with no clear patterns as would be expected.

IV. SEASONAL VARIATIONS DUE TO THE INFLUENCE OF CLIMATE

Owing to the lack of instruments and facilities to measure microclimate it is difficult to assess the influence of climatic factors on the behaviour of the Hartmann zebra in a more than a general way. This paper will therefore deal only briefly with the innumerable possible combinations of those physical factors which may have an effect on the behaviour pattern. The Hartmann zebra is so well adapted to changes in its habitat brought about by changing physical factors that only very subtle changes in its activity patterns were observed. Furthermore it is only because of the repetitive nature of some of these "subtle changes" in their behaviour that one can, albeit with a certain amount of trepidation, try to link them to the annual changes in climate. In this regard, the physical factors that cause the most marked change in their activities are temperature and rainfall.

a) Nutritional activities

Grazing: —

From the figures (figures 14 to 25) depicting the grazing patterns and daily temperatures for the various months no obvious nor dramatic change is immediately visible. On studying the figures more closely however, three factors regarding the temperature come to one's notice.

(i) That the grazing patterns for the colder months (June, July and August) are not so extremely irregular as for the warmer months (October, November, December and January). During these latter months the grazing intensity is initially very high, being higher than 70 per cent at first light. It then has a number of high peaks during the day, with periods in between of very low grazing intensity. Bligh and Harthoorn (1955) in East Africa have shown with the aid of radio telemetry that animals lose much body temperature while standing inactive in the shade. (See figure 26.) This irregular grazing pattern shown by Hartmann zebra during the hot months thus could be an adaptation, the animals grazing in the sun until their body temperature reaches a certain peak then retiring in to the shade to lower their body temperature.

(ii) The daily temperature at first light has an apparent effect on the intensity of grazing at this time of the day. During June ,July and August the temperatures fell to below 20°C at daybreak. In each case only about 40 per cent of the animals under observation grazed at first light. During the rest of the year the percentage of animals actively grazing at first light is well over 50 per cent.

(iii) Another interesting aspect is the change in the time of highest grazing intensity during the various months of the year. During the more temperate months of April, May and September about an equal amount of very high intensity grazing takes place during the morning and afternoon. During the cold months of June, July and August after an initial burst, apparently just to satisfy their immediate needs, the animals stand around sunning themselves. As the temperure rises so does the grazing intensity increase. The bulk of the most concentrated grazing takes place during the afternoon.

(iv) Despite the fact that the grazing pattern for October is erratic it still has a very high intensity. This is most probably due to the flush of green grass on the veld after some showers of rain fourteen days earlier.

Another behavioural trait modified by climate is the orientation of the body to physical stimuli. It is a well known fact that black surfaces absorb more heat than do lighter coloured or white surfaces. Although no experimental physiological proof exists it appears from the behaviour shown by Hartmann zebra that this may influence their behaviour. As can be seen from figure 27 a zebra standing broadside on displays a body surface with a light: dark ratio of approximately 1:3. When facing away however, this ratio changes to approximately 3:1. This fact, combined with the difference in total body surface when viewed laterally and posteriorly makes the orientation of body surfaces to physical stimuli an important factor in the adaptation of the Hartmann zebras to their environment. This behaviour was especially marked during the early mornings of the colder months of the year. During these months they would also frequently sun themselves throughout the day at regular intervals especially if the environmental temperature was below approximately 20°C. This orien-

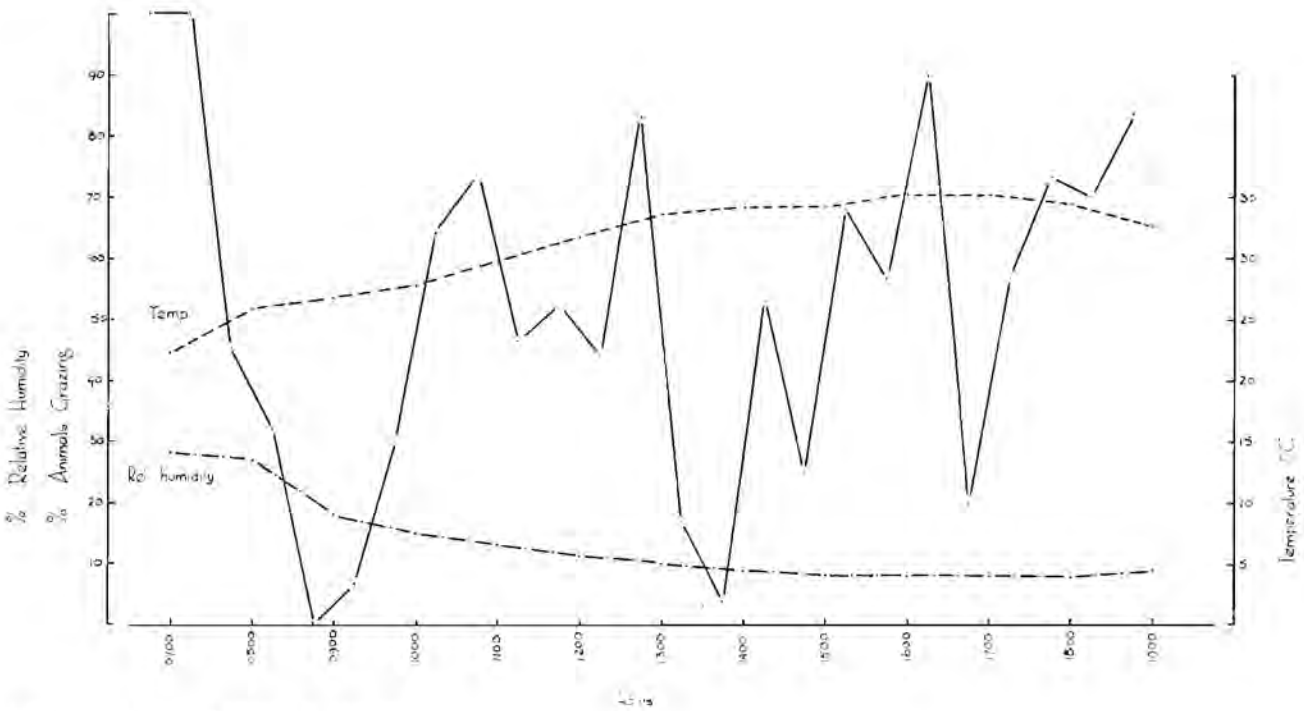

Figure 14: Grazing Pattern for January.

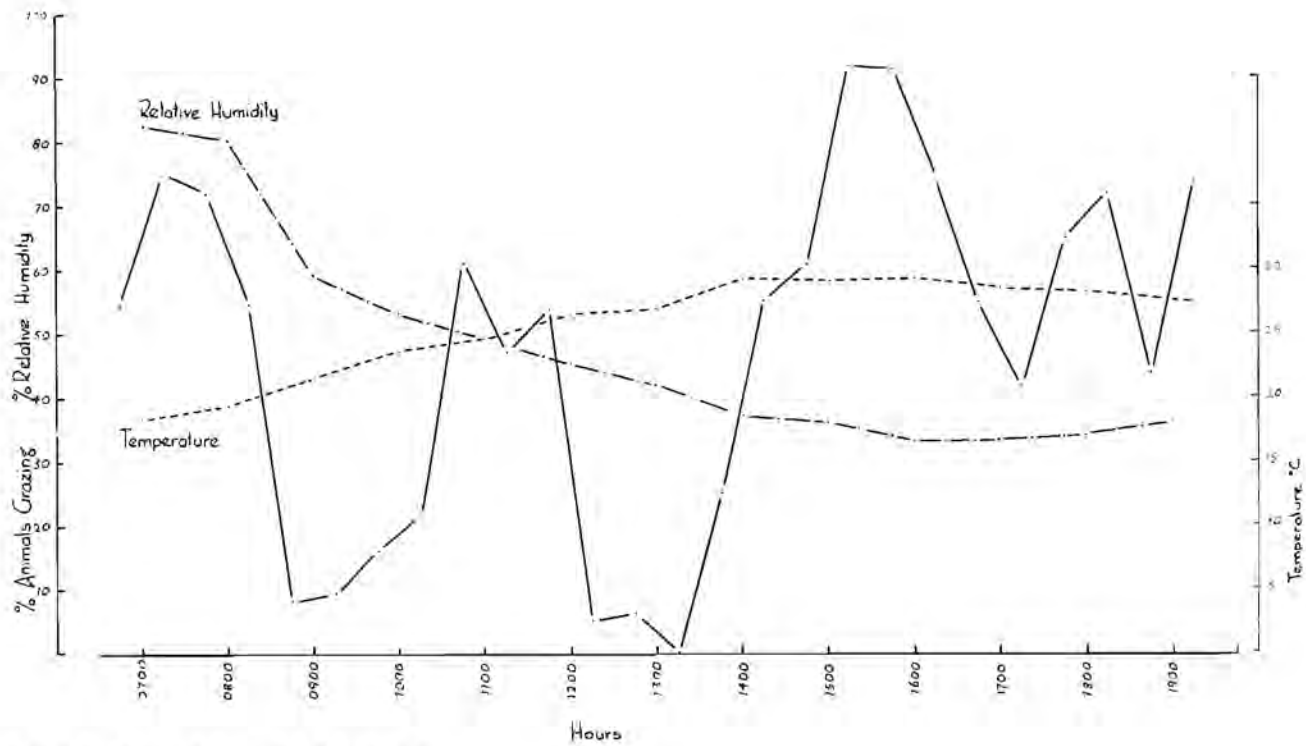

Figure 15: Grazing Pattern for February.

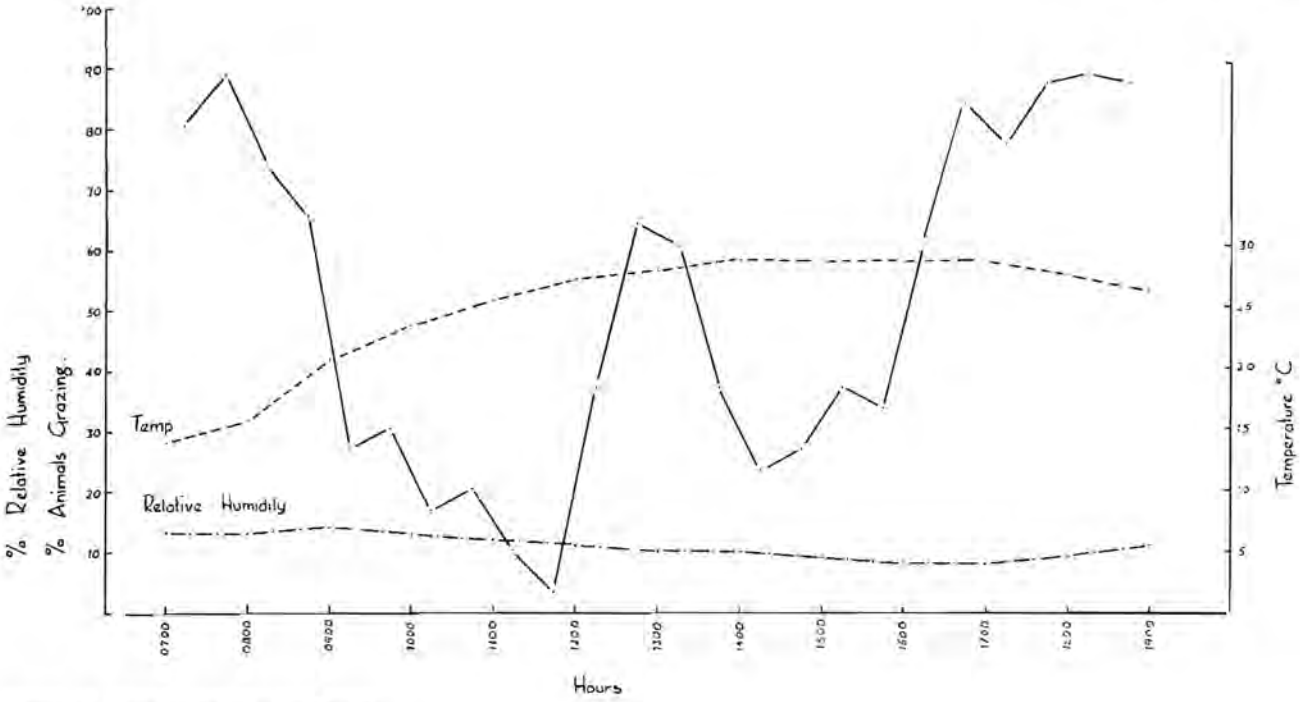

Figure 16: Grazing Pattern for March.

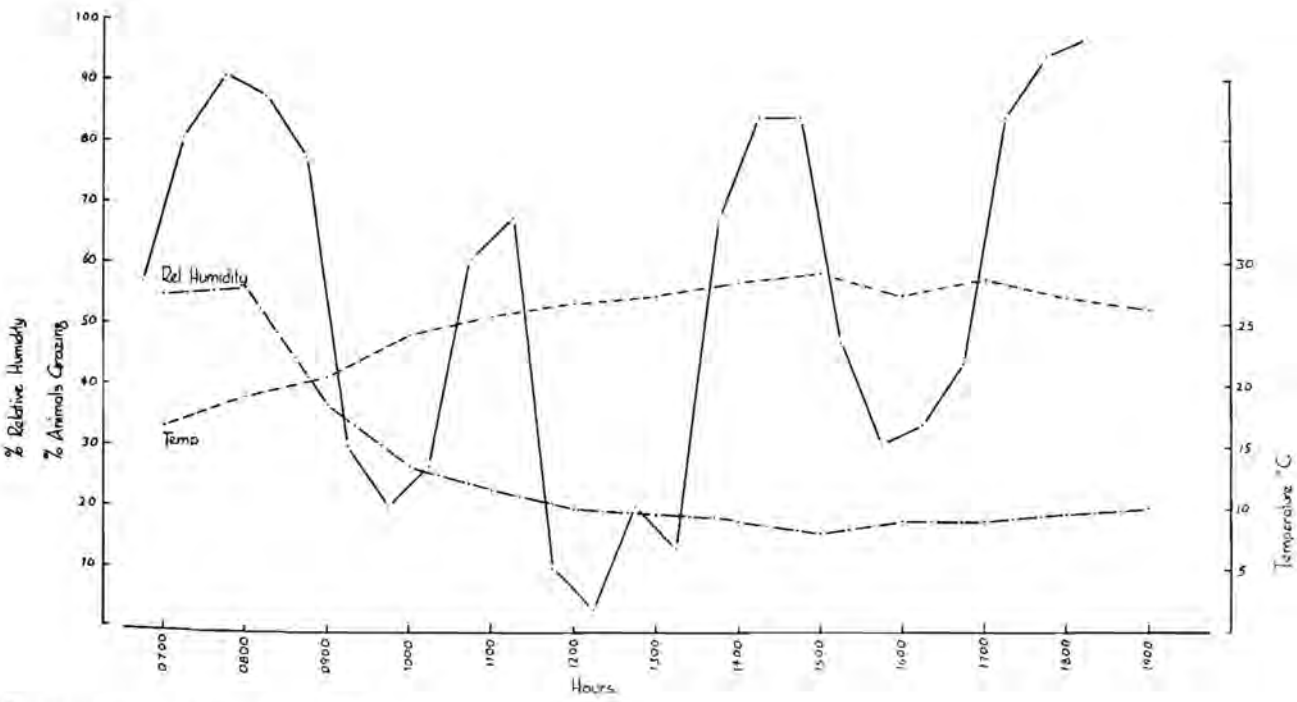

Figure 17: Grazing Pattern for April.

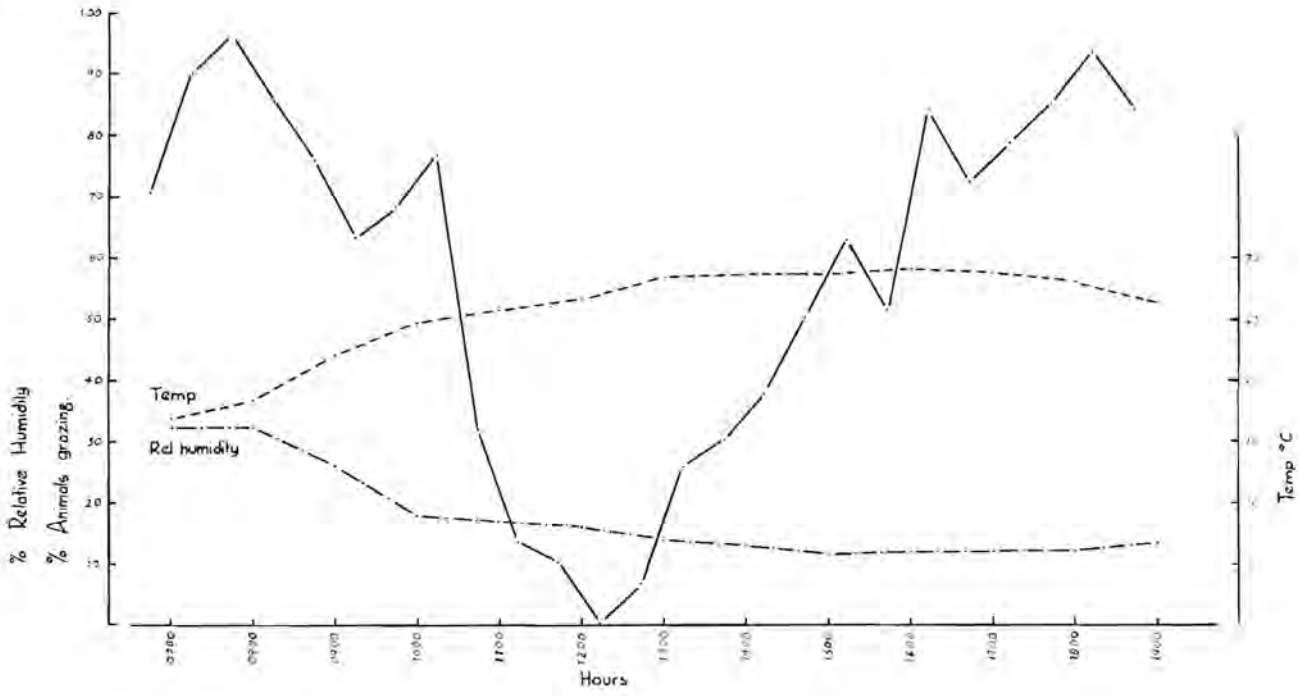

Figure 18: Grazing Pattern for May.

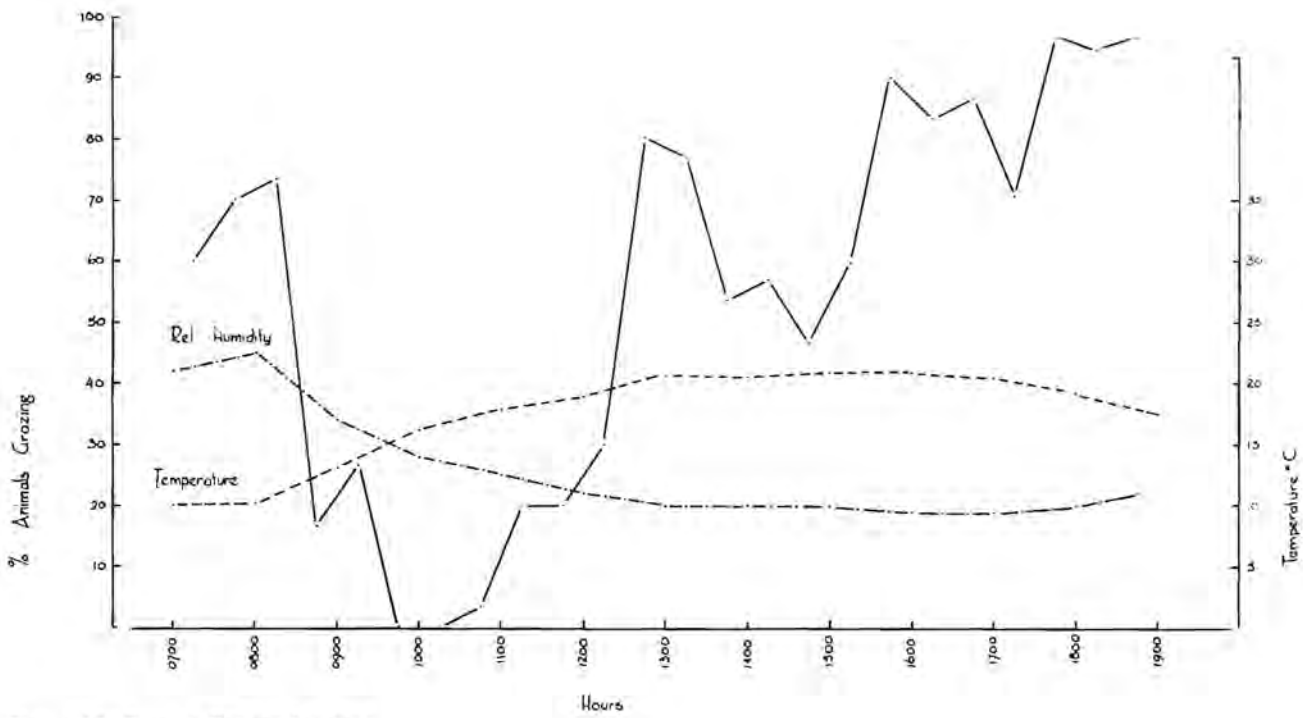

Figure 19: Grazing Pattern for June.

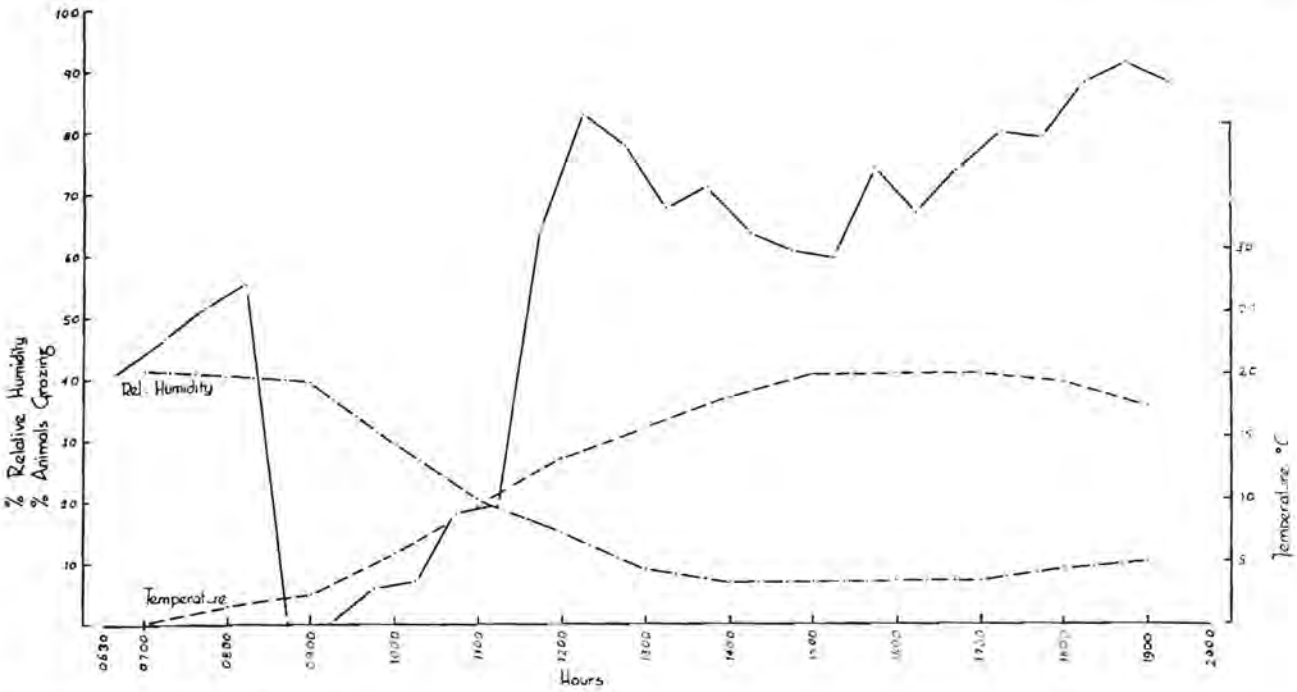

Figure 20: Grazing Pattern for July.

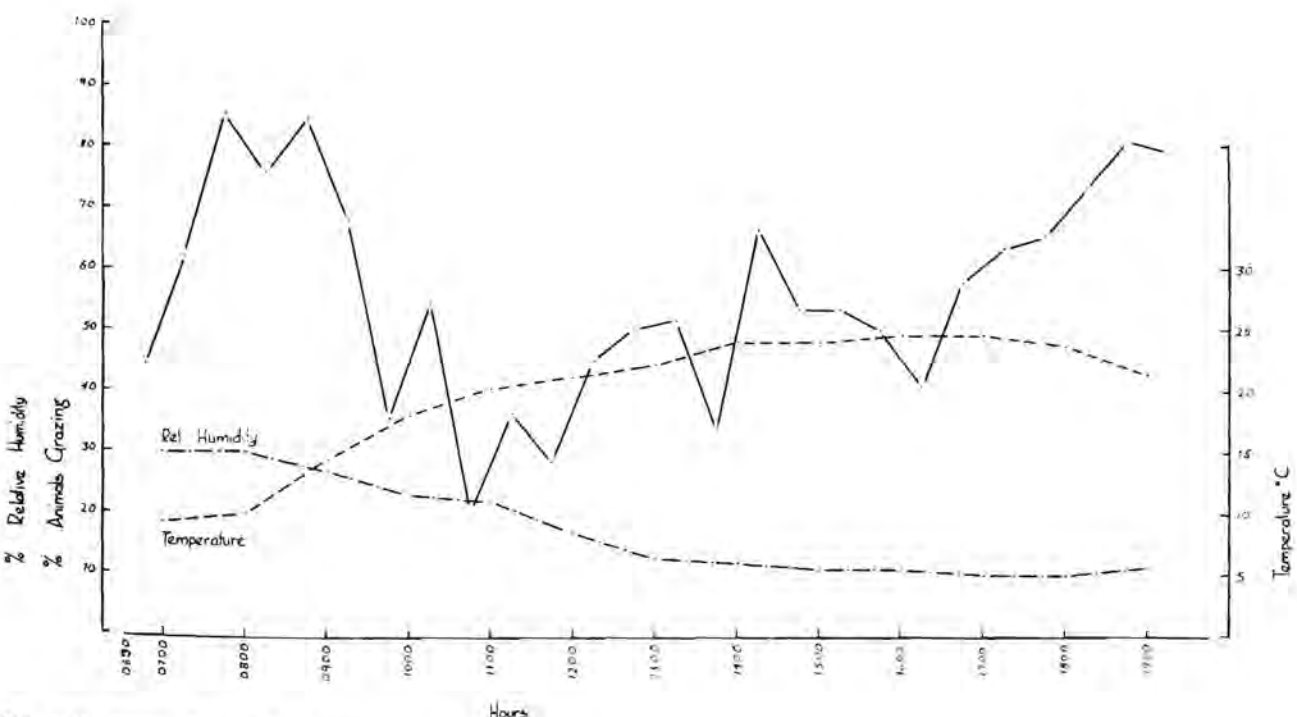

Figure 21: Grazing Pattern for August.

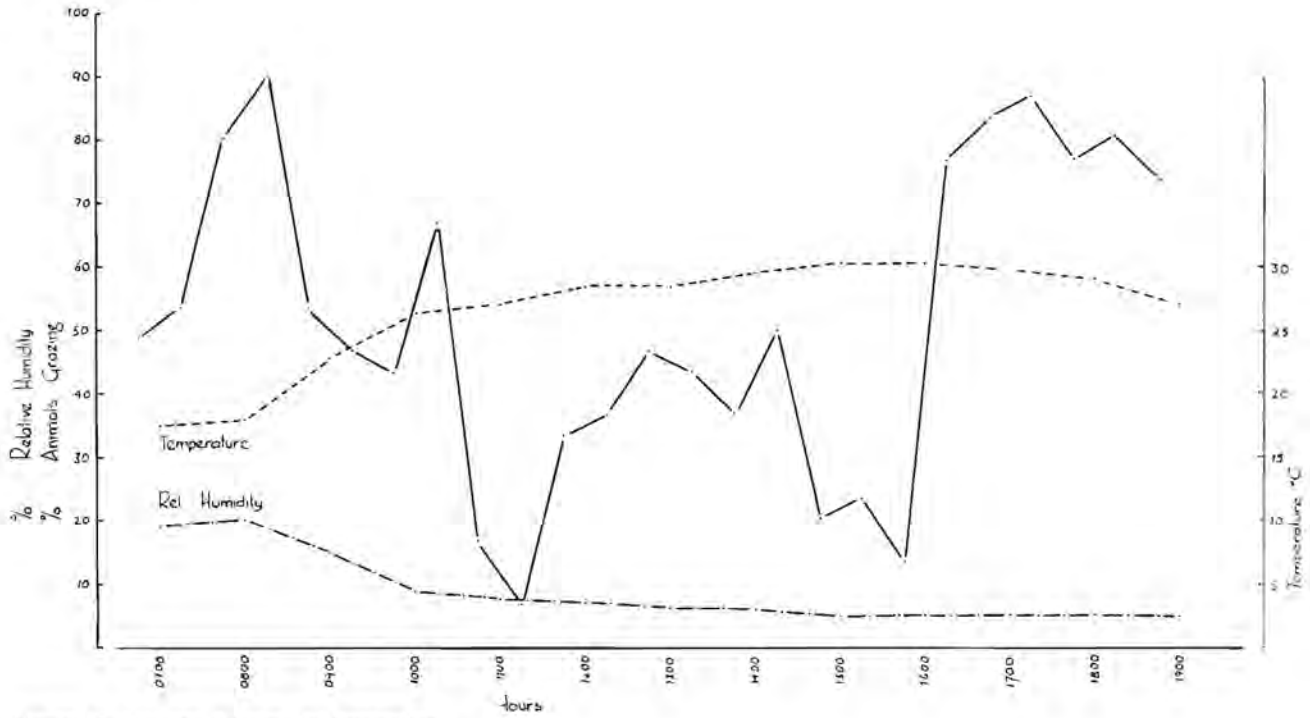

Figure 22: Grazing Pattern for September.

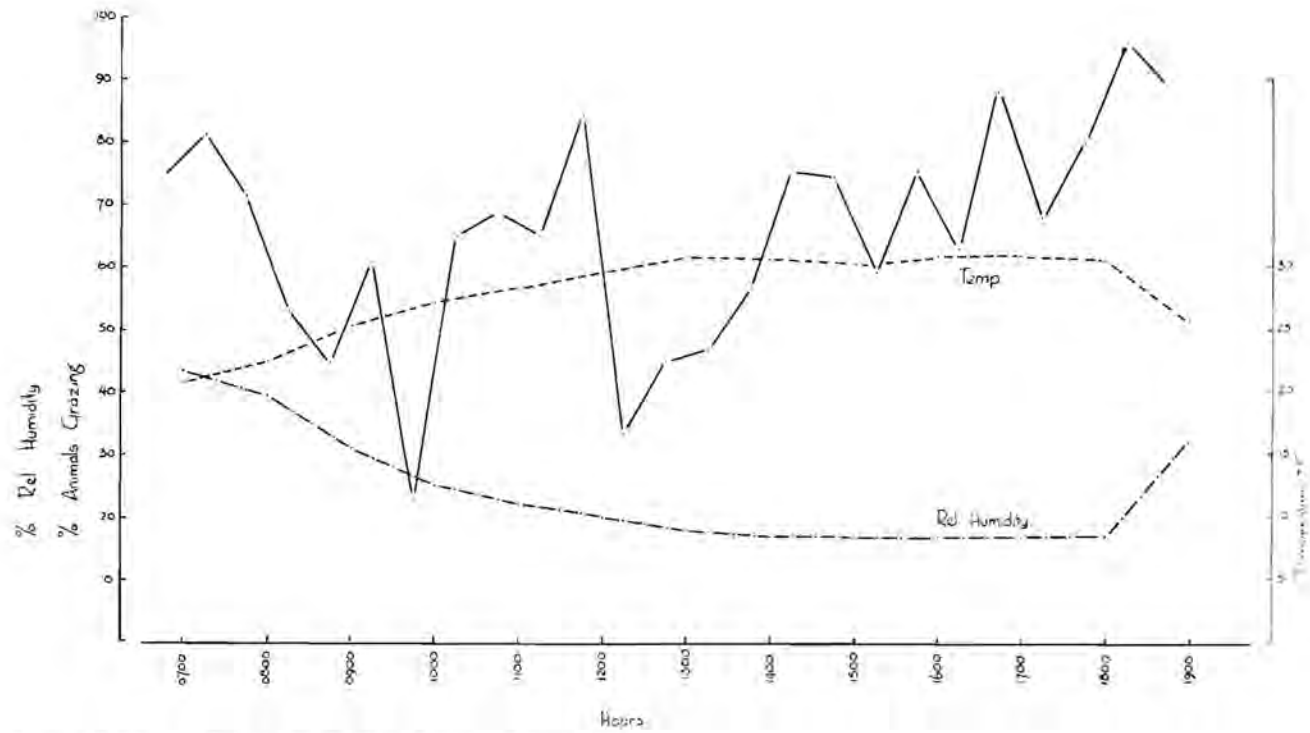

Figure 23: Grazing Pattern for October (Rain — Green flush).

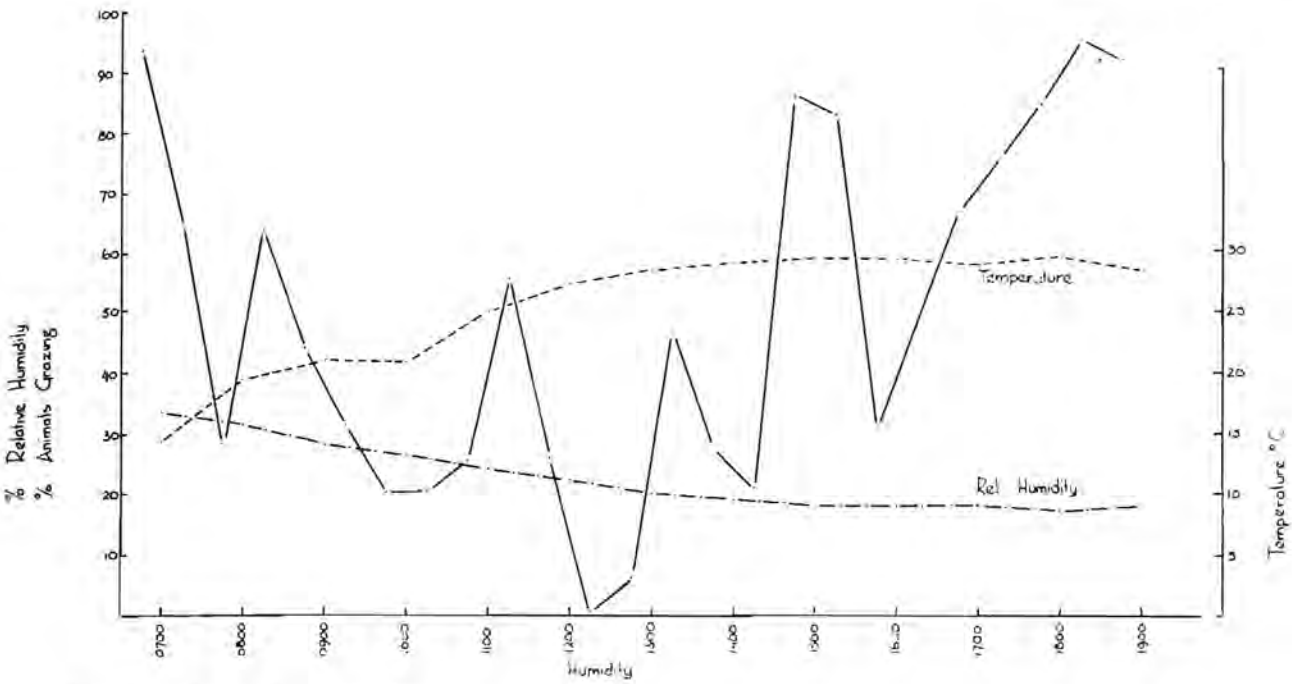

Figure 24: Grazing Pattern for November.

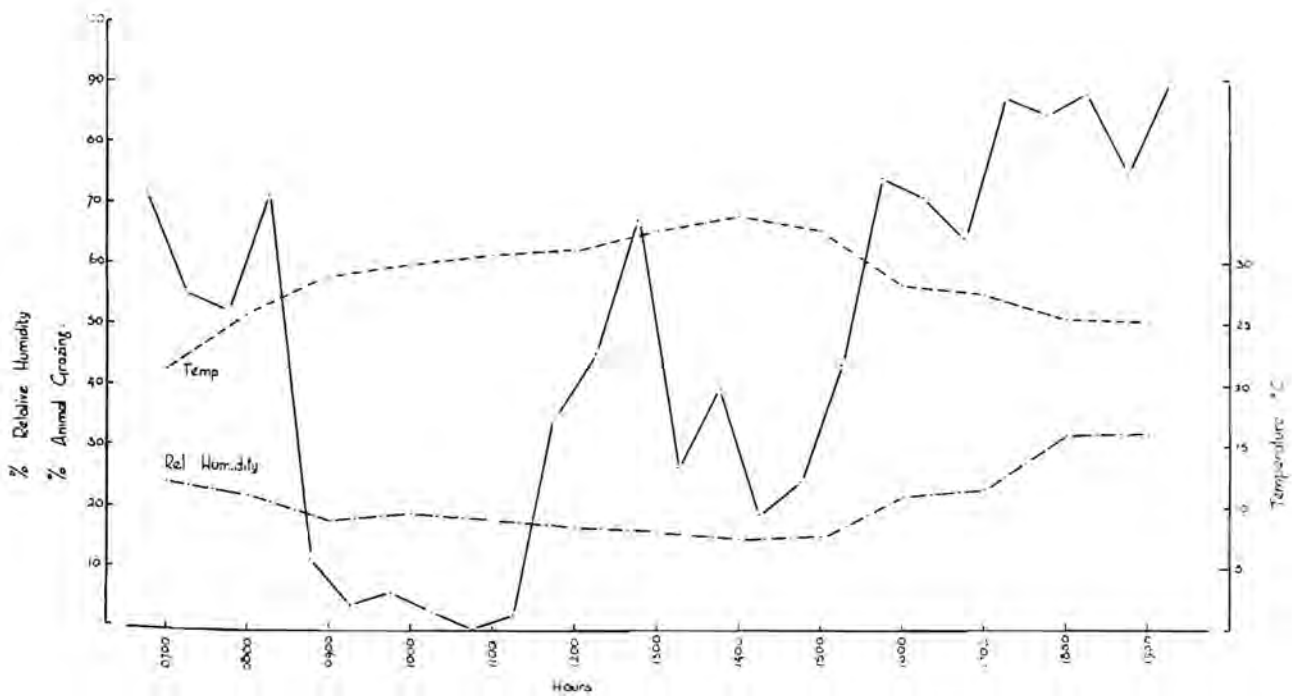

Figure 25: Grazing Pattern for December.

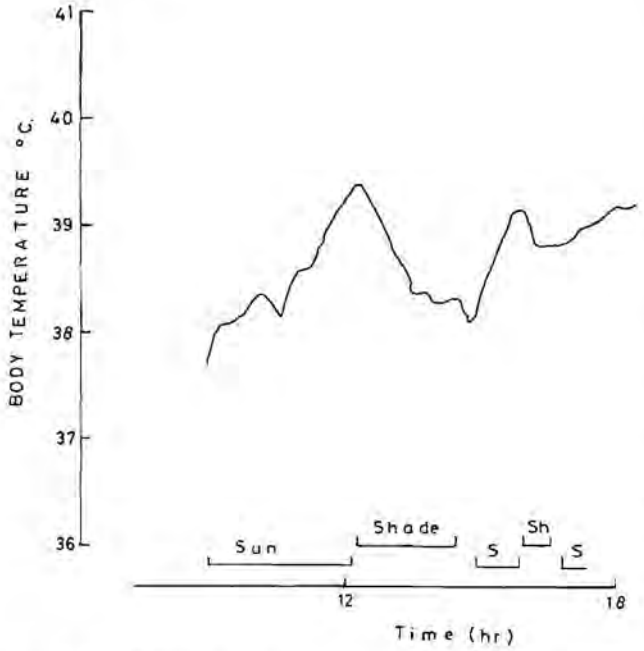

Figure 26: The deep body temperature of a 2-year-old Black Rhinoceros (After Bligh and Harthoorn 1965).

tation of the body to gain maximum absorbsion of heat, however, was not limited to the winter months. Even during the early mornings of summer months they would sometimes orientate themselves laterally to the rising sun — apparently to raise their body temperature. When the environmental temperature however, rose above approximately 25°C the zebras would normally orientate their bodies with the posterior end towards the sun while grazing. This of course means that more of the lighter shaded body surface for less absorption is presented towards the sun.

Another facet of this orientation to ameliorate the effect of temperature is the way in which Hartmann zebras tend to use the upper third of hill slopes more frequently than the lower two thirds during the heat of the day in warm weather. This is possibly a means of making full use of the cooling effect of breezes. The sometimes unpleasantly cold westerly wind in the study area was avoided by grazing on the lee sides of hills. Wind has very little other effect on the grazing pattern as zebra show no other apparent orientation towards the wind.

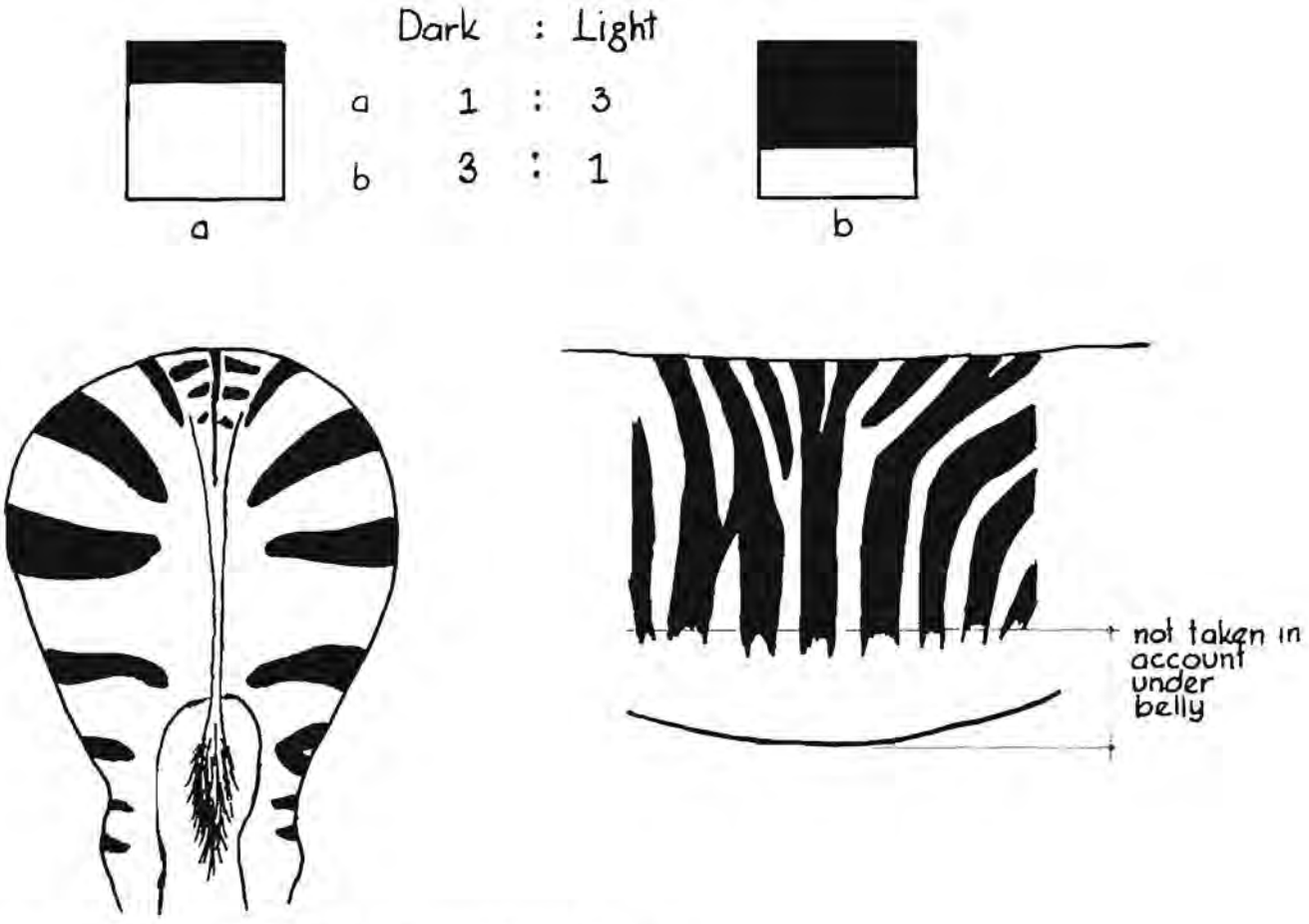

Figure 27: Dark and Light Ratios in Lateral and Posterial views.

Plate 4. A Hartmann zebra foil suckling.

Relative humidity has no conspicious micro-climatic influence on the grazing pattern of the Hartmann zebra.

Nutritional activities of foals: —

Seasonal variation of the nursing behaviour of the foals is completely indirect. As the Hartmann zebra breeding season reaches an apparent peak during the rainy season it follows that most of the foals are older during the autumn and winter and accordingly suckle less.

Drinking: —

As already stated the Hartmann zebra drinks more frequently during the hot, dry months of October, November and sometimes December. During this time they visit the waterholes at least once a day.

b) Social activities

The social activity patterns of Hartmann zebras appear to be only slightly affected by seasonal variation of climatic factors. Only two, slightly interrelated aspects, are indirectly influenced by climate. As Hartmann zebra have a peak breeding period during the rainy season it stands to reason that mating activity occurs with higher frequency during this period. In correlation with this the foals, as they grow older, indulge more and more in play with other foals in the family group.

c) Comfort activities

Resting: —

There is no significant difference in the total amount of time spent resting during the various seasons of the year. The percentage of animals seeking shelter in the shade of trees during the different months of the year, on the other hand, shows a very marked difference. As may be seen in figure 28 the number of animals seeking shade varies from remarkably high during the warmer months of the year to absolutely none during July.

It is interesting to note that animals resting in the shade also show a definite behaviour pattern. They always distribute themselves one, or in the case of a female with a foal, two, to a tree. They nearly always stand with their posterior ends close to the tree while facing outwards. Although they are in the shade they still frequently orientate themselves with their posterior ends to the sun as well. This latter might be to make full use of the denser shade of the bole of the tree.

Disturbance caused by insects: —

As already discussed the intensity of disturbance caused by insects does not show a clear pattern on a daily basis, apart from the fact that their activity normally only starts after the environmental temperature has reached a suitable heat. However, on a monthly basis a very clear pattern is discernible. As may be seen in figure 29 the irritation activities caused by insects were very pronounced during the warmer months but decreased until June and July when no irritation caused by insects was recorded. During August and September their influence is also very limited but suddenly increases markedly in October. This sudden increase in irritation from an insect population may be as result of the early October rains. Disturbance by insects thus show a correlation with temperature and rainfall which is proven by determining the "arid" months (See figure 29). The temperature and rainfall graphs in this figure are based on the mean of observations over 26 years. The graph of insect disturbance is unfortunately only based on two years observations (1969 and 1970) during which time the area received good rains during October 1970. Coetzee (1967) quoting Gaussen (1954) used this consideration of mean monthly precipitation and temperature to determine the "arid" months. The "arid" months are determined by plotting mean monthly temperature and rainfall on the same graph using a scale in which 40 mm mean rainfall corresponds to 20°C mean temperature.

d) Sanitary activities

No seasonal variations could be recorded.

e) Other movements

A limited amount of migration stil occurs in the Khomas Hochland and in the Kaokoveld. With the

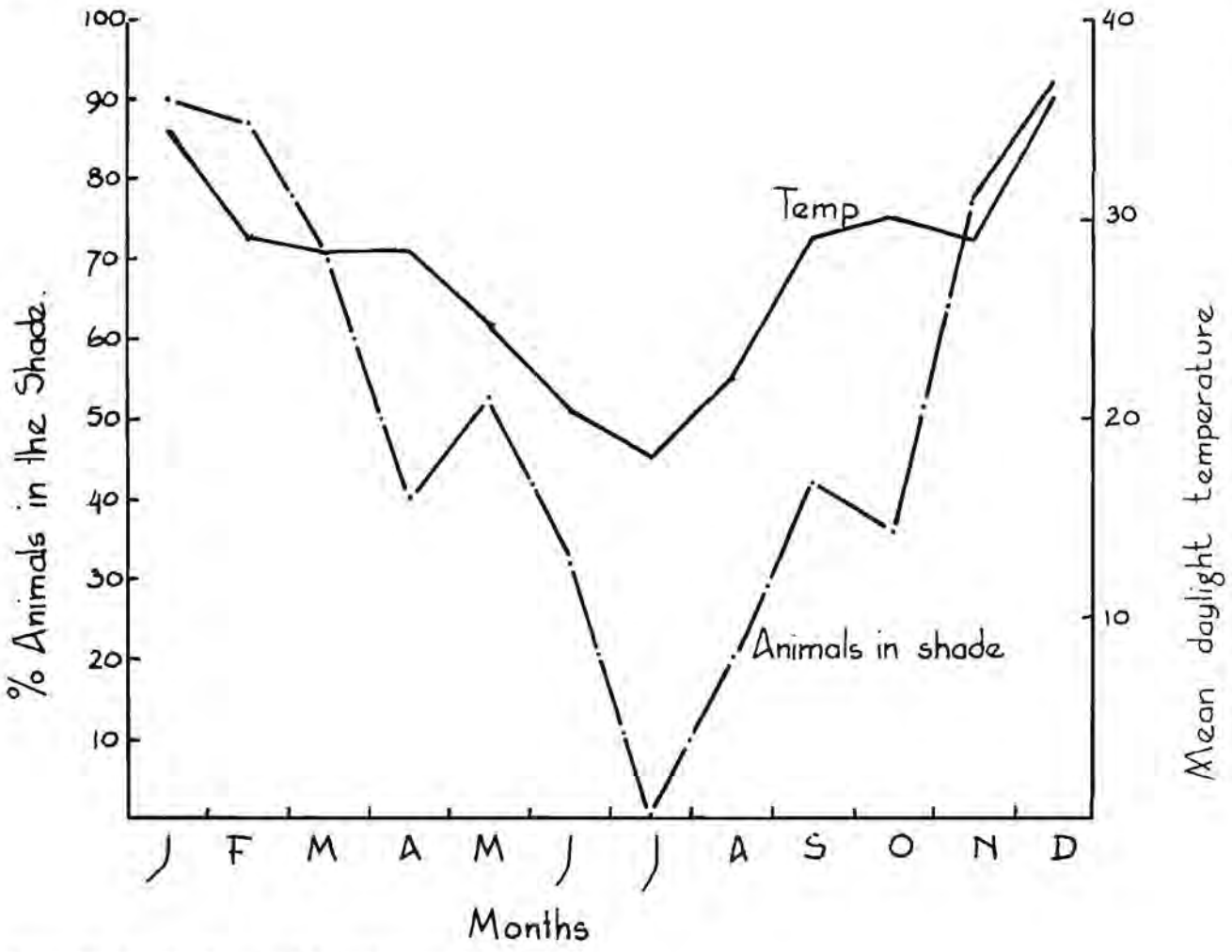

Figure 28: Monthly Pattern of Animals resting in the Shade.

onset of the rainy season as soon as the pre-Namib plains receive their first rains the Hartmann zebra move out of the mountains onto these plains. If unhindered they stay here until the grazing deteriorates after the first cold spells.

V. DISCUSSION AND CONCLUSIONS

Although the daily activity patterns of individual animals and even those of various family groups vary a basic pattern is perceivable. As already mentioned these activity patterns are variable and affected by innumerable possible combinations of such factors as climate, vegetation, time of day, time of year, location and interactions with other individuals or groups. Normally however, the daily routine can be summarized as follows: A period of high intensity grazing from approximately first light in the morning followed by dust-bathing and/or resting (in the shade or not, depending on circumstances). While resting in the shade approximately 80 per cent of all rubbing activities takes place. The question as to whether the animals stand in the shade for shelter or for rubbing activities is easily answered. There are nearly three times as many observations of animals just standing in the shade as there are of animals actually rubbing themselves. In the middle of the day major periods of grazing are alternated with periods of dust-bathing. This is then followed by the build up to another major grazing period. Most of the other social activities aimed at enforcing the family bond take place throughout the day. It does, however, show a slightly higher incidence of occurring outside the high intensity grazing periods.

The climatic factors which show the most marked influence on the activity patterns of the Hartmann zebra are temperature and rainfall. In this respect temperature has an influence on the time of day when the bulk of the grazing activity takes place. During the summer months this activity is very erratic, apparently to offer the animals an opportunity to lose body temperature in the shade. During the temperate months of autumn and spring an equal amount of time is spent grazing in the mornings and afternoons. During winter, however, the bulk of the grazing takes place during the afternoon. Field observations further show that the Hartmann zebra have also adapted their behaviour

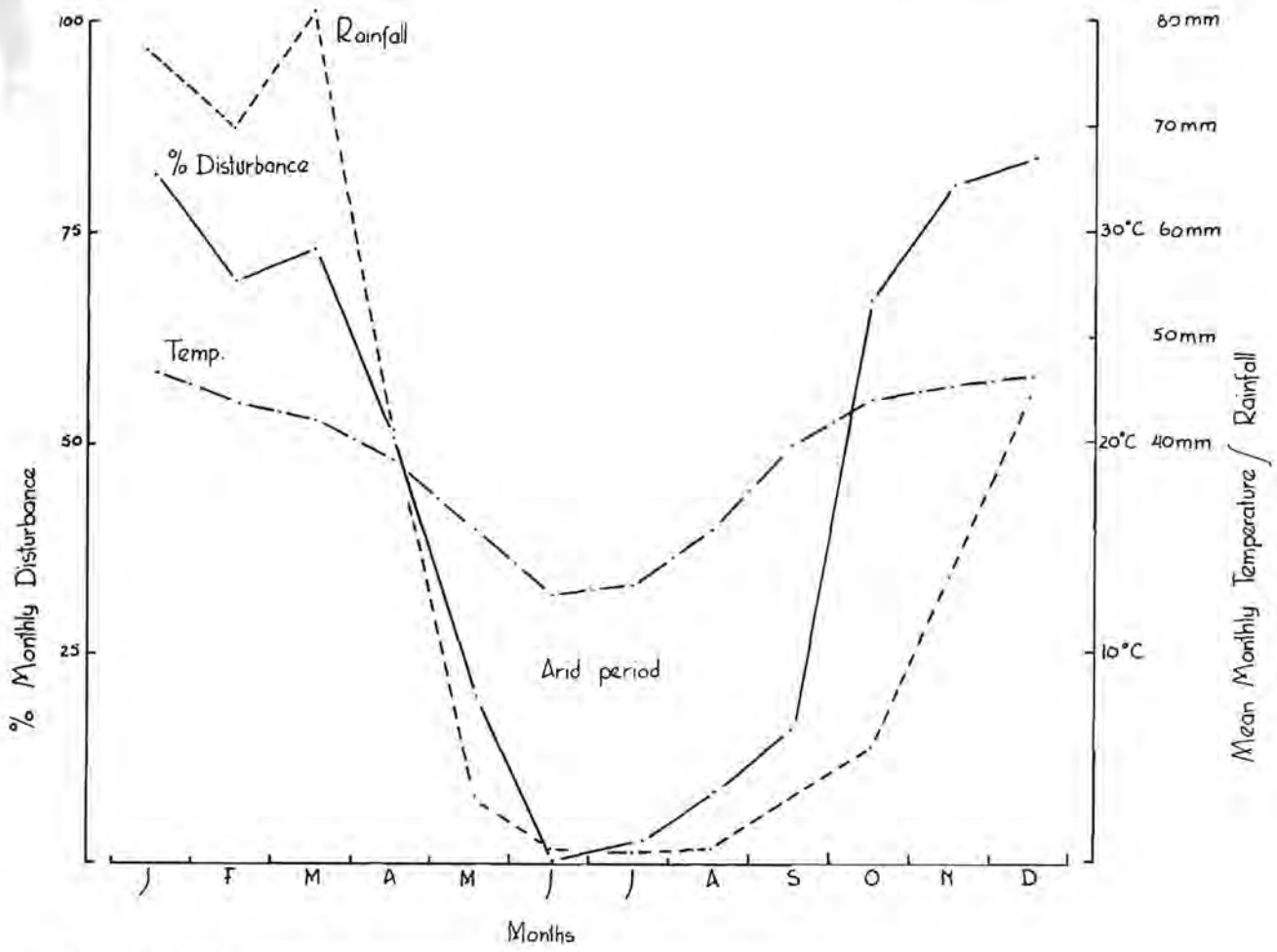

Figure 29: Relationship between % Disturbance by Insects and "arid" period.

to gain full advantage from their colouring pattern. They use their relatively darker shaded sides for heat absorption in cold mornings and their lighter coloured posterior parts for radiation of heat during hot days. Disturbance by insects also seems to follow the seasonal variation of climate regarding temperature and rainfall.

In conclusion it may therefore be said that the daily activity pattern of Hartmann zebra is definitely influenced by climatic factors. They have, however, adapted themselves to the climate of their preferred habitat by evolving certain remarkable behavioural traits to ameliorate the more unfavourable climatic effects.

VI. ABSTRACT

Free-living Hartmann zebra at the Daan Viljoen Game Reserve, Khomas Hochland, were studied over a two-year period. Attention was given to nutritional, social, comfort and sanitary activities and the various activity patterns determined. Different macro-climatic factors that may influence this behaviour were considered. Although daily activity patterns were variable a basic pattern was perceivable. Temperature and rainfall were the two climatic factors which had the most marked influence on daily activity. Disturbance caused by insects also followed the seasonal variations of climate regarding temperature and rainfall. Hartmann zebra has adapted itself to the climate in its habitat by evolving certain behavioural characteristics.

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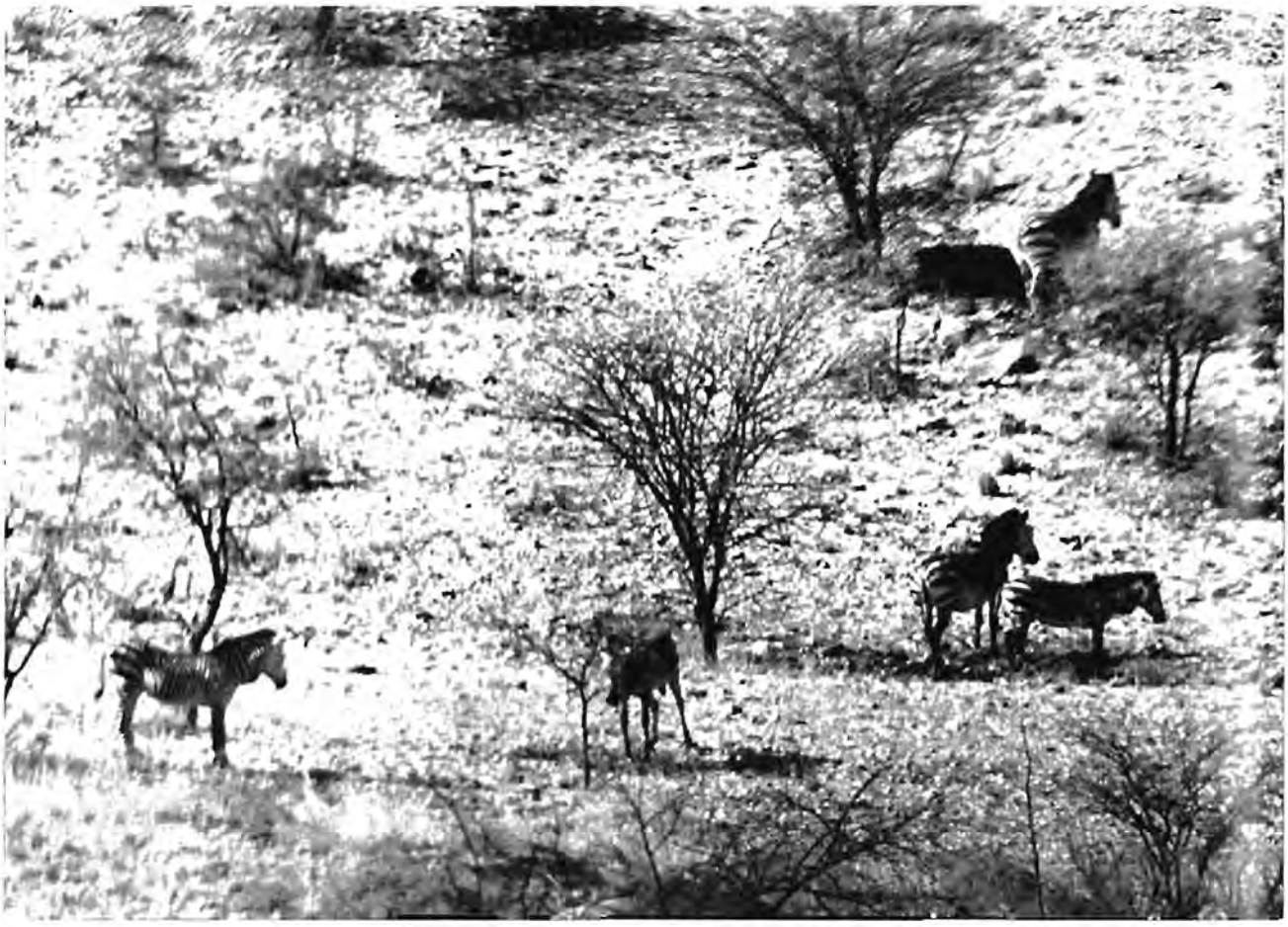

Plate 5. A breeding unit of Hartmann zebra resting in the shade of trees. Note that the individuals are restricted one to a tree or a female and her foal to a tree. They also show an orientation of their backs towards the sun.

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