ACTIVITY PATTERNS OF BABOONS

(*Papio ursinus*)

AT CAPE POINT

CHRISTINE DAVIDGE

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INTRODUCTION

"Baboon" is the vernacular name given to two genera (*Papio* and *Theropithecus*) of terrestrial primates which live in open country and have highly organized social systems (Hill 1970). Baboons exhibit marked sexual dimorphism. Males are roughly twice as large as females and have heavier muzzles and better-developed canines (Hill *op. cit.*). Males do not acquire all the secondary sexual characteristics until about 8 years of age, while females attain puberty between 3 and 4 years of age (Hill *op. cit.*). Baboons are basically omnivorous. However, in most areas vegetable matter forms the bulk of their diet, covering the entire edible range available (DeVore & Hall 1965). Diet of animal origin includes insects, crustaceans, molluscs and occasionally mammals (Hill *op. cit.*).

The chacma baboon *Papio ursinus* is the largest and darkest of five congeneric species. These species replace one another geographically through most of Africa. The chacma baboon is widely but sparsely distributed in southern Africa, ranging from the sea-shore of the south-western Cape to altitudes of 3000 m in the grassy Drakensberg (Hill *op. cit.*). The chacma baboon favours broken terrain where cliffs provide safe sleeping sites. Troop size varies from 8 to 109 individuals (Hall 1963).

Chacma baboons inhabiting the Cape Peninsula belong to the nominate form. A very dark pelage and comparatively small size are among their distinguishing characteristics. These baboons are unique in that they inhabit the most southerly latitude (34^{o} 15'S) for any non-human primate, and occasionally eat marine shell-fish in the littoral zone (Hall *op. cit.*).

The majority of chacma baboons on the Cape Peninsula are accustomed to regular feeding by the public. However, one troop in the Cape of Good Hope Nature Reserve has a home-range that brings it into only infrequent contact with humans. This "Olifantsbaai" or "O" troop was chosen for study because of its relatively undisturbed state.

Interest in primate biology has flourished during the last two decades. Baboons, in particular, have been studied in captivity, and under natural conditions in savanna and montane habitats (see DeVore 1965; Kummer 1968; Altmann & Altmann 1970). Most studies conducted to date have focused on the behaviour, particularly social behaviour, of baboons in the wild. This approach was pioneered by the late Professor K.R.L. Hall, who made a study of chacma baboons in the Cape of Good Hope Nature Reserve (Hall 1962a, 1963). Few studies have been carried out to date on the ecology of baboons. The little information which is available on this subject is based largely on unquantified data (Hall 1962a, 1963; Rowell 1966; Struhsaker 1967).

The climate in the Cape of Good Hope Nature Reserve is "mediterranean", unlike most of sub-saharan Africa, and the strong south-east winds in summer keep air temperatures comparatively low. The reserve is covered by soil with a low mineral content (Taylor 1969). Vegetation (fynbos) in the area has a low nutritive value (Dept. Pasture Science 1972a). Approximately 150 baboons, divided among four troops, lead a successful existence in the reserve, despite these apparently unfavourable conditions. A major part of my study was designed to investigate some of the ways by which this success is achieved in O troop.

AIMS OF THE PROJECT

Questions were formulated as guide-lines for data to be collected:

1. What is the approximate daily energy requirement of the troop, or individuals within the troop? Data are required on the amount of daily activity within the troop and the various energy costs of these activities to answer this question.

2. In what form is this daily energy requirement obtained? This involves knowledge of the various types and parts of plants and other food items utilized.

3. How are additional dietary requirements, e.g. minerals and proteins, obtained?

4. Is there a seasonal change in diet?

5. Do seasonal changes in vegetation and diet affect the behaviour of the troop? For example, does the troop split into several small groups at any time to facilitate foraging? Is there a parturition peak, or are infants born throughout the year?

CAPE OF GOOD HOPE NATURE RESERVE

GEOGRAPHICAL PERSPECTIVE

The Cape Peninsula forms the most south-westerly portion of the African continent, jutting southwards into the sea for 64 km (Fig. 1). The Cape of Good Hope Nature Reserve (latitude 34^{o} 15'S; longitude 18^{o} 25'E) occupies the southern tip of the peninsula. Roughly triangular in shape, the reserve covers an area of 7750 ha (Fig. 2). The northern boundary extends for 13,5 km overland from Schuster's Bay south-east to Smitswinkel Bay. The 40 km coastline forms the rest of the boundary, with the Atlantic Ocean on the west and the Indian ocean False Bay on the east. The maximum length of the reserve, from Schuster's Bay to Cape Point, is 21 km and the greatest width is 9 km.

The "study area" was defined by the home-range of the troop under observation. It comprised the north-western and west-central sectors of the reserve, an area of roughly 4000 ha.

FIG. 1: The Cape Peninsula to show the Cape of Good Hope Nature Reserve (CGHNR - hatched area)

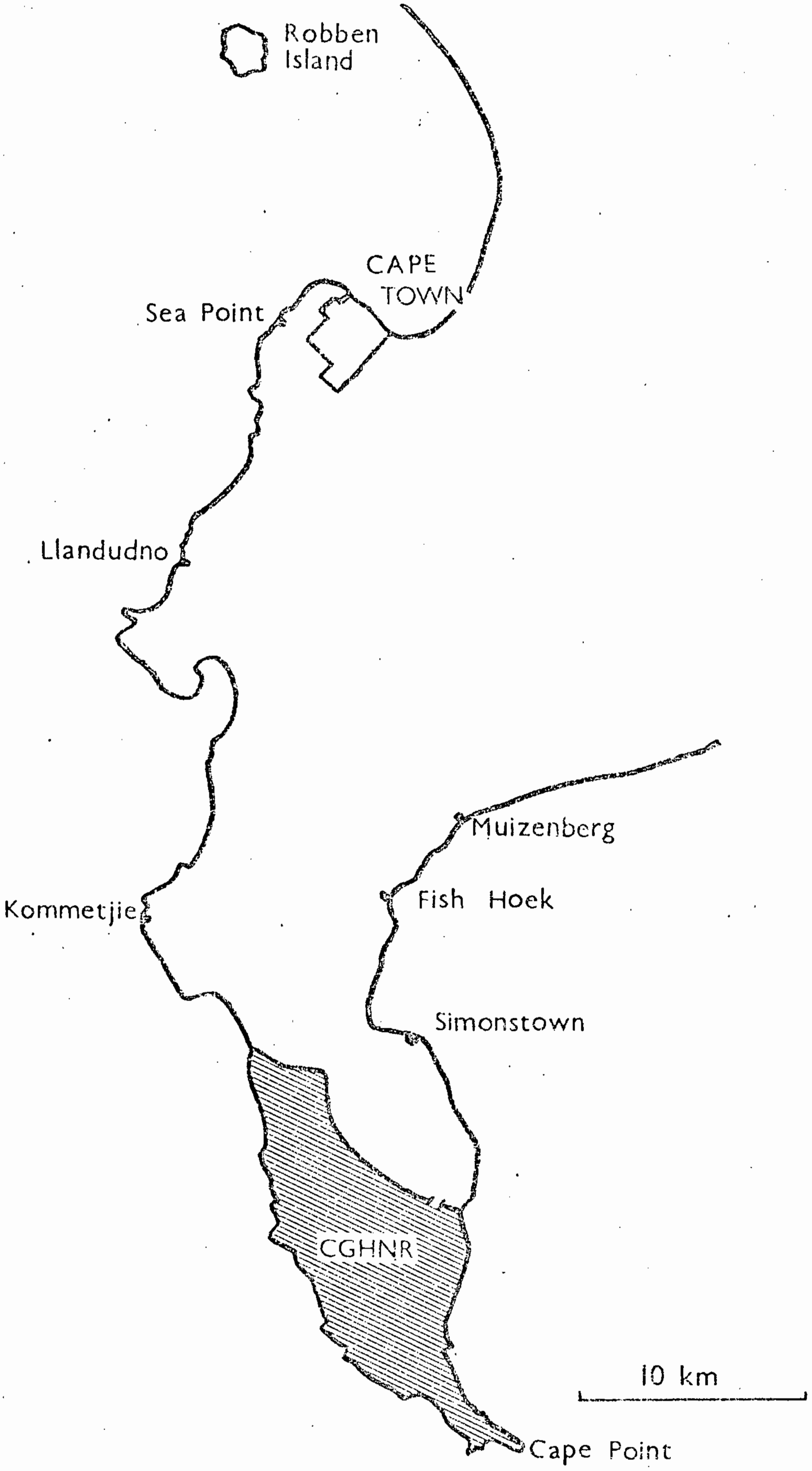
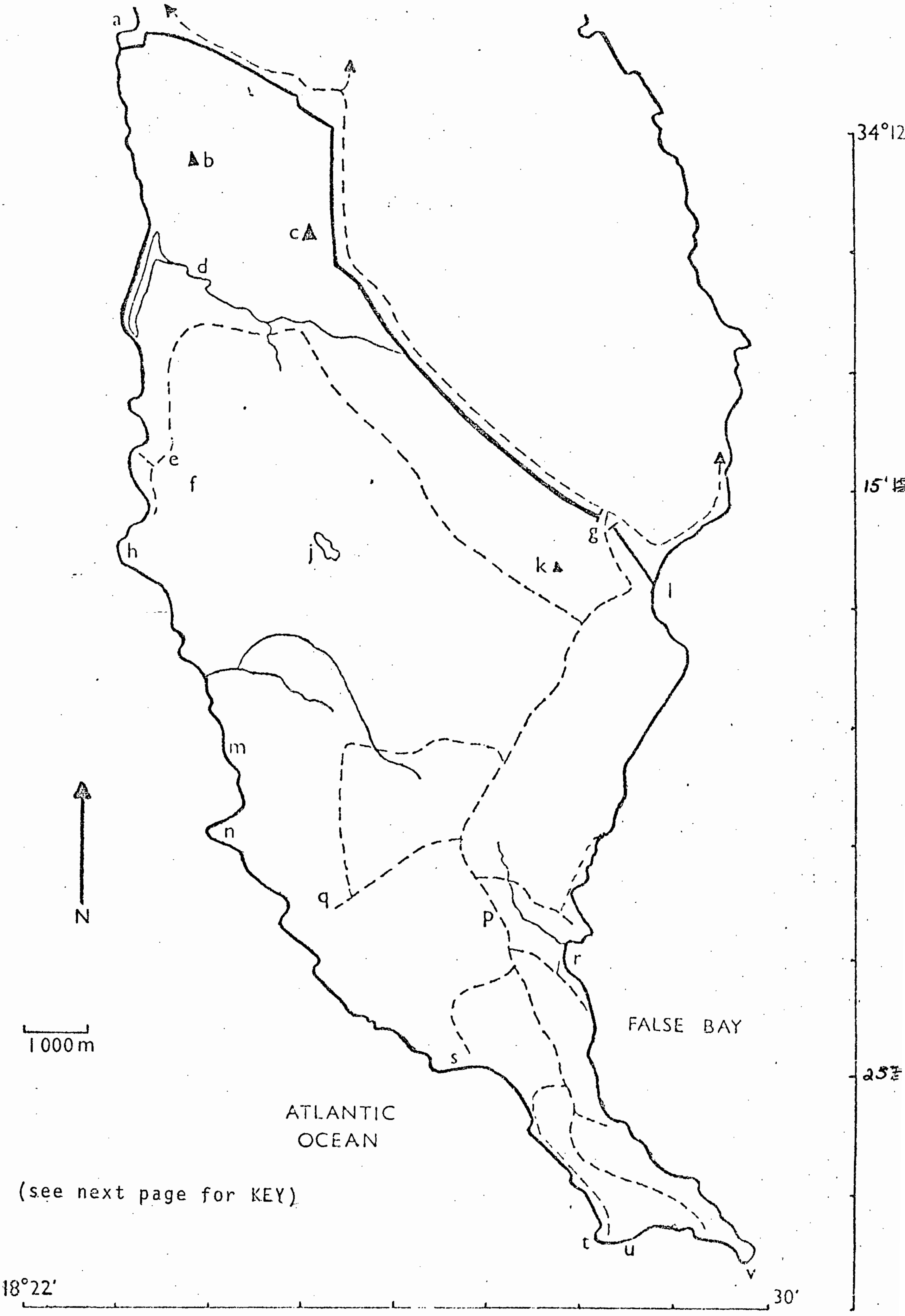


FIG. 2: The Cape of Good Hope Nature Reserve



(see next page for KEY)

Place names and physical features of the Cape of Good Hope Nature Reserve

(Fig. 2)

━ boundary of reserve

--- tarred roads

— streams

▲ sighting points

a = Schuster's Bay

b = Bonteberg

c = Teeberg

d = Krom River

e = Olifantsbos

f = Die Kloof

g = main entrance

h = Olifantsbospunt

j = Sirkelsvlei

k = Rooihoogte

l = Smitswinkel Bay

m = Brightwater

n = Hoek van Bobbejaan

p = Homestead restaurant

q = Groot Blouberg

r = Buffels Bay

s = Platboom

t = Cape of Good Hope

u = Cape Maclear

v = Cape Point

GEOMORPHOLOGY

Geology and topography

The reserve is composed of level or gently inclined sandstone beds of the Table Mountain group (Cape supergroup). These beds rest on Cape granite, visible in the reserve only at the base of the Cape Point cliffs (Fig. 2). Sandstone sediments were deposited on the granite during a period of submersion (Walker, 1952).

The Table Mountain group consists mainly of hard resistant sandstone which forms characteristic steep-sided blocks and conical hills. The sandstone owes its durability to the silica which cements the constituent sand grains. The weathered surface of Table Mountain sandstone is often highly irregular owing to differences in the hardness of the cement. It may be brown or red owing to leaching of iron which is deposited as brown hydroxide or red oxide. Exposed deposits of ferricrete are occasionally found and quarried for road gravel. Lichen flourishes on the sandstone, imparting a grey colour to it. The lower strata of the Table Mountain group are softer, the grains smaller and bound together by a bright red or purple muddy sand. These basal shales are seen in places along the foot of the cliffs, as at Cape Maclear.

The northern land boundary of the reserve (Fig. 2) follows the line of a fault which caused a vertical displacement of a hundred or more metres (Walker *op. cit.*). A chain of hills runs to the south of this in which

Bonteberg (227 m) and Rooihoogte (275 m) are prominent. These hills merge into the mountain range of the False Bay coast to the east. The summit of Paulsberg (360 m) is the highest point of the reserve and is the chief peak in the range. The eastern slopes of these mountains are almost sheer cliffs, truncated by wave attack. The coast is also steeply shelving.

The western slopes of the False Bay mountains fall less steeply to a central plateau stretching westward for 5-6 km (Taylor 1969). The plateau slopes gradually from 150 m in the east to about 60 m above sea level in the west, where it terminates in a steep sandstone scarp. The plateau forms the most level surface of the reserve. It is almost devoid of surface rock, unlike the rest of the reserve. A series of shallow seepage steps, usually less than 3 m high, traverse the plateau (Taylor *op. cit.*). These are formed where a band of tilted sandstone approaches the surface and dams the soil water. Drainage of the plateau is poor. The flooded marshy flats are connected by a few streams in winter.

The only permanent body of water on the reserve is Sirkelsvlei on the west of the central plateau. The vlei appears to be fed by underground springs since it is never empty nor stagnant, though no streams flow into it. The overflow passes north-west through marshy ground to drain into Die Kloof and thence into the sea at Olifantsbos. This stream runs only during the winter and spring months. All water in the reserve is dark brown in colour, thought ? to be tannic acid staining extracted from rotting vegetation

(Harrison & Agnew 1962). Most streams and ridges in the reserve follow geomorphological lines of weakness (joints or faults), running roughly north-west to south-east, or at right-angles to this. The main drainage system is the Krom River in the north of the reserve. This rises in the Smitswinkel Flats and flows north-west to the coastal plain, where it is joined by the Klaasjagers River. The river forms a lagoon at the Fishery during the summer, when the outlet is deflected southward by "beach drift" (Mabbutt 1952).

There is evidence in the peninsula for at least two sea-levels higher than the present one. Along the west coast between Cape Maclear and Kommetjie a wave-cut shelf terminates against the cliff base at 6 m a.s.l. Evidence exists also for sea-levels at 30, 18, 9 and 3 m, with intermittent minor fluctuations between these and the present level. World-wide changes in ocean level that occurred during the Pleistocene Ice Ages partly explain the fluctuations. Changes were also caused by the local land uplift, which continued into the early Pleistocene period (Mabbutt *op. cit.*).

Ocean levels fall at times of glacial advance, exposing extensive sand flats to the prevailing winds. A major sand invasion in the area about 100 000 years ago coincided with the retreat of the sea after the 6 m beach period. Probably at this time the inland dunes of the reserve were formed (Taylor 1969). The sand was blown inland by the south-east wind to form one dune extending from Smitswinkel Bay to the nek between Teeberg and Bonteberg, and another running from

Buffels Bay to Brightwater. These dunes are now stabilized. Calcrete dunes occur to the north of Buffels Bay and south almost to Diaz Beacon. Variation in structure and vegetation suggests that the dunes differ quite widely in age. The calcrete dunes may be the oldest (Taylor *op. cit.*).

Soil

Table Mountain sandstone weathers to form a "sugary" grey soil. This soil, poor in plant nutrients, tends to accumulate in depressions and at the foot of hills, leaving the rock of the steep slopes exposed. The soil contains little organic matter, except where marshy conditions exist. Nowhere is the soil of any great depth and much of its natural accumulated humus has been burnt out by fire (Opie 1967). Soil tests at various points on the plateau reveal a deficiency of phosphate and potassium. Sandstone-derived soil is acidic with a pH of 3,5 (Opie *op. cit.*).

CLIMATE

General climatic cycle

The Cape Peninsula lies at a latitude of 34°S, with the cold Atlantic Ocean on the west and the warmer waters of False Bay on the east coast. The maximum temperature over oceans is retarded by about 2 months in relation to the maximum solar radiation (Schulze 1965). The climate is moderated by maritime air to make it more equable than that of most land masses at this latitude. The relief of Table Mountain and the surface temperature of the oceans are important factors affecting the peninsula's climate. The area is almost entirely under the influence of westerly air circulation, and weather changes are largely dominated by perturbations in this circulation (Schulze *op. cit.*).

Areas of high atmospheric pressure lie to the south of the peninsula in summer. The weather is mainly warm and dry, with frequent strong south-east winds lasting from a few hours to several days. The air cools as it is forced to rise over the mountains and condenses to form characteristic clouds such as the "tablecloth" of Table Mountain. The south-east wind is generally stronger and of longer duration in the southern peninsula. Periodically the wind backs to north-westerly, and low nimbus cloud, accompanied by light rain and drizzle, covers the peninsula. This is the fringe effect of a depression moving far to the south of the Cape. Early morning mist sometimes shrouds lowlying areas up to 260 m a.s.l. This results from a temperature inversion caused by the advection of chilled air from the Benguela current. This mist occurs only on still, windless nights and is soon dispersed by the sun. The lack of cloud in summer causes a large daily range (29°C) of temperature (Weather Bureau 1954a).

The northward shift of the high pressure areas in winter causes the eastward-moving cyclones to affect Cape weather directly (Schulze *op. cit.*). The wind blows over the Atlantic from the north-west, bringing cool moist air which condenses as rain. The rainfall increases with altitude. The wind backs to south-westerly and later to southerly, with clearing showers and a drop in temperature as the cyclone passes. Fine weather following a depression may last for over a week.

The gradual transition between summer and winter conditions gives rise to prolonged spring and autumn seasons, in contrast to most parts of continental Africa.

Temperature

Cape Point has the lowest average annual range in mean daily maximum and minimum air temperatures (4,2°C) of all weather stations in the Republic (Weather Bureau 1954a). By comparison, the average annual range for Simonstown is 8,5°C and for Cape Town 10,5°C. The smallest monthly range at Cape Point occurs in summer (December 3,6°C), while at Simonstown the largest monthly range occurs during the same season (February 9,0°C). This is because Cape Point is continually exposed to the cooling south-east winds, while Simonstown is in the lee of a range of mountains. The exposed weather station at Cape Point is not, however, representative of general conditions in the reserve. The xerophytic vegetation of north slopes in the reserve suggests that their temperature regime is that of Simonstown rather than Cape Point (Taylor 1969). The south-east slopes are cool and moist since they face directly into the south-east winds and are shaded from the sun.

Seasonal temperature variation at Cape Point is also small (Table 1). Average summer and winter temperatures differ by only 5°C (daily $\frac{\text{max.} + \text{min.}}{2}$ for February 18,3°C, for July 13,4°C) while at Simonstown the corresponding figure is nearly 17°C (March 31,3°C, July 14,6°C) (Weather Bureau *op. cit.*). The Cape Point figures are representative only of exposed bluffs and headlands, while many inland parts of the reserve are comparable with Simonstown. Highest average summer temperature (mean of daily maximum for February) at Cape

Point is only 20,3°C while at Simonstown it is 27,1°C. The lowest mean daily minimum temperatures are in July: 15,5°C for Cape Point, 18,5°C for Simonstown. The winter maxima show smaller differences than the summer because the cool south-east winds are rare during winter. Frost was never recorded at Cape Point during the period 1921-1950. It is unlikely that any part of the reserve ever experiences frost.

Air temperatures near the coast are affected by the differing ocean temperatures on the east and west coasts. Ocean temperatures differ most widely during summer when the warm Agulhas current flows more strongly, penetrating westward into False Bay and around Cape Point. The summer south-east winds accentuate the difference by piling up warm surface waters against the False Bay coast and blowing them away from the Atlantic coast, where their place is taken by the cold Benguella current welling up from beneath. Thus, summer sea temperatures on the west coast are about 6°C colder than in False Bay. Temperatures along the western hills on calm days are noticeably cooler than on the eastern side. The warm Agulhas current is weaker in winter and the north-west wind blows the surface waters away from the east coast while piling them up on the west coast, thus reducing the temperature difference.

TABLE 1: Air temperature data obtained at Cape Point weather station, 1921-1950 (Weather Bureau 1954a)

°C

Month	Daily $\bar{x}$ max.	Month $\bar{x}$ max.	Extreme daily maximum	Daily $\bar{x}$ min.	Month $\bar{x}$ min.	Extreme daily minimum	$\frac{\text{Max + min}}{2}$	Range
Jan.	20,0	24,3	36,1	16,3	13,2	5,6	18,1	3,7
Feb.	20,3	25,8	31,1	16,2	13,7	8,9	18,3	4,1
March	19,7	26,2	32,8	15,3	12,4	9,4	17,5	4,4
April	18,9	26,7	35,6	14,3	10,9	4,4	16,6	4,6
May	17,7	24,9	30,6	13,2	9,0	6,7	15,5	4,5
June	16,8	24,5	28,9	12,1	7,6	2,8	14,5	4,7
July	15,5	23,0	26,1	11,3	7,6	1,7	13,4	4,2
Aug.	15,9	24,6	29,4	11,4	8,2	5,0	13,7	4,5
Sept.	15,8	24,2	30,6	11,5	8,2	4,4	13,7	4,3
Oct.	16,7	22,2	33,3	12,9	9,8	5,8	14,8	3,8
Nov.	18,0	23,6	32,2	14,2	11,3	7,2	16,1	3,8
Dec.	18,9	23,4	31,7	15,3	12,2	7,8	17,1	3,6
Year	17,9		36,1	13,7		1,7	15,8	4,2

Wind

The dominant weather factor in the reserve is wind. Few places are wholly sheltered either from the south-east trades of summer of from the north-west winter winds. The south-easters blow for longer periods than the north-westers - up to a week or more. South-easters of 16-40 km per hour occur regularly in the reserve during summer, gusting up to 102 km per hour. The average wind speed is 21 km/hr in summer, dropping to 13 km/hr in June. The maximum wind speed occurs in the afternoon during winter and summer (Schulze 1965).

The south-easters have an important effect on the vegetation. Deformation - caused by strong winds from a constant direction - is characteristic of the coast vegetation (Taylor 1969). Dunes may be formed in recently burnt coastal areas by winds that blow chiefly in the fire season. Winter winds seldom form dunes but have a greater scorching effect on the vegetation of the coastal shelf. Plants on the west coast show marked browning of the growing tips on the north-west side after a severe winter storm, probably as a result of wind-borne salt spray (Taylor *op. cit.*).

Precipitation

About 90% of rain in the mediterranean-type climate of the south-western Cape falls in winter. The rainy season extends from about the middle of April to September. The frequency of showers is at a maximum in the early morning (Weather Bureau 1954b). About 12-15 rain-days per month are expected during the season of maximum rainfall, while only 4-5 rain-days per month occur in the dry season. The rainfall is mainly cyclonic and orographic, but occasional thunderstorms (5 per year) occur.

The rainfall at Smitswinkel Bay, just outside the north-eastern corner of the reserve, averages 698 mm per annum, while Cape Point (on the ridge at an altitude of 217 m) receives only about 333 mm per year (Weather Bureau *op. cit.*). The maximum recorded was 736 mm in 1944; the minimum was 209 mm in 1934. The large discrepancy between the rainfall of Smitswinkel Bay and Cape Point is remarkable, but no intervening records are available to show whether a gradient exists. The peaks south of Smitswinkel Bay probably receive a higher rainfall than the bay itself, while the lowlands south of Smith's Farm, with their modified vegetation, may be drier. The exceptionally low figure for Cape Point may be due partly to inaccurate recording as a result of marked air turbulence on the windy ridge (Taylor 1969). Nevertheless, the rainfall of the whole reserve is generally lower than that of the northern part of the peninsula (Taylor *op. cit.*).

Evaporation

Data are available only for D.F. Malan airport (Weather Bureau 1954a). Evaporative water loss in summer is 44% as against 9% in winter and about 20% in spring and autumn.

Sunshine

This is regulated by cloud cover. Sunshine in the peninsula varies from about 60% of the possible duration in July to 77% in January (Weather Bureau 1954a).

VEGETATION

General

The following vegetation description for the reserve is based on Taylor (1969).

The vegetation of the reserve is classified by Acocks (1975) as "Macchia" (Mountain Fynbos), with a narrow strip of Strandveld on the west coast. Fynbos is an indigenous term for the evergreen sclerophyllous shrubland of the winter-rainfall area of the south-western Cape. The term reflects the fine-leaved form and shrubbiness of much of the vegetation. The most important plant families in fynbos are Proteaceae, Ericaceae, Restionaceae, Compositae, Leguminosae and Bruniaceae (Dept. Pasture Science, 1972b). Shrub life-forms are basically of two xerophytic types. The ericoid leaf is small, hairy and brittle, while the proteoid leaf is larger, leathery and smooth. The place of grass is largely taken by coarse reed-like Restionaceae.

The vegetation is a mixture of two physiognomic units, fynbos and forest. Fynbos occupies a major area while forest persists as scattered relict patches only. The main plant communities are given in Table 2. Sub-division of fynbos into two floristically-defined groups ("alliances") reflects the presence of two major soil types. Plant communities within each alliance are correlated firstly with edaphic factors, secondly with the physiographic factors determining local climate, and thirdly with biotic pressures resulting from man's activities.

Fire is an ecological factor of particular importance in fynbos. Most of the flora is adapted to surviving fire by one or more methods. Geophytes (e.g. Liliaceae, Amaryllidaceae, Iridaceae and Orchidaceae) are dependent on regrowth from underground storage organs. Perennial shrubs, such as *Protea cynaroides*, rely on regrowth from rootstocks. Shrubs with thick, corky bark (e.g. *Leucospermum conocarpodendron*) are insulated from all but the slowest, hottest fires, which cause internal water to burst the bark. Many *Leucadendron* species and the exotic *Acacia* species are encouraged by fire to cast seed.

Most of the larger shrubs may be exterminated by regular hot fires despite adaptation. Many Proteaceae, for example, require 5 to 7 years from germination to first seed production. Herbivores are attracted to the palatable regrowth and retard post-fire succession. Recurrent fires will probably cause regression and finally extermination of the scrub if conditions are such that the scrub is totally burnt out as soon as it becomes inflammable (Wicht 1945).

A controlled burning programme is operated in the reserve, since total protection from fire is not possible. The main advantage of this is the reduction of inflammable plant litter. A secondary effect is the propagation of geophytes characteristic of recently-burnt ground.

The following preselected plant communities (Taylor 1969) occur within the north-western sector of the reserve:

1. *Eriocephalus* Coast-shelf Fynbos Association:

TABLE 2: Plant communities in the Cape of Good Hope Nature Reserve (after Taylor 1969)

FYNBOS FORMATION (sites exposed to fire)	COAST FYNBOS ALLIANCE	1. *Eriocephalus* Coast-shelf Fynbos Association on well-drained marine sands of coastal shelf.
		2. Dune Mixed Fynbos Association on well-drained aeolian dunes of mixed origin.
		3. *Helichrysum-Scirpus* Marsh Association on poorly drained coastal flats of marine origin.
		4. *Coleonema* Fynbos Association on well-drained Table Mountain sandstone coastal cliffs.
	INLAND FYNBOS ALLIANCE	5. Upland Mixed Fynbos Association on well-drained rocky hills and mountains.
		6. *Protea lepidocarpodendron* Tall Fynbos Association on well-drained ferricrete slopes.
		7. *Protea arborea* Pseudo-Savannah Association on steep, well-drained, rocky, northerly slopes.
		8. Restionaceous Plateau Fynbos Association on drained level plateaus.
		9. Restionaceous Tussock Marsh Association on seasonally-inundated flats of plateaus.
		10. *Berzelia-Osmitopsis* Seepage Scrub Association on permanently moist seepage steps demarcating the terraced flats of the plateaus.

TABLE 2: continued

BROAD-LEAVED SCRUB FORMATION (sites protected from fire)	11. *Sideroxylon* Scrub Association on dunes of marine origin. 12. *Maurocenia-Linociera* Tall Scrub Association on Table Mountain sandstone slopes and screes.

The coastal shelf occurs chiefly on the west coast, comprising old raised beaches at 6 and 18 m a.s.l. (Mabbutt 1952). Coast-shelf Fynbos is found to the 18 m beach level, up to 400 m inland. The vegetation varies in height:

a. Low scrub, 15-30 cm high, of succulents (Mesembryanthemaceae, *Cotyledon*, *Euphorbia*, *Othonna*), woody shrubs (*Nylandtia spinosa*, *Euclea racemosa*), and grass (*Stenotaphrum secundatum*). Annuals and geophytes seasonally colonize the bare patches.

b. Fine-leaved shrubs, shaped by salt-laden winds into domed hummocks about 60 cm high, of *Eriocephalus racemosus*, *Metalasia muricata* and *Passerina vulgaris*. *Coleonema album* occurs on rocky outcrops.

c. Tufts of *Thamnochortus spicigerus*, 1,5 m high, occur as pure stands of erratic size.

The vegetation becomes richer in species with increasing distance from the sea, but the paucity of Restionaceae and predominance of woody shrubs separates it from Inland Fynbos. Coast-shelf Fynbos is heterogeneous where the coastal shelf is wide (as at Brightwater), being mixed with Inland Fynbos elements on Table Mountain sandstone soil washed down from the plateau.

2. Upland Mixed Fynbos Association:

This is the most extensive and variable community on the reserve, varying greatly with slope, aspect and altitude.

The soil, composed of coarse whie sand over bedrock, is usually shallow. The shallow soil combined with steep slopes generally results in rapid drainage. Local patches of poor drainage result in the very few places where the ground is level. Great variation in composition and stratification has been caused by other factors such as fire, wind and previous grazing by domestic stock. The community is floristically richest 2 to 5 years after fire, when annuals, geophytes, sprouting perennials and seed-regenerating shrubs occur together. The latter predominate in subsequent stages, while the other three classes eventually die out. Conversely, stratification is simplest in the early stages, becoming more complex with age. Starting from a single low layer of sprouting and seed-regenerating plants, it increases to a three-layered community of:

a. emergent shrubs, often Proteaceae;
b. canopy shrubs, usually fine-leaved, mixed with taller Restionaceae; and
c. ground layer of the lower tufted Restionaceae, Cyperaceae, Gramineae and herbs.

All three layers become moribund after twenty years of protection from fire and the emergents and shrubs slowly die out. The dead twigs and leaves decompose slowly, suppressing even the sprouting element of the lower layer.

The community is so rich and variable that only the most striking plants can be mentioned here. Mature Mixed

Fynbos is typically three-layered along the western edge of the plateau. *Leucospermum conocarpodendron*, a rounded, densely-branched shrub, and *Mimetes hartogii*, a small tree with umbrageous crown, form an erratic savannah-like emergent layer about 3 m high. Individuals are about 4 to 6 m apart. Below this is a denser layer of *Leucadendron laureolum*, a globose bush 90 to 120 cm high. Its broadly oblong leaves give a characteristic yellow-green tinge to plateau vegetation during the winter flowering period. The lowest layer, densely filling interspaces and extending more sparsely beneath the *Leucadendron*, is dominated by restionaceous plants 30 to 75 cm high, among which *Thamnochortus dichotomus*, *Hypodiscus alboaristatus* and *Restio cuspidatus* are common. Minor ericaceous genera and other fine-leaved shrubs are present. *Tetraria thermalis* occurs sparingly, but its gross-leaved yellow-green tufts are conspicuous. The drier northern hills of the inland boundary have a simpler vegetation. *Leucadendron laureolum* is conspicuous on the lower slopes, less abundant on the intermediate slopes. The crests and higher slopes are sparsely covered by pseudo-savannah bushes such as *Leucospermum conocarpodendron* and *Mimetes hartogii*, with *Tetraria thermalis* occasional to fairly frequent. *Aspalathus capensis* and *Phylica buxifolia* sometimes form dense scrub on screes and warm boulder-slopes.

3. Restionaceous Plateau Fynbos Association:

Plateau Fynbos occupies the second largest area on the reserve. It is found on the level central plateau, excluding areas occupied by Tussock Marsh which are usually sharply delineated. This vegetation fans out northwestwards from Suurdam in the south, to include the Smitswinkel Flats and the shallow drainage system of the Krom River. Drainage is neither very poor nor very good. Plateau Fynbos gives way abruptly to Tussock Marsh where standing water occurs in winter.

The main cover is afforded by a dense uniform layer of Restionaceae mixed with more decumbent soft shrubs 30 to 45 cm in height. *Leucadendron laureolum* forms a conspicuous but discontinuous layer, about 90 to 120 cm high, above this throughout most of the plateau north of Suurdam.

This category was extended during the study to include all communities 1 to 4 years after fire. For example, a fire in March 1975 burnt the northern fifth of the reserve, along the length of the road boundary. The resultant, youthful community, depicted as Upland Mixed Fynbos (Taylor *op. cit.*), was categorized in this study as Restionaceous Plateau Fynbos. The post-burn and Plateau Fynbos communities are visually similar, being low and "grassy".

Defined thus, Restionaceous Plateau Fynbos covers approximately half of the north-western and western-central sectors of the reserve.

4. Restionaceous Tussock Marsh Association:

Tussock Marsh is found where water is stagnant during winter but dries up in summer. It occurs in shallow depressions within the central plateau and on some terracesteps, where seepage is insufficient to support *Berzelia-Osmitopsis* Seepage Scrub. Tussock Marsh, dominated by one or two species, is a sharply delineated community. The simplest form is found in enclosed, shallow depressions. The community consists typically of dense single-layered stands of *Elegia parviflora* 30 cm high. Other members of the Restionaceae and a few low shrubs (*Erica clavisepala, Serruria glomerata*) occur sparingly, especially towards the edges of the community.

5. *Maurocenia* Tall Scrub Association:

This is a dense, mixed scrub 1,5 m tall and quite impenetrable. The following woody species are conspicuous: *Cassine maritima, Euclea racemosa, Rhus laevigata, R. lucida* and *Tarchonanthus camphoratus*. *Sideroxylon inerme* is sometimes found. The highest development of scrub occurs on the steep, bouldery, southerly slopes above Gifkommetjie. Here an encircling arc of sandstone cliffs has afforded protection from fire, possibly for centuries.

Map?

Alien vegetation

Australian *Acacia* species (wattle) were originally planted in the reserve as windbreaks around farmlands, as shade trees near homesteads and as sand stabilizers near the coast. This has given rise to impenetrable wattle thickets on disturbed areas and, aided by fire, rapid invasion of the adjoining veld. *Acacia cyclops* (rooikrans), the most aggressive form, is concentrated on dune sands in the south. It is successful in a variety of habitats owing to the highly efficient seed dispersal and wide ecological amplitude of the species, and is spreading widely in the reserve. *Acacia saligna* (Port Jackson Willow) occurs mainly on moister soils in the north, such as along the Krom River and around the farm "Theefontein". *Acacia longifolia* occurs as dense populations on moist flats and the stream banks of the Klaasjagers valley. A stand of alien *Pinus pinaster* (cluster pine) occupies part of the Krom River drainage.

The first eradication programme for alien vegetation in the reserve started in 1943 when five belts of *Acacia* species were cut (Opie 1967). Burning as a control method was suggested in 1944, but not until 1954 was an experimental plan proposed for the reserve. The area south of the Homestead restaurant was treated in 1957 by felling and burning ("stumping") some of the trees. Fire cracked the seed tests, allowing rapid germination to occur. Weedkillers 24D and 245T (Opie *op. cit.*) were applied to the seedlings. No further progress was made since the programme was not continued systematically.

Labourers have chopped down a few trees each day over the past few years. These have been sold as firewood. No effort has been made to eradicate seedlings. *Acacia cyclops*, in particular, is consequently spreading rapidly throughout the reserve. Seventy-five percent of the plots used by Taylor for vegetation analysis in 1967 contained alien species (Taylor 1969). *Acacia* species are now dominant in the moister areas of the reserve. Isolated trees occur also over the entire plateau.

The present ranger responsible for eradication of alien vegetation is experimenting with herbicides. Widespread use of these is not advisable owing to possible detrimental effects on herbivores. The Advisory Board for the reserve has recently approved a new ten-year burning programme (A Proposed Burning and Alien Eradication Plan for the Cape of Good Hope Nature Reserve, unpublished report). It is recommended that "major revision [of the programme] should however only take place after one full cycle of 10 years has been completed." The programme involves burning a block of 1500 ha in the autumn every 2 years. The block would be inspected after the fire and all remaining alien vegetation stumped. Thereafter, the block would be weeded consistently to remove all new alien seedlings. It must be emphasized that this programme will be effective in eliminating alien vegetation only if weeding is carried out intensively over a period of years. The reserve has been divided into seven blocks for this purpose. The first of these blocks, containing the north-eastern sector, was burnt in 1975. The second sector, including the north-western part of the reserve, is due for burning in 1977. The third sector, due for burning in 1979, includes the west coast from Olifantsbaai to Hoek van Bobbejaan and inland to the mid-line of the reserve (Fig. 3).

FAUNA

Present-day mammals in the reserve are but a remnant of the indigenous fauna. Species such as the lion (*Panthera leo*), aardvark (*Orycteropus afer*) and African buffalo (*Syncerus caffer*) are extinct in the area. However, many of the large indigenous mammals shot out by the early settlers have been re-introduced to the reserve. Table 3 lists mammals to be found in the reserve (Langley and Wright, pers. comm.). There are no large mammalian carnivores in the area.

One hundred and sixty-six species of birds have been recorded in the reserve (Middlemiss & Langley 1975). The greatest avian biomass is contributed by 70 ostrich *Struthio camelus*. A pair of black eagles *Aquila verreauxi* is resident (Cooper pers. comm.). These birds, known occasionally to take young baboons (McLachlan & Liversidge 1957), are the only remaining predator of *Papio ursinus* in the reserve.

TABLE 3: Mammalian species found in the reserve

Vernacular name	Species	Numbers
black rat (exotic!)	*Rattus rattus*	
blesmol	*Georychus capensis*	
bontebok	*Damaliscus dorcas dorcas*	*ca* 60
brown rat (exotic)	*Rattus norvegicus*	
Cape grey mongoose	*Herpestes pulverulentus*	
Cape pole-cat	*Ictonyx striatus*	
Cape spiny mouse	*Acomys subspinosus*	
chacma baboon	*Papio ursinus ursinus*	*ca* 150
clawless otter	*Aonyx capensis*	
common genet	*Genetta genetta*	
duiker	*S~~i~~ylvicapra grimmia*	3
dune mole-rat	*Bathyergus suillus*	
eland	*Taurotragus oryx*	*ca* 80
forest shrew	*Myosorex varius*	
golden mole	*Chrysochloris asiatica*	
grey tree mouse	*Dendromus melanotis*	
grysbok	*Raphicerus melanotis*	*ca* 150
house mouse (exotic)	*Mus musculus*	
Kreb's fat mouse	*Steatomys krebsi*	
larger spotted genet	*Genetta tigrina*	
mountain zebra	*Equus zebra hartmannae*	6
musk shrew	*Crocidura flavescens*	
Namaqua rock rat	*Aethomys namaquensis*	
porcupine	*Hystrix africae-australis*	
pygmy mouse	*Mus minutoides*	
rock rabbit	*Procavia capensis*	
Saunder's vlei rat	*Otomys saundersiae*	
silver fox	*Vulpes chama*	
springbok	*Antidorcas marsupialis*	*ca* 25
steenbok	*Raphicerus campestris*	*ca* 100
striped mouse	*Rhabdomys pumilio*	
vaal rhebok	*Pelea capreolus*	*ca* 60
Verreaux's rat	*Praomys verreauxi*	
vlei rat	*Otomys irroratus*	
water mongoose	*Atilax paludinosus*	

HISTORY

It appears, from various middens discovered, that man has occupied the southern Cape Peninsula since the early Stone Age (Goodwin 1952). There is no evidence in the earliest remains for use of fire. The first signs of fire appear in middens dated by Walker (1952) as approximately 100 000 years old. It seems unlikely that fire was a ? regular natural factor prior to this, since the peninsula ✓ rarely experiences lightning.

Crown land on the peninsula was rented to farmers in the early 1800's. The use of heavy wagons for conveying material to the farms led to deeply rutted tracks. Traces of these tracks are still visible across the sandy plateaus of the reserve, as the more moist hollows created were overgrown by distinctive Restionaceae (Taylor 1969). The farmers cut down proteas, chiefly *Leucospermum conocarpodendron*, for firewood and littoral scrub for timber. The natural vegetation was burnt to provide young pasturage for stock. For instance, at the turn of the century, 6000 ✓ horses were grazed on the area (Opie 1967). Crops such as potatoes, tomatoes, green vegetables and barley were grown on the richer alluvial soil deposits along the rivers. The farming practised was subsistence and, as it became increasingly uneconomical, farms were abandoned. Only a few hundred cattle roamed the area of the present reserve by the 1930's.

The Cape of Good Hope Nature Reserve was established by the Divisional Council of the Cape in 1939. It was created to preserve the flora, fauna and scenic attractions at the tip of the Cape Peninsula. Initially, the reserve comprised three farms purchased by the Council. Two of these, "Buffelsfontein", including Buffels Bay, and "Uiterstehoek", including Cape Point itself, had been granted to John Osmond in 1816. A portion of the present-day Homestead restaurant is part of the original Osmond farmhouse. The third farm, "Bloubergvlei", was donated by the owners. In addition, certain land was granted by the State. This nucleus of the reserve is still demarcated by the inner fence and is now used as an undisturbed faunal breeding area. The reserve was extended to its present size from 1941 to 1966 by the acquisition of the farms "Klaasjagers", "Olifantsbos", "Theefontein" and a part of "Wildschutzbrandvlei".

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METHODS

HABITUATION OF O TROOP

It took some time for the baboons to become accustomed to my presence since they are wary of humans. Their initial reaction was always to flee, after giving a few alarm barks. Most juveniles and adult males became sufficiently accustomed to my presence after 3 months to allow me to approach within 2 m of them. This tolerance progressively increased until most animals in the troop allowed me to approach and to walk past within a few metres of them without interfering with their activities. The only exceptions to this were adult females, especially those with infants. Any movement caused them to run away, although they occasionally approached me quite closely (*ca* 4 m).

DATA COLLECTION

Ten days during January and February 1975 were spent in the reserve familiarizing myself with the area, the baboons and the methods to be used in the study. One hundred and twenty-one days, involving 480 hours of field observation, were spent with O troop during the period March 1975 to February 1976.

Instantaneous Scan data

Data on daily activity schedules were obtained by use of the Instantaneous Scan method (Altmann 1974). This method has previously been used for studying baboons by Crook & Aldrich-Blake (1968) and by Slatkin (1975).

The troop was followed from the first turn of the hour after sunrise on days chosen at random with respect to weather conditions. Six hours was considered to be the minimum period for the collection of data representative for any one day. Observations in the afternoon (from 15h00) were made from the first turn of the hour after sighting the troop. An attempt was made to have an equal number of observations for each hour of the day per month. Four days, or 30 hours, of Instantaneous Scan observations were made on average each month (Table 4).

The age and sex classes and current activity of all visible animals in the troop were noted every 10 minutes, using a tape-recorder. The scan for each individual must be

TABLE 4: Number of hours of Instantaneous Scan observations made, according to time of day, March 1975 - February 1976

	Hour beginning													
Month	06	07	08	09	10	11	12	13	14	15	16	17	18	Total
March		7	7	7	8	7	7	3	3	4	3	3		60
April	6	8	8	8	7	6	6	5	4	1	2	7	6	74
May	1	3	3	3	3	1	1	1	2	3	2	2		25
June		2	2	2	2	2	2	2	3	3	3	3	2	28
July		2	2	2	2	2	2	2	2	2	2			20
Aug.		1	2	2	2	2	2	2	2	2	2	1	1	21
Sept.		2	2	3	3	3	3	2	2	1	1	1		23
Oct.		4	3	3	3	3	3	3	2	3	1	1		29
Nov.		3	3	3	3	3	4	4	3	3	4			33
Dec.	2	3	3	3	3	3	3	2	1	1	3	2	1	30
Jan.		2	2	1	1	1	1	1	1	1	1			12
Feb.	1	1	1	1	1	2	2	1	1	1	1	1		14

decline

equal and short, otherwise it is equivalent to a series of short "Focal Animal" samples of variable and unknown durations (Altmann *op. cit.*). For this reason, it is essential that behaviour is divided into broad categories which allow instant categorization of particular activities. The categories used included all major activities of the animals and were mutually exclusive. The Instantaneous Scan method has the advantage that data are obtained on the time distribution of behavioural states. In particular, it provides information on behavioural synchrony within the troop.

Seven age and sex categories were used:

1. Adult male:

   Animals with fully-developed secondary male characteristics such as shoulder mane, enlarged canines, large head and body size, were included in this category.

2. Adult female:

   All individuals observed to be menstruating or in oestrus were included in this category. Certain of the old animals, recognizable and known to be female, were also included. Categorization was more difficult among younger females who were neither menstruating nor in oestrus. The animal was classed as female if it had divided ischial callosities and was bigger than a certain subjectively determined size. It was termed juvenile if below this size. This method of sex determination caused a variation of 3, plus or minus, in 25 adult females during censuses of the troop.

3. Juveniles:

   This is a subjectively determined category. It includes all individuals below a certain size which are no longer carried by the mother.

4. Brown infants:

   Included in this category are brown-furred infants below a certain size carried jockey-style by the mother.

5. Black infants:

   These are up to 9 months of age and dependent on the mother. The fur is still black. Skin colour ranges from bright pink of the newly-born young to the dark colour of animals in other categories. Black infants may be carried ventrally or jockey-style by the mother.

6. Adult of unknown sex.

7. Animal of unknown sex or age.

Nine activity categories were used:

1. Resting within 1 m of another individual; includes animals auto-grooming, lying, sitting or standing motionless.

2. Resting alone, but farther than 1 m from another animal.

3. Feeding within 1 m of another individual. Animals categorized thus could be standing or sitting, on the ground or in a bush or tree. Feeding encompasses digging, pulling up of roots, cleaning and gathering of food items. Chewing of food appeared not to interfere with other behavioural activities, nor did it appear to limit the rate at which an animal took in food. Chewing

is therefore not considered as a separate feeding activity, and was discounted in the categorization of activities. Movement during feeding, other than very slight, was categorized as "walking".

4. Feeding alone, but farther than 1 m from another animal.
5. Walking; includes animals running or climbing.
6. Drinking.
7. Grooming of another individual. Auto-grooming is excluded.
8. Fighting; includes individuals threatening, screaming, fleeing, pursuing or in physical combat.
9. Copulating.

The last three categories (i.e. 7-9) can be combined as social behaviour.

Focal Animal data

The Instantaneous Scan method gives no information on rates of events or duration of various behavioural states. For this, the Focal Animal method is used (Altmann *op. cit.*). An individual was followed exclusively and all its activities were categorized as in the scan method. A stop-watch was started at the onset of observation and the time of termination of each behaviour, as well as the following behaviour, noted by using a tape-recorder. It is essential that the Focal Animal is easily identifiable, so that ~~he~~ it may be followed again after being temporarily concealed in vegetation. One hundred and ten hours of Focal Animal observations were made.

Other data

Data on the following parameters were noted every 30 minutes:

1. The grid area containing more than 50% of the troop. A large-scale map (1:35000) of the reserve was divided into 350 x 350 m grids, each grid identified individually by two pairs of numerals.
2. Cloud cover (estimated 1/8 ths of sky covered), wind speed (Beaufort scale), wind direction (estimated) and ambient temperature. A thermometer held in shade, 1 m above the ground, for 5 minutes gave ambient temperature.
3. Predominant food item(s) eaten by the majority (75% or more) of the troop during the preceding 30 minutes, determined subjectively.
4. Height of vegetation, percentage of bare rock, gradient and vegetation type of the grid. The vegetation type was categorized as described in the vegetation section.

Samples of plant species seen to be eaten by baboons were collected for identification. Specific quantities of certain foods (for instance, the amount consumed in 1 minute) were collected for calorific and water analyses.

The route travelled by the troop was plotted on a large-scale map (1:35000) for each day of observation. Direct measurement from the map gave the distance covered during the day. Measurement was made only of day-journeys plotted for a full day (dawn to dusk).

DATA ANALYSES

Instantaneous Scan and environmental data were stored in a Univac 1106 computer. Instantaneous Scan data were sorted to present individual scans in the format:

```
      DATE:18-04   TIME:12-40  PLACE 07-18NUMBER:65  LENGTH SCAN: 48SECONDS
      CLOUD COVER :0 WIND SPEED:1   DIRECTION:4   TEMP:26   VEG:3511 PREDM. FOOD  2
                    **************************************************************
                    *     ADULTS     *           *    INFANTS    * UNIDENTIFIED
                    ******************* JUVENILES ********************************
                    *MALES  * FEMALES *           * BROWN * BLACK * ADULTS *  ?
**********************************************************************************
SITTING WITHIN 1M.  *       *         *           *    1  *       *        *
   SITTING ALONE    *    1  *         *      4    *    1  *       *        *
FEEDING WITHIN 1M.  *       *         *           *       *       *        *
   FEEDING ALONE    *       *         *           *       *       *    1   *
     DRINKING       *       *         *           *       *       *        *
      WALKING       *    1  *     2   *           *       *       *        *    1
     GROOMING       *       *         *      1    *       *       *        *
  PLAYING/FIGHTING  *    1  *         *      8    *    2  *       *        *
    COPULATING      *    1  *     1   *           *       *       *        *
**********************************************************************************
```

Two other statistics were then analysed:

1. the percentage of each hour passed in various activity categories; and
2. the frequency (hours/month) with which the troop was seen in a particular map-grid.

A programme was written to calculate the total number of baboons of each age and sex class observed in every hour. The number of individuals engaged in various activities for each hour was then extracted according to age and sex class. These values were divided by the corresponding first totals. Each computed value was the percentage of a particular hour spent by baboons of a certain age and sex class in a specific activity. These percentages were tabulated for every hour of observation during each month and analysed as follows:

1. Activities expressed as percentages of the same hour are obviously interrelated. It is therefore unnecessary to subject all activities to rigorous analysis. Feeding and walking were chosen for the following analysis as being the activities most prone to seasonal variation induced by environmental changes, such as food availability. Feeding and walking percentages in each hour (e.g. 07h00) in every month (March 1975 - February 1976) were analysed by computer using the sum of squares simultaneous test procedure (STP) taken from Sokal & Rohlf (1969). The programme computes a critical SS value for a test of significance of an analysis of variance. Overall significance exists if SS_{group} is greater than the critical SS. The procedure is applied "in a stepwise manner, testing differences among a set of means only if the set is contained within a larger set that was found to be significant ... it is inherently impossible that a significant smaller set is contained within a non-significant larger set" (Sokal & Rohlf *op. cit.*).

STP analyses were made of feeding and walking percentages from March to February separately for each hour between 07h00 and 18h00 for three age and sex classes (adult male, adult female and juvenile).

2. Percentages for each month and each hour were averaged to give an hourly percentage for each activity for three age and sex classes (adult male, adult female and juvenile). Hourly percentages (07h00-18h00) for each month were averaged for the age and sex classes to give the percentage of day spent on each activity. Hourly percentages could have been averaged for each day of observation separately and then averaged over a month. However, equivalent hours of observation per day were not made (Table 4). Averaging values on an hourly basis, to produce a single "average" day of 12 hours, irrespective of component observations, was felt to be a more accurate determination.

Comparison of activity values for three age and sex classes (adult male, adult female and juvenile) is possible only if the three classes were seen with equal frequency. I felt that adult male baboons were likely to be seen most frequently, being more conspicuous than other classes. A correcting factor (Chalmers 1968) was therefore calculated for the other age and sex classes. The ratio of adult males, adult females and juvenile baboons in O troop was 3:6:10 at the end of the study (Table 7). Ten random samples were taken from all scans made during the study and the number of adult males seen used as the base unit. Numbers of adult females and juveniles seen in the same scan were compared with this value. The observed ratio of adult males, adult females and juveniles is given in Table 5. A theoretical ratio of sightings of baboons of each age and sex class was calculated from the known ratio for O troop (above). The average number of baboons of each age and sex class observed was divided by the theoretical value. The resultant factor (Table 5) was used to correct adult female and juvenile activity values for each month with respect to those of adult males.

Monthly activity percentages refer to an average "day", although day-length (i.e. time of local sunrise to time of local sunset) at latitude $34^{O}S$ varies considerably during the year (Table 6). Activity percentage values for each month were therefore multiplied by the average day-length of that month to give the average number of minutes in a day spent on each activity.

TABLE 5: Observed frequency of sightings of three age and sex classes of chacma baboons compared with the expected frequency

	Adult male	Adult female	Juvenile
Number of animals observed in one scan compared with base unit (adult male)			
Scan 1	3,0	7,6	27,8
Scan 2	3,0	5,4	12,0
Scan 3	3,0	5,0	7,7
Scan 4	3,0	5,8	12,3
Scan 5	3,0	7,8	14,7
Scan 6	3,0	4,5	10,6
Scan 7	3,0	6,6	15,0
Scan 8	3,0	4,3	8,8
Scan 9	3,0	5,6	11,4
Scan 10	3,0	4,5	11,7
Total animals observed	30,0	57,1	132,0
Expected ratio	30,0	60,0	100,0
Correcting factor	1,0	0,9	1,3

TABLE 6: Average monthly day-length (minutes) at latitude 34^{o}S (Anon. 1957)

Month	Average day-length (mins)
Jan.	843
Feb.	798
March	745
April	671
May	624
June	595
July	604
Aug.	648
Sept.	707
Oct.	772
Nov.	830
Dec.	860

RESULTS AND DISCUSSION

TROOP COMPOSITION

O troop

Censuses were made of O troop whenever it crossed a road. The animals were classified according to age and sex. Fourteen censuses were made between April 1975 and February 1976, but only the final two censuses almost certainly included all animals (85) in the troop (Table 7). Troop-size has been reported as ranging from 15 to 80 ($\bar{x}$ 44) individuals for 21 chacma baboon troops studied in South Africa (Hall 1963; Stoltz & Saayman 1970).

Twelve adult male baboons were observed in O troop during each of the last five censuses (Table 7). Four of these males were noticeably larger than the others. Adult females were more difficult to categorize, for reasons given on page 53. Twenty-eight adult females were observed during the February census, although this is possibly a slight overestimation.

Thirty-six juveniles were counted in the February census (Table 7). These ranged in age from 1 to 4 years for females and 1 to 6 years for males. A juvenile male (aged 2-3 years) with a blue tag in his left ear was easily identifiable. This animal had been removed from N troop (page 68) and released into O troop in June 1974 (Lloyd pers. comm.).

Five brown infants were counted in April 1975. This number decreased in successive censuses, presumably as the animals aged and moved into the juvenile class. No brown infants were observed after the September census (Table 7).

At least ten infants were born in the period May to November. Nine of these were alive at the end of the study.

The term "adult sex ratio" is used widely in the non-human primate literature (Hall 1962a; Altmann & Altmann 1970; Stoltz & Saayman 1970). This ratio, when derived from field data, is of limited use for a number of reasons. Female baboons, for instance, are categorized "adult" at 4 years and older, whereas males are not "adult" until 6 years of age (Altmann & Altmann *op. cit.*). Males between 4 and 6 years are categorized as "sub-adult" (Altmann & Altmann *op. cit.*) or juvenile (Stoltz & Saayman *op. cit.*). According to Stoltz & Saayman (*op. cit.*): "It was, however, sometimes difficult to distinguish sub-adult males from adult females". I frequently found difficulty in distinguishing anoestrus females from juveniles. Further problems arise when classifying immature animals. A juvenile category comprising individuals incapable of fully functional mating (Hall *op. cit.*) is not comparable with one formed on the basis of a size criterion as was done by Hall. Categories based on body size are not strictly comparable between studies, since size can be assessed only subjectively in the field.

"Adult sex ratios" and ratios of adult to immature animals for 11 troops in South Africa are given, without further comment, in Table 8.

Other troops in the reserve

Opportunistic, but not always accurate, counts were made of three other baboon troops when these were encountered on roads in the reserve. Home-range data (page 67) indicate that these troops correspond with Hall's (1962a) troops C, N and S. Maximum counts obtained by Hall (*op. cit.*), Millar (1970) and the present study are given in Table 9. One hundred baboons were trapped for removal from S and N troops during 1967 and 1968 (Millar *op. cit.*). The total number of baboons taken from the reserve since 1960 is not known.

TABLE 7: Censuses of O troop, April 1975 - February 1976

	3 April	8 April	18 April	30 April	5 May	21 May	4 June	1 July	11 Aug.	8 Sept.	7 Nov.	14 Jan.	22 Jan.	3 Feb.
Adult male	6	6	8	8	8	10	8	8	9	12	12	12	12	12
Adult female	12	5	8	9	6	15	14	20	21	23	23	25	26	28
Juvenile female									15	13	10	7	4	
Juvenile male									19	13	12	11	9	
Total juveniles	25	35	19	34	27	37	34	37	40	38	39	37	38	36
Brown infant	5	4	5	3	4	3	2	3	4	2				
Black infant						1		1	3	6	6	9	9	9
Unidentified		9	4		1		2					9	0	
Total baboons	48	57	45	58	55	66	63	69	77	81	80	83	85	85

TABLE 8: Composition of chacma baboon troops in South Africa

Troop	No. adults Males	 Females	No. juveniles	No. infants	Troop total	? "Adult ① sex ratio"	? "Adult to ② immature ratio"	Source
C	5	21	27	?	53	1:4	1:1	Hall (1962a)
N	1	10	9	?	20	1:10	1:1	" "
TM	3	12	13	?	28	1:4	5:4	" "
S	2	8	16	?	26	1:4	5:8	" "
W	18	31	15	13	77	1:2	5:3	Stoltz & Saayman (1970)
RB	19	24	7	10	60	5:6	7:3	" " "
KMO	9	18	4	6	37	1:2	3:1	" " "
K	11	11	2	6	30	1:1	3:1	" " "
GK	16	21	6	2	45	4:5	9:2	" " "
O	12	28	36	9	85	3:7 [1]	8:9 [2]	Present study

[1] ratio of adult males to adult females as defined on page 41

[2] ratio of adult animals of both sexes to remaining categories

TABLE 9: Size of three baboon troops in the Cape of Good Hope Nature Reserve

Census year	Troop	Max. no. animals[1]	Source
1959	C	53	Hall (1962a)
1967	C	45	Millar (1970)
1970	C	30	Millar (1970)
1975	C	27	Davidge (this study)
1959	N	20	Hall (1962a)
1967	N	50	Millar (1970)
1970	N	16	Millar (1970)
1975	N	35	Davidge (this study)
1959	S	26	Hall (1962a)
1967	S	45	Millar (1970)
1970	S	9	Millar (1970)
1975	S	6	Davidge (this study)

[1] includes all age and sex classes

MAINTENANCE ACTIVITIES

Diurnal variation in activities

Baboons of O troop seldom emerged from their shelters at sleeping sites before 07h00. "Rising" time thus appears not to be related to time of sunrise (Fig. 3). Adult male baboons generally appeared first, usually at the top of the cliff. Gradually, other baboons became visible as they moved onto ledges or ascended the cliff. The troop rested near or at the top of the cliff for periods of a few minutes to 3 hours after rising. This period (Fig. 4) was significantly longer in winter (June-August) than in the period November to February ($t=7,56$ $p<0,0005$), disagreeing with Hall's (1962a) statement: "Although groups in the Cape tend to leave the sleeping cliffs and start their day-ranges later in the summer months ... the differences are not significant". Hall (*op. cit.*) did, however, caution "... the probability of interference [by the observer] ... significantly delays the start of day-ranging." Observer interference was negligible in the present study owing to the habituation of O troop.

Social behaviour (including copulating, playing and grooming) among adult females appeared to occur more frequently during the initial morning resting period than at other times of day (Figs. 6 & 8). Feeding did not generally occur while the troop rested near the sleeping site, although a few juveniles sometimes fed intermittently on nearby plants.

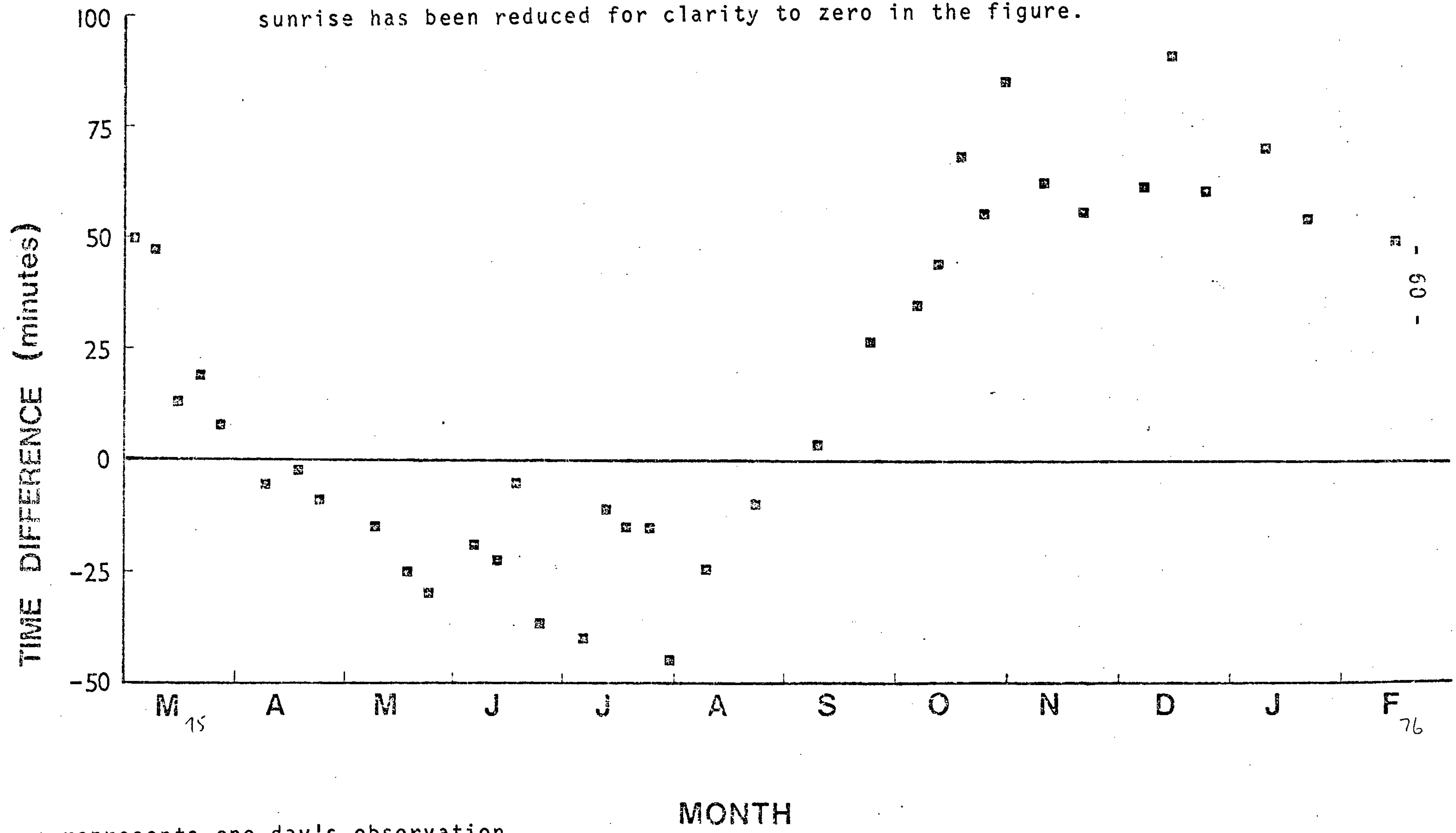
The troop abruptly commenced the day-range (page 83) after the resting period, and all the baboons began feeding. However, on 10 days the troop moved directly for 0,5 km to the Olifantsbos *Acacia cyclops* thickets before first feeding.

Feeding was generally the predominant activity from 10h00 to 15h00 throughout the year (Figs. 5-8). The proportion of time spent feeding decreased progressively during the late afternoon (from 16h00) when the troop was in the vicinity of a sleeping site. The decline in "foraging activity ... during the mid-day rest periods" reported by Stoltz & Saayman (1970) for baboons in the Transvaal was not observed for O troop (Figs. 5-8).

Figures 5 to 8 show that there was considerable diurnal variation in the average daily number of minutes spent feeding or walking by the baboons. Thus, conventional statistical analyses could not be applied to data averaged over one day. The "simultaneous test procedure" (STP, page 47) compared data from 12 months separately to overcome this difficulty.

Table 10 shows that there were significant differences between months, for several hours of the day, in the average hourly number of minutes spent feeding or walking. Up to 64 "non-significant subsets" (monthly values which, for a given hour, did not differ significantly from one another) were produced for each hour. Thus significant differences between values for one set of months and another were not demonstrated by the STP analysis. This apparent failure of the analysis was almost certainly owing to insufficient data, since, for accuracy, a minimum of ten samples must be analysed for each hour in every month.

FIG. 3: Time difference (mins) between the emergence of the first 10 or more baboons of 0 troop from night shelter and sunrise, March 1975 - February 1976. Time of local sunrise has been reduced for clarity to zero in the figure.



▪ represents one day's observation.

Negative time difference indicates baboons emerged before sunri

FIG. 4: Initial morning resting period between the time of O troop's emergence from night shelter and start of day-range, March 1975 - February 1976

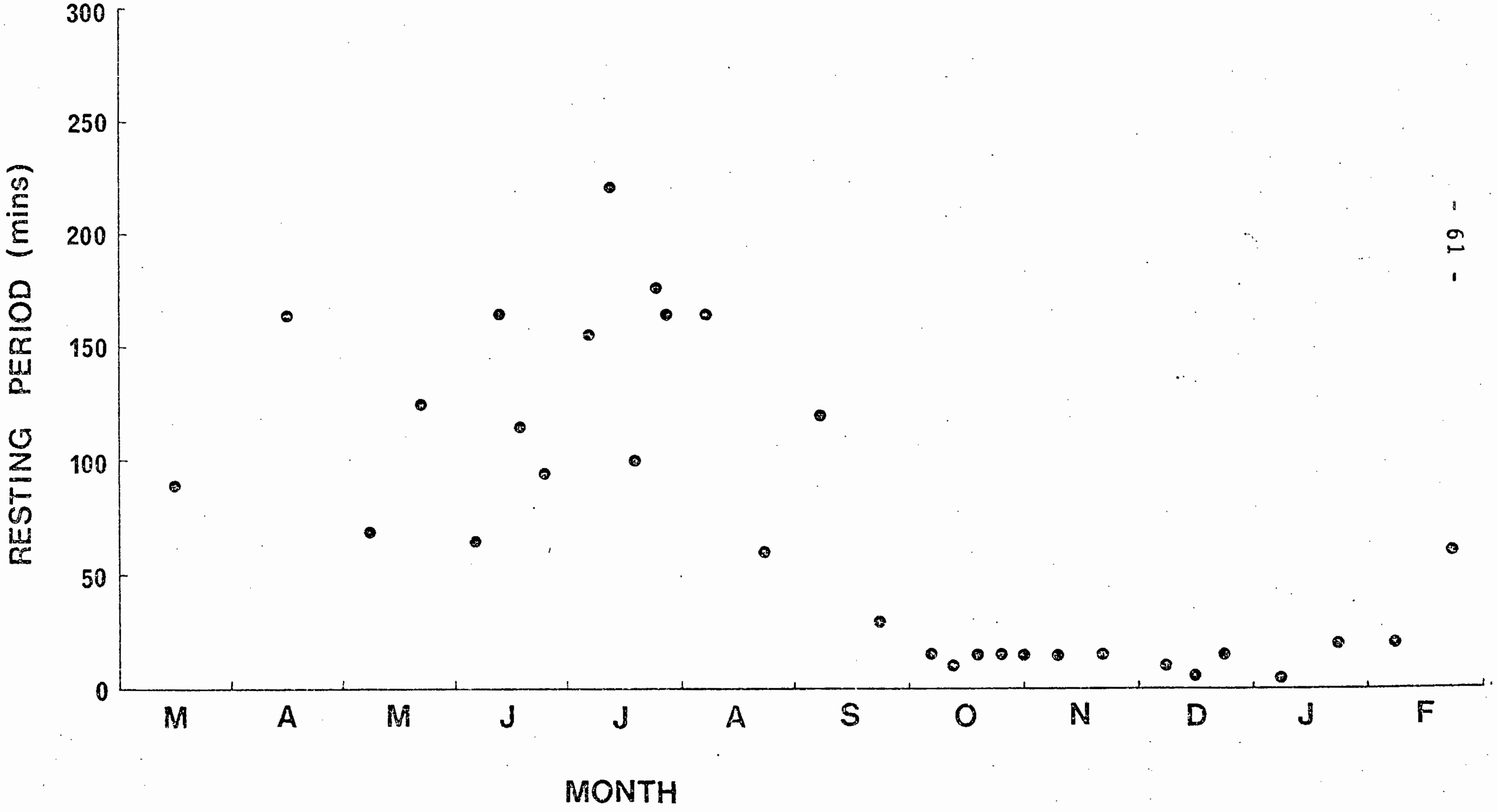


FIG. 5: Average diurnal variation in activities of 12 adult male chacma baboons in June 1975

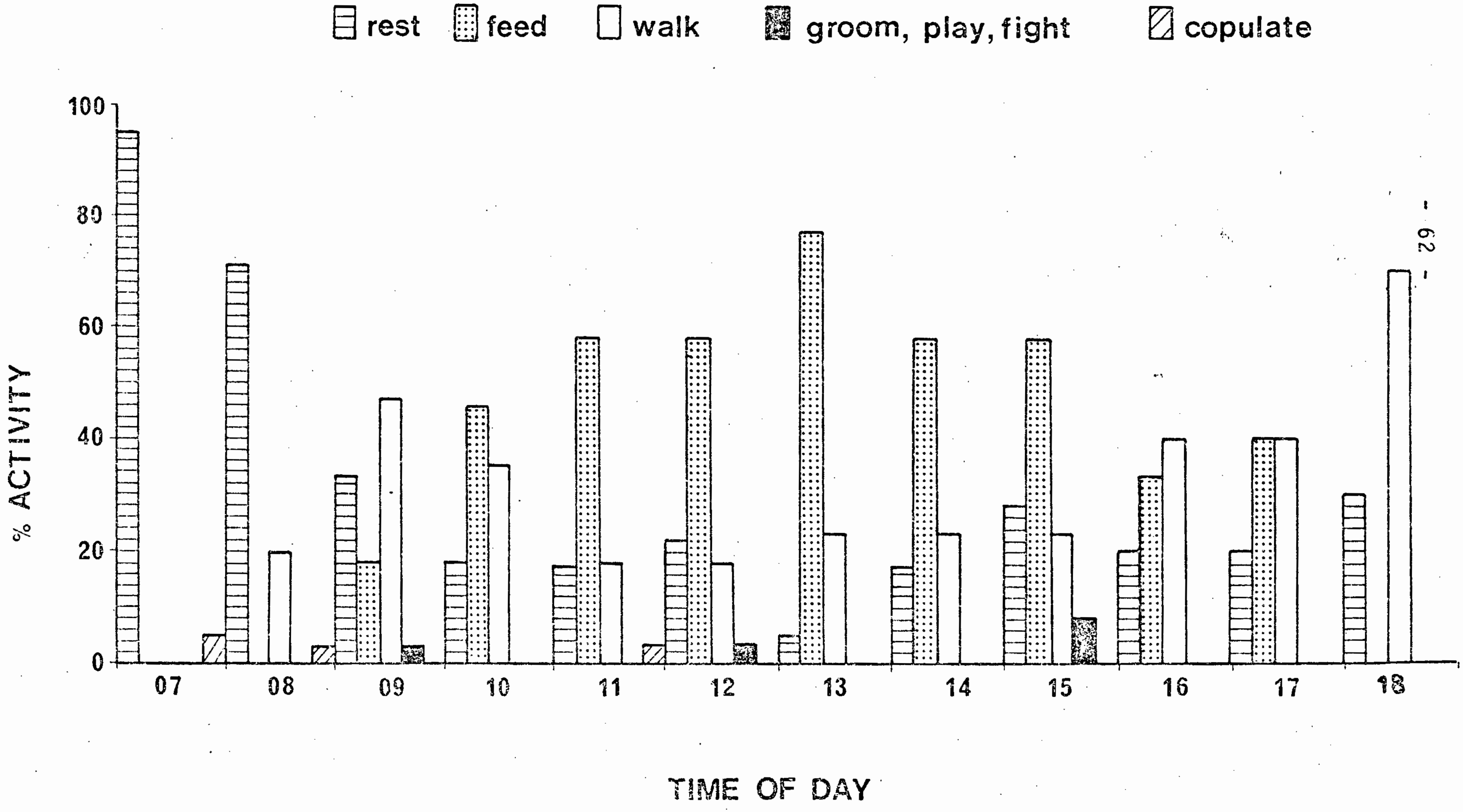


FIG. 6: Average diurnal variation in activities of 24 adult female chacma baboons in June 1975

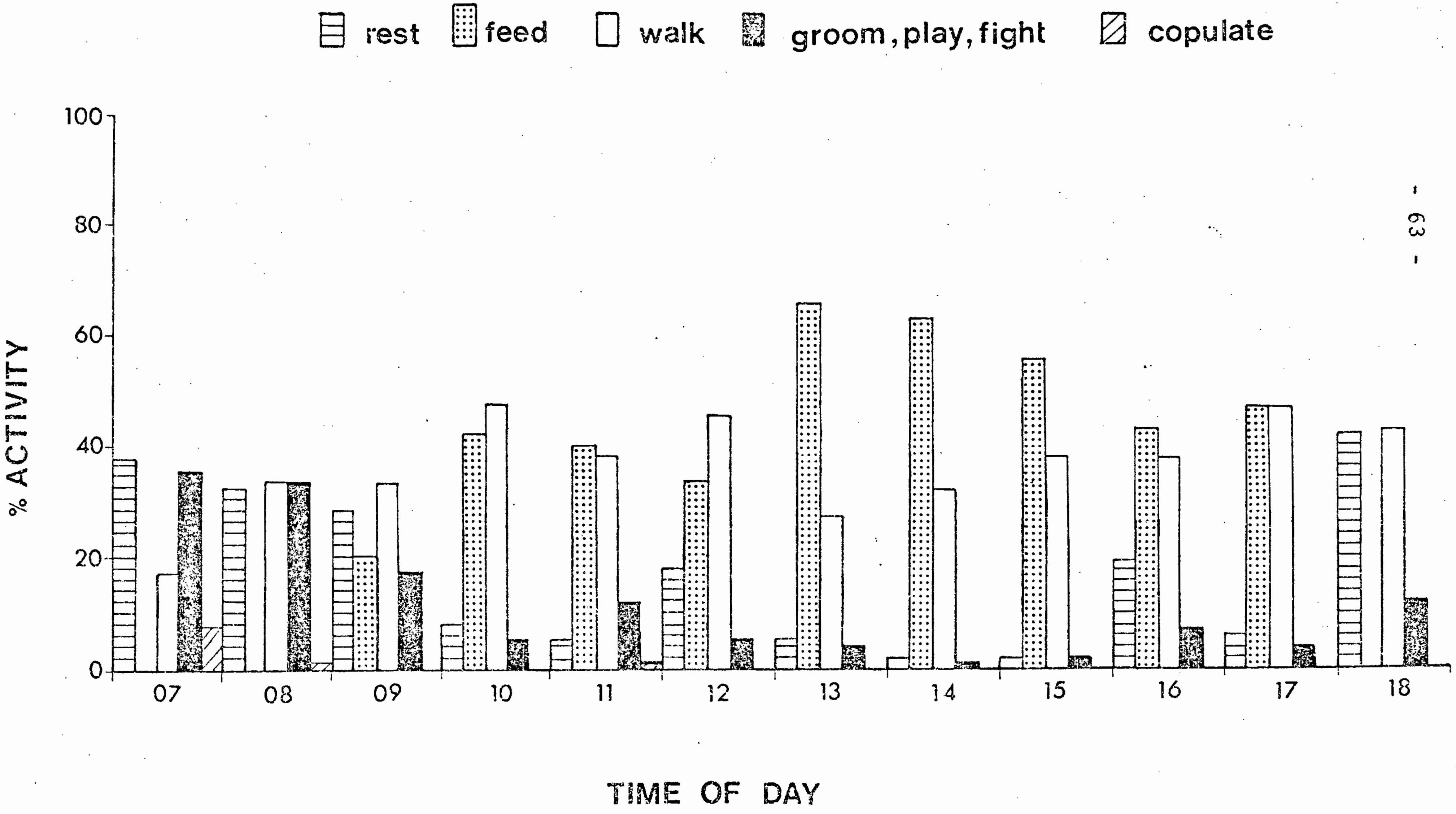


FIG. 7: Average diurnal variation in activities of 12 adult male chacma baboons in December 1975

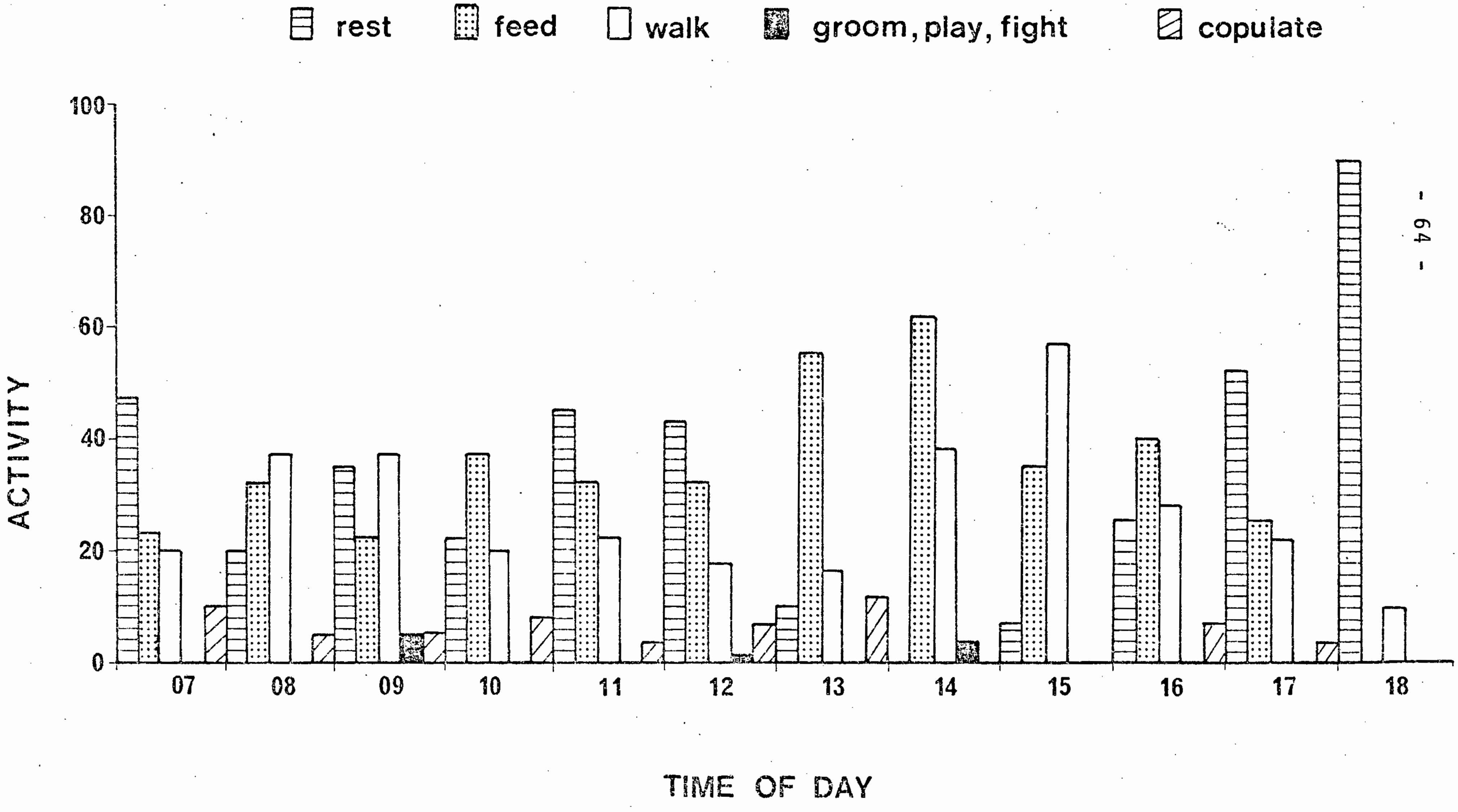


FIG. 8: Average diurnal variation in activities of 24 adult female chacma baboons in December 1975

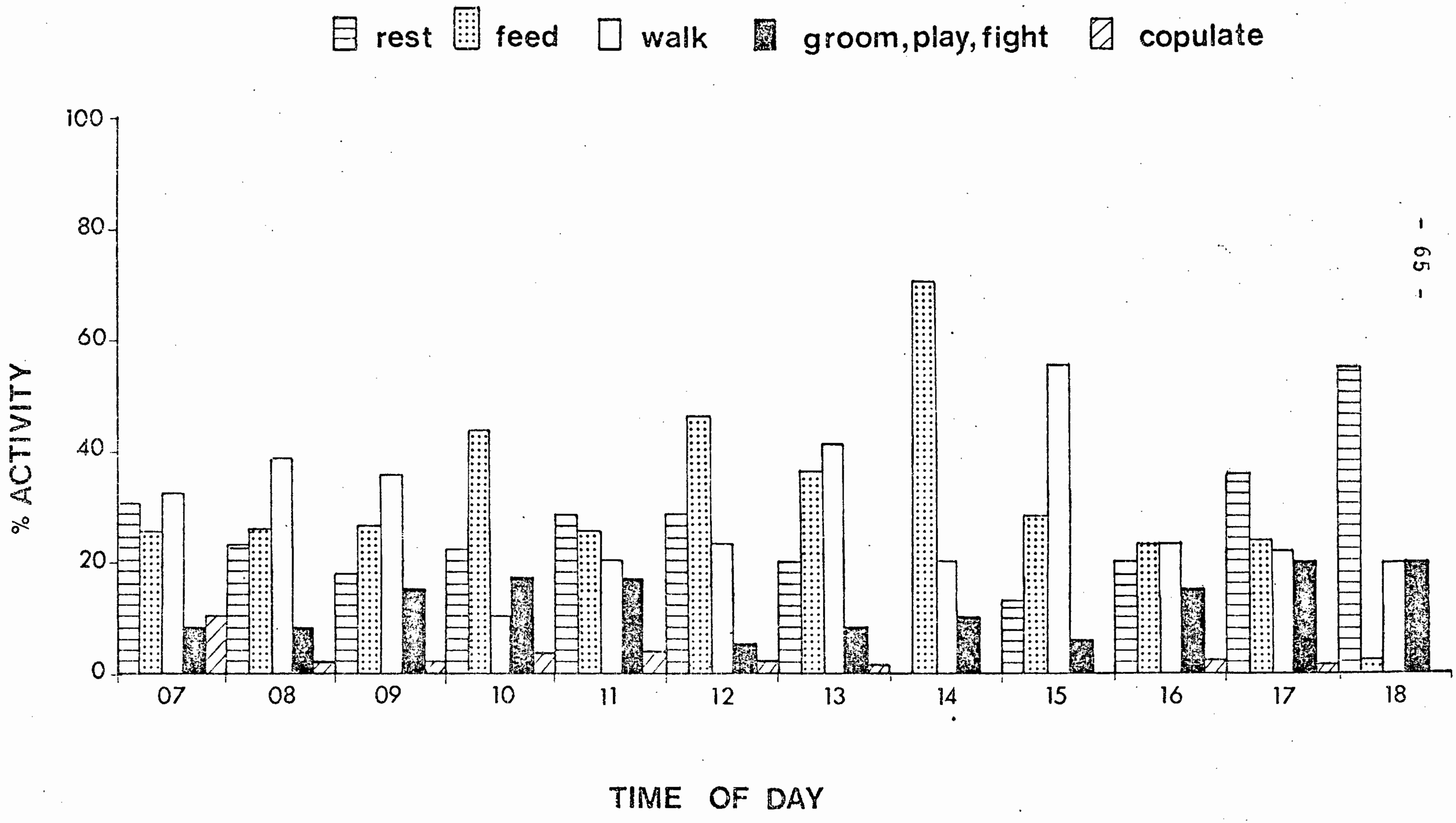


TABLE 10: Hours shown by STP analysis (page 47) to have monthly differences, significant at the probability level specified, in the number of minutes spent walking or feeding for three age and sex classes of chacma baboons in O troop, March 1975 - February 1976.

	level of significance					
	adult male		adult female		juvenile	
Hour	feed	walk	feed	walk	feed	walk
07h00	0,05		0,01		0,01	
08h00	0,01	0,01	0,01	0.10	0,10	0,10
09h00	0,05		0,05			
10h00		0,01	0,10			0,05
11h00		0,10	0,10	0,10		
12h00	0,05					
13h00	0,05					
14h00		0,10			0,10	
15h00	0,10					
16h00						
17h00			0,10		0,01	

Footnote: Each hour was compared, in this analysis, with the same hour for all other months, although the relation of each hour to sunrise changes throughout the year concommitantly with daylength (Table 6). It is usual, with animals whose activity appears to be regulated by time of sunrise and sunset, to compare activities occurring after the same number of hours following sunrise e.g. activities occurring at 07h00 in summer are compared with those at 09h00 in winter. However, activities of baboons appeared to be independent of sunrise (Fig. 3, page 58) and sunset (page 59) requiring that comparison be made of activities occurring in the same hour throughout the year.

Use of habitat

Home-range

The home-range of primates is that area normally occupied by an animal throughout its adult life (Jolly 1972). An area marked on a map as being the home-range of an animal is useful but misleading, since all parts of the range are not used equally (Rowell 1966). The part of the home-range habitually used for sleeping and feeding is termed the core area (Kaufmann 1962). This term is used here for that part of the home-range occupied by O troop for more than 50% of observation time.

The approximate annual home-range of O troop is shown in Figure 9. Each blocked grid represents at least one observed day-time occupation of that area by O troop during the study. The approximate minimum area of this home-range, enclosed by a line drawn around the outer occupied grids, is 3700 ha. The home-range was extended, in January 1976, to include a farm outside the northern boundary of the reserve. The area covered by this extension is not known and is not included in home-range data given here. Home-ranges reported for other troops in the reserve (Hall 1963) are 900 ha (N troop), 1470 ha (S troop) and 3370 ha (C troop). Troop size is linearly correlated with minimum home-range area in the reserve (Fig. 10). O troop's home-range is approximately twice the area of those reported for *Papio cynocephalus* (Altmann & Altmann 1970) and *P. anubis* (DeVore & Hall 1965) in savanna.

The grid-hour system (Rowell *op. cit.*) indicates the intensity of home-range use. Each daylight hour spent by O troop in a particular 350 x 350 m area of the reserve is represented by one dot in the corresponding map-grid (Fig. 11). It can be seen that the troop intensively used a relatively small part of its home-range. This core area is approximately 45 ha.

Home-range data for other troops in the reserve were collected from opportunistic personal observations and rangers' reports. The troop at Cape Point sleeps and forages throughout the year mainly near the car-park. The animals are adept at begging and stealing food from visitors. These baboons range only within boundaries prescribed for S troop (Hall *op. cit.*).

A troop within the home-range of C troop (Hall *op. cit.*) was encountered several times from September to February. The home-ranges of C and O troops overlap in the Hoek van Bobbejaan area (Fig. 2). There was no evidence of C troop's use of west-coast sleeping sites during the winter months. It has been suggested (Hesterman, pers. comm.) that the baboons of C troop are a summer breakaway group from N troop.

N troop (Hall *op. cit.*) ranges over the north-eastern sector of the reserve, as well as an undetermined area outside it. This home-range extends as far south as the Homestead restaurant. The baboons are seen frequently (up to four times a week) along the Smitswinkel Bay road, begging food from the public. There appears to be no overlap between N and O troops' home-ranges.

FIG. 9: Occupation of 350 m grid-squares by O troop, based on one or more daytime observations, March 1975 - February 1976

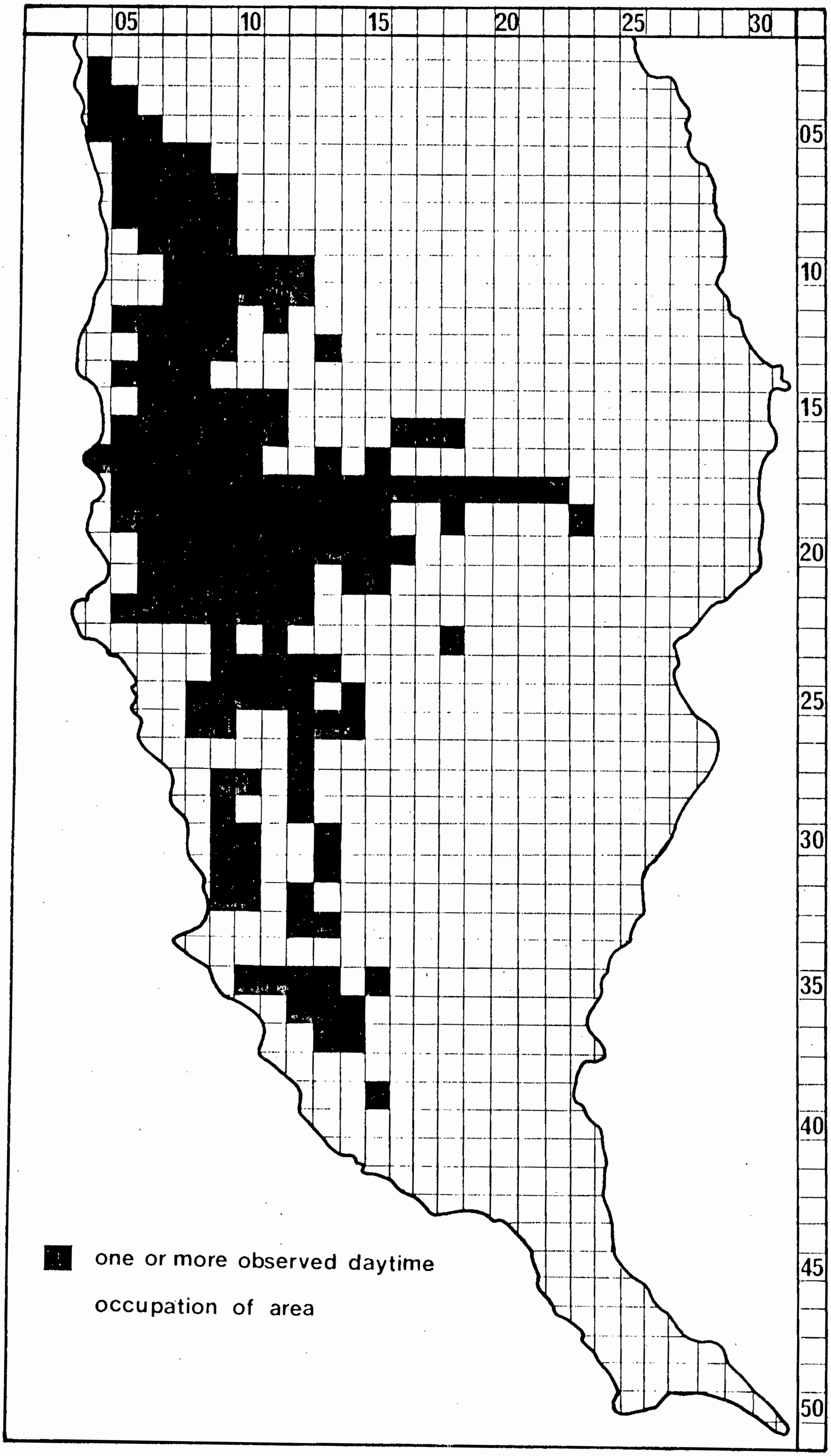


FIG. 10: Correlation between troop size and home-range area for four troops in the Cape of Good Hope Nature Reserve

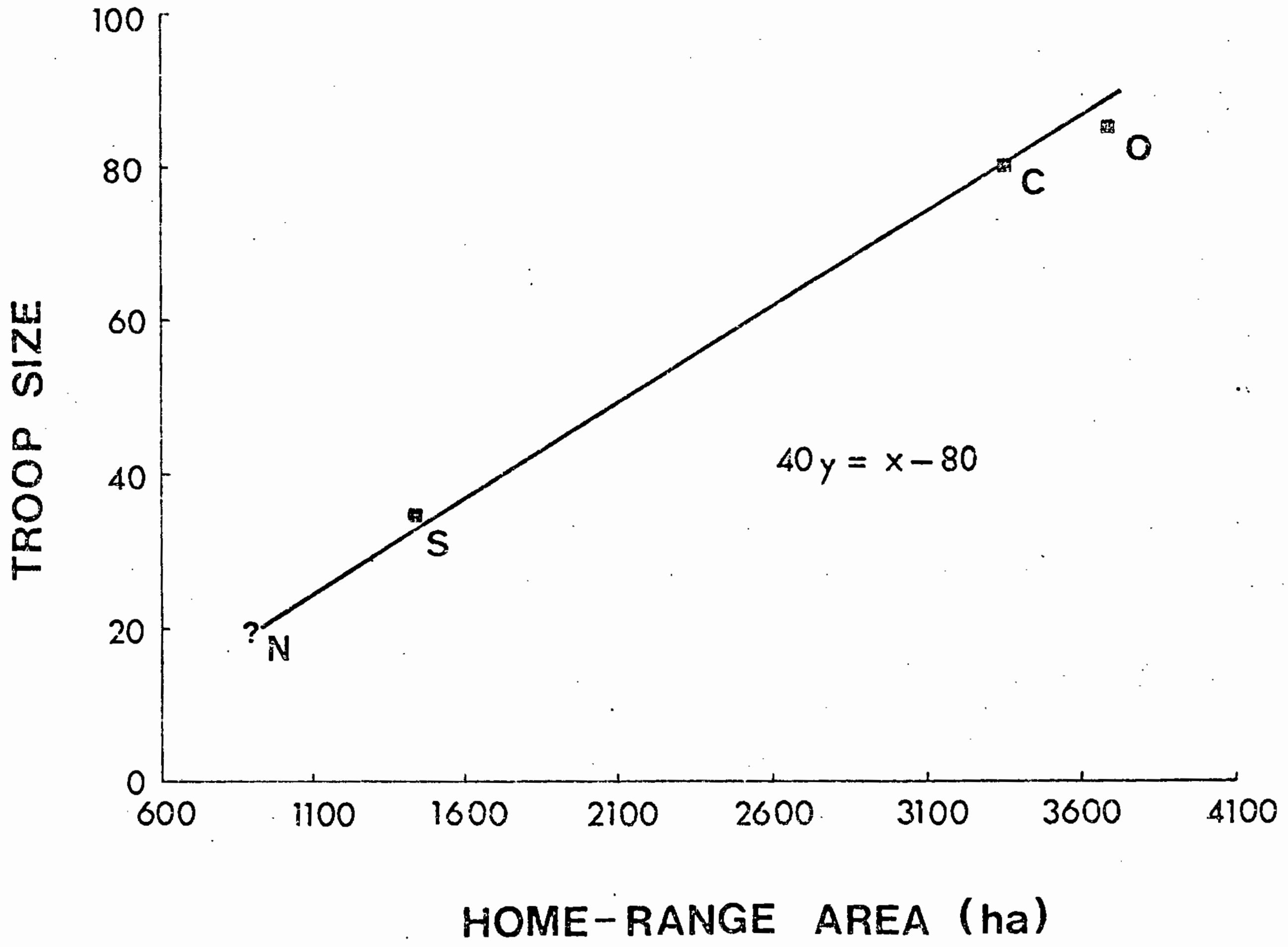
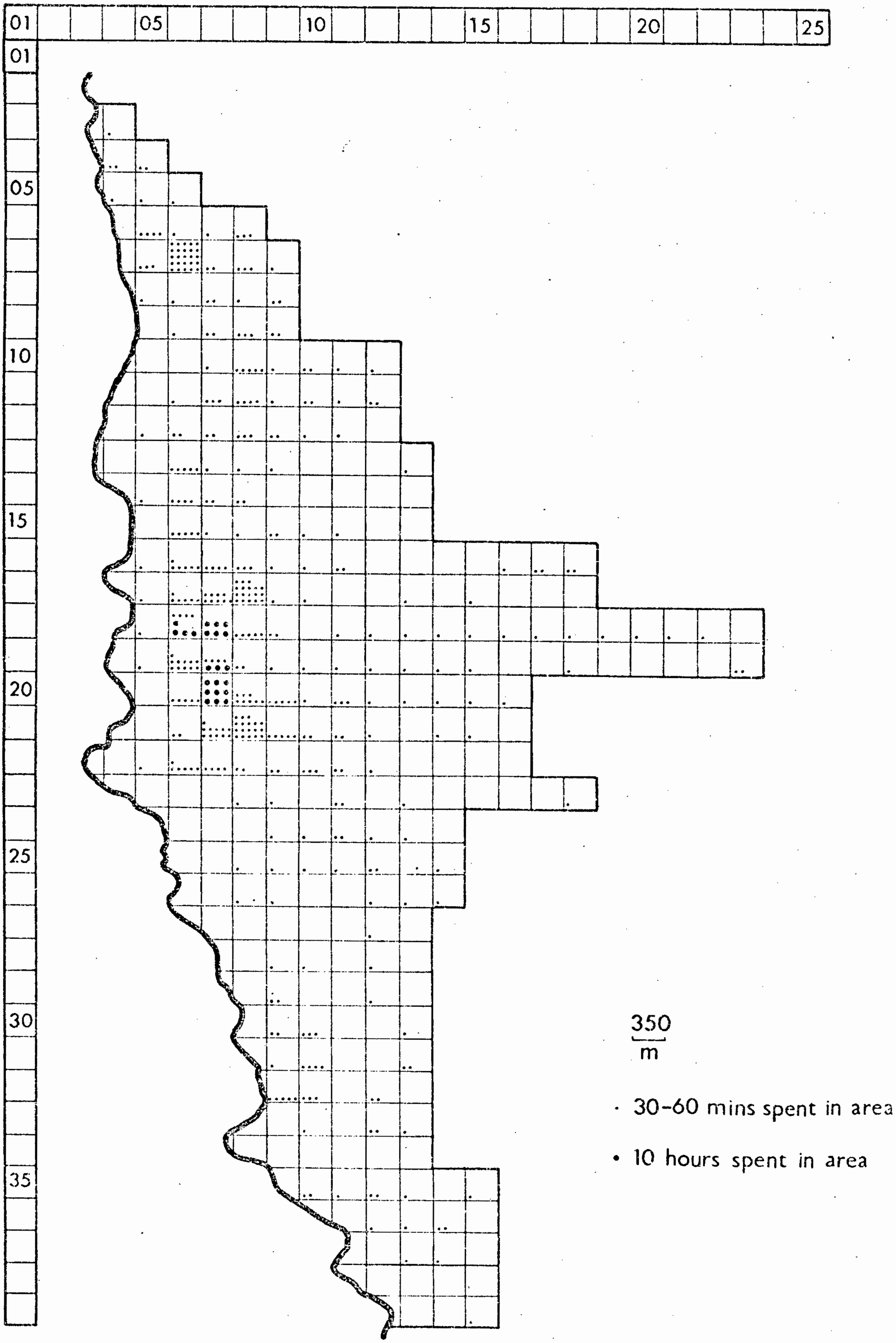


FIG. 11: Time spent observing O troop in 350 m grid-squares
March 1975 - February 1976



Range in relation to vegetation

Distribution of the six vegetation types within O troop's home-range is shown in Figure 12 and Table 11. Squared paper was overlaid on Taylor's (1969) vegetation map for the reserve of scale 1;36000. The vegetation type covering more than 50% of a 0,65 cm square on the map was taken as representative of that square. The large area covered by "Restionaceous Plateau Fynbos" is mainly an effect of a fire in March 1975 which burnt the majority of the north-western and north-central sectors of O troop's home-range. The percentage of monthly observation time spent by O troop in each vegetation type is given in Table 12.

The time spent by O troop in alien vegetation was remarkably high (Table 12). An average of 21% of all observation time was spent by the troop in the 5% of its home-range covered by alien vegetation. The proportion of time spent in Upland Mixed Fynbos was high in relation to the occurrence of this type (40% of observation time in 28% occurrence). Average percentage of time spent in Coastal/Dune Fynbos was roughly equivalent to the percentage of home-range covered by this vegetation type. Little time was spent in Restionaceous Plateau Fynbos and Restionaceous Tussock Marsh with respect to the percentage occurrence of these vegetation types.

Monthly changes in use of vegetation types can also be seen in Table 12. Foraging was the major daytime activity of baboons (page 102). It is therefore assumed here that use of vegetation types in the home-range was related to food availability.

More time was spent on average in Upland Mixed Fynbos from October to February, when inflorescences of *Leucospermum conocarpodendron* were maturing (Rourke 1972), than during the rest of the year (54% and 30% respectively). The greatest percentage of time spent in Restionaceous Plateau Fynbos was during March and April (immediately after the fire) and from July to October. The vegetation is rich in sprouting geophytes post-burn and during the winter period (Wicht 1945), and thus is apparently attractive to baboons. The reduced occupation of Restionaceous Plateau Fynbos areas in spring and summer (September-February) appeared to reflect the decrease in plant food potentially available to baboons after the winter flush had died. The most frequent occupation of areas of alien vegetation was in May and June. I observed that *Acacia cyclops* seeds dehisced during this period and were readily available on the ground. The troop occupied mainly Coastal/Dune Fynbos and Upland Mixed Fynbos areas in November and December, when *A. cyclops* was flowering and few seeds were available. The increase in occupation of Coastal/Dune Fynbos areas in November and December can possibly be related to the availability of berries of *Nylandtia spinosa* and other species. Beach areas were visited mainly in March and April. The infrequent occupation of the beach in other months was rarely for foraging purposes.

Possible sources of bias must be considered, since this discussion of home-range use is based on a time sample.

1. Observations were not evenly distributed throughout the day or month (Table 4).
2. Increasing knowledge of the troop meant that the baboons were sought most in places where they had previously been observed.
3. An effort was made not to "herd" the animals. "Herding" may have occurred occasionally but generally the baboons' behaviour did not suggest this.

Qualitative trends in gross use of home-range occupation are probably valid although, perhaps, too much attention should not be paid to the details.

FIG. 12: Distribution of vegetation types within O troop's home-range (from Taylor 1969)

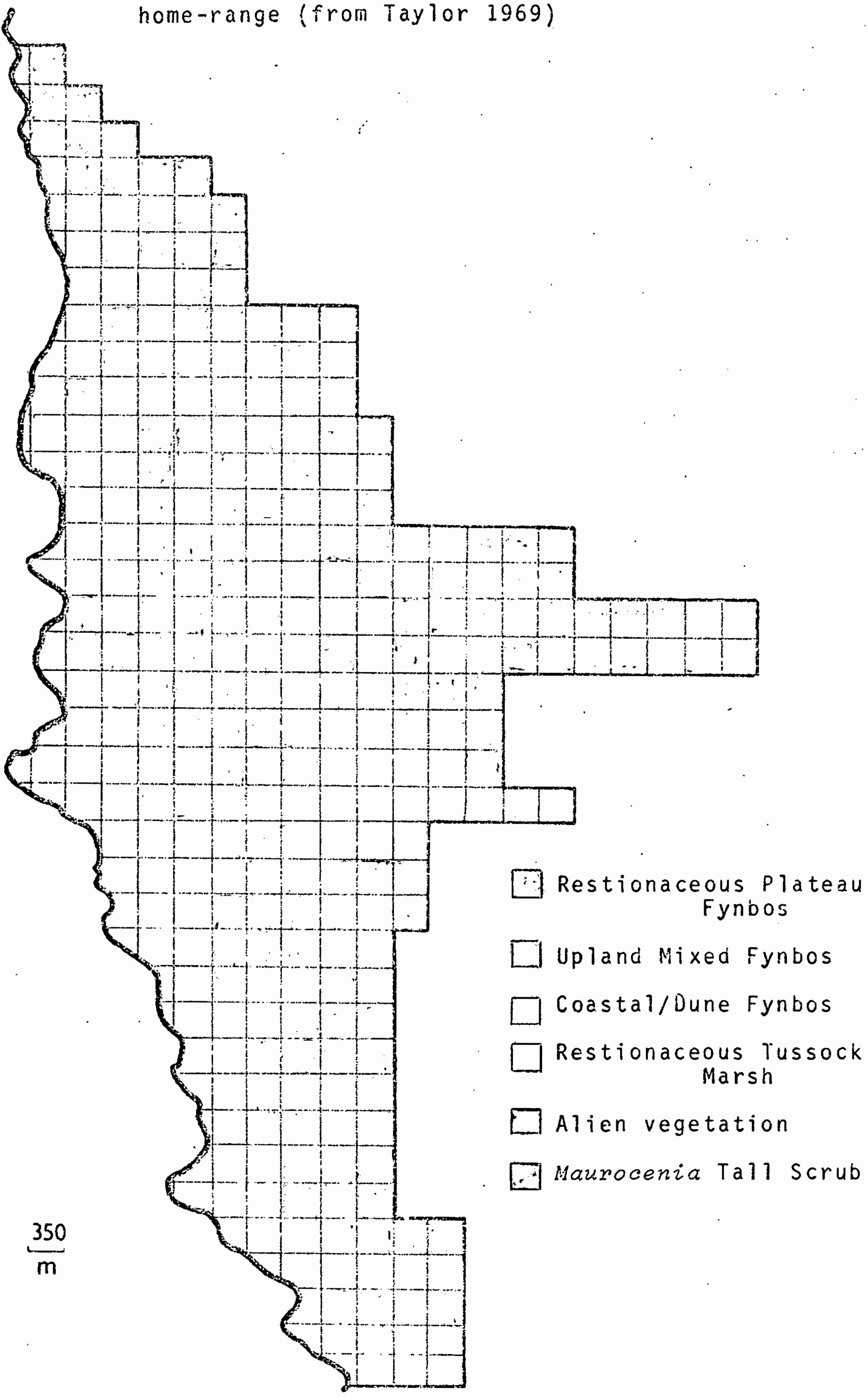


TABLE 11: Occurrence of vegetation types in O troop's home-range (from Taylor 1969)

Vegetation type	% occurrence in home-range	area within home-range (ha)
Upland Mixed Fynbos	28	1029
Restionaceous Plateau Fynbos	39	1445
Alien vegetation	5	183
Restionaceous Tussock Marsh	9	343
Coastal/Dune Fynbos	18	686
Maurocenia Tall Scrub	1	24

TABLE 12: Percentage observed monthly time spent by O troop in different vegetation types

	Vegetation type[1]							Number hours
Month	1	2	3	4	5	6	7	observation
March	15	10	29	4	20	1	20	45,0
April	17	15	33	2	25	2	6	89,5
May	31	6	44	0	15	0	4	79,0
June	37	2	48	0	11	0	1	41,5
July	42	14	12	0	27	0	5	42,5
Aug.	35	31	18	8	8	0	0	39,0
Sept.	34	4	20	0	34	7	1	37,0
Oct.	41	35	10	0	12	0	1	53,5
Nov.	43	1	5	0	48	0	3	31,5
Dec.	41	3	8	0	45	0	3	33,0
Jan.	80	4	12	0	4	0	0	12,5
Feb.	66	7	12	0	15	0	0	20,5
Average	40	11	21	1	22	1	4	

= 83% !

[1] Vegetation types:

1 Upland Mixed Fynbos
2 Restionaceous Plateau Fynbos
3 Alien vegetation
4 Restionaceous Tussock Marsh
5 Coastal/Dune Fynbos
6 *Maurocenia* Tall Scrub
7 Beach areas

Sleeping sites

Baboons sleep in the safest place available (DeVore & Hall 1965). Baboons in Rhodesia and Kenya usually sleep in tall trees (Hall 1963). Chacma baboons in montane areas of South Africa use the base, or face, of a steep cliff as a sleeping site (Hall *op. cit.*). Sleeping sites have a characteristic smell and are marked by an accumulation of dung (Stoltz & Saayman 1970).

O troop habitually uses cliff-faces for sleeping, as do other troops in the Cape of Good Hope Nature Reserve (Hall 1962a). However, I saw a small group (8-12 baboons) descend from wattle trees early one morning. The rest of the troop was sitting and lying on the sleeping cliff nearby. Other baboons in the reserve have been recorded emerging in the early morning from behind dense bushes at the base of a cliff (Hall 1963). Baboons of O troop were generally in the vicinity of a sleeping site by 16h00 throughout the year, and began climbing the cliff with the onset of darkness.

Nine separate sleeping sites (Fig. 13) were used by O troop on 114 nights from March 1975 to February 1976. "The number of sleeping sites used by a troop seems to be a direct function of the number of tall and spacious trees or of the extent of the steep cliffs available" (DeVore & Hall *op. cit.*). Three troops in the eastern Cape, reported by a farmer, each habitually used only one sleeping site (Hall 1963).

The observed frequency with which O troop's sleeping sites were used is shown in Table 13. The troop was not observed to use sleeping sites 7 and 8 (Fig. 13) until September 1975. However, old faeces at these sites indicated that the cliffs had been used previously by baboons. O troop had not been known to use the area containing site 9 prior to January 1976 (Wright pers. comm.). Use of this site appears to be linked to the extension of home-range (page 67). Sleeping site 4 (Fig. 13) was used most frequently (Table 13).

Sleeping sites for consecutive nights were recorded for 65 pairs of nights. The troop returned to the previous night's sleeping site on 29 of 65 days recorded. Consecutive nightly use of a site (two or more occasions) occurred most frequently from March to June, and at site 4 (23 of 29 days; 79%).

The frequency and constancy of use of sleeping site 4 supports the theory of a core area within the home-range (page 67).

FIG. 13: Location of O troop's sleeping sites

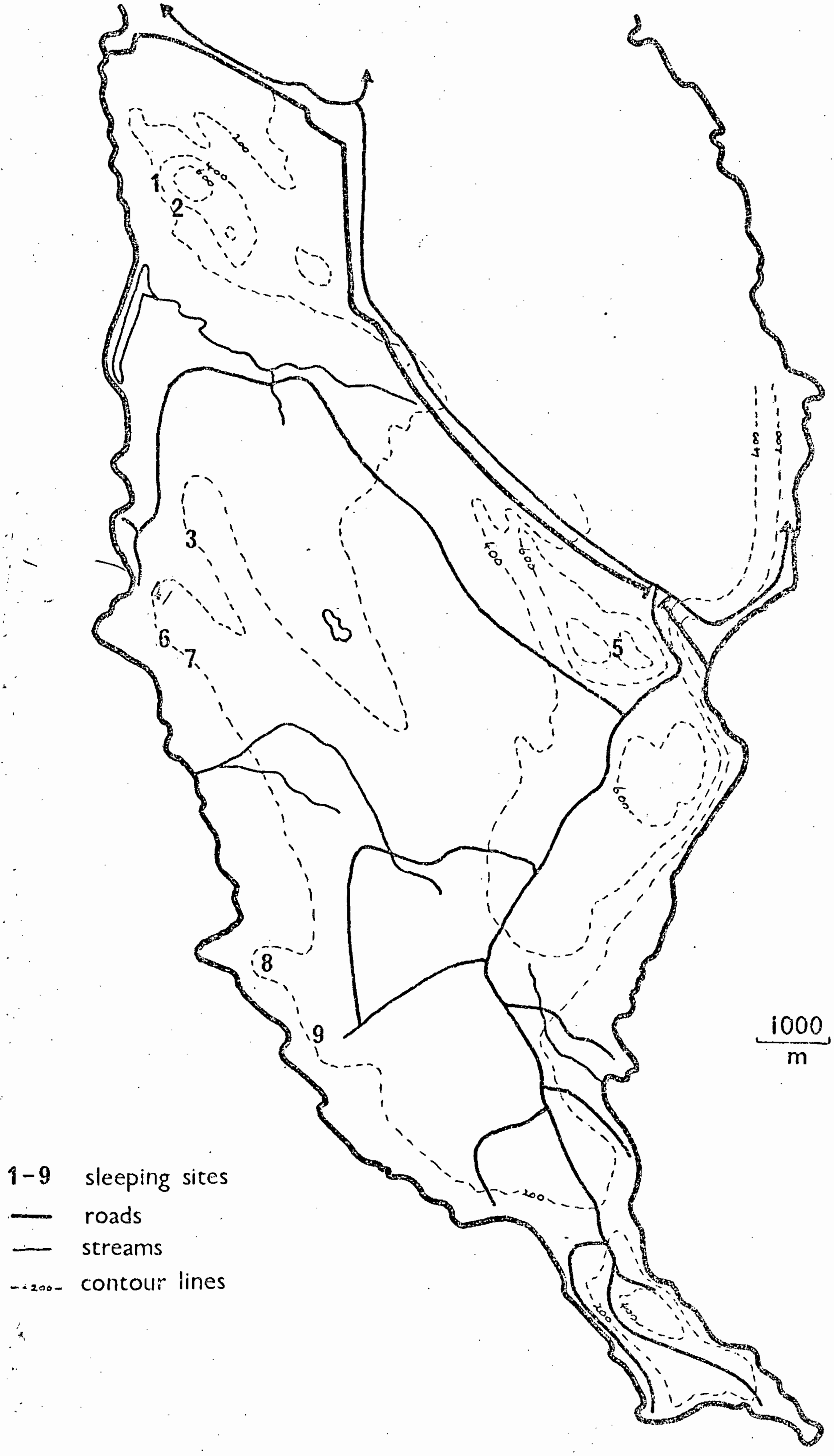


TABLE 13: Average use of sleeping sites for quarter-year periods. Values are percentages of total observation nights during each period

Period	sleeping site[1]									Total nights
	1	2	3	4	5	6	7	8	9	observation
March-May (autumn)	2	23	8	62	0	2	0	0	2	32
June-Aug. (winter)	5	12	3	64	0	7	0	0	8	28
Sept.-Nov.(spring)	2	24	4	25	6	13	5	12	10	32
Dec.-Feb. (summer)	0	0	7	70	19	0	0	0	4	18
				mean = 55%						

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[1] see Fig. 13

Troop movements

Temporal variation in walking

The average daily number of minutes spent walking ("walking time") by adult male, adult female and juvenile baboons of 0 troop is given in Appendices 1 to 3. "Walking time" was greatest during October to April for all three age and sex classes. However, there were significant differences between the mean "walking times" in this period for adult male, adult female and juvenile baboons (258, 307 and 199 minutes respectively) (adults: $t=3,15 \quad p<0,005$; adult male and juvenile: $t=16,39 \quad p<0,0005$; adult female and juvenile: $t=7,11 \quad p<0,0005$). This indicates that juvenile baboons spent approximately 30% less time walking than did adults. It is possible that the observed difference in "walking time" between adult and juvenile baboons was an artefact of differences in frequency of sighting of the two age and sex classes (page 48). Alternatively, juvenile baboons may have fed without moving for longer periods of time, and hence foraged over a relatively smaller area, than adult baboons. Temporal variation in "walking time" is discussed further under "foraging" (page 102).

Day-range

Day-range is the average distance travelled by a troop in one day (Jolly 1972). Figure 14 shows 51 dawn to dusk day-ranges of O troop. The mean was 7,9 km (range 3,0-13,8 km). Mean day-ranges previously reported for *Papio ursinus* were 4,8 km (Hall 1962a) and 8,0 km (Stoltz & Saayman 1970). According to DeVore & Hall (1965): "Studies in southern Africa, Kenya and on hamadryas in Ethiopia all indicate the average distance travelled by baboons during a day is three miles (4,8 km) ... The distance the group or any individual baboon actually walks is much greater, since feeding activity is meandering."

Data on day-ranges were arranged into five periods each embracing ten observations (Table 14). Differences between successive periods were significant ($0{,}05 < p < 0{,}1$), except for the pair 17 March-5 May and 6 May-24 June ($p > 0{,}1$). Maximum average day-ranges of O troop occurred in the summer period 4 November-3 February (Table 14). These were significantly longer than the average day-ranges in the winter period 6 May-24 June ($t = 4{,}61$; $p < 0{,}01$), and do not agree with Hall's (1962a) findings for other troops in the reserve, whose longest day-ranges occurred in winter. No seasonal variation in day-range was found for *Papio ursinus* in the Transvaal (Stoltz & Saayman *op. cit.*) or for *P. cynocephalus* in Kenya (Altmann & Altmann 1970).

Forty-two individual day-ranges of O troop were plotted against maximum daily air temperatures (Fig. 14). The relationship was assessed by the Pearson product-moment coefficient of correlation (Roscoe 1969). There was no correlation between the two variables ($r=0,16 \quad p>0,05$). However, other baboon troops in the reserve were found to travel farthest on cool winter days (Hall *op. cit.*). Stoltz & Saayman (*op. cit.*) found a negative correlation ($r=-0,05 \quad p<0,01$) for troops in the Transvaal and concluded, "baboons in the study area, therefore, tended to travel farther on cooler days."

Day-ranges which involved 0 troop returning to the sleeping site used the previous night (Fig. 14) were significantly shorter ($t=4,25 \quad p<0,01$) than those in which different sleeping sites were used. This agrees with findings for other troops in the reserve (Hall *op. cit.*).

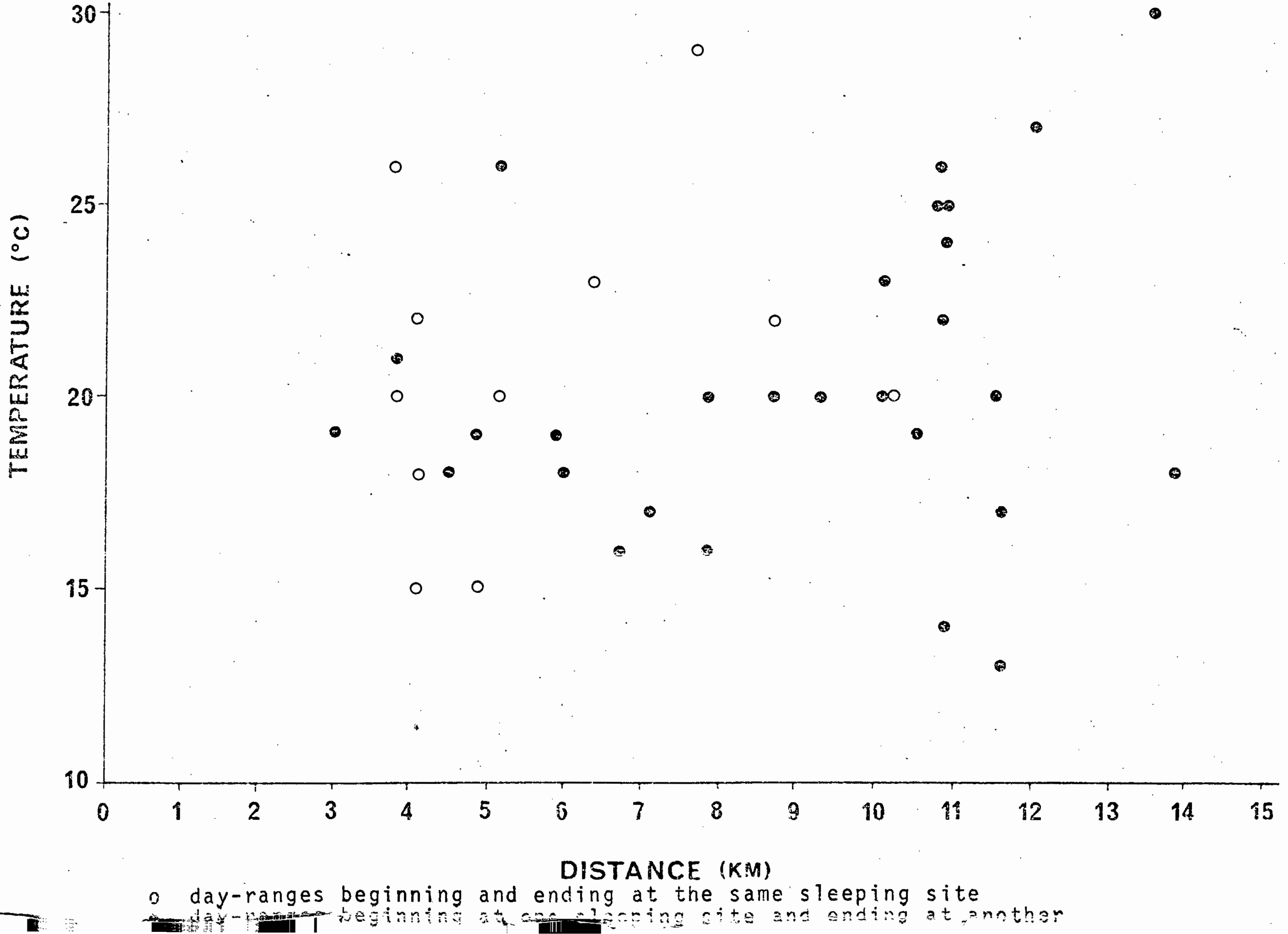
TABLE 14: Mean day-ranges (km) of 0 troop March 1975-February 1976

Period	Mean	S.D.	Range	Number day-ranges
17 March-5 May	8,1	± 14,4	3,0-13,5	10
6 May-24 June	5,2	± 4,1	3,7-10,1	10
25 June-20 Aug.	7,6	± 6,1	4,5-10,8	10
8 Sept.-28 Oct.	9,3	± 8,7	4,8-13,8	10
4 Nov.-3 Feb.	9,4	± 4,2	5,9-11,5	10

?

x

FIG. 14: Correlation between daily maximum temperature and maximum distance walked by O troop, March 1975 - February 1976.



Foraging formation

Papio species in East Africa have been reported to walk and forage in clearly defined formations (Hall & DeVore 1965; Altmann & Altmann 1970). These formations provide maximum protection for lactating females and younger baboons in the company of dominant males at the centre of the troop. Sub-adult and adult males provide a defensive phalanx around the troop. Dominant male baboons in Kenya were reported to interpose between the troop and a source of danger (Hall & DeVore *op. cit.*). This defensive behaviour is thought to be an anti-predator adaptation in an open savannah habitat (Kummer 1968).

I did not observe clearly defined formations in O troop. This agrees with previous observations on *Papio ursinus* in the Transvaal (Stoltz & Saayman 1970).

My casual observations provided the impression that baboons of O troop moved independently of one another while foraging arboreally in *Acacia cyclops* thickets. Three or more feeding individuals grouped, apparently at random, at concentrations of food on the ground. This occurred, for instance, where piles of *A. cyclops* branches had been burnt, leaving a concentration of seeds. Individuals appeared to leave and join the groups haphazardly.

The troop foraged over the relatively open plateau of the reserve in the form of a ragged line, up to 0,5 km long, perpendicular to the direction of progression. Individuals formed temporary groups at concentrations of food, for instance, in protea bushes. I did not observe sentinel behaviour (*sensu* Hall 1960) during this type of foraging.

The foraging formation was not as randomly constructed as first appeared. It was possible to split the formation into several recurring groups as I became more familiar with the baboons. It was difficult to verify the constancy of these groups since positive identification of most individuals was impossible. The most frequent group appeared to comprise an adult male and two to five adult females (with or without infants) accompanied by five to ten juveniles. Such adult males were generally the largest in the troop. Similar "family" groups have been reported for *P. anubis* (Strum 1975). All juveniles not part of a "family" group formed another group with which an adult male was loosely associated. Sub-adult, and a few adult, males appeared to be largely independent of groups within the troop.

Baboons of O troop sometimes moved rapidly in ragged single file. The "family" and other groups were fairly obvious at these times, often separated from one another by several metres. This formation has been recorded for other *Papio* species moving to a feeding area (Altmann & Altmann 1970; Stoltz & Saayman 1970).

Feeding

Temporal variation in feeding

The average daily number of minutes spent feeding ("feeding time") by adult male, adult female and juvenile baboons of O troop is given in Appendices 1 to 3. "Feeding time" was greatest during August to January for all three age and sex classes. There was no significant difference ($t=0,29$ $p > 0,1$) in this period between mean "feeding time" for adult male and adult female baboons (332, 324 minutes respectively). Mean "feeding time" for juveniles, however, was significantly greater than that for each of the adult classes ($t=4,44$ $p < 0,005$; $t=10,57$ $p < 0,0005$). Temporal variation in "feeding time" is discussed further under "foraging" (page 102).

Why 'appendices'?

Plant food

A list of 77 plant species is given in Appendix 4, including only species identified from specimens seen to be eaten by baboons. The species are listed alphabetically within categories describing the part of plant eaten. The list does not include 41 species recorded by Hall (1962a). One hundred and fourteen plant species are taken up in a combination of Hall's records and my observations (Appendix 5). Almost the entire diet (approximately 95%) of baboons of 0 troop consisted of plant food throughout the year.

Animal food

The mainly herbivorous diet of O troop was supplemented by animal food. Grasshoppers (Orthoptera) appeared to be the chief item in this category. They were taken on the ground or chased and sometimes caught in mid-air. Ants (Formicoidea) were infrequently eaten, usually by picking up 6 to 12 individually between thumb and forefinger. Bark was sometimes prised loose from a tree and the exposed insects picked up with the tongue. Similar behaviour has been recorded for S troop (Hall 1962a). These food items all appeared to be taken opportunistically.

O troop was observed feeding in the marine littoral zone at low tide on several occasions during the study. It was impossible to identify all food items taken, but one shellfish, the common limpet *Patella granularis* was confirmed. The baboons lifted clumps of beach-stranded kelp (*Ecklonia* spp, *Laminaria* spp) with one hand and made restricted grabbing movements with the other hand. It seems likely that small crustaceans are collected in this way. Crabs (*Cyclopgrapsus punctatus* and *Plagusia chabrus*), sandhoppers (*Talorchestia*) and sea-lice (Isopoda) have been identified from the faeces of other troops in the reserve (Hall *op. cit.*). Juvenile baboons on one occasion picked up eggs of an oyster-catcher (*Haemantopus* sp) and played with them. The undamaged eggs were later discarded (Marais, pers. comm.).

None of the baboons was seen eating scorpions (*Opisthophthalmus* and *Uroplectes*), although each overturned one to ten stones a day. No scorpions were found under 30 stones that I overturned at random.

A large insect larva was seen lying undamaged at the bottom of a hole dug by a baboon a few minutes earlier. An eagle owl (*Bubo*), feeding on a freshly killed bird, was disturbed by the troop. The discarded bird was ignored by all but a few juvenile baboons. These approached the carcass suspiciously and sniffed it, but did not attempt to eat it. Baboons in the reserve have not been recorded hunting or eating any mammals. No mammalian remains were found in 54 *Papio ursinus* stomachs collected over a year from the Loskop Dam area (Moolman & Breytenbach 1976). "Our 1959 observations indicated that the carnivorous tendencies of baboons have often been overestimated" (DeVore & Hall 1965).

Mineral supplements

I observed individuals of all age and sex classes at the coast drinking brackish water in pools just above the high-water mark. This behaviour was also reported for other troops in the reserve (Hall 1962a).

Adult male baboons (and, once, a juvenile) ate small handfuls of ferricrete on four occasions. The ferricrete was taken from the treated surface of dirt roads and from a pile of road-surfacing deposited at Olifantsbos. S troop has previously been reported eating white clay (Hall 1962a & 1963). "Large clods of earth without any roots or bulbs" were found in *Papio ursinus* stomachs collected in the Transvaal (Loskop Dam) in February (Moolman & Breytenbach 1976). These authors concluded that, "soil eating might be the result of the absence of an essential mineral or trace element."

Feeding techniques

I observed that baboons processed most plant and animal food items before ingesting them. The opposable thumb and general manual dexterity enabled the baboons to be highly selective of plant parts. Food value per unit weight of intake is presumably thus increased.

A few examples of baboon feeding techniques that I observed are given here to illustrate manual dexterity and selective feeding.

1. *Acacia cyclops*

Baboons, particularly juveniles, sometimes foraged in the branches of *Acacia cyclops* trees. Seeds (with or without aril) were removed, using the thumb and forefinger, from pods still attached to the branch. Alternatively, the pod was broken off and run between the lips. The seeds were removed by the lips and tongue. The more frequent method of seed collection was from the ground (Hall 1962a). The animals sat under *A. cyclops* trees and swept from median outwards with one or both hands to move aside the tree litter. Exposed seeds were picked up between thumb and forefinger of one or both hands at a rate of roughly one per second (Table 15). The seeds were conveyed individually to the mouth where they were either chewed or stored in the cheek pouches. A cracking sound was audible at 5 m when seeds were chewed.

2. Restionaceae

Seeds appeared to be the only restionaceous plant part eaten. A baboon sat or, less frequently, stood beside a tuft of a seeding plant (e.g. *Hypodiscus aristatus*, *Willdenowia lucaeana*). Individual stems were grasped by one hand, or each hand alternately, and bent towards the mouth. The seed was bitten out of the inflorescence and the stem released. I observed that a baboon took only four to eight seeds from a tuft, though each tuft may have been visited by more than one baboon.

3. Underground storage organs of plants

The cues for location of these food items are not known. It is possible that an aerial part of the plant must be present to attract a baboon's attention. Baboons sat in most cases while excavating bulbs and corms. Both hands were used to dig away soil from around the storage organ, producing a hole about 15 cm deep and 10 cm wide. The storage organ was then pulled out, sometimes with the aid of the aerial part of the plant. The storage organ was usually brushed against the forearm or rubbed between the hands to remove adhering soil. The whole underground storage organ of plants such as *Albuca* and *Gladiolus* was eaten, although occasionally the outermost covering was discarded. Corms with fibrous covering (*Wachendorfia*) were bitten in half and the contents removed using the teeth and hands.

4. Marine shellfish

The only identified marine shellfish species eaten by O troop was the limpet *Patella granularis* (about 5 cm in diameter). Baboons used their premolar and molar teeth to break off the apex of the shell while the limpet was attached to a rock on the beach. The contents of the severed apex were scooped out using the tongue. The portion of limpet still adhering to the rock (the muscular "foot") and remaining shell were ignored. Limpets wholly detached from the rock were discarded.

5. Protea inflorescences

Baboons of all age and sex classes plucked entire protea (generally *Leucospermum conocarpodendron*) inflorescences, reaching up to them from the ground or while climbing in the shrubs. A baboon sometimes carried an inflorescence to a nearby rock before dealing with it. Young green inflorescences were most frequently taken. Discarded young inflorescences of *L. conocarpodendron* and *Protea cynaroides*, which I examined, showed that only a small portion was eaten. These inflorescences had been broken off from the peduncle to expose the pithy base of the capitulum, which was then hollowed out from the intact head. The baboons generally pulled (using either hands or mouth) a bunch of flowers from open, mature involucral cups and ate the base of the flowers (ovaries? nectar?), discarding the rest. Occasionally I saw a baboon break open an old dried head, possibly to obtain insects rather than seeds.

TABLE 15: Rate of *Acacia cyclops* seed consumption by chacma baboons, March - May 1975

	No. seeds consumed	No. secs feeding	Average no. seeds consumed/sec.
Adult male	60	60	1,0
" "	34	34	1,0
" "	27	36	0,7
" "	24	25	1,0
" "	44	39	1,1
" "	60	53	1,1
" "	63	60	1,0
" "	29	20	1,4
Adult female	25	37	0,7
" "	17	22	0,8
Juvenile	26	60	0,4
"	22	22	1,0
"	11	21	0,5
"	30	45	0,7
Total	472	534	0,9

Temporal variation in diet

The number of hours in a month spent by baboons of O troop feeding on each food item was calculated from data on "predominant food eaten" (page 45). These values were expressed as a percentage of the total number of observation hours in that month (Table 16) to give the relative importance of various food items in the diet.

Acacia cyclops seeds featured in the diet of all the baboons throughout the year, although the seeds were of minor importance in August (Table 16). *A. cyclops* seeds were the most frequently taken food item during April to June, and during December and February. Exotic *Acacia* species seeds were the "commonest" items taken by other troops in the reserve during May to July, and during November to March (Hall 1962a). Analyses of stomach contents of *Papio ursinus* in Transvaal savanna (Loskop Dam area) showed that indigenous *Acacia* seeds were consumed at the end of the dry season (July and August, Moolman & Breytenbach 1976).

"Underground storage organs" of plants were the predominant food items taken by baboons of O troop during July to November, and were second in importance in late summer to early winter (January-June, with the exception of March, Table 16). This contrasted with the diet of *P. ursinus* in the Loskop Dam area, which included only a small percentage (0,1-10,0%) of "roots and bulbs", taken only during August to October and during January and April (Moolman & Breytenbach *op. cit.*). This difference in diet, between Cape Peninsula and Transvaal baboons, might be related to the greater relative abundance of geophytes in fynbos compared with savanna.

"Grass" (soft, green herbs, mainly of Gramineae) was taken by baboons of O troop in the rainy season (May-October, Table 16). Baboon stomachs from the Loskop Dam area at the start of the summer rains (late August-October) also contained "blades of green grass" (Moolman & Breytenbach *op. cit.*).

Inflorescences of *Leucospermum conocarpodendron* were eaten frequently by baboons of O troop from late spring to early autumn (November-March, Table 16). Hall (*op. cit.*) reported other troops in the reserve taking inflorescences of *L. conocarpodendron* during July to April and inflorescences of *Protea lepidocarpodendron* during April to June. Thus it appears that other troops in the reserve utilized parts of Proteaceous plants throughout the year. Members of the Proteaceae are an insignificant part of Transvaal savanna vegetation (Acocks 1975). However, "Monocotyledon stems" and "Dicotyledon stems and bark" (Moolman & Breytenbach *op. cit.*) are food items of similar woody composition and low energy-content to inflorescences of Proteaceous plants. "Stems and bark" were found in baboon stomachs from Loskop Dam for all the months sampled (April-February, with the exceptions of November and December, Moolman & Breytenbach *op. cit.*).

I observed baboons of O troop eating small quantities of marine shellfish in autumn (March-May) and during August to January, with the exceptions of October and November (Table

16). Moolman & Breytenbach (*op. cit.*) recorded, for *Papio ursinus* in the Loskop Dam area, that "invertebrates were present in all the [stomach] samples throughout the year."

In summary, baboons of O troop utilized *Acacia cyclops* seeds throughout the year and Proteaceous inflorescences in the dry summer months. "Underground storage organs" of plants were taken in the winter, when rain induced germination. The baboons utilized the abundant, tender "grass" that grew at the onset of winter rains. Marine shellfish were eaten mainly in the dry season.

Care must be taken when comparing temporal variation in the diets of *Papio ursinus* from different areas. The Cape Peninsula has a winter rainfall (page 20), whereas most of the remainder of the distributional range for *P. ursinus* receives rain mainly in the summer. Thus, food plants of ecological equivalence are potentially available to baboons at different times of the year in the two climatic zones. For instance, grass was eaten by baboons in the Cape Peninsula and Loskop Dam area in different months (May-October and late August-October respectively). Inclusion of grass in the diet, however, coincided with the rainy season in both areas.

TABLE 16: Percentage time spent by baboons of O troop feeding on various food items March 1975-Feb.1976

Food item	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Acacia cyclops seeds	18	82	48	37	9	17	14	4	19	39	30	30
"Underground storage organs"	19	7	19	20	36	24	54	50	35	12	0	20
Proteaceous inflorescences	5	3	2	4	0	0	0	4	22	20	55	19
Grass	0	0	9	22	38	6	30	4	0	0	0	0
Restionaceae seeds	0	0	0	0	0	27	0	30	4	0	10	0
Berries	0	2	2	0	0	5	0	8	11	12	0	25
Pinus seeds	51	0	2	0	2	0	0	0	0	0	0	0
Carpobrotus	0	0	0	0	0	0	0	7	9	12	5	6
Twiner	0	0	16	14	3	0	1	0	0	0	0	0
Arctotis	0	0	0	2	11	20	0	0	0	0	0	0
Marine shellfish	5	2	1	1	1	1	1	0	0	4	0	0
Acorns of *Quercus robur*	2	3	0	0	0	0	0	0	0	0	0	0
No. hours observation	60	74	25	28	20	21	23	29	33	30	12	14

Foraging

O troop generally ranged over a wide area each day while searching for food (page 62). The activities collectively defined as "walking" (page 43) were therefore considered as part of a wider category, viz. "foraging". Selection, manipulation, preparation and ingestion of food items ("feeding") were also categorized as "foraging". Monthly "foraging time", defined here as the sum of time spent "walking" and "feeding" (Appendices 1-3), for adult male, adult female and juvenile baboons of O troop, is shown in Figure 15. There appeared to be no consistent difference in foraging time between the three age and sex classes for each month.

Foraging time for the troop would be the same for all months, if the nutritive value and abundance of food potentially available to baboons in the reserve remained constant throughout the year. However, Figure 15 shows that foraging time increased from June to November, i.e. concomitantly with increasing day-length. This increase in foraging time could have been due to an increase in time spent walking, feeding, or in both activities proportionately. Feeding time for three age and sex classes (adult male, adult female and juvenile) was expressed as a percentage of the foraging time for each month to determine which of the two activities more affected foraging time.

Figure 16 shows that the three age and sex classes devoted similar proportions of time to feeding in each month.

The feeding component of foraging increased for all three age and sex classes from May to September (Fig. 16), indicating a relatively large intake of freely-available food. This suggests that the nutritive value of food at this time was low. The baboons fed largely on grass, leaves, berries and flowers, which have a relatively low fresh-weight nutritive value (Table 17), from May to September (Table 16). The walking and feeding components of foraging were roughly equal throughout the dry months (November-February), suggesting that the observed increase in foraging time (Fig. 15) was due to a relative scarcity of food. The predominant food eaten by O troop at this time was inflorescences of *Leucospermum conocarpodendron* (Table 16). Walking was the major component of foraging in March and April, indicating a relatively small intake of food. The comparatively small amount of time spent foraging in these months also suggests that the food ingested (predominantly *Acacia cyclops* seeds - Table 16) had a relatively high fresh-weight nutritive value. This was supported by calorific and protein analyses of *A. cyclops* seeds (Table 17).

TABLE 17: Energy, water, protein and lipid content of some food items eaten by baboons in O troop's home-range, April - October 1975.

Food item	Month samples collected	Dry wt. sample (g)	% water	% protein content	% lipid content	kcal/g dry wt.	kJ/g dry wt.
Acacia cyclops seeds	April	6,67	1,4	24,7	10,4	4,66	19,51
A. cyclops arils	April	3,06	4,2	12,3	43,6	6,33	26,50
A. cyclops seeds + arils	Oct.		4,5	15,8	32,7	5,08	21,26
"grass" (unidentified sp.)	May					4,44	18,59
"flowers" (unidentified sp.)	May	1,30	78,7			4,82	20,18
Pelargonium "root bark"	May	2,90	71,6			4,28	17,92
"twiner (unidentified sp.)	May	2,19	89,9			4,12	17,25
Arctotis (whole plant)	June	2,30				3,81	15,95
?*Briza* sp.	July	7,12				3,32	13,90
Medicago sp.	Aug.	5,84				5,00	20,93
Hypodiscus seeds	Aug.	7,30				4,38	18,33

FIG. 15: Average daily (dawn-dusk) duration (mins) of foraging activity by baboons of O troop, March 1975-February 1976. Adult female and juvenile values have been corrected with respect to those of adult males.

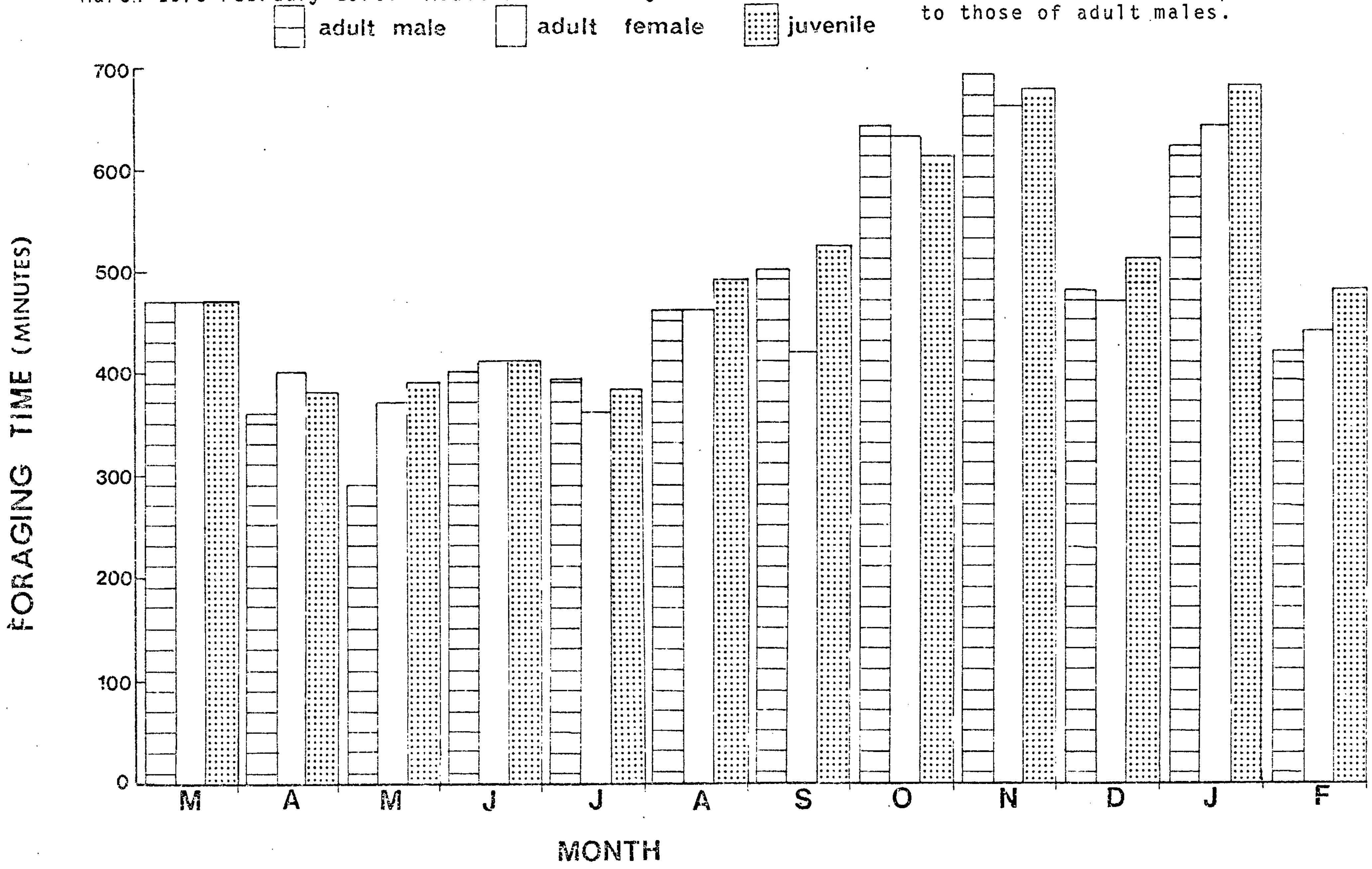
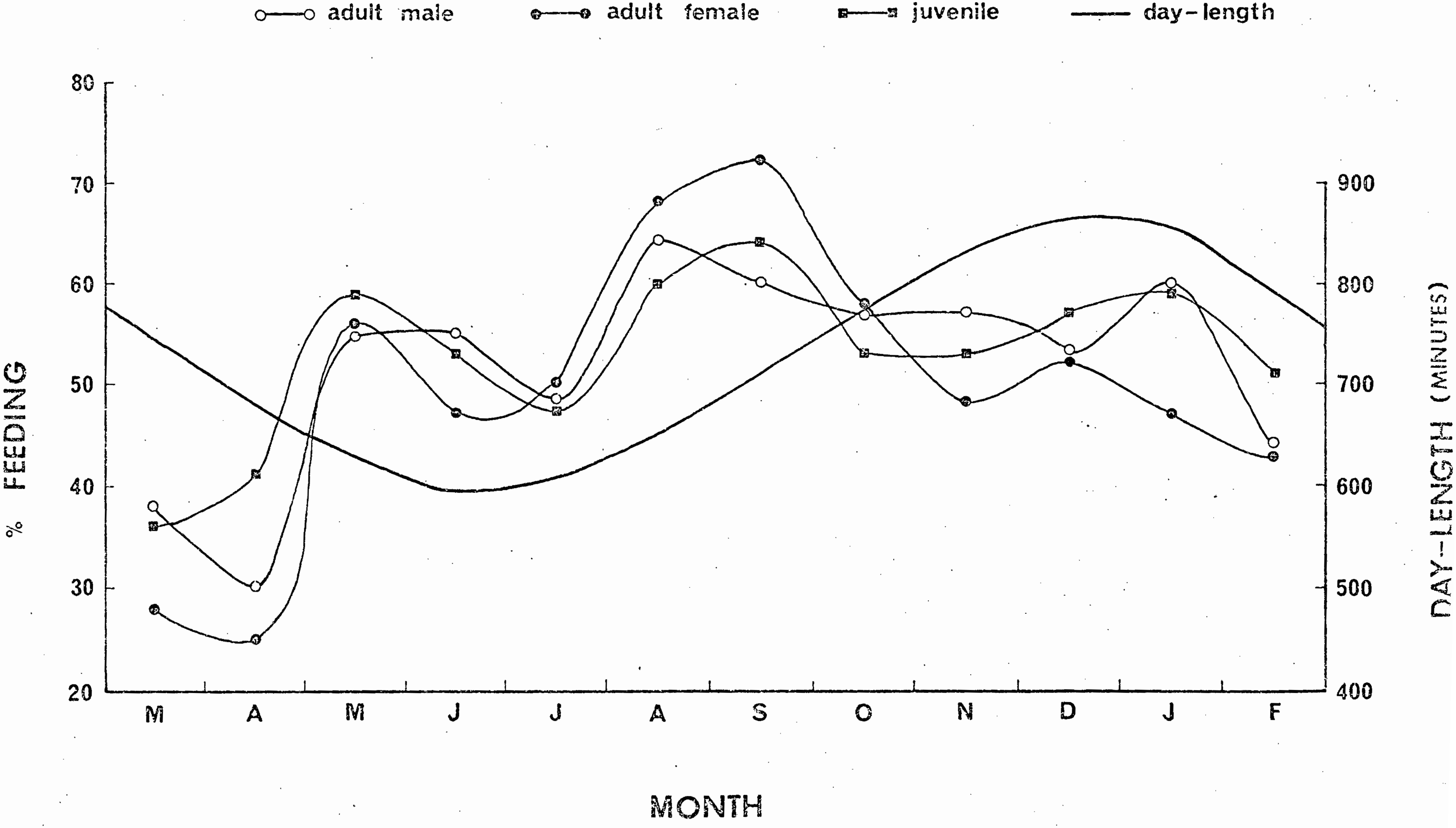


FIG. 16: Feeding component of foraging for three age and sex classes of baboons in O troop, March 1975 - February 1976, plotted with day-length for comparison.



Drinking

Water sources

Water was available throughout the year at Sirkelsvlei and the Krom River (Fig. 2) within O troop's home-range. A stream, draining Sirkelsvlei into the Atlantic Ocean at Olifantsbaai, contained water from May to January. Many pools formed in rock crevices in the rainy season (May-October). Brackish water was frequently held in coastal rock-pools above the high-water line.

Temporal variation in drinking

Monthly frequencies of drinking by baboons of O troop are given in Appendices 1 to 3. A zero monthly frequency does not necessarily indicate that no drinking occurred, but that the frequency was too low in relation to other activities to be shown as a percentage rating.

Baboons of O troop appeared not to drink every day or regularly to visit water. Drinking appeared to be opportunistic and only a few (up to five) baboons drank at a time. "Drinking was carried out by individuals as and when need required it" (Hall 1963). "It seems probable that the animals obtained most of their water from dew precipitation and from the water-content of the flora on which they fed" (Hall 1962a). This behaviour contrasts with that observed by Stoltz & Saayman (1970) for a Transvaal chacma baboon troop: "The proximity of sleeping sites to sources of water was therefore an important determinant of the day-ranges of the troop."

I gained the impression that the baboons increased their drinking in autumn (March-May), although this was reflected only in data for adult males (Appendix 1). Such an increase, if it occurred for all the baboons, might be correlated with the increased consumption of dry *Acacia cyclops* seeds at this time (Table 16).

Reproduction

Temporal variation in copulation

The daily average proportion of time in each month spent in copulation by adult baboons is given in Appendices 1 and 2. There was a small difference each month in the amount of time spent copulating by adult males and adult females, although this was not significant ($t=0,17 \quad p < 0,1$). Copulation incidence was relatively low in winter and spring (June-November, Appendices 1 & 2), although the number of females with maximum turgescence in this period was not correspondingly low (Fig. 17). Hall (1962b) found the "overall copulation frequency" to be greatest in March and April and least in September and November.

Figures 5 to 8 show that there was apparently no tendency for copulation to occur more frequently at one time of day than at another. This is possibly an artefact of the data processing, since Hall (*op. cit.*) suggested that, "sexual activity [of troops in the reserve] tends to be greatest in the early part of the day."

Oestrus females

The oestrus cycle of captive female chacma baboons averages 35 (range 29-42) days (Gillman & Gilbert 1946). Sexual swelling (turgescence) increases gradually over 10 to 12 days, remains constant for about 8 days and then decreases during the next 2 to 5 days (Hall & DeVore 1965).

Female baboons in O troop exhibited all stages of the oestrus cycle throughout the year. The number of females with maximum turgescence at the mid-point of each month only is shown in Figure 17. Female baboons in the Transvaal have been reported also to have menstrual cycles throughout the year (Stoltz & Saayman 1970).

Parturition

Figure 18 shows the minimum number of births in O troop in each month of the year. Dates of birth were known only approximately, since newly-born infants were first observed after an unknown period (maximum of 14 days) following parturition.

Parturition data for the present study were insufficient to reveal a regularly recurring seasonal incidence in births. Newly-born infants (total 10) were observed in O troop in seven out of eleven months (Fig. 18).

The mean gestation period for captive chacma baboons is about 6 months ($\bar{x}$ 187; range 173-197 days) (Gilbert & Gillman 1951). A late winter-spring parturition grouping in O troop occurred 7 months after a rise in the incidence of females with maximum turgescence.

Other chacma baboon studies have failed to establish an optimum parturition season. "In the Cape, where the seasons are less marked and the food supply subject to less variation, there is no clear evidence of a birth peak (Hall & DeVore 1965). Births were observed "at all seasons" in Transvaal troops (Stoltz & Saayman 1970). However, 10 out of 14 births in a captive group of chacma baboons in Johannesburg were "in the winter and spring months" (Gilbert & Gillman 1951). The evidence of Gilbert & Gillman supports the increased probability of parturition in late winter and spring (July-November) that I found for O troop.

Population recruitment

At least 10 infants were born between May and December 1975. A female baboon was seen carrying a dead infant for several hours on 14 October. The cause of death was unknown. No other deaths of young or adults were observed. Nine of the ten infants were alive at the conclusion of the study (Table 7). O troop thus increased in size by 12% in 1975.

Ten infants (Fig. 18) were born during 8424 "female-days" (24 adult females x 351 days covered by the study). This gave a reproductive rate of one infant per female every 842 days. A rate of one infant per female every 661 days was calculated from 6608 "female-days" for savanna *Papio cynocephalus* (Altmann & Altmann 1970). A similar reproductive rate (one infant per female every 665 days) was calculated from 17304 "female-days" for forest-living *P. anubis* (Altmann & Altmann *op. cit.*, from data given by Rowell 1966). The reproductive rate of O troop thus appears to be roughly 80% of those recorded for other *Papio* species.

FIG. 17: Number of female chacma baboons with maximum turgescence at the middle of each month. Figures in parenthesis are the number of days of observation.

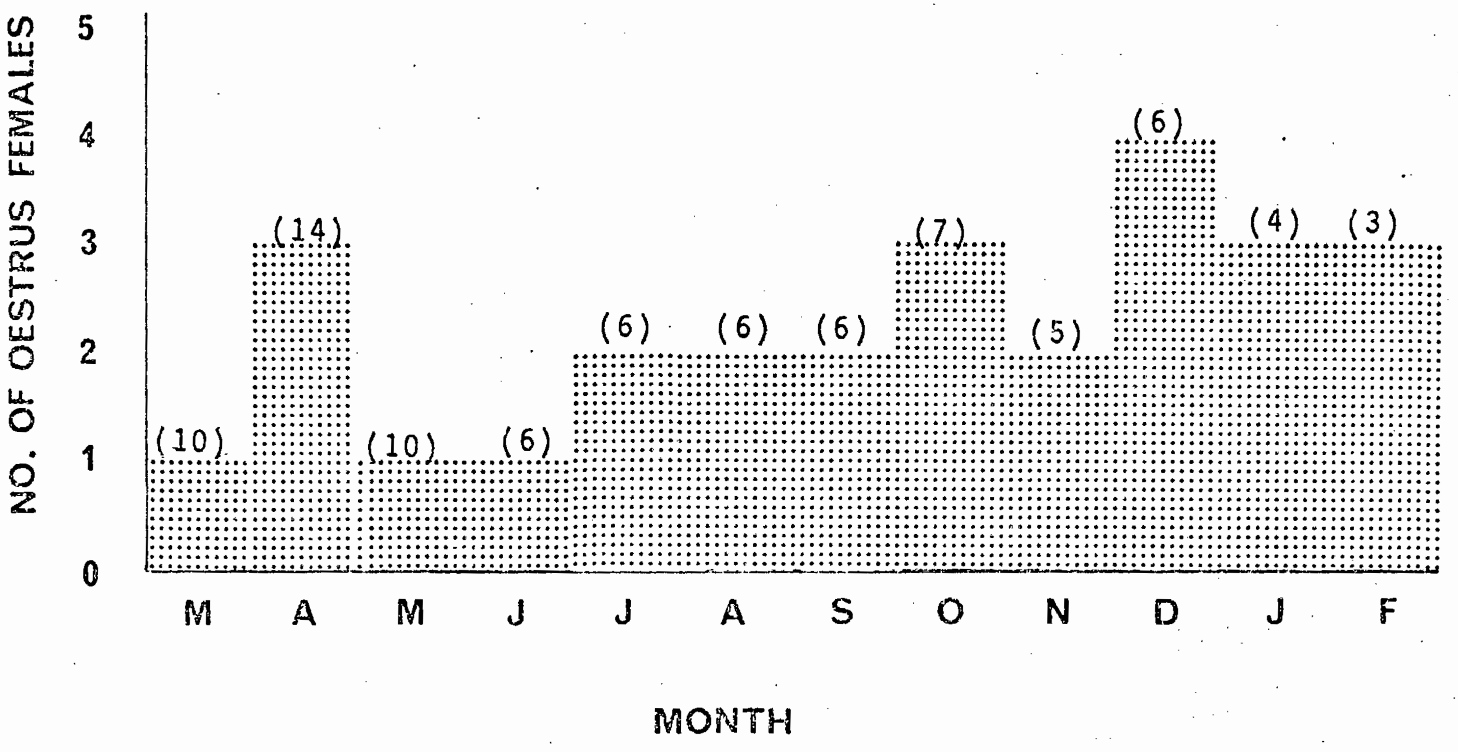
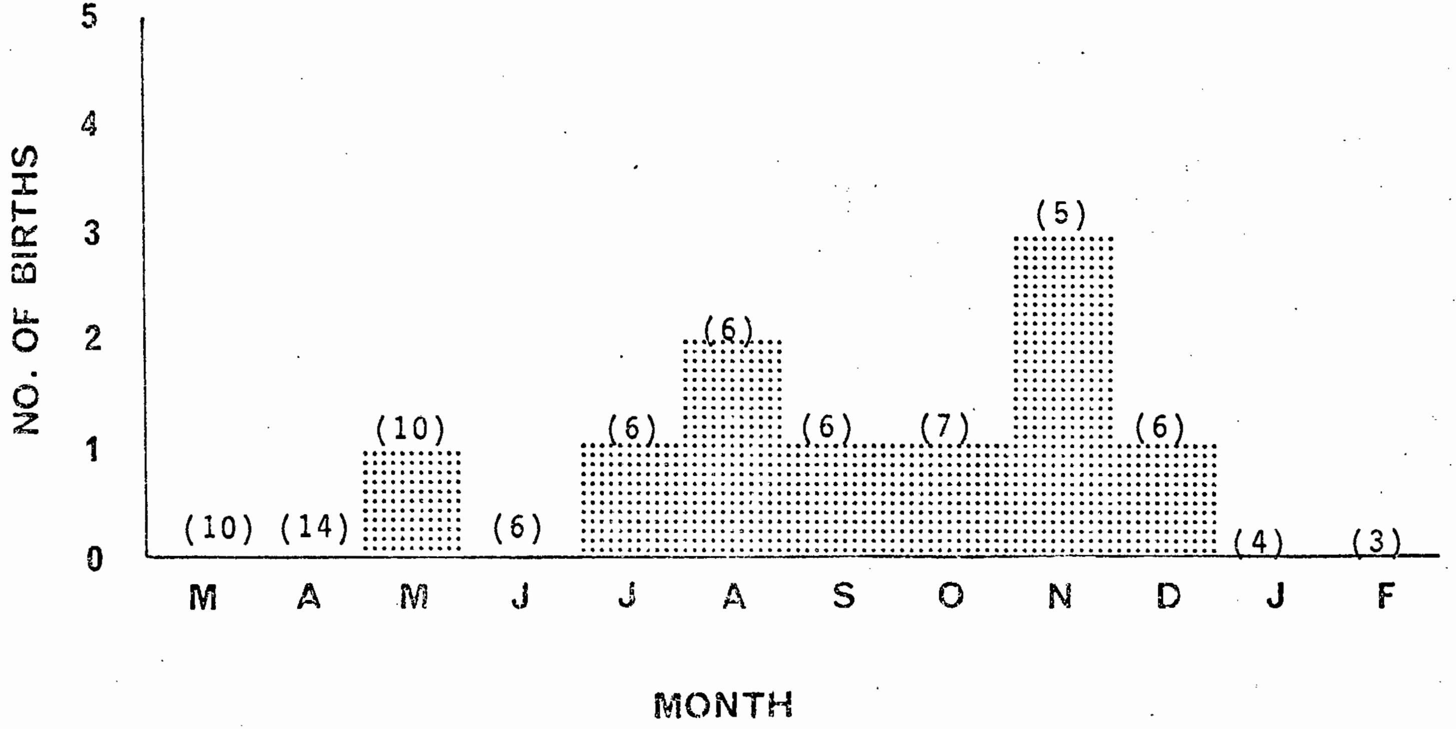


FIG. 18: Number of births recorded in O troop for each month. Figures in parenthesis are the number of days of observation.



METABOLIC RATES FOR CHACMA BABOONS

The basal metabolic rate (BMR) for an homeotherm was defined by Kleiber (1965) as, "the rate of heat production of the animal in a post-absorptive condition, in a comfortable microclimate and at rest." The lowest metabolic rate, about 10% lower than BMR (Tepperman 1962), occurs during sleep. BMR may be determined in the laboratory using the "open circuit method" described by Consolazio, Johnson & Pecora (1963). The defining conditions normally preclude the precise measurement of BMR for free-living animals in the wild, since the microclimate is rarely "comfortable" and a resting animal is usually digesting food.

Empirical observations showed that a log linear correlation (slope 0,75) exists between BMR and body weight for a large range of homeothermic animal species (Davson 1970). BMR has thus also been defined as a power function of body weight, viz. $BMR \propto BW^{2/3}$. Kleiber (1961) found the relation of BMR to body size to be summarised best by the equation:

$$\log M = \log 1{,}83 + 0{,}756 \log W \pm 0{,}05$$

where M = metabolic rate in cal/day, W = body weight in kg. This equation enables the BMR of free-living animals in the wild to be estimated.

Recorded weights of adult male chacma baboons are given in Table 18. I noticed that adult male baboons of 0 troop ✓ were generally slightly smaller than those I observed elsewhere. I therefore selected 25 kg to represent the average weight of an adult male baboon in 0 troop. Similarly, 12 kg was taken as the average weight of an adult female baboon in the troop. The average weight of a juvenile baboon was taken as 7 kg, based on the weight of a drowned male ? baboon that I estimated to be about 9 months of age. Basal metabolic rates for adult male, adult female and juvenile baboons of 0 troop, calculated from Kleiber's (1961) equation, are given in Table 19. The value for juvenile baboons is possibly underestimated, since the calculation did not include a modifying factor for age. The BMR for a human adult male (0,74 kcal/min.), calculated for comparison, was lower than that given in the literature. For instance, Durnin & Passmore (1967) give the BMR for an "average" male of 70 kg as 1,21 kcal/min. Consolazio et al. (*op. cit.*) give the BMR for a 25-year old male as 37,5 kcal/hr/m^2 (I calculated this to be 1,156 kcal/min from a surface area of 1,85 m^2 given by Altman & Dittmer (1964) for a 180 cm male weighing 70 kg).

Consolazio et al. (*op. cit.*) measured the energy cost of activities of military personnel. I calculated the factor of increase in human BMR (using BMR value given by Durnin & Passmore *op. cit.*) for each of these activities most relevant to baboons (Table 20).

Focal Animal data (page 44) were used to calculate the daily number of minutes spent in various activities (Table

21). Only days represented by nine or more hours of Focal Animal data were analysed, since I felt that fewer hours did not accurately represent the total day's activities. I did not have adequate data for adult female and juvenile baboons since these had proved difficult to follow continuously. Data for adult male baboons only, based on studies of two individuals, were analysed.

Sleeping time was taken arbitrarily as 480 minutes (8 hours - equivalent to that for humans) throughout the year. I considered that "resting" was the most likely activity for a further 180 minutes (3 hours) of the night. Data missing for the remaining 3 or 4 hours of the day were extrapolated from existing data for that day.

The daily energy cost for each activity was calculated by multiplying BMR for adult male baboons by the relevant factor of increase (Table 20) and by the number of minutes spent in the activity (Table 21). The average daily energy expenditure for an adult male baboon in O troop from May to October was 730 kcal. The values for each of the 6 months did not differ significantly from one another ($\chi^2 = 0{,}009$ $p > 0{,}995$).

I observed that an adult male baboon, used as a Focal animal on one day in May, spent 328 minutes feeding almost exclusively on *Acacia cyclops* seeds, at a rate of roughly one seed per second (Table 15). Calorific analyses showed 200 seeds to contain approximately 40 kcal (Table 17). The estimated 19680 seeds eaten by the baboon, i.e. one day's energy intake, therefore contained 3936 kcal. Gilbert & Gillman (1956) reported the average daily calorie intake by largely inactive, captive female baboons, kept at a constant temperature (not specified), as 1084 kcal for a 20,3 kg baboon and 1275 kcal for a 19,3 kg baboon.

Energy intake on one day for an adult male baboon was estimated here as roughly 4000 kcal, while average output over 6 months was 730 kcal. The values calculated for energy intake and energy expenditure might be modified by several factors:

1. Daily energy expenditure was probably underestimated here since the calculation did not take into account the effect on BMR of temporal temperature changes. BMR of humans has been reported to rise by 7% for an increase of 1°C in ambient temperature (Altman & Dittmer 1964). This variable was impossible to assess, since the extent to which physiological temperature adaptation affected the baboons' BMR was not known.
2. "Wind-chill" on exposed skin (Table 22) averaged 1287 kcal/m^2/hr at noon. The true energy loss from baboons caused by this factor was not known, since the protection afforded by the thick coat of baboons has not been assessed.
3. Metabolizable energy available to baboons from ingested food was likely to have been lower than the energy content obtained from bomb calorimetry. Burning reduced the samples to final oxidation products of low energy-

content not usually produced by metabolism.

4. Digestive efficiency, rarely 100% in mammals, is partly a function of the crude fibre content of the diet (Golley & Buechner 1968). The proportion of crude fibre in the diet of baboons of O troop was not known.

TABLE 18: Recorded weights for adult chacma baboons

Sex	Weight (kg)	Source
Male	22-30	Napier & Napier (1967)
Male	18-23	Shortridge (1934)
Male	40,0	" "
Male	31,7	Hill (1970)
Male	24,9	Lloyd (pers. comm.)
Male	20,4	" " "
Male	27,2	" " "
Male	27,2	" " "
Male	23,6	" " "
Male	24,5	" " "
Female	11-15	Napier & Napier (1967)
Female	14-19	Shortridge (1934)
Female	15,5	Lloyd (pers. comm.)
Female	14,5	" " "
Female	18,4	" " "
Female	16,0	" " "
Female	11,3	" " "
Female	13,6	" " "
Female	13,1	" " "
Female	10,9	" " "
Female	12,1	" " "
Female	11,8	" " "
Female	11,3	" " "
Female	10,8	" " "

TABLE 19: Basal metabolic rate for three age and sex classes of chacma baboons, and for a human adult male, calculated from the equation given by Kleiber (1961)

	body wt. (kg)	kcal/min	kcal/kg /10 min	kcal/ 24 hr
Adult male baboon	25	0,341	0,14	491
Adult female baboon	12	0,196	0,16	282
Juvenile baboon	7	0,132	0,19	190
Human adult male	70	0,738	0,10	1062

TABLE 20: Calculated factor of increase of BMR for various human activities broadly applicable to chacma baboons (after Consolazio, Johnson & Pecora 1963)

Activity	Factor of increase
Sleeping	0,97
Sitting[+]	1,06
Sitting[1], eating	1,23
Standing[1], light activity	2,15
Walking at 2,27 mph	3,53
Sprinting[2]	19,26

[+] I observed that the predominant activity classified as "social" for adult male baboons generally involved the male sitting while being groomed by another baboon. The factor of increase for sitting was therefore used in calculation of the energy expenditure for the "social" category.

[1] These values were averaged to provide an estimate for baboon energy expenditure while feeding, since I observed that feeding combined the two activities.

[2] I observed that "fighting" by a baboon generally involved chasing one or more other baboons. The sprinting factor of increase was therefore used in calculation of the energy cost for the "fighting" category.

TABLE 21: Daily energy expenditure (kcal) calculated for an adult male chacma baboon in O troop, May-Oct. 1975. The total daily energy expenditure refers to a 24-hour day. Figures in parentheses are the number of minutes spent in that activity calculated from Focal Animal data.

Month	No. days obs.	No. hours obs.	Daily energy expenditure for each activity sleep (kcal)	rest (kcal)	feed (kcal)	walk (kcal)	social (kcal)	fight (kcal)	Total daily kcal
May	3^+	30	159 (480)	134 (370)	199 (346)	135 (112)	42 (116)	7 (1)	676
June	2^+	17	159 (480)	129 (356)	201 (349)	164 (136)	42 (116)	0 (0)	695
July	1	10	159 (480)	129 (331)	160 (278)	218 (181)	56 (155)	13 (2)	726
Aug.	1	9	159 (480)	132 (365)	146 (254)	284 (244)	34 (94)	7 (1)	772
Sept.	1	9	159 (480)	102 (282)	237 (412)	256 (213)	18 (49)	7 (1)	779
Oct.	1	10	159 (480)	134 (371)	151 (290)	251 (209)	36 (99)	0 (0)	731

[1] daily values were averaged to give one value for the month

TABLE 22: Average daily weather parameters recorded in O troop's home-range March 1975 - February 1976

Month	Number of days	Average noon temp. (^{o}C)	Cloud cover (1/8ths sky)		Average wind direction	Wind speed (Beaufort scale)		Average wind speed (m/sec)	"Windchill"[+] at noon kcal/m^2/hr
			average	range		average	range		
March	10	23	1	0-8	SE	2,5	1-5	2,0	1300
April	14	24	2	0-9	SE	1,6	1-4	1,0	1125
May	10	21	4	1-9	SE	0,8	0-3	0,5	950
June	6	19	1	0-5	SE	1,3	0-2	0,8	1000
July	4	16	4	0-9	SE	1,4	0-3	1,0	950
Aug.	4	18	3	0-9	NW	1,8	0-3	2,0	1150
Sept.	4	17	6	0-8	NW	2,8	0-4	2,8	1225
Oct.	7	19	5	0-9	NW	3,6	0-5	5,0	1600
Nov.	6	20	2	0-9	NW	3,4	0-4	4,6	1550
Dec.	5	20	1	0-7	SE	3,4	1-5	4,6	1550
Jan.	2	24	3	0-8	SE	2,8	1-4	2,8	1400
Feb.	2	27	0	0	SE	3,5	2-5	4,8	1650

[+] taken from a nonogram, including air temperature and wind velocity, presented by Consolazio, Johnson & Pecora (1963)

SUMMARY

Four troops of chacma baboons *Papio ursinus*, comprising approximately 150 individuals, have home-ranges largely in the Cape of Good Hope Nature Reserve. One hundred and twenty-one days of observation was made of one of these troops, O troop, between March 1975 and February 1976.

O troop occupies a home-range of roughly 4000 ha, using nine different sleeping cliffs. Troop members were observed most frequently throughout the year in a 45 ha core area containing one sleeping cliff. The troop showed no clear habitat preferences, but occupied alien *Acacia* thickets and Upland Mixed Fynbos more frequently than expected from the spatial distribution of these vegetation types in the home-range. Frequency of baboon occupation for each of five vegetation types varied seasonally, and appeared to be a reflection of the availability of plant food.

Seventy-seven species of plants were added to the previously recorded diet of baboon troops in the reserve. Baboons of O troop were observed eating marine shellfish (mainly *Patella granularis*) in the littoral zone, although throughout the year almost the entire diet (roughly 95%) consisted of plant food. The diet varied seasonally, presumably in relation to availability of plant food, ranging from an almost exclusive intake of *Acacia cyclops* seeds to a high-bulk diet comprising mainly fresh, green leaves, grass and flowers.

The baboons of O troop had a diurnal pattern of activity in which the incidence of social activities was highest in

the morning before the animals began foraging. The average number of minutes per day spent by baboons in five major categories of activity varied seasonally. Baboons walked farther (approximately 9 km per day) during October to April (spring-autumn), when apparently less food was available to them, than in other months. The greatest proportion of the day spent feeding was during August to ? January, suggesting that the nutritive value of food was lower in this period than at other times of the year. The troop rested for relatively longer in the early morning during May to September than in other months, leaving fewer daylight hours for foraging. The reduced foraging time may be linked to the apparent abundance of plant food available to baboons in this period. The energy output in 24 hours by an adult male baboon from May to October was estimated to have been 730 kcal.

Female baboons of O troop had menstrual cycles and copulated throughout the year. Ten infants, of which one died, were born during the study period. No seasonal variation in the incidence of births was established. The reproductive rate of O troop in the study period was roughly 80% of rates recorded for *Papio* species elsewhere.

CONCLUSION

This study was an attempt to apply an internationally recognized method (Instantaneous Scan), widely used in ethological studies, for assessing the daily activity of a troop of free-living chacma baboons. The main findings are given in the summary (page 125). Not all of the aims of the project (page 4) were realized. I wish to stress that, owing to difficulties I experienced in collecting data in the field, the results obtained are a guide to, rather than a definition of, seasonal changes in the daily activities of the baboons.

Locating O troop was always a major difficulty. The home-range (4000 ha) was too large for the troop to be found during its day-range, except by chance. It proved impossible to visit all nine sleeping sites in one morning or evening, so that frequently two or more days passed in fruitless searching for the baboons. I experienced a great problem with fatigue, and was unable to follow the troop for more than 8 hours continuously. This meant that data were collected less frequently in the late afternoon.

Gross seasonal changes in daily activities of O troop, as shown by computer-assisted analyses of data obtained from the Instantaneous Scan method, were very similar to qualitative impressions which I gained from watching the animals in the field. However, the data were not always comprehensive enough for the sophisticated computer analyses which I used. Also, the monthly samples were not large enough to distinguish statistically significant differences (if any) in activity patterns for separate age and sex classes of baboon. Nevertheless, analysis of variance is a valuable aid for determining seasonal changes in animal activities quantified by the scan method.

The report on the energy cost of various activities of baboons required, ideally, data derived from laboratory studies of changes in metabolic rate of baboons for a range of activities. Computing the energy requirements of baboons from data based on humans is a questionable procedure, but at least it enabled me to make rough estimates of energy costs in the apparent absence of laboratory data.

Estimation of the daily intake of food by the baboons proved to be almost impossible without a second observer in the field. I found that the daily diet of baboons generally consisted of small quantities of a large range of food items. Definitive information on the relative importance of the different food items ideally required data on the energy content and precise quantities of all food items eaten. It was, however, very difficult to assess the quantity of leaves eaten while they were being stripped by teeth from twiner tendril straight into a baboon's mouth. Similarly, it was almost impossible to assess the amount of material taken from a protea inflorescence when this had been torn apart and chewed by a baboon. The estimated energy intake of an adult male baboon was based on one day's observation only and is included solely for heuristic value.

Plant species which I observed to be eaten by baboons of O troop presumably comprised only a sample of their total diet. The list already covers a wide range of plant families and genera, but it is likely that further observation will lead to more species being added. Although the omnivorous diet of baboons is clear, the study was too short to determine whether or not seasonal changes in vegetation and diet affected the behaviour of the troop, particularly in relation to parturition times.

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APPENDIX 1: Average daily (dawn to dusk) duration (minutes) of activities of adult male chacma baboons. Figures in parenthesis are percentages.

	Rest	Feed	Drink	Walk	Social[+]	Copulate	No. hrs observation
March	171 (23)	179 (24)	0 (0)	290 (39)	75 (10)	22 (3)	60
April	215 (32)	179 (16)	7 (1)	248 (37)	40 (6)	54 (8)	74
May	200 (32)	162 (26)	44 (7)	131 (21)	37 (6)	44 (7)	25
June	190 (32)	220 (37)	0 (0)	179 (30)	6 (1)	0 (0)	28
July	211 (35)	181 (30)	0 (0)	193 (32)	6 (1)	6 (1)	20
Aug.	181 (28)	292 (45)	0 (0)	162 (25)	6 (1)	0 (0)	21
Sept.	184 (26)	304 (43)	0 (0)	198 (28)	7 (1)	7 (1)	23
Oct.	124 (16)	371 (48)	0 (0)	270 (35)	0 (0)	8 (1)	29
Nov.	108 (13)	398 (48)	0 (0)	299 (36)	0 (0)	17 (2)	33
Dec.	318 (37)	258 (30)	0 (0)	224 (26)	9 (1)	43 (5)	30
Jan.	202 (24)	371 (44)	0 (0)	244 (29)	17 (2)	9 (1)	12
Feb.	311 (39)	184 (23)	0 (0)	231 (29)	24 (3)	48 (6)	14

[+] "Social" category includes playing, grooming and fighting.

APPENDIX 2: Average daily (dawn to dusk) duration (minutes) of activities of adult female chacma baboons. The values are corrected for comparison with those for adult males. Figures in parenthesis are percentages.

	Rest	Feed	Drink	Walk	Social[+]	Copulate	No. hrs observation
March	173 (23)	141 (19)	0 (0)	353 (47)	102 (14)	15 (2)	60
April	134 (20)	106 (16)	0 (0)	311 (46)	85 (11)	71 (11)	74
May	79 (13)	223 (30)	0 (0)	171 (27)	105 (17)	79 (13)	25
June	106 (18)	206 (35)	0 (0)	232 (39)	75 (13)	6 (1)	28
July	171 (28)	191 (31)	1 (0)	184 (30)	83 (14)	6 (1)	20
Aug.	116 (18)	327 (50)	0 (0)	151 (23)	82 (13)	0 (0)	21
Sept.	208 (29)	320 (45)	0 (0)	119 (17)	89 (13)	7 (1)	23
Oct.	105 (14)	382 (49)	0 (0)	276 (35)	41 (5)	8 (1)	29
Nov.	122 (15)	332 (40)	0 (0)	358 (43)	43 (5)	8 (1)	33
Dec.	254 (29)	262 (30)	0 (0)	236 (28)	126 (15)	27 (3)	30
Jan.	168 (20)	319 (38)	0 (0)	355 (42)	44 (5)	8 (1)	12
Feb.	235 (29)	145 (25)	0 (0)	260 (33)	118 (15)	25 (3)	14

[+] "Social" category includes playing, grooming and fighting

APPENDIX 3: Average daily (dawn to dusk) duration (minutes) of activities of juvenile chacma baboons. The values are corrected for comparison with those for adult males. Figures in parenthesis are percentages.

	Rest	Feed	Drink	Walk	Social[+]	Copulate	No. hrs observation
March	147 (20)	117 (17)	0 (0)	226 (30)	62 (8)	0 (0)	60
April	159 (23)	117 (17)	0 (0)	167 (25)	81 (12)	0 (0)	74
May	118 (19)	170 (27)	0 (0)	118 (19)	66 (11)	0 (0)	25
June	104 (17)	167 (28)	0 (0)	144 (24)	36 (6)	0 (0)	28
July	147 (24)	137 (23)	0 (0)	147 (24)	23 (4)	0 (0)	20
Aug.	88 (14)	221 (34)	0 (0)	147 (23)	24 (4)	0 (0)	21
Sept.	96 (14)	257 (36)	0 (0)	139 (20)	39 (6)	0 (0)	23
Oct.	70 (9)	245 (32)	0 (0)	217 (28)	47 (6)	0 (0)	29
Nov.	69 (8)	270 (33)	0 (0)	239 (28)	44 (5)	0 (0)	33
Dec.	156 (18)	221 (26)	0 (0)	163 (19)	111 (13)	0 (0)	30
Jan.	70 (8)	313 (37)	0 (0)	204 (24)	45 (5)	0 (0)	12
Feb.	145 (18)	187 (23)	0 (0)	175 (22)	97 (12)	0 (0)	14

[+] "Social" category includes playing, grooming and fighting

APPENDIX 4: Plant species eaten by baboons of O troop March 1975 - February 1976

Part of plant eaten	Taxon
UNDERGROUND STORAGE ORGANS	*Albuca* sp.
	Amaryllidaceae sp.
	Babiana villosula
	Cyanella capensis
	Gladiolus sp.
	Gynandriris rogersii
	Hyobanche sanguinea
	Iridaceae sp.
	Moraea bituminosa
	Othonna heterophylla
	Oxalis polyphylla
	Pelargonium longifolium
	Satyrium bicorne
	Satyrium odorum
	Watsonia spp.
ROOT CORTEX	*Lobelia pinifolia*
	Monadenia micrantha
	+*Pelargonium capitatum*
	Roella amplexicaulis
	Trachyandra tabularis
	Wachendorfia spp.
FLOWERS/INFLORESCENCES	Amaryllidaceae sp.
	Aristea spiralis
	Aspalathus capensis
	Bobartia gladiata
	Bobartia indica
	+*Carpobrotus edulis*
	Coleonema album
	Cullumia setosa
	Dorotheanthus bellidiformis
	+*Elegia cuspidata*
	Erica coccinea
	Erica mammosa
	+*Fagelia bituminosa*
	Gymnodiscus capillaris
	Leucospermum conocarpodendron
	Leucospermum hypophyllocarpodendron
	Liparia parva
	Liparia sphaerica
	Mimetes hartogii
	Oxalis spp.
	+*Pelargonium capitatum*
	Salvia aurea
	Sideroxylon inerme
	Tarchonanthus camphoratus

APPENDIX 4: continued

LEAVES	*Aethephyllum pinnatifidum*
	Arctotis acaulis
	Briza sp.
	+*Carpobrotus edulis*
	Corymbium africanum
	+*Cynanchum obtusifolium*
	Erodium moschatum
	Olea exasperata
	+*Pelargonium capitatum*
	Rhus lucida
	Twiner (unidentified)
BERRIES	*Asparagus asparagoides*
	Diospyros glabra
	Euclea racemosa
	Maurocenia frangularia
	Nylandtia spinosa
	Olea capensis
	Rhus laevigata
SEEDS	*Acacia cyclops*
	Acacia saligna
	+*Elegia cuspidata*
	Elegia vaginulata
	+*Fagelia bituminosa*
	Hypodiscus aristatus
	Pentameris macrantha
	Phylica buxifolia
	Pinus pinaster
	Tetraria bromoides
	Willdenowia lucaeana (teres - same?)
WHOLE PLANT	*Caucalis africana*
	+*Cynanchum obtusifolium*
	Cynodon dactylon
	Medicago hispida
	Oxalis luteola
	Oxalis obtusa
UNKNOWN	*Protea cynaroides* (pith, insects?)
	Tetraria thermalis (leaf base?)
	Watsonia sp. (stem of young plant?)

+ parts utilized in more than one category

APPENDIX 5: Plant species eaten by baboons in the Cape of Good Hope Nature Reserve

Taxon	Recorded by Hall	Present study
Acacia cyclops	+	+
Acacia saligna	+	+
Aethephyllum pinnatifidum		+
Albuca canadense	+	
Albuca sp.		+
Amaryllidaceae sp.		+
Anomalesia cunonia	+	
Antherium divaricatum	+	
Arctotheca calendula	+	
Arctotis acaulis		+
Arctotis aspera	+	
Aristea spiralis		+
Aspalathus capensis		+
Asparagus asparagoides		+
Astephanus neglectus	+	
Babiana nana	+	
Babiana villosula	+	+
Berkheya ilicifolia	+	
Bobartia gladiata	+	+
Babartia indica		+
Briza sp.		+
Carpobrotus edulis	+	+
Cassine barbara	+	
Caucalis africana		+
Chrysanthemoides monilifera	+	
Coleonema album		+
Corymbium africanum	+	+
Cotula turbinata	+	
Cullumia setosa		+
Cullumia squarrosa	+	
Cyanella capensis		+
Cynanchum obtusifolium		+
Cynodon dactylon	+	+
Diospyros glabra		+
Dischisma sp.	+	
Dorotheanthus bellidiformis	+	+
Elegia cuspidata		+
Elegia vaginulata		+
Erica cerinthoides	+	
Erica coarctata	+	
Erica coccinea		+
Erica mammosa	+	+

APPENDIX 5: continued

Taxon	Recorded by Hall	Present study
Erica phylicifolia	+	
Erica plukeneti	+	
Erodium moschatum		+
Euclea racemosa	+	+
Fagelia bituminosa		+
Ferraria undulata	+	
Gladiolus sp.	+	+
Gymnodiscus capillaris		+
Gynandriris rogersii		+
Hyobanche sanguinea	+	+
Hypodiscus aristatus		+
Hypochoeris glabra	+	
Iridaceae sp.		+
Leucadendron salignum (=*adscendens*)	+	
Leucadendron laureolum (=*decorum*)	+	
Leucadendron coniferum (=*sabulosum*)	+	
Leucospermum conocarpodendron	+	+
Leucospermum hypophyllocarpodendron		+
Liparia parva		+
Liparia sphaerica		+
Lightfootia parvifolia	+	
Lobelia pinifolia		+
Lobostemon montanus	+	
Maurocenia frangularia		+
Maytenus oleoides (=*Gymnosporia laurina*)	+	
Medicago hispida	+	+
Metalasia muricata	+	
Mimetes hartogii		+
Monadenia micrantha		+
Moraea bituminosa		+
Myrica cordifolia	+	
Nylandtia spinosa		+
Olea capensis	+	+
Olea exasperata		+
Othonna filicaulis	+	
Othonna heterophylla		+
Oxalis dentata	+	
Oxalis luteola		+
Oxalis obtusa		+
Oxalis polyphylla		+
Passerina paleacea	+	

APPENDIX 5: continued

Taxon	Recorded by Hall	Present study
Pelargonium capitatum	+	+
Pelargonium longifolium		+
Pelargonium tabulare	+	
Pentameris macrantha		+
Phylica buxifolia		+
Pinus pinaster	+	+
Polygala myrtifolia	+	
Protea cynaroides		+
Protea lepidocarpodendron	+	
Protea scolymocephala	+	
Roella amplexicaulis		+
Rhus glauca	+	
Rhus lucida		+
Rhus laevigata (=*mucronata*)	+	+
Rumex sp.	+	
Salvia africana	+	
Salvia aurea	+	+
Satyrium bicorne		+
Satyrium odorum		+
Scirpus cartilagineus	+	
Senecio elegans	+	
Sideroxylon inerme		+
Tarchonanthus camphoratus		+
Tetraria bromoides		+
Tetraria involucrata	+	
Tetraria thermalis	+	+
Torillis sp.	+	
Tritoniopsis dodii	+	
Wachendorfia sp.		+
Watsonia tabularis	+	+
Willdenowia lucaeana	+	+

Adult male baboon of O troop easily distinguished by the streak of white fur on the head and the pink patch on either side of the ischial callosities.

PLATE 2: Juvenile male baboon with blue tag in left ear introduced into O troop.

PLATE 3: Part of the troop in an area of alien vegetation (Olifantsbos)

PLATE 4: Upland Mixed Fynbos (social activities occur throughout the day)

APPENDIX 6 continued

PLATE 5: Foraging on the beach (Olifantsbos)

PLATE 6: The cliff most frequently used for sleeping by O troop (Olifantsbos)

APPENDIX 6 continued

PLATE 7: Baboons ate fresh green shoots of grass in the winter

PLATE 8: Baboons sometimes took inflorescences of *Leucospermum conocarpodendron* to a rock before dealing with them

APPENDIX 6 continued

PLATE 9: Baboons searched on the ground for *Acacia cyclops* seeds by sweeping tree litter with the arm from median outwards

PLATE 10: Adult male baboon sits on a pile of ferricrete roadsurfacing from which he had just consumed a small handful