FYNBOS BIOME PROJECT: FIRST ANNUAL RESEARCH MEETING

ABSTRACTS (UNEDITED)

MONDAY 29 JANUARY 1979

SESSION 1. Physical environment of the fynbos biome

1. Preliminary synthesis of macroclimatic patterns within the fynbos biome

The objectives of the climatological studies are outlined, and the major features and geographical variation of macro-climates of the fynbos areas are reviewed.
A survey of existing climatological reports and summaries relating to the sources of data in the Southern Cape is presented, and is intended as a guide to research workers requiring information on the availability of climate records from the fynbos study areas.

2. A soil map of the fynbos biome

The procedure adopted for the drafting of a preliminary soils map of the fynbos biome is as follows:
1. Acocks' (1975) mapped subdivisions of fynbos viz. Macchia, False Macchia and Coastal Macchia, modified by C. Boucher for the Western Cape Coast (Personal Comm.), at a scale of 1:10^{6} was used as a base map.
2. Using all information on soil distribution available through land resources surveys, botanical surveys, etc., the fynbos biome was subdivided into ten broad soil associations each more or less uniform with regard to soil types, soil slope catenas, geology, terrain and climate.
3. Mainly on the dominance of soil types, soil associations were subdivided into one or more soil regions. (See attached Soils map and List of Soil regions with map numbers, dominant and subdominant soils.)
In an article titled Geology, Geomorphology and Soils to be published by the CSIR in a publication on the Fynbos Ecology, a concise review was given of existing knowledge on the genesis and distribution of fynbos soils as affected by geology, terrain and climate.

3. Correlation between soil type and fynbos plant community type along selected enviornmental gradients

4. Historic and present land-use patterns in the fynbos biome - a preliminary synthesis

The objective of this project is to prepare a preliminary synthesis of the characteristics of land use within the fynbos biome and its immediate surrounds. The primary component of the study will be a land use map to a regional scale of 1:250 000 supported by secondary cartography of physiography, regional climatic variables, other environmental characteristics and details of existing agro-economic regions.
Primary mapping of land use details is being undertaken at a scale of 1:50 000 recording all uses with an areal extent greater than 2500 square metres. Sources of data appropriate to the needs of the final map include current 1:50 000 topographic sheets supported by random checks using current air photography and a series of sample field transects drawn through the biome. Land uses identified will include: cultivated land, vineyards and orchards, timber plantations, gradations of natural vegetation and rough grazing, water features, mines and quarries, urban built-up land and transportation networks. All areas controlled by local authorities, the state, conservation bodies and the like will be recorded. The absence at this stage of a definitive boundary to contain the components of the biome seriously limits assessments of land use characteristics. Urgent attention should be paid to this problem. While the cartographic exercise is the major element of work in the project, data gathered will be synthesized in a short written report.

Biogeography and palaeoecology

5. Palaeoecological studies in the fynbos zone of the southern Cape

The aim of the palaeoecological studies being undertaken is to allow a more dynamic view of the biology of the region. Information is being sought on the effects of palaeoenvironmental changes on the vegetation types, animal population and their distributions and the role of man particularly in respect to the incidence of fire and the introduction of stock.
While the whole Cenozoic history is relevant to the discussion of the biogeography and is given mention some studies on materials from Upper Pleistocene and Holocene contexts are reported. Stratified and dated charcoal samples from localities in the foothills of the Swartberg have been analysed to gain a measure of changes in the woody vegetation in the last 15 000 years. Palynological studies have been initiated as a further approach to the investigation of recent vegetation changes. In addition relevant faunal occurrences are considered.

6. A survey of rare and endangered plant species

A brief review is given of the background to the threatened plant problem at the Cape. The methods and results of a survey carried out since 1974 are noted. The theoretical problems that exist in creating a secure future for artificially threatened species are discussed. It is concluded that although extinction has been an important natural process in the past and may shape much of the evolutionary future of the Cape flora, it is critically under-studie

7. A survey of the reptiles and amphibians of the Cape Province

This is a long-term project which commenced in 1972 and is scheduled to close in 1982. The object is to determine as far as possible the status and distribution of the Cape herpetofauna. At present, due to financial problems and travel restrictions, collections are being confined to the fynbos zone of the SW Cape.
Several species are endemic to the fynbos biome, and some of these are directly threatened by habitat destruction. The area has been poorly collected in the past, and the taxonomy of fynbos herpetofauna is far from complete. The work of the Department is obviously concentrated on the forms known to be threatened but extensive general collections have also been made.

Vegetation classification and mapping

8. An investigation to determine the usefulness of various remote sensing techniques for studying and mapping the fynbos biome

This project is an investigation into the usefulness of various remote sensing products and in particular satellite derived products, in determining the extent of the biome and identifying its major vegetation components.
Three areas have been chosen as training sites within the biome on the basis of availability of ground truth in the form of air photographs, maps and reports. These areas also cover some of the range of topographic and vegetation formation variation present in the biome. The areas are Cape Peninsula, Langebaan-Saldanha and the Jonkershoek Valley.
Landsat-1 imagery is being used for experimental purposes. Landsat-3 imagery has been successfully motivated for in the SW Cape region and should shortly be available for comparative purposes. Numerical or computer based techniques are being used in the interpretation of the satellite imagery. These have been developed by Mr A Jackson of the NPRL CSIR. Computer generated classes obtained by application of these techniques are compared with units on aerial photographs and the ground truth data for correlation with surface features and in particular vegetation surface features.
Preliminary results have been very pleasing, particularly in areas of low vegetation ground cover and little topographic variation.

9. Structural and functional classification of fynbos vegetation

The first phase of the project has almost been completed. In this phase I (1) have erected a growth-form system for use in the next two phases of the project,
(2) compared classifications derived from floristic and structural data sets.
Alternate growth form systems were constructed for the specimens collected in 30 plots in the Cedarberg and those growth forms which showed the best correlation with environmental factors have been selected for use in the next phase. The final growth-form system that was selected has about 100 different growth-forms.
A numerical classification using this growth-form system compared favourably with a numerical floristic classification.

10. Coastal foreland vegetation survey: West Coast

The western component of the coastal lowlands is receiving attention first as it is considered a higher priority on the basis of extent of remaining natural vegetation.
The brief is, initially to study four to six east-west aligned transects, using accepted phytosociological techniques. In this case the Braun-Blanquet method as applied by the Zurich-Montpellier school is to be applied. This is followed by extrapolation of community information, laterally, using available orthophoto maps and aerial photographs, to end in the delimitation and description of the communities in the Strandveld, Coastal Fynbos and Coastal Renosterbosveld, at a semi-detailed level. Maps of the vegetation will be produced at a 1:50 000 scale.
Floristic, physiognomic, economic and habitat information is being collected.

11. Semi-detailed surveys of selected mountain catchment areas. A reconnaissance survey of the vegetation of the Rooiberg State Forest.

To provide basic data for conservation and catchment management, the vegetation of Rooiberg State Forest was classified and mapped on a simple physiognomic-structural system designed for use by personnel with no botanical training. This classification was supplemented by 30 floristic releves from which a phytosociological table was prepared.
A provisional Check List of 588 flowering plants and ferns was compiled and the relationships of the flora briefly discussed. Tables of Noteworthy and threatened species, both requiring special care in management were drawn up. Finally, some observations and suggestions on management and research were offered.
The present report describes the structural units, shows how they relate to gross physiography and habitat, and compares the usefulness of this classification with the phytosociological one.

Local phytosociological studies

12. A survey and classification of the vegetation of the Zachariashoek catchments, Lamotte State Forest

The bulk of the survey was devoted to the enumeration of 161 50m^2 releves, of which 103 were permanently marked. This enumeration consisted of listing the flora on each releve and assigning cover abundance values by species. Environmental data were also recorded at each site.
The data set was examined by means of various ordination techniques, and this work has yet to be finalised. To date thirteen major plant communities have been recognised, but it may be possible to sub-divide these further.
Supplementary surveys were done on vegetation structure, aerial plant biomass foliar nutrient levels and soils.
The final report, now in preparation, will contain Braun-Blanquet tables showing the major plant communities. These will also be related to soil and other environmental factors.
Idealised transects showing the relation of vegetation to topography and soils, as well as a vegetation map, will be presented.

13. An ecological study of the Gamka Mountain Reserve

The Gamka Mountain Reserve (10 000 ha) was acquired by the Cape Department of Nature and Environmental Conservation in 1969/70 to provide suitable habitat for the conservation of the Cape Mountain Zebra (Equus zebra zebra). The reserve includes part of the Gamka Mountain, an'island' in the Little Karoo, which lies SW of Oudtshoorn and SE of Calitzdorp.
According to Acocks (1975) four major Veld Types are represented in the reserve viz. Mountain Renosterbosveld, False Macchia, Succulent Mountain Scrub and Succulent Karoo.
While subsidiary projects are underway by various workers to determine the status, distribution and role of various faunal types occurring in the reserve, the main project is aimed at providing a broad classification of the vegetation in order that a management programme can be drawn up. This takes the form of a physiognomic/semi-floristic study. Altogether 60 sample sites were chosen as being representative of the major topographical and vegetational variations within the reserve and to date data collection has been completed at 50 of the sites. On completion of the final 10 sites, extrapolation, mapping and compartmentalization for management purposes will be undertaken. In addition a list of rare species and also species of spcial interest is being compiled.

14. 'n Studie van die plantegroei van die Rocherpan-Natuureservaat

Die Rocherpan-Natuureservaat is ongeveer 25km noord van Velddrif geleë en is die enigste natuurreservaat in Acocks (1975) se Strandveld van die Weskus (Veldtipe 34).
Die reservaat is hoofsaaklik 'n watervoëlskuiling en ongeveer 100ha van die 390 ha natuurreservaat bestaan dan ook uit die pangedeelte. Aan die see se kant, wes van die pan, is duinsand en aan die oostekant van die pan is wit tot ligrooi sanderige grond. Behalwe vir die pangedeelte, is die plantegroei 'n tipiese voorbeeld van die strandveld van die weskus met bv. Euclea racemosa, Zygophyllum morgsana en Pterocelastrus tricuspidatus.

Die pangedeelte sal spesiale aandag kry in die opname vanweë die seisoenale invloei van water en die eilande wat gevorm word. Hierdie eilands is die broeiplekke van die watervoëls en dit is as sulks nodig om te weet presies wat hulle habitatsvereistes vir nesmark is. Die water wat die pan vul is afkomstig van die Papkuilsrivier, waarvan die mond ongeveer 50 jaar terug na die see afgesluit is en die stroom na Rocherpan gedflekteer is. In goeie jare stoot die water verder noord as die grense van die reservaat en daarom sal die opnames ook buite die grens gedoen word om "n geheelbeeld te kry van hierdie waterekosisteem. Suid van die Papkuilsrivier is daar ook "n reeks soutpanne wat miskien soortgelyk was aan Rocherpan voordat hierdie pan water gekry het van die Papkuilsrivier, en dit sal dus interesant wees om die twee pangedeeltes met mekaar te vergelyk.
Die Braun-Blanquet phytososiologiese opnamemetode sal gebruik word met spesiale verwysing na die struktuur van die plantegroei.

Gradient analyses

15. Gradient analysis of the vegetation of the mountain catchment areas of the Southern Cape and the Tsitsikamma Forest Regions

Four study areas were selected covering gradients in Southern Cape mountain climate and vegetation. Two areas each were located on the inland (Swartberg Pass in the west, Baviaanskloof Mountains in the east) and two in the coastal ranges (Robinson's Pass, Outeniquas, west and Stormsriver, Tsitsikamma, east). Each area is a band up to 6 kms wide from southern to northern foothills on Table Mountain Group geology. Areas are stratified in six altitudinal belts and four relevés randomly located within each belt. Floristic, structural and environmental data were recorded at each relevé. Altitudinal gradients and north/south and east/west variation in floristic and structural features will be compared by classificatory and ordination techniques.

Eight permanent sites have been located on each transect, covering altitude and aspect variations. These provide data on ecosystem processes, faunal communities (G.J. Breytenbach) and additional structural features. Features so far studied include foliage profiles, litter accumulation, phenology of representative life forms, leaf duration of selected Proteaceae, species area curves and soil profiles. Weather stations have been established in each study area and additional data on temperature and rainfall on an altitudinal gradient is collected in the Swartberg.

16. Comparative studies of the avifaunas of different fynbos plant formations

This study aims at broad definition of avian ecology in fynbos. Plots of 21 ha were marked out in six homogeneous study areas of, respectively, immature Montane Fynbos, mature Protea Fynbos, Coastal Fynbos, Coastal Renosterbosveld, West Coast Strandveld and Coastal Bush/Strandveld. Birds are censussed on a monthly basis along 600 m of transect in each plot, giving a primary census area of 3 ha/plot. In addition, niche data, primarily breeding and feeding activity, are recorded within the plot on census days and occasionally at other times.

Botanical data on the plots are gathered concurrently. A detailed structural analysis is being performed on all plots in representative 100m^2 sub-plots, recording projected canopy cover of 12 growth forms, vegetation profiles and floristic composition. Phenology data are collected on a monthly basis.

Coding of the data has begun. The preliminary fieldwork phase is scheduled to end in 1979, when a year's uniform data have accumulated for each plot. Various correlation analyses will be performed by computer.

17. A gradient analysis of animal communities on forest lands in Southern Cape and Tsitsikamma Forest Regions, and Surveys and assessments of the fauna of forest and land catchments in the Southern Cape and Tsitsikamma Forest Regions

Eight study sites at each of four study sites are being monitored to determine the response of certain faunal elements to an altitudinal gradient.

1. (a) Small mammals: Small mammals are being sampled by using 50 Sherman live traps and 50 snap traps in two separate 10 x 5 grids at each sample site.

   (b) Species diversity and density is being determined from the results.

   (c) Stomach analysis and food preference trials are being used to determine plant utilisation and possible niche separation.

   (d) Animals captured live at different altitudes will be used to determine differential energetic requirements.

2. Birds: Birds are being monitored with bird nets (25 nets (25 metres) at each site.

   Counts are also being done from vantage points, all birds seen and heard within an estimated 1 ha area.

3. Arthropods: Arthropods are being sampled by using sweep nets (100 sweeps) and by beating (5 min.). Pitfall traps baited with either banana or faeces or meat are also being used.

<u>Surveys and assessments of the Fauna of Forest land catchments in the Southern Cape and Tsitsikamma Forest Regions</u>

The whole Southern Cape is being monitored. All animals that are identified either by sampling or observation are plotted on 10 maps of the area.

SESSION 4. Community analyses

18. Vegetation dynamics within and between fynbos and adjacent biomes

The Eastern Cape is a region of spectacular vegetational overlap which provides a number of interesting tension zones between adjacent biomes. This region constitutes the north-eastern and eastern limit of the fynbos, where the biome has its interface with bushveld, highland sourveld and certain karooid vegetation types.

The aim of this project is to define the limits of fynbos communities in this region and to determine how these limits relate to environmental gradients. I intend to do this by charcterising fynbos and adjacent vegetation types in terms of floristic, structural and functional attributes; investigations of phytochorological relationships between fynbos and the adjacent vegetation types, especially in terms of the extent, direction and rate of vegetation change as a result of past and recent land-use practices.

19. Analysis of Coastal Fynbos/ Strandveld communities on the Cape Flats

Initial projects are of a general nature owing to the distinct lack of information on the ecology of plant communities in coastal fynbos and strandveld. In the near future these will form the basis for more detailed work in certain spheres.

On-going projects in the Cape Flats Nature Reserve include shooting, flowering and fruiting phenology in some 25 common species, and a BB survey of plant communities. Projects on the Cape Flats consist of a preliminary investigation of phytomass of dune scrub species; with correlation of shrub parameters with above ground phytomass (for non-destructive phytomass studies) and a description of communities which are threatened by development or with invasion by alien vegetation: monitoring of rate of encroachment by Acacia saligna.

Projects planned for the near future which are largely dependent on acquisition of sufficient funds, include phytomass (above and below ground parts) of dune scrub vegetation and; primary production, litter fall and litter decomposition studies in dune scrub species.

20. Experimental investigations of the effects of season of burn of fynbos communities in plot trials at Kogelberg: studies on community structure and function and the immediate response of communities to treatment

The aim of this project is to determine the influence of fire in different seasons on community structure in the broad-sclerophyllous shrublands of the Southern mountains. Treatments include spring, summer and autumn burns and are applied to 8 plots each up to 50x50 m in size. The relatively small number of plots available precluded a random experimental design of the classic kind, and inferences from results will be based on analysis of time trends. Replicated treatments (the summer burn is not replicated) are staggered over three years, beginning 1976.

Six plots have been treated, and the last will be burnt in the coming autumn (one serves as a 'control'). The pretreatment measurement programme includes princ-pally a botanical analysis by means of a sample of 2 x 2 m^2 quadrats, and an analysis of above-ground biomass by means of a combination of allometric and clipping quadrat samples. Cover is recorded by means of

low-level vertical photography.

Treatments are accompanied by measurements of available fuel and of fire spread, and hence of fire intensity. Change in the vegetation will be followed by means of repetitive samples for botanical composition, cover and biomass.

The experiment has yielded useful data on the structure of fynbos communities and on fire behaviour. It is possible to gather preliminary information on community response to treatment now.

A phenological study in a fynbos community in Swartboskloof, Jonkershoek State Forest

Phenological studies were initiated with the aim of establishing the essential features of seasonality in fynbos plant communities, principally because this is necessary in order to understand the differential effects of fire in different seasons.

Tagged individuals of a number of representative species of a typical fynbos community were monitored for phenophase over a 24-month period. Shoot elongation in three dominant species of Proteaceae has been measured over a similar interval. The field programme will be terminated shortly and results compiled in a report.

Process studies

21. Studies on phosphorus cycle in the fynbos biome

Fynbos vegetation appears to grow successfully under conditions of very low nutrient status and preliminary studies show low phosphorus levels when compared with data for soils of European heathlands and Australian forests.

Phosphorus turn-over will be studied in selected Fynbos communities by determining soil phosphorus levels (eg. total phosphorus, organic phosphorus) and levels of organic and inorganic phosphorus in the vegetation.

Levels of phosphorus and uptake of ^{32}P in specific elements of the Fynbos vegetation (eg. selected species of the Restionaceae, Ericaceae and Proteaceae) will be studied at various stages of growth and senescence to determine whether Fynbos plants efficiently conserve phosphorus.

The function of specialised root systems such as mycorrhizal and proteoid roots with respect to (a) nutrient storage, (b) active absorption of nutrients from the soil and (c) mineralization of insoluble phosphates by surface phosphatases will be considered.

22. A preliminary study of mineral cycling and the distribution of soil micro-organisms in the fynbos biome

Work will be initially concentrated on investigating the seasonal fall of plant litter in fynbos of different ages (growth measurements of certain dominant plants will be taken concurrently), together with the seasonal distribution of microorganisms at different depths within the soil profile. Organic matter, soil moisture, temperature, pH and total carbon will also be monitored at different depths, and attempts will be made to correlate

the data with microbial distribution and activity. Activity within the soil will be measured by means of ATP analysis and the production of carbon dioxide.

Plant litter will be collected, and the rate of decomposition and colonization by microorganisms will be assessed. At a later stage of the project, the extent of mycorrhyzal associations and the occurrence of specialised root systems will be investigated.

23. Dendrographic studies of the water relations of the fynbos

This project is still at the stage in which equipment is being tested in the glasshouse. Experimental investigations have been conducted and there are promising results to hand.

Stem contractions in woody plants and light intensity can be shown to be closely linked. (i) The initial stem contractions are linearly related to light intensity until a light saturation point is reached.
(ii) The quantity of light needed to reach saturation is constant. Therefore the time at which saturation occurs is determined by the environment, especially the amount of cloud present.

During this pre-saturation phase, (iii) transpiration is directly proportional to stem contractions or stem strain as it is termed.

After the light saturation phase, conditions are more complex and have not been studied in detail yet.

Plants studied are Ficus retusa, Carcia papaya, Poinsettia sp. and Cestrum sp.

24. A study of interception loss in mature Hakea sericea Schrad stands, and
A study of the water balance of a plantation of Pinus radiata and of fynbos at the Jonkershoek Forestry Station: rainfall interception and soil moisture fluctuation

Rainfall interception has been studied in four stands of Pinus radiata at Jonkershoek and field work is complete. Interception data was collected manually. Preliminary analysis of data for Biesiesvlei has been collected and results are summarised. Linear, multiple and curvilinear regressions have been fitted to the data. No work has been done on soil moisture fluctuation. Automatic data capture is considered essential for measurement of interception in hakea and fynbos. A complete automatic weather station with additional raingauge channels will also be used for this purpose. Large capacity tipping bucket guages will be built to take throughfall and streamflow. The experimental site for hakea interception will be at Banhoek, and for fynbos at Swartboschkloof.

25. Theoretical analysis of the subsurface water regimes of experimental catchments in the Western Cape Forest Region

The programme UNSAT 1 (Neuman, 1972) was used to simulate the drainage of water from a uniform soil on the hillslope so as to investigate the effects of extraction of water from the unsaturated zone. The results indicate that transpiration losses from the unsaturated zone may be a contributory cause of the daily fluctuations of streamflow encountered at Jonkershoek.
It is planned to continue the study of methods of solution of soil water flow problems during 1979.

SESSION 5. Animal ecological studies

26. Coevolutionary consequences of pollination of selected fynbos plants by birds in fynbos

Attention is focused on flowering phenologies of Erica species, and the shape, size and colour of the flowers in relation to the temporal and spatial incidence of sunbirds in mountain fynbos, along a transect from sea level to 1 000 m.

Hypotheses for relationships between Erica species and sunbirds are enumerated, and descriptions are given of methods which are being used in the collection of data for testing various assumptions.

27. The ecological impact of wild and domestic large herbivores on selected Fynbos communities

Initially, attention will be focussed on patterns of resource partitioning on a site (farm) in the Bokbaai-Yserfontein district of the west coast. Sheep are presently being grazed continuously on approximately 800 ha of strandveld (Acocks NO. 34) ecotonal to coastal macchia (Acocks No. 47). No antelope have apparently been shot on this farm for over 40 years. Sightings of grey duiker Sylvicapra grimmia, Cape grysbok Raphicerus campestris will be mapped in order to quantify habitat preferences, while exclusion plots should yield information on the plant preferences of both antelope and sheep. Simultaneously, information will be collected on daily and seasonal grazing and browsing activity. Eventually this information may be assembled into energy budgets for these animals.

An essential part of the project is a qualitative/ quantitative study of the dynamics of the major components of the vegetation. This includes monthly phenological observations of shoot and root activity; at least of the predominantly browsed/grazed plants. Macro and micro-climatic data will be a useful aid to further understanding the vegetation dynamics.

28. Surveys and assessments of the fauna of western Cape mountain catchments

The original purpose of the project was to document basic zoo-geograhpic information, which would also be of value for conservation, on the distribution of mammals in State forests. The Western Cape administrative region has been covered in the initial phase. In this region most of the areas support fynbos. Methods have involved interviewing experienced staff for records of medium- and large-sized mammals. Additional field records have been collected by student survey parties who have also extended the scope of the work in a few areas to include small, mammal trapping records. Interpretation of the data will be delayed until information on vegetation types becomes circulable in the course of the fynbos project.

29 a) Habitat ecology of the klipspringer Oreotragus oreotragus in the Cape Province

This project, which is nearing completion, deals with basic aspects of the biology of klipspringer, such as social organisation, feeding behaviour, and population structure, around the central theme of the animals remarkable adaptation to rocky mountain habitat. This information will enable us to manage populations on a more scientific basis. The main study areas were in the Gamka mountain near Oudtshoorn and in the Namaqualand near Springbok, with additional observations at Zachariashoek, near Paarl and Augrabies Falls. Competition with other mountain herbivores, especially dassies, was also studied and at Gamka some observations were made on habitat preferences of Vaalribbok, grysbok and steenbok and their overlap with klipspringer.

b) An ecological study of the leopard Panthera pardus in the Cape Province

This study, which will start later this year, has two rather conflicting themes, the leopard as an endangered species and the leopard as a problem animal. The most important aspect is to gain some idea of the numbers of leopards in the Cape and what trends the population is showing. As yet we have little information on the basic biology of the leopard in the mountains, so studies such as day-to-day and seasonal movements, food searching behaviour and social factors should shed light on the periodical and often disastrous attacks on domestic stock. Some understanding of the abundance and seasonality of the leopard's natural food resource must be gained. The study areas have not yet been decided on.

30. Population ecology of the striped fieldmouse Rhabdomys pumilio on the Cape Flats including their dependence on invasive Acacias

Fieldwork was commenced in April 1972. A live trapping control grid of 10 x 6 stations, with stations 10 m apart, was established on a farm 24 km east of Cape Town in alien vegetation consisting of rooikrans and Port Jackson willow. Regular monthly live-trapping was conducted for four nights and days during the last week of each month from July 1972. All animals captured were marked and released. Kill trapping was conducted simultaneously in a separate area. From February 1975 to February 1976, live-trapping was conducted in a large grid of 96 stations which surrounded the control grid on three sides (the fourth side bordered the Kuilsriver). This was primarily an attempt to detect dispersal from the control grid. A prime food source for the mice were the seeds of the alien acacias. An experimental grid was established adjacent to a control grid in March 1976. The food supply of seeds to the mice was monitored on these two grids by the use of seedfall bags placed under the trees and cleared at the end of each month. In addition, the seed available in the leaf litter was measured by means of 0,25 m^2 quadrats. On the experimental grid supplementary food was supplied in the form of Epol rat cubes in order to test whether shortage of food in the winter could account for the decline in numbers of mice at that season. Predation by mongooses was investigated by mark-release methods and by systematic collection and analysis of mongoose scats for rodent remains (chiefly hair). The fieldwork was terminated in July 1977

31. A study of the ecology of the geometric tortoise Psammobates geometricus

Psammobates geometricus, the geometric tortoise, is one of the rarest tortoise species in the world. It is confined to the coastal fynbos of the

SW Cape. Its decline may be attributed solely to habitat destruction, and it exists now in fewer than a dozen localities from Strand in the south to Porterville in the north. Tortoises from all populations have been marked and released. Information on growth rates and population sizes is accumulating steadily. The object of the study is to provide biological data relevant to management, for example, the resistance of tortoise populations to fire, and their relationship with grazing animals.

32. Distribution and status studies of problem taxa:
a) A distribution, status and feeding habit survey of the larger birds of prey and vultures in the Cape Province

The first phase of this project, viz. the postal survey of all land-owners, has been completed and the results are in the final stages of being written up. Altogether 12 birds, 8 eagles and 4 vultures, were covered by the postal survey and of these only three species of eagle, viz. the Black, Crowned and Fish Eagles, are likely to be found in or close to the Fynbos areas. Similarly only one species of vulture, viz. the Cape Vulture, is likely to be found in the area covered by the fynbos.

A certain amount of ground trailwork has been carried out on the postal survey results and this has indicated that the Black Eagle is relatively common in areas of suitable habitat in the south-western and southern Cape. This species is directly persecuted by certain farmers while birds are frequently caught in gin traps set for mammalian predators. Nevertheless it appears that there is a reasonably healthy population of mated, territorial Black Eagles in the areas mentioned mentioned above outside of the Eastern Cape. The Crowned Eagle is found in the Southern Cape in the area between George and Patensie where it appears to be scarce, this probably due to evergreen forest destruction to make way for commercial timber cultivation. It appears that this species has also been the subject of direct and indirect persecution in the Southern Cape. The Fish Eagle is a relatively common species in the South Western and particularly the Southern Cape. It is frequently found in most areas of suitable habitat such as dams, lakes, river courses and at certain estuaries along the coast. This species is not directly persecuted by man but habitat destruction or disturbance may affect the population.

The Cape Vulture used to be fairly common throughout the South Western and Western Cape but the population has now dwindled to approximately 100 birds. Many earlier breeding sites have declined to roosts or become disused. The last remaining regularly breeding colony, at the Potberg, Bredasdorp district, is rapidly declining as a major breeding site in the Cape Province and with only 12 nests active in 1978 appears close to extinction.

At present the Cape Department of Nature Conservation is data banking information on all raptors throughout the province and it is hoped to be able to monitor, to some extent, any population fluctuations that may take place. This is an on-going project with periodic trend assessments.

b) The distribution, status, feeding habits and reproduction of carnivores of the Cape Province

Distribution information has been collected from museums, literature and active collection, and maps following the $1/4^{\circ}$ system have been compiled for each species. Status has been assessed and one species Lycaon pictus is now known to be extinct in the Cape Province. Felis serval is virtually extinct and a number of species have been found to have limited ranges and their status will have to be regularly monitored.

The majority of carnivore species are however considered to be safe despite heavy pressure from problem animal control measures.

The feeding and reproductive aspects of the study are designed merely to give a general idea of feeding preferences of the different species in the major habitat types and to what extent certain species do in fact prey on domestic stock. The reproductive aspects have allowed us to determine the breeding seasons, litter sizes and information on population composition and the rate of growth of some species.

As a result of certain findings, an intensive survey of the serval position is in progress and recommendations for the establishment of a leopard 'safe zone' have been put forward. An intensive ecological study of Felis caracal is to start from 1979 - it will include detailed home-range and movement studies and the accumulation of other information.

c) A study of the Chacma baboon Papio ursinus in the Cape Province

This study, based at the De Hoop Provincial Nature Reserve, Bredasdorp Division, forms part of a larger ecological study of the baboon in the Cape Province. Essentially the project consists of a capture, mark, release and observation routine, in which 142 individuals have been marked thus far, in at least three different groups. The object of the exercise is to establish the population growth rates of each group and to determine whether any differences exist between groups which more or less confine their activities to natural veld on the reserve and groups which to a greater extent utilize neighbouring farmlands with the hypothesis being that those living on the reserve itself will represent the closest approximation to a naturally stable population, despite a probably lowered level of predation by larger carnivors, whereas those that utilize agricultural lands could show a faster turn-over within its population due to a stimulated birth rate countered by a higher mortality rate since they are more likely to be shot (at an earlier age) because of their activities. Hopefully this will then put us in a position to inform agriculturalists at what rate control, where necessary, should take place ie on a sustained yield basis.

d) 'n Studie van die orde Chiroptera in die Kaapprovinsie

Tot voor hierdie projek is daar 33 spesies Vlermuise in die Kaapprovinsie beskryf waarvan sowat 7 endemies was tot die fynbosarea. Geeneen van die vorige opnames is sistematies uitgevoer oor die hele Kaapland om die verspreiding en veral die status van elke spesies akuraat te bepaal nie.

Met hierdie projek word beoog om enersyds die populasie dinamika en migrasie-gewoontes van 'n paar spesies te ondersoek om sodoende 'n idee te kry van die werklike rol wat die orde in die natuur speel. Dit is beslis so dat hulle rol geweldig onderskat word deur veral die breë publiek. Andersyds word beoog om 'n effektiewe verspreiding en statusopname oor die hele Kaapprovinsie van alle soorte te doen om sodoende te probeer vasstel watter spesies relatief skaars en bedreig is, sodat voldoende beskermingsmaatreëls getref kan word om hulle voortbestaan te veseker.

Hierdie orde behoort 'n belangrike rol veral in die fynbosgebied te speel en behoort beslis 'n uitwerking op ander komponente te hê.

Die projek is op 'n gevorderde stadium en behoort teen die einde van 1979 afgehandel te wees.

SESSION 6. Autecological and related studies - plants

33. Investigation of the population dynamics, germination and establishment of Orothamnus zeyheri Pappe.

Critically low numbers of Orothamnus in the Kogelberg State Forest resulted in the Department of Forestry altering their management practices, in an attempt to stimulate the regeneration of this species. The Botanical Research Institute was approached to monitor the reaction of this species to various treatments.

The aims of the project are: (i) to locate as many populations as possible; (ii) to monitor their dynamics - numerically and developmentally; (iii) to make phenological observations, and (iv) to measure habitat features.

This project was started in 1968. The state of affairs at the end of 1978 is reported on.

34. Investigation of the population dynamics of Widdringtonia cedarbergensis Marsh and its interaction with fire

This project was initiated with the objective of studying critical features of reproduction and growth of Widdringtonia cedarbergensis in relation to the incidence of veld fires, since the effect of fire is the most controversial aspect of conservation of the species.

Earlier attempts at field experiments were abandoned when the trial plots which had been monitored for about five years, were burnt out during wildfires. However, a better picture of fire survival and of germination and growth is emerging from the long-term programme of monitoring on these and other plots. Most data have been summarised in a recent report.

The programme of field research has as yet not clarified several important questions. Germination and establishment in nature is highly unpredictable. Most attempts at artificial re-establishment have failed. Autecological studies, aimed at determining the set of environmental conditions which determine establishment and successful growth, are seen as priority requirements, as is the study of the influence of small mammals on establishment.

Present management aims at fuel reduction in cedar areas through low-intensity prescribed burns, to prevent recurrence of disastrous fires like those of 1975. This is accompanied by a programme of ground monitoring by means of small format air photography and survey. A detailed map of the distribution of the species is currently in preparation, mainly from black and white air photographs.

35. Aspekte van die minerale voeding van Acacia saligna

Ten spyte van simptome van vergiftiging by hoë soutkonsentrasies (NaCl), is 'n hoë mate van soutbestandheid aangetoon, selfs by jong plante vóór die ontwikkeling van fillodes.

'n Lae behoefte aan N en 'n groot mate van gevoeligheid teenoor hoë Mn-konsentrasies is aangetoon.

36. The influence of different soil moisture regimes on growth, water relations and chemical composition of members of the proteaceae

Impact of landuse on ecosystem processes

37.(a) Die vasstel van die invloed van bestuursmaatreëls op die kwaliteit van water in die eksperimentele opvanggebiede van Jonkershoek, Zachariashoek en Jakkalsrivier.

Die waterkwaliteit studie is in die begin 1971 te Zachariashoek begin en in 1974 uitgebrei na Jonkershoek.

Die studie by Zachariashoek behels die insameling van 7 stroom en 2 neerslag monsters by spesifieke punte oor die hele opvanggebied. Die doel van die studie is om vas te stel wat die invloed van beheerde brand, in November, met rotasie van 6 en 12 jaar teenoor totale beskerming van fynbos op die kwaliteit van die water is.

Die waterkwaliteitstudie te Jonkershoek poog om inligting te verskaf in verband met die invloed van kaalkapping van 10 jaar oue uitheemse denne op die kwaliteit van die water. Hier word weekliks sewe monsters getrek.

Weekliks word pH en geleidingsvermoë lesings van die monsters gedoen terwyl volledige ioonontledings op maandelikse monsters uitgevoer word.

Na brand van die opvanggebiede, in November 1978 is die eerste twee spitsafvoergebeurtenisse deeglik bemonster.

'n Verslag in die vorm van 'n publikasie oor beheerde brand se invloed op die kwaliteit van water by Zachariashoek sal gedurende die komende jaar voltooi word.

37 (b) Die vasstel van die invloed van beheerde brandstelsels soos toegepas in fynbos op stroomafvoer-komponente van eksperimentele opvanggebiede te Jonkershoek, Zachariashoek en Jakkalsrivier

Die studies is in 1965 te Zachariashoek en Jakkalsrivier begin.

Die doel van die studie is om vas te stel wat die invloed van beheerd brandsisteme op stroomvloei is. By Zachariashoek word in November brand toegepas op twee opvanggebiede met rotasies van 6 en 12 jaar. Die kontrole opvanggebied se natuurlike plantbedekking word beskerm. Beheerde brande is reeds in 1971 en 1977 uitgevoer. By Jakkalsrivier word 'n brandbehandeling in September en Maart met siklusse van 5 en 10 jaar in 5 opvanggebiede toegepas. Beheerde brande is reeds in 1969, 1970, 1974 en 1975 uitgevoer.

Die fynbos in drie kontrole opvanggebiede word beskerm. Slikmetings word in al die opvanggebiede gedoen.

Die behandeling van Abdolskloof, Jonkershoek het reeds in 1941 'n aanvang geneem. Die siklusse hier van toepassing varieer van 4 tot 13 jaar. Die maand van brand kan lente, somer of herfs wees.

Weerkundige gegewens word by al die eksperimente ingesamel.

Die dataverwerking van die onderskeie subprojekte is gedoen. Op die stadium word geen ontledings vir die komende jaar beplan nie. Data-insameling en verwerking sal voortduur.

37 (c) Bepaling van die invloed van die vervanging van beskermde fynbos met plantasies van Pinus radiata op die stroomafvoerkomponente by die Jonkershoek Bosbounavorsingstasie

Die eksperiment by Jonkershoek omvat die aanplant van Pinus radiata van 'n opvanggebied elke agt jaar. Vyf opvanggebiede is beplant vanaf 1940 tot 1972. Die sesde opvanggebied se fynbos word sedert 1942 beskerm. Die laasgenoemde opvanggebied dien as 'n kontrole. Die beboste opvanggebiede word op 'n 40 jaar rotasie bestuur.

Stroomvloei en weerkundige gegewens word ingesamel. Die stroomvloei rekord word afgebreek na vloedvloei, sugwaterafvoer, totale vloei en dampverliese. Die stroomvloei van die behandelde opvanggebied word as afhanklike veranderlike en weerkundige gegewens dra by tot 'n verhoogde verklaring van variasie in stroomvloei. 'n Onlangse studie het aangedui dat die gemiddelde afname in stroomvloei na bebossing by Biesievlei 300 mm/jaar was. Die maksimum afname in stroomvloei is 16 jaar na bebossing waargeneem. Daarna het vloei konstant gebly, alhoewel daar voorlopige aanduidings van 'n toename waargeneem kan word.

38. Investigation of the effects of community structure and mineral balance of clearfelling of Pinus radiata in Bosboukloof catchment, Jonkershoek Forestry Research Station

The Bosboukloof catchment is 58 percent afforested with Pinus radiata and is to be clearfelled between 1979 and 1981. Effects of afforestation on streamflow have been monitored since 1937. The impact of clearfelling on the plantation ecosystem is being studied on a multidisciplinary basis. Aspects of study, past, present, and projected are summarised. With regard to nutrient cycling a study into litter fall and decay rates is well advanced. The annual litter return rate in mature pines is 3,5 - 4,0 tonnes ha^{-1} yr^{-1} of which needles form 70 percent. Nutrient return in needles is 50 kg ha^{-1}. The standing biomass is calculated at 255 tonnes ha^{-1} and annual litter return is therefore 1,5 percent of standing mass. Needle decay was 25-30 percent in the first year while branches and cones show a 2-3 percent breakdown.

39 (a) The influence of mountain catchment declaration on land management in the Groot-Winterhoek area of the Western Cape: ecological, economic and social implications.

It is proposed to analyse the ecological, economic and social implications of the declaration of private land as mountain catchment areas in terms of the Mountain Catchment Areas Act, (No. 63 of 1970), and to develop a method of assessing alternatives with a view to determining optimum land use combinations and land management practices.

The need for control over land use practices in mountain catchment areas is discussed. Control by prescription or expropriation are considered and discussed as alternatives. The question of land values is posed and some proposals made as to how these values may be determined. Two factors are playing an increasingly important role in mountain land evaluation, namely; presence of saleable natural plant material on the one hand and purely aesthetic appeal on the other.

39 (b) Distribution and abundance of invasive alien plants in mountain catchments of the Western Cape forest region

The objective of this study is to determine and map distribution and abundance of invasive alien plant species in mountain catchments, in order to assess the extent of the problem and plan the necessary control measures.

The method of obtaining information on alien species as part of a comprehensive field survey of each mountain catchment area is briefly described. Use of air photographs and problems of interpretation are mentioned. Results of a completed survey of the Cedarberg catchment area and two surveys still in progress, of the Groot-Winterhoek and Hottentots Holland mountain catchments, are sketched.

SESSION 7: Impact of Fire on Communities

40. Investigation of the effects of burning and protection on the structure of fynbos in experimental catchments at Jonkershoek, Jakkalsrivier and Zachariashoek Research Stations

The complex of cathment experiments at Jonkershoek, Zachariashoek and Jakkalsrivier include extensive areas of fynbos subject to different burning regimes and therefore offer a range of opportunities for study of the ecological effects of burning.

An analysis of the recovery of plant communities after the first cycle of a six-year rotation burning regime on fynbos communities at Zachariashoek has recently been completed. Data were obtained from repeated observation on a sample of fixed plots. Very little change in the overall composition of the vegetation was apparent.

Little work has been executed on the vegetation at Jonkershoek, except that populations of selected species have been monitored for reproduction and survival over the last five years. Investigations comparing the effects of short rotation burning with those of complete protection from fire will commence soon. This study is expected to last for about two years, and valuable information is expected.

The study at Jakkalsrivier is essentially a replication of the experiments at Zachariashoek and Jonkershoek in an area representative of the southern catchments, but also aims to test the influence of burning season. A plant community monitoring programme began in 1967. Sub-catchments were burnt in spring 1969 and autumn 1970. Two selected for short-rotation treatment were burnt again in 1974 and 1975, but all are due for retreatment in the coming spring and autumn. Field sampling, due shortly, will complete a 10-year quantitative analysis of plant succession in the area.

41. The effect of veld burning on small mammal populations in fynbos, with special reference to Jonkershoek and Zachariashoek

This project aims to follow up results of preliminary studies in fynbos which indicate considerable differences between the species composition and especially density of bird and mammal populations in areas subjected to different burning regimes. It would be closely integrated with the proposed project "Effect of fire regime on fynbos plant community structure and dynamics: survey of responses in Jonkershoek and elsewhere" in order to relate animal responses to measured changes in plant communities. Data would be gathered mainly at the same sites selected for that project. In essence it aims

(i) to test the hypothesis that frequently burnt fynbos is more productive as an animal habitat than long protected stands

(ii) to establish successional trends in species composition and population density following burning, partly by examining changes on newly burned areas over a two year period and partly by comparisons between sites of

different known age. Effects of environmental gradients and season will have to be separated from those of burning frequency.

(iii) to explore reasons for observed responses of animal communities, relating them to vegetation changes determined by the botanical study mentioned above. Effect of season of burn, changes in cover and in quantity and quality of plant foods will require particular attention.

(iv) While it would be desirable to include all vertebrates and invertebrates present in the study, this would be impractical. Attention will be concentrated on mammals, which are relatively readily trapped. Previous work suggests that densities are generally low and there is no certainty about the most effective trapping methods to ensure sensitive reflection of changes which may be slight and subtle. The project would therefore involve a preliminary comparison of different traps, baits and sampling layouts. Incidental observations on other vertebrate groups and on invertebrates will be made whenever possible.

42 Study of the origin, occurence and spread of fynbos fires and controlling effects of weather as indicated by available records

A survey of all fires occurring on Forestry land during one calendar year is being undertaken by means of questionnaires. Information being gathered includes weather and fuel data, cost breakdowns and fire behaviour characteristics for prescribed burns. Causes and behaviour of wildfires under weather conditions will also be investigated.

It is hoped to devise a fire danger rating based on weather forecasts. Such a rating is important for the application of prescribed burns as well as for control of the public. To date little progress has been made. A report will be prepared on completion of the questionnaire survey (31 March 1979).

43 The role of fruit- and seed-eating birds as dispersors of seeds in relation to colonization by plants of burnt areas of fynbos

This is a one-year study which has been launched at the Lebanon Forest Reserve in rather varied montane fynbos to monitor the role of fruit- and seed-eaters in the regeneration of fire-destroyed fynbos. Four transect-lines of 200 m (i.e. 1 ha belts) are censused in the same way as in the 21 ha fynbos comparative study plots, on a monthly basis. Niche data is also gathered in the same way as in the comparative study.

The transects lie in plots of 4-30 ha which are aged respectively 3-4, 8-9, 8-9 and 19-20 years post-burn. They were burned either in March or November.

In addition, a 600 m transect was marked out in the Silvermine Nature Reserve in a 20 ha plot containing dense Leucadendron stands. This plot was cut and burned completely in June 1978. A few censuses and niche data observations were carried out there before the burn, and regular monthly census/niche visits after the burn are being made.

The data will be analyzed in a similar way to the comparative fynbos study at the end of 1979.

Invasive Plants

44. Aspects of the distrubution and antecology of Hakea

A national distribution map of the three introduced Australian pest hakeas, Hakea sericea, Hakea gibbara and Hakea saaveolens, is nearing completion. The map will be of use in day-to-day research and management of mountain catchment areas. The map will help in the identification of areas threatened by pest hakea invasion.

The phenology and growth of the three pest hakeas has been studied at two field sites. The first site, had three age groups of Hakea sericea and the second site although having only one age group had all three pest species. The measurements were taken over a year and are complemented by weather data for both sites. Special note was taken of root and branch development in nursery seedlings as these characters could not readily be studied in the field. This contributes towards the understanding of ecology hakea.

A method of estimating fruit production has been derived. This method will be of great use to biological control workers who can use the method to estimate the success of their introduced Australian insects.

45. Survey of the Western Cape coastal lowland alien vegetation

The survey of the Cape coastal foreland vegetation is to include a survey of the alien vegetation, invasive in the natural veld, to provide more accurate information as to their distribution, species composition, cover and development.

Field distribution data of species will be collected within transects of the overall vegetation survey, while extrapolation from, and interpretation of, available orthophoto maps and aerial photographs, together with incidental field observations, will fill in the gaps and be the basis for measurement of alien vegetation cover.

Comparison of orthophoto maps and aerial photographs, taken at different times, will provide information as to the development

of alien populations, the susceptibility of various communities within veld types to, and the influence of veld disturbance on, alien invasion.

Shortcomings of the method used, such as the recognition of aliens on orthophotomaps and aerial photographs, quality and date of photography are recognised.

46. Invasive plants in the Cape of Good Hope Nature Reserve - a comparison of the extent of invasion over 10 years

During 1966 and 1967 when the senior author was doing field work for the vegetation survey of the Cape of Good Hope Nature Reserve, an assistant carried out a concurrent survey of the extent of infestation by invasive plants. The re-survey of invasives after "ten" years, still in progress, will be briefly reported on.

47. Aspects of the population biology of invasive Acacias

Research priorities were dictated by the needs of those working in the fields of biocontrol, veld management, education and ERTS/photo interpretation.

Acacia cyclops, A.longifolia, A.melznoxylon and A. saligna, all pests in the S.W.Cape, were selected for detailed study and observations were made on other introduced species.

A phenological study showed that the flowering times of the various species are discrete. The duration of bud and pod bearing differed greatly between species, but pods of all species ripen and release seed during the dry season. These events are presented for all species on a simple chart for easy reference. (Fig. 1.)

The study species grew throughout the year, with a maximum growth rate in spring. During their second year, saplings may grow three metres in height and produce their first seed crop.

Large stores of viable seed (1500-8200 seeds/sq. metre) are found in the soil under Acacia thickets. About 2% of these germinate annually and substantial quantities remain two years after burning and clearing.

A taxonomic study of A.cyclops, A.longifolia, A.saligna and possibly A.dealbata is planned for 1979. Seed and phyllode samples have been collected throughout the distribution ranges in South Africa. Morphological study of phyllodes and seedlings, gel electrophoresis of seed proteins, cytology and possibly serology and anatomy, will be used to determine the variability within and between populations. Local and Australian material will be compared.

The results of this study should assist in the selection of organisms for biological control.

48. Leptospermum laevigatum Navorsingsprojek

a) Werk wat reeds voltooi is:

I 'n Verspreidingskaart: Die verspreiding wat kol-kol is, is hoofsaaklik tot die Weskaap met een of twee verspreidingsgebiede in die omgewing van Humansdorp.

II 'n Vergelykende studie van die hout en blare van Suid-Afrikaanse en Australiese materiaal - word gepubliseer in Aust. Jl. Bot.

b) Navorsing wat nog gemonitor word:

Verspreidingstempo
Groeitempo
Saadproduksie

c) Beoogde navorsing vir 1979.

I Bepaling van suikers en proteiene in sade. Hierdie projek mag moontlik verder uitgebrei word deur dit te vergelyk met Australiese Materiaal.

II Fosfaat- en stikstofinhoud van plante met die nywerheidsgebied Milnerton as middelpunt.

49. Aspects of the chemical control of Pinus pinaster Ait. and Hakea sericea Schrad.

Self sown Pinus pinaster can be killed by making an axe cut or a drilled hole on either side of the tree and treating each with ½ ml (axe) or ¼ ml (hole) of Reglone herbicide. The wounds should be angled into the sapwood to ensure retention of the herbicide. The cost of treatment, excluding labour which could be largely voluntary and unpaid, is unlikely to exceed one cent per tree.

Although the problem of self-sown Pinus pinaster is a formidable one, the use of this technique should allow for its resolution provided an adequate controlling organisation is created.

Reglone treatment of pines should be confined to the summer/autumn until results from winter/spring trials become available.

Promising results have been obtained from a trial in which a mature Hakea sericea stand was sprayed with 3, 6, 9 and 12 litres Roundup* herbicide per ha. Conclusive results cannot be made at this stage, but 10 months after application it appears that the lowest rate of application is insufficient, but the three heaviest rates of application will eventually kill the hakea. If successful, a block burn after the released seeds have germinated and follow-up work should be an effective measure of control at a total current cost of approximately R115/ha (for 6 litres Roundup/ha). The best season for spraying, based on three ground sprayings, is autumn.