

**9TH ANNUAL RESEARCH MEETING
OF THE
FYNBOS BIOME PROJECT**

Saasveld School for Forestry
23,24 and 25 June 1987



**9DE JAARLIKSE NAVORSINGSVERGADERING
VAN DIE
FYNBOSBIOOMPROJEK**

Saasveld Skool vir Bosbou
23,24 en 25 Junie 1987

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NATIONAL PROGRAMME FOR ECOSYSTEM RESEARCH
TERRESTRIAL ECOSYSTEMS SECTION

FYNBOS BIOME PROJECT : 1987 ANNUAL RESEARCH MEETING

INTRODUCTION

The Fynbos Biome Project of the National Programme for Ecosystem Research is one of several national scientific programmes administered by the CSIR. The National Programme is a co-operative undertaking of scientific bodies in South Africa concerned with research related to environmental problems. It includes research designed to meet local needs as well as projects being undertaken in South Africa as contributions to the international programme of the Scientific Committee on Problems of the Environment (SCOPE), the body set up in 1969 by the International Council of Scientific Unions (ICSU) to act as a focus of non-governmental international scientific effort in the environmental field.

The Fynbos Biome Project forms part of the activities of the Committee for Terrestrial Ecosystems of the National Programme for Ecosystem Research. It aims to provide the fundamental knowledge needed for the optimum use of natural communities by man. It is a joint undertaking of scientists from the Department of Agriculture and Water Supply, the Cape Provincial Administration, the CSIR, the Department of Environment Affairs and the three western Cape universities. As far as possible, participating organizations finance their own research within the Project. University research is financed from a central fund administered by the National Committee for Ecosystem Research and contributed largely by the Department of Environment Affairs.

The overall and ultimate objective of the Project is to **provide sound scientific knowledge of the structure and functioning of constituent ecosystems as a basis for the conservation and management of the fynbos biome**. At the outset of the Project it was intended that the objective would be realized by:

- synthesizing available knowledge in order to identify major gaps;
- stimulating and coordinating existing research in order to optimize present efforts;
- giving priority to the urgent launching of new research in order to gain a deeper understanding of:

- the major natural influences which control the distribution, structure and functioning of ecosystems within the biome, as well as
- the effect of major disturbances, especially fire and invasive weeds, on these systems. The results of these studies would be used to predict the effects of land management practices.

The research programme of the Fynbos Biome Project was divided into three phases: Phase I - baseline studies of the fynbos biome; Phase II - comparative studies of component ecosystem structure and functioning; Phase III - validation studies or testing of Phase II hypotheses and models.

Formal coordination at an inter-organizational level is provided by the Steering Committee, while informal contact between field workers is maintained through workshop meetings, seminars, etc. As the Project has developed over the years, annual research meetings have become a major mechanism for bringing all parties together for an exchange of progress reports, research plans and the review of programme goals. The ninth such meeting will be held from Tuesday, 23 to Thursday, 25 June 1987 at the Saasveld School for Forestry near George.

The Organizing Committee for the annual research meeting has decided not to adapt a specific theme for the 1987 meeting. Contributed papers have been grouped into the categories reproductive biology, ecophysiology, microbiology and disturbance. Poster papers will be grouped into similar categories. A separate group of posters will deal specifically with the Swartboskloof burn experiment.

The Organizing Committee decided that a field trip with participation by everyone would be preferable to the passive show-and-tell situation. It was also felt that the field trip should be structured around a general theme, but not so tightly structured as to suppress creativity. To this end it has been decided to investigate the general theme of island biogeography and boundary dynamics of the so-called "fynbos islands" near Knysna.

About eight islands will be selected as study sites. Participants will be divided into working groups composed of researchers with different fields of specialization/interest. Groups will make their basic data available to all other groups on the evening of the field day. The following morning, groups will present a synthesis of all their information and all other additional information they may have collected. The main aim of the field trip is interaction.

PROGRAMME

Monday 22 June 1987

- late afternoon Arrival
- 17h30 REGISTRATION (R10,00 per person for teas and conference literature. Lunch included in daily rate for those staying in the School for Forestry, otherwise R5,60)
- Speakers to give their slides to the secretariat.
- 18h00 SUPPER

Tuesday 23 June 1987

- 07h00 BREAKFAST
- 07h30 LATE REGISTRATION
- 08h00 INTRODUCTION
 Mr F J Kruger
 Director: South African Forestry Research Institute

Session I : Reproductive biology

- Chairman : Mr D C le Maitre
 Jonkershoek Forestry Research Centre
- 08h10 FAKTORE IN DIE NATUUR WAT DIE ONTKIEMING VAN SAAD VAN
LEUCOSPERMUM CORDIFOLIUM BEÏNVLOED
 R Pool
 Jonkershoek Natuurbewaringstasie
 G J Brits
 Protea Research Centre
- 08h25 DISCUSSION

- 08h35 SHORT-DISTANCE SEED DISPERSAL IN THREE SEROTINOUS CAPE
PROTEACEAE
G J Brits
Protea Research Centre
- 08h50 DISCUSSION
- 09h00 RESPONSE OF WATSONIA FOURCADEI TO FIRE
J H J Vlok
Saasveld Forestry Research Centre
- 09h15 DISCUSSION
- 09h25 POPULATION STUDIES ON SELECTED SOUTH COAST DUNE FYNBOS SPECIES
S M Pierce
Department of Botany, University of Cape Town
- 09h40 DISCUSSION
- 09h50 REPRODUCTIVE STRATEGIES OF PLANTS IN RELATION TO THEIR
RE-ESTABLISHMENT
R S Knight
Department of Botany, University of Cape Town
- 10h05 DISCUSSION
- 10h15 **TEA**

Session II : Ecophysiology

- Chairman : Ms N Allsopp
Department of Botany, University of Cape Town
- 10h45 AN INVESTIGATION OF PHOTOSYNTHETIC C-FIXATION IN SELECTED
FYNBOS GROWTH FORMS AND ITS VARIATION WITH SEASON AND
ENVIRONMENTAL CONDITIONS
F van der Heyden and O A M Lewis
Department of Botany, University of Cape Town
- 11h00 DISCUSSION
- 11h10 SOIL AND FOLIAR NUTRIENTS IN THE WESTERN CAPE - EMERGING
PATTERNS AND SOME APPARENT ANOMALIES
A B Low
Cape Flats Nature Reserve, University of the Western Cape
- 11h25 DISCUSSION
- 11h35 THE EFFECTS OF NUTRIENT ADDITIONS ON SAND-PLAIN LOWLAND FYNBOS
VEGETATION AT PELLA, SOUTH-WESTERN CAPE
E T F Witkowski
Department of Botany, University of Cape Town
- 11h50 DISCUSSION

Session III : Microbiology

Chairperson: Ms N Allsopp
Department of Botany, University of Cape Town

- 12h00 PROTOZOA IN TWO SWARTBOSKLOOF SOILS: ARE THEY IMPORTANT AS MICROBIAL PREDATORS?
M A Loos and P H de Koker
Department of Microbiology and Virology, University of Stellenbosch
- 12h15 DISCUSSION
- 12h25 WHAT IS PHYTOPHTHORA CINNAMOMI DOING IN THE FYNBOS?
S L von Broembsen
Plant Protection Research Institute
- 12h40 DISCUSSION
- 12h50 LUNCH

Session IV : Poster presentations

- Chairman: Dr H J van Hensbergen
Department of Nature Conservation, University of Stellenbosch
- 14h00 Poster presentations
- 15h00 TEA (poster presentations continued)

Session V : Disturbance

- Chairman: Mr P T Manders
Jonkershoek Forestry Research Centre
- 15h30 THE RESPONSE OF MOUNTAIN FYNBOS ECOSYSTEMS TO PHYSICAL DISTURBANCE
G W Davis
Botanical Research Institute
- 15h45 DISCUSSION
- 15h55 HYDROLOGICAL EFFECTS OF CONTROLLED BURNING IN FYNBOS EXPERIMENTAL CATCHMENTS
S R Juhnke
Jonkershoek Forestry Research Centre
- 16h10 DISCUSSION
- 16h20 RESPONSE OF INDIGENOUS VEGETATION TO ACACIA CYCLOPS ON THE WESTERN CAPE COASTAL LOWLANDS
M C Rutherford and J de W Bösenberg
Botanical Research Institute

16h35 DISCUSSION

16h45 THE EFFECTS OF ALIEN PLANTS AND FIRE ON AVIAN COMMUNITY
STRUCTURE IN MOUNTAIN FYNBOS
M W Fraser
Percy FitzPatrick Institute of African Ornithology, University
of Cape Town

16h55 DISCUSSION

17h30 BRIEFING FOR FIELD TRIP

18h00 SUPPER

19h30 SLIDE AND VIDEO PRESENTATION : SWARTBOSKLOOF EXPERIMENTAL BURN
MARCH 1987

Wednesday 24 June 1987

06h30 BREAKFAST

Field trip : Island biogeographical theory

Chairman: Mr J J Midgley
Saasveld Forestry Research Centre

07h30 Departure

16h00 Return. Working up of results

18h00 Basic data available

18h30 **SOCIAL FUNCTION** (braai - weather permitting)

Thursday 25 June 1987

07h00 BREAKFAST

08h00 Report-back from field trip by working group leaders

10h30 TEA

Session VI : Biogeography and evolution

Chairman: Mr W J Bond
Saasveld Forestry Research Centre

11h00 FYNBOS IN RELATION TO THE TROPICAL AFRICAN VEGETATION TYPES
H P Linder
Bolus Herbarium, Department of Botany, University of Cape Town

- 11h20 DISCUSSION
- 11h30 WHY ADAPTATIONISM WITHOUT PHYLOGENISM IS LIKE AN EGG WITHOUT SALT
J J Midgley
Saasveld Forestry Research Centre
- 11h50 DISCUSSION
- 12h00 NUTRIENT AND WATER STRESS AS SELECTIVE FORCES IN THE EVOLUTION OF THE FYNBOS AND KWONGAN FLORAS
W D Stock
Department of Zoology and Entomology, University of Natal
- 12h20 DISCUSSION
- 12h30 CLOSING COMMENTS
W J Bond
Saasveld Forestry Research Centre
- 12³⁰
13h00 LUNCH
- 14h00 DEPARTURE

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ABSTRACTS OF PAPERS

1. SHORT-DISTANCE SEED DISPERSAL IN THREE SEROTINOUS CAPE PROTEACEAE

G J Brits

Protea Research Centre, Tygershoek Experimental Farm, RIVIERSONDEREND, 7250

The appendages of most achenes of serotinous Cape Proteaceae suggest that they are adapted to long-distance dispersal. Four point seed sources were established on 1 and 9 May 1985 on mesic mountain fynbos soil, sterilised by 25 years of pine forest occupation and subsequent burning. Each seed source contained three serotinous Proteaceae, *Leucadendron salignum* Berg, *Protea neriifolia* R Br and *P. repens* (L) L. The seed sources consisted of defoliated 10 yr old plants obtained from adjacent fynbos stands. These were staked upright at 60 m intervals and left to dry and disperse their seeds, thus simulating the effects of fire. Dispersal occurred towards the north-west and south-east. This dispersal pattern was roughly the inverse of the wind distribution pattern of especially the first 14 days following the death of parent plants. Effective dispersal distances were short: the seedlings of all three species recruited at average maximum distances of less than 20 m from point sources, with 95% of recruitment occurring within 15 m of point sources on average. Topochory (short-distance dispersal) in serotinous Proteaceae is discussed as a possible adaptation to several stress syndromes of the Fynbos Biome.

2. THE RESPONSE OF MOUNTAIN FYNBOS ECOSYSTEMS TO PHYSICAL DISTURBANCE

G W Davis

Botanical Research Institute, Private Bag X16, RONDEBOSCH, 7700

Mountain fynbos land has historically been afforded protection from excessive human exploitation by its rugged topography and infertile soils. In recent years it has come to be viewed by the production side of the ornamental wild flower industry as a potentially valuable arable resource for the cultivation of commercially desirable indigenous species which, it is reasoned, are adapted to these infertile sites. Described here is a study aimed at quantifying and elucidating some of the ecosystem changes that can be induced in mountain fynbos by the physical disruption of tilling. Work at an experimental site in the Highlands State Forest Reserve near Grabouw has involved the rotavation of strips on land which had been cleared of its proteoid-restioid cover by fire, and the subsequent monitoring of its response by observation of selected parameters. Results obtained during the first two years after treatment indicate that the energy and water budgets, as well as the structure of the natural plant community, were all significantly altered by the perturbation of tilling. The long-term effects of soil disturbance, and the implications for both conservation and watershed management in mountain fynbos are considered and mooted for discussion.

3. THE EFFECTS OF ALIEN PLANTS AND FIRE ON AVIAN COMMUNITY STRUCTURE IN MOUNTAIN FYNBOS

M W Fraser

Percy FitzPatrick Institute of African Ornithology, University of Cape Town, RONDEBOSCH, 7700

A two year study of avian community structure was undertaken in mountain fynbos of the Cape of Good Hope Nature Reserve. Study plots were established in vegetation exhibiting degrees of infestation by alien woody plants (notably Acacia cyclops) and three uninfested fynbos communities (upland mixed fynbos, restionaceous tussock marsh) at three stages since burning (1,5, 5,5, >15 years).

Effects of alien infestation: The major effect of increasing alien infestation was the decline of nectarivores through the elimination of their food plants. No other feeding guilds showed a marked response to increasing alien infestation. Two frugivores implicated in the successful spread of A cyclops, redwinged starling and Cape bulbul, displayed no measurable response to the availability of the fruit or increase in density of this alien plant.

Effects of fire/veld age: The density of birds in the fynbos as a whole was low, with an average of 1,3 birds ha⁻¹. Twenty eight species were recorded overall and turnover between different ages of veld was high. Eleven species found in 1,5 year old vegetation were not found in >15 year old. A further eleven displayed the opposite trend and five were common to all ages. Density (1,8 birds ha⁻¹) and biomass (45,8 g ha⁻¹) were highest in the youngest veld. Nectarivores rose from a 1% and 2% contribution to biomass in 1,5 and 5,5 year old veld respectively, to 50% in >15 year old.

No bird species was found in all vegetation communities at all ages. Yellowrumped Bishop was absent only from 1,5 year old "plateau" vegetation and le Vaillant's cisticola was the most habitat-specific bird, occurring in only the two older "marsh" vegetation plots. This vegetation was the first community to regain its pre-fire height and structure with a correspondingly rapid re-establishment of the avian community. Most birds (1,23 ha⁻¹) were found in 15 year old "upland" vegetation, but at 80,1 g ha⁻¹ biomass was by far the greatest in 1,5 year old "plateau" vegetation.

4. HYDROLOGICAL EFFECTS OF CONTROLLED BURNING IN FYNBOS EXPERIMENTAL CATCHMENTS

S R Juhnke

Jonkershoek Forestry Research Centre, Private Bag X5011, STELLENBOSCH, 7600

Prescribed burning is presently accepted as a management tool for mountain catchment areas. The effects which controlled, man-made fires have on these areas are, however, not yet fully understood.

This paper addresses some of the hydrological effects of burning in fynbos catchments. The burning experiments of the Jakkalsrivier catchment near Grabouw in the southwestern Cape will be referred to specifically.

Streamflow records are analysed to determine the effects of different treatment burns on the flow regime. The treatments consist of different season and frequency of fires.

5. **REPRODUCTIVE STRATEGIES OF PLANTS IN RELATION TO THEIR RE-ESTABLISHMENT**
R S Knight
Department of Botany, University of Cape Town, RONDEBOSCH, 7700

The recruitment of plant species, with particular attention to bird-dispersed re-seeding species, was monitored in an artificially cleared area formerly dominated by mountain fynbos vegetation. Sampling was undertaken using 62 1m² quadrats, 27 of which were positioned under potential avian perches. Bird-dispersed re-seeding species accounted for 2,8% of the total number of recolonizing species. Individuals of these bird-dispersed species were best represented in sites occurring below perches. Woody and semi-woody non-vertebrate dispersed species had the highest representation of the total colonizing flora (38,5%). All plant species found to be colonizing the site were categorized into a reproductive/re-establishment classification similar in concept to the vital attributes classification of Noble and Slatyer (1980).

6. **FYNBOS IN RELATION TO THE TROPICAL AFRICAN VEGETATION TYPES**
H P Linder
Bolus Herbarium, Department of Botany, University of Cape Town,
RONDEBOSCH, 7700

The major vegetation types of sub-Saharan Africa (and in particular East and Southern Africa) are compared. An analysis of the effects of altitude, latitude and total rainfall on the vegetation type showed that (a) there is no simple rule of 'altitude recapitulates latitude' and (b) the southern and northern hemispheres in Africa are climatically highly asymmetrical. It is shown that the type of seasonality (equatorial bimodal, summer maximum monomodal and winter maximum monomodal) has a very strong influence, that is evident throughout the rainfall range. The northern, 'tropical' outliers of fynbos occur within the forest to alpine gradient, and so can be placed relative to the other tropical vegetation types. This allows some speculation on the 'position' of fynbos, from different initial assumptions than the classical climate-soils hypotheses. This analysis also allows for some comment on the use of the terms 'alpine', 'afro-alpine', 'montane' and 'temperate'.

7. **PROTOZOA IN TWO SWARTBOSKLOOF SOILS: ARE THEY IMPORTANT AS MICROBIAL PREDATORS?**
M A Loos and P H de Koker
Department of Microbiology and Virology, University of Stellenbosch,
STELLENBOSCH, 7600

Microbial CO₂ production by a granitic Glenrosa soil and a weathered sandstone Clovelly soil in Swartboskloof over a 2-year sampling period was correlated with moisture content, whereas microbial ATP in the soils tended to vary in the

opposite direction. We hypothesized that rapid development of predator and prey microorganisms in the moist soils might result in high respiratory activity, but that active predation might cause a net decrease in microbial cell material, including ATP. If the predators (mainly protozoa) declined rapidly during drying, the prey organisms might multiply, albeit slowly with slow respiration, to produce higher populations of cells and hence increased ATP.

Most probable number counts of active and encysted protozoa in the two soils during drying-remoistening cycles in the laboratory, showed rapid increases of the former and usually declines of the latter following remoistening of the soils. As the soils dried, the active protozoa declined rapidly while the cysts increased or showed little change. Numbers of aerobic bacteria by plate count also increased when the soil was remoistened and decreased slowly thereafter as the soil dried. In a limited study with the Glenrosa soil, microbial ATP showed the same trend. This ATP result, if confirmed, does not explain the long-term trends in soil microbial ATP in the field and further experiments with moisture regimes that more closely approximate the field conditions in different seasons are required.

8. **SOIL AND FOLIAR NUTRIENTS IN THE WESTERN CAPE - EMERGING PATTERNS AND SOME APPARENT ANOMALIES**
A B Low
Cape Flats Nature Reserve, University of the Western Cape, Private Bag X17, BELLVILLE, 7535

Analytical data from a wide cross section of soils in the Western Cape indicate a close relationship between soil type and geology. However, on the basis of 20 variables examined, soils could not always be classified into "nutrient rich" and "nutrient poor" classes.

Rather, soil fertility could be rated on the basis of foliar nutrient levels which in turn probably reflect the degree to which a substrate can supply nutrients to a particular plant species or community. Fynbos invariably displayed the lowest nutrient levels as opposed to Renosterveld and karroid vegetation, despite "overlaps" in soil nutrient status.

"Base-rich" substrates, given their universally high Ca and P contents, also demonstrated a dichotomy between high (Strandveld) and low (Fynbos) foliar nutrient levels.

The distribution of soil and vegetation groups in the fynbos biome is briefly discussed in the light of plant nutrient demand rather than absolute differences in soil nutrient status.

9. **WHY ADAPTATIONISM WITHOUT PHYLOGENISM IS LIKE AN EGG WITHOUT SALT**
J J Midgley
Saasveld Forestry Research Centre, Private Bag X6515, GEORGE, 6530

Adaptationism should be performed at the intraspecific level (population genetics); but a diet of this would be bland. However, rampant hyperadaptationism at the interspecific level is giving Darwinism a sour taste. I argue that a way to give meaning and spice to adaptationism, is by considering the history and relationships of the study taxa and their traits.

The subtle assumptions of adaptationists who use interspecific level data are;
1) all species are equally informative and thus get equal statistical weight and
2) number of species possessing a trait is a reflection of the importance of the trait. However, in Leucadendron, there is no relationship between the number of times a trait appears to have evolved and the number of species possessing the trait. Proportions of species within a taxon which exhibit a trait may thus be relatively uninformative.

10. **POPULATION STUDIES ON SELECTED SOUTH COAST DUNE FYNBOS SPECIES**
S M Pierce
Department of Botany, University of Cape Town, RONDEBOSCH, 7700

The study aims to determine the feasibility of using demography to predict the response of shrub populations to disturbance such as fire. Demography involves the measurement of changes in population size and their causes. Six species were selected to represent different guilds of small-leaved shrubs, each showing different life-history attributes which enable them to regenerate after disturbance. The species studied were Metalsia muricata, Muraltia suarrosa, Passerina vulgaris, Agathosma spiculata, A stenopetala and Felicia echinata, all of which regenerate after fire but show different degrees of longevity. Studies of life-history traits include phenology, seed production, soil-stored seed banks, germination, and seedling growth and survival. These stages are discussed in relation to environmental parameters (climate), biotic interactions (predation) and season of disturbance.

11. **FAKTORE IN DIE NATUUR WAT DIE ONTKIEMING VAN SAAD VAN LEUCOSPERMIUM CORDIFOLIUM BEÏNVLOED**
R Pool
Jonkershoek Natuurbevestigingstasie, Privaatsak X5014, STELLENBOSCH, 7600
G J Brits
Protea Navorsingseenheid, Tygerhoek Proefplaas, RIVIERSONDEREND, 7250

Dit is bekend dat groot getalle jong plante van lede van die Proteaceae onmiddellik na 'n herfsbrand in 'n fynbosstand verskyn. In verband met die redes daarvoor is daar al baie gespekuleer. Daar bestaan reeds sekere leemtes in verband met die faktore wat 'n stimulus vir ontkieming na 'n brand verskaf. Daar is dus sekere eksperimente uitgevoer ten einde lig op sodanige leemtes te werp.

Die invloed van ontblote areas op die ontkieming van saad van L cordifolium is in 'n onversteurde Protea repens-gemeenskap ondersoek. Die terrein is in drie dele, nl 'n onversteurde deel, 'n gebrande deel en 'n geskoffelde deel, verdeel. Saad van L cordifolium is in al drie areas geplant. Die resultate verskaf statistiese bevestiging vir die waarnemings dat saad wel ontkiem in ontblote areas wat na 'n brand ontstaan, maar nie in 'n onversteurde fynbosstand nie. Na aanleiding van die resultate van saad wat beide voor sowel as na die brand geplant is, blyk dit dat die direkte hitte van die brand nie 'n rusbrekende effek op die saad het nie.

Die invloed van grondfaktore op ontkieming is bepaal deurdat saad in kisties met sand in die natuur geplant is. Hieruit het geblyk dat die grondmedium waarskynlik nie 'n invloed op die ontkieming uitgeoefen het nie. Ander grondfaktore wat

ondersoek is, bv suurgehalte, ontbinde organiese materiaal, as na 'n brand en worteluitskeidings, het geen betekenisvolle verskille opgelewer nie.

Die invloed van daaglikse temperatuurspeling op ontkieming is ondersoek deurdat maksimum-minimum termometers in die natuur in al drie areas, nl onversteurd, gebrand en geskoffel, geplaas is. Hieruit blyk dit of die verskil in temperatuurspeling tussen die ontblote areas en die onversteurde fynbos 'n verklaring vir die verskil in ontkiemingspersentasies bied.

12. **RESPONSE OF INDIGENOUS VEGETATION TO ACACIA CYCLOPS ON THE WESTERN CAPE COASTAL LOWLANDS**

M C Rutherford and J de W Bösenberg

Botanical Research Institute, Private Bag X16, RONDEBOSCH, 7700

The response of indigenous plants to the pressure of the invasive alien plant species, Acacia cyclops, on selected sites of the western Cape coastal lowlands, is investigated. The effects are plant species specific and depend on the duration of exposure to the invasive populations. Patterns of response are related to changes in water, radiation and nutrient regimes as well as to indirect biotic effects.

13. **NUTRIENT AND WATER STRESS AS SELECTIVE FORCES IN THE EVOLUTION OF THE FYNBOS AND KWONGAN FLORAS**

W D Stock

Department of Zoology and Entomology, University of Natal, P O Box 375, PIETERMARITZBURG, 3200

The floras of mediterranean south-western Cape fynbos and Australian kwongan show a striking pattern of convergence of phylogenetically related and unrelated species to a common set of morphological, physiological and life-history traits. Selection forces responsible for convergent evolution and high species diversity of these floras include low edaphic nutrient availability, recurrent fire and climate changes. This paper attempts to explain the diversity of strategies of resource acquisition and allocation in terms of a minimum number of selection pressures. In particular, the role of nutrients and water stress in selecting the ecological groups (guilds) of species in these floras will be considered. The range of resource acquisition and allocation strategy present in these ecological groups is large and may include the formation of symbiotic associations, morphological or physiological modifications which improve resource uptake and allocation. An inductive a posteriori method is employed as this provides a first step in observing how organisms have met the challenges of different ecological circumstances over evolutionary times. Fynbos and kwongan appear to be floras that have evolved under predictable resource levels as the species life-histories found in these floras include long lifespans, high seedling mortality, low reproductive output, small soil seed pools and large high quality seeds. Although explaining life-history phenomena as outcomes of single or two selection pressures may obscure many explanations of life-history differences within and between species, our knowledge of plant physio-chemico processes is so incomplete that we are unable to formulate a precise phenotypic theory of natural selection in these floras.

14. **AN INVESTIGATION OF PHOTOSYNTHETIC C-FIXATION IN SELECTED FYNBOS GROWTH FORMS AND ITS VARIATION WITH SEASON AND ENVIRONMENTAL CONDITIONS**
F van der Heyden and O A M Lewis
Department of Botany, University of Cape Town, RONDEBOSCH, 7700

Field measurements of the diurnal variation in stomatal conductance, net photosynthesis and transpiration rate of Protea laurifolia Thunb, Thamnochortus lucens Pill and Erica plukenetii L were made from January to August 1986. All relevant environmental parameters were also monitored. Net photosynthetic rate was measured using an open-flow infrared gas analysis system. The shallow rooted species (T lucens and E plukenetii) experienced greater water stress and an earlier decline in carbon uptake with advancing drought than the deep rooted P laurifolia. Increasing water stress of the shallow rooted species also resulted in more severe midday depressions of net photosynthetic rate due to stomatal closure. During the winter months, atmospheric stress in the form of lower temperatures resulted in decreased rates of net photosynthesis. Results are discussed in relation to measured environmental parameters.

15. **RESPONSE OF WATSONIA FOURCADEI TO FIRE**
J H J Vlok
Saasveld Forestry Research Centre, Private Bag X6515, GEORGE, 6530

Hypotheses were set to test the adaptive significance of the mass flowering of Watsonia fourcadei after fire.

Comparative studies were done to determine to what extent flowering is stimulated by fire, and how the physiology of the plants is influenced by the post-fire environment.

Burnt plants were defoliated during the flower initiation phase. This was done to determine if stressed plants would stop sexual reproduction to prevent a possible negative balance in the storage reserves of the parent plants.

Results will be discussed in the context, that mass flowering after fire in geophytes is an adaptation to evade competition for light, water and nutrients in time.

16. **WHAT IS PHYTOPHTHORA CINNAMOMI DOING IN THE FYNBOS?**
S L von Broembsen
Plant Protection Research Institute, Private Bag X5017, STELLENBOSCH, 7600

Phytophthora cinnamomi, a destructive root pathogen, causes significant losses of proteas cultivated for cut-flower production in South Africa. The fungus is widespread in fynbos mountain catchments but is not causing appreciable mortality of the numerous susceptible plants (especially Proteaceae) found there. To investigate this apparent paradox, field trials were set out to compare the behaviour of the fungus in cultivated pincushion fields and in adjacent fynbos. Sporulation of the fungus in root-zone soil was examined in alternate months for one year at fynbos and cultivated sites near Kleinmond. Total sporulation was considerably less in fynbos than at cultivated sites. Fluctuations in soil

temperature and moisture were smaller and less frequent in fynbos than at cultivated sites, thus providing few periods suitable for sporulation in fynbos. The limited sporulation of P cinnamomi under the prevailing soil conditions in natural fynbos may be a significant factor contributing to the limited mortality of fynbos vegetation. The moderated sporulation of P cinnamomi in fynbos is consistent with the hypothesis that the fungus is an indigenous component of fynbos.

17. THE EFFECTS OF NUTRIENT ADDITIONS ON SAND-PLAIN LOWLAND FYNBOS VEGETATION AT PELLA, SOUTH-WESTERN CAPE.

E T F Witkowski

Department of Botany, University of Cape Town, University of Cape Town, RONDEBOSCH, 7700

The effects of nutrient additions on soil fertility, plant growth and nutrient uptake, and litter production in sand-plain lowland fynbos at Pella, south-western Cape, will be discussed in this paper.

A factorial fertilizer experiment was set up on four-year-old post-fire vegetation at Pella in September 1984. Nutrient treatments consisting of: (a) 0,5 g Phosphorus m^{-1} ; (b) 5 g Nitrogen m^{-1} ; and (c) 'balanced nutrients' (all other nutrient elements essential for plant growth) were applied at random onto 36 10x5 m plots. The concentrations in the soil of nitrate-, ammonium- and total nitrogen, resin-extractable-, Bray No 2- and total phosphorus, exchangeable calcium, magnesium and potassium and soil pH and organic matter were monitored over a two-year period. Shoot extension and inflorescence production of a proteoid shrub, Leucospermum parile (Proteaceae) and an ericoid shrub Phyllica cephalantha (Rhamnaceae) were monitored over the 1984/85 and 1985/86 growing seasons. Whole Thamnochortus punctatus (Restionaceae) plants were also harvested at the end of both seasons. Leaf, stem and inflorescence nitrogen and phosphorus contents were analysed in all three species as well as the nitrogen and phosphorus contents of the roots and rhizomes of T punctatus. Litter production was measured at bi-monthly intervals for two years and litter nitrogen and phosphorus contents were determined at each sampling period.

The results will be discussed in terms of the nutrient-poor status of the soil and the adaptations of the vegetation to seasonal and annual climatic variation.

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SUMMARIES OF POSTERS

1. **VESICULAR-ARBUSCULAR MYCORRHIZAL FUNGI OF A SAND PLAIN FYNBOS SOIL**
N Allsopp
Department of Botany, University of Cape Town, RONDEBOSCH, 7700

The spores of vesicular-arbuscular mycorrhizal (VAM) fungi were isolated from the root systems of legumes growing in clovelly sand from Pella.

Spores of three Endogonaceae genera were identified: Glomus, Gigaspora and Acaulospora. Three Gigaspora species are probably new species. The VAM fungal population at Pella is compared to VAM fungal populations from other regions.

2. **FYNBOS POLLINATORS**
G J Breytenbach and E Breytenbach
Saasveld Forestry Research Centre, Private Bag X6515, GEORGE, 6530

We present the results of a two year study in coastal mountain fynbos of the southern Cape. The major objectives were:

1. To identify the most important insects active on flowering plants in mountain fynbos and to assess relative pollen loads.
2. To show whether these agents are affected by the presence of Hakea sericea.
3. To test the hypothesis that floral diversity in the fynbos is a function of pollinator fidelity.

3. **STREAM STUDIES AT SWARTBOSKLOOF**
D Britton, M P Henshall-Howard and J A Day
Freshwater Research Unit, Department of Zoology, University of Cape Town,
RONDEBOSCH, 7700

For the past three years, the physico-chemical and biological conditions of the Swartboskloof stream in the Jonkershoek Mountains have been monitored by the Freshwater Research Unit. The programme aims to investigate the effects of catchment burning on stream biology and chemistry. To date, the burning of the the Swartboskloof catchment, though imminent, has not yet taken place. The poster presented illustrates results of pre-burn studies on this mountain stream.

4. **THE ABERRATION OF POST-FIRE VEGETATION REGENERATION DUE TO SOIL DISTURBANCE**
G W Davis and A Flynn
Botanical Research Institute, Private Bag X16, RONDEBOSCH, 7700

A stand of mesic mountain fynbos characterized by Leucadendron xanthoconus and Chondropetalum hookerianum was subjected to a summer burn, followed by strip rotation during the next winter period. This poster illustrates quantitatively the differences between the natural pattern of revegetation, and that occurring on adjacent tilled soil during the first two years after the experimental treatment.

5. **MONITORING EROSION IN FYNBOS: THE POTENTIAL OF HEURISTIC MODELS**
D C Grey
Saasveld Forestry Research Centre, Private Bag X6515, GEORGE, 6530

The ability to distinguish when erosion exceeds the long-term geological rates or when management actions transgress natural thresholds, is critical for catchment conservation.

Knowledge-based systems represent a new approach to capture scarce expertise, to deal with uncertain, untrue and incomplete data and to improve consistency in decision making.

Consultation or diagnostic based expert systems using a variety of knowledge representation and inference techniques offer exciting possibilities to help evaluate erosion rates. Current research is concerned with developing a prototype expert system.

6. **AN ENDANGERED GLADIOLUS**
T Greyling
Foundation for Research Development, CSIR, c/o University of Cape Town,
RONDEBOSCH, 7700
E R Ashton
Cape Town City Council, P O Box 1694, CAPE TOWN, 8000

Recent monitoring of a rare species of Gladiolus, G jonquilliodorus in the south western Peninsula, has shown the population to be seriously threatened by acacia invasion and housing development. An illustrated description of the situation is given.

7. **SURVIVAL AND TURN-OVER OF ALIEN ACACIA SEED BANKS**
P M Holmes
Department of Botany, University of Cape Town, RONDEBOSCH, 7700

Seed germination, survival and viability were determined for Acacia cyclops and A saligna at Pella (33° 30'S 18° 32'E, a sand plain fynbos site with a predominantly winter rainfall of 630 mm pa). Seeds were buried under rodent enclosures at 4 depths in the sandy soil (1, 5, 10 and 15 cm) and destructive samples removed after 3, 6, 12 and 24 months).

Percentage germination and decay both increased with depth of burial, but optimal germination depth was 5 cm for A cyclops and 10 cm A saligna. Losses to the seed

bank were much greater for A cyclops than A saligna: at 1 cm only 32% versus 87% remained after one year, and only 12% versus 82% remained after 2 years. Seeds persisting after one year thus have a greater probability of remaining dormant in the soil than fresh seeds. Predictions for seed bank turn-over are based on the 1 cm results as these most closely mimic conditions of newly recruited seeds. In the absence of post-dispersal seed predators, A cyclops seed banks accumulate more gradually than those of A saligna.

8. ACACIA SALIGNA - A COMPETITIVE ADVANTAGE?

J J Jackelman

P O Box 10416, Meerensee, RICHARDS BAY, 3900

A B Low

Cape Flats Nature Reserve, University of the Western Cape, Private Bag X17,
BELLVILLE, 7535

The 'physiological hypothesis' states that the alien plants in the fynbos biome are likely to be more efficient at resource capture than fynbos species. Nutrient enrichment by Acacia saligna may be one of the factors enabling it to change, degrade and replace original vegetation. Preliminary investigations of three sites in the W Cape (shale, acid sand, calcareous sand) showed major differences in vegetation composition and soils, while adjacent A saligna dominated communities at each site displayed greater height, litter layer and to some extent soil nutrient status over their indigenous counterparts.

In this study the effect of A saligna infestation on the three soil types was examined with respect to the relative changes in soil nutrient status down the soil profile (to a depth of 40 cm). The soil differences were most apparent with regard to organic matter (OM) and nitrogen (N) due to the high litter input and N-fixing abilities of A saligna. The differences in OM and N were most evident in the top 10 cm where the bulk of litter accumulation occurs. The pattern of fine root distribution corresponded closely to the pattern of OM and N. At each site pH levels in the A saligna infested sites were consistently shifted towards a neutral pH, thus enabling optimal nutrient uptake by the acacias.

Modification of the soil nutrient status by A saligna was most marked in the shale derived soils.

Management options for control of Acacia infested sites and future research needs are also presented.

9. EFFECTS OF DRY HEAT ON SEED GERMINATION IN SELECTED INDIGENOUS AND ALIEN LEGUME SPECIES IN SOUTH AFRICA

D J Jeffery and P M Holmes

Department of Botany, University of Cape Town, RONDEBOSCH, 7700 and
A G Rebelo

Percy FitzPatrick Institute of African Ornithology, University of Cape
Town, RONDEBOSCH, 7700

The effect of dry heat on the percentage germination, germination rate and lethal temperatures of selected legume species was investigated by exposing seeds to

different intensities and durations of heat. Two alien invasive legumes (Acacia saligna and A cyclops) and two indigenous legume species: Podalyria calyptrata, which is a fynbos species, and Virgilia oroboides, a forest precursor, were tested. Results were compared to a priori predictions based on published accounts of the species' ecology. A saligna and P calyptrata fitted predictions: high percentage germination, high germination rates and a tolerance to high temperatures; with A saligna outperforming P calyptrata in the latter two responses. Both A cyclops and V oroboides did not conform to predictions: dry heat had little positive effect on germination, and in A cyclops it had a negative effect.

10. REPRODUCTIVE BIOLOGY OF CHRYSANTHEMOIDES MONILIFERA IN SOUTH AFRICA AND AUSTRALIA
R S Knight
Percy FitzPatrick Institute of African Ornithology, University of Cape Town, RONDEBOSCH, 7700

Fruit production, seed-dispersal, seed-storage and seedling establishment of Chrysanthemoides monilifera were studied in the southwestern Cape, and the results compared to those found in Australia (Weiss 1983). Fruit crops of local plants were approximately 11% smaller than those occurring in Australia. The proportion of seed falling to the ground is locally smaller due to higher seed-predation. Unlike Australia, local soil-stored seed banks are virtually non-existent. A higher percentage of that seed falling to the ground germinated under local conditions (8%) than in Australia (2%). Local seedling survival is also 10 times greater. It is concluded that the invasiveness of C monilifera in Australia is due to escape from seed-predators rather than being ideally suited to their environment.

11. PLANT-WATER RELATIONS IN SCLEROPHYLLOUS TREES AND SHRUBS FROM RIPARIAN AND NON-RIPARIAN HABITATS IN SWARTBOSKLOOF
F J Kruger
South African Forestry Research Institute, P O Box 727, PRETORIA, 0001
D M Richardson and R Smith
Jonkershoek Forestry Research Centre, Private Bag X5011, STELLENBOSCH, 7600

Plants of riparian habitats, in which no drought is experienced, will tend to differ from those of non-riparian habitats in terms of functional features governing their water relations. These differences have been examined in a comparative field study of species in Swartboskloof, Jonkershoek, involving five riparian forest species and six non-riparian fynbos species.

Hypotheses about patterns of stomatal behaviour, leaf and wood anatomy, and water-use efficiencies in relation to habitat and climate periodicity are presented, as well as the initial results of studies directed at partial tests of these hypotheses. Results reported include those for water potentials, stomatal conductances, and transpiration rates in relation to soil moisture potential and vapour pressure deficits. Aspects of anatomical and morphological differences are also included.

12. INITIAL OBSERVATIONS ON THE REGENERATION OF PLANTS AFTER THE FIRE IN SWARTBOSKLOOF
D C Le Maitre
Jonkershoek Forestry Research Centre, Private Bag X5011, STELLENBOSCH, 7600

The Swartboskloof catchment was burnt on 17 and 18 March 1987. The regeneration of geophytes and selected plant species in the Proteaceae has been observed and recorded. The first plants to produce new leaves were a number of the grasses and geophytes such as Watsonia pyramidata and Aristea africana, with new growth on a few grasses already evident three days after the fire. Cyrtanthus ventricosus was first seen in bud on 30 March, 13 days after the fire, and was in full flower by 7 April. An Othonna spp and Oxalis purpurea were also flowering on 8 April. New buds were found on the lignotubers of Mimetes cucullatus on 3 April and 95% of the tagged plants of this species and 11% of the tagged Leucadendron salignum plants had sprouted by 13 April. Emergent seedlings of M cucullatus and Protea neriifolia were first found on 18 and 25 May respectively.

13. OPTIMIZING THE CONTROL OF ALIEN WOODY PLANTS IN THE FYNBOS
I A W Macdonald
Percy FitzPatrick Institute of African Ornithology, University of Cape Town, RONDEBOSCH, 7700
C Wissel
Fachbereich Physik, Philipps-Universität, Marburg
R S Knight and P Holmes
Department of Botany, University of Cape Town, RONDEBOSCH, 7700

Data on the costs and efficacy of a range of control measures for Acacia cyclops and A saligna were collected at Pella, the fynbos research site, during 1985. Using these data to give transition probabilities and cost per individual plant treated, it is possible to model the fate of a population of alien plants given all combinations of different control measures in initial and follow-up clearing programmes. By simultaneously inserting the appropriate values for the costs of these different procedures, the total cost of each of the clearing programmes can be calculated. An optimization procedure allows the cheapest combination of sequential control measures to be selected. The model allows for different densities, size class distributions and ratios of coppiced to uncoppiced plants in the initial plant population. Similarly one can vary the density and size class distribution of the target population and the number of years in which this target is to be achieved. The potential this procedure has for increasing the efficiency of alien plant control in the fynbos is stressed.

14. A CENTRIFUGING METHOD FOR THE REMOVAL OF INSECT POLLEN LOADS
D B MacGillivray and J H Giliomee
Department of Entomology, University of Stellenbosch, STELLENBOSCH, 7600

The insect pollination of eight selected Erica spp occurring in Swartboskloof, Stellenbosch, is being studied. The Erica spp comprise E articularis, E curvirostris, E caffra, E grandiflora, E intervallaris, E plukenetii, E nudiflora and E sphaeroidea.



In the study it was necessary to remove all the pollen grains from each individual insect caught on the ericas listed. A process whereby the pollen is centrifuged off the insect was developed, displacing the laborious method of brushing the pollen off each individual insect by means of a fine brush.

Valuable information on aspects such as the identity of the major host plant, generalist or specialist foraging behaviour of pollinators and the quantity of pollen carried by individual insects, can be obtained using this process.

15. **INITIAL EFFECTS OF FIRE ON FOREST CANOPIES IN SWARTBOSKLOOF**

P T Manders

Jonkershoek Forestry Research Centre, Private Bag X5011, STELLENBOSCH, 7600

Three sets of transects were established after the March 1987 fire, from within the Rapanea melanophloeos-Cunonia capensis high forest community on the main Swartboskloof stream into the adjacent Rhus angustifolia-Restio sieberi tall closed shrubland fynbos. The volume of the component species canopy and the effect of the fire on the canopy were estimated on each set of transects. These initial effects of the fire on the canopy are presented. Data on the recovery of the canopy will be collected later in 1987 and used to answer the questions now posed.

16. **A RARE ERICA FROM THE LANGEBERG**

D J McDonald and E G H Oliver

Botanical Research Unit, P O Box 471, STELLENBOSCH, 7600

A rare species of Erica, E. barrydalensis L Bol in the section Pachysa has been rediscovered on the dry northern slopes of the Langeberg above Witbooisrivier, Cape Province. A brief, illustrated description of the species is presented together with a description of its habitat and a locality map.

17. **SEED BIOLOGY OF AGULHAS PROTEACEAE**

P Mustart

Department of Botany, University of Cape Town, RONDEBOSCH, 7700

The proposed work plan is to look at the effects of wild harvesting on viable canopy-stored seed banks and plant regeneration of two closely related species pairs: Protea obtusifolia (limestone) and P. susannae (alkaline sands) and Leucadendron meridianum (limestone) and L. coniferum (alkaline sands). Field germination trials of these species in their own soil types together with exact monitoring of environmental data will generate hypotheses on the conditions necessary for in vivo seed germination and seedling establishment. These hypotheses will, where possible, be tested by in vitro methods. Reciprocal transplant experiments will provide information on edaphic and environmental controls of the distribution of these species.

18. **CICEC : A DATAMANAGEMENT SYSTEM DEVELOPED BY THE CDNEC FOR RARE AND THREATENED SPECIES IN THE CAPE PROVINCE**
R Pool, C J Burgers and D F Laidler
Jonkershoek Nature Conservation Station, Private Bag X5014, STELLENBOSCH,
7600

The Cape Inventory of Critical Environmental Components (CICEC) is a data-management system for all rare and threatened species, habitats and plant communities in the Cape Province. It is an adaptation of a system developed by the Nature Conservancy in the USA to South African conditions. The system was designed in such a way that it will allow one to manage information on many different biological disciplines, ie plants, mammals, birds, fish, reptiles etc. It will initially be developed as a database for threatened plants. The management system involves both computerised and non-computerised components. The information in the database will be readily available to researchers and planners while retaining confidentiality of information on detailed localities of some severely threatened species.

CICEC has been developed to manage information on numbers, locality, threats, degree of protection and conservation status of all rare and threatened species as well as natural community types (habitats) and plant communities. An attempt will be made to conserve most species by conservation of the habitats and plant communities in which they occur. Only as a last resort should conservation, separate from the habitat or community, be considered.

The Proteaceae is being tackled as a test group. All available information is being transcribed onto manual forms and will soon be entered into the computer. Some field work will be done on priority species and conservation plans will be drawn up for every species explaining the present status and stating what actions must be taken to ensure the survival of the species in the future.

The ideal is to protect suitable habitats of all species that are not already protected adequately in existing conserved areas and in addition to persuade landowners to protect, voluntarily, the habitats and species that occur on their property. By achieving this we would be a step further on the way to the conservation of our heritage of genetic diversity.

19. **POPULATION DYNAMICS AND COMMUNITY STRUCTURE OF RODENTS AND INSECTIVORES (SMALL MAMMALS) IN COASTAL FYNBOS**
E Pretorius
Department of Zoology, University of the Western Cape, Private Bag X17,
BELLVILLE, 7530

Studies were undertaken during 1984 and 1985 on three areas in the Betty's Bay and Palmiet River areas to determine the small mammal community structure and population dynamics. Reproduction cycles were calculated and certain vegetation preferences found.

20. **PHOTOSYNTHESIS AND WATER-USE EFFICIENCY IN PROTEA REPENS AND BRABEJUM STELLATIFOLIUM (PROTEACEAE) DURING SUMMER IN SWARTBOSKLOOF**
D M Richardson

Jonkershoek Forestry Research Centre, Private Bag X5011, STELLENBOSCH, 7600

Diurnal patterns of net leaf photosynthesis and water relations were examined in two sclerophyllous species in contrasting environments of water availability during the summer of 1986/7 at Swartboskloof, Stellenbosch. Protea repens, a tall deep rooted shrub found on the lower mountain slopes away from streams, and Brabejum stellatifolium, a shrub or tree that is confined to the banks of perennial streams were studied.

The main object of the study was to test whether the more xeric conditions experienced by P repens would be reflected in the diurnal patterns of net leaf photosynthesis (NP). Water use efficiency (the instantaneous ratio of NP to transpiration) of the two species was determined to test the hypothesis that the hillslope species would exhibit greater water use efficiency than the riparian species because of the need to conserve water in the relatively dry environment.

Neither of the species experienced significant drought stress during the observation period. Midday xylem pressure potentials remained above -2.0 MPa. Stomatal closure at midday was more pronounced in P repens and resulted in depressed transpiration, leaf photosynthesis and water use efficiency at midday. With declining vapour pressure deficit after midday, conductance, photosynthesis and water use efficiency returned to early morning levels. In B stellatifolium the midday depression in stomatal conductance was not reflected in the daily curve of transpiration which followed closely the increase in evaporative demand to reach a peak at midday. Diurnal curves in water use efficiency are, however, very similar for the two species suggesting different mechanisms of water conservation.

21. **SPECIES-AREA RELATIONSHIPS IN CEDERBERG PLANT COMMUNITIES**

H C Taylor

Botanical Research Institute, P O Box 13, CLANWILLIAM, 8135

During the reconnaissance for a phytosociological survey of the Cederberg in the north-western part of the fynbos biome, optimal plot size was determined by means of a series of nested quadrats in different communities. The poster depicts the results of the investigation.

22. **HOME RANGES OF GENETS IN THE JONKERSHOEK VALLEY**

H J van Hensbergen

Department of Nature Conservation, University of Stellenbosch,
STELLENBOSCH, 7600

Genets have been radio-tracked in the Jonkershoek Valley since June 1985. The short-term home ranges of a number of genets are presented. The long-term home range of a single female which shifted its position several times during 15 months of tracking, is also shown.

23. **SMALL MAMMAL POPULATIONS IN SWARTBOSKLOOF, 1985-1987**
H J van Hensbergen
Department of Nature Conservation, University of Stellenbosch,
STELLENBOSCH, 7600

The preliminary results of two years of grid trapping of small mammals in Swartboskloof will be presented.

The relationship with vegetation structure will be discussed. The immediate effects of the March 1987 burn will be discussed.

24. **TORTOISES AND FIRE : CHERSINA ANGULATA AT THE CAPE OF GOOD HOPE NATURE RESERVE**
M G Wright
Department of Zoology, University of Stellenbosch, STELLENBOSCH, 7600

The aim of this study was to determine the effects of fire on tortoise Chersina angulata (Schweigger 1812) populations in mountain fynbos. Mortality of tortoises due to fire was investigated, as well as behavioral adaptations to ensure survival. The home-range of tortoises was investigated to obtain some idea of the rate of recolonization of burnt areas, and population densities in various ages of vegetation were compared.

Mortality due to fire was found to vary between rocky areas ($\approx 0\%$) and plains ($\approx 100\%$). Tortoises occurring in rocky areas appeared to actively seek protection in crevices and behind rocks, those occurring in open areas were exposed to fire, no shelter being available. Home-range of marked tortoises in four-year old vegetation was found to be one to five hectares (no distinction made between sexes). Population densities in four-year old vegetation were higher (two to six individuals per ha) than in one- and two-year old vegetation (zero to one individual per ha). Branch (Amphibia-Reptilia 5[1984]:43-55) suggests that C angulata population densities may be as high as 38 tortoises per ha in dune thicket. These results indicate that recolonization of burnt areas by tortoises is slow, due to limited home-range of adults and high mortality in areas of scant rock cover. Rock cover appears to be an important aid to survival of tortoises, particularly with short interburn periods.

It is concluded that in order to maintain populations of tortoises in plain-areas of mountain fynbos, burns should be planned so that the area burnt is small enough to allow recolonization from adjacent older vegetation, and enough time (16+ yrs) should be permitted between successive burns to allow viable breeding populations to become established.



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