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NEWS-LETTER OF THE SOUTH AFRICAN ASSOCIATION OF BOTANISTS
NUUSBRIEF VAN DIE SUID-AFRIKAANSE GENOOTSKAP VAN PLANTKUNDIGES

DIRECTORATE OF FORESTRY, DEPARTMENT OF ENVIRONMENT AFFAIRS (DIVISION OF FORESTRY RESEARCH): The Directorate has sent Forum the following report on its revised conservation research programme, 1982-1986.

1. INTRODUCTION

Conservation forestry is the field of activity that includes the management of natural ecosystems in the forestry sphere - mountain catchments, indigenous forests, coastal dunes, and associated ecosystems - for a sustained yield of benefits, as well as aspects of the management of industrial forests that relate to maintenance of non-timber resources such as water and native biota.

Conservation forestry research has the purpose of developing the ecological foundations for the management of such ecosystems, as well as the necessary management systems and techniques. This is to be achieved by undertaking original research directed at the problems in hand, by assembling and synthesising available knowledge, and by encouraging research by suitable individuals or institutions outside the Division. Apart from yielding the usual scientific publications, research should culminate in practical aids to management, such as field manuals and mathematical simulation models.

Traditionally, conservation forestry research has been placed in two categories, water conservation and nature conservation, equivalent to forest hydrology and forest ecology. This is a pragmatic arrangement but the two fields are integrated scientifically at the ecosystem level and in practical management.

This revision of the research programme consists of two parts: (a) the text in which the framework is established and goals stated in broad terms and (b) an appendix in which details of key programmes are presented as a list of projects and sub-projects, in the conventional manner but reorganised according to current needs.

2. WATER CONSERVATION

2.1 General. A predictive knowledge of the effects on the hydrology and nutrient

balance of land-use and management practices, and applied to both mountain catchments and plantation ecosystems, is crucial in South African forestry. This Division continues to take the lead in forest hydrological studies.

This program is concerned both with plantation ecosystems and natural moun= tain catchments. Principal problems are currently as follows:

(a) empirical data are needed for catchments in some bioclimatic zones not yet represented in the experimental network, especially those in the Southern Cape and afforested zones between the 800 and 1000 mm isohyets in the summer-rainfall area,

(b) an empirical and theoretical basis for determining spatial patterns in evapotranspiration is required, to solve the problem of riparian-zone management,

(c) lack of an improved model to calculate the hydrological effects of afforestation under various conditions, and especially to determine the effect on variability in water yield, rather than just the mean,

(d) development of water-balance models, with corresponding work on hydrological processes, has to be undertaken, and

(e) lack of information on the essential effects of mountain catchment and plantation management on sediment yield and nutrient loss.

2.2 Components of the programme.

2.2.1 Studies on the climatology of mountain catchments (project 1/03/07/12) This project aims to augment the national meteorological network to provide essential data for hydrological and ecological studies and for development of management systems. A major problem is that of understanding the spatial variations in rainfall and other climatic variables in mountain catchments, not only to allow improved hydrological modelling but also for forest fire hazard studies and the like.

2.2.2 Experimental studies into the effects of catchment management on streamflow in South Africa (project 1/03/07/11). This project includes classical catchment experiments, incorporating whole-catchment treatments as well as riparian-zone treatments. The objective is to provide empirical data on streamflow responses to management as well as a data base for trial and development of models. The experiments will demonstrate unambiguously what the effects of treatment are, and also provide water-balance data. Sub-projects exist for the study of afforestation effects, of influences of management of natural mountain veld, and statistical studies of general responses of streamflow components to management.

2.2.3 Hydrological process studies in afforested and mountain catchments of South Africa (project 1/03/07/05). Studies on key hydrological processes in the experimental catchments are undertaken for three purposes:

(a) Certain aspects of hydrological response to vegetation change require explanation to allow proper understanding and prediction of management effects; this applies especially where experimental results appear counter-intuitive. Overland flow is a case in point.

(b) Relationships between vegetation variables and important loss components must be determined to allow development of adequate models. This applies, for example, to interception losses.

(c) Water balance simulation models need to be applied to or adapted for the different kinds of catchment study, mainly for their heuristic value in hydrological and other fields of research.

Research in this project currently focuses on interception losses, on exploratory soil-moisture studies, and on development of a water-balance model for mountain fynbos.

2.2.4 Studies on the effects of management of afforested and mountain catchments on water quality, sediment yield and nutrient balance (project 1/03/07/04). The catchment experimental programme allows measurement of the response of water quality variables, sediment yields and nutrient concentrations to management measures such as forest harvesting operations and veld burning. The aims are twofold (a) to determine the magnitude and importance of the effects of specific management measures on water quality and sediment yield, and indicate changes in management that are required to ameliorate effects, and (b) to examine the likely magnitude of management effects on ecosystem nutrient pools, and hence on the long-term stability of managed ecosystems, especially with regard to burning in mountain fynbos and Drakensberg grassland.

2.2.5 Development of a hydrological decision model for management of afforested and mountain catchments in South Africa (project 1/03/07/13). Aids to simulate and assess the hydrological effects of land-use changes in and management of catchment ecosystems are required for (a) evaluation of afforestation projects, (b) choosing between catchment management alternatives, as between long-rotation and short-rotation veld burning, and (c) to accommodate such effects in the pro= cess of planning water resources development projects. These aids must pre= ferably allow prediction of hydrological effects but at least allow simulation of certain assumed effects. The minimum requirement is for a synthesised flow record for any given case, that realistically includes the effects of

variation in climate, topography and land-use, and provides data for season and other variation in flow as well as annual runoff totals. The hydrological simulation procedures would be available for use with cost-benefit analyses and other decision modelling techniques in aiding policy and management decisions.

The first requirement is to test the performance of currently used hydrological models against experimental results.

3. NATURE CONSERVATION

3.1 General. Managers in the Directorate of Forestry but also in other national organisations and other Southern African states are presently faced with a range of new problems as they extend scientific management over new areas, incorporate new goals in their programmes, and discover gaps in understanding as they monitor the effects of their decisions. These problems need to be solved not on an ad hoc basis but in a way that extends the set of general principles upon which management is based - the ecological foundation. Managers also require new methods and techniques, such as those of fire-hazard prediction, and research is necessary for their development. Also important, however, are the needs for education and training, and for this purpose appropriate knowledge must emerge from the research programmes and be synthesised in a way that is useful for instruction of managers, in service or otherwise.

The principal biomes in which research is required are as specified in the list of key programmes below: these incorporate the ecosystems where a comprehensive body of information is required by foresters for rational resource management. Apart from research to understand the ecology and management of each biome, surveys and inventories of the natural landscapes are necessary for the data basic to management, and for the classifications and maps that are required in any plan. Furthermore, special problems arise in the management of the wild faunas of certain areas, and provision is made for studies in this connection. Use of forest and mountain lands, either for natural produce or for recreation, sometimes has special consequences, not directly related to the nature of the biome concerned, and research on such consequences will at times be necessary. Finally, results of relevant research from all spheres must be integrated in a useful fashion as multiple-use management systems and for this two kinds of activity are necessary: investigation of past management and of potential management methods, and assembly of management systems. This work would to some degree cut across biome boundaries.

Whatever the case, the priority lies ultimately with vegetation management problems on the one hand, and ecosystem processes on the other. Vegetation

is the single ecosystem component that is manageable on a large scale, whether as catchment cover, anti-erosion agent, of wildlife habitat, and management systems therefore centre on techniques for manipulating vegetation. Never= theless, integration at the ecosystem level is essential, to allow proper linkage between management actions and major ecosystem components, and to relate research to major management aims expressed in terms of water resources, species diversity, energy balance, and erosion.

3.2 Components of the programme.

3.2.1 Surveys, assessments, and classification of indigenous veld and forest resources. Basic information on the nature of the natural ecosystems of the relevant biomes is necessary as a framework for management and research. There are three requirements (a) inventories of the biotas of State Forests and Mountain Catchment Areas, (b) classification and description of ecosystem types in a manner useful to management, monitoring and research, and (c) inventories of special features or resources as required by management, such as rare and endangered species and cultural history resources.

Such work would to a large extent be undertaken on behalf of the Division by other organisations but staff of the Division would undertake certain projects as dictated by need and also see to the ongoing task of collecting and identi= fying fauna and flora and producing check lists.

3.2.2 Studies on the ecology and management of indigenous forests. The eco= systems concerned here include the Afromontane forests (Acocks's Veld Types 4, 5, 8, 44 and 45) and the forests of the Indian Ocean Coastal Belt (Acocks's Veld Type 1) and transitional types (Veld Type 2).

Immediate priorities are as follows:

(a) Management systems for Knysna forests

(i) Regeneration studies: the relationships between canopy-species regeneration and gap-formation, understorey dynamics (including the role of Trichocladus), seed biology and seed dispersal, physio= graphy, and overstorey composition, and the role of animals in the regeneration process must be determined.

(ii) Stand dynamics: determination of patterns of succession, of stable stand composition (i.e. normality criteria), and of stand and species increments, and how these are affected by silviculture and timber harvesting.

(iii) Animal-habitat relationships: the habitat requirements of noteworthy forest animals and their responses to forest management must be determined.

(iv) Management systems: stand simulation models must be developed as aids to management planning, and techniques developed and applied to monitor the effects of management on the forest ecosystem.

(b) Conservation of forests of the Transvaal escarpment: an ecological basis is required to plan protection and management of the forest/grassland/plantation complex in this area: the avifauna is to be studied as ecological indicator to assess the biogeography of forest patches and the effect of ecotonal and other management on forest habitats.

3.2.3 Studies on the ecology and management of Mountain Fynbos ecosystems. Work here focusses on management problems in Acocks's Veld Types 69 and 70. These highly complex ecosystems are still poorly understood, and even now it is difficult to interest other scientific institutions in research on Mountain Fynbos problems. Consequently, the Division plays a leading role in research on the ecological problems of the biome.

Major problems are presently as follows:

(a) Biogeography and autecology of prominent fynbos plant species: Management of Mountain Fynbos is strongly influenced by the dictate to conserve rare or otherwise noteworthy species; their responses are also used to gauge the success of management. Studies on factors governing the distribution and populations of selected species are a priority.

(b) Post-fire regeneration of vegetation. The structure and dynamics of any fynbos stand is set largely by the composition of regeneration after a fire. This is determined by interactions between the timing of the fire in relation to the life cycles of constituent plant species, to plant phenology, seed biology, current and subsequent climatic conditions, survival of stored seed, plant-animal interactions, physiography, and local climate. Essential patterns must be established to allow proper management prescriptions that accommodate geographical heterogeneity and also goals that differ in regard to balances desired between woody and herbaceous vegetation, and seeding and sprouting species. Three approaches are necessary: plant demographic studies, surveys and monitoring to assess vegetation response to documented veld fires, and replicated controlled burning experiments.

(c) Vegetation dynamics: pyric succession (especially growth and compositional change) and secular changes in vegetation under given fire regimes must be determined to allow proper prescriptions for burning rotation and cost-effective fire control, including the use of fuel models in fire behaviour prediction.

(d) Plant-animal interactions. The role of animals as pollinators, herbivores, predators and seed dispersal vectors has been underestimated as a factor governing ecosystem response to management. This role as it is affected by pattern and regime of prescribed burning must be determined with regard to key plant-animal groups.

3.2.4 Studies on the ecology and management of Montane Grasslands. This loosely defined biome includes the grasslands, shrublands and woodlands of Acocks's Veld Types 8, 9, 44 and 58. Grasslands of South Africa and their management have been the subjects of extensive research in the past and comprehensive pro= grammes are presently under way in various research institutes. Consequently, the Division need not play a leading role in grassland research but it is never= theless necessary to supplement these programmes with one directed at the dis= tinct problems associated with the management of montane ecosystems that are clearly differentiated bioclimatically and biogeographically from the ecosystems of the surrounding lowlands.

Priority problems at present are the following:

(a) Montane gradients: management presently caters in a loose way for changes in ecological conditions along steep elevational gradients but research is necessary to show the intensity and nature of changes in vegetation structure, plant phenology and regeneration rates, animal breeding seasons, grassland curing rates, and the ecological effects of fire, with elevation, aspect and substrate. Grassland management requires large numbers of prescribed burns annually, that must be executed during a relatively short ecologically safe season defined by plant, animal, and climatic seasonality. Optimising management depends on how these constraints vary along montane gradients.

(b) Effects of fire on grassland composition and recovery rates: The composi= tion and recovery rates of grassland respond strongly to fire regime as a result of interactions between fire regime, seasonality of grass tillering, and interspecific differences in tillering processes. These relationships are not known for montane ecosystems and must be determined by phenological and demographic studies and replicated field experiments, so that management prescriptions can be matched to the rather precise goals required for grass= land catchments.

(c) Fire and vegetation dynamics: the extent of the different montane for= mations - forest, savanna, heath, and grassland - can significantly be altered by fire management and management goals are already directed at inducing such changes. The responses of each formation to fire regime, and potential replacement patterns, must be dtermined to ensure effective and cost-efficient management.

3.2.5 Studies on the ecology and management of coastal dune and lowland eco= systems. The special ecosystems of coastal dunes and the immediate hinterland (principally Acocks's Veld Types 1, 34 and 47) present complex management pro= blems arising from man's use of such labile ecosystems. The present priority is a national survey and inventory of coastal dune ecosystems, to identify significant types of ecosystems and the particular ecological and management problems associated with each, as well as research priorities.

In the dunes, lowlands and marshes of Zululand, however, there is an immediate need to develop the foundations for land-use planning and ecosystem management because of the rapid changes that follow on changes in land-use and management there.

3.2.6 Studies on the ecology and conservation of fauna of State Forests. Whereas most research projects form part of an integrated key programme for a given biome it is sometimes necessary by force of circumstances to undertake special studies on one or more elements of the fauna of an area, to solve a particular forest management problem. Furthermore, the opportunity to gain useful knowledge often arises when university or other researchers can be assisted to work on appropriate species.

Though priorities are thus dictated by circumstance projects could to a large extent be organised around the theme of faunal responses to changes in the forest-plantation-grassland habitat mosaic, because habitat changes through afforestation and forestry activities are correlated with significant respon= ses in the fauna of arboreal habitats, responses that are seen, for example, in the extension of ranges, growth of populations, or changes in migrations of such typical species as the samango monkey, crowned eagle, and rameron pigeon.

3.2.7 The effects of management treatments of catchment, veld and forest ecosystems on energy, water, and nutrient flow. This has been dealt with elsewhere.

3.2.8 Studies on land-use impact, resource protection, and monitoring. Current and new patterns of land-use, and special resource conservation questions, raise problems that need research before the questions can be

accommodated in management policy and practice. Current priorities include the following:

(a) Impact of flower harvesting on fynbos veld;
(b) Safe grazing practice for fynbos ecosystems;
(c) Socio-economic evaluation of Mountain Catchment Area proclamation;
(d) Protection of archaeological resources in the Natal Drakensberg;
(e) Impact of recreation use on fragile ecosystems.

Monitoring to assess ecosystem condition under prescribed management is an ongoing task but research is required (a) to develop techniques and (b) to evaluate special problems, either from the records maintained for fixed samples or through surveys. Research support to the monitoring system is particularly urgent.

3.2.9 Development of multiple-use management systems. Research and management must be linked through the development of practical methods as elements in the system. Such elements include the following:

(a) Management manuals;
(b) Computer-based simulation and prediction aids, such as a fire-hazard prediction system;
(c) Resource policy decision aids, such as cost.benefit analysis tools.

4. ORGANISATION

The present and planned organisation of this field of research is expressed as a summary of professional and technical staff in a table available from the S.A. Forestry Res. Inst., Box 727, Pretoria, 0001.

The programme also depends to a large extent on collaboration with other research groups. Active contributions to the programme will be found through (a) direct grants to university groups for research on selected topics, (b) indirect assistance to researchers wanting to do appropriate work on State Forests, (c) active participation in projects under the National Programme for Environmental Sciences and (d) close liaison with the Botanical Research Institute and with Provincial conservation research organisations. Overseas expertise will be tapped by supporting research fellows on sabbatical in South Africa about once in three years.

5. FINANCE

Expenditure on conservation forestry research has been as follows:

Financial year	Total	Provision for new or expanded projects, included in total.
1979/80	R443 000	R13 000
1980/81	R542 000	R30 000
1981/82	R741 000	R53 000
1982/83	R700 000	R24 000

The report on resources for research and development of the Science Planning Branch shows that, on average, labour costs for research in South Africa during 1979/80 amounted to 42% of the total research budget, and the expenditure per man-year was about R20 400. In this Division, the average expenditure on manpower amounts to 70-80% of the budget, and the expenditure per man-year in 1979/80 was about R9 800, assuming a total staff of 45. This emphasises the perennial problems encountered, in financing overheads such as travel costs and of equipping research teams. Clearly, manpower must be used more efficiently, by ensuring correct placement of personnel, creating the right training oppor= tunities, by maintaining priorities, and through automation, while the funds available for overhead costs and capital expenditure must be increased relative to funds for manpower. An encouraging recent development has been the improve= ment in computer services, with considerable promise for the future. A matter for immediate attention is the question of financing consultation with and assistance to management out of non-project funds.

BOTHALIA 13 INDEX: Unfortunately owing to an error all or most S.A.A.B. members were sent a copy of the index to Bothalia 13. It would be much appre= ciated if members could return these copies to: Librarian, Botanical Research Institute, Private Bag X101, Pretoria, 0001.

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