Environmental research perspectives in South Africa

Annual Report to the National Committee for Environmental Sciences, July 1981 to June 1982

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Cover: Table Mountain viewed from above the Fynbos Biome Project research site, Pella. The south-western Cape contains the highest floristic richness of any equivalent land area on earth, with over 6000 plant species in 18 000 km^2. The lowland fynbos communities of its west coastal margin are, however, the most seriously threatened in Africa. Agricultural, industrial and urban development have reduced these vegetation communities to less than ten per cent of their former range. Invasive acacias are rapidly infesting the small patchwork of remnants, while recurrent fires reduce the ability of certain rare proteas to reach maturity and set seed. These and other problems in this unique ecosystem are being studied by participants in the Fynbos Biome Project, one of several large cooperative research undertakings of the National Programme for Environmental Sciences.
(Photo: B van Wilgen/D Versfeld).

Compiled by:
Ecosystem Programmes
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P O Box 395
PRETORIA
0001
South Africa

THE NATIONAL PROGRAMME FOR ENVIRONMENTAL SCIENCES was established in 1972 and is administered by the National Committee for Environmental Sciences. The aims of the programme are:

- To identify and gain knowledge on present and future environmental problems in South Africa.

- To stimulate and coordinate the research needed to provide solutions to these problems.

- To make possible the improved management and utilization of the various ecosystems and natural resources.

- To promote South African participation in appropriate international scientific programmes.

- To assist government departments, provincial administrations and other organizations to keep environmental problems to a minimum through well informed planning.

THE NATIONAL COMMITTEE FOR ENVIRONMENTAL SCIENCES is appointed by the President of the CSIR and comprised the following membership during the 1981/82 period:

Dr C F Garbers (Chairman), President, CSIR
Mr J P de Wit (Vice-Chairman), CSIR
Mr W J R Alexander, Department of Environment Affairs
Dr J K Basson, Nuclear Development Corporation of South Africa (Pty) Ltd
Mr B J G de la Bat, South West African Administration
Professor P de V Booysen, University of Natal
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Professor W R Siegfried, University of Cape Town
Professor D F Toerien, University of the Orange Free State
Dr G I van Rooyen, Department of Health and Welfare
Mr N Viljoen, Office of the Prime Minister

ABSTRACT

The National Programme for Environmental Sciences is a cooperative undertaking of scientists and scientific institutions in South Africa concerned with research related to environmental problems. This annual report describes the rationale, approach and current activities of the National Programme. Fields of endeavour include detailed research projects, the preparation of syntheses and bibliographies, nation-wide surveys and monitoring programmes. The report includes comment on research highlights for the period under review, such as a detailed study of the processes of eutrophication in Hartbeespoort Dam, the development of principles for bushveld management, the theory and practice of large mammal management in Africa and the measurement of quality of life in rural and urban environments.

OPSOMMING

Die Nasionale Program vir Omgewingswetenskappe is 'n koöperatiewe onderneming van wetenskaplikes en wetenskaplike instansies in Suid-Afrika betrokke by navorsing met betrekking tot omgewingsprobleme. Hierdie jaarverslag beskryf die motivering, benadering en huidige aktiwiteite van die Nasionale Program. Die veld wat gedek word sluit in gedetailleerde navorsingsprojekte, die voorbereiding van sinteses en bibliografieë, landwye opnames en moniteringsprogramme. Die verslag sluit kommentaar in oor navorsingshoogtepunte gedurende die betrokke periode, soos 'n intensiewe studie van die proses van eutrofikasie in die Hartbeespoortdam, die ontwikkeling van beginsels vir bosveldbestuur, die teorie en praktyk van die bestuur van groot soogdiere in Afrika en die meting van lewensgehalte in landelike en stedelike omgewings.

ORGANIZATIONS PARTICIPATING IN THE NATIONAL PROGRAMME FOR ENVIRONMENTAL SCIENCES

Alexander McGregor Museum, Cape Provincial Administration, Department of Agriculture and Nature Conservation (SWA/Namibia), Department of Agriculture, Department of Cooperation and Development, Department of Environment Affairs, Department of Health and Welfare, Fisheries Development Corporation of South Africa Limited, Human Sciences Research Council, Natal Parks Game and Fish Preservation Board, National Botanic Gardens of South Africa, National Institute for Personnel Research, National Institute for Transport and Road Research, National Institute for Water Research, National Parks Board, National Research Institute for Oceanology, Nuclear Development Corporation of South Africa (Pty) Ltd, Office of the Prime Minister, Potchefstroom University for CHE, Provincial Administration of the Orange Free State, Rand Afrikaans University, Rhodes University, Southern African Nature Foundation, Southern African Ornithological Society, Technical Advisory Committee for Nature Conservation, Transvaal Provincial Administration, University of Cape Town University of Durban-Westville, University of Natal, University of Port Elizabeth, University of Pretoria, University of South Africa, University of Stellenbosch, University of the North, University of the Orange Free State, University of the Western Cape, University of the Witwatersrand, Water Research Commission and the Wildlife Society of Southern Africa.

EXECUTIVE SUMMARY

The report

- Provides an outline of the current activities of the National Programme for Environmental Sciences, against the background of its development since its establishment in 1972.

- Illustrates the degree to which researchers and decision takers from over a dozen universities and as many government organizations have integrated their efforts to identify, research and solve environmental problems in South Africa.

- Describes in detail some of the results from among several hundred individual research projects coordinated within the NPES.

- Indicates the tremendous growth in research funding provided through the National Committee for Environmental Sciences, by several government departments.

For user agencies:

- The NPES provides a forum for contact and detailed discussion between leading academics, decision takers and students as a means to identify priorities for research and the implementation of findings.

- The report highlights activities of direct relevance to user agencies. An example is the synthesis of information on the water resources, and threats to these, in the Buffalo River catchment. The synthesis, prepared by researchers of the Inland Water Ecosystems Section provided a rapid response to a request for information from the Department of Environment Affairs (page 7).

- In the south-west Cape, the unique coastal fynbos vegetation has been reduced to less than ten per cent of its former range. Participants in the Fynbos Biome Project have developed a technique for the objective evaluation of conservation values and priorities in this region, providing conservation departments with a framework for future action (page 13).

- The problem of overabundant large mammals in efficiently conserved national parks has become a serious dilemma to those charged with their protection. The theoretical and practical aspects of the issue were exhaustively reviewed at an international conference convened by the Nature Conservation Research Section. The meeting produced a textbook for academics and a handbook for managers of African national parks (page 27).

- One's perception of the quality of life is a highly variable concept - but can be a valuable tool to measure trends in socio-economic development. A system for obtaining reliable and consistent assessments of the quality of life perceived by different social groups has been developed within the Human Needs, Resources and Environment Programme (page 35).

For research institutes:

- The National Programme for Environmental Sciences provides researchers with an opportunity to review the relevance of their work to national needs as defined by major user agencies. The research undertaken within the programme is not restricted to so-called applied fields, however, but includes a broad fundamental component which provides the theoretical underpinning to studies aimed at providing rapid answers to urgent problems.

- The series of major impoundment studies undertaken within the Inland Water Ecosystems Section have provided detailed information on the interaction of suspensoids, phosphorus, nitrogen and the plant and animal communities of man-made lakes.

- The Savanna Ecosystem Project has helped develop and clarify concepts of stability and resilience in semi-arid systems. The mechanisms evolved by plants and animals to succeed in environments which are subjected to frequent major changes in rainfall and defoliation or predation pressures are now becoming better understood through work at Nylsvley (page 15).

- The theoretical basis for assessing biological rarity and the implications of low density to survival and the conservation implications of this have been reviewed within the Threatened Species Programme - which has provided the data base essential to developing South Africa's policy and role in the Convention on the International Trade in Endangered Species (page 26).

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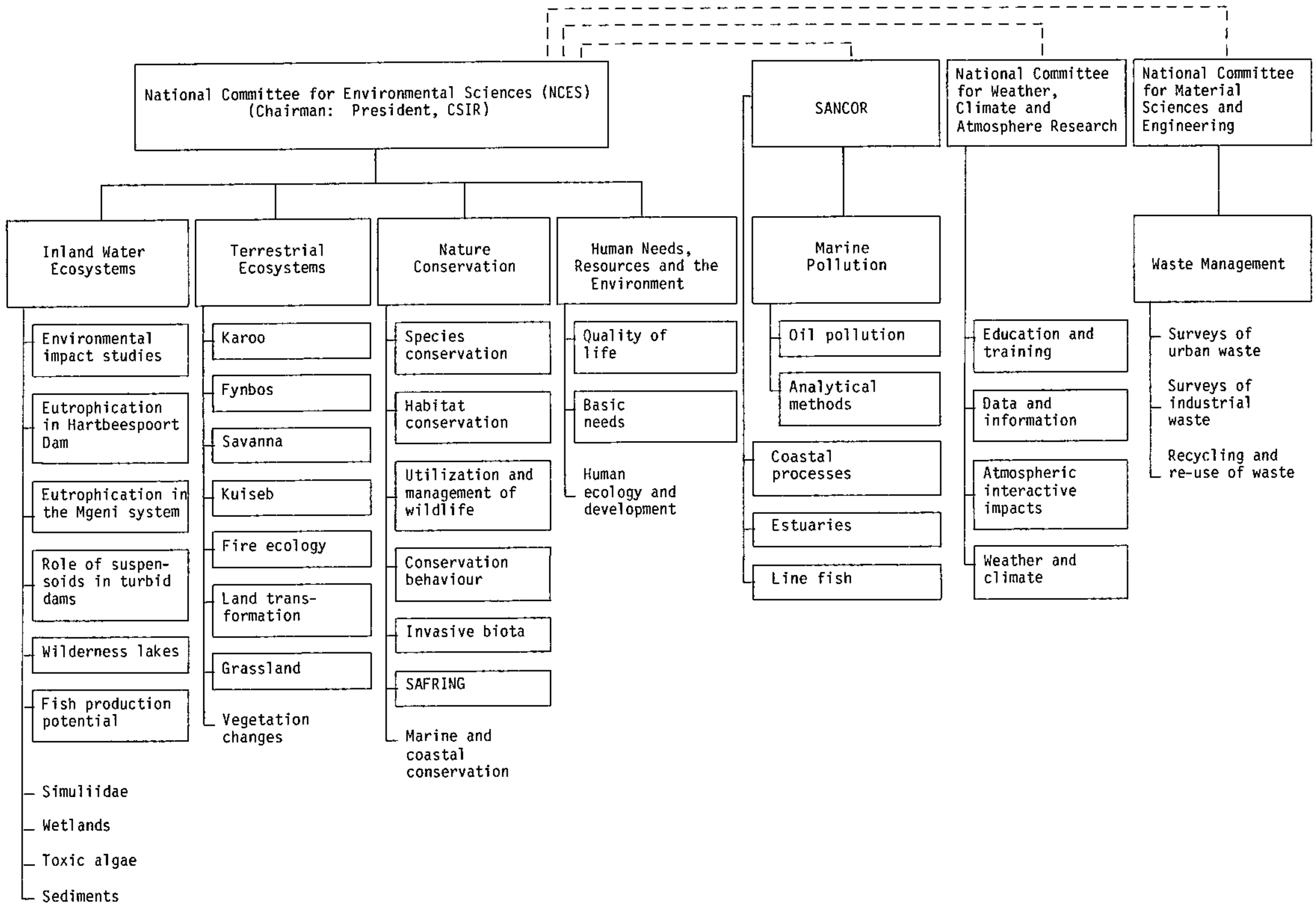


Figure 1. Organization of the National Committee for Environmental Sciences and related activities of the CSIR's Cooperative Scientific Programmes

INTRODUCTION

The rapid development and utilization of South Africa's industrial, mining and agricultural resources during the post-war decades, and the projected expansion of these activities before the end of this century place unprecedented stresses on an environment which was largely unmodified by man until a hundred years ago. Awareness of the need to ensure the conservation of environmental qualities and the maintenance of critical life support systems such as soil, water and biotic resources, led to the establishment of the National Programme for Environmental Sciences (NPES) in 1972. The establishment of the NPES followed immediately upon the conclusion of the International Biological Programme (IBP), the first major attempt to stimulate biological research on a global scale. South Africa played a significant role in the IBP, during which the concept of cooperative biological research had gained momentum.

The primary goal of the NPES is to gain knowledge on present and future environmental problems in South Africa and to seek solutions to these problems through multi-organizational, interdisciplinary research projects. The NPES is administered by the National Committee for Environmental Sciences (NCES), appointed by the President of the CSIR. This Committee also serves as the South African National Committee for SCOPE (Scientific Committee on Problems of the Environment), the body set up in 1970 by ICSU (International Council of Scientific Unions) to act as a focus of non-governmental international scientific effort in the environmental field.

The organization of the NPES and its sub-programmes is shown in Figure 1. The NPES originally comprised six main sub-programmes, arising from similar sections in the IBP. Activities relating to the environment in terms of the atmosphere, marine pollution and waste management, which were originally administered by the NCES, now report to the national committees of other Cooperative Scientific Programmes, but are also represented on the NCES in order to maintain close liaison between all aspects of environmental research in South Africa. The activities of these sections, while still within the NPES, included the study of long-term rainfall patterns, urban heat islands, wind patterns over industrial growth points, the development of a national marine pollution monitoring programme, the organization of a major international workshop on the dynamics of pollutants in the south Atlantic and Indian Oceans and the survey of solid and toxic wastes in South Africa.

The NPES currently comprises four sections - on Inland Water Ecosystems, Terrestrial Ecosystems, Nature Conservation and on Human Needs, Resources

and the Environment - administered by the Ecosystem Programmes division of Cooperative Scientific Programmes. The activities of these sections are described in detail in this report.

The approach adopted within the NPES differs markedly from environmental research endeavours in most other countries and reflects our concern for the optimal use of our country's limited scientific and technological resources. It involves close collaboration of all members of our scientific community concerned with environmental matters - drawn together in committees, seminars, workshops and active research projects, through a common interest in maintaining renewable natural resources and environmental quality in South Africa. The NPES involves the participation of over 300 scientists from numerous government and provincial departments and institutes, universities, museums and many private individuals in their personal capacity. The identification of priorities for study, their detailed analysis and the development of appropriate research projects to aid their solution is undertaken through a highly integrated system of working groups and steering committees and, where necessary, symposia and workshops at both national and international levels.

Funding for research is drawn principally from the budgets of participating organizations, but substantial funds for research at universities are made available to the NCES by the Department of Environment Affairs, by the Water Research Commission, by the Prime Minister's Office and by the Provincial Administrations of Natal, the Cape, the Transvaal and the Orange Free State. Funds available to the seven sections which are represented on the NCES now exceed R2 000 000 per annum, having expanded rapidly from the initial R60 000 provided in the 1972/73 budget. The costs of managing the programme and providing various specialized scientific facilities are borne by the CSIR.

INLAND WATER ECOSYSTEMS

BACKGROUND

The Inland Water Ecosystems Section of the NPES evolved directly from section PF (Production of Fresh Water Communities) of the IBP. Section PF had initiated detailed studies of coastal lakes in Zululand, primary production and hydrobiological studies in the Orange River, studies of fish production in Natal and Transvaal and had compiled a list of conserved aquatic sites of scientific importance. A study of the ecological implications of the construction of the J G Strijdom Dam on the Pongolo River also commenced during the IBP and became one of the major activities of the Inland Water Ecosystems Section during the late 1970's. Similarly, multi-disciplinary studies on the Wilderness Lakes followed the elegant work undertaken at Lake Sibaya in Zululand, while studies on water quality, in particular mineralization, eutrophication and turbidity, were built on the earlier studies undertaken in the Orange River system.

RATIONALE AND OBJECTIVES

South Africa is dominated by a semi-arid climate with a national average annual rainfall of only 475 mm compared with a world average of 860 mm. Over much of the country, rainfall fluctuates greatly from year to year, as does river flow, and small streams with very erratic flow characterize a land endowed with very few large perennial rivers. Existing major dams have a capacity of 40% of the total mean annual runoff of all South Africa's rivers - already commanding virtually the entire runoff from the interior plateau on which the nation's industrial activity is centred. The development of water use facilities on the coastal rivers is not only confronted with engineering difficulties, but also introduces severe environmental problems to the sensitive estuarine systems. These and other issues indicate that South Africa faces a rapidly approaching water crisis, both in terms of water quantity and quality.

Major research programmes on the estimation of water needs and resources, the use and re-use of available supplies and the allocation of these have been undertaken by the responsible authorities over many years. More recently, studies on the limnological features of river systems, vleis, pans, coastal and estuarine lakes and lagoons and on man-made impoundments have been developed and coordinated by the Committee for Inland Water Ecosystems, with the following primary aims :

- The development of the understanding necessary to predict the effects of natural events, planned development and management actions on inland water ecosystems.

- Improving the scientific basis for utilizing these ecosystems, for instance for biological production and recreation.

- The search for solutions to particular environmental and management problems relating to inland water ecosystems.

CURRENT ACTIVITIES

The wide range and complexity of research needs in South African inland water ecosystems has provided a formidable challenge to the country's limnologists. Aspects of some of the main current activities include :

Environmental impact studies. Assessment of the implications of future development within particular catchment areas and planning regions, ways of keeping impacts to a minimum and identifying subsequent research needs. Current studies include the upper Olifants River, the Buffalo River, the Mooi River and the Modder River catchments.

Eutrophication in Hartbeespoort Dam. Synthesis of available information on the influence of eutrophication on this impoundment ecosystem and on the cycling of nitrogen and phosphorus. Development of methods for predicting the consequences of planned development in the catchment area and of possible management actions. Examination of the potential of measures such as aeration for the rehabilitation of eutrophic impoundments.

Eutrophication in the Mgeni system. Testing in Midmar Dam of models to predict algal growth as a function of phosphate loading. Examination of the recycling of phosphates and the role of sediments. Prediction of the consequences of planned development in the catchment area.

The role of suspensoids in turbid impoundments. Investigation of the fate of sediments and suspensoids, the effects of turbidity on production processes, and on silt particles as a substratum for microbes and as a food source for zooplankton and fish.

Wilderness Lakes. Investigation into the impact of construction works, of intended development and of such management measures as weed control and the opening and closing of the mouth of the Touw River floodplain on its lakes.

Fish production potential of impoundments. Experimental netting in representative impoundments. Limnology and fish production potential in the P K le Roux Dam.

RESEARCH HIGHLIGHTS

The Hartbeestpoort Dam Ecosystem Study

Eutrophication, which results in excessive biological activity and the

impairment of water quality, is a global problem. It must be regarded particularly seriously in South Africa where water is a scarce resource.

Hartbeespoort Dam is hypertrophic. Quantification of the sources of nutrients reaching the Dam has shown that nutrient loads from diffuse (uncontrollable) sources is sufficient to maintain the Dam in a eutrophic state. The Dam is, in this respect, the harbinger of the probable fate of many other important impoundments in South Africa, such as Vaal Dam, Bloemhof Dam and Loskop Dam, in whose catchments there is intensive industrial development and urbanization.

The Hartbeespoort Dam Ecosystem Study is intended to provide the scientific basis for the active, informed management of eutrophied impoundments in South Africa, so that benefit may be derived from their enhanced productivity and their undesirable characteristics may be ameliorated. This basis is a quantitative understanding of the dynamic interplay between the physical and chemical environment and the biota, not overlooking interrelationships and feedback loops within the biota itself. Whole ecosystem functioning is indeed so complex that one can, at best, hope to achieve a broad understanding and one is forced to use mathematical models to express the understanding. The study therefore commenced with an attempt to build a simplified quantitative mathematical model of the cycling of phosphorus (the most important plant nutrient) through the ecosystem, using the fragmentary information available at that time. A rational ordering of research priorities and of project coordination arose out of this exercise. The ecosystem was divided into ten principal research areas and research projects covering each were defined.

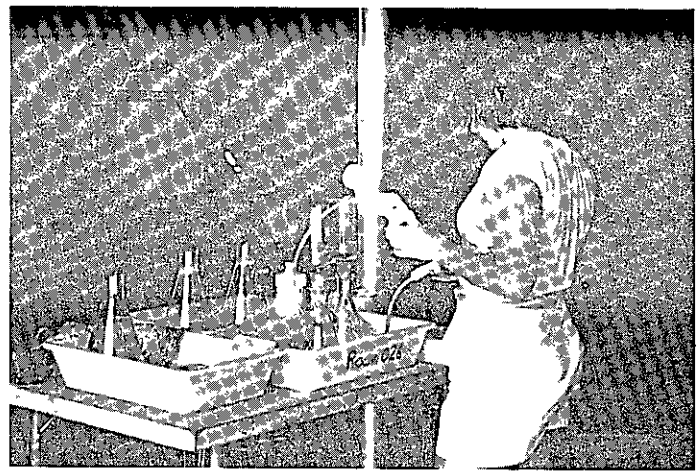
Individual resources being insufficient to support so large a research programme, the major research group, the National Institute for Water Research, sought the collaboration of outside bodies. Two projects, on general physical-chemical limnology and on phytoplankton species composition and respiration are supported by the Water Research Commission. Projects on hydrodynamics, on sediment/water phosphorus exchange and on fish population dynamics are funded through the Committee for Inland Water Ecosystems. The Directorate of Water Affairs provides flow and meteorological data, allows use of its waterside building and has moored a raft at the deep water sampling station. Projects funded by the National Institute for Water Research cover nitrogen cycles, primary production, the role of zooplankton, fish feeding and turnover rates of phosphorus in the phytoplankton. Some projects commenced as recently as January 1982.

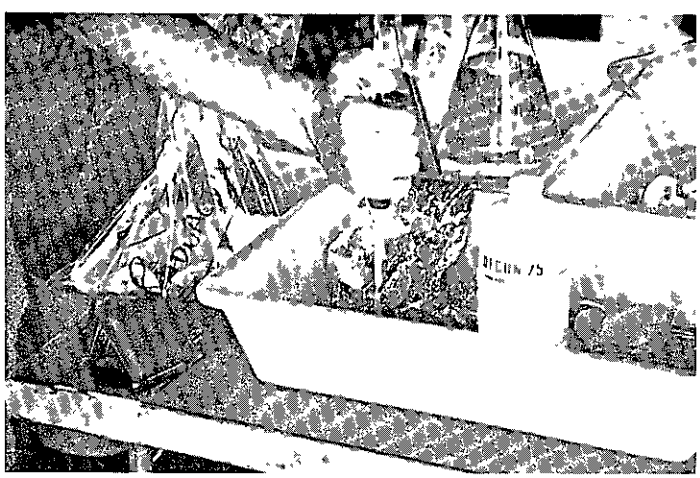
Activities in most of the individual studies of this cooperative project fall into two categories, the weekly monitoring of conditions in the Dam and the measuring of rate processes. Important findings to date are :

- In quantitative terms the largest pathways of phosphorus cycling are abiotic - into and out of the sediments.

- At least 60% of the incoming nitrogen load can be denitrified and lost to the system, mainly at the autumn destratification.

- Autumn turnover is modified by summer hydrology and climate, but can result in almost complete lack of dissolved oxygen in the main basin for three to five days.





The research programme at Hartbeespoort Dam is aimed at understanding the functioning of the whole lake. To obtain samples of lake water at depth a Van Dorn water sampler is used; its 6 litre volume and inert PVC construction enables the sampler to be used for a variety of purposes such as sampling plankton and collecting water for chemical analysis. Water samples are processed in a number of ways. Much of the initial sample preparation is done in the field. Using hand-operated vacuum pumps, particulate and dissolved components of a water sample are separated by filtration. The filtrate is retained for chemical analysis whilst the filter is used for biomass, suspended load, and chlorophyll determinations. Whole water samples are also collected, being used for chemical analysis and enumeration of microscopic aquatic organisms such as bacteria, algae and zooplankton. Low energy radio isotopes provide an ideal "tag" with which to follow the movement of chemical nutrients such as carbon, nitrogen and phosphorus within the lake and short term, in situ experiments form the core of many of the projects involved in the Hartbeespoort Dam study.

Photos: T Fenn

- Algal nutrients are always present in excess. Phytoplankton growth is governed by physical processes of mixing and light penetration.

- The Dam is a clear water system in which inorganic suspensoids do not govern light penetration.

- Winds are generally gentle and frequently transport floating algae across the water surface rather than mixing them into the water, so that large dense phytoplankton scums accumulate.

- Floating scums are unusually important in the dynamics of the phytoplankton. It would appear that particularly in April/May the greatest part of the phytoplankton can accumulate as a vast scum in the Crocodile Arm and that during the winter the scum is eroded back into the main basin.

- Due to scum formation and movement, primary production rates and phytoplankton densities are highly changeable and range from hypertrophic levels right down to oligotrophic levels.

- Fish populations appear to be smaller than it would be reasonable to expect.

As new information becomes available it is incorporated into existing models which are then modified where necessary. Simultaneously, feedback from the models may indicate the need to revise research priorities. Ultimately, but almost certainly not in the initial three year period of the project, it is hoped that models will become usefully predictive. They would then be used to predict the outcome for the whole ecosystem of management options such as aeration and destratification, species additions and selective harvesting of biological components.

Water quality in the Buffalo River catchment

The need to assess the implications of industrial and agricultural developments within particular catchment areas and to make recommendations on ways of reducing the negative impacts of such developments has long been recognized by the Committee for Inland Water Ecosystems. Several preliminary syntheses of knowledge on which such recommendations could be based have been prepared for the committee, the most recent of these being on the Buffalo River catchment in the Eastern Cape.

The report, compiled by researchers at Rhodes University, provides a valuable basis for the identification of critical problems, research needs and priorities for immediate action. It also serves to illustrate the rapidity with which a multi-disciplinary group of experts can prepare a comprehensive report on an issue of national importance at a very modest cost to user agencies. The report highlights many of the sensitivities and vulnerabilities of the water resources of the catchment, which with the area's natural vegetation provides the only resource base for development in an area devoid of exploitable mineral resources. Some of the key pointers to the problems facing the catchment's water quality include:

- The underlying geology imparts a high level of natural mineralization to ground and surface waters.

- Local climatic conditions accentuate the problem of natural mineralization.

- Geological and physiographic characteristics of the catchment favour high sediment production rates.

- Water quality is degraded further from a naturally elevated baseline condition as a result of industrial, domestic and agricultural effluents.

- The major storage reservoirs are situated downstream of major pollutant sources, while the largest reservoir (Bridle Drift Dam) is threatened by runoff containing a high organic and suspended solids content from high-density urbanization.

- The joint storage capacity of existing mainstream reservoirs approximates the average assured net annual yield of the catchment, thus increased storage capacity cannot be sensibly contemplated.

- Average population density is extremely high.

- The number of people in the area is expected to increase, perhaps rapidly, due to government efforts to stimulate industrial development in the East London area. In the longer term, population pressures may increase still further as a result of the predicted eastward encroachment of the karoo.

- The subsistence economy of many contemporary inhabitants of this catchment forces their reliance upon natural vegetation as a resource for fuel and construction materials. The implications of reduced vegetal cover to the hydrological cycle are generally known to be alarming and difficult to control or reverse.

- Increasing demands for irrigable lands and water for irrigation purposes can be expected.

- The two major storage reservoirs have exhibited almost exponential increases in the plant nutrient content of their waters in the past decade. It is clear that eutrophication poses a continuing and serious threat to the water resources of the catchment.

The report concludes with the observation that the particular socio-politic circumstances of the catchment have complicated the assignment or allocation of specific group or institutional responsibility for particular environmental concerns or have at least hampered the implementation of such responsibilities. Acceptance of responsibility for specific environmental issues is vital to curtail environmental degradation of the catchment. Collaborative efforts between a multiplicity of concerns and interests will be necessary to accommodate decisions upon which the long-term viability of the catchment depends.

INTERNATIONAL ACTIVITIES

Wetlands

South African scientists are participating actively in an international SCOPE project on continental wetlands and shallow lakes. They are playing a leading role in the following three components of this project :

- A bibliography on major African wetlands and shallow lakes, for publication in 1983.

- A directory of major African wetlands and lakes, summarizing available information on these systems and on their conservation status, for publication in 1983, this part of the project to be undertaken jointly with the IUCN (International Union for the Conservation of Nature and Natural Resources).

- A synthesis on ecosystem functioning, utilization, environmental impacts and management of African wetlands and shallow lake systems, for completion in 1985.

Wetlands worldwide have been drastically modified for utilization purposes. The international SCOPE project began against a background of serious problems of environmental degradation resulting from wetland drainage in the Soviet Union and is an attempt to improve the scientific basis for the management and utilization of such systems. The continent of Africa has a number of very major wetland systems, including the world's biggest swamp (the Sudd) and some enormous endorheic wetland/lake systems (for instance Chad and Chilwa). In a continent poor in water resources, wetland areas are of major economic importance. These systems are under very real threat of drastic modification in large development schemes, which are often planned and implemented without regard to the available scientific knowledge. The African bibliography, directory and synthesis are planned to take a form which will make this knowledge available to developers, planners and decision-makers.

Although South Africa has no major wetlands, there are systems of considerable local importance. These wetlands have been shown to be susceptible to the impacts of development and there has been controversy about their value for soil, water and nature conservation, for recreation and for water purification. Some are drained or cleared while the expansion of others is encouraged, some have been greatly modified and management practices such as burning and cultivation vary tremendously. The synthesis and the stimulation of participation in the international project will improve our understanding of their dynamics, will provide an improved scientific basis for their management and will clarify future research needs.

FUNDED PROJECTS 1981 AND 1982

Hartbeespoort Dam

1. The dynamics and structure of fish populations in relation to phosphorus cycling in Hartbeespoort Dam. Dr K L Cochrane and Dr F M Chutter (National Institute for Water Research), 1981-1984.

2. The hydrodynamic processes within Hartbeespoort Dam and their importance to phosphorus cycling. Dr F M Chutter (National Institute for Water Research), 1981-1984.

3. The role of bottom sediment and the sediment/water interface in phosphate cycling in Hartbeespoort Dam. Dr A J Twinch (National Institute for Water Research), 1981-1984.

Fish Production Potential

1. Limnology of the P K le Roux Dam. Professor B R Allanson (Department of Zoology, Rhodes University), 1981-1983.

2. The population dynamics, feeding biology and energetics of zooplankton in the P K le Roux Dam. Professor R C Hart (Institute for Freshwater Studies, Rhodes University), 1981-1983.

3. Orange River Dam fish population study project. Mr P Jackson (JLB Smith Institute for Ichthyology, Rhodes University), 1979-1983.

4. Resource utilization by lacustrine populations of Barbus holubi in the P K le Roux Dam. Mr D H Eccles (Institute for Freshwater Studies, Rhodes University), 1982-1983.

5. The biology and fisheries potential of the catfish Clarius gariepinus in the P K le Roux Dam. Dr M N Bruton (JLB Smith Institute for Ichthyology, Rhodes University), 1982.

6. The fisheries production potential of turbid dams. Professor B R Allanson (Department of Zoology, Rhodes University), 1982.

Turbid Impoundments

1. A study of the growth, production and feeding biology of fish in the Wuras Dam. Dr I G Gaigher (Institute for Environmental Sciences, University of the Orange Free State), 1980-1982.

2. Productivity of reedbeds round a silt-laden dam. Dr G H Wiltshire (Institute for Environmental Sciences, University of the Orange Free State), 1978-1982.

3. Sediments of Wuras Dam and its catchment area and the nutrients and sediment loading of Wuras Dam. Dr P C Keulder (Department of Botany, University of the Orange Free State), 1979-1982.

4. Suspensoids as a nutrient source for the zooplankton in Wuras Dam. Mr M T Seaman (Institute for Environmental Sciences, University of the Orange Free State), 1980-1982.

5. Absorbed nutrients for photosynthetic organisms and the carbon cycle of turbid water systems. Dr J U Grobbelaar (Institute for Environmental Sciences, University of the Orange Free State), 1979-1982.

6. The microbiology of Wuras Dam with special reference to microbes as secondary producers. Professor D F Toerien and Dr I G Gaigher (Institute for Environmental Sciences, University of the Orange Free State), 1977-1982.

7. Wuras Dam synthesis. Professor A J H Pieterse (Department of Botany, University of the Orange Free State), 1982.

8. The water movement of Wuras Dam. Mr P Stegmann (Institute for Environmental Sciences, University of the Orange Free State), 1981.

9. The zoobenthos of a turbid impoundment (Wuras Dam). Mr M T Seaman (Institute for Environmental Sciences, University of the Orange Free State), 1979-1981.

Mgeni

1. Patterns of nutrient loading in the Mgeni catchment area. Mr C E M Archibald (National Institute for Water Research), 1981-1984.

2. The zooplankton of the Midmar and Albert Falls Dams. Professor J Heeg (Department of Zoology, University of Natal), 1981-1983.

3. Factors affecting phytoplankton diversity and succession. Professor C M Breen (Department of Botany, University of Natal), 1981-1983.

4. The interaction between phytoplankton, nutrient loading and the hydroclimate of Midmar and Albert Falls Dams. Professor C M Breen and Mr E G J Ackhurst (Department of Botany, University of Natal), 1981-1983.

5. Studies on the extent of effects of sediment resuspension in the impoundments of the Upper Mgeni River. Professor C M Breen (Department of Botany, University of Natal), 1981-1983.

6. Physical/chemical limnology and meteorological monitoring of Midmar and Albert Falls Dams. Professor J Heeg (Department of Zoology, University of Natal), 1980-1983.

Wilderness

1. The ecological impact of the hydraulic management of the Touw River floodplain following the building and operation of a sluicegate in the "Serpentine" Wilderness. Professor B R Allanson (Institute for Freshwater Studies, Rhodes University), 1982-1984.

2. Numerical model of Serpentine and Wilderness. Mr K S Russell (National Research Institute for Oceanology), 1979-1982.

3. Monitoring of the Touw River floodplain. Professor B R Allanson (Department of Zoology, Rhodes University), 1981.

Toxic Algae

1. Modelling of the growth of Microcystis. Professor J N Eloff (Department of Botany, University of the Orange Free State), 1982.

Environmental Impact

1. The impact of development in the Witbank/Middelburg area on the water quality of the upper catchment area in the Olifants River. Professor D F Toerien (Institute for Environmental Sciences, University of the Orange Free State), 1979-1981.

2. The impact of existing and planned development on the water environment of the Mooi River catchment area. Professor P A J Ryke (Institute for Zoological Research, Potchefstroom University for CHE), 1982.

3. Impact of development on the water environment of the Modder River catchment area. Professor D F Toerien (Institute for Environmental Sciences, University of the Orange Free State), 1982-1983.

4. Atmospheric fallout in the Umhlatuze Water Board area (Richards Bay). Mr C Archibald (National Institute for Water Research), April 1982-March 1984.

Wetlands

1. Bibliography of African wetlands. Dr B R Davies (Department of Zoology, University of Cape Town), 1982.

2. A directory of African wetlands. Professor C M Breen (Department of Botany, University of Natal), 1982-1984.

TERRESTRIAL ECOSYSTEMS

BACKGROUND

The International Biological Programme had given a strong impetus to detailed studies of the structure and functioning of terrestrial ecosystems. Many of these studies, especially those in the USA and Canada, had been extremely ambitious and costly, introducing "big science" to the field of biology. In South Africa only a limited activity developed in this area of the IBP, but important contributions were made by the Conservation of Terrestrial Biological Communities (CT) Section. In particular, the CT Working Group produced valuable assessments of the conservation status of vegetation types, rare plants and certain vertebrate groups.

The CT Section of the IBP led to the formation, within NPES, of the Sub-committee for Terrestrial Biology, now the Committee for Terrestrial Ecosystems. The committee's activities initially embraced topics such as plant physiology, threatened plants, vegetation surveys, ecosystem research, mammals and birds. As the programme advanced it became apparent that a biome-based approach, rather than the traditional discipline orientation, would be appropriate. South Africa comprises a wide range of terrestrial ecosystems, the major groupings of these being termed biomes. Each biome is characterized by distinctive floristic, faunistic, physiognomic, climatic and edaphic features, and by exhibiting a similar response to environmental pressures, whether these be natural or man-induced. The Terrestrial Ecosystems Section has therefore organized its activities within the framework of the major biomes - where research focuses on ecosystem structure and functioning - and on nationwide problems related to ecosystem processes - such as fire, water use, grazing or nutrient cycling.

The first major study within a South African biome was the South African Savanna Ecosystem Project initiated at the Nylsvley Provincial Nature Reserve in the northern Transvaal bushveld. It was also the first attempt to bring a large diversity of state and provincial departments, museums and universities together in an intensive, cooperative, interdisciplinary study of a South African ecosystem. The project grew rapidly from its planning phase in 1973 to a very active field and laboratory study through the late 1970's. Up to thirty researchers from seven participating universities and three government departments were involved at its height. The Savanna Ecosystem Project proved to be the forerunner of other similar projects in the fynbos, grassland, karoo and forest biomes. The approach adopted varied according to the inherent characteristics of

the ecosystems involved, and the available manpower. Whereas the savanna project was limited to the study site at Nylsvley, the other biome projects have involved both site-bound and extensive studies - introducing a greater level of comparative biology into the programme. All the studies differ from the largely descriptive IBP biome studies in their strong emphasis on developing a predictive ability and in the focus given to developing an understanding directly relevant to the conservation and management of our ecosystems.

The Terrestrial Ecosystem Section has not limited its programme to funding research, but has been involved in the organization of numerous workshops, symposia, seminars and visits by leading international experts. Products of these meetings and visits include a long list of scientific publications, project descriptions and policy recommendations. Most significant of the proceedings of these activities are those that have been published or are in press on the international symposia and workshops on "Dynamic Changes in Savanna Ecosystems", "The Conservation of Threatened Natural Habitats" and "Mediterranean-type Ecosystems : the Role of Nutrients".

RATIONALE AND OBJECTIVES

Natural and semi-natural terrestrial ecosystems occupy more than 80% of the surface area of South Africa. The maintenance of their productivity for agriculture, forestry and water supply requires careful management and, in certain areas, rehabilitation. The dimension of the problems involved in the optimal use of these ecosystems is indicated by the fact that during the last century over 12 million ha of grasslands have been transformed to karoo, over 2 million ha of grazing lands in the bushveld have been invaded by acacia thicket while in the eastern Cape over R2 million is spent annually on controlling invasive cactus species. Soil erosion is a national problem, with reliable estimates indicating that more than 25% of the country's original soil fertility was lost in the first half of this century.

Conventional research programmes, often empirical in nature and of short-term duration, have provided valuable insights into the treatment of certain of these problems. But an adequate understanding of the ecological processes involved has not yet been developed as a basis for long-term planning and utilization. The goal of the Terrestrial Ecosystems Section is to meet this need, through :

- The development of an understanding of the nature and functioning of representative ecosystem types in order to make it possible to predict the consequences of planned management actions.

- The search for solutions to specific problems such as invasive plants, fire, soil erosion, pesticide residues and for information which will throw light on such problems.

CURRENT ACTIVITIES

Fynbos Biome Project. The fynbos biome comprises a floristically unique heathland and shrubland vegetation complex, of considerable aesthetic, recreational and conservation value. The project has adopted a research

approach which is influenced by the extremely heterogeneous composition and structure of fynbos ecosystems. Characterization of fynbos communities is being undertaken through extensive surveys of climate, soil, vegetation, fauna and land-use, and biogeographic and palaeoecological studies. Simultaneously intensive studies of selected components and processes in lowland and mountain ecosystems are being conducted. Investigations into ecosystem functioning are concentrating on plant nutrient requirements, water relations, and the effects of fire and invasive plants. The conservation status of species and communities is being determined in lowland fynbos systems.

Savanna Ecosystem Project. This is a major integrated investigation of a savanna ecosystem at the Nylsvley Provincial Nature Reserve, with emphasis on the processes which determine stability and resilience in bushveld ecosystems. The research programme includes detailed studies on the abiotic, primary producer, consumer and decomposer components, and the interactions between these. Particular attention is being paid to plant/herbivore interactions.

Grassland Biome Project. The initial phase of this project has involved the synthesis of information developed during the last half century by range and pasture scientists in the grasslands of South Africa. The research programme, for initiation in 1983, is aimed at filling the gaps in our understanding of key components and processes. Study topics will include water use, nutrient cycling and the utilization of grassland communities.

Karoo Biome Project. The first phase of this project comprises the preparation of an annotated bibliography and the synthesis of existing information on the functioning of karoo ecosystems, in particular the processes of accelerated veld deterioration, soil erosion and desert encroachment. The synthesis project will be completed in 1982 and will be followed by an investigation of the karoo invasion process and how it is influenced by interactions between the moisture factor and utilization by herbivores.

Forest Biome Project. A survey of the distribution of indigenous evergreen forests and their conservation status, the preparation of a bibliography of research published on South African forests and the planning of an ecological research programme in selected examples of this biome.

Kuiseb Environment Project. A short-term investigation of the possible impacts of water extraction on the fauna, flora and geomorphology of the Kuiseb River valley of the Namib Desert.

Ecological effects of fire. This project forms part of an international programme initiated by SCOPE to develop new insights into the ecological effects of fire. The South African contribution includes the preparation of an annotated bibliography and the synthesis of information on the role of fire in South African ecosystems.

Land transformation. This is another SCOPE project, involving the examination of the processes causing veld deterioration and other changes, the definition of parameters which can be used to quantify land transformation and criteria for their evaluation.

Ecology of biological invasions. This SCOPE project arose largely from initiatives taken after the South African MEDCON Conference. It comprises the examination of the nature and extent of invasions by alien species and their effects on the natural systems which they invade. A simultaneous investigation of the characteristics of the more successful invading species will be conducted with a view to developing systems for their control. Intercontinental comparative studies will explore the general mechanisms of biological invasions, a phenomenon which is particularly evident in the winter rainfall areas of South Africa.

RESEARCH HIGHLIGHTS

Developing ecological principles for bushveld management

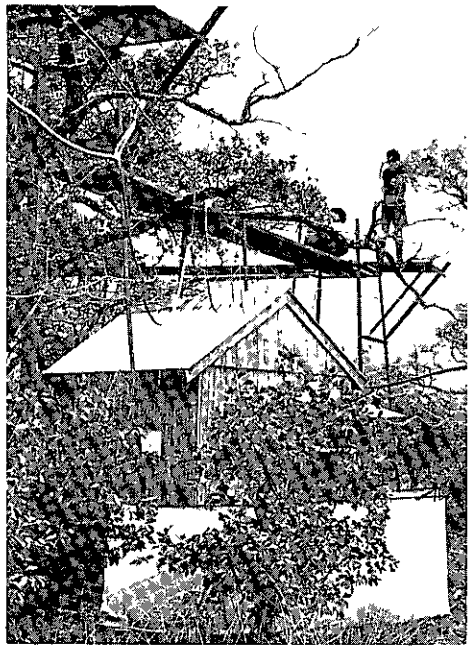
The South African Savanna Ecosystem Project (SASEP) was initiated in 1974 with the objective of strengthening our knowledge of the working of bushveld systems to the point at which we could predict the outcome of, in particular, various forms of land-use in this biome. The first phase described the numerous biotic and abiotic features of the research site at the Nylsvley Provincial Nature Reserve and was followed by an extended second phase which examined the interrelations of the major ecosystem components and processes. Particular attention was paid to the long- and short-term dynamics of the vegetation and fauna, to the energy, water and nutrient balance and flows in the system, and to the interaction between animals and plants.

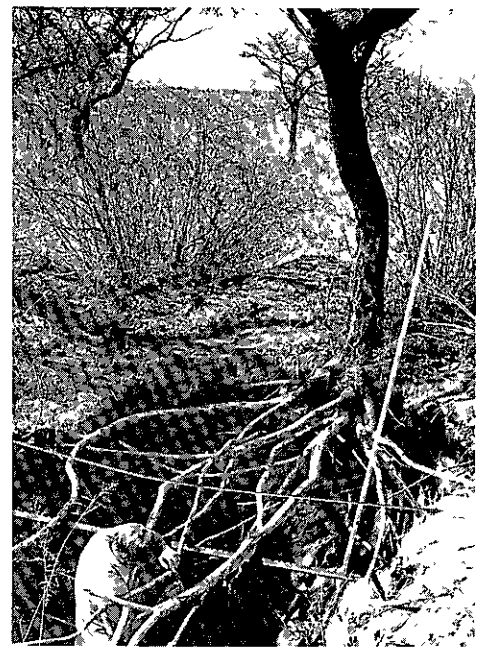
The vast amount of information collected in this phase was reviewed and synthesized at a symposium during July 1982. Much of this information has been published already, or will be included in the synthesis volume resulting from the symposium. Several fundamental features of the ecology of tropical savannas have without doubt been reassessed through the project's activities, and deserve mention at this point.

First, the savanna concept, its definition, characterization and interpretation through the southern continents in terms of arid/eutrophic (sweet bushveld) and moist/dystrophic (sour bushveld) savanna biomes has been carefully reviewed. Much of the confused thinking on the interrelationships of ecosystems within Africa and between Africa and other Gondwanaland continents has been clarified through the active international exchanges initiated by SASEP and through the testing of ideas within the Nylsvley study area. The recognition of the dual roles of grasses and woody plants on the unique nature of savanna ecosystem processes has been a major contribution in this respect.

Second, the development and application of the evolving concepts of stability and resilience to savanna systems is based entirely on the contributions made by Nylsvley project leaders. The intermittent need of varied forms of stress, such as fire, drought or overgrazing for the development of system resilience is only now coming to be seen as a vital component of savanna functioning.

Third, research at Nylsvley has provided mounting evidence of a wide range of buffering processes - such as underground storage systems, extended rooting patterns, seasonal pulses in plant growth activities, slow release of nutrients from decomposing litter, internal cycling of nutrients within





The Savanna Ecosystem Project at Nylsvley is endeavouring to develop a predictive understanding of how bushveld communities work. Earlier research had provided valuable information on the grass and large mammal components of African savannas, but little was known of the dynamics of the woody plants and of the processes of decomposition and nutrient cycling. The photos indicate some of the approaches used to investigate standing crop and growth in Burkea africana and Ochna pulchra. The biomass distribution in trees and shrubs was examined from the top of their canopies to their deepest roots, while radio-active labelling, gas-exchange and shoot length measures were used to determine changing growth rates through several seasons. (See list of recent publications arising from the Nylsvley project on pages 37 and 38 of this report).
Photos: M D Panagos, M C Rutherford

plants through translocation, etc - all giving the savanna ecosystem a capacity to endure periodic severe stress such as drought, overgrazing or fire.

Fourth, the relative roles of consumers and decomposers in energy and nutrient transfer in arid/eutrophic and moist/dystrophic savannas have been described for the first time from Nylsvley studies.

These are but a few of the general principles currently emerging from SASEP. Their significance to the needs of farmers and other land users in the bushveld is not immediately apparent, but is fundamental to a broader understanding of how bushveld communities work, and how they respond to use. Such background knowledge is essential to the third phase of the project, which looks more specifically at management problems in savanna ecosystems. The main approach will be through the construction and analysis of decision models addressing specific management problems. To fully appreciate such problems from the manager's viewpoint, and thus identify the need for information at this level, active cooperation with agencies directly involved with the management of agriculture systems and game and nature reserves will be established during this third phase of the project. Towards this end, a preliminary survey of bushveld management problems, as perceived by farmers in the northern Transvaal, has been initiated and will lead to more detailed studies of socio-economic and ecological factors accounting for the generally low level of agricultural productivity of many bushveld areas.

Preliminary decision analyses carried out have identified the need for various forms of information, including :

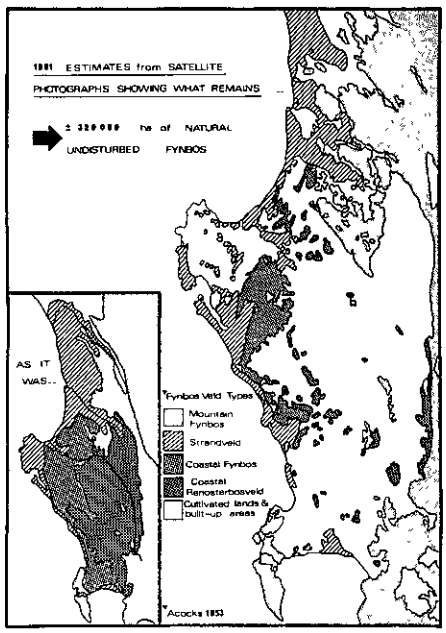
- Fundamental information on process rates and on the likely form of certain ecological relationships, eg rate of bush encroachment and of the re-establishment of woody cover after clearing, rate of veld decline with grazing and the rate of grass recovery after fire.

- Historical information has been shown to be of importance in assessing the probability of various states of nature, in particular rainfall and fire.

- Current information and its role in management urgently needs investigation. An attempt will be made to assess what immediately available information managers use at present, what they monitor and how they use this information in making their decisions. This will identify the potential for developing effective and practical monitoring systems.

Lowland fynbos : southern Africa's most threatened ecosystem

Over three centuries of settlement and development of the south-west Cape has led inevitably to the reduction of the area of undisturbed lowland fynbos to a mere patchwork of tiny remnants. The floristic richness, beauty, commercial value and scientific interest of these fynbos communities has long been recognized, as has the need for their conservation. Yet an objective basis for the selection of priority sites for conservation, out of hundreds of isolated patches, has not been available. The seriousness of this problem was highlighted at a symposium



The lowland fynbos of the south-western Cape is the most critically threatened vegetation type in Africa. The map indicates current estimates, based on satellite imagery, of the decrease in the extent of natural fynbos since development commenced in the area some three hundred years ago. Principal causes in the deterioration of the situation include invasive aliens such as acacias, pines and hakea and the expansion of agricultural lands over all but the most unproductive lowland areas. (See also Hall, de Winter, de Winter and van Oosterhout Threatened plants of southern Africa SANSP Report No 45).
Photos: A V Hall

on lowland fynbos conservation held in 1980, leading to the appointment by the Minister for Environment Affairs and Fisheries, of a committee to make recommendations on conservation needs in the region.

During 1981 a series of workshops organized jointly by the Fynbos Biome Project and the Nature Conservation Research Section, brought together participants with a wide range of expertise to develop a system for the evaluation of conservation priorities in fynbos communities. An array of selection criteria was used: habitat diversity; species richness; number of threatened plant species; size; shape; degree of invasion by aliens; and level of disturbance by other factors. These were allocated scores, to rank 28 existing reserves and 67 additional sites within the western forelands, the most critically threatened of all fynbos areas. The area covered extends from the lower Olifants River to False Bay and from the Atlantic coast to the foot of the Cape folded belt mountains.

The analysis revealed that half the existing reserves had little if any conservation merit when assessed on objective criteria. About the same number were so small, having an average size of 65 ha, that their long-term viability is in doubt. Indeed, of the 32 sites ranked in the top half of the combined scale of conservation values, only five are existing reserves. The detailed data sheets for each site, together with the results of the evaluation procedure, have been included in a comprehensive report being made available to the Cape Provincial Administration and the Department of Environment Affairs.

This exercise has special points of interest. It is the first instance in South African conservation history in which a diverse set of detailed scientific data has been used to evaluate conservation priorities. Secondly, it is satisfying that the wide range of expertise developed within the Fynbos Biome Project from a variety of disciplines, could so rapidly respond to the needs of a user agency. The multi-organizational, multi-disciplinary interaction developed through this project's activities has provided a unique capacity to examine and report on issues affecting the severely depleted natural habitats of the south-west Cape Province.

INTERNATIONAL ACTIVITIES

The ecology of invasions by animals and plants

Biological evolution on the three southern continents is distinctive and closely reflects their geological history. The diversity and highly specialized nature of these biota are a specifically southern global asset of inestimable value. In addition, these ecosystems have only recently been severely disturbed by modern man and as such contain many habitats that are not irreversibly modified by development. This has meant however, that where man-induced impacts occur their effects are generally more dramatic and more damaging than in equivalent situations in the northern hemisphere.

One such man-induced impact is the spread of alien species to areas remote from their centres of origin. In South Africa the spread of alien invasive plants in particular, is a phenomenon which is costing the country tens of millions of rands annually in lost production and control costs and has seriously threatening consequences for nature conservation.

Several agricultural agencies, including the agro-chemical industry, are involved in research and control work related to species of direct agricultural threat, but little has been done about those threatening our indigenous plant and animal communities.

Recognition of this research need has existed for some time, but it was recently formalized by South African ecologists who initiated a proposal on the ecology of biological invasions for presentation to SCOPE. This proposal emphasizes the importance of intercontinental comparisons in any comprehensive research programme to study invasion processes. It has also given rise to the drafting of a research programme on South African invasive biota.

The emphasis in this programme will focus on three important components of the problem. It will seek to identify the factors that determine whether or not a species will become invasive; it will analyse site properties to determine whether an ecological system is susceptible or resistant to invasion; and it will investigate management and control strategies so as to make recommendations for both the control and prevention of invasions. The programme has already been initiated by the compilation of a bibliography and the initiation of a synthesis project on the inventory and classification of South African invasive plants. Due to the high incidence of invasive species in the fynbos biome, it is logical that initially this area will provide a geographical focus for the project.

FUNDED PROJECTS 1981 AND 1982

Savanna Ecosystem Project

1. Iron age settlement and the Burkea/Acacia mosaic at Nylsvley. Professor T N Huffman (Department of Archaeology, University of the Witwatersrand), 1980-1981.

2. Autecological studies in selected species of trees, shrubs and grasses of Acacia and Burkea savannas. Professor G K Theron (Department of Botany, University of Pretoria), 1979-1981.

3. Stability of the Burkea/Acacia mosaic and the grass/woody ratio within the Burkea. Professor B H Walker (Centre for Resource Ecology, University of the Witwatersrand), 1980-1984.

4. A survey of the woody vegetation of the Nylsvley Study Area. Dr R A Lubke (Department of Plant Sciences, Rhodes University), 1974-1982.

5. The climate and microclimate of Nylsvley. Professor J M de Jager (Department of Agrometeorology, University of the Orange Free State), 1979-1982.

6. Examination of a water budget for the Burkea savanna. Professor G C Bate (Department of Botany, University of Port Elizabeth), 1978-1982.

7. A comparative study of the effect of environmental variation on the rate of photosynthesis and aboveground respiration of the vegetation at Nylsvley. Professor C F Cresswell (Department of Botany and Microbiology, University of the Witwatersrand), 1978-1982.

8. A study of the fate of photosynthate in selected grasses and woody plants in the savanna ecosystem during different stages. Professor C F Cresswell (Department of Botany and Microbiology, University of the Witwatersrand), 1981-1985.

9. Pathogens and their effect on the physiology of the plants in the Burkea savanna. Professor H M Garnett (Department of Botany and Microbiology, University of the Witwatersrand), 1978-1982.

10. Trophic ecology of large herbivores : factors influencing the consumption of woody plants and forbs. Professor B H Walker (Centre for Resource Ecology, University of the Witwatersrand), 1980-1983.

11. Trophic ecology of large herbivores : comparative diet selection strategies of grazing and browsing ungulates. Professor B H Walker (Centre for Resource Ecology, University of the Witwatersrand), 1980-1983.

12. Trophic ecology of large herbivores : grass responses to consumption by grazing ungulates. Professor B H Walker (Centre for Resource Ecology, University of the Witwatersrand), 1980-1983.

13. The influence of rumen cellulolytic bacteria on forage selection and digestion of wild herbivores. Dr R R H Hill (Department of Botany and Microbiology, University of the Witwatersrand), 1980-1983.

14. Feed-energy economy in the digestion process and determination of carrying capacity of game at Nylsvley : (1) Kudu. Dr W van Hoven (Department of Zoology, University of Pretoria), 1981-1983.

15. Decomposition rates of plant litter in Nylsvley soils. Professor P L Steyn (Department of Microbiology and Plant Pathology, University of Pretoria), 1975-1983.

16. Examination of a nitrogen budget for the Burkea savanna. Professor G C Bate (Department of Botany, University of Port Elizabeth), 1978-1981.

17. The availability and cycling of minerals in Burkea savanna. Professor G C Bate (Department of Botany, University of Port Elizabeth), 1980-1982.

18. Rate of biological nitrogen fixation during different times of the year and identification of organisms involved. Professor N Grobbelaar (Department of Botany, University of Pretoria), 1979-1982.

19. Simulation modelling of a savanna ecosystem. Professor M Sears (Department of Applied Mathematics, University of the Witwatersrand), 1975-1984.

20. Long-term monitoring studies of the herb layer on the Nylsvley Nature Reserve (Burkea africana savanna). Professor G K Theron (Department of Botany, University of Pretoria), 1974-ongoing.

21. The role of arboreal ants in the savanna ecosystem. Professor V C Moran (Department of Zoology, Rhodes University), 1981-1984.

22. Factors determining Acacia shoot production. Professor E J Moll (Department of Botany, University of Cape Town), 1982-1985.

23. Effects of subsistence agriculture on savanna with special reference to fuelwood collection. Professor J Hanks (Institute for Natural Resources, University of Natal), 1979-1982.

Fynbos Biome Project

1. Dendrographic studies of water relations of the fynbos. Dr K H Schütte (Department of Botany, University of Cape Town) and Mr K Achtleitner (Department of Biochemistry, University of Cape Town), 1979-1981.

2. Effect of fire regime on mammal populations in fynbos at Jonkershoek and elsewhere. Professor R C Bigalke (Department of Nature Conservation, University of Stellenbosch), 1979-1981.

3. Detail-characterization of soils under different fynbos-climate-geology combinations in southern and southwestern Cape. Mr J J N Lambrechts, Professor A A Theron and Mr M Fry (Department of Soil Science, University of Stellenbosch), 1979-1982.

4. Post-fire regeneration studies at Pella. Professor E J Moll and Miss J E M Sommerville (Department of Botany, University of Cape Town and Mr C Boucher (Department of Agriculture), 1980-1990.

5. Phenological studies in representative fynbos types. Professors E J Moll and D T Mitchell (Department of Botany, University of Cape Town), 1980-1982.

6. Vegetation dynamics within and between fynbos and adjacent biomes. Professor E J Moll (Department of Botany, University of Cape Town), 1979-1982.

7. Ecophysiological survey of fynbos, especially with regard to nutritional aspects and water relations. Dr J H Jooste (Department of Botany, University of Stellenbosch), 1979-1982.

8. Pleistocene and Holocene environments in the fynbos area. Professor H J Deacon (Department of Archaeology, University of Stellenbosch), 1979-1983.

9. An investigation of cycling and processing of nitrogen in the fynbos biome. Professors O A M Lewis and D T Mitchell (Department of Botany, University of Cape Town), 1979-1982.

10. Studies on the phosphorus cycle in the fynbos biome. Professors D T Mitchell and O A M Lewis (Department of Botany, University of Cape Town), 1979-1983.

11. A preliminary study on mineral cycling and the distribution and activity of microorganisms in the soil. Professor D T Mitchell (Department of Botany, University of Cape Town) and Miss D L Olivier (Department of Microbiology, University of Cape Town), 1979-1983.

12. A preliminary investigation of the ecological role of mole-rats in the fynbos of the western Cape. Professor J U M Jarvis and Mrs K C Davies (Department of Zoology, University of Cape Town), 1981-1982.

13. The reproductive physiology of representatives of the fynbos biome. Mr L Raitt (Department of Botany, University of the Western Cape) and Dr J J Jooste (Department of Botany, University of Stellenbosch), 1980-1990.

14. Limnology of standing waters in the fynbos areas of the south-western Cape. Dr J Day (Department of Zoology, University of Cape Town), 1981-1982.

15. Determination of monocharacter growth forms in the winter rainfall area of South Africa. Professor E J Moll (Department of Botany, University of Cape Town) and Professor G Orshan (Hebrew University of Jerusalem), 1981-1982.

16. Microbial populations of fynbos soils in relation to soil conditions, particularly pH. Professor M A Loos (Department of Microbiology and Virology, University of Stellenbosch), 1982-1986.

17. Sunbird-Erica pollination systems in mountain fynbos. Professor W R Siegfried (Percy FitzPatrick Institute of African Ornithology, University of Cape Town), 1982-1984.

18. Effects of recent landuse on a fynbos site. Professor J Grindley (School of Environmental Studies, University of Cape Town) and Mr C Boucher (Department of Agriculture), 1982.

19. Comparative gradient studies in Australia and the Cape. Professor E J Moll (Department of Botany, University of Cape Town), 1982.

Karoo Biome Project

1. Karoo biome synthesis. Professor A J H Pieterse (Department of Botany, University of the Orange Free State), 1981-1982.

Grassland Biome Project

1. Grassland biome synthesis. Professor N M Tainton (Department of Grassland Science, University of Natal), 1982.

2. A simulation of the grazing of sour grassveld. Mr M T Mentis (Department of Grassland Science, University of Natal), 1982-1985.

NATURE CONSERVATION RESEARCH

BACKGROUND

The first meeting of the National Committee for Environmental Sciences agreed that it would provide, through its Inland Water and Terrestrial Biology Sections, for the coordination of research relating to nature conservation. The NPES would report both to NCES and to NAKOR (the National Committee for Nature Conservation, a coordinating committee of all state organizations involved in nature conservation in South Africa). The IBP activities, especially those within the Conservation of Terrestrial Biological Communities (CT) and Project Aqua projects, had already initiated important work on the survey of the conservation status of terrestrial and aquatic ecosystems. The new programme concentrated primarily on the preparation and publication in the South African National Scientific Programmes Report Series of South African Red Data Books on threatened species. To date, plants, large and small mammals, fish, birds, reptiles and amphibians have been dealt with. All these lists are now somewhat dated and second editions for birds and fish are currently being prepared. Two major meetings on threatened ecosystems and species have also been held. A symposium and workshop on the Conservation of Threatened Natural Habitats (HABCON) was held in the Cape in September 1980. The symposium proceedings and workshop report from this meeting will be published shortly. The second meeting was the Workshop on the Assessment of Bird Populations held at the Percy FitzPatrick Institute of African Ornithology (PFIAO) in February 1981, which provided a basis for the current review of the role of the South African Bird Ringing Unit (SAFRING) and the operation of a Bird Populations Data Bank.

The impetus given to nature conservation research efforts by the National Programme led to a request from NAKOR for a separate section within NPES to deal solely with nature conservation research needs. After prolonged negotiations, new funds were made available by the Department of the Environment, and the Committee for Nature Conservation Research was established in 1979.

The new committee has assumed responsibility for the threatened species studies of the Terrestrial Ecosystems Section, and administers, on behalf of the Committee for Terrestrial Ecosystems, the project on invasive biota which has an antecedent in the Invasive Weeds Working Group of the original Committee for Terrestrial Biology. This working group had, in collaboration with the Department of Agriculture, initiated the biennial "National Weeds Conferences" which have made a major contribution to research in this field during the last decade. Another activity which was

strongly funded by the Committee for Terrestrial Biology was the Pesticide Residues Working Group, which established facilities and methods for the measurement of pesticide residues in animals and animal products. This activity is currently dormant, but in the wider context of environmental pollutants, is likely to come under review by the Committee for Nature Conservation Research.

RATIONALE AND OBJECTIVES

South Africa encompasses a great variety of climatic conditions, natural landscapes and diversity of wild plant and animal communities. Although semi-arid karoo habitats occupy over one third of the country, it contains climatic and biotic heterogeneity typical of countries many times its size. For example: the unique Cape Floristic Kingdom, restricted to the south-western Cape, contains the highest species richness of any floristic zone on earth, with over 6000 plant species in 18 000 km^2. Furthermore, South Africa's indigenous mammals of over five kilogram body mass number 61 species, the greatest number of terrestrial large mammals of any nation, regardless of size.

Such unique wildlife assets have led to the creation of over 50 major protected areas managed by state funded agencies. But these comprise only 3,5% of the country and are principally in savanna areas, selected due to their diversity of the more spectacular large mammals. Many habitat types and ecological systems such as highveld grasslands, river systems and the sea shore are virtually without conservation protection and are already extensively modified by man. Outside of the protected areas, over 80% of the country produces food and fibre off semi-natural vegetation, most of it privately owned and much of it degraded in terms of ecosystem health and productivity. With their competing or incompatible objectives, these rigidly separated forms of land-use will be subject to soaring demands in the next decade. Furthermore, the public's awareness of the environmental limits which affect our land and which already have had an impact on the quality of life of all South Africans differs considerably between social, political and economic communities.

In the past, wildlife research has included a strong emphasis towards wildlife management and the description and understanding of individual species. Although this activity has put South Africa in the forefront of wildlife research in Africa, it is counter-balanced by our high degree of development, and the threat this poses to the sustainability of these natural resources. In order to coordinate the research needed to measure and describe the extent of this threat and to advise on strategies for counteracting it at a national level, the Committee for Nature Conservation Research has as its principal objective :

- To stimulate and coordinate the research needed for the development of ecological principles and practices necessary for the conservation of indigenous species and communities together with their habitats and life-support processes for the long-term benefit of mankind.

CURRENT ACTIVITIES

Research coordination is carried out within six interrelated compartments with the possibility of additional ones being developed in the future.

Species conservation concerns the continual evaluation of the threatened status of all plant and animal species throughout the region. An ongoing review of species distribution data is carried out using all available records. In liaison with the habitat conservation group, priority areas are identified as sites for potential extinctions. These data are used to indicate conservation and research priorities and as a means for revising the criteria used for designating species as "rare" or "threatened". The main function of the group is to update and republish the South African Red Data Books and provide species data to user agencies and particularly to the habitat conservation group.

Habitat conservation concerns the survey, inventory and classification of the full range of biotic communities and their habitats throughout southern Africa. It includes not only habitats as identified by veld types but also ecological systems such as wetlands, river systems and water catchments, mountain ranges, coastal dunelands, estuaries and coastal marine systems. Current activity is focused on a recently completed assessment of the coastal dune systems of Natal and the Cape Province and on future projects on wetlands, lotic systems and the winter rainfall karoo. Close liaison is maintained with NAKOR in their preparation of the National Plan for Conserved Areas and the development of a National Conservation Strategy.

Management and utilization of wildlife concerns the development of principles and practical guidelines for the management of protected areas, particularly for the long-term use of the habitats and wildlife species they contain. This includes the production-orientated management of wildlife species such as mammals, birds and fish, as well as management for outdoor recreation, game viewing, education or wilderness use. These guidelines are to be relevant to resource managers, policy makers, educators and interested members of the public, as well as functioning as indicators of research priorities. The group's current activities have been confined to the International Conference on the Management of Large Mammals in African Conservation Areas reported on below.

Conservation behaviour concerns the examination of those aspects of human behaviour which affect or arise from man's interaction with the natural environment. This is undertaken to facilitate better personal motivation for the conservation of environmental resources and to develop values and attitudes leading to positive conservation behaviour by individuals. It involves the entire field of environmental education and awareness, and the group is currently occupied in producing a research opportunities document to stimulate interest in starting a national programme of research in this field.

Invasive biota concerns the coordination of research into the causes, extent, effects and control of alien invasive species in southern African natural ecosystems, and the implications of these phenomena for nature conservation. This project, administered by the Nature Conservation Research Section, is described in the Terrestrial Ecosystems Section of this report.

SAFRING. The South African Bird Ringing Unit is a service and monitoring facility affiliated to the Nature Conservation Research Section and is located within the PFIAO, University of Cape Town. It serves as a repository for all bird ringing records from southern Africa and more

recently for a wider range of ornithological records from several national efforts in ornithological monitoring. Its aim is to coordinate the collection of these data and to analyse and publish the resultant findings on a continuous basis. In addition to its considerable volume of ongoing work in the field of bird ringing research SAFRING is currently considering expanding its role to that of handling all bird record collecting schemes at a national level in a consolidated Bird Populations Data Bank.

HIGHLIGHTS FROM AN INTERNATIONAL CONFERENCE

The management of large mammals in African conservation areas

In recent years South African conservation authorities have been criticized by the international conservation community for their practice of culling certain large mammal species in order to maintain a "natural balance" in national parks and reserves. The problem has become especially acute where species such as white rhinoceros and elephants - the survival of which is threatened in other parts of Africa - have had to be culled in the very reserves established for their protection.

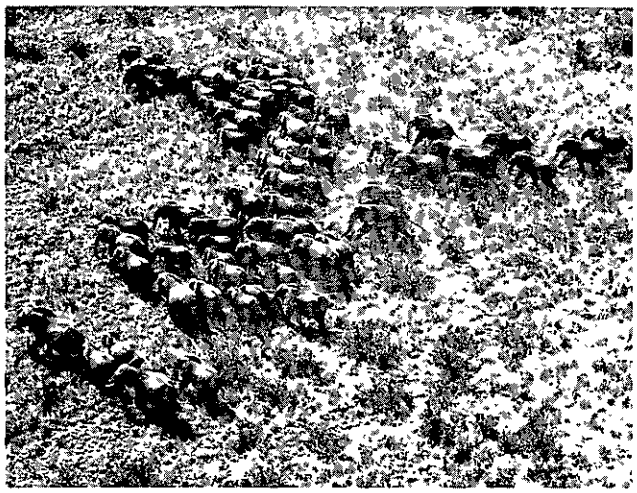
International interest in southern African wildlife management experience prompted the Nature Conservation Research Section to organize a symposium and workshop on the culling dilemma. The workshop, convened in May 1982 at Olifants Camp in the Kruger National Park, was attended by 40 wildlife scientists and managers from Australia, Europe, Kenya, Malawi, Mocambique, South Africa, South West Africa, Swaziland, Tanzania, USA, Zambia, and Zimbabwe. Despite their varied experience and personal views, they reached a surprising degree of consensus, shortly to be published in a handbook, "Guidelines for the Management of Conservation Areas for Large Mammals in Africa". It is specifically being written for conservation policy makers as well as scientists and managers in the field. A sample of some practical highlights demonstrates the wide ranging treatment given to this often emotive and misunderstood subject:

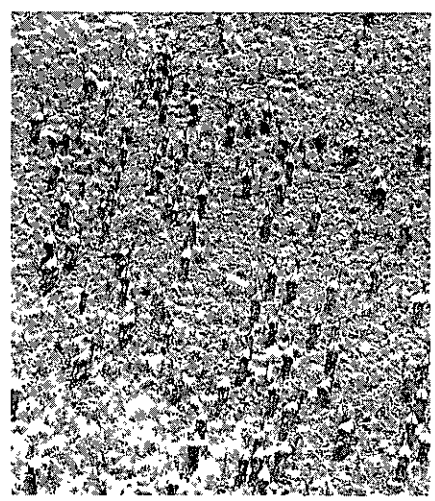
- The conservation of a single species is just as valid an objective as the conservation of an entire ecosystem. But it is vital to realize that the management practices that result from the former could be diametrically opposed to those that result from the latter.

- When size permits, a wide variety of conservation goals should be set for a protected area, because goal options tend to diminish along with size.

- Protected areas are at risk in the long-term, unless their mode of land-use achieves a level of compatability with and appreciation from land-users surrounding them.

- Emphasis on extractive forms of wildlife utilization and cost-effectiveness to justify the existence of a reserve, is likely to be prejudicial to its long-term sustainability. A policy of developing cultural and aesthetic values for such areas, through broad interpretive programmes, is essential.





The vegetation structure of vast areas of Africa has undergone dramatic changes during the last century in response to over- or under-utilization by grazers and browsers. Bush encroachment has reduced over 2 million hectares of our best cattle production areas to dense thorn thickets, while the reverse situation has developed in strictly protected conservation areas where increasing populations of large browsers such as elephant have destroyed woodland communities. The latter phenomenon places the national park manager in a dilemma - whether to allow nature to run its course, possibly leading to the elimination of certain tree species, or to cull the animals which he has been charged to protect. The theoretical and practical aspects of this issue have been exhaustively reviewed by the Nature Conservation Research Section of NPES.
Photos: National Parks Board

- Cause and effect relationships in natural systems are often counter-intuitive. This has often given rise to management decisions based on untested assumptions.

- In the management decision-making process applied to nature reserves, there are two types of decisions: scientific or technical decisions, based on facts; and value judgements or opinions, based on experience and personal preference. Whereas in the presence of facts, the first type of decision may be taken confidently and without bias, the second may not.

- When the conservation of ecosystem processes forms part of the objectives of a reserve, the imposition of management carries with it an additional obligation. For every management action there should be adequate monitoring to measure ecological reaction. Where practical, this involves the setting aside of "control" zones, where no management takes place, as an integral part of a wider monitoring strategy.

- Monitoring and research programmes within a protected area must be undertaken relative to specific goals which are themselves of direct relevance to the objectives of the reserve.

As these points demonstrate, the "cull or not to cull" dilemma received a much broader treatment than many of the 40 workshop participants expected. It was evident that the entire management process needed examination. A significant conclusion of the discussions was the recognition that the debate on the moral rights and wrongs of culling was a red herring - there are no incontrovertable rights or wrongs. It all depends on one's objectives, what one is trying to conserve and why.

FUNDED PROJECTS 1981 AND 1982

Threatened Species

1. Survey of rare and endangered plants in the Cape Province. Professor A V Hall (Bolus Herbarium, University of Cape Town), 1974-1984.

2. Revision of the South African Red Data Book : Aves. Professor W R Siegfried (Percy FitzPatrick Institute of African Ornithology, University of Cape Town), 1978-1981.

3. A revision of the South African Red Data Book : Fishes. Dr P Skelton (Albany Museum, Grahamstown), June 1982-June 1983.

Management and Utilization

1. Game management strategies for South African reserves. Professor B H Walker (Centre for Resource Ecology, University of the Witwatersrand) and Professor A M Starfield (University of Minnesota), July 1981-July 1982.

2. Awards to registered bird ringing projects. Mr T B Oatley (Percy FitzPatrick Institute of African Ornithology, University of Cape Town), 1982-ongoing.

Habitat Conservation

1. A survey of the conservation status of the coastal dune ecosystems of South Africa. Dr K L Tinley (Consultant Ecologist, East London), June 1981-June 1982.

HUMAN NEEDS, RESOURCES AND THE ENVIRONMENT

BACKGROUND

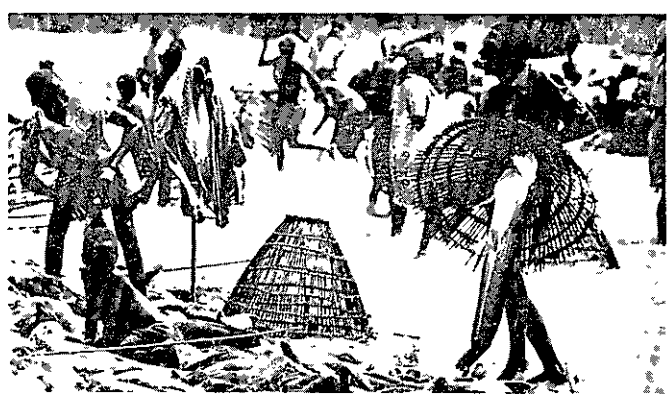
In common with other NPES activities, the Human Needs, Resources and the Environment Programme (previously called the Human Adaptability Programme (HA)) has its historical origin in the South African contribution to the International Biological Programme. The IBP/HA section concluded its programme with a symposium on "Two Populations in Transition", in October 1972. The symposium reported on a multi-disciplinary study of Venda and Pedi communities in both rural and urban environments.

The new NPES/HA section proposed that its programme should develop the theme "Interactions between environmental transformations and genetic, sociological, socio-economic and demographic changes" in parallel with that of Man and the Biosphere (MAB) and IBP/HA projects. A few research projects were carried out in this first phase of the programme on funding provided by NPES, the Human Sciences Research Council (HSRC) and the Medical Research Council (MRC). One of these, a study of the impact of development activities on the Tembe-Thonga population of the Pongolo Floodplain, formed part of a multi-disciplinary study of the possible effects of the construction of the J G Strijdom Dam.

The second phase of the programme began in 1976 with a new Human Adaptability Committee, which saw the impact of development as its principal topic. It hoped to set up one or more critical studies of very rapidly developing sites in order to provide information and insights which could be used by planners and decision-makers to regulate the development and obviate problems which may arise. In collaboration with the South African Iron and Steel Industrial Corporation Ltd (ISCOR), Ellisras was selected as the site and a first phase study undertaken by the University of South Africa (UNISA) School of Business Leadership.

Quality of Life (QOL) emerged as the focus of this study and of most of the rest of the Human Adaptability Programme. The same group undertook a study of an area at Brits considered to represent a similar scale and tempo of development at a later stage in the development process. Preparations were made to carry out expanded and follow-up surveys at Ellisras and Brits and to develop techniques for using QOL parameters to study past impacts and predict consequences of future development both in rural areas and in the larger urban complexes of South Africa.

The third phase of the Human Adaptability Programme began in 1979. The second phase of the Ellisras study was carried out, a theoretical QOL



The Pongolo floodplain was one of the last corners of South Africa to be influenced by development. The construction of a major dam at Josini introduced the possibility of dramatic changes to the river's flooding regime and to the functioning of the floodplain ecosystems. The Tembe-Thonga populations which live on the floodplain have developed a subsistence economy in close harmony with the ever fluctuating levels of flooding, siltation and fish production. The interdependence of man and the floodplain ecosystem was studied in detail by both the Inland Water Ecosystems and Human Needs, Resources and the Environment Sections of the NPES. The photos illustrate the nature of land-use along the floodplain, providing sustained yields of vegetable and animal proteins. (See Heeg and Breen Man and the Pongolo floodplain SANSP Report No 56).
Photos: H D Furness, H M Kok, K H Rogers

study was undertaken and a questionnaire designed for use in Soweto. By 1981 the focus of research in the Human Adaptability Programme had progressed to such an extent from that which was envisaged by the original Human Adaptability Working Group that it was decided to change the name to the Human Needs, Resources and the Environment (HNRE) Programme.

RATIONALE AND OBJECTIVES

South Africa has a highly complex and diverse society with great differences in levels of human development and quality of life amongst different sectors of its society. Although richly endowed with natural resources, they are spatially unevenly spread. For these and other reasons one finds regions of high economic growth surrounded by large areas of stagnation or underdevelopment. The achievement of balanced development and the satisfaction of human needs are great challenges facing decision-makers in this country today. The QOL focus of earlier studies in the programme, such as those of Ellisras and Brits, thus also included the extent to which people's needs were met and the possibility of developing a model or instrument with which one could measure their ensuing QOL (both in concrete terms as well as regards perceptions). Later projects in the QOL Sub-programme have culminated in the development and testing of such an instrument.

The achievement of national goals of balanced development and the satisfaction of human needs can only result from policies formulated on the basis of the interdependence of socio-political, economic and ecological factors. The need to understand these inter-dependencies is being repeatedly stressed. In the latest Economic Development Programme released by the Office of the Economic Advisor to the Prime Minister (1978-1987) the relationship between economic growth and employment creation is discussed. Other important relationships include those between quality of life, the distribution of resources and the attainment of social aspirations. There is a further world-wide recognition that a perception of the problem of ecological balance has been conspicuously absent in development policies in recent years. It is vitally important that the possibilities offered and limitations imposed by the physical environment in especially the underdeveloped regions of South Africa, should be reflected in such policies. In this respect, a central issue is the need for a re-emphasis on developing man living in two systems, the ecological and the social, with a high degree of interdependence between them. Furthermore, the need to secure over the long-term the conditions conducive to economic growth and employment creation, calls for a continuous assessment of the balance between resource exploitation and conservation. The HNRE Programme has thus evolved two more sub-programmes, ie the Basic Needs Sub-programme and the Human Ecology and Development Sub-programme, in which these various interrelationships are being studied. One of these interrelationships, ie that between the satisfaction of basic needs and QOL, has been the theme of a research project to be completed by the end of 1982.

The overall aim of the HNRE programme is to develop the capacity to assist in the understanding, measurement and prediction of relative effects of factors involved in the achievement of balanced socio-economic development and the satisfaction of human needs. The following are the main objectives of the programme :

- To determine the most relevant and important socio-political, economic and ecological relationships involved in the satisfaction of human needs.

- To develop the capacity to measure and predict both the interrelationships and the outcome of planning policies.

- To provide the inputs necessary for planning policies aimed at balanced development and the satisfaction of human needs.

CURRENT ACTIVITIES

Quality of life (QOL)

The relative importance of the various factors playing a role in the QOL of different societies, as well as the adaptation of people to their milieu, are still foci of this sub-programme. Research projects in this regard include those on the adaptation of black people to the expectations in the urban industrial milieu, and the effect of the living environment on their QOL.

The concern of social scientists about the use of more obvious indices like income, disease rates, housing characteristics, etc as the only measure of a differential experience of well-being, especially in more affluent societies, has led to the emphasis on the introduction of more subjective indicators in QOL assessments. The measurement of QOL, using a model or instrument containing both objective and subjective elements, is the present main focus of this sub-programme (cf discussion below under "Research highlights").

Basic needs

Research activities within this sub-programme are concerned with the problems involved in the satisfaction of people's basic needs, as a pre-requisite for sustained development. Specific needs, (eg health) are being assessed within a national context. Projects focusing on the effect of urbanization on the satisfaction of basic needs, and on the institutional identification and response to certain basic needs, are also at present funded. There are thus two main research foci: the determination of people's basic needs, the resources available and the bottlenecks between resource allocation and the satisfaction of needs; and, secondly, the relationships between QOL, the satisfaction of basic needs, and planning policies.

Human ecology and development

Development activities often reflect scant attention to and understanding of ecological factors. Past research has usually been concerned with either the ecological or the socio-political and economic factors which play a role in the development process. This sub-programme's research activities revolve around the determination of the extent to which people can exist on the resources at their individual disposal, especially in underdeveloped rural areas, and the short-term and likely long-term

consequences of this resource use. In addition, consideration is given to the implications of the above-mentioned factors for policies aimed at socio-economic development and the satisfaction of basic needs.

RESEARCH HIGHLIGHTS

The determination of quality of life

An instrument (or methodology) for the measurement of quality of life has been developed by the Centre for Applied Social Sciences, University of Natal. This instrument includes not only objective indicators, but also involves the assessments of objective basic needs, subjective responses to life in general or in its various domains and very broad mood reactions to contemporary life. The instrument was critically reviewed at two meetings of experts in this field, and revised and adapted to solve the problems raised. In view of the urgent need for such an instrument, it will now be tested amongst various urban population groups by the Opinion Survey Centre of the Human Sciences Research Council. Rural testing will be undertaken mainly with Cooperative Scientific Programmes funding.

RESEARCH PROGRAMME IN SUPPORT OF REGIONAL ECONOMIC DEVELOPMENT PROGRAMMING IN SOUTHERN AFRICA

Cooperative Scientific Programmes was approached by the Economic Planning Branch of the Prime Minister's Office to undertake the organization and administration of a research programme in support of regional economic development programming in southern Africa, as an infrastructure for this purpose already existed within the Human Needs, Resources and the Environment Programme. The research needs and questions which are to be answered are to be determined by the Office of the Prime Minister. The purpose of the research programme is to make available information which has been collected and analysed in a scientific way, in order to provide the government with effective advice to assist in the process of regional economic development programming for southern Africa.

The research programme focuses on four main areas of concern :

- Economic growth.
- Creation of employment opportunities.
- A more even spatial distribution of socio-economic development.
- The satisfaction of basic needs.

FUNDED PROJECTS 1981 AND 1982

1. Industrialization and quality of life : a sociological study. Mr P G Human (Department of Sociology, University of South Africa), 1980-1982.

2. The effect of the living environment on the quality of life of blacks and coloureds. Dr C F Swart (Institute for Urban Studies, Rand Afrikaans University), 1979-1981.

3. Cognitive adaptation to forms of modern disequilibrium among urbanising blacks. Professor L Schlemmer and Dr V Möller (Centre for Applied Social Sciences, University of Natal), 1979-1982.

4. Community health research project. Professor M T D Savage (Department of Sociology, University of Cape Town), 1982-1983.

5. Basic needs and quality of life. Professor G F R Ellis (Department of Applied Mathematics, University of Cape Town), 1982.

6. Framework for a national settlement strategy and the satisfaction of basic needs. Professor D Dewar (Urban Problems Research Unit, University of Cape Town), 1982-1983.

7. Conditions of life in rural areas project. Professor M E West, Dr J S Sharp and Mr A D Spiegel (Department of Social Anthropology, University of Cape Town), 1981-1983.

8. Technological change and employment in South African agriculture: a case study. Professor F A H Wilson (Southern Africa Labour and Development Research Unit, School of Economics, University of Cape Town), 1982.

9. Examination of factors affecting employment opportunities for low income groups in the Western Cape. Mr D Horner (Southern Africa Labour and Development Research Unit, School of Economics, University of Cape Town), 1982.

10. Occupational mobility of black workers. Mr C E W Simkins (Southern Africa Labour and Development Research Unit, School of Economics, University of Cape Town), 1982.

11. Rural communities in transition - a study of socio-economic and agricultural implications of agricultural betterment and development in Ciskei and Transkei. Professor S B Bekker (Institute of Social and Economic Research, Rhodes University), and Mr C de Wet and Mr P McAllister (Department of Anthropology, Rhodes University), 1982-1983.

12. Quality of life and basic needs survey. Professor L Schlemmer and Dr V Möller (Centre for Applied Social Sciences, University of Natal), 1982 - May 1984.

13. Public utility pricing and regional development in southern Africa. Professor M L Truu and Mr J L Wallis (Department of Economics, Rhodes University), March 1982-March 1984.

14. Analysis of factors influencing labour market participation decision of black workers as an element of the dynamics of migration in development regions. Professor G G Maasdorp (Economic Research Unit, University of Natal) and Mr N Bromberger (Development Studies Research Group, University of Natal), June 1982-May 1983.

15. The determination of the basic needs for transport/accessibility in respectively rural and urban areas of development regions. Mr J W M Cameron and Mr A H Naudé (National Institute for Transport and Road Research, CSIR), April 1982 - March 1983 (1st phase)

MAJOR PUBLICATIONS ARISING FROM NPES ACTIVITIES, 1980 – 1982

The findings of research projects funded by NPES are normally published in the open literature. In order to provide a medium for the publication of programme descriptions, bibliographies, syntheses on problems of general interest, etc, Cooperative Scientific Programmes initiated a series in 1975 within which several dozen NPES reports have appeared. Those published during the last two years are listed below.

In addition to the coordination of research programmes, NPES has convened a series of major national and international conferences during the past four years. These meetings have taken the form of symposia, at which invited papers have been presented by local and overseas experts, and workshops at which participants have developed guidelines on issues of special interest to both the scientific community and user agencies. The proceedings of these meetings are currently being published by local and international publishers.

Publications within the South African National Scientific Programmes (SANSP) Report Series

Advances in understanding phosphorus cycling in inland waters - their significance for South African limnology. A J Twinch and C M Breen. SANSP Report No 42, March 1980. 22 pp.

Terrestrial ecology in South Africa - project abstracts for 1978. SANSP Report No 43, February 1980. 92 pp.

A manual of methods for use in the South African Marine Pollution Monitoring Programme. R J Watling. SANSP Report No 44, July 1981. 82 pp.

Threatened plants of southern Africa. A V Hall, M de Winter, B de Winter and S A M van Oosterhout. SANSP Report No 45, May 1980. 244 pp.

South African legislation with respect to the control of pollution of the sea. André Rabie. SANSP Report No 46, January 1981. 73 pp.

Terrestrial ecology in South Africa and South West Africa - project abstracts for 1979. SANSP Report No 47, May 1981. 107 pp.

South African Marine Pollution Monitoring Programme 1979-1982. R J Watling and C E Cloete (Editors). SANSP Report No 51, July 1981. 52 pp.

Structural characterization of vegetation in the Fynbos Biome. B M Campbell, R M Cowling, W J Bond and F J Kruger in collaboration with D P Bands, C Boucher, E J Moll, H C Taylor and B W van Wilgen. SANSP Report No 52, August 1981. 19 pp.

A bibliography of fynbos ecology. M L Jarman, R M Cowling, R Haynes, F J Kruger and G Moll. SANSP Report No 53, August 1981. 73 pp.

Trophic ecology of lepidoptera larvae associated with woody vegetation in a Savanna Ecosystem. C H Scholtz. SANSP Report No 55, June 1982. 29 pp.

An inventory of plant communities recorded in the western, southern and eastern Cape Province, South Africa up to the end of 1980. C Boucher and A E McDonald. SANSP Report No 57, September 1982. 58 pp.

A bibliography of African inland water invertebrates (to 1980). B R Davies, T Davies, J Frazer and F M Chutter. SANSP Report No 58, September 1982. 418 pp.

An annotated checklist of dung-associated beetles of the Savanna Ecosystem Project study area, Nylsvley. S Endrödy-Younga. SANSP Report No 59, September 1982. 34 pp.

The termites of the Savanna Ecosystem Project study area, Nylsvley. P Ferrar. SANSP Report No 60, September 1982. 42 pp.

A description of the Grassland Biome Project. Edited by M T Mentis and B J Huntley. SANSP Report No 62, October 1982. 30 pp.

Description of a fire and its effects in the Nylsvley Nature Reserve: A synthesis report. M V Gandar. SANSP Report No 63, October 1982. 39 pp.

Workshop Proceedings

Man and the Pongolo Floodplain. J Heeg and C M Breen (Editors). SANSP Report No 56, June 1982. 117 pp.

Conservation of ecosystems: theory and practice. A report on a workshop meeting held at Tsitsikama, South Africa, September 1980. Edited by W R Siegfried and B R Davies. SANSP Report No 61, September 1982. 97 pp.

Mineral nutrients in relation to mediterranean-type ecosystems : a workshop in Hermanus, South Africa, September 1980. J Day (Editor) (in prep).

Guidelines for the management of conservation areas for large mammals in Africa. A A Ferrar (Editor) (in prep).

The ecological effects of fire in South Africa. P de V Booysen (Editor) (in prep).

Symposia Proceedings

The ecology of tropical savannas. B J Huntley and B H Walker (Editors). Ecological Studies 42. Springer Verlag, Berlin. 669 pp.

Mediterranean-type ecosystems : The role of nutrients. F J Kruger, D T Mitchell and J U M Jarvis (Editors). Ecological Studies. Springer Verlag, Berlin. 550 pp.

Proceedings of the symposium on the management of large mammals in African conservation areas. R N Owen-Smith (Editor). Educational Publishers, Pretoria.

Conservation of threatened natural habitats. A V Hall (Editor). David Phillips, Cape Town. (in press) 200 pp.

ACRONYMS USED IN THE TEXT

CT	Conservation of Terrestrial Biological Communities
HA	Human Adaptability
HABCON	Conference on the Conservation of Threatened Natural Habitats
HNRE	Human Needs, Resources and the Environment
HSRC	Human Sciences Research Council
IBP	International Biological Programme
ICSU	International Council of Scientific Unions
ISCOR	South African Iron and Steel Industrial Corporation Ltd
IUCN	International Union for the Conservation of Nature and Natural Resources
MAB	Man and the Biosphere
MEDCON	Conference on Mediterranean-type Ecosystems
MRC	Medical Research Council
NAKOR	National Committee for Nature Conservation
NCES	National Committee for Environmental Sciences
NPES	National Programme for Environmental Sciences
PF	Production of Fresh Water Communities
PFIAO	Percy FitzPatrick Institute of African Ornithology
QOL	Quality of Life
SAFRING	South African Bird Ringing Unit
SANSP	South African National Scientific Programmes
SASEP	South African Savanna Ecosystem Project
SCOPE	Scientific Committee on Problems of the Environment
UNISA	University of South Africa