

Focus on CSIR research in Ecosystems

Main Focus

CSIR research in this area focuses on understanding the functioning of ecosystems so as to manage these systems and enable them to retain their integrity, while continuing to deliver optimal goods and services in a sustainable fashion. Primary users of this research are:

- State custodians of resources, and the users of such resources in support of sustainable development (e.g. the departments of Environmental Affairs and Tourism, and Water Affairs and Forestry);
- The international array of research funds targeting natural ecosystems in pursuit of the Millennium Development Goals (European Union, Global Environmental Facility (GEF), United Nations, etc);
- Private sector organisations seeking to manage their impact on the environment in a responsible manner.

Focused Research Groups

Ecosystem Processes and Dynamics

The ecosystem processes and dynamics research group works on understanding the behaviour of relatively complex ecological systems (including those influenced by people). Much of the research falls in the general area of "global change" or "earth systems". The core competencies in the group include ecosystem analysis and modelling, advanced statistical analysis, earth observation, biogeochemistry and environmental isotope analysis. The group operates a laboratory, unique in Africa, for light isotope analysis, and a flux measurement site.

Biodiversity and Ecosystem Services

The Biodiversity Research Group promotes long-term biodiversity conservation and poverty alleviation at a landscape scale through the interface between biodiversity, ecosystem services and human well being. This group focuses on three key thematic research areas:

- Integrated conservation planning deals with the identification of terrestrial and aquatic areas requiring conservation action;
- Nature-based tourism is a developing area in the group and a growing sector in South Africa. It is a unique opportunity to research the drivers and limits of the sector;
- Ecosystem change is a research area that focuses on the impacts of human activities on ecosystems and the consequences of these changes for biodiversity, ecosystem services and human well being.

Ecophysiology

The ecophysiology research group's purpose is to use the understanding of ecophysiological processes to establish a science platform that will have an impact on the quality of life of South Africans by addressing national and international issues related to water-use efficiency, dry-land water use allocation, and global change. The three key issues addressed in the research are:

- Increasing and extending the availability of the water resource for rain-fed forestry and agriculture;
- Increasing the efficiency of using the water resource (water use efficiency);
- Determining who makes best use of the water in the public interest. Emphasis will be placed on reducing the risks and vulnerabilities associated with small-scale farming under marginal climatic conditions.

Marine and estuarine ecosystems

The marine and estuarine ecosystems research group's focus is on providing an understanding of, and applying ecosystem approaches to the management of marine and estuarine resources. The scope covers ocean and coastal ecosystems on a scale between small (such as estuaries) to regional (such as the cross-

boundary large marine ecosystems or coupled river basins and coastal ecosystems), and these scales shape the particular approaches of the research.



A strong observational capability, which includes both field and laboratory technology, is integrated with modelling platforms dealing with natural ecosystem processes as well as human impacts, to respond to the level of complexity, predictive requirements and legislative implications of the system. A significant section of the work is undertaken through medium to long-term interdisciplinary collaborations with regional and international partner institutions.

Coastal Zone Management

The coastal zone decision support research group comprises a strong marine science and engineering capability that provides both operational and strategic decision support for the optimal utilisation and sustainable development of the estuarine, coastal and marine natural resource base of southern Africa and Africa by:

- Providing an in-depth understanding of primarily the physical coastal processes (e.g. wave, current and sediment transport processes) operating in complex coastal zone and shelf systems;
- Providing an appropriate predictive capability in these coastal processes to support planning decisions in the coastal zone;
- Ensuing a critical mass of expertise in a number of core disciplines that provide the essential foundation and building blocks forming the basis of more integrated and cross-disciplinary ecosystem research initiatives.

The group presently focuses on decision support at various levels of integration to maritime industries involved in:

- The exploitation of coastal and offshore non-renewable resources (mining, energy, etc.);
- The maintenance and development of coastal infrastructure (coastal developments, marines, ports, power plants, marine outfalls, etc) with a limited but envisaged growing role in governance and planning decisions in the coastal zone related to tourism and coastal real estate.

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Earth Observation (EO)

EO provides solutions for environmental applications and research by establishing robust technology and integrative (cross-disciplinary) platforms. These will be achieved by focusing on provision of:

- Specific, application-oriented information products, e.g. object-oriented and data-integrative remote sensing techniques will become more superior to pixel based methods;
- Hyper spectral imaging;
- Moderate to high-resolution land cover mapping that is moving towards dynamics and sub-pixel feature extractions from pixel data;
- Standardisation and harmonisation of datasets;
- De-coupled service-oriented architectures for reusable processing chains built of modular service providing components;
- Open source products and adoption of open geospatial consortium web service specifications and interfaces.

Current Research Projects

The CSIR supports research on the impacts of biological control on the population dynamics of the target weed species. This research offers exciting prospects for expanding the understanding of the impacts of biological control. The key objectives of the work are to develop simulation models of the population dynamics of hakeas and acacias, with and without biological control agents. The work is a collaborative effort between the CSIR, the universities of Cape Town and Stellenbosch, and the Agricultural Research Council. A sound understanding of the impact of biological control on weed populations will help increase the efficiency of control programmes, as weed populations cost the country hundreds of millions of rands each year.

Research Successes

Management of Invasive Alien Plants

A substantial contribution has been made to the understanding of the ecology, impact and management of invasive alien plants in South Africa. The team has produced over 30 publications in this area in the past four years, many published in some of the world's top journals. The scope of the work has been wide, but it has maintained a focus on the central problem that is recognised as one of the major threats to ecosystem integrity, namely the invasion of ecosystems by a number of alien plant species.

Much of the recent work is summarised in a dedicated issue of the South African Journal of Science (Volume 100) that appeared in 2004.

Adaptations to Climate Change

Determining the impacts of and adaptations to climate change within the biodiversity sector in southern Africa was a collaborative project between the CSIR, the South African National Biodiversity Institute and the universities of Pretoria, Stellenbosch and the Witwatersrand. It was one of 24 regional studies funded by the GEF through the assessments of impacts and adaptations to climate change programme, and was the only project to focus specifically on biodiversity. Climate change is becoming a reality, and one of the predicted impacts will be widespread extinction of species. This will happen in a surprisingly short timeframe, with possible losses of 20% of species predicted by as soon as 2050.

This project attempted to understand the adaptation options available to society to mitigate the biodiversity loss. A number of models were developed to understand the dynamic responses of both individual species and functional groups of species to climate change. This was done in three pilot sites - the fynbos biome, the Karoo and the lowveld savanna. The project highlights the need for a new paradigm for conservation planning that recognises that habitats will change over time and that even sedentary plant species will have to effectively move through the landscape to track the changing location of suitable habitats.

Marine Research on Catchment to Coast

The Catchment2Coast project comprises research on and modelling of the impacts of river catchment developments on Maputo Bay Incomati River complex and on the sustainability of coastal resources, which support urban and rural economies. It takes an interdisciplinary systems approach to understand the linkages between river catchments and their associated coastal environments. It uses both measured data and linked dynamic numerical models as tools to translate the impacts of human development in the river basins into cost-based consequences to rural and urban economies in the coastal domain. The tools and capabilities produced will help in the anticipation and resolution of aquatic resource-based conflict and will support regional integration.