RESEARCH STRATEGY AND FUNDING PRIORITIES FOR THE CAPE FLORISTIC REGION

AUGUST 2007

Prepared for the Fynbos Forum Research Working Group by
Lala Steyn, Theresa Wilson, Donovan Kirkwood and Cornelia B. Krug

TABLE OF CONTENTS

1.INTRODUCTION TO THE FYNBOS RESEARCH FUNDING STRATEGY

The Cape Floristic Region (CFR) is the most species rich of the world's floristic regions, and has been identified as a biodiversity hotspot (Myers et al. 2000). Over the last century, the CFR, especially the lowlands of the region, has been under increasing human pressure, mostly through agricultural conversion and urbanisation (Krug and Krug 2007, Rebelo 1992). In the Millennium Ecosystem Assessment, the three main lowland ecosystems (renosterveld, sand fynbos and strandveld) were classified as critically endangered, endangered and vulnerable, with 15 of 21 critically endangered vegetation types located in the Cape lowlands (von Hase 2005). The fynbos lowlands are also severely under-protected (von Hase 2005), with most of the remaining habitat remnants located on private lands. The conservation and management of biodiversity thus presents a great challenge to conservation scientists, planners and managers.

To enable successful conservation of the exceptional biodiversity of the CFR, which has a high degree of local floral and faunal endemism in a spatially highly complex landscape, natural habitats must not only be adequately represented, but these remaining habitats must be spatially configured and managed in such a way that biodiversity can persist, and ecological processes be maintained across the landscape (Cowling et al. 2003, Pressey et al. 2003). Although about 20% of the CFR is formally protected, preservation and conservation is mainly restricted to the (more inaccessible) mountainous areas, limiting the representation of biodiversity pattern and processes (Rouget et al. 2003a). Conservation in such a landscape should thus not be restricted to "classic" reserves, but must take place outside reserves and in human influenced and managed areas. This is no simple task where remaining natural habitats continue to be threatened by habitat degradation, spread of invasive alien species and habitat transformation by agricultural and urban development (Rouget et al 2003). Global climate change is likely to exacerbate many of these impacts (Midgley et al. 2003).

Biodiversity research in the CFR has a long tradition, and the Fynbos Biome Programme was the first of the nationwide biome programmes to be implemented 30 years ago. However, research has mostly focussed on the rich plant diversity, which is likely to be matched by its insect diversity (Picker and Samways 1996)[1].

This research strategy aims to fill the gap in current key biodiversity research knowledge, and to bridge the gap between ecological research and conservation implementation in order to improve the management and mitigation of human impacts in the CFR. With this, the research strategy will contribute directly to the C.A.P.E. goal, which states that "by the year 2020, the natural environment of the Cape Floristic Region will be effectively conserved and restored wherever appropriate, and will deliver significant benefits to the people of the region in a way that is embraced by local communities, endorsed by government and recognised internationally" (www.capeaction.org.za).

The development of this research strategy and funding priorities involved an intensive consultative process with researchers, policy makers and conservation practitioners working in the CFR (see Annexure A for more information). Building on previous work done, this document provides the following information:

▪Section Two describes the broader context within which a fynbos research funding strategy needs to be conceptualised;

[1] The current state of the art in Fynbos and Cape Floristic Region research is being captured in the Fynbos i-forum, an online bibliography initiated and maintained by C.A.P.E at http://nivenlib.pfp.uct.ac.za/wwwisis/FYNBOS.01/form.htm.

▪Section Three outlines the goal and objective of the research strategy and funding priorities;
▪Section Four details the proposed funding priorities for the Cape Floristic Region; and
▪Section Five outlines the institutional arrangements for accessing research funding and managing the implementation of the research strategy.

This research strategy focuses specifically on bio-physical conservation sciences, however it is recognised that the successful implementation of conservation scientists research efforts requires the mainstreaming of biodiversity concerns into the behaviour of individuals and organisations which, in turn, requires an understanding of these behaviours (Cowling et al., 2007). Limited social science research has been undertaken in this field of study and a focused research strategy to address the social dimension of conservation research will be developed as a separate exercise.

2.CONTEXT FOR DEVELOPING A FYNBOS RESEARCH FUNDING STRATEGY

The case for long term funding for fynbos research or for any long-term biodiversity research, is made within a context that has changed over the past ten years. For the fynbos research strategy to be successful it needs to articulate itself in terms of this new context, key aspects of this context are discussed below.

Poverty focus of national, provincial and municipal government priorities
The context within which the democratically elected government operates is fundamentally different to that prior to 1994. Overall the emphasis is on economic development for poverty alleviation. Presently the emphasis is on ASGISA (the accelerated shared growth initiative for South Africa), which is the country's strategy to achieve the core objective of government, i.e. to halve poverty and unemployment by 2014, and to South Africa's international obligations towards achieving the Millennium Development Goals. Accelerating development means that, in the absence of adequate information and focused conservation interventions, we are likely to see much greater irreversible biodiversity loss per annum than in the past and are unlikely to be able to optimise the trade off between conservation and development in the most pressured landscapes.

National and provincial biodiversity research priorities
National and provincial government biodiversity research priorities are guided by legislative mandates including the Biodiversity Act, 2004; Regulations for the Proper Administration of Special Nature Reserves, National Parks and World Heritage Sites 2005; the Protected Areas Act (2003); and the World Heritage Convention Act (1999).

A range of initiatives to implement these legislative mandates are being undertaken by a multitude of stakeholders engaged in biodiversity conservation. One of these initiatives is the Cape Action for People and the Environment (CAPE.). CAPE is a programme of the South African Government, with support from international donors, to protect the rich biological heritage of the Cape Floristic Region (CFR). CAPE seeks to unleash the economic potential of land and marine resources through focused investment in development of key resources, while conserving nature and ensuring that all people benefit (www.capeaction.org.za). The CAPE strategy is closely aligned with the priorities of national, provincial and local government. A comparative analysis of the C.A.P.E. M&E objectives hierarchy and the proposed research priorities for the Cape Floristic Kingdom established a clear alignment of priorities (see Annexure B for more information). Specific priority research areas identified by C.A.P.E. include the impact of climate change on the region; and

fragments and lowlands. These research priority areas are addressed in the Research Strategy for the CFR.

The SANBI business case is also aligned with these national legislative mandates. It identifies the need for long-term ecological research (in all of South Africa's biomes) to enable scientists to inform decision makers about long-term environmental responses to different development actions. This approach requires suitable long-term studies to provide insights into responses, over decades or centuries, to natural cycles (e.g. weather or fire) or human-induced changes such as global warming, increased water extraction, invasive species and land use. Priority research areas in SANBI that have relevance for the fynbos region and are addressed in the Research Strategy for the CFR include:

- Climate change and land use;
- Control of invasive alien species;
- Threatened biodiversity; and
- Managing human impacts.

Changed system of funding for scientific research in South Africa

The system of funding for scientific research in South Africa, in particular biodiversity and fynbos research has changed since late 1980's. In the 1970's, ecosystem research was promoted through a series of major cooperative scientific programmes under the banner of the National Programme for Ecosystem Research (NPER), and administered by the CSIR's Foundation for Research Development (FRD). The aim of the cooperative scientific programme was to address a wide diversity of complex environmental problems that required a multi-organisational, interdisciplinary research approach and develop a strong community of environmental scientists with the capacity to respond to the need for guidance expressed by decision makers responsible for the implementation of national and regional development plans. The NPER provided a 'home' for the research communities in the fynbos, karoo and forest biomes[2]. The cooperative scientific programme was closed in 1988 and scientific funding moved towards individual project funding. As a result, individual research interests rather than sector-wide priorities increasingly drove research priorities – and this remains the case today, which is one of the main reasons for the impetus by the Fynbos Forum to develop a research strategy for the Cape Floristic Region.

The science budget allocated by the SA government has increased in SA over the past 10 years. Some universities, research institutes and individuals have been successful in accessing new funds, but the emphasis is on research projects spanning a period of 2-5 years which makes it impossible to pick up longer-term trends that are important for policy decisions. In addition despite this increased funding, biodiversity research and in particular fynbos research has not been able to sufficiently tap into these funds. Key reasons for this have been the lack of a biodiversity research strategy, or at the biome level a fynbos research strategy, as well as a lack of coordination. For fynbos research to access significant long term additional funding these issues need to be addressed.

Focus of International funding programme design not ecological research

Over the past 5 to 10 years the country has experienced an increase in international donor funding support for biodiversity/bioregional programmes. The C.A.P.E, Succulent Karoo Ecosystem Programme (SKEP), Subtropical Thicket Biome Programme (STEP) and Grassland Programmes illustrate this. What is important about these bioregional programmes is that the funding is focused on programme design (which involves using existing research findings and some new but often short

[2] B.J. Huntley (1987) Ten years of cooperative ecological research in South Africa. *South African Journal of Science*. Vol 83.

term research) and implementation. The main funders have been the GEF, via either the World Bank or UNDP, and the Critical Ecosystem Partnership Fund (CEPF). The design of interventions for all these programmes has been based on the systematic spatial biodiversity assessment approach (which culminated in the National Biodiversity Spatial Assessment). This approach emerged from long term research and lessons learnt from application. Despite the fact that the bioregional programmes are fundamentally based on an approach that emerged from long term research these funders have an implementation focused agenda (quite correctly too) and are not in a position to provide funding for long term biodiversity research. There is no obvious international source for long term research funding.

New institutional mandate for SANBI

The passing of the Biodiversity Act has altered the institutional landscape by creating SANBI out of the National Botanical Institute (NBI). SANBI's role is much broader than the NBI, primarily because its functions have changed from being focused on plants to being the public entity mandated by government as responsible for biodiversity. In grappling with its new role SANBI developed a Business Case for submission by DEAT to National Treasury. There are a number of aspects of this Business Case which are important to understand as follows:

- SANBI's objectives, including the biodiversity research agenda, are articulated in relation to the government's overall goal – "DEAT has determined the imperatives of SANBI in the medium and longer term, in support of the implementation of NEMBA and thus to contribute directly to the ASGI-SA goals of sustainable economic growth of 6% per annum to achieve Millennium Development Goals in South Africa … SANBI's primary focus is on progressively improved regulation of the Biodiversity Economy".[3] If the fynbos research strategy wants to access government funding, it will need to articulate itself in relation to government's broader goals, and it will need to be part of a broader national strategy where other biomes also receive additional funding.
- The strategic and funding model adopted by SANBI, is that of the managed network, where SANBI acts as the agent that will leverage expanded contributions from the entire biodiversity community in South Africa, rather than just using the resources in the MTEF autonomously and alone. SANBI's role is not one of accessing biodiversity resources for its exclusive use, and thus a large new institution with a hugely expanded establishment is not created. Rather SANBI coordinates and facilitates reaching agreements with institutions so that existing capacity can be utilised in a coordinated way. This would include the establishment of a Targeted Research Procurement facility so as to procure research, from existing biodiversity research groups, targeted at priorities identified in a biodiversity research strategy. This managed network approach holds opportunities for the fynbos research strategy when institutional arrangements are considered.
- SANBI has not yet been successful in making its Business Case to government and in significantly increasing it parliamentary grant. This is partly a matter of timing – for example SANBI's long standing CEO has left and presently senior staff fulfills the acting CEO position on a rotational basis. SANBI will be in a position to pursue its Business Case once a new CEO is on board.

South African government priorities in relation to a national scientific research agenda

Different government departments have identified specific scientific research priorities that provide potential opportunities research collaboration and funding of research priorities for the CFR in the short to long term (see Annexure C for more information).

[3]DEAT, July 2006, Business Case for the SANBI: Adjustments for 2007/08 and 1008/09 and proposed funding from the National Revenue Fund for the MTEF period 2009/10 to 2011/12

3.GOAL AND OBJECTIVE OF THE FYNBOS RESEARCH FUNDING STRATEGY

Goal: To contribute to the achievement of the CAPE goal whereby the biodiversity of the Cape Floristic Region is conserved, sustainably utilised and effectively managed in a way that is embraced by local communities, endorsed by government and recognised internationally.

Objective: To fill key biodiversity research knowledge gaps to improve the management of human impacts in the Cape Floristic Region[4].

4. PROPOSED RESEARCH PRIORITIES FOR THE CAPE FLORISTIC REGION

Six key research priority themes have been identified as requiring the most attention if the Fynbos Research Strategy goal and objective are to be achieved. These are:

1.Discovering and understanding the Cape Floristic Region's biodiversity
2.Ecosystem health and services
3.Fragmentation
4.Climate Change
5.Alien Invasives
6.Freshwater Ecosystems

The key areas highlighted within the six research themes are by no means meant to be exhaustive. However, they represent a selection of key knowledge gaps thought to be constraining the mitigation of the largest potential causes of biodiversity loss in a human-impacted landscape. It is to be noted, however, that these themes are closely linked, and often work in synergy. For example, biodiversity loss in fragmented habitats might be exacerbated by the invasion of alien species, or climate change. Similarly, the spread of alien species might be increased with rising temperatures, and small habitat remnants are more likely to be invaded by invasive species. Both researchers and conservation practitioners need to keep these linkages in mind when working to conserve the unique biodiversity of the region.

Outcomes of research conducted under the six themes need to be communicated to a variety of stakeholders, ranging from conservation managers, spatial planners, decision makers to the general public. A communication strategy thus needs to be incorporated into each theme. However, research into how best to communicate the results and outcomes is not part of this research strategy, but should form part of complementing socio-economic research strategies.

4.1 Theme One: Discovering and understanding CFR biodiversity

4.1.1 Overview of theme

This theme includes most of the baseline and simple background information required to understand the components of biodiversity, and their spatial and geographical distribution. The use of molecular techniques refines taxonomic research, leading to the discovery of new species, or identification of cryptic species. Information generated in this area is the backbone of strategic conservation prioritisation and action and underlies much other research.

[4] As mentioned earlier, this strategy is only intended to fill the knowledge gaps in the bio-physical research realm. To completely reach the C.A.P.E. 2020 goal, socio-economic (including communication) research strategies need to be developed to complement the strategy presented here.

Research focus areas/questions under this theme are as follows:
▪Spatial and geographic distribution of biodiversity:
  -Plants surveys
  -Terrestrial Invertebrates
  -Aquatic macro-invertebrates
  -Vertebrates (amphibians, reptiles, birds & (small) mammals)
▪Taxonomy of CFR organisms
▪Life history research
▪Communicating with and influencing people

4.1.2 Spatial and geographical distribution of biodiversity

A key need is to locate multiple components of biodiversity, including genetic variation within species, in relation to plants, invertebrates, aquatic macro-invertebrates, and vertebrates, and the spatial and bio-geographic patterns of biodiversity distribution.

Of particular importance is the accurate mapping of threatened and non-threatened locally endemic and restricted distribution species. Especially the under-protected lowlands of the region need attention, as these areas are under ongoing threats from development. Mapping and monitoring is important for the following reasons:
- Responsibilities arising from the Biodiversity Act;
- As input into appropriate-scale conservation plans and other products, which otherwise will not adequately represented locally unique components of diversity
- As input via these fine-scale conservation plans into land use plans
- For monitoring (state of the environment assessments) purposes, especially when linked with the identification of indicator and umbrella species

However, in general, all biodiversity in an area should be monitored and mapped.

(a) Plant surveys
Plant distributions are better known than many other components of diversity, but given the high degree of endemism and spatial turnover of diversity in the Western Cape, there is still an ongoing need to better map ALL occurrences of very range-restricted plants or endangered and critically endangered (SA Red Data List) plants with only a few populations, with a focus on lowland diversity. With likely 2000+ RDB or very range restricted species and the difficulty of locating these species in the field, this is a huge and time intensive task requiring experienced field botanists and amateur involvement. Any projects that add to this data set are useful.

Secondary question: plant communities, and some taxonomic groups (e.g. proteas and birds) are used as surrogates of total biodiversity – to what extent are plant-based units (functional, structural, phyto-sociological or a combination of these) a reasonable surrogate for other components of biodiversity? Approaches should take cognisance of different methods of recognising vegetation units.

(b) Invertebrates
Early indications are that invertebrate diversity and endemism parallels plant richness and endemism, but recognisable associations of species are not necessarily correlated with plant species associations (recognisable communities or vegetation types). There is thus a need for landscape scale characterisation of invertebrate diversity, as well as locality data for range restricted and threatened species.

(c) Aquatic macro-invertebrates

There is a need for improved knowledge of the macro-invertebrate biodiversity and levels of endemicity in rivers across the CFR. There is also a need to investigate what differences there are in the same river zone between different rivers as a consequence of different vegetation, climates, geologies, etc. This will aid river conservation in general, and maintenance of aquatic ecosystems and processes in particular.

(d) Birds, amphibians, reptiles & small mammals

Distributions of most species in the Western Cape are relatively well known at a broad scale, with the possible exception of a few species such as Van Zyls Golden Mole in the Lambert's Bay area. Birds have been comprehensively atlassed, an Amphibian survey completed and a Reptile Atlas is currently underway. However, all these surveys are at a 1:50 000 grid scale: at 25x25km these surveys are too coarse to determine if species exist in nature reserves (hence the Birds in Reserves Project), or to determine which vegetation types – let alone plant communities - the species require for foraging, reproduction, roosting and other conservation considerations. In the case of small mammals, recent studies using molecular techniques have revealed new small mammal species for the Western Cape (e.g. Fynbos golden mole *Amblysomus coriae*), and the occurrence of cryptic species (e.g. Saunder's vlei rat, *Otomys saundersiae*) have been refuted or confirmed. Very little is known about the distribution of very small species, such as the shrews, or fossorial species such as the golden moles, which are difficult to trap. More detailed surveys of all vertebrate groups are required, especially in regard to distribution, habitat requirements and habits.

4.1.3 Taxonomy of CFR organisms

For maximum immediate conservation benefit, research should focus on groups that are currently taxonomically poorly resolved. Molecular techniques combined with morphological approaches are especially useful in this regard. With this, locally endemic species are identified and separated from more widespread species, thus contributing substantially to locating species diversity in a region. Taxonomy of many floral and faunal species is insufficiently resolved, and distinction of species and subspecies are often blurred. Detection of subspecies (and ecotypes, for that matter) is important, as these might show specific adaptations to local climate and environmental conditions, assisting in the understanding of potential rate of evolution in the CFR. This is important to improve the understanding of the requirements for mitigation and adaptation to climate change. While evolution rates between tropical and polar regions are currently receiving much attention there are few or no studies at a biome level.

Beyond these guidelines, almost all taxonomic research is of long-term value in identifying components of biodiversity, nodes of diversification and genetic diversity, movement trajectories and refugia, but projects directly funded from conservation budgets will have to be carefully assessed to evaluate their likely impact. More realistically, the conservation community should engage with taxonomists to direct and encourage conservation relevant research.

4.1.4 Life history research

There is a need for research on the life histories – especially habitat requirements for larvae – of key pollinators such as long-tongued flies, bees, wasps and monkey beetles. Given the importance of these species for plant persistence, this research is urgently required for conservation planning and management. Of similar importance is an understanding of habitat requirements of species that are dependent on water for at last part of their life cycles, such as amphibians and aquatic macro-

invertebrates. Larvae of macro-invertebrates are important indicators used in SASS scores to assess water quality in rivers, while amphibians seems to be hardest hit by climatic changes and pollution of the environment.

Research into life histories of a range of species has given rise to “flagship stories”, which are unequalled in drawing attention the unique biodiversity of the region and justify the status of the CFR as a world heritage site. “Research for research's sake” should thus be especially encouraged in this context.

4.1.5 Communicating with and influencing people

The Cape Floristic Region has been awarded world heritage status based on the unique biodiversity of the region. Further research under this theme will underpin and strengthen this status, while life history research, especially “flagship stories”, e.g. the pollination of proteas by birds and small mammals will increase the interest and awareness of the general public.

Previous basic inventory work describing the incredible biodiversity of the CFR was responsible for putting the region in the local and international conservation spotlight in the last decade and initiating massive funding of conservation programmes. This has catalysed a robust and sustainable regional conservation program and this basic descriptive research remains very relevant to motivate ongoing local and international investment and to support strategic decision-making required to achieve conservation goals. In addition, the outcomes of other the research thrusts also need to be communicated to a broader public to ensure the implementation of conservation strategies and management recommendations. This field has only recently received attention, but this “bridging of the gap” is the backbone of defensible and successful biodiversity conservation.

4.2 Theme Two: Ecosystem function and services

4.2.1 Overview of theme

This theme addresses our very limited understanding of ecosystem health and the underlying ecological processes and functioning of terrestrial ecosystems, the ecosystems services the CFR ecosystems can provide, the direct and indirect value of biodiversity and natural systems to the people of the CFR, including consumptive use, and our ability to communicate this value and C.A.P.E.’s vision to the broader community.

While most of the priorities presented in this strategy cut across different ecosystems, it is clear that a concerted effort is required to better understand all aspects of the ecology of Cape lowland ecosystems (renosterveld, sand fynbos and strandveld) and eastern grassy fynbos ecosystems.

Research focus areas/questions under this theme are as follows:
- Ecosystem health
  - Ecological processes
  - Ecosystem functioning
- Ecosystem services
- Understanding and managing consumptive and non-consumptive utilization
- Socio-economic valuation of biodiversity and ecosystem services
- Communicating with and influencing people

4.2.2 Ecosystem health

Research within this aspect should be concerned with establishing a baseline which ecological processes in a system are required to ensure optimum ecosystem functioning. Information on ecological processes and resulting ecosystem function can be used to assess the ecosystem health of degraded or fragmented systems.

In order to reach an understanding of the key terrestrial ecosystems, complex ecological processes and functioning in the systems, a collaborative research approach is required. The formation of interdisciplinary research working groups should thus be facilitated.

4.2.2.1 Ecological processes

Although efforts have been made to determine ecological processes in the CFR, key information, especially in the lowlands, is still lacking. Of particular interest should be ecological processes that might be interrupted by habitat degradation, habitat fragmentation, invasion of alien species, and climate change.

(a) Fire
The ecosystems of the CFR are generally regarded as fire-driven, and considerable research has been conducted to this effect. However, key information is still outstanding, especially in regard to plant population and faunal responses to fire, and suitable fire regimes for lowland ecosystems. Special attention needs to be paid to identify the most suitable indicators for appropriate fire regimes. Currently, long-lived protea species are used as surrogates for biodiversity, but this might not be appropriate for all systems.

(b) Herbivory
Understanding of the utilization of Cape plants by indigenous herbivores, and the associated impacts on community structure and dynamics, and ecosystem processes, is another important aspect. Many landowners change from livestock husbandry to game farming in renosterveld, grassy fynbos and little Karoo areas. Changes in grazing preferences may alter competitive hierarchies in plant communities in the region, which might both be beneficial and detrimental to biodiversity. Information is also required to develop biodiversity based carrying capacities and appropriate stocking rates for all the habitats of the CFR, with priority sensitive and fragmented, critically endangered and endangered ecosystems which are likely to suffer the greatest biodiversity impacts from inappropriate stocking rates.

(c) Pollination
The CFR has a number of unique pollination systems, and strong pollinator specialisation exists across a range of taxa. Plant-pollinator mutualisms in the the bulb species rich lowlands need special attention, especially in view of the fact that the high degree of plant richness and endemism is matched (or even surpassed) by invertebrate taxa.

(d) Dispersal
A number of specialised dispersal mechanisms have evolved in the fire-prone, nutrient-poor ecosystems of the CFR, among these myrmechory and serotony. Corms of bulb species in the CFR lowlands are dispersed by burrowing activities of porcupines, mole rats and other small mammals. Little information is available on the role large indigenous herbivores might have played in the dispersal of renosterveld, strandveld and karoo plant species, and the role of frugivorous (bird) species of thicket and forest species. Information is also lacking on dispersal distances for key species in the fragmented lowlands ecosystems.

4.2.2.2 Ecosystem functioning

Research within this aspect deals with the interaction of ecological processes within a system, and how they contribute to the functioning of healthy ecosystems. Especially required is research into the substitution of ecological processes, and into process thresholds, after which ecosystem functions break down. Information on potential substitution of ecological processes and on process thresholds are important for managing fragmented or invaded ecosystems, and to mitigate climate change.

4.2.3 Ecosystem services

Ecosystem goods and services, such as clean water and air, pollinator provision or flood control, provided by healthy ecosystems are beneficial to humans, and are thus of value, and can be used to motivate for conservation of remaining natural areas. Currently, little compelling evidence of the direct and indirect value to humans of biodiversity and ecosystem services is available. However, this is a major topic globally and a good research framework is available. Information generated will contribute to convince various economic sectors to mainstream biodiversity into their policies and practices. Spatial mapping of ecosystem services should be supported and explored as a method of making conservation plans more sustainable and defensible.

4.2.4 Understanding and managing consumptive (and non-consumptive utilization)

Harvesting of natural products can be a form of land use that supports conservation, both directly by providing an incentive to maintain land in a natural state and indirectly by demonstrating economic benefits of such land. However over-harvesting or targeting of inappropriate species can rapidly cause local and/or global extinction of target species.

Access to natural resources on and off formally protected areas is now implicit in the Protected Areas Act. However there is almost no literature on impacts of harvesting on populations of target species in the Western Cape. Research should focus on identifying thresholds for sustainable harvesting of various natural products in identified groups of species. Development of very simple but adequate monitoring protocols to ensure sustainability must also be evidence based. This field is likely to require detailed demographic analysis of target populations of plants or animals.

Information is also required on the non-consumptive and aesthetic value of natural areas, especially in view of the gross economic disparities in our country, and the “alienation” and exclusion of communities from natural areas and reserves.

4.2.5 Communicating with and influencing people

Research outcomes within this theme will provide information on the benefits and values healthy ecosystems have for humankind in general, and for communities using the resources specifically. Reliable estimates of values of ecosystem services and information on the benefits and value of natural areas and their ecosystems services is essential to influence government, decision makers and the public.

Information generated will contribute to convince various economic sectors to mainstream biodiversity into their policies and practices, while spatial mapping of ecosystem services can contribute to making conservation plans more sustainable and defensible.

4.3 Theme Three: Fragmentation

4.3.1 Overview of theme

This thematic area received a very high weighting in the 2006 Fynbos Research Strategy, which properly reflects both the urgency and impact of information required.

Although the effects of habitat fragmentation on biodiversity have received considerable research attention in a range of ecosystems, the results are by no means clear-cut and consistent. While habitat loss almost ever has a negative impact on biodiversity, the "real" fragmentation effects, i.e. the breaking apart of habitat into smaller, isolated pieces, are less clear and often contradictory. Most of the studies have concentrated on the effects of habitat fragmentation on biodiversity patterns, while information is still required on how habitat fragmentation impacts on key ecological processes such as pollination and dispersal. Only a few studies have attempted to apply the results of fragmentation studies to conservation planning and implementation. This is an area that is crucial to ensure the survival of species in protected and natural landscapes in the context of land-use, future climate change and invasive alien species.

Research focus areas/questions under this theme are as follows:

- Spatial configuration of fragmented landscapes (thresholds and corridors);
- Management in fragmented landscapes;
- Habitat restoration;
- Ecological and economical tradeoffs in conservation of fragmented habitats; and
- Communicating with and influencing people.

4.3.2 Spatial configuration of fragmented landscapes (thresholds and corridors)

Loss of various components of biodiversity may be mitigated by the selection or prioritisation of conservation areas in particular configurations. Currently, little information is available on threshold values of size, shape, distance and the nature of the matrix influence retention of most components of biodiversity. Research on corridor positioning and the role of small fragments as "stepping stones" linking larger remnants is also a crucial aspect, as this contributes to the understanding how ecological and evolutionary processes that underpin CFR diversity can be maintained across space and time. In combination with taxonomic research, selection of areas supporting long-term evolutionary processes can be improved.

Studies should be designed in such a way that they produce results that can be applied to other ecosystems (although this might not always be possible), or that they produces meta-analyses of fragmentation effects across a range of ecosystems /habitat types. Capture of best corridor and stepping stone configurations in conservation plans, should be an immediate priority as these components of conservation plans are currently little more than guesswork.

4.3.3. Management in fragmented landscapes

Studies have shown that small fragments are prone to exotic grass invasions, due to edge effects. The likelihood of invasions is significantly increased when small fragments are burned too frequently, or are overgrazed. Reserve managers are often reluctant to burn small fragments, or have them grazed, for fear of loosing rare or endemic species that occur in relict populations.

Investigations into appropriate management of these small remnants, especially in regard to the impacts of grazing by indigenous herbivores, and appropriate fire management (frequency and intensity of burns) are required to maintain biodiversity.

This aspect of the fragmentation theme is closely linked to 4.2.2. Ecosystem health.

4.3.4 Habitat restoration

Vegetation and habitats in small fragments are often degraded, as key ecological processes are interrupted, and disturbance regimes are altered. Research into restoration of systems damaged by alien plants, game/livestock, agricultural activity etc should be supported where there is a clear need in order to prevent further regional biodiversity loss, or improvement in ecosystem services, for example on riparian systems.

Research should also explore in which circumstances restoration is most needed and justified, identifying cheap, wide-scale interventions that can arrest regional biodiversity loss by restoring or rehabilitating degraded and transformed terrestrial habitats. Attention should also be paid to areas that have recently been cleared from invasive species, and restoration efforts should be incorporated into alien clearing projects.

Research should focus both on the biological justification for fragmentation and examine the cost relative to regional biodiversity benefits.

4.3.5 Ecological and economical trade-offs in conservation of fragmented habitats

While the Environmental Impact Assessment (EIA) framework is theoretically capable of making an appropriate recommendation for a particular impact, on a case-by-case basis, biodiversity losses are usually seen as less problematic than constraining economic development. Effectively combating this bias might be aided by evidence of economic value of intact habitat/ecosystems, but may also be combated by a better communication strategy from the biodiversity sector. There is a high level of ignorance among municipal-level decision makers of the value of ecosystem services to the sustainability of many enterprises in their municipalities.

Conservation authorities work in general on a limited budget and with limited resources. The higher cost of appropriately managing fragmented areas might result in increased loss of biodiversity in less transformed habitats, when attention is focused on retaining biodiversity in the most fragmented landscapes, leaving little or no resources for effective off-reserve conservation. The short and long term implications of this for especially proactive interventions in the landscape should be carefully explored to ensure that we achieve optimal conservation outcomes with available resources. Information on the “value” of a habitat remnant within the landscape, based on its ecosystem health and ecosystem services it provides, is important influence management and decision-making. This aspect is closely linked with aspect 4.2.3, Ecosystem services.

4.2.6 Communicating with and influencing people

The true extent of human impacts on the landscape are difficult to assess without scientific tools – they happen over spans of time longer than we can easily track with memory, and many of the impacts are massive and far-reaching, but not easily visible to the untrained eye. In order to properly respond to and communicate our impacts

on the landscape we need clear and convincing evidence of what they are and how they influence biodiversity and ecosystem services. Of equal importance is the filtering down of scientific research results into conservation plans and management recommendations for fragmented landscapes, in order to maximally protect biodiversity in the region.

4.4 Theme Four: Climate Change

4.4.1 Overview of theme

Global climate change will influence species distribution, abundance and ecosystem processes such as fire, and these changes are exacerbated in fragmented landscapes. Mitigation of negative impacts of global climate change must include both the selection of areas at all scales required to retain biodiversity, and management regimes required to maintain diversity. Without substantial further understanding of ecosystem responses, appropriate action will remain guesswork.

Research focus areas/questions under this theme are as follows:

- Understanding and managing global climate change:
  - -How do organisms respond to global climate change?
  - -How should global climate change best be factored into conservation planning?
  - -How is fire being influenced by global climate change and how should we respond?
  - -How rapidly can organisms adapt to a changing climate?
- Communicating with and influencing people on biodiversity matters.

4.4.2 Understanding and managing global climate change

(a) How do organisms respond to global climate change?
There is a need to move beyond the climate-envelope-GCM approach in order to achieve a mechanistic rather than phenomenological understanding of climate change impacts. Thus, the calls for experimental research on climate change impacts (via altered temperature and moisture regimes) on the regeneration biology of selected species are most welcome. Many fynbos plants depend on seeds for persistence and preliminary research has shown that germination is very strongly influenced by different moisture regimes.

(b) How should global climate change best be factored into conservation planning?
This is a very broad research area that effectively asks "How are organism likely to move and persist in a fragmented landscape influenced by global climate change?" Climate change process areas are usually extremely land-hungry components of conservation plans and should have a massive impact on potential land-use (and thus the economy) and management requirements for identified areas. There is thus a strong need to substantially improve the evidence on which the need for such corridors is based and design parameters required to meet this need. Any research that evaluates the likely value of large-scale connectivity corridors and altitudinal gradients currently considered to allow species to persist by moving in response to climate change is an urgent priority. Research should also explain optimal design features for process areas intended to ameliorate effects of climate change.

(c) How is fire being influenced by global climate change and how should we respond?
Global warming is likely to substantially influence both fire regime and biodiversity response. Both need to be understood in order to optimize management response to changing regimes and requirements. Research should be tackled at a large enough scale to provide generalisable conclusions. Note that this may include research that examines spatial allocation of resources to optimize regional biodiversity retention.

(d) How rapidly can organisms adapt to a changing climate?
To understand the requirements for mitigation and adaptation to climate change, we need to get to grips with the potential rate of evolution of fynbos taxa. While evolution rates between tropical and polar regions are currently receiving much attention there are few or no studies at a biome level.

4.4.3 Communicating with and influencing people

Climate change is likely to dramatically reduce the resilience of natural systems to fragmentation, degradation and disturbance, and thus reduce ecosystem's ability to maintain biodiversity and deliver critical ecosystem services. This means that conservation efforts need to be more precautionary that in the past, potentially increasing conflict with economic development. Research areas described above are required in order to understand and motivate appropriate conservation measures.

4.5 Theme Five: Alien Invasives

4.5.1 Overview of theme
Unmanaged alien plant invasions are capable of completely displacing natural flora and irreversibly altering ecosystem function, causing biodiversity loss throughout the CFR comparable to that caused by outright habitat loss. Similarly, terrestrial, aquatic and marine exotic animal invasives can completely alter ecosystems they invade and have the potential to cause multiple extinctions of indigenous species.

Although we understand the impact of invasives, particularly invasive plants quite well, research on effectively tackling these problems with limited resources is still in its infancy, and once again hampered by the perception that this is not an academically interesting field. Combating these invasions is hugely expensive and outcomes are greatly influenced by strategy and methods used. In the face of limited resources, these must be substantially improved. This need is reflected in the Working for Water research priorities at a national scale, but must also be tackled at a more local scale to allow meaningful action in the CFR.

Research focus areas/questions under this theme are as follows:
▪Management of alien invasions;
▪Mapping methodology;
▪Emerging invasives;
▪Investigation of the impact of the Working for Water on the ecological functioning and biodiversity of our rivers; and
▪Communicating with and influencing people.

4.5.2 Management of alien invasions

While local and site specific methods of controlling invasive plants are well developed, regional strategies for allocation of very limited resources for optimal impact in the landscape are still undeveloped. Typically, decision makers rapidly become bogged down by the many variables influencing selection of areas for clearing. The CIB at Stellenbosch University currently have a post-doctoral student developing spatial spread models with a view to informing regional clearing strategies, but further development of tools to aid objective and systematic spatial allocation of adequate funding are urgently required. Research in this arena should focus on the optimal allocation of resources and the effects of trade-offs between different choices.

Further basic research is also required on the impact of clearing operations and where and when active rehabilitation is required.

4.5.3 Mapping methodology

Strategic use of available resources requires detailed province-wide knowledge of the state of invasives. Mapping is currently mainly manual, expensive and rapidly becomes out of date. Research likely to yield more efficient and/or accurate mapping of invasive stands (especially lower density stands that should be the focus of clearing operations) should be supported.

4.5.4 Emerging Invasives

There is a need to develop methods to identify “new” invasive aliens, i.e. those species in the very early stages of the invasive process, and to develop and implement early control interventions before further spread makes control exponentially more expensive.

4.5.5 Investigation of the impact of the Working for Water on the ecological functioning and biodiversity of our rivers

To what extent does the removal of aliens increase the water flow? The clearing of alien invasive plants from catchments and rivers is thought to have a significant positive impact on water yield and quality, and river health in general, but there is very little direct evidence. Additional quantitative evidence would make the case for renewed investment in this programme. Long-term hydrological studies are most likely to provide useful information.

4.5.6 Communicating with and influencing people

Despite a strong understanding of the large negative impacts of invasive plants on native biodiversity, and an acceptance of their role in reducing water available for ecosystems and human use, other motivations to provide additional resources to tackle the problem are limited. Any research likely to make a strong objective case for increased spending should be supported. This might range from evidence of the negative economic impacts (direct or on ecosystem services) of invasives, through to visual spread models to show the outcomes of different spending scenarios

4.6 Theme Six: Freshwater Ecosystems

4.6.1 Overview of theme

Freshwater systems provide not only the most obvious ecosystem service in the dry Western Cape, but these ecosystems are likely to harbour and support substantial unique biodiversity. However, nearly every major wetland and river system in the CFR is under enormous pressure from direct abstraction, pollution and loss of riparian and terrestrial habitat. This pressure is likely to increase and understanding where and how to best manage impacts on these systems is crucial.

Although already covered explicitly in Theme 1 (4.1.2 Spatial and geographic distribution of biodiversity), it is worth emphasising that aquatic biodiversity is very poorly surveyed and mapped and deserves substantial further attention.

Research focus areas/questions under this theme are as follows:

- Ecological and environmental impacts of large-scale groundwater developments in the Table Mountain Group (TMG) aquifer systems;
- Getting a good basic understanding of wetlands:
  - Wetland typing and inventory;
  - Understanding the relationship between fynbos vegetation and aquatic ecosystems;
  - Understanding Vernal Pools.
- Improving our data on the value of wetlands in the CFR;
- Understanding the impacts of water abstraction on river systems;
- Communicating with and influencing people on biodiversity matters.

4.6.2 Ecological and environmental impacts of large-scale groundwater developments in the Table Mountain Group (TMG) aquifer systems

Increasing the use of groundwater resources to meet water needs requires a proper understanding of the role groundwater plays in maintaining biodiversity, systems and processes in the Cape Floral Region. Improved knowledge of the interaction between groundwater targeted for abstraction and both terrestrial ecosystems and

surface waters is required, as is understanding of possible negative impacts of large-scale abstractions from such aquifers on the ecological health of rivers and other wetlands.

Development of monitoring and research methodology most likely to detect impacts is urgently required.

4.6.3 Getting a good basic understanding of wetlands

(a) Wetland typing and inventory
As with rivers, wetland typing in order to adequately designate a representative selection of types for conservation is in its infancy in the Western Cape and requires substantial development. Research should focus on inventory – surveying components of diversity across a wide range of wetlands in order to allow representation and characterisation.

(b) Understanding the relationship between fynbos vegetation and aquatic ecosystems
In a fynbos context it might be most useful to look at the relationship between fynbos vegetation and aquatic ecosystems. We know fynbos strongly influences water chemistry and this in turn strongly influences plant life and animal life. Human influences can change the relationship between fynbos and aquatic ecosystems but we don't know how.

(c) Understanding Vernal Pools
Vernal pools and wetlands are often overlooked in the landscape and may be vulnerable to the effects of climate change. It is important to understand their specific contribution to biodiversity and how this is influenced by human impacts including climate change.

4.6.4 Improving our data on the value of wetlands in the CFR

Wetlands typically come under huge pressure from impacts on surrounding habitats, eutrophication, alteration of water regimes and outright transformation. Although we suspect that many contain unique elements of biodiversity, support key ecosystem services and play a crucial role in supporting terrestrial biodiversity, there are very few explicit measures of any of these, even for aspects like flood attenuation and improvement of water quality in riparian systems. Any research focused on this area is a high priority.

4.6.5 Understanding the impacts of water abstraction on river systems

Although ecological reserves have been determined for many rivers according to standardised methodology, flow regimes required to maintain system health and biodiversity are less well understood, and the amount of water legally allocated for use and actually abstracted from rivers is poorly known. These basic parameters must be investigated to make appropriate decisions.

4.6.6 Communicating with and influencing people

Although we know that freshwater systems are vital to both human health and livelihoods, and harbour substantial biodiversity in their own right, the almost complete lack of explicit measure of these aspects compromises our ability to motivate for appropriate conservation measures. The most important research to achieve these goals are likely to be the basic inventory work and explicit measures of economic and other values of these systems.

5. INSTITUTIONAL ARRANGEMENTS FOR IMPLEMENTING THE FYNBOS RESEARCH STRATEGY

The institutional arrangements outlined below have been developed following discussions and agreements with key partners who would be involved in the process.

The Fynbos Research Partnership (FRP) Committee

A Fynbos Research Partnership will be established to co-ordinate and implement the Fynbos Research Programme, hosted by SANBI (Kirstenbosch Research Unit) and enabling involvement by a range of partners, including the Fynbos Forum, the C.A.P.E. CCU, the TMF, SANParks, CapeNature, SAEON and others.

A Fynbos Research Partnership Committee (FRP) Committee will be established to guide implementation.

Partner organisations will:

- Co-operate to secure research funding for a fynbos-biome wide research strategy and priorities as outlined in this document;
- Manage their own research funding in alignment with the priorities of the Fynbos Research Programme;
- Co-operate to adaptively manage the strategy, and review its implementation;
- Co-operate to allocate research funding sourced in the name of the partnership in accordance with the priorities outlined in the research strategy;
- Actively encourage other research institutions to join the Partnership.

In addition, SANBI will:

- Co-ordinate implementation as advised by the FRP Committee;
- Appoint a staff member to serve as the Fynbos Research Co-ordinator;
- Receive and manage funds on behalf of the Fynbos Research Programme Partnership, and in accordance with the funders' requirements and the directions provided by the Fynbos Research Committee;

Purpose and Functions of the FRP Committee

It is suggested that Terms of Reference or similar are developed by the members when the Committee is initiated to confirm the purpose and functions and other details.

The purpose of the FRP Committee is to facilitate a cooperative and strategic approach to the undertaking of fynbos research so that it fills biodiversity knowledge gaps to improve the management of human impacts in the cape Floristic Region.

Functions of the FRP Committee could include the following:

- Agree on the Research Strategy and Funding Priorities for the Cape Floristic Region;
- Receive and decide on research project applications;
- Exercise oversight over the Research Strategy budget and disbursements;
- Share information on and coordinate fynbos research;
- Set up protocols for reviewing research proposals/outputs and procedures for the funding of research programmes/projects;
- Ensure that all research programmes/projects include a focused capacity building element, particularly of PDI researchers;

- Review research outcomes on an annual/bi-annual basis and identify or translate these outcomes into conservation management issues;
- Develop a focused communications and marketing strategy for sharing of research outputs with stakeholders;
- Develop a focused research strategy to address the social dimension of conservation research.

FRP Committee Membership

It is proposed that the FRP Committee include delegated representatives from the following institutions:

- SANBI – Kirstenbosch Research Centre;
- Table Mountain Fund (TMF);
- Cape Nature - Scientific Services;
- Working for Water Programme (DWAF) – Research Development Unit;
- CAPE Coordinating Unit;
- SAEON;
- SANParks – Fynbos Research Node;
- Fynbos Forum; and
- Others (to be added as required).

These members should discuss how to engage with and involve tertiary institutions/ universities in the process.

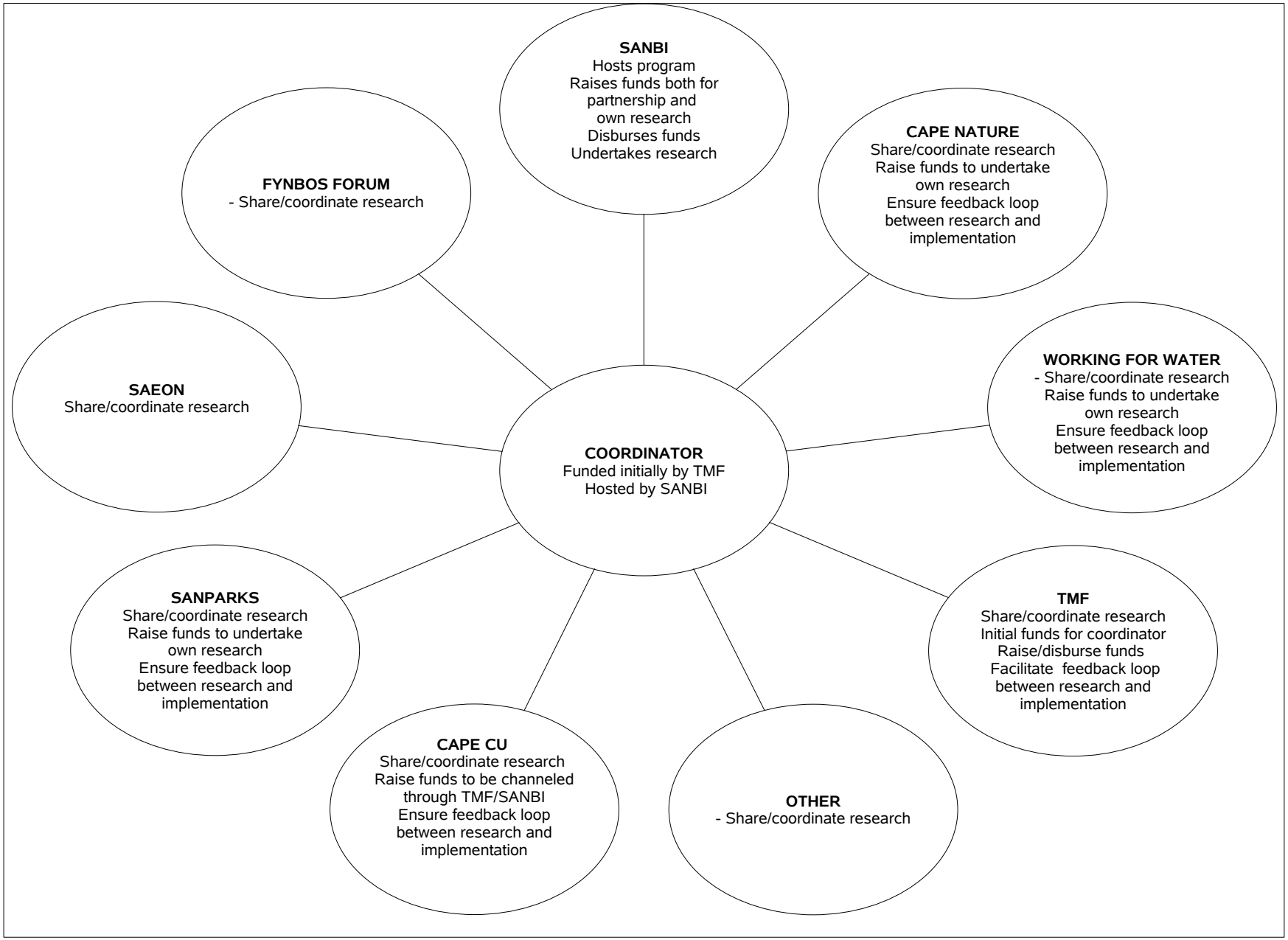
Suggested roles of the different members are as follows:

Partner	Roles
SANBI	▪ Hosts program ▪ Raises funds both for partnership and own research ▪ Disburses funds ▪ Undertakes research ▪
Table Mountain Fund (TMF)	▪ Shares/coordinates research ▪ Provides initial funds for coordinator (2 yrs) ▪ Raises and disburses funds for partnership ▪ Facilitates feedback loop between research and implementation ▪
Cape Nature	▪ Shares/coordinates research ▪ Raises funds to undertake own research ▪ Ensures feedback loop between research and implementation ▪
Working for Water Programme (DWAF)	▪ Shares/coordinates research ▪ Raises funds to undertake own research ▪ Ensures feedback loop between research and implementation ▪
CAPE Coordination Unit	▪ Shares/coordinates research ▪ Raises funds to be channeled through TMF/SANBI ▪ Ensures feedback loop between research and implementation ▪
SAEON	▪ Shares/coordinates research ▪
SANParks	▪ Shares/coordinates research ▪ Raises funds to undertake own research ▪ Ensures feedback loop between research and implementation ▪
Fynbos Forum	▪ Shares/coordinates research ▪

Partner	Roles
Others	▪ Shares/coordinates research -

See explanatory diagram on following page.

FYNBOS RESEARCH PROGRAM PARTNERSHIP – ROLES



Funding mechanisms

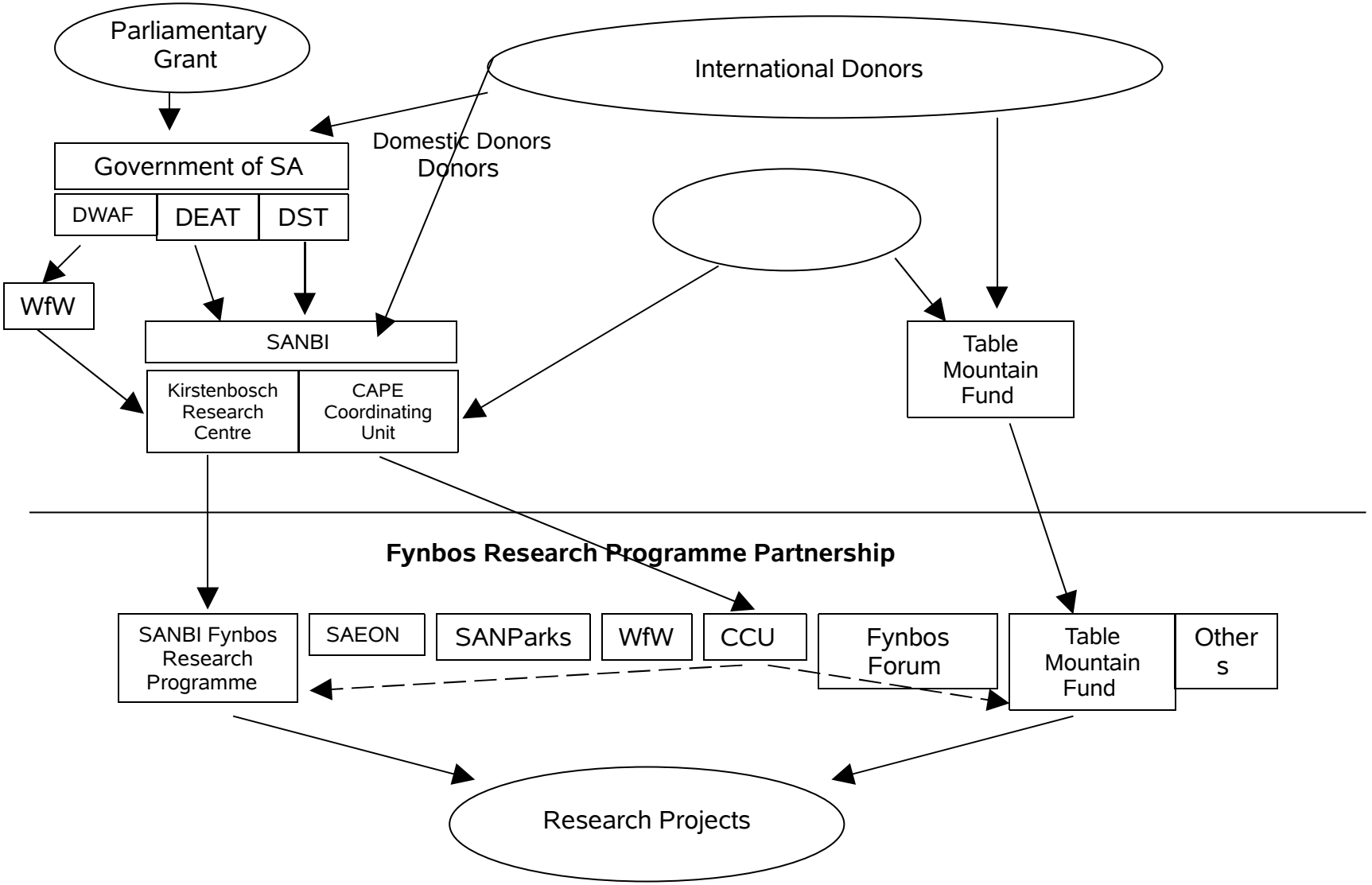
It is important to remember that the intention with the FRP is that it raises new long term funds for research in the fynbos biome for the fynbos research strategy and priorities reflected in this document. The partners who form the committee will also continue with their own research programmes and activities, but ensure that these align with the strategy. Funding for the FRPP's research programme will need to be raised from the SA government, international and domestic donors by various partners. Potential sources for funding have been identified and are reflected in a separate document. Raised funds will be channelled directly via SANBI's Kirstenbosch Research Centre or the TMF. The financial management and procurements systems of the organisation through which the funds are raised will apply to how these funds are managed and disbursed.

Through the process undertaken to develop this document, two short term sources of funding to catalyse the FRP have been identified. The first is the TMF which will provide initial funding for a research coordinator to be contracted who will take forward the recommendations from this document and initiate the establishment process i.e. set up the research programme and source funding. TMF will be able to provide 100% funding for the first year of this post with a view to phasing out this funding over the following two years as additional funding from other sources is secured. It is intended that the research coordinator contract post be added as a permanent post to the SANBI establishment. This requires that SANBI's Head of Research should go through the process of drawing up the job description, creating the post, grading the post, advertising and appointing the fynbos research coordinator as a SANBI contract employee. It is understood that this process will take between 6 – 9 months.

The second catalytic source of funding is from Working for Water's research division for research on alien invasives, one of the thematic areas identified in the research strategy. These funds will be channelled via SANBI and the implementing agreement through which this will occur is presently being finalised between SANBI and Working for Water.

The diagram below illustrates the funding flows to the FRP.

FYNBOS RESEARCH PROGRAMME PARTNERSHIP – FUNDING FLOWS



5.5 Proposed Operations of the FRP Committee

These proposed operations will be confirmed and endorsed by founding members at inaugural meeting/s.

5.5.1 Chair

SANBI will be responsible for chairing the FRP Committee.

5.5.2 Secretariat~~Proposal~~

~~Since the mandates of existing departments and institutions include many of the activities listed in the concrete measures of the SA SACM, it is proposed that the SA SACM Committee should complement the functions of existing institutions and not duplicate them.~~
~~Successful SAICM implementation will require full support from all relevant government departments and other organizations.~~

~~The SA SACM Committee will be supported by a secretariat that will provide the administrative and technical support required. The Secretariat will undertake the functions assigned to it by the Committee~~

The secretariat function will be the responsibility of the research coordinator. The functions of the secretariat will be to support the activities of the FRP Committee by undertaking the following tasks:

- Notices for meetings, agendas and minutes;
- Prepare progress reports;
- Help identify gaps in scientific knowledge;
- Promote information exchange and scientific and technical cooperation;
- Provide an overall coordinating role between the partners.

5.5.3 Meetings

The FRP Committee will meet once per quarter. Research sub-committees will be constituted and meet as required.

5.5.4 Decisions

Decisions will be taken by a consensus approach.

5.6 Review and quality assurance mechanisms

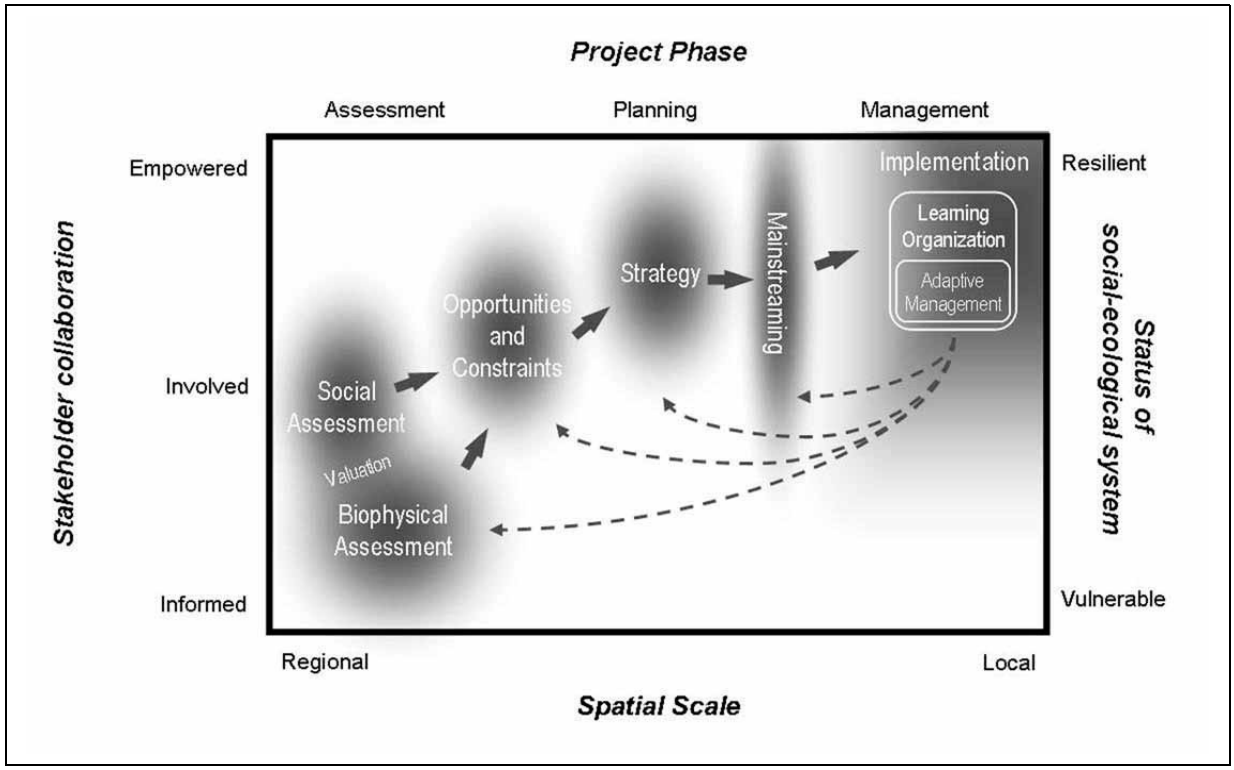
The FRP Committee will develop protocols for reviewing research proposals; awarding research funding; and reviewing research outputs to ensure quality.

The FRP Committee will monitor research outcomes and translate these outcomes into conservation management issues/solutions. Monitoring activities will therefore strive to ensure that there is on-going feedback between biophysical/social research outputs and conservation management implementation programmes – and that the outcomes of these management programmes will feedback into/inform the biophysical and social research agenda (i.e. a feedback loop).

Multi-stakeholder engagement in the process is essential and the structure of the FRP is well suited to ensuring engagement from natural and social scientists and

managers from the conservation and social development sectors. Stakeholder engagement is required throughout the process – including the design and implementation of the initial research exercises.

The 'feedback loop' process is illustrated in the diagram below[5].



[5] This diagram was developed by Cowling et al (2007) to illustrate an operational model for mainstreaming ecosystem services for implementation. The diagram refers to biophysical and social assessments rather than research projects but these are understood to mean the same thing.

REFERENCES

Cowling, R.M.; Egoh, B.; Knight, A.T.; O'Farrel, P; Reyers, B.; Rouget, M.; Roux, D.; Welz, A.; & Wilhelm-Rechman, A. 2007. An operational model for mainstreaming ecosystem services for implementation. Department of Botany, Nelson Mandela Metropolitan University.

Cowling, R.M. & Wilhelm-Rechman, A. 2007. Social assessment as a key to conservation success. Oryx. 41: 135 – 139.

Cowling, R.M., Pressey, R.L., Rouget, M. and Lombard, A.T. 2003. A conservation plan for a global biodiversity hotspot - the Cape Floristic Region, South Africa. Biological Conservation 112: 191-216

Huntley, B. J. 1987. Ten years of cooperative ecological research in South Africa. South African Journal of Science. Vol 83.

Krug, C.B. and Krug, R.M. 2007. Restoration of old fields in renosterveld: a case study in a Mediterranean shrubland of South Africa. In Cramer V.A. and Hobbs R.J. (eds) Old fields: Dynamics and restoration of abandoned farmland. Island Press / Society for Ecological Restoration

MacDonald, I.A.W. 2006. A kingdom in search of a wise ruler. A report prepared for the Fynbos Forum with funding from the Critical Ecosystems Partnership Fund. With contributions from members of the Fynbos Forum Research Working Group: J. Donaldson, P. Holmes, D. Kirkwood, R. Knight, C. Krug, J. Midgley, G. Palmer, T. Rebelo, J. Wood, R. Cowling, M. Barnett and K. Maze

Midgley, G.F., Hannah, L., Millar, D., Thuiller, W. and Booth, A. 2003. Developing regional and species-level assessments of climate change impacts on biodiversity in the Cape Floristic Region. Biological Conservation. 853-858 112: 87-97.

Myers, N., Mittermaier, R.A., Mittermaier, C.G., da Fonseca, G.A.B. and Kent, J. 2000. Biodiversity hotspots for conservation priorities. Nature 403: 853-858

Picker, M.D. and Samways, M.J. 1996. Faunal diversity and endemicity of the Cape Peninsula, South Africa - a first assessment. Biodiversity and Conservation 5, 591-606.

Pressey, R.L., Cowling, R.M. and Rouget, M. 2003. Formulating conservation targets for biodiversity pattern and process in the Cape Floristic Region, South Africa. Biological Conservation 112: 99-127

Rebelo, A. 1992. Preservation of biotic diversity. In Cowling, R. (ed): The Ecology of Fynbos. Nutrients, Fire and Diversity. Cape Town: Oxford University Press, pp. 309-344.

Rouget, M., Richardson, D.M. and Cowling, R.M. 2003a. The current configuration of protected areas in the Cape Floristic Region, South Africa--reservation bias and representation of biodiversity patterns and processes. Biological Conservation 112: 129-145

Rouget, M., Richardson, D.M., Cowling, R.M., Lloyd, J.W. and Lombard, A. T. 2003. Current patterns of habitat transformation and future threats to biodiversity in

terrestrial ecosystems of the Cape Floristic Region, South Africa. Biological Conservation 112: 63-85

von Hase, A. 2005. Biodiversity & Conservation: Cape Lowlands Coastal Renosterveld. 40th Congress of the Grassland Society of South Africa, Kapenta Bay, South Africa, 18th - 21st July 2005

ANNEXURE A: PROCESS OF DEVELOPING THE FYNBOS RESEARCH FUNDING STRATEGY

The process to develop a research strategy for the Cape Floristic Region (CFR) started in August 2003 when the Research Task Team of the Fynbos Forum, supported by a small grant from the Critical Ecosystems Partnership Fund, commissioned research to evaluate the major research questions that needed to be addressed in the CFR.

The primary objective of this initial exercise was to obtain a consensus on the current research priorities that were most likely to contribute to successful natural ecosystem management and biodiversity conservation in the CFR and the achievement of the C.A.P.E. Strategy. The exercise involved filtering research areas/questions from survey information collected from researchers and conservation practitioners in the CFR.

The resulting assessment of key gaps, areas of urgent research needs and main human impacts were then collated by a panel of researchers and conservation practitioners who produced the *Research Strategy for the Cape Floristic Region*. This report informed the writing of the second report called *A kingdom in search of a wise ruler (or the urgent need for research in the Cape Floristic Region* (MacDonald & Cowling 2006), which argued for a massive investment of funds into biodiversity research and provided some recommendations on how to take the process forward including:

▪The creation of a body to drive the re-invigoration of research into biodiversity and its conservation in the Cape Floristic Region, linked to C.A.P.E;
▪Securing massively increased levels of funding for the necessary research;
▪"Re-glamorising" research in the CFR.

The report was finalised in January 2006 and accepted at the 2006 annual Fynbos Forum meeting, where it was also agreed that the SANBI KRC offices should coordinate the implementation of the strategy, offering not only a link to the bioregional SANBI research agenda but also to that of SAEON.

The Fynbos Forum then sought to extend refine the research funding priorities and extend the existing strategy in the form of a detailed funding appeal. Two consultants were contracted to do this work between May and August 2007.

As a starting point for the consultants work, Don Kirkwood (a FF Research Task Team member) further refined the draft Research Strategy to select key priority areas for research in the fynbos region. He developed a framework to allow for a more systematic approach to selecting these priority areas, which included the following criteria:

- Likely Biodiversity impact of improving **conservation area selection**;
- Likely Biodiversity impact of improving conservation area **management**;
- Change in **cost** to conservation implementers and/or society by altering conservation site selection (actions or decisions with very high cost implications require better evidence);
- Change in **resources** available;
- **Urgency** (Conservation decisions with big implications will happen soon regardless of evidence available OR biodiversity loss of regional importance highly likely without this information); and
- **Impact** (scale of influence on biodiversity loss).

The consultants prepared a concept document which was presented for discussion and endorsement at a Fynbos Forum workshop in July 2007. The final Research Strategy and Funding Priorities for the CFR was completed by the end of August 2007.

ANNEXURE B: ALIGNING FYNBOS RESEARCH PRIORITIES WITH C.A.P.E. STRATEGIC OBJECTIVES

C.A.P.E. Programme Draft Objectives Hierarchy	Fynbos Research Strategy Priorities
GOAL: By the year 2020, the cooperation of capable institutions ensures that the biodiversity of the CFR is conserved, sustainably utilised and effectively managed, delivering significant benefits to the people of the region in a way that is embraced by local communities, endorsed by government and recognised internationally	**Goal: To contribute to the achievement of the CAPE goal whereby the biodiversity of the Cape Floristic Region is conserved, sustainably utilised and effectively managed in a way that is embraced by local communities, endorsed by government and recognised internationally.**
SO1: An adequate and representative protected area network (incorporating terrestrial, freshwater and marine priorities) is secured and effectively managed	*4.1 Theme One: Discovering and understanding the Cape Floristic Region's biodiversity* 4.1.3 Taxonomy of CFR organisms 4.1.4 Life history research *Theme Two: Ecosystem Health and Services* 4.2.1 Ecosystem health 4.2.2 Ecosystem services *4.3 Theme Three: Fragmentation* 4.3.2 Spatial configuration of fragmented landscapes (thresholds and corridors) 4.3.3 Management in fragmented landscapes 4.3.4 Habitat restoration *4.4 Theme Four: Climate Change* 4.4.2 Understanding and managing global climate change
1.1: Priority biodiversity (terrestrial and aquatic) on private and state land is conserved	*4.1 Theme One: Discovering and understanding the Cape Floristic Region's biodiversity* 4.1.2 Spatial and geographical distribution of biodiversity – informs where protected areas need to be.
1.2: Protected Areas (including terrestrial, freshwater and marine) support relevant spatial targets and are effectively managed	*4.1 Theme One: Discovering and understanding the Cape Floristic Region's biodiversity* 4.1.2 Spatial and geographical distribution of biodiversity - provides information on the situation outside protected areas.
SO2: Wise development, regulation and use of natural resources safeguards biodiversity	
2.1: Land-use planning, decision making and regulation enforces the protection of biodiversity priorities	*4.6 Theme Six: Freshwater Ecosystems* 4.6.2 Ecological and environmental impacts of large-scale groundwater developments in the Table Mountain Group (TMG) aquifer systems 4.6.3 Getting a good basic understanding of wetlands 4.6.4 Improving our data on the value of wetlands in the CFR 4.6.5 Understanding the impacts of water abstraction on river systems
2.2: Production sectors protect priority biodiversity and utilise natural resources sustainably	*4.2 Theme Two: Ecosystem Health and Services* 4.2.3 Understanding and managing consumptive (and non-consumptive utilization) *4.3 Theme Three: Fragmentation* 4.3.5 Ecological and economical tradeoffs in

C.A.P.E. Programme Draft Objectives Hierarchy	Fynbos Research Strategy Priorities
	conservation of fragmented habitats *4.6 Theme Six: Freshwater Ecosystems* 4.6.2 Ecological and environmental impacts of large-scale groundwater developments in the Table Mountain Group (TMG) aquifer systems 4.6.3 Getting a good basic understanding of wetlands 4.6.4 Improving our data on the value of wetlands in the CFR
SO3: Integrated and coordinated management of aquatic and terrestrial natural resources ensures ecosystem integrity, resilience and functionality	*4.1 Theme One: Taxonomy, Distribution and Utility of the Cape Floristic Region's Biodiversity* 4.1.3 Taxonomy of CFR organisms 4.1.4 Life history research *4.2 Theme Two: Ecosystem Health and Services*: 4.2.1 Ecosystem health 4.2.2 Ecosystem services *4.4 Theme Four: Climate Change* 4.3.2 Understanding and managing global climate change
3.1: Aquatic resources (groundwater, rivers, estuaries, wetlands, marine) are sustainably managed for ecosystem continuity	*4.6 Theme Six: Freshwater Ecosystems* 4.6.2 Ecological and environmental impacts of large-scale groundwater developments in the Table Mountain Group (TMG) aquifer systems 4.6.3 Getting a good basic understanding of wetlands 4.6.4 Improving our data on the value of wetlands in the CFR 4.6.5 Understanding the impacts of water abstraction on river systems
3.2: Integrated and coordinated management of invasive alien species, restoration and rehabilitation, contribute to ecosystem functionality	*4.5 Theme Five: Alien Invasives* 4.5.2 Management of alien invasions 4.5.3 Mapping methodology 4.5.4 Emerging Invasives 4.5.5 Investigation of the impact of the Working for Water on the ecological functioning and biodiversity of our rivers
3.3: Integrated and coordinated fire management contributes to the restoration of ecosystem functionality	*4.4 Theme Four: Climate Change* 4.4.2 Understanding and managing global climate change *(c) How is fire being influenced by global climate change and how should we respond?*
SO4: The sustainable use of biodiversity resources in the CFR delivers socio-economic benefits for local communities, and particularly marginalised groups	
4.1 Biodiversity based enterprises and natural resource management deliver social & economic benefits to communities	*4.2 Theme Two: Ecosystem Health and Services* 4.2.4 Socio-economic valuation of biodiversity and ecosystem services required to motivate their conservation *4.6 Theme Six: Freshwater Ecosystems* 4.6.4 Improving our data on the value of wetlands in the CFR
4.2 Local communities derive benefits from non-commercial consumptive use of natural resources	*4.2 Theme Two: Ecosystem Health and Services* 4.2.3 Understanding and managing consumptive (and non-consumptive utilization)
4.3 Local communities derive value from non-	*4.2 Theme Two: Ecosystem Health and Services*

C.A.P.E. Programme Draft Objectives Hierarchy	Fynbos Research Strategy Priorities
commercial non-consumptive use of natural resources	4.2.3 Understanding and managing consumptive (and non-consumptive utilization)
SO5: The required enabling environment (including institutional and professional capacity, policy and legal framework, strategic & operational alignment & stakeholder support) is established and sustained	
5.1: A coherent, integrated, enabling policy & legislative framework is developed, implemented & enforced	The research priorities for this strategy focus specifically on biophysical conservation sciences. However it is recognised that conservation research needs to be embedded in the social dimension and a focused research strategy to address this need will be developed by the Fynbos Research Programme Partnership in a separate exercise. It is envisaged that the social science research agenda will be closely aligned with meeting this C.A.P.E. objective.
5.2: Partner institutions effective in carrying out mandates that effect delivery of key components of the programme	
5.3: Cooperative governance, stakeholder participation & institutional alignment are effective and maintained	
SO6: An established managed network for learning and research underpins the programme and informs policy, planning & practice	*All thematic areas:* Communicating with and influencing people
6.1: An adequately resourced and coordinated research programme supports biodiversity conservation	
6.2: Learning networks, facilitate collaborative problem solving, and support policy, planning and best practice development	*All thematic areas:* Communicating with and influencing people
6.3: An understanding of the value of biodiversity underpins sustainable living in the CFR	*4.2 Theme Two: Ecosystem Health and Services* 4.2.4 Socio-economic valuation of biodiversity and ecosystem services *4.3 Theme Three: Fragmentation* 4.3.5 Ecological and economical tradeoffs in conservation of fragmented habitats *4.6 Theme Six: Freshwater Ecosystems* 4.6.4 Improving our data on the value of wetlands in the CFR

ANNEXURE C: SOUTH AFRICAN GOVERNMENT NATIONAL SCIENTIFIC RESEARCH PRIORITIES

Institution	Scientific Research Focus Areas
Department of Science and Technology	▪A new 10 year research strategy has been proposed with four components, three which would be highly relevant to the fynbos research strategy including: -Climate change; -Earth observation system (SAEON); and -From farmer to pharma ▪It is likely to take a year to 18 months to finalise this strategy but it is important that whoever is driving the implementation of the fynbos research strategy keeps abreast of these developments.
National Research Foundation	▪Ecosystems and biodiversity is a funding focus area. Specific research programmes under this focus area are SEACHANGE (marine ecosystems); the South African Biosystemics Initiative; and SAEON. ▪Albert van Jaarsveldt identified alien invasives and climate change as the most pressing issues threatening fynbos. The NRF focus areas could be used to fund individual projects along these lines on a competitive basis.
Working for Water Programme (DWAF)	▪Working for Water's *Research Strategy & Action Plan (2005) outlines five* priority areas for Working for Water's ecological research contribution. *WFW* identified a few possible opportunities for collaboration in implementing the fynbos research strategy in the following research areas: -Determining the extent of alien invasive plants in the region, the determinants of spread, and the likely extent of invasions at different times in the future; -Investigating the impact of WFW on ecological biodiversity and functioning of rivers; -Understanding the taxonomy of fynbos for purposes of bio-control – this is a major focus of the WFW programme (80% of WFW research budget goes into biological control research in collaboration with ARC and CSIR; also have an agreement with ARC around mapping of alien invasives – their total budget is R16 million a year)
Water Research Commission (WRC)	▪The WRC has five key strategic areas two of which are relevant to the fynbos research strategy: -*Water Resource Management* Generating the knowledge, tools and skills to ensure that water resources of South Africa are protected, utilised, developed, conserved and managed to achieve environmental, social and economic sustainability. -*Water-Linked Ecosystems* Providing knowledge to ensure sustained functioning of aquatic ecosystems and ongoing provision of ecosystem goods and services.