C·I·B
DST-NRF Centre of Excellence for Invasion Biology

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ANNUAL REPORT 2007

National Research Foundation

science and technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

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DST-NRF Centre of Excellence for Invasion Biology

ANNUAL PROGRESS REPORT

Reporting period from 1 January 2007 to 31 December 2007

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Identification

Name of Director	:	Professor Steven L. Chown
Name of CoE	:	DST-NRF Centre of Excellence for Invasion Biology
Abbreviated CoE Name	:	Centre for Invasion Biology
Host institution	:	Stellenbosch University
Date completed	:	Report: 4 March 2008
	:	Financials: 7 March 2008

EXECUTIVE SUMMARY

1. Financial Information (Funding of the CoE)

Total NRF funding for 2007	:	R 5 834 955.00
Funding from Host institution in 2007	:	R 765 651.19
Funding from other sources for the CoE in 2007	:	R 1 067 005.36
Total funding	:	R 7 667 611.55

2. Summary of progress against 5 KPAs. (Please limit your responses to completed tasks or work in progress and exclude plans for the future.)

(i) Research

Work to address all of the research objectives is underway, and delivery is excellent against many of them. The growth in publication activity, representing a doubling of output since 2006, is demonstrable evidence of sound performance. In 2007, the C·I·B published 86 papers in the primary literature, including in the general, high-impact journals *Nature*, *Science*, and *PNAS*, and in high-impact disciplinary journals such as the *Annual Review of Ecology, Evolution and Systematics*, *Proceedings of the Royal Society of London B*, and *Philosophical Transactions of the Royal Society of London B*.

(ii) Education and Training

Student throughput remains excellent, with a continuous registration and graduation of students. The first C·I·B Ph.D. has submitted her thesis and graduation is expected in 2008. In 2007, 41 students and 11 post-doctoral associates were registered with the C·I·B. Of the 41 students, 23 are women and 18 black. Four post-doctoral associates are male and one black (from India). Three Hons./4th year students, four M.Sc. students (one with distinction), and one Ph.D. student completed their degrees, and one M.Sc. student upgraded her studies to the Ph.D. level. Of the eight graduates, five are women and three are black.

(iii) Information Brokerage

The C·I·B continues to maintain a high media profile thanks to the excellent work it is doing, the concerted strategy to draw media attention to the work not only via journal offices, but also using the systems in place at Stellenbosch University, and the efforts of the outreach manager in the C·I·B. The Iimbovane project continues to grow, with considerable interest for expansion from the Western Cape Education Department. A business plan for the expansion is in place, additional funds have been successfully solicited, and proposals for further funding have been implemented, which will be followed through in 2008. Communication within the C·I·B has been streamlined with ongoing information flow via the home page and direct communication from the hub to all partners. Both the Information Retrieval and Submission System and the Document Management System are now fully operational.

(iv) Networking

The most significant collaborative agreement, with Working for Water, was finalized in 2007. Additional agreements with CAPE and with the Centre for Advanced Studies in Ecology and Biodiversity were finalized, or further developed, respectively. The open bursary programme continues to attract and involve students and PIs from a range of non-core institutions in the field of invasion biology. During 2007, the Centre's Director, Deputy Director: Operations and various

members of staff visited the Universities of Fort Hare, Johannesburg, KwaZulu-Natal, Limpopo, Pretoria, Rhodes, Venda, Witwatersrand, Zululand, Nelson Mandela Metropolitan University and Walter Sisulu University. At each university the Centre made contact with staff in the life sciences departments and presented a seminar or informal talk to undergraduate and postgraduate students and staff encompassing the Centre's aims, structure and research interests.

(v) Service rendering
Service rendering to the science community, by way of editorships and reviewing, continued with an upward trend, and the numbers of reviews for granting agencies was also high. C·I·B core team members continue to play significant roles in international and national committees and bodies. Several specific services were rendered especially to the NRF (which was sometimes coordinating ventures on behalf of several partners). These included hosting of the South African National Antarctic Programme PI, Post-doc and Student Symposium, and the delivery of Background Report for the assessment of the South African National Antarctic Programme produced in conjunction with an external consultant.

3. What was the gender impact of your work?

The C·I·B continues to focus on the development of women in science in several ways. Overall, the staff complement is dominated by women, as is the student complement. Increasing numbers of women fill the post-doctoral ranks too. The large majority of recent graduates are women, and the Iimbovane outreach project serves as an important role model to young women learners because all of its very capable staff are women. Core team members continue to play development roles such as in HERS-SA and SA-WISE.

4. Red Flags. Please indicate any major concerns you have for the future of your CoE

Four matters are of concern. First, following 'round-the-country' visits to tertiary institutions by the Director and Deputy Director: Operations, it has become apparent that the numbers of excellent students entering the field of whole organismal biology/ecology, and the numbers of HDI students in this field, remain relatively low. The situation is improving, but it does not appear that lack of effort on the part of the tertiary sector (at least not in the whole organismal and ecological sciences) to promote the excellent opportunities in the field lies at the root of slow growth. The employment market is also highly active at the moment, so job scarcity is probably not at fault either. Certainly, secondary education is a major factor, but perhaps others also play a role, such as the early realization by students that Ph.D. graduates perhaps don't command the respect they once did and the remuneration has not changed much to make up for this decline in profile. Nonetheless, the performance demands have accelerated steeply and the field globally has become exceptionally tough. Being a 'published student/academic' is now much more difficult than it ever used to be. The expectation that this minimum requirement is met, and that the publications are in top-end journals, is global, but is not especially encouraging to newcomers.

Second, as the second five-year cycle of the Centre is approaching, clear direction from the DST-NRF is required concerning the plans for or likelihood of further support for the C·I·B. The original proposal indicated an exit strategy for the C·I·B, in keeping with proposal instructions, but given the considerable interest from and endorsement by many sectors for the work done by the C·I·B this no longer seems advisable. If the C·I·B is to be continued, then a strategy must make provision for the existence of the Centre beyond its second five-year term.

Third, because a new strategic plan must be developed for 2009 onwards, the DST-NRF and Board must now determine whether the C·I·B has met with the following requirements stated in the letter of award:

- "The objectives need to be more clearly delineated, with special attention to the specific tasks of team members.
- The plan for information dissemination and communication needs to be reworked and improved.
- The projected research outputs, especially Masters and Doctoral students, is too low and the Centre needs to be challenged to do better.
- The lack of a GIS component in the proposed work (i.e., track the growth of aliens, spread of desertification, etc.) was of concern and would need to be driven by a specialist in the field.
- The challenge for this centre will be to strongly communicate the need for this type of work to the people of South Africa, because it is not at all clear why drought or pollution research should not be funded before this work. There is enormous scepticism and cynicism amongst people about the removal of invasive trees, for example, because this simply removes construction materials and fuels from the people who need them the most."

Finally, it should be noted that in several cases Ph.D. students and their supervisors appear to be planning on at least four years for the Ph.D. work. Steps have been taken to address the matter, but it is concerning given the SLA requirement for an average duration of 3.5 years.

5. General Comments

The C·I·B continues to perform well and certainly above its Service Level Agreement expectations in many respects. Thanks are due to the Department of Science and Technology, the National Research Foundation, Stellenbosch University, and the C·I·B's collaborators and partners for their support. The Director wishes to convey special thanks to Gerhard Moolman, Doug Rawlings and Guy Preston for their interest in and support of the Centre.

2007 ANNUAL REPORT

1. Scientific Research

A. Objectives

The major objective of the research undertaken by the C·I·B is to understand the biodiversity consequences of biological invasions. A combination of long- and short-term research on biodiversity patterns and processes, the way invasive species alter these, the lessons invasions can teach about biodiversity processes, and the approaches that need to be taken to reduce the scale and impact of invasions form the key elements of this research. The sections below describe some highlights of research in 2007.

B. Progress

Long-term work

a. Listing and mapping of invasive species

Understanding the ecology of invasive species and developing effective management strategies for them demands sound information on the distribution and abundance of the species. Challenges involved in acquiring accurate and useful data vary considerably among and within taxonomic groups. A wide range of projects undertaken during 2007 examined the distribution of invasive alien species. Some of the research areas are reviewed briefly here.

Rats, rats, rats

About 50 species of murid rodents have been recorded in southern Africa. Some species cause extensive damage to agricultural products and are involved in the spread of diseases especially in rural areas. Examples include multimammate mice (*Mastomys* spp.), gerbils (*Tatera* spp.) and brown or roof rats (*Rattus* spp.). Agricultural problems include damage to all crop stages and to electrical installations. Diseases of interest in South Africa include leptospirosis, plague and toxoplasmosis that are becoming more prevalent in people whose immune systems have been compromised by the prevailing HIV/AIDS epidemic. Clearly, an understanding of rodent distribution patterns and the factors that control these is crucial for management. A major challenge is that the identification of some rodent species is difficult due to the presence of morphologically indistinguishable cryptic species.

Work by a C·I·B core team member and students, in collaboration with the Department of Zoology and Entomology at the University of Pretoria, aims to: (1) Provide a cost-effective means for identifying potentially problematic murid rodents in South Africa using a multidisciplinary approach that includes molecular, cytogenetic, and morphometric data; (2) Map the actual and potential distributions of problematic rodent species; and (3) Screen for pathogens in these problematic murid rodents to assess their zoonotic potential (zoonotic diseases are those caused by infectious agents that can be transmitted between, or shared by, humans and other animals).

Results of molecular studies to date have revealed the presence of a novel invasive alien species, *Rattus tanezumi*. This species, indigenous to south-east Asia, occurs sympatrically with the well known invasive alien *R. rattus*. Data show that the traditionally known distributions of *Rattus* species in South Africa are largely inaccurate (Fig. 1) and highlight the need for further investigation involving extensive sampling and the use of GIS analysis. Polymerase chain reaction (PCR) amplifications showed for the first time the presence of *Bartonella* and *Helicobacter* in all three species of *Rattus* from South Africa. Both pathogens have zoonotic potential.

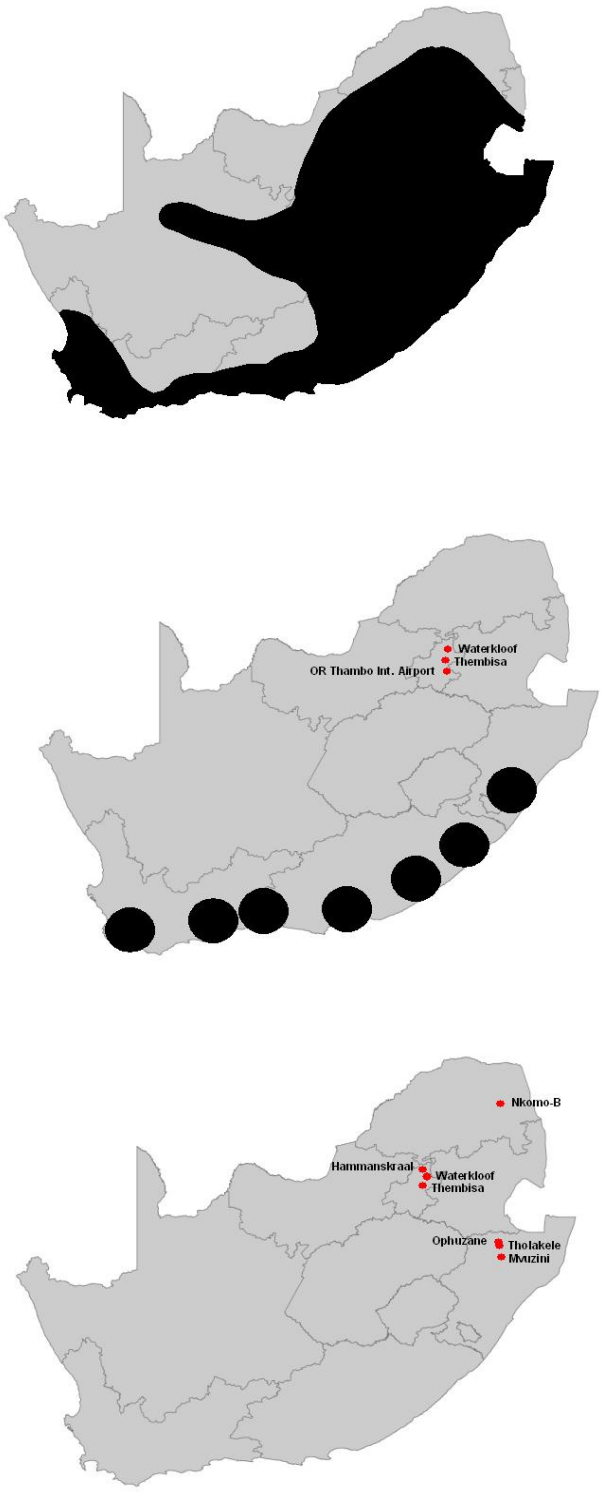

Figure 1. The traditionally known geographic distributions of *Rattus rattus* (top, shaded area) and *R. norvegicus* (middle, shaded areas), and recently sampled localities with genetically identified *R. norvegicus* (middle, red dots) and *R. tanezumi* (bottom, red dots) in South Africa. The three species can also be separated using geometric morphometric data, which may facilitate the development of user-friendly identification keys for use by scientists and the public.

Painted reed frogs spread their colours

The painted reed frog *Hyperolius marmoratus* is indigenous to parts of South Africa, but is spreading outside of its native range and has invaded novel habitat as far west as Cape Town. The object of C·I·B-funded research on this species is to understand its range dynamics in the new part of its range and to identify the direct human, climate- or landscape-change related causes of the invasion. Work to determine the current distribution of *H. marmoratus*, with a focus on the Western Cape, started in 2007. Incidental observations and active searches during the summer breeding seasons showed that the frog is widely distributed in the more mesic and transformed parts of the province. These data informed the development of a diffusion-based metapopulation model which will be tested and further developed in the next few years.

Mussels muscling along to Marion – insects too

As part of the International Polar Year investigation of alien invasions into the Antarctic, the C·I·B team has been investigating the extent to which the South African supply ship, the *SA Agulhas*, moves propagules to and from South Africa's Antarctic and Southern Ocean island stations. Increasing numbers of scientific and tourist vessels are entering the Antarctic region, increasing the chances of introducing a range of organisms that are not currently found in the region. Little is known about the frequency of such introductions or the identity and survivorship of the species associated with them. The work involved inspecting the sea chests of the *SA Agulhas* while the vessel was in dry dock. Large populations of a known invasive mussel, *Mytilus galloprovincialis*, were found. By extrapolating from shell length, the age of individuals was estimated. Results suggested that some specimens have survived transportation to the Antarctic region on multiple occasions. These findings are cause for concern and demonstrate that Antarctic research and supply vessels are important vectors for marine non-indigenous species into the region.

Ongoing work at sub-Antarctic Marion Island has also revealed colonization of the island by a new invasive alien insect species. Over the past two decades seven non-indigenous vascular plant or arthropod species have established reproducing populations at the island. The eighth establishment, of a braconid wasp *Aphidius matricariae* was recorded. This species uses the introduced aphid *Rhopalosiphum padi* as its only host on the island. Molecular markers (18S rDNA and mtCOI) supported the conventional taxonomic identification and indicated that all individuals are characterized by a single haplotype. Surveys around the island revealed that adult abundance and the frequency of aphid parasitism are highest at Macaroni Bay on the east coast, and decline away from this region to low or zero values elsewhere on the coast. The *SA Agulhas* regularly anchors at Macaroni Bay, and *Aphidius* sp. has been collected from its galley hold. Current abundance structure, low haplotype diversity, and the operating procedures of the *SA Agulhas* all suggest that the parasitoid was introduced to the island by humans. Regular surveys indicate that this introduction took place between April 2001 and April 2003, the latter being the first month when this species was detected. The wasp's establishment has significantly added to trophic complexity on the island. Low haplotype diversity in this species suggests that propagule pressure is of little consequence for insect introductions. Rather, single or just a few individuals are probably sufficient for successful establishment.

This absence of a propagule pressure effect was borne out by further genetic work on the indigenous and invasive springtails found on the island. The patterns in and the processes underlying the distribution of invertebrates among Southern Ocean islands and across vegetation types on these islands are reasonably well understood. However, few studies have examined the extent to which populations are genetically structured. Given that many sub-Antarctic islands experienced major glaciation and volcanic activity, it might be predicted that substantial population

substructure and little genetic isolation-by-distance should characterize indigenous species. By contrast, substantially less population structure might be expected for introduced species. These predictions and their consequences for the conservation of diversity in the region were explored by examining haplotype diversity based on mtCOI sequence data, from two indigenous (*Cryptopygus antarcticus travei*, *Tullbergia bisetosa*) and two introduced (*Isotomurus cf. palustris*, *Ceratophysella denticulata*) springtail species from Marion Island. Considerable genetic substructure was found in the indigenous species that is compatible with the geological and glaciological history of the island. Moreover, by employing ecological techniques, it was shown that haplotype diversity is likely much higher than suggested from the sequenced samples. No structure was found in the introduced species, with each being represented by a single haplotype only. This indicates that propagule pressure is not significant for these small animals unlike the situation for other, larger invasive species: a few individuals introduced once are likely to have initiated the invasion. These outcomes demonstrate that sampling must be more comprehensive if the population history of indigenous arthropods on these islands is to be comprehended, and that the risks of within- and among-island introductions are substantial. The latter means that, if biogeographical signal is to be retained in the region, great care must be taken to avoid inadvertent movement of indigenous species among and within islands. Thus, quarantine procedures should also focus on among-island movements.

Argentine ants – fine tuning current understanding of distributions

The database of presence and absence records for the Argentine ant in South Africa was refined and extended during 2007. The temporal accumulation of records and inferred pattern of range expansion by the species in South Africa were also examined.

The spatial spread of the Argentine ant extends from the Cape Peninsula and Western Cape through the Eastern Cape and northwards into the Free State and Gauteng. A single record exists for Limpopo, and one record from Lesotho. The species is also present at localities spread around the periphery of the Northern Cape Province, but is apparently absent from the central region of this province. The species is absent from most of the North West and Limpopo provinces and is presently also considered absent from KwaZulu-Natal Province.

Following the first records of the Argentine ant in South Africa in 1901, the accumulation of records was extremely slow for the following half century (Fig. 2). The number of presence records increased sharply in the mid 1950s and again in the mid 1980s. The sharp increase in the number of both presence and absence records since 2000 is largely attributable to the field surveys conducted as part of this study.

The minimum convex polygon of all data records (presence and absence) for the Argentine ant in South Africa covers 83 % of the country's surface area. The extent of occurrence (EOO) of the Argentine ant in South Africa at present is estimated at 70.16 x 104 km^2, or 58 % of the country's surface area. This percentage declines to 44 % if one excludes intralimital areas of absence records. Outside of the bounds of the EOO the species was shown to be absent across 25 % of the country's surface area, with the status of the species in the remaining 17 % of the country unknown.

The estimated range expansion of the species in South Africa since 1901 is depicted by the minimum convex polygons and α-hull, and these are, as expected, very different (Fig. 3). The α-hull, considered to represent a comparatively unbiased trend estimate, peaked in the 1960s, dropped somewhat in the 1970s and has been fairly stable at approximately 130 000 km^2 since. This suggests that the extent of the range was reached fairly early and subsequent records have been largely space-filling within the boundaries of the range. However, with an increase in the

density of presence records, the mean length of lines constituting the Delaunay triangles declined, leading to the exclusion of more outlying presence records. This is likely to be the cause of the slight decline in area across later decades. The large increase in range in the mid-1950s on the other hand is mirrored by an increase in the number of records for the species at that time. However the fairly shallow increase in range size since the 1970s in spite of a dramatic increase in the number of species records suggests that the estimated current range of the Argentine ant in South Africa is beginning to approximate the actual spatial spread of the area occupied by the ant in the country.

Minimum estimates of the rate of radial spread of the Argentine ant in South Africa range from 16.14 to 20.1 km.y^{-1}: values within the range of jump-dispersal spread rates recorded for the species globally. Data records provide only a latest date of arrival estimate and thus under estimate the rate of spread. Nonetheless, based on the available data the rate of spread is estimated at greater than 20.1 km per year. Between 1900 and 1950 the Argentine ant had reached 22 % of its current distribution, by 1970 it had reached 82 % and by 1990, 99.5 % of its current distribution in the country. In the last twenty years at least there has thus apparently been only a small increase in the extent of its known distribution at a national scale.

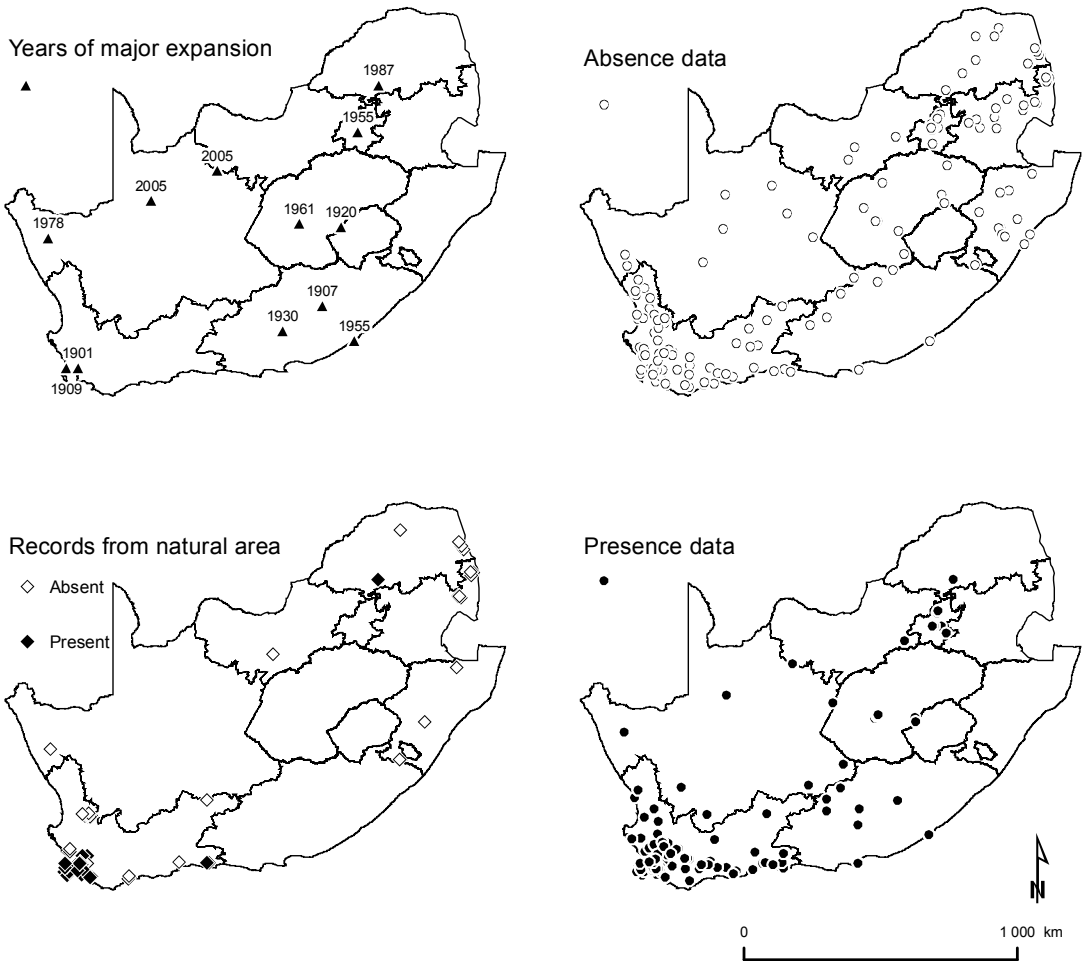

Figure 2. Maps of South Africa showing the first years in which the Argentine ant was recorded as present across a selection of widely separated localities, i.e. estimates of major range expansion events. The distribution of all available absence and presence records is also shown, as well as the distribution of records available for natural areas.

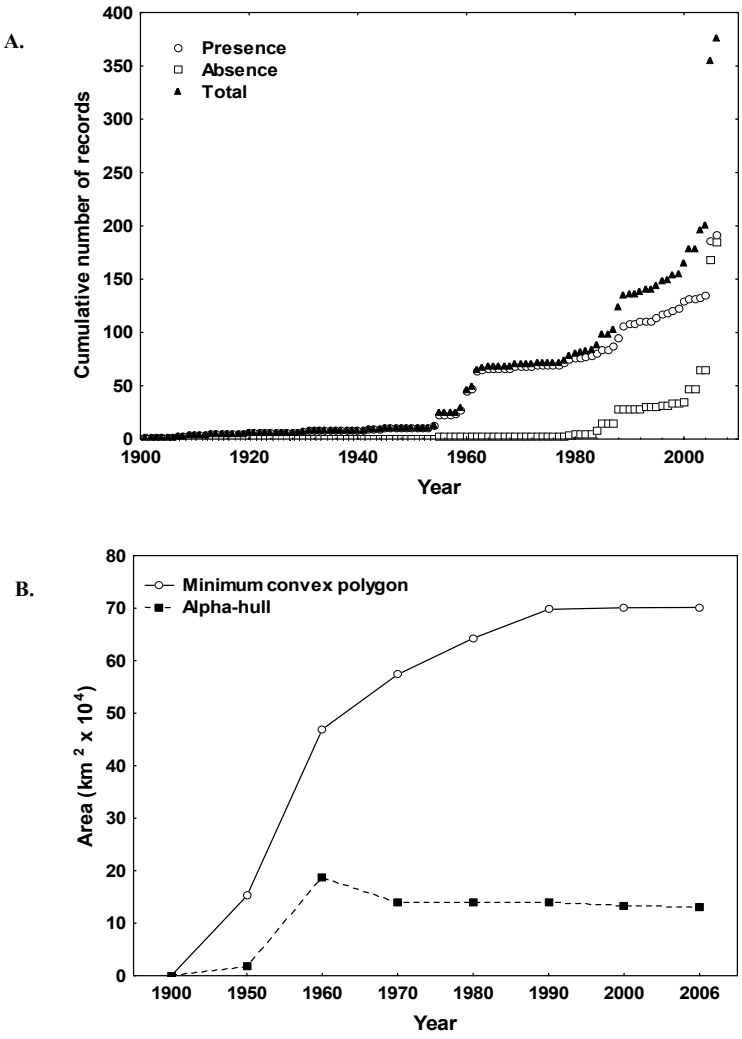

Figure 3. Invasion curves. A. The number of unique (locality, date, habitat combinations) presence and absence records accumulated for the Argentine ant in South Africa since 1901. B. Cumulative extent of occurrence of the Argentine ant in South Africa over the last 100 years, shown as calculated by minimum convex polygon and α-hull.

Patterns of alien plant distribution at multiple spatial scales

Spatial scale is critical for understanding and managing biological invasions. In providing direction to management of alien plant invasions, much emphasis is placed on collecting spatial data and producing maps of the distribution of invasive species. Very often, insufficient thought is given to how the distribution data or maps are to be used. Given the expense of collecting distribution data, it makes sense to collect such data at resolutions and intensities that will ensure optimum utility and flexibility of derived products such as distribution maps. Extremely detailed distribution data for invasive alien plants in the Kruger National Park facilitated an investigation of the implications of mapping distributions at different scales (Fig. 4). When assessed at a fine resolution, the distribution of *Opuntia stricta* in the Kruger Park can be clearly related to the Skukuza village, from where the species originally spread 50 years ago. When mapped at courser scales, the association with the original focus and patterns of spread are not clearly evident. Another important invader, *Parthenium hysterophorus*, is clearly associated with roads when mapped at a fine scale, but the

strength of this association, which is crucial for understanding and managing these invasions, is lost at coarser scales. The close association between the distribution of *Lantana camara* and the location of rivers in the park is another example. Collection, curation, and analysis of distribution data is expensive, and care must be taken to ensure that effort should not be wasted on collecting data at fine resolution when coarser-resolution data could provide adequate information. On the other hand, effective management for certain species and conditions may require high-resolution data, for example to capture information on outlier populations and spatial patterns relevant to management. The ongoing evaluation of different datasets from the Kruger National Park will provide useful guidelines in this regard.

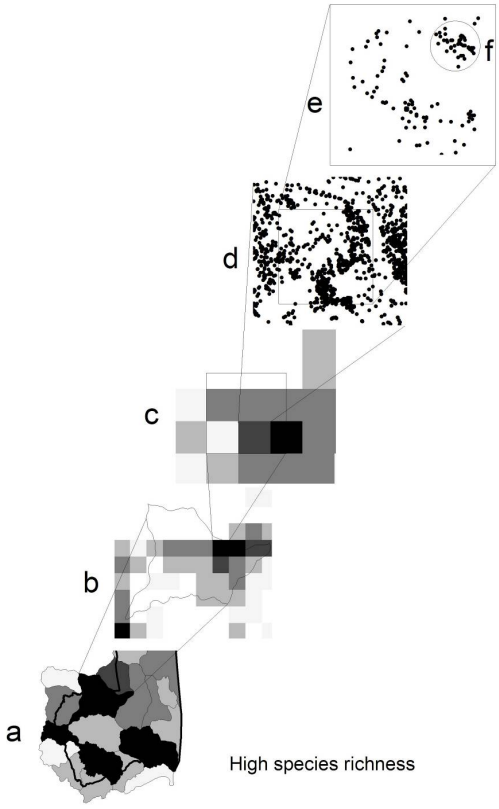

Figure 4. Data on the distribution of alien plant species in a section of the Kruger National Park, showing the effect of mapping patterns at different spatial scales. The dots in panels (d) and (e) indicate individual alien plant records.

Patterns of alien plant distribution in a river landscape following an extreme flood

Rivers provide important conduits for the dispersal of invasive species. Previous work done at the C·I·B devised protocols for defining levels of risk for different areas outside protected areas serving as sources for propagules. In 2007, a detailed study was made of invasion patterns along the Sabie River in the Kruger National Park. A 1-in-100 year flood in 2000 along this river had a major influence on the distribution of invasive plant species, with important implications for management in the park. The main aim of the study was to document the impact of the 2000 flood on the Sabie River landscape with respect to the distribution of patches that provide resources for alien plant establishment. The study found that some patches, notably bedrock distributary and braid bar geomorphic units, contained higher densities and more species of alien plants. The mapping of such locations and the conceptualization of how such foci affect spread at the landscape scale are

being used to plan effective intervention strategies to slow the spread of invasive species in the region. Effective management of invasive species demands such multi-scale perspectives.

The Peruvian pepper tree in South Africa – new insights from different spatial scales

Schinus molle (Peruvian pepper tree) was introduced to South Africa in the middle 1800s and was widely planted along many roads, especially in the Northern Cape and Western Cape provinces, to serve as a shade tree. It is classified as a major invasive species, although it is not naturalized or invasive in all regions where it was planted. A range of studies was carried out to gather information of key aspects of the biology and ecology of this species to guide management and to predict the full potential of this species to invade South African ecosystems.

An indigenous wasp, *Megastigmus transvaalensis* (Hussey) (Hymenoptera: Torymidae) was found to be destroying seeds of *S. molle* over part of its range. A survey revealed that a significantly higher proportion of *S. molle* fruits were damaged in the summer-rainfall part of its range than in the winter-rainfall region. Currently, the focus of widespread invasions of this species is the semi-arid savanna in the vicinity of Kimberley. Several studies were conducted to elucidate the invasion ecology of the species in this area. One set of experiments investigated the effects of soil type, microsite condition, and herbivory by large mammals on growth and survival of *S. molle* seedlings. Seedlings were raised in a greenhouse and then transplanted into four treatment groups: in open grassland, under tree canopies, and with and without cages to exclude large herbivores (cattle and game). The same experiment was repeated in two different soil types: coarse sand and fine-textured clay soil. Results suggest that protection provided by canopies of large indigenous acacias facilitates *S. molle* invasion, regardless of soil type. Whether exposed to or protected from large herbivores, no seedlings planted in open grassland survived the first winter. Seedlings grew better and had higher survival rates beneath tree canopies than in the open sites, but exposure to large herbivores significantly decreased heights and canopy areas of seedlings compared with those protected from large herbivores, more so on clay than on sandy soil. Overall, results suggest that low temperatures (frost) and possibly inter-specific competition with grasses, may limit *S. molle* seedling establishment, survival and growth away from tree canopies in semi-arid savannas. Low soil nutrient status and browsing may also delay growth and development of this species.

The widespread planting of *S. molle* over large areas of South Africa, but with naturalization and invasion taking place over a much smaller part of this sampled range, offered the opportunity to determine the key differences that separate sites where the species can grow (i.e., survive following planting and initial tending) from those where the species becomes naturalized or invasive. Niche-based modelling techniques were applied to the problem to determine the extent to which environmental factors defined conditions where *S. molle* can invade and the extent to which invasion is influenced by propagule pressure, i.e. the number of trees planted (and therefore the number of propagules available) to initiate invasions. Studies elsewhere have shown that very high levels of propagule pressure can facilitate invasions even in conditions that are sub-optimal for establishment. Preliminary results suggest that propagule pressure is extremely influential in defining potential invasion opportunities for *S. molle*. These findings are useful for management of this species at regional and national scales, and for prediction of likely trajectories of invasion under climate change.

Alien conifers in South America – short fuse burning?

South Africa, Australia, and New Zealand have long histories of afforestation with alien conifers. In all three countries the invasive spread of pines and other conifers is a major problem. Detailed research has been undertaken on the ecology of alien conifer invasions in these regions, and various innovative means of managing the problem have been developed. South America has a

much shorter history of introductions and large-scale afforestation with alien conifers, but very large afforestation projects have been undertaken in countries such as Argentina, Brazil, and Chile in recent decades. The extent of spread of planted conifers is poorly documented for this continent, but all evidence points to a rapid escalation of invasion. An international workshop was convened in Bariloche, Argentina, to discuss the emergence of problems with invasive alien conifers in South America and to explore the extent to which experience over three centuries in other southern hemisphere regions could be applied in South America to reduce problems in the future. The workshop concluded that: (1) the problem is expected to increase substantially in many parts of the continent; (2) the scale and extent of the current problem and the potential for rapid escalation is not widely recognized; (3) lessons from elsewhere can be transferred; and 4) collaboration can bring benefits. A series of projects were identified, including one to map areas under plantations and invasive stands, and will be conducted over the next few years.

b. Risk Assessment and scenario planning

Physiological response as a component of risk

Synergies between global change and biological invasion have been identified as a major potential risk to global biodiversity and human welfare. The global change-type drought characteristic of many temperate terrestrial ecosystems is especially significant because it will apparently favour invasive over indigenous species, adding to the burden of conservation and compromising ecosystem service delivery. However, the nature of and mechanisms underlying this synergy remain poorly explored. Studies undertaken by the C·I·B have shown that in a temperate terrestrial ecosystem invasive and indigenous springtail species differ in the form of their phenotypic plasticity such that warmer conditions promote survival of desiccation in the invasive species and reduce it in the indigenous ones. These differences were consistent with significant declines in the densities of indigenous species and little change in those of invasive species in a manipulative field experiment that mimicked climate change trends. It appears that it is not so much the extent of phenotypic plasticity that distinguishes climate change responses among these invasive and indigenous species, as the form that this plasticity takes. Nonetheless, this differential physiological response provides support for the idea that in temperate terrestrial systems experiencing global change-type drought, invasive species may well be at an advantage relative to their indigenous counterparts. Risk assessments of the interactions among climate change and biological invasions will have to take account of the likely promotion of invasive species above their indigenous counterparts as climate change proceeds.

Environmental management plan for the Prince Edward Islands – identifying and reducing the risks

The drafting of the Environmental Management Plan (EMP) for the Prince Edward Islands (PEI) was undertaken on contract to the Department of Environmental Affairs and Tourism (DEAT) in 2005/6, and led to an invitation to the C·I·B to participate in the International Forum on the Sub-Antarctic in Hobart, Tasmania in July 2006. The EMP was presented at the Forum and the proceedings of the meeting were published in November 2007. Participation in the Forum, where management provisions for all of the island groups were presented, showed that the new plan for the PEI is comparable with those of several of the best-managed sub-Antarctic islands. However, the PEI EMP is unusual for three reasons: (1) It explicitly uses the International Standards Organisation (ISO) principles of quality management, emphasising a systems approach to management, a factual approach to decision-making, and the need for continual improvement. Although the plan was produced as a requirement of national legislation, the ISO 14000-series approach brings the plan in line with international standards normally used in voluntary adherence systems; (2) An integrated life-cycle approach takes into account all phases of management, from planning and policy-making to implementation and review; (3) The management provisions set out

in the plan are comprehensive and clearly articulate actions, targets, roles and monitoring and remedial actions in a systematic framework that guides management responses to routine and extraordinary situations such as disease outbreaks. The EMP also serves as an information source for all visitors to the islands since it contains a comprehensive background to the physical, biological and social environment of the islands. The EMP is currently being integrated into DEAT's sub-Antarctic operations as part of the South African National Antarctic Programme.

Fine-tuning knowledge of the role of plant traits in determining invasiveness as input to risk-assessment tools

Work undertaken at the C·I·B provided strong evidence to support the idea that invasiveness of plants can be predicted from their breeding systems. The main finding to emerge from this work is that reproductive biology has important implications for the population ecology of plants. This link between two disparate fields was first made by Herbert Baker in his famous Baker's law in the 1950s which predicted that colonization ability is enhanced by uniparental reproduction. This work has shown convincingly that Baker's idea is applicable to plant invasions. Southern African Iridaceae, species of which have frequently been introduced elsewhere as horticultural subjects, was used as a model system. By comparing invasive and non-invasive congeners that have been introduced elsewhere many of the problems that beset comparative studies in invasion biology were overcome. Invasive European plants in North America were also studied. Results revealed the same pattern – namely that ability to self-fertilize is key to invasion success. The dependence on self-fertilization is greatest in wind-pollinated plants; this suggests that a lack of mates in small populations (wind-pollinated plants have short distance pollen dispersal), rather than pollinator limitation explains the importance of self-fertilization.

Population-level work continued on the reproductive biology and demography of *Lilium formosanum*, an Asian geophyte, in the KwaZulu-Natal midlands where the species is fast becoming a problem weed. In 2007 work focused on demographic studies which attempted to elucidate the link between seed production via autonomous selfing and population growth. Crossed and selfed seeds were planted at the study sites to establish whether inbreeding depression affects the likelihood of establishment through autogamous reproduction.

Towards a pragmatic management strategy for alien reptiles and amphibians in South Africa

Although alien reptiles and amphibians (together known as herps) are not currently a major problem as invaders in South Africa, escalating invasiveness in these groups elsewhere in the world, together with a marked increase in the demand and inter-continental transport of species, suggest that problems should be expected in the future. The C·I·B is undertaking a thorough survey of alien herps in South Africa: which species are here, how many individuals are present, where they are kept, and the factors that drive the current demand for importation of and trade in these alien species. The National Environmental Management: Biodiversity Act calls for a risk assessment protocol for evaluating all new introductions. Sound information on which to base objective risk assessment protocols for South Africa is lacking. A major problem on this front for herps is that each of South Africa's nine provinces has its own legislation for deciding whether a permit should be issued for a particular alien species and situation. The regulations to guide the implementation of the National Act have yet to be finalized, and consistency is absent in the application of risk assessment practices. Figure 5 summarizes some aspects of work underway at the C·I·B on this front.

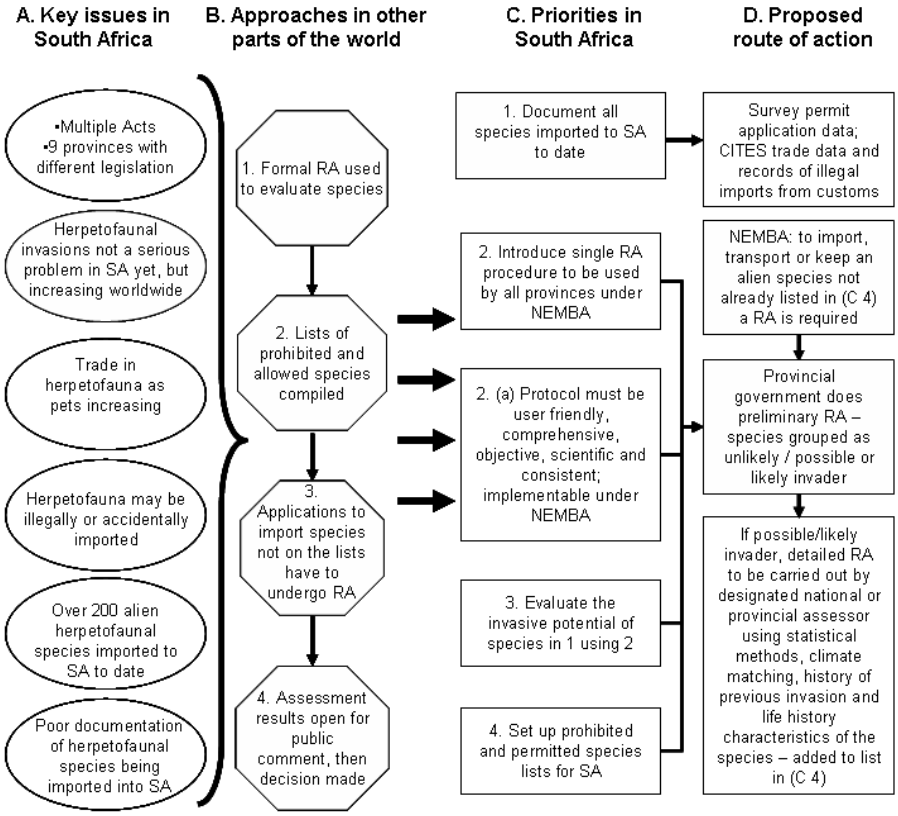

Figure 5. A framework for defining priorities for dealing with alien reptiles and amphibians in South Africa. The figure shows how the identification of key issues facing South Africa (A) and consideration of the situation and advances elsewhere in the world (B) can be used to set priorities (C) and suggest a course of action (D). SA = South Africa; RA = Risk Assessment; NEMBA = National Environmental Management: Biodiversity Act.

Risk assessment for biotechnology: genetically modified canola (oilseed rape)

Of the environmental risks posed by transgenic plants, those associated with the transfer of transgenes have been identified as most significant. Gene flow between crops and wild relatives is well documented, and recently the possible movement of transgenes has resulted in more focus on gene flow from crop plants to wild relatives. Gene flow, from transgenic or non transgenic crops, to wild relatives may have numerous negative effects. For instance, gene flow from crops (non-transgenic) to wild relatives has been associated with the evolution of weediness in seven of the world's 13 most important crops. Transgenic technology however raises further concerns as this technology introduces novel or fitness-related traits into a crop. These same traits may be conferred into many different crops with each of these crops possessing its own specific pathways for outcrossing. Information on the likelihood of introgression of transgenes into wild relatives is generally lacking.

One of the species for which concern has been expressed regarding increased weediness associated with transgenic gene flow is *Brassica napus* (Brassicaceae) or oilseed rape. Oilseed rape is becoming one of the most important sources of oil and protein in the world and was introduced fairly recently to South Africa, with 5 000 ha being planted in 1994. It has since become established as a crop in South Africa with 40 200 ha being planted in the 2005/6 season. In addition, it is possible that in the future the area planted to oilseed rape may be increased as a result of the development of a biofuels strategy in South Africa. Recent policy has indicated

substantial South African Government support for the development of a biofuels industry in South Africa. With a larger area planted to oilseed rape, interest in the use of transgenic technology may increase. Transgenic oilseed rape expressing herbicide resistance already received trial release in 2000 in South Africa.

Oilseed rape has several characteristics that have the potential to increase the likelihood of gene flow. These include the ability of oilseed rape to form feral and volunteer populations as well as its capacity to be a weed in other cultivated crops. Oilseed rape seeds can then remain in the soil seed bank for several years after harvest. Additionally oilseed rape seed and pollen are highly mobile. Oilseed rape has a potentially large capability for pollen dispersal and it has been demonstrated to outcross and hybridize with other local oilseed rape plants as well as wild relatives such as *Brassica rapa* and *Raphanistrum raphanistrum*. Studies elsewhere have reported that several cultivated species, including representatives of the genus *Brassica*, hybridize with sexually compatible wild (non-transgenic) relatives. Although several studies have investigated the probability of gene flow of *Brassica* species with their wild relatives the likelihood and consequences of transgenic gene flow within South Africa have not been considered.

South Africa is home to five naturalised species in the genus *Brassica*, as well as several indigenous and naturalised representatives from closely related genera where the potential for gene flow may exist. A rapid field survey of Brassicaceae species growing along road verges in the fynbos biome, where most cultivated canola is grown in South Africa, was undertaken. Although the systematics of the group remains unresolved and morphology-based identification difficult, approximately 15 species of wild relatives were found, of which at least three species are indigenous. This rapid assessment showed that spatial concordance between canola fields and populations of wild relatives is substantial (Fig. 6), demonstrating that at least one of the barriers to gene flow between canola and its wild relatives, namely spatial contiguity of populations, may be considered ineffectual.

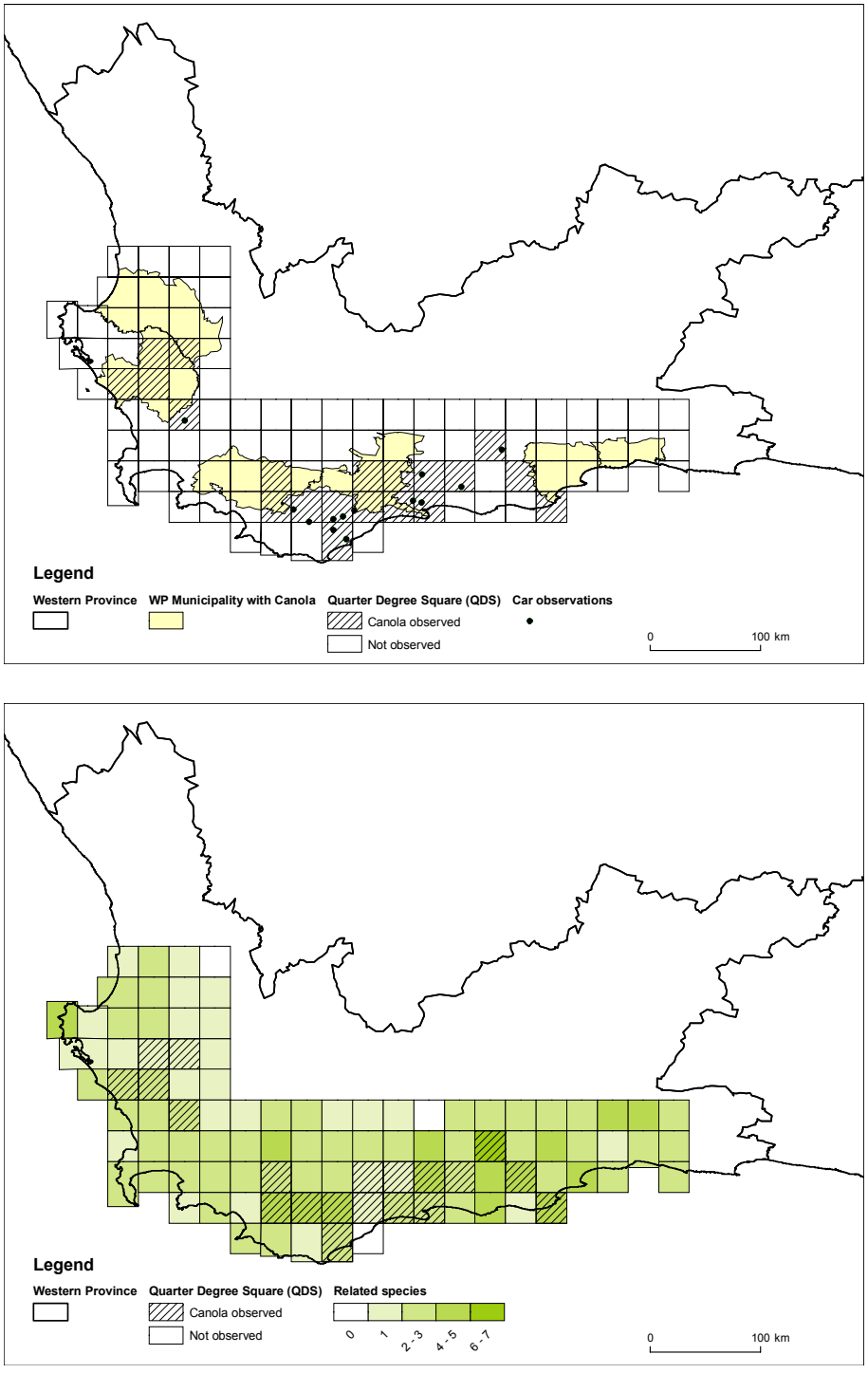

Figure 6. Distribution of canola (*Brassica napus*) in the fynbos biome of South Africa based on agricultural database records and observations made in 2007 (above), and distribution of the species richness of wild relatives of canola (below).

c. Invasive and remediation effects on biodiversity

Restoration of riparian ecosystems

Intact riparian vegetation plays a crucial role in maintaining ecosystem health and services. An important category of impacts on riparian ecosystems is with plant invasions. Transformers, those species that significantly alter indigenous composition, structure and function, are now receiving considerable attention as attempts are made to manage their negative impacts. The WfW programme has been operating under the assumption that its target ecosystems, mostly riparian, would self-repair once the main stressor (dense stands of invasive alien trees) was removed. This assumption has been largely untested until now, and was the focus of a project commissioned by WfW on targets for ecosystem repair in alien-invaded riparian zones of South Africa (2005-2007). This work involved C•I•B core team members and culminated in a Special Issue of *South African Journal of Botany* (completed in late 2007 and to be published in 2008). The special issue, co-edited by C·I·B team members, and collaborators Pat Holmes (City of Cape Town) and Ed Witkowski (University of the Witwatersrand), comprises 15 papers, including detailed syntheses of the research and guidelines for restoration. Preliminary results for the Western Cape were presented at the MEDECOS conference in Perth, Australia.

Results indicate that current alien-clearing practices are only partially meeting the WfW ecosystem repair goals of restoring indigenous riparian vegetation structure, diversity and functioning. Dominant riparian scrub trees are not present in the seed bank, and if eliminated from an area by aliens or injudicious control methods, would have to recruit from outside. The soil seed bank species surviving under dense aliens have the potential to initiate recovery of indigenous pioneer herbaceous and shrub species, and this is sufficient in many cases to stabilize banks and provide suitable habitat for the later re-colonization of non-seed bank closed-scrub species. Comparisons of different clearing treatments indicate that careful felling of aliens and removal of slash from the riparian zone best facilitates this recovery process. However in many cases it is too expensive or impractical to remove slash and managers have the choice of leaving the slash or burning it. Both methods delay recovery, but burning appears to retard recovery more, either via the direct effects of the slash fire killing surviving indigenous species (in the vegetation and seed bank) or via the post-fire follow-up control method which is usually spot herbicide-spraying. Herbaceous alien species readily colonize after this treatment, potentially leading to an alternative stable state that resists progression towards the target community. Restoration protocols for a variety of situations were recommended.

Impacts of silver wattle invasion on beetle diversity

The impact of invasion of silver wattle, *Acacia dealbata*, on assemblages of beetles (Coleoptera) was examined in the grasslands of the Drakensberg region. Data from pitfall trap samples from uninvaded grassland and grassland sites invaded by *A. dealbata* showed that the composition of Coleoptera assemblages differed significantly between invaded and uninvaded grassland habitats. Coleoptera richness and especially abundance values were significantly lower in the invaded stands than in the grassland. Mean body size showed significant differences when compared between the two habitat treatments. The invaded sites exhibited a marked decline in the larger and less abundant species. Moreover, species unique to the grassland were, in general, characterized by larger body sizes compared with those unique to the invaded sites (Fig. 7. Clearly, silver wattle invasion of grasslands has substantial negative impacts on beetle diversity.

d. Roadsides as reserves and bridgeheads

Roadside plant invasions in the nama karoo

Disturbed habitats are often colonized by alien plant species. Human inhabited areas may act as sources from which such aliens disperse, while road verges are thought to be corridors that facilitate their dispersal. It was hypothesized that (i) houses and urban areas are propagule sources from which aliens disperse, and that (ii) road verges act as corridors for their dispersal. Presence and cover of aliens were sampled in 20 plots (6 x 25 m) per road at 5-km intervals for four roads, nested within three localities around towns in the nama karoo biome. Plots consisted of three adjacent nested transects. Houses (n = 3349) within a 5-km radius of plots were mapped. Environmental processes as predictors of alien composition differed across spatial levels. At the broadest scale, road surface type, soil type, and competition from indigenous plants were the strongest predictors of alien composition. Within localities disturbance-related variables such as distance from dwellings and urban areas were associated with alien composition, but their effect differed between localities. Within roads, density (+) and proximity of houses (-) were significantly related to higher alien species richness. Plot distance from urban areas, however, was not a significant predictor of alien richness or cover at any of the spatial levels, refuting the corridor hypothesis. Verges hosted but did not facilitate the spread of alien species. The scale dependence and multiplicity of mechanisms explaining alien plant communities found here highlight the importance of considering regional climatic gradients, landscape context and road verge properties when managing verges.

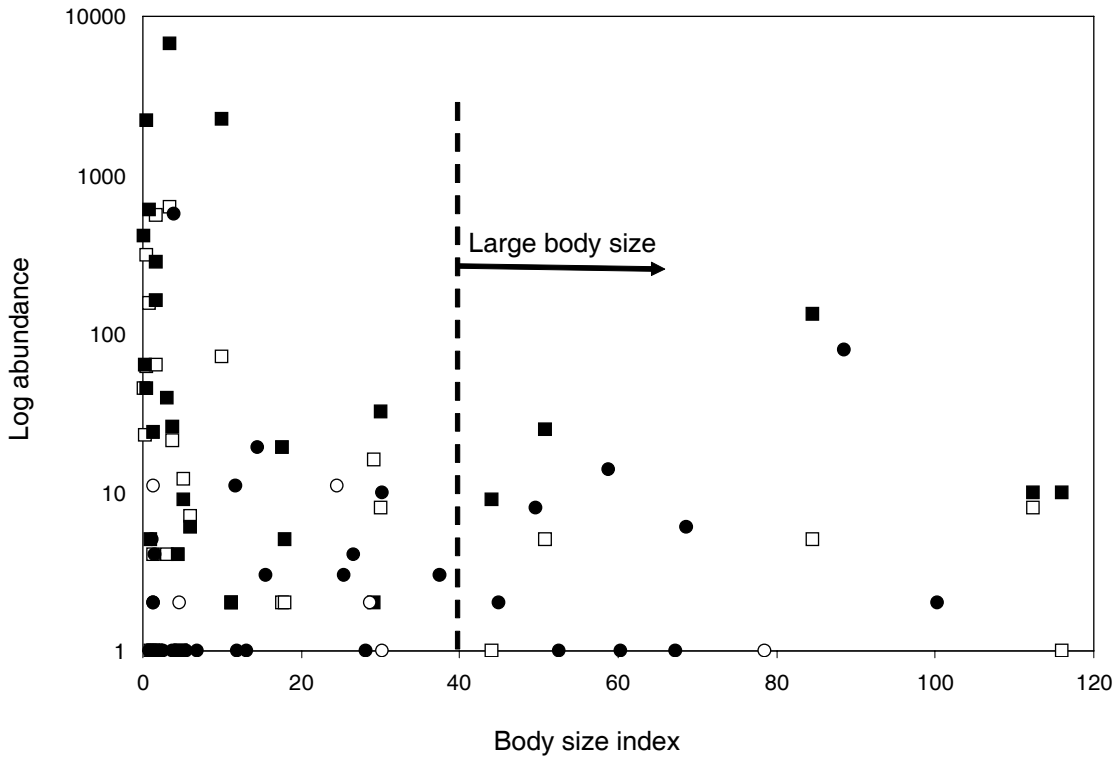

Figure 7. Body size index and abundance relationship for sites invaded by *Acacia dealbata* and uninvaded grassland sites. Differences in shared species indicate difference in abundance between invaded and uninvaded areas. Shared parataxonomic units in *A. dealbata*-invaded sites (□); shared species in uninvaded grassland sites (■); species unique to *A. dealbata*-invaded sites (○); species unique to uninvaded grassland sites (●).

Distribution patterns of invasive plants along a road in the Drakensberg

Permanent vegetation plots were identified during January 2007 to examine the long-term altitudinal distribution of alien plants along the Sani Pass road, to determine the status of invasion by exotics along the Sani Pass in the Cobham area, and to elucidate the potential effect of tarring the Sani Pass road on the distribution of alien plants. The Sani Pass road is located in the grassland biome in the Drakensberg. Results from the 2007 survey suggest that community structure, richness and abundance of alien plants are negatively correlated with altitude. Of the 44 observed exotics, 27 (61 %) were found at higher altitudes than expected and upper altitudinal limits were spatially clustered around potential propagule sources. Spatial clustering of upper altitudinal limits around human inhabited areas suggests that aliens originate from there. The planned tarring of the Sani Pass road is likely to cause an increase in alien species richness and abundance: initially due to construction related soil disturbance and subsequently due to increased traffic, water run-off, and fire frequency.

Fountain grass

The C·I·B-funded research initiative on movers (vectors that disperse seeds in creeps and jumps at different spatial and temporal scales), and shakers (natural and man-made disruptors of established natural vegetation) continued in 2007. Fountain grass is already a serious invader in Hawaii and other parts of the world where it replaces indigenous species and poses a serious fire hazard. The performance of fountain grass in response to competition, habitat characteristics, resources and habitat conditions and the invasion potential of the grass are being experimentally tested in three biomes in South Africa. Over 800 fountain grass seedlings were translocated to the study sites in winter, 2007. Despite a variety of environmental hazards, 64 % of the grass seedlings survived for 5 months at all the sites. At all three sites fountain grass performed well under reduced competition from locally present indigenous species. It performed equally well away from a river and in the dry bed of a river, and particularly well on rocky surfaces. These results have important implications for management of fountain grass where it is invasive. The results confirm the status of this grass as an emerging weed and invader that must be prohibited and controlled in South Africa. The results also contribute significantly to the understanding of basic processes that affect emerging invaders, especially grasses in new environments in South Africa.

e. Spatial concordance in diversity and its temporal change

The mathematics of spatial ecology

Continuing the work on patterns in and relationships between species abundance and occupancy, research was initiated on the species-area relationship and the adequacy of self-similarity as an approach to modelling it. Previous work had shown that the power law form of the species-area relationship may be derived from a bisected, self-similar landscape and a community-level probability rule. This self-similarity model has since been widely applied in modelling species distributions. However, it has also been argued that this self-similarity model generates biologically unrealistic predictions. C·I·B core team members have resolved this debate by demonstrating that the problems with the approach result from an assumption that the probability of occurrence of a species at one scale is independent of its probability of occurrence at the next, termed a 'non-heritage assumption'. By altering this assumption to one in which each species in the community has an occupancy status that is partially inherited across scales (a more biologically realistic, scale-heritage assumption), the predictions of the self-similarity model are neither mathematically inconsistent nor biologically unrealistic. Thus, the self-similarity model remains an important framework for modelling species distributions. Results illustrate the importance of considering patterns of species co-occurrence, and the way in which species occupancy patterns change with scale, when modelling species distributions.

Long-term monitoring of biodiversity and climate change

In the face of escalating change across South African ecosystems, well-studied reference sites, situated along appropriate gradients that will allow detection of changes in ecosystem composition and functioning, are crucial for sustaining research. The C·I·B has invested substantial effort in setting up two transects for this purpose in the Cederberg and Drakensberg.

Recent studies have both predicted and shown that global climate change will have a substantial influence on biodiversity. This is true especially of a global biodiversity hotspot, the Cape Floristic Region (CFR). Although the effects of predicted changes have been widely assessed for plants, little is known about how insect diversity in the region might be affected. In particular, patterns in and the correlates of diversity in the region are poorly understood, and therefore the likely effects of a changing abiotic environment on this significant group of organisms are not clear. Therefore, investigations were initiated on patterns in, and correlates of, epigaeic beetle (Tenebrionidae and Carabidae) diversity in one of the most climate change-sensitive areas in the CFR, the Cederberg, using the C·I·B's long-term transect. In particular, the issues of whether epigaeic beetle assemblage structure differs between the main vegetation types in the Cederberg (strandveld, mountain fynbos and succulent karoo), how restricted these beetles are to specific vegetation types, and which environmental variables might be associated with site-related differences in beetle richness and abundance, were addressed. Sampling was undertaken during October 2002 and 2003 across the altitudinal gradient ranging from sea level (Lambert's Bay) to approximately 2000 m above sea level (Sneeukop, Cederberg) and down again to 500 m above sea level (Wupperthal) using pitfall traps. The environmental correlates of abundance and species density in the epigaeic beetles were similar to those identified previously for ants across the transect, with both taxa being positively related to several temperature variables. Several species showed habitat specificity and fidelity, and clear distinctions existed between the vegetation types across the transect. A larger proportion of the variance in tenebrionid species density was explained by environmental variables and spatial factors than was the case for carabids. The most likely explanation for this difference is that the correlates might well reflect co-linear historical processes, rather than a causal relationship between contemporary environmental variables and species density. If this is the case, it suggests that caution should be exercised when interpreting environmental correlates of species density, and making climate change predictions based on these correlates.

Since 2005, epigaeic ants and spiders have been sampled annually during January (early wet season) and September (late dry season) along the altitudinal gradient in the Drakensberg. The aim of this work is to examine how spatial patterns in arthropod diversity may change along an altitudinal gradient and over time taking changing climatic conditions into account. A total of eight altitudinal bands are sampled with each having a total of forty pitfall traps (four replicates spaces 300 m apart with 10 traps per replicate). Although the taxonomic identification has not yet been completed, a total of 86 ant species in 24 genera has been recorded across the altitudinal gradient. When ant sampling representivity was tested, using three species accumulation curves (ICE, Chao 2, MMMean), the observed values and the accumulation curves join and plateau, suggesting adequate sampling effort across the altitudinal gradient. Comparing the number of individual ants between the wet and dry seasons and across altitude, numbers are higher at lower altitude (900 m to 1500 m) compared with higher altitudes (1800 m to 3000 m), and ant abundance is highest in the wet season at all but two altitude levels. Ant species richness shows a significant monotonic decrease as altitude increases. Although certain groups of animals (Chiroptera) show the same trend across an altitudinal gradient, most recently conducted research on elevation gradients using

invertebrates shows a unimodal relationship between species richness and altitude, with a peak in species richness at intermediate altitudes.

The investment in establishing and surveying the above two transects is likely to yield substantial research dividends in future years.

Dragonflies as indicators

Flying insects such as dragonflies can disperse rapidly and select optimal habitat conditions at appropriate elevations. Such behaviour is likely to be especially important in areas which are subject to major climatic events such as El Niño Southern Oscillation. Accordingly, a C·I·B core team member and collaborators studied dragonflies and environmental variables in a series of reservoirs over an elevation range of 100 – 1350 m a.s.l. at the same latitude on the eastern seaboard of South Africa. The aim was to determine how elevation and climate (as regional processes), as well as local factors, influence species assemblage variability, habitat preference and phenology. Certain environmental variables strongly explained the main variation in species assemblage. These included local factors such as pH, marginal grasses, percentage shade, exposed rock, marginal forest and to a lesser extent, marshes and flow. Different species showed various levels of tolerance to these variables. Elevation and climate as regional processes had very little influence on dragonfly assemblages by comparison with these environmental factors. The odonate species studied are essentially sub-tropical, and are similar to their tropical counterparts in that they have long flight periods with overlapping generations. Yet they also have temperate characteristics in that they over-winter mostly as larvae. Most species are widespread and opportunistic habitat generalists. The National endemics *Pseudagrion citricola* and *Africallagma sapphirinum* only occurred at high elevations. However, the endemic *Agriocnemis falcifera* was found at all elevations, suggesting that regional endemism does not necessarily equate to elevation intolerance. Overall, the results suggest that long periods of high climatic variation have led to a highly vagile and elevation-tolerant dragonfly assemblage which readily occupies new water bodies. Such an assemblage is likely to be highly tolerant of global climate change, so long as there is sufficient water to keep the reservoirs at a constant level. An additional consideration for invasion biology is that it is the common, widespread species which are most tolerant of invasive alien trees, while it is the narrow-range species which are most sensitive. A Dragonfly Biotic Index (DBI) has been developed to measure this and is now available for general use by practitioners. The DBI will be included in the book on *Dragonflies and Damselflies of South Africa* to be published in 2008.

Highlights of short-term work

a. Large scale patterns in biodiversity

Reviewing fire-related research in the Kruger National Park

Fire is an important ecological process that is often responsible for the spread of invasive species. In consequence, it is important to gain an understanding of how South African ecosystems react to different fire regimes. A C·I·B core team member and collaborators reviewed a long-term fire experiment in the Kruger National Park established in 1954 to support fire management. The goals of the recent work were: (1) to assess learning, with a focus on relevance for fire management; (2) to examine how findings influenced changes in fire management; and (3) to reflect on the experiment's future. Results showed that fire treatments affected vegetation structure and biomass more than species composition. Effects on vegetation were most marked in extreme treatments (annual burning, burning in the summer wet season, or long periods of fire exclusion), and were greater in areas of higher rainfall. Faunal communities, and soil physiology, were largely unaffected by fire. Since the inception of the experiment, paradigms in savanna ecology have changed to

encompass heterogeneity and variability. The design of the experiment, reflecting the understanding of the 1950s, did not cater for variability, and as a result, the experiment had little direct influence on changes in management policy. Notwithstanding this, managers accept that basic research influences the understanding of fundamental ecosystem function, and recognize that it promotes appropriate adaptive management by contributing to predictive understanding. This has been a major reason for maintaining the experiment for over 50 years.

b. Interactions between indigenous and invasive species on the Southern Ocean Islands

Species bar-coding – mice

DNA bar-coding provides a useful tool to assign unknown individuals to species and also to enhance discovery of new species. Importantly, this is based on the premise that large-scale screening of one or few reference genes (most noticeably the COI gene) has been completed for reference species. Specifically relating to invasive species and biosecurity, DNA bar-coding allows the identification of invasive / alien species in the absence of any other reliable data to identify them. This is especially true in the absence of alpha taxonomists who can identify these species or where different life stages are obscure. Successful control of invasive species quite often depends on accurate species identification (for example to identify the correct biocontrol agent).

A DNA bar-coding approach was successfully applied by a C·I·B core team member and collaborators to identifying the taxon of house mouse (*Mus musculus*) The house mouse is thought to have been introduced to sub-Antarctic Marion Island by sealers in the early 1800s. It is currently widespread across the island and has a large impact on the indigenous biota. To date, limited genetic studies have been done with contrasting outcomes. Previous workers have proposed that the house mouse on Marion Island was introduced from Denmark (based on the presence of a unique allele found only in Denmark and the Faroe Islands) or from the Alps and Italy in southern Europe (based on evidence of the fusion of two chromosomes into one larger one, a phenomenon known only from this region). Sequences of the mitochondrial control region revealed only two haplotypes, separated by a single site change. More importantly, these haplotypes are shared between the eastern and western side of Marion Island. Comparing the sequences with data available on GenBank provided evidence that house mouse on Marion Island is *Mus musculus domesticus*, closely related to haplotypes characterizing this species from Denmark, Sweden, Finland and northern Germany. Although the Marion Island haplotypes have a Scandinavian origin, they were very similar to haplotypes derived from house mice sampled on Porto Santo (Madeiran Archipelago). Although the history of islands in the Madeiran Archipelago has been closely linked to Portugal, it is thought that northern Europeans must have frequented these islands long before Portuguese settlers first arrived.

c. Determinants of invasions and scenarios of change

Further development and application of a global indicator for biological invasions

A project to test the Global Indicator of Biological Invasions using information on the introduced fauna and flora of Antarctica and the sub-Antarctic islands was initiated in 2007 (in collaboration with researchers from Australia, France and the U.K.). Preliminary results for the sub-Antarctic show that whereas McDonald Island has reached the Invasive Alien Species (IAS) Target (it has no aliens, thus no requirement for species management plans, and all potential introduction pathways are actively managed), Amsterdam and Kerguelen are comparatively furthest from reaching this target (Fig. 8). The objective here was not only to display the sub-Antarctic global IAS indicator results for one temporal snapshot, but in applying it to the data set to identify challenges to the application of the indicator. Some of the insights that became apparent were: (1) that the management status information is generally more difficult and time consuming to access than

information to inform the problem status indicator; (2) nations' perceptions of the degree to which they are addressing alien species risk often differ from any quantitative evidence in support of such risk management; (3) that the data quality differs substantially between localities. This work on a global indicator for biological invasions is gaining increasing attention from bodies responsible for addressing the Convention on Biological Diversity's 2010 goals.

d. Impacts of invasion

Invasive fish, remediation and stream impacts

Although not especially strong in this area, the C·I·B is funding several projects examining the impacts of invasive fish species, and their removal, from rivers in the Eastern Cape and Western Cape. In the former province, research by a C·I·B post-doctoral associate working in collaboration with the South African Institute for Aquatic Biodiversity has demonstrated trophic cascades in river systems that have been invaded. Typically, concerns have been expressed about the impacts of invasive fish on indigenous fish species and on aquatic invertebrates. The current work is demonstrating how a suite of changes takes place in river systems, resulting from indirect effects and trophic cascades. These effects extend from the top predators in the system to primary producers and affect every aspect of the stream system, from food web structure to the distribution of organisms along the river channel. The work is now being extended to determine the effects of simultaneous remediation of stream banks by removal of invasive alien tree species and the removal of non-indigenous fish. Similar trials are underway in the Western Cape.

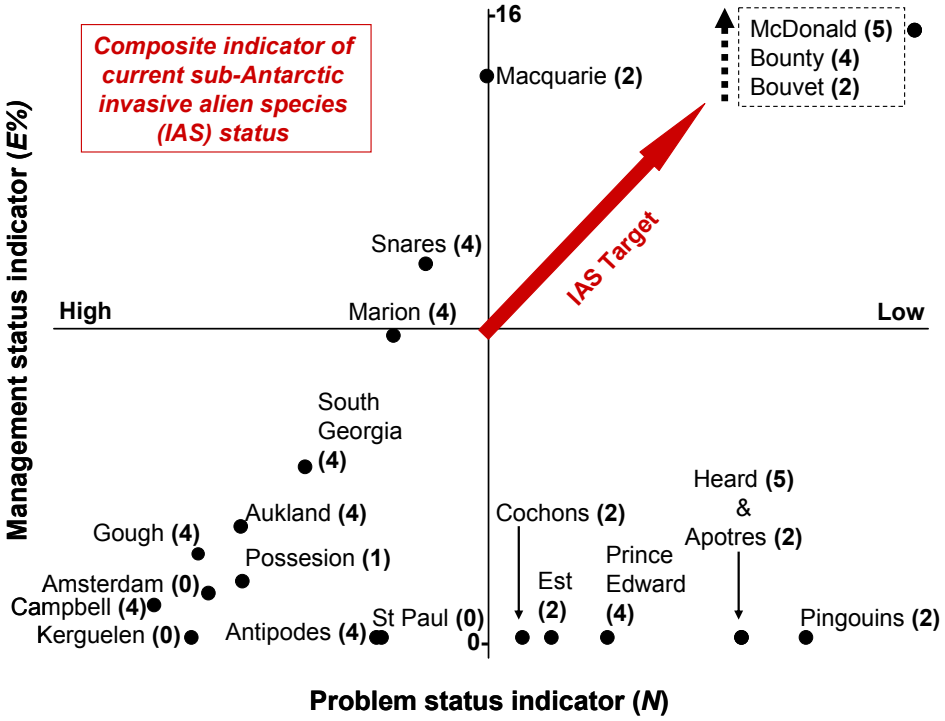

Figure 8. Composite indicator of current sub-Antarctic invasive alien species status. N is the relative number of alien species on each island. E % is the relative number of alien species present for which there are operational management plans. The number in brackets next to each island is the number of potential introduction pathways (air, sea, road, postal and intraboundary translocation) that are covered by operational management plans to prevent further introductions.

e. Ecosystem services and alien invasions

Mapping ecosystem services for conservation planning

Increasing attention is being given to the assessment of the value of services provided by ecosystems. The value of ecosystem services is increasingly being considered as a crucial input to systematic conservation plans. Such baseline assessments are also important for evaluating the potential impact of invasive alien species and other factors that degrade ecosystems and such perspectives are becoming increasingly important for setting priorities for management. A C·I·B core team member and student, together with collaborators from the CSIR and SANBI, undertook a major study to map the production of five ecosystem services in South Africa: ground and surface water, soil formation and retention, and carbon storage. Using concepts borrowed from biogeography the ranges and 'hotspots' of ecosystem services were mapped, and the relationship and spatial congruence between services was examined. The study showed that: (1) most of South Africa's land surface is important for supplying at least one service; (2) low levels of congruence exist between the service ranges and even lower levels between the hotspots for different ecosystem services; (3) primary production appears to show potential as a surrogate for ecosystem service distribution. Further work is needed to examine how different major invasive species currently and potentially affect the provision of these ecosystem services, and how this information can be fed into regional and national management plans.

f. Social perceptions of invasion

Biodiversity, invasive species and livelihoods

Core team members continued to explore ways to collaborate to expand research on the sociological aspects of invasions. They worked on a project which aimed to understand behaviour and attitudes related to conservation of renosterveld. Personal, semi-structured interviews were conducted with landholders in the Overberg region, on topics such as their management and utilisation of Overberg coastal renosterveld (OCR), the depth of their knowledge of its conservation importance, what they perceive its value to be, and extent of their willingness to conserve it. Farmers more willing to conserve were younger, did not necessarily have a better formal education, and owned larger farms (> 500 ha) with a greater amount of remnant renosterveld (> 300 ha), than those less willing to conserve. Attitudes towards OCR were largely negative, due to associated invasive plants and problem animals, and because it is not economically advantageous to retain it. However farmers are of the opinion that provision of incentives and increased extension support will provide practical positive inducements for conservation. Landholder education and extension support is paramount to preventing further transformation of critically endangered habitats.

g. Additional new research fields

The metabolic theory of ecology

Work continued on testing aspects of the Metabolic Theory of Ecology (MTE). The nutrient supply network model of the MTE predicts that metabolic rate scales as $mass^{0.75}$ at all hierarchical levels. An alternative, cell size, model suggests that the scaling of metabolic rate is a by-product of the way in which body size changes, by cell size or number, or some combination thereof. It predicts a scaling exponent of $mass^{0.75}$ at the widest interspecific level, but values of $mass^{0.67-1.0}$ for lower taxonomic groups or within species. These predictions were tested in insects using 391 species for the interspecific analysis, and the size-polymorphic workers of eight ant species at the intraspecific level. In the latter, the contribution of ommatidium size and number to variation in body length, which is closely related to eye size, is used to assess the relative contributions of changes in cell

size and number to variation in body size. Before controlling for phylogeny, metabolic rate scaled interspecifically as mass$^{0.82}$. Following phylogenetic correction, metabolic rate scaled as mass$^{0.75}$. By contrast, the intraspecific scaling exponents varied from 0.67 to 1.0. Moreover, in the species where metabolic rate scaled as mass$^{1.0}$, cell size did not contribute significantly to models of body size variation, only cell number was significant. Where the scaling exponent was < 1.0, cell size played an increasingly important role in accounting for size variation. Data for one of the largest groups of organisms on earth are therefore inconsistent with the nutrient supply network model, but provide support for the cell size alternative.

Problems with the MTE were highlighted by additional work on the effects of acclimation on scorpions. The fundamental equation of the MTE indicates that most of the variation in metabolic rate is a consequence of variation in organismal size and environmental temperature. Although evolution is thought to minimize energy costs of nutrient transport, its effects on metabolic rate via adaptation, acclimatization or acclimation are considered small, and restricted mostly to variation in the scaling constant, b_0. This contrasts strongly with many conclusions of evolutionary physiology and life-history theory, making closer examination of the fundamental equation an important task for evolutionary biologists. The implications for the fundamental equation of metabolic rate variation and its temperature dependence in the scorpion *Uroplectes carinatus* following laboratory acclimation were explored. During 22 days of acclimation at 25°C metabolic rates declined significantly (from 127.4 to 78.2 lW) whereas mean body mass remained constant (367.9–369.1 mg). In field-fresh scorpions, metabolic rate–temperature (MRT) relationships varied substantially within and among individuals, and therefore had low repeatability values and no significant among-individual variation. However, acclimation resulted in a decline in within-individual variation of MRT slopes which subsequently revealed significant differences among individuals and resulted in a fourfold increase in repeatability values. These results highlight the fact that MRT relationships can show substantial, directional variation within individuals over time. A randomization model was used to demonstrate that the reduction in metabolic rate with acclimation while body mass remains constant causes a decline both in the value of the mass-scaling exponent and the coefficient of determination. Furthermore, interspecific comparisons of activation energy, E, demonstrated significant variation in scorpions (0.09–1.14 eV), with a mean value of 0.77 eV, significantly higher than the 0.6–0.7 eV predicted by the fundamental equation. These results add to a growing body of work questioning both the theoretical basis and empirical support for the MTE, and suggest that alternative models of metabolic rate variation incorporating explicit consideration of life history evolution deserve further scrutiny.

Reintroduction biology of carnivores in small reserves

Reintroduction biology is becoming increasingly important. Reintroductions are attempts to return species to parts of their historical ranges, and involve the release of either captive-bred or wild caught individuals. This new field has much to learn from invasion biology (and *vice versa*), since both are concerned with the fate of organisms arriving in new environments, usually with small founder populations. Linkages between these fields are being explored by a C·I·B core team member and collaborators. For lions, the research has shown that it is possible to infuse new genes rapidly and successfully into a small, isolated population. For wild dogs, rates and causes of mortality in eight populations in southern and eastern Africa were examined. The research showed that probabilities of detecting wild dog deaths were influenced by the monitoring methods used. The least biased estimates of mortality causes were obtained through intensive monitoring of radio-collared individuals, although this is impossible for pups. Mortality patterns varied substantially between populations. Rates of human-caused mortality were higher for wild dogs radio-collared outside protected areas than for those collared inside, but rates of natural mortality were comparable, suggesting that anthropogenic mortality is additive to natural mortality. The relative

importance of factors such as snaring and infectious disease also varied regionally. Hence, although the analyses identified no new threats beyond those highlighted in a 1997 range wide Action Plan, they suggest that local plans will be valuable to target conservation activities more precisely.

Prioritization of catchments for alien control – an objective approach

This work, led by a C·I·B core team member, and involving collaborators from the CSIR and SANBI, aimed to expand on previous initiatives that have addressed the prioritisation and management of invasive alien plant species, the prioritization of rivers for the conservation of biodiversity, and broad-scale planning for water resource management. The work combined aspects of these approaches to develop a composite index of prioritization of quaternary catchments for alien plant control purposes. An approach was proposed that will enable managers to prioritise river systems and their catchments for the purposes of invasive alien plant control.

For each quaternary catchment in South Africa, a simple composite index was calculated that combined estimates of: (1) the number of invasive alien plant species present; (2) the potential number of invasive alien plant species that would be present if they occupied the full range as determined by climatic envelope models; (3) the degree of habitat loss in rivers; (4) the degree of water stress. Of the 1911 quaternary catchments in South Africa and Lesotho, just over one third fell in the highest-priority category. 14 % of catchments had the maximum scores. The approach identified priority areas that have not been identified as such, and should provide decision-makers with an objective and transparent method with which to prioritise areas for the control of invasive alien plants.

2. Education and Training

A. Objectives

The C·I·B plans to educate students and provide them with career path opportunities from the undergraduate to the post-doctoral level and beyond.

B. Progress

Forty one students and 11 post-doctoral associates were registered with the C·I·B in 2007. Of the 41 students, 24 are women and 19 black. Four post-doctoral associates are male and one black (from India). Three Hons./4th year students, four M.Sc. students (one with distinction), and one Ph.D. student completed their degrees (marks are not yet finalized in a few cases and graduations typically take place early in 2008). One M.Sc. student upgraded her studies to the Ph.D. level. Of the eight graduates, five are women and three are black. Whilst the year was marked by the completion of the Centre's first Ph.D. student (within the required three years), it was marred slightly by the sudden withdrawal of one student who simply abandoned her project for a better position elsewhere in the organization where she is employed. In all, two Ph.D. students resigned during the year and one post-doctoral associate withdrew without taking up her award. The C·I·B placed several students/post-docs in the marketplace, including at Universities both in South Africa and abroad, in a domestic conservation agency, and in a consultancy firm.

The open bursary programme continued to draw students into the field, with support being given to students at the University of the Western Cape, Nelson Mandela Metropolitan University, University of the Free State, University of the North West, and University of the Witwatersrand. One of these students, Ms. Lukeshni Chetty won the C·I·B travel prize for a Ph.D. student, while the second prize was won by Ms. Natasha Mothapo for her M.Sc.-level poster presentation. The judges (the C·I·B

Board Science Advisors and Prof. Andrew Clarke from the British Antarctic Survey) were relentless in their insistence on quality and clarity. In consequence, that two students from the disadvantaged groups should come out as the winners is a gratifying demonstration that the intense focus on quality by the C·I·B is helping to erase the effects of past inequities.

C·I·B core team members continued to promote the importance of invasion biology as a field of research as part of their normal teaching duties at the Universities by whom they are employed. Moreover, the significance of invasions and the importance of invasion biology both as a field of study and as a contributor to human well-being were also communicated to a range of students, both at C·I·B core institutions, and a range of others during several trips by the Director and Deputy-Director: Operations (see Section 4 below).

3. Information Brokerage

A. Objectives

The objectives are to ensure access to scientific information by peers and students, enhance data availability to all scientists and to ensure long-term continued access, to facilitate communication amongst partners in the field, and to develop an outreach programme demonstrating the significance of biodiversity, and the threats posed to it by invasive species, to all sectors of society.

B. Progress

Scientific communication with peers

In 2007, the C·I·B core team members, post-doctoral associates and students published 87 papers in the primary literature, including in the general, high-impact journals *Nature*, *Science*, and *PNAS*, and in high-impact disciplinary journals such as the *Annual Review of Ecology, Evolution and Systematics*, *Proceedings of the Royal Society of London B*, and *Philosophical Transactions of the Royal Society of London B*. Simply from a numbers perspective this effort represents a doubling in output from the previous year. Centre members also delivered nine keynote/plenary presentations at international symposia and three at national meetings. Thirty presentations were made at international meetings and 26 at National symposia, whilst eight posters were presented internationally and nine nationally. Although these conference activities mean a high profile for the C·I·B, the ratio of published work to conference attendance is skewed. The pre-occupation of South African academics with, especially international, scientific meetings can possibly be explained by a previous lack of access to international science and scientists, and with the tendency of many, welcome, bilateral agreements to promote travel more than any other single activity. As South African science matures, it may be wise to reflect on the fact that the tendency to attend meeting after meeting perhaps now needs to be tempered by judicious selection of appropriate meetings where key inputs can be made, and a greater focus on published work and an improvement in the quality of students being produced.

Scientific communication with students

The C·I·B hosted a successful Annual Research Meeting that provided students with an opportunity to communicate across the Centre's membership and to hold discussions on issues of significance to them. In starting to address the requirements of a new relationship developing with the Working for Water programme, students were also requested to provide their thoughts on how work within the C·I·B could better be integrated to deliver results relevant to policy makers and managers. The involvement of the C·I·B students and post-doctoral associates in the business of the Centre was maintained with the inclusion of a representative as an observer to the Board meeting.

In addition to this formal C·I·B activity, the C·I·B also hosted a Principal Investigator, Post-Doctoral Associate and Student Symposium for the South African National Antarctic Programme. This was the first such symposium in many years and provided students, post-docs and PIs an opportunity to see the full range of science being undertaken. The C·I·B volunteered (by means of a proposal) to undertake organization of the meeting on behalf of the NRF, who also funded it, together with the C·I·B and Stellenbosch University.

Communication with partners

Over the course of the year regular communication was maintained by the C·I·B hub with core team members, and in several instances visits were made to their institutions for discussions with all core team members, post-doctoral associates and students associated with the C·I·B (see Section 4 below).

The C·I·B home-page has continued to serve as a vehicle for communication with a range of partners, as has the open section of the Annual Research Meeting. In the latter case interest by partners in attending the full meeting is increasing. In one case, the C·I·B received exceptionally favourable comments, in this case from Dr. Guy Preston, National Programme Leader of Working for Water. He noted, *inter alia*: '*I was really impressed with the work that is being done, and its vital relevance to informed decision-making for invasive alien species prevention, eradication and control. I was also taken by how articulate the students were in their presentations (especially given that few had English as their home language). The CIB is doing vital work in preparing the next generation of invasive specialists, and addressing transformation imperatives in doing so.*' The C·I·B science advisors, and the guest speaker for the Annual Research Meeting, Prof. Andrew Clarke, from the British Antarctic Survey, were likewise impressed by the quality of the work being produced by the C·I·B.

Communication with partners included formal visits to the Scientific Services unit in the Kruger National Park. In Skukuza the C·I·B team had an opportunity to meet scientific staff and discuss the C·I·B's research projects, many of which involve data collection in national parks and postgraduate study opportunities offered by the Centre.

C·I·B core team members leading the roadsides as reserves and bridgeheads consortium focussed on communication, which was identified as a key priority in the 2006 Darling Workshop on managing road verges. An active e-mail distribution network is maintained, which addresses many pressing issues relating to roadside management and promoted communication between stakeholders on several key issues. A popular article solicited an enthusiastic response and resulted in invitations to speak to the Winelands branch of the Botanical Society (over 40 people attended from a range of stake-holder groups), an invited talk at the 35th Annual Weeds Workshop (June 2007), a workshop in Durban, 'Towards best practice in the management of road, rail and power line reserves' (June 2007), sponsored by WESA-KZN as part of the 'Stop the Spread Campaign', and a talk to the Gouritz Initiative in Oudtshoorn (November 2007) that was attended by about 50 people from NGOs, and government and private conservation and tourism sectors.

Communication with the public

a. limbovane outreach project

Following the confirmation in late 2006 that three new schools would join the limbovane project and following discussions with Western Cape Education Department (WCED) it was determined that the three new schools would be located near to three existing pristine sites within the limbovane

sampling network. Schools that were selected were Swellendam Senior Secondary School (partnered with Bontebok National Park) (Fig. 9), Gerrit du Plessis Secondary School in Riversdale (partnered with Werner Freshe Nature Reserve) and Vusisizwe Secondary School in Worcester (partnered with Worcester Veld Reserve). An additional control site located near Koup Station on National Route 1 (N1 between Laingsburg and Prince Albert Road) was also added to the project.

During the first part of the fieldwork season the Iimbovane team was joined by Mr. Magajana, an education officer from the South African Institute for Aquatic Biodiversity (SAIAB). Although Iimbovane and SAIAB focus on terrestrial and aquatic environments, respectively, there are many overlapping activities, as SAIAB has a very strong outreach component. SAIAB outreach at school level was, at this stage, still in the development phase. Mr. Magajana joined the team to gain a better understanding of how Iimbovane was implemented in the field and had obtained such a high level of buy-in from teachers and the WCED.

Figure 9. Learners from Swellendam Secondary School were able to visit their control site in Bontebok National Park and assisted the Iimbovane team with sampling.

In April the second annual report to the Darwin Initiative was submitted. The comments from the independent review carried out by the Edinburgh Centre for Tropical Forests were received in June. As in 2006, the independent reviewer was impressed with the progress the Iimbovane project had made, concluding the review by stating: *'I think this is an exceptional project: it genuinely involves schools in real monitoring and learning about local biodiversity and the impact of climate change. This project, it seems, is having a real impact on the pupils and teachers involved. Biodiversity is a concept that is not dealt with well in schools anywhere and here the pupils are involved in real scientific work with real meaning in their own local environment. The principle of working with schools on a real piece of research is an important one. The project states that some pupils have returned to help the new year group with their field work. This shows real involvement from the pupils. I am hugely impressed.'*

In June it was decided that by-catch collected through the Iimbovane sampling was not being utilised sufficiently. Dr. Ansie Dippenaar of ARC-Plant Protection Research Institute's South African

National Survey of Arachnida (SANSA) was contacted and it was agreed that samples of spiders and allied invertebrates that are collected by the Iimbovane team will be sent to SANSA for further determination and analysis. Thus the data collected by Iimbovane is being used to broaden the distribution knowledge for a host of other invertebrate groups and increasing our knowledge of South Africa's biodiversity.

Following requests from the Senior Curriculum Planner involved in the Iimbovane project for Curriculum Advisors (CAs) to receive training in the Iimbovane project a second training workshop for the year was hosted in June (Fig. 10). Training provided the CAs involved in the Iimbovane project with enough background knowledge to assist teachers in their implementation of the project. The day was well attended and very successful, with Curriculum Advisors gaining a better understanding of what the project entails and how they could assist their teachers.

Preliminary scientific results from the first year of data were presented by Dr. Braschler at the Society for Conservation Biology conference, hosted in Port Elizabeth from the 1 - 5 July 2007. Over the same week, the outreach component of the project was presented in Durban at the World Environmental Education Conference by Kirsten Mahood.

With continued funding from the Darwin Initiative the Iimbovane project was able to buy additional equipment for all of the schools participating in the project. Each of the new schools received an IBM laptop computer, and all 13 schools involved each received a Leica EZ4D stereomicroscope with a built-in digital camera attachment. The schools received this equipment in August, when schools were visited to hand over data and give lessons to learners on working with biological data. These visits to schools took place later in the year that was originally planned due to teacher strike action during June and July.

Figure 10. Curriculum advisors in the field find out more about how Iimbovane works.

The Iimbovane project was involved in three youth symposia during 2007. On Women's Day in August South African Women in Science and Engineering hosted a day to raise awareness among schoolgirls about careers in Science, Engineering and Technology. At this event the Iimbovane team had a stall displaying all the equipment used in the ant lab as well as a detailed poster based on the Iimbovane team about the different career options open to women in the Natural Sciences. This display was followed by a stall promoting the Iimbovane project at the Cape Town regional finals of the Eskom Expo for Young Scientists. Two groups of learners from Cape Academy (a participating school) presented posters at the Expo. The stall generated a great deal of interest amongst both learners and teachers.

A group of three learners from Cape Academy decided to develop their poster from the Eskom Expo into a presentation for the Youth Environmental Schools Symposium hosted by the City of Cape Town in August. As part of their preparation for this event the learners visited the Iimbovane team to find out more about the science behind the project. At the symposium the presentation was very well received and was one of a few presentations that included scientific results. In September the learners gave the same presentation to a delegation from the British Council visiting the school. Delegates (including Sir David King) were very impressed by the work the learners had done and have sponsored the learners to attend the Science Festival at Grahamstown in 2008.

A new partnership is developing with the Discover Life group at the University of Georgia, United States of America. Together with Discover Life, who run Ant Hunt! in the USA, a project very similar to Iimbovane (www. http://www.discoverlife.org/pa/pr/anthunt.html), the Iimbovane team has submitted a proposal to the Ecological Society of America to host a special session on community-based biodiversity projects at the 2008 meeting, to be hosted in Milwaukee, Wisconsin in August 2008.

The 2007 year ended on a high note for the Iimbovane project with the announcement that the Iimbovane project had been awarded a grant of US $ 27 000 by the May and Stanley Smith Charitable Trust. This funding will go towards the running expenses of the project. A second highlight was the announcement that Kirsten Mahood was awarded the Rector's Award for Excellence in Community Interactions. In terms of promoting the project, a highlight was the inclusion of the Iimbovane project on the television show 'Beyond the Classroom' (SABC 2), which focuses on outcomes-based education techniques that are actively used at schools.

Iimbovane continues to go from strength to strength, with pressure from the WCED to expand the Iimbovane project to all secondary schools in the Western Cape. In light of this a business plan has been developed which sets out a suitable way forward. The business plan will be used to source additional funds for the project from various social investment companies.

b. SAEON open day

The C·I·B was invited to participate in the South African Environmental Observation Network's Science Week events in Phalaborwa held on May 2007 (hosted by Tony Swemmer, coordinator of the SAEON Ndlovu Node). The C·I·B's presentation addressed the Iimbovane outreach project and the importance of invasion biology and science careers for South Africa's development, and was attended by 174 learners from local secondary schools.

c. Media highlights

The full list of media interactions can be viewed in the media section of this report. The paper published by several C·I·B core team members and others in *Proceedings of the Royal Society B*, concerning interactions between invasions and climate change, generated a great deal of broad-

based interest, not only from traditionally environmentally-focused media groups, but also from a number of business-focused newspapers. The paper was reported on in most major newspapers across South Africa, a range of news websites, and one of the authors was interviewed twice on SABC Radio Sonder Grense. C·I·B work on how invasive marine invertebrates are transported to sub-Antarctic islands and Antarctica also generated a great deal of interest, being covered extensively in a wide range of print media.

d. Knowledge Management System

The C·I·B's Information Retrieval and Submission System (IRSS) was tested and commissioned early in 2007 after extensive development by the Stellenbosch University Library and Information Service using an open-source DSPACE platform. During May 2007 the then Database Manager, Mr. Lufuno Vhengani, presented the IRSS to a range of interested parties at the NRF and to core team members and C·I·B students at the University of Pretoria. Feedback from these presentations was incorporated into the final version of the IRSS. The IRSS is now accessible to all core team members, post-doctoral associates, students and staff from the C·I·B's web page, and documents, publications, theses and data sets are stored and maintained in 'libraries' dedicated to particular individuals and projects.

The C·I·B's Sharepoint Document Management System continues to be used for core staff and management communication. In addition, a systematic data backup system is operated by the database manager and all staff.

4. Networking

A. Objectives

The C·I·B will maintain existing partnerships and develop additional relationships with South African and international partners working in the same broad fields. The partnerships will involve research, student and post-doctoral training, and knowledge exchange and will be based on complementarity of skills and core business directions.

B. Progress

Agreements with partner institutions

a. International

During 2007 the C·I·B further developed its relationship with the Center for Advanced Studies in Ecology and Biodiversity (CASEB), at Pontificia Universidad Católica de Chile in Santiago, Chile. As part of an initial seed grant, a delegation from CASEB visited Stellenbosch in June. During the visit initial discussions were held on joint student training initiatives and the Memorandum of Understanding was drafted. Later in the year two separate visits to CASEB were undertaken, one by the C·I·B Director further to discuss the MoU, and one by six C·I·B researchers and staff who visited CASEB to identify areas of potential joint research and to participate in the Third Binational Meeting of the Ecology Society of Chile and the Argentine Ecological Society. The MoU between the C·I·B and CASEB will be signed early in 2008.

Ms. Genya Dana, a Ph.D. student from University of Minnesota, USA is one of the first fellows under a US National Science Foundation Integrated Graduate Education and Research Training (IGERT) grant, through which the University of Minnesota trains graduate students in risk analysis for introduced species and genotypes. The C·I·B is an international partner on the IGERT grant, and Ms. Dana's visit to the C·I·B in 2007 initiated a research partnership between the C·I·B,

University of Minnesota and other institutions in South Africa. Ms. Dana is studying environmental risk analysis, focusing on methodologies for involving stakeholders in the assessment and management of environmental risk.

b. National

Working for Water

The C·I·B's Memorandum of Agreement with the Department of Water Affairs and Forestry's Working for Water Programme was negotiated and concluded during 2007. The memorandum focuses on a five-year programme of research and knowledge transfer on two core projects. 'Using genetic techniques to improve understanding and management of invasive alien plant species in South Africa' aims to understand the genetic aspects of key woody plant invasions across South Africa and Australia with reciprocal research being carried out in the two countries, while 'Documenting the effects of invasion, control and rehabilitation in support of the management of biological invasions in South Africa' aims to understand the impacts of remediation on target and non-target taxa. The Memorandum of Agreement is viewed as a starting point for developing cooperation between the Centre and Working for Water collaboration, and may extend to further new interactions as additional needs and interests are identified jointly.

University of Venda and Walter Sisulu University

As a consequence of the information sharing sessions, the C·I·B is developing two new research collaborations with higher education institutions. First, a new core team member has been identified at Walter Sisulu University. Dr. Augustine Niba is an entomologist and lecturer in the Department of Botany and Zoology. A growing interest in invasion biology and in long term biodiversity monitoring at the Department of Botany and Zoology, University of Venda prompted Mr. Stefan Foord to approach the C·I·B with a proposal to collaborate. The form and level of collaboration between the two institutions is under discussion and is expected to become more active in 2008.

Information sharing sessions

During 2007 the Centre undertook formal information sharing visits to eleven South African higher education institutions. The Centre's Director, Deputy Director: Operations and various members of staff visited the Universities of Fort Hare, Johannesburg, KwaZulu-Natal, Limpopo, Pretoria, Rhodes, Venda, Witwatersrand, Zululand, Nelson Mandela Metropolitan University and Walter Sisulu University. At each university the Centre made contact with staff in the life sciences departments and presented a seminar or informal talk to undergraduate and postgraduate students and staff encompassing the Centre's aims, structure and research interests.

c. Research Associates programme

The Centre for Invasion Biology's research outputs, active collaboration and policy engagement the past three years have led to a significantly increased national and international profile, and an

increase in the number of approaches by local and international researchers to undertake research visits to the Centre or to initiate joint research, student and post-doctoral training initiatives. One of the priorities that has emerged from the Centre's operations and from the national drive for research capacity development is the need to remain in contact with graduates and former post-doctoral associates of the Centre and to maintain relationships with these individuals, some of whom now occupy influential positions in partner organisations. Although mechanisms are already in place to facilitate continuous contact with alumni, several young researchers who are currently collaborating with Core Team Members have approached Centre management with requests to explore the ways in which they could be formally associated with the Centre.

In 2007 the Centre planned and began implementing a Research Associates programme that will allow the Centre to develop its relationships with local and international researchers by providing forms of support that are valuable but cost effective. Research Associates from historically disadvantaged institutions will benefit from informal discussion groups, workshops held by the Centre, and an opportunity to obtain research advice. The Research Associates Programme will provide additional expertise, skills and knowledge on which the Core Team Members, post-doctoral associates and students can draw. The programme will also provide stability for medium-term (i.e. regular) relationships between the Centre and researchers who are working collaboratively with Core Team Members and staff. The Centre will require research products derived from the programme to be attributed or co-attributed to the Centre. It will also require active collaboration and engagement with more than one Core Team Member.

Academic visitors to C·I·B

Ms. Michelle Aitken, Monash University, School of Geographical and Environmental Science *Collaborator on the political ecology of* Acacia *transfers* (van Wilgen).

Prof. John Avise, Ecology and Evolutionary Biology, School of Biological Sciences, University of California, Davis, USA. *Discussions on advances in phylogeography (*Richardson).

Prof. Janne Bengtsson, Department of Ecology, Swedish Agricultural University, Sweden. *Collaborator on a large bilateral (SA-Sweden) project on soil diversity and human impacts thereon in the fynbos (*Chown).

Dr. Alan Crowden, Publishing Consultant and Editor of the Bulletin of the British Ecological Society. *Discussions on science publishing (*Richardson).

Prof. David Currie, Biology Department of the University of Ottawa, Canada. *Prof. Currie spent a six-month sabbatical at the C·I·B from January to July 2007 (*Richardson).

Ms. Genya Dana, Ph.D. student from University of Minnesota, USA. *Discussions on environmental risk analysis, focusing on methodologies for involving stakeholders in the assessment and management of environmental risk (*McGeoch).

Prof. Kevin Gaston, BIOME Group, Department of Animal and Plant Sciences, University of Sheffield. *Co-PI of Darwin Initiative limbovane project and collaborator on macroecological work (*Chown).

Mr. Oscar Godoy, Ph.D. student, University of Madrid / Centro de Ciencias Medioambientales, Spain. *Three-month visit to work on a comparative analysis of flowering phenology of invasive alien plants in mediterranean-climate regions (*Richardson).

Dr. Angelika Hilbeck, Institute of Integrative Biology, Swiss Federal Institute of Technology, Zurich. *Dr. Hilbeck visited the C·I·B and presented a seminar titled: 'The science of risk assessment for genetically modified organisms: models and lacewings'. (*McGeoch).

Prof. Fabian Jaksic and colleagues, Center for Advanced Studies in Ecology and Biodiversity, Pontificia Universidad Católica de Chile in Santiago, Chile. *Development of a MoU with the Centre for Invasion Biology (*Chown, Richardson, Davies).

Prof. Hans Petter Leinaas, Department of Biology, University of Oslo, Norway. *Collaborator on a large bilateral (SA-Norway) project on springtail diversity in the fynbos, sub-Antarctic and Arctic (*Chown).

Dr. Ara Monadjem, Department of Biological Sciences, University of Swaziland. *Collaborator on small mammal research on invasive alien* Rattus *species (*Chimimba).

Dr. Kate Parr, Research fellow in African ecology, Centre for the Environment, Oxford University, UK. *Collaborator on projects related to faunal responses, especially invertebrates, to fire in African savannas. Dr. Parr is also involved with identifying ants collected in the Sani Pass, Drakensberg (*van Rensburg).

Mr. Marc Rius, Ph.D. student from University of Barcelona. *Collaborator on project to survey alien invasive and other ascidian fauna of harbours along the South African coast (*Griffiths).

Dr. Frank Schurr, Plant Ecology and Nature Conservation, University of Potsdam, Maulbeerallee 3, 14469 Potsdam, Germany. *Collaborator on Allee effects in proteas resulting from habitat fragmentation* (Esler).

Dr. Cheryl Swift, Department of Biology, Whittier College, Whittier, CA 90608 USA. *Collaborator on a project relating to water relations in riparian trees (*Esler).

Prof. Lorne Wolfe, Georgia southern University. *Discussions on plant-pollinator interactions and Prof. Wolfe presented a seminar on the role of escape from enemies in the invasion of European* Silene *plants in North America (*Johnson) and *two-day visit to discuss advances in plant invasion ecology (*Richardson).

Ms. Claudia Zetlmeisl, Ph.D. student from Dansk Skaldyrcenter. *Collaborator on European green crab (*Carcinus maenas*) parasite loads in introduced populations (*Griffiths).

Prof. Peter McEvoy, Department of Botany and Plant Pathology, Oregon State University, USA. *Discussions on plant-animal interactions and advances in plant invasion ecology (*Richardson).

Mr. Peter Gardiner, Mondi International. *Collaborator on development of a co-operative programme on development of ecological networks as a mitigation measure for commercial forestry (*Samways).

Academic visits to other institutions

Australian Centre of Excellence for Risk Analysis, University of Melbourne, Australia. *Collaboration on developments in risk analysis with Prof. Mark A. Burgman* (Richardson).

Brunei University, Brunei. *Initiation of co-operative project on the Heart of Borneo Transfrontier Park* (Samways).

Center for Advanced Studies in Ecology and Biodiversity (CASEB), Pontificia Universidad Católica de Chile. *CIB delegation to participate in the Third Binational Meeting of the Ecology Society of Chile and the Argentine Ecological Society and to initiate research collaborations with CASEB* (Chimimba, Davies, Esler, Richardson, van Rensburg, Clusella Trullas (post-doctoral associate)).

Center for Advanced Studies in Ecology and Biodiversity, Pontificia Universidad Católica de Chile. *Development of MoU with the Centre for Invasion Biology* (Chown).

CSIRO Entomology, Canberra, Australia. *Discussion of prospects for CSIRO-CIB collaboration in research with Drs. Mark Lonsdale and Andrew Sheppard* (Richardson).

Department of Biological Sciences, Macquarie University, Australia. *Discussions on comparative plant ecology with Dr. Michelle Leishman* (Richardson).

Department of Biology, University of Oslo, Norway. *Work on a large bilateral (SA-Norway) project on springtail diversity in the fynbos, sub-Antarctic and Arctic* (Chown).

Department of Ecology, Swedish Agricultural University, Sweden. *Collaborator on a large bilateral (SA-Sweden) project on soil diversity and human impacts thereon in the fynbos* (Chown).

Department of Zoology, Oxford University, UK. *Discussions on the contributions and legacy of Charles Elton in the field of invasion ecology with Lord May (Prof. Robert M. May)* (Richardson).

Department of Zoology and Department of Statistical Sciences, University of Cape Town. *Collaboration with Prof. Cliff Moran (Zoology) and Prof. Theo Stewart (Statistical Sciences) on multicriteria decision analysis for release of biological control agents* (van Wilgen).

Duke University, North Carolina. *Collaboration with Prof. Lynne Maguire on decision theory analysis regarding release of biological control agents* (van Wilgen).

Oxford University, *Development of European Union RUBICODE Project* (Samways).

School of Geography, Oxford University, UK. *Discussions on conservation biogeography and links with invasion ecology with Robert J. Whittaker* (Richardson).

University of Adelaide, Australia. *Discussions on molecular methods in plant invasion ecology and establishment on long term collaboration with Prof. Andrew Lowe* (Richardson).

Travel awards to Core Team Members

Prof. Melodie McGeoch received the University of New England Distinguished Visitors Award to visit Dr. Nigel Andrew, School of Environmental Sciences and Natural Resource Management, University of New England, Australia during October 2007. Collaboration on invasive species and climate change impacts on biodiversity.

Prof. Sue Milton received the Ecological Society of American lifetime honorary membership award and presented a talk at the ESA annual conference in San Jose, California in August 2007. She visited Jasper Ridge experimental station to see climate change experiments involving field manipulation of heat, moisture and nitrogen in *Bromus*-invaded Mediterranean landscape and visited Dr. Jayne Belnap (USGS) to view similar experiments in a cold desert ecosystem and see the effects of biological control of *Tamarisk ramossissima*. This was followed by a three-day visit to Dr. Sandy Tartowski (NMSU) to see *Prosopis* and *Larrea* control trials at Jornada Experimental ranch, and a week-long visit to the central plateau of Mexico with Prof. R.I. Yeaton provided insight into the effects of African *Eragrostis* dominance on rangelands in this area.

Research collaborations

Acclimation effects in stochastic environments. Collaborator: Dr. Jesper Sørensen, Aarhus Centre for Environmental Stress Research, Ecology and Genetics, Department of Biological Sciences, University of Aarhus (Chown).

Alien invasive *Rattus* species in South Africa. Collaborators: Dr. Amanda Bastos, Department of Zoology and Entomology, University of Pretoria; Dr. Peter Taylor, Durban Natural Science Museum; Dr. Frikkie Kirsten and Dr. Emil von Maltitz, Plant Protection Research Institute, Agricultural Research Council; Dr. Steve Belmain, Natural Resources Institute, Kent, UK (Chimimba).

Apis mellifera capensis honeybees as a continuous threat to *A.m. scutellata* honeybees – potential prevention of the spread of invasive Cape honeybee workers. Collaborator: Mr. Mike Allsopp, Plant Protection Research Institute, Agricultural Research Council (Wossler).

Best practice for maintenance of road verges for road safely, biodiversity conservation and prevention of the spread of invasive alien plants. Collaborators: National Roads Agency; National

Department of Public Works, conservation agencies, private landowners, provincial government (Milton, Esler).

Biodiversity value and conservation importance of ecological transition zones. Collaborator: Dr. Salit Kark, The Biodiversity Research Group, Dept. of Evolution, Systematics and Ecology, The Hebrew University of Jerusalem, Israel (van Rensburg).

BTB/buffalo/helminth interactions in Hluhluwe-iMfolozi Park. Collaborators: Anna Jolles, Oregon State University; Vanessa Ezenwa, Princeton University; Sue van Rensburg, Ezemvelo KZN Wildlife (Somers).

Carnivore Reintroduction Biology in Hluhluwe-iMfolozi Park. Collaborators: Micaela Szykman, Humboldt State University; Dave Wildt and Steve Monfort, Smithsonian Institute; Ant Maddock, Joint Nature Conservation Committee, UK; Harriet Davies, Endangered Wildlife Trust; Rob Slotow, University of KwaZulu-Natal (Somers).

Cape honeybee invasions, the honeybee hybrid zone and why *A.m. capensis* has not expanded its range. Collaborator: Prof. Madeleine Beekman, School of Biological Sciences, University of Sydney; Prof. Ben Oldroyd, School of Biological Sciences, University of Sydney (Wossler).

Chromolaena odorata and biodiversity in Hluhluwe-iMfolozi Park. Collaborators: Dr. Ansie Dippenaar-Schoeman, Agricultural Research Council; Sue van Rensburg, Ezemvelo KZN Wildlife; Alan Anderson, CSIRO, Australia (Somers).

Comparative phylogeography of introduced and invasive species on Marion Island. Collaborators: Dr. Peter Convey, British Antarctic Survey; Dr. Mark Stevens, Allan Wilson Centre, New Zealand (van Vuuren).

Comparative phylogeography of invasive alien plants in Australia and South Africa. Collaborator: Prof. Andrew Lowe, Plant Conservation Biology at the University of Adelaide and Head of Science, State Herbarium and Biological Survey, Department for Environment and Heritage (Richardson).

Comparison of plant species in their native and invaded ranges: A leaf carbon approach. Collaborator: Dr. Michelle Leishman, Department of Biological Sciences, Macquarie University, Australia (Richardson).

Discontinuous gas exchange in insects. Collaborator: Dr. Craig White, School of Integrative Biology, University of Queensland (Chown).

Diversity and distribution of insect herbivores associated with *Acacia* species in South Africa and Australia. Collaborator: Dr. Nigel Andrew, School of Environmental Sciences and Natural Resource Management, University of New England, Australia (McGeoch).

Ecology of invasive alien plants in South African National Parks. Collaborator: Dr. Llewellyn C. Foxcroft, Savanna Ecolosystems Research Unit, South African National Parks (Richardson).

Effects of invasion by flammable grass *Pennisetum setaceum* on an inflammable succulent Karoo ecosystem. Collaborator: Dr. Phoebe Barnard, SANBI (Milton, Esler).

Effects of ungulates on spider diversity in Hluhluwe-iMfolozi Park, 2005-2007 – Collaborators: William Bond, University of Cape Town; Ansie Dippenaar-Schoeman, Agricultural Research Council; Sue van Rensburg, Ezemvelo KZN Wildlife; Alan Anderson, CSIRO Australia (Somers).

Environmental physiology of insects and other groups. Collaborator: Prof. Francisco Bozinovic, Center for Advanced Studies in Biodiversity and Ecology and Department of Ecology, Pontificia Universidad Católica de Chile, Santiago (Chown).

Impact of climate change on the South African Important Bird Areas network, 2007. Collaborator: Dr. Wilfried Thuiller, Laboratoire d'Ecologie Alpine, UMR CNRS 5553, Université J. Fourier, BP 53, 38041 Grenoble Cedex 9, France (van Rensburg).

Impacts of introduced freshwater fishes on threatened fish species in the Cape Floristic Region. Collaborator: Prof. Paul Skelton, SAIAB, Grahamstown; Prof. Jenny Day. Freshwater Research Unit, UCT; Mr. Dean Impson, CapeNature (Griffiths).

Impacts of invasive alien species on biodiversity in South Africa. Collaborator: Dr. Mark Robertson, Department of Zoology and Entomology, University of Pretoria, Pretoria (van Rensburg).

Impacts of *Opuntia stricta* on invertebrate assemblages in the Kruger National Park, 2005 – 2007. Collaborator: Dr. Llewellyn C. Foxcroft, South African National Parks, Savanna Ecolosystems Research Unit, South African National Parks (van Rensburg).

Invasion biology and the Argentine ant. Collaborators: Prof. Andrew Suarez from the University of Illinois, USA; Prof. Neil Tsutsui from the University of California, Berkeley, USA (van Vuuren, Wossler).

Macroecology and macrophysiology for a changing world. Collaborator: Prof. Kevin J. Gaston, BIOME Group, Department of Animal and Plant Sciences, University of Sheffield (Chown).

Parasite communities on alien freshwater fish species and their potential spread to, and impacts on, indigenous fish. Collaborator: Dr. Kevin Christison, Department of Biodiversity and Conservation Biology, UWC (Griffiths).

Risk assessment protocols in invasive species management: Collaborator: Prof. Mark A. Burgman, Australian Centre of Excellence for Risk Analysis, University of Melbourne, Australia (Richardson).

Scientific Working Group on the Ecological Risk of Genetically Modified Organisms in South Africa. Collaborators: Prof. Johnnie van den Berg, School of Environmental Sciences and Development, North West University; Prof. Chris Viljoen, Department of Plant Sciences, University of the Free State (McGeoch).

Soil biodiversity in the fynbos: patterns and processes. Collaborator: Prof. Janne Bengtsson, Department of Ecology, Swedish Agricultural University (Chown).

Soil faunal responses to changing, variable environments: a bi-polar approach linking individuals to ecosystems. Collaborator: Prof. Hans Petter Leinaas, Department of Biology, University of Oslo, Norway (Chown).

Targets for Ecosystem Repair in Riparian Ecosystems in Fynbos, Grassland and Savanna Biomes. Collaborators: Department of Water Affairs and Forestry, Working for Water, Universities of Cape Town, Stellenbosch, Rhodes and Witwatersrand (Esler).

5. Service rendering

A. Objectives

The C·I·B plans to become known as *the* centre for obtaining reliable, credible scientific information on a wide range of biodiversity and biological invasion issues at a national level, or as the point of contact for reaching those who have much of this information.

B. Progress

National panels and committees

Advisory Committee to South African Minister of Agriculture and Land Affairs on Genetically Modified Organisms: member (McGeoch).
BIOTA SA: Liaison Committee: member (Esler).
Cape Action for People and the Environment Alien Species Task Team: member (Richardson).
Centre of Excellence at the Percy FitzPatrick Institute of Ornithology, University of Cape Town: Advisory Board member (Chimimba).
Fynbos Forum Committee: Member (Esler).

Helderberg Nature Reserve Advisory Board: Member (Wossler).
Higher Education Resource Systems: Advisory Board member (Esler).
IUCN South African Wild Dog Advisory Group: Member (Somers).
MARE Institute, UCT: Board member (Griffiths).
National Committee for the Scientific Committee for Antarctic Research: Member (Chimimba).
National Environmental Advisory Forum, Department of Environmental Affairs and Tourism: Alternate member (McGeoch).
National Environmental Management: Biodiversity Act (10 of 2004), Second Task Team for development of regulations for alien species: Member (Chown).
National Science and Technology Forum and the Scientific, Engineering and Technological Societies and Allied Professions Group of South Africa (SETAG): Member (van Rensburg).
Paarl Mountain Advisory Board: Member (Esler).
Reference Group for the WfW Project: Monitoring and Evaluation: Member (Esler).
South African Association of Botanists: Council president (Esler).
South African Association of Women in Science and Engineering: Western Cape Branch committee member and treasurer (Esler).
South African Data Centre For Oceanography: Board member (Griffiths).
South African National Survey of Arachnida: Steering Committee member (Chimimba).
Transvaal Museum: Advisory Board member (Chimimba).
Working for Water Research Advisory Panel: Member (van Wilgen).
Zoological Society of South Africa: Council member and holder of the Aardvark newsletter portfolio (van Vuuren).
Zoological Society of Southern Africa: Council member and holder of the biodiversity portfolio (van Rensburg).

International panels and committees

Africa Regional Implementation Committee, Census of Marine Life Programme: Chair (Griffiths).
International Association for Biological Oceanography: Executive Member and South African National Representative (Griffiths).
International Society for Mediterranean Ecology: Executive Committee member (Esler)
IUCN Species Survival Commission and Species Programme's Freshwater Biodiversity Assessment Work Team for mapping of Dragonflies in southern Africa: Member (Samways).
IUCN Species Survival Commission Invertebrate Conservation Sub-Committee: Chair (Samways).
IUCN Species Survival Commission Steering Committee: Member (Samways).
IUCN Species Survival Commission Re-introduction Specialist Group: Member (Somers).
IUCN Species Survival Specialist Groups: Conifers: Member (Richardson).
IUCN Species Survival Specialist Groups: Invasive Organisms: Member (Richardson).
IUCN Species Survival Specialist Groups: Otter Specialist Group: Member and African Coordinator (Somers).
IUCN Species Survival Specialist Groups: Pig, Peccary and Hippo Specialist Group: Member (Somers).
IUCN Species Survival Specialist Groups: Southern African Plants: Member (Richardson).
Orthopterists' Society: Board member (Samways).
IUCN/SSC Chairs Meeting to be held in Abu Dubai in February 2008: Programme Advisor (Samways).
Scientific Committee for Antarctic Research, Antarctic Treaty System Standing Committee: Chief Officer (Chown).

Editorial and refereeing activities

a. Editor

African Zoology, Co-editor (Griffiths)
Diversity and Distributions, Editor-in-Chief (Richardson)
Journal of Biogeography, Editor (McGeoch)
PLoS One, Academic Editors (Chown, Somers)
South African Journal of Botany, Guest editors on Riparian Repair Special Issue (Esler, Richardson)
South African Journal of Wildlife Research, Editor-in-Chief (Somers).

b. Associate Editor

American Naturalist (Chown)
Biological Invasions (Richardson)
International Journal of Wildland Fire (van Wilgen)
Journal of Applied Ecology (Milton)
Journal of Arid Environments (Milton)
Journal of Insect Conservation (Samways)
Journal of Mammalogy (Chimimba)
Journal of Orthoptera Research (Samways)
Marine Biology (Griffiths).

c. Editorial Boards

African Natural History. Editorial board member (Griffiths)
Antarctic Science. Editorial board member (Chown)
Biodiversity and Conservation. Assigning editor (Samways)
BMC Ecology. Editorial board member (Chown)
Cambridge University Press Book Series: Conservation Biology. Editorial board member (Richardson)
Cambridge University Press book series: Ecology, Biodiversity, and Conservation. Editorial board member (Richardson)
Conservation Biology. Assigning editor (Samways)
Encyclopedia of the Antarctic. Editorial advisor (Chown)
Environmental Management. Editorial board member (Richardson)
Koedoe. Editorial board member (Griffiths)
Navorsinge van die Nasionale Museum, Bloemfontein, South Africa. Consulting editor (Chimimba)
Odonatologica. Editorial board member (Samways)
Smithiana. Editorial board member (Griffiths).

Reviewing

a. International journals

Acta Zoologica Sinica; African Journal of Ecology; Agriculture, Ecosystems & Environment; American Journal of Botany.; American Naturalist; Animal Conservation; Annals of Botany; Aquatic Botany; Austral Ecology; Australian Ecology; Basic & Applied Ecology; Behavioral Ecology; Biodiversity & Conservation; Biological Conservation; Biological Control; Biological Invasions; Biology Letters; Conservation Biology; Diversity & Distributions; Ecography; Ecological Applications; Ecology; Ecology Letters; Evolution; Evolution & Systematics; Evolutionary Ecology Research; Forest Ecology & Management; Global Ecology & Biogeography; Hydrobiologia; ICES Journal of Marine Science; International Journal of Odonatology; International Journal of Wildland

Fire; Journal of Animal Ecology; Journal of Applied Ecology; Journal of Arid Environments; Journal of Biogeography; Journal of Environmental Management; Journal of Experimental Biology; Journal of Insect Conservation; Journal of Insect Physiology; Journal of Vegetation Science; Journal of Zoology; Landscape Ecology; Mammalia; Marine Biology; Molecular Ecology; New Phytologist; Oecologia; Oikos; Perspectives in Plant Ecology; Physiological & Biochemical Zoology; Plant Ecology; Plant Protection Quarterly; Preslia; Proceedings of the National Academy of Sciences of the USA; Proceedings of the Royal Society of London B; Science; Rangeland Ecology & Management; Revista Chilena de Historia Natural; The International Journal of Biodiversity Science & Management; Trends in Ecology & Evolution; Tropical and Subtropical Ecosystems; Weed Research.

b. National journals

African Entomology; African Journal of Range and Forage Science; African Natural History; African Zoology; Annals of the Transvaal Museum; Durban Museum Novitates; Koedoe; South African Journal of Botany; South African Journal of Science; South African Journal of Wildlife Research; Water SA.

c. Grant reviews for external bodies

Australian Centres of Excellence in Science and Innovation Program, Office of Science, Technology and Innovation, Western Australian Department for Industry and Resources. Expert review of proposal for new Centre of Excellence (Richardson).

British Ecological Society Overseas Bursary Panel (Chown).

Critical Ecosystem Partnership Fund (Milton).

Leverhulme Trust (Chown).

National Science Foundation, USA (Milton).

South Africa-Netherlands Research Programme on Alternatives in Development (Esler).

Vlaamse Interuniversitaire Raad/University Development Corporation, Belgium (Chimimba).

Worldwide Fund for Nature (Milton).

d. Appointment reviews and committees

Bartholomew Award, USA: referee for applicant (Chown).

Charles University, Prague: professorial appointment (Richardson).

Killam Prize, Canada: referee for applicant (Chown).

University of Limpopo (MEDUNSA Campus): associate professorial appointment (Chimimba).

University of Vermont: professorial appointment (Richardson).

e. Conferences/workshops organized

International

10th International African Small Mammal Symposium, Abomey-Calavi, Benin, August 2007. Member of scientific committee (Chimimba).

5th Western Indian Ocean Marine Science Symposium Durban, October 2007. Co-organiser and Chair of special session on Census of Marine Life (Griffiths).

First regional Southern African International Association of Impact Assessment conference, Somerset West, November 2007. Organiser of agricultural theme (Milton).

Pine invasions in South America – patterns, trends and prospects, Bariloche, Argentina, May 2007. Co-organizer and chair (Richardson).

9th International Conference on the Ecology and Management of Alien Plant Invasions (EMAPI9), Perth, Australia, September 2007. Member of international organizing committee (Richardson).

IUCN/SSC Invertebrate Conservation sub-committee meeting, Malaga, Spain, October 2007. Organizer and chair (Samways).

21st Annual Meeting of the Society for Conservation Biology, Port Elizabeth, South Africa, July 2007. Co-organizer and co-chair of symposium entitled 'Reintroduction of top-order predators – using science to improve conservation management' (Somers).

National

South African National Antarctic Programme Principal Investigator, Post-doctoral Associate and Student Symposium, Stellenbosch, South Africa, October 2007. Event hosted by the C·I·B. Convenor and organizer (Chown).

Workshop to determine individual contributions and guidelines on structure and content that laid the foundation for the collaboration in publishing the book, Fynbos: Ecology and Management, eds Esler, Pierce, de Villiers, February 2007. Convenor (Esler).

Arid Zone Ecology Forum 'Drought as a Driver', Sutherland, September 2007. Member of programme committee (Milton).

1st Student Symposium of the South African Environmental Observation Networks Graduate Student Network, Cape Town, September 2007. Member of organising committee (Mr. Bernard Coetzee, M.Sc. student of van Rensburg).

33rd Meeting of the Zoological Society of Southern Africa, Potchefstroom, July 2007.Co-organiser of phylogeography workshop (van Vuuren).

Current status of phylogeography research in South Africa. NRF-sponsored workshop held in Grahamstown, South Africa, June 2007. Co-organizer (van Vuuren).

Consultancy products

Chown, S.L (Ed.). (2007). *Current status of the Ross Seal (*Ommatophoca rossii*): A Specially Protected Species Under Annex II.* Information Paper prepared for SCAR for submission to the XXX Antarctic Treaty Consultative Meeting, New Delhi, 5 pp.

Chown, S.L. & de Beer, J.H. (2007). *Commissioned Background Report. 2007 Review. South African National Antarctic Programme*. Report prepared under contract to the Department of Environmental Affairs and Tourism and the National Research Foundation, 100 pp.

Chown, S.L. & Lee, J.E. (2007). *Hull fouling as a source of marine invasions in the Antarctic*. Information Paper prepared for SCAR for submission to the XXX Antarctic Treaty Consultative Meeting, New Delhi, 2 pp.

Chown, S.L., Froneman, P.W. & McQuaid, C. (2007). Response to IUCN query regarding World Heritage Nomination of the Prince Edward Islands, on behalf of South African National Department of Environmental Affairs & Tourism, 4 pp.

Van Wilgen, B.W. and Moran, V.C. (2007) Integrated management of invasive alien plants in South Africa: A case for biological control. The Working for Water Programme, Department of Water Affairs and Forestry, Cape Town, 27 pp.

6. Gender impact of research

The C·I·B continues to focus on the development of women in science in several ways. Overall, the staff complement is dominated by women, as is the student complement. Increasing numbers of women fill the post-doctoral ranks too. The large majority of recent graduates are women, and the Iimbovane outreach project serves as an important role model to young women learners because all of its very capable staff are women. Karen Esler continues to be an active participant in two women's organizations, South African Women in Science and Engineering (SAWISE) and Higher Education Resource Systems South Africa (HERS-SA), both of which provide important networking opportunities for women in academia. The Deputy Director: Operations participated in a HERS-SA course, funded by Stellenbosch University, and aimed at further development of women in managerial leadership roles.

Human resources

1. Core Team Members

Name	Citizenship	Institution	Gender	Race	% time spent working in CoE
Prof. Steven L. Chown (Director)	South Africa	SU	M	W	100
Prof. Dave M. Richardson (Deputy Director)	South Africa	SU	M	W	100
Ms. Sarah J. Davies (Deputy Director)	South Africa	SU	F	W	100
Prof. Christian T. Chimimba	South Africa	UP	M	B	10
Dr. Savel R. Daniels	South Africa	SU	M	B	5
Prof. Karen J. Esler	South Africa	SU	F	W	10
Prof. Charles L. Griffiths	South Africa	UCT	M	W	20
Prof. Steven D. Johnson	South Africa	UKZN	M	W	10
Prof. Melodie A. McGeoch	South Africa	SU	F	W	20
Prof. Sue J. Milton *	South Africa	SU/UCT	F	W	10
Dr. Heidi E. Prozesky	South Africa	SU	F	W	10
Dr. Victor R. Rambau	South Africa	SU	M	B	5
Prof. Michael J. Samways	South Africa	SU	M	W	10
Dr. Michael J. Somers	South Africa	UP	M	W	10
Dr. Berndt Janse van Rensburg	South Africa	UP	M	W	20
Dr. Bettine Jansen van Vuuren	South Africa	SU	F	W	10
Dr. Brian W. van Wilgen	South Africa	CSIR	M	W	5
Dr. Theresa C. Wossler	South Africa	SU	F	W	10

* Prof. Milton resigned from the Core Team effective end 2007.

2. Post-doctoral Associates

Name	Citizenship	Institution	Gender	Race	Percentage time spent working in CoE
Dr. Susana Clusella Trullas	Spain	SU	F	W	100 %
Dr. Mirijam Gaertner	Germany	SU	F	W	100 %
Dr. Cang Hui	China	SU	M	W	100 %
Dr. Jesse Kalwij	Netherlands	SU	M	W	50 %
Dr. Steven Lowe	UK	SAIAB	M	W	100 %
Dr. Nuria Roura Pascual	Spain	SU	F	W	75 %
Dr. Gyan Sharma	India	SU	M	B	40 %
Dr. Justine Shaw	Australia	SU	F	W	25 %
Dr. John Terblanche	SA	SU	M	W	100 %
Dr. John Wilson	UK	SU	M	W	100 %

Name	Citizenship	Institution	Gender	Race	Percentage time spent working in CoE
Dr. Mark van Kleunen	Netherlands	UKZN	M	W	40 %

3. Students

Name	Surname	Citizenship	Institution	Gender	Race	Level	Status
Stephan	Herb	SA	SU	M	W	Hons./4th yr.	Completed
Rolanda	Julius	SA	UP	F	B	Hons./4th yr.	Completed
Mohlamatsane	Mokhatla	SA	UP	M	B	Hons./4th yr.	Completed
Sabelo	Nkosi	SA	UKZN	M	B	Hons./4th yr.	Continuing
Bernard	Coetzee	SA	UP	M	W	M.Sc.	Continuing
Lihle	Dumalisile	SA	UP	F	B	M.Sc.	Completed
Kyle	Harris	SA	UP	M	W	M.Sc.	Continuing
Tanya	Haupt	SA	UCT	F	B	M.Sc.	Continuing
Sanet	Hugo	SA	UP	F	W	M.Sc.	Continuing
Keafon	Jumbam	SA	SU	F	B	M.Sc.	Completed
Monique	Maseng	SA	UWC	F	B	M.Sc.	Continuing
Nomvuyiso	Matokazi	SA	UP	F	B	M.Sc.	Continuing
Phemelo	Mogodi	SA	UNW	M	B	M.Sc.	Continuing
Elmarie	Mostert	SA	UP	F	W	M.Sc.	Continuing
Palesa	Mothapo	SA	SU	F	B	M.Sc.	Continuing
Sarah	Muhl	SA	SU	F	W	M.Sc.	Continuing
Kanyisa	Nyafu	SA	NMMU	F	B	M.Sc.	Continuing
Ethel	Phiri	SA	SU	F	B	M.Sc.	Continuing
Dylan	Prentice	SA	UP	M	W	M.Sc.	Continuing
Charlene	Scheepers (née Janion)	SA	SU	F	W	M.Sc.	Continuing
Colin	Schoeman	SA	SU	M	W	M.Sc.	Completed
Nicola	van Wilgen	SA	SU	F	W	M.Sc.	Continuing
Shelley	Vosse *	SA	SU	F	W	M.Sc.	Completed
René	Wolmarans	SA	UP	F	W	M.Sc.	Continuing
Emile	Bredenhand	SA	SU	M	W	Ph.D.	Continuing
Lukeshni	Chetty	SA	UFS	F	B	Ph.D.	Continuing
Benis	Egoh	SA	SU	F	B	Ph.D.	Continuing
Thomas	Lado	Sudan	SU	M	B	Ph.D.	Continuing
Jennifer	Lee #	UK	US	F	W	Ph.D.	Continuing
Kate	Lorentz	SA	Wits	F	W	Ph.D.	Continuing
Rembuluwani	Magoba	SA	SU	M	B	Ph.D.	Continuing
Elrike	Marias	SA	SU	F	W	Ph.D.	Completed
Sean	Marr	SA	UCT	M	W	Ph.D.	Continuing
Greg	McClelland	Canada	SU	M	W	Ph.D.	Continuing
Donald	Midoko Iponga	Gabon	SU	M	B	Ph.D.	Continuing
Fatima	Parker-Allie	SA	SU	F	B	Ph.D.	Resigned
Sebataolo	Rahlao	Lesotho	SU	M	B	Ph.D.	Continuing
James	Rhodes	SA	SU	M	W	Ph.D.	Resigned
James	Rodger	SA	UKZN	M	W	Ph.D.	Continuing
Dian	Spear	UK	SU	F	W	Ph.D.	Continuing
Anne	Treasure	SA	SU	F	W	Ph.D.	Continuing

* Degree awarded *cum laude*; # Upgraded from masters

4. Collaborators

See Section 4: Networking.

5. Administrative Staff

Surname	Position	Based at	Gender	Race
Kirsten Mahood	Outreach Manager	SU	F	W
Lufuno Vhengani #	Database Manager	SU	M	B
Suzaan Kritzinger-Klopper	Senior Technical Officer	SU	F	W
Erika Nortje	Technical Officer	SU	F	W
Mathilda van der Vyver ##	Administrative Officer	SU	F	W
Patricia Josias **	Administrative Officer	SU		
Anel Garthwaite	Personal Assistant to the Director	SU	F	W
Natasha Kruger	Iimbovane Technical Officer	SU	F	B
Mawethu Nyakatya *	Research Management Intern	SU	M	B
Thembile Khoza *	Technical Officer: Long term monitoring sites	SU	F	B
Leonie Joubert	Contract Administrative Assistant	SU	F	W
Josephine de Mink	Administrative Assistant: Blackwell Publishing	SU	F	W
Charlene Scheepers (née Janion) *	Contract Technical Officer	SU	F	w

* Appointed effective 1 Dec. 07; ** Appointed; resigned; # Resigned effective 31 Aug. 07; ## Appointed effective 1 Feb. 07.

6. Resources placed in the market

Name	Level at which supported	Supervisor	Organisation
Michelle Greve	M.Sc.	Prof. S.L. Chown	Department of Zoology, University of Zululand
Shelley Vosse	M.Sc.	Prof. K.J. Esler	Genesis Analytics, Cape Town
Lihle Dumalisile	M.Sc.	Prof. M.J. Somers	Gauteng Nature Conservation
John Terblanche	Post-Doctoral Associate	Prof. S.L. Chown	Department of Conservation Ecology and Entomology, Stellenbosch University
Mark van Kleunen	Post-Doctoral Associate	Prof. S.D. Johnson	Institute of Plant Sciences, University of Bern, Switzerland

Outputs

Books / Chapters in books

Holmes, P.M., Richardson, D.M. and Marais, C. (2007) Costs and benefits of restoring natural capital following alien plant invasions in fynbos ecosystems in South Africa. In: *Restoring natural capital: Science, business and practise*. Aronson, J., Milton, S. J. and Blignaut, J. N. (eds.) Island Press, Washington DC, pp. 188-197.

McGeoch, M.A. (2007) Insects and bioindication: theory and progress. In: *Insect Conservation Biology*. Stewart, A. J. A., New, T. R. and Lewis, O. T. (eds.) CABI Publishing, Oxfordshire, pp. 144-174.

Pysek, P. and Richardson, D.M. (2007) Traits associated with invasiveness in alien plants: Where do we stand? In: *Biological Invasions*. Nentwig, W. (ed.) Springer, Berlin, pp. 97-125.

Richardson, D.M. (2007) Preface – All you ever wanted to know about hogweed, but were afraid to ask! In: *Ecology and management of giant hogweed (Heracleum mantegazzianum)*. Pyšek, P., Cock, M. J. W., Nentwig, W. and Ravn, H. P. (eds.) CABI Publishing, Wallingford, UK, pp. xv-xvii.

Samways, M.J. (2007) Implementing Ecological Networks for Conserving Insect and other Biodiversity. In: *Insect Conservation Biology*. Stewart, A. J. A., New, T. R. and Lewis, O. T. (eds.) CABI Publishing, Wallingford, UK, pp. 127-143.

Thuiller, W., Richardson, D.M. and Midgley, G.F. (2007) Will climate change promote alien plant invasions? In: *Biological Invasions*. Nentwig, W. (ed.) Springer, Berlin, pp. 197-211.

Articles in peer-reviewed journals

Boonzaaier, C., McGeoch, M.A. and Parr, C.L. (2007) Fine-scale temporal and spatial dynamics of epigaeic ants in Fynbos: sampling implications. *African Entomology* **15**, 1-11.

Botes, A., McGeoch, M.A. and Chown, S L. (2007) Ground-dwelling beetle assemblages in the northern Cape Floristic Region: Patterns, correlates and implications. *Austral Ecology* **32**, 210-224.

Chown, S.L. and Convey, P. (2007) Spatial and temporal variabilities across life's hierarchies in the terrestrial Antarctic. *Philosophical Transactions of the Royal Society B* **362**, 2307-2331.

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Theron, N., Esler, K., Dreyer, L., Jansen van Vuuren, B. and Rambau, V. (2007) Genetic and morphological comparisons of a potentially invasive weed (*Argemone ochroleuca*) from it's natural (Mexico) and invaded (South Africa) habitat. In: Abstract. South African Association of Botanists – Annual meeting 2006. *South African Journal of Botany* **73**, pp. 338-339.

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Vosse, S., Esler, K.J., Richardson, D.M. and Holmes, P.M. (2007) Effect of alien plant invasion on riparian seed bank assembly rules. In: Abstract. South African Association of Botanists – Annual meeting 2006. *South African Journal of Botany* **73**, p. 320.

Wilson, J.R., Richardson, D.M., Rouget, M., Procheş, Ş., Amis, M. A., Henderson, L. and Thuiller, W. (2007) Residence time and potential range: Crucial considerations in modelling plant invasions. In: Abstract. *South African Journal of Botany* **73**, p. 322.

Products / Artifacts / Patents

See Section 5, Consulting and other services rendered.

Conferences / meetings attended

Invited, plenary and keynote presentations

a. International

Chown, S.L. Evolutionary physiology of thermal responses: challenges in linking molecular mechanisms to population dynamics. *Invited address at the first workshop of the European Science Foundation Scientific Programme 'Thermal adaptation in ectotherms: Linking life history, physiology and behaviour', Barcelona, Spain, March 2007.*

Chown, S.L. Linking molecular mechanisms to population dynamics: challenges for evolutionary physiologists*. Plenary Address at the 7th International Congress of Comparative Physiology and Biochemistry, Salvador, Brazil, August 2007.*

Chown, S.L. Hemispheric asymmetry in diversity: polar perspectives on a changing world. *Opening Presentation at the NIOO Current Themes in Ecology Meeting: Polar Biodiversity, Past, Present and Future, Wageningen, Netherlands, November 2007*.

Milton, S.J. Introduction to the agricultural theme of the IAIA annual conference. *International Association of Impact Assessors, Somerset West 5-7 November 2007.*

Richardson, D.M. Plant invasion ecology - recent advances and changing priorities. *Annual conference of the Swedish Oikos Society, Stockholm, Sweden, February 2007*.

Richardson, D.M. Biological invasions in mediterranean-climate ecosystems – key challenges. *Medecos (International Conference on Mediterranean-type Ecosystems), Perth, Australia, September 2007*.

Richardson, D.M. Mutualisms - key drivers of invasions…. key casualties of invasions. *9th International Conference on the Ecology and Management of Alien Plant Invasions (EMAPI9), Perth, Australia, September 2007*.

Samways, M.J., Hitchins, P. and Bourquin, O. Restoration of Paradise: Cousine Island, Seychelles. Plenary address at *The Biodiversity Crisis on Tropical Islands, Brunei, July 2007.*

Samways, M.J. Conserving the small and uncharismatic. One of a series of plenary addresses at the *Trade-offs in Conservation Symposium, Zoological Society of London, November 2007.*

b. National

Esler, K.J. On the verge: managing road servitudes as conservation assets or liabilities. *Invited talk at the 35th Annual weeds workshop, Natalia, KZN, 3 – 8 June 2007.*

Samways, M.J., Addison, M., Addison, P. and Pringle, K. Towards insecticide-free fruit. *Symposium on Insecticide-free fruit, Stellenbosch, September 2007.*

Oral presentations

a. International

Abdel-Rahman, E.H., Bloomer, P. and Chimimba, C.T. Phenotypic evolution of veld rat sibling species *Aethomys chrysophlius* and *A. ineptus* (Rodentia: muridae) from southern Africa. *10th International African Small Mammal Symposium. Abomey-Calavi, Benin, August 2007.*

Braschler, B., Kruger, N., Mahood, K., Gaston, K.J. and Chown, S.L. Ant diversity patterns in the Cape Floristic Region. *21st Annual Meeting of the Society for Conservation Biology, Port Elizabeth, South Africa, July 2007.*

Clusella Trullas, S., Davies, S.J., Chimimba, C.T., Esler, K.J., Richardson, D.M., van Rensburg, B.J. and Chown, S.L. Objetivos principales y resultados de las investigaciones del Centro de Biología de Invasiones, Sudáfrica. *Third Binational Meeting of the Ecology Society of Chile and the Argentine Ecological Society, La Serena, Chile, September 2007.*

Coetzee, B.W.T., van Rensburg, B.J., Robertson, M.P. and Erasmus, B.F.N. Current and future threats to the South African Important Bird Areas Network. *21st Annual meeting of the Society for Conservation Biology, Port Elizabeth, South Africa, July 2007.*

Esler, K.J. Interrogating gradients from sub-continental to site-specific scales: have southern African studies yielded answers to global change challenges? Symposium 8: The Vegetation of African Plant Habitats. *XVIIIth AETFAT Congress, Yaonde, Cameroon, 26 Feburary - 2 March, 2007.*

Esler, K.J. and Milton, S.J. Scientists, managers and mandates: communicating to improve conservation along road, rail, river and powerline servitudes. *21st Annual meeting of the Society for Conservation Biology, Port Elizabeth, South Africa, July 2007.*

Esler, K.J. and Milton, S.J. The movers and the shakers: Invasive alien plant dispersal interactions with disturbances in arid environments. *Proceedings of the International Conference on Mediterranean Ecosystems, Perth, Western Australia, September 2007.*

Foxcroft, L.C., Rouget, M. and Richardson, D.M. Risk assessment of riparian alien plant invasion into protected areas. *21st Annual Meeting of the Society for Conservation Biology, Port Elizabeth, South Africa, July 2007.*

Foxcroft, L.C., Richardson, D.M., Rouget, M. and MacFadyen, S. Patterns of alien plant invasion in Kruger National Park, South Africa: perspectives from multiple spatial scales. *9th International Conference on the Ecology and Management of Alien Plant Invasions (EMAPI9), Perth, Australia, September 2007.*

Griffiths, C.L. and Robinson, T.B. Patterns and impacts of marine bioinvasions in South Africa. *Fifth International Conference on Marine Bioinvasions, Boston, May 2007.*

Holmes, P and Esler, K.J. Restoration protocols for fynbos riparian vegetation following alien plant invasion. *Proceedings of the International Conference on Mediterranean Ecosystems, Perth, Western Australia, September 2007.*

Hugo, S. and van Rensburg, B.J. Species richness and human density: explanations for a positive spatial correlation. *21st Annual Meeting of the Society for Conservation Biology, Port Elizabeth, South Africa, July 2007.*

Hugo, S. and van Rensburg, B.J. Species richness and human density: explanations for a positive spatial correlation. *British Ecological Society Annual Meeting, University of Glasgow, Glasgow, UK, September 2007.*

Jansen van Vuuren, B., Mortimer, E., Daniels, S.R., Lee, J. and Chown, S.L. Comparative phylogeography of invertebrate taxa on the sub-Antarctic Marion Island. *Evolution 2007, Christchurch, New Zealand, July 2007.*

Jansen van Vuuren, B., Mortimer, E., Stevens, M.I., Marshall, D.J., Convey, P., Daniels, S.R. and Chown, S.L. Molecular data can help to unveil biogeographic complexities since the Miocene: lessons from ameronothroid mites and isotomid springtails. *10th Internation Symposium on Antarctic Earth Sciences, Santa Barbara, USA, August 2007.*

Lee, J.E. and Chown, S.L. Crossing boundaries: alien species in the Antarctic. *21st Annual Meeting of the Society for Conservation Biology, Port Elizabeth, South Africa, July 2007.*

Mahood, K., Braschler, B., Kruger, N., Gaston, K.J. and Chown, S.L. Iimbovane: Exploring South African Biodiversity and Change outreach project. *IV World Environmental Education Congress, Durban, South Africa, July 2007.*

Mahood, K., Kruger, N., Braschler, B.M., Gaston, K.J. and Chown, S.L. Iimbovane: It's about the learners. *Fynbos Forum Meeting, Langebaan, August 2007*.

Marais, E. and Chown, S.L. Survival of subzero temperatures as a metabolic strategy: a test of the metabolic control hypothesis. *7th International Congress of Comparative Physiology and Biochemistry, Salvador, Brazil, August 2007.*

McGeoch, M.A. A global indicator for biological invasions. *Ad hoc meeting of Invasive Alien Species data provider and user groups to develop the 2010 indicator: IUCN Species Survival Commission. Imperial College, Silwood Park, 22-23 January 2007.*

McGeoch, M.A. Biotic Impacts of Climate Change: the future of Marion Island. *Seminar presented to school of environmental sciences & natural resource management, University of New England, Australia, 30 October 2007.*

Rius, M., Griffiths, C.L. and Turon, X. Introduced ascidians along the coast of South Africa: water temperature as a predictor of their geographical distribution. *International Invasive Ascidian Conference Canada, October 2007.*

Samways, M.J. Development of Ecological Networks. Presentation to Mondi Board, Addlestone, UK, November 2007.

Somers, M. and Gusset, M. Carnivore social behaviour and its role in reintroduction programmes. *21st Annual Meeting of the Society for Conservation Biology, Port Elizabeth, South Africa, July 2007.*

Spear, D. and Chown, S.L. Taxonomic homogenisation in ungulates at global and local scales. *21st Annual Meeting of the Society for Conservation Biology, Port Elizabeth, South Africa, July 2007.*

Swift, C., Esler, K.J., Jacobs, S. and Schlegal, J. Comparative water relations of riparian species in South African and southern California. *Proceedings of the International Conference on Mediterranean Ecosystems, Perth, Western Australia, September 2007.*

Van Rensburg, B.J., Levin, N. and Kark, S. Are areas of ecological transition important for biodiversity conservation? *21st Annual Meeting of the Society for Conservation Biology, Port Elizabeth, South Africa, July 2007.*

Wilson, J.R.U. and Richardson, D.M. Explaining and predicting the range of introduced plants: perspectives from South Africa. *Invited oral presentation at Annual conference of the Ecological Society of America, San Jose, California, USA, August 2007.*

Wilson, J.R.U. Insect loads on Australasian and South African plants in South Africa: should we expect natural enemy release when comparing areas that have been separated for a long time? *Medecos (International Conference on Mediterranean-type Ecosystems), Perth, Australia, September 2007.*

Wilson, J.R.U. Phylogenetic patterns in South African plant invasions. *9th International Conference on the Ecology and Management of Alien Plant Invasions (EMAPI9), Perth, Australia, September 2007.*

b. National

Coetzee, B.W.T., van Rensburg, B.J., Robertson, M.P. and Erasmus, B.F.N. Current and future threats to the South African Important Bird Areas Network. *South African National Biodiversity Institute's Biodiversity Planning forum, Pilansberg National Park, South Africa. February 2007.*

Dalerum, F., Somers, M.J., Cameron, E.Z. and Kunkel, K. An assessment of large carnivores as surrogate species for biodiversity conservation in southern Africa. *33rd Conference of the Zoological Society of Southern Africa, University of the North West, July 2007.*

Dumalisile, L. and Somers, M.J. The changing effects of invasive alien plant encroachment over time – small mammals in South African are affected by *Chromolaena odorata*. *Hluhluwe-iMfolozi Park Management Feedback Meeting. Hluhluwe-iMfolozi Park. March 2007.*

Esler, K.J. and Milton, S.J. The movers and the shakers: Invasive alien plant dispersal interactions with disturbances. *Annual Conference of the South African Association of Botanists. University of Cape Town, January 2007.*

Esler, K.J., Milton, S.J and Jacobs S.M. Rebuilding a culture of curiosity, passion, descriptive natural history and hypothesis testing in young South African professionals. *1st Annual Conference on Teaching and Learning. Protea Hotel, Stellenbosch, 22-23 May, 2007.*

Foxcroft, L.C. and Richardson, D.M. Ornamental plants as invasive aliens: problems and solutions in the Kruger National Park, South Africa. *Annual Conference of the South African Association of Botanists, University of Cape Town, January 2007.*

Foxcroft, L.C. and Richardson, D.M. Patterns of alien plant invasion in the Kruger National Park, South Africa: perspectives from multiple spatial scales. *Combined symposium of the South African Weed Science Society and South African Weeds Biological Control Group, Natalia, KwaZulu-Natal, June 2007.*

Graf, J.A., Somers, M.J., Szykman, M.J. and Slotow, R. Density and distributions of spotted hyaenas in Hluhluwe-iMfolozi Park, South Africa. *Hluhluwe-iMfolozi Park Management Feedback Meeting. Hluhluwe-iMfolozi Park. March 2007.*

Harris, K.R., van Rensburg, B.J., Robertson, M.P., and Coetzee, J.A. Assessing local scale impacts of Opuntia stricta (Cactaceae) invasion on arthropod assemblages in the Kruger National Park, South Africa. *Kruger National Park 5th Annual Science Networking Meeting, Skukuza, Kruger National Park, South, Africa, April 2007.*

Harris, K.R., van Rensburg, B.J., Robertson, M.P., and Coetzee, J.A. Assessing local scale impacts of Opuntia stricta (Cactaceae) invasion on arthropod assemblages in the Kruger National Park, South Africa. *1st Student Symposium South African Environmental Observation Network (SAEON) Graduate Student Network, Cape Town, South Africa, September 2007.*

Janion, C., Chown, S.L. and Leinaas, H.P. The effect of temperature on the egg development of Collembola from Marion Island: a comparison between indigenous and invasive species. *Conference of the Zoological Society of Southern Africa, University of the North West, Potchefstroom, July 2007.*

Jansen van Vuuren, B., Mortimer, E., Daniels, S.R., Lee, J. and Chown, S.L. Comparative phylogeography of invertebrate taxa on the sub-Antarctic Marion Island. *33rd Congress of the Zoological Society of Southern Africa, University of the North-West, July 2007.*

Jumbam, K., Jackson, S. and Chown S.L. Critical thermal limits and their responses to acclimation in Argentine ants (*Linepithema humile*). *Conference of the Zoological Society of Southern Africa, University of the North West, Potchefstroom, July 2007.*

Kalwij, J.M., Milton, S.J. and McGeoch, M.A. Road verges: corridors for plant invasion – a spatial hierarchical approach. Annual Conference of the South African Association of Botanists, University of Cape Town, January 2007. *South African Journal of Botany* **73**, 293-294.

Marais, E., Irlich, U.M. and Chown, S.L. Survival of subzero temperatures as a metabolic strategy: a test of the metabolic control hypothesis. *Conference of the Zoological Society of Southern Africa, University of the North West, Potchefstroom, July 2007.*

Matokazi, N.J., Jolles, A.E., Ezenwa, V.O. and Somers, M.J. Effects of bovine tuberculosis on African buffalo (Syncerus caffer) activity budgets. *Hluhluwe-iMfolozi Park Management Feedback Meeting. Hluhluwe-iMfolozi Park. March 2007.*

Matokazi, N.J., Jolles, A.E., Ezenwa, V.O. and Somers, M.J. Effects of bovine tuberculosis and gastro-intestinal parasite infections on African buffalo (*Syncerus caffer*) activity budgets**.** *5th Kruger National Park Science Networking Meeting. Skukuza. April 2007.*

McGeoch, M.A. Plenary Lecture: Long Term Ecological Research in the sub-Antarctic: South Africa's Prince Edward Islands. *SAEON Graduate Student Network Symposium, University of Cape Town, Cape Town, 11-13 September 2007.*

McGeoch, M.A., Kalwij, J. and Rhodes, J. Supporting ecological risk assessment for transgenics with information on the composition and distribution of biodiversity. *Environmental Programme Meeting: Biosafety Cooperation between South Africa and Norway, Pretoria, November 2007.*

Mgobozi, M. and Somers, M.J. Spider responses to alien plant invasions: the effect of short- and long-term *Chromolaena odorata* invasion and alien clearing. *Hluhluwe-iMfolozi Park Management Feedback Meeting. Hluhluwe-iMfolozi Park. March 2007.*

Rambau, R.V., Maree, S. and Taylor, S. Comparative cytogenetics of phenotypically-similar species of laminated toothed rats, genus *Otomys*. *33rd Conference of the Zoological Society of Southern Africa, University of the North-West, July 2007.*

Spiering, P., Szykman, M.J. and Somers. M.J. The short- and long-term effects of reintroductions for the KZN wild dog population: Hormones and genetics. *Hluhluwe-iMfolozi Park Management Feedback Meeting. Hluhluwe-iMfolozi Park. March 2007.*

Swift, C.C., Jacobs, S.M., Esler, K.J. and Crous, C. Water relations of selected fynbos riparian species. *Annual Conference of the South African Association of Botanists. Cape Town, South Africa, January 2007.*

Veldtman, R., Chown, S.L. and McGeoch, M.A. Can national occupancy patterns predict landscape-level invasion risk of an invasive species? Annual Conference of the South African Association of Botanists, University of Cape Town, January 2007. *South African Journal of Botany* **73**, 319.

Vosse, S., Esler, K.J., Richardson, D.M. and Holmes, P.M. Effect of alien plant invasion on riparian seed bank assembly rules. *Annual Conference of the South African Association of Botanists. University of Cape Town, January 2007.*

Wilson, J.R.U. Long term monitoring and biological control programs. *South African National Weeds Workshop, Durban, South Africa, June 2007.*

Wilson, J.R.U., Richardson, D.M., Rouget, M., Procheş, Ş., Amis, M.A., Henderson, L. and Thuiller, W. Residence time and potential range: crucial considerations in modelling plant invasions. *Annual Conference of the South African Association of Botanists, University of Cape Town, January 2007.*

Wolmarans, R., Robertson, M.P. and van Rensburg, B.J. Predicting the potential ranges of alien plant invaders using distribution records from the native and adventive range. 35th Annual Weeds Workshop, KwaZulu-Natal, South Africa, June 2007.

Zietsman, J., Dreyer, L.L. and Esler, K.J. An assessment of the reproductive biology and ecology of selected rare and endangered *Oxalis* species. *Annual Conference of the South African Association of Botanists. University of Cape Town, January 2007.*

Poster presentations

a. International

Coetzee, B.W.T., van Rensburg, B.J., Robertson, M.P. and Erasmus, B.F.N. Birds, humans and Important Bird Areas (IBAs) in South Africa. *7th Student Conference in Conservation Science, University of Cambridge, UK, March 2007.*

Do Lin San, E., Malongwe, N.B., Somers, M.J. and Walters, M. Diet of the black-backed jackal, *Canis mesomelas*, in the Great Fish River Reserve (South Africa). *5th European Congress of Mammalogy, Siena (Tuscany), Italy. September 2007.*

Harris, K.R., van Rensburg, B.J., Robertson, M.P. and Coetzee, J.A. Assessing local scale impacts of *Opuntia stricta* (Cactaceae) invasion on arthropod assemblages in the Kruger National Park, South Africa. *21st Annual Meeting of the Society for Conservation Biology, Port Elizabeth, South Africa, July 2007.*

Iponga, D.M., Milton, S.J. and Richardson, D.M. *Schinus molle* (Peruvian pepper tree) reproductive potential and seedling establishment in relation to invasion in South African ecosystems. *21st Annual Meeting of the Society for Conservation Biology, Port Elizabeth, South Africa, July 2007.*

Jacobs, S., Swift, C., Esler, K. and Crous, C. Water relations in woody riparian species in South African rivers. *Proceedings of the International Conference on Mediterranean Ecosystems, Perth, Western Australia, September 2007.*

Rahlao, S., Esler, K.J., Milton, S. and Barnard, P. Corridor interchange and fountain grass (*Pennisetum setaceum*) success in South Africa. *21st Annual Meeting of the Society for Conservation Biology, Port Elizabeth, South Africa, July 2007.*

Wilson, J.R.U.; Kotzé, I.; Hill, M.; Brudvig, R.; King, A. and Byrne, M. Water hyacinth biological control management recommendations. *XIIth International Symposium on the Biological Control of Weeds, La Grand Motte, France, April 2007.*

Wilson, J.R.U., Richardson, D.M., Lowe, A.J., Hedderson, T. A.J., Hoffmann, J.H., Sheppard, A.W., Witt, A.B.R. and Foxcroft, L.C. Comparative invasion histories of Australians invading South Africa. *XIIth International Symposium on the Biological Control of Weeds, La Grand Motte, France, April 2007.*

b. National

Dumalisile, L. and Somers, M.J. The effects of an alien invasive plant (*Chromolaena odorata*) on large mammal diversity. *Southern African Wildlife Management Association Conference, Didima. September 2007.*

Esler, K.J. and Milton, S.J. Managing roads, rivers and powerline servitudes as biodiversity corridors through the landscape. *Annual Meeting of the South African Association of Botanists, University of Cape Town, January 2007.*

Esler, K.J., Milton, S.J. and "roads and rivers workshop" delegates. Managing roads, rivers and power line servitudes as biodiversity corridors through the landscape. *Annual Meeting of the South African Association of Botanists, University of Cape Town, January 2007.*

Foord, S, Dippenaar-Schoeman, A.S., van Rensburg, B.J., Haddad, C. and Van den Berg, A.M. Preliminary patterns of spiders (Arachnida: Araneae) diversity in the Savanna Biome of South Africa. *33rd Conference of the Zoological Society of Southern Africa, University of the North-West, July 2007.*

Maseng, M., Christison, K. and Griffiths, C. Risk imposed by imported Koi and Goldfish along with their monogenean parasites on the local commercial fishing industry. *Aquaculture Association of Southern Africa. Cape Town, October 2007.*

Mokhatla, M.M., Chimimba, C.T. and van Rensburg, B.J. An assessment of anthropogenic threats associated with areas important for frog conservation. *33rd Conference of the Zoological Society of Southern Africa, University of the North-West, July 2007.*

Pretorius, M.R., Esler, K.J., Holmes, P.M. and Prins, N. Re-evaluation of a riparian restoration experiment in the Western Cape Province: status 8 years down the line. *Annual Meeting of the South African Association of Botanists, University of Cape Town, January 2007.*

Theron, N, Esler, K.J., Dreyer, L, Jansen van Vuuren, B. and Rambau, R.V. Genetic and morphological comparisons of a potentially invasive weed (*Argemone ochroleuca*) from it's natural (Mexico) and invaded (South Africa) habitat. *Annual Meeting of the South African Association of Botanists, University of Cape Town, January 2007.*

Conferences / meetings hosted

a. International

Risk Assessment in Invasion Ecology, 26 June 2007, Stellenbosch, South Africa. Mini-symposium hosted by the C·I·B. Convenor and organizer (Richardson)

b. National

South African National Antarctic Programme (SANAP) Principal Investigator, Post-doctoral Associate and Student Symposium, Stellenbosch, South Africa, October 2007. Event hosted by the C·I·B. Convenor and organizer (Chown).

Workshop to determine individual contributions and guidelines on structure and content that laid the foundation for the collaboration in publishing the book, Fynbos: Ecology and Management, eds Esler, Pierce, de Villiers, February 2007. Convenor (Esler).

Other relevant outputs

Popular articles and talks

a. Articles

Esler, K.J. and Milton, S.J. (2007) Towards best practice in management of road reserves. *Veld and Flora*, March 2007, pp. 222-223.

Griffiths, C.L. (2007) Eight great sights to see. *Envirokids* **28** (3), 6-7.

Griffiths, C. L. (2007) Our marine heritage. *Envirokids* **28** (3), 4-5.

Griffiths, C.L. (2007) Marine Invaders- the aliens have landed. *African Wildlife* **60** (3), 10-11.

Griffiths, C.L. (2007) Our Oceans – an overview. Guest editorial *African Wildlife* **60** (3), 6-7.

Procheş, S. (2007) Wild almond ark: *Brabejum stellatifolium* and its unique load of passengers. *Veld and Flora*. June 2007, pp. 86-88.

Anonymous. (2007) Book review: Scorched: South Africa's changing climate. *Environmental Management*. January 2007, pp. 25-26.

Van Wilgen, B.W. Gums, badgers and economics. *Quest: Magazine of the South African Academy of Science* **3**, 41.

b. Talks

Esler, K.J. On the verge: Managing road servitudes as conservation assets or liabilities. *Stellenbosch University Forum, Stellenbosch, March 2007.*

Esler, K.J. On the verge: Managing road servitudes as conservation assets or liabilities. Wildlife and Environment society of South Africa (WESSA) Workshop, Durban, June 2007.

Esler, K.J. On the verge: Managing road servitudes as conservation assets or liabilities. Invited talk to the Winelands Branch of the Botanical Society. Franschhoek, May 2007.

Griffiths, C.L. University of the Western Cape Research Open Day. Plenary speaker.

Griffiths, C.L. SANCOR Western Cape Student Symposium. University of Cape Town. June 2007. Plenary speaker.

Hui, C. Climate change, environmental sustainability and the future. The Prince of Wales Seminar Series, Cambridge University Programme for Industry, Stanford, July 2007. Invited speaker.

Hui, C. Climate change: threats and opportunity to the financial services industry. Nedbank Workshop, Johannesburg, April 2007. Invited speaker.

Hui, C. A dilemma between social development and environmental sustainability. The Mandela Rhodes Scholarships Programme, The Mandela-Rhodes Foundation, Robben Island, Cape Town, July 2007. Invited speaker.

Hui, C. Sustainability: A story of life and death. The Prince of Wales Seminar Series, Cambridge University Programme for Industry, Stanford, March 2007. Invited speaker.

Milton, S.J. On the edge: vegetation management on roadsides**.** Gouritz Initiative Forum, Oudtshoorn November 2007.

Milton, S.J. Veld bestuur, beoordeling en rehabilitasie. Leeugamka Boerevereniging, Kleinvee Dag, Leeugamka, April 2007.

NRF Service Provision

a. Rating and project proposal reviews

Number of reviews completed: 20 (Chimimba, 2; Esler, 1; Griffiths, 3; McGeoch, 2; Milton, 6; Rambau, 1; Richardson, 1; Somers, 1; van Vuuren, 1; van Wilgen, 2)

b. Panel and committee service

South African National Committee for SCAR, 2004-2007. Chair (Chown).

South African National Antarctic Programme Steering Committee, 2006-2008. Member (Chown).

SEAChange Advisory Panel Meeting, October 2007. Member (Griffiths).

Advisory Panel: Ecology and Zoology, October 2007. Members (Milton, Somers).

Media Interactions

a. Newspaper Articles

Anonymous. 2007. Invasives prefer the heat, study shows. Die Bolander, 15 August 2007.

Anonymous. 2007. Cold facts on invaders who like it hot. The Star, 8 August 2007.

Anonymous. 2007. Global warming gives aliens the edge – study. Cape Times, 8 August 2007.

Anonymous. 2007. Leader page cartoon about the Iimbovane project. District Mail, 16 February 2007.

Anonymous. 2007. Studie van klipklaasneus werp lig op Knersvlakte. Die Burger, 21 September 2007.

Bonthuys, J. 2007. Britse Matie bekyk “verstekelinge” op skip na Marion. Die Burger, 11 April 2007.

Bonthuys, J. 2007. Goggas gedy in warmer weer. Die Burger, 23 August 2007.

Bonthuys, J. 2007. Indringers sluip Marion binne. Die Burger (Western Cape), 29 October 2007.

Bonthuys, J. 2007. Indringers sluip Marion op skepe binne. Die Burger (Eastern Cape), 1 November 2007.

Bonthuys, J. 2007. Nuwe soogdiertjie in die Sentraal-Karoo ontdek. Die Burger, 21 September 2007.

Campbell, C. 2007. Women’s day event will encourage girls to play role in science and technology. Cape Times, 7 August 2007.

Duvenage, E. 2007. Local students help scientists with their research on ants. Paarl Post, 29 November 2007.

Duvenage, E. 2007. Wetenskapleerders het miere danksay Maties. Suid-Kaap Forum, 23 February 2007.

Duvenage, Engela. 2007. Ants in her jam sandwich makes this girl smile! District Mail, 9 February 2007.
Fredericks, E. 2007. Hoërskoolmeisies hang aan vrouewetenskaplikes se lippe. Die Burger, 9 August 2007.
Kahn, T. 2007. Marion Island clue to global warming threat. Business Day, 8 August 2007.
Natal Witness reporter. 2007. Alien plants invade roads, rail and power. Natal Witness, 29 May 2007.
Pritchard, D. 2007. Jennifer, 25, off to remote island to study marine life. The Star (Sheffield, UK), 31 March 2007. http://www.thestar.co.uk/viewarticle.aspx?articleid=2194620&sectionid=5730
Smillie, S. 2007. Ships take alien species to other ecosystems. The Star, September 2007.
Smillie, S. 2007. Student tracks aliens from SA to the Antarctic. The Mercury, 28 September 2007.
Tempelhoff, E. 2007. Aardverwarming is 'n feit, nie meer net fiksie. Volksblad, 7 March 2007.
Tempelhoff, E. 2007. In die hitte van die werklikheid. Beeld, 7 March 2007.
Tempelhoff, E. 2007. Klimaatsveranding raak Marion-eiland so. Beeld, 10 August 2007.
Tempelhoff, E. 2007. Noodtoestand op ons planeet. Die Burger (Cape), 13 March 2007.
Tempelhoff, E. 2007. Uitheemse insek dryf ander op eiland weg. Die Burger (Eastern Cape), 10 August 2007.
Tempelhoff, E. Indringers op Marion knou inheemse species. Volksblad, 1 September 2007.
Van Wilgen, B.W. Lighting fires regularly is vital for fynbos to thrive. Cape Times, 27 April 2007.
Van Wilgen, B.W. Fires were a benefit to the park. Star, 17 August 2007.
Yeld, J. 2007. As SA Fights Invaders, locals are pests abroad. Cape Argus, 26 April 2007.
Yeld, J. 2007. Eco-detective tracks alien species. Cape Argus, 9 March 2007.

b. Newsletters

Anonymous. 2007. Iimbovane Outreach Project: Exploring South African Biodiversity and Change. *UK Darwin Initiative Newsletter. Issue 10. December 2007*.
Prentice, D. 2007. Projects in the grassland biome. Project: Sani Pass. *SANSA Newsletter no. 3.* (www.arc.agric.za/home.asp?pid=3732).

c. Articles published by Stellenbosch University

Duvenage, E. 2007. Cum laude for C·I·B's first graduates. Matieland. Winter, 2007.
Esler, K.J. 2007. Mainstreaming gender issues. Opinion article. Kampusnuus. September 2007.
Unknown. 2007. Personeellede oor breë spektrup vir voortreflikheid beloon. Kampusnuus. December 2007.

d. Electronic sources

Duvenage, E. 2007. C·I·B shows climate change gives invasive species the edge. Stellenbosch University home page. 13 August 2007. http://www.sun.ac.za/News/NewsItem_Eng.asp?Lang=2 &ItemID=12578&Zone=AEX.
Duvenage, E. 2007. Climate change gives invasive species the edge over their indigenous counterparts. Science in Africa. http://www.scienceinafrica.co.za/2007/august/climate.htm.
Duvenage, E. 2007. The first four MSc graduates produced by the DST-NRF Centre of Excellence for Invasion Biology (C·I·B) received their degrees at the March Graduation Ceremony. Stellenbosch University home page. 30 March 2007. www.sun.ac.za.
Kahn, T. Marion Island clue to global warming threat. Business Day. 8 August 2007. http://allafrica.com/ stories/200708080070.html.
SAPA. 2007. Invasives like it hot. 24.com. 8 August 2007. http://www.24.com/news/?p=pscitech&i=624371.

Unknown. 2007. Global warming gives invaders the edge. TNT Magazine. September 2007.

e. Radio and Television

Chown, S.L. Interviewed for Ekoforum, the environment programme of Radio Sonder Grense hosted by Jacqui January concerning work appearing in Proceedings of the Royal Society of London B on invasions and climate change, 12 August 2007.

Chown, S.L. Interviewed for Spektrum, a reality and news programme of Radio Sonder Grense concerning work appearing in Proceedings of the Royal Society of London B on invasions and climate change, 10 August 2007.

Chown, S.L. Interviewed on Radio Sonder Grense, Monitor concerning the Centre for Invasion Biology and its first five masters graduates, all women, 2 April 2007.

Griffiths, C.L. Interviewed for SABC 2, 50/50 (Semaka section), appeared twice.

Mahood, K. Interviews for Beyond the Classroom, SABC 2. Aired 2 December 2007 and repeated on 3 December 2007.

Samways, M. Interviewed for SABC 2, 50/50 (Semaka section), appeared four times. Recorded May 2007.

Samways, M. Interviewed for Radio Elsenberg, May 2007.

Samways, M. Interviewed for Radio Elsenberg, October 2007.

Stage progress

The Centre has completed year two of Service Level Agreement 3 (2006-2008). This section reports progress towards the completion of Stage 3.

Timeframes:

- The pending Gate review (Gate 3) shall take place during February or March 2009.
  Stage: Pending

- Two CoE Advisory Board (virtual or real) meetings should take place per annum during this Stage: Typically during March and October of each year.
  2007: Two full Board meetings were held in March and October

Activities related to the Current Stage:

- The CoE shall provide to the NRF a list of students that are being supported by the Centre by March of each year. Additional students can be appended to this list as and when they arrive. The list should indicate their progress and expected or actual dates of completion.
  2007: Student lists submitted in April and July

- The CoE and the NRF will exchange “nuggets” of information for publication on the CoE website at regular intervals. (This means the NRF will be slightly more active in interviewing members of the CoE and packaging information for sharing).
  2007: Nuggets have been submitted

Financial responsibilities:

- The CoE shall present an audited set of financial statements annually at the February / March Advisory Board meeting reflecting the financial situation of the CoE during the previous financial year.
  2007: Audited statements have been submitted (see below)

- The CoE shall submit monthly cash-flow statements within 15 days of the end of each calendar month, indicating expenditure and commitments.
  2007: Completed

Reports due in this Stage:

- The CoE shall submit an Annual Progress Report by no later than March each year, including the Stage 3 Gate Review Documentation by no later than March 2009 to be reviewed by the CoE Advisory Board.
  2007: Completed

- The CoE shall submit a Statement of Compliance by no later than March 2009 referring to stage 3.
  Stage: Pending

Standard Output Targets per annum in the Current Stage:

- Total number of students supported ≥ ***40*** on average per annum
  2007: 41 students supported (excluding post-doctoral associates)

- Woman students ≥ ***50*** % of all students on average per annum
  2007: 24 women students supported (59 %)

- Black students ≥ ***50*** % of all students on average per annum
  2007: 19 black students supported (46 %)

- Number of social science students ≥ 1 on average per annum
  2007: no social science students supported. Social science post-doctoral award for 2007 was not taken up by the candidate.

- Average duration of submitted Masters degrees (post Honours) ≤ ***2.5*** years at end of stage
  So far: 2.1 years (n = 9)

- Average duration of submitted PhD degrees (post Masters) ≤ ***3.5*** years at end of stage
  So far: 3 years (n=1)

- Average duration of submitted PhD degrees (upgraded from Masters) ≤ ***5*** years at end of stage
  No upgraded Ph.D.s have been submitted yet

- Post-doctoral researcher ≥ ***10*** % of all students at end of stage
  2007: 11 post-doctoral associates supported (21 % of total student/post-doc body)

- Core team members undertaking at least one scientific review per annum on behalf of the NRF = ***100*** %
  20 reviews in total; average 1.2 per CTM; 10 CTM undertook reviews

- Number of patents ≥ ***0***
  N/a

- Number of the peer-reviewed publications ≥ ***35*** on average per annum
  2007: 88 in total

- Number of the peer-reviewed publications ≥ ***1*** with an impact rating of ≥ ***15*** on average per annum
  2007: 2 publications

- Number of the peer-reviewed publications ≥ ***5*** with an impact rating of ≥ ***3.5*** on average per annum
  2007: 15 publications

- Number of national conference presentations ≥ ***20*** on average per annum
  2007: 2 invited, plenary and keynote; 29 oral presentations; 8 posters

- Number of international conference presentation ≥ ***8*** on average per annum
  2007: 9 invited, plenary and keynote; 30 oral presentations; 8 posters

- Number of joint venture student training initiatives ≥ ***5*** on average per annum
  2007: Ten students were co-supervised within the core team

- Number of local conferences organized ≥ ***1***
  2007: Two (SANAP PI symposium; fynbos management book workshop)

- Number of international conferences organized ≥ ***1*** at end of stage
  2007: One (Risk Assessment Mini-Symposium)

Special Output Targets for the Current Stage:

- Fine tuned strategy to increase research and other output from the key performance areas.
  Implemented

- At least one full CoE team activity per annum.
  2007: Annual research meeting held from 15 to 16 November. Two CTM were unable to attend due to international meeting commitments.

- The CoE shall report on activities initiated under the auspices of the CoE.
  As per this report

- The CoE shall demonstrate a sound working relationship between the CoE host institution and the satellite institutions.
  Existing relationships maintained and further relationsips with HDIs developed during 2007

- Successful adoption of *limbovane* outreach program by schools in the WCED region.
  Programme successfully adopted, expanded to an additional three schools and further plans for independent funding and expansion made during 2007.

Long Term Outputs:

- Have a defined strategy and report on progress in the development of at least five career academics from designated (formerly disadvantaged) groups. Carried over from SLA 1.
  Several HEI were visited in 2007 to seek out further partnerships for this programme. At present, four HDI academics are working with the Centre. In one instance the partnership is new, in two it is growing and successful, and in the fourth the partnership will likely be terminated. Additional attention will be given to this requirement in 2008. In particular, a fifth partnership will focus on an entire Department to provide opportunities and identify appropriate individuals.

FINANCES

DST / NRF CENTRE OF EXCELLENCE FOR INVASION BIOLOGY

BALANCE SHEET AT 31 DECEMBER 2007

	Notes	2007 R	2006 R
ASSETS			
NON-CURRENT ASSETS		1 180 239.34	1 201 476.82
Property, plant and equipment	3	1 180 239.34	1 201 476.82
CURRENT ASSETS		1 156 410.58	920 720.09
Trade receivables	4	153 048.00	10 213.20
Stellenbosch University	5	1 003 362.58	910 506.89
TOTAL ASSETS		**2 336 649.92**	**2 122 196.91**
EQUITY AND LIABILITIES			
CAPITAL AND RESERVES		2 165 417.41	2 002 257.09
Accumulated funds		2 165 417.41	2 002 257.09
CURRENT LIABILITIES		171 232.51	119 939.82
Trade and other payables	6	171 232.51	119 939.82
TOTAL FUNDS AND LIABILITIES		**2 336 649.92**	**2 122 196.91**

DST / NRF CENTRE OF EXCELLENCE FOR INVASION BIOLOGY

INCOME STATEMENT FOR THE YEAR ENDED 31 DECEMBER 2007

	Notes	2007 R	2006 R
INCOME		7 667 611.55	6 140 809.07
Exchange rate gain		-	1 550.52
Interest received		173 360.85	126 792.39
NRF grant		5 834 955.00	4 654 680.00
Other income		1 659 295.70	1 335 877.27
Profit on sale of property, plant and equipment		-	21 908.89
EXPENDITURE		7 504 451.23	7 100 145.36
Operational expenses		5 351 452.50	5 332 384.60
Advertisements		175 708.37	2 970.06
Audit fees - current year		30 500.00	28 500.00
- previous year underprovision		-	9 920.00
Consumables		88 276.48	55 177.89
Copying and stationery		15 693.60	19 532.13
Depreciation		387 097.51	291 239.05
Entertainment		33 984.92	47 543.61
Exchange rate loss		195.23	1 116.39
Interest paid		1 165.55	1 980.51
Insurance		1 482.34	1 800.00
Levies		30 793.53	33 507.66
Loss on sale of property, plant and equipment		3 119.49	-
Marketing		-	-
Membership and affiliation fees		21 396.96	78 801.19
Non-capitalised books		150.00	(51.50)
Small capital works: not capitalised		44 869.96	29 433.98
Postage, telephone and fax		58 885.49	50 043.32
Publishing costs		56 000.00	-
Research costs		66 293.88	99.95
Rent paid for facilities		-	-
Repairs		4 183.48	7 341.37
Software and internet		8 277.70	4 779.00
Sundry expenses		2 724.51	420.00
Team member research costs		3 835 480.00	4 124 184.30
Transport and accommodation		465 271.66	543 545.69
Workshops		19 901.84	500.00
Personnel expenses		2 152 998.73	1 767 760.76
Salaries		2 152 998.73	1 767 760.76
NET SURPLUS/(LOSS) FOR THE YEAR		163 160.32	(959 336.29)

DST / NRF CENTRE OF EXCELLENCE FOR INVASION BIOLOGY

STATEMENT OF CHANGES IN EQUITY FOR THE YEAR ENDED 31 DECEMBER 2007

	2007 R	2006 R
ACCUMULATED FUNDS		
At the beginning of the year	2 002 257.09	2 961 593.38
Net surplus/(loss) for the year	163 160.32	(959 336.29)
At the end of the year	2 165 417.41	2 002 257.09

DST / NRF CENTRE OF EXCELLENCE FOR INVASION BIOLOGY

CASH FLOW STATEMENT FOR THE YEAR ENDED 31 DECEMBER 2007

	2007 R	2006 R
CASH FLOW FROM OPERATING ACTIVITIES		
Net surplus/(loss) for the year	163 160.32	(959 336.29)
Adjustment for:		
Interest received	(173 360.85)	(126 792.39)
Interest paid	1 165.55	1 980.51
Exchange rate gain	-	(1 550.52)
Depreciation	387 097.51	291 239.05
Profit on sale of fixed assets	(3 119.49)	(21 908.89)
Operating profit/(loss) before working capital adjustments	374 943.04	(816 368.53)
Working capital adjustments	(91 542.11)	40 359.73
(Increase)/Decrease in trade receivables	(142 834.80)	74 040.78
Increase/(Decrease) in trade and other payables	51 292.69	(33 681.05)
Cash (utilised in)/generated from operations	283 400.93	(776 008.80)
Interest received	173 360.85	126 792.39
Interest paid	(1 165.55)	(1 980.51)
NET CASH FLOW FROM OPERATING ACTIVITIES	455 596.23	(651 196.92)
CASH FLOW FROM INVESTMENT ACTIVITIES		
Equipment purchased	(368 979.52)	(558 852.84)
Equipment sold	-	84 325.00
Increase in amount owed by Stellenbosch University	(92 855.69)	1 125 724.76
NET CASH FLOW FROM INVESTMENT ACTIVITIES	(461 835.21)	651 196.92
NET INCREASE IN CASH AND CASH EQUIVALENTS	(6 238.98)	-
CASH AND CASH EQUIVALENTS AT THE BEGINNING OF THE YEAR	-	-
CASH AND CASH EQUIVALENTS AT THE END OF THE YEAR	(6 238.98)	-

DST / NRF CENTRE OF EXCELLENCE FOR INVASION BIOLOGY

NOTES TO THE ANNUAL FINANCIAL STATEMENTS FOR THE YEAR ENDED 31 DECEMBER 2007

1. ACCOUNTING POLICY

The financial statements are prepared on the historical cost basis, with the exception of IAS39/AC133 where assets and liabilities are stated at fair value, in accordance with South African Statements of Generally Accepted Accounting Practice. The following are the principal accounting policies of the centre which are consistent in all material respects with those applied in the previous year, except where stated otherwise.

PROPERTY, PLANT AND EQUIPMENT

Property, plant and equipment is stated at historical cost and depreciation is calculated on the straight-line method to write off the cost of the assets to their residual values over their estimated useful lives as follows:

Laboratory equipment at 20% per year on the straight-line method;
Office equipment at 10% per year on the straight-line method;
Computers at 33.3% per year on the straight-line method;
Vehicles at 25% per year on the straight-line method, with a 40% residual

IMPAIRMENT OF ASSETS

Property, plant and equipment are reviewed for impairment losses whenever events or changes in circumstances indicate that the carrying amount may not be recoverable. An impairment loss is recognised for the amount by which the carrying amount of the asset exceeds its recoverable amount, that is, the higher of an asset's selling price and value in use. For the purposes of assessing impairment, assets are grouped at the lowest level for which there are separately identifiable cash flows.

FINANCIAL INSTRUMENTS

Financial instruments on the balance sheet include other payables and a loan to Stellenbosch University. These instruments are generally shown at their estimated fair value.

INCOME RECOGNITION

Income consists mainly of a NRF grant, the contribution from the Vice-chancellor: Research to the centre, refunds received for expenditure incurred and income received for work performed on sundry projects.

Income from the NRF and the Vice-chancellor: Research is recognised when it is received. Other income is recognised as it accrues.

Interest income is recognised as it accrues (taking into account the effective return on assets) unless collectability is in doubt.

DST / NRF CENTRE OF EXCELLENCE FOR INVASION BIOLOGY

NOTES TO THE ANNUAL FINANCIAL STATEMENTS FOR THE YEAR ENDED 31 DECEMBER 2007 (continued)

1. ACCOUNTING POLICY (continued)

STANDARDS, INTERPRETATIONS AND ADJUSTMENTS TO PUBLISHED STANDARDS NOT YET EFFECTIVE

Certain new standards, amendments and interpretations to existing standards have been published that are mandatory for the centre's accounting periods beginning on or after 1 January 2008 or later periods but which the centre has not early adopted, as follows:

- IAS 1 (AC 101) - Presentation of Financial Statements (effective from 1 January 2009) (1)
This revised statement requires information in the financial statements to be aggregated on the basis of shared characteristics and to introduce a statement of comprehensive income. Changes in a company's equity resulting from transactions with owners in their capacity as owners (such as dividends) are separately disclosed from non-owner changes in equity (such as transactions with third parties).
- IFRS 8 (AC 145) - Operating Segments (effective from 1 January 2009) (2)
This new standard replaces IAS 14. It redefines "operating segment" and prescribes various disclosures. This standard only affects disclosure and will not impact the centre's results.
- IFRS 3 (R) (AC 440) - Business Combinations (effective from 1 January 2009) (2)
- IAS 27 (R) (AC 132) - Consolidated and Separate Financial Statements (effective from 1 January 2009) (2)
- IFRIC 12 (AC 445) - Service Concession Arrangements (effective from 1 January 2008) (2)
- IFRIC 13 (AC 446) - Customer Loyalty Programmes (effective from 1 July 2008) (2)
- IFRIC 14 (AC 447) - IAS 19 - The Limit on a Defined Benefit Asset, Minimum Funding Requirements and their Interaction (effective from 1 January 2008) (2)
- IAS 23 (AC 114) - Borrowing Costs (effective from 1 January 2009) (2)

(1) The financial statements will be affected mainly by additional disclosures.
(2) No material effects on the financial statements.

CRITICAL ACCOUNTING ESTIMATES AND JUDGEMENTS

Estimates and judgements are continually evaluated and are based on historical experience and other factors, including expectations of future events that are believed to be reasonable under the circumstances.

The centre makes estimates and assumptions concerning the future. The resulting accounting estimates will, by definition, seldom equal the actual results. The estimates and assumptions that have a significant risk of causing a material adjustment to the carrying amount of assets and liabilities within the next financial year are discussed below.

Useful lives of assets

The useful lives of assets is estimated based on past experience and the characteristics of the specific items.

There were no critical judgements in applying the centre's accounting policies.

2. COMPARATIVE FIGURES

The following comparative figures in the income statement have been reclassified to allign with current year allocations which provides a more appropriate allocation of costs.

	As prevously stated	Reclassification	Currently stated
Advertisements	-	2 970.06	2 970.06
Consumables	27 975.46	27 202.43	55 177.89
Copying and stationery	46 734.56	(27 202.43)	19 532.13
Marketing	2 970.06	(2 970.06)	-
Rent paid for facilities	500.00	(500.00)	-
Workshops	-	500.00	500.00
	78 180.08	**0.00**	**78 180.08**

	2007 R	2006 R
3. EQUIPMENT		
Carrying amount at the beginning of the year	1 201 476.82	996 279.14
Cost	1 569 313.80	1 131 319.74
Accumulated depreciation	(367 836.98)	(135 040.60)
Additions during the year	368 979.52	558 852.84
Disposals	(3 119.49)	(62 416.11)
Cost	(6 581.58)	(120 858.78)
Accumulated depreciation	3 462.09	58 442.67
Depreciation for the year	(387 097.51)	(291 239.05)
Carrying amount at the end of the year	1 180 239.34	1 201 476.82
Cost	1 931 711.74	1 569 313.80
Accumulated depreciation	(751 472.40)	(367 836.98)

DST / NRF CENTRE OF EXCELLENCE FOR INVASION BIOLOGY

NOTES TO THE ANNUAL FINANCIAL STATEMENTS FOR THE YEAR ENDED 31 DECEMBER 2007 (continued)

	2007 R	2006 R
4. TRADE AND OTHER RECEIVABLES		
Trade receivables	152 748.00	10 213.20
Other	300.00	0
	153 048.00	10 213.20
The ageing of these receivables are as follows:		
Up to 3 months	153 048.00	10 213.20
3 to 6 months	-	-
	153 048.00	10 213.20

5. STELLENBOSCH UNIVERSITY

The loan to Stellenbosch University is not secured and is subject to interest rates linked to prime. The loan has no fixed terms of repayment.

6. TRADE AND OTHER PAYABLES

Leave pay provision	126 837.78	90 364.75
Other creditors	13 894.73	1 075.07
Provision for audit fees	30 500.00	28 500.00
	171 232.51	119 939.82

DST / NRF CENTRE OF EXCELLENCE FOR INVASION BIOLOGY

NOTES TO THE ANNUAL FINANCIAL STATEMENTS FOR THE YEAR ENDED 31 DECEMBER 2007 (continued)

7. FINANCIAL INSTRUMENTS

Credit risk

Financial assets which potentially subject the centre to concentrations of credit risk consist principally of receivables and a loan to Stellenbosch University. Receivables are presented net of the provision made for impairments of these receivables. Management believes the centre has no significant concentration of credit risk. The carrying amounts of financial assets included in the balance sheet represent the centre's exposure to credit risk in relation to these assets.

Fair values

On 31 December 2007 and 2006 the carrying amounts of the financial instruments shown in the financial statements, approximates their fair values.

Interest rate risk

The centre is exposed to interest rate risk due to loans made at variable rates.

	Interest %	Interest-bearing R	Interest free R	Total R
31 December 2007				
Financial assets				
Receivables		-	153 048.00	153 048.00
Stellenbosch University	5.70	1 003 362.58	-	1 003 362.58
		1 003 362.58	153 048.00	1 156 410.58
Financial liabilities				
Trade and other payables	-	-	(171 232.51)	(171 232.51)
Net financial assets/(liabilities)		1 003 362.58	(18 184.51)	985 178.07
31 December 2006				
Financial assets		910 506.89	10 213.20	2 120 485.63
Financial liabilities		-	(119 939.82)	(155 171.39)
Net financial assets/(liabilities)		910 506.89	(109 726.62)	800 780.27

Conclusion

The Centre for Invasion Biology is now well established. Output is excellent in quantity and growing in quality. The student turnover is good, but a careful watch needs to be kept on Ph.D. throughput rates over the next year. The range and depth of the C·I·B's partnerships are also growing, as is the financial support required to give effect to the C·I·B's strategy. Engagement by all of those interested in the C·I·B, from Board to students, is now required to give further effect to delivery against the 2007-2009 strategic plan. Moreover, commitment by the Board and the core team members will be required as the C·I·B approaches its next five year term, especially in developing a sustainability strategy for the period beyond the coming term.