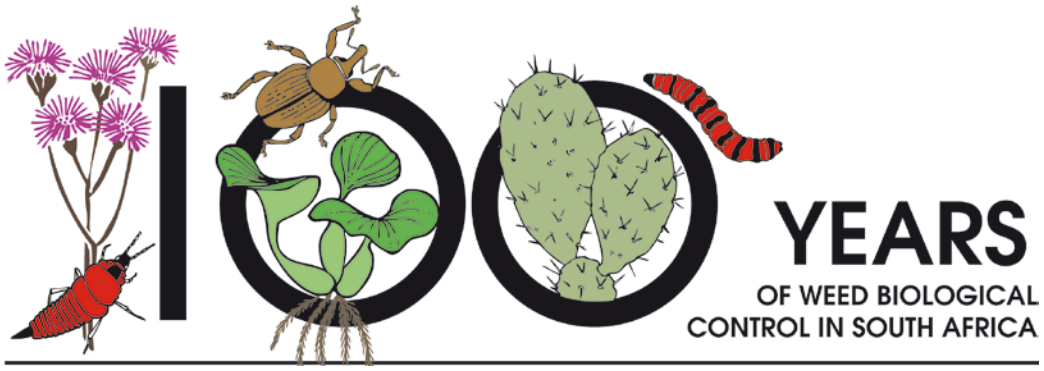
Proceedings of the 41st Annual Symposium on Management of Invasive Alien Plants
Cape St Francis Resort
8-10 May 2013



Contents:

25	Survey and clearing of *Cylindropuntia fulgida* var. *mamillata* (boxing glove cactus) and *Cylindropuntia pallida* (thistle cholla)	Travor Xivuri
26	Black River: A case study of integrated control methods and collaboration between different departments	Chandre Rhoda
	Pre-release studies and host specificity	
27	Suitability of the defoliating beetle *Physonota maculiventris* (Coleoptera: Chrysomelidae) for release against *Tithonia diversifolia* (Hemsl.) A.Gray (Asteraceae) in South Africa	Tshililo Mphephu
28	Report back on host specificity testing by CABI (UK) of *Puccinia lantanae*	Alan Wood
29	A new host specific insect for the control of *Pereskia aculeata*	Iain Paterson
30	Host specificity testing of congeneric species of leaf-mining flies, *Hydrellia pakistanae* (Diptera: Ephydridae) and *Hydrellia* sp. – two candidate biocontrol agents for *Hydrilla verticillata* (Hydrocharitaceae) in South Africa.	Angela Bownes
	Post release evaluation of biological control agents	
31	Biological control of Australian Acacias: what you see is not what you get	John Hoffmann
32	Aquatic Weed Survey 2013	Grant Martin
33	Impact of the biological control agent *Aceria lantanae* (Cook) (Acari: Trombidiformes: Eriophyidae) on the invasive weed *Lantana camara* (Verbenaceae) in South Africa.	Ludzula Mukwevho
34	Status of aquatic weeds associated with biological control agents in the southern Mozambique rivers	Silvia Langa
35	The biological control of boxing-glove cactus	Hildegard Klein
36	Host plant has no effect on the performance and fitness related traits of the biological control agent, *Pareuchaetes insulata*	Osariyekemwen Uyi
	Genetics in weed control	
37	Determining the origin of *Phragmites australis* in South Africa based on chloroplast DNA	Kim Canavan
38	The role of genetic diversity in biological control agents	Sven Tozer
39	Is South African pompom weed (*Campuloclinium macrocephalum*, Asteraceae) clonal? Evidence from ITS sequence data.	Lucy Gitonga
40	The power of molecular ecology in uncovering the truth behind *Tamarix* invasion in South Africa	Guelor Mayonde
	Weeds on the web	
41	The unofficial *Working for Water* Website	Andrew Wannenburgh
42	Communicating invasives in a digital era	Kay Montgomery
	Weed Society of South Africa	
43	Weed Society of South Africa	Andrew Wannenburgh

1. Alien Invasive plant threats to wetlands and riparian areas in the Southern and Eastern Cape

Japie Buckle
Provincial Coordinator: Eastern Cape, Working for Wetlands
South African National Biodiversity Institute
31 Newcombe Ave., Miramar, PE, 6070
E-mail: buckle@sanbi.org

Wetlands in the Southern and Eastern Cape are mostly associated with high energy rivers systems that drain the steep catchments in the area. Unsustainable land management practices (over burning and over grazing) in these areas often resulted in many degraded catchments and highly impacted and disturbed riparian areas and wetlands which promote the infestation of IAP.

Several well established and emerging weed species are further contributing to the degradation of riparian areas and wetlands. The following invasive plant species will be illustrated and highlighted as major or potentially problematic species which might be considered for biological control in future:

Arundo donax - Giant reed in various river systems in the South-eastern Cape

Rubus spp – Bramble in the North-eastern Cape and TMS rivers

Cortaderia selloana - Pampas grass in the Tsitsikamma area and Langkloof

Acacia spp. - Black and Silver Wattle

Lantana camara - in the Wild Coast but spreading to the south-western part of the Eastern Cape

Salix fragilis – Crack Willow in the North Eastern Cape

2. A decade of biological control implementation in South Africa: Working for Water

Debbie Sharp
Department of Environmental Affairs: Natural Resource Management Programmes
14 Loop Street, Cape Town, 8300

Working for Water, a Natural Resource Management programme of the Department of Environmental Affairs has funded the research into biological control agents over the past decade. The biological control implementation programme was initiated in earnest in 2000 when the first implementation staff where employed by the department. In the beginning, the implementers reared, released and monitored the biocontrol agents and sites themselves. The programme has increased over the years and the entire strategy was relooked at to a more sustainable strategy where research, mass rearing, releases and large scale monitoring is possible. The proposed emphasis should be on a 'cradle to grave' strategy where the research and implementation of a biocontrol agent is seen to function as a unit and not as separate entities. Research goals should be fed back into implementation and feedback on corrective actions taken must be given. Research priorities should be identified with implementation input and monitoring programmes identified for established agents.

3. Weed biocontrol agent mass rearing at SASRI from 2010 to 2013: What, where, how many and what about the future?

Des Conlong[1, 2] and Denise Gillespie[1]
[1]South African Sugarcane Research Institute, 170 Flanders Drive, Mount Edgecombe. 4300. KwaZulu-Natal, South Africa.
[2]Department of Conservation Ecology and Entomology, Faculty of Agri-Sciences, Stellenbosch University, P.O. Matieland, Stellenbosch. South Africa.
Denise.Gillespie@sugar.org.za ; Des.Conlong@sugar.org.za

The South African Sugarcane Research Institute (SASRI) has since 2010 reared and supplied selected alien invasive plant (AIP) biocontrol agents (BCA) across South Africa for the aquatic weeds *Pistia stratiotes, Eichornia crassipes* and *Salvinia molesta*; and the terrestrial invasives *Chromolaena odorata, Solanum mauritianum, Lantana camara, Pereskia aculeata and Parthenium hysterophorus.* The agents reared and released on these AIP over the last three years are in excess of 536000, and include *Neohydronomus affinis, Neochetina bruchi* and *N. eichhorniae*, and *Cyrtobagous salviniae* respectively for the aquatic weeds; and *Calycomyza eupatorivora* and *Lixus aemulus, Anthonomus santacruzi, Longitarsus bethae* and *Coelocephalapion camarae,* and *Phenrica guérini* respectively for the terrestrial invasives. In addition, the rust fungus *Puccinia xanthii* was propagated for release against *P. hysterophorus.*

During the early part of the contract between SASRI and Working for Water (WfW), the funders of the project, it was agreed, following discussions with the Agricultural Research Council – Plant Protection Research Institute (ARC-PPRI), to terminate the rearing of *C. eupatorivora* to devote more time and resources to the rearing of *L. aemulus.* Agents named in the contract for mass rearing, but on which no action could be taken because of quarantine release restrictions, included *Dichrorampha odorata* for *C. odorata* control, and the *P. hysterophorus* biocontrol agents *Listronotus setosipennis* and *Epiblema strenuata.* Towards the end of the contract period, permission was obtained from WfW to mass rear *Cornops aquaticum* for release against *E. crassipes* in place of *E. strenuata.*

The first part of the presentation outlines the successes and constraints experienced over the three year contract in terms of mass rearing and release, why some agents are reared in higher numbers than others, and distribution of the BCA throughout South Africa from SASRI. In addition, the capacity building outcomes which became apparent as the contract progressed are highlighted. Many lessons were learnt which certainly will be carried forward for future mass rearing efforts.

The second part of the presentation will deal with the ending of the current contract on 31 October 2013, and planning the continuation of the mass rearing of selected or all BCA currently being reared, and considering new agents for current and/or additional AIP. This congress provides the ideal opportunity for all concerned to have input into these decisions, and to finalise such a list. This will allow a new budget to be drawn up for the selected biocontrol agents and proposed to the funders (WfW), so that a new contract can be finalised, signed by all parties, and implemented on 1 November 2013.

4. Releases of mass reared alien invasive plant biological control agents against aquatic weeds in the Kruger National Park- a worthwhile exercise?

Des Conlong [1, 2] and Ezekiel Khosa[3]
[1]South African Sugarcane Research Institute, 170 Flanders Drive, Mount Edgecombe. 4300. KwaZulu-Natal, South Africa.
[2]Department of Conservation Ecology and Entomology, Faculty of Agri-Sciences, Stellenbosch University, P.O. Matieland, Stellenbosch. South Africa.
[3]SAN Parks, Alien Biota Section, Skukuza, Kruger National Park.
Des.Conlong@sugar.org.za; Ezekiel.Khosa@sanparks.com

Since 2010, the South African Sugarcane Research Institute (SASRI) has supplied the Alien Biota section of the South African National Parks (SAN Parks), biological control agents for water lettuce (*Pistia stratiotes*) and water hyacinth (*Eichornia crassipes*) control at selected sites in the Kruger National Park. Sites with the former weed included the Sabie river below Lower Sabie Rest Camp in the South, around Skukuza Rest Camp, Orpen Dam, the Letaba river and Dakamila Pans in the north. *Neohydronomus affinis* exclusively was released at these sites. A mixture of *Neochetina bruchi* and *N. eichhorniae* were releases at sites infested with water hyacinth on the Letaba river at Engelhardt Dam and Makhadzi spruit. Initially, the mired *Eccritotarsus bethae* was also released at Makhadzi spruit.

The numbers of biocontrol agents released at each site over time, and the colonisation and progress of control over the last three years at the various sites will be presented and discussed. At some sites herbicide use has been drastically reduced. A case will be made for regular monitoring of these sites, and the implementation of an integrated pest management approach to minimise costs, and maximise sustainability of the control of these weeds at these sites and others.

5. Bridging the knowledge-doing gap in invasion biology- prioritisation for research and management action

Mirijam Gaertner[1] & Louise Stafford[2]
[1]Centre for Invasion Biology, Department of Botany and Zoology, Stellenbosch University, Private Bag X1, Matieland 7602, South Africa
[2]Environmental Resource Management, Westlake Conservation Office, Ou Kaapse Weg, Postnet Suite 80 Private Bag X26, Tokai, 7966, South Africa

A new collaboration has been established between the City of Cape Town and the DST-NRF Centre of Excellence for Invasion Biology (CIB). The main aims of the collaboration are to identify research needs and prioritise research actions in relation to the management of invasive alien species in the Cape Town metropole and to effectively translate research findings into management action for input into policy.

The main research areas covered will be the links between ecosystem services and alien species invasions, invaded habitats as novel ecosystems and implications for management and restoration, and the interface between biological invasions and human attitudes to the environment and change.

The first project undertaken is a restoration study at Blaauwberg Nature Reserve including two MSc studies, one on fynbos seed ecology and germination and the other one on restoration after alien clearing. Other priority areas for the first year will be to identify priority species for the early detection and rapid response program and provide a management plan for eradication and to select established, invasive species as priority for management.

An overall objective is to develop a strategic plan for the management of key invasive species in the City of Cape Town.

6. Managing invasive plants in an urban environment: City of Cape Town as a case study

Dieter Schlange
Invasive Species Management, Environmental Resource Management, Westlake Conservation Office, Ou Kaapse Weg, Postnet Suite 80 Private Bag X26, Tokai, 7966, South Africa

Invasive plant management is the responsibility of every landowner including local municipalities. Managing invasive plants in an urban environment brings its unique challenges and opportunities. This talk will highlight the challenges and opportunities that the Invasive Species Management Unit faces within the City of Cape Town.

7. Are NRMP funded Programs meeting funder and institutional objectives: Perspective from South African National Parks.

Nicholas Cole
South African National Parks, Biodiversity and Social Projects unit, NMMU Saasveld campus, George

With NRMP funding allocation to SANParks increasing from cR25.5 million in 2002/2003 to cR216.6 million in 2012/2013 the relationship between the funder [NRMP] and SANParks can be considered healthy and mutually beneficial. However, as in any relationship between two parties one has to ask if each individual's expectations and objectives as well as their joint expectations and objectives are being met. Further, as simple as the relationship may look on the surface, the marriage between NRMP and SANParks has spawned many children some of whom may seem illegitimate to either party. To top this throw in the lovers and hangers –on to be found gravitating around any well-healed family and you have a soapy in the making.

The bread winner [NRMP] expects poverty alleviation to be a key focus area whereas the bed partner [SANParks] looks towards bio-diversity as a key focal area, well at least institutionally so. SANParks have, seemingly, proven themselves capable of implementing funding received from NRMP [keeping the bed warm] and in doing so manage to produce employment opportunities for communities adjacent to and beyond National Park boundaries [keeping the children happy].

However are these employment opportunities really alleviating poverty, do training and social interventions up-skill people to the point where they can be considered as skilled and does this all contribute to biodiversity conservation? Without doubt strides are being made in realizing partners expectations and objectives, poverty alleviation and biodiversity conservation [two of the children], but could a higher state of euphoria be reached in this relationship?

8. Berg River Project, powering the Green Economy

Francis Steyn
Western Cape Department of Agriculture, Private Bag X1, Elsenburg 7607, South Africa.
Tel: +27 21-8085090 Fax: +27 21-8085092 Cell: +27 82 907 2813, E-mail: franciss@elsenburg.com

This project is work in progress and it has already demonstrated great value in promoting the Green Economy, **by adding financial value to alien biomass which could result in the beginning of the end of one of our greatest threats to biodiversity in South Africa; namely alien plant infestation**. The ultimate aim of this project is to restore the most important river system in the Cape Town Metro pole area to a healthy river system that will promote human wellbeing. To remove the alien vegetation and replace this with indigenous vegetation would cost the Government approximately R300 million and the sustainability of the present initiatives could be doubtful. This project is aimed at doing this clearing by creating a value for the biomass and thereby adding value to the problem. This value would then partially or even totally fund the restoration and the biomass could be used to enhance energy production further displaying sustainable technologies.

This important natural resource affects every person indirectly in the Metro pole area due to the food that is produced from this resource and the value adding from the agricultural industry. This river also supply a major portion of the water required for domestic purposes in the Cape Metro. Some 22 500 ha of irrigation of high value crops on 600 farm units along the Berg River resulted in a gross farm gate value of R 911 million of which R 642 million was from exports (2005 figures). The agricultural activities also provided 14 100 permanent and 16 500 temporary jobs during 2005. Presently this resource is in a degraded state and poses a major threat to human health, decline of rural economy (especially the loss of permanent jobs), negatively affect the entire value adding economy of the Western Cape and further degradation of the environment increasing the risk of losing more precious natural resources during flooding events.

A healthy river system would enhance the economy of the Western Cape by creating more permanent jobs, especially in Agriculture, but more importantly in new industries, such as Agri Tourism, created due to the vast improvement in the quantity and quality of water within the Berg River system. The improvement of the quality of water alone could prevent the risk of losing important export markets to the value of billions of rand to the economy. The removal of 1500 ha of alien plants would save enough water for the planting of at least as many hectares of food crops thereby building our base to food security in the Province.

9. Plans for the eradication of small populations of *Asphodelus fistulosus* from the West Coast of South Africa

Nolwethu Jubase[1], Ernita van Wyk[1] and Stephen Boatwright[2]
[1]Invasive Species Programme, South African National Biodiversity Institute, Private Bag X7, Claremont, 7735. N.jubase@sanbi.org.za
[2]Department of Biodiversity and Conservation Biology, University of the Western Cape, Private Bag X17, Bellville, 7535, South Africa.

Asphodelus fistulosus (onion weed), native to Europe, was recently recorded in South Africa for the first time and represents a first record of an invasive member of the Asphodelaceae family in South Africa. So far, five small populations (<100 m^2) of this plant have been found along disturbed roadsides in deep sandy soils on the West Coast of South Africa. The known extent of the infestation in South Africa is still limited, such that it may be a feasible eradication target. The species is an aggressive invader in other parts of the world, notably South West Australia and Califonia. Very little information is available to guide the practical management of this species. To confirm the current extent and the feasibility of eradication, we propose to: a) survey known *A. fistulosus* patches in a predetermined radius from each population and along all the nearby roadsides; b) distribute pamphlets asking for sightings of the plant; c) compare the efficacy of two control methods (chemical vs. mechanical); and d) monitor the post-treatment recovery of *A. fistulosus.* We hope to determine whether eradication is feasible for this species, and what control method is most effective.

10. *Carduus nutans* in South Africa: distribution, threats, and opportunities for management

Kanyisa Jama and Thifhelimbilu Rambuwane
Invasive Species Programme, South African National Biodiversity Institute, 4a Princess Road office Park Vincent, East London 5200
k.jama@sanbi.org.za

Carduus nutans is native to Europe and Asia, but is a serious invader in many parts of its introduced range in North America, South America, Australia, and New Zealand. For example, in the United States the species is declared as a noxious weed in 22 states. It is unclear how the species was introduced into South Africa. . However the first SAPIA records dates back to 1925, and it is now widespread in areas like Grahamstown, Cradock, Kenton-on-Sea, Paterson and Addo, yet it has not been categorized and listed as an invasive plant under CARA or NEM:BA. Here we propose a research project to assess the current distribution and risks posed by *Carduus nutans* to South Africa. The results of the risk assessment will give us an indication of whether the species is a threat to South Africa, what management options are available, and whether the species should be listed as an invasive species requiring control.

11. Invasive potential of *Melaleuca parvistaminea* in South Africa and the need to assess invasive potential of dry-seeded Myrtaceae

Llewellyn Jacobs[1,2,3], Dave Richardson[2], John Wilson[2,3]
[1] Scientific Services, CapeNature, Private Bag X5014, Stellenbosch, 7599
[2]Centre of Excellence for Invasion Biology, Department of Botany and Zoology, University of Stellenbosch, Private Bag X1, Matieland, 7602
[3]Invasive Species Programme, South African National Biodiversity Institute, Private Bag X7, Claremont, 7735

Melaleuca parvistaminea Byrnes (Rough-barked Honey myrtle) was first brought to SANBI's ISP attention in 2009. Here we describe the survey and management of the population (the first record of an invasion for this species in the world). As yet not all areas have been searched exhaustively. We have found over 13 000 plants spread over 372 ha (condensed canopy area of ~0.73 ha) at 3 sites between Tulbagh and Wolseley, in the Western Cape. Population structure indicates considerable spread by seed with at least 63% of plants being seedling or juvenile. Clearing and fire trigger seed release causing prolific recruitment (up to ~18 000 seedlings/m^2) after winter rain. No evidence for a soil stored seed bank was found. Risk assessment shows significant invasive potential, while bioclimatic niche modelling indicates high suitability in the southern Cape region. Plants however only reproduce at 5 years or older, allowing for sustained clearing efforts before juveniles can set seed.

Initially, this serotinous reseeder was identified as *Melaleuca ericifolia* Sm. (Swamp paperbark), a sister taxon, but examination of morphology and reproductive characters led to revised identification, highlighting the need for taxonomic work on new detections.

Given the potential for the species to dominate wetland habitats, we propose that this species should be listed as a target for compulsory control (i.e. eradication). We estimate eradication would currently cost ~R1.6 million.

There are several other invasive melaleucas in South Africa, and we briefly discuss current management and research efforts on each. Building on this work, we propose an MSc- project looking at a detailed assessment of dry-seeded Myrtaceae—assessing the factors that determine success at each stage of invasion at a global scale; evaluating which species are present in South Africa and which pathways these are associated with; and exploring the mechanisms underlying invasiveness in the ornamental genera *Melaleuca* and *Callistemon*.

12. Determining the invasive potential of *Crotalaria agatiflora* (Crotalarieae, Fabaceae) in South Africa

T. Phago.[1,2], B-E. Van Wyk.[1], J.S. Boatwright.[3]
[1]Department of Botany and Plant Biotechnology, University of Johannesburg, P. O. Box 524, Auckland Park, 2006, Johannesburg, South Africa.
[2]Invasive Species Programme, South African National Biodiversity Institute, Private Bag X7, Claremont, 7735.
[3]Department of Biodiversity and conservation biology, University of the Western Cape, Private Bag X17, Bellville, 7535, South Africa.

Crotalaria agatiflora is native to the tropical East Africa with its distribution mainly occurring in Tanzania, Kenya and Ethiopia. In South Africa this plant was introduced as an ornamental garden shrub, but because it invades natural vegetation (savannah biome, grasslands, watercourses and forest margins) in Gauteng, North West, Limpopo, Mpumalanga, Free State, Kwazulu-Natal and some parts of the Eastern Cape Provinces. It is proposed that it be listed as a category 1a invader under the National Environmental Management: Biodiversity Act (NEM:BA). We used standard methods to explore and monitor five populations of this species. We recorded more than thirty populations of this species in addition to the SAPIA records around Gauteng, measured and counted the number of individuals in populations. We predict the future distribution of the species based on climatic suitability. Soil seed bank show that *Crotalaria agatiflora* is a slow but persistent invader. Its seed coat dormancy and ability to resprout makes it very persistent. The preliminary scientific data obtained from this study show that *C. agatiflora* poses a significant threat to the flora of South Africa and that it should be controlled. This study supports the listing of this species as a category 1a invader especially in Gauteng where the number of recorded populations are increasing greatly.

13. Alien grasses: The current local perspective and forming a "National Working Group on Alien Grasses"

Vernon Visser[1] and John Wilson[1,2]
[1]Centre of Excellence for Invasion Biology, Private Bag X1, University of Stellenbosch, Matieland 7602,
[2]Invasive Species Programme, South African National Biodiversity Institute, Private Bag X7, Claremont, 7735..
Email: vernonvisser@sun.ac.za

The grasses form the fourth largest plant family with over 11,000 species with some of the most important crop and pasture species, so it is not surprising that many grass species have been extensively moved around the world. Some of the best examples of invasive species causing radical ecosystem transformations are also the result of introduced grasses—e.g. radically altered fire regimes—with grasses of African origin having often the largest impacts. Comparatively, Africa appears to have suffered far smaller impacts from invasive grasses, with some notable exceptions, e.g. giant reed (*Arundo donax*), Pampas grass (*Cortaderia selloana*) Kikuyu grass (*Pennisetum clandestinum*) and a number of annual grasses of Eurasian origin. Grasses have also received far less attention than woody plants in South Africa, not least because of the difficulty of distinguishing between many grass species. This suggests that there are probably far more exotic grass species in South Africa, at various stages of the invasion process, than we are currently aware of. In addition, increased interest in growing exotic grass species for biofuel (e.g. *Arundo* donax, *Miscanthus* spp., *Sorghum halepense*) or for carbon offsetting (e.g. various bamboo species; e.g. www.trees.co.za/bamboo-for-africa/) is resulting in the introduction of new species and genetic strains of species, and extensive plantings of these species, making the chances of these species becoming invasive much more likely.

Revisiting the paper by Milton in 2004, I will discuss the current state of knowledge of alien grasses in South Africa and around the globe, and provide a brief overview of current and potential impacts of alien grasses both locally and globally. I will then provide an overview of a proposed alien grass working group for South Africa, whose aims will possibly be twofold:

1) producing an inventory of all known alien grass species in South Africa;
2) and conducting a national risk assessment of potential alien grass invaders.

Anyone interested in participating in a working group to achieve these aims is encouraged to attend. This session is intended as an open platform for discussion on the issue of alien grasses in South Africa and the input from interested parties would be most welcome. We also intend to set dates for a possible workshop to be held in Stellenbosch, to further the abovementioned aims.

REFERENCES

CLAYTON, W.D., HARMAN, K.T. & WILLIAMSON, H. 2006 onwards. GrassBase - The Online World Grass Flora. Available at http://www.kew.org/data/grasses-db.html.

D'ANTONIO, C. & VITOUSEK, P.M. 1992. Biological invasions by exotic grasses, the grass/fire cycle, and global change. *Annual Review of Ecology and Systematics* 23: 63-87.

VAN WILGEN, B.W., REYERS, B., LE MAITRE, D.C., RICHARDSON, D.M. & SCHONEGEVEL, L. 2008. A biome-scale assessment of the impact of invasive alien plants on ecosystem services in South Africa. *Journal of Environmental Management* 89: 336-349.

MUSIL, C.F., MILTON, S.J. & DAVIS, G.W. 2005. The threat of alien invasive grasses to lowland Cape floral diversity: an empirical appraisal of the effectiveness of practical control strategies. *South African Journal of Science* 101: 337-344.
MILTON, S.J. 2004. Grasses as invasive alien plants in South Africa. *South African Journal of Science* 100: 69-75.
HENDERSON, L. 2007. Invasive, naturalized and casual alien plants in southern Africa: a summary based on the Southern African Plant Invaders Atlas (SAPIA). *Bothalia* 37: 215-248.
BLANCHARD, R., RICHARDSON, D.M., O'FARRELL, P.J. & VON MALTITZ, G.P. 2011. Biofuels and biodiversity in South Africa. *South African Journal of Science* 107: 19-26.

14. Estimates of the impacts of invasive alien plants on water flows in South Africa

David Le Maitre, Greg Forsyth, Sebinasi Dzikiti and Mark Gush
Natural Resources and the Environment, CSIR, P O Box 320, Stellenbosch

This paper summarises the results of a new assessment of the impacts of invasive alien plants on the water flows in South Africa based on the mapping done by Kotzé *et al.* (2010). The approach took into account basic hydrological principles and factors which limit plant water-use and the accumulated information on water-use by these species in both plantation settings and those typically invaded since the publication of the previous national assessment in 1998. The unit area reduction of 97 mm/yr found in this assessment is about half the 190 mm/yr reported by Versfeld *et al.* (1998). The total reduction in mean annual runoff is about 1 444 million m^3/yr or 2.9% of the naturalised mean annual runoff (see Table A below) which is much lower than the 3 300 million m^3/yr estimated in 1998. The main reason for this is the lower flow reduction, but the decrease in the condensed are from 1.76 million ha in 1998 to 1.50 million ha in this study also reduced the impacts. The greatest reductions were recorded in primary catchment T (former Ciskei & Transkei, 322 million m^3/yr, 4.5%), followed by U (southern KwaZulu-Natal, 154 million m^3/yr, 5.0%) and W (Northern KZN, 149 million m^3/yr, 2.3%). The greatest proportional reductions were in K (Mossel Bay-Tsitsikamma, 8.4%), M (Port Elizabeth coast-Coega, 6.5%), H (Breede, 6.1%) and G (Berg-Agulhas, 6.0%). The taxon with the greatest impacts was the wattles (*Acacia mearnsii, A. dealbata, A. decurrens*) which account for 33.5% of the total reductions, followed by *Pinus* species (18.9%) and *Eucalyptus* species (15.1%). The unit area flow reductions due to pines were 212.1 mm/yr, followed by *Hakea* species (199.5 mm/yr) largely because they occur mainly in high yielding montane fynbos catchments.

This estimate is considered conservative for the following reasons. The approach we used probably underestimates the extent of riparian invasions within the mapped areas. The mapping was limited to catchments which cover only about 54% of the country (but do yield more than 80% of the MAR). There are also extensive riparian invasions by eucalypts, wattles and other species along perennial rivers in semi-arid and arid environments (e.g. middle and lower Orange R, lower Vaal River) whose impacts have not been included in this assessment. In addition, *Prosopis* invasions in the Northern Cape result in a further reduction of about 8.94 million m^3/yr. There are extensive invasions of *Prosopis* species in the North West, Free State and Western Cape provinces which have not been adequately mapped so their impacts cannot be quantified at the moment.

15. Southern African Plant Invaders Atlas (SAPIA) phase II update.

Lesley Henderson
ARC-PPRI, Private Bag X134, Queenswood 0121, Pretoria

The SAPIA database and atlassing project catalogues localities, abundances and habitats of alien plant species growing outside of cultivation. SAPIA phase II launched in 2005 aims to continue Henderson roadside surveys and to encourage public participation. Particular emphasis is on emerging weeds and those proposed for legislation. SAPIA II will provide support for the South African National Biodiversity Institute (SANBI)'s Early Detection and Rapid Response of Emerging Invasive Alien Species project (EDRR).

In the past year 2 400 records were added to the SAPIA database, with 1 800 records from roadside surveys conducted by Lesley Henderson and 600 records from other SAPIA participants— 200 records from EDRR and 400 from another 17 contributors. Eighteen species were added to the SAPIA database, of which 14 were new or emerging species. To date the SAPIA database contains 78 000 records, in c. 1 500 quarter degreee squares (= 15 minute squares), c. 720 species, spanning 34 years. Since October 2006 a total of 28 SAPIA Newsletters have been e-mailed on a quarterly basis to more than 500 recipients.

Emerging species recorded during the past year include: common bee-brush (*Aloysia gratissima*) (Verbenaceae), onion weed (*Asphodelus fistulosus*) (Asphodelaceae), glory flower (*Clerodendrum bungei*) (Verbenaceae), midnight lady (*Harrisia pomanensis*) (Cactaceae), prickly Australian pest pear (*Opuntia stricta* var. *dillenii*) (Cactaceae) and rabbit-foot fern (*Phlebodium aureum*) (Polypodiaceae). Plants of great concern are the 'strangler invaders' such as Queensland umbrella tree (*Schefflera actinophylla*) and pitch apple (*Clusia rosea*). These species germinate on palms and in the forks of trees and grow as epiphytes, sending down aerial roots that will eventually smother the host tree.

The prevention of new invasions is being severely hampered by a lack of effective legislation and law enforcement. Investigations into the potential invasiveness of so-called sterile cultivars of declared invasive species is urgently needed.

16. The National Invasive Alien Plant Survey Phase II

JDF (Ian) Kotzé*, BH (Hein) Beukes and EC (Elna) Van den Berg,
ARC-ISCW, Private Bag X5017, Stellenbosch, 7599, South Africa
*kotzei@arc.agric.za

The negative impact of Invasive Alien Plant (IAP) species on natural areas, as well as other areas such as agricultural land, has been extensively researched. Certain mitigation strategies and programmes have been put in place such as the internationally recognized Working for Water Programme of the Department of Environmental Affairs. Such an initiative requires objectively determined spatial distribution data of IAP species at the required scale to allow for effective planning, implementation and future monitoring of IAP spatial changes. The National Invasive Alien Plant Survey project was initiated by the Working for Water Programme and implemented by the Agricultural Research Council. The aim was to establish and implement a cost effective, objective and statistically sound IAP monitoring system for South Africa, Lesotho and Swaziland at a quaternary catchment level. A complete inventory and a standard sampling approach both have limitations, mainly due to the size of the study area (127 million hectares) and variation in the natural environment, leading to high associated costs. An innovative sampling approach was therefore required. Phase I of the project dealt with the latter, whilst the current Phase II is a spatial refinement of Phase I.

17. A standardized set of metrics to assess and monitor tree invasions

John R. Wilson[1,2]
[1]Centre of Excellence for Invasion Biology, Private Bag X1, University of Stellenbosch, Matieland 7602
[2]Invasive Species Programme, South African National Biodiversity Institute, Private Bag X7, Claremont, 7735.
Email: jrwilson@sun.ac.za

Metrics that are useful for scientists, managers, and policy makers are needed to improve our ability to understand and manage biological invasions at a global level. Here we discuss some of the fundamental features of tree invasions, and what methods can be used to record and monitor them. The aim is develop a standardized set of metrics to describe tree invasions appropriate to meeting specific management goals and increasing compatibility across administrative borders, and between invasions. We recommend six basic metrics: a) status per region (including an interpretation for trees of Blackburn's unified framework for classifying invasive species according to their invasion status); b) the number of populations as an estimate of the number of foci requiring management (defined by a separation of >10km); c) compressed canopy area (i.e. area of occupancy; AOO; net infestation) as a measure of abundance; d) range size (i.e. extent of occupancy; EOO; gross infestation) as an estimate of the total affected area that needs to be considered for management; e) qualitative observations of current and potential impact; and f) a species distribution model to estimate the potential range that could be occupied. These metrics can be used in concert (e.g. we describe a proposed method of categorising invaders based on AOO and EOO), but they represent a basic level of information. For many purposes, additional information will be required (e.g. on potential status, and predicted future population growth rates and spread rates). We hope this represent a step towards a standardised method of reporting invasions along the lines of those already seen in conservation science, but even at a basic level more work is required to develop standard metrics for impact and threat.

18. The Bottom Line: Impacts of Alien Plant Invasions in Protected Areas

Llewellyn C. Foxcroft [1,2], Petr Pyšek [3,4], David M. Richardson[2] , Jan Pergl[3] and Philip E. Hulme[5]
[1]Conservation Services, South African National Parks, Private Bag X402, Skukuza 1350, South Africa; email: Llewellyn.foxcroft@sanparks.org
[2]Centre for Invasion Biology, Department of Botany and Zoology, Stellenbosch University, Matieland 7602, South Africa; email: rich@sun.ac.za
[3]Institute of Botany, Department of Invasion Ecology, Academy of Sciences of the Czech Republic, Průhonice, CZ 252 43, Czech Republic; email: pysek@ibot.cas.cz, pergl@ibot.cas.cz
[4]Department of Ecology, Faculty of Sciences, Charles University, Viničná 7, CZ 128 44 Prague 2, Czech Republic
[5]The Bio-Protection Research Centre, PO Box 84, Lincoln University, Canterbury, New Zealand; email: Philip.hulme@lincoln.ac.nz

Phrases like "invasive species pose significant threats to biodiversity..." are often used to justify studying and managing biological invasions. Most biologists agree that this is true and quantitative studies support this assertion. Protected areas are the foundation of conservation initiatives in many parts of the world, and are an essential component of an integrated approach to conserving biodiversity and the associated ecosystem services. The invasion of alien plants constitutes a substantial and growing threat to the ability of protected areas to provide this service. A large body of literature describes a range of impacts, but this has not been assessed within the context of protected areas. We do not aim to review the state of knowledge of impacts of invasive plants; rather, we collate examples of work that has been carried out in protected areas to identify important patterns, trends and generalities. We also discuss the outcomes of various studies that, while not necessarily undertaken in protected areas, are likely to become important for protected areas in the future.

19. Investigating the influence *of Opuntia fulgida* on species diversity, abundance and soil nutrients: A case study of Guyu Communal Lands-Gwanda.

Buhle Francis
Natural Resources Unit and or Climate Change Unit, National University of Science and Technology (NUST), Bulawayo, Zimbabwe

Various invasive alien species cause significant ecological problems in many different forms and are a hazard to biodiversity. A once off study investigating the influence of invasive alien *Opuntia fulgida* on diversity, abundance of indigenous woody plants and soil nutrients was conducted in the South Western part of Zimbabwe. Randomized plots measuring 30m x 5m replicated 6 times (making a block of 900m2) were demarcated on of 4 different sites with an overall area of 3600m2. The 4 blocks were constituted of; 1) no presence of *Opuntia fulgida* infestation (control), 2) with low infestation, 3) medium infestation and 4) high levels of *Opuntia fulgida* infestation. Species diversity /abundance were measured and calculated in each block including the counting of any carcasses that was present. Soil samples were randomly collected from the surface (0-10cm) in each block to determine the levels of pH, N. P, K, Ca and Mg. Diversity and abundance of indigenous woody species and the levels of N declined with the increase in density levels of *Opuntia fulgida*. High numbers of carcasses were present in the blocks with high and medium density levels of *Opuntia* species and also, Mg increased in these blocks. Generally pH was low in all the blocks while levels of P. K and Ca were insignificant. The paper concluded by acknowledging that invasive alien *Opuntia fulgida* was indeed detrimental to the ecosystems and the environment. As a result, it was causing serious socio-economic problems for the villagers whose livelihood is at threat. Furthermore, the paper proposes the Zimbabwean government to intervene urgently by collaborating with the South African counterparts on the use of bio control (*Dactylopius tomentosus*) and / or consider the economic benefits of *Opuntia* species especial on the production of alcohol as a way to manage the problematic invasive *Opuntia fulgida*.

20. A simple method to develop 'watch lists' for invasive species

Katelyn Faulkner[1,2,3], Mark Robertson[2,3], Mathieu Rouget[2,4] and John Wilson[1,2]
[1]Invasive Species Programme, South African National Biodiversity Institute, Private Bag X7, Claremont, 7735.
[2]Centre of Excellence for Invasion Biology, Private Bag X1, University of Stellenbosch, Matieland 7602
[3]Zoology and Entomology Department, University of Pretoria, Hatfield, 0028
[4]School of Agricultural, Earth and Environmental Sciences, University of KwaZulu Natal, Pietermaritzburg, 3209

Preventing the introduction of high-risk species is often the most logistically and economically efficient form of invasive species management. However, such preventative management strategies must focus on species with a high invasive potential, without unduly restricting personal freedom or commercial activities. To achieve this, methodologies for the prediction of invasive species have been developed around the world, including the development of 'watch lists' of species whose introduction should be prevented. However, the development of such watch lists are not always transparent or scientifically defensible. Using South Africa as a case study, we developed a rapid, easily repeatable invasive species risk assessment method. Three basic criteria: a history of invasion, climate match and propagule pressure were used to identify alien plants as either potential future invaders, non-invaders and those requiring further study. Additionally, the use of two climate match methods and three propagule pressure levels were assessed. The resultant models performed well (sensitivity ranged between 95 and 100%) and predicted that between 81 and 99% of alien plant species with a history of invasion elsewhere may have the potential to become invasive in South Africa. This is a promising technique that can be used in any region of the world for the rapid identification of potential threats.

21. A database of aquatic weeds and biocontrol in South Africa after 6 years of national surveys: a tool for researchers and managers of South African water bodies.

Matthew C. Parkinson
Department of Zoology and Entomology, Rhodes University, Grahamstown, 6140, South Africa.
m.parkinson@ru.ac.za

The database is primarily the compilation of data from 6 years (since 2008) of field surveys conducted by the Biological Control Unit of the Rhodes University Department of Zoology and Entomology, funded by Working for Water. Currently the database holds over 900 sites and over 1 500 individual records, with each of the major weeds at a site during a given year making up one record. The survey focusses on the 5 floating aquatic weeds: red water fern, *Azolla*, Kariba weed, *Salvinia molesta,* water hyacinth, *Eichhornia crassipes*, parrot's feather, *Myriophyllum aquaticum* and water lettuce, *Pistia stratiotes*. Data collected during these national fieldtrips pertain to the species present at a site, the extent of the cover of the water body by each species, the presence of biological control agents and an assessment of general plant health and damage caused by the biological control agents that were present. Digital photographs were also taken at most of the sites that were visited. The data are useful firstly in documenting where the different weeds occur within the country and the extent to which biological control has been implemented in different regions, and secondly contribute towards the long-term monitoring and assessment of management strategies that have been implemented for various water bodies. The data, which is freely available to any person upon request, will allow managers to adopt an adaptive management approach, whereby the efficacy of different strategies can be assessed and modified as and when necessary. Parrot's feather, and its control agent *Lysathi* sp., is presented as a case study.

22. Management of the invasive cord grass, *Spartina alterniflora,* in the Groot Brak Estuary: challenges in a complex estuarine system

Ernita van Wyk[1], Virgil Jacobs[1], Janine Adams[2] and Taryn Riddin[2]
[1]Invasive Species Programme, South African National Biodiversity Institute, Kirstenbosch Research Centre, Claremont 7735, South Africa
[2]Department of Botany, Nelson Mandela Metropolitan University, PO Box 7700, Port Elizabeth 6031, South Africa

Spartina alterniflora is an invasive cord grass native to the Atlantic and Gulf Coasts of North America. The species is adapted to living in salt marshes and estuaries and was found growing in the Groot Brak estuary between Mossel Bay and George in 2004. Research shows that, if left unmanaged, the population in the Groot Brak estuary can spread at a rate 0.162 ha per year and that it can cover 41% of the total vlei area. Currently, the plant occupies 0.9 ha of the intertidal marsh. Experiences from other management attempts, particularly from Washington State, suggest that small populations of this species can be eradicated. An additional advantage for management of the species in the Groot Brak and beyond is that this population does not produce viable seed. Despite these points favouring possible success, management of the species in a seasonally open-closed estuary is challenging. Mechanical removal encourages spread of the plant and therefore herbicides must be used. The use of a glyphosate-based herbicide (Kilomax) was approved in 2010, but the application of the herbicide has been challenged by various factors: financial constraints and the transition of operational responsibility from one agency to another, administrative delays in putting contractors in-field and a relatively short treatment season influenced by whether the estuary mouth is open or closed, such that when the mouth is closed, the plants are submerged for many months and inaccessible for treatment. Treatment must also be confined to low tides, low wind speeds and dry conditions, i.e. no rain. Various treatments are possible and are being tested within the constraints imposed by the estuarine system. These management options and a system to monitor the response of the *Spartina* population to the treatments are described.

23. Developing a national strategy for cactus management in South Africa

Haylee Kaplan[1] and the National Cactus Working Group
[1]Invasive Species Programme, South African National Biodiversity Institute, Private Bag X7, Claremont, 7735.

Cactus species are among South Africa's worst invaders, posing both economic and ecological threats to our country. To effectively deal with both existing and future cactus invasions, the National Cactus Working Group was established in 2012, comprising representatives of all major stakeholders directly involved in cactus management and policy implementation. The purpose of the Cactus Working Group is to co-ordinate cactus management at a national level with the specific objective of drawing up a strategic framework in which this can be accomplished. The goals of the national cactus management strategy are to: 1) prevent new invasions through risk assessment, surveillance and rapid response; 2) manage existing cactus invasions effectively through integrated management of widespread species using best practice methods and eradication of current and potential invaders where possible; and 3) improve knowledge and capacity to manage cactus invasions through research and assessments, education and awareness campaigns, information sharing and engagement with stakeholders. Roles and responsibilities are defined for each strategic action and the Cactus Working Group will continue to meet biannually to ensure effective implementation and evaluation of the strategy. The working group approach has proven to be highly useful in this instance, and might be a useful model for managing other groups of invasive species.

24. Optimizing glyphosate efficacy to successfully control alien invasive species

Hestia Nienaber
Agricultural Research Council – Small Grain Institute, P/Bag X29, Bethlehem, 9700
Email: deweth@arc.agric.za

Glyphosate is a broad spectrum, non-selective systemic herbicide. It is effective in killing all plant types including grasses, perennials, woody plants and alien invasive species. An invasive species refers to those non-indigenous species which have evolved elsewhere and have been purposely or accidentally relocated into an environment where they persist, proliferate and cause harm to the environment as well as to the inhabitants of that environment. Glyphosate is one of only a few herbicides registered for use on alien invasive species. However, when glyphosate is mixed with carrier waters that contain high salt levels, the activity of glyphosate is reduced as a result of chemical modification of the herbicide. This effect is known as antagonism in the spray mixture. Adjuvants, such as ammonium sulphate, are added to such spray mixtures to overcome antagonism. Although adjuvants do not have any herbicidal effects of their own, they play an important role to increase herbicide efficacy. Several adjuvants are registered for use with pesticides, however there is a misconception that adjuvants are alike and that one adjuvant may be substituted for another. This study was conducted to determine which specific adjuvants, including ammonium sulphate, optimise glyphosate efficacy.

Multiple greenhouse trials were conducted at the Agricultural Research Council Small Grain Institute, Bethlehem. Roundup® (glycine) was used as representative of a glyphosate herbicide for all trials. Four registered and five unregistered adjuvants, representative of seven different adjuvant classes, were applied to cultivated oats, cv. Potberg at the recommended rate. A treatment without adjuvant served as control. All experiments were set up as randomized complete block designs. Distilled water was used to eliminate the effect of poor water quality since glyphosate is very sensitive to poor water quality (eg. hard and brackish water). The five unregistered adjuvants that were applied were included in the trials to determine their effect on glyphosate efficacy. The experiments were evaluated after fourteen days by means of weighing fresh shoot mass and data was analyzed using Genstats 15th ed.

Antagonism still occurred when a spreader/sticker adjuvant was mixed with Roundup® in the spray mixture. Low percentages control was also recorded with both buffer/wetter adjuvants (lower than 45%); both stickers (lower than 77%) and the plant oil (lower than 80%). Percentages control of higher than 85% were recorded with when ammonium sulphate, mineral oil or a wetter on its own was mixed with the spray mixture. Additionally, the addition of ammonium sulphate to spray mixtures most often leads to greater herbicide efficacy and weed control.

Results from this study indicate that various adjuvants always have an impact on the efficacy of glyphosate herbicides. This interaction however does not necessarily increase the efficacy of the herbicide and therefore it remains important that correct choices are made and most appropriate spray mixtures be used for optimal weed control.

25. Survey and clearing of *Cylindropuntia fulgida* var. *mamillata* (boxing glove cactus) and *Cylindropuntia pallida* (thistle cholla)

Travor Xivuri
Invasive Species Programme, South African National Biodiversity Institute, Private Bag X7, Claremont, 7735.
t.xivuri@sanbi.org.za

Cylindropuntia fulgida var. *mamillata forma monstrosa* (boxing glove cactus) and *Cylindropuntia pallida* (thistle cholla) are native to south-western USA and northern Mexico. Invasive populations of these cacti have been found in the arid areas of the Northern, Western and Eastern Cape provinces of South Africa, with the invasions likely the result of escapes from succulent gardens. Since 2011, 738 532 ha of farmland have been surveyed to search for boxing glove cactus by visiting farms and homesteads and interviewing landowners. Populations of boxing glove cactus have been chemically controlled using 4% Garlon (Triclopyr (as butoxy ethyl ester) 480 g/L) at thirteen sites in the Northern and Eastern Cape (total of 217 ha). Cochineal insects (*Dactylopius tomentosa*) were released at a further four sites in the Northern Cape and are currently being monitored. *Cylindropuntia pallida* has been chemically controlled at four sites (384 ha) in the Eastern Cape using 2% Garlon. There is no effective biological control agent available in South Africa for *C. pallida*. I will be giving feedback on the progress to date of managing these two species, including the effectiveness of our surveillance strategies and control methods, and how our new insights into these species' distributions and dispersal vectors will help us improve future management plans.

26. Black River: A case study of integrated control methods and collaboration between different departments

Chandre Rhoda
Invasive Species Management, Biodiversity Branch, City of Cape Town
Chandre.rhoda@capetown.gov.za

Three different departments are responsible for clearing the City of Cape Town's waterways, vleis and rivers. Aquatic weed management is not their mandate or core function. Aquatic weed control has always been fragmented, reactive with no long-term planning and budget commitments. The historical lack of cohesive activities and knowledge management, as well as the lack of trained aquatic weed contractors in the City have resulted in poor quality of work. Integrated control options include manual removal, mechanical control, herbicide application and the use of biological control agents. To successfully control aquatic weeds in the City of Cape Town we need to use integrated control methods collaborate between departments and pool resources so that more can be achieved.

The invasive species management within the system are discussed, in relation to historic management. Emphasise will be on the collaboration between departments and the lessons learned that could be rolled out to a variety of projects.

27. Suitability of the defoliating beetle *Physonota maculiventris* (Coleoptera: Chrysomelidae) for release against *Tithonia diversifolia* (Hemsl.)A.Gray (Asteraceae) in South Africa

T. E. Mphephu[1, 2*], D. O. Simelane[1] & T. Olckers[2]

[1]Agricultural Research Council-Plant Protection Research Institute, Private Bag X134, Queenswood, 0121 South Africa

[2]University of Kwazulu-Natal, Private Bag X01, Scottsville, 3209 South Africa

Tithonia diversifolia (Hemsl.)A.Gray (Asteraceae), commonly known as Mexican sunflower, is a perennial bushy plant of Mexican and Central American origin. It has become naturalized in South Africa, particularly in Kwazulu-Natal, Limpopo and Mpumalanga provinces where it has become a problematic aggressive weed. A biological control programme against *T. diversifolia* was initiated in South Africa in 2007. The tortoise beetle, *Physonota maculiventris* (Coleoptera: Chrsomelidae), was initially selected as a promising candidate agent and imported into South Africa in 2010 for host-specificity testing in quarantine. Tests carried out on the beetle so far have shown positive results, including severe damage by the adults and immature stages to the plant's leaves. *Physonota maculiventris* has a relatively short generation period and highly damaging larval stages. Among the 64 test plant species screened, the beetle has caused only minor damage on two non-target speices. Based on these preliminary results, *P. maculiventris* appears to be a highly promising agent for *T. diversifolia* and could provide a solution to the threat posed by this weed in South Africa.

28. Report back on host specificity testing by CABI (UK) of *Puccinia lantanae*

Alan Wood
ARC-Plant Protection Research Institute, P. Bag X5017, Stellenbosch 7600, South Africa

CABI (UK) undertook the host specificity testing of the rust fungus *Puccinia lantanae* for introduction of this pathogen into Australia. An isolate originating from Peru that is more damaging than most was selected for testing. Additional testing of plants of interest to South Africa was opportunistically included, as previous work showed that at least some South African forms of the weed are highly susceptible to this isolate. A total of 46 plants were tested, most in the Verbenaceae but also including some from closely related plant families. Twelve of the species included were of interest to South Africa. The results indicate that the rust fungus isolate is suitable for release in both Australia and South Africa.

29. A new host specific insect for the control of *Pereskia aculeata* (Cactaceae)

Iain Paterson and Martin Hill
Department of Zoology and Entomology, Rhodes University, PO Box 94, Grahamstown 6140

Pereskia aculeata Miller (Cactaceae) is still a problematic invasive in South Africa. The plant outcompetes native vegetation and leads to a reduction in native plant biodiversity. Many protected areas, including national parks and world heritage sites, are threatened by *P. aculeata* infestations resulting in a large amount of resources being used to try control the weed. Mechanical and chemical control is ineffective, expensive and unsustainable because of the plants ability to grow from small cutting and because herbicides are not translocated within the plant tissue. Biological control is considered the only possible method that could reduce the negative impacts of *P. aculeata*.

One biological control agent, *Phenrica guerini* Bechyne (Chrysomelidae) has been released on *P. aculeata*, and although the insect has established at many sites around the country, the damage inflicted by the insect appears to be minimal. New biological control agents are required to reduce the density of *P. aculeata* to appropriate levels.

In this study, a new potential biological control agent for *P. aculeata*, *Catorhintha schaffneri* (Coreidae) was subjected to host specificity testing. Newly hatched nymphs were allowed to feed on six plant species in the Cactaceae, ten species in the closely related plant families, the Basselaceae and Portulaceae, and eight species in more distantly related plant families that have similar mucilaginous or succulent leaves to plants in the Cactaceae. Development to the adult stage was only possible on *P. aculeata* and the closely related congener, *Pereskia grandifolia*. *Pereskia grandifolia* is an exotic species that is a declared weed in South Africa so any damage inflicted to *P. grandifolia* in South Africa is of little concern. No survival to the adult stage was reported on any other species.

Catorhintha schaffneri is safe for release in South Africa. An application for release will be submitted pending the results of an impact study to ensure that the agent is destructive enough to warrant release. The impact of *C. schaffneri* on *P. aculeata* is expected to be significant based on observations in quarantine and in the native range where it is very damaging.

30. Host specificity testing of congeneric species of leaf-mining flies, *Hydrellia pakistanae* (Diptera: Ephydridae) and *Hydrellia* sp. – two candidate biocontrol agents for *Hydrilla verticillata* (Hydrocharitaceae) in South Africa.

Angela Bownes
Agricultural Research Council – Plant Protection Research Institute (ARC-PPRI), Private Bag X6006, Hilton, 3245, South Africa

Hydrilla, *Hydrilla verticillata* is a submerged aquatic macrophyte, native to Asia and Australia that has invaded South Africa, and which is a serious economic and environmental aquatic weed. Hydrilla is genetically diverse, with a wide distribution in its native range hence biotype matching was an important consideration for the biological control programme. Two leaf-mining flies, *Hydrellia pakistanae* and *Hydrellia* sp. of different origins have been under consideration for release against South African hydrilla, a monoecious biotype of Malaysian/Indonesian origin. *Hydrellia* sp., was considered the better match for S.A. hydrilla due to its origin on monoecious hydrilla from Singapore and was therefore the focus of host specificity testing. Additionally, comparative studies showed that *Hydrellia* sp. performs better on S.A. hydrilla compared to *H. pakistanae*, which originates on Indian dioecious hydrilla. Host range testing focused on ecologically similar and closely related species to hydrilla within the order Alismatales. *Hydrellia* sp.'s host range was also compared to *H. pakistanae*, on 'susceptible' non-target species to supplement the performance data which led to a decision reject *H. pakistanae* as a biocontrol agent for hydrilla in South Africa. Test plant species within a closely related genus, *Lagarosiphon* proved to be the most susceptible to both fly species, supporting complete larval development to varying degrees. However, choice tests and host suitability trials with *Hydrellia* sp. demonstrated a distinct preference for its host plant as well as limited potential to establish viable populations on the non-target species. Overall, there were minor differences in non-target host use between the two fly species, further supporting the decision to reject *H. pakistanae. Hydrellia* sp. is considered to pose no risk to native aquatic plant species in South Africa and is thus a promising candidate for biological control of *H. verticillata.*

31. Biological control of Australian acacias: what you see is not what you get

John H. Hoffmann[1], Fiona A.C. Impson[1,2] & Carien A. Kleinjan[1]
[1]Department of Biological Sciences, University of Cape Town, Rondebosch 7700, South Africa.
[2]ARC-Plant Protection Research Institute, P. Bag X5017, Stellenbosch 7600, South Africa.
John.hoffmann@uct.ac.za

Biological control is being used against 13 species of invasive Australian acacias in South Africa with agents comprising two gall midges (Cecidomyiidae), two gall wasps (Pteromalidae), several seed beetles (Curculionidae) and a rust fungus (Basidiomycetes). The fungus is the only agent that damages the whole plant. The insects are all associated with the flowers and seeds on the plants. It is 40 years since the first agent was released, the bud gall wasp *Trichilogaster acaciaelongifoliae* on *Acacia longifolia*. The question is what has happened in the interim and have we achieved anything worthwhile with the flower and seed-feeding insects. An overview of historic and recent events is used to show that, while the record is regrettably incomplete, there is enough evidence to show that the investment in biological control has been very worthwhile and will provide increasing benefits into the future.

32. Aquatic weed survey 2013

Grant D. Martin and Matthew C. Parkinson
Department of Zoology and Entomology, Rhodes University, Grahamstown, 6140, South Africa.
G.martin@.ru.ac.za, M.parkinson@ru.ac.za

Annually, the Rhodes University Entomology Department, funded by Working for Water, Department of Water Affairs, conducts a national aquatic weed survey. To date in 2013 over 150 aquatic weed sites have been assessed in the Eastern Cape, Western Cape, KwaZulu-Natal, Free State, Gauteng and North West provinces. High numbers of biological control agents were found at the majority of water hyacinth, water lettuce, salvinia, parrot's feather and red water fern sites. Excellent control was noted at the majority of sites, however, a couple of sites were found to have no biological control agents particularly in the Eastern Cape. *Sagittaria platyphylla*, an emerging aquatic invasive, was recorded at sites in the Eastern Cape, KwaZulu-Natal and Western Cape and was found to be spreading within the systems where it has established. A summary of the biological control agents released from the Rhodes University mass rearing facility between May 2012 and May 2013 are also presented.

33. Impact of the biological control agent Aceria lantanae (Cook) (Acari: Trombidiformes: Eriophyidae) on the invasive weed Lantana camara (Verbenaceae) in South Africa.

Ludzula Mukwevho1, 2*, Rembu N. Magoba1 and Terry Olckers2
1Agricultural Research Council-Plant Protection Research Institute, Private Bag X134, Queenswood, 0121 South Africa
2University of KwaZulu-Natal (Pietermaritzburg), School of Life Sciences, Private Bag X01, Scottsville, 3209. South Africa

In South Africa, several biocontrol agents for *Lantana camara* have been released over the years, but limited information is known on their distribution and impact on the natural ecosystems invaded by the weed. The study is therefore undertaken to determine the impact of the selected biological control agent, *Aceria lantanae* on *L. camara* in coastal and inland areas and to assess whether biological control of *L. camara* has influenced plant and invertebrate richness and community composition of invaded habitats.

A total of twenty sites (25m2 quadrat each) will be selected from the severely invaded inland (Limpopo) and coastal (KwaZulu-Natal) areas/ Provinces of South Africa. Study sites will include eight *L. camara* infested sites with biocontrol agent *Aceria lantanae*, eight *L. camara* infested sites, free of *A. lantanae* by means of chemical exclusion (control), and four *L. camara* free sites. Biodiversity and lantana growth and reproduction parameters will be collected seasonally from each site.

Epigaeic invertebrates will be sampled using pitfall traps, whereas vegetation parameters will be sampled by means of quadrats. Plant growth and reproduction parameters will be collected from randomly selected lantana plants at both treatment and control sites. This study will generally ascertain the laboratory studies on the impact of *A. lantanae* and provide some insight into the agent's efficiency/ performance in the field.

34. Status of aquatic weeds associated with biological control agents in the southern Mozambique rivers

Silvia F.Langa[1,2] and Martin P.Hill[2]

1. Departamento de Ciencias Biologicas, Universidade Eduardo Mondlane, C.Postal 257, Maputo, Mozambique;

2. Department of Zoology and Entomology, Rhodes University, P.O. Box 6140, Grahamstown, South Africa

The release of biological control agents has reduced the problems caused by many invasive weeds throughout Africa. In Mozambique, the first biological control agents released on the aquatic weeds were *Neochetina eichhorniae* and *Neochetina bruchi* to control water hyacinth. Other biological control agents used on aquatic weeds included *Stenopelmus rufinasus* on *A. filiculoides*, *Neohydronomus affinis* on *P. stratiotes,* and *Cyrtobagous salviniae* on *S. molesta*, but nothing is known of their establishment and impact. The aim of this study was to identify the biological control agents associated with water hyacinth, water lettuce, salvinia and red water fern and to evaluate the impact of the biological control agents on the weeds in southern Mozambique rivers. At Maputo, Umbeluzi, Incomati, Limpopo, Inharrime, Govuro and Save, samples were taken once each in the dry season, and in the wet season to measure the damage caused by the biological control agents. It was observed that two arthropods fed on water-hyacinth plants, namely *Neochetina eichhorniae* and *N. bruchi,* and they varied from site to site. The number of weevils per plant showed varied in different rivers but those numbers did not show significant seasonal differences. The evidence of damage caused by the weevil *N. eichhorniae* on the water hyacinth leaves was remarkable only in the Umbeluzi and Incomati rivers, as shown by the relatively higher number of scars on leaf per total number of weevils found in each plant during the two sampling occasions. The number of scars per most recently opened leaf in the Maputo and Limpopo rivers was very low compared to that from the Umbeluzi water hyacinth communities. No *Neochetina* feeding scars on the leaf most recently opened water hyacinth plants were found in the Govuro and Inharrime rivers. Consequently, water hyacinth in the Maputo, Govuro, Inharrime and Limpopo rivers were healthy, since no weevils were found on the plants, even though there were some old scars on the leaves on plants in the Maputo and Limpopo. Water hyacinth appeared to be in poor health in the Umbeluzi and Incomati rivers; the plants had brownish leaves and, in some places, water hyacinth mats were mixed with grasses. Surveys also showed that the weevil *Neohydronomus affinis* was found in the studied rivers but at a very low density, too low to effectively control *Pistia stratiotes.* It was very difficult to find *Stenopelnus rufinasus* on the *Azolla* plant and no *Cyrtobagous salviniae* was found on *S. molesta* along the studied rivers. This study serves as a baseline of biological control of aquatic weeds in southern Mozambique rivers and should be added to over time. For biological control methods to be effective, it is recommended that the number of biological control agents in the weeds be increased and monitored further.

35. The biological control of boxing-glove cactus

Hildegard Klein,
ARC-PPRI, Private Bag X134, Queenswood 0121, Pretoria. E-mail: KleinH@arc.agric.za

During October 2008, an exceptionally damaging biotype of the cochineal *Dactylopius tomentosus* was first released against the invasive chain-fruit cholla (*Cylindropuntia fulgida* var. *fulgida*) in the Limpopo and Northern Cape Provinces. Following its success in controlling chain-fruit cholla in especially Limpopo and Zimbabwe (which it reached through natural distribution), a trial release was made on the closely related boxing-glove cactus, *Cyl. fulgida* var. *mamillata*, near Askham, Northern Cape, during October 2011. The cochineal biotype was shown to be just as damaging to boxing-glove cactus as it is to chain-fruit cholla. Biological control has now become the preferred control method against this cactus, especially where infestations are dense. Members of EDRR have since harvested cochineal at Askham and redistributed it to several other sites. Two releases (July 2012 and March 2013) have also been made at the rural community of Heuningvlei, NC, where approximately 400 ha have been invaded by a mixture of cactus species, including boxing-glove cactus. It is still too early for results from these releases, but large additional quantities of cochineal will be needed to ensure a reduction of the invasive potential of the cactus in that area.

36. Host plant has no effect on the performance and fitness related traits of the biological control agent, *Pareuchaetes insulata*

Osariyekemwen Uyi[1,2], Martin P. Hill[1], Costas Zachariades[2,3]
[1]Department of Zoology and Entomology, Rhodes University, P. O. Box 94, Grahamstown 6140, South Africa
[2]ARC-Plant Protection Research Institute, Private Bag X6006, Hilton 3245, South Africa
[3]School of Life Sciences, University of KwaZulu-Natal, Private Bag X01, Scottsville, 3209 South Africa

Recent studies have elucidated the morphological and genetic differences between the biotype of *Chromolaena odorata* invasive in southern Africa and the more widespread chromolaena biotype invasive in Asia and West Africa. Incompatibility of biological control agents with the southern African chromolaena biotype has been suggested as a possible factor responsible for the limited success of the biological control of this weed in South Africa. The first biological control agent to establish on *Chromolaena odorata* in South Africa, *Pareuchaetes insulata*, was collected in Florida, USA, on chromolaena plants dissimilar to the southern African chromolaena biotype. Although this insect did establish at one site, out of some 30 sites at which over one million individuals were released, its population level in field generally remains low. In order to understand the reasons behind the poor performance of *P. insulata*, we hypothesized that *P. insulata* larvae prefer chromolaena from Florida to the southern African chromolaena biotype, and that larvae reared on Florida chromolaena should have higher fitness and performance than those reared on southern African chromolaena. To test this, we compared neonate larval preference, larval performance, leaf area consumption, fecundity, survival and several other life history traits on two host plants (Florida and southern African chromolaena) in the laboratory. Our results showed that the neonate larvae of *P. insulata* preferred Florida chromolaena. With the exception of pupal mass, which was higher for individuals reared on the southern African chromolaena biotype, and longevity, which was greater in individuals reared on Florida chromolaena, host plant did not appear to have an influence on other performance parameters and life history traits such as survival rates, development time, female fecundity, duration of egg laying, egg hatchability and mating success. Consequently host plant did not affect host suitability index (HSI) scores. Host plant did not influence leaf consumption. The significantly higher pupal mass of individuals that were fed on southern African chromolaena, compared to the ones that were fed on Florida chromolaena, did not influence female fecundity and other life history traits. Most importantly, our findings indicate that *P. insulata* preference for Florida chromolaena plants did not have any obvious negative consequence on the reproductive performance and other fitness related traits of the insect. Therefore, we conclude that biotype incompatibility may not be the reason or factor responsible for the limited success and/or the poor performance of *P. insulata* in the field.

37. Determining the origin of *Phragmites australis* in South Africa based on chloroplast DNA

Kim Canavan and Iain Paterson
Department of Zoology and Entomology, Rhodes University, Grahamstown, 6140, South Africa

The common reed, *Phragmites australis* (Cav.) Trin. ex Steud. is a perennial reed-like cosmopolitan grass that is one of the most widely distributed angiosperms in the world. In South Africa, *P. australis* is considered an indigenous plant, having a long history of utilisation in the country. However, in recent years expansion of *P. australis* range and abundance has suggested the possibility of a cryptic invasion by a non-native strain. This study determined the origin of *P. australis* in South Africa based on genetic analyses of haplotypes. Two non-coding regions in the chloroplastic DNA were sequenced from samples collected across the reed's range in South Africa. Sequences were compared to Saltonstall (2002) worldwide haplotypes, which included the invasive haplotype 'M' that was found to be invading parts of the U.S.A. Results suggest that there has not been an introduction of an invasive haplotype, more specifically haplotype 'M', and that *P. australis* stands in South Africa are a unique, possibly African haplotype.

38. The role of genetic diversity in biological control agents

Sven Tozer and Iain Paterson
Department of Zoology and Entomology, Rhodes University, P.O. Box 94, Grahamstown, 6140
South Africa

Biological control agents imported into novel environments are often found to be genetically depauperate when compared to the populations in their native ranges. The lack of diversity in the genetic pool may have beneficial or detrimental impacts on aspects of their life histories, host ranges and efficacy as biological control agents. This study examined the effects of reduced genetic diversity in two separate biological control systems, the Pereskia flea beetle, *Phenrica guérini* Bechyné (Coleoptera: Chrysomelidae), a control agent on *Pereskia aculeata* Miller (Cactaceae), and *Eccritotarsus catarinensis* Carvalho (Hemiptera: Miridae) the control agent released on water hyacinth (*Eichhornia crassipes* (Mart.) Solms-Laub. (Pontederiaceae).

The life history of two genetically distinct strains of *P. guerini* such, as the duration of development, fecundity, sex ratio of eclosed individuals, weight at eclosion and weight at pupation were measured. This study found that a more genetically diverse strain performed better than the less diverse strain under uniform conditions. The more diverse strain had an increased developmental time, increased fecundity, was heavier at pupation and eclosion, and expressed a female biased sex ratio with heavier females at eclosion.

Eccritotarsus catarinensis is being investigated in a similar manner to determine if a larger gene pool will increase the efficacy of the control agent. Three genetically distinct strains were created by subjecting populations to varying degrees of bottlenecks. The study will use ISSR markers to compare the levels of diversity between the treatments. An impact study has been initiated which compares the plants response to inoculation by the different treatments and parameters such as ramet production, biomass production, chlorophyll content and surface area damage will be used to quantify impact and damage. Finally a comparison of the fecundity between the three strains will be conducted. The more genetically diverse strain is expected to perform better than a less diverse strain in terms of fecundity of the insects and impact to the target weed.

39. Is South African pompom weed (*Campuloclinium macrophalum*, *Asteraceae*) clonal? Evidence from ITS sequence data.

Lucy Gitonga[1], Glynnis V Cron[1], Andrew Mcconnachie[2] & Marcus Byrne[1]
[1]School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Private Bag X3, WITS 2050, South Africa
[2]Agricultural Research Council-Plant Protection Research Institute, Private Bag X6006, Cedara, 3245, South Africa

Campuloclinium macrocephalum is a highly invasive alien weed in South Africa that is native to Central and South America but the exact origin of the South African populations is currently unknown. It is targeted for biological control but the success of bio-control agents will depend on host specificity and biotype compatibility to the full genetic diversity of pompom weed in South Africa. A total of 52 specimens from across South Africa, 14 specimens from Argentina and three from Brazil were sequenced for the nuclear ribosomal ITS regions. No genetic variation in the ITS regions was found among all the South African specimens sequenced. In the consensus tree resulting from Maximum Parsimony analysis using the ITS regions, one clade comprised all the South African specimens together with the Argentinean specimens and one specimen from Parana Province in Brazil, while two other Brazilian specimens formed a separate clade. Network analysis generated three haplotypes consistent with the phylogenetic tree. One haplotype is shared by all the South African specimens, one Brazilian specimen, and all the Argentinean specimens bar one from Corrientes, which has a unique haplotype. The third haplotype is shared by the two Brazilian specimens. The South African specimens represent a single clone throughout the introduced range that is possibly triploid. The likely origin of the genetically similar South African populations appears to be Argentina, suggesting that candidate biological control agents sampled from Argentina should be equally effective on all South African populations.

40. The power of molecular ecology in uncovering the truth behind *Tamarix* invasion in South Africa

Guelor Mayonde
[1]School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Private Bag X3, WITS 2050, South Africa

Tamarix (Tamaricaceae) is from the Old World, but has become naturalized and invaded other parts of the world including South Africa. *Tamarix usneoides* is the only species native to southern Africa, but the exotic species *T. aphylla*, *T. chinensis*, *T. parviflora* and *T. ramosissima* have been reported to be present in South Africa and these *Tamarix* species are hypothesized to be hybridizing among themselves and with the indigenous *T. usneoides*. Among the exotic species, *T. chinensis*, *T. ramosissima* and their putative hybrids have become invasive. *Tamarix usneoides* is used in southern African mines for phytoremediation as it has the ability to hyper-accumulate sulphate and heavy metals from Acid Mine Drainage from Tailing Storage Facilities and excretes gypsum ($CaSO_4$). *Tamarix* species are morphologically and ecologically similar, making them difficult to distinguish and hybridization adds to the taxonomic confusion. Identification of *Tamarix* species in South Africa is of great importance because of the invasive potential of *T. chinensis*, *T. ramosissima* and their putative hybrids, and also because of the potential usefulness of *T. usneoides*. This investigation aimed to identify populations of pure *T. usneoides* that can be cloned for cultivation for phytoremediation on the mines, and to reveal the geographic origin of the invasive species to facilitate a biological control programme. Nuclear (ITS) and plastid (*trn*S-*trn*G) DNA sequence data and the multilocus Amplified Fragment Length Polymorphisms (AFLPs) markers were used in this study to characterize southern African *Tamarix* species and their putative hybrids. Phylogenetic analyses and population genetic structure confirm the presence of three *Tamarix* species in South Africa (*T. chinensis*, *T. ramosissima* and *T. usneoides*) with admixed individuals. The indigenous *T. usneoides* is clearly genetically distant from the alien species *T. chinensis* and *T. ramosissima*. Although the exotic species remain largely unresolved in the phylogenies, they are distinctly separated through AFLP markers. The *Tamarix* infestation in South Africa is dominated by hybrids between *T. chinensis* and *T. ramosissima*, and the parent species match their counterparts from their places of origin in Asia, which can provide the source of potential biological control agents. Some remote populations, e.g. in north western South Africa at the border with Namibia, of pure breeding *T. usneoides* have been identified and these should be used as a source of genetic material that can be propagated for planting on the mines for phytoremediation programmes.

41.The unofficial Working for Water website

Andrew Wannenburgh[1]

[1]***Working for Water*** **Programme, Department of Environmental Affairs, Private Bag X4390, Cape Town, 8000;**

E-mail: AWannenburgh@environment.gov.za

The unofficial *Working for Water* website was created in 2009 to overcome maintenance delays and content restrictions associated with the corporate website. During its four year existence, the site has been visited by 1,534 unique visitors, 80% from South Africa. The site's focus is on labour-intensive, established, terrestrial invasive alien plant operational support and planning and is divided into assessment, strategy, implementation and monitoring & evaluation pages. The site hosts the only sources of the national assessments; prioritisation strategies; treatment tables, density, workload and herbicide estimation tools; and mechanical, chemical & biological control spatial data.

42. Communicating invasives in a digital era

Kay Montgomery
Nurseries and Pet Trade Partnership, Environmental Programmes

Invasive alien species (IAS) are considered by the International Union for Conservation of Nature (IUCN) to be the second greatest threat to biodiversity on Earth, after climate change. Scientists have battled invasives for a century, governments have employed a range of strategies to control invasives for two decades and conservationists have been flagging the issue as environmentally critical for years. It is now time to take the issue of invasives to the people.

Environmental Programmes is a pioneering leader in the field of communicating the issue of invasives in South Africa. This presentation surveys the communication strategies used internationally over the past decade, explores the range of communication channels open to scientists and professionals working with invasives in South Africa and proposes an exciting new campaign for promoting the issue of invasive species to the public this summer. If you would like people across the world to better understand your work in the field of invasive species in South Africa, this presentation will give you a step-by-step guide on what to do…

Kay Montgomery has a Masters in Geography and Environmental Sciences from the University of the Witwatersrand and has spent two decades working in the South African media. She has worked on various communication and stakeholder projects for Working for Water, Working on Fire and Working for Wetlands - now Environmental Programmes – since 1999.

43. Southern African Weed Science Society

Andrew Wannenburgh[1]

[1]***Working for Water*** **Programme, Department of Environmental Affairs, Private Bag X4390, Cape Town, 8000;**

E-mail: AWannenburgh@environment.gov.za

The Southern African Weed Science Society is a voluntary association, founded in 1978, for scientists and managers in weed science and related disciplines. The Society's mission is to further weed science in Southern Africa through: improving control of the many weeds that drastically reduce our crop production and the alien invader plants that impact on our natural resources; supporting the use of the most efficient and environmentally acceptable control methods to benefit soil, water and atmosphere as well as plant and animal life. The Society promotes weed science in the sub-continent by: holding regular conferences & workshops; supporting the publication of the South African Journal of Plant & Soil; distributing a regular newsletter; encouraging contact with international weed science organisations and local, allied agricultural, industrial, biological and conservation organisations; providing functions and awards to stimulate and recognise excellence and service.