Plant Protection Research Institute

April-June 2011

No 88

Newsletter of the Plant Protection Research Institute (PPRI), an institute in the Natural Resources and Engineering Division of the Agricultural Research Council (ARC)

Inside this issue:

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ARC-PPRI expertise helps protect invertebrates from extinction

South Africa's National Environmental Management: Biodiversity Act (NEMBA) requires that a list of **T**hreatened and **P**rotected **S**pecies ('**ToPS**') be compiled and published by the Minister of Environmental Affairs. This is a principal-conservation measure to assist threatened or imperilled species when they additionally face the hazards of tiny distributions, tiny populations, or direct use such as over-collecting, wanton destruction, illicit trade, and other so-called 'Restricted Activities'. The threat of extinction due to habitat destruction, faced by so many organisms, is addressed in a range of other legislation.

The first ToPS list was published in 2007. As could be expected, it featured mainly rare and threatened plants and vertebrates, but a range of beetles, baboon spiders, scorpions, and a few other invertebrates were also afforded protection in this way.

To keep the ToPS list relevant and current, the Act requires that it be reviewed every five years, which is done by the South African National Biodiversity Institute (SANBI). The 2007 listing of invertebrate animals was controversial and was criticised for being subjective and not based on solid science. For the first statutory ToPS review, in mid-2011, SANBI consulted with several taxon specialists. Herein, Ansie Dippenaar-Schoeman and Riaan Stals, respectively spider and beetle experts of the Biosystematics Programme, played key roles in the creation of an objective ToPS list of terrestrial invertebrates for the coming five years.

Sensibly, compilation of the new ToPS list was based on current IUCN Red Listings, rather than the mere opinions of people. The IUCN 2001 Red List system is objective, transparent and internationally accepted. Hence, a fairly large number of insects, arachnids and other invertebrates were formally Red List-assessed to make their inclusion in, or exclusion from, the ToPS list scientifically defensible. Species previously listed, but not meeting the rigorous Red Listing criteria, were removed from the list.

Which invertebrates are now ToPS?

A draft ToPS list has been submitted to the Department of Environmental Affairs, who will review it and make it available for public comment. The draft list includes 42 terrestrial invertebrate species, 29 of which are listed as Critically Endangered, the most threatened category. They include the following.

- Nine butterfly species on the brink of extinction, all of which have small, declining populations and some of which may already be extinct.
- Two baboon spider species and five large burrowing scorpion species, all threatened by unregulated collecting for the national and international pet (terrarium) trade.
- Cape stag beetles of the well-known genus *Colophon*, in danger of being wiped out through illegal collecting for the beetle collector's trade.
- A damselfly species that was thought to be extinct, but was later rediscovered ata single site, where it is extremely sensitive to disturbance.
- A huge millipede species, five delicate land snail species and two mysterious velvetworm species, all restricted to tiny and vulnerable areas. One of these, the Lion's Hill Velvetworm, has not been seen alive since the year 1900.

The Horned Baboon Spider *Ceratogyrus paulseni* is Critically Endangered and occurs only in an area of 2–3 hectares. A single illegal collection for the pet trade could wipe out the species. (Photograph: Richard Gallon)

Biosystematics

(Continued from page 1)

Specimens in the National Collection of Insects proved instrumental in deciding the threat status of the small stag beetles of the genus *Oonotus*, restricted to South Africa and Zimbabwe.

The list produced by the *ad hoc* team of invertebrate specialists is undoubtedly a huge improvement on the previous list, resulting from its objectively scientific foundation. More potentially threatened species will be formally Red List-assessed in the coming five years for possible protection in a future revision of the ToPS list.

Contact: Riaan Stals at StalsR@arc.agric.za

SPIDER SORTING AND IDENTIFICATION WORKSHOP

As part of the South African National Survey of Arachnida (SANSA), large sample series are received from a variety of projects. These include long-term surveys in the Cederberg, Sani Pass and the Soutpansberg, several student projects, and other research initiatives, such as the Thuthuka Grassland and Savanna Projects.

As a result, the National Collection of Arachnida (NCA) is growing by around 6000 accessions per year. Most of the material received first has to be sorted and labelled before it can be identified. Recently, the Spider Club of South Africa offered to assist with this task, and two very successful sorting and identification workshops were held over weekends at the PPRI Spider Unit.

Large numbers of specimens were sorted and labelled by the volunteers. Their efforts are of great value, as the processed material is now available for identification and for accession into the Arachnida Collection.

Ansie Dippenaar-Schoeman and Petro Marais of the Spider Unit, and Robin Lyle of the Ditsong Museum assisted the volunteers with the specimen sorting procedures.

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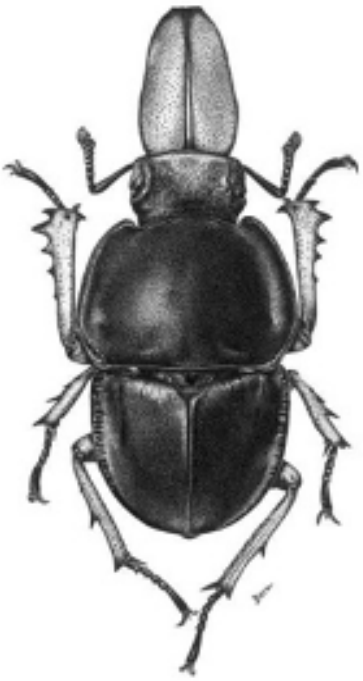

The Endangered *Colophon primosi* (Primos's Cape Stag Beetle) is targeted by the beetle collector's trade. It is potentially threatened also by future climate change. (Illustration: Beth Grobbelaar)

New South African National Coordinator of SAFRINET

Dr. Mariette Truter from Biosystematics was recently nominated as South Africa's new national coordinator for the Southern African subregional Technical Cooperation Network (SAFRINET). SAFRINET forms part of BioNet (the global network for taxonomy), and consists of 15 member countries: Angola, Botswana, Democratic Republic of the Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe. The goal of SAFRINET is to promote taxonomy through various capacity building projects.

Current activities and projects which are driven by Dr. Connal Eardley, the regional coordinator of SAFRINET, include the GBIF World Bee Catalogue, the CBOL bee barcode project, Scale Insect Barcode Initiative (SIBI), etc. Dr. Truter replaced Dr. Gerhard Prinsloo who retired in 2010.

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Biosystematics (continued)

Georeferencing, the science behind an age old practice

Georeferencing is the precise recording of localities. With regard to biodiversity collections, it is the spot where a specimen was collected, and specimen collections are the fundamental data repositories for biodiversity research. Georeferenced collections enable species distributions to be documented. This is vital for understanding the composition and function of ecosystems and agro-ecosystems.

Pollination is an essential ecosystem service. Neither agro– nor natural ecosystems can exist without pollinators since pollination precedes seed and fruit production. Core to understanding pollination is the study of bee biodiversity, documentation of the plants they pollinate and where they occur. Thus, bee taxonomy goes hand in hand with georeferencing.

For this reason Beth Grobbelaar and Connal Eardley, both of the PPRI-Biosystematics Progamme, attended a georeferencing course during April 2011, hosted by the South African node of the Global Biodiversity Information Facility (GBIF), called SABIF. The world experts, John Wieczorek, Nelson Rios, Carol Spencer and David Bloom, presented the course. They were assisted by SABIF's expert staff. Apart from detailed lectures on the theory behind georeferencing, the latest software packages for accomplishing the task were demonstrated and time was allowed for practice.

An aim of the workshop was to train trainers and, although Beth and Connal are not experts, they could help a little in getting others going in using georeferencing software. It does make life a lot easier and quicker than the old printed gazetteer methods.

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Foreign scientist studies South African bees

Like honeybees, stingless bees are social and produce honey. However, they are much smaller and produce less honey than honeybees. Stingless bees are kept by bee-keepers for pollination and honey in many tropical countries around the world, including many African countries. South Africa is still far behind in using them, and further studies are required for the following reasons.

- Their honey has more medicinal properties than honeybee honey. In tropical Africa it is widely used for a number of ailments.
- They are pollinators, and some live in very hot, dry areas where honeybees do not thrive. Also, different bees pollinate different plants.
- They do not sting, and can be kept close to the homestead.
- They are part of our biodiversity.

Earlier this year, Ms Kathrin Krausa, from Ruhr-University Bochum, Germany, spent several weeks in the Soutpansberg in Limpopo Province studying the biology of stingless bees. In June, she visited Dr Connal Eardley at PPRI-Biosystematics. Several years ago, Connal undertook a taxonomic revision of the group to identify the bees she had been studying.

Kathrin's work is important to South Africa because, before bees can be domesticated, knowledge of their taxonomy and biology is required. We hope that Kathrin will return to further her studies in South Africa, and become involved in training locals to understand this untapped resource.

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BIO-INFORMATION WORKSHOP HELD AT ARC-PPRI

As part of the global movement in Bio-information Management, the different National Collections housed at the Biosystematics Programme of ARC-PPRI are busy digitising the natural history collections in their custodianship. The Biosystematics Programme invited ARC-ICT to a Bio-information management workshop where the following aspects were discussed:

- different collections and size;
- digitising activities;
- programmes used;
- where the data is stored;
- challenges facing the researchers;
- way forward.

Seven researchers representing different collections gave presentations. They were:

Dr Riana Jacobs	Fungi
Dr Mariette Marais	Nematodes
Ms Beth Grobbelaar	Cetoniinae (fruit chafer beetles)
Dr Eddie Ueckermann	Acari (mites)
Dr Ansie Dippenaar	Arachnida, non-Acari
Dr Janine Kelly	Apoidea (bees)
Ms Ros Urban	Other insects

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Biosystematics (continued)

5TH AFRICAN ACAROLOGY SYMPOSIUM, ZAMBIA

Prof. Eddie Ueckermann and Ms Tshidi Makutoane attended the 5th African Acarology Congress in Livingstone, Zambia, held from 15-20 May 2011. A total of 27 delegates from 7 countries attended the congress, and 5 were South Africans. A total of 17 papers were presented, and Eddie and Tshidi participated in the following presentations:

TIEDT L.R. & UECKERMANN E. A. Eriophyoid species (Acari: Eriophyoidea) in galls on *Searsia lancea* (L.F.) F.A. Barkley, an indigenous tree from southern Africa.

FASHING N, UECKERMANN E. A. , FASHING P & NGUYEN, N. A new *Bryobia* (Trombidiformes: Tetranychidae) from Ethiopia.
MAKUTOANE M.M.C. & UECKERMANN, E.A. The South African National Collection of mites: documenting southern Africa's mite biodiversity.

NEW MITE DATABASE

The South African National Collection of Arachnology (NCA) of the Arachnology Unit, consists of two collections, the Mite Collection and a collection of the other Arachnida orders. The Mite Collection was established in 1959 by the late Dr. M.P.K. Smith-Meyer. This collection presently consists of 47 812 mounted slides containing > 80 000 specimens including representatives of plant and animal parasitic mites as well as predatory, saprophytic and stored product mites. It represents 117 mite families, 402 genera, and 1 257 species of which 780 are type specimens.

The Mite Collection is also the custodian of the Zumpt Collection of parasitic mites, donated by the Medical Research Council in 1982. The Zumpt Collection consists of a total of 15 500 slide-mounted specimens that represent 42 families, 288 genera, and 535 species including 1 267 type specimens .

To make the Mite Collection more accessible for research, the Arachnida MYSQL relational database, consisting of different modules developed by ARC-ICT department in 2001, was implemented in 2010. This database will eventually house information on the taxonomy, morphology, images, literature and distribution data of specimens collected and housed in the NCA. The Mite Collection is a valuable tool for mite research in southern Africa and the rest of Africa, and has already played an important role in an extensive revision of the sub-Saharan Phytoseiidae, an important predatory mite family.

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Biosystematics building where the Mite Collection (below) is housed

Biosystematics (continued)

Eminent weevil expert visits National Insect Collection

In May 2011, Dr Rolf Oberprieler, world-renowned weevil specialist based at the Australian National Insect Collection in Canberra, paid a day-long visit to the beetle group of the SA National Collection of Insects (SANC). In a way, he was briefly returning to his "own" former collection, as he was the weevil expert at SANC until 1997, when he was appointed to research weevils in Australia.

South Africa and Australia have more than this in common where weevils are concerned. The eucalyptus weevil, a major pest of cultivated eucalypts (gum trees), is of Australian origin, as are the trees themselves. Eucalyptus weevils were first detected in South Africa in 1916, and soon became a very serious pest. In one of the most famous success stories of biological control, these weevils were brought under highly satisfactory control through the importation of an Australian egg-parasitoid wasp. It was first released here in 1926.

For reasons not yet clear, the efficacy of this biocontrol intervention has decreased in recent years. Some research suggests that more than one eucalyptus weevil species may be present in South Africa. Rolf Oberprieler initiated a taxonomic revision of the weevil group in question, and his preliminary findings clearly indicate that the eucalyptus weevils in South Africa are not—as they have been widely known for almost a century—the species *Gonipterus scutellatus*, but a different and hitherto undescribed *Gonipterus* species!

Rolf closely examined the large number of weevil specimens classified as "*Gonipterus scutellatus*" in the SANC as part of his study of this taxonomic problem. It became apparent that every single one of them had previously been misidentified, and that they all belong to the yet unnamed species of *Gonipterus*.

An update will be published in Plant Protection News as this tale unfolds.

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See no weevil. Hear no weevil. Speak no weevil. **Visitor Rolf Oberprieler (centre) with SANC coleopterists Riaan Stals and Beth Grobbelaar**

Acarologist to participate in EU project with Turkey and France

Plant parasitic mites are among the major pests in agriculture throughout the world, and their control still involves the widespread use of pesticides with serious ecological problems. These chemicals kill non-target organisms including predators, and the pests are able to build up resistance against these chemicals. Biological control is, thus, the more logical replacement for these pesticides. Predatory mites, of the family Phytoseiidae, are excellent biological control agents capable of suppressing spider mites and other arthropod pests in agricultural areas.

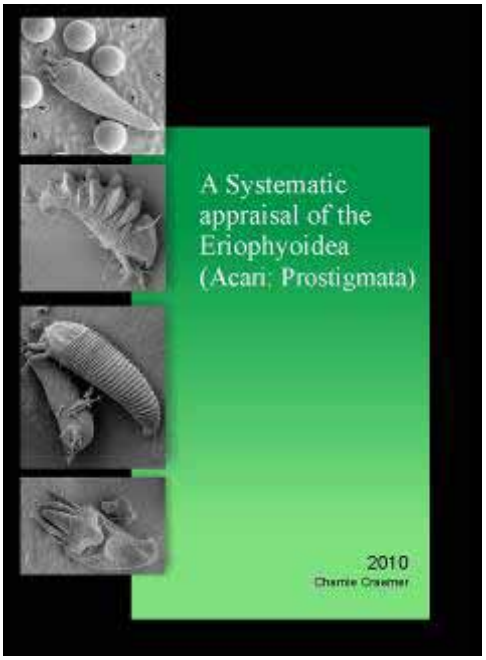
A three year European Union project, called DetanMite, was recently approved with Turkey and France. The aim of the project is to detect and analyse inter- and intra-specific variability of common pest and predatory mites using new molecular and imaging tools. Both molecular markers (DNA) and comprehensive morphological studies, using scanning electron microscopy (SEM), will be used to determine the pests and predators they come across during this study. This project brings together a very strong team from Turkey, France and South Africa, with a high level of scientific expertise in the diagnostics of plant parasitic and predatory mites and biological control. The aim of this project is to produce biological control solutions for agricultural pests, and so to improve and maintain agricultural production, mainly in Europe. However, it also holds promise for South Africa, since surveys will be conducted in all three countries.

Contact: Prof Eddie Ueckermann at UeckermannE@arc.agric.za

Examples of predatory mites

Biosystematics (continued)

CONGRATULATIONS!



Charnie Craemer, of the mite section of the Biosystematics, Arachnology Unit, obtained her Ph.D. in Zoology at the University of Pretoria on 15 July 2011. Her dissertation is titled ,"A systematic appraisal of the Eriophyoidea (Acari: Prostigmata)", and her supervisors were Profs. Clarke Scholtz and Christian Chimimba.

Her study concerned the minute plant-feeding mites of the superfamily Eriophyoidea. The diversity of the Eriophyoidea is largely unknown, and their systematic study mostly entails alpha-taxonomy which is critically important for these mites. Eriophyoid morphology is almost exclusively studied on slide-mounted specimens and, since truly permanent specimen slides cannot be prepared, they are eventually lost. Shortcomings in taxon descriptions are persistent, and too few morphological characters are available for systematic use, particularly for phylogenetic studies. The fragile, simplified and minute eriophyoid bodies, and the inadequate study methods and technology, including preparation and light microscopy, contribute to these problems. The present eriophyoid classification is widely accepted, relatively stable and useful. The major part of the classification, however, is probably artificial, and some taxon delimitations and identifications are becoming increasingly difficult.

Scanning electron microscopy (SEM) is only sporadically used to supplement conventional descriptions of eriophyoid mites, and their phylogeny has hardly been studied. In this study, aspects of eriophyoid systematics are appraised. Some of these are improved by using SEM for morphological study and phylogenetic analyses to test and improve the current eriophyoid classification.

The morphology of about 64 species, mostly from South Africa, was studied with low-temperature (cryo) SEM. The specimens remained turgid and the shape of the mites largely unaltered. A general overview of the contribution of the SEM study towards systematic morphology of the Eriophyoidea is presented. Discrepancies between species descriptions from slide-mounted specimens and the SEM images were found. These include body form, interpretation of structures, resolution and information on minute morphology, and the presence of secretions. Some of these differences were caused by artifacts introduced through slide-mounting of specimens. The SEM study included a comparative morphological study of the gnathosoma, including a review and appraisal of characters presently used in eriophyoid systematics. New morphological information was found, including new characters that may be of systematic use. Charnie proposed that morphology studied with SEM should be routinely incorporated into eriophyoid descriptions, which is not presently the case.

In addition, using morphological data, Charnie studied the phylogeny of the Eriophyoidea at genus level to test the monophyly of the present suprageneric taxa. Three data matrices with 66, 60 and 27 informative characters of 316 (including most *Diptilomiopus* spp.), 64 and 17 eriophyoid ingroup species respectively, were analyzed with parsimony analyses, and trees were searched under different parameters. This was done to find different hypotheses regarding the taxon relationships, to roughly assess the robustness of the tree groups, and to use different approaches: a very comprehensive taxon sample, but with low ratio of characters to taxa; an exemplar species sample to improve the ratio between characters to taxa; and a very small taxon sample with a good ratio between characters and taxa, but very little inclusion of variation found in the Eriophyoidea. Most groups found were supported only by homoplasy, but many made biological sense, and various potentially monophyletic groups, additional to taxa in the present classification, were proposed for further study. The robustness and convergence of these groups on monophyly were discussed. The Phytoptidae was found to be polyphyletic. Part of the Nalepellinae is probably positioned outside the remainder of the Eriophyoidea, while the rest of the Phytoptidae were positioned in smaller subgroups among the Eriophyidae. The Phytoptinae and Sierraphytoptinae, including Pentasetacus, may group together. The Eriophyidae never grouped together with much support, and the family is both polyphyletic and paraphyletic. The Diptilomiopidae was largely found to be monophyletic, with a relatively strong phylogenetic structure. The Rhyncaphytoptinae is mainly paraphyletic, and the Diptilomiopinae polyphyletic, but part of the Diptilomiopinae may be monophyletic.

Three new *Diptilomiopus* spp. from South Africa were described as part of the study. They are leaf vagrants which do not cause any observable symptoms.

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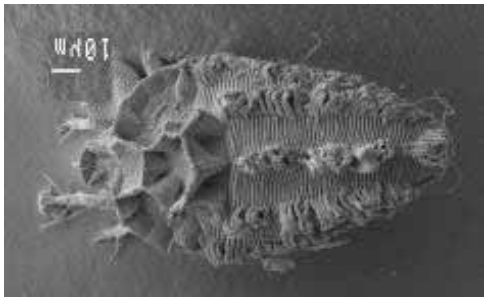

The rust mite, *Calacarus* sp.,has a purple body covered with white wax structures. These mites live on the leaves of the karee tree, *Searsia lancea*

Biosystematics (continued)

SPIDERS….. SPIDERS EVERYWHERE

The Spider Identification Service has been inundated with queries about large spiders found in golden orb-webs during the past summer season. These spiders have been observed in high numbers, and more than 50 photographs were sent to the Virtual Museum for identification. According to members of the public, they have been recorded for the first time in certain areas.

These spiders were identified as being members of the family Nephilidae (genus *Nephila*). They are the largest of our orb-web spiders, with females reaching a body length of 30-40 mm. Males are very small, and are usually seen on the edge of the female's web. The females build large (1-1,5m) orb-webs. The viscid spiral of the web is yellowish, and the radii are pulled out of their direct lines which gives the web a notched appearance. The supporting lines are very strong, and some resistance is felt if one accidentally walks into them. The spiders make use of the same web over a long period of time, replacing only the viscid lines. The web of an older spider is only half a circle, while the web of a young spider is a more complete orb.

Three species of nephilas are found in South Africa, but *N. fenestrata* (black-legged nephila) and *N. senegalensis* (banded-legged nephila), have been the two species mainly recorded. The third species, *N. inaurata*, is more restricted to the western part of the country. Each species is recognizable by its bright, colour pattern which may be yellow with blue or black markings, or creamy yellow with legs banded or with a red hue. Two species have conspicuous tufts of setae on the femora and tibiae of legs I, II and III.

Thanks to all the photographs received, important new distribution data have been added to the Spider Atlas. These spiders are more common in the warmer, humid regions and are found in grassland, savanna, and open forest. They are also frequently encountered in urban gardens. They prey on a variety of flying, and jumping invertebrates. The maps below depict their distribution, and are from the new Spider Atlas.

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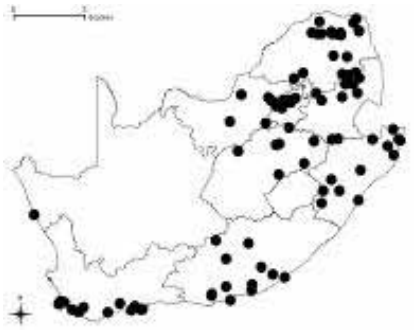
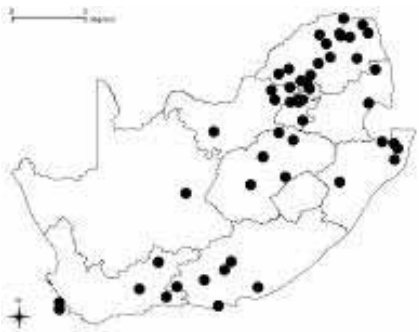
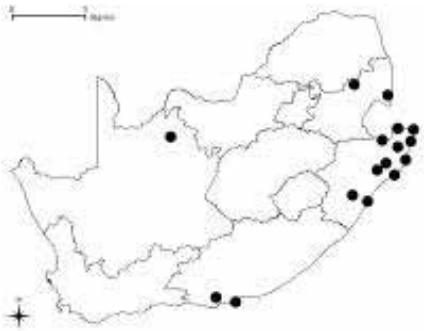
Nephila fenestrata

Nephila senegalensis

Nephila inaurata







Biosystematics (continued)

Reginald Christiaan

INTERN TO LEARN MORE ABOUT ARACHNIDS

Reginald Christiaan, from Soebatsfontein, received funding from the South African National Biodiversity Institute (SANBI) and the University of Cape Town to do a six month internship in Pretoria where he will learn more about the arachnids.

Reginald was previously employed by BIOTA as para-ecologist and has a keen interest in the arachnids, especially the scorpions. While in Pretoria, he also received funding which enabled him to attend a meeting for para-ecologists in Germany in June.

Reginald spends most of his time at the Ditsong Museum but, since mid-June, he has also been visiting the Spider Unit where he has helped sort and label sampled material.

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Researcher from Cameroon visits Mycology Unit

The Mycology Unit received a visit from Rosemary Tonjock Kinge, a researcher from the Department of Plant and Animal Science, University of Buea, Cameroon, in April 2011. She is currently investigating the incidence of the basal stem rot disease caused by *Ganoderma* species in oil palm plantations, and is also involved in determining the identity of various species of *Ganoderma* collected from different hosts, including ornamentals and forest trees, in the Mount Cameroon region. Using morphological and molecular characteristics, the diversity and evolutionary relationships of these specimens collected during different field surveys, will be compared with other *Ganoderma* specimens from other regions in the world. During Rosemary's visit, she deposited 21 *Ganoderma* specimens in the National Collection of Fungi (PREM). This is the first deposit of *Ganoderma* specimens from Cameroon in PREM. All specimens were collected in Cameroon, and comprise 10 different *Ganoderma* species, of which five species did not previously occur in the PREM collection. Currently, the PREM collection houses 37 different *Ganoderma* species. We look forward to receiving more samples from Cameroon for the collection.

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Ms Rosemary Tonjock and Dr Mariette Truter in front of the Biosystematics building

"UP with Science"- group visits ARC-PPRI

Group of UP with Science participants during their visit to Biosystematics and Plant Microbiology

A small group of high school learners who are participating in the "UP with Science" programme, visited Biosystematics and Plant Microbiology in June 2011. The "UP with Science" programme is a science enrichment programme for high school learners, presented by the University of Pretoria. Annually, a number of learners are selected to take part in a three year programme (from grade 10 to 12) aimed at increasing their interest in, knowledge of, and skills in science. The learners, accompanied by their mentors (post-graduate students), received short lectures on the wonders of biodiversity, the importance of preserving our biodiversity through the various National Collections housed at ARC-PPRI, methods of preserving various type of specimens, and the various research projects of the personnel in Biosystematics and Plant Microbiology.

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Pesticide Science

Proposal writing workshop at National Research Foundation (NRF)

Etienne van der Walt attended the NRF Workshop on proposal writing, held on 22 June 2011 at the CSIR Convention Centre. The workshop was facilitated by Dr Robin Drennan of the University of the Witwatersrand. Dr Drennan shared some of his valuable insights for preparing and submitting a successful proposal.

The following is a summary of the crucial aspects of a good proposal.

- It is a good idea to meet with the relevant NRF staff who are involved in administering the proposal, and to discuss the particular request for funding.
- Attention should be paid to the detail of the proposal, and authors should adhere strictly to the guidelines which form part of the submission process.
- The NRF proposals can be downloaded as MS Word attachments, and all formatting should be strictly adhered to.
- The proposal must be kept simple so that the referees can easily glean the information required to complete their adjudication.
- It is advisable to collaborate with other scientists who are known leaders in their field.
- Capacity building through students carries significant weight during the scoring process and, therefore, requires special attention.
- After completion, the proposal should be given to a trusted and respected colleague for input before final submission to the NRF.
- Careful attention should be paid to the structure of a proposal, e.g. headings, sub-headings, introduction, body, and conclusion.
- More details can be found at http://nrfonline.nrf.ac.za
- The author's CV should be updated on the NRF website before submitting a proposal.

The NRF Proposal Writing Workshop document can be viewed at the ARC-PPRI Van der Plank Library (Tel no. ***0128088000).***

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The 11th African Small Mammal Symposium

The **11th African Small Mammal Symposium** hosted by Department of Biological Sciences, University of Swaziland, Kwaluseni, Swaziland took place from 3-8 July 2011. The following three oral presentations were presented by researcher of the ARC-PPRI.

S.R. BELMAIN, **E. VON MALTITZ**, S. EISEB, T. MAHLABA, L.S. MULUNGU, **F. KIRSTEN**, A. MASSAWE, **P. MALEBANE**, A. MONADJEM, P. TAYLOR & R.H. MAKUNDI. Case-control studies of ecologically-based rodent management in rural communities of Swaziland, Tanzania and Namibia.

P.J. TAYLOR, S. DOWNS, A. MONADJEM, S. EISEB, L.S. MULUNGU, A. MASSAWE, T.A. MAHLABA, **F. KIRSTEN, E. VON MALTITZ, P. MALEBANE**, R.H. MAKUNDI, J. LAMB & S.R. BELMAIN. Cryptic species of agriculturally important and associated non-target rodents in Africa: Implications for ecologically based rodent management, taxonomy and conservation.

A.W. MASSAWE, L.S. MULUNGU, R.H. MAKUNDI, N. DLAMINI, S.J. EISEB, **F. KIRSTEN,** T. MAHLABA, **P. MALEBANE, E. VON MALTITZ**, A. MONADJEM, P. TAYLOR, V. TUTJAVI & S.R. BELMAIN. Spatial and temporal population dynamics of rodents in three geographically different regions: implication for ecologically-based rodent management.

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Microbiology and Plant Pathology

Improvement of cross-protection against severe *Citrus tristeza virus* strains in grapefruit

With approximately 55 000 hectares of citrus orchards, South Africa ranks 12th worldwide in terms of total area under citrus. Despite this, South Africa ranks second only to Spain as the largest exporter of citrus fruit. This is largely due to the high quality of South African citrus, which is mainly exported to northern hemisphere countries during their summer season. The high quality is achieved in part due to good agricultural practices, as well as the implementation of the southern African Citrus Improvement Scheme (CIP), which is overseen by Citrus Research International (CRI). The CIP strives to provide growers with planting material that is true to type, and free from harmful pathogens. Citrus is affected by a multitude of bacterial, fungal and viral pathogens, which can reduce the yield and quality of the crop and, thus, degrade the profitability of citriculture.

Citrus tristeza virus (CTV) is the most severe viral pathogen of citrus, and is present in almost all citrus production areas around the world. It is transmitted from tree to tree by a number of aphid species. CTV exists as a large number of different strains, which can be either mild or severe, and can be responsible for a variety of disease symptoms (Fig. 1). Severe strains can induce decline, quick decline, stem-pitting, stunting, reduction in fruit size and yield, and seedling yellows, while mild strain infections are usually asymptomatic. To reduce the damage caused by potential severe strain infections in the orchard, the CIP pre-immunises all planting material with a mild strain population of the virus through a process called cross-protection. Cross-protection is described as the partial, or complete, resistance of a plant to infection of a severe strain of a virus after the intentional inoculation of a mild strain of the same virus. Of all the commercially grown citrus cultivars, grapefruits are the most sensitive to the effects of a severe strain infection, which usually results in the extreme reduction of productivity within a few years after infection. Despite rigorous cross-protection regimes for grapefruit in South Africa, severe strains are still able to infect the plants, and induce what is known as cross-protection breakdown.

Research at the Plant Virology group of the ARC-PPRI/ University of Pretoria/FABI (Fig. 2) is currently being conducted to determine the reasons for cross-protection breakdown, and to improve the efficiency of cross-protection in grapefruit. It is well known that CTV strains have differing capacities to replicate within the various citrus cultivars. Within a population of strains, severe components may be present at low levels on one cultivar, but when transferred to a different cultivar, the severe component may be allowed to replicate to high levels and induce disease symptoms. Some mild strain protecting populations for grapefruit cultivars may contain severe components, allowing for the breakdown of protection. Previous research by our research group has shown which strains are able to replicate to high levels in some grapefruit cultivars. This involved characterising the viral populations at the genetic level on trees showing signs of breakdown.

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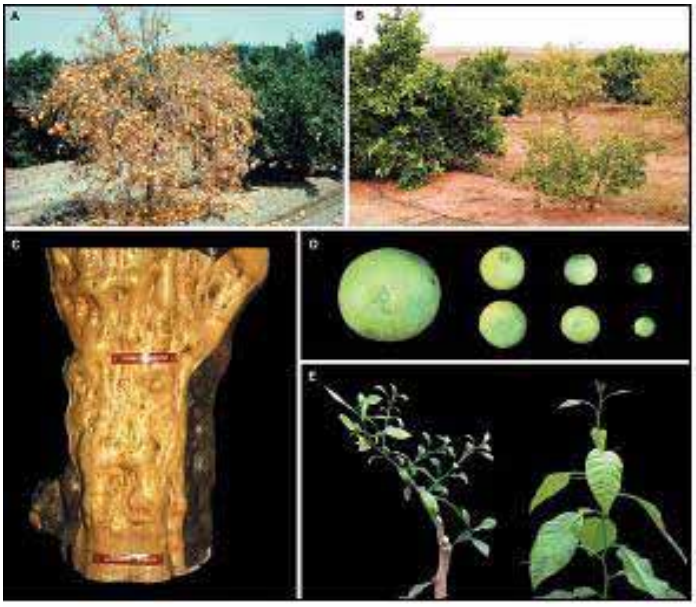

Fig 1: Symptoms induced by severe CTV strains. A: Quick decline, B: Stunting, C: Severe stem-pitting, D: Reduction in fruit size and E: Seedling yellows. (Moreno et al, 2008)

Future research will involve the complete genetic characterisation of potential mild-strain protecting isolates, which can then be assembled into a truly mild population for the cross-protection of grapefruit trees. Improvements achieved for grapefruit cross-protection can then be implemented across all citrus cultivars and will have a positive impact on the profitability of citriculture in South Africa.

Fig. 2: The plant virology group of ARC-PPRI/UP/FABI. From left to right, front to back, Ronel Viljoen, Helen Walsh, Jacolene Lubbe, Olivier Zablocki, David Read and Gerhard Pietersen

Reference

Moreno P., Ambros S., Albiach-Marti M.R., Guerri J. and Pena L. (2008). '*Citrus tristeza virus*: A pathogen that changed the course of the citrus industry'. *Molecular Plant Pathology* 9: 251-268

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David Read is the recipient of the Citrus Research International Prestigious bursary award for the period 2011 to 2014. He will be using it to further his PhD studies working on a number of aspects discussed above under future research objectives.

Weeds Research

Beware of invasive and toxic *Cestrum* species (inkberries, jessamines)

Cestrum is a predominantly tropical American genus of 175 to 250 species, extending from the southern United States and the Bahamas southwards to Chile and northern Argentina. They are small trees or shrubs with leaves usually alternate, simple and entire; the flowers are tubular or funnel-shaped; fruits are fleshy berries, often black (hence the name 'inkberry') and flowers often fragranced (hence the name 'jessamine'). Many species and hybrids are cultivated as ornamentals.

Currently the following species are category 1 declared weeds under the Conservation of Agricultural Resources Act (CARA), and should be eradicated wherever possible: *C. aurantiacum* (orange cestrum) (**Fig. 1**), with orange-yellow flowers and white mature berries; *C. elegans* (crimson cestrum) (**Fig. 2**), with reddish-purple or pink flowers and red berries; *C. laevigatum* (inkberry) (**Figs 3 & 4**), with greenish-yellow flowers in axillary clusters, broad leaves, and black mature berries; *C. parqui* (Chilean cestrum) (**Figs 5, 6 & 7**), with greenish-yellow or brownish flowers in axillary and terminal clusters, narrow, elongated leaves and black mature berries. All *Cestrum* species have been proposed as category 1 plants under the revised CARA and National Environmental Management: Biodiversity Act (NEMBA).

All parts of *Cestrum* species are toxic to mammals. Inkberry and Chilean inkberry are extremely toxic to cattle, especially during the winter months of June and July, and early spring. If large quantities of inkberry are eaten the animal usually dies suddenly; less acute poisoning is accompanied by salivation, watering of the eyes, unsteady gait, accelerated breathing, weak pulse and increasing debility. This condition is sometimes known as "Chase Valley disease" after an area near Pietermaritzburg where this poisoning was prevalent. Orange cestrum is often the cause of poisoning in Zimbabwe and East Africa (Vahrmeijer, J. 1981. Poisonous plants of South Africa). Night-blooming cestrum (*C. nocturnum*), can cause respiratory problems from the scent, and feverish symptoms following ingestion.

Inkberry (*C. laevigatum*) is the most widespread and abundant *Cestrum* species in South Africa (see map), occurring mainly in the moist eastern coastal belt where it grows at the margins of bush clumps and forest, and in the under-storey of forests and plantations. Chilean inkberry (*C. parqui*) is similar, but most easily distinguished by its much narrower leaves. It is better adapted to the cold Highveld, where it has been known along the Vaal River for many years although it was misidentified as inkberry.

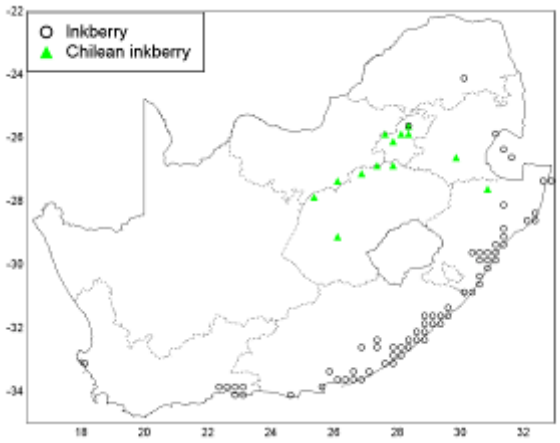
Beware of Chilean inkberry! Toxic to cattle, sheep, goats, horses, pigs, poultry (leaves) and humans. This toxic species is becoming increasingly invasive in Gauteng. Municipalities and residents are urged to eradicate these plants. The plants sucker vigorously from the roots and root fragments. Mechanical control will require repeated cutting. Chemical control options would be better; however, herbicides have been registered only for inkberry in South Africa.

Fig. 1. *Cestrum aurantiacum* (orange cestrum)

Fig. 2. *Cestrum elegans* (crimson cestrum)

Figs 3 & 4. *Cestrum laevigatum* (inkberry)

Figs 5,6 & 7. *Cestrum parqui* (Chilean cestrum)



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Weed Research

Research towards enhancing the biological control of invasive cactus in Northern Cape

A particularly effective biotype of the cochineal insect, *Dactylopius tomentosus,* was released in South Africa during 2008 to reduce the invasive potential of a problematic cactus weed, *Cylindropuntia fulgida* (chain-fruit cholla). As reported in *Plant Protection News* No 79 (2009), the cochineal is extremely damaging to populations of this cactus weed growing near Musina (Limpopo Province), as well as on the Zimbabwean side of the Limpopo River near Beit Bridge, where it has killed cactus plants over extensive areas.

The only other parts of South Africa where chain-fruit cholla has been reported are near Douglas, Campbell and Schmidtsdrift (Northern Cape). The same cochineal biotype was released there during 2003 (in small numbers only) and again in 2008, and although it has resulted in the death of most small cactus plants and detached segments, many large cactus plants still continue to produce new growth from the stem tips, despite the loss of most of their segments. A research project is underway to investigate the reasons for the relatively poor performance of the cochineal in the Northern Cape and, ultimately, to develop an effective integrated control strategy for that area.

One of the apparent reasons for the resilience of chain-fruit cholla in the Northern Cape is that the infestation has existed there since at least the early 1980s, whereas the one in Limpopo was only reported by the late 1990s. The older plants in the Northern Cape have developed thick, woody trunks that persist, despite the attack by cochineal, and are able to compensate for the lost segments by producing new growth. Unlike Limpopo, the lower winter temperatures in the Douglas area will probably retard the activity of the cochineal insects. The extended rainy season, with abnormally high precipitations in the Douglas area during the past summer, can also explain the strong regrowth on the cactus plants which is currently causing concern among affected land owners. Heavy showers are known to dislodge cochineal insects from the plants, while encouraging the host plants to grow strongly. In addition, large numbers of coccinellid (ladybird) beetles were observed feeding on the cochineal during a recent visit to the Douglas area. Another complicating factor is that, during the early 1980s, a different biotype of the same cochineal species was released near Douglas in an attempt to control chain-fruit cholla. This was done long before molecular techniques were developed that revealed the existence of different, host-adapted races (biotypes) within the same cochineal species. Individuals of the two biotypes cannot be distinguished morphologically, but they can interbreed, and this may possibly affect the ability of the progeny to damage a particular cactus species.

Trials are in progress to investigate whether the felling of old cactus plants with woody stems, and that have been significantly damaged by cochineal, will accelerate the demise of the plants. When the results of these trials are available, recommendations for an integrated control strategy for chain-fruit cholla for that area will be communicated to land owners and organisations involved in clearing the cactus.

Financial assistance received from the *Working for Water* Programme towards this research is gratefully acknowledged.

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A large chain-fruit cholla plant near Douglas

Chain-fruit cholla reproduces mainly by detached stem segments that take root. Note that most of these have been killed by the cochineal

Although these large plants have lost most of their old segments, new ones are being produced

Coccinellid (ladybird) beetles feeding on the cochineal

Weed Research (continued)

Current status of yellow bells (*Tecoma stans*), an invasive ornamental plant in South Africa

Tecoma stans L. ex Kunth, also known as yellow bells, is an evergreen shrub or tree in the family Bignoniaceae. Yellow bells (Fig. 1) is native to Mexico and was introduced into South Africa as an ornamental plant because of its attractive, yellow flowers. It has escaped from cultivation and now invades roadsides, watercourses, rocky habitat and unused land. This plant produces large clusters of seedpods with papery seeds that are easily dispersed by wind.

In 1995, *T. stans* was still regarded as an emerging weed and its distribution was restricted (Fig. 2), but by 2010 its distribution extended into seven provinces. It has the potential to extend its range even further, as it is still found in many suburban gardens, and also in neighbouring countries. Mechanical control is not an option for the control of *T. stans*, as it tends to re-sprout when chopped. Also, there are no registered herbicides to control it chemically. Biological control is being investigated as a sustainable, inexpensive and environmental friendly method of controlling *T. stans*.

Currently, there are two biological control agents in quarantine awaiting authorisation for release. They are a leafmining fly, *Pseudonapomyza* sp. (Diptera: Agromyzidae) (Fig. 3), and a leaf-feeding lady-beetle, *Mada polluta* (Coleoptera: Coccinellidae), (Fig. 6). An application for the release of the leafmining fly has been submitted to the National Department of Agriculture, Forestry and Fisheries, while the release application for *M. polluta* still needs to be drafted for submission to the authorities.

The lady-beetle, *Mada polluta*, has been found to be a suitable biocontrol candidate for *T. stans* in South Africa. Both larvae and adults feed on the leaves of the host. The female lays large numbers of clustered eggs (Fig. 4). The insect has a short life-cycle, and is highly damaging to the host plant. The plant can become completely defoliated after the larvae (Fig. 5) and adults have skeletonised the leaves. This level of damage has a huge impact on both under-ground and below-ground biomass. This is an indication that *M. polluta* should be an effective biological control agent, and that it has the ability to reduce the plant populations.

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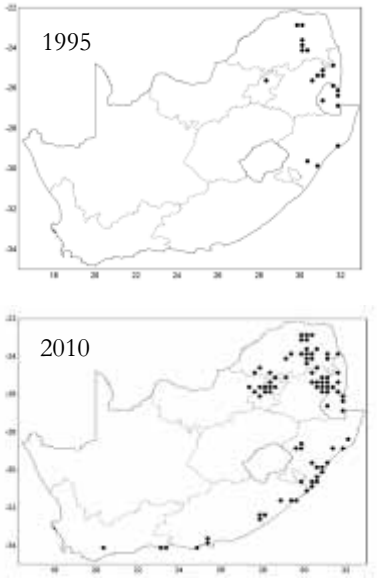

Fig. 2. *Tecoma stans* distribution for 1995 and 2010, showing a huge extension of its invaded range (Drawn by L. Henderson, ARC-PPRI)

Fig. 3. Leafmining fly, *Pseudonapomyza* sp.

Fig. 1. *Tecoma stans* with yellow flowers and immature, green pods

Figs 4 & 5. Clustered eggs and larva of the lady-beetle, *Mada polluta* (Photos: S. Neser)

Fig. 6. Adult of the lady beetle, *Mada polluta* (Photo: S. Neser)

Technology Transfer

Scientific publications

BAGHERI M., BONAB R.N., **UECKERMANN E.A.**, GHORBANI H., MEHRVAR A. & SABER M., 2011. Description of a new species of the genus *Stigmaeus* Koch (Acari: Prostigmata: Stigmaeidae) from East Azerbaijan Province, Iran. *Systematic and Applied Acarology* 16: 181-186.

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