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General News

Taming a Stinging Caterpillar in Hawaii with a Parasitic Wasp

'Foliage voraciously eaten to near decimation', 'Crops gone to waste', 'Itchy rashes, skin welts from burning stings': these complaints from plant growers when the stinging nettle caterpillar (SNC), the larva of the limacodid moth *Darna pallivitta*, was first found on Hawaii Island in September 2001 were not exaggerations. SNC is a noxious leaf-feeding pest of high value crops as well as ornamental foliage, pasture grasses and indigenous flora. Equally important, the unpleasant sting of the larva can result in skin allergy. This was a challenging issue that nurserymen had to deal with because of overhead expenses incurred from a shortage of farm labour due to fear of being stung plus the urgent medical care needed for those stung.

Thought to have been introduced inadvertently from Southeast Asia, SNC quickly spread to the islands of Maui, Oahu and Kauai. Initial efforts to contain the pest with chemical pesticides and other preventative measures proved not only ineffective but costly. Hence, the Pest Control Branch of the Hawaii Department of Agriculture (HDOA) decided to undertake classical biological control to provide long-term mitigation of pest impact on agriculture, risks to public health, and spread throughout the state.

In October 2004 one of our staff travelling overseas made a visit to a plant nursery at Tien Wie in Taiwan and found a ubiquitous insect attacking the larvae of SNC. Sickly-looking larvae were collected and brought back to Hawaii, which yielded several individuals of a tiny wasp. They were identified as the eulophid parasitoid *Aroplectrus dimerus*, which attacks all stages of the larva of SNC. Subsequently, a risk assessment evaluation of 25 species in 13 families of Lepidoptera showed that the parasitoid is highly specific and would not pose a threat to non-target organisms in the natural habitat if introduced to Hawaii. Shortly after, the parasitoid was approved for release in Hawaii by the state and federal regulatory agencies.

In May 2010 we commenced open field releases of *A. dimerus*. The efficacy of the parasitoid was evaluated at several locations on Oahu, Maui and Hawaii Island where plants were heavily infested with SNC. Habitats at the experimental sites included plant nurseries, residential communities and wild vegetation. Censuses of SNC were undertaken at these sites before and at monthly intervals after parasitoid introduction. Periodic collections of larvae were checked for parasitization and moth abundance was monitored with baited traps. By the conclusion of our 12-month field trial we had demonstrated that *A. dimerus* was successfully established in the site habitats, that both single and multiple releases of the parasitoid were sufficient to suppress the pest larvae by more than 80–90%, and that adult moths had become scarcer as our evaluations progressed.

The effectiveness of *A. dimerus* as a larval mortality agent translated to a steady decline in pest moth abundance over time. Moth catches in nearly 200 pheromone-baited traps deployed on the islands of Oahu, Hawaii, Maui and Kauai ebbed several-fold to reach their lowest numbers within three years of liberation. Apparently, persistent parasitization of SNC larvae by *A. dimerus* had effectively prevented the pest larvae from completing development into moths, thus reversing pest build-up to epidemic proportions.

The introduction of this highly specific natural enemy in Hawaii has continued to mitigate the damage inflicted by SNC on high value plants. In addition, people are relieved of burning stings and skin allergies. These findings were echoed by community residents and plant growers in statements such as: 'We do not get stung anymore', 'We hardly see the stinging caterpillar', 'Thankful for the job the wasp has done', and 'Understand and appreciate more the value of biological control'. The impact of the parasitic wasp is demonstrated at a farm nestling in a valley on Maui. The farm is a 1-acre (0.4-ha) commercial planting of 'ti' (*Cordyline fruticosa*), a foliage crop commonly used on the islands for decoration, culinary dishes and religious ceremonies. Before the biocontrol agent was introduced, almost all the plants on the farm were heavily infested with pest larvae so that foliage was pockmarked with holes and many plants were close to defoliation. The farmer was on the point of giving up and ploughing in the plants and planning to switch cultivation to another crop when the parasitoid was introduced. Six to eight months later, pest larvae were considerably suppressed and moth trap catches had dropped dramatically by ten-fold to an almost undetectable level. Consequently, foliage production picked up, harvests bounced back, and the entire crop was saved.

To date, more than 17,000 parasitoids have been liberated statewide. Of this number, 40% were released on Oahu, 30% on Hawaii Island and 15% each on Maui and Kauai. Our field survey suggests that *A. dimerus* is already established throughout the island chain and is keeping the target pest in check at a level that would not have been possible in its absence.

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New Zealand and the Cook Islands Tackle Weed Biocontrol

New Zealand's Landcare Research, funded by the Ministry of Foreign Affairs and Trade, has begun a five-year project led by Quentin Paynter to develop classical biological control of invasive plants in the Cook Islands. The team will be working in collaboration with Maja Poeschko of the Ministry for Agriculture in Rarotonga, and Gerald McCormack, who directs the Cook Islands Natural Heritage Project. It is hoped that the project will not only tackle some of the Cook Islands' worst weeds, but also pave the way for initiatives against the weeds in other Pacific island countries and territories (PICTs) and farther afield – in some cases New Zealand itself.

Island ecosystems are identified in the Convention on Biological Diversity as particularly vulnerable to invasive species and the Pacific region amply illustrates the danger they pose. In the Cook Islands, a large number of plants introduced for their ornamental value, edible fruit or timber have become seriously invasive, and are now threatening native biodiversity, traditional cultural practices, and sustainable development. The eight species targeted by the new project were identified through consultation between Landcare Research scientists and experts in agriculture, biodiversity conservation and biosecurity in the Cook Islands, a process that took into account the importance of each weed and the feasibility of its control. The project is adopting a dual strategy based on biological control of the weeds elsewhere: it is hoped that releases of tried-and-tested biocontrol agents will proceed relatively rapidly against weeds that have already been targeted in other countries, while more research will be needed for the others before introductions can be contemplated.

Biocontrol agents developed elsewhere are slated for release against mikania weed (*Mikania micrantha*), Noogoora burr (*Xanthium pungens*), grand balloon vine (*Cardiospermum grandiflorum*), strawberry guava (*Psidium cattleianum*) and giant reed (*Arundo donax*).

One of the first activities will be to apply for permission to release a rust fungus (*Puccinia spegazzinii*) that has already been released against *M. micrantha* in the Pacific region (Papua New Guinea, Fiji and Vanuatu) and requires no additional testing. It is hoped releases of this rust will begin in the Cook Islands this year. A second rust fungus (*Puccinia xanthii*) has been used successfully in Australia against *X. pungens*, and some additional testing will be undertaken during 2014 to check it is safe to release in the Cook Islands and populations there are susceptible. A third rust fungus (*Puccinia arechavaletae*) and a weevil (*Cissoanthonomus tuberculipennis*), have been identified as good potential agents for *Cardiospermum grandiflorum* in South Africa where this weed is also problematic; the weevil was released there in 2013. The plan is to import both species into containment and obtain clearance for their release in the Cook Islands in 2016/17. *Psidium cattleianum* is naturalized in New Zealand, and may become a weed in the future – as it is in the Cook Islands. A scale insect (*Tectococcus ovatus*), recently released in Hawaii against *P. cattleianum*, is sufficiently specific for the Cook Islands and will be imported into containment to await final clearance for release in 2016. Giant reed is already a weed in both the Cook Islands and New Zealand. Two insects developed as biocontrol agents for *A. donax* in the USA, a gall wasp (*Tetramesa romana*) and a scale insect (*Rhizaspidiotus donacis*), will be imported with a view to releases in the Cook Islands, although with sufficient interest they could also be considered for New Zealand.

Novel research will be undertaken for the remaining three target species: red passionfruit (*Passiflora rubra*), African tulip tree (*Spathodea campanulata*) and peltate morning glory (*Merremia peltata*), and it is these activities in particular that other countries may in future benefit from, particularly the PICTs where the species appear frequently among lists of the most significant invasive weeds but limited or no research into the potential for biological control has been conducted until now.

For *P. rubra*, two *Heliconius* spp. butterflies will be imported into containment for host testing in 2015. For *S. campanulata*, potential agents were identified in preliminary surveys in Ghana in 2009, funded by the Secretariat of the Pacific Community. Landcare Research's plant pathologist, Sarah Dodd, has been assisting collaborators from Rhodes University in South Africa to complete additional surveys in Ghana, the first of which was completed in March. Three candidate biocontrol agents (an eriophyid mite, a tingid bug and a flea-beetle) were selected for host-testing and are currently being cultured in quarantine in South Africa by Iain Paterson of Rhodes University. Finally, a molecular study of *M. peltata* will try and determine how and when this plant colonized the Pacific region. Conflicting views on whether the invasive vine is native or introduced to various islands need to be resolved before further steps can be taken to develop classical biological control for this target weed.

Main source: Anon. (2014) Cook Islands project becomes a reality. *What's New in Biological Control of News* 67, p. 4. Landcare Research New Zealand Ltd 2014.

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NBAII Champions Taxonomy to Underpin Biological Control

Although some 60,000–70,000 species of insects have been described from India, this is estimated to represent less than 50% of the total insect fauna. The potential usefulness of the 70,000 undescribed species is highlighted in 'Vision 2050' from the National Bureau of Agriculturally Important Insects (NBAII), which lays out the ambitious goal of having 100,000 species from India's varied agricultural and natural ecosystems described, with barcodes and relevant bioinformation, by 2050. Some 2% of described species are barcoded to date, and the plan involves increasing this by 2–3% each year with the aim of reaching 80% of species barcoded in a virtual knowledge bank repository by 2050. In addition, only about half of the described species are currently represented by specimens in national collections and there will be an emphasis on collecting and depositing type and voucher material for all current and future described species in the repository at NBAII in Bangalore.

These plans are pertinent to biological control because, as the Director of NBAII, Dr Abraham Verghese wrote in a recent newsletter, more than 50% of India's agriculture does not rely on pesticides but on natural pest controls; this applies especially to small and marginal farmers and 'to them we owe biocontrol services'. At least 10–12% of the planned 100,000 described species are anticipated to be agriculturally important. NBAII's remit includes provision of biocontrol agents and it currently maintains live cultures of over 100 species of arthropods (hosts/prey and natural enemies), entomopathogens and entomopathogenic nematodes. It made over 1000 shipments of parasitoids, predators and microbial agents to farmers, researchers, students and several commercial producers in the 2012/13 year. Under the 'Vision 2050' plan, NBAII will endeavour to increase live cultures to 500 species to aid the delivery of biological control to replace synthetic pesticides for many pests.

Invasive mealybugs in India illustrate well the significance of taxonomy to pest management. In recent issues (*BNI* 34(1) and 35(1)), authors described the successful classical biological control campaign against the papaya mealybug, *Paracoccus marginatus*, following its discovery and definitive identification in India[1], but there are several other exotic species of this group in the country.

Mealybugs had been a minor pest in cotton until outbreaks of varying intensity in 2006/07 caused up to 50% yield loss. These were found to be of a species new to India, identified as the North American species *Phenacoccus solenopsis*[2,3]. Cultural control measures were developed by the National Centre for IPM to reduce its impact, and in 2008 an unknown encyrtid parasitoid of the mealybug, with parasitism rates of 20–70% on various hosts, was found in New Delhi. The new species, probably introduced from the New World with the pest, was described as *Aenasius bambawalei*[4]. Subsequent surveys in 2008 and 2009 found it had spread to most cotton-growing zones, causing up to 90% parasitism in unsprayed crops, and outbreaks ceased as mealybug populations were reduced to trace numbers. A second hymenopteran species, also new to India, turned out to be a hyperparasitoid, *Promuscidea unfasciativentris*, but, although equally widespread, has not significantly diminished the control exerted by *A. bambawalei.* By identifying the new mealybug and parasitoid, the reasons for the sudden outbreaks and their subsequent cessation were clear.

A survey for *P. marginatus* in June 2012 in Tamil Nadu came across another mealybug, which was identified as Jack Beardsley mealybug, *Pseudococcus jackbeardsleyi*, a neotropical species previously unknown from India, and also apparently the first record from papaya[5]. Since then, surveys in Karnataka and Tamil Nadu indicate that it is showing a worrying expansion in its host range over time although it is currently being kept under control by local natural enemies, including *Cryptolaemus montrouzieri*, *Spalgis epius* and species of gnats. Continuing monitoring will ensure that if outbreaks do occur they are identified quickly.

In 2012 yet another exotic mealybug, *Phenacoccus madeirensis*, was recorded for the first time in India[6]. The highly polyphagous species was found on 20 host species in Karnataka, and there were outbreaks in cotton in Mysore but it did not appear to be damaging other crops. Surveys the same year recovered an undescribed parasitoid in large numbers from the mealybug; the same species had been found in the USA, and was presumably accidentally introduced to both countries with its host. A 2013 publication described the new species as *Anagyrus amnestos*[7]. The authors of this paper underline the importance of the formal description given its importance as a potential classical biocontrol agent for what can be an important economic and invasive pest.

General Sources

NBAII sources: Vision 2050 (www.nbaii.res.in/vision.html); Annual Report 2012/13 (www.nbaii.res.in/annual_report/ann12-13.pdf); September and December 2013 Newsletters (www.nbaii.res.in/news_letter.html); Pest Alert (www.nbaii.res.in/news/pestalert1.pdf) – all accessed 11 April 2014.

NCIPM: Mealybug management: a success story of biological control. (www.ncipm.org.in/NCIPMPDFs/success%20story/Mealybug%20success.pdf – accessed 11 April 2014).

Taxonomic References

[1]Muniappan, R., Shepard, B.M., Watson, G.W., Carner, G.R., Sartiami, D., Rauf, A. and Hammig, M.D. (2008) First report of the papaya mealybug, *Paracoccus marginatus* (Hemiptera: Pseudococcidae), in Indonesia and India. *Journal of Agricultural and Urban Entomology* 25(1), 37–40.

[2]Suresh, S. and Chandra Kavitha, P. (2008) Seasonal incidence of economically important coccid pests in Tamil Nadu. *In*: Branco, M., Franco, J.C. and Hodgson, C.J. (eds) *Proceedings of the XI International Symposium on Scale Insect Studies*, Oeiras, Portugal, 24–27 September 2007. ISA Press, Lisbon, Portugal, pp. 285–291.

[3]Hodgson, C.J., Abbas, G., Arif, M.J., Saeed, S. and Karar, H. (2008) *Phenacoccus solenopsis* Tinsley (Sternorrhyncha: Coccoidea: Pseudococcidae), an invasive mealybug damaging cotton in Pakistan and India, with a discussion on seasonal morphological variation. *Zootaxa* 1913, 1–35.

[4]Hayat, M. (2009) Description of a new species of *Aenasius* Walker (Hymenoptera: Encyrtidae), para-

sitoid of the mealybug, *Phenacoccus solenopsis* Tinsley (Homoptera: Pseudococcidae) in India. *Biosystematica* 3, 21–26.

[5]Mani, M., Joshi, S., Kalyanasundaram, M., Shivaraju, C., Krishnamoorthy, A., Asokan, R. and Rebijith, K.B. (2013) A new invasive Jack Beardsley mealybug, *Pseudococcus jackbeardsleyi* (Hemiptera: Pseudococcidae) on papaya in India. *Florida Entomologist* 96(1), 242–245.

[6]Shylesha, A.N. and Joshi, S. (2012) Occurrence of Madeira mealybug, *Phenacoccus madeirensis* Green (Hemiptera: Pseudococcidae) on cotton in India and record of associated parasitoids. *Journal of Biological Control* 26(3), 272–273.

[7]Rameshkumar, A., Noyes, J.S., Poorani, J. and Chong, J.H. (2013) Description of a new species of *Anagyrus* Howard (Hymenoptera: Chalcidoidea: Encyrtidae), a promising biological control agent of the invasive Madeira mealybug, *Phenacoccus madeirensis* Green (Hemiptera: Sternorrhyncha: Pseudococcidae). *Zootaxa* 3717, 76–84.

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In the Eye of the Beholder: Water Hyacinth Management in Florida

A paper in *Biological Control*[1] suggests that a preoccupation of land managers with weed coverage as a proxy for weed status in waterbodies underestimates the potential contribution of biological control to water hyacinth (*Eichhornia crassipes*) management in Florida.

Although four bicontrol agents (the weevils *Neochetina eichhorniae* and *N. bruchi*, the moth *Niphograpta albiguttalis* and the planthopper *Megamelus scutellaris*) have been deliberately introduced since 1972, with another (the mite *Orthogalumna terebrantis*) arriving accidentally, and another two generalist moths (*Samea multiplicalis* and *Synclita obliteratis*) feeding widely on water hyacinth in Florida, herbicides remain the control option of choice and there is little interest in developing an integrated approach.

The authors conducted six 21- to 28-week field experiments at four sites in 2008–2010 that quantified suppression of water hyacinth by the established agents (*M. scutellaris* was introduced only in 2010), using the insecticides acephate or bifenthrin to create herbivore-free controls. Results indicated that, across the sites, biological control reduced water hyacinth biomass by 58% and inflorescences by 97% but coverage was reduced by less than 17% (and this last figure was largely attributed to the disproportionate impact at one low-nutrient site; at other sites cover approached 100% by the end of experiments). Although even a 17% reduction in coverage would not be sufficient to convince land managers whose sole metric is open water that biological control has anything to offer, the authors say that coverage is 'a somewhat arbitrary measure'. They point out that the short-term impact they recorded on biomass and flowering indicates that successive generations of biocontrol agents will gradually weaken plants, and they argue that the success of current herbicide-based management programmes is in large part due to the biocontrol agents' long-term action.

Herbicides have remained the preferred option for water hyacinth control in Florida because they are effective and cheap and their use has been consistently supported by public funds. Although visible insect damage to water hyacinth is widespread, there has generally been no attempt to integrate this natural control with herbicide use because it is easier and simpler to follow spray programmes against aquatic weeds. The authors of this paper suggest, however, that reductions in public funding during the latest economic downturn which, in some cases, allowed weed populations to resurge, provide an opportunity for encouraging land managers to rethink their strategy. Nonetheless, while open water remains the only criterion for judging success, the authors conclude that biological control is not likely to be taken seriously unless new agents (such as *M. scutellaris*) can significantly reduce weed cover.

[1]Tipping, P.W., Martin, M.R., Pokorny, E.N., Nimmo, K.R., Fitzgerald, D.L., Dray, F.A., Jr and Center, T.D. (2014) Current levels of suppression of waterhyacinth in Florida USA by classical biological control agents. *Biological Control* 71, 65–69.

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Ragweed Beetle in Europe: Good or Bad News?

Common ragweed, *Artemisia artemisiifolia*, has the dubious honour of achieving flagship status as an invasive alien plant in Europe. This North American species is an agricultural weed, particularly in spring-sown crops such as sunflower, maize, sugar beet and soybean, but its major claim to notoriety is as a human health issue, with its allergenic pollen now responsible for a significant proportion of asthma cases and allergic rhinitis. Biological control is being considered under a European Union-funded project, SMARTER (Sustainable management of *Ambrosia artemisiifolia* in Europe), drawing on experiences in Australia and Asia.

During project surveys in 2013, a North American leaf beetle was unexpectedly found on *A. artemisiifolia* in southern Switzerland and northern Italy. *Ophraella communa* was recorded over some 20,000 km, in all habitats where ragweed was present, attacking up to 100% of plants, causing severe defoliation, suppressing flowering, and reducing seed set by 10- to 100-fold; pollen loads were also down, e.g. up to 80% less than in the previous ten years around Milan[1]. While unclear how it reached Europe, it has been accidentally introduced elsewhere: it was found in Japan in the late 1990s and China in 2001, and in the latter country is now described as the most successful biocontrol agent of *A. artemisiifolia*.

The rapid spread and the impact of *O. communa* in Europe seen last year could herald the first weed biocontrol success for the continent. Or it may presage a significant agricultural pest issue. The beetle is oligophagous within the tribe Heliantheae and was rejected for introduction to Australia because in no-choice tests it attacked and completed development on sunflower. Indeed, previous studies of prospective biocontrol agents for Europe had prioritized its more host-specific congener *O. slobodkini*[2]. More recent studies in Canada and China, however, suggest that *O. communa* is more specific in the field and sunflower may not be at risk.

While an unregulated introduction should not be celebrated, scientists on the SMARTER project are in a good position to assess potential risks and benefits. They will conduct stratified sampling across a wider area in 2014 to assess the current distribution of *O. communa* in Europe in relation to *A. artemisiifolia* abundance and environmental variables. Its presence in Italy/Switzerland allows them to assess its impact and non-target effects, using inclusion/exclusion studies to quantify impact on the population dynamics of *A. artemisiifolia* and the amount of pollen released in the air, and assess whether European native Heliantheae and sunflower cultivars planted nearby are at risk, especially when the beetles have defoliated the *A. artemisiifolia* plants.

[1]Müller-Schärer, H., Lommen, S.T.E., Rossinelli, M. Bonini, M., Boriani, M., Bosio, G. and Schaffner, U. (2014) *Ophraella communa*, the ragweed leaf beetle, has successfully landed in Europe: fortunate coincidence or threat? *Weed Research* 54, 109–119.

[2]Gerber, E., Schaffner, U., Gassmann, A., Hinz, H.L., Seier, M. and Müller-Schärer, H. (2011) Prospects for biological control of *Ambrosia artemisiifolia* in Europe: learning from the past. *Weed Research* 51, 559–573.

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When Two Aliens Meet: Positives and Negatives

A paper in *Biological Invasions*[1] describes an unusual example of a new-association case of biological control: an ornamental-turned-invasive New Zealand tree in southern California is being brought rapidly under control by a new-association natural enemy that is not a native of California, but a thrips of Australian origin that is itself an accidental introduction to California. The author, while pleased to document the decline in the invasive plant, highlights aspects that give a more worrying perspective to the story.

Myoporum laetum (ngaio) from New Zealand began to be widely planted in urban areas and along highways in coastal California during the twentieth century, becoming in places the most abundant amenity tree. Planting continued despite the growth of naturalized populations that in some cases formed dense monocultures and in the last two decades gave rise to increasing concern. In 2005, an unidentified thrips, subsequently described as *Klambothrips myopori*, was found attacking ngaio in southern California. Over the next 3–4 years the thrips spread rapidly, almost certainly facilitated by the horticultural trade, to sites up to 750 km apart – from San Diego to San Francisco. Locating the origin of the insect was a slower process. There were no published records of the species in New Zealand and targeted searches failed to find it. A similar but distinct species feeds on another *Myoporum* species, *M. insulare*, in southeastern Australia, but searches for *K. myopiri* there were fruitless, until 2011 when it was discovered feeding on *M. insulare* in Tasmania.

The author describes how he recorded the impact of *K. myopori* on *M. laetum* during a series of visits to southern California over some 14 years. While he recorded only healthy plants during his first visit in late 1997, by the time of his eighth visit in 2011 almost half the plants he had been sampling were dead and most of the others were being slowly defoliated. He discusses possible reasons for the unusually fast rate of this ‘inadvertent’ classical biological control together with some other puzzles. However, he finds little mystery in how the thrips managed to reach distant California from Tasmania although it has not crossed the shorter distance across the Tasman Sea to attack *M. laetum* in New Zealand. He points to the role of southern California as an international trade hub, and New Zealand’s strict biosecurity legislation and effective border biosecurity procedures. Since he began studying the thrips, it has made another oceanic journey. Sullivan suggests that its arrival in Hawaii in 2009, where sustained outbreaks on the native *M. sandwicense* have since been reported, was almost certainly an onward move from California, and argues that lax biosecurity measures in the region are putting other Pacific *Myoporum* species under threat.

Sullivan, J.J. (2014) Inadvertent biological control: an Australian thrips killing an invasive New Zealand tree in California. *Biological Invasions* 16, 445–453.

Remembering CABI Biocontrol Staff

Many colleagues will remember with affection two former CABI staff, both active in biological control, who have died this year. Dr T. Sankaran, who passed away in January, was Principal Entomologist and then Director of the Commonwealth Institute of Biological Control’s Indian Station in Bangalore, which has since morphed into NBAII. Dr Dieter Schroeder, an entomologist and forest-pest and weed biocontrol scientist at CABI’s centre at Delémont in Switzerland, and latterly its Director, died in March. We plan to include articles about their contributions to biological control later this year.

Where Has Natural History Gone?

The article earlier in this issue describing NBAII's commitment in their 'Vision 2050' to taxonomy in India brings to mind a recent paper by 17 North American scientists in *BioScience*[1], which describes the importance of 'natural history' in many disciplines, provides evidence that support for it has declined in developed economies, and calls for a revitalization that should take advantage of new technologies and would benefit science and society. The paper was the subject of an editorial in Nature[2] that took issue, in particular, with how natural history has been squeezed out of undergraduate courses in the USA. Both articles are available online and make good reading.

[1]Tewksbury, J.J., Anderson, J.G.T., Bakker, J.D., Billo, T.J., *et al.* (2014) Natural history's place in science and society. *Bioscience* 64(4), 300–310. Web: http://bioscience.oxfordjournals.org/content/64/4/300.full.pdf

[2]Anon. (2014) Natural decline. Editorial. *Nature* 508, 7–8 (3 April 2014). Web: www.nature.com/news/natural-decline-1.14966

Conference Report

The XIV International Symposium on Biological Control of Weeds, South Africa, March 2014

Overview

The XIV International Symposium on the Biological Control of Weeds (ISBCW) was held from 2 to 7 March 2014 in South Africa at an adventurous choice of venue, the conference centre at the Skukuza Camp, in the Kruger National Park. The latter, 360 km from north to south and up to 80 km wide (and about the same land area as Massachusetts) is in the northeast corner of South Africa. It is part of the Great Limpopo Transfrontier Park shared by sections of conserved wild lands in the adjoining countries of Zimbabwe and Mozambique.

The symposium (as depicted conspicuously on the conference logo, programme and meeting paraphernalia) was purposefully planned to commemorate '100 years of weed biological control in South Africa'[1]. The symposium was organized by a small committee comprising: Fiona Impson (Chair), Carien Kleinjan who was responsible for the scientific programme, and John Hoffmann, all from the University of Cape Town; Andrew McConnachie of the South African Agricultural Research Council – Plant Protection Research Institute (ARC-PPRI); Martin Hill of Rhodes University (who was unable to attend the meeting, but whose team of enthusiastic and purposeful proxies from Rhodes, led by Grant Martin and Philip Weyl, ensured that none of the attendees were without suitable liquid refreshments); and Llewellyn Foxcroft, of the South African National Parks, who is based at Skukuza. The organizing committee skilfully and imaginatively arranged and timed events, starting with the dawn chorus at 05.30 when visitors went on 'game drives', followed by the serious business of the conference proceedings (which were greatly facilitated by the audio-visual support provided by Anthony King and Liamé van der Westhuizen and their team), and then an evening drive, or a social event that inevitably extended well into the night, with the jovial sounds of the participants mixing intermittently with those of crickets, frogs, owls, hyenas and lions. The unseasonably heavy downpours (some of the delegates were stranded between flooded rivers and have their own tales to tell) provided further interest and it would be true to say that none of those present had time to be bored.

The Skukuza Camp offered a conference setting with an exceptional African flair. Delegate accommodation was provided in comfortable, air-conditioned, thatched, round houses ('rondavels') dotted around the conference centre and despite them all looking very much alike, lost souls straying around the camp in search of their assigned hut were encountered only occasionally. In addition to the well-organized game drives led by knowledgeable and enthusiastic staff eager to give everybody the full safari experience, the local Skukuza Camp wildlife did its best to contribute to this experience. Highlights included sighting of a stray hyena in the camp restaurant area after the conference dinner, monkey raids on fridges of unsuspecting owners, and the loud nocturnal cries from the trees of other (but perhaps more endearing) primates, the bushbabies.

The conference centre comfortably accommodated the number of delegates attending the meeting and proved to be a suitable venue for both conference presentations and social events. While the lack of WiFi in the auditorium very much enhanced the focus of the audience on the scientific oral presentations, temperamental internet connectivity in the separate, specially-designated computer room caused intermittent frustration amongst users; however, this 'downtime' also created opportunities for bonding and scientific exchange.

Perhaps partly because of the increasingly severe constraints on funding and failure to gain official approval from respective governments/organizations, which made it impossible for many people to attend, there were 156 delegates (and 22 accompanying persons) at the conference, compared to 207 in Hawaii at the XIII ISBCW, and 202 on a previous occasion in 1996 when the IX ISBCW was held in South Africa. Fluctuations in the proportional representations from countries traditionally known to be among the 'big five' (Australia, Canada, New Zealand, South Africa, USA) in weed biological control (WBC) provide cause for thoughtful reflection. Current trends have already become transparent during discussions about the state of biological control in different parts of the world, for example in the workshop which was held during the last ISBCW meeting in Hawaii entitled 'Is classical biological control an "old science" paradigm that is losing its way?' Nevertheless some of these changes can equally well be logical manifestations of dynamic and flexible adaptations to differing circumstances and attitudes to WBC in different parts of the world and, in some countries, signal the growth and development of WBC as a science

(i) Australia was clearly underrepresented with only nine (5.8%) of the delegates at the XIV ISBCW compared with 29 (14.4%) at the 1996 symposium in South Africa, and 17 (8.2%) in Hawaii. Bill Palmer presented a sombre picture explaining these data as an official shift from supporting research on environmental weeds to a present-day emphasis on agricultural weeds: in 1980 there were 33 'full-time-equivalent' (FTE) scientists and 15 technicians engaged in WBC research in Australia; this number has dwindled, in 2014, to 7.5 FTE scientists and no technicians to 'serve all of Australia's WBC needs'. This development starkly contradicts the recent investments in infrastructures such as new state-of-the-art quarantine facilities in Brisbane and Melbourne and has taken place in spite of a demonstrated overall benefit:cost ratio for WBC of 23:1 over the years in Australia.

(ii) Bernd Blossey in his talk commented that in the USA, the risk-averse, 'insane' host-specificity requirements, 'revenge effects', the incomprehensible WBC/conservation divide, and the present climate of restrictive regulations brought about largely by two decades of over-emphasis on the non-target effects of WBC agents, have badly affected the discipline of WBC there. He stressed the irrationality of the argument that once a WBC agent is released this action and its consequences cannot be reversed, because this applies far more strongly to herbicidal use and also applies to other forms of weed suppression. The upshot, in his opinion, is that WBC in the USA is 'in dire straits' although the facts are that 'WBC is successful [at suppressing invasive plants] some of the time, while ALL other management tools fail ALL OF THE TIME!' For years the USA has been dominant at these four-yearly symposia (comprising nearly 60% of the delegates at Hawaii) but was represented by only 27 (17.3%) delegates at the event in South Africa in 2014.

(iii) Surprisingly Canada, who hosted the VI ISBCW in 1980, seem almost to have disappeared from the WBC scene in 2014 with only two (1.3%) of the delegates at the XIV ISBCW compared to their representation in Hawaii – 12 (5.8%).

(iv) On the other hand it was clear from the 2014 proceedings that, even though it is obviously far smaller by land area and population than others in the so-called 'big five', New Zealand with eight (5.1%) of the delegates is probably the leading nation in overall WBC practice in terms of the efficiency and innovation of its administration, organization, regulations, implementation and research, and is palpably making rapid progress.

(v) Also clearly on the crest of a wave is South Africa (not surprisingly as the host nation making up 44.2% (i.e. 69) of the delegates at this symposium cf. 6.3% in Hawaii), which has been increasingly generously funded by the Department of Environmental Affairs, Working for Water programme, with about 35 FTE scientific staff and 40 technical and support staff involved in WBC research and implementation. Many of the oft-time and senior attendees at previous conferences remarked that WBC success in South Africa is not only attributable to committed political support but also relates to strong ties of cooperation over the last 50 years between research personnel at different government institutions and at the universities that are involved in WBC.

Further, as far as the other demographics of attendance at the XIV ISBCW go, it was clear from the conference proceedings that there is a rapidly increasing interest in WBC in Europe (and in several other countries such as Brazil, Saudi Arabia, Indonesia and the Philippines not traditionally associated with WBC) which accounts for the enhanced representation of European delegates at the meeting in the Kruger National Park – 28 (18%) from Europe compared with only 19 (9.2%) in Hawaii. A reflection of this was the many and telling contributions from persons from CABI. This organization was represented by 13 delegates (8.3%) compared with only eight (3.9%) in Hawaii. Sadly, apart from participants from South Africa, only one other African country was represented, where, in any event, that single person is a South African now working for CABI in Kenya.

Lastly, it was an important and positive feature of attendance at this symposium that up-and-coming, younger scientists from all over the world were very well represented. The structure of the programme made it possible for them to make a significant contribution through their confidently presented talks and excellent science. Thus, however the attendance statistics are judged, the presence, prominence and enthusiasm of the next generation of WBC scientists at the XIV ISBCW seems to bode well for the future of the discipline.

Scientific Programme

The organizing committee put together an interesting, well-balanced scientific programme structured into nine WBC-thematic sessions, as well as an opening and closing session.

Session 1: Exploring new biological control possibilities;
Session 2: Exploration, and host-specificity testing of promising agents;
Session 3: The efficacy of proposed or established biological control agents;
Session 4: Post-release evaluation of biological control agents;
Session 5: Risk assessment;
Session 6: Interactive effects in biological control;
Session 7: Biological control in the 'developing' world;
Session 8: Management and implementation of biological control; and
Session 9: Diminishing resources despite effectiveness of biological control.

In addition, the following three topics were addressed during evening workshops: 'Eupatorieae' (i.e. mostly discussions on *Chromolaena odorata*); '*Tamarix*' (running concurrently); and 'Barriers to biological control in the developing world'.

In contrast to previous meetings there were no allocated keynote talks for sessions, thus allowing more time for individual 15-minute oral presentations. Another bold change was the introduction of five-minute 'speed talks' for poster presentations rather than the traditional poster sessions with designated board displays. These novelty speed-talks were an outstanding success, giving younger and perhaps less well-known scientists an opportunity to present orally the essence of their research (backed up in most cases by hand-outs outlining the synopsis of the talk) and giving the audience the chance to put faces to names. Considering the option to attend early-morning or late-afternoon game drives, there was also no mid-symposium tour scheduled. These 'time-saving measures' combined with good time-keeping by speakers and session chairs allowed 130 oral presentations in four days giving a far wider spectrum of participants the opportunity to present themselves and their work. Throughout the symposium the general levels of audience interest, as gauged by nearly full-houses for every session, and by a very gratifyingly high 'alert:nodding-off' ratio even during the 'funeral hour' after lunch, were remarkable, especially in view of the early start to each day.

The thought-provoking opening address delivered by William Bond (University of Cape Town) scientifically embedded the conference into the hosting continent. The presentation analysed the fate of African grasslands in connection with key drivers such as climate, atmospheric composition, fire, herbivory and new biotic lineages, and discussed potential scenarios for the uncertain future of this enigmatic ecosystem. Following on from this, John Hoffmann (University of Cape Town) put the theme of the conference '100 years of weed biological control in South Africa' into context by giving a fair balance in explaining its successes, failures and recent innovations. WBC started in South Africa in 1913 with the highly successful introduction of a cochineal insect against a prickly pear cactus, *Opuntia monacantha.* Since then some 75 agents have been established against 48 weeds species.

With the scene for the meeting set, the presentation of specific scientific topics of interest to the biocontrol community commenced. As in previous years the ratio of entomological versus pathology-focused contributions of 7:1 clearly reflected the respective proportional representation of members' research interests in the audience. However, a number of talks, particularly in sessions 5, 7, 8 and 9, addressed overarching issues and problems in the field of WBC.

Advances in finding WBC agents for new weed targets, and successes and failures both at the laboratory testing and the post-release stage were regaled with enthusiasm, and provoked much interest in the audience. However, while difficult to pick with so many excellent presentations, a few topics stood out in terms of their importance to the field. Europe is changing its long-established role of being solely a 'donor' of nearly 500 species of biocontrol agents to other parts of the world. With the release of an arthropod agent against Japanese knotweed (*Fallopia japonica*) and a potentially soon-to-be-released pathogen against Himalayan balsam (*Impatiens glandulifera*) in the UK, the European region is actively joining the WBC-implementing nations, only a century behind the 'big five'! Brazil, also a significant WBC-agent 'donor', is now considering introducing an off-the-shelf pathogen agent for the control of rubber vine (*Cryptostegia grandiflora*).

The importance of post-release monitoring (especially long-term evaluations), an area notoriously poorly funded, was emphasized repeatedly; not only for its value in helping to convince donors of the value of WBC, but also to improve release strategies and to help with targeting areas where agents are most likely to establish. There was a clear emphasis on the promotion of a holistic strategy in the development, implementation and monitoring in the WBC field, for example as an objective of the South African Working for Water programme.

A number of presentations looked at issues that arise when considering redistribution of successful biological control agents: for example, the ethics of introducing a WBC agent into one region (South Africa to control parthenium weed, *Parthenium hysterophorus*) when a crop species in a distant country (Ethiopia) is known to be at risk from this agent. Despite such concerns, a gratifyingly significant number of success stories were told: for example, prickly pear (*Opuntia stricta*) and several other invasive cactus species, red water fern (*Azolla filiculoides*) and parrot's feather (*Myriophyllum aquaticum*) in South Africa; mist flower (*Ageratina riparia*) and Montpellier broom (*Genista monspessulana*) in Australia; tropical soda apple (*Solanum viarum*) in the USA; mikania weed (*Mikania micrantha*) in Asia… and the list goes on.

Issues that are currently holding back the implementation of WBC were well covered, focusing on safety and providing help to the regulatory authorities in making decisions regarding the risk of releasing biocontrol agents. For example, a 'risk index' was presented for insect agents that was based on combining the relative performance in no-choice larval starvation and oviposition tests; also featured was the use of open-field testing in providing data to back up laboratory studies. A comprehensive worldwide assessment was presented of non-target attack putting this fundamentally important and contentious issue into perspective (a storm in tea cup!) and this analysis will surely be seen as the catalyst in allowing WBC to make its full contribution to invasive plant suppression in future.

Many new techniques were demonstrated, such as those that can help hone host-specificity testing by considering a multiplicity of cues (not only olfactory and gustatory) to try and comprehend host-plant feeding and oviposition choice by insects in the field and in the laboratory. In this context, an important cautionary talk was presented concerning potential pathogen 'hitch-hikers' when testing WBC agents –

especially insect phloem-feeders – which must be proven to be non-vectors of plant diseases before they are declared safe for release. This presentation also highlighted how the continuous development of more sophisticated diagnostic tools and technologies increases the possibility of detecting such organisms, which have previously remained cryptic and escaped detection.

Possibly the cherry on the top of the entire proceedings was an account of the updated (but different, much more comprehensive, and vastly improved) version of the up-to-now-indispensible Julien and Griffiths work from 1998 *A World Catalogue of Agents and Their Target Weeds*. News of the updated catalogue, by Mark Schwarzländer and co-authors, comprised an astounding story of checking, re-checking and verification which will result in a book of nearly 1000 pages with 2800 references and an online version containing additional information. It is doubtful that there is any other sub-discipline in biology that can boast such a complete and accurate record of its worldwide activities since its inception.

The closing address by Marcus Byrne (University of the Witwatersrand) was an entertaining and fascinating account of the complex biology of dung beetles, a group that has featured in biological control for decades with several species from southern Africa imported into Australia to disrupt the breeding of fly-populations in mammalian dung.

Conclusions

Throughout the conference, from the overall organization to queries by individual scientists, from game drives to social evening events, from the welcoming on the day of arrival to the farewell on the last day of the meeting, the professionalism and hospitality of the South African hosts shone through every aspect, thus making the meeting a memorable event for all, not only for the science presented and discussed, but also for the friendships revived and forged. The proceedings of the meeting will be, for the first time, produced as a CD rather than as a book and will also be available in PDF format on the ARC-PPRI website (www.arc.agric.za). Apart from saving on paper and printing costs, this has the advantage that colour pictures and posters can be easily and cheaply included.

The final session before closure of the conference was devoted to the bid to host the XV ISBCW in 2018. Hariet Hinz (CABI Switzerland) presented an entertaining proposition to organize the next meeting in the alpine resort of Davos in Switzerland, capturing the imagination of delegates not only because of the location, but also because of the attractive prospect of exploring the uniquely Swiss way of life. The bid was unanimously accepted.

[1]Moran, V.C., Hoffmann, J.H. and Zimmermann, H.G. (2013) 100 years of biological control on invasive alien plants in South Africa: history, practice and achievements. *South African Journal of Science* 109, 1–6.

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