instituted in the 1920s prohibiting gooseberry cultivation. After the lifting of the Federal quarantine and the more recent availability of disease-resistant gooseberries, States in the Northeast amended their restrictions. In 2011 a breakdown of WPBR immunity in cultivated gooseberries was discovered in Connecticut. A second problem, an unprecedented epidemic of foliar pathogens, has repeatedly defoliated white pines since 2010 following an unusually wet spring. Thirdly, Caliciopsis canker is a native disease that has been receiving renewed interest because of its association with declining white pine health. Cooperative efforts have been established among the U.S. Forest Service, Canadian Forest Service, Cornell University, University of New Hampshire, University of Maine, and forest health cooperators from New England to 1) continue regional surveys to evaluate the impact of WPBR, 2) monitor and evaluate impact of foliar diseases, 3) develop management guidelines for Caliciopsis canker, and 4) provide disease information products.

Alien invasive threats to UK forests: a reassessment in the wake of ash dieback. Woodward, S., Boa, E. (*University of Aberdeen, UK; s.woodward@abdn.ac.uk; e.boa@cabi.org*).

UK forests and woodlands, and trees in other situations, are facing unprecedented challenges from the influx of alien invasive pests and pathogens resulting from increased global trade. Confirmation of the presence of ash dieback, caused by *Hymenoscyphus pseudoalbidus*, in UK woodlands in late 2012 provided a wake-up call to the authorities, leading to a flurry of activity from the government, sometimes prompted by the noisy clamour raised by the media on the subject, aimed initially at containing the problem, but rapidly evolving into planning for a future without substantial numbers of *Fraxinus excelsior* in the environment. The arrival of this new disease, however, should not have been a surprise. Ash dieback was well-known from a steady advance across Europe. Ash dieback, however, is only one of many known pests and pathogens threatening trees in the UK. Add the potential numbers of unknown pathogens, and the number of threats could become very large indeed. Current threats, including the panoply of *Phytophthora* spp. already present in Europe, along with pathogens such as *Ceratocystis platani* and *Fusarium circinatum*, will be put in perspective against the potential hosts present and grown widely in the UK. In addition, the recommendations of the UK Government's Tree Health Task Force will be presented for discussion.

G-05 Global approaches to the biological control of invasive Eucalyptus pests

Organizers: Simon Lawson (Queensland Department of Agriculture, Fisheries and Forestry, Australia), Toni Withers (Scion, New Zealand) & Helen Nahrung (University of the Sunshine Coast, Australia)

Biological control of the eucalyptus gall wasp, *Leptocybe invasa*, in South Africa. Hurley, B., Dittrich-Schröder, G., Baffoe, K., Wingfield, M., Slippers, B., Garnas, J. (*FABI, University of Pretoria, South Africa; brett.hurley@up.ac.za; Gudrun.Dittrich@fabi.up.ac.za; kwabena.baffoe@fabi.up.ac.za; mike.wingfield@fabi.up.ac.za; Bernard.Slippers@fabi.up.ac.za; jeff.garnas@fabi.up.ac.za*).

The eucalyptus gall wasp, *Leptocybe invasa* (Hymenoptera, Eulophidae), is native to Australia, but since 2000 has spread to all continents where *Eucalyptus* spp. are grown commercially. The insect causes leaf and petiole galls which result in deformation and stunted growth in numerous species of *Eucalyptus,* causing substantial losses in countries where it has been introduced. Biological control is one of the most viable options for the management of this pest. The parasitic wasp, *Selitrichodes neseri* (Hymenoptera, Eulophidae), was discovered in Australia in 2010, and successfully reared in quarantine and later released in South Africa. *Selitrichodes neseri* has displayed many favorable characteristics as a potential biological control agent, including high rates of parasitism on *L. invasa*, short developmental time, lack of a pre-oviposition period, long adult lifespan, ability to utilize a range of different gall ages, and high host specificity. Post-release studies have shown a high establishment success, but the impact of these releases on *L. invasa* populations must still be determined. Research is also underway to investigate the influence of temperature and other climatic factors on *S. neseri* survival and establishment, and to better understand host behaviors.

BiCEP: Australia's key role in providing biocontrol solutions for global Australian-origin eucalypt pests. Lawson, S., Griffiths, M., Nahrung, H. (*University of the Sunshine Coast, Australia; Simon.Lawson@daff.qld.gov.au; manon.griffiths@daff.qld.gov.au; hnahrung@usc.edu.au*).

Australian-origin insect pests threaten the productivity and sustainability of eucalypt plantations worldwide. New pests such as the bronze bug (*Thaumastocoris peregrinus*), two gall wasps (*Leptocybe invasa* and *Ophelimus maskelli*) and the lerp psyllid (*Glycaspis brimblecombei*) have emerged as key global pests, while longer-established pests such as the eucalyptus snout beetle (*Gonipterus* spp. complex) are re-emerging as significant issues. The speed at which these pests have emerged, invaded, and spread globally has taxed industry's ability to manage them effectively. Global issues such as these require global solutions. The Biological Control of Eucalypt Pest Research Alliance (BiCEP) has been established in Australia to provide a focus for developing biological control solutions for key eucalypt pests. BiCEP is funded by eucalypt plantation industry partners and delivers the research and development required to underpin effective biological control of pests in three categories of need: discovery (pests that do not have known effective biocontrol agents), application (pests with known but not yet established or evaluated biocontrol agents), and fine-tuning (pests that have established biocontrol agents but which require better climate/host matching). BiCEP is funded pro rata on area of partner's plantations. Examples of research in these categories will be outlined.

Towards biological control strategies for the bronze bug, *Thaumastocoris peregrinus*, on eucalyptus plantations in South America. Martinez, G. (*National Agricultural Research Institute, Uruguay; gmartinez@tb.inia.org.uy*), Barbosa, L. (*EMBRAPA, Brazil; leonardo.r.barbosa@embrapa.br*), Botto, E. (*Instituto Nacional de Tecnología Agropecuaria, Argentina; enbotto@cnia.inta.gov.ar*), Wilcken, C. (*São Paulo State University, Brazil; cwilcken@fca.unesp.br*).

The bronze bug is an invasive Australian pest that has reached eucalypt production areas worldwide in <10 years. The first record in South America was in 2005 in Argentina. Collaboration in the region towards a unified strategy for the management of the

bronze bug started soon after the dispersal of the pest into Brazil and Uruguay was confirmed. Here, we present the main achievements of this collaboration in four main topics: 1) biology of the pest, 2) monitoring, 3) biological control, and 4) cooperative networks. Two mass rearing procedures have been implemented in the region with relative success, allowing basic biological studies on the pest. Continuous monitoring in the region for >5 years has provided a reasonable knowledge on seasonal patterns of *T. peregrinus*. Biological control strategies developed include the use of local natural enemies of *T. peregrinus*, the development of biopesticides, and the introduction of *Cleruchoides noackae*, an egg parasitoid of *T. peregrinus* from Australia. We review the main achievements in each country. Finally, a regional network of institutions, researchers, and students has strengthened in the region, providing a solid background for future collaboration.

Lessons from successful classical biological control in Israel of *Leptocybe invasa* and *Ophelimus maskelli*. Mendel, Z., Protasov, A. (*Agricultural Research Organization, Israel; zmendel@volcani.agri.gov.il; protasov@volcani.agri.gov.il*), Brand, D. (*Keren Kayemeth LeIsrael, Israel; davidb@kkl.org.il*), Branco, M. (*Technical University of Lisbon, Portugal; mrbranco@isa.utl.pt*).

Two gall wasps were the targets of a biological control project in Israel. Approximately a decade after the liberation of seven parasitoid species, both gallers have become quite rare. In each galler case, it was eventually difficult to predict which parasitoid species might be the best agent for biocontrol. Here, the dominant parasitoid species during the early stage of colonization and the outbreak situation was not necessarily the common species when the galler population had reached the latent phase. Another question is how many and what groups of parasitoids are required to achieve desirable and stable biological control. It is interesting to note that local parasitoid species adopted the gallers as new hosts. The question whether the above-mentioned imported natural enemies may have a negative impact on populations of non-target indigenous galler species needs to be addressed. Importation of alien parasitoids and testing their host specificity were revealed as major challenges. Among these were reluctance of the quarantine authority to issue an introduction license for unidentified species, the problematic mass rearing of the host galler, and the selection of appropriate species for testing non-target organisms. Another important take-home lesson is that the accomplishment of such biological control programs depends very much on international collaboration. All these and other related issues will be discussed.

The Californian experience of eucalypt insect biological control with special emphasis on the red gum lerp psyllid *Glycaspis brimblecombei*. Paine, T. (*University of California, USA; timothy.paine@ucr.edu*).

Although insect free for almost 150 years in California, eucalyptus has accumulated approximately 20 insect herbivores in the last 2 decades. Biological control efforts have been attempted against two wood borers, two folivores, and four fluid-feeding insects. The introduction of two strains of an encyrtid egg parasitoid has resulted in complete or nearly complete biological control of two cerambysid borers. Complete biological control of a leaf feeding weevil was achieved with the introduction of another egg parasitoid and this has been maintained for more than a decade despite breaking down in other parts of the world. Attempts to establish biological control of a chrysomelid leaf beetle with a fourth species of egg parasitoid failed. Complete successful biological control of one psyllid was achieved with intentional introduction of a parasitoid and partial success has been observed against two other psyllids following the serendipitous invasion of two parasitoids and, unfortunately, their hyperparasitoids. The biological control of red gum lerp psyllid following introduction of a hymenopteran parasitoid has been very successful in some parts of California and less successful in other regions. The reasons for the differences in success are not clearly resolved but may include different responses to local climate and the presence of an endosymbiotic bacterium in the psyllid.

Biological control of the bronze bug, *Thaumastocoris peregrinus*, in eucalyptus plantations in Brazil. Wilcken, C. (*São Paulo State University, Brazil; cwilcken@fca.unesp.br*), Barbosa, L. (*EMBRAPA, Brazil; leonardo.r.barbosa@embrapa.br*), Zache, B., Firmino, A. (*São Paulo State University, Brazil; bzache@bol.com.br; anacarfir@gmail.com*), Sa, L. (*EMBRAPA, Brazil; luiz.sa@embrapa.br*), Zanuncio, J. (*Federal University of Viçosa, Brazil; zanuncio@ufv.br*), Junqueira, L. (*Forestry Science and Research Institute (IPEF), Brazil; renato@ipef.br*).

The bronze bug *Thaumastocoris peregrinus* (Hemiptera: Thaumastocoridae) was detected in Brazil in 2008 and infested >180 000 ha of eucalyptus plantations in 2011. The bronze bug can cause a reduction of 10–15% in wood productivity after 2 years of heavy infestation. Although there is not an effective control method known, biological control is the main control strategy studied. An exotic egg parasitoid, *Cleruchoides noackae* (Hymenoptera: Mymaridae), was imported from Australia in 2012, reared in a laboratory and released in three Brazilian regions. Parasitoids were recovered at release points after 20–30 d. In 2013, preliminary evaluations demonstrated parasitoid establishment in these areas, and the parasitoid was recovered in adjacent areas after 1 year of release. Bioassays confirmed egg parasitism of 15–20% by *C. noackae*. Other native natural enemies were studied. We found green lacewing *Chrysoperla externa* and predatory bugs *Supputius cincticeps* and *Atopozelus opsimus* preying on nymphs and/or adults of *T. peregrinus*. Another promising possibility is entomopathogenic fungi. Commercial formulations of *Beauveria bassiana* were tested with success in lab and field conditions. *Fusarium proliferatum* and *Paecilomyces cateniannulatus* caused mortality of *T. peregrinus* in natural epizooties. After 5 years of research, it is possible to develop an integrated pest management system (IPM) for eucalyptus plantations based on biocontrol strategy for bronze bug.

An island downwind of Australia has a unique experience of eucalyptus pest biological control: the New Zealand story. Withers, T., Sopow, S. (*Scion, New Zealand; toni.withers@scionresearch.com; stephanie.sopow@scionresearch.com*), Murray, T. (*University of Canterbury, New Zealand; tara.murray@canterbury.ac.nz*).

Eucalyptus trees are not native to New Zealand, but since the 1860s, Australian insects have steadily colonised them. Currently there are 30 specialist eucalypt insects established in New Zealand which is 1 800 km downwind from Australia across the Tasman Sea. In some cases, the major insect pests are those shared by other countries (e.g., *Gonipterus platensis* and *Thaumastocoris peregrinus)*. Some other important insect pests have been rare or not described from Australia, prior to their appearance as a pest in New Zealand (e.g., *Paropsis charybdis, Nambouria xanthops*, and *Ophelimus eucalypti).* Of most interest has been the introduction of biological control agents. In some cases the natural enemy arrived with its host (e.g., *Psyllaephagus pilosus*