WESTERN AUSTRALIA

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PLANTATIONS

Pinus radiata

Insect pests

Sirex noctilio (sirex wood wasp)

The Forest Products Commission (FPC) in Western Australia conducts an annual monitoring programme throughout its estate. Monitoring in WA is now done using static (panel) traps, which are effective in detecting very low numbers of sirex. The traps are erected in pairs in open areas of plantations that would likely be used as flight paths for the wasp. Last year they were deployed in plantations from Perth to Albany, as well as Albany town site and a Bunbury sawmill. It is planned to further increase the coverage of the traps outside of plantations to cover 'points of entry' such as borders, sea ports, airports, container depots and along transport corridors.

No sirex wood wasps (*Sirex noctilio*) were detected in any of the traps in the 2008/2009 flight season.

Ips grandicollis (fivespined bark beetle)

Bark beetle distribution and abundance were monitored in conjunction with the sirex trapping programme. *Ips* was found in all plantation areas over the length of the trapping season. No *Ips* was detected in the Albany town site traps. Numbers were highest in the west coastal plantations of Gnangara, McLarty and Myalup as well as the pine mill near Bunbury. Numbers peaked in February for McLarty, Myalup and the mill and in March for Gnangara. No significant reports outside of the trapping areas were received in 2008/2009.

Essigella californica (Monterey pine aphid)

Although *Essigella* is present it is still not regarded as a problem in WA. Ian Dumbrell (FPC) is the WA representative on the *Essigella* biocontrol project steering committee. (I. Dumbrell, FPC)

Hylurgus ligniperda (golden hatred bark beetle)

Hylurgus was only found in traps from the west coast plantations and the Bunbury mill and generally only in February. The exceptions were Myalup plantation where numbers caught were steady (but not high) through February, March and April and the pine mill where numbers were higher peaking in February and tapering off through March and April.

Pinus pinaster

Insect pests

***Hylotrupes bajulus* (European house borer)**

Management

In June 2008, the European house borer (EHB) response group was fairly confident the infestation had been contained and that eradication was a good possibility.

- Currently clear falling infested plantations (including a 2km buffer)
  - Total clean up of clear fall sites
  - Option to further clean up the site and remove wildings after 12-18 months (in discussion)
  - Plans to have all areas within Restricted Movement Zone's harvested and cleaned up by 2015 and the areas declared 'all clear' by 2021

Regulations have now been enacted (Agricultural and Related Resources Protection (European House Borer) Regulations 2006) which place restrictions on the movement of pine wood, of certain types within certain geographical and seasonal constraints.

Surveillance

- Visual surveillance
  - Ongoing in RMZ
  - Annual from Geraldton to Esperance
  - 75% effective
- Sniffer dogs (2 beagles)
  - Can detect larvae before they emerge
- Trap poles
  - 1000 currently deployed
  - Visual and sniffer dog detection
  - Automatic acoustic detection being trialed

Research

Previous research has focused on biology (Life cycle, Mating habits, movement).
A number of new research activities have been undertaken into the EHB, such as DNA profiling to validate movement theory, acoustic detection technology, pheromone trapping and efficacy of insecticidal timber preservatives. Two replica houses have been built to monitor infestation of timber 'in-service'.

Education

An intensive media campaign to educate the public is in place and includes

- Newspapers
- Door-knocking and mail-outs in RMZ
- Posters on buses etc
- Shopping centre displays
- Website
- Working directly with timber suppliers and the building industry
- New road signs

So far the response to this campaign has been generally positive.

***Phaulacridium* sp. (wingless grasshopper)**

From November 2008 to March 2009, the usual annual incursions of wingless grasshoppers occurred in plantations throughout the South West, but were not in plague proportions. Misting with alphacypermethrin was undertaken on affected properties on a fortnightly basis.

***Nysius vinitor* (Rutherglen bug)**

Rutherglen bugs are a regular problem in plantations from October to late December. Infestations are misted in conjunction with wingless grasshopper control.

Diseases

No major problems reported.

Eucalyptus globulus

Insect pests

***Gonipterus scutellatus* (eucalyptus weevil)**

The Eucalyptus Weevil or Eucalyptus Snout-Beetle, generally referred to as *Gonipterus scutellatus* Gyllenhal, is a significant pest of *Eucalyptus* species in Africa, South America, North America, Europe and New Zealand. Within its native range in south-eastern Australia, it is controlled effectively by an egg-parasitic wasp, *Anaphes nitens*. However, in the state of Western Australia, where the weevil is thought to have been introduced, the rapid expansion of eucalypt plantation forestry in the last 20 years has seen the Eucalyptus Weevil become a significant pest in spite of the presence of *A. nitens*, suggesting that the egg parasitoid is not able to effectively control the Eucalyptus Weevil. This could be possible if *G. scutellatus* was a complex of cryptic species or made up of locally distinct populations. A phylogenetic analysis and morphological analysis to determine identity and the origin of *G. scutellatus* in Western Australia has been conducted. For molecular analysis, a 413 bp fragment of mtDNA from the cytochrome oxidase I gene corresponding to protein coding region and also a 317 bp region of nuclear DNA corresponding to the 5′ end of elongation factor 1 alpha (EF-1α) was used. Examination of the male genitalia, in particular in the shape of the internal armature of the aedeagus was also conducted. Molecular analysis revealed seven distinct clades and morphological analysis confirmed that each clade corresponded to a distinct species based on male genitalia. All specimens from Western Australia were found to belong to one species. The very low variability observed in Western Australia supports that this species was introduced to Western Australia recently, with the source population likely to be from Tasmania. (T. Mapondera, honours Murdoch University).

Diseases

No major problems reported.

***Eucalyptus* spp. (*E. cladocalyx, E. maculate* and *E. saligna*)**

Insect pests

***Phylacteophaga froggatti* (leafblister sawfly)**

Leaf blister sawfly has been noted on stress exposed *E saligna* (G. Hodgson, FPC).

***Liparetrus jenkinsi* (spring beetle)**

Spring beetle features as a significant problem in establishment of *E saligna*, *E cladocalyx* and *E maculata* plantations. Attacks predominate in late September/October. 2008 spring season was not an unusual season and limited damage recorded.

***Santalum spicatum* (sandalwood)**

Insect pests

***Nysius vinitor* (Rutherglen bug)**

FPC is finding significant Rutherglen bug attacks on newly established sandalwood seedlings. This is providing new challenges in taking sandalwood into the pastoral areas in the intermediate/low rainfall zones of the South-west. (G. Hodgson, FPC). This insect is generally a seasonal pest within plantations in the Midwest region of WA from October to January. 2008/2009 saw this sap sucking pest in large proportions from October right through to early June, the last misting was carried out in June 2009. The Rutherglen bugs were associated with the *Acacia* host plants.

MANAGED NATURAL FORESTS

***Eucalyptus marginata* (jarrah)**

Insect pests

***Perthida glyphopa* (jarrah leafminer)**

Populations still exist extensively throughout the forest but levels are below severe damage thresholds. A cut-out boundary survey is due to be conducted in late October 2009 (A. Wills, DEC).

***Uraba lugens* (gumleaf skeletoniser)**

Populations of gumleaf skeletoniser (*U. lugens*) remain very low in the southern Jarrah forest (J. Farr, DEC).

***Opodiphthera helena* (helena moth)**

Although not normally recognised as a serious pest of native forests, populations of Helena gum-moth were significantly higher during 2007 (Table 1). Adult numbers, as

measured from light trap captures for spring 2007, have been recorded at over 100 individuals in some sites with consistent captures across most sites. This compares with isolated captures of only one or two individuals in previous years. Helena gum moth still higher in numbers than it used to be (prior to 2007) but no trapping was conducted in Spring 2008 to confirm actual numbers (A. Wills, DEC).

Table 1. Helena moth captures from FORESTCHECK sites using light traps from 2001/2008.

Year	Helena abundance
2001	4
2002	1
2003	0
2004	6
2005	0
2006	No data
2007	633
2008	No Data

Diseases

No new major disease problems were reported. Management and survey of *Phytophthora* root disease in jarrah forests continues to command attention (see Forest Health Surveillance and Diagnosis and Research and Development).

***Eucalyptus diversicolor* (karri)**

Insect pests

No major pest problems reported.

Diseases

Recently *Cryptosporiopsis actinidiae* was identified from karri scantling using molecular sequencing on isolates that had been stored since 1986. *Cryptosporiopsis actinidiae*, an important post-harvest pathogen of kiwi fruit and New Zealand research suggests that there may be a number of diseases of woody plants that can cause opportunistic post-harvest infection. This is of interest because there may be a number of other potential diseases harbouring in native forest (E. Davison, Curtin University).

NURSERIES

No major problems have been reported in either conifer or hardwood seedlings in nurseries.

NATIVE PLANT COMMUNITIES

Phytophthora in natural ecosystems

For 30 years large-scale aerial photography has been used to map the extent of Phytophthora dieback disease in native forests in the south-west of Western Australia, with validation of the observations involving routine testing of soil and root samples for the presence of *Phytophthora cinnamomi.* In addition to *P. cinnamomi*, six morpho-species have been identified using this technique: *P. citricola, P. megasperma, P. cryptogea, P. drechsleri, P. nicotianae* and *P. boehmeriae.* In recent years many new *Phytophthora* species have been described world-wide, often with similar morphology to existing species, thus, as many of the isolates collected in Western Australia have been difficult to identify based on morphology, molecular identification of some of the morpho-species is required. Based on amplification of the internal transcribed spacer (ITS) region of the rDNA gene sequence data of over 230 isolates were compared to that of existing species and undescribed taxa. *Phytophthora inundata, P. asparagi*, *P.* taxon Pgchlamydo, *P.* taxon personii and *P.* taxon niederhauserii were identified based on sequence data. Phylogenetic analysis revealed that nine potentially new and undescribed taxa can be distinguished. Several of the new taxa are morphologically indistinguishable from species such as *P. citricola, P. drechsleri* and *P. megasperma*. In some cases, the new taxa are closely related to species with similar morphology (e.g. *P*. sp. 4 and *P. citricola*). However, the DNA sequences of other new taxa such as *P*. sp. 3 and *P*. sp. 9 show that they are not closely related to morphologically similar species, *P. drechsleri* and *P. megasperma,* respectively. Most of the new taxa have been associated with dying *Banksia* spp. while *P*. sp. 2 and *P*. sp. 4 have also been isolated from dying *Eucalyptus marginata* (jarrah). Some taxa (*P*. spp. 3, 6 and 7) appear to have limited distribution, while others like *P*. sp. 4 are widespread. Burgess, T. I., Webster, J. L., Ciampini, J. A., White, D., Hardy, G. E. StJ and Stukely, M. J. C.

A new *Phytophthora* species (previously known as *P*. sp. 4), isolated from rhizosphere soil of declining or dead trees of *Eucalyptus gomphocephala*, *E. marginata*, *Agonis flexuosa* and another 13 plant species and from fine roots of *E. marginata* and collar lesions of *Banksia attenuata* in Western Australia, is described as *Phytophthora multivora* sp. nov. It is homothallic and produces semipapillate sporangia, smooth-walled oogonia containing thick-walled oospores and paragynous antheridia. Although morphologically similar to *P. citricola,* phylogenetic analyses of the ITS and *cox*I gene regions demonstrate that *P. multivora* is unique. *Phytophthora multivora* is pathogenic to bark and cambium of *E. gomphocephala* and *E. marginata* and is believed to be involved in the decline syndrome of both eucalypt species within the tuart woodland in south-west Western Australia. (P.M. Scott, T.I. Burgess, P.A. Barber, B.L. Shearer, M.J.C. Stukely, G.E.St.J. Hardy, T. Jung).

DEC Phytophthora Research Project

Funded through the State Government's Biodiversity Conservation Initiative a research project was commenced in late 2006 into the epidemiology and control of *P. cinnamomi* on the south coast of WA. The project is investigating the seasonal disease dynamics of *P. cinnamomi* including the mechanisms to disease centre extension and survival. Further the project is also investigating the use of phosphite basal stem application to prevent disease centre expansion and its effect on the epidemiology of the pathogen.

Results from the epidemiological investigations have shown that season has little effect on the inoculum distribution of *P. cinnamomi* on sandy coastal sites, however it does appear to effect pathogen isolation rates in the rocky soils of the Stirling Range National Park. The highest amount of inoculum is concentrated in the shallow part of the soil profile (0-40 cm) and although inoculum distribution appears non-uniform there is a strong correlation between isolation and the presence of plants roots. Rainfall, soil moisture and temperature had only a limited effect on the probability of isolating the pathogen from soil. The pathogen can be isolated all year around including periods of very low soil moisture and can be isolated with a high probability from around the root systems of susceptible plants species over a year after the plant has died from the disease.

The use of high intensity phosphite application (ie basal stem application) at 30% active ingredient seems to be able to reduce disease centre expansion in *P. cinnamomi* infested sites. Although its still too early to judge success of applying phosphite at this very high rate it appears to reduce *P. cinnamomi* inoculum within soils. Some severe phytotoxicity was observed in the weeks and months after treatment, however, after 1 year over 90% of plant species had fully recovered. A few particular species such as *Banksia falcata* appear sensitive to the treatment (C. Dunne, DEC).

URBAN AND RURAL

Insect pests

See section on wandoo decline (below).

Diseases and Declines

Pathogens of boabs

Surveys for fungi associated with boab (*Adansonia gregorii*) are underway in both South Africa and Western Australia. In this study, seven new species of the Botryosphaeriaceae are described from baobab (*Adansonia gibbosa*) and surrounding endemic tree species growing in the Kimberley region of northwestern Australia. Members of the Botryosphaeriaceae were predominant endophytes isolated from apparently healthy sapwood and bark of endemic trees; others were isolated from dying branches. Phylogenetic analyses of ITS and EF1-α sequence data revealed seven new species: *Dothiorella longicollis*, *Fusicoccum ramosum Lasiodiplodia margaritacea*, *Neoscytalidium novaehollandiae*, *Pseudofusicoccum adansoniae*, *P. ardesiacum* and *P. kimberleyense*. The most commonly isolates species was *Lasiodiplodia theobromae*. A pathogenicity test has shown that this species is highly pathogenic to boabs (Monique Sakalidis, T. Burgess and G. Hardy, Murdoch University and M. Wingfield, Tree Pathology Cooperative Program (TPCP) South Africa).

Pathogens of marri

Corymbia calophylla is an important, endemic eucalypt species throughout the south west of Western Australia. It is currently in decline in its native habitat due to the presence of the canker pathogen *Quambalaria coyrecup*. Few fungal leaf pathogens have been described from *C. calophylla*. We have isolated and described two new species of *Teratosphaeria* from *C. calophylla, Teratosphaeria calophylla* sp. nov and *T. rubidae* sp.

nov. *Teratosphaeria australiensis* (=*Leptomelaconium australiense*) was isolated from symptomatic leaves of *C. calophylla*. This species was originally described from *C. ficifolia* (V. Andjic, K. Taylor, P. Barber, T. Burgess and G. Hardy, Murdoch University).

Peppermint dieback

Agonis flexuosa, commonly known as the Western Australian Peppermint, is a tree native to the south-west of Western Australia and severe dieback symptoms have been recently observed in some areas. A species of fungus was believed to be the causal agent. For this project, fungi were collected, isolated, identified and tested for pathogenicity to determine the causal agent of the decline of *A. flexuosa* in natural ecosystems in Western Australia. Fungi were isolated from symptomatic and asymptomatic material collected from *A. flexuosa*, cultured and then identified using molecular taxonomy, microscopy and vegetative compatibility trials. Pathogenicity trials using *A. flexuosa* seedlings were carried out to prove Koch's Postulate. All isolates caused lesions in the seedlings and there is no significant difference between lesions caused by isolates from symptomatic and asymptomatic material. This suggests that the causal agent could be an endophytic fungus which has become a pathogen (N. Dakin, BioGENIUS student, T. Burgess, D. White and G. Hardy, Murdoch University).

Mundulla yellows

Monitoring of the occurrence and symptom development of Mundulla yellows (MY) in WA has continued. Symptomatic eucalypts (both planted trees and remnant native trees) have been observed in several additional locations. Spread of symptoms within affected sites appears generally to be slow and diseased and apparently-healthy trees can grow alongside each other. The observed distribution of MY symptoms in the south of the state is from north of Geraldton to Esperance and it occurs on alkaline coastal sands as well as on acid soils including laterites. As in South Australia, MY in WA is only seen in vegetation in disturbed sites or modified landscapes such as road verges and medians, parks and gardens and in parkland or paddock remnant stands where symptomatic trees can be several hundred metres from, and sometimes upslope from, any road. Symptoms have not been observed within undisturbed native forest or woodland stands in WA. Collaboration is continuing in the investigation of the cause(s) of MY with D. Hanold and J. Randles from the University of Adelaide. (M. Stukely, DEC).

Tuart decline

In recent years, tuart (*Eucalyptus gomphocephala*) woodland within Yalgorup National Park, south of Mandurah has suffered a severe decline in health. Research carried out by the Tuart Health Research Group (THRG) has shown from surveys of tuart across the range, that the major decline syndrome is confined to the Yalgorup region. A new species of *Phytophthora*, *P. multivora,* has been recently isolated from a number of rhizosphere soil of declining or dead trees of *E. gomphocephala* and other species in the Yalgorup region (Scott et al. 2009 Persoonia 22: 1-19). Further work is being conducted to determine the pathogenicity of these isolates and to characterise them (P. Scott, Murdoch University). A very close correlation between foliar zinc levels and crown health has been observed and treatment trials with nutrient implants have shown promising results. Trials with injection of phosphite have also shown promising results (P. Scott, Murdoch

University). Trees are still showing signs of an increase in crown health four years after treatment. Strong correlations also exist between crown health and soil microbial function and diversity (Y. Cai, Murdoch University). Studies on the role of fire and competition show a lack of fire may be contributing to the decline of tuart, however, it is not a major factor (R. Archibald, Murdoch University). Monitoring and capture of fauna within sites throughout the Yalgorup region have also shown a strong correlation between the abundance of particular reptile species and crown health of tuart (K. Wentzel, Murdoch University). A new project is looking at restoring sites where soils have lost their tuart seed banks (Katinka Ruthrof, Murdoch University) (P. Barber, THRG, Murdoch University- http://www.tuarthealth.murdoch.edu.au/).

Botryosphaeriaceous taxa have been isolated as endophytes and canker pathogens from numerous hosts in many parts of the world and have been implicated in the decline of *E. gomphocephala*. In a current study, endophytic fungi were isolated from a wide variety of native woody plant species (*Acacia cochlearis, A. rostellifera*, *Allocasuarina fraseriana, Agonis flexuosa, Banksia grandis, E. gomphocephala*, *E. marginata* and *Santalum acuminatum*), at two locations in native *E. gomphocephala* woodland; a site in decline at Yalgorup National Park and a healthy site at Woodman Point Regional Park. Of the 226 isolates obtained, 154 were botryosphaeriaceous taxa, 80% of which were found to be *Neofusicoccum australe*, isolated from all hosts at both collection sites. Four new species are described; *Dothiorella moneti*, *Dothiorella santali*, *Neofusicoccum pennatisporum* and a species belonging to a genus only recently included in the Botryosphaeriaceae, *Aplosporella yalgorensis*. The other species isolated were *Botryosphaeria dothidea* on the new hosts *A. rostellifera*, *A. cochlearis* and *E. marginata* and *Dichomera eucalypti*, on the new host *E. marginata.* None of the new species formed lesions on excised stems of their host species, *E. gomphocephala* or a common plantation species *E. globulus*. However, *Neofusicoccum australe* formed lesions on excised stems of *E. globulus* and *E. gomphocephala* (K. Taylor, P. Barber, G. Hardy and T. Burgess, Murdoch University).

Wandoo decline

Crown decline of wandoo (*Eucalyptus wandoo*) in southwest Western Australia has escalated over the last 15 years, so that very few unaffected stands remain. This decline is widespread and a cause of significant concern. The Wandoo Recovery Group's (WRG) role is to support research to identify possible causes of crown decline and communicate knowledge and information about wandoo. To date, research efforts to examine the causes of wandoo crown decline have been undertaken by the University of Western Australia (UWA). The new State Centre of Excellence for Climate Change; Woodland and Forest Health will now drive coordinated research into wandoo, tuart and other tree declines (L. Manning, WRG).

There has been no active research into wandoo decline during 2009, but there has been progress in the reporting of previous research and in the planning of future research. Scientific publication of wandoo water relations research is being prepared. A PhD thesis was submitted in July 2009 (R. Hooper, UWA) and a second PhD on ecophysiological differences between wandoo provenances is not expected before late 2010 (E. Dalmaris, UWA). Discussions are ongoing regarding the focus, approach and location(s) for research to be undertaken by postdoctoral research associates at UWA and Murdoch. DEC managers have been involved in these discussions (L. Manning, WRG).

A wood boring insect (Coleoptera: Buprestidae), has been identified as the primary contributing factor in dieback and decline of wandoo trees. Fungal pathogens isolated on dying branches were not particularly aggressive and are commonly found in *Eucalyptus* trees. Rather, it is thought activity of the insect and its high emergence rate during the recent severe decline in Talbot forest (in the 1990's) facilitated damage by these normally benign organisms. Active populations of the borer were evident in areas recently affected by decline. Understanding the balance between borer populations and tree response is a crucial factor in the decline and recovery cycle, which must be viewed in a time frame relevant to wandoo's life span. Ryan Hooper has been monitoring phenology (development of bud formation, flowering and seed set) and growth in the wandoo forest (R. Hooper, UWA).

Abiotic stress can deteriorate tree health directly or through a reduced ability to withstand attack by pest and disease organisms. Central to the research effort regarding abiotic stress has been the hypothesis "Does drought play a role in wandoo crown decline, and if so, to what extent are declining trees drought stressed?" During hot summer months as leaves and stems dry out, tensions develop that cause the loss of cell integrity (and the capacity to grow and function well), and also the loss of ability to transport water. Measurements on the hydraulic characteristics of powderbark wandoo (*E. accedens*), jarrah (*E. marginata*), and marri (*Corymbia calophylla*) confirm large differences in water status and water use patterns between these species. Preliminary results show that wandoo and powderbark are adapted to operate at greater tensions and can lose more water before they lose turgor than jarrah and marri. Moreover wandoo and powderbark can accumulate more osmotically active compounds, allowing greater tissue dehydration and better water uptake from dry and clayey soils. Their stems are much more resistant to high tensions. Although tensions in wandoo reach higher values than the other species, they don't cause greater loss of stem functionality (E. Veneklaas, UWA).

Broad-scale survey and mapping over the last ten years have identified temporal and spatial trends in wandoo health that indicate decline patterns are broad scale, variable and not continuous across the landscape. While crown decline still occurs across wandoo's range (albeit at low levels), at other sites decline has stabilised and trees have started to recover (J. Mercer, WRG, K. Whitford, DEC).

FOREST HEALTH SURVEILLANCE AND DIAGNOSIS

Dieback mapping and management

Mapping the presence of symptoms of the plant disease caused by *P. cinnamomi* was carried out by accredited interpreters to determine areas suitable for protection. Hygiene requirements were specified for activities likely to result in the movement of soil (and as a consequence, *P. cinnamomi*) on lands managed by DEC. A total area of 33,230 ha was mapped to assist the planning of roading and timber harvesting operations undertaken by the FPC. This included 10,210 ha of previous mapping that was checked for further spread. Mapping and hygiene planning were undertaken on a further 4,720 ha for the Parks and Visitor Services, Nature Conservation Service and Sustainable Forest Management Service of DEC and 1,600 ha for external parties. Interpretation from helicopter, coupled with field sampling, was undertaken to explore for new infestations in the Fitzgerald River National Park. Training programs were carried out in disease mapping and hygiene management (G. Strelein, DEC).

In the year to 30th June 2009, a total of 1,789 samples was tested for the presence of *Phytophthora* by DEC's Vegetation Health Service (VHS). These samples were associated with verification of dieback mapping for the above projects, as well as external requests. DNA sequencing has been carried out at the Centre for *Phytophthora* Science and Management (CPSM), at Murdoch University, on various recent and historical isolates of unidentified *Phytophthora* in the DEC culture collection, from a range of WA locations and ecosystems. This had earlier led to the identification of *P. inundata, P. asparagi* and *P. niederhauseria*. At least nine new and undescribed *Phytophthora* taxa occurring in native vegetation in WA have been distinguished, based on their ITS rDNA sequences. Several of them are indistinguishable, on morphological characters, from known species such as *P. citricola*, *P. drechsleri,* or *P. megasperma*. The formal description of the first of these new WA species, *Phytophthora multivora*, was published. (This species had previously been identified as *P. citricola* from morphological characters; however, no true *P. citricola* has yet been found among the VHS cultures tested). Most of the newly identified Phytophthoras have been associated with multiple species of dying native plants in natural vegetation communities. A PhD project commenced in April 2007 at Murdoch University to describe several of the new Phytophthoras and to test their pathogenicity (A. Rea – see Research and Development). In addition, there is now strong new evidence of naturally-occurring *Phytophthora* hybrids in WA native ecosystems; these are being further investigated. (M. Stukely, DEC).

RESEARCH AND DEVELOPMENT

General

Western Australian State Centre of Excellence for Climate Change, Woodland and Forest Health.

This new Centre was approved for funding in 2008 is made up of four programs: Climate Change, Woodland and Forest Declines; Decline Ecology; Restoring Biodiversity Values; and Policies and Action for Woodland and Forest Restoration. Murdoch University together with the University of Western Australia and the Department of Environment and Conservation are the primary proponents, with cash and in-kind support from 27 agencies, non-government agencies and industry and collaboration with Universities and agencies in eastern Australia and overseas. Three Post-Doctoral fellows and a Manager have been appointed within the centre with another three post-doctoral fellows to be employed. The focus of this centre will initially be the decline of tuart and wandoo, however, student projects under the centre have been initiated investigating the decline of other iconic WA species including *E. marginata, Corymbia calophylla, E. rudis, Agonis flexuosa* and *C. ficifolia.* Further information about the Centre can be found at www.treehealth.murdoch.edu.au (G. Hardy, Murdoch University).

Molecular Diagnostic Facility at Murdoch University

Nari Anderson (Research Associate, CPSM) has developed Real Time PCR methods to diagnose *P. cinnamomi* from soil samples. She is now developing the method for high throughput and on large (250g) soil samples in order to make the process commercially viable. (Supervisors: P. O'Brien and G. Hardy, Murdoch University).

Plantations

Eucalyptus globulus is the predominant exotic hardwood plantation species in Western Australian (WA), and is often planted adjacent to native eucalypt forests. The increase in a number of *Mycosphaerella* species associated with Mycosphaerella Leaf Disease (MLD) in *E. globulus* plantations in WA in the past decade has raised concern about the possible movement of pathogens between the native forests and plantations. In order to determine whether the introduction of new *E. globulus* genetics into WA may have further exacerbated this situation, juvenile and adult foliage were taken from a genetics trial near Albany, WA consisting of 60 full-sib families and *Mycosphaerella* species identified using morphological and molecular tools. Eleven species of *Mycosphaerella* were identified from one plantation: *Mycosphaerella fori* (*Pseudocercospora fori*) and *M. ellipsoidea* are new records for Australia; *M. tasmaniensis* (*Passalora tasmaniensis*) and *M. suttoniae* (*Kirramyces epicoccoides*) are new records for WA; and *M. nubilosa*, *M. cryptica*, *M. marksii*, *M. molleriana*, *M. lateralis*, *M. aurantia* and *M. parva*, previously recorded for WA. The most frequently isolated species from juvenile foliage was *M. marksii* (77%) followed by *M. nubilosa* (33%). *Mycosphaerella nubilosa* was most frequently isolated from adult leaves (88%) followed by *M. parva* (7.5%). Three species, *M. molleriana*, *M. lateralis* and *M. cryptica*, were only isolated from adult leaves while *M. ellipsoidea* was only isolated from juvenile leaves. These records increase the number of known *Mycosphaerella* species from eucalypts in WA from ten to thirteen. The increase in the number, distribution and impact of *Mycosphaerella* species contributing to MLD in WA is of concern both to the potential productivity of the plantations and the biosecurity of native WA *Eucalyptus* species. Continued monitoring of the plantation estate is required to understand the dynamics of the host-pathogen interactions. (Incidence and new records of *Mycosphaerella* species within a *Eucalyptus globulus* plantation in Western Australia A. Maxwell, AQIS, S. Jackson, T. Burgess, G. Hardy and B. Dell, Murdoch University).

PhD project 'A detailed study of *Mycosphaerella cryptica* and *M. nubilosa* in Western Australia, focusing on the threat to native remnants'.

Collaborative Project - Murdoch University and the Tree Pathology Cooperative Program (TPCP) South Africa.

The project 'New and emerging pathogens threatening the biodiversity of Australia's eucalypts' continues and concentrates on some of the major eucalypt pathogens worldwide (*Kirramcyes* spp. *Mycosphaerella* spp., *Botryosphaeria* spp. *Cryphonectria* spp.). The aim is to determine their origin, movement and the risk they pose to Australia's eucalypts (T. Burgess, MU and M. Wingfield, TPCP).

PhD theses in progress at Murdoch University

Francisco (Paco) Tovar: The cause of basal stem rot in second rotation *Eucalyptus globulus* plantations (Supervisors: T. Burgess, G. Hardy, MU and R. Robinson, DEC). Surveys completed during 2005/2007 indicated that 6 main species of fungi were associated with white rot of *E. globulus* coppice stumps. These species were identified as *Trametes versicolor*, *Stereum hirsutum, Stereum illudens*, *Pycnoporus coccineus, Bjekandera adusta* and *Lopharia crassa.* Levels of fungal colonisation of stumps across all plantations surveyed averaged 56% and were as high as 86% at a plantation in Collie.

Nonetheless, an average of 85% of stumps coppiced successfully, indicating that fungal colonisation was not interfering with coppice shoot emergence. Surveys also showed that less than 1% of stumps lost major shoots due to windthrow. Previous reports of 'significant' losses due to wind throw were attributed to observational bias, possibly, an edge effect. A two year trial testing antifungal treatments on coppice stumps was set up to determine the possibility of preventing fungal colonisation. None of the anti-fungal preventative treatments were effective. A number of other trials and surveys have been undertaken, including:

- An inoculation trial on *E. globulus* coppice shoots was set up to determine the capacity of the above mentioned fungi to move from the stump into the new coppice shoots and cause further rot during the rotation. First results are expected in December 2008.
- An experiment investigating the effect of harvest season on subsequent fungal colonisation is due to be completed in August 2008.
- Further surveys of both 1st and 2nd rotation plantations are currently being conducted to ascertain if there is an overall increase in levels of rot from first to second rotations.

Katherine Taylor: A detailed study of *Mycosphaerella cryptica* and *M. nubilosa* in Western Australia, focusing on the threat to native remnants (Supervisors: T. Burgess, G. Hardy and P. Barber, MU, C. Mohammad, Forestry CRC and A. Carnegie, SF NSW).

Monique Sakalidis: Investigation and analysis of taxonomic irregularities within the fungal genus *Botryosphaeria.* This thesis is answering questions that have arisen within the genus *Botryosphaeria* relating to divisions amongst and within taxa (Supervisors T. Burgess, G. Hardy, MU and B. Wingfield University of Pretoria).

Sarah Jackson: Taxonomy and biology of *Mycosphaerella* species found on *E. globulus* (Supervisors: G. Hardy and B. Dell, MU).

Patsy Stasikowski: An investigation into the mechanism of action of phosphite mediated resistance of plants to *P. cinnamomi* infection. Patsy is also in the process of developing a rapid analytical method to rapidly and cheaply determine the levels of phosphite in plant tissues under field conditions. We hope to be commercialising this in a kit form in the near future (Supervisors: G. Hardy, J. McComb and P. O'Brien, MU).

Leila Eshraghi: The role of plant defense pathways in Phosphite induced protection of *Arabidopsis thaliana* from *Phytophthora cinnamomi* infection (Supervisors: P. O'Brien, J. McComb and G. Hardy MU).

Kylie Ireland: Susceptibility of Australian plants to *Phytophthora ramorum,* an emerging potential threat to Australian plant industries and ecosystems. Kylie is working at the University of California Davis (UCD) screening Australian species for potential susceptibility to *P. ramorum.* She has found a large number of sporulating hosts and will start to look at 'dead-end' hosts in the near future. She will also use risk modelling to determine areas in Australia most at threat to *P. ramorum.* This project is funded by the CRC National Plant Biosecurity and The Department of Environment, Water, Rivers and Heritage (Supervisors: G. Hardy and D. Huberli, MU, I. Smith DPI Vic. and D. Rizzo, UCD).

Alexander Rea: Classical and molecular taxonomy and pathogenicity testing of *Phytophthora* species. Alex is currently describing five new *Phytophthora* species from the Department of Environment and Conservation's Vegetation Health Service culture collection. This is also including pathogenicity screening and ecological studies. This project is funded by the CRC National Plant Biosecurity (Supervisors G. Hardy, T. Burgess, MU and M. Stukely, DEC).

Papori Barua: Screening *Lambertia* species for susceptibility and resistance to *Phytophthora cinnamomi* to develop a model plant system to examine resistance mechanisms (Supervisors: G. Hardy, J. McComb, MU and B. Shearer, DEC).

Peter Scott: The potential role of *Phytophthora* species in *Eucalyptus gomphocephela* (Tuart) decline. Peter has isolated a *P. citricola*-like *Phytophthora* from the fine roots and rhizosphere of tuart. Morphological and sequence data indicate that the pathogen is undescribed and he is currently working on describing this organism. He also has field and glasshouse pathogenicity trials in place. Trees in the decline treated with phosphite respond very well in comparison to control treatments further indicating that this new *Phytophthora* species could be playing a role in the decline syndrome (Supervisors G. Hardy, P. Barber, MU and B. Shearer, DEC).

Honours theses in progress at Murdoch University

Katherine Edwards: Phytophthoras associated with *E. rudis* (Supervisors: G. Hardy, W. Dunston and T. Jung, Murdoch University).

Cielito Marbus: *Quambalaria* spp. Associated with marri (*C. calophylla*) (Supervisors: G. Hardy, B. Dell and T. Paap, Murdoch University).

Anna Bedford: Soil-borne Phytophthoras associated with marri (*C. calophylla*) (Supervisors: G. Hardy, T. Burgess and T. Jung, Murdoch University).