B14. Pathogen Management

Phytophthora Dieback

What is Phytophthora Dieback?

There are over 120 described species of *Phytophthora* in the world, but the species that causes the most severe and widespread damage to native plants in Western Australia is *Phytophthora cinnamomi*. Phytophthora Dieback refers to the plant disease caused by *P. cinnamomi*, an introduced soil borne plant pathogen that poses a serious threat to vegetation. This pathogen is recognised by the Commonwealth's *Environmental Protection and Biodiversity Conservation Act 1999* as a 'key threatening process' to Australia's biodiversity. Phytophthora Dieback is arguably the greatest biological threat to biodiversity throughout the South-West region in Western Australia. Infestations have been recorded from Geraldton in the north, to east of Esperance in the south with the disease causing death to 40-50 per cent of native plant species in this region.

Where does Phytophthora Dieback exist?

Phytophthora *cinnamomi,* considered to have originated from South-East Asia, is now found around the world causing disease in native and introduced plant species alike. In the south-west of WA it is found in areas receiving more than 400 mm annual rainfall between Jurien and east of Esperance. Phytophthora dieback is found all around the Perth metropolitan area causing disease in our native banksia woodlands and jarrah forests as well as affecting plants in private and public gardens, and street-scapes. The establishment and spread of the pathogen is most common in wetter, neutral to acidic soils common to the Bassendean sands and Darling Scarp. While less common in the well-drained alkaline soils of the western coastal dune systems, amended soils such as public or private gardens and pockets of acidic duplex soils can still be susceptible to the disease.
Other *Phytophthora* found in the Perth Region in recent years, such as *Phytophthora multivora* associated with Tuart decline, that can cause disease in the more alkaline coastal soils, it has a wide host range that is increasing rapidly both here in WA and elsewhere in the world. The impact of other *Phytophthora* species should not be under estimated.

How does Phytophthora Dieback impact vegetation?

Phytophthora *cinnamomi* spends its whole life in the soil and in plant tissue. It causes root rot in susceptible plants, thereby limiting or preventing the uptake of water and nutrients leading to plant death. The pathogen is able to survive within plant roots and soil during the dry soil conditions commonly experienced during the summer months via special survival spores. It can also survive in resistant hosts as an endophyte or as a biotroph. Consequently, once in an area it is unlikely to disappear irrespective of the absence of susceptible plant species.
Within infested areas, *Phytophthora* dieback acts like a 'biological bulldozer' by killing susceptible tree and understorey plant species. The introduction of the pathogen results in dramatically altered plant communities which have a greater susceptibility to additional threats such as invasive weeds. These changes result in the loss of plant habitats which provide food and shelter for marsupials, birds, reptiles and insects.

Implications for Local Government Activities

Once Phytophthora Dieback becomes established at a site it is very difficult to eradicate it. Management of the disease must aim to prevent further spread within infected areas and prevent spread of the disease into new areas. Spores are spread predominantly by the movement of soil and soil water.

This has major implications for local government operational activities that involve the movement of soil and equipment between locations such as:

- Maintenance of bushland reserves;
- Revegetation and restoration works;
- Road and drain construction/maintenance;
- Land developments;
- Fencing and provision of recreational/play equipment and;
- Earthworks and landscaping activities.

Activities undertaken by local governments and bushland and park management have the potential to introduce Phytophthora Dieback to a previously uninfected area, or increase its rate of spread. The disease can be spread in small quantities of soil, such as mud attached to tyres, plant material, gardening tools or shoes. The disease can also be introduced to uninfected areas via infected plants, mulch, soil improver or water sources.

Indicator Species
Species susceptible to *P. cinnamomi* (or 'indicator species') vary according to vegetation type and location. Common indicator species in the northern Jarrah forest include *Banksia grandis* (Bull Banksia), *Patersonia* spp. (Purple Flag and Yellow Flag), *Persoonia longifolia* (Snottygobble), *Xanthorrhoea gracilis* (Graceful Grass tree) and *Xanthorrhoea preissii* (Grass tree). If these plants are selectively dead or dying, amongst otherwise healthy bushland plants, the presence of the Phytophthora Dieback disease should be suspected, until confirmed otherwise, by experts. Refer to the current list of dieback susceptible (native) species posted on the 'Centre for Phytophthora Science and Management' (CPSM) website:
http://www.cpsm-phytophthora.org/downloads/natives_susceptible.pdf
Lists of resistant native bushland and garden species can also be found on the CPSM website.

Strategic Management of *Phytophthora* Dieback
Local governments have an important role to play in managing Phytophthora dieback. Whether or not dieback has been identified within a natural area, it is necessary to manage for Phytophthora dieback to prevent its introduction to, or spread within, such areas. Phytophthora dieback should not be treated in isolation to other organisations and land tenures so a coordinated approach to management activities/efforts for cross-tenure management is best.

A variety of management strategies are required in order to adequately reduce the risks of spreading the disease. Strategies may include:

- Mapping - identify high risk areas, identify vegetation communities/natural areas of high biodiversity conservation priority (NAIA Assessments, WALGA). Mapping the extent of dieback infestation within local government-controlled land will assist with prioritisation of management efforts. Interpretation of dieback requires considerable expertise, thus if it is suspected to be present, professional interpretation is required. Where mapping of whole Local Government areas is not practical or financially viable, there are still many procedural practices which can greatly reduce the risk of introduction or spread of Phytophthora dieback - see the Dieback Working Group (DWG) website: http://www.dwg.org.au/.

- Education - raising awareness via website, brochures, community, schools, social marketing techniques and signage- Project Dieback, in conjunction with the State Dieback Consultative Council (DCC), DWG and the Department of Parks and Wildlife (previously Department of Environment and Conservation), have developed a standard dieback signage system to be used across all land tenures. The consistent use of signs to indicate dieback status, where this is known, may improve management, especially in areas where vehicles, horses, bikes or walkers traverse in wet conditions. A range of signs are available depending on the

management objectives of an area. The disease status symbols can be incorporated into interpretive or other kinds of signage.

- Training - train on-ground staff about the disease and how to manage their risk of spreading it. Train staff to a high standard for undertaking vehicle and equipment hygiene. The DWG provides a number of different levels of training or they can help you to develop your own internal training. In addition, you should provide the resources for undertaking hygiene as part of daily practice, e.g. depot wash-down facilities or vehicles equipped with units for in-field wash-down. The DWG also holds an annual Dieback Information Group (DIG) conference to communicate the latest research into Phytophthora Dieback and the latest management strategies. Many of the attendees are local government staff seeking networks and information.

- Seek Resources - apply for funding – budget, grant and/or corporate funding, agency and institutional advice (DWG, DPaW, WA NRM agencies), encourage student involvement, partner with research bodies to trial new treatments/ containment techniques/ eradication techniques, buy DIY kits, use DWG Registry of volunteers- DWG maintains a list of trained volunteers who wish to be involved in bushland treatment activities. Volunteers will be contacted about any events in the areas they are willing to volunteer;

- Planning Conditions - ensure Local Government Planning staff recognise the importance of planning conditions around pathogen risk abatement and the provision of notice to developers (large and small);

- Working towards Industry Acceptance – Communicate importance of risk abatement strategies with Nurseries, Developers, Utility agencies, Bushfire Prevention Maintenance /Control (Bushfire Volunteers/FESA) and Local Government Operational staff.

- Use accredited suppliers and contractors – where Phytophthora Dieback hygiene standard accreditation exists, such as NIASA-accreditation for production nurseries and suppliers, use suppliers and contractors that are accredited. The DWG is working to facilitate the development of Phytophthora Dieback hygiene accreditation systems across the many different industries operating in natural areas. Currently recommended businesses and contractors will be found on the DWG contacts page at www.dwg.org.au .

- Treatment options are restricted, as spores persist within the soil and root material for extended periods of time. Limited protection is provided with the treatment of individual trees, by injection with phosphite, and the spraying of understorey foliage. However, the treatment does not kill the pathogen and therefore treatment of vegetation must be ongoing. Phosphite is a biodegradable fungicide that protects plants against *P. cinnamomi* by boosting their natural defences. However, in all instances with *P. cinnamomi*, prevention in the first instance is more efficient and cost effective than treatment. There is a phosphite treatment registry available online at www.dwg.org.au . The registry lists materials available for phosphite treatment, where to get them and who to contact.

Resources
Guidelines for management of Phytophthora dieback have been published by the DWG available on the DWG website: http://www.dwg.org.au/

Publications available for download include:
"Managing Phytophthora Dieback – Guidelines for Local Government" (Dieback Working Group, 2000);
Operating procedures for phosphite treatment (injection and spraying);
guide for Landholders and Community Conservation Groups.

The DWG have also developed a framework for integration of dieback management into Local Government policy so that recommended on-ground actions can be supported by council. The framework will soon be made available to Local Governments.

Mapping Tool
Project Dieback have developed a mapping tool (DIDMS) containing strategic advice, strategic mapping, protected area mapping and a map of the current dieback community activities including volunteer treatment activities. Registered users of the site can make their dieback-related events and activities publicly available, by entering the details into mapping on the DIDMS website. Please visit the site for more information http://didms.gaiaresources.com.au/bdrs-core/home.htm.

Quambalaria coyrecup - Marri Canker

What is Marri Canker?
Cankers are a symptom caused by the death of areas of bark and the cortex tissue below that, and are caused by the plant pathogen *Quambalaria coyrecup*. A severe canker disease has been contributing to decline in marri (*Corymbia calophylla*) for some years now. It also affects amenity-planted red flowering gum (*Corymbia ficifolia*). Canker disease occurs on marri across the natural range of this tree in south west WA. The incidence of trees with canker is much higher in disturbed areas, such as along roads, in parks, in remnant bushland on farms and on small rural blocks. Once canker symptoms are evident, trees do not appear to be able to recover. The canker is present on trunks, branches and twigs of trees of all ages.

Identifying the symptoms
The canker disease can easily be recognised by the following identifying symptoms:

- The bark surrounding the affected area cracks and is eventually shed. Large amounts of kino (gum) are produced, staining the limb or trunk dark red.
- Large target-like lesions are formed as a result of a progressive 'tug-of-war'. The tree produces a defence response that 'walls off' the diseased region, but with time the fungus manages to penetrate this barrier and reinvade.
- The pathogen *Quambalaria coyrecup* is sometimes observed sporulating on the diseased area, visible as a powdery white mass. This contains many millions of spores that can be spread by rain splash, wind, insects and pruning. Once the disease has progressed to the point of girdling the host, it has effectively ring barked the tree, resulting in the death of the affected limb or the entire tree if the trunk has been girdled.
- Observe the 'target like' scarring around the trunk.

Control & Management
While there have not yet been control or management options developed for this disease, fencing off remnant stands of trees to support seedling recruitment and planting understorey species is

encouraged. As part of the marri decline research project, the Centre of Excellence for Climate Change, Woodland and Forest Health (CoE) is looking at a number of possible treatments including application of fungicides and nutrients.

Marri Smartphone Application
In 2013 the CoE and the East Metropolitan Regional Council developed a 'Marri App' - a smartphone application to record marri health around the south west of WA. This mobile app has been designed to be used by interested members of the public, local government agencies, foresters and scientists to capture GPS location, incidence and severity of cankers on trees, and to lodge photographs and other site information to a central server, providing a valuable addition to our current knowledge on the incidence of this disease. It can be used not only to collect data on canker incidence but also to create wider involvement in conducting treatments. For more information on the marri decline research project please contact Cielito Marbus at c.marbus@murdoch.edu.au or Giles Hardy at g.hardy@murdoch.edu.au or phone (08) 9360 6272.

Root and Collar Rot - *Armillaria luteobubalina*

What is *Armillaria*?
Root and Collar Rot caused by *Armillaria luteobubalina* or the Australian honey fungus is a soil borne fungus that causes root rot of a variety of plants including many introduced ornamental plants and native plant species. It has a very large host range, but the information listing susceptible species is poor. In Perth, susceptible species include marri (Corymbia calophylla) and tuart (*Eucalyptus gomphocelphala*) amongst others.

Identifying the symptoms
Early symptoms of the disease can be difficult to detect, but early symptoms are similar to *Phytophthora* dieback. These include dieback of the limbs and branches, yellowing of the foliage and poor tree vigour. Frequently, in early winter (May-June) olive brown to yellow fruiting bodies (mushrooms) will form at the base of the tree. These mushrooms are gilled and can be 12 cm in diameter and on a stalk up to 15 cm high, although usually less. Stress such as drought predisposes trees to infection. In addition, excess watering can also intensify the severity of disease symptoms. Reducing watering in parks or gardens can reduce disease severity.

Control & Management
There is no simple control method available, including the use of chemicals. Good hygiene is essential to prevent the spread between diseased to healthy sites.

- Do not use infected trees as mulch.
- Removal of stumps and roots is recommended, as these can remain a source of inoculum for many years and.
- The application of organic matter to soils can help retard the activity of the pathogen.

Pathogen Management Case study:

'City of Joondalup Pathogen Management Plan 2012-2017'
The City of Joondalup recently developed and adopted a Pathogen Management Plan which prioritises the risk of pathogens for parks and natural areas utilising a Desktop Risk Analysis.

The Pathogen Desktop Risk Analysis included:

- Identification of areas within the City at risk of pathogen infestation including the likelihood of introduction to or establishment and spread of pathogens within the area.
- Identification of vegetation communities of high priority and assessment of the level of risk pathogens pose to the area.
- Assessment of the manageability of the risk within the Study Area.
- Prioritised list of reserves for further investigations.

In order to assess the level of risk for infestation by threatening pathogens, factors affecting the likelihood for infestation were assessed for each separate area within the Study Area.

Variables that affect the level of risk which were included within the Desktop Risk Analysis were:

- If disease is suspected at the site (based on observations and previous surveys);
- If the area is irrigated or non-irrigated;
- Proximity to other vegetated areas;
- Vegetation type;
- The level of protection (e.g. Bush Forever site) and;
- Priority ranking for natural areas, derived from the Western Australian Local Government Association's Natural Area Initial Assessment (NAIA).

The City of Joondalup adopted the following management strategies:

- Pathogen Interpretation and Mapping (project);
- Hygiene procedures and cleaning stations;
- Treatment options;
- Purchasing Protocol (landscaping materials);
- Visitor guides and signage;
- Community education program;
- Staff and Friends Group training and;
- Monitoring and Reporting.

The City of Joondalup Pathogen Management Plan can be found on the City of Joondalup's website at: http://www.joondalup.wa.gov.au/Files/COJ%20Pathogen%20Management%20Plan%202013-2016.pdf

We would request that the City of Joondalup be formally acknowledged if you choose to use any of the content or methodology contained within the Pathogen Management Plan.