Weste, G. 2003. Disease caused by *Phytophthora* in Australia and its impact on native forests, woodlands and heathlands. Sudden Oak Death Online Symposium. www.apsnet.org/online/SOD (website of The American Phytopathological Society). doi:10.1094/SOD-2003-GW

Disease caused by *Phytophthora* in Australia and its impact on native forests, woodlands and heathlands.

Gretna Weste

Phytophthora cinnamomi has caused severe dieback and disease in the native forests, woodlands and heathlands of southern Australia. The 'stringy bark' eucalypts, (*Monocalyptus* spp.) and 50 to 75% of the forest, woodland and understory species are susceptible and die when infected; however, the degree varies with the species. *P.cinnamomi* was evidently introduced into Western Australia in 1921 and, although dieback and deaths were recorded, the causal pathogen was not established until 1965. In 1969 dieback disease was recorded in Victoria and subsequently in other southern forests. The microscopic pathogen is dispersed by swimming spores in water or wet soil. It infects root tips and causes hormonal changes that prevent water transport, so that the host dies later during a period of water stress. Infection commonly occurs in the spring when conditions are moist and soil temperatures are greater than 10°C. Within 24 hours of infection sporangia form on the root surface and liberate swimming spores that disperse in water to infect more plants.

Many of the open or dry sclerophyll forests of Western Australia are dominated by jarrah, tall eucalypts with a fibrous bark. These large, slow-growing trees are well adapted to survive in dynamic equilibrium with a climate that would not otherwise support a forest. The soils are poor, laterites with a low organic content and hence contain relatively few soil micro-organisms. The jarrah are adapted to survive a dry summer-autumn period, and bushfires, and to grow in poor soils, low in phosphorus. They have a two-tiered root system; the surface roots suffice during winter and the deep 'sinker' roots extend downwards through the soil, through the bauxite into the underlying water. *P. cinnamomi* accumulates there and decays the 'sinker' roots. It also attacks the vascular tissue in the collar, just above the soil. The death and degradation of a complete, unique, and beautiful forest ecosystem is shocking. The slow-growing jarrah will never be replanted.

Figure 1. Healthy jarrah forest, Western Australia

Figure 2. Two-tiered root system of jarrah

Figure 3. Forest 'graveyard' caused by *Phytophthora cinnamomi*

The Australian flora is entirely different from that of other countries; high species richness developed during a long period of isolation. *P. cinnamomi* has devastated the diverse species of the understory, caused epidemic disease since 1973. More than 1000 species are susceptible, and the rarer species are endangered and may become extinct. Many monocotyledons such as sedges and rushes are resistant, because new roots grow to replace those infected. However, the dominant plant of both understory and heathland is often a large perennial monocotyledon that grows with a trunk bearing a huge tuft of grass-like leaves, the grass tree, *Xanthorrhoea* spp. These common, large plants provide shelter and habitat for the small marsupials. They are resistant to fire and drought, but highly susceptible to *P. cinnamomi*, and the whole population dies when infected. So the mammals die too.

Figure 4. Victorian open forest, healthy

Figure 5. Death of grass trees due to *P. cinnamomi*

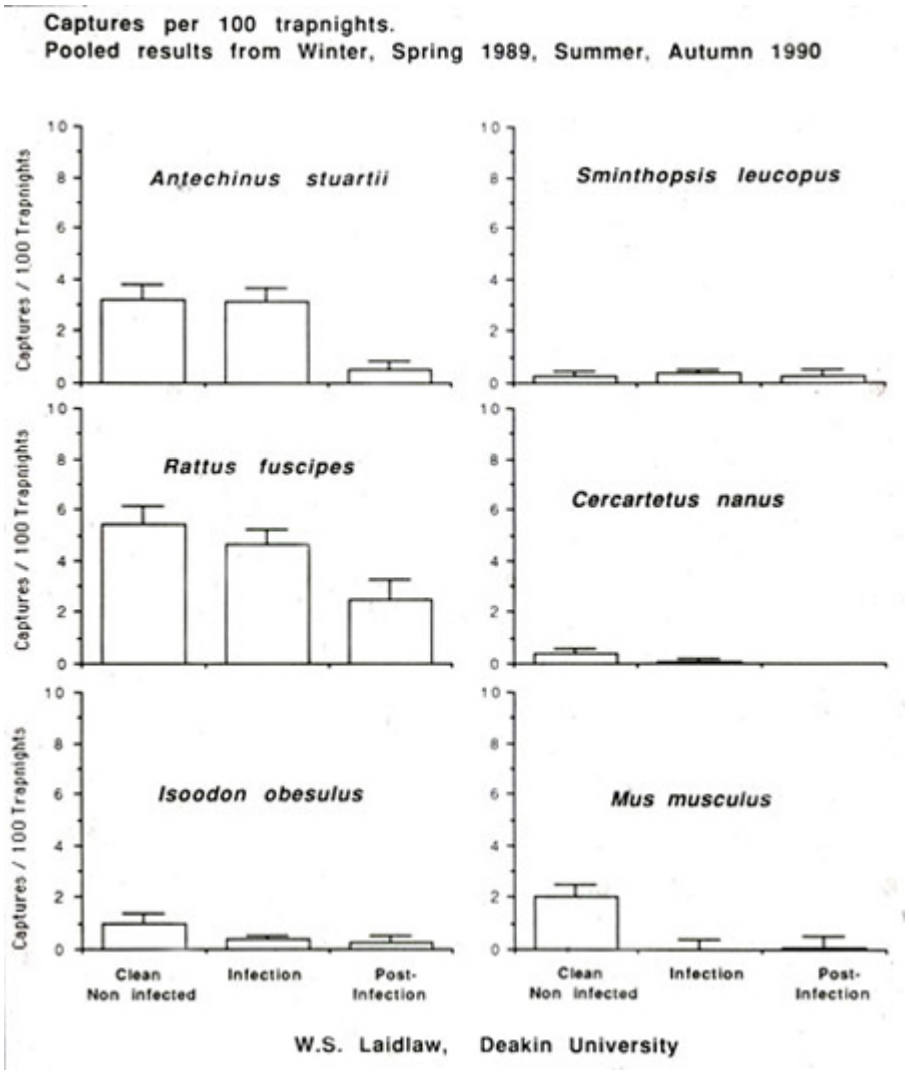

Figure 6. Decline in small mammal population with death of grass trees

Both the heathland and the understory plants produce colored

flowers, nectar, and nutrient- rich pollen that support insects, birds, and small mammals. In diseased areas these plants are replaced by sedges and rushes, that are wind pollinated and produce neither nectar nor nutrient.

Figure 7. Dead banksia and sedges which are resistant and replace the grass trees

Disease due to *P. cinnamomi* leads therefore to loss of trees,- up to 45% in some areas, loss of 50 to 75% of the wildflowers; a high loss of plant species, sometimes the entire population of rare or endangered plants; a decrease in the total number of plants; loss of diversity; increase of bare ground; change to sedges, rushes, and grasses; loss of birds, marsupials, and insects. The disappearance of colorful heaths, peas and other plants unique to Western Australia is tragic and happened before some of the plants could be identified and recorded.

In addition to downhill spread in water the disease is very easily spread by man and his activities, such as by all construction work,by logging, by changes in drainage and on off-road vehicles, and equipment.

Control: During wet periods the forest may be closed to industry. Otherwise all vehicles and equipment must be cleaned before leaving an infested region, and footbaths should be provided. Phosphonate, a cheap, water-soluble, non-toxic phosphorus acid may be sprayed from air or backpack to increase resistance. Resistant plants may be planted. Usually all these methods are

combined.

Figure 8. Cleaning forest equipment to avoid spreading infection.

The pathogen does not survive for long in the soil. The enemies are the soil micro-organisms that engulf, antagonize, or out-compete the pathogen. So with the death of all the susceptible plants, the pathogen disappears. This has been recorded in the large number of permanent quadratsthat I have monitored for 30 years in different areas of forests, woodlands, and heathlands. Regeneration of the susceptible plants then occurred mostly from seed in the soil. Susceptible plants immediately died if they contacted any surviving pathogen, but otherwise survived. The dominant grass trees grow very slowly (0.9 cm p.a.), but after a 30 year cycle abundant regeneration of these and other susceptible plants has occurred. Endangered species are at risk of extinction because they grow only in a few areas with little available seed source. New areas may become infected and begin a new cycle. The current 7 year drought,-(courtesy of El Nino) has favored the native flora, but not the water mold. A series of warm wet seasons would be conducive to disease.

The huge eucalypts that grow in wetter forests are susceptible, but the soils are rich in organic matter and mulch. They support a high population of micro-organisms, greater by several orders of magnitude, and are therefore suppressive to *P. cinnamomi*.

P. cinnamomi may also cause dieback and death in tropical forests in northern Australia, especially when aidedby ponding due to feral pigs. Disease in pineapples is contolled by applications of sulphuric acid. A dieback syndrome in durian orchards growing in marginal conditions is caused by a complex of *P. palmivora*. *P. nicotianae*, and *Pythium vexans*. A number of other *Phytophthora* spp. Have been detected in Western Australian forests, but these cause severe disease only in very wet or waterlogged conditions, and the damage is never comparable with that due to *P. cinnamomi*.

References

Podger,F.D., Doepel, R.F.,and Zentmyer,G.A. 1965. Association of *Phytophthora cinnamomi* with a disease of *Eucalyptus marginata* forest in Western Australia. Plant Disease Reporter **49** 943-7

Shea,S.R., Shearer,B. and Tippett,J.T. 1982. Recovery of *Phytophthora cinnamomi* Rands from vertical roots of jarrah (*Eucalyptus marginata*). Australian Plant Pathology **11**: 25-27.

IMPACT

1. Death of trees-45%
2. Death of 50- 75% different species
3. Big decline in number of plants
4. Decline in plant diversity
5. Extinction of endangered species
6. Increase in % of bare ground
7. Change to sedges and rushes
8. Loss of birds, marsupials, and insects