Report on mass plant deaths near Bluff Knoll, Stirling Range National Park

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The Problem

Mass plant deaths were observed in the Bluff Knoll area, in February – March 2005.

- Is this due simply to drought, or to *Phytophthora cinnamomi*, or both?

Site Characteristics

- To the south of Bluff Knoll, the plant deaths have occurred on all landscape elements, including ridge-tops, on upper, mid and lower slopes, and in gullies.
- Soils are shallow, light, and very stony, over uplifted, weathered, sedimentary rock.

Recent Plant Disease, Fire and Weather History

- The area is known to have been infested with *P. cinnamomi* for some decades.
- The area experienced a hot wildfire in November 2000, and plants are regenerating vigorously. The jarrahs, in particular, have produced multiple new coppice stems.
- Summer 2004-2005 was relatively dry (December – February Bluff Knoll rainfall total = 10.5mm), and the total annual rainfall at Bluff Knoll in recent years (2002-2004) has been well below average.
- Unseasonable, very heavy rain (380mm) occurred in April 2005, and relatively warm temperatures persisted to late May. Soil is moist, and a heavy flush of new growth on trees has resulted. It would be expected that these warm, moist conditions would also have favoured the activity of *Phytophthora*.

Plant Species Affected

- Jarrah (in large numbers), but rarely marri on the sites inspected.
- Various understorey plants including *Banksia*, *Dryandra*, *Xanthorrhoea*, and also *Beaufortia* sp., *Loxocarya flexuosa*, and some others not generally regarded as highly susceptible to *P. cinnamomi*.

Sites Inspected and Sampled on 3rd June 2005

Two sites with mass deaths near Bluff Knoll were inspected in detail with Sarah Comer (CALM, Albany) and samples (soil plus roots from affected, partially-dead plants) were collected for testing for *P. cinnamomi*:

1. Upper slope, on the second ridge north of the car-park along the walking trail to Bluff Knoll; jarrah and *Banksia gardneri* sampled.
2. Gully head, immediately below and to the north-west of the car-park; jarrah and a prostrate *Dryandra* sp. sampled.

Several other sites with similar patterns of dead vegetation were seen.

Observations

- Plant deaths are often in large, fairly clearly defined patches, but also dead individuals are sometimes scattered amongst stands of healthy plants. Jarrah mortalities are the most prominent and numerous from a broad-scale viewpoint.
- Foliage of all dead plants is fully brown, indicating that leaf death occurred several months ago (ie prior to the April rainfall event), and with all foliage dying at about the same time.
- Some jarrah (as well as, for example, the *Banksia* and *Dryandra* sampled) had only a part of the plant (one or two branches) dead, with the remainder still green and living. Some jarrah plants also had some surviving foliage showing partial (but not fresh) necrosis of individual leaves, with the remainder of the affected leaf appearing normal.
- Not a single “fresh” death of any plant species was seen.

- There was no active disease front of dying plants seen at the edge of any patch of dead vegetation.
- The visual impact of the dead patches of (mainly) jarrah is already significantly diminishing, as many trees (and surprisingly, even some of those which had fully brown foliage) are now producing fresh apical and epicormic shoots that are healthy and vigorous. Leaf-fall of the dead foliage has begun.
- Understorey plants – most are likely to be new recruits after the 2000 wildfire.
- Jarrah – the regrowth (largely multiple new coppice shoots from lignotubers) following the 2000 wildfire is now approaching the height of the dead, burnt stags. This regrowth is very vigorous, and probably the total new leaf area of many trees now equals or exceeds that of these same trees before the fire.

***Phytophthora* Isolations**

Plant species (all had part of foliage dead, part green)	*Phytophthora cinnamomi* isolations from:	
	Roots	Soil
Site 1 (upland)		
E. marginata	-	+
B. gardneri	-	-
Site 2 (gully head)		
E. marginata	-	+
Dryandra sp.	+	+

The frequency of positive *P. cinnamomi* isolations from **soil** from such limited sampling was surprisingly high, given that these are long-term Pc-infested sites where the "first wave" of plant death occurred long ago. Clearly, Pc inoculum is at high levels in the soil following the recent rain and warm conditions. Pc was not isolated from the **root** sample taken from either of the jarrahs.

Conclusions

The pattern of plant deaths in affected sites (with no apparent active disease front associated with the affected patches), and its timing, strongly suggests that drought is the main factor involved in this mass death event. This is supported by the observation of new apical and epicormic shoots on many jarrahs whose foliage had appeared to be fully dead only a month or so ago. This regeneration indicates that the trees have experienced a "drought scorch" effect that is analogous to fire scorch. Such regeneration is rarely seen on jarrah showing sudden crown collapse as a direct result of Pc infection. Pc was not isolated from the root samples taken from either of two small (<1m) jarrahs with partially-dead tops.

However, *P. cinnamomi* is also involved. These sites have long been infested with Pc, and the positive Pc isolations from soil clearly show that inoculum is still present there (and probably has been boosted by the recent unseasonable conditions), although there have been no significant numbers of plant deaths following the April rainfall event. It is likely that generally-susceptible plants such as jarrah may be carrying sub-lethal Pc infections, with varying levels of chronic root damage being present as a result. [Also, the very large numbers of jarrah remaining on these sites suggest that the jarrahs here may have a substantial level of tolerance to Pc.]

The vigorous post-fire regeneration of (in particular) the jarrah is now leading to the development of new crowns that are fast approaching the size of those that existed before the fire. This continuing rapid top growth, together with increasing between-tree competition, will now place increasingly heavy demands on the trees' root systems to supply adequate water to them in dry seasons. Where there is also pre-existing (and sometimes still progressing) root damage caused by *Phytophthora*, these new crowns may become unsustainable, and sudden collapse will then occur. Therefore, it can be expected that further mass death events of this type will occur in coming years if the summer drought is severe, until equilibrium is regained. This is a good example of the dynamics of the "Disease Triangle" (Host-Pathogen-Environment) in action.