Distribution and etiology of aerial stem infections of *P. ramorum* and *P. taxon C* at three woodland sites in the UK

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*Phytophthora ramorum* and *Phytophthora* taxon C are recently invasive pathogens in woodlands in southern Britain. *P. taxon C* is a newly discovered taxon, shortly to be named *P. kernovii* sp. *nov*. Both species can aggressively infect foliage and shoots of Rhododendron ponticum and then spread aerially to attack the inner bark of tree stems, especially Fagus sylvatica and some Quercus species, causing bleeding lesions. Three woodlands in south-west England with extensive naturalised understory *R. ponticum* infected with *P. ramorum* and/or *P. taxon C* were investigated for spread of these pathogens onto trees.

Following a preliminary survey, 127 trees with 'suspicious' external stem symptoms were investigated for *Phytophthora* by isolation. Overall, 18/49 (37%) of trees investigated at Site 1 yielded a *Phytophthora*, 24/63 (38%) at site two and 10/15 (67%) at site 3. *P. ramorum* was isolated from aerial stem lesions on *F. sylvatica*, *Q. cerris*, Aesculus hippocastanum and Nothofagus obliqua. *P. taxon C* was isolated frequently from beech and a Liriodendron tulipifera. *P. citricola*, an established endemic, was regularly isolated from *Acer pseudoplatanus*, and may also have spread from the adjacent diseased rhododendron. *P. ilicis*, another recently invasive aerial *Phytophthora*, was obtained from stems of two Chinese *Ilex* species. Surprisingly, *P. gonapodyides*, a weak parasite and common soil inhabitant, and *P. cambivora*, an established endemic collar pathogen, were also obtained from aerial bark lesions on several beech trees.

26 mature (50-140 cm diam) *F. sylvatica* were investigated for processes of local spread and infection. These included proximity to rhododendron, pattern and mode of spread within a tree, and tree response. Three trees were infected with *P. ramorum*, 22 with *P. taxon C* and one with both *Phytophthoras*. Aerial bark lesions, ranged in size from small ca 3 cm diam. to lesions of >1m diam. These occurred from near ground level to 11m. One tree had completely girdling lesions for over 6 m of its length.

The study indicated: (i) intact beech bark can be penetrated and infected by *P. ramorum* zoospores and probably by *P. taxon C* zoospores; (ii) direct contact or close proximity (< 3m) to infected rhododendron is a major but not universal factor in infection; (iii) rainwater accumulation and run-off at branch forks may account for a minority of infections; (iv) simultaneous multiple infection of stems is occurring; (v) vertical spread may occur within a tree; (vi) *P. ramorum* and *P. taxon C* can penetrate and be recovered from the underlying wood; (vii) the tree may respond to a bark lesion by attempting to wall it off with callus; (viii) *P. taxon C* (at least) may pump water out of the xylem into the inner bark; (ix) stem lesions sometimes extend 10-20 cm below ground level; (x) some trees are multiply infected by *P. taxon C*, *P. ramorum* and *P. gonapodyides*; (xi) developing lesions are soon invaded by unknown basidiomycetes and ascomycetes.

Wider risk issues arising from these observations will be discussed.