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Commentary

Parasitic plants and forests: a climate change perspective

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Infection of trees by parasitic plants can be costly, since parasites usually decrease tree growth and fruit production or increase tree mortality. In Switzerland, for example, damage from *Viscus album* ssp. *austriacum* (pine mistletoe) infection has been estimated to cause the cutting or death of 10% of *Pinus sylvestris* (Scots pine) in the Rhone Valley (Dobbertin et al. 2005). However, at the ecosystem scale, parasitic plants also play important roles in providing structural diversity in forest stands and food sources for birds (Watson 2001), as well as increasing local nutrient cycling by concentrating nitrogen in their leaves at much higher levels than the host tree (Escher et al. 2004, Reblin et al. 2006). In this issue, Bell and Adams (2011) review the effects of plant parasites on woody species. They emphasize physiological research, but also scale up to examine implications for ecosystem functioning, and scale down to point out recent advances in plant–parasite interactions from molecular biology, an approach that *Tree Physiology* strongly advocates.

While the effects of infection on host carbon and water fluxes have received a fair amount of study, scaling these effects to the ecosystem level has not, as Bell and Adams (2011) note. Importantly, our lack of understanding of how parasitic plants impact forest functioning impedes our ability to predict how these symbioses will affect forests in the future as the climate changes. Data from dendrochronology show that the growth of infected trees is more sensitive to climate, especially moisture stress, than that of uninfected trees (Stanton 2007). Since rising temperatures and changing precipitation patterns are expected to increase drought frequency and severity in many regions (IPCC 2007), and plant parasites increase host tree water stress and drought-associated mortality (Dobbertin 1999, Dobbertin and Rigling 2006), infection is likely to exacerbate climate-related drought stress in forests. Warmer, drier conditions are also expected to cause more frequent fires. While fire can control parasitic plant infestations by killing infected branches or individuals, low-intensity surface fires can jump into the canopy more easily in infested than healthy stands, thus becoming severely damaging crown fires (Hoffman et al. 2007). In contrast to the potential for parasitic plant infection to intensify climate change stress, rising CO_2 might benefit infected trees. Host trees with greater carbon resource uptake also support greater growth rates in parasitic plants (Bickford et al. 2005). Thus, while higher host photosynthetic rates under elevated CO_2 may stimulate parasitic plant growth, the extra tree carbon uptake could also help compensate for the extra carbon sinks of holoparasitic plants, which rely on their host for not only water and nutrients, but also carbon.

Predicting how climate change will alter tree–parasitic plant relationships is difficult, since climate change can be expected to affect both the host and the parasite species individually, leading to changes in the strength or even presence of the symbiosis. We might expect parasite ranges to move with their host species as the climate changes, and there is evidence that warming has already extended the altitudinal range of some tree parasitic plant species (Dobbertin et al. 2005). However, over a much longer time scale, there are many factors that can disrupt the match between host and parasite range and migration. Using fossil pollen data and population genetics, Tsai and Manos (2010) found that since the last glaciation, *Fagus grandifolia* (American beech) density was a more important predictor of the spread of an obligate, host-specific parasite, *Epifagus virginana*, than was the range expansion of the tree itself. Thus, as trees migrate in response to changes in climate, parasitic species may not be able to follow. The dependence of many parasitic plants on birds for pollination and seed dispersal adds another layer of intricacy to predicting how the entire species assemblage involved in the host tree–parasitic plant relationship will respond to climate change. Bell and Adams (2011) provide a comprehensive overview of our current knowledge of the effects of parasitic plants on tree physiology and the few studies of larger-scale forest implications, but more research on the role of these parasites in forest processes is needed to understand how we should manage these infections in the future.

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