

Red Heart Disease in Pines caused by *Porodaedalea* (*Phellinus*) *pini* in Florida¹

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Summary

Porodaedalea pini causes red heart disease on mature pine trees. The disease name "red heart" is derived from the infection of heartwood—the dense inner part of a tree trunk—by the fungus. All pine species in Florida are susceptible to infection by *Porodaedalea pini*. It can result in significant decrease of the market value of timber and can lead to the infected trees becoming structurally unsound. The structurally weakened trees may pose potential threats to people and property. Although *Porodaedalea pini* is pathogenic to individual trees, this fungus can be considered beneficial in natural forest ecosystems, particularly in the southeastern United States. This fungus serves as an important disturbance agent that facilitates forest succession. In addition, it can assist cavity-nesting animals, such as the endangered red-cockaded woodpecker, by softening heartwood. Management of this fungus should therefore be dependent on the objectives of the owner or manager of the land. In pine plantations, infected trees should be removed to reduce the abundance of spores, and extra care should be taken with infected trees in public areas. Avoidance of unnecessary wounds is the most effective way to prevent new infections of this disease.

Introduction

Porodaedalea pini, more commonly known by its former names *Phellinus pini* and *Fomes pini*, is one of the most important wood-decaying fungi in pine forests, causing damage known as "red heart" or "red ring rot." This fungus infects conifer trees, not broadleaf trees. Red heart disease can affect all pine tree species, especially in mature and over-mature stands. The infected pine tree shows the typical symptom of reddish-brown decay, with "white pocket" in the heartwood (Figure 1) causing considerable loss of heartwood volume (Myren et al. 1994), and therefore of the economic value of the

timber. In addition, heartwood rot can also render the affected trees structurally unsound.



Figure 1. Symptom of red heart disease caused by *Porodaedalea pini*, showing the reddish-brown decay with "white pocket" in the heartwood.
Credit: Jeffrey Lotz (FDACS-DPI)

In Florida, all pine species are susceptible to infection by *Porodaedalea pini*. Unlike most wood-decaying fungi, *Porodaedalea pini* can colonize living trees, but it typically does not kill the tree. It primarily infects heartwood—the dead tissue in the center of the stem that does not conduct water and nutrients—and does not invade living or active tissues. Therefore, technically, *Porodaedalea pini* is not considered as a pathogenic agent that kills trees. However, the infected pines are mechanically weakened, which makes them more susceptible to breakage. The structurally vulnerable trees may pose potential threats to nearby targets such as people and property. This fungus primarily affects mature pines and typically does not affect younger trees. Damage caused in younger stands is limited because the spread of heart rot is often exceeded by the faster growth rate of young trees (DeNitto 2005).

Recent research has found that the taxonomic species *Porodaedalea pini* is present only in Europe. The similar fungi that affect conifers in North America are likely comprised of multiple related species of *Porodaedalea* that have not yet been formally described and named (Brazee and Lindner 2013). Fungi from this group in the southeastern United States have been temporarily termed "*Porodaedalea pini* SE" (Jusino et al. 2014).

Ecological roles in the Southeast Ecosystem

While *Porodaedalea pini* is a problematic pathogen for the timber industry, this fungus functions as an important and beneficial component of the ecosystem. For example, it accelerates the decay process of tree stands in a way that enables forest succession and regeneration. With the progress of forest pathology research, it is increasingly accepted that forests need a "healthy amount of disease" to sustain their long-term stable and healthy condition (Manion 2003). Many tree-declining agents, including *Porodaedalea pini*, maintain forests' health by weakening large trees (canopy-dominating trees), thus enabling the growth of understory species and allowing species diversification in the environment (Manion 2003).

In addition, *Porodaedalea pini* provides essential habitat for cavity-nesting animals by decaying and softening the heartwood of standing trees. An important example in the southeastern United States is the federally endangered red-cockaded woodpecker, which nests in living pine trees and often uses areas decayed by this and other heart-rot fungi (Conner and Locke 1982). Given its ecological significance, it has been suggested that this fungus is an indicator species for assessing the health of pine ecosystems, and infected trees should be retained on sites that are managed for wildlife conservation (Löhmus 2016).

Signs, Symptoms, and Biology

Red heart disease caused by *Porodaedalea pini* can be readily identified in pines by the presence of conks (fungal fruiting bodies) on the stem, usually emerging from branch stubs or knots of the infected trees. Conks are shelf-like, hoof-shaped, usually 4 to 10 cm (1.6 to 4 inches) in diameter (Figure 2). The upper surface of a conk is ridged, red-brown to dark-brown, often showing concentric rings, while the underside is almond-yellow with pores. Within the stem, the fungus often initially

spreads along the boundary between heartwood and sapwood, causing a reddish decay in concentric circles (which gives it the "red ring rot" name). Advanced infection shows spindle-shaped white pockets in the heartwood due to the degradation of lignin, a pattern known as "white pocket rot" (Figure 1).



Figure 2. Fruiting body of *Porodaedalea pini* on an infected pine tree (arrow).

Credit: Edward Barnard (FDACS-FFS)

Conks can live and generate spores for years. These wind-blown spores serve as the primary source of infection. Infection normally occurs upon the arrival of spores on small wounds such as branch stubs or knots. Under suitable conditions (dependent on temperature and moisture), the spores can germinate and start to colonize wood tissues. The fungus develops within the tree and establishes in the heartwood, usually with no visible signs of defect, e.g., wilting or decline, for many years. It may take more than ten years after the initial infection for the conks to develop (Forest Health Protection Rocky Mountain Region 2010). The disease cycle can then be repeated with spores generated by the newly formed conks.

Management

Management of red heart disease on pines is dependent on the setting and the landowner's objectives. For public safety, infected pines in public areas should be checked frequently and be removed by a certified arborist if the trees are structurally unstable. Unstable trees are dangerous to people and property. From the perspective of timber management, infected trees should be harvested before the progress of disease has significantly decreased their economic value. In pine plantations, infected trees should be removed to reduce spore production (Forest Health Protection Rocky Mountain Region 2010). Since the fungus generally does not affect younger pines, reducing the rotation age need only be considered in areas where the disease occurs frequently (Forest Health Protection Rocky Mountain Region 2010). Given the important ecological roles of *Porodaedalea pini*, eliminating the fungus is not an objective in natural forests or where management for wildlife habitat is a priority.

There is currently no effective way to chemically treat infected trees. Since wounds are the primary route for new infection of tree, preventing unnecessary injuries to trees while logging and pruning is the most effective way to prevent the disease.

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