TITLE: Distribution and Impacts of *Heterobasidion* Root Disease in the Lake States and Development of a Standardized Early Detection Protocol

LOCATION: Michigan, Minnesota and Wisconsin

DATE: 09/30/2013

DURATION: 2 Years  FUNDING SOURCE: Base

**PROJECT LEADERS:** Glen Stanosz, University of Wisconsin  
608-265-2863, gstanosz@wisc.edu  
Dana Richter, Michigan Technological University  
906-487-2149, drichte@mtu.edu  
Tara Bal, Michigan Technological University  
906-487-1898, tblal@mtu.edu

**COOPERATORS:** Roger Mech, Michigan Department of Natural Resources  
Robert Heyd, Michigan Department of Natural Resources  
Jana Albers, Minnesota Department of Natural Resources  
Kyoko Scanlon, Wisconsin Department of Natural Resources

**FHP SPONSOR/CONTACT:** Joe O’Brien, USFS S&PF Unit, 651-649-5266; jobrien@fs.fed.us

**PROJECT OBJECTIVES:**
- Delimit current distribution of HRD in Michigan, Minnesota and Wisconsin.
- Develop a cost-effective *Heterobasidion* root disease (HRD) field sampling protocol for use in the Lake States.
- Identify risk factors affecting establishment and spread of HRD.
- Develop management guidelines for HRD to minimize resource impacts.

**JUSTIFICATION:**
**Linkage to FHM program.** Since detected in Wisconsin 20 years ago, ground surveys have revealed presence of HRD in 60 locations in 23 counties (WI DNR 2013). Historic FHM off-plot survey data have indicated that HRD distribution in Michigan is limited to the extreme southern edge of red pine’s natural range. In 2011, however, off-plot surveys documented HRD in the northwestern Lower Peninsula for the first time. In addition, a fruiting body collected in Houghton County, Michigan in 1908 was confirmed as *H. irregulare* in 2013. There is currently no official confirmation of HRD in Minnesota, despite the collection of a *H. irregulare* conk from a downed spruce log in the Itasca State Park in 1970.

**Significance/impact of forest health issue.** HRD is the most damaging disease of conifers in the North Temperate Zone. Some 150 species of trees are susceptible, with conifers being the major hosts. In the Lake States, pines are the most economically important species attacked. The economically and ecologically important pine resource occupies almost 2 million acres in Michigan, over 1.5 million acres in Wisconsin, and approximately 800,000 acres in Minnesota, mostly in age classes in which thinning will repeatedly occur (Wisconsin DNR 2012). Compared to the southeastern US, where Powers and Boyce reported 82% of thinned slash pine plantations affected and 69% of thinned natural stands affected (Powers and Boyce 1961), there is little knowledge of the incidence of HRD in the Lake States. HRD causes root and butt...
rot, reduced growth, and tree mortality. Intensified surveys are needed to accurately delimit the range of this disease across the region.

**Cost/economic efficiency.** Data from annual aerial surveys will be used to identify established areas of red pine mortality. In Michigan, a newly-developed forest health data-logging application will be used by DNR foresters statewide to report areas of concern during their regular daily work activities. In Wisconsin, existing distribution information and previous experience with spore trapping (Smith et al 2012) will be used in refining spore trapping methods.

**Priority Issues.** Early detection of HRD in new areas is critical to ensuring that management practices are applied in a timely fashion and economic impacts are minimized. Determining risk of red pine areas to HRD is an essential first step in reducing losses from this disease. While various Lake State forest health programs are surveying for HRD, standardized field sampling protocols do not exist and efficiency of spore trapping to detect areas at risk for infestation is unknown.

**DESCRIPTION:**

**Background:** Annual surveys indicate that HRD is expanding its range in the Lake States. Concerns about potential impacts of HRD have escalated among resource professionals, forest industry and private landowners. Economic losses due to mortality and decreased growth, as well as additional costs associated with treatment regimes, can be significant. In addition, significant loses can be expected when trees weakened by HRD die from subsequent bark beetle attack.

Determining the distribution of active HRD infestations, and areas where viable inoculum is being deposited across its conifer host range is a critical first-step in developing a cost-effective approach to managing the disease. Unfortunately, not enough is known about the behavior of HRD on red pine in the Lake States. In order to develop a hazard risk rating system, information is needed on timing of fruiting; location of fruiting bodies; relationship between host age, stocking and management history; susceptibility of host trees growing on various soil types and factors that affect subsequent attack by bark beetles and other opportunistic pests.

**Methods:** Areas of current red pine mortality will be identified using digital aerial sketchmapping (DASM) and subsequent ground surveys, including GIS-based forest health reports provided by MDNR field foresters. A minimum of 30 sites across state and federal forestland in Michigan will be surveyed (60 plots total over 2 years). Inventory data will be used to determine stand and site characteristics, including age, stocking, management history, soil type and other parameters. In Wisconsin, stand and site characteristic data from 30 confirmed HRD sites will be collected.

A total of 3 to 5 symptomatic trees per site will be tagged and examined for signs of HRD, including fruiting bodies, stringy white rot and resin-soaked roots (Barnard et al. 1991). In addition, adjacent stumps will be examined for signs. If no fruiting bodies are found, wood samples will be collected from the lower trunk/root collar zone of symptomatic trees for culturing in the lab.

The effect of various treatments on relative efficiency of red pine disks used as spore traps will be tested under natural conditions in Wisconsin in Year 1. Following two weeks of exposure in pine stands, disks will be retrieved, incubated, and examined. Field methods will be refined in Wisconsin to determine the highest efficiency of detection of viable *H. irregulare* inoculum.
In Year 2, Michigan surveys for infested stands will continue and the refined spore trapping method will be used to assess areas of at-risk conifer forests in Michigan, Wisconsin and Minnesota.

FHM/FIA crown indicators (density, transparency, dieback, vigor class, live crown ratio) will be measured to establish condition of trees within, adjacent to and outside of the mortality pockets. Host trees in and adjacent to pockets will be examined for presence of bark beetles.

**Products:**
- Map and associated GIS products showing current distribution of HRD in the Lake States.
- Map and associated GIS products identifying HRD hazard zones for the Lake States.
- A standardized protocol for confirming HRD, including detailed field and lab procedures.
- A list of risk factors associated with susceptibility and vulnerability of pine to HRD in the Lake States for use in NIDRM.
- HRD management guidelines for pine in the Lake States.
- Presence or absence of *H. irregulare* by sample and site.
- Comparison of confirmation by incubation of samples at ambient temperature versus agar culture.

**Schedule of Activities:**
- **Spring/Summer 2014:** Identify RPPM using aerial and ground surveys; establish plots; analyze inventory data for sites; test different spore trap disk treatments in Wisconsin lab.
- **Late Summer/Fall 2014:** Field evaluation of plots, lab analysis, data entry in MI; test different spore trap disk methods in field in vicinity of known infestations in WI.
- **Winter 2014/Spring 2015:** Data analysis; FHM poster synthesis; annual project report.
- **Spring/Summer 2015:** Identify RPPM using aerial and ground surveys; establish plots; analyze inventory data for sites.
- **Late Summer/Fall 2015:** Field evaluations of plots; lab analysis; data entry in MI; implement refined spore trap disk methods in MI, MN, and WI.
- **Winter 2015/Summer 2016:** Data analysis; FHM poster synthesis; final project report

**Literature cited:**


Wisconsin Department of Natural Resources. 2012. Pine resources and treatment of Annosum root rot in North America. Madison, WI.


COSTS:

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