Title: INT-EM-04-01  Alder Dieback and Mortality in the Southern and Central Rocky Mountains: Extent, Severity and Cause

DURATION: Year 3 of 3-year project.

PROJECT LEADER: Jim Worrall, R2 Forest Health, (970) 642-1166, jworrall@fs.fed.us

COOPERATORS: Barry Johnston, R2 Plant Ecologist; Tom Eager, Entomologist, R2 Forest Health Mgmt.; Roy Mask, Entomologist, R2 FHM; Gerald Adams, (Cytospora expert) Michigan State University

PROJECT OBJECTIVES: Determine the extent, severity and cause of alder dieback and mortality in riparian areas of Colorado and neighboring mountain states.

JUSTIFICATION: This project addresses three of the primary emphases of the Base EM subprogram:

Tree mortality. Our 2004 survey, including 6,503 standing stems from northern New Mexico to southern Wyoming, indicate that 37% of stems are dead.

Poor crown conditions. In the same survey, 29% of standing stems were alive but with dieback. Only 34% were alive and healthy.

Insects and diseases. We have identified an apparently aggressive canker pathogen, Valsa melanodiscus, and are currently trapping insects.

In addition, it addresses selection criteria as follows:

Linkage to FHM Detection Monitoring. This damage was detected by our observations and those of range conservation staff rather than the Detection Monitoring system. However, the EM program is designed to investigate “undesirable changes in forest health identified through Detection Monitoring and other means.”

Significance in terms of geographic scale. It is widespread in Colorado, southern Wyoming and northern New Mexico. A similar phenomenon occurs in Alaska on the same species. It may occur in other states also.

Biological/political impact of the issue. Alnus incana ssp. tenuifolia is a critical riparian species in the Rocky Mountains. Riparian vegetation provides valuable species and niche diversity, prevents erosion of riparian soils, and provides the only trees or large shrubs in dry landscapes. This damage has in some cases become enmeshed with issues of range management. Riparian areas are also heavily used for recreation: picnicking, fishing, rafting, kayaking, hiking, and scenic enjoyment.

Feasibility of project completion. In 2004, we completed a major survey to assess extent and severity of the damage. In 2005 we initiated sampling to help characterize the dynamics and cause of the damage. Thus much of the project is completed. At the conclusion, we will have good information on extent and severity and will at least be able to rule some causes out. We have a good track record of providing reports and publications from work such as this.
a. Background: For several years, dieback and mortality of thinleaf alder, *Alnus incana* ssp. *tenuifolia*, has been reported and observed in riparian areas of Colorado and neighboring states. Evidence suggests that it began by the early 1990s. Etiological hypotheses that we have tentatively excluded include: (1) Drought. Dieback occurs even in trees rooted partially in permanent streams, and may not occur to trees in drougthy locations away from a stream. Also, the time frame of mortality extends to years before the current drought. (2) Phytophthora disease of alder: A lethal disease of alder, caused by a new, hybrid species of *Phytophthora*, was found in England in 1993 and is now known in much of Europe. Symptoms are not at all consistent with that disease and we could not isolate *Phytophthora* using a selective medium.

Other hypotheses on the cause include: (1) Cytospora canker. Cytospora canker is clearly associated with dieback, but *Cytospora* spp. can be opportunists that attack stressed trees. Another biotic or abiotic cause therefore seems likely. If *Cytospora* sp. is causing a primary disease, some explanation is needed. (2) Alder phytoplasma: The alder yellows phytoplasma was first described from Europe but has since been found in the U.S. (3) Borers: An unidentified borer and galleries have been seen in some trees with dieback. (4) Climate cycles or other change.

b. Methods:

*Remeasure a sample of 2004 transects.* The transects we established in 2004 were marked with 12” spikes and located by GPS. Two years should be sufficient time to detect change if dieback and mortality are continuing. We will resample locally accessible transects.

*Inoculations.* Inoculations conducted with one isolate of the putative pathogen in 2002 resulted in no disease. Dr. Adams later confirmed that isolate as *Valsa melanodiscus*. We will conduct additional inoculations with more isolates and techniques to explore pathogenicity. In addition, Dr. Glen Stanosz, supported by a related project of Lori Trummer in Alaska, is conducting greenhouse inoculations of Colorado and Alaska cuttings with isolates from both areas.

*Canker growth measurements.* This fall (end of growing season) and next spring we will revisit cankers that were marked to determine the rate and seasonality of canker growth. Results thus far indicate that canker development is rapid, and suggest that cankers may grow during the plant’s growing season. This would suggest an aggressive pathogen. In spring we will also mark additional cankers and follow monthly during the growing season.

*Insect trapping.* Identify emerging adults collected from traps this fall and redeploy traps in 2006 for additional sampling.

*Latency and consistent association.* Conduct isolations from healthy bark, wood and canker margins to determine if *V. melanodiscus* is present in healthy tissues as latent infections, and to determine if it is present in all cankers in early stages.

*Fungal community.* Examine fruiting of *V. melanodiscus* and associated fungi to determine what type of fruiting (sexual or asexual) and species occur at different stages of the disease and on different plant parts (twigs, branches, stems).

*Phytoplasma.* Collect phloem and leaf samples of symptomatic and asymptomatic alder through the growing season for detection of phytoplasmas. Dr. Harrington (Iowa State) will do DNA extraction, PCR, and molecular analysis of DNA for phytoplasma-specific sequences.

c. Products: A technical report will present information on the distribution, severity, cause and prognosis. A journal article will provide more detailed technical information on the survey, studies into the cause and association of disease severity
with site and plant community features such as elevation, aspect, community type, etc. A final report is expected in early 2007.

d. Schedule of Activities: Field activities will take place during summer 2006. Data analysis, integration of results, and writing of a report will occur in fall and winter.

e. Progress/Accomplishments: Results of our survey of watersheds from northern New Mexico through southern Wyoming were briefly described in the FY05 proposal and are mentioned above. We characterized the severity of the problem, the status of alder, and within the area that we can reach, the extent. In 2005 we began work on the cause. One of the aspects that must be considered is the dynamics of alder populations. We measured and aged 129 stems, both with and without dieback, including recently killed stems. The maximum age was 69 years. We detected no effect of dieback on growth (as measured by 5-year ring-width increments), nor does it appear that stems decreased growth over a number of years before death. Other evidence also indicates that canker growth, dieback and death progress very rapidly. We marked edges of 10 cankers on live trees in late 2004. In July 2005, 4 trees were completely dead, 3 were girdled but still had green foliage (essentially dead), 1 was a branch infection and the infected branch had died, and 2 infected trees were still alive but the cankers had grown. In ungirdled trees, canker growth was several feet up and somewhat less down. Reexamination this fall of cankers marked this summer will indicate if canker growth occurs during the growing season, but that appears to be the case. Attempts to detect change in alder over time, by finding and remeasuring old riparian transects, were largely unsuccessful. However, we established 32 new, permanent transects this year that will permit detection of changes in alder in the future. Confirming the results of the broader, previous survey, severity was similar and there was no correlation with elevation. Our cooperator from Michigan State University, Dr. Gerry Adams, conclusively identified the canker pathogen in Colorado as \textit{Valsa melanodiscus} (anamorph \textit{Cytospora umbrina}), and preliminary indications are that the pathogen causing the similar disease in Alaska is the same. We closely examined roots on 5 sites and found no significant root disease, fine root mortality or N$_2$-fixing nodule mortality preceding or even accompanying early stages of dieback. We placed net traps on 39 stems in 6 sites to trap any boring insects exiting diseased trees.

**COSTS:**

Salary expenses include 1 GS-5 and a GS-4 for a 13-week field season. Salary is also requested for a GS-4 student to enter data conduct mycological studies and isolations through the academic year (35 weeks, 10 hr/wk). Funds are requested for project travel and a vehicle. Procurement includes phytoplasma sampling.

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