

TITLE: Rapid aspen decline on the southwestern edge of its range

LOCATION: Northern Arizona - Kaibab National Forest (South Zone)

DATE: September 24, 2010

DURATION: Year 2 of a 2 year project **FUNDING SOURCE:** Base EM

PROJECT LEADERS: **Margaret M. Moore**, School of Forestry, Northern Arizona University (NAU), Flagstaff AZ (928) 523-7457, Margaret.Moore@nau.edu; **P. Z. Fulé**, Ecological Restoration Institute, NAU, (928) 523-1465, Pete.Fule@nau.edu; **M. L. Fairweather**, USFS R3 FHP, Flagstaff (928) 556-2075, mfairweather@fs.fed.us;

COOPERATORS: **C. H. Sieg**, USFS RMRS, Flagstaff, AZ (928) 556-2151, csieg@fs.fed.us

FHP SPONSOR/CONTACT: M.L. Fairweather, USFS R3 FHP, Flagstaff, (928) 556-2075, mfairweather@fs.fed.us

PROJECT OBJECTIVES: This proposal requests continuing funds to complete this project. We propose to examine the relationships among stand conditions, site factors, and causal agents associated with the accelerated decline, dieback, and mortality of aspen on the southwestern edge of its range. The Kaibab National Forest-South Zone (KNF-SZ) has a mixture of aspen stands ranging from high elevation, large stands to low-elevation pockets of aspen. Specific objectives of the project are to: 1) determine the biophysical setting of these aspen stands (i.e., elevation, slope, aspect, etc.); 2) determine the current aspen stand structure (density, diameter, age), dieback and mortality on a subset of conditions across the Forest; 3) investigate the relationships of climate (especially drought) and age as factors in aspen mortality, and 4) eventually, to reconstruct aspen stand history on this subset of stands. We are interested in how short-term (past 5-15 yrs) and long-term (past 100-150 yrs) aspen stand structure varies with climate, drought, fire occurrence, domestic and wild ungulate populations, and insect or disease.

JUSTIFICATION:

Linkage to FHM Detection Monitoring - Aspen dieback and mortality have increased rapidly over the past 10 years throughout the Southwest and on the KNF-SZ, and have been reported by aerial detection surveys (ADS), Forest Health Protection, and KNF-SZ forest managers. Aspen damage in the southwestern region was detected on about 176,000 acres in 2008, which is an increase from ~85,000 and 143,000 acres reported in 2006 and 2007, respectively. Arizona's aspen suffered the majority of this damage (123,130 acres) (USDA, 2008). Significant mortality has occurred in northern and central Arizona, particularly in aspen stands located below 8,500 feet elevation. Fairweather (INT-EM-03-02) initiated an EM project on aspen decline on the Coconino National Forest in 2003, followed by the Apache-Sitgreaves NFs in 2004. Aspen on low-elevation xeric sites (<7500 ft) sustained 95% mortality since 2000 while mid-elevation sites (7500–8500 ft) lost 61% of aspen stems during the same time period.

Significance in terms of the geographic scale – ADS has reported rapid aspen dieback and mortality across many National Forests in the West, and the southwestern region (R3) is no exception. This project will complement previous studies on aspen decline in the USFS R3, and contribute to a broader perspective on aspen decline and dieback in R3 and throughout the Rocky Mountains. In addition, this project will offer a unique perspective because the study area occurs

within the southwestern edge of aspen's range, and therefore, these aspen stands may have the most rapid and most severe responses to climate change, periods of drought, etc.

Biological impact and/or political importance of the issue - Aspen stands provide critical (and disproportionately high) amounts of plant and animal habitat and aesthetics in the Southwest. A loss of aspen results in a loss of biodiversity, aesthetics, and loss to local rural economies.

Scientific Basis/Feasibility – The project leaders have experience with inventory, monitoring, and analysis of aspen; and experience in reconstructing stand dynamics and history. We also have experience in completing large projects such as this one. Lastly, there is a good working relationship among USFS FHP, USFS RMRS, KNF-SZ and Northern Arizona University.

Priority Issues – This project will address the following priority issues: effects of climate change forests, drought impacts, tree mortality and poor crown condition (branch and crown dieback).

DESCRIPTION:

Background – The long-term persistence of aspen on the landscape is a concern across much of the western U.S. The extent of aspen decline is controversial. In the past 5-15 years, many western forests experienced rapid mortality of aspen. Decline disease includes predisposing factors, such as long-term climate change, rate of plant succession, site, and stand characteristics. Specific predisposing site factors for aspen include low elevation and southerly aspects, while stand factors include large stem size and low stand density (Worrall et al., FE&M 2008, 2010). Severe drought, high temperatures during the growing season, and defoliation (insects, diseases, or late frost) are important inciting factors. Chronic ungulate browsing exacerbates the problem since aspen regeneration is already low. In Arizona, Fairweather et al. (2008) noted an accelerated rate of decline following a severe frost event in June, 1999, and severe drought in 2000 and 2002. Although ADS results report on the change in defoliation of aspen at a broad level, the extent and severity of the decline and mortality at the local stand level is unknown.

Methods - We inventoried 50 aspen sites on the KNF-SZ during the summer 2010. Aspen stands on KNF-SZ were stratified by elevation, aspect and slope and a stratified random sampling strategy were used to select field sites proportional to the occurrence of these strata within aspen's current distribution. A nested plot design was used to collect data at each site. A 20-m radius circular plot was established with the random sample point at site/plot center. The 20-m radius plot is the unit of analysis and data from the subplots will be averaged prior to the analysis. Four 8-m radius subplots were located 20-m from site center in each of the cardinal directions. The plot center of the large 20 m plot and the four 8 m subplots were permanently marked with rebar and the location recorded with a GPS. For each 8 m subplot, elevation, aspect and slope were recorded. In addition, tree species, diameter, crown class/strata, crown dieback, tree condition (mortality), age, incidence of damaging agents (insect, disease, browse, etc.) were recorded on all mature aspen trees (> 10 cm dbh). Species, diameter, crown class/strata, tree condition, and age were collected on all non-aspen species. Seedlings/suckers (< 2.0 cm DBH) were stratified into two height classes, with 1.37 m serving as the boundary between seedling height classes, as height is a better indicator of the likelihood of seedling/sucker canopy recruitment than age. Variables recorded for seedlings/suckers included: species and percent incidence of damage agents. Variables that were recorded for saplings (> 2.0 but < 10 cm DBH) include everything recorded for mature trees. Saplings were not tagged. Species and stand-level (plot/site level) statistics will be determined such as density, basal area (BA), and average age and growth rates. We have preliminary stand-level data on 12 high elevation and 12 low elevation sites (see below). A 2-4 ha area including and surrounding the 20-m circular plot were searched for fire scar evidence during the summer 2010.

Products – Anticipated products include posters or oral presentations at meetings such as FHM Working Group Meeting and WIFD Work Conference. We will also present results at the Society of American Foresters (SAF) conference in Albuquerque, NM (in October 2010). Results will also be published in a refereed journal. The information will be disseminated to forest managers in USFS R3, state foresters in AZ and NM, and others interested in the results.

Schedule of Activities –

Summer 2010: Field survey and fire scar sampling on KNF – SZ
 Fall 2010-Spring 2011: Analysis of summer 2010 data. Tree core /fire scar preparation, data entry, data analyses. Present preliminary results at SAF meeting in Albuquerque, NM (Oct 2010)
 Spring/Summer 2011: Final data analyses; report and manuscript writing

Progress/Accomplishments: We installed 50 permanent evaluation monitoring (EM) plots on the KNF – SZ during the summer 2010. The plots were stratified by 25 high elevation and 25 low elevation aspen sites. Data collected are described in the Methods. For a preliminary analysis, we compared 12 high (>2400 m) with 12 low (<2400m) elevation aspen sites, and compared forest structure, amount of crown dieback and mortality, and composition and relative abundance of damaging agents. Our forest structure results show that high elevation sites have a greater stand density of live mature aspen, less aspen crown dieback and mortality and more aspen regeneration. Insect (*Agrilus liragus* and *Trypophloeus populi*) and pathogen (*Cytospora chrysosporium* and *Encoelia pruinosa*) damage to mature stems and ungulate damage to all size classes was severe and widespread, especially in lower elevation sites. Our results are similar to sudden aspen decline etiology described in southwestern Colorado. Our work during the fall 2010 and spring/summer 2011 will be to include all 50 aspen sites in the analyses, and to investigate the relationships of climate and age as factors in aspen mortality, and determine if past drought is an inciting factor.

COSTS: Budget estimates for **FY11**.

	Item	Requested FHM EM Funding	Other-Source Funding	Source
YEAR 2011				
Administration	Salary ^a	\$19,961		
	Indirect costs ^b	\$ 2,404	\$11,898	NAU
	Travel ^c	\$ 2,380		
Procurements	Contracting	\$0		
	Equipment	\$0		
	Supplies	\$ 200		
	Publication costs	\$ 1,500		
Total		\$26,445	\$11,898	

^a Includes salary and ERE. The requested salary will be used to support one undergraduate in spring semester 2011 (part time 19 weeks) and one graduate student’s stipend for spring semester 2011 plus 7 weeks in summer 2011.

^b For Northern Arizona University (NAU) indirect costs (10% of Total Direct Costs - TDC); NAU contributed 49% of Modified TDC plus tuition remission for graduate student for spring 2011.

^cTravel: 4 weeks of data collection in summer 2011 (June) and travel to one professional meeting to present the results.