Piñon Pine Mortality Event in the Southwest: An Update for 2005

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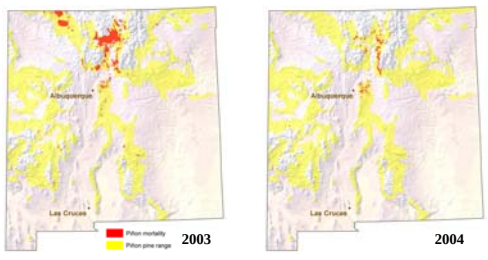
Drought conditions in the Southwest have persisted for a number of years resulting in large areas of piñon pine mortality. In 2002 drought conditions became extreme, facilitating an outbreak of piñon ips beetles (*Ips confusus*, Coleo:Scolytidae) which, in 2003, killed many millions of piñon pines over a six-state region. In response to this unprecedented mortality, Forest Health Monitoring provided funds to Forest Health Protection units so that the extent and intensity of the event could be evaluated. This evaluation and monitoring project continued in 2004.

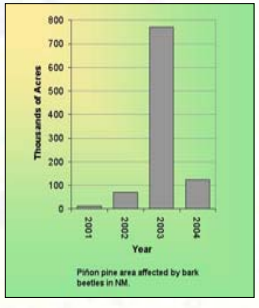
The results from this project reveal that the situation on the ground is a quickly changing phenomenon. While the huge amounts of mortality seen in 2003 were caused by the aforementioned piñon ips, mortality throughout much of the affected area decreased sharply in 2004. In addition, a number of other damaging agents played a more prominent role in the damage that did occur. Conditions varied widely throughout the project area, so brief summaries from each of the participating Forest Health Protection units are presented below.

New Mexico

The impacts of the drought on the piñon-juniper woodlands in New Mexico became evident beginning in 2001. The outbreak of piñon ips beetles expanded rapidly and by the end of 2002, large areas were affected. To evaluate the extent of the mortality, supplemental aerial detection surveys were conducted using input from National Forest, BLM, BIA and State Forestry Division land managers to identify priority areas. Six million acres, approximately 60% of the piñon-juniper woodlands in the state, were surveyed. The aerial surveys recorded a peak of 770,800 acres (45 million piñon trees) affected in 2003, which dropped to 122,400 acres (5.6 million piñon trees) in 2004 (see chart). Although activity has declined considerably, remaining areas of activity are present in patches through north-central New Mexico and especially along the western foothills of the Sangre de Cristo Mountains.



New Mexico Aerial Survey Results



Piñon pine area affected by bark beetles in NM.

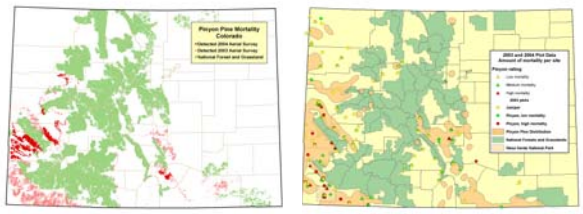
Ground plots were measured in 2003 and 2004 to provide ground-based estimates of piñon mortality throughout the state. Analysis of the 2003 plot data showed a wide range of mortality across the state with an overall mortality level of 15%. The 2004 data have not yet been analyzed. Ips flight periodicity was monitored using Lindgren traps at five sites beginning in 2002 and was expanded to nine sites in 2003. Trapping from March through December showed two flights in northern NM and three flights in southern NM; however, monitoring of freshly-cut screened bolts showed a potential of up to five generations per year in central New Mexico.

Colorado

Intense mortality of piñon pine was recorded in the southwest and central-west portions of Colorado in 2003. The vast majority of these trees were killed by the piñon ips. Observations made during the winter of 2003-2004 revealed that large numbers of beetles could be found throughout the affected areas.

However, the cold, wet spring of 2004 appeared to sharply reduce the numbers of ips beetles. A large cohort of twig beetles emerged late that spring, apparently having been protected from the harsh conditions in their cryptic habitat. For much of the early summer, unprecedented amounts of tree mortality due to the twig beetle was observed in western Colorado. The activity of the twig beetles tapered off with the progression of summer, and overall mortality seemed to have returned to "normal" levels by the beginning of autumn.

Ground plot work continued throughout this period. Although data is still in the process of being analyzed, it appears to validate the predominent observations of 2004: that large amounts of tree mortality are due to twig beetles, and that overall mortality of piñon pines was much reduced.

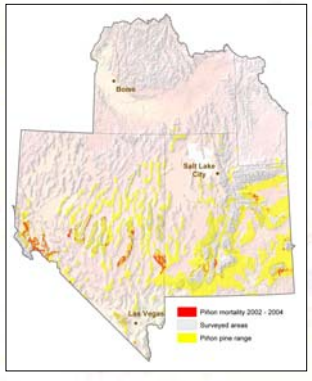


Colorado Aerial Survey and Plot Results

Nevada and Utah

In Utah and Nevada, USDA Forest Service, Forest Health Protection personnel have been assessing the extent and level of tree mortality and collected data on related insect and disease agents. Data collected from aerial surveys and ground plots show annual changes in the levels of mortality. Within the Great Basin several significant trends have become apparent between 2003 and 2004. Unlike most other piñon cover types in other states, the rate of tree mortality did not decline greatly from 2003 to 2004, large numbers of trees are still dying in many areas. In addition, a large number of damage agents in addition to piñon ips are causing a significant amount of this mortality.

Most of the mortality observed in piñon pine is still caused by piñon ips, *Ips confusus*, but Black stain root disease, *Leptographium wageneri* var. *wageneri* and pitch mass borer, *Dioryctria sp*., have also contributed to a significant proportion of the mortality. Piñon pine dwarf mistletoe is very common throughout the piñon type and may predispose trees to attacks by other insect and disease agents. Piñon needle scale, *Matsucoccus acalyptus*, piñon pine sawfly, *Neodiprion edulicolus* and tip moth, *Dioryctria albovitella* are active in some areas and have contributed to tree stress in affected sites



Arizona

Bark beetle related piñon pine mortality in Arizona occurred at epidemic levels beginning in 2001 through 2004 (more than 6 million trees were killed across 1.2 million acres between 2001-2004). The current drought-related mortality has possibly exceeded the extent and severity of the 1950's drought. This outbreak is thought to have been caused by record low precipitation and overly dense stands of trees. Precipitation levels increased during 2004; however, much of the state continues to report below average levels of moisture preceding and during the growing season. Piñon pine was attacked primarily by piñon ips in 2001 through 2003. Beginning in 2003 we observed a large increase in piñon being attacked by an unidentified twig beetle, typically on trees that had initially been attacked by piñon ips or on small diameter piñon. In 2004 the pattern was largely reversed with twig beetle initiating attacks on all diameter trees followed by piñon ips on the main bole of larger diameter trees. Initial mortality of piñon occurred at the lower elevational range of piñon or in stress prone sites such as areas with poor site quality, shallow soils, cinder hills, south facing aspects and areas heavily infected with dwarf mistletoe. However, beginning in 2003 pine mortality was occurring across all areas of its range including higher elevations and areas of high site quality. Overall in 2004 we have seen a decline in piñon ips populations as much of the susceptible host type has already been severely impacted.

To document the impacts of this piñon pine mortality, permanent fixed radius plots were installed on five National Forests in Arizona during 2003 and 2004 (see table below). The objectives of installing these plots are to:

1. **Quantify the impact, extent and severity of bark beetles at the stand level through an extensive plot network on National Forests in Arizona.**
2. **Describe the forest conditions in areas that have experienced moderate to high levels of mortality induced by recent drought and bark beetles.**
3. **Look for correlations between stand and site conditions and pine mortality.**

During 2005 all plots will be revisited to document additional changes occurring in the piñon pine-juniper woodlands across Arizona.

Piñon branches attacked by twig beetles

	Pinyon Pine Plots	
	Clusters/Plots	Single
Prescott NF	6/8	9
Kaibab NF	17/51	14
Coconino NF	43/129	43
Apache-Sitgreaves NF	24/72	26
Tonto NF	9/27	13
TOTAL	99/297	105

Number and distribution of fixed radius plots established At pre-determined geographic sites on National Forests in Arizona

California

During 2004 there was a dramatic decrease in the level of pinyon mortality in California. Aerial surveys were conducted specific to detecting pinyon mortality in both 2003 and 2004. In 2003 some level of mortality was detected over 541,000 acres, compared to only about 129,000 acres of detectable mortality in 2004. This trend was also observed in *Ips confusus* trap catches when comparing 2004 with the previous two years of beetle catches.

Additional work was completed during in 2004 to determine: 1) if periods of peak catches in the traps corresponded to when beetles were actually emerging; 2) to determine the number of generations of *Ips confusus* at a site in western Nevada and 3) to compare trap catches using racemic ipsdienol or +97/-03 ipsdienol in conjunction with racemic ipsenol and cis-verbenol.

Effects of 2002 drought on needle length in *P. quadrifolia*, Santa Rosa Mountains, California. Photo: L. Merrill, USFS, Nov. 2004.

Summary of 2003-2004 Piñon Mortality in CA from Aerial Surveys

	2003	2004
< 5 tree/acre	252,491	67,635
6 – 15 trees/acre	149,760	43,494
16 – 30 trees/acre	139,044	18,190
TOTAL	541,295	129,319

~7.5 million acres flown in 2003
Fewer total acres flown in 2004 (Bill Woodruff, Jeff Mai, Jerry Westfall)