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"STEWARDSHIP IN FORESTRY"

MEMORANDUM

Subject: 2011 Aerial Survey of Tree Mortality in Northwest OR

To: Aerial Survey Cooperators

From: Rob Flowers, Mike McWilliams, and Alan Kanaskie

Date: September 26, 2011

The attached information provides the approximate location and size of areas with tree damage and mortality detected during the aerial survey of northwest Oregon conducted in July and August of 2011. Also included are estimates of the number of trees affected annually for the major agents observed over the last five years.

Survey Rationale

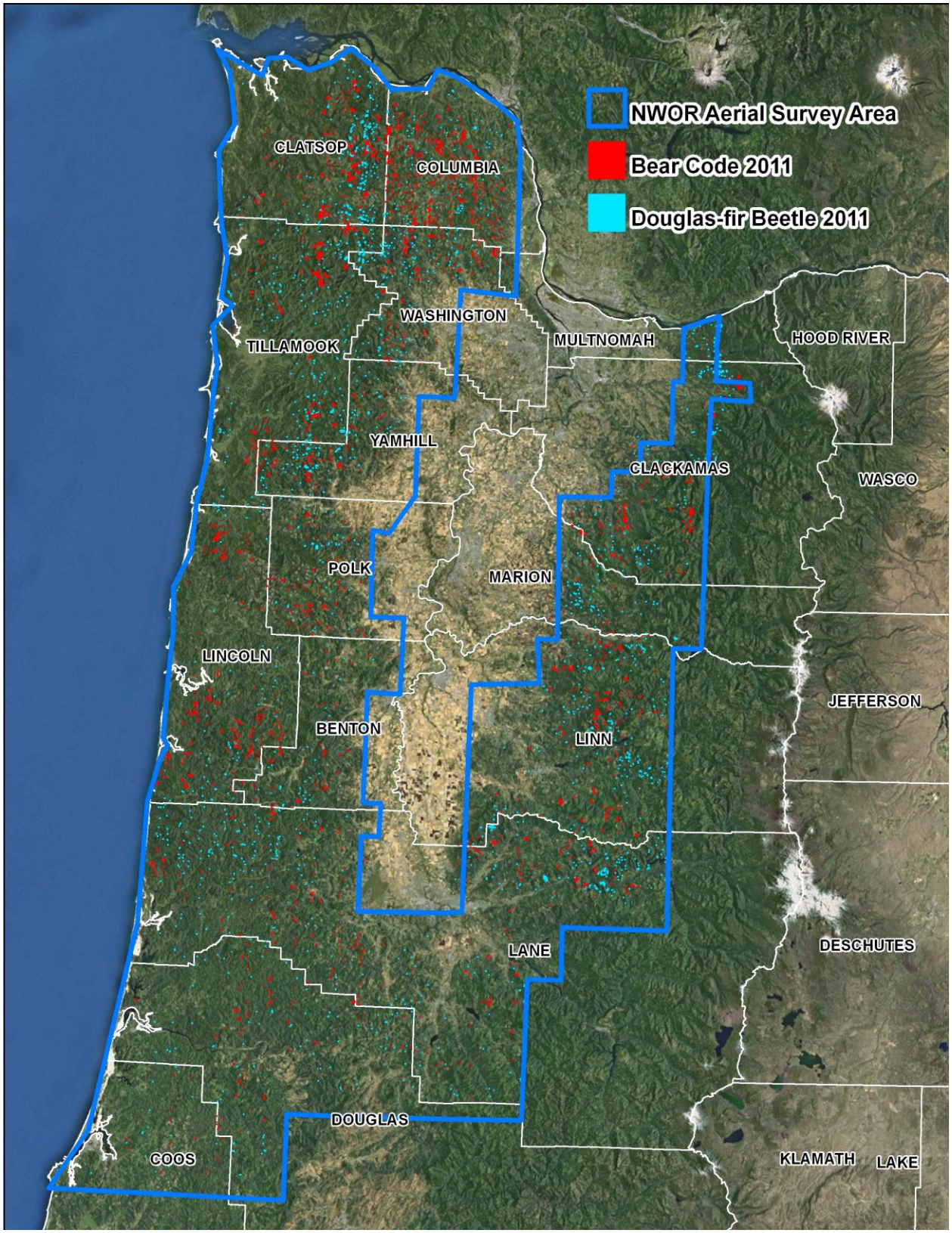
Forest lands in northwest Oregon are consistently impacted by animal, insect, and disease agents or weather events that can lead to substantial damage and loss. Since 1993, forest landowners with an interest in the locations and causes of tree mortality, particularly those resulting from damage by bears, have sponsored an annual aerial survey. Although the average number of trees per acre damaged by bears annually over the survey area is relatively low, it is highly variable and can result in significant losses over time given its clumped distribution and tendency to occur in similar locations for consecutive years.

The objectives of this survey are to provide the locations of current year tree mortality or other damage and to document trends over time. The aerial survey is designed to provide estimates only and is not able to precisely quantify levels of tree mortality or the extent of particular damaging agents; this can only be accomplished by additional ground surveys of mapped areas.

Survey Description

The aerial survey is flown in early summer, as this is the optimal time to detect the damage signatures (change in foliage color) associated with bear damage that occurred the previous year. Damage from a number of other agents, including Douglas-fir beetle, fir engraver, Port Orford cedar root disease, and storm events are also recorded during the survey. Approximately 7.7 million acres are flown each year over BLM, USDA-Forest Service, State, and private ownerships (**Figure 1**).

Figure 1: *The 2011 Northwest Oregon aerial survey included 7.7 million acres in 15 Counties. Tree mortality was most often attributed to bears or Douglas-fir beetle.*



The survey aircraft flies a grid pattern at an altitude of 1,000-1,500 ft above the ground. Since 2009, flight lines have been 4 miles apart with each of two aerial observers mapping a 2 mile area on one side of the aircraft. A digital sketch-mapping system is used, consisting of a touch-screen computer linked to a GPS receiver. The computer displays topographic maps, satellite imagery and aircraft position, allowing observers to locate and record affected areas in the form of polygon figures.

When tree mortality occurs in small areas the total number of affected trees in the polygon is estimated. When tree mortality occurs over large areas, the number of affected trees per acre is estimated (1A = 1 tree per acre). The mapped areas designate approximate damage boundaries and are coded with the suspected agent and an estimate of tree mortality or other damage. A separate document containing a key is provided to describe the agent(s) and primary host(s) for each code.

Ground surveys conducted by ODF and private cooperators in 2000 examined the correlation between the number of dying trees recorded during aerial surveys and the occurrence of bear damage. The results clearly showed that mapped areas containing a higher number of affected trees (>10) were much more likely to have bear damage than areas with only a few affected trees visible (≤5).

Survey Results

Young Conifer Mortality

Results are summarized by ownership class and county for: 1) the number of mapped areas (polygons) and 2) the estimated number of trees killed within those areas. As bear damage is often scattered within the polygons, the overall number of dying trees generally provides a better estimate than the total acreage over which it occurs. Survey findings are shown here for the last five years, 2007 to 2011.

In 2011, the number of areas mapped by ownership class was similar to that in 2010, while the observed tree mortality increased overall. Increases were most prevalent this year on State and private forest lands. Relative to 2010, the overall number of areas mapped increased by 12% (**Figure 2**), while the estimated number of trees killed within the survey area increased by 166% (**Figure 3**). These findings suggest that while the overall affected area was similar to last year, tree mortality within these areas intensified. Still, tree mortality levels remained below the long-term average, calculated since 1993, and the high levels observed in 2006 and 2007.

Comparisons among the 15 Counties included in the survey area remained highly variable. Relative to 2010, the number of areas mapped increased in 11 Counties by an average of 36%, while declines occurred in Lincoln, Linn, Marion, and Polk Counties, by an average of 20% (**Figure 4**). The estimated number of trees killed within the polygons increased in 14 Counties by an average of 167%, with only a single decline observed, by 28%, in eastern Multnomah County (**Figure 5**).

Figure 2: The number of mapped areas (polygons) with young conifer mortality by ownership class within the survey area, 2007-2011.

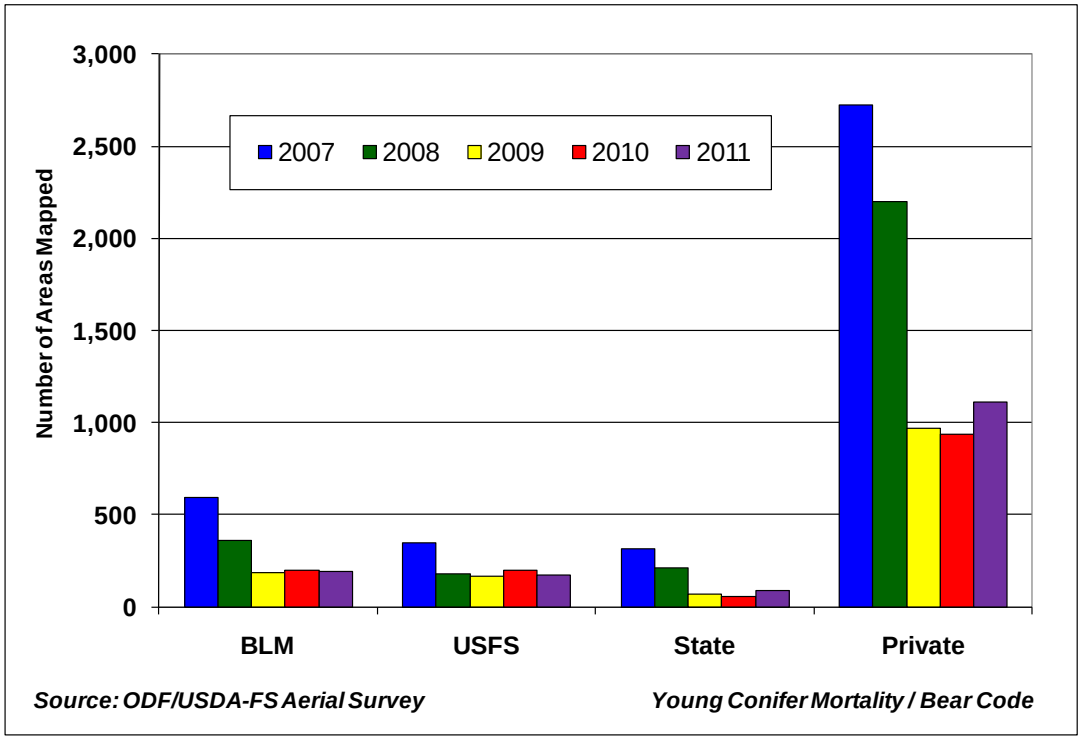


Figure 3: The estimated young conifer mortality within the survey area by ownership class, 2007-2011.

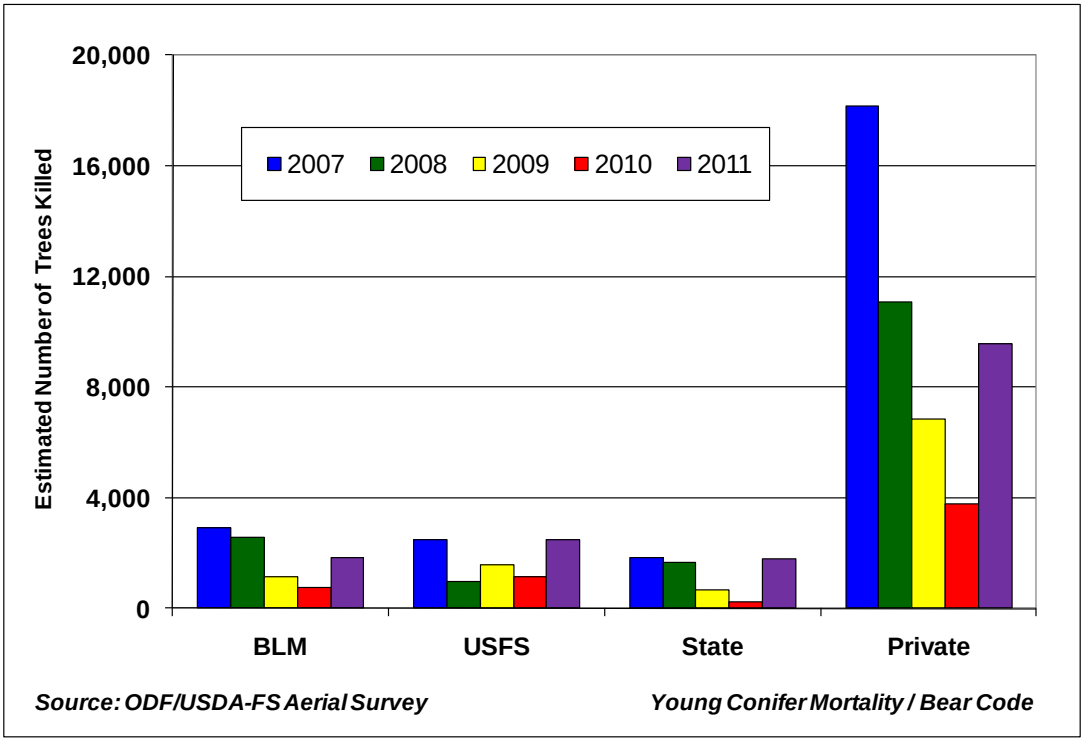


***Figure 4**: The number of mapped areas (polygons) with young conifer mortality by County within the survey area, 2007-2011.*

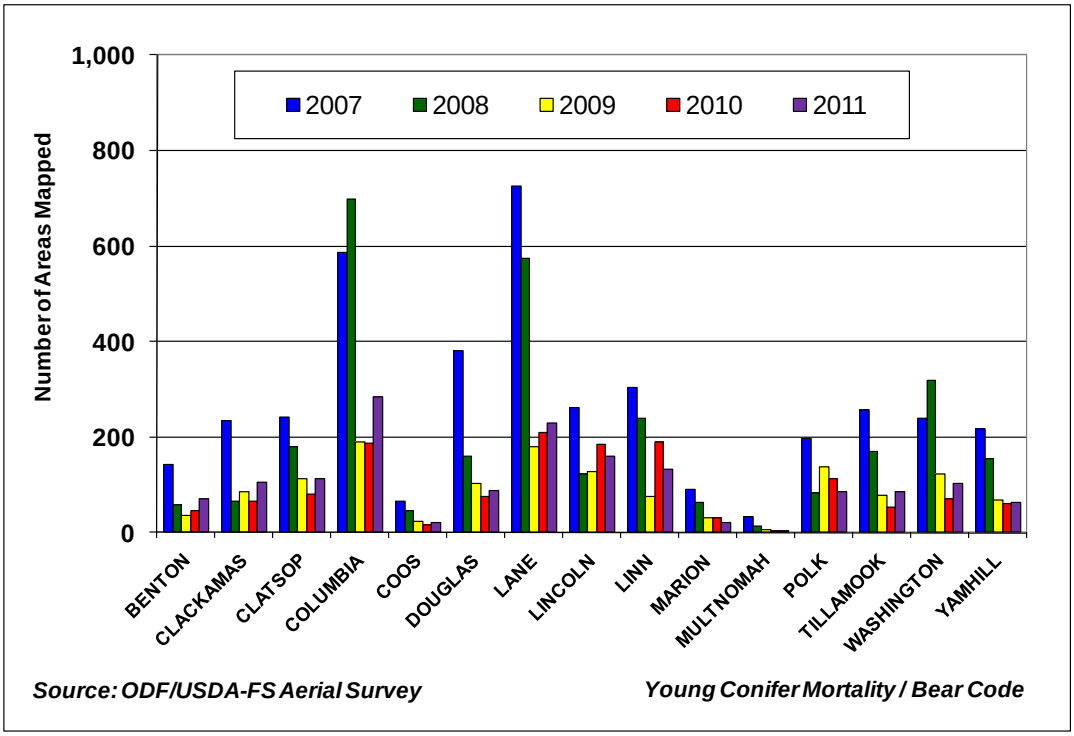
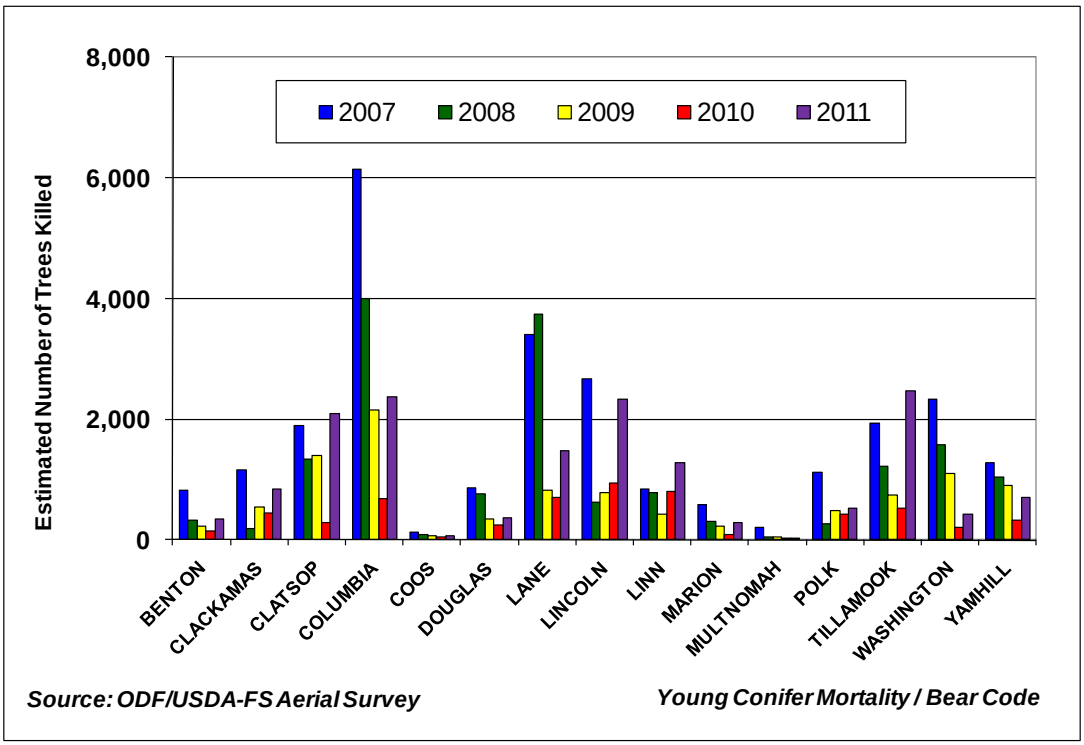


***Figure 5**: The estimated young conifer mortality within the survey area by County, 2007-2011.*



Many factors contribute to recent tree mortality detections. Spring weather conditions in 2009 and 2010 appeared to be much colder and wetter than normal and anecdotal observations suggest that symptom development (change in foliage color), may have been delayed in many areas. Often, trees do not exhibit observable crown symptoms until the onset of water stress, which can show tremendous annual variation. When delays occur, this results in fewer dying trees being mapped within the areas where damage has previously occurred.

While the number of areas mapped and the estimated tree mortality in 2011 increased relative to the previous year, it continued to remain below the long-term averages, calculated since 1993. Periodic, comprehensive ground surveys are needed to further understand the causes of tree mortality and grant funding is currently being pursued.

Other Tree Mortality and Damage

During the aerial survey, observers also record other tree mortality and damage to a number of conifer and hardwood species. Among the most prevalent causes of tree mortality are root diseases, often working in combination with bark beetles. Among larger diameter conifers in the survey area, the Douglas-fir beetle (DFB) and fir engraver are most commonly credited with causing tree mortality. Outbreaks of these bark beetles occur periodically, often following large storm events and/or prolonged droughts. Other important causes of tree mortality within the survey area include Port Orford cedar root disease and wind/water damage related to the storm events.

For the agents listed above, the observed tree mortality and damage in 2011 was also below their respective long-term averages, and each measure showed declines relative to 2010. The total number of areas mapped for these agents decreased by an average of 50% (**Figure 6**), while the estimated area (acres) of tree mortality decreased by 55% overall (**Figure 7**).

Tree mortality from DFB is highly variable within the survey area, and outbreak levels were observed at some sites in 2009 and 2010. Overall, these localized outbreaks and the associated tree mortality has declined in 2011, decreasing in 11 Counties by an average of 58%, with increases observed in only Clatsop, Multnomah, Tillamook, and Yamhill Counties (**Figure 8**). Tree mortality was highest in 2011 in Clatsop and Lane Counties, with the greatest increases seen at high-elevation areas along the Columbia River Gorge. Outbreaks of DFB are often initiated by large blowdown events, but can also be caused and prolonged by other stand conditions conducive to outbreaks including overstocking and drought.

Port Orford cedar root disease was first reported in Oregon in the 1940's and within a decade severe losses had occurred. The disease later appeared in southern Oregon where cedar commonly occurs in forests. Progressive tree mortality continues where the pathogen is found, and tends to be most severe along waterways and roads. Similar to bear damage, we suspect that the lower levels of tree mortality in 2011 may be due to delays in tree symptom development related to above-average moisture.

Tree mortality due to damaging wind/water from storm events was relatively low in 2011, detected on over 500 acres, primarily in Clatsop County. Aerial detections of storm-related damage are often limited to larger, more visible, contiguous areas.

Figure 6: The number of mapped areas (polygons) with tree mortality from Douglas-fir beetle (DFB), fir engraver (FE), Port Orford cedar root disease (POC-RD), and storm damage (STORM) within the survey area, 2007-2011.

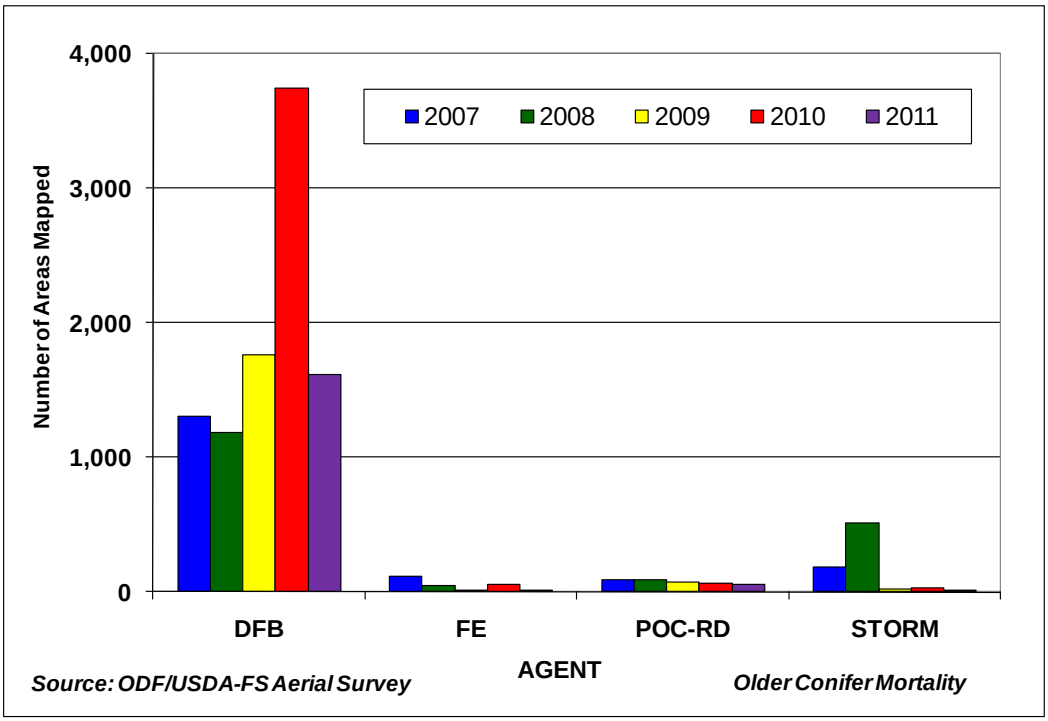


Figure 7: The estimated area (acres) with tree mortality from Douglas-fir beetle (DFB), fir engraver (FE), Port Orford cedar root disease (POC-RD), and storm damage (STORM) within the survey area, 2007-2011.

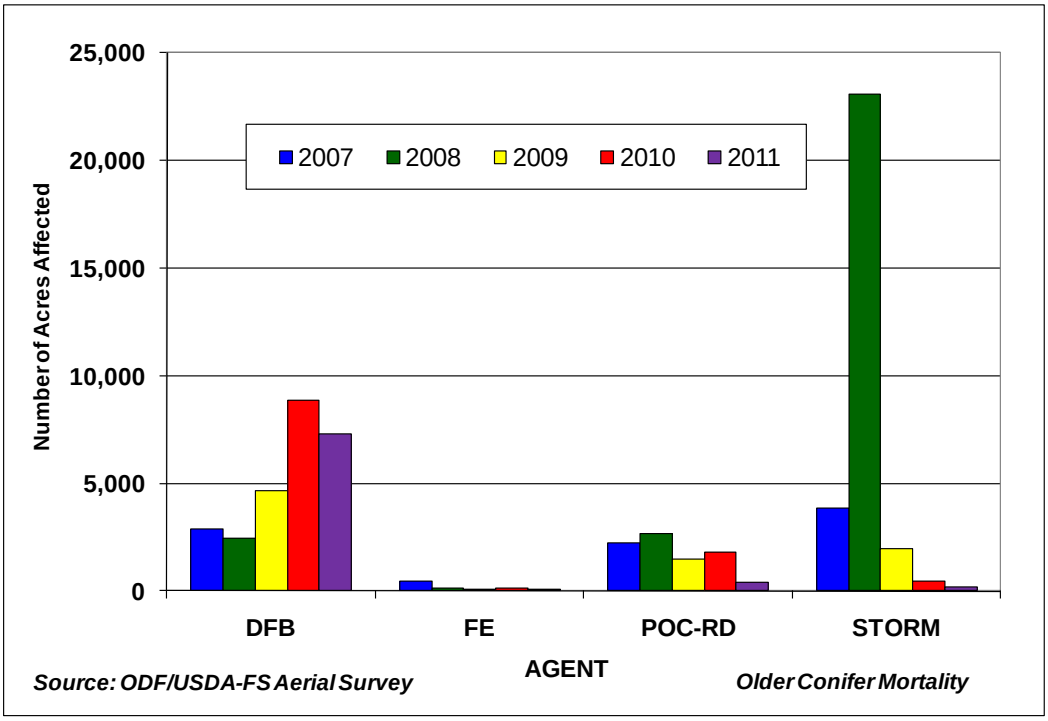
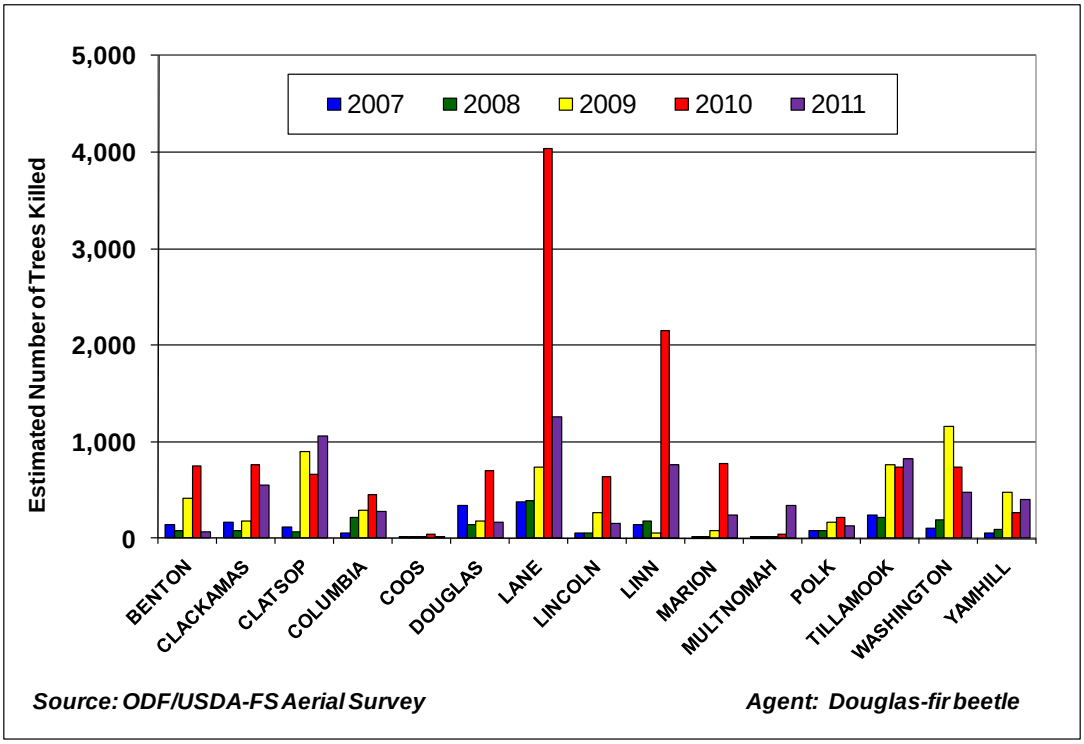


***Figure 8**: The estimated tree mortality from Douglas-fir beetle within the survey area by County, 2007-2011.*



Survey Discussion

The comparisons presented here represent a limited time frame that may not reflect long-term trends. In addition, the survey can only detect tree symptoms that are visible at the time a particular area is flown. Attempts are made to coordinate flights with the peak visibility of tree mortality, but survey timing and symptom development are often confounded by weather. Still, aerial surveys represent the most efficient and cost-effective method for obtaining general estimates of tree mortality.

Acknowledgments

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