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## Evaluation of Declining Douglas-firs in the Pine Brook Hills Community, Boulder County, Colorado

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On November 15, 2012, I met with Bruce Benninghoff, Consulting Forester, and Jo Davies and Jim Adams, volunteers for “BeetleBusters”, to assess declining Douglas-firs within the Pine Brook Hills neighborhood just west of Boulder, Colorado. Pine Brook Hills is an unincorporated mountain community that consists of approximately 400 homes nestled in the foothills of the Front Range of the Rockies. My findings and recommendations are contained within this report.



**Figure 1. Douglas-fir with a drooping crown, 572 Timber Lane (Photo: Jim Adams).**

Homeowners have expressed concern about the unhealthy, droopy appearance of Douglas-fir crowns in many locations within the Pine Brook Hills neighborhood over the past couple of years (fig. 1). We examined many symptomatic trees closely but could not find any evidence of biotic damaging agents. Crowns looked fairly full and needle retention was adequate in most trees. The tree in the photo to the left was planted by a homeowner and was off-site for Douglas-fir and from an unknown seed source. We concluded that the abnormal growth pattern is most likely associated with drought stress. Other factors, such as high tree stocking levels and maladaptation, are causing additional stress. Severe drought stress can predispose trees to some diseases, insects, and fire. Homeowners can reduce losses by managing competing vegetation, maintaining lower stocking levels, and selecting tree species and seed sources properly adapted to the site.

We also assessed several mature trees with severe crown thinning and dieback (fig. 2). Since these symptoms are consistent with a root problem such as root disease, we carefully examined the roots on many trees using a Pulaski. None of the roots we examined had any obvious resinous, a common indicator of Armillaria root disease, which is the most common root disease in Douglas-fir and all of the roots had healthy, live phloem. We only observed one recent tree failure. The roots of the failed tree were heavily decayed with a brown cubical rot. We also sounded several trees with an axe and cored those that sounded like they may be hollow with an increment borer. All of the cores appeared completely or nearly completely solid.





**Figure 2. Severely declining Douglas-firs observed near 784 Bow Mountain Road and 792 Pine Brook Road (Photos: Jim Adams).**

The decline is likely associated with magnesium chloride ( $MgCl_2$ ) toxicity exacerbated by persistent drought. Liquid  $MgCl_2$  solutions are applied frequently to the roads of Pine Brook Hills for dust abatement and deicing. Magnesium chloride can move into soils, particularly on the downhill side of the road, with precipitation. With high concentrations of chemicals in the soil matrix, trees take up soil chloride and magnesium through their roots and accumulate them in their leaves, where dieback occurs. Plant growth and survival are altered both indirectly and directly, through changes in water relations or direct ion toxicity.

Most of the trees we examined were growing along, or on the downhill side of the road and thus could have been impacted by road salts. A query of the NOAA database shows that statewide, January to November, 2012 was the 3rd driest on record and models predict drought will persist or intensify throughout the winter (<http://www.ncdc.noaa.gov/>). Some of the declining branches may also be infested with secondary bark beetles, such as Douglas-fir pole and engraver beetles, which are particularly active during droughty years. We were unable to reach any affected branches, but if any of these trees are taken down the galleries will be evident underneath the bark.

Unfortunately, trees with severe decline and dieback will probably will not survive much longer (maybe 1 or 2 years) but some steps can be made to reduce future losses.

For road salt, prudent use will reduce losses. To reduce over-application, machines should be calibrated to apply the optimum level of salt for reducing surface ice or dust in order to not apply excessive levels. Mortality can be high when salts are applied for dust abatement before heavy rainstorms, so this should be avoided. The amount of salt damage is directly related to the distance from a road, with the exception of salt runoff in limited downhill areas. Therefore, planting trees farther from the road or cutting trees near a road will reduce salt damage.

For drought, management of competing vegetation, stand thinning, planting techniques that reduce drought, and selection of a tree species compatible with a site will reduce losses.

Because Douglas-fir pole beetles and engraver beetles are secondary insects associated with trees under stress, enhancing tree quality will help to prevent attacks. The best management approach is to promote stand vigor by thinning and promptly removing windthrown trees or trees damaged by other stand disturbances.

