Failure Potential of Dead Trees

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Consulting arborists may be asked to assess the likelihood of failure of standing dead trees. One of the significant limitations for consultants is the lack of information about stability of dead trees for a wide range of species, particularly those that are not native to North America. Consultants can, however, apply what information is available from forestry literature.

Helms (1998) defined a snag as a "standing…dead tree from which most of the leaves and most of the branches have fallen." A snag may be described as either hard (generally intact with little decay) or soft (extensively degraded). The progression from hard to soft snag has been well-documented and follows a predictable pattern. Initially, leaves and small twigs are lost, followed by branches of increasing size. Bark detaches from the trunk. Decay enters the trunk and roots, showing characteristic changes in color and structure.

How rapidly an individual tree deteriorates is a function of a variety of factors. Cluck and Smith (2007) summarized the results of 13 publications for trees in the Sierra Nevada Mountains of California, all of which focused on conifers. They observed that 1) larger diameter trees stand longer than smaller diameter, 2) trees killed by fire fall faster than those killed by insects, 3) 2 to 5 years elapsed between death and the first tree to fall, 4) there were differences in the time to failure among the species examined, and 5) higher rates of fall occurred in disturbed sites.

Comparison of hard and soft snags in Monterey pine (*Pinus radiata*).
Hard snag stage. Left: recently dead before needle loss. **Right:** needles have falled but most twigs, branches and bark remain.

Soft snag stage. Note loss of needles, twigs, small branches and bark. The lower trunk is extensively decayed (lower right)

Cluck and Smith noted that hardwoods generally degrade more rapidly than conifers. Vanderwel *et al.* (2006) examined fall rates in a hardwood forest in Ontario. Results were similar to those for conifers in that smaller trees fell sooner than larger trees, different species fell at different rates, and fall rates were higher on disturbed sites. Fall rates may be faster in warmer climates. Working with diverse forest types in the Piedmont region of South Carolina, Moorman *et al.* (1999) observed that 95% of hardwood snags had fallen within 6 years after death. From 21% to 38% of snags fell within 2 years after death.

In most tree risk assessment protocols, dead trees are described as having a high likelihood for failure. In Wagener's (1963) seminal publication on managing risk in California forest recreation areas, he noted "it appears wise to regard all snags as potentially dangerous and to remove them in campgrounds and in similar areas of concentrated use." Harvey and Hessburg (1992) made the same recommendation: "When dead trees are encountered in developed sites they should be removed immediately." Similarly, the tree risk assessment publications of Matheny and Clark (1994) and Pokorny (2003), assign dead trees and branches of any type the highest failure ranking.

For the consultant who is evaluating dead trees, the need for action might be measured against the consequences of a failure. Where the consequences are high to extreme, the prudent management course is to remove dead trees as soon as possible. Where the consequences are low to moderate, it may be possible to delay removal of recently dead and stable trees for a year or two. In situations where there is no risk of injury or damage, dead trees can be retained for their habitat value.

In summary, observations of trees in forest settings indicate that few trees fail immediately following death. The transition from hard to soft snag may take several years. The loss of needles, twigs, and finally branches; the detachment and separation of bark; and the development of decay are the three broad categories that mark this transition. As the deterioration of the dead tree progresses, the likelihood for failure increases.

Consultants assessing the stability of snags should refer to the forestry literature for the timing and patterns of degradation in individual species.

References

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